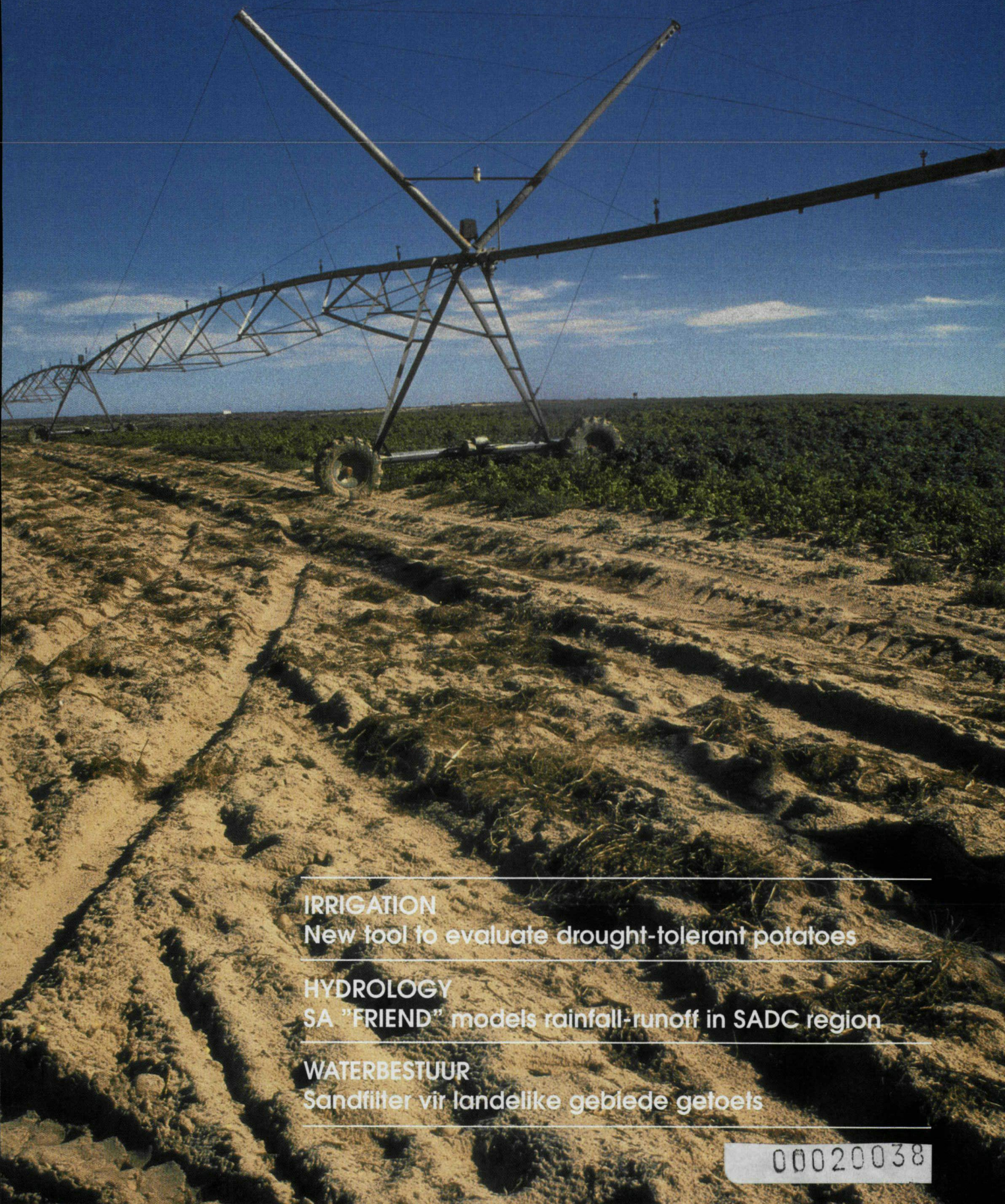


# S4 waterbulletin

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Junie/Julie 1998



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## IRRIGATION

New tool to evaluate drought-tolerant potatoes

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## HYDROLOGY

SA "FRIEND" models rainfall-runoff in SADC region

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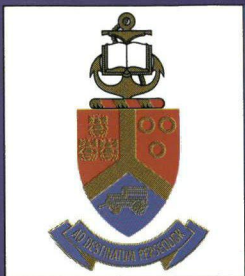
## WATERBESTUUR

Sandfilter vir landelike geblede getoets

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# SHORT COURSE

## UNIVERSITY OF PRETORIA

### Water Utilisation Division

## MANAGEMENT AND TREATMENT OF PROCESS WATER AND INDUSTRIAL WASTEWATER

**Date:** 28 September - 2 October 1998

**Venue:** Water Utilisation Building  
South Campus, University of Pretoria  
(Map will be provided on request)

The course is aimed at engineers, scientists and technicians responsible for the management of water-related functions in industry and mining, to provide the water manager with knowledge enabling him/her to:

- manage water use and effluent disposal functions in accordance with statutory requirements;
- evaluate and optimise treatment processes for preparation of process water;
- evaluate and optimise treatment processes for treatment and disposal of wastewater;
- evaluate and implement systems for waste minimisation and clean technology.

#### **Main focus** of course contents

- Statutory requirements regarding industrial water use and wastewater disposal, focussing on new policies of the Department of Water Affairs and Forestry.
- Treatment processes for preparation of process water, including conventional coagulation - filtration; softening and stabilisation; membrane processes; ion exchange; disinfection and control of biofouling.
- Treatment processes for industrial wastewater, including chemical treatment processes; biological processes; membrane processes; final disposal techniques.
- Technologies for the optimisation of process water use.
- Waste minimisation and clean technologies.

#### **Lecturers**

Prof WA Pretorius  
Prof CF Schutte

Tel No: (012) 420-3566  
Tel No: (012) 420-3571

#### **Language**

The course notes are in English. Lectures and discussions will be conducted in both English and Afrikaans in order to ensure that all obtain full benefit from the short course.

#### **Course fee**

R3 000,00 per person (excluding VAT)

The course fee includes course notes, tea/coffee and lunch daily, but **excludes** accommodation.

#### **Enquiries**

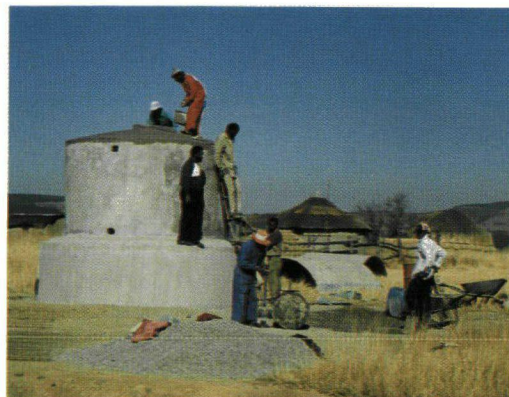
To register please contact Mrs Elmarie Otto at:

Tel: (012) 420-3566  
Fax: (012) 362-5089

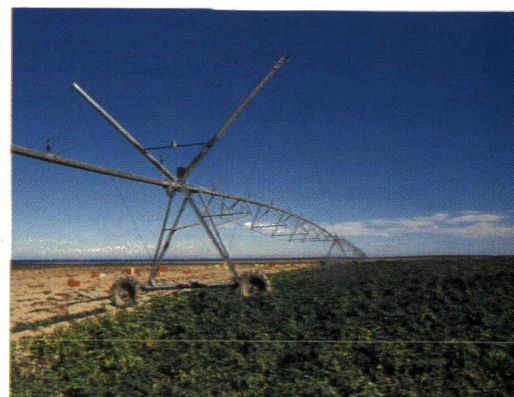




p 12



p 19



p 16

## Contents

HYDROLOGY	<b>6</b>	SA "FRIEND" project models rainfall-runoff in SADC region
GROUNDWATER	<b>8</b>	Researchers investigate Port Elizabeth's hidden water resource
WATER QUALITY	<b>10</b>	Simple water treatment technology tested
HYDROLOGY	<b>12</b>	Researchers analyse palaeoflood records
INDUSTRIAL WATER	<b>14</b>	Catch the water, catch the future...
IRRIGATION MANAGEMENT	<b>16</b>	Valuable new tool available for selecting drought-tolerant potato genotypes
WATER TREATMENT	<b>19</b>	Cross-flow sand filter tested for rural water treatment
WASTE WATER MANAGEMENT	<b>24</b>	Predicting pollution loads from sulphide-containing waste materials
MEMBRANE TECHNOLOGY	<b>25</b>	Something new from membrane technology
CLIMATE RECONSTRUCTION	<b>26</b>	SA trees don't tell easily...
FEATURES	<b>4</b>	Waterfront
	<b>23</b>	WRC Online
	<b>29</b>	Conferences and Symposia

*Cover: Potato field under irrigation in the Western Cape. (Photo: JJJ Harmse)*

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# British Award honours SA research

The Director of the Foundation of Water Research (FWR), Britain, Caryl Stephen, presented WISA president Danie Klopper with the FWR Award Shield at the banquet of the WISA '98 conference which was held in Cape Town. She said that the shield is in recognition of South African water research, and a token of appreciation for the warmth and friendship she has always received here, whereby she wanted to sustain the enthusiasm and quality of research which she has encountered on her visits to South Africa. In presenting the shield to the best paper submitted by a young Southern African to the biennial WISA conference, she lauded SA research as producing results "to offer the rest of the world".

