SA waterbulletin

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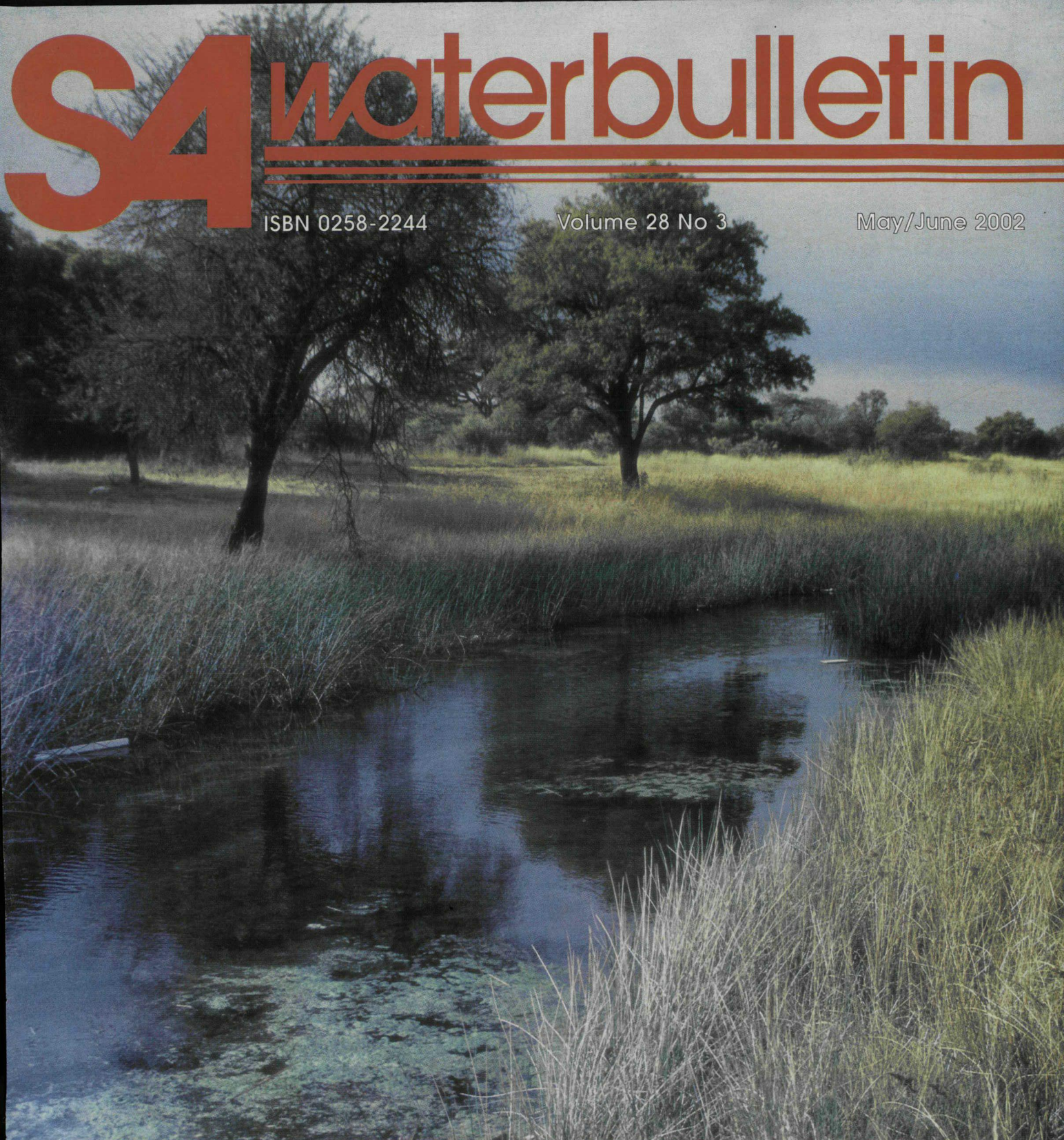

WATER QUALITY
Low-cost techniques for estimating river flows

IRRIGATION
Researcher investigates small-scale irrigation schemes

INDUSTRIAL WATER
Tools for cleaner production discussed

Introductory course in Water Microbiology

13 - 16 August 2002

Division of Water, Environment and Forestry Technology, CSIR

Pretoria

The Water Programme, Pretoria presents a course for people in the water industry who need to know more about the basic techniques used in the microbiological analysis of water. The course is recommended for industries, municipalities, government departments, water boards and water bottlers.

The course is limited to a maximum of 10 participants to ensure personal attention. They will be trained in the basic concepts of health related water microbiology. The theoretical (theory 25% and lectures 15%) and the practical (60%) aspects to be covered will include:

- Detection and enumeration of indicators of pollution (heterotrophic plate count, total and faecal coliforms, faecal streptococci, coliphage and the confirmation of *E. coli*.
- Demonstration of the detection of other pathogens in water (viruses, parasites and *Legionella*).
- Interpretation and reporting of results
- Lectures on water purification and water disinfection, the importance of the chemical composition of water and their related health implications, the geology and hydrology of ground water
- Quality control and laboratory safety

A certificate of attendance will be issued on completion of the course.

All interested, please contact:
Pauline Coubrough / Elzabe Truter
Tel: 012 841 3952 / 012 841 2289
Fax: 012 841 2506
e-mail: pcoubrou@csir.co.za
e-mail: etruter@csir.co.za

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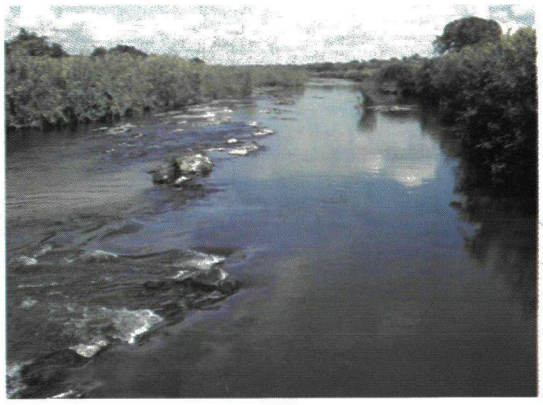

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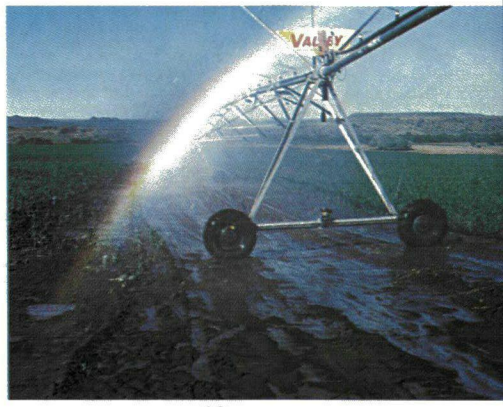

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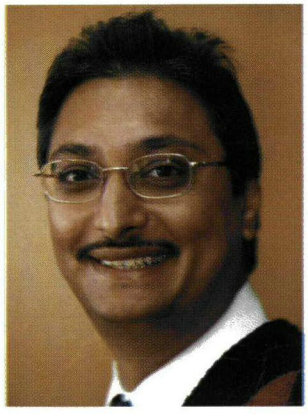
Cover: Groundwater source near Kuruman in the Northern Cape. (Photo: JP du Plessis)

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, Privatebag X03, Gezina, 0031, 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). Ed Secretary: Rina Human (E-mail: rina@wrc.org.za). Layout: Ronel Urquhart - 4Images. Colour Separations: 4Images. Printing: Beria Printers.

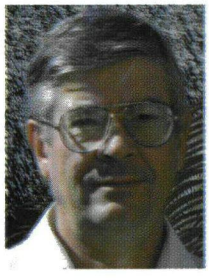
Newly appointed members of the Water Research Commission announced

The Minister of Water Affairs and Forestry, Mr Ronnie Kasrils, recently announced the names of the members of the newly constituted Commission. The members will serve on the Water Research Commission Board for a period of three years - 1 June 2002 to 31 May 2005.

CHAIRPERSON
Dr HC (Hamanth) Kasan, General Manager, Water Treatment Technology, Rand Water.

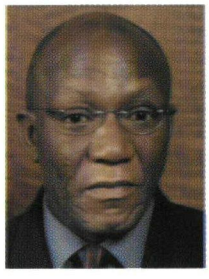


MEMBER
Mrs MM (Mampiti) Matsabu, Director, Dynacon Technologies, Pinegowrie.



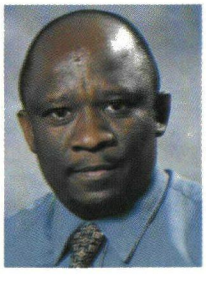
MEMBER
Dr DJ (Doug) Merrey, Director for Africa, IWMI, Pretoria.

MEMBER
Dr R (Rifka) Kfir, Chief Executive, Water Research Commission.

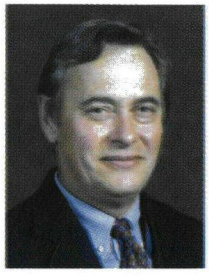


MEMBER
Mr NL (Neo) Moikangoa, Executive Vice-President Sustainable Development & Policy, CSIR, Pretoria.

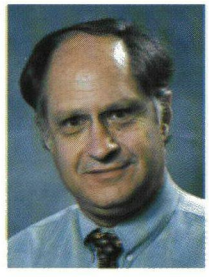
MEMBER
Dr SJ (Snowy) Khoza, General Manager R&D, National Electricity Regulator, Pretoria.



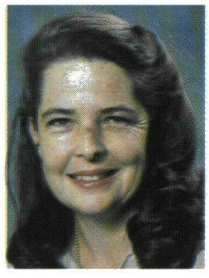
MEMBER
Dr BM (Mishack) Molope, Group Executive Officer, Agricultural Research Council, Pretoria.



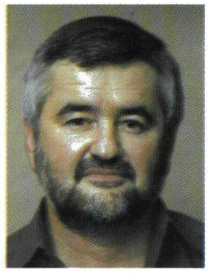
MEMBER
Mr AM (Mike) Muller, Director-General, Department of Water Affairs & Forestry, Pretoria.



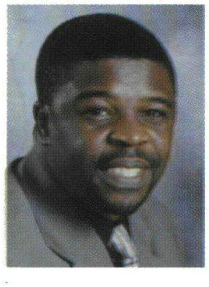
MEMBER
Mr RJC (Rodney) Nay, Convener Engineering Services, City of Johannesburg, Wynberg.



MEMBER
Professor CG (Tally) Palmer, Director: Centre for Aquatic Toxicology, Institute for Water Research, Rhodes University, Grahamstown.



MEMBER
Mr MP (Martin) Rall, Executive Director, Mvula Trust, Johannesburg.



MEMBER
Mr JS (Jerry) Vilakazi, Executive Director of Services, SA Institute of Chartered Accountants, Kengray, Johannesburg.

Identification Workshop on Freshwater Crustacea

By F C de Moor, Albany Museum Grahamstown

Participants to the Identification workshop to Freshwater Crustacea at UCT. Front: Ms Belinda Day. Front row kneeling: Ms Candice Haskins, Ms Geordie Ractliffe, Mr Cebo Mhlongo, Dr Jenny Day, Dr Barbara Cook nee Stewart, Ms Genevieve Jones. Middle row: Ms Petro Vos, Mr Mbongeni Baninzi, Ms Tembela Mapukata, Dr Nancy Rayner. Back row: Dr Rob Hart, Dr Liz Day, Ms Christa Thirion, Ms Rebecca Tharme, Dr Ferdy de Moor, Dr Koen Martens.

A project aimed at improving the understanding of inland water biodiversity and to make knowledge on the freshwater macroinvertebrate fauna of southern Africa more accessible, is being funded by the Water Research Commission. The project "Guides to the Freshwater Invertebrates of southern Africa." will eventually produce ten independent guide books to the identification of selected faunal taxa found in inland aquatic ecosystems in southern Africa. Three volumes of the guides dealing with all known inland water Crustacea were published by mid 2001.

As part of the technology transfer phase of this Water Research Commission project, a three day workshop to familiarise conservation officers, biomonitoring and river health practitioners, freshwater biologists, ecologists and invertebrate biologists was held at the Zoology Department at the University of Cape Town (UCT) between 5-7 September 2001. The workshop was divided into five half-day sessions, with each session dealing with a specific group of animals. The workshop was attended by 14 participants and five specialists facilitated the identification of the invertebrates. After a brief introduction, by Dr Jenny Day of UCT, to the general features characterising each group of animals, specialists for each group of animals presented a more detailed lecture and hands-on workshop where participants could improve their skills while attempting to identify selections of various animals put out for study.

In the first session dealing with Ostracoda, Dr Koen Martens (Royal Belgian Institute for Natural Sciences), revealed how extremely interesting and evolutionary controversial this group of animals comprising about 150 species in southern Africa is. The difficult dissecting technique to be mastered to accurately identify these animals was discussed and practical experience was gained by all. The Copepoda were covered by Dr Nancy Rayner from (University of Durban Westville) KZN and again the salient features used for identifying the various groups within this microcrustacean group were carefully revealed to the participants. Dr Rob Hart (University of Natal, Pietermaritzburg) and Dr Barbara Stewart (University of Stellenbosch) dealt with the decapod Crustacea (Crabs, shrimps and prawns) and hands on experience was gained by examining the large diversity of animals available for study. Dr Barbara Stewart also dealt with the peracarid Crustacea, and Amphipods and Isopods were closely examined and salient features were highlighted. Dr Michelle Hamer (University of Natal, Pietermaritzburg) and Dr Nancy Rayner dealt with the temporary water branchiopod Crustacea and the Cladocera.

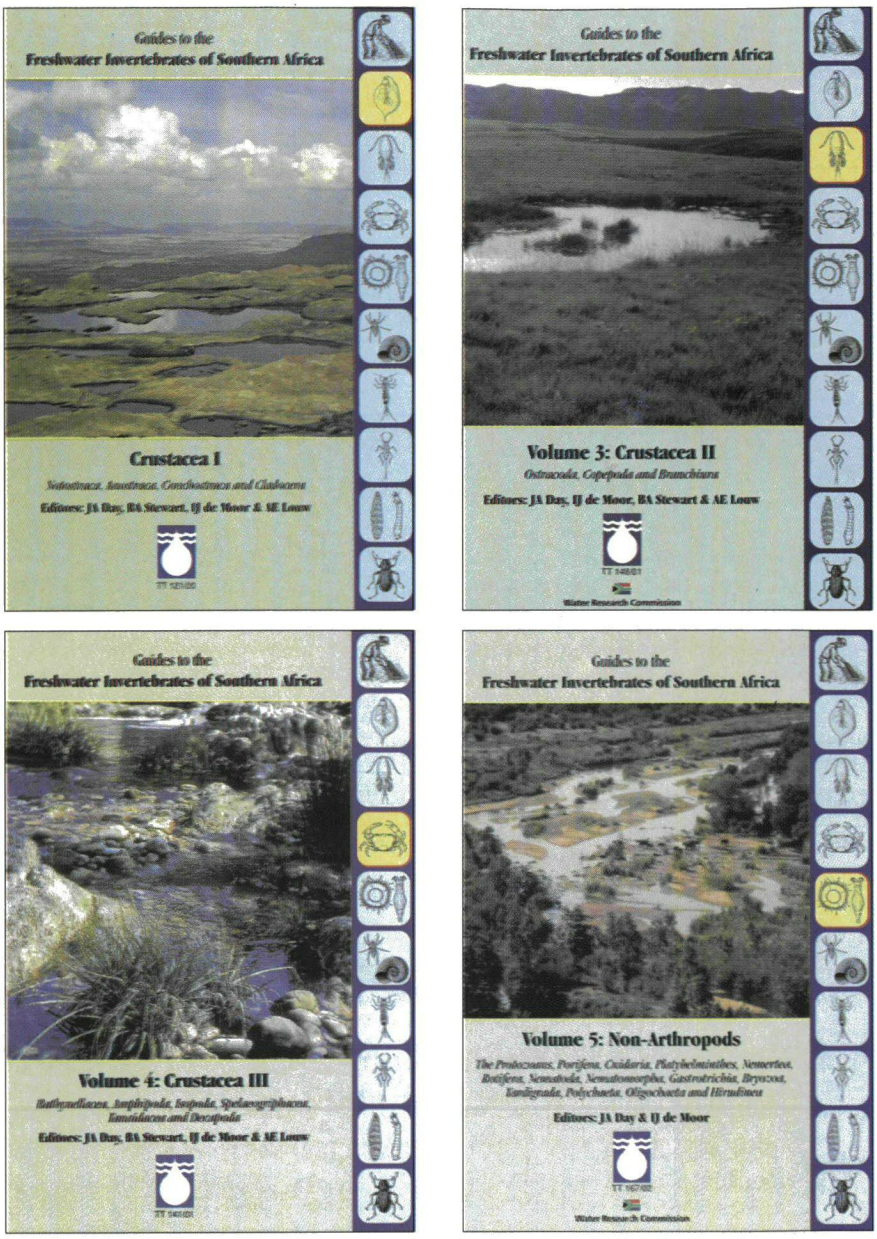
The specialists are to be thanked for

their enthusiasm and hard work and the delegates for having the desire to learn more about the invisible (ostracods, copepods and cladocerans), the near visible (most other things) and the clearly visible but downright dangerous (crabs, shrimps and prawns). Some comments made by both delegates and specialists serve to indicate how well the workshop was received and that future workshops dealing with the other freshwater invertebrates are definitely worthwhile.

