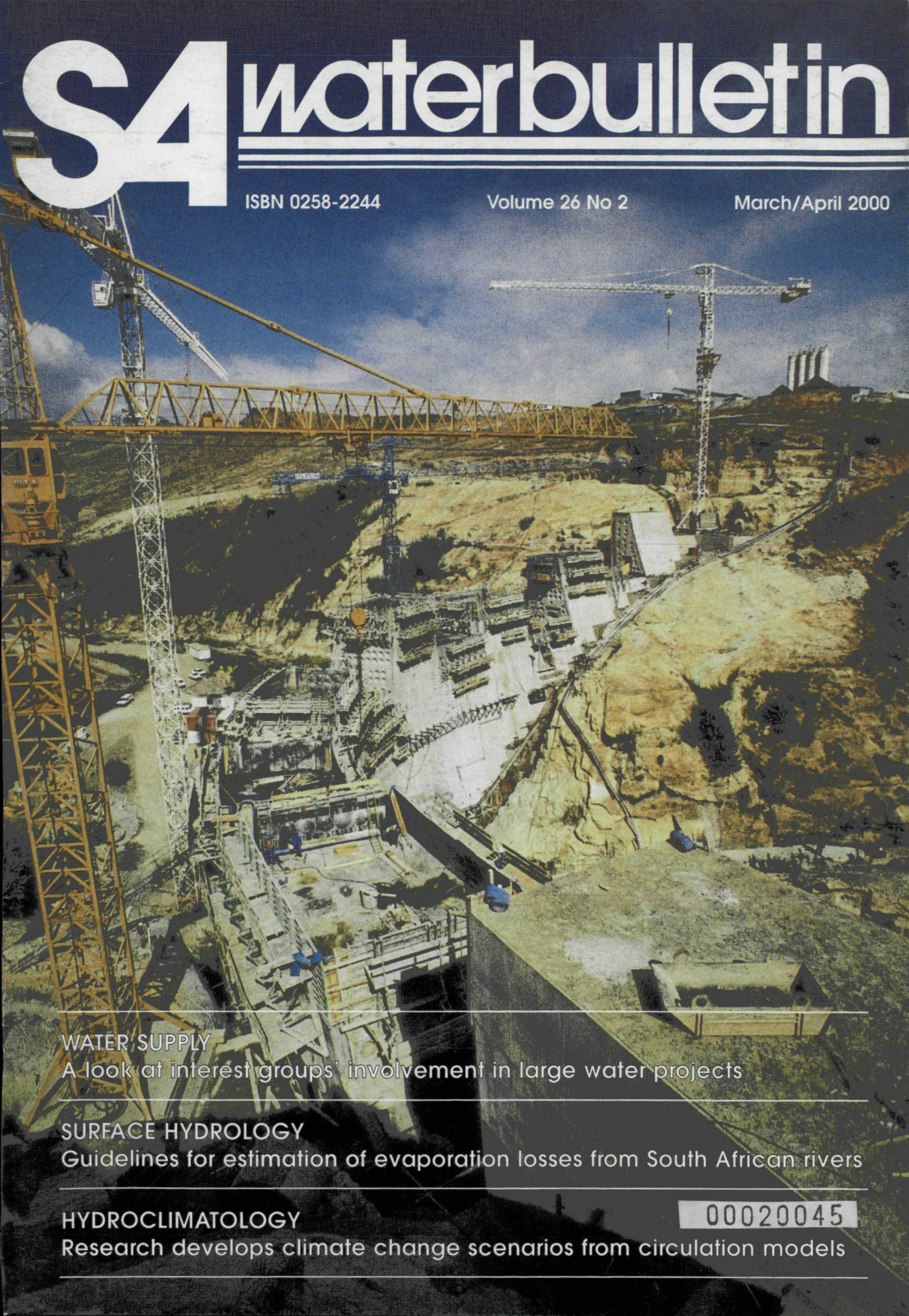


S4 waterbulletin



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WATER SUPPLY

A look at interest groups' involvement in large water projects

SURFACE HYDROLOGY

Guidelines for estimation of evaporation losses from South African rivers

HYDROCLIMATOLOGY

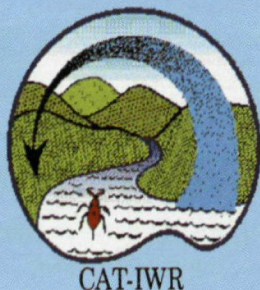
Research develops climate change scenarios from circulation models

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ANNOUNCEMENT OF A COURSE IN INTRODUCTORY AND ADVANCED AQUATIC TOXICOLOGY

presented by

Centre for Aquatic Toxicology
Institute for Water Research
Rhodes University



*Contributing to
sustainable management of
water resources in southern Africa*

About the course

The application of aquatic toxicology in Ecological Risk Assessment and water resource protection and management is becoming increasingly important in South Africa. With this in mind, CAT-IWR has developed Introductory and Advanced Toxicology courses. The series offers a comprehensive overview of aquatic toxicology and how aquatic toxicological data can be utilized by water resource managers and industry. Lectures provide the theoretical framework for the course while the practical sessions demonstrate the application of the theory. The Introductory Aquatic Toxicology course is an introduction to basic aquatic toxicology and covers such topics as acute and chronic toxicology, testing single substances and whole effluents for toxicity, selecting suitable and relevant test organisms, as

well as designing toxicity experiments and data analysis. The application of aquatic toxicity data in water quality management in South Africa will be introduced. Further application of aquatic toxicology in water resource protection and management, and its application in industry and Ecological Risk Assessment will be demonstrated in the Advanced Aquatic Toxicology course. Experts will lecture on diverse topics such as the role of environmental chemistry in aquatic toxicology and the development of an accredited aquatic toxicology laboratory. The advanced course follows on from the introductory course, but may also be attended by delegates who can prove an understanding of the basics of toxicology.

Where and when

Both courses will be held in Grahamstown

Introductory Aquatic Toxicology:

5 - 10 June 2000

Advanced Aquatic Toxicology:

12 - 17 June 2000

Cost

Course fees for the Introductory Aquatic Toxicology and Advanced Aquatic Toxicology module are **R5 500** each. However, attendance of both courses in the same year will cost **R9 000** (*costs exclude accommodation*).

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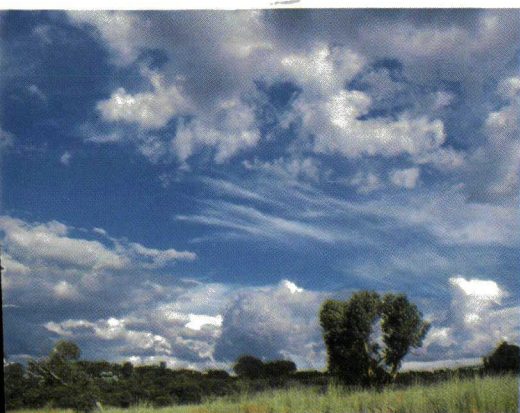
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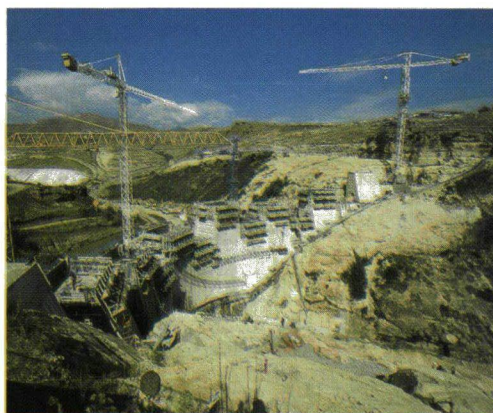
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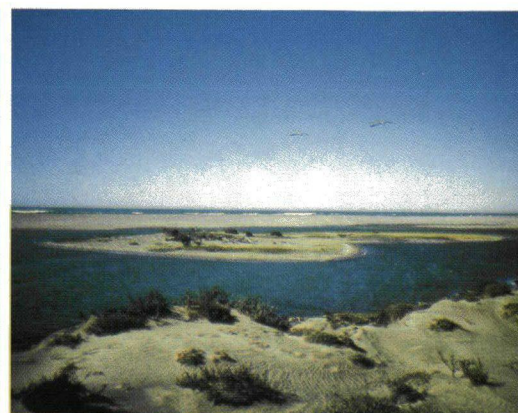
RHODES UNIVERSITY
Where leaders learn



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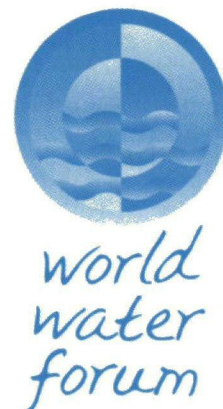
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*Cover: The Lesotho Highlands Water Project (LHWP) in Southern Africa is an example of a large water project in which both local and international interest groups have involved themselves. (See page 24)
(Photo: Courtesy of Trans-Caledon Tunnel Authority)*

SA Waterbulletin is a two monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament. Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source. Editorial offices: Water Research Commission, PO Box 824, Pretoria 0001, Republic of South Africa. Tel (012) 330-0340. Fax (012) 331-2565. WRC Internet address: <http://www.wrc.org.za> Editor: Jan du Plessis (E-mail: Jan@wrc.org.za). Asst Editor: Helene Joubert (E-mail: Helene@wrc.org.za). Ed Secretary: Rina Human (E-mail: Rina@wrc.org.za). Layout: Ronel Urquhart - 4Images. Colour Separations: 4Images. Printing: Beria Printers.

World Water Forum meets in The Hague



The Second World Water Forum (WWF) was held in The Hague in the Netherlands from 18 to 22 March 2000. A multitude of key stakeholders and delegates, including ministers, scientists, environmentalists, representatives from water organisations and the private sector, gathered from around the world to participate in this six day event. According to the President of the World Water Council, Dr Mahmoud Abu-Zeid, it provided an opportunity for stakeholders to present their needs and learn about the needs and interests of others. He hailed it as an opportunity for "working together during the Forum and beyond to create the awareness and commitment that is essential if we are to take on the challenge of securing a sustainable freshwater future".

The official opening ceremony of the Forum was planned as a formal but festive occasion with the Dutch Crown Prince taking the chair. His Royal Highness Prince Willem-Alexander, the Prince of Orange, has an active interest in world water affairs, and had been invited to chair this Forum meeting. All started well with the colourful performance of a group of singing women, coming from thirteen different countries and each a celebrity in her own right.

CEREMONY IN COMMOTION

However, Dr Abu-Zeid had barely spoken a word of welcome when unexpected "participants" disrupted his speech. A number of activists turned the opening ceremony into an "unforgettable" one with all their antics and "sideshows"! Amongst others a man and a woman ran on stage, stripping off their clothes and shouting slogans. They had slogans written all over their bodies as well. Security guards had barely removed the naked couple when another activist

launched himself from the rafters. He came down a rope carrying a banner with him. Yet another activist scaled a brick wall in rock-climbing fashion. He had the audience transfixed and having gained their full attention he unfurled a banner with the words "Stop Itoiz Dam". He continued to interrupt the proceedings from his impregnable position.

H R H the Prince of Orange stepped forward and addressed the protesters saying that although the Dutch were known for their improvisations the Forum was intended for real discussions where people behave decently. As the demonstrators showed no sign of relenting, the group of singing women filled the gap with an impromptu performance. The Prince of Orange continued with his welcoming speech as the last of the demonstrators were removed. The activists however had successfully gained everyone's attention, including the media, and put the spotlight on their protest against the construction of large dams and "the wholesale privatisation of water". The protest represented the anti-World Bank sentiments coming from European trade unions and various environmental groups.

Dr Ismael Serageldin, chairman of the World Commission on Water for the 21st century was the last speaker at this rather unceremonious opening which set the scene for the rest of the World Water Forum where the new World Water Vision was to be discussed, analysed and criticised. Dr Serageldin remarked in the Introduction to the Forum Programme that "There needs to be a move from competition and conflict between different uses and users towards co-operation and co-ordination. The needs of the present and future generations must be secured and issues of quantity and quality of water must be addressed".

INTERACTION

Vigorous interaction amongst the 4600 delegates attending was the order of the day. The Forum and programme was planned to promote an interactive process rather than merely having formal presentations of technical papers.

Diversity was the hallmark of the Second World Water Forum as delegates could attend any of some 80 parallel sessions in all. The sessions included a considerable number of major themes and a spectrum of special subjects. Interesting and innovative presentations were part of the programme, while important ideas and information were presented through discussions and materials made available at the Forum.

PANEL DISCUSSIONS

Amongst the many sessions at the Forum there were three specific panel discussions arranged by Green Cross International, an international environmental non-governmental organisation (NGO), active in Russia, the Middle East and Africa. The two of the panel discussions were on Water for Peace in Southern Africa and in the Middle East respectively, followed by the concluding Sovereignty Panel discussion.

These panel discussions was attended, amongst others, by Mikhail Gorbachev the former President of the USSR. He is currently President of Green Cross International and has strong views on the environment. These views grew from the large-scale environmental degradation that accompanied the collapse of the former Soviet Union. In recent years he has said that "The relationship between man and the environment has become menacing. Problems of ecological security affect all - the rich

and the poor. What is required is a global strategy for environmental protection and the rational use of resources".

SOUTHERN AFRICA

AWIRU coordinated the Southern African panel for the discussion session on Water for Peace in Southern Africa, at the Forum on 20 March 2000. The Southern African panel members were: Mr Tony Turton (AWIRU), Prof Peter Ashton (CSIR), Dr Joanne Leestemaker (Eduardo Mondlane University, Mozambique), Dr Pieter van der Zaag (University of Zimbabwe), Dr Ebenizario Chonguica (IUCN Mozambique) and Mr RT Mochebelele (Lesotho Highlands Water Authority).

A number of SADC Ministers also participated at this event, all making formal presentations. These included Mr R Kasrils (South Africa), Mr Moleleki (Lesotho), Mr Y Mwawa (Malawi), Mr V Shiwuti (Namibia), Mr D Saviye (Zambia), Mr B Mokgothu (Botswana), Mr A. Tito (Angola) and Mr H Cossa (Mozambique).

Mr Ronnie Kasrils, Minister of Water Affairs and Forestry, stated the South African concern with the notion of full cost recovery, which is an integral part of the World Water Vision, as this notion has severe implications for the poor. Mr Cossa in turn distributed an alternative draft of the SADC Water Protocol, stating that Mozambique was dissatisfied with the existing document.

For a more detailed report of the Southern African panel at the WWF, please refer to the AWIRU Web site <http://www.up.ac.za/academic/libarts/polsci/awiru> or use the links page to visit the World Water Forum home page.

NEW DEBATE

An interesting new debate emerged from the Sovereignty Panel at the Second World Water Forum. All existing international water-sharing agreements are based on the notion of rights, derived from the sovereignty of the co-basin states. The emerging consensus is that this rights-based approach is inherently conflictual because it is based on a zero-sum game (what one party gains, another party loses). A new alternative is now being discussed. This is based on needs rather than rights. It is particularly relevant in a basin configuration such as the Okavango where the upstream riparian contributes the majority of the streamflow (and therefore has a large claim to the water by right), and where the downstream riparian is highly dependent on the flow (and thus has a greater need).

Significantly, the delegates from Mozambique, Namibia and Botswana all tended to favour the needs-based argument. This new approach is interesting and should be watched as it is resonating with changing global opinion on resolving conflict over shared resources such as water, says Mr Tony Turton.

PUBLICATIONS AVAILABLE

Two books of interest to water resource managers were made available at the Forum. The first entitled "National Sovereignty and International Water-courses" was written under the supervision of Prof. Laurence Boisson de Chazournes (Professor of International Law at Geneva University and past legal advisor to the World Bank) and Dr. Salman M.A. Salman, Senior Council at the World Bank. AWIRU was involved in the consultations for this book.

The second book is entitled "Water for Peace in the Middle East and Southern Africa", and was brought out by the joint sponsorship of Green Cross International and ACCORD, a South African based conflict resolution NGO. Copies of these books are being placed in various libraries in South Africa and limited copies may still be obtainable by sending an e-mail to secretariat@gci.ch along with your postal address and institutional details.

