Water Research Commission

Annual Report 2002/03

Water Research Commission

Our Vision & Mission

Vision

To be a globally recognised leader in providing innovative solutions for sustainable water management to meet the changing needs of society and of the environment.

Mission

The WRC is a dynamic hub for water-centred knowledge, innovation and intellectual capital. We provide leadership for research and development through the support of knowledge creation, transfer and application. We engage stakeholders and partners in solving water-related problems which are critical to South Africa's sustainable development and economic growth, and are committed to promoting a better quality of life for all.

Water Research Commission
Private Bag X03, Gezina, Pretoria 0031, Republic of South Africa
Tel: +27 12 330 0340 • Fax: +27 12 331 2565
Website: www.wrc.org.za • E-mail: wrc@wrc.org.za

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From the Chair

Prof HC Kasan (Chairperson)
General Manager:
Water Treatment Technology
Rand Water

During the year under review the Water Research Commission (WRC) made significant progress along the strategic road set out during 2001/2002. The internal and external strategic drives undertaken by the organisation and the organisation's achievements during the year under review clearly demonstrate that the WRC is rapidly transforming into a dynamic, innovative 'hub' for water-centred knowledge and a networking organisation, linking the nation by working through partnerships.

During 2002/2003 the WRC began implementation of a number of strategic initiatives aimed at improving the organisation's strategic positioning and relevance to its stakeholders and the effectiveness of its core business processes. The WRC has widely shared its new strategic direction with various stakeholders and refined its research portfolio and mode of operation through different modalities, allowing the organisation to develop a better understanding of the challenges facing the South African water sector and the short- to long-term research needs required in order to overcome these challenges. The organisation has developed new initiatives regarding knowledge dissemination, public understanding of science and has actively addressed the issue of capacity-building in the water sector with regard to equity and redress. The establishment of new publications such as the *Knowledge Review* and *The Water Wheel* allow for both scientific/technical and popular dissemination of water-centred knowledge. In addition, the WRC participated in a number of drives supporting *Women in Water* in partnership with other organisations. Capacity-building for the water sector became one of the key strategic drives for the WRC, providing for a new generation of graduates with the competence to serve the water sector, i.e. academia, Government and the water industry. The WRC also contributed to knowledge/technology transfer via many workshops and conferences either organised by or supported by the WRC.

The WRC has established its knowledge generation, capacity-building, and knowledge transfer and dissemination portfolios of each of its key strategic areas (KSAs). The KSAs, which focus on water resource management, water-linked ecosystems, water use and waste management and the utilisation of water in agriculture, were found to be effective and appropriate building blocks for addressing water-centred knowledge needs in South Africa as indicated by many stakeholders.

The year under review marks a year of great importance to the South African water sector. One of the major global events that shaped the world approach to managing water was the World Summit on Sustainable Development (WSSD)

which was held in South Africa, with an emphasis on water-centred activities at the WaterDome. The WRC played an active role in the preparation towards the WSSD (various local workshops, support to different Government Departments, Afrisan, and the Accra declaration) and during the WSSD the WRC led and participated in many sessions, having a strong presence at the WaterDome as well as the Science and Technology Fora. Another major event shaping global activities regarding water was the 3rd World Water Forum (3rd WWF) which was held in Japan during March 2003. The WRC also participated in many discussions during this Forum, in support of the South African water sector. In both the WSSD and 3rd WWF the contributions of the WRC towards South Africa's research and development achievements and the building of a strong water-centred knowledge base were clearly reflected (and recognised) in the high standing of the South African water sector (academia, industry or Government) in the global water community.

The WRC has developed strong partnerships with many local, African and global institutions, with the aim to leverage research inputs and outputs, enhance knowledge dissemination and actively support the NEPAD initiative. Some examples include the WRC partnership with the Collaborative Council for Water and Sanitation, the SADC water sector, the Global Water Research Coalition and many other local and international bodies.

The WRC has established and implemented many new processes and procedures. These include the implementation of its new funding process which includes a number of funding streams, the introduction of solicited projects and the comprehensive reviewing of research proposals. Coinciding with the above was the formulation of a new contracting framework which introduces the emphasis on management of research deliverables. The organisation has also upgraded and decentralised its financial system and improved its management and governance practices.
The year under review has also been a year of change regarding governance and leadership. The new Board appointed by the Minister of Water Affairs and Forestry commenced its term during June 2002. The composition of the new Board provides for strong water-centred knowledge and leadership as well as a high level of competence regarding governance, skills and knowledge in all domains of corporate management which require appropriate governance. The new Board includes representatives of the water industry, central and local Government, academia, research councils, other research organisations (local and international), NGOs and implementing agencies. The new Board has made its mark during the year under review, actively directing the WRC to greater heights.

I would like to thank the Minister of Water Affairs and Forestry for his keen support of the WRC and its activities, the South African water sector, practitioners, decision-makers and researchers for their continuous commitment, support, valuable feedback and active participation in the implementation of the WRC's strategy and research portfolio. I wish to thank all the members of the Board (previous and current members) for their dedication and leadership as well as the management and staff of the WRC for the dynamic and strong leadership both in-house and within the water sector. I hope that the WRC will continue to serve South Africa as a strong and dynamic 'hub' for water-centred knowledge, while strengthening South Africa's position and its ability to support the rest of our continent as well as strengthening South Africa's position as a strong leader within the global water sector.

Prof HC Kasan
WRC Board Chairperson

Board Members

Water Research Commission

Prof HC Kasan (Chairperson)
General Manager:
Water Treatment Technology,
Rand Water

Prof CG Palmer (Vice-Chairperson)
Director: Centre for Aquatic Toxicology,
Institute for Water Research,
Rhodes University

Mr AM Muller
Director General:
Dept of Water Affairs & Forestry

Dr R Kfir
Chief Executive Officer:
Water Research Commission

Mr JS Vilakazi
Executive Director of Services:
SA Institute of Chartered Accountants

Dr SJ Khoza
Executive Manager:
Knowledge Management,
Development Bank of Southern Africa

Dr BM Molope
Group Executive Officer:
Agricultural Research Council

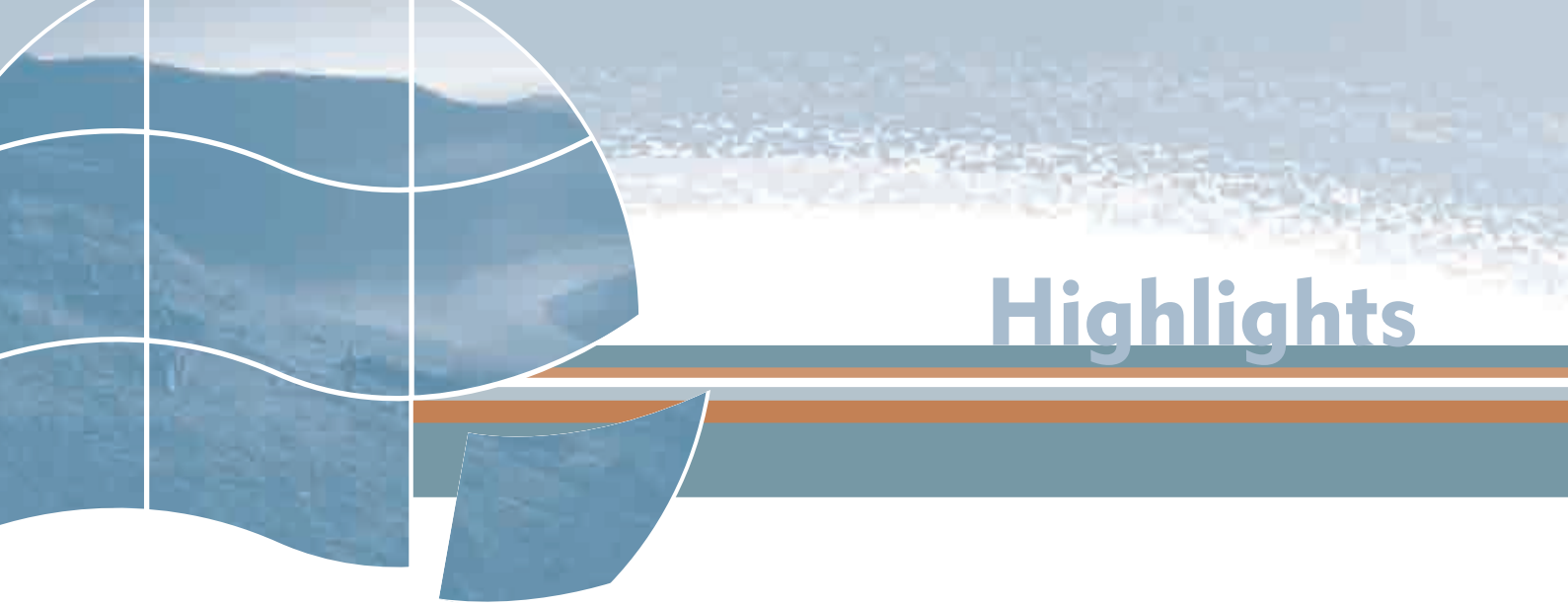
Mr NL Moikangoa
Executive Vice President:
Sustainable Development & Policy,
CSIR

Mr RJC Nay
Convenor: Engineering Services,
City of Johannesburg

Dr DJ Merrey
Director for Africa:
IWMI Africa Regional Office

Mr MG Rall
Executive Director:
Mvula trust

Mrs MM Matsabu
Director:
DYNACON Technologies



Highlights

The Water Research Commission (WRC) serves as the innovation hub of the South African water sector. Our strategy is to provide knowledge, skills and technology of the best quality to enable the people of South Africa to manage water resources wisely, sustainably and for the benefit of all.

Together with stakeholders, we identify critical water-related problems and translate these into R&D needs with the aim of developing fitting solutions using a problem-solving approach. In accordance, we fund appropriate research projects which constitute the portfolios of key strategic area (KSA) thrusts and programmes. The desired outcome is the development, dissemination and application of new knowledge for the formulation of water policy, water resource management, water utilisation for social and economic development and, importantly, safeguarding human and ecosystem health.

The various WRC activities illustrate our strategic commitment to research excellence and the undermentioned selected highlights for the 2002/03 financial year affirm the WRC's continued engagement in this regard:

Water Resource Management

Assessing benefits of water resource development

A manual on conducting cost benefit analysis (CBA) in South Africa, with specific reference to evaluating the development and management of water resources, has been developed. The CBA method provides a logical framework by means of which projects can be evaluated and the decision-making process assisted. In the published manual, attention is given to costs associated with both water resource development and river basin management. The opportunity cost of water is also addressed. Furthermore, the manual takes into consideration a range of environmental aspects related to water development. The manual will assist greatly in evaluating water resource development projects, which is a difficult task since costs and benefits are often hidden and frequently only become evident with the passage of time.

Towards application of the 'polluter pays' principle

Economic instruments useful for supplementing the traditional command-and-control approach to water quality management and encouraging behavioural change among water polluters have been identified in partnership with the Department of Water Affairs and Forestry (DWAF). The development of an implementation strategy, specifically for waste discharge charges, is now far advanced and will be published shortly. This promotes the application of the 'polluter pays' principle as envisaged in the National Water Act (NWA).

Getting on top of eutrophication

An implementation manual for a National Eutrophication Monitoring Programme has been produced. It provides DWAF with a practical plan of action for initialising and sustaining local and regional eutrophication monitoring in support of the NWA, which requires the monitoring of national water resources as a means of early detection of water quality problems. Eutrophication refers to the enrichment of water bodies with plant nutrients, which cause troublesome algal blooms and aquatic weed infestations. Being aware of its extent is the first step towards combating this problem.

Impact of saline mine-water disposal on dam-water quality

Software to guide the operation of a controlled saline mine-water release scheme has been developed and is currently being utilised by DWAF to control the release of saline mine-water into the Olifants River upstream of Witbank Dam during flood conditions. The software provides the ability to predict and manage the local impacts of releases at various downstream abstraction points, both in the river and in Witbank Dam. Previously, the inability to do this was a matter of considerable concern. The software links a model to simulate water and salinity profiles in the upstream catchment to a hydrodynamic salinity simulation model of the dam. It is used in both operational mode (to address the daily operation of the release scheme) and in scenario mode (to look at possible future impacts on dam water quality). In operational mode, the linked model can predict the impact of a flood-associated release into the dam well in advance of the event. The user can then establish whether any of the set water quality objectives will be violated as a result of the release.

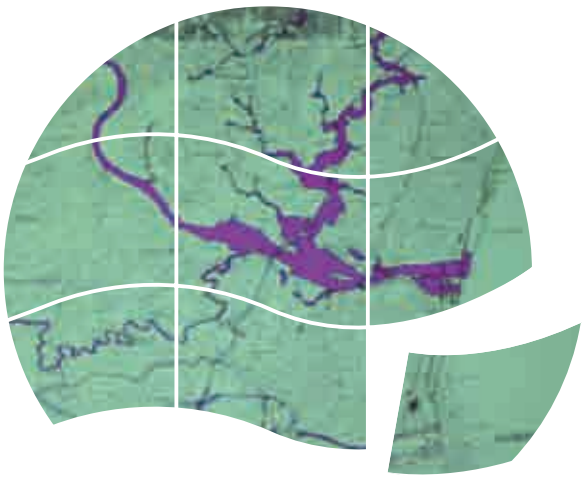
Release of radionuclides from river sediments

A preliminary risk assessment revealed that radionuclides

such as uranium, which might enter a river and get trapped in river sediments, could pose a risk to humans even though concentrations in the river water itself are too low to be dangerous. Studies in the Mooi River catchment, which has been impacted by mining operations for more than 60 years, showed that uranium in sediments could be solubilised through normal environmental processes. Solubilisation is most likely to happen under conditions of high oxidation potential and low to intermediate pH, which would occur when sediments are exposed to drainage or to dredging operations. The potential environmental threat posed by the release of radionuclides from sediments is being investigated further.

Forecasting extreme rain events

Software for delineating areas where there is a high probability of future heavy rainfall from either tropical weather systems in the interior or from coastal zone baroclinic systems has been developed. This enhances the capacity of weather forecasters to recognise developing conditions conducive to occurrence of heavy rain events and to forecast their probable location and intensity one to two days in advance. It also complements recently-acquired capacity, developed in partnership with the SA Weather Service, to use radar for real-time measurement of heavy rainfall, to track the movement of associated storms and to provide predictions of their behaviour over the next hour or two. Such advances in technology increase the readiness and ability of disaster managers to respond to threats of imminent extreme rain events and associated floods.



Licensing of SFRAs

Methods utilised in the licensing of afforestation, the first water use to be identified as a streamflow reduction activity (SFRA) under the NWA, were developed in collaboration with the CSIR and DWAF. The underlying research also helped to improve the general understanding of SFRAs and especially their implications for low-flow situations. Application of these licensing tools to other potential SFRAs requires further improvement in order to increase confidence levels attached to streamflow reduction quantities on which the licensing is based. The spatial and temporal resolutions of streamflow reduction assessments are further areas that need to be strengthened to limit the possibility of water users contesting SFRA charges. The WRC, in partnership with DWAF, is currently working towards addressing the shortcomings of the available licensing tools, as well as building the knowledge available for the Minister to declare additional SFRAs.

Water-Linked Ecosystems

Aquatic invertebrate identification guides

Identification guides for aquatic invertebrates have been prepared as a ten-volume series. This series forms the definitive work on the identification of Southern African freshwater invertebrates as it draws together all previous definitive works (some dating back to before 1950) and all recent literature in an easy-to-use format. Several of the guides, in their draft forms, have for some time been in regular use in laboratories for instruction of students in invertebrate taxonomy, so have been well and truly tested. The guides are also of great value to people involved in assessing river health, where detailed knowledge is needed about the taxa occurring in a water body. Support in the form of short courses on the use of the guides is available to users. **Volumes 2, 3** and **4** (the Crustacea), **Vol 5** (other aquatic invertebrates), **Vol 6** (Mollusca and Arachnida) and **Vol 9** (Diptera) have already been published. **Volumes 1** (Introduction), **7** (Plecoptera, Ephemeroptera and Odonata), **8** (Hemiptera, Trichoptera, Megaloptera and Lepidoptera) and **10** (Coleoptera) are well advanced and will be published during 2003.

Some for all, forever – water ecosystems and people

A highly effective booklet, which introduces water ecosystems to non-scientists, was produced by the WRC and distributed to all who attended recent workshops held throughout the country during the programme of public participation around DWAF's National Water Resource Strategy. The production of the booklet arose from courses presented to social facilitators who, for their work, needed a basic understanding of the water resource and how water ecosystems and people relate to each other. The publication, which has proved to be highly popular, conveys a wealth of information in an easily understandable fashion.

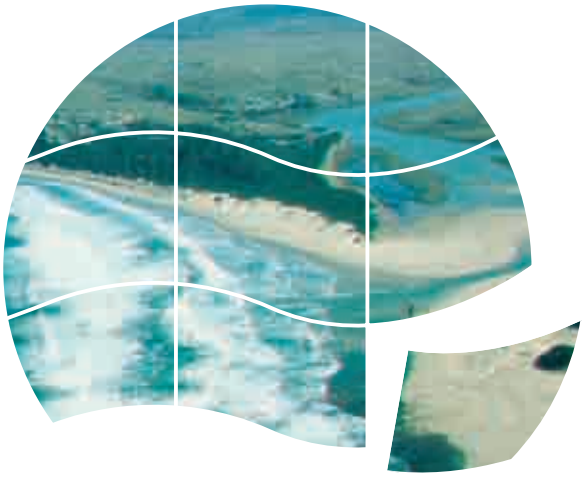
The cultivation of high-value plants in urban wetlands

The feasibility of growing economically valuable plants at high densities in degraded wetlands has been demonstrated through the Inyibiba Pilot Project, carried out in the Tygerberg area of the Cape Metropolitan Council. A decision-support system (DSS) for assessing wetland sites for their suitability and a database (with manual) for selecting useful wetland plants which have sufficient economic value, have been produced. Sustainable cultivation, which pays sufficient attention to the soil and nutrient requirements of the plants selected for cultivation, has the additional benefit of providing economic incentives which help to ensure that the wetlands are kept clean and that further degradation is prevented. Urban wetland cultivation also creates a source of employment and skills development for communities living near wetlands and may provide a focus for other busi-

ness and entrepreneurial activities in surrounding communities.

Inclusion of water quality in environmental reserve determinations

New knowledge gained through research at two universities has enabled water quality to be linked to streamflow with sufficient confidence for water quality to be included in the methodology used for assessing the environmental reserve. The relationship between water quality and streamflow is not simple, which has meant that the ability to estimate the quality aspects of environmental water requirements has made slower progress than the ability to estimate the quantity aspects. The new knowledge has two components: A series of models ranging from the simple to the more complex, which enables the prediction of water quality for specified flow scenarios; and a water quality module for inclusion into the DSS to be used in determining the environmental reserve.



Hydraulics in support of river ecosystem preservation

Equations which have been newly developed and verified can be used to better describe the relationships between river flow, sediment transport and other channel processes, thereby enabling more accurate predictions to be made of the flows required to preserve crucial habitats in regulated rivers. The science of hydraulics forms the link between hydrology and the habitats that rivers provide for a diverse range of biota. Early on in endeavours to establish environmental water requirements, it was recognised that the conventional equations, used to describe the relationships between river flow and channel processes, are not accurate at low flows. The new equations, which have been developed both in the laboratory and the field, are now being successfully applied in various low-flow studies.

Understanding the impacts of interbasin transfers on biodiversity

Studies on the genetic structure of selected aquatic fauna indicate that the fauna in streams of the Western Cape is as diverse as its flora. This new knowledge throws light on potential impacts of interbasin transfers on biological diversity. While robust insects with a high potential for dispersal (e.g. dragonflies) show little genetic variation, the Cape Galaxiid, a small endemic freshwater fish with no potential to move between catchments and the net-winged midge, with a very limited potential for dispersal, both show high genetic variability between catchments. What was once considered as a single species of Galaxiid may in fact be five or more species – a different species in each of the rivers studied. In catchments where there are taxa with a low potential for dispersion, the negative impact of interbasin transfers on biodiversity is potentially substantial. These findings emphasise that the impact on the biodiversity of the recipient river system needs to form part of the investigation into the feasibility of any new interbasin transfer scheme, especially as South Africa is signatory to the International Convention on Biological Diversity.