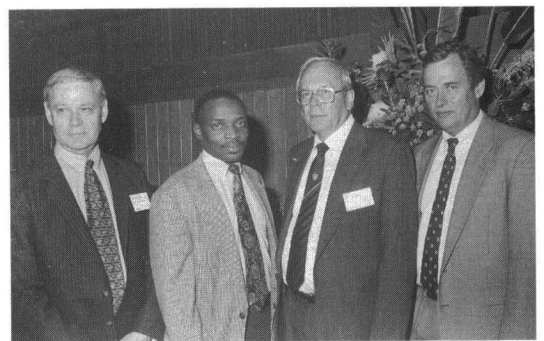
The conference was opened by a spirited Prof Kader Asmal, Minister of Water Affairs and Forestry, who had just returned from a UN session on sustainable development and told delegates that policies which are currently implemented in South Africa, are now being recognised internationally as leading the way regarding water management in the future. He also announced the establishment of a National Water Forum, which is to be a multi-stakeholder forum for sharing and exchange of ideas.

He praised the South African scientists and engineers in the water field for their outstanding work, innovative thinking and technology development and asked that their knowledge should be shared with neighbouring countries and beyond, in these challenging and rewarding times.

Apart from the varied topics, excellent papers, renewing of acquaintances and meeting new faces, the WISA '98 conference will be remembered for the wet, rainy weather and a record number of delegates (over 800) attending. All honour are due to the Cape Town organising committee for all their efforts to create a friendly conference and accommodate almost double the number expected. They kept it floating while we enjoyed the socials !



*Danie Klopper, (WISA President) and Caryl Stephen (Director, Foundation for Water Research, UK) display the FWR Award Shield presented to WISA.*



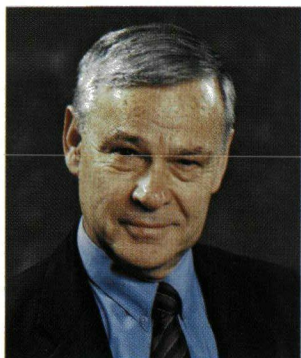
*Above: Keynote speakers at WISA '98 (from left): Mr Piet Odendaal (Water Research Commission) and top officials of the Department of Water Affairs and Forestry, Mr Tami Sokutu, Mr Hendrik Best and Mr Mike Muller.*



*Left: Officials at the opening plenary session of the conference (from left): Dr Chris Viljoen (outgoing President of WISA), Henk Beekman (Chairman: Organising Committee), Prof Kader Asmal (Minister of Water Affairs and Forestry), Alderman Reverend William Bantom (Metropolitan Mayor: Cape Metropolitan Area) and Prof John Martin (Deputy Vice Chancellor, University of Cape Town).*



# Odendaal leads prestigious international organisation



*Mr Piet Odendaal*

Mr Piet Odendaal, executive director of the Water Research Commission, was recently elected president of the International Association on Water Quality (IAWQ) during its biennial conference in Vancouver, Canada. He succeeds Professor Tom Keinath of the United States.

Established in 1965, the IAWQ aims to promote research and education relat-

ing to the control of water pollution around the world and to encourage the exchange and application of research information. This is done through the publication of scientific journals and technical guidelines and the organising of more than 20 international conferences annually. The IAWQ has more than 7 000 members in 132 countries. It operates some 35 specialist groups which act as international networks of experts issuing their own newsletters and organising their own conferences and workshops.

Mr Odendaal is the second South African to hold the position of IAWQ president. Dr GJ Stander, the first chief executive officer of the WRC, was president of this international association during the 1970s.

According to Mr Odendaal, his election - and the role South Africans play in IAWQ activities - is an indication of the high esteem enjoyed by South African

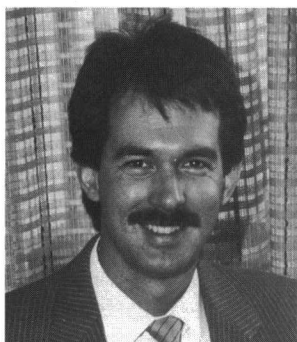
water researchers in the international research community.

He says South Africa's involvement in organisations such as the IAWQ opens many doors for local researchers internationally and his presidency should hopefully contribute further to this process.

He sees his greatest challenge during his term of office as facilitating the merging of the IAWQ with the International Water Services Association (IWSA). "It was decided to merge the two organisations because of a growing overlap worldwide between potable water provision and pollution control." The official merger is planned for the end of 1999.

Mr Odendaal believes that the new organisation, to be known as the International Water Association, will make a meaningful contribution to promote the integrated management of water resources around the world.

## Obituary - Tony Reynders



*Mr Tony Reynders*

Mr Tony Reynders, the WRC's research manager responsible for groundwater projects, died suddenly on 5 July 1998 after a year long struggle with cancer.

Born in Queenstown in July 1959, Tony completed his schooling at Queen's College and graduated with a BSc degree in geology and geography from

Rhodes University in 1980. He was awarded a BSc (Hons) in geography (hydrogeology) first class in 1981 and a MSc in hydrogeology in 1984. At the time of his death he was registered for a PhD at the University of the Free State.

Before joining the WRC in 1988 Tony worked as a hydrologist in the Directorate of Geohydrology at the Department of Water Affairs and Forestry. He was a registered natural scientist, a council member of the International Association of Hydrologists, a member of the American Association of Groundwater Scientists and Engineers and a member of the Groundwater Division of the Geological Society of South Africa, where he served on the executive committee. He was generally recognised as one of South Africa's leading geohydrologists and an outstanding research manager.

He is survived by his wife Judy and their three year old son Jonathan.

Paying tribute to Tony shortly after his death, Dr Mark Dent, managing director of the Computing Centre for Water Research in Pietermaritzburg said Tony was so special to so many because he was so genuinely interested in others and so kind to so many.

"I saw the light of the Christian faith shining through Tony in everything he did - his enormous courage, his wisdom, his humility, his patience, his humour, his tireless hard work, his listening ability, his balance, his firmness and strength when needed, his width and breadth of vision, his dignity and his warmth as a colleague and dear friend."

Friends and colleagues have all been greatly saddened at Tony's death. May his memory remain an inspiration to all.



# SA "FRIEND" project models rainfall-runoff in SADC region

A report documenting the Southern African FRIEND project, which is a contribution to the international FRIEND (Flow Regimes from International Experimental and Network Data) programme, and part of the UNESCO Fourth International Hydrological Programme focussing on hydrology and water resources for sustainable development, is presently available from the Water Research Commission. The report entitled **Southern African "Friend"- The Application of Rainfall-Runoff Models in the SADC Region** (WRC Report 235/1/97) was compiled

by researcher DA Hughes of the Institute for Water Research. The main research participants in the Southern African FRIEND project were the University of Dar Es Salaam (Tanzania), the Institute for Hydrology (UK), the National Hydrological Services of the Southern African Developing Community (SADC) member countries and the Institute for Water Research (IWR) at Rhodes University (South Africa). The project, funded by the Water Research Commission (WRC), was initiated by Hugo Maaren, WRC Research Manager for Hydrology.

The potential of time-series modelling to solve water resource related problems has not been addressed adequately in many countries of the SADC region. The Southern African FRIEND project was aimed at improving the experience base of the use of models in the region, identifying some of the problems associated with their application and building capacity in the field of hydrological modelling within the region. The first phase of the project (1994 - 96) has been relatively short and the research was limited to achievable objectives. The main aim was to :

- ☐ develop procedures and guidelines for the application of appropriate deterministic catchments models within the Southern African region for a variety of water resource assessment purposes.