Mr Mbongeni Baninzi: "In the workshop I have learnt that the use of keys is important in identification of the crustaceans but that keys can be meaningless if you do not have background information about the group you are dealing with. Different groups require the use of different segments appendages or sexes when attempting to identify specimens. In future workshops I would like to see a shorter period on background information and more time spent using the keys in the laboratory. More workshops on taxonomy are needed."

Dr Rob Hart: "The workshop was certainly informatively useful. Unfortunately some sessions were time constrained by the need to develop necessary preparatory micro-dissection skills preceding use of the guide keys for identification purposes. Participants at future workshops requiring such preparatory techniques could perhaps be guided to undertake and practice appropriate procedures ahead of the workshops, so that use of keys with any inherent idiosyncracies could form the bulk of the workshop contact time. Distribution of the guides prior to the workshop would enable participants to familiarize themselves with terminology and features. The workshop accomplished much in creating a greater understanding and awareness of freshwater Crustacea."

Mr Cebolenkosi Mhlongo: "Participants at the workshop ranged from beginners to experts from all over the country. The world renowned ostracod specialist Koen Martens "brocolli man" from Belgium presented his course with an excellent sense of humour. The workshop was extremely well organised and quite intensive with a brief introduction and theory component followed by practical work for each section of crustaceans covered. The laboratories at UCT were well equipped with material, microscopes and specimens (dead and alive) used in the practical sessions. One of the highlights, for me, was the presentation by Dr Barbara Stewart on the identification of Decapoda and Peracarida which was relevant to my current work as a laboratory technician at Umgeni Water. The presentation was excellent with clear, concise step by step procedures in the identification of crabs, freshwater shrimps and prawns, animals that I normally encounter in routine sampling. I was able to confirm the identification of decapods collected in Zululand with the knowledge gained during the workshop."



Four identification guides in the WRC series of ten books that include keys to most of the fresh and brackish water invertebrates in southern Africa.

"For follow up workshops more emphasis should be placed on specimen dissection techniques, which are fundamental requirements for proper species identification. Participant numbers should be limited to 15 to allow for interaction with the specialists and individual attention. A suggestion I would like to make is that one of the specialists summarizes the ostracod keys into a user friendly one for beginners. Future workshops should be held at different venues e.g. Pretoria, Durban, Grahamstown some venue in Mpumalanga. In conclusion the crustacean workshop provided the necessary training to become more confident in identifying crustaceans, a field where there was previously limited

expertise and documentation to turn to."

Dr Nancy Rayner: "The Crustacea workshop was an excellent idea! It might be an idea to advertise such workshops more widely and well in advance. The ratio of talking by the specialists should represent about one third and the laboratory work should be about two thirds of allotted time. The workshop presented a good opportunity to test the keys and to highlight any mistakes. Errors should be recorded, listed and sent to the authors or Dr Mitchell at the Water Research Commission. The three Crustacea volumes published are a great success an will be immensely useful to all involved in freshwater research."

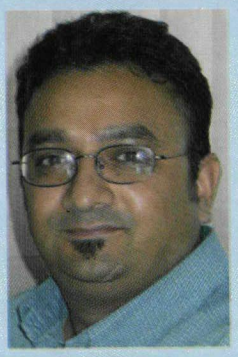
The importance of this workshop cannot be overemphasised. Not only did the participants learn to identify hugely different groups of animals using a vastly different range of characters and criteria for each separate group, but also the specialists and authors could see that what they assumed to be easy to discern features and characters are not necessarily recognised or even understood by the participants. The crustaceans examined and referred to also provided the participants a more diverse array of animals than they would have encountered in their everyday work and monitoring activities and as such allowed them to gain a broader knowledge of all the groups of animals studied.

The series of identification guides will undoubtedly improve the identification skills of field biologists. They will furthermore create a greater awareness and enthusiasm in ordinary people who will also attempt the identification of freshwater aquatic invertebrates in greater numbers. Hopefully with more people attempting to identify these small invertebrates more specimens will be brought in for identification confirmation at Museums, Universities and Nature Conservation organizations. In this way more people will be involved in creating a better understanding of our aquatic biodiversity and as such a greater conservation ethic and an awareness of life in our freshwaters will be engendered in the public. The spin-offs of these guides is immense and they need to become more widely advertised.

ACKNOWLEDGEMENTS

Dr Jenny Day and Ms Belinda Day are thanked for organising the workshop venue and provide all facilities including meals at the University of Cape Town. The Water Research Commission are thanked for providing financial assistance for the running of the three day workshop and also for providing funding to enable the specialists to get to and stay in Cape Town and run various components of the course. Special thanks are extended to the WRC for funding a return air fare and accommodation expenses for Dr Martens from Belgium.

New appointments for Bhagwan

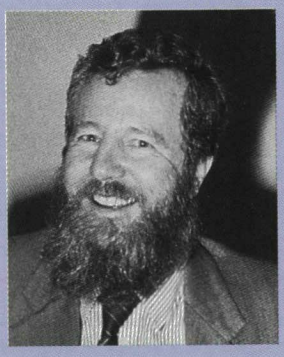


Mr JN Bhagwan, Director: Water Use and Waste Managment *at the Water Research Commission, has achieved the following distinctions -*

- He was appointed second Vice-President of WISA, and
- The Minister of Water Affairs and Forestry appointed him to the National Water Advisory Council, a position that he will occupy for a period of three years.

Congratulations, Jay!

Buckley on National Water Advisory Council



Mr Ronnie Kasrils, Minister of Water Affairs and Forestry, appointed Professor Chris Buckley from the Pollution Research Group, University of Natal, Durban as a member of the National Water Advisory Council for a period of three years from 1 May 2002.

Prof Buckley said he viewed this appointment as a recognition of the research carried out by all the team members (past and present) of the Pollution Research Group.

"Further, this would not have occurred if it had not been for the continued support (for over 30 years) from the School, Faculty and University and from our major funder, the Water Research Commission."

Workshop discusses "tools for cleaner production"

The Water Research Commission (WRC) recently organised a series of one-day workshops at the School of Chemical Engineering, University of Natal, as part of their contribution to the WISA 2002 conference in Durban.

One of the workshops was organised around the theme of cleaner production practices in industry and attended by 65 registered pre-conference delegates from government, local authorities, research institutions and industry.

Mr Greg Steenveld (Convener, WRC) introduced the workshop and outlined the aims, namely -

- to present activities being carried out in the area of Cleaner Production both directly and indirectly related to WRC funding, and
- to receive feedback from the participants, particularly with regard to "needs".

The overall theme, in common with other workshops and presentations at WISA, was "sustainability", with reference also to the forthcoming World Summit on Sustainable Development to be held in Johannesburg. Industry had major twin roles to play, by providing economic growth and employment while at the same time being eco-friendly to the environment and communities. Five courses had been held on various "tools for cleaner production" specifically Mintek, Aquasim, Pinch Analysis, Waste Minimization and Life Cycle Assessments.

SUSTAINABILITY AND CLEANER PRODUCTION

Prof Chris Buckley (Pollution Research Group (University Natal), gave a brief background to cleaner production, starting with definitions of sustainable development as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs" and cleaner production as "increasing the efficiency of resource utilisation, including increasing the reuse and recycling of residues, and to reduce the quantity of waste discharge per unit of economic output" (Earth Summit 1992, Agenda 21) by *"the continuous application of an integrated preventative environmental strategy applied to processes and services to increase overall efficiency and reduce risks to humans and the environment"*. In the context of industry and business, it was noted that:

- Competitive advantages could be gained locally and/or internationally by industries adopting Cleaner Production;
- Good business sense demands that an industrial activity should be financially viable, be environmentally responsible and have community acceptance.
- A number of tools were available for assisting towards cleaner production, including life cycle assessment, resource economics, environmental management systems, environmental impact assessments, eco-labeling, waste minimization, pinch analysis, etc.

WATER LEGISLATION BACKGROUND

With reference initially to the Water Act No. 54 of 1956, Mr Reinholdt Loots (DWAF, Directorate of Water Conservation) outlined the principles of sustainable water management through cooperative guidance, where DWAF acts as a custodian of water in partnership with other parties.

Mr Paul Herbst (DWAF, Directorate of Water Quality) presented a brief history of water legislation in the RSA, noting in particular the development from land disposal (Public Health Act, 1919) to effluent disposal to the aquatic environment (Water Act, 1956) and then to progressive strategies and policies for water quality management (1991). Measures are both source- and resource-directed, with waste minimization at source (directly linked to Cleaner Production) at the top of the hierarchy. The National Waste Management Strategy was currently in the implementation phase and international experience (France et al) was being gathered with regard to setting of waste discharge charges in terms of the National Water Act (1998).

CO-REGULATION CASE STUDY

Mr Neville Burgess (Department of Waste Management, eThekwini Municipality, retired) presented a paper on the "Use of environmental management instruments in a region with particular references to the metal finishing industries (N Burgess, S Redelinghuys, D Braun and M Koefoed). The paper described a recent situation when many metal finishing industries in the Durban Metro area were not complying with the Sewage Disposal Bylaws. A waste minimization club funded initially by the WRC led, in collaboration with DANCED, to the establishment of a regional Metal Finishing Association. These initiatives, focused on waste reduction at source and cleaner production in the industry, resulted in a greatly improved environmental situation (reduction in heavy metals discharge) to sewer and consequently in sludges) in which the industry, suppliers and users, waste disposal companies and the regulatory authorities combined in a more cooperative and sustainable environmental management model. Demonstration plants had in one case achieved a 90 per cent water saving with a 14 month payback time.

WASTE MINIMISATION CLUBS

Ms Sue Barclay (Pollution Research Group, University of Natal) presented a paper on Waste Minimization as a systematic ongoing approach to reducing waste generation at source i.e. as a tool of cleaner production. An outline of the methodology and indicative (potential) materials and energy savings at various production stages were given, and supported by results from a number of factories where significant reductions in water use, effluent generation and power use had been achieved.

Waste Minimization Clubs were a useful vehicle for promoting the exchange of experiences and implementing waste minimization in a cross-sectional or sector-specific group of industries working together to reduce waste and save money. From 2 clubs funded by the WRC in a pilot project commencing in 1998, currently 17 clubs were running in the RSA with a further six planned for the near future.

PINCH ANALYSIS

Mr Chris Brouckaert (Pollution Research Group, University of Natal) presented "Pinch Analysis as a Co-regulatory Tool". From the definition of water pinch as a technique for identifying critical constraints in optimizing water use networks, pinch analysis fulfilled a design and analysis function compared to waste minimization which provided an operational tool and life cycle assessment which gave a strategic perspective.

A case study on a power station was presented, where the objective was to achieve zero liquid discharge by balancing the water circuit so that all effluent was taken up in the ash dump. Such approaches could be used to reduce saline discharges, which have high cost implications in the national water body. DWAF views pinch analysis favorably as a neutral monitoring/analytical tool in assessing water budgets, and the use of pinch analyses in such applications was considered highly likely to grow.

LIFE CYCLE ASSESSMENT

Ms Elena Friedrick (Pollution Research Group, University of Natal) presented an overview on Life Cycle Assessment (LCA) as a tool for assessing the "cradle-to-grave" environmental impact of processes, products and services, stated in one definition as "a process to evaluate the environmental burdens associated with a product system or activity by identifying and quantitatively describing the energy and materials used, and wastes released to the environment, and to assess the impacts of those uses and releases to the environment". An overview of the methodology covering goal and scope definition, inventory analysis, impact assessment and interpretation was given, with case study examples, indications of strengths/limitations, and an outline of current activities regarding the "localization" of LCA methodology for specific (e.g. RSA – salinity) and more general (e.g. developing countries – social issues, poverty).

For more information, contact Mr Greg Steenveld at the Water Research Commission in Pretoria.

WATER RESEARCH COMMISSION (WRC)

Call for research proposals (2003/2004)

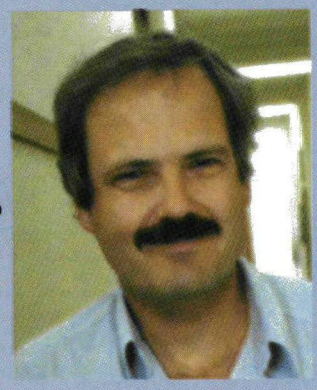
The WRC is calling for the submission of proposals for non-solicited research in the four Key Strategic Areas

- **Water Resource Management**
- **Water-linked Ecosystems**
- **Water Use and Waste Management**
- **Water Utilisation in Agriculture**

Deadline for receipt of proposals: 15 September 2002

For detailed guidelines regarding proposal submission and access to the on-line submission form please consult the WRC website www.wrc.org.za or contact

Zagry Scholtz • E-mail: zagry@wrc.org.za • Tel 012 330 0340



Dr Neil Armitage

DAMBUSTERS

Scour- and man-made structures

In his recent doctoral thesis, Dr Neil Armitage of the Department of Civil Engineering, at the University of Cape Town (and a researcher for the Water Research Commission), has come up with a number of innovations as he designed and developed a mathematical model that predicts the commencement of riverbed erosion around man made structures.

Working with Albert Rooseboom, Professor of Hydraulics at the University of Stellenbosch, and basing his work on an oeuvre of international research compiled over the past 85 years, Armitage came up with a number of modifications to existing models in his thesis on "A unit stream power model for the prediction of local scour". This model describes energy utilisation in rivers, and how this affects the rate of scour in rivers, i.e. the erosion of the riverbed.

Local scour is usually associated with particular features or obstacles in a river, be it a boulder, an island or just a sharp bend, explains Armitage. "But the prime interest for engineers – historically, at any rate – has been the local scour that's come about as a result of man-made structures."

Because of scour, holes are dug around structures – such as bridge piers and abutments – that are built on or below the riverbed. "Those holes can be exceptionally deep, e.g. they can easily run to 20 or 30 metres," notes Armitage.

"Scour can result in the sand around the pier being removed to such a depth that the pier ends up being supported on nothing – the sand's just washed away." Because of this, the pier will fail and the structure will collapse.

This happens far more often than desired, especially in KwaZulu-Natal, a province that experiences many large floods, says Armitage. But this is a worldwide phenomenon, he adds, and of great concern to engineers, both from a financial and communications aspect.

"The simple premise of my thesis was, firstly, that there is a direct connection between unit stream power – the stream power that is dissipated in unit volume – and scour," he notes. "But it's a very complex relationship that is subject to a whole host of very complex influences."

"What I had to do was to build a relatively simple model that could be run on a PC and that would enable us to make some sort of prediction about local scour around any arbitrary engineering structure." To do this, Armitage and Masters student Caroline McGahey adapted a commercial computational fluid dynamics (CFD) programme, which models the physical behaviour of a fluid, to help predict the rate of local scour.

Here, Armitage's main challenge was to try and determine the criteria under which sand will just stop to move, a point that is called the incipient motion criterion. This criterion has been the subject of considerable debate and study, and there is no agreement on the best way to determine it, Armitage says.

He did manage, however, to come up with a modified criterion, which improves on the criterion developed by his supervisor some 30 years ago. He was also able to show the relationship between the rate of movement of sand (intensity of motion) and the unit stream power, something that had not been done before.

"I basically came up with a new criterion for describing the boundary between scour and no scour," he says. His model also stood up pretty well when tested against experimental data.

Armitage's project was funded by the Water Research Commission (WRC). The thesis has also been the basis of a conference paper that was presented at the 10th South African National Hydrology Symposium (SANCIAHS) in Pietermaritzburg at the end of 2001.

The problem with PhDs, says Armitage, is that you inevitably end up with more questions than you started off with. Questions he hopes to answer as he continues his work on the subject over the next few years, he adds.

Armitage graduated from the University of Stellenbosch in March.

The rehabilitation of small-scale irrigation schemes investigated

The Water Research Commission has published the results of a study contributing to the knowledge of the constraints facing small-scale irrigation schemes in South Africa.

Small-scale farmer irrigation schemes in South Africa comprise only approximately 46 000 ha or four per cent of the total area irrigated. However, from a rural development and socio-economic point of view such schemes are of cardinal importance, since more than 223 000 people are dependent at least partially for a livelihood from small-scale farmer irrigation schemes.

The researcher, TJ Bembridge, says the main motivation for the study was that a large amount of capital has already been expended on some schemes which have already almost ceased to function, but which at the same time have the potential to make a significant impact on the local and national socio-economy, as well as in providing for food security, poverty alleviation and increased employment.

He says before schemes can be rehabilitated it is necessary to undertake an appropriate diagnostic analysis to pinpoint major constraints and problems as a basis for innovative changes in the design, concept, management and economic participation of farmers.

The research project focussed mainly, but not exclusively, on four schemes, namely the Tyefu irrigation scheme in the Peddie district, Eastern Cape, the Sekgakgapeng irrigation scheme in the Potgietersrus district, Northern (Limpopo) Province, and two schemes in KwaZulu-Natal, the Thukela Estates irrigation scheme in the Weenen district and the Bululwane scheme near Nongoma.