The Southern African portion of "Water for Peace" in the Middle East and Southern Africa is being published in an expanded and edited volume under the joint editorship of Dr. Hussein Solomon of ACCORD and Tony Turton of AWIRU. This edited volume is being sponsored by ACCORD and Green Cross International. Copies can be ordered by sending an e-mail to CIPS@postino.up.ac.za stating your name, institutional details and postal address.

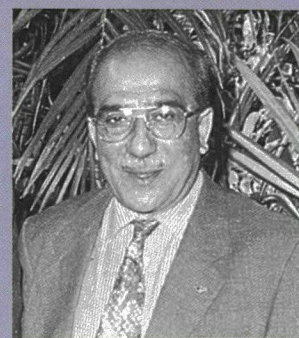
Stockholm Water Prize for Asmal

Professor Kader Asmal, the previous Minister of Water Affairs and Forestry, was announced as recipient of the prestigious 2000 Stockholm Water Prize on World Water Day. According to the Stockholm Water Foundation this award is in recognition of Asmal's "unprecedented efforts" to make water available to all South Africans.

"He pioneered major reforms in

water legislation, which resulted in a new National Water Act for South Africa. ... the legislation, policies and programmes reflected his belief that water for basic human needs and water for ecological functioning have first priority."

Asmal is the first person in Africa to be awarded with this prize. The award will be presented to him in August 2000 by King Carl XVI Gustaf of Sweden.



Prof Kader Asmal

Ministers meet on water security in The Hague

A Ministerial Conference on Water Security in the 21st Century, organised under the auspices of the Government of the Netherlands, ran alongside the Second World Water Forum meeting in The Hague. The Forum, also referred to as "the largest international water policy gathering in history", saw a 115 Ministers and 159 delegations from countries around the world gather at the Ministerial Conference. The Dutch Minister for Development Co-operation, Mrs Eveline Herfkens, opened the conference in the presence of H.R.M. Queen Beatrix of the Netherlands. Mrs Herfkens expressed the hope that the political commitment at the conference would lead to much needed change in water management.

The ministerial gathering was also addressed by Dr Mahmoud Abu-Zeid, president of the World Water

Council, and Dr Ismael Serageldin, chairman of the World Commission on Water for the 21st century. H.R.H. the Prince of Orange, as chair of the Forum, presented the ministerial meeting with the key issues that had been raised in the Forum.

The two-day conference had a number of parallel sessions scheduled for the discussion of thematic as well as regional issues. The thematic sessions focused on seven challenges (see below under "Main Challenges") that had been identified as most important for the purpose of achieving water security.

At the Closing Ceremony concluding the proceedings of both the Second World Water Forum and the Ministerial Conference the following declaration was presented:

Ministerial Declaration of the Hague on Water Security in the 21st Century

□ Water is vital for the life and health of people and ecosystems and a basic requirement for the development of countries, but around the world women, men and children lack access to adequate and safe water to meet their most basic needs. Water resources, and the related ecosystems that provide and sustain them, are under threat from pollution, unsustainable use, land-use changes, climate change and many forces. The link between these threats and poverty is clear, for it is the poor who are hit first and hardest. This leads to one simple conclusion: business as usual is not an option. There is, of course a huge diversity of needs and situations around the globe, but together we have one common goal: to provide water security in the 21st century. This means that fresh water, coastal and related ecosystems are protected and improved.; that sustainable development and political stability are promoted, that every person has access to enough safe water at an affordable cost to lead to a healthy and productive life and that the vulnerable are protected from the risks of water-related hazards.

□ These threats are not new. Nor are the attempts to address them. Discussions and actions started in Mar del Plata in 1977, continued through Dublin and were consolidated in Chapter 18 of Agenda 21 in Rio de Janeiro in 1992. They were reaffirmed in Paris 1998 and at the Second World Water Forum and Ministerial Conference. The process will continue in the meeting in Bonn in 2002, through the ten year review of implementation of Agenda 21, and beyond. These and other international meetings have produced a number of agreements and principles that are the basis upon which this and future statements should be built. The goal of providing water in the 21st century is reflected in the unprecedented process of broad participation and discussion by experts, stakeholders and government officials in many regions of the world. This process has profited from the important contributions of the World Water Council, which launched the World Water Vision process at the First World Water Forum in Marrakech (Morocco), from the formation of the World Commission on Water in the 21st century and from the development of

the Framework for Action by the Global Water Partnership (GWP).

MAIN CHALLENGES

- To achieve water security, we face the following main challenges:
- *Meeting basic needs:* To recognise that access to safe and sufficient water and sanitation are basic human needs and are essential to health and well-being, and to empower people, especially women, through a participatory process of water management.
- *Securing the food supply:* To enhance food security, particularly of the poor and vulnerable, through the more efficient mobilisation and use, and the more equitable allocation of water for food production.
- *Protecting ecosystems:* To ensure the integrity of ecosystems through sustainable water resources management.
- *Sharing water resources:* To promote

peaceful co-operation and develop synergies between different uses of water at all levels, whenever possible, within and, in the case of boundary and trans-boundary water resources, between states concerned, through sustainable river basin management or other appropriate approaches.

- **Managing risks:** To provide security from floods, droughts, pollution and other water-related hazards.
- **Valuing water:** To manage water in a way that reflects its economic, social, environmental and cultural values for all its uses, and to move towards pricing water services to reflect the cost of their provision. This approach should take account of the need for equity and the basic needs of the poor and the vulnerable.
- **Governing water wisely:** To ensure good governance, so that the involvement of the public and the interests of all stakeholders are included in the management of water resources.

MEETING THE CHALLENGES

□ We, the Ministers and Heads of Delegation, recognise that our gathering and this Declaration are part of a wider process, and are linked to a wide range of initiatives at all levels. We acknowledge the pivotal role that governments play in realising innovations in order to move beyond "business as usual" and we resolve to rise to meet these challenges.

□ The actions advocated here are based on integrated water resources management, that includes the planning and management of water resources, both conventional and non-conventional, and land. This takes account of social, economic and environmental factors and integrates surface water, groundwater and the ecosystems through which they flow. It recognises the importance of water quality issues. In this, special attention should be paid to the poor, to the role, skills and needs of women and to vulnerable areas such as small island states, landlocked countries and desertified areas.

□ Integrated water resources management depends on collaboration and partnerships at all levels, from individual citizens to international organisations, based on a political commitment to, and wider societal awareness of, the need for water security and the sustainable management of water resources. To achieve integrated water resources management, there is a need for coherent national and, where

appropriate, regional and international policies to overcome fragmentation, and for transparent and accountable institutions at all levels.

□ We will further advance the process of collaboration in order to turn agreed principles into action, based on partnerships and synergies among the government, citizens and other stakeholders. To this end:

- We will establish targets and strategies, as appropriate, to meet the challenges of achieving water security. As part of this effort, we support the development of indicators of progress at the national and sub-national level. In carrying this forward, we will take account of the valuable work done for the Second World Water Forum.
- We will continue to support the UN system to re-assess periodically the state of freshwater resources and related ecosystems, to assist countries, where appropriate, to develop systems to measure progress towards the realisation of targets and to report in the biennial World Water Development Report as part of the overall monitoring of Agenda 21.
- We will work together with other stakeholders to develop a stronger water culture through greater awareness and commitment. We will identify best practices, based on enhanced research and knowledge generation capacities, knowledge dissemination through education and other channels and knowledge sharing between individuals, institutions and societies at all appropriate levels. This will include co-ordination at regional and other levels, as appropriate, to promote arrangements for coping with water-related disasters and for sharing experiences in water sector reform. It will also include international co-operation in technology transfers to, and capacity building in developing countries.
- We will work together with stakeholders to increase the effectiveness of pollution control strategies based on polluter pays principles and to consider appropriate rules and procedures in the fields of liability and compensation for damage resulting from activities dangerous to water resources.
- Against the background of the preparatory work for and discussions in The Hague, we will work within multilateral institutions, particularly the UN system, International Financial Insti-

tutions and bodies established by Inter-Governmental Treaties, to strengthen water-related policies and programmes that enhance water security, and to assist countries, as appropriate, to address the major challenges identified in this Declaration.

- We call upon the Secretary General of the United Nations to further strengthen the co-ordination and coherence of activities on water issues within the UN system. We will adopt consistent positions in the respective governing bodies to enhance coherence in these activities.
- We call upon the Council of the Global Environmental Facility (GEF) to expand activities that are within the mandate of the GEF in relation to freshwater resources by catalysing investments in national water management issues that have a beneficial impact on international waters.
- We welcome the contribution of the World Water Council in relation to the Vision and of the Global Water Partnership with respect to the development of the Framework for Action. We welcome follow-up actions by all relevant actors in an open participatory and transparent manner that draws upon all major groups in society.
- We note the statements made by the representatives of the major groups and welcome them as a clear reflection of their readiness to work with us towards a secure water future for all.

□ Recognising that the actions referred to above, including progress on targets and strategies, are important and ambitious, we will review our progress periodically at appropriate fora, including the meeting in Bonn in 2002 and the 10-year review of the implementation of Agenda 21.

□ The Ministerial Conference acknowledges with appreciation that a range of issues were discussed during the Second World Water Forum, and that the Chair of the Forum presented these issues to the Ministerial Conference. The importance of these issues is unquestionable; we will raise them for further consideration in relevant fora in the future and will consider their implications for our individual national situations.

We, the Ministers and Heads of Delegation, thank the government and people of the Netherlands for their vision and their hospitality in hosting this conference and forum.

Union of African Water Suppliers celebrates its 20th birthday in South Africa



The Union of African Water Suppliers celebrated its 20th birthday in Durban. Cutting the birthday cake at the gala dinner are (from left) Mr Brian Walford, Congress president, Mr Francois Ombanda from Gabon, the outgoing president, and Dr Abdoulaye Fall from Senegal, the incoming president.



The Minister of Water Affairs and Forestry, Mr Ronnie Kasrils, officially opening the exhibition at the 10th biennial conference of the Union of African Water Suppliers. From left are: Mr Brian Walford, Congress president, Minister Kasrils, Mr Lionel Mtshali, Premier of KwaZulu-Natal and Mr Jean Geoffrion, exhibition organiser. With about 60 participants the exhibition space covered more than 1 200 square metres.

This was the first time the Union of African Water Suppliers held a congress in an Anglophone country, Mr Brian Walford, chief executive of Umgeni Water, said when he welcomed more than 450 delegates from 38 countries at the tenth biennial congress (and the 20th birthday) of the Union of African Water Suppliers (UAWS) in Durban earlier this year. He said holding the congress in South Africa was of great significance.

"Not only does it indicate that South Africa is being accepted back into Africa after many years of isolation but it is also fully supportive of the South African government's commitment to playing an increasing role in all aspects of development of Africa."

Dr Angbo Lucien from the World Bank's Programme for Water And Sanitation said in a keynote address the challenge facing many developing countries today was how to supply sufficient water of good quality at a reasonable price.

"On the one hand demand for water is rising exponentially due to continuing population growth and rising standards of living, while on the other hand water supply companies frequently have to cope with water shortages or pollution of water resources. Furthermore, due to inadequate maintenance many water supply and sanitation systems are in a deplorable state. This has been an almost universal (and costly) failure by infrastructure providers in developing countries with water supply systems delivering an average of less than 70 per cent of their output to users, compared with best-practice delivery rates of 80 per cent. Poor maintenance can also reduce service quality and increase users' costs, some of whom install back-up water storage tanks or private wells.

He said the current situation was that more than 50 per cent of the African population lack access to safe water and

more than 70 per cent lack basic sanitation services.

"These limited health conditions and high mortality rates result in reduced human welfare and lower human productivity. Illness and premature deaths are caused by high incidences of carrier diseases (e.g. typhoid, cholera, dysentery, etc.). Other illnesses are directly related to inadequate sanitation in which water is a key factor in the transmission of diseases (such as malaria).

"Rivers are used for waste conveyance which often lead to polluted water bodies and direct implications on human health, environmental damage and water reuse.

PRICE

He said while the objective of having sufficient water and sanitation for all at an affordable price still holds, water and sanitation should also be treated as a scarce commodity. Water and sanitation services have a price. This has consequences on two fronts: on the one hand it means that customers should pay the full cost of service provision and on the other hand that the water and sanitation supply utilities are obliged to keep their costs as low as possible by improving operational efficiency.

"In many African countries water and sanitation services are controlled by the government. There is a lot to be said for this even if it is only that good water supply and sanitation are in the public interest. The other side of the coin, however, is that government-operated utilities are not always a shining example of efficiency. In recent years privatisation of the water supply and sanitation sector has therefore been the favoured option. Market forces must ensure that supply and demand are efficiently matched. Private business, however, have focussed on areas where demand is backed by purchasing power. This means that there are still sections of the population who do not have access to affordable, good quality water and sanitation services."

What needs to be done?

According to Dr Lucien the answer lies in investing in people and institutions, investing in knowledge and more cooperation between African countries.

□ *Investing in people and institutions.* In the socio-economic arena investing in people is crucial. There should be awareness and involvement of stakeholders and capacity building on water issues. Water should be given higher social and economic value and incentives should be given to attract investment. Investment policies should ensure long term sustainability, cost recovery and price tariff structures affordable to consumers. Participation and community management, such as decentralisation, privatisation, structural and institutional strengthening are also means that would lead to more equitable and efficient management of resources.

The role of national institutions in regulating and allocating resources should be reinforced while local management should be transferred and privatised whenever possible. This would include reviewing and reforming existing legislation, with particular emphasis on community ownership.

Provide training and capacity building through training institutions, universities and professional institutions to commu-

nities and their support agencies to enhance their capacity to manage water using appropriate, gender sensitive and cost effective methodologies.

□ *Investing in knowledge.* Investment in research and development components should increase, in particular with the aim of improving the productivity of water and addressing environmental issues, such as the quality of groundwater and waste water reuse.

Provide knowledge and information through coordination of and access to information, regional databases and national centres for the dissemination of water information. One key issue that will provide a better assessment is the development of performance indicators that measure progress towards milestones regularly revised.

□ *More cooperation.* Specifically, on common water resource management, cooperation strategies need to be developed throughout the African region. Africa should also look towards increasing regional cooperation and water transfers, regional and global coopera-

The Union of African Water Suppliers

In February 1980 various African government bodies and institutions in charge of the public utilities in the area of drinking water and sanitation in Africa decided to constitute an association called the Union of African Water Suppliers (UAWS).

The objectives of the Union are

- to coordinate the search for knowledge and latest development in the technical, legal, administrative and economic fields for drinking water production, supply and sanitation.
- to promote the exchange of information on methods, processes and procedures of drinking water production and supply and sanitation; and
- to initiate, encourage and promote any action of cooperation and exchange in professional training.

The Union furnishes members with results of research and inquiries conducted in all branches of activities in water production and supply and in sanitation. The Union maintains close ties with all regional, national and international agencies devoted to the problems related to drinking water and sanitation. The Union also organises international congresses, seminars, workshops and technical sessions.

The financial resources of the Union come mainly from the contributions of the members.

For more information please contact the administrative secretary of the Union of African Water Suppliers, Mr Koffi N'Dri, at UAWS, 01 BP 1843, Abidjan 01, Côte d'Ivoire. Tel: (225) 2124 1443. Fax: (225) 2124 2629 or 2124 6157.

Benchmarking water services

At the recent 10th biennial UAWS Congress held in Durban, Mr JN Bhagwan, research manager at the Water Research Commission and Mr PJ Pybus, a consulting engineer, presented a joint paper in which the concept of benchmarking to establish progress in water supply and sanitation was outlined.

Titled "Benchmarking water services activities of local authorities in South Africa" the paper explained the concept as a process in which an organisation's progress is measured against progress in a comparable organisation, not necessarily operating in the same field.

The authors gave the example of Dallas-based Southwest Airlines, which sought ways to reduce the expensive 40 minute ground time between flights.

Benchmarking their refuelling time against that of other airlines, Southwest discovered they were already among the leaders. So they benchmarked against Grand Prix Formula 1 racing teams - the most efficient refuellers in the world.