The specific objectives were:

- ☐ to collate information on the previous application of models in the region
- ☐ to compile appropriate test data sets of rainfall, runoff, evaporation and physical characteristics for catchments throughout the region
- ☐ to determine the general applicability of selected models to the different sub-regions of Southern Africa through

model calibration and identify any model, or data availability, related shortcomings

- ☐ to carry out specific tests of the applicability of the models to simulating the impacts of land-use change on flow regimes
- ☐ to prepare guidelines for the estimation of model parameter values at sites (gauged and ungauged) within southern Africa
- ☐ to package the models and associated data preparation and analysis procedures in a software form suitable for use within the region
- ☐ to provide training to build capacity in the understanding and use of rainfall-runoff models in Southern Africa

## FRIEND DATABASE

The report outlines the background to the development of the Southern African FRIEND daily flow time series database and provides some further information about the South African stations (290 in total) that have been included.

## TEST DATA SETS

The compilation of the test data sets

relied heavily on co-operation with the main hydrometric agencies within the partner countries and experienced individuals within those agencies to identify those catchments with the most reliable data and complete information that could be made available for modelling purposes.

The main part of the research programme involved setting up, calibrating and verifying the two models on the test data sets. The intention was to apply the monthly model to as large and representative a number of catchments within the region as possible.

## RAINFALL-RUNOFF MODELS

There is a large body of literature on the application of models within South Africa. However information on the application of models elsewhere in the region is less readily accessible and while many examples are known to exist, access to the results of the studies appears to be more difficult.

The monthly time step Pitman Model has been applied extensively within South Africa and has also been applied



in Swaziland, Lesotho, Botswana, Zambia and Namibia. It is accessible as part of several software packages that have been designed with efficient application in mind and was therefore the logical choice for the coarser time-step model to be used.

The daily VTI model has more stringent data requirements and demands greater resources to apply. Data availability and manpower resource constraints were equally restrictive, therefore the model could only be applied to a sub-set of those used for monthly model testing. The assessment of the applicability of the models had to consider factors relating to data availability, ease or difficulty of parameter estimation and calibration, calibration and verification results, as well as the appropriateness of the models conceptual structure to the real hydrological processes prevailing within different parts of the region. As the impacts of land-use change on hydrology and catchment water yields were perceived to be important issues within the region, the research programme was designed to carry out some limited assessments of the application of the two rainfall-runoff models to simulate these impacts.

The models are already packaged within the HYMAS software system which allows several models to be operated within a common suite of data preparation and analysis programs that are not only designed for simulated data, but also for carrying out a variety of hydrological and water resource assessments using observed data.

The models that were used in the project are briefly described in the report; the models being the Pitman monthly model, the VTI daily model, the reservoir simulation models (daily and monthly) and the Patching model.

## RESULTS

The results are presented in 11 appendices in the report, one for each country and an additional one for the simulations of the impacts of land use change. The chapter summarising and discussing the results aims to provide a succinct overview of the main results obtained from the application of the two main models (Pitman and VTI).

### Pitman model

With respect to the Pitman model the results can be further condensed into

the following points :

- ☐ The model was simple to apply, and more successful in the wetter parts of the region provided the data were adequate.
- ☐ The changes that were made to the model during the project were mainly carried out to improve the model's applicability to semi-arid areas and these were moderately successful. However, there are still some deficiencies in the model formulation that make it difficult to apply in arid and semi-arid areas and these are exacerbated by the limitations of the input data (mainly rainfall) that are normally available for such areas.

### Southern African "Friend" - The Application of Rainfall-Runoff Models in the SADC Region

DA Hughes

Report to the Water Research Commission  
by the  
Institute for Water Research  
Rhodes University

WRC Report No 235/1/97



The project has highlighted a well known and understood (and obvious) problem with the application of any hydrological model. This problem relates to the quality and resolution of the input data and it is clear that without adequate rainfall data, either the simulation results can be expected to be poor, or even if the results are adequate they may be achieved for the wrong reason which suggests that the calibrated parameter set may not be transferable to other periods or catchments.

### VTI model

The main points regarding the application of the VTI model are :

- ☐ This model is inevitably more difficult to apply, partly because it has a far greater parameter space and there was rarely sufficient information on catch-

ment physical characteristics to quantify some of the parameters *a priori*.

- ☐ In general terms it was found that if the Pitman model could be calibrated with reasonable success, then so could the VTI model, while the reverse was also found to be the case. This is an indication that one of the main problems lies with the quality, or representativeness, of the input data - a problem common to the application of any model.

☐ The problems with applying the model to semi-arid areas are similar to those of using the Pitman model. Although the VTI model has a channel transmission loss function, it is very empirical and difficult to calibrate when the processes involved are not well understood and there is no real information available about observed losses.

- ☐ A lack of information about levels of water abstraction and catchment land use changes presented a problem for both models, but more so for the daily model. There were some catchments where the observed flow regimes suggested that such influences were present, but without more data these influences could not be quantified and were therefore difficult to properly account for in the calibration procedures.

☐ The groundwater function of the VTI model is very important with respect to simulating the low flow regimes of perennial rivers, but there is generally very little information about the properties of the aquifers underlying the catchments.

### Data patching

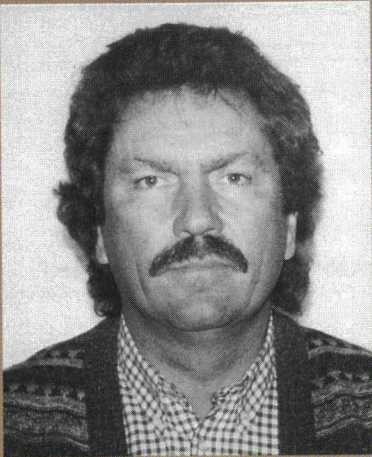
The patching model represents a very simple tool to extrapolate from daily flows gauged at a site, either to other periods at the same site, or to ungauged sites using regional flow duration curves. The model was applied in several areas during this project and the results were very encouraging.

The report **Southern African "FRIEND" - The Application of Rainfall-Runoff Models in the SADC Region** (WRC Report 235/1/97) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. (E-mail: library@wrc.org.za) Foreign orders: US \$30 per copy via surface mail.

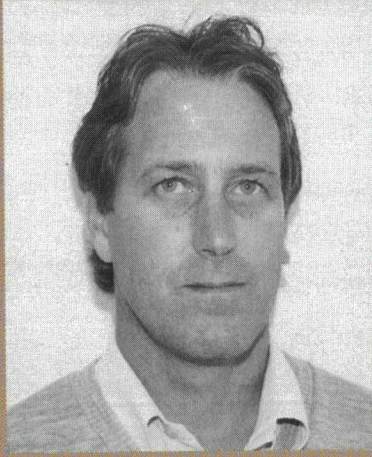


# Researchers investigate Port Elizabeth's hidden water resource

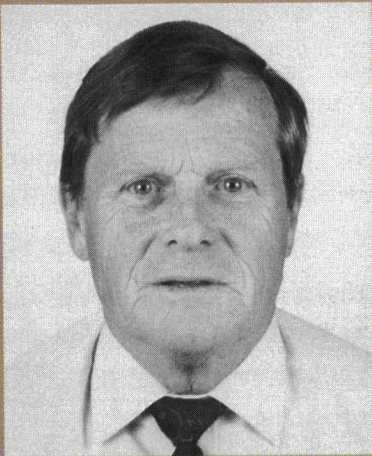
## The Research Team



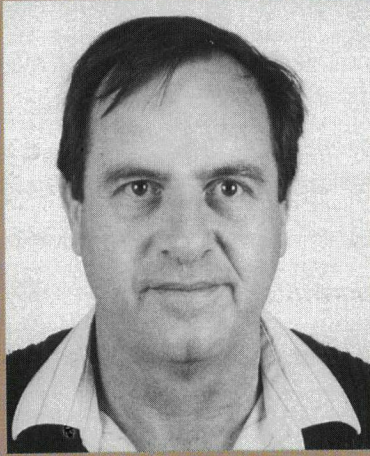
*Peter Rosewarne*



*Chris Lomberg*



*Graham Devey*



*David Raymer*

The Port Elizabeth area experienced a downward trend in rainfall from 1983, culminating in water restrictions being introduced from 1989 to 1992. In response to this drought, a proliferation of private boreholes were drilled into the sandstone aquifer underlying the municipal area. In early 1992 Steffen, Robertson and Kirsten (SRK) held discussions with Port Elizabeth municipality with a view to initiating a research project to investigate the extent and effects of private groundwater abstraction in the municipal area. SRK and the Port Elizabeth municipality then agreed to submit a joint proposal to the Water Research Commission for funding, which was subsequently approved, and the project commenced in January 1993.