Passage for migratory aquatic organisms

A solution has been found to the problem of restricted passage to migratory aquatic organisms in gauged rivers. Gauging weirs are an essential part of the national hydrological monitoring network, but it has long been recognised that, at low to intermediate flows, they form effective barriers to migratory aquatic organisms. The solution involves making use of natural hydraulic controls, such as chutes where flow is confined to a fixed channel, which may be calibrated to measure flows and thereby substitute for gauging weirs. In this way, hydrological monitoring networks can be extended without creating additional barriers to the migration of aquatic organisms that are of key importance to the overall health and biodiversity of the resource.

Evaluating environmental water use in support of Working for Water

A better understanding of how to objectively value the benefits accruing from the Working for Water Programme (WWP) has been developed through an initiative aimed at advising on where in the southern and eastern Cape future WWP operations should be directed in order to maximise benefits. The bulk of water supplies in South Africa are generated in mountain catchments. One of the factors that undermines water supplies from these source areas is the invasion by alien woody species. The WWP, while primarily a management strategy entailing the removal of water-consuming alien vegetation and the restoration of indigenous vegetation with lower water consumption, is also a job-creation strategy having substantial social benefits. The efficiency of the WWP proves to be sensitive to the social discount rate used and the savings of water achievable through removal of invasive alien plants. While more needs to be known regarding non-water benefits of the WWP, it is nevertheless clear that the economic rationale for the programme is strongest in those areas where there are high demands for consumptive uses of water.

Water Use and Waste Management

Sustainable small water-treatment systems for Southern Africa

A new institution focusing on the support of all activities pertaining to small water-treatment systems in Southern Africa has been established. This resulted from fruitful exchanges

of information on small water-treatment systems, which took place at a two-day international workshop on the sustainability of small water-treatment systems arranged to coincide with the World Summit on Sustainable Development (WSSD), which enabled numerous delegates from all over Africa to participate. The new institution is called "The Small Water Systems Association of Southern Africa" and is expected to contribute much to promoting the cause of providing treated water at affordable cost to communities throughout the region and further afield in Africa.

Solar stills for drinking water provision to small communities

An affordable and simple-to-operate solar distillation unit for the provision of potable water from brackish or sea-water sources, was successfully developed. The unit is able to provide water for drinking and cooking purposes to single households and small communities. It derives from the redesign of an international unit, in order to make it more affordable and applicable to South African rural conditions. The retail cost of the local unit is less than R900, compared to approximately R3 000 for the international unit. Single household solar still units have been evaluated in the far Northern Cape, and a community system, consisting of 15 single units in parallel, is in operation at Kerkplaas in the Karoo. This latter system now supplies desalinated water to a community of 40 people. The success of the project has prompted DWAF to fund another experimental system in the Karoo and the Development Bank of Southern Africa (DBSA) to express interest in funding further systems for small communities.

Provision of safe drinking water to rural communities using membrane units

A very successful and sustainable membrane unit for the provision of potable water to small and rural communities was developed. The unit is based on locally developed ultrafiltration membranes, which are capable of removing not only suspended clay particles, but also pathogenic microorganisms such as the protozoan parasites *Cryptosporidium* and *Giardia*. The advantages of using such membranes for potable water supply are that the final water is much clearer than with conventional water treatment systems and is already disinfected at source before the addition of the required residual chlorine. In addition, operation is much simpler in that no constant supply of coagulants or other chemical dosing agents are required. Experimental membrane units have proved themselves at a number of sites throughout the country and the first commercial units have recently been sold by a private company formed to commercialise the membrane systems under licence from the WRC.

Fog interception

The practice of fog interception has been successfully demonstrated and, in the process, pure, safe water delivered to a rural primary school in the Soutpansberg area of Limpopo, which previously had no other form of water supply. While the concept of using screens to capture and coalesce fog droplets was not new, research has placed this technology on a sounder scientific basis and demonstrated its utility and cost-effectiveness under South African conditions. This was achieved with the help of a pilot installation, which also provided convincing evidence that the technology is a viable water supply option for isolated rural communities living in the immediate vicinity of mist-belt conditions.

Water user associations: Roles and challenges

Greater insight has been obtained concerning key roles of water user associations (WUAs) in water management in South Africa. Some of the major challenges in this regard have been highlighted and areas where greater clarity and more knowledge are needed, identified. Multi-sectoral WUAs, including those potentially involved in the provision of water services, would include different water user groups, each with specific management requirements and potentially different management capacity. This will impact on how they are established and organised structurally, and what functions they will perform to the benefit of all their members. Whereas, for example, WUAs may play an important role as providers of bulk water services under contract to relevant water services authorities, it appears inadvisable for them to become involved in water services provision to individual customers or households. The enhanced insight gained from this study will contribute to the successful establishment of these important institutions.

Water conservation and demand management measures: How effective are they?

A methodology to determine the effectiveness of water conservation (WC) and demand management (DM) measures has been developed, taking into account the particular conditions pertinent to South Africa, existing related methodologies as well as local and international case studies. Criteria for effectiveness include facilitation of equitable access to and sustainable use of water resources by all stakeholders within the geographical area of application, while maintaining the characteristics and integrity of the overall water resources within agreed limits. The methodology comprises four steps which are addressed in sequence, and facilitates a consensus-based focus on those WC/DM measures which are most effective for a particular situation. It allows for a number of iterations, depending on specific objectives and circumstances, and the degree of refinement required in assessing effectiveness in relation to WC/DM goals.

Leachate from landfills

Knowledge gained from a study on leachate from landfills raises concerns about both the long-term viability of the current landfilling approach, and the provisions for post-closure monitoring of municipal solid waste landfills in semi-arid parts of South Africa. Present practice is to encapsulate the waste and maintain it at a relatively low moisture content, the effect of which is to retard biological degradation processes and effectively retain the polluting potential of the stored waste. Since waste cannot be isolated from the ingress of moisture in perpetuity, the process of biological degradation, with associated generation of highly contaminated leachate, will resume once moisture begins infiltrating into the stored waste through a damaged or poorly maintained cover system. Furthermore, current legislation in South Africa requires that a landfill and its surrounding environment (e.g. adjacent groundwater) be monitored for a period of 30 years after closure, to ensure that the environmental and health risks posed by the landfill are acceptable. However, in a semi-arid climate, even after such a period of aftercare, the landfill may, in fact, be many years from achieving a stable and acceptable state and may still have a very large proportion of its initial contaminating potential. This new knowledge may prompt a rethink of current practice and legislation in this regard.

Biotechnology for sustainable development

The occasion of the WSSD coincidentally saw the publication and official hand-over to DWAF of the first six volumes of the 12-part series *Salinity, Sanitation and Sustainability: A Study in Environmental Biotechnology and Integrated Wastewater Beneficiation in South Africa*. This series covers research carried out over the past decade into innovative sustainable biotechnologies for addressing major water resource issues such as the treatment of high-volume saline wastewaters (for example acid mine drainage) and the affordable treatment and disposal of sewage wastes (including sludges). As noted by the Minister, Mr Ronnie Kasrils, in his foreword to the series, "in the novel approach followed, salinity and sanitation issues are each viewed as a resource base (rather than simply as 'waste problems') in a suite of integrated process schemes which can be variously manipulated to deliver products of treated water, recovered nutrients and metals, and algal biomass……..the paradigm is consequently changed from one of 'managing problems' to one of 'engineering opportunities', with the potential of offering a major contribution towards the management of water and sanitation in the RSA".

Tool for managing acid mine drainage

A quantitative approach to the prediction of acid mine drainage has been successfully developed. This approach, named ABATE (derived from Acid-Base Accounting Techniques and Evaluation) incorporates static acid-base accounting techniques as well as long-term kinetic testing and geochemical modelling, all of which are applicable to South African open-cast coal-mine conditions. Tests included in the ABATE system and their standardisation have been evaluated under field conditions and are accepted by both regulating authorities and industry consultants. The approach will be used to refine preliminary predictions which suggest that most South African collieries will, at some stage in future, decant acid water with serious consequences for aquatic life in streams and for various water users. This will enable appropriate management strategies to be put in place.

Management of water-related microbial diseases

Recent cholera outbreaks in South Africa served to underline the need for proper sanitation services and safe water supplies, which includes the protection of water resources from microbial contamination and the effective disinfection of drinking water. A new series of publications, under the title Management of Water-Related Microbial Diseases, assists in addressing this need. The series, which is currently in the final stages of development, addresses a variety of questions by water suppliers and members of the public, such as: What causes the diseases; what can we do to protect ourselves; what other diseases apart from cholera can be spread via water; how do we communicate to our customers; how do we assess risk; and, how do we create health and hygiene awareness. These and more questions are answered in the following volumes, namely: **Volume 1**: *What is the Problem? – Disease Characteristics*; **Vol 2**: *What Causes the Problem?- What to do for Water Suppliers Following Diarrhoea Incidents*; **Vol 3**: *How Great is the Problem?- Health Impact Assessment*; **Vol 4**: *How Dangerous is the Problem - Communicating the Risk*; **Vol 5**: *What do We and Our Children Need to Know?- Health and Hygiene Awareness*. The series will also fill a niche in the education system and contribute to knowledge of future generations concerning the spread and control of microbial diseases and how to protect water supplies from contamination. The first volume in the series has been used in draft form and tested for its user-friendliness during the most recent cholera epidemic in the Eastern Cape.

Water Utilisation in Agriculture

Effect of agro-forestry species on soil moisture in traditional cropping systems

Knowledge has been gained with regard to the potential of agroforestry to enhance productivity of small-scale farming

systems, by overcoming certain farming constraints in temperate, frost-prone, drier areas of South Africa. One major constraint in such areas is a lack of animal fodder during the dry winter season, often exacerbated by the shortage of grazing land and the occurrence of drought. This constraint is addressed through introduction of appropriate agro-forestry plant species which are able to continuously provide fodder for livestock during cold winter months. Initial fears that such agro-forestry species would compete for limited soil water in drier areas and thereby reduce yields of traditional crops, proved groundless. In a normal South African rainy season, agro-forestry species do not compete with local traditional crops for soil water as they tend to develop deep root systems which exploit water and nutrients deeper than can be reached by the shallow root systems of crops. Furthermore, certain leguminous agro-forestry plant species such as *Acacia karoo* provide the additional benefit of improving soil productivity through nitrogen fixation. Shading, in fact, proves to be a more significant yield-reducing factor in agro-forestry than does competition for soil moisture. On the whole, fodder flow and biomass analyses showed that intercropping agro-forestry species and maize could result in annual savings per household of up to R4 500 on dry maize supplements and R2 700 on fuel-wood.

Influence of irrigation with gypsiferous mine-water on soil properties and drainage water quality

Irrigation has proved to be a novel approach for the beneficial disposal of gypsum-rich water of mining origin. On a semi-operational scale, it has been confirmed that irrigation of crops with neutralised acid mine-water significantly reduces the salt load normally associated with mine drainage, while at the same time extracting value from saline water that would otherwise pollute water resources. A considerable portion of the salt applied with the irrigation water precipitates within the soil profile and becomes unavailable for further leaching. Achieved crop yields have generally been high and commercially attractive, except in cases where water-logging develops as a result of subsidence of rehabilitated land. Otherwise, no negative effects on crop growth or nutrition, which might be linked to irrigation, have been observed. All indications are that the practice is commercially viable and that it is sustainable from both the crop-production and soil-response perspectives.

Integration of computer models to produce a comprehensive information system for better planning and management of irrigation farming

The development of an integrated information system for irrigation farming using the Water Administration System (WAS), Soil Water Balance (SWB) and RiskMan computer models, represents the culmination of research and development previously done under three different WRC research projects. The result is a tool that can be used on irrigation

schemes to minimise water distribution losses, maximise efficiency of water use through effective irrigation scheduling and incorporate risk analysis into crop and cash-flow planning. Prior to integration, all three models made extensive use of separate databases which have now been integrated and linked to a geographical information system (GIS). Each model in the integrated information system can be used alone or information can be transferred directly between constituent models. For example, WAS saves crop survey data that can be accessed by RiskMan. SWB can create simulated crop yield records that can also be accessed by RiskMan. SWB can generate water request forms that can be used by WAS. Once a farmer has used RiskMan to decide on the best crops to plant, SWB can be used for day-to-day irrigation scheduling. The integrated information system has been implemented successfully on the Loskop and Orange-Riet irrigation schemes. The canal networks of both schemes have been captured electronically and it is possible for models to query the different databases and display output information on GIS maps.

The economic impact of changing water quality on irrigated agriculture in the Lower Vaal and Riet Rivers

Models have been developed to determine the long-term financial and economic viability of irrigation farming in areas affected by rapidly fluctuating salinity and generally poor irrigation water quality. Such areas, along the Lower Vaal and Riet Rivers, have experienced withdrawal of some of the

more profitable crops and reduced yields of remaining crops, raising concerns about the financial sustainability of irrigation farming in these areas. The Salinity and Leaching Model for Optimal Irrigation Development (SALMOD) was developed within a General Algebraic Modelling System (GAMS). Using linear programming, various possible crops and management options are assessed against one another to establish the optimal, profit-maximising combination of crops and management options under different water quality (salinity) and external policy scenarios. Modelling results, to date, show that artificial drainage installation and leaching practices are financially justified under certain water and soil quality scenarios. The results also provide a strong motivation for considering changes in the current water pricing and quota allocation systems used in the study area and elsewhere in South Africa.

Factors affecting the performance of drip irrigation systems in South Africa

Guidelines that enable irrigators to make correct dripper choices and maintain drip irrigation systems effectively have been produced. Potentially, drip irrigation is considered to be the most efficient irrigation method in terms of crop produced per volume of water used. However, efficiency can be badly affected by poor quality water and poor management, coupled with low maintenance. Development of the guidelines was based on the assessment of performance of different drip systems as determined under a range of water quality and farming conditions. Performance information included results of analyses of clogging and other problems experienced with driplines and drippers of varying types and ages in various regions of South Africa. The guidelines provide the means of ensuring that the full water-saving potential of drip irrigation can be realised.

Estimation of rainfall intensity for assessing the probable benefits of in-field water harvesting practices for crop production

An indirect method has been developed for characterising rainfall intensity, a key factor with regard to in-field rainwater harvesting practices which, when applied under dryland farming conditions, can substantially increase crop yields, especially on small farms. Benefits from in-field water harvesting depend on the amount of in-field storm runoff that is produced, and how this runoff can be concentrated and infiltrated to ensure its most efficient use by the root system of the crop being grown. The amount of runoff which can be exploited, choice of water-harvesting practice and associated increases in crop yield all depend closely on the rainfall intensities experienced. Estimates of rainfall intensity are based on measured daily rainfall and, thereafter, used to generate estimates of in-field runoff which, in turn, allow appropriate maize-yield models to be applied to assess benefits and risks associated with various water harvesting and soil tillage scenarios for selected sites with different climatic and soil characteristics.

Directors' Report

WATER RESEARCH COMMISSION DIRECTORS' REPORT 01 April 2002 - 31 March 2003

This report is submitted to the South African Parliament through the Minister of Water Affairs and Forestry on behalf of the Board of the Water Research Commission (WRC). It includes the annual audited financial statements for the WRC, reports on corporate governance practices and structures and progress achieved during the year under review against key performance areas and strategic objectives. It provides a review of the main undertakings, addressing the core business of the organisation.

Introduction

During the year under review (2002/2003) the WRC successfully implemented its new core strategy and progressed significantly towards turning the organisation into a dynamic and innovative 'hub' for water-centred knowledge. Following key changes in its organisational design and mode of operation, the WRC, in line with its new strategic direction, began the implementation of a number of strategic initiatives aimed at improving its corporate governance and core business processes. Under the leadership of a new Board of Commissioners (appointed by the Minister of Water Affairs and Forestry in June 2002), the organisation developed a number of new policies and established frameworks which support sound corporate governance practices based on core values (e.g. the development of a strategic risk plan and a fraud prevention plan). In addition to strengthening its corporate governance practices, the WRC embarked on the revision and implementation of a number of core business processes. These included a new process of funding, allowing for three funding streams, the comprehensive reviewing of research proposals and the decentralisation of the financial system.

The WRC has developed strong relationships with many of its stakeholders and adopted several approaches to improve its understanding of the water sector's needs and aspirations. It has given high priority to appropriate packaging and timely transfer of knowledge and technology products and successfully launched a number of strategic positioning and marketing initiatives. The WRC has invested in building and diversifying the water-centred knowledge base in South Africa, as reflected in the capacity-building drive carried out through the funding of various research projects and other knowledge transfer initiatives. About 300 students are currently supported by WRC project funds. Of these, about 70% are from previously disadvantaged backgrounds.

During 2002/2003 the WRC established a new research portfolio, concentrating on generating new knowledge, as well as the transfer and dissemination of knowledge. The WRC supported various knowledge-centred activities aimed at improving South Africa's ability to appropriately address future water problems in the short- to the long-term. It addressed issues such as water for all, quality of life, and environmental sustainability, which are part and parcel of South Africa's national priorities and require considerable attention. In addition, the WRC has led numerous studies on strategic and implementation issues arising from recent water legislation, including the strategic approach to integrated water resource management (IWRM), the recognition of water as a basic human right and the resultant free water policy, as well as the right of the aquatic environment to its sustaining share of water (the Ecological Reserve).

Strategic Context and Mandate of the WRC

The WRC was established in 1971 (the Water Research Act, Act No 34 of 1971) following a period of water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully, owing to the view held that water would be one of South Africa's most limiting factors in the 21st century. In 1971, water research and development (R&D) in South Africa was limited to a few institutions and the funding level was moderate. There was no research co-ordination and an apparent neglect of some key research fields. In addition, there was little strategic direction or leadership that would provide the identification of priority areas or appropriate technology transfer. Being a water-stressed country, South Africa needs progressively to find innovative ways of

managing water resources to ensure that the basic needs of its citizens are met, that social and economic development are not restricted through lack or poor quality of water, and that sustainability of water resources and of water-dependent ecosystems is secured.

The mandate (of the WRC) highlights the following functions to be carried out by the organisation:

- Promoting co-ordination, co-operation and communication in the area of water research and development
- Establishing water research needs and priorities
- Stimulating and funding water research according to priority
- Promoting effective transfer of information and technology
- Enhancing knowledge and capacity-building within the water sector.

Currently, South Africa remains threatened by water shortages, while water quality issues, also, are becoming more acute. However, the country is much better prepared to deal with this problem, owing to the broadening of the water R&D base and the continuing direction and funding by the WRC of research on critical issues.

Corporate Governance

The WRC and the Board of the WRC recognise the importance of sound corporate governance and, during the year under review, further developed the structures and practices which support the implementation of good corporate governance.

Risk management

The WRC developed a risk management plan. This included the identification and rating of risks, and the development of a risk assessment plan. The plan includes both strategic and operational issues of significance to the current and future health of the organisation. This plan was approved by the Board of the WRC and was used as a basis for internal audits.

The plan meets the requirements of both the Public Finance Management Act (PFMA), which requires all Public Entities to maintain an effective, efficient and transparent system of financial and risk management and internal control, and the Treasury Regulations which specify that the accounting authority (the Board) must ensure that risk assessment is conducted regularly to enable emerging risks to be identified and addressed timeously.

Audits

Following review by and approval of the Audit Committee of the Board of the WRC, an internal audit plan was implemented on their behalf by an external firm of auditors and two internal audits were conducted. The audits were based on the risk management plan (see above) and addressed both financial and strategic risk areas. The outcomes of both audits were discussed with WRC's management and reviewed by the Audit committee and the Board.

Fraud prevention plan, code of ethics and procurement policy

The WRC has developed a comprehensive fraud prevention plan and a code of ethics linked to the WRC's corporate values. In addition, a procurement policy was developed and a procurement committee was established. These developments were reviewed and approved by the Board and promoted widely within the organisation.

Values

- Service orientation
- Care for people, society and the environment
- Fairness to all
- Dedication to quality
- Integrity and ethical behaviour
- Respect for human and individual rights
- Innovation and learning

Delegation of powers

A revised Delegation of Powers, linked to the PFMA and the Water Research Act, as well as to the new structure of the WRC, was developed and approved by the Board (July 2002). The delegation of authority clearly spells out reporting lines, powers of approval and signing authority at Board and management levels, and provides a clear corporate governance framework.