TYEFU IRRIGATION SCHEME

The Tyefu irrigation scheme is designed to provide bulk water to irrigate some 5 400 ha on the east and west banks of the Great Fish River. At present the scheme is divided into five sectors comprising 29 commercial farmers with 4 ha land allocations and 1 485 food plot holders with units of between 0,16 and 0,25 ha.

From the outset it was realised that the scheme was not economically viable. However, because of considerations of poverty alleviation and the fact that in due course the present high cost pumping scheme would be superseded by a gravity canal system, the previous homeland government decided to proceed with the scheme, which is situated in an area of extreme poverty. The climate and soils are suited to the production of a wide range of crops and vegetables. The scheme, managed by consultants, functioned reasonably well in the early years. Due to financial constraints, the Eastern Cape government decided to disband the then managing agents, Ulimocor, in 1995.

The present water supply system is inadequate for sustained irrigation from May to October in years of low rainfall. The high cost of electricity for pumping water from the Great Fish River make the scheme completely uneconomic. The quality of water during periods of low flow is such that it presents a salinity problem.

The development of the irrigation

scheme has resulted in infrastructural development, including electricity supply, schools health services and retail outlets, which otherwise may not have reached this remote area. After 15 years much of the above-ground piping and equipment is in poor condition and needs to be upgraded and replaced.

Farmer leadership was generally weak. This was compounded by political rivalry between farmers' unions.

Participants had divided perceptions on scheme impact and whether they had benefited from the scheme, as well as on the effectiveness of previous management. They were unanimous that the scheme should be rehabilitated, that there should be greater farmer participation in managing the scheme, on the need for land tenure reforms, as well as the need for improved institutional support.

An evaluation of extension workers on this scheme as well as a scheme in KwaZulu-Natal revealed many shortcomings in their competency to advise irrigation farmers.

Thirty per cent of heads of households were widowed and 37 per cent were over the age of sixty years. The majority - 57 per cent - were illiterate. Monthly expenditure and savings were low. A large proportion of income was derived from pensions and spent on food. Three in five households were estimated to be living below the poverty datum line. Farmers had very limited resources in terms of livestock and equipment.

It was concluded that in the long term the only means of reducing pumping costs and preventing soil salinity was to extend the pipeline from the Glen Boyd dam to supply the areas presently dependent on pumped water from the great Fish River. Rehabilitation of the scheme is only justified as a poverty relief and food security measure, provided the cost of present development and rehabilitation costs are written off. Detailed conclusions and recommendations are given in the report.

SEKGAKGAPENG IRRIGATION SCHEME

The 28 ha centre pivot irrigation scheme near Potgietersrus in the Northern (Limpopo) Province was established in 1984 and allocated to 14 farmers who were prepared to farm on a full-time basis. Because of pressures from non-participants in the Sekgakgapeng community, possibly due to the clamour for additional land, the scheme was sabotaged in 1995 and has not operated since.

The climate is suitable for a wide range of field and vegetable crops and is situated near a ready market. Due to saline water some of the soils were found to have a high sodium content. The original water supply was from pumping from a large vlei area in the Mogalakwena River. During a drought period six boreholes were drilled and equipped, none of which are functional at present.

The current irrigation committee comprises seven farmer members. One in five participants were widow-headed households, with 30 per cent over 60 years of age. Sixty five per cent were functionally illiterate.

Closure of the scheme has resulted in considerable reduction in household income to the extent that 65 per cent are estimated to be living below the poverty datum line, despite 47 per cent of households receiving pensions. Although two farmers possessed tractors, in general they had limited resources.

The general feeling was that the centre pivot scheme was not ideally suited to individual farmers, because of the lack of freedom of choice in growing crops.

Interviews with non-participant groups in the local community showed dissatisfaction with the original allocation of plots. They felt that opportunities should be created for greater local involvement, both in rehabilitating the scheme, as well as participating in irrigated food plots.

Allowing for interest and redemption payments and replacing the existing centre pivot with a quick coupling drag line system, and providing mini-sprinklers for food plots, the scheme is potentially viable. However, before modernising the scheme, the quality and quantity of the water supply will have to be fully investigated. In addition, it will be necessary to restructure the local committee into a fully fledged Water Users Association with wider community participation to gradually take over the management of the scheme.

BULULWANE IRRIGATION SCHEME

The Bululwane irrigation scheme established some 33 years ago is located in the Nongoma district of KwaZulu-Natal. The Zulu king, Goodwill Zwelithini, has one of his palaces in close proximity to the scheme, and also has a plot on the scheme.

The scheme is gravity fed by a canal from the Bululwane River. Water shortages are sometimes experienced in August and September. The climate is suited to a wide variety of crops. However, some of the soils are only of marginal suitability for flood irrigation and require further investigation. Approximately 80 per cent of the 345 ha is not being utilised at present due to a combination of lack of motivation and a lack of resources and support services. On average, farmers were allocated units of approximately one hectare.

Due to the age of the scheme, canals and distribution sluice gates have become worn and corroded and are badly in need of repair. In addition to wear and tear in the canals the main storage dam and the silt dam have become silted up. A start has been made on rebuilding the main canal and patching up of other areas, as well as secondary canals. However, approximately R2 million is required to completely rehabilitate the irrigation and ancillary works.

Fifteen per cent of households were widow-headed. Two in five heads of households were over 60 years of age and 58 per cent were illiterate. The socio-economic situation was marginally better than on the other three case study schemes, with approximately 50 per cent living below the poverty datum line. Sixty per cent of households were in receipt of pension income and one in five were unemployed. They also owned larger numbers of cattle and equipment than on comparative schemes. Crop production income only comprised a small proportion of total household income and crop yields were considerably below potential.

A major advantage of the scheme is that it has a gravity flow supply system with low water distribution costs. Scheme participants were unanimous that the scheme should be rehabilitated and the majority felt management of the scheme should, over time, be taken over by the

farmers themselves.

Discounting expenditure to date on rehabilitation works, as well as capital still required to complete the rehabilitation exercise, the scheme is considered potentially viable from a poverty alleviation point of view. However, to be successful this will require the institutional support suggested in the report.

THUKELA ESTATES IRRIGATION SCHEME

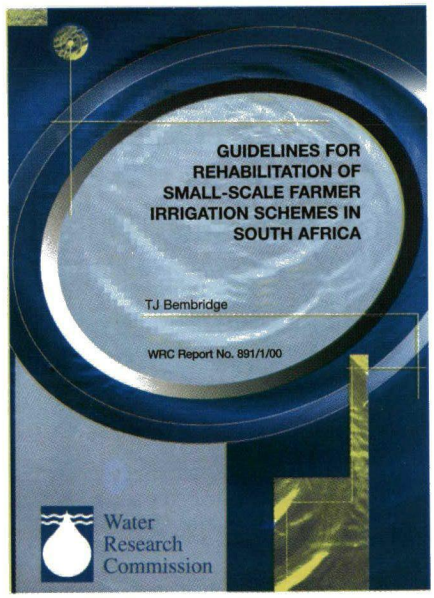
The 813 hectare Thukela Estates irrigation scheme has a long history going back to 1912. In 1985 the responsibility for the scheme reverted to the KwaZulu Department of Agriculture. A number of attempts have been made in the past to revitalise and rehabilitate the scheme. Apparently institutional problems relating to land allocation, inappropriate management, lack of participation and local conflicts have led to failure. Virtually all of the 1 275 households living near the scheme have been allocated small plots of varying sizes.

Because of the lack of maintenance and deterioration, the original canal is no longer functional and only about 30 per cent of the productive area is being utilised by pumping from the Tugela River. Many potential participants are unable to irrigate due to the collapse of the main supply canal and ancillary works. The pressurised system is in a poor state of repair and dysfunctional. More recently, lack of unity and stability within the community due to faction conflicts have hindered the study, as well as rehabilitation of the scheme.

Although the area does experience frosts during winter, the climate is suited to a wide variety of crops and vegetables. With sound irrigation management suitable soils are not a constraint on this scheme. Likewise, the quality and potential quantity of water from the Tugela River do not impose a constraint to the rehabilitation and modernisation of the scheme.

The original main canal has been repaired to field edge. It is estimated to cost over R5,3 million to fully repair the main canal to command approximately 550 ha. Approximately 274 ha is irrigated from the four pump stations all equipped with electric pumps. Much of the piping is in a poor state of repair and has been in disuse for some years. The pump stations are prone to flooding with resultant high maintenance costs. Pipelines often break due to the class of piping and poor installation.

There was complete unanimity among participant groups that the scheme should be rehabilitated by repairing and upgrading the infrastructure. The expectation was that this would result in food security for the community in this area of extreme poverty. It was estimated that 86 per cent of households were living below the poverty datum line. There was an extremely high level of illiteracy (91 per cent) among heads of households, of whom 21 per cent were widow-headed and one third over sixty years of age. As with the other three case studies, the scheme is worth rehabilitating and modernising as a poverty alleviation measure, provided the interest and redemption of the R7,74 million capital required is written off. However, before this can take place the conflicts within the community need to be solved and the necessary institutional support services put in place.



CONCLUSIONS

A comparison of data from the four case study schemes revealed many common problems. There was common consensus on the main project objectives of food security, increased incomes and development of farming skills. Except for commercial farmers on two of the schemes, plot sizes were too small to derive a living from agriculture alone.

The four case studies reported on shows that, with the exception of sugar cane schemes in KwaZulu-Natal, which have a ready market and good support services, many of South Africa's small-scale irrigation schemes are in a state of crises. The near or complete collapse of schemes due to a combination of lack of funding, poor management and maintenance of infrastructure, as well as inappropriate organisation, has led to low productivity and poverty.

GUIDELINES

The process of rehabilitation planning and modernisation is complex and diverse. It is difficult to provide definitive guidelines to suit all schemes. Not two schemes are the same. In the report a check-list and discussion of the basic elements to be considered in rehabilitating selected irrigation schemes are put forward. These include:

- Sustainable irrigation rehabilitation should be integrated as part of the whole process of area and rural development, including consultation with the various role players and a participative approach to feasibility studies, planning and implementation.

- A thorough understanding of the socio-economic situation is an essential pre-requisite for scheme rehabilitation. After identifying key informants and local groups, it is important through structured interviews, and if necessary, household sample surveys, to establish approximations of age structure, education and literacy, managerial ability, the role of youth, gender issues, poverty indicators, labour, health, land tenure and various perceptions. An analysis of these variables will establish constraints as well as determining the likelihood of overcoming constraints through training and assistance which may support or otherwise facilitate efforts to rehabilitate the scheme concerned. An example in this study was the need to encourage younger scheme participants.

- It is important to recognise any potential negative impacts on the natural environment, such as soil erosion, destruction of vegetation, water pollution and water borne diseases.

- Before considering rehabilitation it is important to establish present con-

Many of South Africa's small-scale irrigation schemes are in a state of crises. The near or complete collapse of schemes due to a combination of lack of funding, poor management and maintenance of infrastructure, as well as inappropriate organisation, has led to low productivity and poverty.

straints on crop production, including endemic pest and diseases, soil, climate, labour, draught power, inputs, marketing and agricultural services, which unless remedied, are likely to continue to be experienced in the future.

- It is vital to clearly establish the quality, availability and reliability of the scheme water supply. A careful assessment needs to be made of scheme infrastructure, including water distribution and irrigation methods. Designs should be specific to community needs and resources and will often require professional assistance. There should be full community participation in any construction and implementation. Farmer participation should take place at all stages of the rehabilitation process and may take up to three years to implement. Participation should be through establishing water users associations (WUAs), and should be looked upon as a "learning process". There will be a need for flexibility and experimentation. Sustainability is likely to depend not on total self-reliance, but initially on a new mixture of local resources with limited external support.

- The new National Water Act makes provision for the formation of water users associations. On all schemes undergoing rehabilitation WUAs need to be formed in consultation with local communities. On large schemes there is a need to form block committees responsible to WUAs for water distribution and be represented on the WUA. A concerted training programme for WUAs and block committees is fundamental to successful scheme rehabilitation. Over time, the operation and maintenance of the scheme should be undertaken by the water users association. An important role of the WUAs is to liaise with input suppliers to supply appropriate inputs in bulk, at reasonable cost and in good time for the season.

- Lack of adequate ploughing services is often a serious constraint. It is incumbent upon WUAs to negotiate with contractors, as well as investigate the possibility of using ox drawn tillage and small tractors.

- A pre-requisite for successful scheme rehabilitation is to place well-trained competent extension officers on the scheme, who, together with the project facilitator, can commence training farmers from the outset.

- On-farm research is a much neglected, but essential part, of small-scale farmer irrigation scheme development. Research is needed, not only in the new and alternative high value crops, but also in determining real crop water requirements, and developing integrated farming systems.

Copies of the full report entitled **Guidelines for rehabilitation of small-scale farmer irrigation schemes in South Africa** (WRC report 891/1/00) are available free of charge (in South Africa) from the Water Research Commission, Private Bag X03, Gezina 0031. (Overseas price: US$ 20, via surface mail).

Setting water supply tariffs for industrial and commercial consumers

Commerce and industry represent a major grouping of water consumers in most local authorities, consuming up to 50 per cent of the water supplied in larger municipalities. These enterprises also have significant impacts on the local economy, society and the environment. Yet surveys have revealed significant inconsistencies in the manner in which municipalities set tariffs for these consumers.

The Water Research Commission has already established a guideline on setting water tariffs, in the form of a module in the Management guidelines for water service providers. However, this module concentrates mainly on water tariffs for residential consumers.

Recognising this gap, the Development Bank of Southern Africa and Durban Metro Water and Waste took initiatives which led to the establishment of a new Water Research Commission project in 1998 to establish guidelines for water supply tariffs for industrial and commercial consumers.

The guidelines have been compiled and written by the Palmer Development Group and are aimed at water managers in water services authorities and water services providers who are involved in setting retail water prices, that is, prices to the end-user. The Guide will assist them in setting water supply tariffs for non-residential consumers, taking equity, economic development and conservation objectives into consideration.

In many cases the existing tariffs may be quite different from the desired tariffs. Hence, it is important that the process of tariff reform is given adequate attention. In the Guide, the authors propose the following tariff reform process:

- **Understand the national context.** The roles of various institutions involved in water supply are described, together with the relevant national water pricing policies.
- **Understand the local context.** A broad range of factors are outlined which tariff reformers may wish to consider to better understand their local context. These include the local institutional, historic, economic and water resources context, the consumer market, the costs of supply, revenues and current tariffs. Given the political nature of tariff-setting practitioners are strongly advised to undertake a stakeholder analysis.
- **Set pricing goals**, establishing principles and develop performance indicators. Practitioners are advised to define pricing goals and to prioritise or weigh these as far as possible. A basic set of principles are proposed for good tariff practice. Various practical indicators are proposed in the Guidelines with which to measure organisational performance.
- **Make some preliminary choices.** The possible components of the water tariff are described, including development charges, connection charges, fixed fees and volumetric tariffs. Two approaches are described in the Guidelines for determining tariff levels: the revenue requirements approach and the marginal costs approach. The user is advised to consider the impact of future supply costs and to examine the scope for cost reductions when determining revenue requirements. A set of guidelines are provided to assist with these choices, covering universal cases and specific conditions.
- **Define the tariff structure and set tariff levels.** Users are advised to establish a tariff policy framework on the basis of the selected goals, and to use this for further consultation.
- **Undertake consultation and evaluation exercises.** The likely impacts of tariff reform should be evaluated before approval is sought. Depending on the outcome of the stakeholder analysis, and the extent of the proposed tariff reform, it may be necessary to consult stakeholders prior to seeking political approval. Long-term evaluation procedures should be set up to establish whether the tariff reforms are achieving the desired pricing goals.
- **Refine tariffs.** Users are advised to undertake incremental reforms to tariff structures and levels until they achieve desired goals and adhere to best practice principles.