According to a final report on the project, published by the Water Research Commission, the researchers, CR Lomberg, PN Rosewarne, DA Raymer and DG Devey say the objectives of the investigation were as follows:

- ☐ To determine the number and distribution of boreholes in the Port Elizabeth municipal area.
- ☐ To assess the volumes of groundwater abstraction and overall groundwater quality.
- ☐ To assess the potential for saline intrusion.
- ☐ To investigate legal options for the Port Elizabeth municipality to control development and use of groundwater in the municipal area.
- ☐ To determine spatial and seasonal variations in groundwater use.



□ To assess groundwater contamination from irrigation with final effluent and fertilizer application.

## APPROACH

The initial priority of the investigation was to determine the number and location of boreholes by means of a census. A representative monitoring network of boreholes was established from which data on abstraction, water levels and water quality were obtained. Originally fifty boreholes were selected to be monitored over the study period, including boreholes that fall outside the Port Elizabeth municipality boundary. Sites were selected to enable the collection of representative data from as wide an area as possible, with a balance between private residential and higher consumption corporate and municipal boreholes. Permission was granted to equip 37 boreholes with water meters as principal monitoring points. Monitoring data to be collected included water consumption (abstraction), water levels and samples for chemical and bacteriological analysis.

Once the water meter installation programme was completed, meters were read on a monthly basis along with water levels where possible. In total some 700 meter readings were taken from 37 boreholes. About 1 000 borehole water samples were analysed from the 47 boreholes monitored.

## DATABASE

A database (using Dbase 4) was developed and designed to accommodate information from the census forms. The City Engineer's department also maintained a database on Quattro Pro into which monitoring data on borehole water levels and abstraction rates, as well as records of corresponding municipal consumption were entered. The Scientific Services Division of the Port Elizabeth municipality entered all the results of the hydrochemical analyses on Excel spreadsheets.

## CONCLUSIONS

The main conclusions to be drawn from this study are:

□ There are an estimated 300 boreholes in the Port Elizabeth municipal area, of which 239 have been located.

□ Annual groundwater abstraction is estimated at 370 000 m<sup>3</sup>.

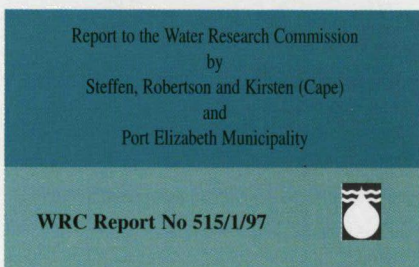
□ There are a few municipalities who have promulgated by-laws to control private groundwater use. Aspects that should be included in a by-law for Port Elizabeth municipality are the following:

- employ an affiliated drilling contractor;
- submission of borehole completion certificates;



### Research into Groundwater Abstraction in the Port Elizabeth Municipal Area

CR Lomberg • PN Rosewarne  
• DA Raymer • DG Devey



- right of access for inspection and monitoring;
- regular submission of water samples for quality analysis
- restrictions on groundwater use in areas with declining water levels or quality, or where mutual interference occurs;
- restriction on groundwater use in an exclusion zone adjacent to the sea;
- public awareness on groundwater issues.

□ Over most of the study area the groundwater is a sodium chloride type. The only exception is Summerstrand where the groundwater has a greater calcium/magnesium bicarbonate component.

□ Groundwater quality in the Port Elizabeth municipal area is generally atypical of the Table Mountain Group sandstones aquifers elsewhere in the Eastern and Western Cape.

□ There is extreme spatial variation in groundwater quality, often over very short distances in the same suburb.

□ There is sporadic and short-lived intrusion of saline water in the boreholes closest to the sea in the Summerstrand area. This is a local and non-permanent phenomenon at the moment but there is potential for deeper incursion of saline water into the aquifer under higher pumping stress, should drought conditions return.

□ There is evidence of groundwater contamination in many areas on the basis of conductivity, chloride and nitrate levels, especially in the context of groundwater quality in the Table Mountain Group sandstone aquifers elsewhere. The contamination is attributed to urbanisation and, specifically old waste dumps, fertilizer application, irrigation with treated effluent, leaking sewers and stormwater runoff.

□ Groundwater use has had a negligible effect on municipal consumption in respect of homeowners.

□ In terms of yield and water quality, the Table Mountain Group sandstone aquifer in the Port Elizabeth municipal area is not a potential source of municipal water supply, unless untapped aquifers exist at greater depths than so far exploited.

Copies of the report entitled **Research into groundwater abstraction in the Port Elizabeth municipal area** (WRC Report 515/1/97) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 25, via surface mail).



# Simple water treatment technology tested

**A** report on the Evaluation of Direct Series Filtration for the Treatment of South African Surface Waters by researchers CD Swartz, CJ van der Walt and PJ van der Merwe, has recently been published by the Water Research Commission. The application of the direct series filtration process for the treatment of South-African surface waters were investigated as an appropriate and affordable water treatment technology because of the low-cost and ease of constructing these filters. In this direct series filtration the upflow filter contains layers of various sand gradings, ranging from a coarse 6-12 mm sand to a fine 1-1,5 mm sand, with the coarse sand at the bottom and the finest sand at the top of the filter. While the downflow filter of this direct series filtration contains a single fine sand only. The sand gradings in the two filtration stages are shown in figure 1. According to the report low turbidity waters would require coagulation and direct series filtration only, while in the case of high turbidity waters the filtration process can be preceded by flocculation and settling.

The researchers say that direct series filtration, apart from lower capital costs, also has the following benefits:

- ☐ easy and economical upgrading of existing treatment systems
- ☐ flexibility because of the use of modular sections
- ☐ high filtration rates can be achieved
- ☐ low coagulant dosages

## AIMS

This technology was applied for the first time at Burgersfort in Mpumalanga, where a full-scale plant provides 5Mℓ of potable water per day (see SA Waterbulletin Nov/Des 1993, Vol.19 no.6.

(p.4) Burgersfort opens unique low cost water treatment plant).

However, this project's main aims were:

- ☐ to evaluate the process on pilot scale at a number of different raw water sources, representative of the major types of different surface waters in South Africa, and
- ☐ to determine whether it presents a cost-efficient treatment option which could replace the more conventional technologies on a large scale.

## Evaluation of Direct Series Filtration for the Treatment of South African Surface Waters

CD Swartz • CJ van der Walt • PJ van der Merwe

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

WRC Report No 354/1/97



A further aim pending the outcome of the pilot tests, was to establish what further applied research would be necessary to draw up design guidelines and develop the process.

## PILOT TESTS

The pilot scale tests with a small direct series filtration unit were performed at

Hectorspruit, Mpumalanga (low turbidity water); Vaalkop Dam, North-West Province (high turbidity water); Roodeplaat Dam, Pretoria (eutrophic water); and Mossel Bay (coloured water). The tests were performed on each source with different coagulants (ferric chloride, aluminium sulphate and cationic polymer) and at different filtration rates (5 m/h; 10 m/h; and 20 m/h).

## CONCLUSIONS

The following conclusions were drawn based on the results of the pilot scale evaluation of the direct series filtration process on South African surface waters:

- ☐ The process is effective for the treatment of low turbidity waters, and can produce product water turbidities of 0,5 NTU on a consistent basis using a metal coagulant such as  $\text{FeCl}_3$ . At normal rapid sand filtration rates of 5 m/h, the run time of the series filtration process can be up to 40 hours or more. Even at a high filtration rate of 20 m/h, filter run times of almost 8 hours can be achieved.
- ☐ Cationic polymers can produce even longer filter runs when treating low turbidity water, but the same low turbidity levels of the filtered water achieved with the use of metal coagulants, are not with the use of cationic polymers.
- ☐ Effective coagulation of the raw water is required to ensure high quality final water after the upflow and downflow filtration process.
- ☐ The process can also effectively treat high turbidity water to produce a filtered water with turbidities down to 1 NTU, but as expected will have much shorter filter run times. This does not present significant problems when treating highly turbid waters at low filtration





Full-scale direct series filtration plant at Hectorspruit.