Governance structures

The WRC operated under the leadership of a new Board as from 1 June 2002. During the two months of the financial year in which the previous Board held office, no full Board meeting was held. However, two of the committees of the previous Board did meet during this period, as is noted below. The new Board includes certain members of the previous Board as well as a number of new members. The following members were appointed (or re-appointed) to the Board of Commissioners of the WRC on 1 June 2002 by the Minister of Water Affairs and Forestry, for a three-year period, ending 31 May 2005:

Board members

Prof HC Kasan (Chairperson)
Prof CG Palmer (Vice-Chairperson)
Dr R Kfir
Dr SJ Khoza
Ms MM Matsabu
Dr DJ Merrey
Mr NL Moikangoa
Dr BM Molope
Mr RJC Nay
Mr AM Muller
Mr MG Rall
Mr JS Vilakazi

Mr AM Muller, Director-General of the Department of Water Affairs and Forestry and Dr Rivka Kfir in her position as Chief Executive Officer of the WRC, were *ex officio* appointments.

Board meetings held:

14 June 2002	Induction Course for new Board members
2 July 2002	Board meeting
6 November 2002	Board meeting
6 November 2002	Board Training - Corporate Governance (Institute of Directors)
5 December 2002	Board Strategic Planning Meeting
15 December 2002	Continuation of Board Strategic Planning Meeting
6 March 2003	Board Meeting

The committees established by the Board to assist in the execution of its various duties, together with the membership, functions and meeting dates of these committees are as follows:

Executive Committee of the Board (ExCo)

Members

Prof HC Kasan (Chairperson)
Dr R Kfir (CEO)
Dr SJ Khoza
Dr BM Molope

Meetings

No Executive Committee meetings were held during the period 1 April 2002 - 31 March 2003, as there were no urgent issues which could not be attended to at scheduled Board meetings.

Functions

The main function of the ExCo is to perform specific tasks, at the request of the Board, which need to be addressed as matters of urgency.

Audit and Finance Committee of the Board

Members

Under the **former Board**, the Audit and Finance Committee consisted of the following members:

Mr RJC Nay (Chairperson)
Dr R Kfir (CEO)
Mr DM Maleka
Mr CHH Scheepers (co-opted)
Prof EM Stack (co-opted)
Mr J Venter (in attendance)

Under the **new Board**, the Audit and Finance Committee was re-constituted as follows:

Mr RJC Nay (Chairperson)
Dr R Kfir (CEO)
Mr JS Vilakazi
Ms MM Matsabu
Mr CHH Scheepers (co-opted)
Prof EM Stack (co-opted)
Mr JA Venter (in attendance, up to 31 October 2002)
Mrs Z Scholtz (Committee Secretary)

Meetings

Under auspices of the **former Board**:
15 May 2002 (Additional non-committee members in attendance at this particular meeting were Mr N Puren, Mr M Meiring, Ms JM Kruger, Ms C Smit, Mr G de Jager, Mr R Sutton, Mrs ZM Scholtz)
Under auspices of the **new Board**:
22 August 2002; 9 October 2002; 14 January 2003

Functions

- Ensure compliance with the PFMA and advise on applications for exemption deemed necessary in the interests of enhancing the WRC's performance
- Monitor and advise on the collection of revenue due to the WRC.
- Evaluate short-, medium- and long-term plans and budgets
- Assess requests by Management for adjustments in water research rates and charges (levies) and make recommendations to the Board
- Review the external audit process at key stages of planning and execution, in terms of addressing (i) critical risks areas (ii) scope and (iii) effectiveness
- Review external audit results, and make recommendations to the Board on acceptability of financial statements and on addressing significant differences between management and the external auditors
- Review, from time to time, the WRC's financial policies and accounting procedures and controls, *inter alia* in the light of external audit results
- Advise on labour dispute strategies
- Monitor the scope and effectiveness of the internal audit function from the financial perspective
- Monitor the ethical conduct of the WRC, its management and senior officials, from the financial perspective
- Report to the Board on an ongoing basis.

Human Resources Committee of the Board (HR Committee)

Members

Under the **former Board**, the Human Resources Committee consisted of the following members:

Dr CT Johnson (Chairperson)
Ms MM Molala
Prof HC Kasan
Dr N Tsengwa
Dr R Kfir

Under the **new Board**, the Human Resources Committee was re-constituted as follows:

Mr JS Vilakazi (Chairperson)
Dr R Kfir (CEO)
Ms MM Matsabu
Prof CG Palmer
Mrs Z Scholtz (Committee Secretary)

Meetings

Under auspices of the former Board:
31 May 2002
Under auspices of the new Board:
23 August 2002; 10 October 2002; 16 January 2003

Functions

- Draft the Executive Director's performance agreement and assess performance on an annual basis.
- Advise on the structure and composition of Top Management
- Review transformation and employment equity plans and assess progress with respect to milestones and targets.
- Review career pathing and personnel development strategies and monitor implementation of skills development programmes.
- Review and advise on job level assessment policy and procedures.
- Advise on amendments to the conditions of employment and remuneration structure.
- Review and monitor the effectiveness of the WRC's performance management system.
- Advise on labour dispute strategies.
- Monitor the scope and effectiveness of the internal audit function from the human resource perspective.
- Report to the Board on an ongoing basis

Research Policy and Strategy Committee of the Board (RPS Committee)

Members

Under the **former Board**, the Research Policy and Strategy Committee consisted of the following members:

Prof CG Palmer (Chairperson)
Prof HC Kasan
Dr MB Molope
Ms ER Hay
Dr R Kfir (CEO)
Dr GC Green (in attendance)

Under the **new Board**, the Research Policy and Strategy Committee was re-constituted as follows:

Prof CG Palmer (Chairperson)
Dr R Kfir (CEO)
Dr SJ Khoza
Dr BM Molope
Dr DJ Merrey
Mr NL Moikangoa
Mr AM Muller
Mr MG Rall
Dr GC Green (in attendance)
Mrs Z Scholtz (Committee Secretary)

Meetings

Committee of the former Board:
11 June 2002
Committee of the new Board:
23 August 2002; 10 October 2002; 16 January 2003; 20 February 2003.

Functions

- Review and advise on the alignment of research goals and plans with national policy and priorities and the mission of the WRC
- Assess and advise on the balance and appropriateness of research strategies (short-, medium- and long-term) in meeting such goals
- Ensure that research plans and strategies are aligned with the WRC's policy for capacity-building and are appropriately designed to meet capacity-building objectives
- Advise on the partitioning of research funds among primary application areas
- Review and make recommendations regarding the acceptability of proposed research programmes
- Monitor progress at the level of research programmes and primary application areas and evaluate outcomes with regard to stated goals, including those concerned with capacity-building, technology transfer and knowledge management
- Review policies and procedures for ensuring beneficial exploitation of research products
- Monitor the scope and effectiveness of the internal audit function from the research perspective
- Report to the Board on an ongoing basis.

The Core Business of the WRC

As reflected in the WRC's mission and its various undertakings, the WRC functions as a 'hub' for water-centred knowledge. It is a networking organisation linking the nation and working through partnerships. Being an innovative organisation, it is continuously providing novel (and practical) ways of packaging knowledge and transforming knowledge into technology-based products for the water sector and the community at large, both locally and globally.

During the year under review the WRC, through a number of initiatives and partnerships (see below), has significantly enhanced its status in being recognised as a global leader.

Key Performance Areas (KPAs) - Performance Against Set Objectives and Targets (2002/2003)

The strategic objectives of the WRC were developed against identified KPAs that address many of the strategic challenges and issues stated above. Specific objectives were set for each KPA. During 2002/2003 most of these objectives were addressed and largely achieved. Furthermore, the WRC has adopted the KPAs as part of its performance management (evaluation) system, with special emphasis being given to KPA-related objectives set for the WRC's core leadership. Each KSA has also developed and worked towards the achievement of its own specific objectives, set within the framework of the organisational KPAs. The WRC views the KPAs presented here as a route for translating the organisation's vision into strategic measures.

The performance objectives of the WRC for 2002/2003 were set against the following five KPAs:

- Stakeholder relationships
- Financial perspectives
- Learning and innovation
- Internal processes
- Organisational transformation.

Highlights of progress made against the set objectives are presented below. It should be noted that although achievements can be reported against each of the KPAs, emphasis is placed on the KPA addressing customer/stakeholder relationships, as this area was deemed to be of special importance during 2002/2003 when the WRC was in an active period of transformation. Initiatives aimed at the positioning of the WRC and communication of its new strategy and operational model, were considered to be key for successful implementation of the core strategy of the organisation.

Customer/Stakeholder Relationships

Key objectives addressed included the development and implementation of a new core strategy (5-year plan) based on a needs analysis, i.e. identification of stakeholder/provider needs; effective implementation of new funding mechanisms; review of methods used for effective dissemination of research findings; the establishment of new channels for public understanding of water-related issues; improved communication of WRC's business (new strategy); and the strengthening of the WRC's international positioning.

The WRC followed various routes to discuss its new strategy, research portfolio, new operational structures, funding process and its general *modus operandi* with many of its stakeholders. These included special visits, group presentations and discussions, workshops and presentations at conferences, symposia and other gatherings. Specific interactions with key stakeholders also took place around terms of reference for proposed solicited projects.

Examples of discussions with stakeholders include a presentation to senior staff at DWAF, followed by a one-day workshop aimed at mutual sharing of new strategies and identification of research needs. Presentations and discussions were also held with water utilities and with a number of universities. Examples of conferences where presentations by WRC staff took place include the Water Institute of Southern Africa, the SA Society of Aquatic Science and the Western Cape Regional Groundwater Conference. The new strategy and research portfolios of the WRC were also widely communicated via the Internet, with feedback received being of great value to the organisation. In addition, each KSA discussed its proposed portfolio of solicited research projects with various stakeholders and providers. The process has proven to be fruitful and most of the participants were willingly engaged and contributed valuable feedback

During 2002/2003 the WRC developed an active positioning programme. This includes a revised format of the annual report (as reflected in the report for 2001/2002) in which emphasis is placed on highlighting the WRC's achievements and providing information on its new strategy. The report for 2001/2002 was handed over to DWAF during a short ceremony at the WaterDome in Johannesburg during the WSSD. New brochures, aimed at the water sector and the general public, were developed. The first two editions of the WRC newsletter (*Amanzi*) were widely distributed to stakeholders. A number of press releases, including an interview with the chairperson of the Board, were published by certain technical journals, e.g. *Engineering News* and *Water Sewage and Effluent*, as well as in daily and weekly newspapers. WRC personnel have, on several occasions, taken part in radio and television interviews.

The WRC has strengthened its regional activities. Two examples of African initiatives include the WRC's contribution to the Accra Declaration and its involvement as implementing agent for a **water resource assessment** project addressing a number of river basins in the SADC region. The WRC also assisted DWAF, the Water and Sanitation Collaborative Council (WSSCC) and the Water

and Sanitation Programme (WSP, World Bank) in hosting the AFRISAN Conference. A further highlight is the appointment of Dr Kfir by Minister Ngubane to serve on the NEPAD working group which addresses Science and Technology (S&T) issues.

The WRC has maintained and extended its international drives. Examples are:

- The strong partnership with the WSSCC
- International workshops hosted by the WRC as part of its links to both the Penta-Party and the Global Water Research Coalition (GWRC). In addition, in the field of membrane technology, a number of collaborative projects have been initiated
- An approach to the WRC by UNEP-IETC, with a proposal that the WRC should become a UNEP collaborative centre, and appointment of one of the KSA Directors (Jay Bhagwan) as an advisory board member
- The WRC-built collaborative relationship with IWMI, and the CEO's appointment to IWMI's Board.

The WRC was actively involved in a number of local initiatives, for example:

- The Small Water Treatment Systems workshop, hosted by the WRC
- The CEO's appointment to chair the Joint Fluoridation Implementation Committee (JFIC)
- Discussions regarding the new R&D strategy (Department of Science and Technology, COHORT/Heads of Science Councils meetings).

The WRC played an active role in many activities during the WSSD in August/September 2002. This included the WRC participation in the South African Pavilion at the WaterDome (the stand was manned by the PR/communications group with great commitment and dedication), the development of communication material which included press releases, information sheets highlighting a number of projects, radio interviews and presentation of some key reports. WRC staff also took an active part in the S&T Forum and a number of individuals chaired sessions at the Forum. A keynote address was presented at the WSSD-linked atmospheric science conference co-sponsored by the WMO and the SA Society for Atmospheric Sciences.

The WRC took an active part in the World Water Forum which was held in Kyoto, Shiga and Osaka, Japan, 16-23 March 2003. The WRC was represented by the chairperson of the Board, the CEO and a number of other staff members, including staff members who were invited to the Forum by international bodies such as UNEP, WSSCC (WHO) and the South African Government (Department of Agriculture). The WRC, in collaboration with DWAF and the WSSCC, contributed to a number of presentations and discussions related to water, sanitation and hygiene. A number of South African researchers with links to the WRC also attended the Forum, mainly on invitation. The importance and contribution of R&D to the South African water sector was repeatedly pointed out by the Minister of Water Affairs and Forestry, as well as by other delegates to the Forum.

Financial Perspectives

This KPA addresses the long-term goals of diversification and growth of income, leveraging of resources through partnerships, as well as the short- to medium-term goals of strategic budget planning, budget revision and management (drafting of 5-year budget plan, assessment of performance against the budget) and the establishment of highly efficient and effective financial practices, including fund management (i.e. investment in R&D and improved contracting practices) and the building of a business-like culture at the WRC.

During 2002/2003 the WRC decentralised its budget and finances to allow for appropriate accountability and active management of both income and expenditure at KSA level. A business-like culture and cost awareness (value for money) was developed in all KSAs with the aim of cutting expenses, while maintaining high-quality services. Examples are the move to digital printing and the printing-on-demand approach (i.e. printing of WRC publications according to need), which has already resulted in major cost savings and reduced the required publications storage area without sacrificing quality.

The format of the WRC's standard research contract was revised, with greater emphasis placed on delivery and payment against deliverables. The new format also addresses the issues of intellectual property (IP) in greater depth than previously. The revised contract is to be implemented in the next financial year (2003/2004).

The WRC has strengthened its corporate governance. The organisation developed a strategic risk plan addressing key financial issues, issues related to corporate governance and other strategic risks. In addition, an internal audit plan aimed at addressing specific risk areas was developed and implemented. In addition, a new delegation of authority (powers) reflecting the new strategy and mode of operation of the WRC and supporting a culture of accountability, was developed and approved by the Board and is currently in use.

A set of financial ratios serving as key indicators of business efficiency has been developed. The budgeted ratios are compared with ratios actually achieved in 2002/2003.

Indicator (%)	*02/03 (budgeted)*	*02/03 (achieved)*
Levies percentage of total income*	93.7	92.9
Other sources of income/total income	6.3	7.1
Research project funding as % of total expenditure **	60.2	62.9
Research support (research project and support and technology transfer)/ total expenditure***	75.9	74.8
Manpower cost/total expenditure	15.7	15.2

* *Total income does not include income arising from the transfer of unutilised funds*

** *The budgeted research project funding is calculated after deduction of the amount budgeted for transfer of unutilised research project funds*

*** *Total expenditure is calculated after deduction of the amount budgeted for transfer of unutilised research project funds and excluding provisions for leave and bad debts*

The WRC has achieved its targets for both levy and other income. The total income reflected for 2002/2003 is R107.6m which is R19.6m more or 22.3% above the budgeted amount of R88m This also reflects a 20% growth of income in comparison to the previous financial year (income as per income statement R107.6m in comparison to R89.6m for the previous financial year).

The financial indicators (ratios) given above show that the WRC has met the set financial targets in accordance with its financial key performance objectives. By meeting or even exceeding the set indicators, the WRC has clearly shown increased effectiveness and efficiency. Investment in the WRC's core activities of knowledge generation and dissemination has increased. The investment in research projects has exceeded the target ratio by 2.7%, indicating a substantial increase in the proportion of research funding.

The WRC achieved significant growth during the year under review in comparison to the previous financial year (2001/2002)

- As indicated above, the WRC total income has grown from R89.6m to R107.6m which represents a growth of 20%.
- The WRC has diversified its income and earned about R2.9m for research and research support and technology transfer from sources other than levies. This is an increase of almost R2m (200% increase) compared to last year and about 81% increase on the original planned budget of R1.6m.
- Levy income as reflected by DWAF year-end information has grown in a very significant manner from R80.9m (2001/2002) to R99.9m (2002/2003). This represents an increase of R19m relative to the expected levy income. However, this amount includes a substantial amount that has not been collected (arrear payments). Of the debtor balance of R30.9m, about R15.5m is due to uncollected levies in comparison to R4.2m for the previous year. With regard to the uncollected levies a provision for doubtful debts of R9.8m has been made.
- Research funding for 2002/2003 was increased by 13%, i.e. from R55.2m (2001/2002) to R62.4m (2002/2003). This increase included a R4m increase in project funds, and about a R3m increase in research consultancies when compared to the previous financial year.
- The net income for the 2002/2003 financial year is R8.4m in comparison to R5.4m for 2001/2002. This is mainly due to the increase in levy income.

Learning and Innovation

This KPA comprises both internal and external objectives. The internal objectives include improved information management (policy and practice) and the effective utilisation of IT tools and systems such as the intranet and project management system. The building of a learning organisation, with a culture of innovation and staff members with a high level of both competence and skills, is also aimed at. Objectives aimed at serving the external market relate to the building of capacity and competence for the water sector at a national level and the application and commercialisation of research funding, whilst improving management of IP and the improvement of knowledge dissemination pathways. During 2002/2003, the WRC built new operational units using the KSAs as strategic frameworks for research support and management. A series of internal presentations by each of the KSAs and crosscutting domains served to increase overall staff understanding of WRC operations and scope. The presentations were well attended and well received by all staff members.

A number of functional forums which support 'community of practice' and innovation have been established. These include a research management forum and a co-ordinator forum. In addition, cross-KSA and cross-functional task teams have been addressing many internal and business operations.

During 2002/2003 the WRC supported about 300 students through various research contracts, mainly with universities and technikons. Of this number, about 70% were from previously disadvantaged backgrounds (see table below). The WRC currently supports several historically disadvantaged universities and a number of technikons throughout South Africa.

The WRC was involved in a number of local and international drives addressing capacity-building, e.g. the Eskom/NRF drive, WARFSA (Water Research Fund for Southern Africa) and FET-Water (capacity-building and training network for the water sector). The WRC is also represented in the COHORT task team, addressing the issue of R&D capacity in South Africa. The WRC is a founding member of the *Women in Water Awards* and has provided a young female scientist with research sponsorship following this year's event.

	Number of disadvantaged students	*Total number of students*
Council for Geoscience	2	2
CSIR		1
DIT	5	5
Ecosun cc		1
Endocrine Consortium *	10	14
ERWAT	3	3
Highveld Biological Association	1	2
Institute for Water Research (Rhodes)	5	9
Institute of Natural Resources	12	17
McCracken	1	1
MEDUNSA	0	1
Peninsula Tech	12	13
PU for CHE	3	3
Pulles, Howard & de Lange	9	10
Rand Afrikaans University	3	5
Rhodes University	9	16
Tech Wits	5	7
University of Cape Town	14	22
University of Durban-Westville	16	16
University of Natal	5	8
University of Natal (Pmb)	4	17
University of Port Elizabeth	5	7
University of Pretoria	24	31
University of Stellenbosch	7	24
University of the Free State	11	23
University of the North	4	6
University of the Western Cape	18	18
University of the Witwatersrand	11	16
University of Venda	10	10
Water Systems Research Group	2	4
Total	211	312
% of total students	(68%)	

* *The consortium includes the universities of Fort Hare, MEDUNSA, Pretoria, Stellenbosch, Technikon Pretoria, CSIR, ARC, Du Buisson & Partners and SABS.*

The WRC has invested in the improvement of its office accommodation, work environment and IT hardware, with the aim of building conditions which are more conducive to working and learning.

The WRC is addressing its IP and commercialisation policy and strategy in order to improve the application and the value of the new knowledge generated by WRC funds. Key clauses regarding IP within the WRC contract were revised according to the recommendations of IP experts.

The WRC is continuing its support of staff members' studies (degree, diploma and other studies).This drive is effective in promoting a learning/knowledge organisation (see also information on human resources, below).

Internal Processes

Key issues to be addressed include functional excellence as reflected in clear, effective and simple-to-manage core business processes, e.g. funding processes as well as strategic and business planning processes, and programme and project management systems and processes. The WRC also strives for management excellence, with clearly assigned responsibilities and accountability (clear delegation of authority), a clear set of HR procedures, and strong corporate governance including 'pro-active' compliance with all Acts of Government that direct WRC corporate governance, i.e. the Water Research Act, PFMA, Treasury Regulations, Public Service Act, Access to Information Act and the Archive Act.