Adopting pit stop turnaround processes, Southwest are now able to refuel an aircraft in 12 minutes.

The authors outlined the practicalities of instituting benchmarking procedures and called for guidelines to be drawn up for the use of local authorities in South Africa.

"There is a need for guidelines for benchmarking the activities of local authorities in South Africa in the supply of water and sanitation services, in order to improve the rendering of the service and to provide cost-effective operations and solutions.

"The extent to which the guidelines will be used will be a function of how they are perceived by the decision-makers and local councillors as a means to improve service delivery and its efficiency and effectiveness."

tion on technology transfer, know-how and research and development. "And not only on water issues, but also on energy and market factors."

SOUTH AFRICA

The Premier of KwaZulu-Natal, Mr LPHM Mtshali, said that South Africa in the past had been guilty of a grave oversight in the priorities of the country.

"South Africa has advanced mining production and electricity technology as well as a fairly advanced infrastructure. The legal and financial institutions rank with the best in the world, but in respect of the use, distribution and conservation of water South Africa has been a society at odds with itself. Amid all this progress, within mere kilometres of this conference centre (in Durban), women are walking hours to draw water from streams, mosquitoes breed in stagnant pools while schools have no taps and water-borne sewerage."

Mr Mtshali said the other challenge South Africa faced was that of affordability. The extension of water service infrastructure would no doubt be much less problematic if one could count on high levels of cost recovery.

"We are still developing a culture of payment, but underlying the difficulties is the brute fact that over 30 per cent of consumers in some areas simply do not have the income to pay for modern services without sacrificing food and housing costs."

He said these distortions in South Africa's development meant that in respect of water services and supplies South Africa had a great deal in common with much less developed countries on the continent and therefore the conference "was an opportunity to share assessments of the challenges we all face".

Touching on the role of the private sector, the Minister of Water Affairs and Forestry, Mr Ronnie Kasrils said the private sector had an important role to play in water delivery, but there was no point in privatising an asset "unless it becomes an even greater asset to those it is designed to serve".

Mr Kasrils said the State was ultimately responsible for the delivery and provision of water supply and sanitation services. "No matter who holds the money, government remains accountable to the people."

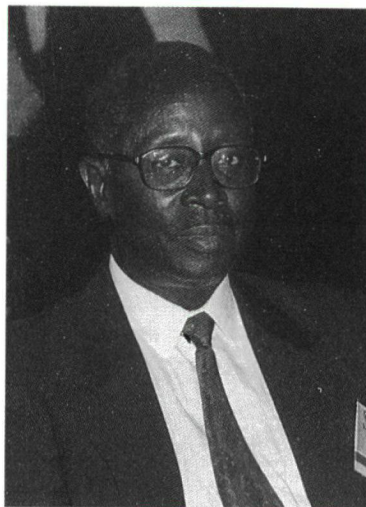
Dr Abdoulaye Fall, the incoming president of the UAWS, said private-public partnerships will have to be a priority in keeping with the international movement towards globalisation.

"Such partnerships have political implications in terms of the principles and policies on which they are based. Poor choices with regard to sector policies and institutional and regulatory frameworks have been root causes of problems in the water sector. Therefore it is essential

that the UAWS takes a leading role in formulating strategies which will contribute to providing the desired services to the populations of the member countries.

He said: "Our first objective 20 years ago was to upgrade the technical and management skills needed for the provision of water and sanitation - to share experiences and thus help improve standards. That principle is unchanged, but we must also now be prepared to deal effectively with the political strategies which are necessary to achieve our objectives."

Since 1990 private participation has accelerated, increasing more than tenfold by the end of 1997 when investment by private companies on water and sewerage projects in developing countries had reached US\$ 25 billion.



Dr Abdoulaye Fall from Senegal, the incoming president of the Union of African Water Suppliers.

According to the World Bank's Private Participation Infrastructure group, the water sector has a long history of tariffs below costs and political resistance to raising them. Considerable government commitment is required to raise tariffs to cover costs and to build regulatory arrangements that give private companies confidence that they can make a fair return on their investments.

Mr Stephen Turner from Water Aid, the London based international NGO which operates in 15 countries throughout Africa and south Asia said there was no magic solution to the problems of providing water and sanitation to the poorest of the poor - needs and circumstances vary from country to country, but experiences in one place can be an invaluable aid to addressing the problems of another.

He said Water Aid's Haiti approach provided a good example of the NGO's rationale. There a tripartite alliance between public sector, private sector and poor communities have taken on joint responsibility for water services.

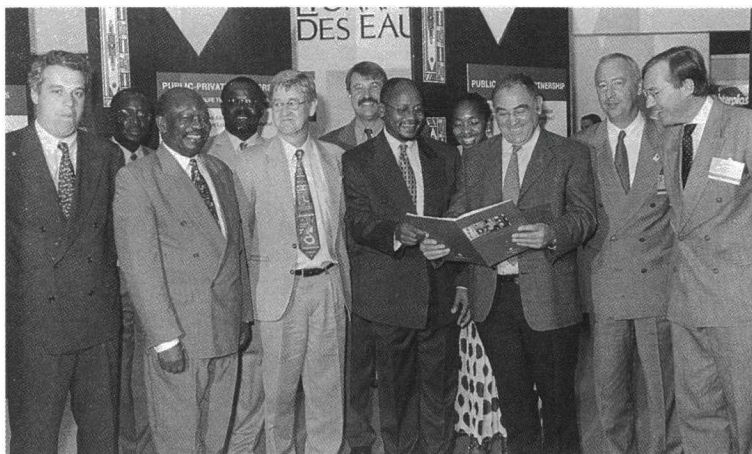
The municipal water service is supported by a private sector company and the communities take on the management of bulk supplies - allocating distribution, collecting payment and monitoring consumption. The result is a win-win situation where the poorest people have a better quality supply which is under their own control, and the municipality is assured of payment.

"In principle, delivering water to the very poor is all about business philosophies," Mr Turner said. "We can't achieve our objectives unless we adopt different morals and different attitudes.

"The poor are still customers and must be treated as part of the solution and not part of the problem - it's no longer a case of 'Government provides' but of fostering a greater self-reliance and awareness of solution management among the very poor communities. Treat them responsibly and with respect and they will respond."

UAWS 2002

The next biennial congress of the Union of African Water Suppliers will be held in 2002 in Libreville, the capital of Gabon.



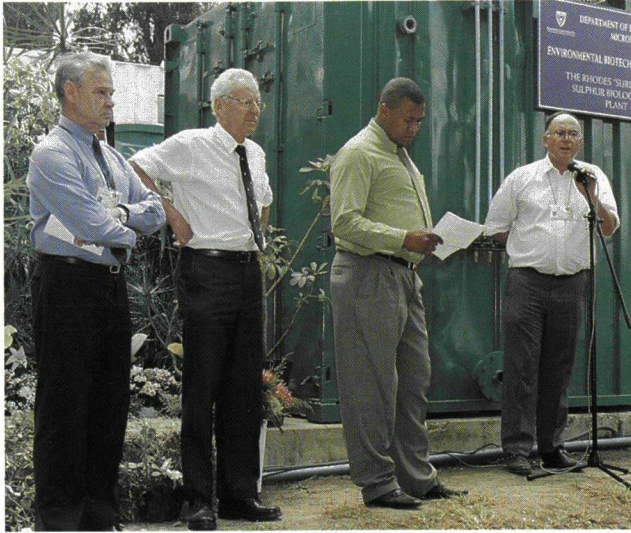
Minister Kasrils visiting the Lyonnaise des Eaux exhibition stand at the Congress.



Enjoying the delegates banquet are from left Lulamile and Thina Ndizana and Mphamore and Cyril Gamede, all from Umgeni Water.



Senegalese delegates - from left - Medieumbe Diouf, Alassane Dieng, Abdoul Niang and Malick So.



Dignitaries at the opening of the Sulphate Reduction pilot plant in Grahamstown. From left are Mr PE Odendaal (WRC), Dr DR Woods, vice-chancellor, Rhodes University, Mr Likhaya Nggezana, mayor of Grahamstown and Professor PD Rose (Department of Biochemistry and Microbiology, Rhodes University).



Professor Peter Rose (centre) introducing some of the students and members of the research team involved with the biotechnology programme at the Sulphate Reduction pilot plant at Rhodes University.

"Rhodes Technology" under the spotlight

The new Rhodes University Sulphate Reduction pilot plant in Grahamstown was recently opened by the executive director of the Water Research Commission, Mr PE Odendaal. The plant is the latest addition to the Rhodes Biotechnology Field Station which represents a unique collaboration between the University (through its Department of Biochemistry and Microbiology), the Water Research Commission and the Municipality of Grahamstown.

In his opening address Odendaal said what the University team, under the leadership of professor Peter Rose, had achieved was to build remarkable expertise on what is ostensibly a very simple wastewater treatment technology, namely pond systems.

"Pond technology has been known and applied for many decades throughout the world, primarily as a relatively cheap method for the treatment of sewage effluent from small communities. Rhodes University, has through some

very novel approaches, taken pond technology into applications which have never been dreamed of before." Odendaal said this became possible through building and understanding of the basic biochemical and microbiological processes involved. The work was done on laboratory scale and then tested on the pilot scale facilities in Grahamstown.

He highlighted some of the novel developments which have emerged during the last few years:

- By studying the performance of high rate algal pond technology in saline and high organic content environments, Rhodes University has succeeded in developing a system to successfully solve a serious environmental problem at a tannery in Wellington where the process has found full-scale application.
- A pilot plant has been operating successfully for some six months near Worcester treating wastes from the manufacture of tartaric acid. This opens the door to a range of applica-

tions in the management of waste streams from the food industry, which are seasonal in nature.

- The successful demonstration at the Grahamstown pilot plant of anaerobic treatment, coupled with high rate algal pond technology, provided a tool to bring sewage treatment to communities that could not previously afford it. Furthermore, preliminary trials by the Department of Ichthyology at Rhodes University has demonstrated the feasibility of aquaculture, using the algae and water produced by the system. This work still needs to be followed up, but the potential for job creation and producing valuable products from wastes is clear.
- Exciting work in progress at the Grahamstown pilot plant involves biological nutrient removal through pond systems. Many countries, including South Africa, place a limit on the nutrient (nitrogen and phosphorus) levels in effluents. This is costly to

achieve and success in this project will undoubtedly be a breakthrough of international standing.

- "Rhodes technology" has been applied to the treatment of mining effluents to correct pH, remove metals and reduce sulphates, using sewage sludge as carbon source. The extent to which sewage sludge was hydrolysed at pilot scale trials exceeded all expectations and led to a reversal of perspective, namely, to use high sulphate acid mine drainage to treat sewage sludge. In Gauteng, the East Rand Water Care Company (ERWAT), which operates some 18 major sewage treatment plants, is testing this process in a large scale facility of 30 Ml/day, while the pilot plant at Rhodes will be used in parallel with the ERWAT plant to optimise the system.

Odendaal paid tribute to professor Rose and his team for the interdisciplinary approach they were following in their research and the degree of networking they had achieved with other research groups and operational institutions.

"In water research the era of single-discipline research is rapidly passing away and we stand in the time of the multi-disciplinary approach which facilitate the interfacing of research and practice," he said.

Requests for Proposals

The Awwa Research Foundation (AwwaRF), a non-profit organisation dedicated to advancing the science of water, has announced the selection of 36 new research projects approved for funding in 2000. AwwaRF sponsors practical, applied research for the drinking water community, and since 1986, has managed research projects worth over \$160 million. The new research topics include UV disinfection, treatment chemistry, customer issues, distribution system water quality, and source water quality and monitoring. Requests for Proposals have been issued for 29 of the new projects and are available on the AwwaRF web site www.awwarf.com

Young South Africans attend WWF



Lara Aucamp (left) and Iwan Aucamp (right) presenting a copy of their project entry for the International World Water Vision competition to Mr David van der Merwe, deputy executive director of the Water Research Commission.

Two South African youngsters, Lara and Iwan Aucamp, also attended the Second World Water Forum (WWF). They were invited, as winners of World Water Vision's youth contest, to participate in the Forum's Youth Panel Programme. They had entered their school science project in the New Thinking Contest, and were amongst the 12 winners worldwide invited to The Hague.

Their project entitled "Antarctic Fresh Water for the Millenium" explains how fresh water from Antarctic icebergs can reach South Africa by using the forces of nature. As Antarctic icebergs migrate northwards on the ocean currents, fresh water from the melting icebergs drifts on top of the salty ocean water since the density of fresh water is lower than that of seawater. They say that the fresh water can be "harvested" from an iceberg by placing a floating plastic "curtain" around the iceberg. The harvested fresh water, floating on top of the plastic "curtain", can then be pumped into a battery of huge plastic bags to drift northwards on the ocean currents towards South Africa. The battery of plastic bags can be collected on the west coast of Southern Africa, where it will be anchored to the coastal floor and pumped out via underwater pipelines.

The project received a gold medal at the

Waterkloof High School Expo, which is a exhibition of science projects by the school pupils. Subsequently the project was awarded gold medals at the Northern Gauteng Expo as well as the National Expo for young scientists.

Lara and Iwan discovered the New Thinking Contest for the youth on the Internet. The contest required the submission of projects to solve the world's fresh water problems. Since their project was ideally suited for this contest they entered by creating a web site for the project.

They also submitted their project to the Water Research Commission, as submission of the project to a government or semi-government organisation was a prerequisite for entering the New Thinking Contest of the World Water Vision. The novel ideas expressed in their project was praised as "new thinking" indeed!

At the WWF they gave a presentation of their project. However, they say that they most enjoyed taking part in the preparation of a youth statement on water, that was presented at the Ministerial Conference in The Hague.

You can visit Lara and Iwan's project web site at: www.geocities.com/global_ice_2000

The newly founded Centre for Aquatic Toxicology (CAT) was recently introduced at an official launch held in Johannesburg. The establishment of the Centre, which will be part of the Institute for Water Research (IWR) at Rhodes University, has been made possible by a grant from the industrial company Lever Ponds SA. Unilever UK, the international holding company of Lever Ponds SA, will be one of the first clients of the Centre, as CAT has been contracted to investigate the effects of the washing powders and detergents used in the washing of clothes in South African rivers.



Speakers at the official launch of the Centre for Aquatic Toxicology (CAT): Dr Su Baird (SEAC Unilever, UK), Mr Mbangi Nepfunbada (Institute for Water Quality Studies, DWAF) and Dr Tally Palmer (CAT).

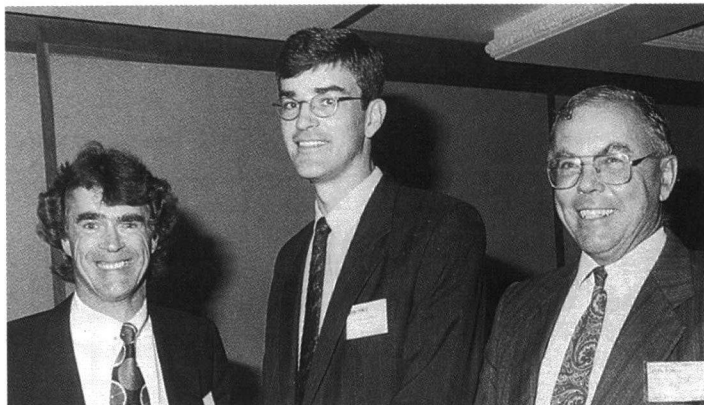


Centre for Aquatic Toxicology - introduced with applause

Mr Piet Odendaal, executive director of the Water Research Commission, expressed his delight at this initiative, as the WRC has also contributed to the establishment of CAT through funding for the IWR to develop a model river facility for aquatic toxicity assessment.

"In an integrated approach to water quality management, all activities impacting on environmental water quality should receive attention. This requires reliable quality monitoring. In the wake of sustained industrial development, a stream of new pollutants is entering the water environment. Except for conservative parameters chemical analysis cannot indicate the toxic status of water. This is where aquatic toxicology finds its place, as it directly assesses the effect of toxic substances on living organisms. It not only provides a tool for the regulator, but also enables the industrialists to self-audit the impact of their operations on the environment. For South Africa to capitalise on the full potential of aquatic toxicology, it has to strengthen methodology and build capacity", said Odendaal.