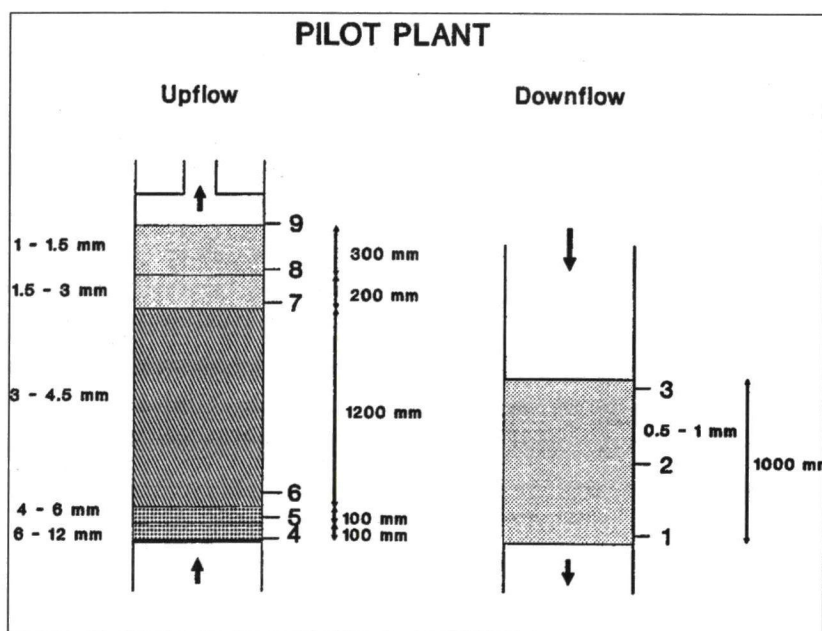


Fig. 1: Sand-gradings and manometer positions in the pilot plant.

rates (typically 5 m/h), but will be a limiting factor when attempting to treat these waters at a high filtration rate on full-scale.

□ The process also produces low final water turbidities (1 NTU and less) when treating eutrophic waters, but is not very effective for removal of algal cells, as measured by the chlorophyll a content of the water.

□ It is not effective for the treatment of highly coloured waters either, mainly

because of the fragile nature of the flocs that are formed when the natural organic matter (mainly humic substances) in the water is coagulated. The strength of the floc seemed to be improved somewhat when dosing with a cationic polymer, but it is still not able to prevent floc breakthrough after relatively short filter run times. The effect of secondary flocculation in the downflow filter and shear forces in the upflow filter appear to be more significant when treating these coloured waters, as evidenced by the more erratic results of the test runs.

Practical experience gained through implementation of the process at full-scale at the four locations in South Africa indicates that:

□ the system consistently provides water of acceptable quality and quantity for small, developing communities

□ by exploiting modular design and the use of prefabricated concrete pipe sections, capital cost savings of 20% to 50% are attained when compared to conventional treatment

□ indirect evidence suggests that coagulant savings of 20% could be realised for series filtration

□ with appropriate safety factors and degree of automation, the system can be successfully operated with limited operator skills, provided that competent technical back-up and guidance are provided at least monthly.

Two criteria are important for establishing the water quality limits within which series filtration can be applied. The first is whether the final water quality meets the required standards, and the second is whether the system can be operated at sufficiently long filtration cycles before terminal headloss or turbidity breakthrough is reached.

In all the cases investigated, both at pilot and at full-scale, final water turbidity below 1.0 NTU could be attained except when a cationic polymer was used as only coagulant. The performance in terms of colour removal was, however, much more erratic. The most important limiting factor was the filter run time as discussed in the report.

The report **Evaluation of Direct Series Filtration for the Treatment of South African Surface Waters** (WRC Report 354/1/97) is available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001 (or E-mail: [tineke@wrc.org.za](mailto:tineke@wrc.org.za)). Foreign orders: US \$25 per copy, via surface mail.



# Researchers analyse palaeoflood records

The lower Orange River could, with the present hydroclimatic changes experience a catastrophic flood with a discharge of 28 000 m<sup>3</sup>/s. This is the conclusion drawn by researchers PK Zawada, J Hattingh and D van Bladeren, of the Council For Geoscience, in their research report to the Water Research Commission. The report is entitled **Paleoflood Hydrological Analysis of Selected South African Rivers**. According to the report paleoflood hydrology

is a multidisciplinary approach involving sedimentology, geomorphology, hydrology and specialist dating techniques. The interdisciplinary nature of palaeoflood hydrology has caused this approach not to be applied extensively, particularly in the field of water resource management. However, this research project has shown that because of the multidisciplinary nature of palaeoflood hydrology, it offers valuable flood information and insights that would otherwise not be obtained.



*Relief peel of climbing ripple lamination from a flood unit. Note the abrupt change from inclined lamination to climbing-ripple lamination.*

**P**alaeoflood hydrology studies past or ancient flow events which occurred prior to the direct measurement by modern hydrological procedures. It is a potentially valuable technique as it seeks to identify persistent geological and geomorphological features which are then used to identify past flood events that are not reflected in the conventional flood-flow record. It uses sedimentological and stratigraphic principles to identify palaeofloods, and with radiometric dating as well as hydraulic modelling of flood flows, can furnish a flood catalogue of peak discharge and temporal occurrence of past events. This flood record can then be used to augment and lengthen the conventional flow record and in this way improve the statistical basis from which flood recurrence intervals can be calculated. Palaeoflood hydrology analysis can also give an indication of the upper

flood limits; information which cannot be obtained by conventional statistical means.

In South Africa palaeoflood hydrology has largely been ignored, as its value in flood forecasting and its application to palaeoclimatology, amongst others, for the southern African region has not been recognised or appreciated. This study adopted a threefold approach to develop palaeoflood hydrological expertise in southern Africa with the objective of establishing it as a complementary tool in the field of water resource management. Firstly the study focussed on establishing an inventory of the types and evidence that exist from differing climatic regions of the country. Secondly a detailed palaeoflood hydrological analysis was done for the Orange River to demonstrate that the technique yields information on the flood history of a river

which would otherwise either be overlooked or inaccessible during conventional hydrological investigations. Thirdly, this study attempted to show that southern African Holocene palaeoflood records represent an important source of proxy palaeoclimatic data that can be used to verify and refine the palaeoclimate change models for southern Africa.

## AIMS

Considering the potential value of Palaeoflood hydrology as an applied research tool, the Water Research Commission funded the research project which aimed more specifically to:

- Evaluate whether palaeoflood hydrology can supply reliable maximum peak-flood estimates for South African rivers, with the aim of placing an upper



limit to the peak-flood for each river under investigation.

□ Refine the present peak-flood estimates as calculated using the statistical, deterministic and empirical approaches as applied by the hydrologist, and in particular, to test the validity of the probable maximum flood and regional maximum flood figures against palaeoflood hydrological data.

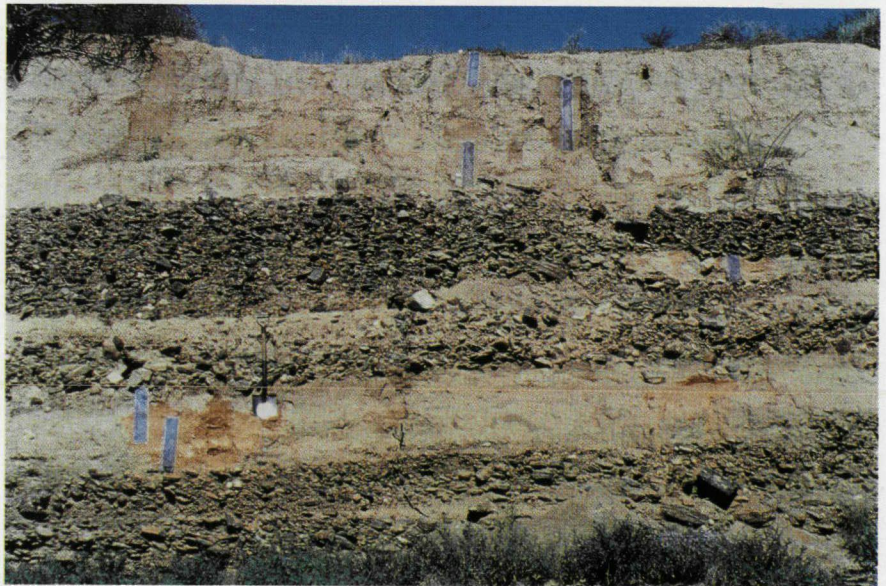
## RESULTS

A reconnaissance investigation of 67 potential palaeoflood sites, for eight major rivers, identified several types of palaeoflood hydrological evidence. The potential for constructing palaeoflood stratigraphies at 49 sites was assessed in terms of their biogenic reworking and the mean annual rainfall at the site. According to the report the Free State, Northern Cape and Cape Mountains from Port Elizabeth westwards to Cape Town are most suited for palaeoflood hydrological analysis using slack-water sediments.