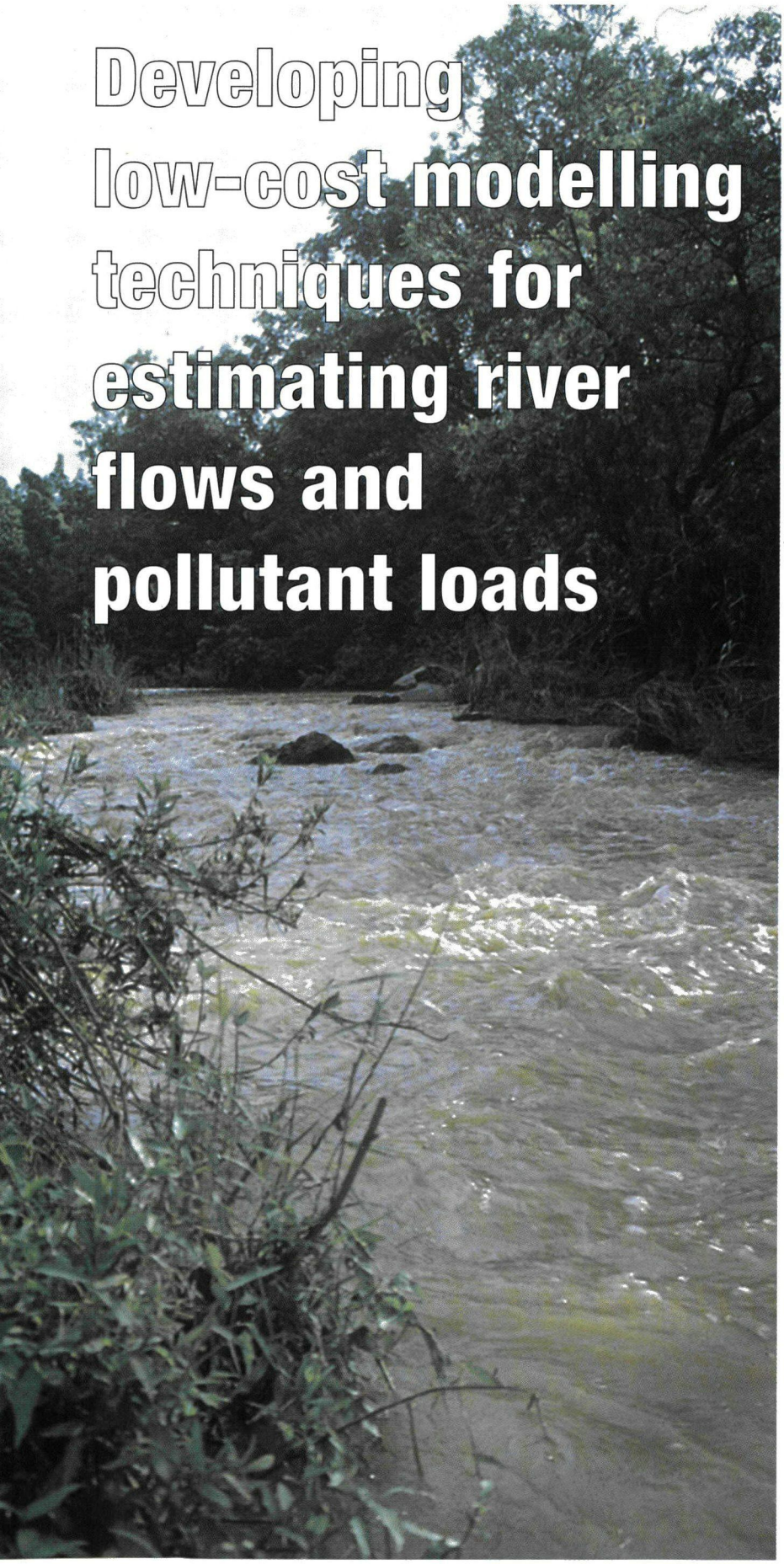
A key conclusion of the research is that there is no practical system to implement inclining block water tariffs for non-residential consumers.

The report also describes some tariff refinements for special cases, such as the use of new development charges, seasonal pricing, drought pricing and commodity price-linked tariffs.

Finally, the report reviews a number of international and local case studies as a means of offering insights into the circumstances of other local authorities.

Copies of the report titled **Guidelines for setting water tariffs - with a focus on industrial, commercial and other non-residential consumers** (WRC report 992/1/00) are available free of charge (in South Africa) from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: US$ 15, via surface mail.

Developing low-cost modelling techniques for estimating river flows and pollutant loads



Non-point resource pollution has been identified as a priority research area in South Africa, because there is limited information available locally to support non-point source quantification for management purposes. One of the major obstacles in increasing the database is the high cost associated with conventional methods of monitoring diffuse source loads. The conventional rigorous approach calls for extremely expensive continuous flow gauging in conjunction with high frequency water quality sampling. A high level of technical competence is also required to maintain equipment and process the large volumes of data.

This is said in a report published by the Water Research Commission on the feasibility of developing a low cost methodology for estimating river flows and pollutant loads at ungauged sites. The research was carried out by CE Herold and PH van Eeden, consulting engineers, at the firm Stewart Scott in Sandton, Gauteng.

The researchers say the high cost associated with conventional methods has tended to limit research to a few small site specific study catchments.

"Since small study catchments are typically dominated by relatively unique local land use characteristics, it is difficult to apply the research results to wider catchment areas. Construction of the large number of monitoring stations that would be required to derive reliable relationships between land use and river quality will in all probability never be realised in time to be of use in predicting the effects of rapid urbanisation. Moreover, the constraints imposed by the difficulty in locating suitable flow gauging sites often prevent the optimal selection of sub-catchments - which should be land use driven."

The researchers say this raises the need to develop a low cost, low technology methodology that can be used to estimate diffuse source loads and develop useful relationships between in-stream river quality and land use.

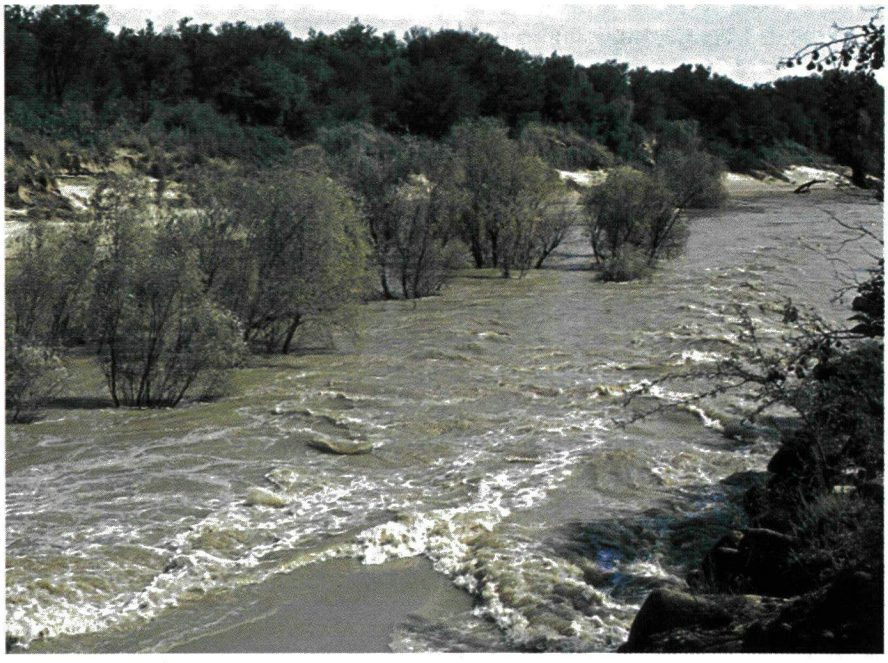
SAMPLING

This study comprises the first phase of the project and was confined to developing the methodology, with only limited water quality sampling and testing. Sample points were chosen below areas with relatively uniform land use development, including low and high density residential areas, industrial, rural (dry land cultivation) and undeveloped land.

Ten samples were taken at each site over a six-month period. Some of the sample dates

were planned to coincide with wet weather conditions, thereby ensuring that the limited number of samples covered a reasonable range of flow conditions. The key water quality variables that were sampled included pH, electrical conductivity, sulphate, nitrate, ammonia, total phosphate, faecal coliform, dissolved oxygen and temperature. The later two variables were used to calculate the percentage oxygen saturation. Very crude estimates of flow were made at each site. However, most of these estimates are considered to be highly inaccurate and were not used in further processing. This had no detrimental effect, since the methodology is based on the assumption that definitive flow data is not available at the monitoring stations.

The small database prevented an assessment of the effect of sampling frequency and sample size on the model results. It also prevented partitioning the sample to test the effect of deriving separate relationships for wet and dry flow ranges.



The use of modelled flow data has the advantage of freeing the practitioner of the need to confine water quality sampling to sites where flows can be gauged. The main requirement is that sufficient samples should be gathered to cover a range of flow conditions.

MODELLING

The daily time step NACL model was used to simulate flows at each monitoring site. As expected, spatial and temporal variations in rainfall prevented the model from accurately replicating the flows that occurred on each day on which water quality sampling took place. The actual accuracy of flow estimation at the sampling points could not be assessed, since only very inaccurate flow observations could be made.

Both natural and power regressions between modelled flow and concentration were derived for key parameters at each site. The water quality variables for which these regressions were derived included electrical conductivity, sulphate, nitrate, ammonia, total phosphate, faecal coliform and the percentage oxygen saturation.

ESTIMATION

The most appropriate regression equation for each water quality variable was used to estimate a regressed concentration corresponding to each simulated daily flow. Normalised random noise was then added to the regressed values to allow for the considerable variation that was attached to the observed data. Provision was made for specifying an applicable range of flow conditions (in this case close to the flow range of the observed data). Allowance was also made to filter out unreasonably high or low concentrations.

The range of concentrations thus generated for each water quality variable and station was also presented in the form of a duration curve. The results were tabulated to show key statistical properties, including mean, standard deviation, regression constants, standard error, correlation coefficient and selected percentile values.

CONCLUSIONS

The researchers say the use of a regression equation results in severe damping of the generated concentrations of non-conservative pollutants. The use of this methodology (or mean values) inevitably leads to gross understatement of the true range of concentrations that arise. The methodology put forward in this report holds the advantage of taking account of the semi-stochastic manner in which concentrations vary about the regressed values.

Use of modelled flow data (suitably corrected against observations at a downstream reference gauge) has the advantage of freeing the practitioner of the need to confine water quality sampling to sites where flows can be gauged. Application of this methodology means that monitoring sites can now be chosen close to source areas, thereby monitoring relatively homogeneously developed areas. The main requirement is that sufficient samples should be gathered to cover a range of flow conditions. It has been demonstrated that by varying sampling dates according to weather conditions, it is possible to monitor a wide range of flows with relatively few samples.

Copies of the report entitled **The feasibility of using low-cost modelling techniques to relate river water quality and diffuse loads to a range of land uses** (WRC report 796/1/01) are available free of charge (in South Africa) from the Water Research Commission, Private Bag X03, Gezina 0031. (Overseas price: US$ 20, via surface mail).

New reports published by the Water Research Commission

The following reports are available free of charge (in South Africa) from the Water Research Commission in Pretoria. To order a copy, please contact the librarian, WRC, Private Bag X03, Gezina 0031. Tel: (012) 330-0340. Fax: (012) 331-2565. E-mail: orders@wrc.org.za

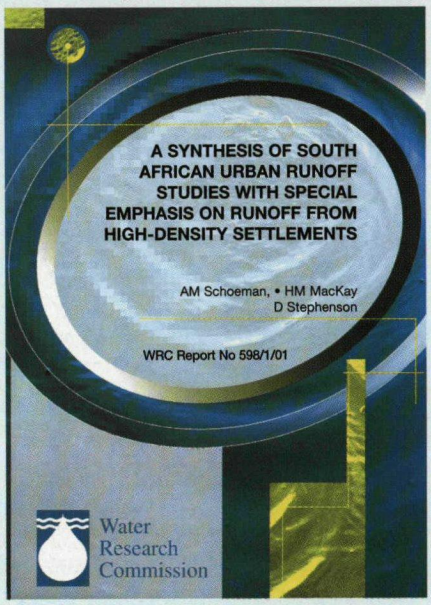
Report 598/1/01 - A synthesis of South African urban runoff studies with special emphasis on runoff from high-density settlements

Report to the Water Research Commission by the Water Quality Information Systems Programme, Division of Water Technology (Watertek), CSIR in conjunction with the Water Systems Research Group, University of the Witwatersrand.

Authors: AM Schoeman, HM MacKay and D Stephenson
Overseas price: US$ 10 (via surface mail)

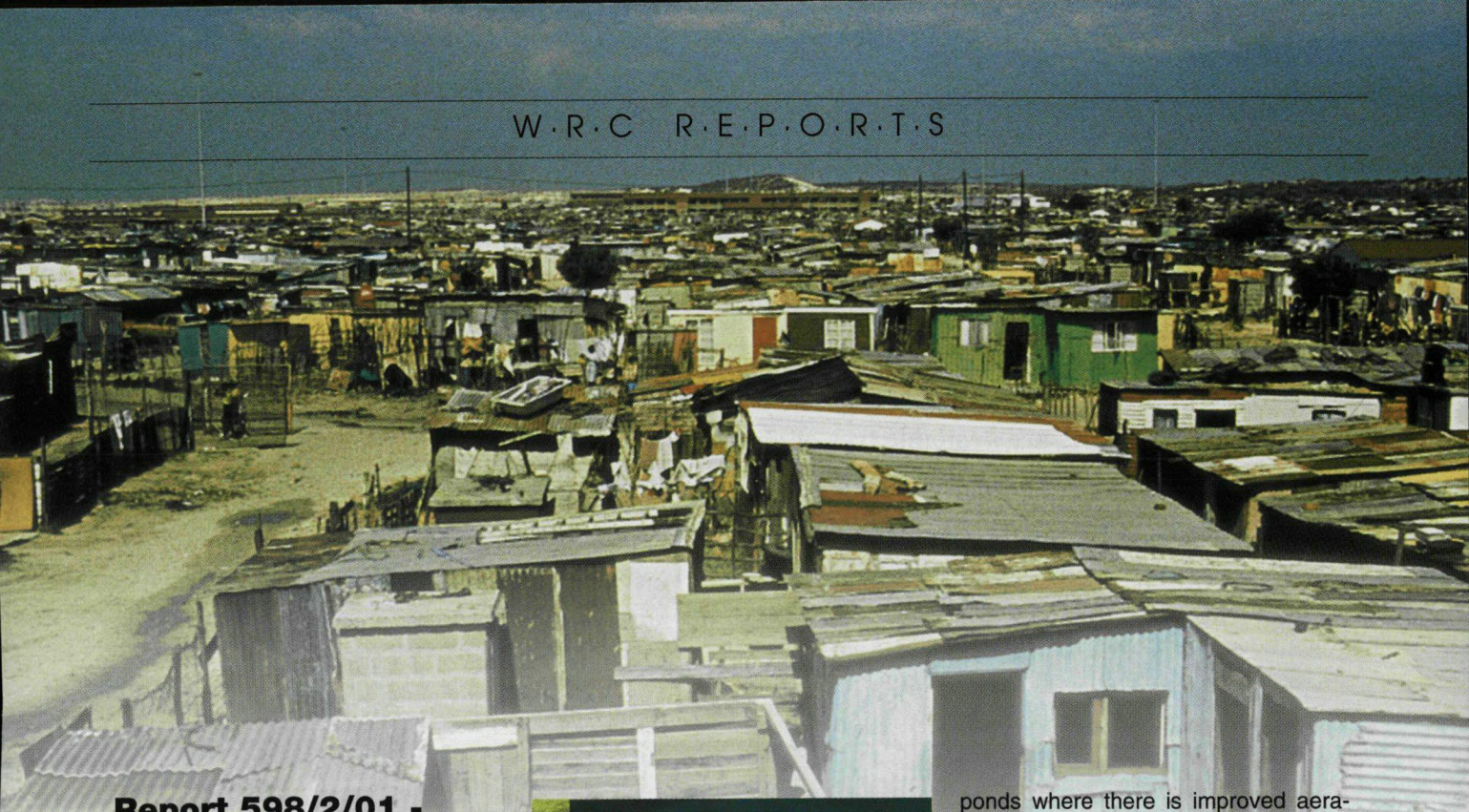
Urban runoff water quality is a rapidly growing problem throughout South Africa and needs to be addressed urgently, so as to prevent the spread of disease, ensure that the costs of purifying potable water are kept within affordable limits, and, to make sure that the integrity and diversity of the aquatic environment are not threatened or compromised.

The report is a synthesis of the literature on South African urban runoff studies and the aim was to derive an overview of the scale and extent of the causes and consequences of contaminated urban runoff with particular reference to high-density urban developments. The outputs from this study formed the foundation for the development of general guidelines and recommendations for the management of urban runoff. A series of reports, as well as a computer program, have emanated from this project.



Specific recommendations for management attention are included in the report. These are:

- Historical population growth rates for a specific community should not be used to plan for future urban needs of that community, because of the extreme variability in township growth rates. Instead, these data should be used as conservative estimates to plan the maximum carrying capacity or population density of an area. This will allow planners and managers to select and develop new areas, once existing areas reach their maximum population density.
- No new urban developments should be allowed to incorporate bucket latrine systems and all bucket latrine systems should be phased out as soon as soon as possible.
- Pit latrine systems should be phased out as soon as possible from all urban developments that are located on sandy or permeable soils.
- All urban developments should be provided with effective garbage collection services and indiscriminate dumping must be avoided.
- All streets in urban areas should be cleared regularly of sand and other debris to minimise the risks of blockages in the stormwater drainage system.
- All stormwater grids should be inspected regularly. Ideally, these grids should be cleared or cleaned on a weekly basis during the dry season and after each storm during the rainy season.
- No human habitation of any sort should be allowed in or near any stormwater detention basins or flood control facilities. All squatters who presently occupy sites in such locations should be provided with alternative locations as a matter of urgency.
- The number of people occupying each residential plot should be controlled in accordance with the level of services provided (i.e. number of toilets and potable water supply points).
- The quality of water emerging from all stormwater outfalls should be sampled regularly to determine whether or not the stormwater outfalls are contaminated, and
- Bathing and collection of water for human use from watercourses that receive any stormwater discharge should be prohibited at all times.