During 2002/2003 the WRC developed and implemented a new funding process allowing for three funding streams: Solicited and non-solicited research proposals and consultancies. This included the institution of a new review process which raises and widens the reviewer's profile and allows for extensive feedback, as well as the establishment of new project management processes supported by a new contract format. The new approach of soliciting research also emphasises the building of consortia and the transfer of knowledge between organisations and individuals.

The new financial procedures resulting from the decentralisation of the budget have enhanced staff members' responsibility and accountability. The revised delegation of powers, supporting the new strategy and mode of operation of the WRC, also supports decentralisation of the budget and establishes the appropriate level of accountability. The new delegation also supports the move from a project-based strategy to a research portfolio strategy at KSA and crosscutting domain levels.

Based on the strategic plan, a new IT plan was developed. A new way of maintaining high-quality IT infrastructure (hardware) was adopted. It is envisaged that by the end of 2003/2004 a clear path aimed at improved IT systems supporting the core business of funding will be well established.

During 2002/2003 the WRC embarked on renewing many of its internal policies and procedures. The development of a new travel policy, new financial rules and procedures, and an investment policy are still in progress.

Following the implementation of the new organisational design, and with staff already functioning in their new roles, the WRC reviewed its job structure (for more details please see section addressing human resources, below). In addition, a performance assessment system for all staff members is currently under development.

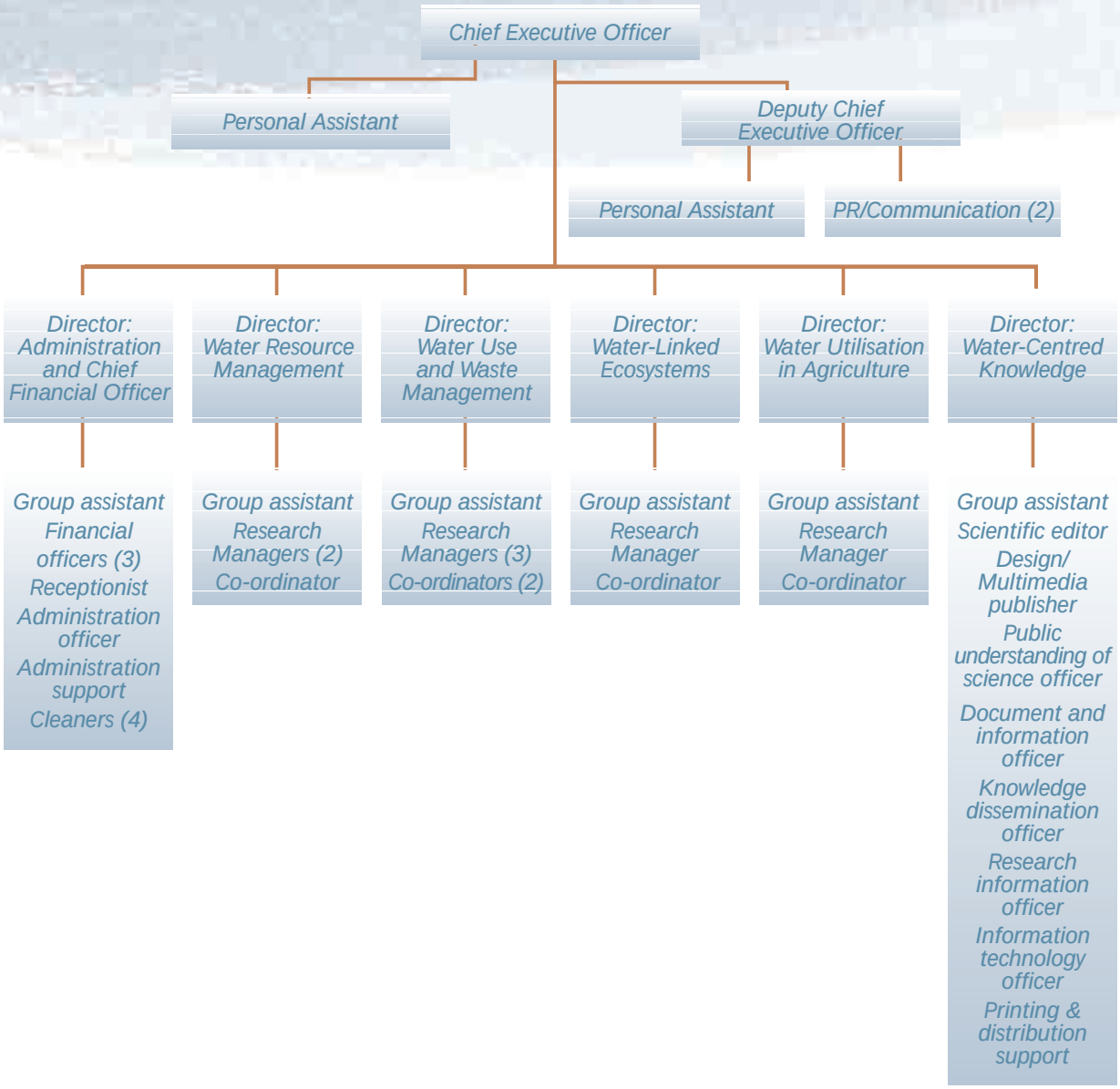
Organisational Transformation

The overarching objective is to establish effective leadership and sound management. More specific goals are to build a clear strategic direction and appropriate implementation plans, a common, shared sense of purpose and a motivating and energising vision and a strategy, structure and system that support and enhance each other. Examples are management structures that provide for delegation of authority and growth. Objectives specific to internal transformation include issues such as accelerated equity and redress, a culture of self-management, an entrenched value system and effective performance management.

During 2002/2003, the WRC revisited its employment equity policy and plan in order to realign the plan with its new strategy and structure, and also reconstituted the employment equity co-ordinating committee (EECC). The WRC fulfilled the requirement to report progress to the Department of Labour with regard to its achievements/deviations against/from its previous plan. The employment equity study undertaken by an external human resource consultancy group indicated that many of the original targets set for employment equity for 2005 in the plan submitted to the Department of Labour in December 2000 had already been met. In September 2002 the WRC employed 43% Black staff members (of a total staff of 49) and 51% female staff members. It should be noted that less than 1% of the Black staff are in the unskilled category. The WRC has significantly reduced all barriers to employment equity, and has introduced clear guides for upholding equity principles in its recruitment and selection processes and in its procurement policy. During the financial year the WRC increased procurement from Black empowered organisations to 35% of its total procurements.

The WRC executive and the WRC staff association have developed a sound working protocol. The two parties discuss all matters and strive for mutual agreement. Representatives of both management and the Staff Association serve on the EECC. The WRC subjected itself to a climate/culture study by external consultants, and is currently developing an action plan in accordance with its findings.

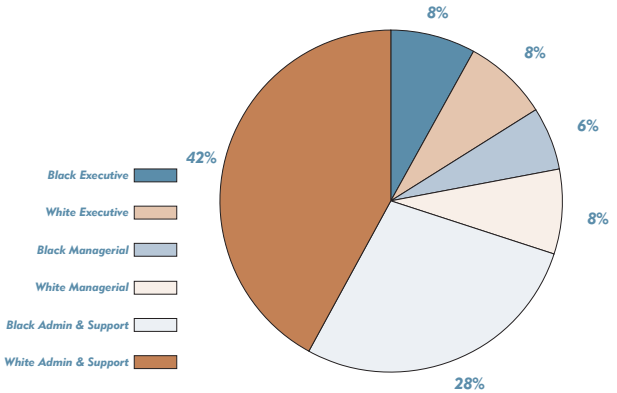
Human Resources



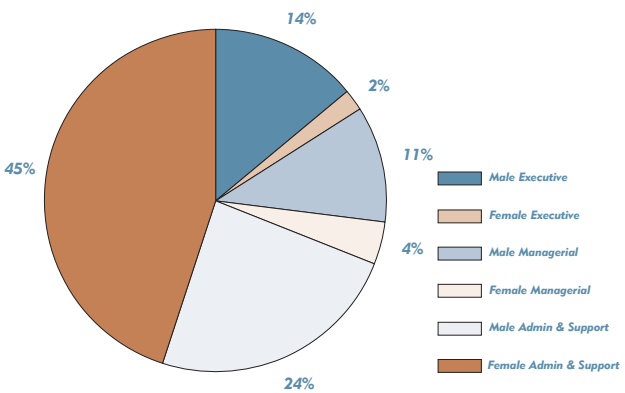
Staff Composition by Gender	
Male	49%
Female	51%

Staff Composition by Race	
Black	43%
White	57%

Job levels by race



Job levels by gender



Structure of the WRC

During 2002/2003 the WRC implemented its new organisational design in accordance with its core strategy. The current structure includes 49 staff members, providing for core and direct support functions. As addressed above, after a period of a few months, with staff already functioning in their new roles, the WRC reviewed its job structure. External consultants carried out a process of job evaluation, based on the Public Service tool (Equate). The evaluation included 48 posts and the results were approved by the Board. The new post structure allows for progression within and between job levels and distinguishes between entry level and full proficiency. The WRC staff association was fully informed about the job evaluation process and played an active role in the moderating panel.

As indicated above, the employment equity study indicated accelerated equity and redress as is also reflected in the race and gender statistics. In terms of composition by race, there was an increase of 4% in the number of Black staff during the year under review. Although female staff members still represent the majority, there was a shift in the gender ratio with an increase in male staff, bringing about an almost equal number of male and female employees. At Executive level an increase of Black members to 8% (50% of all Executive) by the end of 2002/2003 is significant, especially as this level had previously been the domain of White males only.

WRC Support for Staff Education and Training

The WRC supported the development of its staff members via formal tuition and shorter-term training courses. During 2002/2003 emphasis was placed on PC skills and adult education. In addition, about 8 staff members (16%) have been engaged in studies, supported by the WRC, for an array of degrees and diplomas as well as pre-university education.

Formal Studies at Various Educational Institutions

Studies	No of Individuals	Status
PhD	2	Ongoing
MBA	1	Ongoing
Market Research	1	Ongoing
B.Com	1	Ongoing
Office Admin	2	Ongoing
Matriculation	1	Ongoing

The Research Portfolio of the WRC: Investment in the Generation and Transfer of Knowledge

During the year under review the WRC placed emphasis on playing a leading role in building a sustainable water-related knowledge base in South Africa by:

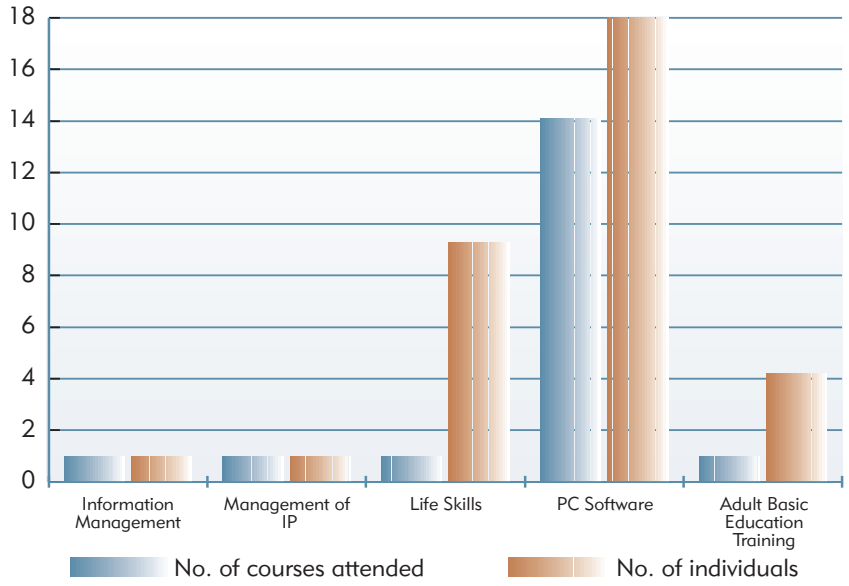
- investing in water research and development
- building sustainable and appropriate capacity
- developing skills for the water sector, and
- being adept in forming strategic partnerships in order to achieve objectives more effectively while making optimal use of the latest global information/knowledge and other technologies available.

The WRC met the challenge of being adaptive and responsive to a changing, dynamic environment by maintaining relevance and providing South Africa with value for the money invested in water R&D. This is reflected in the organisation's performance as measured against its strategic and operational objectives, in the portfolio of research projects and in other knowledge-generation and knowledge-transfer initiatives undertaken by the WRC during the year under review.

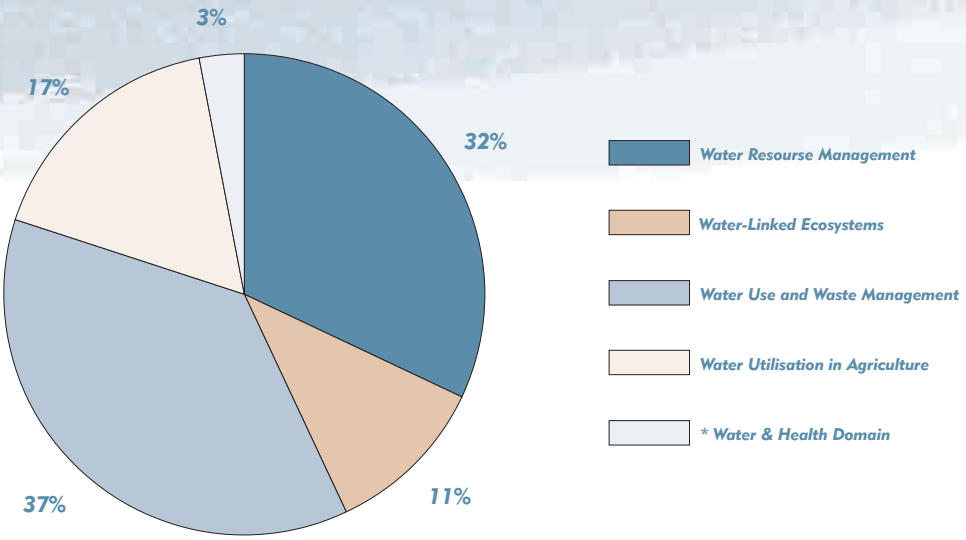
In 2002/2003 R62.4m was invested in knowledge generation and capacity-building and a further R4.2m in technology transfer and dissemination drives (patenting, publication of reports, workshops and conferences, knowledge reviews, publication of *Water SA*, *Amanzi* and *The Water Wheel*). The investment of R62.4m in knowledge generation and capacity-building represents an increase of 13% from the last financial year (R55.2m, 2001/2002).

About R54.5m was invested by the WRC in research projects during the financial year under review. The number of projects supported during this period was 466. Of these, 363 projects (about 78 %) were ongoing and 103 (about 22%)

Training Courses



Distribution of Research Project Funds (%)



* Water and Health was the only domain which was allocated research project funds

were new projects which commenced during the year under review. Of the ongoing projects, 35% (120 projects, or 26% of the total number of projects) were completed (finalised) during the year. In total, 121 research reports were published, some of which pertain to projects which had been finalised during the previous financial year.

Key Strategic Areas (KSAs)

The KSAs commenced operation during 2002/2003, building new working relationships and operational modalities, and supporting both the internal and the external environment. The KSAs have developed their strategic and business plans and implemented these via their new research portfolios, which place emphasis on knowledge generation, dissemination and transfer, as well as capacity-building. Through discussion and consultation, new research thrusts and programmes were established, aimed at addressing key needs and guiding future research. During 2002/2003, these KSAs initiated their leadership role in directing and supporting water-centred knowledge generation in South Africa, linking and networking with local players as well as supporting strong partnerships with global players. The KSAs operate as strategic units, focusing on the recently-established strategic research portfolios, while investigating the need for future refinement based on stakeholder needs and feedback. The knowledge-centred KSA supports the water-centred KSAs in knowledge dissemination and information technology (IT) services.

During 2002/2003, the research portfolio of each KSA was structured on the basis of the new thrusts and programmes mentioned above. The call for research proposals (for projects due to commence in 2003/2004) was based on these KSA-specific research portfolios. Both solicited and non-solicited research proposals were invited, while KSAs also supported other initiatives such as workshops and consultancy projects. Each of the KSAs has also developed innovative processes to effectively manage its ongoing research projects.

The following section presents a short summary highlighting the scope, objectives, and research activities undertaken during 2002/2003, under the various thrusts and programmes for each of the KSAs.

Water Resource Management

The strategic focus for research in this KSA is largely guided by the principles and objectives of the National Water Act (NWA) of 1998. The primary principle of the Act is that water resources should be managed to achieve optimum long-term social and economic benefits for all. This implies maintaining an optimum balance between protection of the environment and efficient water utilisation. This KSA supports the implementation of the policy by developing tools and technologies for water resource assessment and guidelines and decision-support systems to support decision-makers in achieving equitable and efficient allocation of water resources among competing needs. During 2002/2003 the research led by this KSA placed emphasis on

multidisciplinary approaches that provide decision-makers and planners with appropriate tools that enable them to address social, environmental and economic factors in the planning of water resource development.

During the year under review, a shift in the research focus was initiated, from supporting policy-making to providing guidance for policy implementation and development of policy instruments. The research carried out during 2002/2003 enabled significant progress to be made towards the development of the necessary information systems, guidelines, decision-support systems, prediction tools and technologies/methodologies that support protection of water resources and equitable allocation of water to meet the needs of the environment and of social and economic development. The emphasis that the NWA puts on stakeholder participation in water resource management called for a number of research projects on effective participatory tools and approaches that can support multi-stakeholder participation in water resource management at catchment level. The potential impacts of global climate change on water resource management are also being addressed increasingly through research within this KSA.

Objectives

Research studies supported by this KSA all aimed to support the primary and secondary objectives of the KSA, as stated below.

The primary objective of research in this KSA is to ensure that water resources of South Africa are protected, utilised, developed, conserved and managed to achieve environmental, social and economic sustainability. Sustainable water resource management requires a holistic approach that balances competing demands of the different user groups.

The secondary objectives are to:

- Improve policy for promoting equitable, efficient and sustainable allocation of water resources among competing needs.
- Develop a systems approach, supported by necessary management tools and institutions to integrate environmental, economic and social issues within a catchment or water management area into an overall management philosophy.
- Provide scientific explanation and adequate quantitative understanding of the soil-water balance dynamics and streamflow-generating mechanisms for any spatial and temporal scale and their relationships with the physical and chemical transport of matter.
- Acquire adequate understanding of atmospheric processes and develop appropriate atmosphere-based technologies needed for the satisfactory assessment, management and augmentation of South Africa's water resources.
- Refocus groundwater characterisation towards integrated water resource management in line with national needs and priorities.
- Promote better utilisation of South Africa's limited water resources by supporting research, development and technology-transfer actions aimed at improving management (assessment, prediction, control and utilisation) of the quality of South Africa's surface and groundwater resources.

Thrusts and Programmes

The research portfolio includes new initiatives and current projects addressing the objectives as set out above. Overall, about R17.57m was invested in 126 projects at different stages of implementation. More details on the allocation of funds and the number of projects (for 2002/2003) at a thrust and programme level are given below.

Thrust	*Funds (R million)*	*No of Projects*	
		Ongoing	*New*
Water Resource Assessment	9.19	45	12
Integrated Water Resource Development	1.26	7	4
Management of Natural and Human-Induced Impacts	4.36	21	10
Policy Development and Institutional Arrangements for Water Resource Management	2.76	22	5
Total (126 projects)	***17.57***	***95***	***31***

Water Resource Assessment

During 2002/2003 the WRC invested about R9.2m in 57 projects in this thrust area. Of these, 45 projects were either in their final stages or ongoing, while 12 new projects were initiated during the same period.

This thrust focuses on researching the quantity, reliability, quality and fitness-for-use of water resources (at various applicable spatial scales) and their trends over time, resulting from both natural and human (land-use) influences. During 2002/2003 the following programmes were addressed:

- Groundwater occurrence in fractured-rock aquifers: Research provided better understanding of groundwater resources in fractured-rock aquifers by characterising various geological provinces in terms of groundwater occurrence and development potential and by developing techniques and protocols for groundwater exploration. It also addressed the estimation of aquifer parameters using innovative techniques and the development of systems for better resource management.
- Catchment hydrology: Research improved the knowledge on how much water is naturally available in South Africa and the impacts that human activities may have on this resource. Studies on the hydrology of South Africa, aiming to provide a scientific explanation and adequate quantitative understanding for resource management, were carried out.
- Understanding and predicting rainfall variability: Progress was achieved towards the aim of achieving better forecasts of rainfall variability (including rainfall events and amounts), this being of great importance for water resource management.
- Development of appropriate techniques for evaporation monitoring: Research carried out during 2002/2003 aimed at improving the basis for measuring and estimating evaporation from various dry-land crops and

veld types in South Africa, with the aim of contributing to the better understanding of the relative consumptive use of water by different vegetation types.