He commended Dr Tally Palmer, director of CAT, for the courage and vision she displayed in setting up and launching the Centre. He said that with her guidance and perseverance the technology had evolved



Present at the CAT launch were Mr Bill Rowston (DWAF), Mr Ross Plumbley (Lever Ponds SA) and Dr Steve Mitchell (Water Research Commission).



Staff members of CAT: Dr Nikite Muller, Dr Patsy Scherman and Ms Lora Pakhomova.

into an effective and practical tool, which was already being used, on a contract basis, in assessing the quality of specific industrial effluent streams.

WATER STEWARDSHIP

According to Mr Ross Plumbly, community development manager of Lever Ponds SA, they are looking forward to the research by CAT, trusting that it will benefit their water stewardship programme.

Speaking at the launch Dr Su Baird from Unilever's Safety and Environmental Assurance Centre (SEAC) said aquatic toxicology forms an essential part of environmental safety assessment. She gave a brief overview of the research activities at SEAC, which is Unilever's specialist laboratory facilities and outdoor model streams in the UK dedicated to the study of the effects of ingredients (of Unilever products) in the aquatic environment. She said that Unilever's concern for clean water stewardship was due to their dependence on water throughout the life cycle of their products.

"We are working to improve our understanding of the many ways we affect

water supplies and quality, and to reduce these impacts through effective management and stewardship." With regard to the establishment of CAT she said that such centres of expertise, with the advantage of local knowledge and social science, was very much in Unilever's interest.

"It provides us with the opportunity to contribute to the development of world class science whilst building Unilever's ecotoxicological expertise in a way we could not achieve on our own. The lessons we hope to learn from our collaborations with CAT will help us understand more fully the impact of our ingredients in developing and emerging markets."

AIMS

Dr Tally Palmer said CAT aimed to contribute to the understanding and sustainable management of water resources in Southern Africa, particularly with regard to water quality management. The specific aims of the Centre are:

- ☐ to undertake research in applied aquatic toxicology
- ☐ to teach aquatic toxicology at all tertiary education levels (training and

capacity building)

- ☐ to provide consulting expertise to industry and water resource managers, and

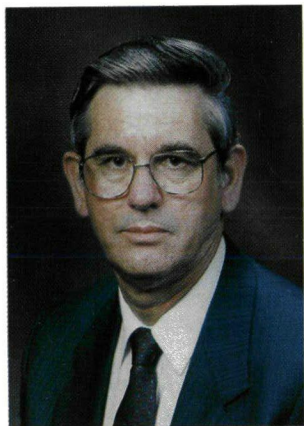
- ☐ to contribute to the implementation of the National Water Act.

POTENTIAL

Mr Mbangi Nepfunbada, director of the Institute of Water Quality Studies, Department of Water Affairs and Forestry (DWAF), said the Centre had the potential to make a key contribution to capacity building in water resource management in South Africa. He pointed out that toxicology is a "very specialised field" and it is important that water resource managers and water users understand that the results of toxicological research can contribute to effective water resource management.

"It is good to see the wide range of partnerships that have already been developed and the training courses that are already tailor-made for industrial participation. I will watch with real interest as these efforts are translated into the business of managing our water resources," Mr Nepfunbada said.

Newly elected chairman



Professor Willie Grabow

Professor Willie Grabow has recently been elected Chairman of the South African National Committee of the International Water Association (IWA).

Prof Grabow says there has been an increasing awareness, globally, that in the face of growing populations, agriculture and industry, it is no longer possible to separate drinking water supply and pollution control. These developments have led to the merging of the International Association of Water Quality (IAWQ) and the International Water Services Association (IWSA) into the new IWA.

He says South Africans have played major roles in the activities of both of the former associations, and they have been among the world leaders in research and progress in both the supply of safe drinking water and control of

pollution of water resources.

Prof Grabow himself is an accomplished researcher and leader in research. He has been awarded with the IAWQ's Samuel H Jenkins Medal for Contributions to Water Pollution Research and Control.

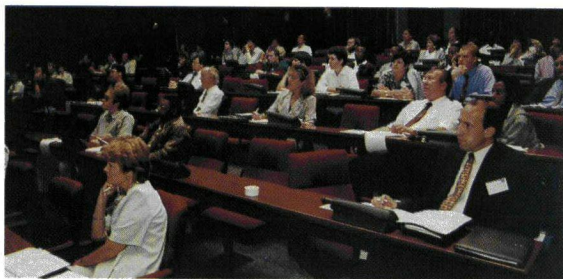
He heads the Department of Medical Virology at the University of Pretoria, and is a member, or chairman, of a large number of national and international committees and task groups related to research, management and collaboration. In 1995 he was invited by the American Society for Microbiology to serve in a task group working on Global Issues in Microbiological Water Quality for the Next Century. An international engineering consortium has invited him to serve as consultant on the health aspects in the design of a water reclamation project in Singapore.

Seminar looks at *Legionella*



Left: The *Legionella* Action Group committee members are (from left): Kelley Reynolds from ESKOM (secretary), Michelle Truscott from the Free State Technikon (treasurer), and Pauline Coubrough from the CSIR (chairperson).

Below: The *Legionella* seminar in progress.



A successful *Legionella* seminar focusing on "Information sharing and a proposed national standard detection method", was held in Pretoria during February 2000. The seminar, organised by the Water Programme of ENVIRONMENTEK, CSIR, in collaboration with the *Legionella* Action Group, was attended by some seventy delegates from various disciplines and industries.

The aim of the seminar and workshop was to provide a forum for the transfer of the newest detection technology and research developments concerning *Legionella* in South Africa, particularly to inform industry. Furthermore, it was to provide an opportunity to investigate the possibility of establishing a national standard detection method for the optimum recovery of *Legionella* from environmental water sources.

Research conducted over the past few years to assess the various methodologies used to ensure *Legionella*-free water sources has generated new ideas. These have resulted in the development of more reliable assessment methods to determine accurate levels of *Legionella* contamination. In the light of these results, it became clear that the currently accepted procedures used for the

detection of *Legionella* should be revisited, said Pauline Coubrough, chairperson of the *Legionella* Action Group.

The following *Legionella* research projects were carried out locally over the past two years:

- A research programme to evaluate international standard detection and enumeration methodologies together with those developed in-house, which was funded by the Water Programme, ENVIRONMENTEK, CSIR. Confirmation procedures and verification tools for the optimum recovery of *Legionella* from environmental water sources were also investigated. The assessment of human health risks, both in the industrial as well as the non-industrial environment, was also included.
- *Legionella* research at the University of Pretoria was funded by the Water Research Commission (WRC). The results have provided additional evidence that the international standard detection techniques which include pre-treatment procedures of water samples (actually) decrease the sensitivity of the recovery procedures. Molecular techniques, the detection of *Legionella* from biofilms and the effect other organisms have on the recovery of *Legionella* were also

investigated in the research carried out. These results were also discussed in the seminar presentations.

- An investigation to determine the impact that *Legionella* concentrations have on recovery rates was funded by the National Foundation for Research (NRF).

TESTING STANDARDS

Presently the various laboratories in South Africa involved in testing for *Legionella*, utilise different detection techniques, without any set testing standard. This invariably leads to a questioning of the credibility of results obtained. The *Legionella* Action Group was founded in 1995 to address this matter. An investigation to evaluate the different detection methodologies being used was set in place with the aim of providing information that would permit laboratories to measure the reliability of the various detection methods.

An inter-laboratory proficiency study, funded by the NRF, indicated that there were differences between the research results amongst service laboratories in South Africa. This highlighted the necessity to discuss the different recovery techniques used by the various laboratories. The development of a standard

technique for *Legionella* detection in South Africa has become a matter that needs the urgent attention of all the role players.

At the seminar the need to link more closely with all the relevant management bodies and policy makers was identified as a priority. This would provide the essential decision support to assist these agencies to review and if necessary amend the current standard methods used for *Legionella* assessment of environmental water sources.

The seminar also included informative presentations on the quality of the cooling water of the power stations in South Africa, as well as investigations of work-

site outbreaks of Legionnaires disease. The later study clearly showed that the disease is endemic in certain population groups, and generally under-reported in South Africa.

NEW ACTION

A new project to develop guidelines and a human health risk assessment for *Legionella* levels in cooling water, funded by the WRC, has been initiated. Researchers Pauline Coubrough and Bettina Genthe of the CSIR are undertaking this research in collaboration with the *Legionella* Action Group. It is anticipated that with this research a set of guidelines will be formulated to address the following:

- ☐ prevention of outbreaks legionellosis in South Africa
- ☐ savings on costs
- ☐ use of the most efficient biocide
- ☐ general maintenance of cooling towers
- ☐ protection of the environment.

The proposed guidelines will be discussed with industry, the Department of Water Affairs and Forestry, and the Department of Health at a workshop planned for 18 November 2000. Should you be interested in attending this workshop, please contact Pauline Coubrough at:
Tel: (012) 841-3952
Fax: (012) 841-2506
E-mail: pcoubrou@csir.co.za

Water Wars in Southern Africa?

A seminar entitled **Hydropolitical Hotspots in Southern Africa: Will there be a Water War?** was held in February at the University of Pretoria. The seminar was organised and hosted by the African Water Issues Research Unit (AWIRU), a unit of the Centre for International Political Studies (CIPS), in association with Green Cross International (GCI), ACCORD and the Pretoria branch of the South African Institute of International Affairs (SAIIA), as the South African precursor to the Second World Water Forum's gathering in The Hague during March 2000.

The aim of the seminar was to discuss the issue of whether the wars in this century would indeed be fought over water. A number of speakers coming from a wide variety of backgrounds, including ecologists, interest group representatives, water utility administrators, and political scientists, presented their

papers on the topic of hydropolitical hotspots in Southern Africa.

The participants sketched the theoretical background to the problem of water wars, and then used practical examples from their own countries to either argue for or against the occurrence of water wars in the Southern African region. Some of the issues that were discussed were: why water conflict is likely, and what needs to be done about it, good governance and conflict resolution - the Lesotho Highlands Water Project experience, as well as the Zambian experience and hydropolitics in the Kunene River. The general consensus that emerged was that water wars were not a likely occurrence, but that conflict over water as a result of its scarcity was inevitable, and that the need for co-operation between Southern African role players, as well as co-ordination of the use of this resource was of paramount importance.

The seminar was well attended by interested parties from various sectors of South African society, including the business, academic and government sectors. The topicality of the issue also attracted interest from the Media, including the BBC Radio, SABC TV News, various South African radio stations, as well as journalists, who interviewed some of the participants.

The positive response which the seminar elicited from both participants and guests indicates a need for further discussion on water-related issues and politics within the Southern African region.

The papers presented at the seminar will be made available in a special edited volume. Should you be interested in acquiring a volume of papers, please contact: Senzo Ngubane at the ACCORD office, tel: (031) 502-3908 or fax: (031) 502-4160.

AWIRU Council appointed

The African Water Issues Research Unit (AWIRU) at Pretoria University has announced the appointment of the AWIRU Council. The Council will advise the Unit Head on the strategic direction and priorities of the

unit. The members of the Council are: Prof. Tony Allan of the SOAS Water Issues Study Group at the University of London; Ms. Barbara Schreiner, chief director of Water Use and Conservation at the Department of Water Affairs and

Forestry; and Mr. Phera Ramoeli, Coordinator of the SADC Water Sector based in Maseru. This Council will bring a wealth of knowledge and insight on global, regional and local water issues together for the benefit of AWIRU.



Some of the delegates to the mine water conference held in Grahamstown in January this year. The international delegates included the following speakers: Prof. P. Younger - Newcastle University, UK; Mr. R. Hewitt Cohen - Colorado School of Mines, USA; Mr. G. Watzlaf - US Department of Energy, USA; Mr. B. Johnson University of Wales, UK; Mr. A. Jarvis, Newcastle University, UK; Ms. M. Kalin, Boojum Technologies, Canada; Mr. C. Buisman, PAQUES Bio Systems, The Netherlands.

Acid mine drainage discussed in Grahamstown

The Water Research Commission (WRC) regards mine-water related problems as so serious that it has recognised mine water as a separate research field. Mr Piet Odendaal, executive director (WRC), said when he opened a mine water conference in Grahamstown earlier this year. The theme of the conference was the

biotechnology of acid mine drainage wastewater treatment and Odendaal said that the Commission had funded much of the South African research into this problem so far.

He said current technology to deal with acid mine drainage, such as the high density sludge system, was expensive.

"We need sustainable, environmentally-friendly solutions, and there are strong indications that biotechnology heralds the answer. Research over the last few years into the application of biotechnology for the treatment of acid mine drainage has made great strides - it has been innovative and exciting, and I do believe we have here a technology

whose time has come."

Odendaal said the conference was aimed at informing representatives from the mining industry of the practical and cost-benefit feasibility of biotechnology in the treatment of acid mine drainage.

"Most of the work has progressed well beyond laboratory-scale and has become or is on the brink to become, mature for full-scale application."

The conference also created an excellent opportunity for researchers in the field to do some networking as there were not so many researchers working in this area and the research was becoming progressively more multi-disciplinary.

"Networking can essentially create synergism and accelerate progress in the development and refinement of technology," Odendaal said.

Odendaal highlighted the nature of the relevant "biotechnological thrusts" which he said "was mainly along the directions of passive and active technology.

"Passive technologies are suited to low-flow situations. They are, however, not able to cope with high-flow scenarios for which active, that is, high-rate technologies must be employed. In addition to the fact that the two approaches do not involve the expensive addition of chemicals, they also have the potential of by-product recovery in the form of metals, sulphur and algae.

PASSIVE TREATMENT SYSTEMS

According to Mr William Pulles of the firm Pulles, Howard & De Lange, passive water treatment technology is considered one of the most promising options for the long-term treatment of effluents discharged from closed mines. Substantial research has been undertaken on this technology by both South African and international researchers.

Results from several years of studying full-scale passive treatment systems in the USA, Canada, UK and RSA were presented at the conference. The various types of passive treatment systems

currently in use for mine water treatment include the following:

- ☐ Aerobic, surface flow wetlands (reed beds)
- ☐ Anaerobic, compost wetlands
- ☐ Mixed compost / limestone systems, with predominantly subsurface flow ("SAPS" units)
- ☐ Subsurface reactive barriers to treat acidic, metalliferous, ground water
- ☐ Anoxic limestone drains (ALD)

Each of these technologies is appropriate for a different kind of mine water or for specific hydraulic circumstances.

Research from Wales University on column reactors containing immobilised biomass was assessed for treating synthetic and actual acid mine drainage (AMD) waters. Results indicated that using such systems, indigenous acidophilic bacteria could be effective at remediating AMD. In recent years, Dutch research also demonstrated that sulphate-reducing bacteria (SRB) can be used beneficially for biological treatment of various industrial process- and waste streams.

Research efforts from the University of Newcastle include the investigation of rapid oxidation and accretion of iron onto high surface area media as a potential passive treatment option for ferruginous, net-alkaline mine waters. Results indicate that this may be a promising alternative passive technology treatment to constructed wetlands at certain sites.

South African research efforts are specifically focussing on a number of essential aspects of the treatment technology. These aspects include hydraulics of packed bed reactors, carbon substrate hydrolysis and sulphide oxidation. Results have demonstrated that passive treatment technology is capable of very efficient and consistent removal of heavy metals. Acidity and sulphate removal rates close to the desired economically sustainable level have also been achieved in field scale pilot units that have been in operation for over three years.

A BIOSURE process, which utilises primary sewage sludge as the carbon and electron donor source for sulphate

reduction was discussed. Accelerated hydrolysis of complex carbon takes place within a reactor providing an easily accessible feed for SRB activity. A site visit to this reactor took place. Further research efforts included the progress towards understanding the enzymatic processes of hydrolysis of accelerated primary sewage sludge in the sulphur-reducing environment.

Assessing the biological sulphate reduction in artificial acid mine drainage using different carbon sources found that the most effective carbon sources tested were Kikuyu grass cuttings, silage and hay.