Report 598/2/01 - Options for the interception and appropriate treatment of urban runoff

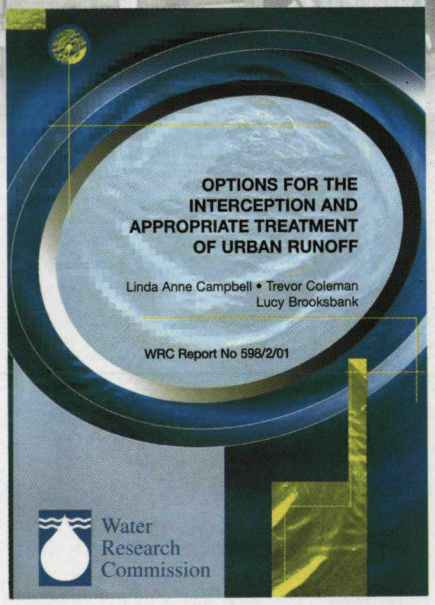
Report to the Water Research Commission by the Water Systems Research Group, University of the Witwatersrand.

Authors: Linda Anne Campbell, Trevor Coleman and Lucy Brooksbank
Overseas price: US$ 15 (via surface mail)

In this report a number of urban runoff treatment options are reviewed. Different treatment systems were chosen as they were suitable for areas in which little space is available, where cost is of importance to the local community and where little operation or maintenance by skilled operators is required.

The treatment systems were divided into pond systems, filtration and vegetated filtration systems, chemical treatment and wetland systems. The river itself can be imagined as a treatment system and the equations and factors describing the assimilation of the various pollutant types can be seen in WRC report 598/3/01 entitled "A study of stormwater/urban runoff from Alexandra Township in the Jukskei River".

Pond systems are one of the most widely applicable and advantageous



methods of treating wastewater in hot climates. They provide a site in which water can be contained for a period of time during which processes such as settling, oxidation, uptake of pollutants by algae and plants, bacterial die-off and thermal and wind mixing are active to improve the water quality.

Ponds are designed in a number of ways to enhance each of these processes with pollutant loading, size of the pond, retention time and reaeration being controlled. The usual removal efficiencies in ponds are 60 to 90 per cent for phosphorus, 80 to 90 per cent for biochemical oxygen demand (BOD), 80 to 90 percent for suspended solids and some removal of metals. These values change with different pond systems. For example, in ponds where there is improved aeration due to mechanical aeration, oxidation of organic matter by bacteria increases and the removal of BOD can be increased to about 95 per cent.

Pond systems require very little maintenance but it is important that excess vegetation is removed, the littoral zones of the pond are stabilised and are not allowed to erode, and that excess sludge at the bottom of the pond is removed by dredging from time to time.

The report includes a review of rock filters, sand filters and gross pollutant traps. Rock filters and sand filters can be described as being forms of biological filtration, in that as the wastewater flows over the medium, biochemical reactions can take place.

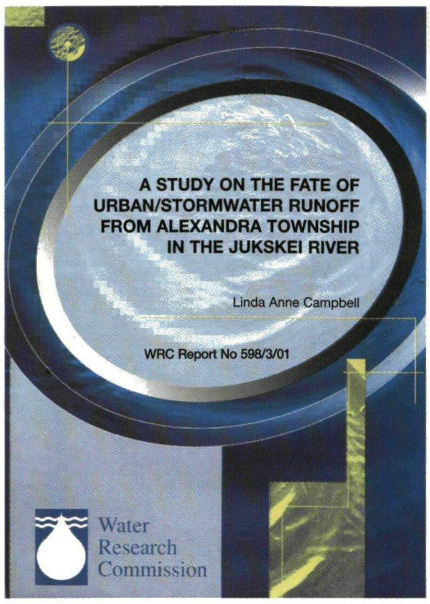
Infiltration structures are popular in European countries. Processes include filtration of solids by the soil matrix, adsorption to dissolved ions in the soil matrix, oxidation and nitrification by the soil microorganisms, with the effluent water being discharged to the groundwater. In this report grass swales, grass plots and buffer strips are reviewed.

Most chemical systems work by the principal of chemical precipitation. The most common chemical treatment is the disinfection of waste waters with chlorine. Disinfection and phosphate removal are reviewed in this report, while a section on constructed wetlands as a water treatment system, is also included.

Report 598/3/01 - A study on the fate of urban/stormwater runoff from Alexandra township in the Jukskei River

Report to the Water Research Commission by the Water Systems Research Group, University of the Witwatersrand.

Author: Linda Anne Campbell
Overseas price: US$ 25 (via surface mail)



A stretch of the Jukskei River, just downstream of the Alexandra Township near Johannesburg, was used to determine the different biological, physical and chemical processes that pollutants undergo during natural assimilation, their rates and efficiencies of assimilation in rivers and their impact on the environment downstream of the urban area. "Grab" samples were taken over a period which included both low-flow and storm events.

The report says it was found that microbiological pollution, nutrients and litter, typical of runoff from townships, were found to be the major pollutant problems. Due to the high concentration of nutrients in the run-off from Alexandra Township, the major changes seen were in the biological conversion of organic nitrogen compounds and ammonia to nitrates, in the biochemical oxygen demand (BOD) and in the concentration of dissolved oxygen in the river, with lows of 1.1 to 1.5 mg/ℓ oxygen being recorded at Alexandra. A high concentration of ammonia at Alexandra, where most of the pollution is discharged into the river, is seen. This decreases rapidly by nitrification to nitrates. The chloride concentrations were much lower than those seen in other studies.

A rapid rise in the concentration of faecal coliforms has been noted with a high of 31 million/100 mℓ being recorded at Alexandra in September 1994. This poses a health risk but fortunately a rapid decrease in faecal coliform concentrations were seen with distance downstream, due to their exposure to the alien water environment and the ultraviolet ray disinfection from the sunlight.

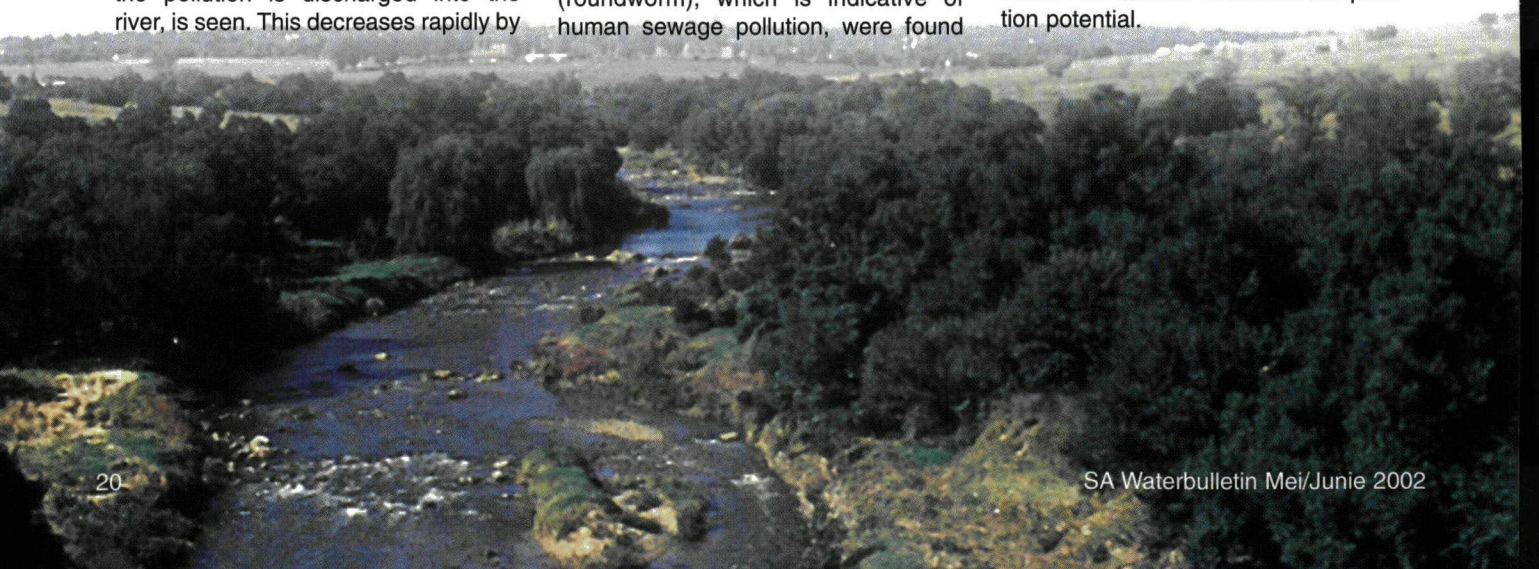
Oxidation reactions for nitrogen and carbonaceous pollutants are also important but significant changes were only seen after some time as the reaction rates are slow. Most of these reactions take place in the benthic layer of the river bed. A major portion of the dissolved oxygen is used for these oxidation reactions.

Large concentrations of Ascaris eggs (roundworm), which is indicative of human sewage pollution, were found down the whole length of the six kilometre reach used for the study. Ascaris eggs are used as indicators of pollution as they are usually found in large numbers.

The QUAL2E water quality model, used by the Environmental Protection Agency (EPA) in the United States, was used to model the reactions that the nutrients, biochemical oxygen demand and dissolved oxygen undergo.

During storm events, the main process occurring is the entrainment of pollutants from the river bed. These are then washed downstream. Many pollutants such as phosphates, lead, iron and organic nitrogen are associated with the suspended solids and had similar pollutagraphs. Factors to determine the pollutagraphs for each of these pollutants downstream of a pollution source were calculated and used in the modelling of these pollutants with WITQUAL, a water quality model developed by the Water Systems Research Group.

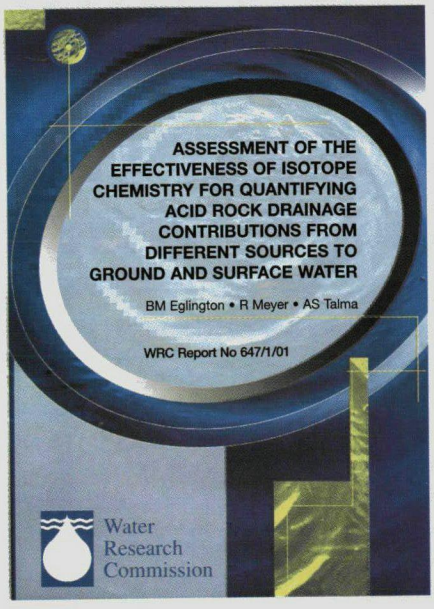
To combat these problems, various treatment options would have to be implemented. A number of these options are detailed in the Recommendations section in the Summary and Conclusions chapter of the report. The main problem associated with non-point source pollution coming off catchments such as Alexandra, is that costly at source diversion treatment processes would not be viable. Due to the constant influx of people to the townships, there is little chance that the provision of water-borne sewerage can keep up with the ever increasing demand. Diversion systems like ponds or wetlands could be implemented to collect the runoff and treat it before it is discharged into the water. Buffer strips and other vegetated infiltration systems could also be built to reduce the pollution potential.



Report 647/1/01 - Assessment of the effectiveness of isotope chemistry for quantifying acid rock drainage contributions from different sources to ground and surface water

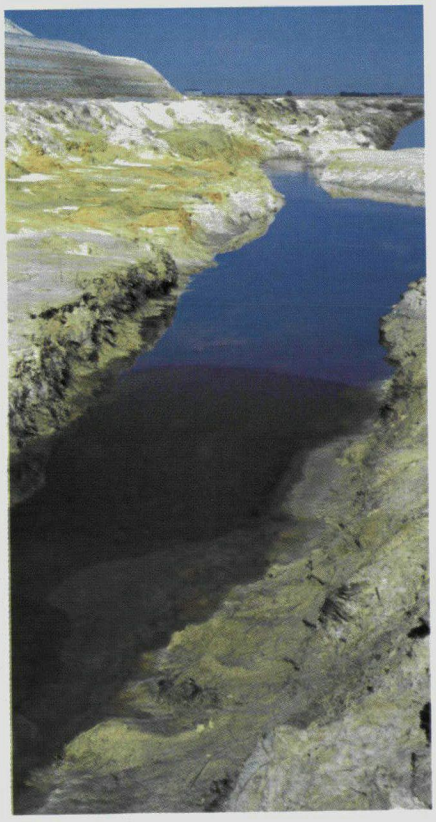
Report to the Water Research Commission by the CSIR, Pretoria.

Authors: BM Eglington, R Meyer and AS Talma
Overseas price: US$ 20 (via surface mail)



This report deals with a project designed to investigate the feasibility of using various isotopes of elements common in acid mine drainage to provide supporting information for standard chemical and hydrogeological studies of water quality downstream of acid rock drainage sources.

Acid rock drainage is common in both the gold and coal mining districts of South Africa. In general, acidic water is produced by the interaction of water with sulphide minerals, e.g iron pyrites in the ore bodies (conglomerate or coal, respectively) or in tailings dumps associated with mining activity in these environments. Experience of acid rock drainage has provided examples where pH has been reduced from a normal value of ~6 to as low as 1.5. Sulphate contents frequently exceed 5 000 mg/ℓ and the researchers have measured point sources in excess of 40 000 mg/ℓ. The severe reduction in water quality has major implications for industrial, urban and agricultural activity further downstream whilst also adversely affecting the long-term habitability of the earth in these areas. To ameliorate the effects of existing acid rock drainage and to plan for future mining and industrial activity, it is necessary to have a better quantitative understanding of the migration paths for ground water and the interaction between mine water and both surface and ground water Quantification of water quality in terms of source, travel distance, route and time is thus very important for the effective management



of South Africa's scarce water resources.

Studies to distinguish between water derived from various sources are currently based on routine chemical analyses for elements and ions such as calcium, magnesium, sodium, iron, chlorides, sulphates, etc. One of the major disadvantages associated with such standard chemical investigations of water is that the different elements are variably prone to precipitation or adsorption onto clay particles and hydroxides. The chemical composition of water may thus vary non-linearly with distance from the source. This is particularly prevalent for acid rock drainage where pH typically varies from < 2 in badly contaminated situations to ~6 - 8, resulting in enhanced diversity of chemical behaviour between the different elements.

The isotopes selected for use in this study were deuterium, oxygen, strontium and lead. The first two elements are the major components of water and therefore provide a direct indication of the history of the water sampled. Strontium is a common trace constituent of the rocks and the soil through which ground water passes and is always present at measurable levels in water. Lead is a trace component of sulphide minerals such as iron pyrite, the oxidation and dissolution of which is the prime cause of acid rock drainage. Lead therefore provides a direct link to the source of contamination in acid rock drainage situations. Lead is also present in certain silicate minerals, usually at lower concentrations than is strontium.

Deuterium and oxygen are classified as light, stable isotopes whereas strontium and lead are termed radiogenic, stable isotopes. All the isotopes concerned are readily measured in ground and surface water provided that certain precautions to avoid contamination are taken during field sampling and in the laboratory. These are particularly important for lead because of its low concentration in natural waters.

This study has demonstrated that radiogenic isotopes in water vary according to a structured, easily determined manner and are sensitive indicators of both mixing of water with different isotopic compositions and of water-rock exchange processes. Together with light stable isotopes and macrochemical constituents, they are ideally suited for precise, often quantitative studies of acid rock drainage pollution. They may be used to identify different, isotopically distinct sources of pollution and, in certain situations, may also quantify relative proportions contributed from the different sources.

Report 1005/1/02 - A linear catchment model for real time flood forecasting

Report to the Water Research Commission by the Civil Engineering Programme, University of Natal.

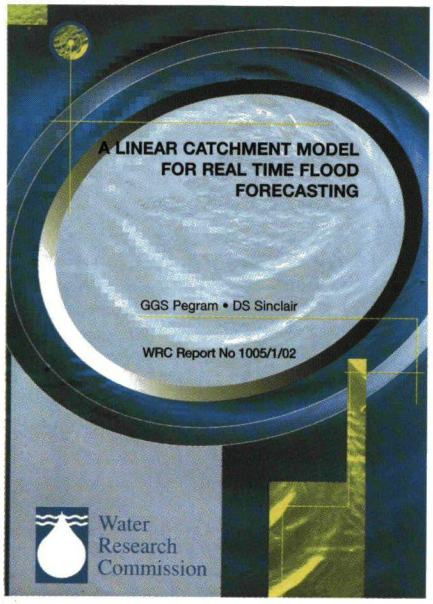
Authors: GGS Pegram and DS Sinclair
Overseas price: US$ 20 (via surface mail)

The report discusses the refinement of a linear transfer function model which, in operation, is very fast, readily updateable, robust in calibration and exploits the data dense information from weather radar measurements to maximise the advantage of forecasting future flows and floods in problem rivers.

Flood forecasting has become an increasing necessity in South Africa, because as the population puts more pressure on the land near waterways for habitation, business and recreation, there is a greater potential for loss of life and damage to property. Therefore, catchment and disaster managers need to be armed with tools which work well to yield timeous, reliable and useful forecasts of floods in urban and rural areas.

In an urban environment, short reaction times (of the order of one hour) are typical. Flood forecasting in this situation requires a robust model, operating in small time steps. Existing rain gauge networks do not provide real time rainfall information and lack sufficient spatial detail. Weather radar provides a promising tool with high resolution real time information on rain rates. The combination of an efficient catchment model with the real time radar data creates an attractive way of providing flood warnings for disaster management in urban situations.