- Water quality assessment studies and information systems: Projects concentrated on the development of information and monitoring systems at national level for both surface and groundwater as well as the establishment of improved methods for monitoring risk assessment.
- Real-time mapping of daily rainfall over South Africa: A national system for the spatially continuous measurement of rainfall in real-time has been piloted. The implementation of a country-wide, integrated rainfall monitoring system, based on remote sensing and point sampling, was supported.

Integrated Water Resource Development

During 2002/2003, the WRC invested about R1.3m in 11 projects in this thrust area. Of these, 7 projects were either in their final stages or ongoing, while 4 new projects were initiated during this year.

Research in this thrust focuses on providing information to support integrated water resource development. It seeks to find a balance between approaches to improve supply and to develop optimisation tools for cost-effective, sustainable exploitation of available water sources. It also seeks to find a balance between supply-side considerations and demand-side management. Integration of social, economic and environmental considerations which are critical to sustainable water resource development and management will be reflected in the outcomes of research within this thrust. This thrust addressed a number of programmes, as follows:

- Integrated catchment management: Studies aimed at improving the understanding of the links between different biophysical components of the water resource system at a continuum of scales.
- Groundwater resource development: Projects carried out during 2002/2003 attempted to study various geological provinces in terms of groundwater occurrence and development potential. New techniques and protocols for groundwater exploration were addressed and innovative techniques for estimating aquifer parameters explored. The overarching aim is to develop systems for better resource management.

Management of Natural and Human-Induced Impacts

The WRC invested about R4.36m in 31 projects in this thrust area during 2002/2003. Of these, 21 projects were either in their final stages or ongoing, while 10 new projects were initiated during this year.

Research in this thrust focuses on developing tools and methodologies for managing the impacts of climate variability and change and human interventions on the hydrological cycle and related water resources. In the year under review, this included development of systems (e.g. river flow and inundation forecast models, drought impact monitoring systems) for managing floods and droughts and developing the ability to recognise and address, in an integrated way, human-induced impacts on inter-related components of the hydrological cycle (e.g. river systems and underlying aquifers) over a range of relevant space and time scales. Research supports improvement in water quality management with special reference to non-point sources, as well as chemical and biological pollution impacts on surface and groundwater. The following programmes were addressed:

- Predicting the impact of global climate change: Projects in this programme are aimed at improving South Africa's ability to cope with global climate change, an issue of paramount and strategic importance. Relationships between groundwater levels and long-term climatic conditions were studied with the aim of improving understanding of the impact of climate change and the frequency and magnitude of extreme rainfall events on hydrogeological responses. The effective use of existing conceptual and numerical models for deriving global change-related, downscaled, hydroclimatic information likely to relate to land-use, ecosystem, hydrological (including geohydrological), water yield and water quality changes at regional/catchment level, was also addressed.
- Groundwater protection: Studies are focused on groundwater quality in areas of intensive land-use (both urban and agricultural) as a consequence of increased human settlement and economic development, especially where possible serious negative impacts may be evident. The research findings contribute towards the improved understanding of the relationship between polluting activities (sources) and quality effects in the groundwater, given that water quality impacts of naturally occurring hazardous constituents in groundwater have also been studied.
- Pollution of surface water: Investigations were carried out on the extent of eutrophication, its trends, causes (sources and levels of nutrients entering the aquatic systems due to land use such as mining and agriculture) and specific, issues (environmental and human health, social and economic impacts) associated with eutrophication. The findings of these investigations contribute to improved management of the eutrophication problem.
- Human-induced impacts: Five new studies were initiated to address methods for quantifying and modelling the impact of human activities (urbanisation and industrialisation) on water resources with a view to assessing the need for management and mitigation of negative impacts.

Policy Development and Institutional Arrangements for Water Resource Management

During 2002/2003 the WRC invested about R2.76m in 27 projects in this thrust area. Of these, 22 projects were either in their final stages or ongoing, while 5 new projects were initiated during this year.

Research in this thrust focuses on supporting policy developments, implementation processes and evaluation of policy impacts. The concept of co-operative governance with respect to water resource management is studied so that practical guidelines can be developed. The development of tools for stakeholder participation is receiving attention, in line with the growing emphasis on social, environmental and political components, as compared with the past emphasis on techno-economic issues. An institutional arrangement for the management of both surface- and groundwater in a catchment-based approach remains a major challenge. The research also investigates tools and institutional arrangements for resolving potential water-centred conflicts and for the management of shared international rivers and transboundary aquifer systems. During 2002/2003 studies were undertaken within the following programmes:

- Decision support for water policy formulation and implementation: Studies focused on acquiring and interpreting information on the impact of water-related public policy and on disseminating related knowledge and information to officials in government departments and representatives of water users in different use sectors. Ongoing and new projects addressed the economic value of water, or water as an economic resource, and development of protocols for integrated catchment management.
- Development and implementation of water policy instruments: Studies included the evaluation of the role of water user associations in water management in South Africa, and gender issues in water policy and management. The findings of these studies will support the development and implementation of policy instruments.
- Institutional arrangements for integrated water resource management (IWRM): Studies have focused on stakeholder participation in IWRM (including both surface- and groundwater components) and included investigations into human resource needs assessment, economic models and decision-support systems.
- Transboundary water resource management: This programme focuses on the provision of tools and guidelines for resolving potential water-centred conflicts for the management of shared international rivers and transboundary aquifer systems.

Water-Linked Ecosystems

Water-linked ecosystems are defined as in-stream (fully aquatic), riparian (dependent on water stored in the river banks and linked to the river) and water-table dependent (dependent on a water table, but not on surface water). This KSA focuses on the protection and sustainable utilisation of the aquatic environment and biota (in-stream, riparian and groundwater). This includes addressing research needs around the international conventions on environmental management (e.g. biodiversity) as well as human needs from the aquatic environment (e.g. sustainable management for equitable ecosystem resource utilisation, recreation and ecotourism).

During the year under review, progress has been made in developing technologies and methodologies, adaptive management processes and capacity in order to protect water-linked ecosystems and to sustain the flow of goods and services in a time of both demographic and climatic change in the Southern African context. Technologies and methodologies have been developed within this KSA to support the implementation of national water policy which aims to ensure sustainable resource use.

Objectives

The primary objective of this KSA is:

The provision of knowledge to enable good environmental governance so as to ensure the utilisation and sustainable management of water-linked ecosystems in a water-scarce country during a time of demographic and climatic change.

This is achieved through the following (secondary) objectives, namely to:

- Develop an understanding of the ecological processes underlying the delivery of goods and services.
- Develop the knowledge to sustainably manage, protect and utilise the aquatic ecosystem.
- Transfer the knowledge to appropriate end-users.
- Build capacity in both research and management to sustainably manage aquatic ecosystems.

Thrusts and Programmes

During 2002/2003 the research portfolio of this KSA contained a number of new initiatives and also included current projects within the various strategic thrusts and programmes which directly address the above-mentioned objectives.

Thrust	Funds (R million)	No of Projects	
		Ongoing	New
Ecosystem management and utilisation	4.85	24	11
Ecosystem protection	1.05	8	2
Total (45 projects)	***5.90***	***32***	***13***

Ecosystem Management and Utilisation

The WRC invested about R4.85m in 35 projects in this thrust area during 2002/2003. Of these, 24 projects were either in their final stages or ongoing while 11 new projects were initiated during this year.

Within this thrust, research is conducted to specifically address the management of ecosystems for sustainable utilisation. Central to this is the need to manage the social and economic requirements of society from ecosystems and the implementation of policy and legislation. It also covers the amelioration of the impacts of human activities. Programmes supported in this thrust are the following:

- Ecological Reserve: Studies were aimed at the development of methods for determining and operationalising the ecological Reserve as required by the NWA. Projects also addressed the development of a classification of rivers, a model for analysing trends in the condition of rivers and numerical methods for assessing water quality in rivers.
- Estuary management: The ecological processes within estuaries, and the effect of anthropogenic disturbance on these, were addressed. Better understanding of these processes will support better management of estuaries in a sustainable manner.
- Ecosystem health: Progress toward the establishment of a coherent biomonitoring programme with well-defined indices was achieved during 2002/2003. Projects also addressed additional issues on the management of river health.
- Toxicology: The development of bio-assays (both in the laboratory and the field) which will be employed to protect people and the environment from the effects of poor water quality were studied. Progress was also made on the establishment of methods and competence to enable the use of toxicology in effluent discharge licensing as well as in environmental water quality assessment as required in ecological Reserve determination.
- Amelioration of impacts: Within this programme research will be conducted to develop methods to ameliorate the effects of human impacts such as flow regulation and infrastructure development. While there was no investment in this programme during 2002/2003, a call for proposals for appropriate research projects is planned.

Ecosystem Protection

During 2002/2003 the WRC invested about R1.05m in 10 projects in this thrust area. Of these, 8 projects were either in their final stages or ongoing, while 2 new projects were initiated during this year.

This thrust includes research addressing the processes and functioning of ecosystems, dealing more specifically with the biophysical processes and form of ecosystems as well as the rehabilitation of degraded ecosystems. Knowledge generated by research within this thrust has been used to increase the national capability to sustainably manage ecosystems and the impact of people on ecosystems.

- Rehabilitation: Within this programme, research was conducted with the aim of developing methods to rehabilitate rivers (including wetlands) through addressing both abiotic and biotic components, and seeking to restore ecological processes and biodiversity as far as possible in degraded rivers and wetlands. This was done in terms of both the international conventions to which South Africa is signatory, as well as recent legislation emanating from both DEAT and DWAF. The programme also supports the development of competence needed to implement rehabilitation measures.
- Kruger National Park river programme: This programme is in its final stage and includes a number of projects that were completed during the review period, or are about to be completed. The programme has contributed to the development of a systematic bank of knowledge aimed at improved capacity to enable the Kruger Park to manage its resources optimally.
- Wetlands: The ecological processes and functioning of wetlands were studied and their value to both the catchment and the people living adjacent to the wetlands was assessed. Cultivation of high-value aquatic plants in restored urban wetlands for income generation was investigated.
- Groundwater-dependent ecosystems: Research was initiated with the aim of improving the understanding of the environmental value of groundwater systems. Within this programme the dynamics of groundwater-dependent ecosystems are being investigated in relation to the aquifers on which they depend. Special attention is being given to the vulnerability of these systems.

Water Use and Waste Management

This KSA focuses mainly on the domestic, industrial and mining water sectors and aims to proactively and effectively advance technology, science, management and policies relevant to water supply and waste and effluent management in the municipal, commercial, industrial and mining sectors.

Objectives

The primary objective of this KSA is to provide knowledge that ensures reliable, affordable and efficient services to enhance the quality of life and contribute to economic growth and improved public health.
The secondary objectives are to:

- Improve the management of water services in both rural and urban areas
- Develop appropriate technologies for improving the quality and quantity of our water supplies for both domestic use and industrial applications
- Develop new approaches to manage and enhance hygiene and sanitation practices
- Provide appropriate, innovative and integrated solutions to water and waste management in the industrial and mining sectors
- Develop applications for improved treatment of wastewater and effluent and improved processes for enabling increased reuse thereof
- Improve health, economic and environmental conditions while supporting the development of appropriate technologies and socially-focused management practices related to water and effluent management.

Thrust	Funds (R million)	No of Projects	
		Ongoing	New
Water services - Institutional and management issues	3.27	26	12
Water supply and treatment technology	3.49	51	7
Wastewater and effluent treatment and reuse technology	9.41	78	19
Industrial and mine-water management	3.84	22	9
Total (224)	**20.01**	**177**	**47**

Thrusts and Programmes

The research portfolio (comprising new initiatives and ongoing projects) includes four strategic thrusts and programmes which directly address the above-mentioned objectives.

Water Services - Institutional and Management Issues

During 2002/2003 the WRC invested R3.27m in 38 projects in this thrust area. Of these, 26 projects were either in their final stages or ongoing, while 12 new projects were initiated during this year.

The efficient functioning of Water Services Institutions and their viability is important to sustaining water services in rural and urban areas. The focus of this thrust is to address strategic research aspects related to policy issues, institutional reform, regulation, infrastructure management, operations and maintenance, sanitation (stormwater, sewerage and on-site sanitation), water-related competencies and capacity required for the strengthening of water institutions (water services providers, water services authorities, water boards, national departments) in providing sustainable water services.

The following programmes were addressed:

- Cost-recovery in water services (cost-recovery) has been identified as a critical aspect affecting sustainable services. A number of projects addressed this issue including, for example, studies on price elasticity of demand for water, an investigation into successful approaches to cost-recovery in low-income urban and peri-urban areas and the assessment of innovative modes of cost recovery such as electronic pre-paid meter technology.
- Institutional and management issues (water services) studies resulted in significant progress towards the development of processes that support service delivery. This includes the development of guidelines for water services providers and other innovative management techniques that could aid sustainable water service provision.
- Innovative management arrangements (rural water supply) studies have provided support to water service institutions, with special reference to the implementation of the free basic water policy. Projects included the establishment of key performance indicators for monitoring and evaluation of service delivery; guidelines for sound management of water service institutions and development of effective strategies for promoting an integrated approach to rural development.
- Rural sanitation and hygiene education: Accelerating the delivery of adequate sanitation services to millions of households who currently lack access to these services was the key focus of the studies carried out during 2002/2003. Projects addressed approaches to raising awareness of the issues of adequate sanitation, and ways of empowering rural communities to take an active role in improving their sanitation facilities and adopting hygienic practices. The development and

evaluation of key performance indicators for successful sanitation and hygiene promotion programmes were also addressed.

- Peri-urban sanitation research: During the year under review a number of projects have addressed technological and managerial aspects of improved sanitation in informal and developing urban areas. The results of these investigations are of great importance because the situation in urban areas is critical and volatile in terms of public health.

Water Supply and Treatment Technology

The WRC invested about R3.49m in 58 projects in this thrust area during 2002/2003. Of these, 51 projects were either in their final stages or ongoing, while 7 new projects were initiated during this year.

The reliable provision and supply of affordable water of suitable quality and quantity for drinking (domestic) and economic (industrial/commercial and mining) activities, remain continuous challenges. Research support for these activities is the focus of this thrust and includes the following programmes:

- Drinking water treatment technology: Progress was achieved toward the better understanding of potable water treatment processes and related activities. The findings of the investigations undertaken under this programme contribute to improved efficiency and cost-effectiveness of water treatment for both potable and industrial use. A few examples of technologies under investigation include desalination using membranes, UV and ozonation processes, and assessment of filtration processes, namely micro-filtration and ultra-filtration.
- Water treatment for rural communities: Research products include the provision of adequate water for rural communities, in terms of both quantity and quality, on a sustainable basis. Investigations into different technologies ranging from the application of simple chemical dosing systems, through upflow roughing filtration in layers, slow sand filtration, assessment of solar stills, to the removal of fluoride by clay adsorption units, are currently being conducted. In addition, studies have also addressed the softer issue of social acceptance of such technologies by the community. These investigations have already resulted in the establishment of knowledge-transfer initiatives, e.g. development of a guidebook for alternative small-scale desalination technologies for potable household water augmentation.
- Drinking water quality: The detection and identification of the presence of health hazards in water and the assessment of potential risk are being addressed with the aim of protecting human health by ensuring that water supplies and sanitation meet the required standards. Outcomes during 2002/2003 included improved analytical methodologies, monitoring and surveillance methods, methods for risk assessment, treatment technologies and hygiene practices.
- Water distribution and distribution systems: Studies aimed to optimise the quality, quantity and reliability of the distribution and supply of treated, potable water to end users. Progress was achieved towards establishing more reliable processes for predicting and improving the operational efficiencies in distribution systems in order to reduce both capital and operational costs. Progress was also made with the development of innovative methods, tools and processes that will improve system integrity and reliability.

Wastewater and Effluent Treatment and Reuse Technology

During 2002/2003 the WRC invested about R9.41m in 94 projects in this thrust area. Of these, 78 projects were either in their final stages or ongoing, while 19 new projects were initiated during this year.

With the continuous increase in wastewater and effluent flows, the challenge is to better manage treatment, so that the effluent produced meets requirements and can be considered as a resource. Research in this thrust aims to develop innovative treatment technologies and systems that would optimise treatment processes and infrastructure in the municipal, mining and industrial sectors. This includes:

- Biological sewage treatment processes: The development, process modification and optimisation of activated sludge and other biological systems for sewage treatment was addressed with the aim of achieving greater cost-efficiency, affordability, enhanced performance, security and wider application.
- Sludge characterisation, treatment, utilisation and disposal: Studies addressed the systematic characterisation (organic and inorganic), quantification and categorisation of sludges from domestic and industrial sources and the development of technically secure, cost-effective, environmentally acceptable and sustainable treatment process technologies, utilisation strategies and disposal practices.
- Treatment and recovery of organics from agro-industrial processing: Significant progress was achieved in the development of treatment technologies for problematic organic effluents from agro-industry processing, including forestry (pulp and paper) and livestock products. In particular, effluents which generated contained organic components which are too concentrated, refractory, inhibitory or even toxic in terms of the normal biological treatment processes available at municipal sewage works.
- Treatment and recovery of inorganics (including sulphate, metals) in industrial and mining effluents: Technologies for the treatment, removal and recovery of heavy metals and inorganic salts such as sulphates in industrial and mining effluents were addressed. These inorganics have deleterious bio-inhibitory or bio-toxic effects on the performance of sewage works, the fitness of treated wastewaters for reuse, the sludge quality produced and the aquatic environment in general.
- Training in wastewater treatment plant operation:

During 2002/2003 a project was initiated, aiming at the development and delivery of appropriate course material, management systems and training for wastewater treatment operators, to provide tools for strengthening and enhancing the skills base necessary for effective control and management of the diverse needs of the water industry in the RSA.

Industrial and Mine-Water Management

During 2002/2003 the WRC invested about R3.85m in 31 projects in this thrust area. Of these, 22 projects were either in their final stages or ongoing, while 9 new projects were initiated during this year.

The usage of water in the mining and industrial sectors produces high concentrations of wastes and effluents. Some mining activities produce wastes that act as non-point sources of water quality degradation and acid mine drainage. This thrust aims to provide appropriate, innovative and integrated solutions to water use and waste management in the industrial and mining sectors through the following programmes:

- Quantification of water use and waste production: Overall assessment was made of the effect of mining or industrial waste on water quality. This included studies on water usage by gold and platinum mine flotation plants and in power generating plants.
- Regulatory mechanisms to improve industrial and mine-water management: The use of the established mode and new, indirect economic or other instruments to supplement or even replace the established mode (command-and-control approach) of water quality management, was investigated. These new approaches are believed to be more cost-effective and to improve equity. The findings of these studies aim to support improvements to the regulatory mechanisms that are used to control and reduce the negative environmental effects associated with industrial and mining waste.
- Minimising the impact of waste on the water environment: Projects have addressed the development of cost-effective techniques and approaches to minimise or reduce the impact that historical and new waste products have on the water environment. Approaches such as pollution prevention, rehabilitation, waste beneficiation and reuse, are being investigated to assess their application potential and suitability to reduce and minimise the negative impact of industrial and mining waste on water quality.
- Minimising waste production: Studies focused on both technological and managerial aspects and included investigations into life-cycle analysis, the application of pinch technology as well as the establishment of supporting structures such as waste minimisation clubs.
- Improved ability to predict and quantify effects: The environmental consequences of waste products were investigated. The studies are being primarily aimed at establishing and improving pollution prediction capabilities which are appropriate to the South African situation.

Water Utilisation in Agriculture

The strategic focus of this KSA is on increasing the efficient use of water for the production of food, fibre, fuelwood and timber, ensuring sustainable water resource use, reducing poverty and increasing the wealth of people dependent on water-based agriculture. The needs and requirements of present and future generations of subsistence, emergent and commercial farmers are addressed through the creation and application of water-efficient production technologies, models and information systems within the following inter-related subsectors of agriculture:

- Irrigated agriculture
- Dryland agriculture
- Woodlands and forestry
- Grasslands and livestock watering
- Aquaculture

The challenge for applied research and knowledge dissemination is to provide solutions to practical problems which are experienced in the process of utilisation, development and protection of water resources, thereby contributing to productivity growth in agriculture.