In this project the detailed palaeoflood hydrological analysis focussed on recording and constructing dated and flow-modelled palaeoflood catalogues for the middle (Prieska) and lower (Richtersveld) reaches of the Orange River. This was done using five bedrock-controlled reaches comprising slack-water sediments in back-flooded tributaries. For each site detailed sedimentological analyses of the slack-water sequences were made, to ensure the confident differentiation between palaeoflood and non-palaeoflood deposited sediments, and to gain a better understanding of the sedimentation dynamics during slack-water deposition. A total of 43 palaeoflood slack-water units were identified from the five sites.

In addition to detailed outcrop descriptions, the well-established technique of relief peels was applied to the fine- to very fine-grained Orange River slack-water sediments. Relief peels represent a new approach to the study of slack-water sediments which assisted the hydrodynamic interpretation to slack-water deposition and the accurate differentiation of palaeoflood-deposited units.

According to the results reported the lower Orange River has experienced 13 palaeofloods with discharges in the range of approximately 10 200 - 14 660



*Sequence of interbedded slack-water deposited sand and non-palaeoflood tributary-deposited gravel at section 1, site 19. Shovel for scale is approximately 90 cm long.*

m<sup>3</sup>/s during the last 5 500 years. These discharges are considerably larger than the largest historically documented or gauged discharge of 8 330 m<sup>3</sup>/s in 1974 at Vioolsdrift, and therefore represents additional flood information for the lower Orange River.

Slack-water sediments representing a flood with a discharge of approximately 28 000 m<sup>3</sup>/s were recorded at these sites. This flood was over three times the discharge of the largest historically recorded or gauged flood and is therefore regarded and termed as a catastrophic flood. It was almost twice the discharge of 16 000 m<sup>3</sup>/s recorded for the Mfolozi River in 1984 (Domoina) which represents the largest recorded flood in South Africa. Three radiocarbon dates indicated that this catastrophic flood recorded from the lower Orange River occurred relatively recently in the period after 1444 -1462 AD.

## CONCLUSION

This project has shown that palaeoflood hydrology not only represents a tool but an important applied technique that is of particular value in southern Africa where an increasing demand is made on planners to develop water resources in the region. The researchers indicated that the multi-disciplinary approach of palaeoflood hydrology should be extended to include water resource planners and civil engineers, as well as environmentalists specialising in the field of fluvial or fresh-water ecology.

The report **Palaeoflood Hydrological Analysis of Selected South African Rivers** (WRC Report 509/1/96) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001 (or E-mail:tineke@wrc.ccwr.ac.za). Foreign orders: US \$30.

### Paleoflood Hydrological Analysis of Selected South African Rivers

PK Zawada • J Hattingh • D van Bladeren

Report to the Water Research Commission  
by the  
Council of Geoscience

WRC Report No 509/1/96



Palaeodischarge estimates based on the maximum elevation of the flood units indicate that the palaeoflood sequences of the middle and lower reaches of the Orange River represent two ranges of palaeodischarge. At Prieska the range varies from 2 660 - 13 080 m<sup>3</sup>/s, whereas the Richtersveld sites record a range of 5 580 - 27 870 m<sup>3</sup>/s.



# Catch the water, Catch the future...

**T**he Water Research Commission has recently published the report **Hydrology and Water Quality of the Mgeni Catchment**, emanating from a project in which researchers SW Kienzie, SA Lorentz and RE Schulze developed a distributed hydrological modelling system for the Mgeni catchment.

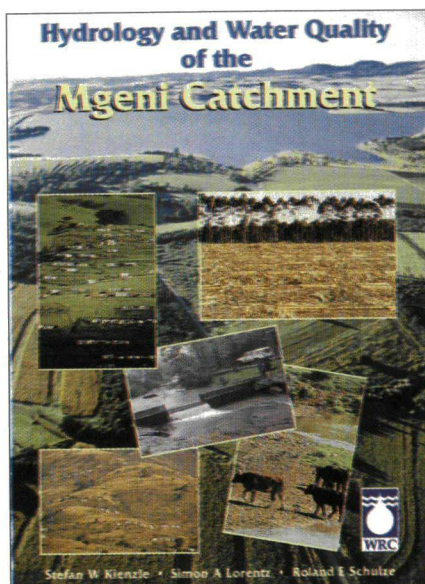
The Mgeni Catchment upstream of the Inanda Dam, is the vital water source for both the Greater Durban and Pietermaritzburg Metropolitan areas in Kwa-Zulu-Natal. It supplies water for approximately 45% of the Province's population in a region which produces 20% of South Africa's gross national product. In this area of highly variable rainfall, Umgeni Water manages five dams for water supply. The population in the Greater Durban and Pietermaritzburg Metropolitan areas projected to expand to between 9 and 12 million by the year 2025. The rapidly accelerating water demand is expected to exceed local raw water resources by the turn of the century. The increased occurrence of return flows, intensified agricultural practices and the presently unco-ordinated growth of large informal settlements (associated with the population expansion and influxes into the region) are expected to lead to severe deterioration of the water quality of streams, rivers and dams. During summer months, frequent convective thunderstorms result in the transport of suspended solids, pathogens and phosphorus from the subcatchments into receiving channels, with the consequence that domestic, agricultural, industrial, ecological and recreational user groups are affected.

## PROJECT AIMS

In response to these perceived potential water-related problems, the Umgeni modelling group approached the Department of Agricultural Engineering at the University of Natal in Pietermaritzburg in 1988 to undertake a two-phase research programme which would develop a dynamic system model of the Mgeni catchment. Phase 1 of this

research programme was completed in 1992. The main objectives of Phase 2 of the research programme, entitled *Development of a Distributed Hydrological Modelling System to Assist with Water Quantity and Quality Management in the Mgeni Catchment* (Phase 2) were:

- the development of a simulation tool, in which the *ACRU* modelling system would be further developed to incorporate relevant water quality simulation capabilities and enable the modelling of



selected water quality parameters, viz sediments, phosphorus and *Escherichia coli* (E. Coli), which are important for the planning and management of Mgeni catchment's water resources, and

- the setting up of an operating model - in which the extended and verified *ACRU* modelling system would be applied in simulations of water quantity and water quality in order to implement and evaluate the model for potential catchment scenarios of the future.

*ACRU* is a multi-purpose model centred on daily multi-layer soil water budgeting. It has been structured to be highly sen-

sitive to climate and to land cover and land use changes on soil water and runoff processes.

## STREAMFLOW SIMULATION

The *ACRU* hydrological and water quality modelling system was configured for the Umgeni catchment upstream of Inanda Dam to simulate daily streamflows for 137 subcatchments for the 34-year period from 1 January 1960.