From the time that the rainfall hits the ground there is a delay before the water travels over the ground and enters the stream or drain which channels it to the point of concern. There is another delay while the flow in the channel builds up and travel down towards the problem point. The total time lag on a small catchment (10 km²) may be in the order of an hour while on a large catchment (5 000 km²) one might find up to ten



hours delay. To take advantage of this opportunity to provide advance warning one needs to find out how much rain is arriving now and where.

The weather radar gives an almost instantaneous picture of where the rain is falling in fine detail over a large area. By contrast, rain gauges give accurate at-a-point measurements but are not useful for spatial estimation except over a long period of time (such as a month or a year). They are a poor substitute for the radar information but are necessary for checking the radar measurements over a long period of accumulation (a week or a month). They are only useful for flood forecasting if they telemeter the information instantaneously - it is no good experiencing a flood and then reading the rain gauges the following day to find out how much it rained, unless one is doing analysis.

The advantage of the radar in forecasting is that one knows in detail where it is and, equally important, where it is raining. This means that with weather radar cover on a catchment one has detailed information about where the rain is falling so its progress through the catchment can be predicted and then tracked by stream gauges.

The report says there are two approaches to improving forecasting ability. The first is to make more refined models with more intensive measurements to improve the estimates. The second is to improve the information collection instrumentation for both rainfall and stream flows and telemeter their measurements instantly to the flood control room. This up-to-the-minute information allows the model estimates to be continually adjusted to improve the future forecasts. A combination of these two approaches will give the best results mindful of the need for relatively fast and straightforward computational procedures which the decision makers can trust.

It is possible to get good 10 minute to 30 minute forecasts of rainfall amounts and locations on a one kilometre grid from a sequence of radar images which are usually five minutes apart. This is done by exploiting the time and space dependence in rainfall fields which is explicitly modelled by the String of Beads model (see WRC Report 1010/1/02) in forecast mode. By the time one forecasts to two hours ahead using statistical methods the forecasts deteriorate in accuracy. However, from the viewpoint of a coastal city such as Durban, for instance, there is great benefit in being able to "see" (with a radar) what is coming in from the sea where there are no rain gauges, especially if that is the prevailing direction from which the weather arrives.

The complexity of modelling a non-linear process such as rainfall-runoff conversion by any means is difficult and approximate. The more complex the model, the more unwieldy the model fitting process. This is amply demonstrated in the report where a generated rainfall-runoff process (from a known model) is used to generate a sequence of flows and the model parameters are re-estimated and compared with the originals. It is shown that the more complex the definition, the less precise the outcome. When it comes to a natural catchment where there are gross approximations used in the modelling, then the fitting of any model is fraught with difficulty and the larger the number of parameters, the less precise their estimation.

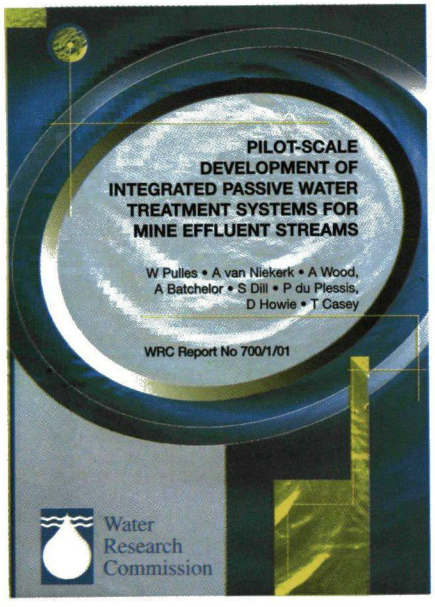
By contrast with more "physically based" models, the linear transfer function approach has the advantage that although one knows it is an approximate model, it captures most of the important characteristics of the rainfall-runoff process - storage, losses, delays, topography, etc. The linear construct has the particular beauty of being relatively fast and simple to apply.

Report 700/1/01 - Pilot-scale development of integrated passive water treatment systems for mine effluent streams

Report to the Water Research Commission by Pulles Howard & De Lange Incorporated

Authors: W Pulles, A van Niekerk, A Wood, A Batchelor, S Dill, P du Plessis, D Howie and T Casey
Overseas price: US$ 30 (via surface mail)

The South African mining industry is facing major problems with regard to the management and treatment of contaminated mine water. These problems occur at operational mines and, importantly, they also occur at mines which have ceased operations and which have long term water quality problems.



Currently available effluent treatment technology for dealing with water quality problems is primarily of a chemical or physical nature. Although this technology is generally effective, it typically has very high capital and operating costs and intensive, ongoing long-term maintenance requirements. This is a particular problem for those mines that have ceased operations and where it is not practical or cost-effective to construct an active treatment plant that requires constant supervision and maintenance.

The report contains the results of a research project in which the researchers tried to develop low cost, self-sustaining, low maintenance passive treatment systems to address the problems of acidification and salinisation (especially in terms of sulphate removal technology) at operating, defunct and closed mines in South Africa.

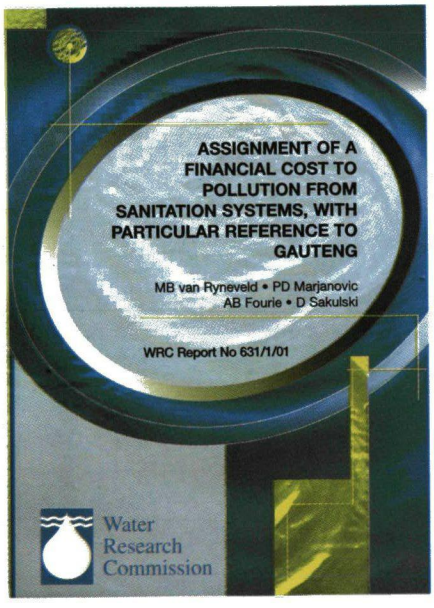
Two mines, Randfontein Estates Limited and Arnot Colliery, were identified as suitable pilot plant sites and details of the design approach are given in the report. According to the report the project team had mixed success in addressing the objectives of the project, however, valuable lessons were learnt which can be and are being used in the planning and undertaking of further research into the development of passive treatment technology.

Report 631/1/01 - Assignment of a financial cost to pollution from sanitation systems, with particular reference to Gauteng

Report to the Water Research Commission by the Department of Civil Engineering, University of the Witwatersrand.

Authors: MB van Ryneveld, PD Marjanovic, AB Fourie and D Sakulski
Overseas price: US$ 20 (via surface mail)

This report provides a methodology for assigning a financial cost to the environmental impact of different sanitation systems. It also provides a first estimate of the comparative costs of pollution from different sanitation scenarios in Gauteng, as well as a very rough first estimate of the comparative costs of pollution from different sanitation systems in general.



Various studies have suggested that in order to ensure access to adequate sanitation facilities for all the citizens of South Africa within the constraints of the country's financial resources, it will be necessary to use a mix of levels of service - an option which (ignoring costs of pollution) is significantly cheaper than high levels of service throughout.

Studies have also envisaged a significant amount of on-site sanitation in use in the urban areas of South Africa for the foreseeable future. However, a concern that is often raised in relation to the use of on-site sanitation is the potential pollution of water resources that is associated with these systems. This concern about environmental impact of on-site sanitation systems appears to be serious enough to persuade some decision-makers in the urban areas of the country to opt for the provision of full water-borne sanitation.

This report therefore fulfils a need to translate the environmental impact of sanitation systems (and on-site sanitation in particular) into financial terms so as to enable a comparison of these systems to be made, which includes not only the cost of the construction, operation and maintenance of the systems, but also the cost of their respective environmental impacts.

Report 520/1/01 - Guidelines on appropriate technologies for water supply and sanitation in developing communities

Report to the Water Research Commission by the Division of Water, Environment and Forestry Technology of the CSIR.

Authors: LA Pearson, J Bhagwan, W Kariuki and W Banda
Overseas price: US$ 20 (via surface mail)

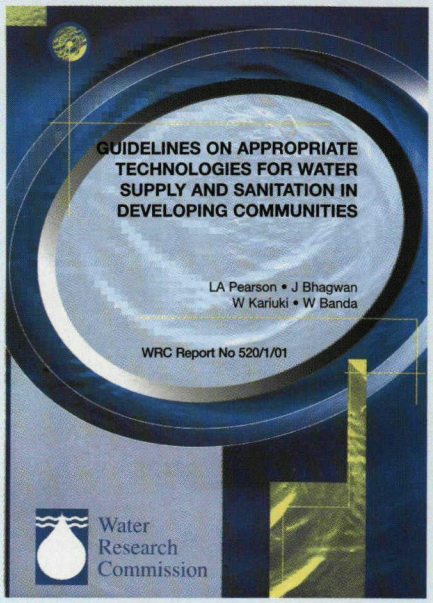
The new emphasis in South Africa on health and hygiene awareness has created a significant demand and need for information on appropriate technologies in the field of water supply and sanitation for developing communities. This report contains six documents dealing with technologies and approaches which work in the developing areas. The documents are:

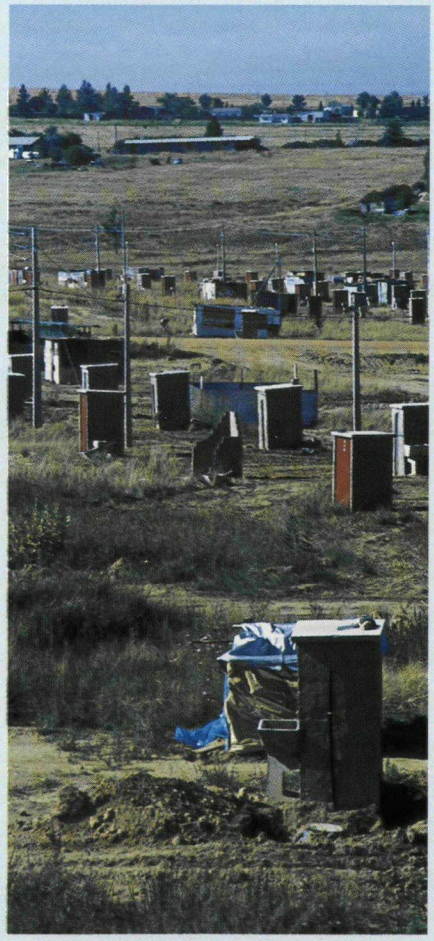
❒ Groundwater exploration, use and conservation

This guideline document has been compiled particularly for implementing and project agents. It describes the occurrence of groundwater in nature and the approaches and methodologies applied to extract groundwater as a water supply. In addition the guideline addresses the requirements for good care of boreholes and the proper management of the groundwater aquifer to avoid over-exploitation.

❒ Primary health care through improved water supply, sanitation and community education

This document is easily useable as a training tool by community health workers. It describes the health impacts of water supply and sanitation, including disease transmission routes. This is followed by a section on educational techniques and programmes in the area of primary health care. The main section of the document deals with the planning and implementation of a targeted health and hygiene education programme in a community.





❒ Springs and spring protection

This document deals with the occurrence of groundwater at the near surface and the occurrence of springs. The different types of springs are discussed in detail and the approach to be adopted in selecting a spring for use as a water source for a community water supply. The quality of spring water is addressed, including steps that can be taken to improve the water quality without the need for treatment. The different options for the development and protection of the spring source is described and the ongoing maintenance requirements are addressed.

❒ Small-scale desalination

Desalination is not a general need in rural water supply schemes in South Africa. However, there are a few areas in South Africa where almost all sources of water are saline or carry a salt that can be harmful to the health of the users. This includes areas using groundwater that has a high fluoride content, a high nitrate content or a high salinity.

The guideline document is written specifically for development agencies having to deal with such situations. The document describes the different types of problems salinity found in water and the different options for treatment of these waters. These range from the relatively sophisticated technologies of reverse osmosis and electrodialysis, to the age-old technique of solar distillation. A method for the selection of an appropriate technique is described, including a method for costing.

The guideline can be used as a training manual for those who have to deal with salinity problems in water. However, it is not written as an operators manual.

❒ Pumps and pumping system

The document describes the different types of pumps, the different energy sources that can be employed for pumping and the requirements of different pump installations. The methodology for selecting a pump for a particular application is discussed as well as the operation and monitoring programme for different pumps.

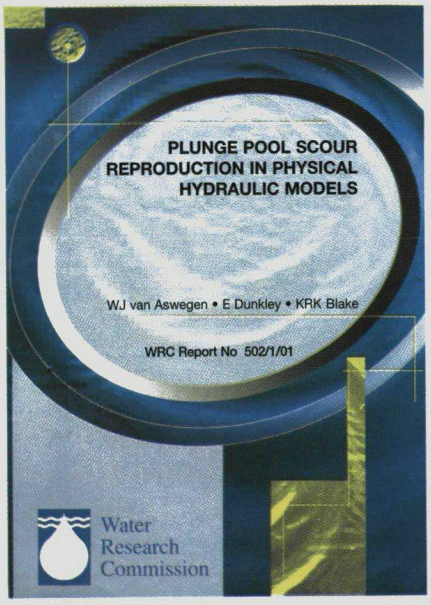
❒ Sanitation for rural communities

This document has been specifically written for community committees involved in the initiation or implementation of a sanitation programme.

Report 502/1/01 - Plunge pool scour reproduction in physical hydraulic models

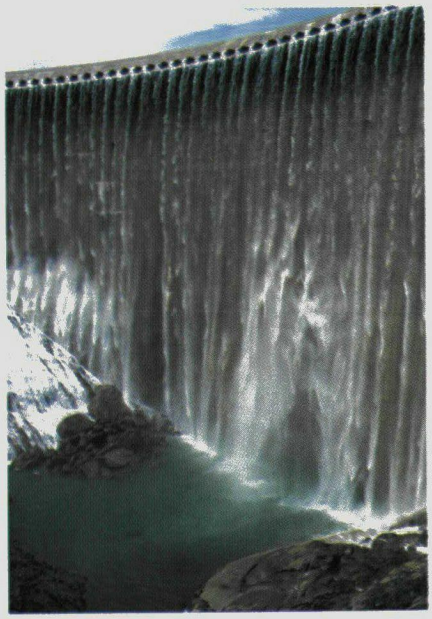
Report to the Water Research Commission by Environmentek, CSIR, Stellenbosch.

Authors: WJ van Aswegen, E Dunkley and KRK Blake
Overseas price: US$ 35 (via surface mail)



Free trajectory water jets are often used as a means to pass excess flood waters from a dam to the river below. This inevitably results in the formation of a scour hole downstream of the dam wall. If this scour hole is extensive, as is often the case, it may endanger the dam's ancillary structures and even the stability of the dam wall itself. It is therefore imperative that the ultimate size of the scour hole is known at the design stage of a dam.

The mechanism of scour is an extremely complex process due to the influence of various hydraulic, hydrological and geological factors. Some of these factors are difficult to assess theoretically and limited success has been enjoyed when trying to reproduce them experimentally. It is not surprising, therefore, that a reliable method of predicting the size and depth of scour holes is still not available. Although some empirical formulae have been proposed to predict such scour holes, in most cases, scale physical models are constructed to try to reproduce what will ultimately happen in the prototype. This report summarises the results of a research project aimed at investigating the most appropriate materials to be used to model the bed rock below a dam wall, for use in such physical models. At the same time the researchers also looked at the reliability of the available empirical formulae proposed to date. Nineteen scour prediction formulae were used to predict the scour depths at various known sites and the results compared with the actual scour data. Analysis of these results showed that while certain formulae worked with some degree of success at certain given sites, problems always arose when using the formulae at other sites. It would appear that the proposed formulae do not take into account all the factors influencing the formation of the hole, or that the data used to derive the formulae did not represent the ultimate scour depth. In hindsight, the researchers say, it would seem that a reasonably accurate generic scour prediction formula is not possible. The engineer is thus forced to turn to scale modelling to obtain a more accurate prediction of the depth of the scour hole.



To test the proposed model bed materials an existing dam had to be modelled in the laboratory, such that its scour hole could be used as a criterion for the tests. However, due to the lack of appreciable depth of scour below suitable dams within South Africa, no sites could be found for this purpose. Therefore, the search had to be extended further north and the Kariba Dam on the Zambezi River was chosen. The scour hole below this dam has extended almost 75 m below the river bed and annual surveys have been kept of the progress of the hole since the dam's construction.

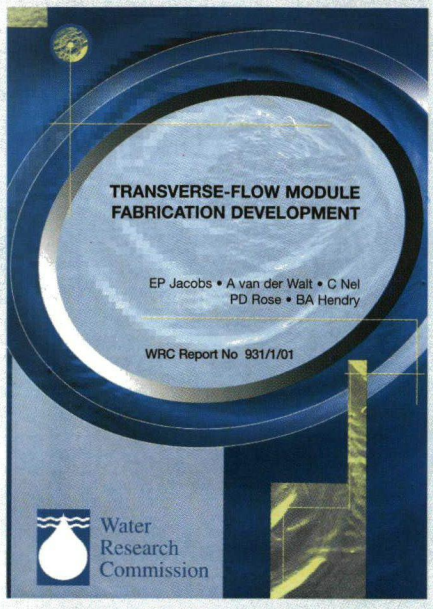
During the extensive model testing phase of this study, a number of aspects were highlighted concerning the accurate reproduction of scour holes. The most important of these was the sensitivity of the formation of the scour hole to the flow patterns in, and around, the eroding hole. The final scour depth was found to vary greatly if the local topography was not exactly reproduced in the model, or if the material being eroded from the hole was not ejected as it would be in reality. Coupled to the latter was the effect of the confinement of the developing hole on the plunging water jet. This confinement tended to enhance the erosive power of the jet by concentrating its energy onto a smaller area, resulting in a much deeper scour hole. Thus, the use of cohesive materials to represent the bed rock in the model, which could sustain the steep sides expected in reality, gave deeper, more realistic scour holes. Testing with non-cohesive materials lead to shallower scour holes that, if taken as correct, may result in an under designed system.