Results from monitoring passive treatment systems, (including ALD's, aerobic wetlands and reducing and alkalinity producing systems), located in the eastern USA over a period of ten years indicate that the generation of alkalinity displays seasonal variation with significantly more sulphate reductions occurring in the warmer months.

The use of a sulphate reduction based, anaerobic treatment system in the USA was effective for metal laden wastewater with elevated concentrations of arsenic and chromium. The system removed 90 to 99 per cent of the arsenic and between 86 and 94 per cent of the chromium from a waste stream containing 5 mg/l of each.

The development of a model for an anaerobic treatment process for high sulphate, metal-containing wastewater was considered. The actual process of developing a model may be extremely useful for the experimental programme and as an aid to insight into the system of interest.

Particular challenges identified for future research relate to sulphur and carbon cycling in compost-based systems, the dynamics of plant-microbe-solute interactions in aerobic reed-beds, and changes in the permeability and mineralogy of subsurface passive systems. It was concluded that there should be more discussion and collaboration between researchers internationally. This would prevent similar research mistakes being made and duplication of research efforts.

**WRC supports
research to
model Future
Climate Scenarios**

Presently there is a high probability that anthropogenically induced global climate change will impact in a significant manner on society." This is said by researcher BC Hewitson of the Department of Environmental and Geographic Science, at the University of Cape Town, in a report to the Water Research Commission. According to the report the issue of global climate change has become a widely accepted probability, if not already a fact. Such climate change, which is being quantified at a global scale using various general circulation models (GCMs), will also have an impact on South Africa.

South Africa is characterised by a relatively dry climate, a high degree of inter-annual and intra-seasonal variability, and consequently a high degree of vulnerability to changes in the climate system. Any future global climate changes will also have significant impacts on the Southern African regional climate dynamics, causing changes in precipitation and water resources, directly affecting the South African society.

Therefore the Water Research Commission has funded a research project with regard to regional climate change scenarios to assist in giving direction for suitable responses to possible impacts on society.

CLIMATE INFORMATION

Regional climate change poses an important threat, and current scenarios of potential change are severely limited due to problems in obtaining accurate regional climate information from the General Circulation Models (GCMs), especially with regard to precipitation. As GCMs are the only really viable means of generating future climate scenarios there is a critical need to use the capabilities of GCMs to their best advantage in developing viable scenarios in order to plan for the future.

DOWNSCALING

Downscaling, whereby one uses the larger scale circulation dynamics to infer local climate, is one widely recognised methodological approach for dealing with GCM inadequacies in developing regional scale climate change scenarios, and is considered the most viable for the South African context.

Hewitson says that multiple approaches to downscaling are available, but some have significant infrastructural constraints or problematic assumptions which underlie their procedures. However, the methodological option of direct downscaling, in which direct quantitative transfer functions between atmospheric forcing and local climate response are used, currently offers the most viable approach for South Africa.

An evaluation of the initial methodology against three other downscaling approaches, in an earlier Water Research Commission study, showed that the downscaling approach adopted is able to capture important aspects of regional climates not managed by other techniques. Problems were also identified in the former comparative study, and this project sought to address these, and provide a refined, more stable and extensible methodological procedure.

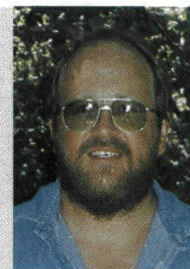
PROJECT AIMS

This project aimed to further develop the scenario-generating methodologies in the following respects:

- ☐ Application of the regional scenario methodologies with other GCM data to determine the degree of consensus between different GCMs.
- ☐ Further analysis of the regional scenario time series in terms of temporal variabilities such as extreme events, persistence, and particularly, seasonal boundaries.
- ☐ Work in conjunction with the University of Natal to transfer the scenario information for use in hydrological applications.
- ☐ Disaggregation of the regional scenarios down to catchment basin and station scales.

The research project has produced a sophisticated downscaling methodology incorporated into a stable software package. The most important features of the methodology are the following:

- ☐ it employs the direct transfer approach,
- ☐ it incorporates three sources of forcing, which are important in determining the manner in which local climates are derived from the general circulation-based climates, and
- ☐ it has been validated against observational data and shown to effectively capture the spatial and seasonal



Bruce Hewitson.

attributes of precipitation over South Africa, from general circulation data.

CIRCULATION MODELS

As previously mentioned the only viable approach to evaluating future climate conditions is through the use of General Circulation Models (GCMs). Therefore GCMs initially formed the basis of information for developing regional scenarios. However, it was quickly recognised that while GCMs are able to simulate the synoptic scale atmospheric dynamics over South Africa quite well they are particularly poor at representing regional climate, and are especially problematic when representing precipitation. In this respect the GCMs are at odds with end-user needs; while the skill of the GCM increases with greater spatial/temporal aggregation, the needs of the impacts researcher are conversely greatest at high spatial and temporal resolutions.

The pragmatic demands on downscaling are more than simply the derivation of sub-grid-scale information from GCMs. Included is the need for a range of climate change scenarios obtained from multiple GCM simulation. This is necessary to be able to:

- ☐ evaluate consensus among GCMs as a means of attaching confidence levels to the scenarios, and
- ☐ span a reasonable range of future climate possibilities.

Therefore, any downscaling methodology should, from the perspective of impacts research, focus on the spatial and temporal needs of the end-user, and present a tractable means for handling multiple scenarios from different GCM sources.

In all cases the basis for downscaling is the implicit assumption that local climates are dominantly a response to larger scale atmospheric forcing - an

assumption that is largely true but has a number of important caveats. Downscaling uses those atmospheric variables indicative of the synoptic scale circulation and dynamics in order to determine the local climate response, and then uses these variables from the GCM to derive the local climate change scenarios. The premise in this case is that GCMs are able to adequately simulate the larger scale dynamics of the climate system, in contrast to the poor "skill level" at the regional scale.

ANNS

The researcher says that of all the empirical downscaling techniques, the direct transfer function approach is arguably the method with the least problematic assumptions, and provides a tractable procedure for developing regional scenarios from long term GCM simulations, and for use with multiple GCM data sets. In this approach the transfer functions are derived using observed atmospheric and local climate data, by means of Artificial Neural Nets (ANNS), a non-linear procedure analogous to multiple regression. After validation, the functions are applied to atmospheric data from GCM simulations of future climates, and used to derive the local climate response, and hence climate change scenarios.

Three sources of forcing on the local climate are incorporated into a downscaling methodology based on ANN empirical transfer functions using observational data. These three primary sources of forcing which are to be accounted for and required in determining the local climate response, are:

- *Atmospheric circulation dynamics.* This determines the transport characteristics of the air mass, and the dynamics determining vertical motion, and hence condensation, cloud formation, and the precipitation processes.
- *Atmospheric water vapour content.* This attribute, neglected by many other studies, is of critical importance in the context of global warming. The water vapour content determines the precipitable water from the atmosphere, and under global warming it is probable that atmospheric water vapour will increase due to increase evapo-transpiration from land and ocean surfaces.

- *Local sources.* These refer to variance from features such as the particular trajectory taken by a precipitating convective cell. This source of variance is important if analysis of future climates is to be done with daily resolution data from the GCM, as opposed to seasonal means. As this source of variance is relatively insensitive to the climate change signal, it can be treated mathematically as a stochastic process.

Deriving Regional Precipitation Scenarios from General Circulation Models

BC Hewitson

Report to the Water Research Commission
by the
Department of Environmental and Geographical Science
University of Cape Town

WRC Report No 751/1/99



Validation of the ANN techniques has shown the procedure to be viable and effective in capturing the primary forcing over a wide range of climate regimes and seasonal variation. Using geopotential height fields representing circulation dynamics, and atmospheric humidity as an indicator of precipitable water, the ANN procedure is able to effectively capture the spatial and seasonal attributes of precipitation over South Africa.

ATMOSPHERIC HUMIDITY

It is in recognizing the important role played by atmospheric humidity that the methodology has been further refined in comparison to work carried out by other research groups. According to the report atmospheric humidity has been shown to be a critical variable in terms of the local climate response to global change. In particular the inclusion or exclusion of specific humidity (a measure of total water vapour content) in the procedure can influence the results to such an

extent that over certain regions the sign of the climate change may alter, let alone the magnitude. Consequently it is argued that downscaling without cognisance of the role of atmospheric humidity leads to scenarios that only represent climate response to circulation dynamics, which, while informative, may be substantially different from actual climate response.

EVALUATION

Similarly, as much of the potential climate impact within different components of the physical system may be sensitive to the daily temporal characteristics of climate, it is important that the downscaled climate reasonably reflects daily variance. Since the downscaling cannot include local forcing factors, and as these are largely insensitive to the global climate change signal, the methodology incorporated this source of variance through stochastic modelling. The role of the local forcing was evaluated by downscaling both with and without the local forcing component included. According to the report the addition of this source of variance substantially improves the daily characteristics of the downscaled climates and allows scenarios to be constructed in terms of the daily behaviour of the downscaled climate.

CONCLUSION

The researcher says that the remaining errors in the downscaled climate (methodology) are manifest primarily as a tendency toward nominally wetter than observed conditions. However, in the context of the GCM skill, and considering the limitations of alternative sources of regional climate change scenarios, the downscaled procedure and subsequent climate projections represent a viable, justifiable, and pragmatic solution for the immediate and near future climate change impact research needs.

Copies of the research report entitled **Deriving Regional Precipitation Scenarios from General Circulation Models** (WRC Report No. 751/1/99) are available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. (E-mail: library@wrc.org.za) Foreign orders: US \$15 per copy, via surface mail).

Corrosion of pipe coatings evaluated

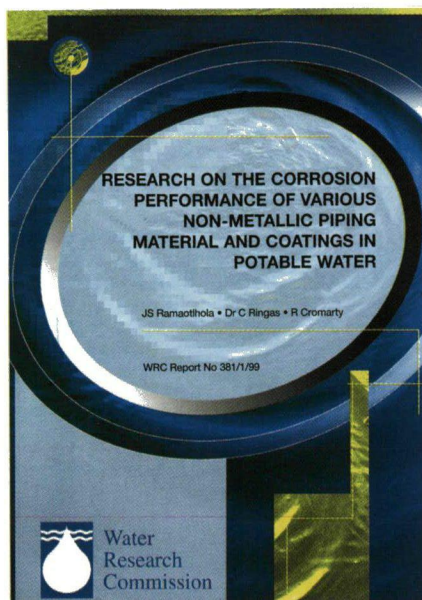
The results are available of a Water Research Commission (WRC) study which was designed to:

- Critically evaluate the effect of mineralisation on the service performance of various non-metallic pipe materials and linings in the PWV/Klerksdorp areas;
- Determine which water parameters are important when selecting coatings and non-metallic piping materials for conveying potable water; and
- Recommend candidate coatings and non-metallic piping materials such that internal corrosion of pipes can be reduced.

The investigation was carried out by JS Ramothola, C Ringas and R Cromarty, from the Division of Materials Science and Technology at the CSIR.

The researchers say in their final report to the WRC that "since there are many types of coatings available for use as linings on carbon steel piping, it was necessary to evaluate the performance of generic coating systems in a systematic, scientific manner. These results will allow authorities to decide on what type of coating systems to use in their piping systems in a cost-effective manner so that costly failures are avoided."

Non-metallic coatings, metallic coatings, non-metallic piping materials, cement



mortar-lined and carbon steel pipe samples were exposed to potable water in a flow loop system. These samples were examined and evaluated every year for their corrosion performance and rated accordingly. The quality of the water was also monitored with a data acquisition system and was related to the corrosion rates of carbon steel pipe samples.

RESULTS

The results show that organic coatings

varied in their performance and that the quality of coatings is dependent on a number of factors such as adhesion, composition and water quality. The two polyamide cured epoxy linings and the solvent-free aliphatic amine-cured epoxy (hot applied) and the elastoplastic polyurethane performed well.

The results also reinforce the fact that unprotected carbon steel pipes conveying potable water are prone to internal corrosion which is often due to microbial corrosion. An effective way to reduce the impact of this corrosion is internal lining. The performance of metallic coatings (zinc) on carbon steel pipes was found to be good as was evident by the formation of hard uniform scaling on the internal surface of the water pipe samples.

The performance of non-metallic piping materials was good and they may be considered in future as a satisfactory method of corrosion protection in potable water.

Copies of the report entitled **Research on the corrosion performance of various non-metallic piping materials and coatings in potable water** (WRC report 381/1/99) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 30, via surface mail).



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In the spotlight...

Interest groups as a role player in large water projects



Richard Meissner, research associate at the African Water Issues Research Unit (AWIRU), University of Pretoria, presents a picture of interest group involvement in large water projects, such as the Lesotho Highland Water Project (LHWP).

This article aims to:

- ☐ explore the involvement of interest groups in the LHWP, and
- ☐ improve our understanding of interest groups' role in the national and international water sector, in order that project managers can reduce the conflict potential inherent in such projects.

Since the previous century numerous countries have been implementing large dam projects to augment the water supply to their urban, agriculture and industrial sectors. These projects can sometimes be the source of discord between countries sharing an international river in which these schemes are constructed. For example the Greater Anatolia Project (GAP) being built in the headwaters of the Euphrates River in Turkey has created much tension between Turkey and its downstream neighbours Syria and Iraq.

However, another actor which can have a decided impact on large scale water projects, has appeared in water politics in the last part of the twentieth century: the interest group. These non-state entities have the ability to project their influence onto a large dam project in such a way that it can become very difficult for governments and water resource planners to implement these projects, or to go ahead with projects that are currently underway. The Lesotho Highlands Water Project (LHWP) in Southern Africa is an example of such a project in which both local and international interest groups, or non-government organisations (NGO's), have involved themselves. The interest groups became involved in view of the perceived impacts that this engineering project would have on the environment as well as the people living in and around the project area.

DEFINITION

Who or what is an interest group? An interest group can be defined as a non-profit, service oriented organisation which constitute the major link between the government and citizens in modern societies, aiming through its activities to influence government's policies. Some interest groups operate over national boundaries and can mobilise support in a number of countries. At the same time they raise awareness of an issue at the global level. Interest groups are some of the major actors to place water issues, such as large dams, on the international agenda. This in turn makes interest groups one of the most important role-players in the process of globalisation. Interest groups who involved themselves with the LHWP raised certain issues regarding their perception of the project to an international level, thereby creating a higher profile and awareness level with regard to the LHWP.

LHWP BACKGROUND

The concept of water transfer from Lesotho to South Africa was first mentioned in the late 1950's when it was envisaged as a plan to supply water, from the head waters of the Orange River in Lesotho, to the Orange Free State goldfields near Welkom in South Africa. As South Africa's need for water started to increase, it was realised that South Africa's economic heartland, concentrated in the Witwatersrand (Gauteng area), would be in dire need of water in the 1990's and the early part of the twenty-first century. The focus shifted to augmenting the water supply to the Gauteng area. Many alternatives were considered before deciding on the current LHWP. The project commenced in 1986 after much diplomatic fervour and the resolution of political tension, arising from Lesotho and South Africa's differing ideological outlooks at that time.

In the mid-1990's, after the LHWP was well on track, interest groups in South Africa, Lesotho and abroad started to voice their objections. These interest groups came from a wide variety of backgrounds, such as the environmental movement, human rights, anthropological and church groupings.

LOBBYING

Interest groups use an assortment of strategies and tactics in their lobby against a project of this nature. These strategies and tactics vary from direct personal communication to indirect contact, via the media and public opinion, between interest groups and role-players in the national and international dam construction industry. Direct personal interaction includes meetings with decisionmakers and personal presentation of research results and testimonies at hearings. Litigation also falls under direct contact and can be quite effective as a lobbying tool. Most of these strategies and tactics were used by the interest groups in voicing their issues with the LHWP.