Objectives

The primary objective is to increase national food security and to improve the livelihoods of people on a farming, community and regional level through efficient and sustainable utilisation and development of water resources in agriculture.

The secondary objectives are to:

- increase biological, technical and economic efficiency of water use
- reduce poverty through water-based agricultural activities
- increase profitability of water-based farming systems
- ensure sustainable water resource use through protection and reclamation practices.

Thrusts and Programmes

Thrust	Funds (R million)	No of Projects	
		Ongoing	New
Water Utilisation for Food and Fibre Production	1.56	9	2
Water Utilisation for Fuelwood and Timber Production	0.13	3	0
Water Utilisation for Poverty Reduction and Wealth Creation in Agriculture	4.56	15	7
Water Resource Protection and Reclamation in Agriculture	3.11	15	3
Total (54 projects)	**9.36**	**42**	**12**

Water Utilisation for Food and Fibre Production

During the year under review, the WRC invested about R1.56m in 11 projects in this thrust area. Of these, 9 projects were either in their final stages or ongoing, while 2 new projects were initiated during this year. Research activities and outputs are focused on improving knowledge concerning the roles of water in the processes of production of field, horticultural and industrial crops. During 2002/2003, the following programmes were addressed:

- Water-efficient production methods in relation to soils, crops and technology in rainfed and irrigated agriculture: Water productivity can be increased by producing more with the same use of water or by producing the same with less use of water. Studies aimed at the improved understanding of water dynamics in the soil-water-plant-atmosphere continuum, the optimal use of irrigation equipment and water-efficient production methods, were conducted. Research findings contribute to higher water use efficiency in agriculture.
- Fitness-for-use of water for crop production, livestock watering and aquaculture: The emphasis is on the efficient use of water and management of water quality for irrigation of crops, livestock watering and aquaculture in rivers, ponds and dams. During the year under review, processes and factors, which are site-specific and have an influence on the quality of water for crop, livestock and fish production, were investigated. Progress was achieved in studying the fitness-for-use of water sources and identifying water-related production problems.

Water Utilisation for Fuelwood and Timber Production

During 2002/2003 the WRC invested about R0.13m in 3 ongoing projects in this thrust area. The strategic focus which drives research within this thrust is the improvement of knowledge of water-associated tree production processes within the context of woodlands, plantation forestry and agro-forestry. During the year under review, the following programmes were addressed:

- Water-efficient production methods and systems in agro-forestry, woodlands and forestry plantations: Studies conducted aimed at improved understanding of water use by trees and the competitive or complementary use of water by trees and staple food and forage crops. In catchment areas where cultivation of trees is a prominent land-use feature, runoff and deep percolation of water can be regulated by appropriate management of this so-called streamflow reduction activity.

Water Utilisation for Poverty Reduction and Wealth Creation in Agriculture

During 2002/2003 the WRC invested about R4.56m in 22 projects in this thrust area. Of these, 15 projects were either in their final stages or ongoing, while 7 new projects were initiated during this year. The strategic focus for research in this thrust is to acquire knowledge to enable people to manage and use water in more productive ways, thereby contributing to their own well-being. The following programmes were addressed:

- Sustainable water-based agricultural activities in rural communities: Studies were aimed at reduction of poverty, hunger and malnutrition amongst rural people and included investigations into simple, affordable, irrigation scheduling and water conservation techniques for small plots in semi-arid areas, as well as the socio-economic impacts of such conservation techniques. Other topics investigated were methods of water harvesting and floodplain agriculture. The desired outcome is improved knowledge, farming skills and leadership capabilities which contribute to the empowerment of rural people.
- Integrated water management for profitable farming systems: The focus in this programme is on developing procedures, methods and models with which to provide advice to farmers on best management practices and the optimal combination of crop and livestock enterprises within the constraints of water, land and capital resources. During the year under review this programme included studies on models (e.g. the firm-level agricultural risk management simulator (FARMS)) and information systems that can improve commercial farming. This is of importance as commercial farming is a major user of water resources and faces a particular challenge to ensure that this share of water is used effectively and efficiently.

Water Resource Protection and Reclamation in Agriculture

During 2002/2003 the WRC invested about R3.11m in 18 projects in this thrust area. Of these, 15 projects were either in their final stages or ongoing, while 3 new projects were initiated during this year.

The direction and driving force for research activities and outputs are determined by the strategic focus to improve the knowledge of the natural processes and man-induced impacts of resource use. This thrust addresses the following issues:

- Sustainable water resource use on irrigation schemes and within river catchments: Research in this programme is focused on developing methods and models to manage water distribution and preventing water resource degradation. Intensification of crop and livestock production processes can potentially contribute to higher levels of chemical residues of fertilisers, pesticides and herbicides in surface and

groundwater. Knowledge and tools to manage the quantity and quality of water resources for agricultural production are being developed.

- Impact assessment and environmental management of agricultural production: Studies are aimed at improving the understanding of the negative impacts of agriculture and guidelines for the assessment and mitigation of those impacts. Agricultural decisions to cultivate land and to conserve rainfall or to withdraw water from rivers, dams and boreholes, have wide-ranging impacts on the natural environment. Precautions must be taken as part of the agricultural production process to protect the terrestrial and aquatic ecosystems.

Water-Centred Knowledge

Knowledge management in a knowledge-intensive organisation like the WRC is both a core business activity as well as a support function, while IT-based systems and tools are key enablers. This KSA focuses on key aspects of knowledge management that are of importance to the water sector. This KSA also supports the management of knowledge that affects the efficient and effective 'operation' of the WRC. The focus is on the management and creation of documents, as well as their storage and reuse in IT-based systems. This KSA supports the widest possible dissemination of knowledge and information. This encompasses knowledge created via the support of the WRC as well as from other sources of water-centred knowledge. The main focus is on knowledge as a 'value-adding component' that can be located and re-organised, supporting the creation of, capture, distribution, measurement and management of knowledge.

Objectives

This KSA aims to serve the research as well as the wider community by disseminating knowledge through various channels, including the use of different vehicles for increasing public understanding of issues related to water and water research.

The primary objective of this KSA is to support the management of water-centred knowledge. The KSA aims to:

- connect people with reusable, codified knowledge
- develop document management systems
- recognise people for using and contributing to databases.

Thrusts

The knowledge KSA operates within the following thrusts:

Strategic Research Advice (SRA)

The establishment of internal and external knowledge-sharing practices to meet the objectives of the WRC in its knowledge creation and learning activities and the core process of research funding, is the focus of this area. Progress was made towards improved access to the necessary information to make decisions internally as well as externally, and the building of a resource centre to meet information requirements of the WRC and other external bodies.

Information and Communication Technology (ICT)

During 2002/2003 the WRC strove to identify and address information and communication needs of its internal (e.g. staff) and external stakeholders with regard to knowledge management, using ICT as a service delivery tool. Needs for enabling systems and tools, E-publishing and E-business were identified. A new website has been developed, and a new IT- based infrastructure established.

Research Information and Document Management (RIDM)

The key focus is on driving water-centred knowledge dissemination and linking external databases, while, in the long run, building nation-wide knowledge engines/networks and increasing public understanding of water-related issues. During 2002/2003 emphasis was placed on handling and storage of documents, archiving, and maintaining library and information services.

Publishing and Publications Centre (PPC)

This includes dissemination of knowledge created via the support of the WRC as well as from other sources of water-centred knowledge. A true virtual publications centre, E-publishing, E-business and E-business promotion is under development.

Water-Centred Media and Activities (WCM)

This includes dissemination of water-centred knowledge in the national and international arena through initiatives such as the publication of the internationally rated journal, *Water SA* and through increasing the public understanding of water science via a new journal, *The Water Wheel*.

Crosscutting Domains

The core strategy of the WRC calls for specific mechanisms to address key strategic issues of national importance. This has been dealt with in four crosscutting domains which were established during 2002/2003 specifically for this purpose.

Goals

1. Sustainable social and economic development is achieved at national and catchment levels
2. Poverty and water-associated diseases are alleviated
3. Degradation of the water-linked environment is arrested and reversed.

Intermediate goals

1. A balanced, mutual understanding and appreciation of societal, economic, environmental and transboundary water roles and requirements have resulted in a reduced potential for conflict and greater potential for co-operation and sustainability.
2. There exists general awareness, understanding and appreciation of the various roles and responsibilities that water managers, water institutions and water users need to assume, in the interests of achieving both environmental/community health and equitable, sustainable, social and economic development.
3. Knowledge, pertaining to best uses of available water resources for achieving sustainable social and economic development and community and environmental health targets, is available to managers and users, and can be effectively applied.

Purpose

1. The WRC and partner organisations are able to facilitate, among stakeholders, awareness creation of key water-associated health, developmental and environmental issues, in the interests of resolving inter-sectoral and transboundary conflict and promoting co-operation (Outputs 1, 6).
2. The WRC and appropriate development agencies focus on developmental and environmental issues of real need/concern, and use this strategic focus to guide investment in further research, development and implementation along paths of high priority (Outputs 2, 3).
3. Planners and decision-makers use developed analytical and decision-making tools (e.g. water valuation, risk assessment, multicriteria decision-making, social-economic-environmental modelling tools, etc.) to assist in making informed choices concerning water-linked social, economic, environmental and health issues which need to be addressed (Outputs 4, 5, 6).
4. The work of planners and decision-makers is facilitated by having decision-making tools which are integrative, i.e. tools which appropriately weight and combine necessary data and information from a variety of relevant sources (Outputs 5, 6).
5. Practitioners are able to use appropriate "best practice" guidelines for any water-linked development task at hand (e.g. for obtaining stakeholder/community participation, for providing water services within the context of an integrated approach to poverty alleviation, etc.) (Outputs 6, 7).
6. Policy-makers are provided with material to be used for refining water policy, water institutions and co-operative governance, in the combined interests of the health and well-being of society, the economy and the environment (Output 8).

Outputs

1. State-of-art reviews pertaining to water as a key factor in sustainable social and economic development as well as community and environmental health.
2. Needs analyses/assessments relating to optimising roles and usage of water in helping to achieve integrated developmental and environmental targets.
3. Strategic research and development portfolios tailored to identified needs.
4. Analytical tools, e.g. integrated risk assessment, tools for valuation of water, modelling tools, etc.
5. Tools for integrated decision-making, e.g. multicriteria decision-making tools, socio-economic modelling tools, etc.
6. Information dissemination and knowledge-transfer strategies for awareness creation and application, respectively.
7. Best-practice guidelines relating to water-linked societal, economic and environmental practices within the context of sustainable development.
8. Policy analyses/assessments and proposals for policy improvement and filling of policy gaps.

The crosscutting domains focus on the role of water with regard to the following major strategic issues:

- Water and Society
- Water and the Environment
- Water and the Economy
- Water and Health.

During the year under review (2002/2003), the importance of the issues addressed by the crosscutting domains was further emphasised by the emergence of similar issues in the agenda of the World Summit on Sustainable Development (WSSD), as well as in the newly developed agenda for New Partnership for Africa's Development (NEPAD). These domains form integrating frameworks across the KSAs and draw together programmes and projects within the portfolios of each of the KSAs which also address issues relevant to the domains.

The goals, intermediate goals, purpose, and outputs of the above crosscutting domains were identified and developed further. The overarching view is given below in 'logical framework' format.

Water and Society

This domain addresses water as a social good and the vital role that water plays in social development. It provides an integrating framework for, and further facilitates expansion of, that research and development within the different KSAs which contribute to a sound balance between the manner in which water resources are used and cared for by society, and the benefits which society as a whole derives from the use of water. Finding improved, sustainable and socially acceptable ways of meeting society's needs for water services remains an important focus area because of the continuing service backlog. Interlinks among poverty issues, gender issues and access to water and water services are addressed and the knowledge gained will be applied in promoting poverty alleviation and a better quality of life for society as a whole.

Objectives

The domain aims to facilitate and integrate research and development initiatives which promote:

- Healthy perceptions and balanced awareness of key issues relating to water as a scarce and shared resource
- Water services which are socially acceptable, affordable and available to all
- Communities which are empowered to participate effectively in water institutions
- Ready access to water for the poor, women, the youth and the disabled.

Thrusts

Water as a Shared Resource

This thrust focuses on investigating hydro-political issues within South Africa and the SADC region. Issues include the intersectoral and transboundary sharing of water, water scarcity in relation to demand, water quality, and the roles of water in various economic and societal sectors. Appropriate research initiatives are aimed at alleviating the impacts of scarcity and degraded water quality on society and the water environment, thereby reducing potential for conflict, and promoting healthy co-operation with regard to integrated, sustainable management. Research in this thrust will support policy and decision-making regarding the allocation of water (over and above the Reserve) to various development sectors, namely domestic, industrial and agricultural.

Social Needs for Water Services

The focus of this thrust is on analysing and understanding society's needs for water services, which will lead to guidelines aimed at enhancing utilisation of limited water resources and finance in sustainable service provision. Such understanding will ensure that the real needs of society are known and addressed in a flexible and socially acceptable manner. Issues around payment for water, ownership of potable water schemes, hygiene and sanitation are investigated.

Gender and Other Limitations Regarding Access to Water

Research within this thrust focuses on investigating the extent to which gender, age and physical disability influence access to water resources. Knowledge will assist in the development of policy guidelines for improving equity in water access among users.

Poverty Alleviation

Research within this thrust focuses on the links between water and poverty. This will lead to effective strategies for using water resources to break the poverty cycle and promote food security

Water and the Economy

In the SA context, water is first and foremost treated as a common (social) good. Water is recognised as being essential for sustaining life and is a commodity to which people and the aquatic environment have a legally protected right. However, water is also recognised as an economic good, the use of which has a major impact on the creation of wealth and the well-being of people. Almost without exception, there is an increasing interest in assessing the economic value of water, using water as a catalyst for the generation of wealth and prosperity, and using economic instruments to increase efficiency and to effect desired behavioural change among water users. The use of water tariffs to effect changes in water consumption and the use of waste discharge charges to internalise pollution costs and, in

so doing, effect pollution reduction and desirable improvements in water quality, are management options worthy of investigation and are, in fact, provided for in the NWA along with the selling of water-use licences under specific circumstances.

This domain integrates the economic aspects of water-related investigations funded by the KSAs. It will also identify overarching issues that need to be addressed at a higher level of integration. Projects and activities under this domain will determine the value of water, assess its role in wealth creation and the use of economic instruments in changing the behaviour of society at the appropriate micro-, regional and national levels.

Objectives

The primary aim of the research portfolio facilitated through this domain is to demonstrate the applicability of economic principles in the water field and to provide convincing evidence as well as sound knowledge and support to water management institutions and implementing authorities. The legal framework is already reasonably accommodating and stakeholders are expected to be receptive to the knowledge generated.

Secondary objectives are to:

- Assess the value of water for different sectors of the economy
- Investigate the economic advantages and disadvantages of water resource development
- Assess the use of economic instruments to effect behavioural change regarding water utilisation
- Evaluate the use of economic instruments to promote equitable and efficient water allocation and distribution.

Thrusts

The Value of Water for Different Sectors of the Economy

Studies have already determined the economic value of water in several of the important catchment areas in the country and for a few of the important economic sectors. The focus is on innovative means to be employed to establish the value that must be attached to water-linked ecosystems.

The Economic Advantages and Disadvantages of Water Resource Development

Studies focus on quantifying the economic benefits which might arise as a result of the chain effect that water resource development has on wealth creation, or the costs which might be incurred as a result of pollution of the water environment.

The Use of Economic Instruments to Effect Behavioural Change Regarding Water Utilisation

A diverse range of projects aimed at changing behaviour with respect to water use and at assessing the susceptibility of users to economic stimuli are presently being conducted. Research addresses possible behavioural change due to the attachment of an economic value to the use of water, for example by increasing the water tariff on a sliding scale as consumption increases can result in improved water conservation or reduction of pollution may result from an economically efficient way by levying a charge on waste discharges.

The Use of Economic Instruments to Promote Equitable and Efficient Water Allocation and Distribution

Studies focus on the use of economic instruments to be employed for equitable and efficient water utilisation. Examples are the use of cross-subsidisation to promote equitable distribution of water, privatisation of water services to promote efficient service delivery, and trading of water-use licences to achieve optimal redistribution of water in the interest of greater economic efficiency and most efficient use of resources.

Water and the Environment

This domain contributes to the holistic understanding of the environmental (air, land, marine, ecosystem, aquifer) links through the hydrological cycle. Key questions addressed are how environmental degradation impacts on water resources, how water-related activities impact on the environment and which methodologies need to be developed or can be used to minimise detrimental impacts. Research addresses the maintenance and improvement of the atmospheric, land and ecological environment through improved understanding of water-use practices and resultant disturbances that may occur as a result of improper use.

Objectives

In support of a broader understanding of the inter-links of the hydrological cycle in relationship to the environment, and in order to facilitate sustainable development practices and environmental sustainability, the main aims of this crosscutting domain are to:

- Better understand the impact of various land uses on the different components of the hydrological cycle and subsequent risk to environmental functioning (e.g. biodiversity loss).
- Assist in developing environmental governance systems (including communication systems) that are appropriate to SADC circumstances. This needs to include understanding issues that will hamper

environmental governance (e.g. HIV/Aids and poverty).

- Understand impacts of policy on the water environment, by investigating and recommending integrative and co-operative mechanisms to bridge the various legislative frameworks and policy directives.

Thrusts

Environmental Governance Systems

The focus is on investigations which facilitate the creation of institutions that enable the participation of civil society in democratic and accountable environmental decision-making, and develop integrative mechanisms to "simplify" environmental governance. The development of integrated governance systems between national agencies responsible for implementation of environmental and related legislation and treaties is crucial for sustainable development.

Biodiversity Protection

Studies focus on the protection of the indigenous biodiversity landscape from alien infestation, conservation of biodiversity, as well as equitable sharing of benefits arising from biodiversity use, and promotion of indigenous knowledge systems and local protection of the water environment.

Species diversity influences ecosystem stability and underpins essential ecological services. Diversity also bolsters resilience - an ecosystem's ability to respond to pressures - offering insurance against climate change, drought and other stresses. The threat to biodiversity is growing due to human-induced pressures such as over-exploitation, invasive species, pollution, global warming, and habitat loss.

Environmental Functioning

Research aims at providing a detailed understanding of ecosystems, their function and condition. This is of importance for an ecosystems' holistic and sustainable management. While the Water-Linked Ecosystems KSA deals with ecosystem management and utilisation and ecosystem protection, this domain extends this focus to the terrestrial and atmospheric component of the environment. Studies will result in better scientific understanding of the carrying capacity of ecosystems and thresholds for reversible and irreversible change which, in turn, would greatly benefit management efforts. This thrust focuses on impacts of different scenarios of ecosystem loss (or change) through land use; understanding the environmental components (air, land and water), and their inter-links through the hydrological cycle, on ecosystem functioning; understanding the impacts of disrupting the hydrological regime (quality and quantity) on ecosystem functioning (specifically through man-made interventions); and developing strategies and means to reduce net impacts of environmental change on ecosystems and water resources.

Water and Health

This domain provides an integrating framework for all the WRC's health-related research and development initiatives, identifying gaps and negotiating the initiation of gap-filling research in crucial areas. In fulfilling this role, the domain assumes the responsibility for the structuring of a co-ordinated, needs-driven, dynamic health-related water research portfolio on behalf of the WRC, with contributing projects being funded and managed mainly at KSA level.

Health-related water research is undertaken with the aim of improving water quality and hygiene practices in order to save lives and reduce the cost and effort in treating symptoms of disease. The focus is on water-linked diseases associated with microbial or chemical contamination or transferred via water-associated vectors. The domain aims to improve knowledge regarding the origin, survival and persistence of microbial, biological and chemical agents that may pollute water and may affect human health. The domain supports the development and utilisation of methodologies to identify and quantify the occurrence of pathogens and contaminants in water, as well as risk assessment and epidemiological studies.

A holistic, multidisciplinary approach is followed in order to develop a comprehensive understanding of the origin/sources and spatial extent of pollution; water usage patterns; the effects of degraded water quality on animal and human health and the need for water treatment. The development of guidelines, protocols, manuals and pamphlets could be the tools to disseminate the research findings. The emphasis is on a proactive approach to identify and address causes, rather than on a passive response to symptoms. This approach should ensure research products that are relevant, user-friendly, practical and scientifically valid.

Objectives

The primary objective of this domain is to contribute to the protection of human and animal health and that of the aquatic environment by investigating the sources, persistence, and control of water-related diseases.