This study investigated a wide range of possible materials to represent the bed material in scale models. The criterion against which the materials were tested was their ability to reproduce the scour hole formed at the Kariba Dam. It was found that the loose material collecting in the scour hole adversely affected the ultimate depth of the hole. In reality this material would erode into pieces small enough to be ejected from the hole and transported downstream. To resolve the problem, a very light aggregate (coke nuts) was used, that could easily be ejected from the scour hole once it was freed from the binding matrix. Thus the scour hole maintained a shape similar to that expected in the prototype, thereby ensuring that the flow patterns in and around the hole were correct.

Report 931/1/01 - Transverse-flow module fabrication development

Report to the Water Research Commission by the Institute for Polymer Science, University of Stellenbosch.

Authors: EP Jacobs, A van der Walt, C Nel, PD Rose and BA Hendry
Overseas price: US$ 15 (via surface mail)



The report considers the development and characterisation of a special housing for capillary membranes (the transverse-flow bioreactor) for use in laboratory scale experimentation with bioprocessing.

With capillary membranes, there are two conceptually different module designs available. The one design, by far the most commonly encountered, is the so-called axial flow device. In this design, which resembles a tube-within-a-tube arrangement, the feed flow is directed either axially along the lumen of the membranes, or axially along the outside of the membrane. Depending on the design of the membrane, filtration may occur either from the inside to the outside or vice versa.

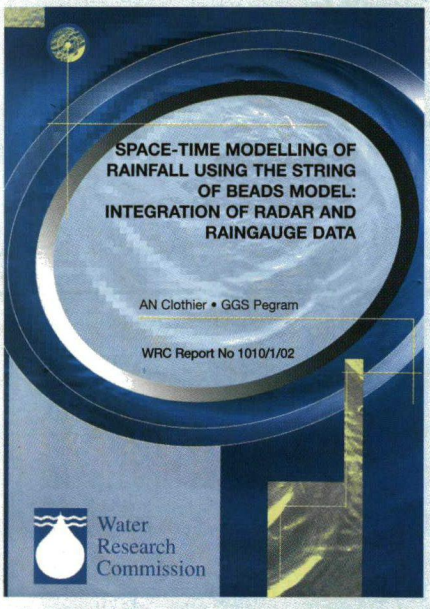
In the other design, the transverse-flow modules, the flow is directed perpendicular to the membrane axis - along the central channel, and the permeate is collected in the four permeate manifolds at the edges of the module.

The researchers also managed to develop various experimental membrane contactors for use in bioreactor application studies. Most of the work concentrated on the development of suitable membranes and techniques to improve gas transport into and out of water. A series of mass transport correlations were established to quantify oxygen and carbon dioxide transport into and out of water. This work is documented and available to laboratories for use.

Report 1010/1/02 - Space-time modelling of rainfall using the string of beads model: integration of radar and raingauge data

Report to the Water Research Commission by the Department of Civil Engineering, University of Natal, Durban.

Authors: AN Clothier and GGS Pegram
Overseas price: US$ 20 (via surface mail)

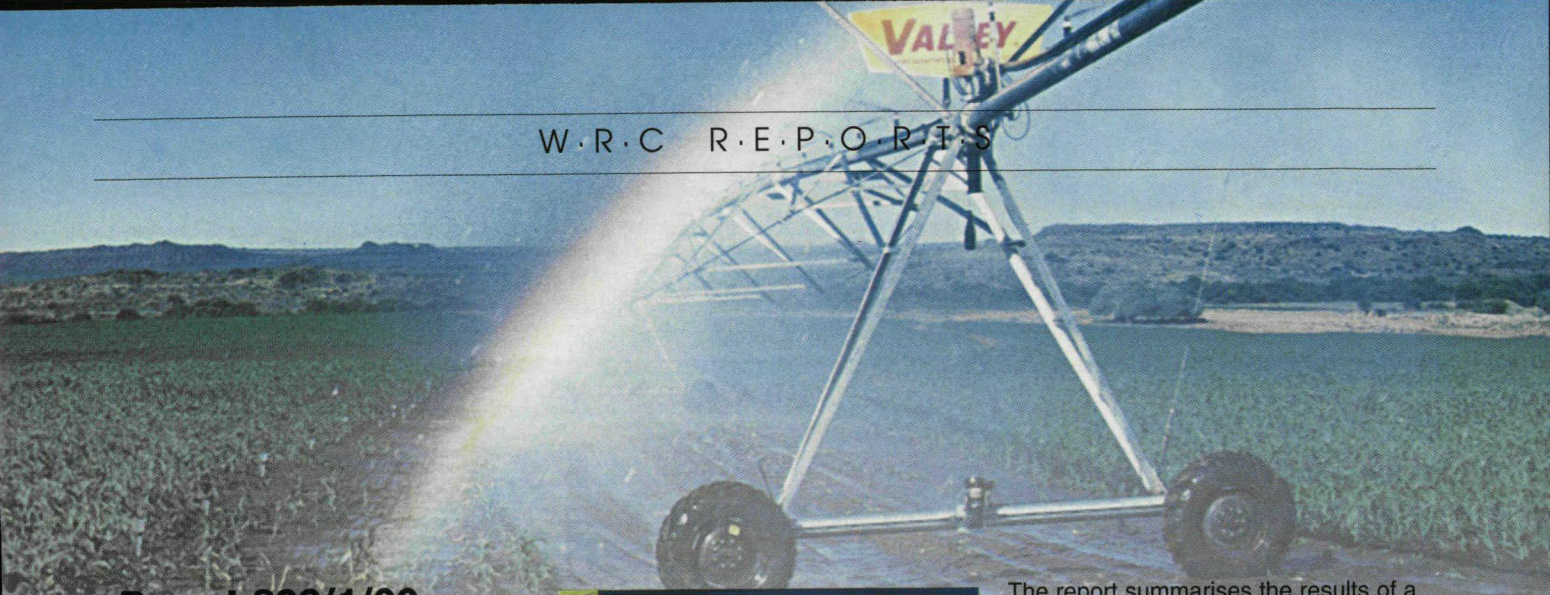


Space-time rainfall is a very complicated physical process and might seem to need a very complicated model to describe it. The String of Beads model, described in this report, is a stochastic rainfall model based on the combined observations of a large network of daily raingauges and an S-band weather radar situated near Bethlehem in the Free State. The advantage of this model is that it is relatively straightforward in that it is defined by a very few parameters and achieves remarkable realism in the synthetic sequences it generates. It was the first model of its sort to present spatial detail and realistic temporal development in one package. It is also adaptable to a variety of rainfall regimes and has successfully been fitted to South African, Swiss, German and English data.

The report says the crucial characteristics that a space-time model of rainfall must capture are the storm arrivals and their duration and intensity while it is raining. Furthermore, the model should also be able to move realistically in the right directions and in the right velocities. Each of these model characteristics must be quantified and their mutual dependence and variability accounted for. The way the String of Beads model works is to examine the "String" of time and identify the alternating wet and dry periods on it. These lengths vary randomly (and as the researchers discovered, independently of each other) but can be characterised by the lognormal probability distribution function whose two parameters vary periodically over the year. This is the basic process.

Once it is raining, the "String" supports a "Bead" of space-time rainfall. The "Beads" have the lengths of the wet periods on the "String" and their structure in space and time defines the behaviour of the rainfall event. These descriptors are its velocity and direction and whether it describes, on the one hand, patchy thunder-storm rainfall or, on the other hand, widespread rain of less variability but longer duration on average. The String of Beads model achieves all this and passes the stringent statistical and visual tests to check whether the result is good.

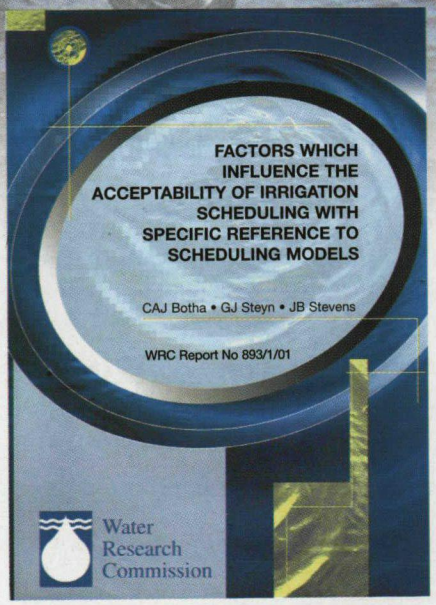
The model software is "freeware" and available on a compact disc at a nominal cost from Professor Geoff Pegram at the University of Natal for the next two years, at least - pegram@nu.ac.za



Report 893/1/00 - Factors which influence the acceptability of irrigation scheduling with specific reference to scheduling models

Report to the Water Research Commission by the Department of Agricultural Economics, Extension and Rural Development in conjunction with the University of Pretoria.

Authors: CAJ Botha, GJ Steyn and JB Stevens
Overseas price: US$ 20 (via surface mail)



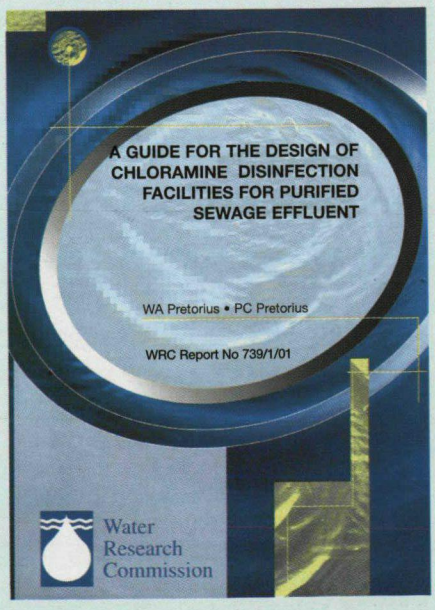
The report summarises the results of a pilot research project aimed at investigating the factors which influence farmers' acceptance of irrigation scheduling and computerised irrigation scheduling models at three different sites:

- The Rust de Winter irrigation scheme, which is representative of a typical land redistribution situation, the Riet River irrigation scheme, which represents a site where an irrigation scheduling model was introduced a number of years ago and the Loskop irrigation scheme, where a new computer-based irrigation scheduling model, known as the Soil Water Balance (SBW) model, was released recently.

Report 739/1/01 - A guide for the design of chloramine disinfection facilities for purified sewage effluent

Report to the Water Research Commission by the Department of Chemical Engineering - Water Utilisation Division - University of Pretoria.

Authors: WA Pretorius and PC Pretorius
Overseas price: US $ 15 (via surface mail)



The first part of this report consists of a guide aimed at the design engineer of a sewage treatment facility. The guide contains an overview of the relevant literature and covers the basic chemical and biological aspects of disinfection. In a section on the kinetics of the inactivation of microorganisms the authors look at the development of mathematical models of disinfection. The disinfectant contact chamber and the factors affecting the process is discussed followed by a step-by-step design example.

The second part contains the findings of a national survey conducted in 1996/1997 to which 175 sewage treatment plants responded. The survey showed that only a third of the total effluent flow complied to accepted bacteriological standards and that 67 per cent of the total flow surveyed was discharged to public streams. These facts indicate the need for better design and operation for disinfection at sewage treatment plants in South Africa.

Part three of the report summarises the results of research conducted at the University of Pretoria. The aim of the research was to evaluate the efficiency of monochloramine as a disinfectant for purified sewage effluent under South African conditions. The research also identified the most suitable mathematical model for predicting the behaviour of continuous flow disinfection using monochloramine. The use of tracer studies to predict the efficiency of a contact chamber is shown.

Women in Water Awards 2003

Call for nominees

To recognise the role that women have played and continue to play in water management in South Africa, the Department of Water Affairs and Forestry, the Water Research Commission (WRC) and the Water Institute of South Africa (WISA) have jointly developed the Women in Water Awards.

BACKGROUND

Post 1994, the South African Parliament has one of the highest proportions of women in the world, powerful, outspoken and committed women. In the water sector many South African women have made their mark. The Women in Water Awards aim to honour and celebrate the hard work of women and to highlight the participation of professional and community-based women in water management and the key role women play with regard to water-related research, in poverty eradication, education and sustainable development in both urban and rural settings.

The launch of the Women in Water Awards on the 19 March 2002 marked the beginning of an important tradition in the water sector in South Africa. Each year these awards will be made to women who played leading roles in five categories:

- ❑ Policy
- ❑ Management
- ❑ Research (nominees over 35 years old)
- ❑ Research (nominees under 35 years old)
- ❑ Community development

At the launch of the event, the Minister of Water Affairs and Forestry exercised a prerogative to recognise a few women whose work exemplifies the calibre of women in water in South Africa. However, for the 2003 awards, nominations will be processed via an adjudicated process. In particular, successful nominations will be chosen by the adjudication panel for:

- ❑ Use of knowledge
- ❑ Skills
- ❑ Considerable capacity to ensure that water management in South Africa contributes to a better life for all.

Nominations for the five categories can be represented either by an individual or group. The awards will be presented to women of stature, women who have excelled in their field, and who made a significant contribution to the management of water in South Africa.

NOMINATION CRITERIA

The following criteria should be used as a guide for nominations of a woman/ women involved in formal and informal water-related projects:

- ❑ Proven record of achievement and involvement
- ❑ Innovation and leadership
- ❑ Project management and implementation
- ❑ Contribution to positive attitudinal and behavioural changes
- ❑ Contribution to development and implementation of sustainable project/s
- ❑ Contribution to public/community/ stakeholder/role-player participation
- ❑ Perseverance and endurance
- ❑ Contribution to decision-making processes
- ❑ Accountability
- ❑ Motivational excellence

RULES

- ❑ The award is open to all women with a proven track record and excellent contribution to the water sector, provided they are not immediate relatives of the Co-ordination Committee or adjudication panel
- ❑ Members of the Co-ordination Committee or the adjudication panel may not be nominated
- ❑ Nominees must have resided in South Africa for 5 yrs prior to the nomination deadline and have contributed to the water sector in this country
- ❑ If criteria are not met successfully, the Minister of DWAF will not be under any obligation to make an award
- ❑ Membership of the adjudication panel will be approved by the Minister of DWAF, and all members will declare any vested interests.

INSTRUCTIONS FOR NOMINATIONS

- ❑ Please type or print clearly when filling out the form.
- ❑ The nomination must be accompanied by the names of two referees and their contact details. Referees may be requested to submit a brief report about the nominee.
- ❑ The term "nominee" is used to refer to either the individual of group being nominated.
- ❑ Only fully completed nominations will be accepted, and must include a 250 - 1000 word motivation as to why the nominee deserves the award.
- ❑ Only original copies of the completed nomination will be accepted.