INTERNATIONAL GROUPS

It seems that international interest groups are still the most prominent in campaigns against the LHWP. The three groups of importance are: the International Rivers Network (IRN), the Environmental Defence (ED), formerly known as the Environmental Defence

Fund (EDF) and Earthlife Africa (ELA), a South African interest group with offices in both South Africa and Namibia. These international groups have formed loose coalitions with local interest groups in Lesotho and South Africa; particularly the Highlands Church and Solidarity Action Group (HCSAG), the Alexandra Civics Organisation (ACO), the Group for Environmental Monitoring (GEM), the Environmental Monitoring Group (EMG) and other international groupings such as the Berne Declaration and Reform the World Bank Campaign. However, some of these local interest groups have had their own independent campaigns against the LHWP. The involvement of interest groups in the LHWP should be understood under the banner of perceptions. Because perceptions differ, the emotive energy can be quite high.

Interest groups, or NGO's, focus on what they perceive to be inefficiencies in the planning or implementation of a project. Project authorities have found it very difficult to change preconceived ideas and perceptions by means of rational arguments and facts.

In the case of the LHWP the governments of Lesotho and South Africa, as well as the utilities the Lesotho Highlands Development Authority (LHDA) and the Trans-Caledon Tunnel Authority (TCTA) implementing the scheme, were lobbied by both international and national interest groups to implement alternatives for Phase 1B of the project. These alternatives were mostly in the form of water demand management projects in order to delay the construction of further dams in Lesotho. The abovementioned organisations were not the only target of the interest groups' lobbying. The World Bank, that finances about four per cent of the LHWP, was also approached by interest groups with the request to look into negative effects, not only regarding environmental impacts but also with regard to issues of the alleged violation of human rights.

On the issue of human rights interest groups keep a close watch on a project like the LHWP and every incident is used in their campaigning against such a project. This can be illustrated by the following example: In September 1996 at Butha Buthe an episode of labour unrest gave rise to an incident ultimately causing the death of six people. A coalition of international and local inter-

est groups called on the World Bank to use its good offices to press the Lesotho government and the LHDA to take proper measures with regard to the incident. The World Bank visited Lesotho in October 1996 to find out for themselves what had happened at Butha Buthe. The interest groups had asked for an international commission of inquiry to be launched but the Lesotho government refused. The Lesotho government did launch an internal inquiry into the incident following pressure from the World Bank however.

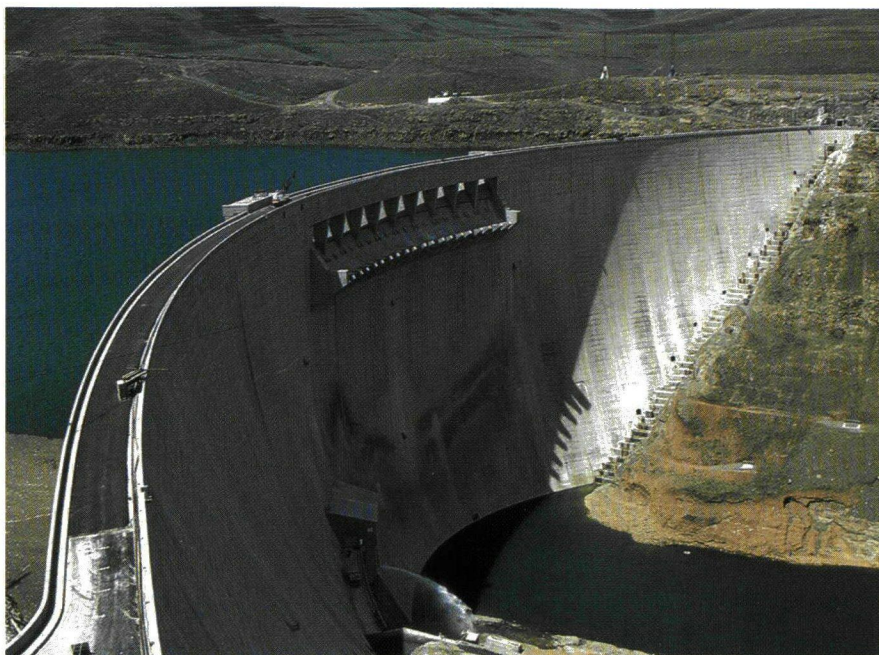
MEMORANDUM

A Memorandum of Understanding (MOU) was signed between the LHDA and the interest groups in Lesotho in May 1998. This memorandum addresses, inter alia, the responsibilities of the interest groups involved in the LHWP. In 1994 the LHDA had initiated regular monthly meetings with the Lesotho-based NGO's at which issues of concern were tabled and discussed, with ensuing action plans developed and implemented. This positive approach eventually led to the signing of the Memorandum, which was hailed by both the World Bank and the United Nations Development Programme (UNDP) as "unique".

Foreign interest groups refused to be included and attempted to derail the signing of the Memorandum by Lesotho-based NGO's under the pretext that it would cause a rift between them and their Lesotho-based counterparts. Despite this pressure the Lesotho interest groups went ahead and signed the Memorandum.

CONTENTS

The Memorandum defines the "rules of the game" with respect to co-operation between the local interest groups in Lesotho and the LHDA, which in terms of the LHWP Treaty of 1986 imposed legal obligations on the concerned state parties to safeguard the welfare of affected persons and communities. The Memorandum further outlines the scope of activities as set out in the parameters of the Environmental Action Plans (EAPs) for Phase 1A and 1B and all other phases to be implemented by South Africa and Lesotho according to the LHWP Treaty. The EAPs provide the main framework for the development of mitigation, compensation, resettlement



The Katse Dam is part of the Lesotho Highlands water scheme to augment the water supply in Gauteng province in South Africa.

and development measures in the short, medium and long term lifespan of the LHWP. Provision is made for other areas of concern that the parties may identify and consider to be in the range of the Memorandum, such as employment conditions and labour relations in the construction, operation and maintenance phases of the LHWP, within the framework set by the Laws of Lesotho. The following areas of co-operation between the LHDA and interest groups have been identified in the Memorandum: monitoring and evaluation activities, advocacy activities, community empowerment activities and service provision and delivery activities.

CO-OPERATION PRINCIPLES

The most important section in the Memorandum concerns the principles of co-operation. These include the commitment of the parties to the Memorandum to work in such a way that integrity, mutual respect, transparency, accountability, efficiency, full disclosure and access to information in their interaction with each other and the affected communities are ensured. The parties are also bound by these principles to commit themselves to a consultative and participatory process in pursuing the objectives of the Memorandum, and to respect each other's autonomy and special attributes, which forms the basis of the co-operation between the role-players. A code of conduct will also be set

up, as outlined in these principles, to govern the co-operative relationship. One of the most important clauses of the Memorandum is the provision of arbitration in the event of a dispute arising out of the agreement.

FUTURE STANDARD

A standard has been set with the Memorandum for the interactive relationship between interest groups, and project authorities (as well as governments) in future, not only in Southern Africa but the world over. Such agreements can also go a long way to mitigate the strenuous relationship between state and non-state entities regarding the reconciliation of their differing resource use perceptions. The Memorandum spells out the role to be played by NGO's in these projects, and as such indicates the role and purpose of interest groups in the international large dam debate.

As water scarcity increases, more role players will become involved, increasing the level of complexity of the situation. We therefore need to develop an understanding of this problem, in order that water resource managers can do their job effectively. A multidisciplinary approach have become imperative. How we rise to this challenge will determine to what extent we will have a relatively conflict free management environment in future.

Strategic master plans available on Web

<http://www.wrc.org.za>

Strategic master plans, focussing on current, high priority research requirements in a number of water-related fields in South Africa, are now available for consultation on the Water Research Commission's web site.

These plans are dynamic in nature and are regularly revised in accordance with the changing needs of society. Dedicated Coordinating Committees are responsible for compiling the plans and for itemising the major goals, objectives and research requirements. All the plans

listed on the web can be downloaded as CorelWord Perfect 7 or MS Word 6 documents.

The main aim of the Water Research Commission (WRC) in making these strategic plans available to the research community is to provide guidelines and motivation for research activities in South Africa in the water-related fields most deserving of attention and commitment. These plans play a vital role in the overall mission of the WRC by providing a coordinated framework for water

research in the country.

Recent updates

Special attention is drawn to two recently revised strategic master plans that are now available on the website:

- ☐ The Strategic Plan for Hydroclimatology,
- ☐ The Co-ordinating Committee for Mining Related Water Research (CCMRWR) has published an update of their Prioritised List of Mining Related Research and Technology Transfer Needs.

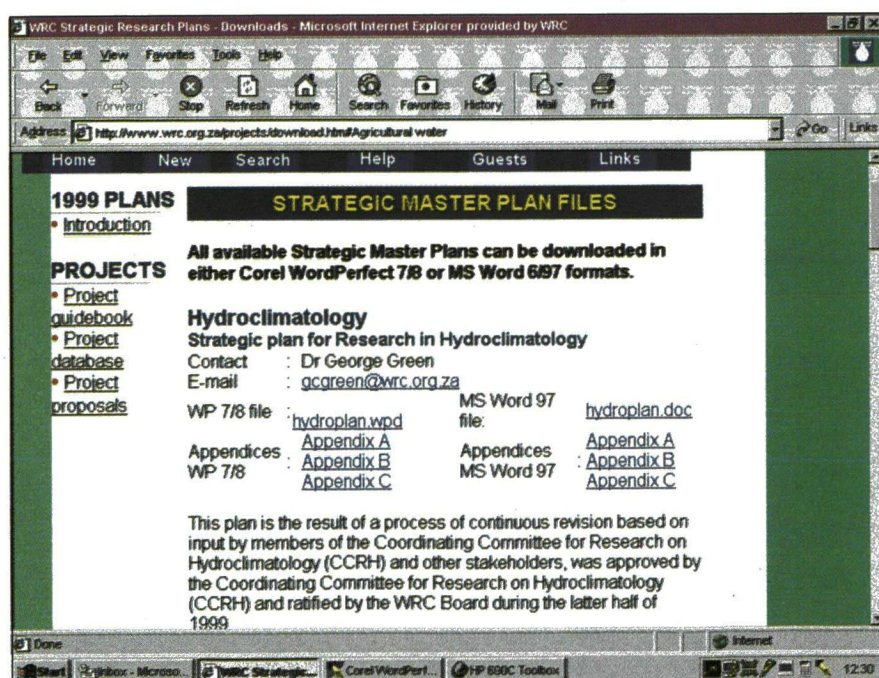
Other research areas

Considering the dynamic nature of these plans, the WRC wants to encourage research or user organisations and individuals to propose additional or alternative areas or topics which they perceive as being in urgent need of research activity. Such proposals should initially be brought to the attention of the WRC, for subsequent evaluation by the appropriate Coordinating Committees.

Contributions invited

Several of the existing strategic plans are presently in the form of a draft or discussion document. Comments from interested researchers which will contribute towards the finalisation of dynamic, goal-orientated strategic plans will be most welcome.

Please send all comments on existing master plans, or proposals for other research areas, to the contact persons listed on the WRC's web site.



Computer screen image.

Estimating evaporation losses from South African rivers - *Phase 2*

Guidelines set out in a report published by the Water Research Commission (WRC) should be used to estimate evaporation losses in future water resource studies on South African rivers say two researchers from the firm BKS Inc (Pty) Ltd, RS McKenzie and AR Craig, who were commissioned by the WRC to carry out an investigation into the water resources of the Orange River system as well as evaporation losses from the river.

The first phase of the research took

place in 1993, followed by a second phase from 1994 to 1997. The purpose of Phase 2 of the River Losses Study was to refine estimates of evaporation losses from the Orange River between Vanderkloof Dam and the river mouth, and to derive a general methodology for calculating losses from other rivers in South Africa.

The researchers say until recently, the water resources of the Orange River were well in excess of the various existing water requirements. As a result, re-

leases could be made in excess of downstream requirements for generating hydroelectric power, and the flows reaching the river mouth were often well in excess of the estuary requirements. In recent years, however, due to increased water requirements and erratic rainfall, water shortages in the Orange River system have occurred for the first time since the construction of Gariep and Vanderkloof Dams. In times of water shortages, the operation of Vanderkloof Dam is particularly difficult, since the dam is located almost 1 400 km from the river mouth. Releases therefore have to be made accurately to satisfy downstream water requirements without shortfalls or excess spillage at the river mouth. Thus it is becoming increasingly important to accurately quantify the evaporation losses from the Orange River between Vanderkloof Dam and the river mouth.

PHASE 1

During the execution of the Orange River system analysis which BKS Inc undertook for the Department of Water Affairs and Forestry the losses downstream of the Vanderkloof Dam were evaluated. The first estimate indicated that losses could be as high as 800 million m³/a which can be compared to the current mean annual runoff at Vanderkloof Dam of approximately 5 000 million m³/a. Because the surplus water resources of the Orange River are becoming limited, the uncertainty in this estimate has the effect that the available yield from Vanderkloof Dam becomes highly speculative and has an impact on the entire phased planning of the Lesotho Highland Water project.

The Department, as a result of these findings, supported a more detailed investigation into the losses of the Orange River. Joint participation by the Department, BKS Inc and the Water Research



The lower Orange River passes through arid, semi-desert regions with very low rainfall and very high evaporation rates.

Commission in undertaking the research associated with the Phase 1 River Losses Study was thus the obvious option. The objective was to obtain more information regarding losses needed for an in depth assessment of water requirements. Phase 1 was completed in 1994 and the results summarised in WRC Report 510/1/94.

In the early stages of Phase 1, further contributing factors (for example air temperature and the temperature profile of the water, bed and bank losses, effect of humidity and windspeed, etc.) were identified for more detailed investigation in order to improve the general understanding of the losses in rivers and to allow formulation of a procedure to determine these losses. This need was emphasized at a workshop on Low Flow Hydrology, organised by the Water Research Commission in 1993.

RESULTS

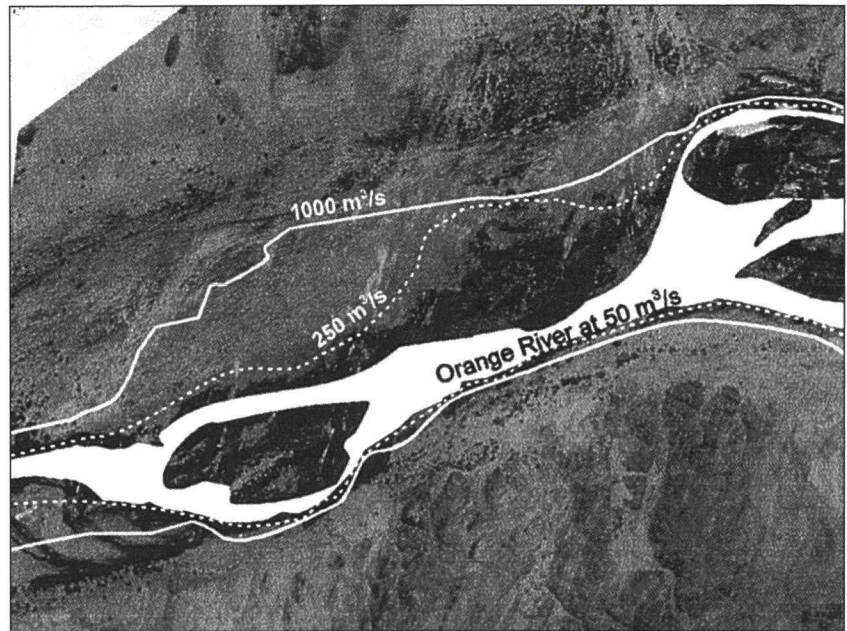
Based on the results presented in the report, the researchers concluded that their study has been successful in improving estimates of river losses downstream of Vanderkloof Dam and in developing a methodology for calculating evaporation losses from South African rivers.

The main new insight that has now been accepted is that the actual evaporation losses can be manipulated to some degree by the way water releases from Vanderkloof Dam are executed in order to control the surface area. The simultaneous linkage to the hydraulic models provides the operators with a tool to fine-tune water releases.

Specific results obtained during the course of the study, with relevant conclusions, are the following:

□ Surface areas of water and riparian vegetation

The areas of water surface and riparian vegetation were determined for the Orange River at different flows for each reach of the river using aerial photographs. Very few aerial photographs exist of the Orange River at low flows, and an extrapolation technique was therefore applied to estimate the water surface areas at low flows. Satellite images and hydraulic modelling were also used to help establish realistic estimates of the water surface areas and areas of riparian vegetation. Approval to fund the collection and processing of



Change of surface area with flow.

aerial photographs of the Orange River at low flows was granted by DWAF in 1996, however, due to higher than normal river flows during the winter months of 1996, 1997 and 1998 it was not possible to carry out low flow aerial photography.