Secondary objectives are to:

- Develop appropriate techniques, technologies and systems for the monitoring of potentially harmful pollutants in water
- Obtain adequate understanding of the origin, survival and persistence of, and inter-relationships among, microbial, chemical and other biological and toxic pollutants in water
- Assess the impacts (actual and potential) of pollutants on human, animal and the aquatic health by performing epidemiological investigations and developing health-risk assessment tools
- Investigate the effects of the environmental change on health (e.g. the impact of global warming on the spread of malaria; the link between climate variability and epidemics caused by water-borne diseases)
- Develop scientifically sound education material on health, hygiene and the effects of and prevention of pollution and the relationship between these
- Provide guidance for appropriate communication, awareness-building and management strategies

Thrusts

In addition to various projects supporting health-related studies under the framework of the different KSAs, this domain supported 17 ongoing projects (under the various thrusts of the domain) resulting in about R1.69m being invested during 2002/2003.

Microbial Water Quality and Associated Diseases

The focus is on improving knowledge, both of the micro-organisms responsible for water-borne diseases and of the epidemiology of such diseases; assessing associated health risks; and developing cost-effective management strategies for preventing water contamination and diseases. It includes studies on protozoan parasites, viruses and other potentially pathogenic micro-organisms, with emphasis on simple, rapid and cost-effective detection techniques.

Chemical Quality of Water and Associated Diseases

Research addresses the characterisation of chemicals in water, both those occurring naturally and those resulting from pollution, which have the potential to cause detrimental health effects in humans, animals and the aquatic environment. Special emphasis is given to studies on endocrine-disrupting contaminants (EDCs), toxins (both those occurring naturally and those associated with industrial, pharmaceutical and agricultural chemicals and sewage-treatment works effluents), algal toxins associated with eutrophication of water resources and fluoridation.

Safeguarding Public Health

Studies are aimed at developing ways of anticipating conditions conducive to the outbreaks of water-linked diseases and appropriate precautionary and preventive measures which can be taken in this regard. The development and use of pollution monitoring systems, early warning systems (possibly environment/climate-based) and hygiene-practice guides are addressed. Examples include the development of protocols, guidelines and manuals for microbial, toxins and EDC monitoring programmes, and the development of public awareness and educational materials such as the guideline series (5 volumes) on the management of water-related microbial diseases.

Looking Ahead

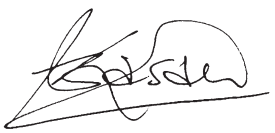
The emphasis during the next financial year will be on 'striving for excellence', establishing best practice and improving relevance and effectiveness. Another key objective is to allow for a period of consolidation and refinement in order to develop appropriate action plans and implementation processes, guided by internal and external feedback.

During 2003/2004, emphasis will also be placed on improving internal relationships and establishing a culture of 'sharing' within strategic groups (KSAs) and between strategic and functional groupings (e.g. KSAs and Administration). The WRC will continue to strive for a strong corporate culture and high staff morale which will be promoted through successful transformation drives, and supporting structures and systems. The organisation will be proud of its performance, and its results-oriented staff will share a clear sense of purpose and vision and will internalise quality and service as their core guiding values.

Board Approval

The annual financial statements of the WRC and wholly-owned company for the year ended 31 March 2003, which appear on pages 39 to 48 of this report, were approved by the WRC Board at its meeting held on 17 June 2003. The Board is of the opinion that the WRC is financially sound and operates as a going concern.

These statements are signed on behalf of the WRC Board by



Prof HC Kasan
WRC Board Chairperson

Dr R Kfir
WRC Chief Executive Officer

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Consolidated Financial Statements 2002/03

Water Research Commission

Report of the Auditor-General to the Minister of Water Affairs and Forestry on the Financial Statements of the Water Research Commission for the year ended 31 March 2003

1. AUDIT ASSIGNMENT

The financial statements as set out on pages 39 to 48 for the year ended 31 March 2003, have been audited in terms of Section 188 of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996), read with Section 3 and 5 of the Auditor-General Act, 1995 (Act No.12 of 1995), and Section 14(1) of the Water Research Act, 1971 (Act No.34 of 1971). These financial statements, the maintenance of effective control measures and compliance with relevant laws and regulations are the responsibility of the accounting authority. My responsibility is to express an opinion on these financial statements based on the audit.

The performance information contained in the Director's report for the year ended 31 March 2003, as set out on pages 16 to 17 is the responsibility of the accounting authority. My responsibility is to provide an assessment of the fairness and the consistency of the performance information of the Water Research Commission against the predetermined objectives set out in the Core Strategic Plan. My role is not to express an opinion on the appropriateness and relevance of the performance measures themselves, nor to evaluate or comment on the entity's actual performance.

2. NATURE AND SCOPE

2.1 Audit of financial statements

The audit was conducted in accordance with Statements of South African Auditing Standards. Those standards require that we plan and perform the audit to obtain reasonable assurance that the financial statements are free of material misstatement.

An audit includes:

- examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements,
- assessing the accounting principles used and significant estimates made by management, and
- evaluating the overall financial statement presentation.

Furthermore, an audit includes an examination, on a test basis, of evidence supporting compliance in all material respects with the relevant laws and regulations, which came to my attention and are applicable to financial matters.

Levy income is collected by the Department of Water Affairs and Forestry and consequently the extent of audit tests on such income is limited to agreeing levy receipts to returns from the Department of Water Affairs and Forestry.

I believe that the audit provides a reasonable basis for my opinion.

2.2 Audit of performance information

The Water Research Commission has reported its performance on pages 16 to 17 of its Director's report. My assessment covers only that section, but does not include all other pages of the Director's Report. To assess this additional information adequately would require a separate examination. I did review the entire report for consistency with the performance information.

I assessed the performance information against the entity's predetermined objectives set out in the Core Strategic Plan.

I believe that the audit provides a reasonable basis for my opinion.

3. AUDIT OPINION

3.1 Audit of financial statements

In my opinion, the financial statements fairly present, in all material respects, the financial position of the Water Research Commission and the group at 31 March 2003 and the results of its operations and cash flows for the year then ended in accordance with generally accepted accounting practice and in the manner required by the Public Finance Management Act, 1999 (Act No.1 of 1999).

3.2 Audit of performance information

In my opinion, the performance information furnished in terms of section 55(2)(a) of the Public Finance Management Act, 1999 (Act No. 1 of 1999) fairly presents, in all material respects, the performance of the Water Research Commission for the year ended at 31 March 2003 against predetermined objectives on a basis consistent with that of the preceding year.

4. EMPHASIS OF MATTER

4.1 Non-compliance with treasury regulations

The Water Research Commission did not have an approved investment policy as required by treasury regulation 31.3.1.

5. APPRECIATION

The assistance rendered by the staff of the Water Research Commission during the audit is sincerely appreciated.

N. Manik
for Auditor-General

Pretoria
28/07/03

Balance Sheet

Water Research Commission and Wholly-Owned Company
Balance Sheet as at 31 March 2003

	NOTES	Water Research Commission 2003 R	Water Research Commission 2002 R	Consolidated 2003 R	Consolidated 2002 R
ASSETS					
Non-current assets		38 260 591	33 326 407	36 281 741	35 894 023
Property and equipment	2	1 356 594	849 817	7 874 620	5 813 512
Interest in subsidiary	3	9 139 423	3 076 423	-	-
Other investments	4	27 764 573	29 400 166	27 764 573	29 400 166
Other loans	5	1	1	1	1
Intangible asset	6	-	-	642 547	680 344
Current assets		85 994 729	73 970 107	87 307 533	74 560 669
Trade and other receivables	7	38 238 046	27 055 964	39 140 576	27 357 250
Cash and cash equivalents		47 756 683	46 914 143	48 166 957	47 203 419
Total assets		124 255 320	107 296 514	123 589 274	110 454 692
EQUITY AND LIABILITIES					
Capital and reserves					
Accumulated fund		87 114 992	78 731 475	86 371 163	81 634 521
Non-current liabilities					
Provisions	8	13 600 120	12 500 000	13 600 120	12 500 000
Current liabilities					
Trade and other payables	9	23 540 208	16 065 039	23 617 991	16 320 171
Total equity and liabilities		124 255 320	107 296 514	123 589 274	110 454 692

Water Research Commission and Wholly-Owned Company
Income Statement for the year ended 31 March 2003

	NOTES	Water Research Commission 2003 R	Water Research Commission 2002 R	Consolidated 2003 R	Consolidated 2002 R
INCOME		107 592 021	89 579 899	106 640 722	89 375 350
Water research levies		99 982 535	80 899 490	99 982 535	80 899 490
Income on investment	10	3 965 394	5 145 794	3 120 831	4 867 977
Other interest		710 301	487 701	713 491	503 668
Profit on sale of fixed assets		18 091	46 600	18 091	46 600
Other income		2 915 700	924 922	2 805 774	982 223
Over provision for bad debts		-	1 989 565	-	1 989 565
Over provision (for VAT)		-	85 827	-	85 827
EXPENDITURE		99 208 504	84 193 041	101 904 080	84 393 403
Administrative services		4 570 764	3 998 426	4 586 241	4 093 366
Interest paid		-	903	-	903
External audit fee		100 794	132 538	123 120	135 858
Internal audit fee		295 853	305 889	295 853	305 889
Municipal services and security		-	-	187 181	237 366
Rental and maintenance		1 344 173	1 869 583	3 698 868	1 634 112
Staff expenditure		13 499 993	12 991 908	13 512 130	12 991 908
Directors emoluments	11	255 641	243 484	255 641	243 484
Depreciation of fixed assets		412 009	414 595	477 972	477 005
Fixed assets written off		-	41 882	-	41 882
Amortisation of intangibles		-	-	37 797	37 797
Provision for bad debts		9 084 588	-	9 084 588	-
Provision for leave pay		1 100 120	-	1 100 120	-
Technology transfer	12	4 184 120	4 598 430	4 184 120	4 598 430
Research projects and support	13	62 437 811	55 249 135	62 437 811	55 249 135
Loss on investment		1 922 638	-	1 922 638	-
Over provision of levy income		-	4 346 268	-	4 346 268
Net income for the year		8 383 517	5 386 858	4 736 642	4 981 947

Statement of Changes in Equity

Water Research Commission and Wholly-Owned Company
Statement of Changes in Equity for the year ended 31 March 2003

	Water Research Commission	Consolidated
	ACCUMULATED FUND R	ACCUMULATED FUND R
Balance at 01/01/2001	73 344 617	76 652 574
Net income for the year	5 386 858	4 981 947
Balance at 31/03/2002	78 731 475	81 634 521
Net income for the year	8 383 517	4 736 642
Balance at 31/03/2003	87 114 992	86 371 163

Water Research Commission and Wholly-Owned Company
Cash Flow Statement for the year ended 31 March 2003

	NOTES	Water Research Commission 2003 R	Water Research Commission 2002 R	Consolidated 2003 R	Consolidated 2002 R
Net cash flow from operating activities		5 070 522	3 950 284	748 004	2 717 631
Cash receipts		91 716 153	83 276 527	80 977 509	82 504 436
Cash payments		(91 321 326)	(82 630 929)	(84 063 827)	(82 829 641)
Net cash generated by/(outflow from) operating activities	15	394 827	645 598	(3 086 318)	(325 205)
Interest received		4 675 695	3 305 589	3 834 322	3 043 739
Interest paid		-	(903)	-	(903)
Net cash outflow from investing activities		(5 328 102)	(1 517 996)	(884 586)	(1 682 598)
Purchase of fixed assets		(945 680)	(236 669)	(2 520 179)	(1 060 195)
Proceeds from sale of fixed assets		44 985	46 600	-	46 600
Decrease/(Increase) in investments		1 635 593	(669 003)	1 635 593	(669 003)
Increase in investment of subsidiary		(6 063 000)	(658 924)	-	-
Net cash inflow/(outflow) from financing activities		1 100 120	(1 844 182)	1 100 120	(1 844 182)
Increase/(Decrease) in provision		1 100 120	(1 844 182)	1 100 120	(1 844 182)
Net increase/(decrease) in cash and cash equivalents		842 540	588 106	963 538	(809 149)
Cash and cash equivalents at the beginning of the year		46 914 143	46 326 037	47 203 419	48 012 568
Cash and cash equivalents at the end of the year	16	47 756 683	46 914 143	48 166 957	47 203 419

Water Research Commission and Wholly-Owned Company
Notes to the financial statements for the year ended 31 March 2003

1 Accounting policies

The financial statements are prepared in accordance with generally accepted accounting practice on the historical cost basis and incorporate the following principal accounting policies which are consistent with those applied in the previous year, unless otherwise stated.

1.1 Fixed assets and depreciation

Land and buildings are not depreciated. Depreciation on office equipment (20%), office furniture (10%), photo and computer equipment (33.33%) is calculated annually on the straight-line method at the rates indicated. Motor vehicles are depreciated on a *pro rata* basis calculated on the basis of kilometres travelled annually as a portion of the expected useful life of the vehicles. The rates are appropriate to reduce each asset to its estimated residual value over the period of its useful life.

1.2 Capital assets purchased by organisations with research grants are written off in the year purchased. These remain assets of the Water Research Commission until the project for which they were acquired has been concluded and the Water Research Commission has decided on the disposal thereof.

1.3 Research projects and research support services

Payments made by the Water Research Commission are accounted for as advances. In cases where audited statements are not received on time, the payments are accounted for as expenditure. It is the policy of the Water Research Commission that its management may allow overspending on a project budget in a given year, only if acceptable reasons are given, provided the total contract amount is not exceeded.

1.4 Investments

1.4.1 Share and unit trust investments are reflected at cost price plus dividends that have been capitalised or net realisable value, whichever is the lower.

1.4.2 Policies are reflected at accounting values as valued by the insurance companies. Annual increases in the values are accounted for as investment income. Decreases in value are acounted for as investment losses.

1.5 Intangible assets

No value is attributed to internally developed patents. Costs incurred on patents, whether purchased or created by the Water Research Commission, are charged to the income statement during the period in which they are incurred.

1.6 Consolidation principles

The consolidated financial statements incorporate the financial statements of the Water Research Commission and its wholly-owned company. The results of the subsidiary are included from the effective date of acquisition. Goodwill, being the excess of the cost of acquisition over the fair value of the net assets of the acquired subsidiary at the date of acquisition, is amortised on a straight-line basis over the period of expected benefit. Inter-group transactions and balances are eliminated on consolidation.

1.7 Post employment pension benefit cost

The Water Research Commission participates in a defined benefit plan. The pension scheme is managed by ABSA.

1.8 Post employment medical aid costs

Provision is made for the actuarially calculated liability of the Water Research Commission for future medical aid contributions of retired staff. The actual contributions paid on behalf of the retired staff are charged to the income statement in the year to which they relate.

1.9 Revenue

The Department of Water Affairs and Forestry, Rand Water and Umgeni Water Boards collect levy income. The rate of the levy is approved by the Minister of Water Affairs and Forestry on an annual basis. Revenue recognition of levy income represents amounts received and receivable from the Department of Water Affairs and Forestry, Rand Water and Umgeni Water Boards.

1.10 Financial instruments

Financial instruments carried on the balance sheet include cash and bank balances, investments, receivables, creditors and liabilities. These instruments are carried at their estimated fair values. The particular recognition methods adopted are disclosed in the individual policy statements associated with each item.

Water Research Commission and Wholly-Owned Company
Notes to the financial statements for the year ended 31 March 2003

	Water Research Commission		Consolidated	
	2003 R	2002 R	2003 R	2002 R
2 Property and equipment				
2.1 Fixed property				
CARRYING VALUE: End of year	-	-	6 514 045	4 893 751
- Cost	-	-	615 855	615 855
- Improvements	-	-	5 898 190	4 277 896
Fixed property consists of Erf 706 Rietfontein, Pretoria, Gauteng. The directors value the property at R6 500 000.				
2.2 Motor vehicles				
CARRYING VALUE: Beginning of year	72 340	128 074	72 340	128 074
- Cost	146 956	215 931	146 956	215 931
- Accumulated depreciation	(74 616)	(87 857)	(74 616)	(87 857)
MOVEMENTS during year	(31 894)	(55 734)	(31 894)	(55 734)
- Disposals	(26 894)	(41 881)	(26 894)	(41 881)
- Depreciation	(5 000)	(13 853)	(5 000)	(13 853)
CARRYING VALUE: End of year	40 446	72 340	40 446	72 340
- Cost	68 975	146 956	68 975	146 956
- Accumulated depreciation	(28 529)	(74 616)	(28 529)	(74 616)
2.3 Office furniture				
CARRYING VALUE: Beginning of year	152 497	139 100	160 842	152 864
- Cost	367 073	323 448	421 261	377 636
- Accumulated depreciation	(214 576)	(184 348)	(260 419)	(224 772)
MOVEMENTS during year	784 238	13 397	778 819	7 978
- Acquisitions	837 747	43 625	837 747	43 625
- Depreciation	(53 509)	(30 228)	(58 928)	(35 647)
CARRYING VALUE: End of year	936 735	152 497	939 661	160 842
- Cost	1 204 820	367 073	1 259 008	421 261
- Accumulated depreciation	(268 085)	(214 576)	(319 347)	(260 419)
2.4 Office equipment				
CARRYING VALUE: Beginning of year	240 954	362 043	302 553	478 233
- Cost	858 253	839 630	1 463 694	1 442 670
- Accumulated depreciation	(617 299)	(477 587)	(1 161 141)	(964 437)
MOVEMENTS during year	(77 797)	(121 089)	(138 341)	(175 680)
- Acquisitions	49 943	18 623	49 943	21 023
- Depreciation	(127 740)	(139 712)	(188 284)	(196 703)
CARRYING VALUE: End of year	163 157	240 954	164 212	302 553
- Cost	908 196	858 253	1 513 637	1 463 694
- Accumulated depreciation	(745 039)	(617 299)	(1 349 425)	(1 161 141)
2.5 Computers				
CARRYING VALUE: Beginning of year	384 026	440 407	384 026	440 407
- Cost	1 191 744	1 017 323	1 191 744	1 017 323
- Accumulated depreciation	(807 718)	(576 916)	(807 718)	(576 916)
MOVEMENTS during year	(167 770)	(56 381)	(167 770)	(56 381)
- Acquisitions	57 991	174 421	57 991	174 421
- Depreciation	(225 761)	(230 802)	(225 761)	(230 802)
CARRYING VALUE: End of year	216 256	384 026	216 256	384 026
- Cost	1 249 735	1 191 744	1 249 735	1 191 744
- Accumulated depreciation	(1 033 479)	(807 718)	(1 033 479)	(807 718)
TOTAL FIXED ASSETS	1 356 594	849 817	7 874 620	5 813 512

Water Research Commission and Wholly-Owned Company
Notes to the financial statements for the year ended 31 March 2003

		Water Research Commission		Consolidated	
		2003	2002	2003	2002
		R	R	R	R
3	**Interest in subsidiary**				
3.1	**Shares at cost**	755 939	755 939	-	-
	Loan to subsidiary	8 383 484	2 320 484	-	-
		9 139 423	3 076 423	-	-

3.2 The following information relates to the Water Research Commission's interest in its subsidiary:
Erf 706 Rietfontein (Proprietary) Limited is incorporated in South Africa. The total issued ordinary share capital of the company is held by the Water Research Commission and amounts to R1.

4	**Other investments**				
	Old Mutual	23 623 416	25 546 054	23 623 416	25 546 054
	Momentum Wealth and NIB	4 141 157	3 854 112	4 141 157	3 854 112
		27 764 573	29 400 166	27 764 573	29 400 166
	Market value				
	Old Mutual	23 623 416	25 546 054	23 623 416	25 546 054
	Momentum Wealth and NIB	4 744 989	4 994 601	4 744 989	4 994 601
		28 368 405	30 540 655	28 368 405	30 540 655

National Treasury has granted exemption from investing surplus cash with the Corporation for Public Deposits in terms of Treasury regulation 31.3.3. National Treasury has also confirmed that the above investments are in compliance with Treasury regulation 31.3.5.

5	**Other loans**	1	1	1	1
		1	1	1	1

Company for Research on Atmospheric Water Supply: This loan was advanced in terms of an agreement for the purchase of research equipment. The remaining assets and equipment were sold and the income derived was transferred to the WRC, thereby meeting all outstanding obligations to the WRC.