## RESULTS

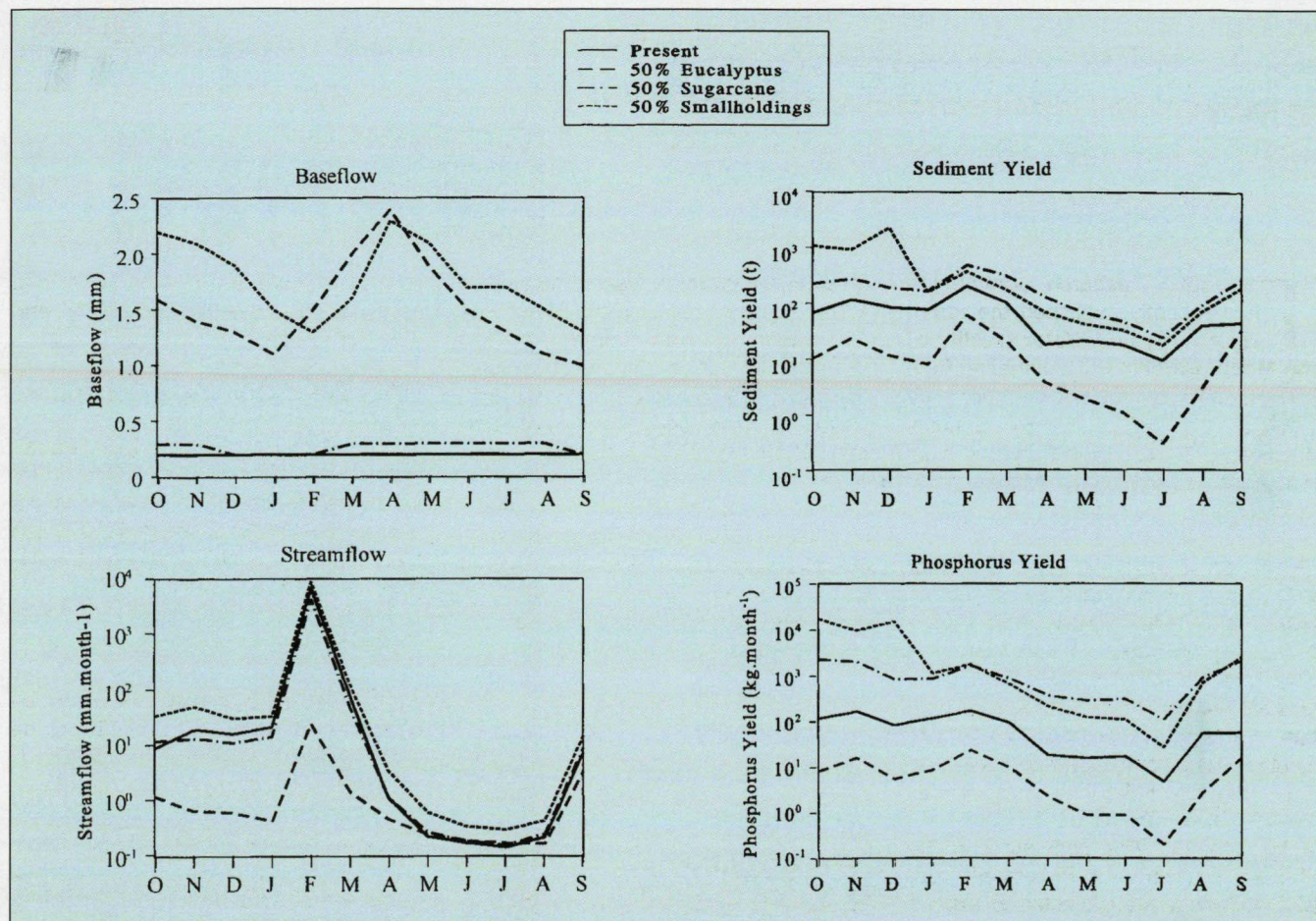
General results as regards the **hydrology component** of this project include the following:

- A modelling system, with comprehensive datasets for the Mgeni catchment upstream of Inanda Dam, has been established to simulate components of the hydrological cycle.
- Observed and simulated runoff compare very favourably in catchments with significantly different land users and water yields.
- The system can therefore be used to study the individual components of the hydrological cycle, such as soil moisture content histories, low flow periods, base flows and peak flows.
- The modelling system can furthermore be used to estimate components of the hydrological cycle which determine water quality processes.
- The system is highly suitable for determining the impacts of anticipated land use change scenarios on the aquatic environment. Two types of hydrological impact studies were undertaken, modelling future water yield scenarios. These are discussed comprehensively in the report.

The achievements in **water quality simulations** of this study include the following:

- A modelling system, with comprehensive data sets for the Mgeni catch-





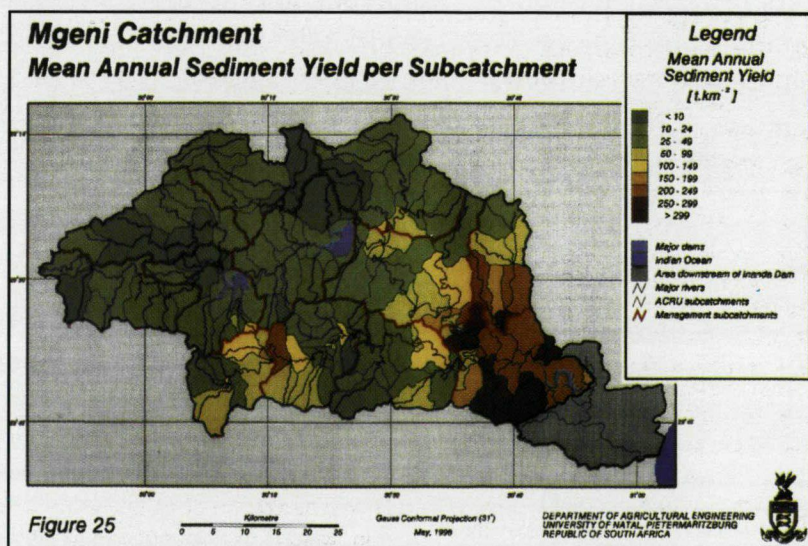
Comparison of hydrological and water quality responses in the Table Mountain area between present and a future scenario in which present land cover is replaced by 50% other land uses.

ment upstream of Inanda Dam, has been established to simulate non-point source sediment yield, phosphorus loads and *E. coli* concentrations at sub-catchment level.

□ The system is highly suited to determining the impacts of anticipated land use change scenarios on selected water quality responses.

□ A need for adequate water quality monitoring methods to yield reliable estimates of the total loading of sediments and phosphorus has been identified. It is recommended that integrated sampling, or automatic sampling, be instituted in critical catchments.

□ A need for experimentation designed to allow for the observation of the transport mechanisms of sediments, phosphorus and *E. coli* within a catchment has also been identified.



Mgeni Catchment Mean Annual Sediment Yield per Subcatchment.

The report **Hydrology and Water Quality of the Mgeni Catchment** (TT87/97) is obtainable, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. (E-mail: library@wrc.org.za) Foreign orders: US \$25 via surface mail.



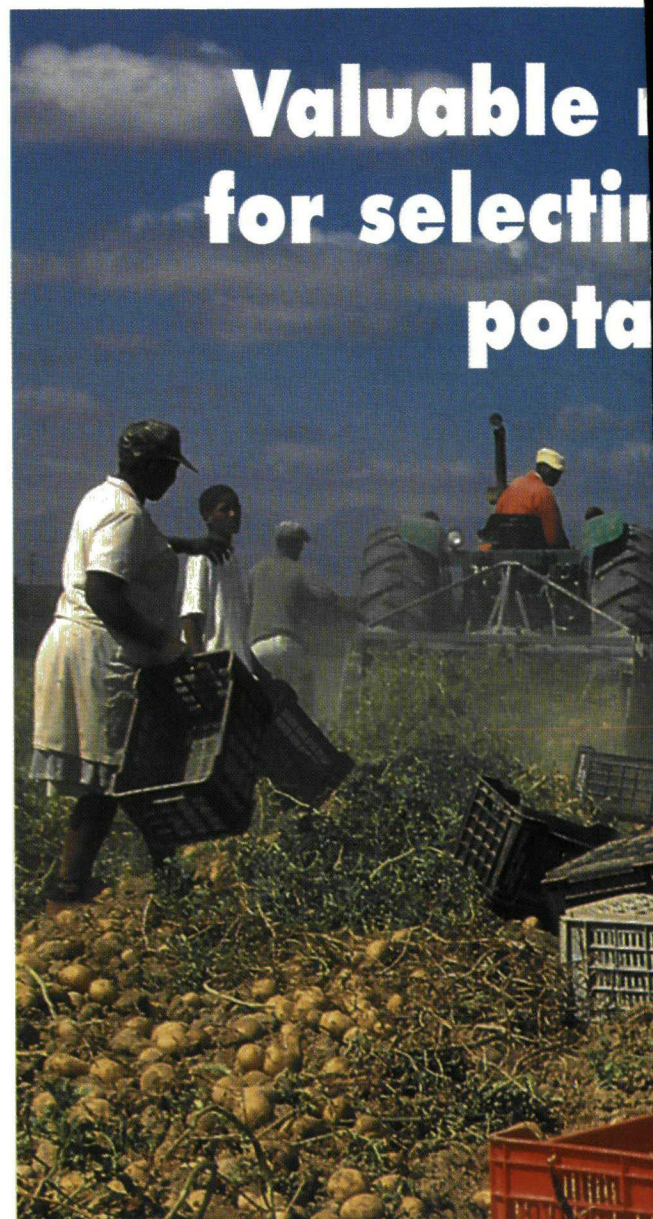
In a study sponsored by the Water Research Commission (WRC) local potato genotypes were for the first time in South Africa characterised according to drought tolerance.