□ Evaporation rates applicable to moving water surfaces and riparian vegetation

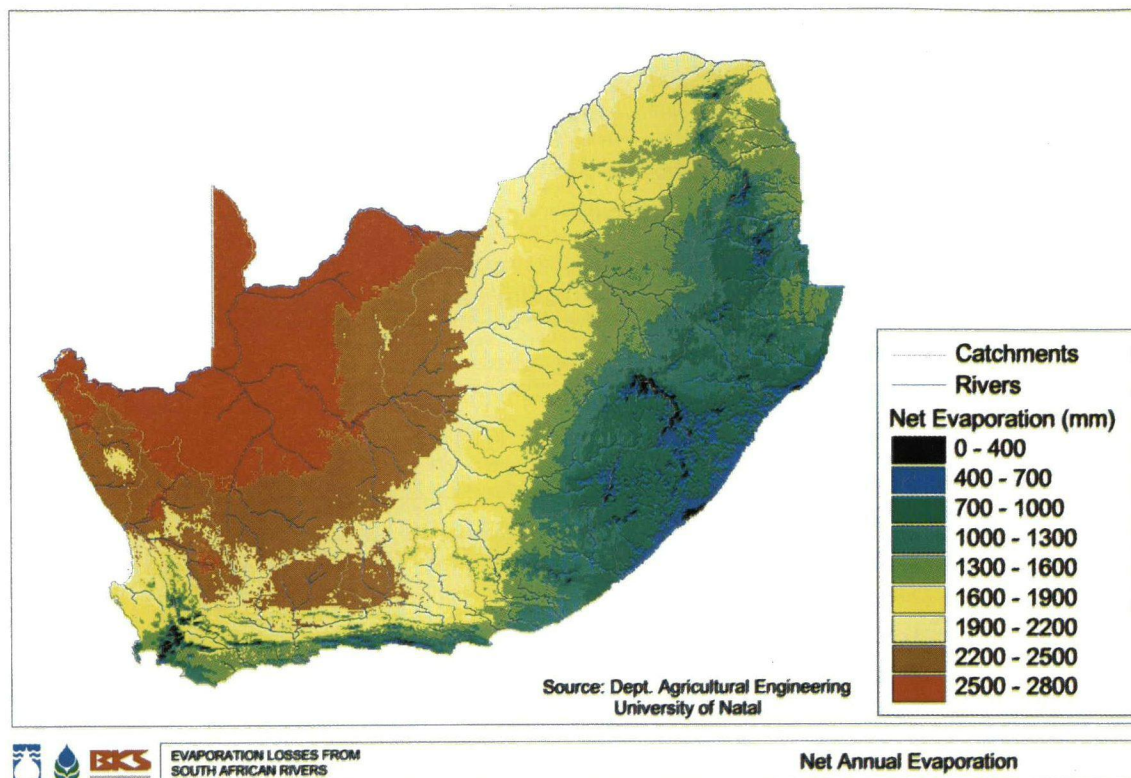
Information on evaporation rates from flowing water was derived from a Bowen Ratio energy balance study carried out by Environmentek on the Orange River near Upington. Further evaluation of the results indicated that the best estimate of river evaporation is given by the A-pan equivalent evaporation prepared by researchers from the University of Natal which varies from 2 500 mm/a to almost 3 000 mm/a on the Orange River. A-pan evaporation data is therefore recommended for use in calculating river losses from South African rivers. The evapotranspiration rates for reeds and trees used in the study were based on research into riparian water consumption in the Kruger National Park (WRC Report 471/1/97), where high gross evaporation of approximately 2 000 mm/a is also experienced.

□ Validation of results using hydraulic model

Three sets of manual flow gaugings were carried out on the Orange River, in July 1993, November 1994 and November 1995, to assist in the verification of the

river loss methodology. The flow gaugings were processed using a sophisticated hydraulic model which indicated that the actual river losses were approximately 14 per cent lower than the theoretical estimate based on the surface areas and evaporation rates discussed previously. Flow gauging in October 1996 on the Vaal river also produced similar results. The discrepancy is most likely due to overestimation of the surface areas at low flows, since aerial photographs of the Orange River at low flows could not be obtained. It is possible that other researchers' (A-pan) equivalent evaporation figures also overestimate river evaporation, however, the proposed methodology was not adjusted, to avoid overestimating the available water resources of the Orange River.

The calculated evaporation losses from the Orange River derived from this research range from 575 million m³/a to 989 million m³/a at an annual release of 400 m³/s. The variation in evaporation losses is due to the change in surface area with flow. In the first phase of the River Losses Study, the losses were estimated to be 960 million m³/a based on surface areas for flows between 400 m³/s and 1 000 m³/s, together with S-pan evaporation values (without pan-to-lake factors). Although the river evaporation has now been estimated to be higher than the S-pan values, the reduction in surface area produces a net reduction in the total estimate of approximately 380 million m³/a. This is a signif-



Evaporation losses from South African Rivers.

icant quantity of water in terms of the available water resources of the Orange River.

☐ Guidelines for estimating evaporation losses from South African rivers

A set of guidelines for estimating evaporation losses from South African rivers has been prepared, based on the research carried out on the Orange River.

The researchers recommend that surface areas be measured from aerial photography, although checks for scale anomalies should also be carried out. Satellite imagery can be used, but extensive visual verification should be undertaken to validate the digital classification. River evaporation should be determined from map overlays or digital 1'x1' grid information obtainable from the Department of Agricultural Engineering at the University of Natal. Rainfall estimates needed to estimate the net evaporation can be obtained in the same format as the evaporation data from the Computing Centre for Water Research in Pietermaritzburg. The rainfall information from Surface Water Resources of South Africa, produced by Midgley, et al, in 1994, may also be used.

Evaporation Losses from South African Rivers

RS McKenzie • AR Craig

Report to the Water Research Commission
by
BKS Inc (Pty) Ltd

WRC Report No 638/1/99



Net evaporation losses can then be estimated from the surface area of water and riparian vegetation (with factors applied) multiplied by the net evaporation rate described in the report. A map of net annual evaporation is also presented in the report to highlight areas where river losses are likely to be most significant.

The researchers say the theoretical estimate of river losses derived from this methodology can also be compared to a water balance of the river if suitable data are available. This will improve the confidence in the results and will help to highlight additional problem areas such as losses to groundwater, or data errors in abstraction information. This method relies heavily on accurate flow measurements, which can often be improved by manual flow gaugings, as well as accurate abstraction information. Depending on the specific nature of the river and the scope of the study, varying levels of detail can be applied in performing the water balance. If a hydraulic model is not used, then it is important that the volumes of water entering and leaving the reach should be integrated over a sufficiently long period to minimise the effects of hydraulic attenuation. It is also important to examine flow data carefully to ensure that travel times can be taken into account.

Copies of the report entitled **Evaporation Losses from South African Rivers** (WRC Report 638/1/99) are available free of charge in South Africa from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 25,00 - via surface mail).

Researchers look at water pipe leaks in the Johannesburg area

Significant water losses due to leaks and other causes are experienced by Johannesburg City Council. In fact, the unaccounted-for water (UAW) losses for 1991 amounted to 23 per cent of the bulk water purchased. Clearly, this waste of water is unacceptable under the current pressures on South Africa's water resources.

The Water Research Commission (WRC) therefore contracted researchers from the CSIR's Division of Materials and Science Technology to critically examine the reasons for leaks from metallic water pipes in Johannesburg; classify the causes of these leaks and then recommend remedial strategies to minimise water losses.

The researchers, JS Ramotlhola and C Ringas, say in their final report to the WRC that "although corrosion is accepted as being responsible for the bulk of the leaks occurring in water pipes, no detailed systematic evaluation has been undertaken to classify the corrosion mechanisms responsible for failure." This aspect is considered to be critically important if correct remedial measures are to be implemented.

"A better understanding of the failure mechanisms of potable water metallic pipes in this area would be of benefit to all local authorities and hopefully contribute to a reduction in water losses."

RESULTS

- Unprotected mild steel pipelines in potable waters are susceptible to microbially induced corrosion (MIC), both internally and externally.

Evaluation of Metal Water Pipe Leaks in the Johannesburg Municipal Area

JS Ramotlhola • C Ringas

Report to the Water Research Commission
by the
Division of Materials Science and Technology
CSIR

WRC Report No 587/1/99



- Sulphate reducing bacteria (SRB) play a major role in the corrosion process.
- The majority of corrosion failures of the potable water pipelines sections studied were external.
- Preferential weld corrosion was prevalent.
- Stray currents are active and contributed to seven per cent of the total failures.
- The level of cathodic protection in Johannesburg municipal area was generally ineffective or non-existent which indicates that active corrosion of metallic pipelines is occurring.

- The findings of a total of 126 pipe samples tested in the Johannesburg area indicated:

- 41 per cent failed due to external corrosion damage
- 25 per cent failed due to internal corrosion damage
- 32 per cent failed due to both external and internal corrosion damage
- Bulk water supply reticulation corrosion failures were due to external corrosion (57 per cent)
- The presence of electric railways, direct current generators and electric cables are common features of a highly developed city like Johannesburg, contributing to seven per cent of all failures due to stray currents. This illustrates the importance of cathodic protection to minimise the problem.
- The effects of galvanic corrosion were noted on some pipelines where two dissimilar metals were joined together either by ignorance or irresponsibility.

Copies of the final report entitled **Evaluation of Metal Pipe Leaks in the Johannesburg Municipal Area** (WRC Report 587/1/99) are available free of charge (in South Africa) from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20,00 - via surface mail).

SA WATERKALENDER

The Water Research Commission is placing this calendar in order to assist with the co-ordinating of water events in South Africa.

You are invited to send information about conferences, symposia or workshops to the SA Waterbulletin.

Address:
The Editor,
SA Waterbulletin,
P.O. Box 824,
0001 Pretoria
Tel (012) 330-0340
Fax (012) 331-2565

Legend:

- An SA Water Event arranged for these dates.
- 2nd SA Water Event scheduled for these dates.
- × 3rd SA Water Event scheduled for these dates.

See conferences and symposia pages for events.

2000

JANUARY	FEBRUARY	MARCH	APRIL
S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
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Die Waternavorsingskommissie plaas hierdie kalender om te help met die koördinering van watergebeurtenisse in Suid-Afrika.

Alle belanghebbendes word uitgenooi om inligting aan SA Waterbulletin te stuur.

Adres:
Die Redakteur
Posbus 824
0001 Pretoria
Tel: (012) 330-0340
Fax: (012) 331-2565

Gids:

- Een SA Watergeleentheid vir hierdie dae.
- 'n Tweede SA Watergeleentheid vir dié datums.
- × 'n Derde SA Watergeleentheid vir dié datums.

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

2001

JANUARY	FEBRUARY	MARCH	APRIL
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SOUTHERN
AFRICA

2000

WATER RESOURCES

JUNE 7 - 9

The 4th biennial congress of the African division of the International Association of Hydraulic Research (IAHR) on conserving and sharing water resources in a water scarce environment will be held in Windhoek, Namibia.

Enquiries: Congress Secretariat, Ms Marelise Serfontein, PO Box 9870, Windhoek, Namibia. Tel: +264-61-251014/272031/254281. Fax: +264-61-272032/251014. E-mail: namlink@iwwn.com.na

GROUND WATER

JUNE 8 - 9

A course on ground water and the national water and water services acts will be held at the University of Pretoria.

Enquiries: The Secretary, Ground Water Division, GSSA. Tel: (012) 803-1545. E-mail address: gwd@icon.co.za. An enrolment form is available in this Bulletin.

WATER SYSTEMS

JUNE 22 - 23

A one and a half day symposium with the theme "Defining, optimising and managing integrated water systems" will be held in Cape Town.

Enquiries: Ms Ilze Potgieter, tel (017) 634-7458. Fax: (017) 631-1442. E-mail: i-w-s@mweb.co.za

GROUND WATER

JUNE 28 - 30

The Geological Society of Southern Africa will present a course - an introduction to ground water - at the University of the Witwatersrand in Johannesburg.

Enquiries: The Secretary, Ground Water Division, GSSA. Tel: (012) 803-1545. E-mail: gwd@icon.co.za. An enrolment form is available in this Bulletin.

WATER AFRICA

AUGUST 22 - 24

The Water Africa 2000 conference will be held at Crown Plaza, Sandton. Theme - Building global strategies for water development and investment.

Enquiries: Zinhle Mpungose - tel

(011) 463 2802. Fax (011) 463 - 6000. E-mail address: zinhlem@aic-africa.com

WASTECON

SEPTEMBER 5 - 7

The Institute of Waste Management will hold its biennial conference and exhibition with the theme "Integrated waste management in the new millennium" at Somerset West, near Cape Town.

Enquiries: Conference Secretariat, PO Box 3483, Tygervalley 7536. Tel: (021) 99 3172. Fax: (021) 99 4707. E-mail address: wastecon2000@mweb.co.za Website: www.weirenvig.co.za/wastecon2000

IRRIGATION

OCTOBER 22 - 27

The 6th international micro-irrigation congress together with the 51st IEC meeting of the International Commission on Irrigation and Drainage (ICID) will be held in Cape Town.

Enquiries: The Congress Secretariat, PO Box 36815, Menlo Park 0102. Tel: (012) 344 0390. Fax: (012) 344 5643. E-mail address: reservations@parkgables.co.za

AGROCHEMICALS

OCTOBER 25 - 26

A workshop on the control of adverse impacts of fertilizers and agrochemicals will take place in Cape Town, South Africa.

Enquiries: Prof A Mermoud, Institute of Soil and Water Management (IATE), Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland. Tel: +41-21-693-3726. Fax: +41-21-693-3739. E-mail: andre.mermoud@epfl.ch

GROUND WATER

NOVEMBER 1 - 3

A course - an introduction to ground water - will be presented at the University of the Witwatersrand in Johannesburg.

Enquiries: The Secretary, Ground Water Division, GSSA. Tel: (012) 803-1545. E-mail: gwd@icon.co.za. An enrolment form is available in this Bulletin.

VAAL RIVER

NOVEMBER 7 - 8

The Vaal River Conference 2000 will be held at the Vaal Riviera Resort near Vanderbijlpark.

Enquiries: Lesley Stephenson, Division of Continuing Engineering Education, University of the Witwatersrand, PO Box 327,

WITS 2050. Tel: (011) 716-5091. Fax: (011) 339-7835. E-mail: stephenson@egoli.min.wits.ac.za Website: www.cee.co.za

HYDROGEOLOGY

NOVEMBER 26 - DECEMBER 1

The International Association of Hydrogeologists' (IAH) XXX Congress 2000 with the theme Groundwater: Past achievements and Future challenges will be held at the University of Cape Town.

Enquiries: Conference Secretariat, IAH 2000, Conferences et al, PO Box 452, Stellenbosch 7599. Tel: (021) 886-4496. Fax: (021) 883-8177. E-mail address: deidre@iafrica.com. Web: http://fred.csir.co.za/conferences/iah/

2001

SASAQS 2001

JULY 1 - 6

The 36th conference of the Southern African Society of Aquatic Scientists will be held at Aventura Eco Eiland in the Northern Province. The theme will be "Aquatic ecology and resource management in Southern Africa".

Enquiries: Mr P Fouche. Tel: (01596) 28383. E-mail address: pso@caddy.univen.ac.za

AFRIWATER EXHIBITION

AUGUST 15 - 17 2001

The international African water, waste & environmental exhibition will be held at Gallagher Estate, Midrand.

Enquiries: Craig Newman, TML Reed Exhibitions. Tel: (011) 886-3734. Fax: (011) 789-6497. E-mail: craign@tmlreed.co.za

AFRIWATER SEMINARS

AUGUST 15 - 17 2001

The Water Institute of Southern Africa will organise a series of half-day seminars on pertinent topics at the Gallagher Estate in Midrand.