6	**Intangible asset**				
6.1	**Goodwill**				
	Opening carrying amount	-	-	680 344	718 141
	Amortised for the year	-	-	37 797	37 797
	Closing carrying amount	-	-	642 547	680 344
	Gross carrying amount	-	-	755 939	755 939
	Accumulated amortisation	-	-	(113 392)	(75 595)
7	**Debtors**				
	Water research levies	30 951 406	15 766 116	30 951 406	15 766 116
	Project advances	15 397 837	11 515 030	15 397 837	11 515 030
	Value added tax	-	-	744 396	285 870
	Hydrological Information Centre	43 226	43 226	43 226	43 226
	Personal computer loans	2 610	15 148	2 610	15 148
	Motor scheme	72 271	258 083	72 271	258 083
	Other	1 640 168	243 245	1 798 302	258 661
		48 107 518	27 840 848	49 010 048	28 142 134
	Provision for doubtful debts	(9 869 472)	(784 884)	(9 869 472)	(784 884)
	Total debtors	38 238 046	27 055 964	39 140 576	27 357 250

Water Research Commission and Wholly-Owned Company
Notes to the financial statements for the year ended 31 March 2003

8 Provisions

8.1 Provisions were made for the following:

	Water Research Commission			Consolidated		
	Balance at beginning of year	New provisions	Balance at end of year	Balance at beginning of year	New provisions	Balance at end of year
2003						
Medical aid: Pensioners	12 500 000	-	12 500 000	12 500 000	-	12 500 000
Leave pay	-	1 100 120	1 100 120	-	1 100 120	1 100 120
	12 500 000	1 100 120	13 600 120	12 500 000	1 100 120	13 600 120
2002						
Medical aid: Pensioners	12 500 000	-	12 500 000	12 500 000	-	12 500 000
VAT on water research levies	1 844 182	(1 844 182)	-	1 844 182	(1 844 182)	-
	14 344 182	(1 844 182)	12 500 000	14 344 182	(1 844 182)	12 500 000

8.2 The present value of the obligation relating to post-retirement medical aid benefits as actuarially valued on 31 March 2000 amounts to R9 977 210. The actuarial valuation determined the liability to be R13 351 758 and R17 867 664 in five and ten years respectively.

The actual valuation was based on:
- the future value
- retirements in the interim
- 12,5% of the members retire within the following five years and 10% of the members retire in the following five years.

8.3 Actual post-retirement medical aid benefits paid for the year amounted to R509 825 (2002- R422 822).

8.4 Leave pay has been provided for during the current year in order to comply with generally accepted accounting practice.

	Water Research Commission		Consolidated	
	2003 R	2002 R	2003 R	2002 R
9 Creditors				
Amounts due to Research Contractors	17 802 370	8 463 635	17 802 370	8 463 635
SAREP (SA Rainfall Enhancement Programme)	166 108	166 108	166 108	166 108
Other	2 840 861	159 372	2 918 644	414 504
Outstanding cheques	31 424	4 744 635	31 424	4 744 635
Value-added tax (VAT)	2 716 934	2 549 452	2 716 934	2 549 452
PAYE outstanding	674	-	674	-
	23 558 371	16 083 202	23 636 154	16 338 334
Provision for creditors written off	(18 163)	(18 163)	(18 163)	(18 163)
Total creditors	23 540 208	16 065 039	23 617 991	16 320 171
10 Income on investments				
Interest on loan to subsidiary	844 563	277 817	-	-
Interest on other investments	287 045	-	287 045	-
Value adjustment of policy	-	2 327 906	-	2 327 906
Interest on deposits and cash investments	2 833 786	2 540 071	2 833 786	2 540 071
	3 965 394	5 145 794	3 120 831	4 867 977

Water Research Commission and Wholly-Owned Company
Notes to the financial statements for the year ended 31 March 2003

		Water Research Commission		Consolidated	
		2003	2002	2003	2002
		R	R	R	R
11	**Disclosure of emoluments of all Board Members (Directors) in terms of section 28 of Treasury Regulations**				
	Fees for services as Director	84 000	78 000	84 000	78 000
	Basic salary (Chairman)	124 464	119 930	124 464	119 930
	Sums paid by way of allowances	47 177	45 554	47 177	45 554
		255 641	243 484	255 641	243 484
12	**Technology transfer**				
	Publications	3 480 084	3 491 958	3 480 084	3 491 958
	Conferences	495 767	507 717	495 767	507 717
	Maintenance of patents	208 269	598 755	208 269	598 755
		4 184 120	4 598 430	4 184 120	4 598 430
13	**Research and research support services**				
	Subsistence and travel	2 041 800	2 051 491	2 041 800	2 051 491
	Research projects	54 535 993	50 978 077	54 535 993	50 978 077
	Research and other grants	-	86 419	-	86 419
	Research consultancies	5 860 018	2 133 148	5 860 018	2 133 148
		62 437 811	55 249 135	62 437 811	55 249 135
14	**Taxation**				
	No provision was made for normal tax as the Water Research Commission is exempted from income tax in terms of Section 10(1)(cA)(I) of the Income Tax Act.				
15	**Reconciliation of net income with cash generated from operating activities**				
	Net income	8 383 517	5 386 858	4 736 642	4 981 947
	Adjustments for:				
	Profit on the sale of fixed asset	(18 091)	(46 600)	(18 901)	(46 600)
	Fixed assets written off	-	41 882	-	41 882
	Depreciation	412 009	414 595	477 972	477 005
	Amortization of intangibles	-	-	37 797	37 797
	Interest received	(4 675 695)	(5 633 495)	(3 834 322)	(5 371 645)
	Interest paid	-	903	-	903
	Net income before changes in working capital	4 101 740	164 143	1 399 188	121 289
	Changes in working capital	(3 706 913)	481 455	(4 485 506)	(446 494)
	Increase in debtors	(11 182 082)	(623 277)	(11 783 326)	(1 452 669)
	Increase in creditors	7 475 169	1 104 732	7 297 820	1 006 175
	Net cash (utilised)/generated by activities	394 827	645 598	(3 086 318)	(325 205)
16	**Cash and cash equivalents**				
	Cash and bank balances	34 089 340	30 580 272	34 499 614	30 781 789
	Amounts immediately recoverable	13 667 343	16 333 871	13 667 343	16 421 630
		47 756 683	46 914 143	48 166 957	47 203 419

Water Research Commission and Wholly-Owned Company
Notes to the financial statements for the year ended 31 March 2003

17 Financial instruments

17.1 Credit risk

Financial assets which potentially subject the entity to concentrations of credit risk consist principally of cash, short-term deposits and trade receivables. The entity's cash equivalents and short-term deposits are placed with high credit quality financial institutions. Trade receivables are presented net of the allowance for doubtful receivables.

17.2 Fair values

The carrying amounts of cash and short-term deposits, accounts receivables, accounts payable and short-term liabilities proximated their fair values due to the short-term maturities of these assets and liabilities.

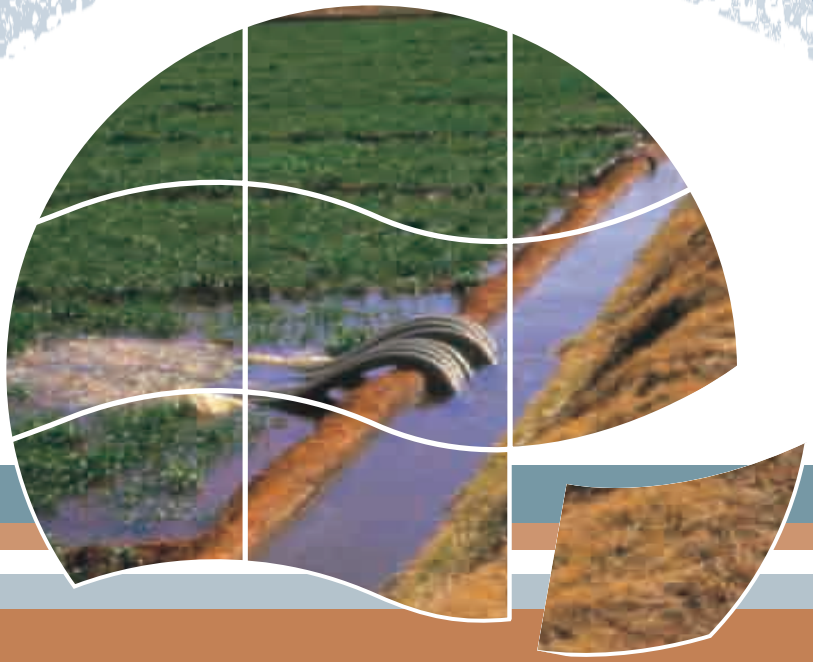
18 Related party transaction

18.1 Controlling entities

Erf 706 Rietfontein (Pty) Ltd is wholly owned by the Water Research Commission.

18.2 Directors

No transactions other than directors' emoluments disclosed in Note 11 were entered into during the year.



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Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd

Financial Statements 2002/03

Water Research Commission

Report of the Auditor-General to the Members on the Financial Statements of the Erf Sewe-Nul-Ses Rietfontein (Proprietary) Limited for the year ended 31 March 2003

1. AUDIT ASSIGNMENT

The financial statements as set out on pages 51 to 59 for the year ended 31 March 2003, have been audited in terms of Section 188 of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996), read with Section 3 and 5 of the Auditor-General Act, 1995 (Act No.12 of 1995), and Schedule 4 of the Company Act, 1973. These financial statements, the maintenance of effective control measures and compliance with relevant laws and regulations are the responsibility of the directors. My responsibility is to express an opinion on these financial statements based on the audit.

2. NATURE AND SCOPE

The audit was conducted in accordance with Statements of South African Auditing Standards. Those standards require that we plan and perform the audit to obtain reasonable assurance that the financial statements are free of material misstatement.

An audit includes:

- examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements,
- assessing the accounting principles used and significant estimates made by management, and
- evaluating the overall financial statement presentation.

Furthermore, an audit includes an examination, on a test basis, of evidence supporting compliance in all material respects with the relevant laws and regulations, which came to my attention and are applicable to financial matters.

I believe that the audit provides a reasonable basis for my opinion.

3. AUDIT OPINION

In my opinion, the financial statements fairly present, in all material respects, the financial position of the Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd at 31 March 2003 and the results of its operations and cash flows for the year then ended in accordance with generally accepted accounting practice and in the manner required by the Company Act.

4. APPRECIATION

The assistance rendered by the staff of the Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd during the audit is sincerely appreciated.

N. Manik
for Auditor-General

Pretoria
28/07/03

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd

Approval of Financial Statements

The Directors' Report and Financial Statements set out on pages 51 to 59 were approved by the Board of Directors and were signed on its behalf by:

Prof HC Kasan
WRC Board Chairperson

Dr R Kfir
WRC Chief Executive Officer

17 June 2003

General Information

Directors:
Dr R Kfir
Prof HC Kasan
Mr R Sutton

Registered office:
301 Watko Building
491, 18th Avenue
Rietfontein
PRETORIA

Registration number:
1984/003566/07

Main business and purpose:
The main business of the company is to own the immovable property known as Erf 706 Rietfontein, in addition and supplementary to the aim of the Water Research Commission, (WRC) and to place the property at the disposal of the WRC as their main place of business.

Directors' Report for year ended 31 March 2003

GENERAL REVIEW

(a) To review the business and operations of the company for the above accounting period generally, the directors draw attention to the balance sheet, income statement, equity and cash flow statement attached, where the business of the company, the results and state of affairs are clearly reflected.

(b) The Fourth Schedule to the Companies Act, 1973, requires the Directors to report on any material facts or circumstances which occurred between the accounting date and the date of their report. No such material facts or circumstances occurred.

SPECIFIC MATTERS

(a) The main aim of the company is that of owning the immovable property known as Erf 706 Rietfontein, including all permanent improvements, and to use the property for the purpose of promoting the operations of the Water Research Commission.

(b) No shares were allotted or issued by the company for the year ending 31 March 2003.

(c) Improvements to the fixed property totaling R1 620 294 were made in this financial year and capitalized.

(d) No dividends were paid or declared during the accounting period and we have no recommendation to make (2002 - RNil).

(e) The Directors and certain members of staff of the Water Research Commission, for whom an administration fee is paid, managed the business of the company. No third person was involved in managing the company.

(f) The names of Directors, including the changes that have been taken place in the appointments during the accounting period, are shown below. No secretary was appointed.

Dr R Kfir
Prof HC Kasan
Mr R Sutton

The company is wholly owned by the Water Research Commission.

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Balance sheet as at 31 March 2003

	NOTES	2003 R	2002 R
ASSETS			
Non-current assets			
Property and equipment	4	6 518 026	4 963 696
Current assets		1 607 628	682 292
Trade and other receivables		1 122 354	405 776
Cash and cash equivalents		410 274	201 516
Investment	5	75 000	75 000
Total assets		8 125 654	5 645 988
EQUITY AND LIABILITIES			
Capital and reserves		(630 437)	2 978 638
Share capital	2	1	1
Accumulated (loss)/profits		(630 438)	2 978 637
Non-current liabilities			
Interest-bearing borrowings	3	7 564 123	1 972 410
Current liabilities		1 191 968	694 940
Trade and other payables		372 607	346 868
Current portion of borrowings	3	819 361	348 072
Total equity and liabilities		8 125 654	5 645 988

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Income statement for the year ended 31 March 2003

	NOTES	2003 R	2002 R
Revenue		1 188 161	2 032 109
Other income		3 190	15 967
Operating expenses		(3 955 863)	(2 137 373)
Loss from operations		(2 764 512)	(89 297)
Finance costs		(844 563)	(277 817)
Loss before taxation		(3 609 075)	(367 114)
Taxation	6	-	-
Loss after taxation		(3 609 075)	(367 114)

The loss from operations was determined after the following items which require separate disclosure in terms of the Companies Act:

Auditors' remuneration	22 326	3 320
Depreciation		
- Furniture and fittings	5 419	5 419
- Equipment	60 544	56 991

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Statement of changes in equity for the year ended 31 March 2003

	Share Capital R	Accumulated Profits R	Total R
Balance at 01/04/2001	1	3 345 751	3 345 752
Net income for the year	-	(367 114)	(367 114)
Balance at 31/03/2002	1	2 978 637	2 978 638
Net loss for the year	-	(3 609 075)	(3 609 075)
Balance at 31/03/2003	1	(630 438)	(630 437)

Cash flow statement

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Cash flow statement for the year ended 31 March 2003

	NOTES	2003 R	2002 R
Cash outflow from operating activities:		(3 762 661)	(1 232 558)
Operating loss before taxation		(3 609 075)	(367 114)
Adjustment for:			
Depreciation		65 963	62 410
Investment income		(3 190)	(15 967)
Finance charges		844 563	277 817
Operating loss before working capital changes		(2 701 739)	(42 854)
Working capital changes		(219 549)	(927 854)
Increase in debtors		(716 578)	(271 469)
Increase/(Decrease) in creditors		497 029	(656 385)
Cash utilized by operating activities		(2 921 288)	(970 708)
Interest received		3 190	15 967
Finance costs		(844 563)	(277 817)
Cash outflow from investing activities:			
Additions to property and equipment		(1 620 294)	(823 619)
Cash flow from financing activities:			
Increase in long-term borrowings		5 591 713	658 921
Net increase/(decrease) in cash and cash equivalents		208 758	(1 397 256)
Cash and cash equivalents at beginning of year		201 516	1 598 772
Cash and cash equivalents at end of year	7	410 274	201 516

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Detailed income statement for the year ended 31 March 2003

	2003 R	2002 R
Income	1 191 351	2 048 076
Rent received	1 004 132	1 844 774
Municipal expenses recoveries	178 056	186 296
Interest received	3 190	15 967
Sundry income	5 973	1 039
Expenses	4 800 426	2 415 190
Administration and management fee	418 439	381 104
Auditor's remuneration	22 326	3 320
Bank charges	2 647	2 711
Depreciation		
- Equipment	60 544	56 991
- Furniture and fittings	5 419	5 419
Entertainment	-	5 964
Insurance	10 822	9 923
Interest paid	844 563	277 817
Municipal services and levies	187 181	237 366
Regional services council	1 175	1 828
Rent - meter readings	1 852	1 716
Repairs and maintenance	3 121 653	1 358 233
Security	109 663	72 798
Staff expenditure	12 134	-
Telephone	2 008	-
Loss before taxation	(3 609 075)	(367 114)

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Notes to the financial statements for the year ended 31 March 2003

	2003 R	2002 R

1 ACCOUNTING POLICIES

1.1 The financial statements have been prepared on the historical cost basis. The following are the principal accounting policies of the Company which are consistent in all material respects with those applied in the previous year, except as otherwise indicated.

1.2 Property and equipment

Land and buildings are not depreciated and all improvements are capitalized against the fixed property.

Furniture and fittings and equipment are stated at historical cost less depreciation. Depreciation is provided on the straight-line method at the following rates:
- Furniture and fittings @ 10%
- Equipment @ 20%

1.3 Revenue

Revenue consists of rental income excluding value-added tax.

1.4 Financial instruments

Financial instruments carried on the balance sheet include cash and bank balances, investments, receivables, creditors and liabilities. These instruments are carried at their estimated fair values. The particular recognition methods adopted are disclosed in the individual policy statements associated with each item.

2 SHARE CAPITAL

Authorized

4 000 Ordinary shares of R1 each	4 000	4 000

Issued

1 Ordinary share of R1 each	1	1

3 LONG-TERM BORROWINGS

Water Research Commission

Total borrowings	8 383 484	2 320 482
Less: Current portion of borrowings	819 361	348 072
Long term portion of borrowings	7 564 123	1 972 410

The loan is unsecured and repayable over 15 years. Interest was charged at 15% on the monthly balance.

During the year R630 500 (2002 - RNil) of the loan was subordinated to the Water Research Commission.

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Notes to the financial statements for the year ended 31 March 2003

	2003 R	2002 R
4 PROPERTY AND EQUIPMENT		
4.1 Furniture and fittings	2 926	8 345
Carrying value: Beginning of year	8 345	13 764
- Cost	54 188	54 188
- Accumulated depreciation	(45 843)	(40 424)
Additions	-	-
Depreciation	(5 419)	(5 419)
Carrying value: End of year	2 926	8 345
- Cost	54 188	54 188
- Accumulated depreciation	(51 262)	(45 843)
4.2 Equipment	1 055	61 600
Carrying value: Beginning of year	61 599	116 191
- Cost	605 441	603 041
- Accumulated depreciation	(543 842)	(486 850)
Additions	-	2 400
Depreciation	(60 544)	(56 991)
Carrying value: End of year	1 055	61 599
- Cost	605 441	605 441
- Accumulated depreciation	604 386	(543 842)
4.3 Fixed property comprise:		
Erf 706, Rietfontein, Pretoria, Gauteng		
- At cost	615 855	615 855
- Improvements	5 898 190	4 277 896
	6 514 045	4 893 751
The directors value the property at R6 500 000.		
Total property and equipment	6 518 026	4 963 696

Erf Sewe-Nul-Ses Rietfontein (Pty) Ltd
Notes to the financial statements for the year ended 31 March 2003

	2003 R	2002 R
5 INVESTMENT		
ABSA Bank: (unsecured) 32 day deposit	75 000	75 000

6 INCOME TAX

No provision has been made for taxation as the company should be exempt from taxation as a wholly-owned subsidiary of an exempt organization. Confirmation of the company's exempt status is pending. Due to the loss incurred, no provision would be required in any event.

7 CASH AND CASH EQUIVALENTS		
Bank balance	410 274	201 516

8 FINANCIAL INSTRUMENTS

8.1 Credit risk

Financial assets which potentially subject the company to concentrations of credit risk consist principally of cash, short-term deposits and trade receivables. The company's cash equivalents and short-term deposits are placed with high credit quality financial institutions. Trade receivables are presented net of the allowance for doubtful receivables.

8.2 Fair values

The carrying amounts of cash and short-term deposits, accounts receivables, accounts payable and short-term liabilities approximated their fair values due to the short-term maturities of these assets and liabilities.

9. RELATED PARTY INFORMATION

9.1 Controlling entity

The company is wholly owned by the Water Research Commission.

9.2 Directors

The directors named in the attached Directors' Report each held office as a director of the company during the year ended 31 March 2003, except for Prof HC Kasan who was appointed on 1 January 2002.

Water Research Commission
Private Bag X03, Gezina, Pretoria 0031, Republic of South Africa
Tel: +27 12 330 0340 • Fax: +27 12 331 2565
Website: www.wrc.org.za • E-mail: wrc@wrc.org.za

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Private Bag X03, Gezina, Pretoria 0031, Republic of South Africa
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