SUBMISSION OF APPLICATION FORMS

Submit entries to: Ms Hayley Rodkin, Women in Water Awards, Co-ordinating Committee, Department of Water Affairs and Forestry, Room 933, Sedibeng Building, Private Bag X313, Pretoria 0001. Telephone: (012) 336 8600 / 8650

Nomination forms may be downloaded from the web site of the Department of Water Affairs and Forestry at www.dwaf.gov.za

SOUTHERN AFRICA

2002

SMALL WATER SYSTEMS
AUGUST 22 - 23
A workshop on the sustainability of small water systems in Southern Africa will be held at the Birchwood Executive Hotel, JNB International.
Enquiries: Chris Swartz. Tel: (044) 691 1242. Fax: (044) 690 7960. E-mail: cswartz@mweb.co.za

SUSTAINABLE DEVELOPMENT
AUGUST 26 - SEPTEMBER 4
The international World Summit on Sustainable Development will be held in Johannesburg.
Enquiries: WISA - Tel: 011-805 3537. Fax number: 011-315 1258. E-mail: wieenv@mweb.co.za Website address: www.wisa.co.za/worldsummit/ or www.johannesburgsummit.org or www.earthsummit2002.org/roadmap

ENVIRONMENT
SEPTEMBER 4 - 6
A new training course on environmental compliance, sustainable development and business opportunities will be held by WSP Walmsley in Johannesburg.
Enquiries: Sharali Barnard - Tel: 011- 233 7886/7. E-mail address: training@wspgroup.co.za

ENVIRONMENTAL MANAGEMENT
SEPTEMBER 17 - 19
A short course on environmental management will be presented by the Environmental Engineering Group at the University of Pretoria.
Enquiries: Ms Tanya de Bruin. Tel: (012) 420 5015. Fax:(012) 362 52 85. E-mail address: tanya.ce@up.ac.za

WATER & SANITATION
SEPTEMBER 23 - 24
A short course on water supply and sanitation will be presented by the University of Pretoria.
Enquiries: Anneke Kruger, University of Pretoria. Tel: 012-420 5026. Fax: 012-362 5285. E-mail: anneke.ce@up.ac.za

WATER DEMAND
OCTOBER 30 - 31
The 3rd Waternet/WARFSA symposium on water demand management for sustainable use of water resources will be held in Arusha, Tanzania.
Enquiries: The Organising Committee, Institute of Resource Assessment, University of Dar es Salaam, PO Box 35097, Dar es Salaam, Tanzania. Fax: +255 22 2410393 or +255 22 241 0029. E-mail: Madulu@ira.udsm.ac.tz or dmashauri@yahoo.com

HYDRAULIC ENGINEERING
DECEMBER 4 - 6
The International Association for Hydraulic Research (IAHR) African Division's biennial congress with the theme " Water - the lifeblood of mankind" will be held in Arusha, Tanzania.
Enquiries: The Institution of Engineers, PO Box 2938, Dar-es-Salaam, Tanzania. E-mail: iet@iet.co.tz Tel: +255 22 212 4265. Fax: 212 2836. Web: http://www.iet.co.tz

2003

PESTICIDES
JANUARY 21 - 23
A joint European-Southern African international conference on pesticides in non-target agricultural environments - environmental and economic implications will be held at the University of Cape Town.
Enquiries: Jenny Day. Tel: (021) 650 3635/6. Fax: (021) 650 3301. E-mail: pest@botzoo.uct.ac.za Web: http://www.uct.ac.za/depts/zoology/fru/mainindex.html

WATER TREATMENT
MARCH 31 - APRIL 2
The 5th WISA Membrane Technical Division (MTD) workshop will be held at the Vaal River Resorts, Gauteng.
Enquiries: Dr Andre Maartens, PO Box 2264, Evander 2280. Tel: 082 326 3820. E-mail: amaartens@buckman.com

OVERSEAS

2002

ACID SOILS
AUGUST 25 - 30
The 5th world acid sulphate soils conference will be held at the Quality Resort Twin Towns, Tweed Heads, NSW Australia.
Enquiries: Jacki Rose. Tel: 0011 61 75536 4000. Fax: 0011 61 7 5599 5167. E-mail: hwtweedm@onthenet.com.au Web: www.acrose69.webcentral.com.au/acidddates.html

GROUNDWATER
AUGUST 28 - 30
A short course on groundwater in the mining industry will be presented by the Centre for Groundwater Studies in Australia.
Enquiries: Trevor Pillar, Manager Communications and Training, Centre for Groundwater Studies. Tel: 08 8201 5632. Fax: 08 8201 5635. E-mail address: trevor@groundwater.com.au Web: http://www.groundwater.com.au

ESBES-4
AUGUST 28 - 31
The 4th European symposium on biochemical engineering science - ESBES-4: Life Science and Technology - will be held in Delft, the Netherlands.
Enquiries: Information and registration through www.esbes4.tnw.tudelft.nl. E-mail: esbes- 4@tnw.tudelft.nl

FLUVIAL SYSTEMS
SEPTEMBER 2 - 6
An international symposium on the structure, function and management implications of fluvial sedimentary systems will be held in Canberra, Australia.
Enquiries: Dr Fiona Dyer, School of Resource, Environment and Heritage Sciences, University of Canberra, Canberra ACT 2601, Australia. Tel: +61 2 62012267. Fax: +61 2 62012328. E-mail: fiona.dyer@canberra.edu.au Web site: http://lake.canberra.edu.au/~iahs2002

RIVERS
SEPTEMBER 3 - 6
The 5th international river management symposium with the theme - "The scarcity of water - the future of rivers, the future of water" - will be held in the Brisbane Convention and Exhibition Centre, Brisbane, Australia.
Enquiries: Selina Ward. E-mail: selina@riverfestival.com.au. Phone: 61 7 38467444. Website: http://www.riverfestival.com.au

ANAEROBIC DIGESTION
SEPTEMBER 11 - 13
The 3rd international symposium on anaerobic digestion of solid waste will take place in Garching, Germany.
Enquiries: Rüdiger Dalhoff, Am Coulombwall, D-85748 Garching. Tel: +40 89289 13710. Fax: +49 89289 13718. E-mail: Dalhoff@bv.tum.de

DRY AREAS
SEPTEMBER 15 - 19
An international conference on environmentally sustainable agriculture for dry areas for the 2nd millennium will take place in Shijiazhuang, Hebei, People's Republic of China.
Enquiries: Mrs Catherine Vachon. Tel: 1 403 317 2257. Fax: 1 403 382 3156. E-mail: vachonc@em.agr.ca Web address: www.res2.agr.ca/lethbridge/hebei/confindex.htm

MINE WATER
SEPTEMBER 15 - 21
The 8th international Mine Water Association congress will be held in Freiberg, Germany. Enquiries: UMH@geo.tu-freiberg.de or http://www.geo.tu-freiberg.de/institut/hydro/UMH

GROUNDWATER
SEPTEMBER 22 - 26
The 4th international symposium on artificial recharge of groundwater with the theme - Sustainability of artificial recharge - will be held in Adelaide, Australia.
Enquiries: Conference Manager, Hartley Management Group Pty Ltd, PO Box 20 Kent Town, South Australia 5071. Tel: +61 8 8363 4399. Fax: +61 8 8363 4577. E-mail: isar4@hartleymgt.com.au

WASTEWATER TREATMENT
SEPTEMBER 23 - 25
The IWA 5th specialised conference on small water and wastewater treatment systems will be held in Istanbul, Turkey.
Enquiries: Prof Dr Izzet Ozturk, Istanbul Teknik University, Civil Engineering Faculty, Environmental Engineering Department, 80626 Maslak, Istanbul, Turkey. Tel: +90 212 2853790. Fax:+90 212 2853781. E-mail address: iozturk@srv.ins.intu.edu.tr

NUTRIENT REMOVAL
OCTOBER 2 -4
An international conference with the theme "From nutrient removal to recovery" will be held in Amsterdam, the Netherlands.
Enquiries: Conference Secretariat, Buerweg 51, 1861 CH Bergen, the Netherlands. Tel: +31 20 460 2466. Fax: +31 20 4602475. E-mail: r.r.kruize@inter.nl.net

DESALINATION
OCTOBER 16 - 18
An international conference on nuclear desalination - challenges & options will be held in Marrakesh, Morocco.
Enquiries: Mr Abdelhamid Mekki-Berrada, AIGAM - Conference Secretariat, 65, rue Tensift, Rabat, Morocco. Fax: (212) 37 779 978. Tel: (212) 37 779 931. E-mail: aigam@cnesten.org.ma Web: http://www.wonuc.org

GROUNDWATER
OCTOBER 21 - 25
The 32nd conference of the International Association of Hydrogeologists (Argentine Chapter) will be held in Mar del Plata, Argentine
Enquiries: Sylvia Caesar Rey, Carlos Pellegrini 3775, 7600 Mar del Plata, Argentina. E-mail: scaesar@argenet.com.ar Web: http://www.mdp.edu.ar/exactas/geologia/iah2002/iah2002.html

AGRO-ENVIRON 2002
OCTOBER 26 - 28
The 3rd international symposium on agro-environmental issues will be held at the National Authority for Remote Sensing and Space Sciences (NARSS) in Cairo, Egypt.
Enquiries: Prof Sami Abdel-Rehman, NARSS, 23 Joseph Brows Titi Street, El Nozha El Gedida, Cairo Egypt. PO Box 1564 Alf-Maskan. Tel (202) 2964386-2975688. Fax: (202) 2964387-2964385. E-mail: sirahman@intouch.com

SANITATION
NOVEMBER 18 - 22
The 28th WEDC conference on sustainable environmental sanitation and water services will be held in Kolkata (Calcutta), India.
Enquiries: Mrs Dot Barnard, WEDC Conference Co-organiser, WEDC, Loughborough University, Leicestershire LE11 3TU, England. Tel: +44 (0) 1509 223772. Fax: +44 (0) 1509 211079. E-mail: wedc.conf@lboro.ac.uk Web: http://www.lboro.ac.uk/wedc/

2003

GROUNDWATER
JANUARY 20 - 23
An international conference on soil and groundwater contamination and cleanup in arid countries will be held in Muscat, Sultanate of Oman.
Enquiries: Dr Anvar Kacimov, Department of Soil & Water Sciences, Sultan Qaboos University, PO Box 34 Al-Khod 123, Oman. Tel: +968 515 223. Fax: +968 513 418. E-mail address: anvar@squ.edu.om or arkasimov@yahoo.com Web: www.squ.edu.om

SOIL & GROUNDWATER
FEBRUARY 26 - 28
An international workshop on diffuse input of chemicals into soil and groundwater - assessment and management - will be held in Dresden, Germany.
Enquiries: Mrs R Kühne, Intercom Conference Service TU Dresden GmbH, Zellescher Weg 3, D-01069 Dresden, Germany. Tel: +49 3 51463 33933. Fax: +49 3 51463 37049. E-mail: rkuehne@intercom-dresden.de Web address: www.tu-dresden.de/fghhigw/workshop/index.htm

WATER & WASTEWATER
MARCH 4 - 6
A conference and exhibition - Water & Wastewater Europe 2003 - will be held in the Acropolis Congress Hall, Nice, France. Over 1 000 products and services will be present on the exhibition floor, including pumps, valves, desalination equipment, water treatment plants, UV disinfection and filtration systems, engineering, drilling, etc. More than 40 papers will be presented at the conference covering desalination, water re-use, water quality, privatisation, finance and legislation.
Enquiries: Ms Charlotte Gliddon-Bush, Conference Co-ordinator. Tel: +44 (0) 1992 656 634. Fax: +44 (0) 1992 656 704. E-mail: charlotteg@pennwell.com

CORROSION
MARCH 25 - 27
The first IWA international conference on scaling and corrosion in water and wastewater systems will be held at the Cranfield University, United Kingdom.
Enquiries: Conference Secretary, School of Water Sciences, Cranfield University, Cranfield, MK43 OAL, UK. Tel: +44 (0) 1234 754902. Fax: +44 (0) 1234 751671. E-mail: iwa@cranfield.ac.uk

AQUIFER MONITORING
MARCH 30 - APRIL 2
The second international conference on salt water intrusion and coastal aquifer monitoring, modelling and management will be held in Merida, Yucatan, Mexico.
Enquiries: Prof Luis E Marin, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico CP 04510. Tel: +52 555 622 4212. Fax: +52 555 550 2486. E-mail: imarin@tonatiuh.igeofcu.unam.mx Web: www.igeofcu.unam.mx/swica2/

URBAN WATER SUPPLY
APRIL 2 - 4
The 2nd international conference on the efficient use and management of urban water supply will take place in Tenerife, Canary Islands, Spain.
Enquiries: Efficient 2003, Consejo Insular Aguas de Tenerife, C/Leoncio Rodriguez 7, 2 Edificio "El Cabo" 38003 Santa Cruz de Tenerife, Espana. Tel: +34 922 208800. Fax: +34 922 208 863. E-mail address: efficientwateruse@iwatenerife2003.org

GROUNDWATER
MAY 2003
The third international symposium on water resources in karst and hard formations will be held in Esfahan, Iran.
Enquiries: Dr A Afrasiabian, Director of National Karst Study and Research Centre, PO Box 15875-3584, Teheran, I.R. Iran. Tel: +98 21 7520474. Fax: +98 21 7533186. E-mail address: karstsympo2003@yahoo.com

FOREST WASTEWATERS
JUNE 2 - 4
The 7th international symposium on forest wastewaters will be held in Seattle, USA.
Enquiries: Ms Sirpa Sandelin, Satakunta Polytechnic, Centre for Adult & Continuing Education, Tekniikantie 2, FI-28600 Pori, Finland. Tel: +358 5050 20130. Fax: +358 26203 105. E-mail: sirpa.sandelin@tp.spt.fi

AWWA 2003
JUNE 15 - 19
The American Water Works Association will hold its annual conference and exhibition in Anaheim, California. Membership in AWWA is not a requirement for presentation.
Enquiries: AWWA, 6666 W. Quincy Ave., Denver, CO 80235. Tel: 303 794 7711. Fax: 303 794 3951. Web: http://www.awwa.org

WASTEWATER
JUNE 23 - 25
An international conference on wastewater sludge as a resource will be held in Trondheim, Norway.
Enquiries: Prof Hallvard Odegaard, Dept of Hydraulic and Environmental Engineering, N-7034 Trondheim, NTNU. E-mail: hallvard.odegaard@bygg.ntnu.no Tel: +47 73 594759. Fax: +47 73 590 544.

BASIN MANAGEMENT
AUGUST 17 - 22
The 7th international conference on diffuse pollution and basin management will be held in Dublin, Ireland.
Enquiries: IWA Conference Secretariat, Centre for Water Resources Research, Civil Engineering Department, University College Dublin, Earlsfort Terrace, Dublin 2, Ireland. Tel:00 353 1 7167 499. Fax: 00 353 1 7167399. E-mail: dipcon@ucd.ie Web: www.ucd.ie/~dipcon/dipcon.htm

BIOFILM SYSTEMS
SEPTEMBER 2003
The 5th international conference on biofilm systems will be held in Noordwijkerhout, the Netherlands.
Enquiries: Mark van Loosdrecht, TU-Delft, Julianalaan 67, 2628 BC Delft, the Netherlands. Tel: +31 15278 1618. Fax: +31 152 78 2355. E-mail address: m.c.m.vanloosdrecht@tnw.tudelft.nl

WASTEWATER PLANTS
SEPTEMBER 1 - 4
The 9th conference on the design, operation and costs of large wastewater treatment plants will take place in Prague, Czech Republic.
Enquiries: Prof Dr Jiri Wanner, Dept of Water Technology and Environmental Engineering, Prague Institute of Chemical Technology, Technicka 5, CZ-166 28 Praha 6, Czech Republic. Tel: +420 2243 53149. E-mail: jiri.wanner@vscht.cz

ODOUR CONTROL
SEPTEMBER 14 - 17
The second IWA international conference on the development of odour measurement, regulation and control techniques will be held in Singapore.
Enquiries: Ms Tan Kim Suan, Corporate Communications Manager, Institute of Environmental Science & Engineering Innovation Centre (NTU), Block 2, Unit 237, 18 Nanyang Drive, Singapore 637723. Tel: +65 6794 1533/1534. Fax: +65 67921291. E-mail: KSTAN@ntu.edu.sg or KSTAN@iese.ntu.edu.sg Web: www.eti.org.sg or www.iese.ntu.edu.sg

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Joint European - Southern African international conference

Pesticides in non-target agricultural environments: environmental and economic implications

January 21-23, 2003
University of Cape Town, South Africa

THEME
Both Europe and Africa are experiencing intensified agricultural development and the inevitable environmental pressures that result. At the same time there is a growing need for 'environmentally friendly' products. Good examples are the fruit and wine industries in South Africa, where competition for world markets requires specialisation and diversification of cropping systems but there is also a need to harmonize production systems with the increasing ecological demands of consumers. It is thus anticipated that ecotoxicological assessments and risk mitigation strategies leading to environmentally acceptable methods of crop production will become increasingly important.

THE MAIN OBJECTIVE of this conference is to bring together scientists, agriculturalists and representatives of government and industry to discuss the various issues, including methods for assessing the effects of exposure to agricultural pesticides, strategies for risk management, and the economic implications of pesticides in non-target terrestrial and aquatic environments. The situation in southern Africa as a developing region will be of particular interest but delegates from elsewhere in the developing and the developed world are encouraged to participate.

The conference is to be structured according to the following main topics:

- pesticide exposure: monitoring and predictive approaches
- ecotoxicological effects at different scales: terrestrial and aquatic individuals, populations and communities, biomarkers, modeling
- risk assessment: policies, risk management and mitigation, probabilistic approaches
- economic implications: links between production processes and consumer needs, resource economics, socio-economic aspects and certification systems

Invited speakers from academia, governmental organisations and industry will cover the different topics in a series of keynote lectures.

If you are interested in attending, please send proposed titles, indication of interest or any queries to:
pest@botzoo.uct.ac.za or visit our web-site at:
http://www.tu-bs.de/conference-CPT
The second announcement will distributed in June 2002 and will call for papers and posters as well as containing information about registration, accommodation and costs.

DATES & DEADLINES
June 15, 2002 - 2nd announcement, call for papers, on-line registration
September 1, 2002 - Deadline for abstract submission and early registration
October 1, 2002 - Notification of abstract acceptance
January 21-23, 2003 - Conference at University of Cape Town, South Africa

CONTACT DETAILS

Local organisers of the conference may be contacted at:
E-mail:pest@botzoo.uct.ac.za • Fax:+27 21 650 3301
or telephone: Jenny Day (Cape Town, South Africa):
Tel: +27 21 650 3635/6 • http://www.uct.ac.za/depts/zoology/fru/mainindex.html
Ralf Schulz (Braunschweig, Germany):
Tel: +49 531 391 3184 • Fax: +49 531 391 821 • R.Schulz@tu-bs.de, • http://www.tu-bs.de/~raschulz