Enquiries: Roelien Bakker, WISA. Tel: (011) 805 6368. Fax: (011) 315 1258. E-mail address: conference@wisa.co.za

OVERSEAS

2000

WATER SURFACES

JUNE 5 - 8

The 4th international symposium on gas transfer at water surfaces

will be held in Miami Beach, Florida, USA.

Enquiries: Gayl van de Bogart, University of Miami, 4600 Rickenbacker Causeway, Miami FL 33149, USA. Web address: http://cheyenne.rsmas.miami.edu/gas2000.html/

GROUNDWATER 2000

JUNE 6 - 8

A conference with the theme Groundwater 2000 will be held in Copenhagen, Denmark.

Enquiries: MiaCon Meeting and Conference Services, Helsingvej 23, DK-2830 Virum, Denmark. E-mail: gw2000@isva.dtu.dk Tel: +45 45 859727. Fax: +45 45 839727. Web: http://www.isva.dtu.dk/grc/gw2000/

AWWA

JUNE 11 - 15

The AWWA 2000 annual conference and exhibition will be held in Denver, Colorado, USA.

Enquiries: David Rossiter, AWWA, USA. E-mail: rossiter@awwa.org Tel: +303 3476209. Web: http://www.awwa.org/tande/awwaconf.html

GIS

JUNE 14 - 16

The 2nd international conference on GIS (Geographic Information Systems) for the 21st century will be held in Lisbon, Portugal.

Enquiries: Gabriella Cossutta, Ashurst Lodge, Ashurst, Southampton SO40 7AA, United Kingdom. E-mail: gcossutta@wessex.ac.uk Tel: +44 2380 293 223. Fax: +44 2380 292 853. Web: http://www.wessex.ac.uk

IRRIGATION

JUNE 20 - 24

An international conference on the challenges facing irrigation and drainage in the new millennium - meeting human and environmental needs through sustainability, rehabilitation and modernisation will be held in Fort Collins, CO, USA.

Enquiries: US Committee on Irrigation and Drainage, 1616 17th Street, 483 Denver, CO 80202, USA. E-mail: stephens@uscid.org Fax: +303 6285431. Web: http://www.uscid.org

FLOW ANALYSIS

JUNE 25 - 29

The 4th international conference on flow analysis will take place in Warsaw, Poland.

Enquiries: Prof Marek Trojano-wicz, Department of Chemistry,

University of Warsaw, Pateura 1, 02-093, Warsaw, Poland. E-mail: trojan@chem.uw.edu.pl Tel: +48 22 8223532. Web: <http://www.congress.pbp.com.pl/flow/>

OCEAN DYNAMICS

JULY 2 - 7

The international union of theoretical and applied mechanics symposium on the advances in mathematical modelling of atmosphere and ocean dynamics, will be held in Limerick, Ireland. Enquiries: PF Hodnett, University of Limerick, Ireland. E-mail address: iutamlim@ul.ie Web: <http://www.ul.ie/~iutamlim/>

WASTEWATER

JULY 3 - 6

The 3rd international symposium on wastewater reclamation, recycling and reuse will be held in Paris, France. Enquiries: Ms Nicole Couesnon, GBE, Université Montpellier II, cc057, 34095 Montpellier cedex 05, France. E-mail: wrrr.2000@dstu.univ-montp2.fr Tel: +33 4 6714 3310. Fax: +33 4 6714 4774.

IWA

JULY 3 - 7

The first world congress of the new International Water Association (IWA), formed by the merger of the International Association on Water Quality (IAWQ) and the International Water Services Association (IWSA), will be held in Paris, France. Enquiries: Aghttm-cfrp, 83 Avenue Foch - B.P. 39.16, 75761 Paris - Cedex 16 - France. Tel: +33 (0)1 53701351 or 53. Fax: +33 (0)1 53701340. E-mail address: aghttm@aghttm.org

AQUATIC ENVIRONMENTS

JULY 3 - 7

A conference on new trends in water and environmental engineering for safety and life: eco-compatible solutions for aquatic environments will be held in Capri, Italy. Enquiries: Terr@A, Dept IAR, Hydraulic Div, Politecnico di Milano, Italy. E-mail address: terra@marina.iar.polimi.it Fax: +39 2 23996298.

METEOROLOGY

JULY 10 - 14

A conference with the theme "Meteorology at the Millennium" will be held in Cambridge, England. Enquiries: Royal Meteorological Society, Executive Secretary. E-mail: execsec@royal-metsoc.

org.uk Tel: +18 956 8500. Fax: +18 956 8571.

EROSION

JULY 10 - 14

An international symposium on the role of erosion and sediment transport in nutrient and contaminant transport will be held in Waterloo, Canada. Enquiries: Dr M Stone, School of urban and regional planning, University of Waterloo, Waterloo, Ontario, Canada. E-mail: mstone@fes.uwaterloo.ca Tel: +519 888 4567. Fax: +519 725 2827.

WATER MANAGEMENT

JULY 16 - 21

A conference on sustainable water management - Quality and Quantity, will be held in Guildford, England. Enquiries: Information Manager, International Seminars, the British Council, England. E-mail: network.events@britishcouncil.org Fax: +44 1865 557368. Web address: <http://www.britcoun.org/networkevents>

FLOODS

JULY 17 - 19

An international symposium on extraordinary floods will be held in Reykjavik, Iceland. Enquiries: E-mail: extremes2000@os.is. Web address: <http://www.os.is/vatnam/extremes2000>

REGULATED STREAMS

JULY 17 - 21

The 8th international symposium on the ecology of regulated streams will be held in Paris, France. Enquiries: Henri Decamps, 29 rue Jeanne Marvig, 31055 Toulouse Cedex, France. E-mail: decamps@cesac.cemes.fr Tel: +33 5 62269960. Fax: +33 5 62269999.

HYDRO-INFORMATICS

JULY 23 - 27

The fourth international conference on hydro-informatics will be held in Iowa, USA. Enquiries: Web address: <http://www.ihr.uiowa.edu/hydro2000>

HYDRAULICS

JULY 25 - 28

The 8th international symposium on stochastic hydraulics (ISSH 2000) will be held in Beijing, China. Enquiries: Prof Dr Zhao-Yin Wang, International Research and Training Centre on Erosion and Sedimentation, PO Box 100044, PR China. E-mail:

zywang@sun.ihep.ac.cn Tel: +8610 684 13372. Fax: +8610 684 11174.

WATER RESOURCES

JULY 30 - AUGUST 2

The 2000 joint conference on water resources engineering and water resources planning and management will take place in Minneapolis, MN, USA. Enquiries: Dr Rollin H Hotchkiss, Washington State University. E-mail: rhh@wsu.edu Tel: +509 335 1927. Web: <http://www.ecn.purdue.edu/Water2000/papers/>

WETLANDS

AUGUST 6 - 12

The 6th wetlands symposium of the international association of ecology - INTECOL VI - "Global wetlands at the millennium" - will be held in Quebec City, Canada. Enquiries: Ms Elizabeth MacKay, CQVB, Bureau 620, 2875 blvd Laurier, Sainte-Foy, Quebec, Canada G1V 2M2. E-mail: cqvb@cqvbc.gc.ca Fax: +1 418 657 7934. Web: <http://www.cqvbc.gc.ca>

WATER SECURITY

AUGUST 14 - 17

The 10th Stockholm water symposium with the theme "Water security for the 21st century - innovative approaches" will be held in Stockholm, Sweden. Enquiries: Water Symposium, Sveavägen 59, SE-113 59 Stockholm, Sweden. E-mail address: sympos@siwi.org Fax: +46 8 22 139 61.

CLOUDS

AUGUST 14 - 18

The 13th international conference on clouds and precipitation will be held in Reno, NV, USA. Enquiries: George Isaac, AIES, 4905 Dufferin St, Downsview, ON M3H 5T4, USA. E-mail: george.isaac@ec.gc.ca Fax: +416 739 4605. Web: <http://www.tor.ec.gc.ca/arm/CP-Conf/CP-Conf.html>

DAM SAFETY

AUGUST 14 - 24

An international technical seminar and study tour on dam safety, operation and maintenance will be presented by the Bureau of Reclamation at the US Department of the Interior in Denver, USA. Enquiries: Leanna Principe, Commissioner's Office, PO Box 25007, Denver Federal Center, Denver, Colorado 80225 0007. Tel: (303) 445-2127. Fax: (303) 445-6322.

WATERSHEDS

AUGUSTUS 27 - 31

The American Water Resources Association's speciality conference on riparian ecology and management in multi-land use watersheds will take place in Portland, OR, USA. Enquiries: AWRA, 950 Herndon Parkway, Suite 300, Herndon, Virginia 20170 5531, USA. E-mail: awrahq@aol.com Fax: +703 904 1228. Web: <http://www.awra.org/~awra>

GIS

SEPTEMBER 2 - 8

The 4th international conference on integrating geographical information systems and environmental modelling will be held in Alberta, Canada. Enquiries: GIS/EM4, University of Colorado, Boulder, CO 80309-0216, USA. Tel: +303 497 6330. Fax: +303 497 6513. Web: <http://www.colorado.edu/research/cires/banff/>

MINE WATER

SEPTEMBER 11 - 15

The 7th international mine water association congress with the theme: "Mine water and the Environment" will be held in Katowice-Ustron, Poland. Enquiries: Dr Andrzej J Witkowski, University of Silesia, Bedzinska Str 60, 41-200 Sosnowiec, Poland. E-mail: awitkows@us.edu.pl Tel: +48 32 291 6888. Fax: +48 32 291 5865.

WATERMATEX 2000

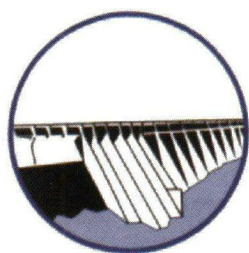
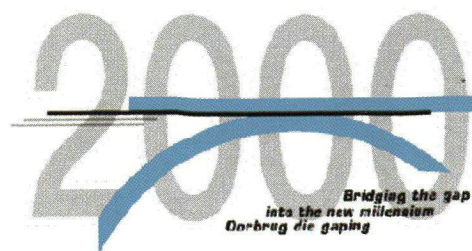
SEPTEMBER 18 - 20

Watermadox 2000 conference with the theme "System analysis and computing in water quality" will be held in Gent, Belgium. Enquiries: Prof Peter Vanrolleghem, Biomath Department, University of Gent, Coupure Links 653, B-9000 Gent, Belgium. E-mail: peter.vanrolleghem@rug.ac.be Tel: +32 9 264 5932. Fax: +32 9 223 4941.

FLOODS

SEPTEMBER 20 - 23

An international symposium on flood defence will be held in Kassel, Germany. Enquiries: DIV Ashauer, c/o Universität Gh Kassel, PO Box 101380, D-34109 Kassel, Germany. Tel: +49 561 804 3203. Fax: +49 561 804 3952. Web: <http://www.uni-kassel.de/fb14/wasserbau/symposium2000/>



Two day Conference

VAAL RIVER 2000

7 & 8 November 2000
Vaal Riviera, Gauteng

Organised by SAICE (Water Engineering Division) and Vaalco,
in association with WISA and the Water Research Commission.

CONFERENCE FOCUS

The Conference will focus on one of the most important rivers in South Africa - the Vaal River, and concentrate on the impact of the new legislation on the Vaal River system and its catchment. It will actively involve a range of stakeholders. It is planned to be informative for both the technical and the not-so-technical minded, to disseminate information on the status of water resources in the Vaal River catchment, highlight various legislative, water resource management, social and technical issues, and discuss advances in water management science.

TOPICS

Vaal River issues that could profit from discussion include:

- Community water supply and sanitation
- Projected water requirements
- The effect of demand management
- Environmental requirements, the water reserve and IFRs
- The place of irrigation
- System analyses
- The National Water Balance model
- Economic impacts
- New developments in modelling the above
- The effect of water pricing policies
- Water quality issues and their effect on water requirements
- The impact of CMAs
- Effect of other recently promulgated legislation (including interaction with environmental policy)

ENQUIRIES

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Division of Continuing Engineering Education
University of the Witwatersrand
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Fax: +27 11 339-7835
E-mail: stephenson@egoli.min.wits.ac.za
www.cee.co.za

TECHNICAL ENQUIRIES

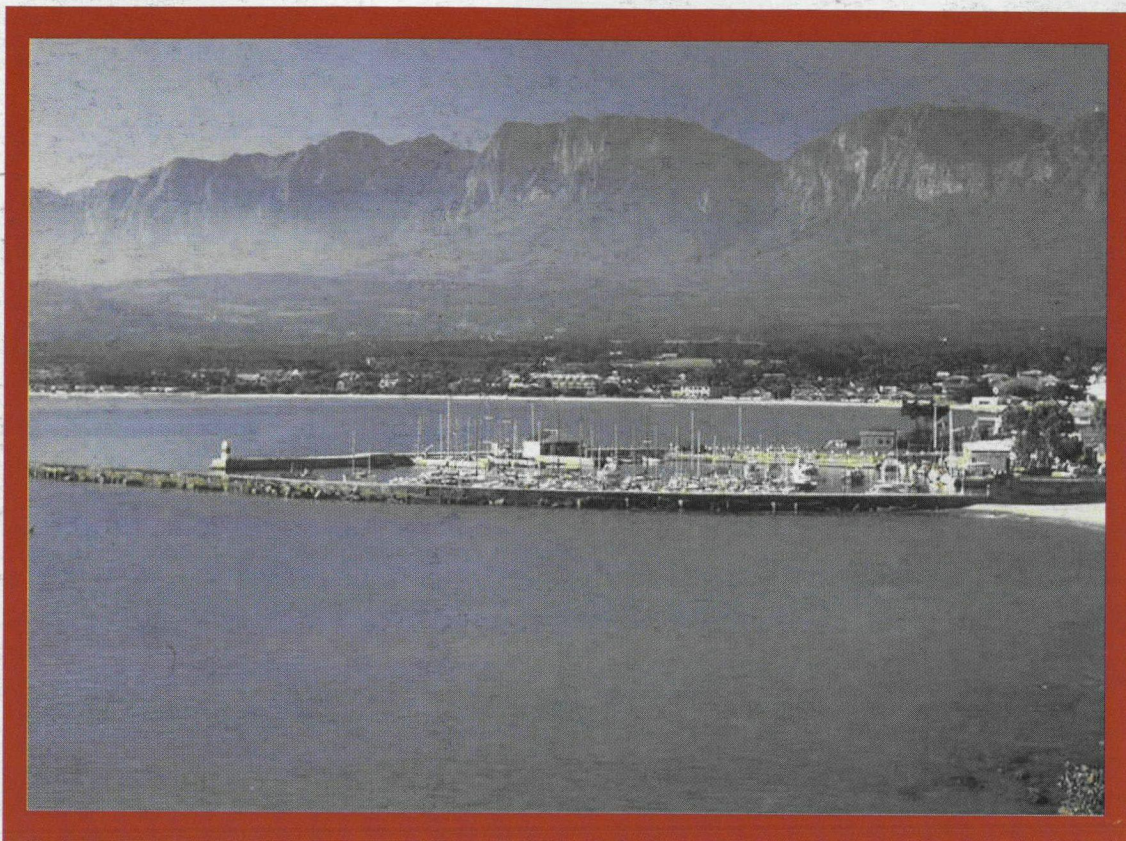
Brian Hollingworth
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Fax: +27 11 313-3086
E-mail: brianh@dbsa.org



WATER
RESEARCH
COMMISSION



BIENNIAL CONFERENCE AND EXHIBITION



BIENNIAL CONFERENCE AND EXHIBITION

"Integrated Waste Management in the New Millennium"

5-7 September 2000

**Somerset West, near Cape Town
SOUTH AFRICA**

WASTECON 2000 SECRETARIAT

Tel: (021) 99 3172 Int: +27 21 99 3172

Fax: (021) 99 4707 Int: +27 21 99 4707

E-mail: wastecon2000@mweb.co.za

Website: www.weirenvig.co.za/wastecon2000



**Organised by the
INSTITUTE OF WASTE MANAGEMENT**