Researchers, JM Steyn, HF du Plessis and P Fourie at the Agricultural Research Council-Roodeplaat Vegetable and Ornamental Plant Institute outside Pretoria, say in a report to the WRC that drought-tolerant genotypes were regarded as those showing the lowest reduction in tuber yield when exposed to water stress.

"Results indicated that Mnandi, Late Harvest, Vanderplank 82-252-5 and 83-252-1 were the most drought tolerant of the genotypes evaluated."

According to the report the drought-sensitivity index demonstrated in this study should be a valuable tool to plant breeders for the selection of drought-tolerant parent material in breeding programmes.

Copies of a final report summarising the study's results - Response of potato genotypes to different irrigation water regimes (WRC report 389/1/98) - are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price US\$ 25-00, via surface mail).



**T**he potato is an important source of food world wide. In South Africa the crop is primarily produced under irrigation (about 73 per cent of the total area under potatoes) for the fresh market, for the processing industry as chips and crisps, and for seed potatoes.

In subtropical climates potato crops are often subjected to unfavourable conditions of high temperatures and water shortages during the growing season: heat and water stress adversely affect growth, tuber yield and quality. In these hot, dry climates the high evaporative demand increases crop water requirements, which may compound the sensitivity of the crop to water stress, resulting in greater yield reductions than

experienced with similar water deficits under cooler conditions.

Due to limited resources and unreliable annual distribution of rain, water stress is a major constraint on potato production in South Africa. In some production areas the quantity and quality of water resources have deteriorated badly due to overexploitation. Two possible approaches could be followed by agriculture to achieve savings on water use without reducing the cultivated area.

### OPTIONS

The first option is to cut down on current water use by the application of sound irrigation scheduling techniques as it

has been shown that, although water stress is considered an important production limiting factor, only a few producers apply scheduling on irrigated crops. The negative attitude towards irrigation scheduling can be attributed to various factors. The lack of easy, quick and reliable scheduling methods seems to be one of the major reasons.

The second option is to breed and select genotypes that are more efficient with regard to water use characteristics, which may be a long term solution to the problem. This alternative is well recognised for many crops and breeding for better adaptability to drought is an important objective of the local potato breeding programme at Roodeplaat.



# new tool available g drought-tolerant to genotypes



Since little is known about the amounts of water required for optimum production and the effects of water stress on local potato genotypes, the following objectives were set to clarify these aspects:

- ☐ Determine the water use of the most important potato cultivars and breeding lines to ensure maximum yield and quality.
- ☐ Identify the critical growth stages of potatoes to water stress.
- ☐ Determine the effect of water stress imposed in different growth stages on growth and development.
- ☐ Determine the suitability of some physiological parameters to indicate the

existence of plant water stress and to serve as early screening methods for drought tolerance in potato genotypes.

- ☐ To use collected data for the development of crop growth models and adapt irrigation scheduling models for potatoes.

Seven trials were conducted from the 1992 autumn planting until the autumn of 1995. The trials were planted under automated rain shelters and irrigation booms were used in combination with rain shelters.

Genotypic yield differences in response to levels of water stress were mainly confined to the spring planting, when temperatures and the atmospheric

evaporative demand are higher than in autumn. Some genotypes were clearly better adapted to water stress conditions than others. Of the late genotypes Late Harvest and Mnandi performed best at the dry treatments, while Mnandi had the highest yields at the wetter treatments as well. The findings of this study contrast with the suggestions of other researchers that there is limited capacity for improved drought tolerance through breeding other than improving the yield potential. Genotypes such as Late Harvest, Vanderplank 82-252-1 and 83-252-1 had low yield potentials under favourable conditions, but had the highest yields when they were water stressed.

The ranking of genotypes according to yields attained at different water treatments is an important contribution to the current state of knowledge and will be valuable to producers in assisting them to select genotypes most suitable to their specific growing conditions. The ranking order of genotypes as a result of water treatments only changed in spring planting, indicating that in autumn genotypes can be selected purely according to yield potential or specific needs of the end user. If producers have a choice between spring and autumn planting seasons, the range of high yielding genotypes to select from will be larger for autumn planting. High yields can usually be expected from autumn planting, while the saving on irrigation water will be substantial, compared to a spring planting.

## WATER STRESS

The negative effect of water stress on tuber size was most severe in spring planting, when temperatures and the atmospheric evaporative demand were higher. The yield of medium and especially large tubers were damaged by water stress, but genotypes within the same trial did not respond differently to water stress.

Water regimes apparently had less effect than temperature on the tuber internal quality in spring planting. The effect of water regimes on tuber quality was not clear and, contrary to most reports in literature, no negative effects of water stress on tuber relative density and chip colour could be demonstrated in spring plantings, while chip colour improved as a result of water stress in autumn plantings. Firstly, the contradictory results are possibly attributable to



the dominating effects of temperature on tuber quality. Secondly, the irrigation boom method used does not resemble field conditions, due to the regular application of small amounts of water to dry treatments.

Photosynthetic rate and stomatal resistance were investigated as indicators of drought tolerance. Tuber yields correlated well with seasonal mean values of both these parameters for all the genotypes, but the regression functions that describe these relationships changed for seasons and genotypes. The magnitude of decline in photosynthetic rate or increase in stomatal resistance in response to drought was found to be related to the magnitude of decline in tuber yield. These relationships are, however, not valid for heat sensitive genotypes such as Up-to-date. These findings may be a significant contribution to early selection techniques for drought tolerance in crops, but the technique should be evaluated on independent data and on a wider range of more diverse material to prove its usefulness.

The objective of finding suitable physiological parameters as indicators of water stress, and to serve as early screening methods for drought tolerance in potatoes, was reached, since the regression functions obtained from this study can in future be used to estimate the expected yield reduction of a specific genotype, once the reduction in photosynthetic rate or increase in stomatal resistance for that genotype is established.

The vast differences in total water use between plantings and years were mainly as a result of differences in atmospheric evaporative demand. Normalising the water-use data for seasonal vapour pressure deficits narrowed the gap between years, but differences between spring and autumn plantings were still evident for the same genotypes. The reason for the remaining differences should probably be attributed to the fact that evapotranspiration and not transpiration data were used for comparison.

The small differences observed between genotypes in water use can perhaps be explained by the way water use was calculated and by the method of irrigation used. Water use was mainly a function of water applied, as genotypes within the same maturity class received the same amount of water. Unfortunately, genotypic differences in water use could

not be determined with the irrigation method used.

## WATER USE

Water-use efficiencies were the highest for autumn plantings, because less water was lost through evaporation without contributing to the production of dry matter. Highest water-use efficiencies were generally recorded at the intermediate treatments for both plantings. The high potential cultivars such as Up-to-date, BP1, Mnandi, 81-163-40 and Mondial had the highest efficiencies in autumn plantings, independent of the water treatment applied, but in spring plantings the water-use efficiencies of genotypes were influenced by water treatments. Generally, Up-to-date and 83-363-67 had the highest efficiencies at the wet to intermediate treatments, while the more drought tolerant genotypes, Vanderplank, Late Harvest and Mnandi, had high efficiencies at all the water treatments in spring plantings. The medium-maturity genotypes 82-252-5 and 83-252-1 had the highest efficiencies at the driest treatments.

which is suggested as the maximum rooting depth for irrigation scheduling calculations.

The Soil Water Balance model (SWB) was calibrated for the cultivar Up-to-date, using data sets of autumn plantings. The model generally performed satisfactorily with regard to the simulation of dry matter production and water deficit of the soil profile for both well-watered and water-stressed conditions in autumn plantings. Simulations of crop growth and soil water depletion were, however, not accurate in spring if the crop parameters determined for autumn plantings were used. Canopy size was underestimated and the date of senescence was too early, resulting in incorrectly simulated soil-water deficits. The reason for the poor results in spring plantings is probably attributable to the fact that the effects of the photoperiod and high temperatures on development and assimilated distribution is not taken into account by the generic crop model. The model therefore needs further refinement to ensure better simulations of canopy development over seasons, possibly by accommodating the effect of day-length on growth, development and senescence. Alternatively, separate crop parameters should be determined for spring or summer plantings. Crop parameters should also be established for cultivars of other maturity classes, which will require complete growth analysis studies.

The objective to use data collected in this study for the development or adaptation of a simulation model for irrigation scheduling purposes was reached for the cultivar Up-to-date, a medium maturity cultivar. Destructive growth analyses were not possible because of the limited number of plants that could be accommodated under the rain shelters. Sufficient crop data were therefore not available for the determination of crop parameters for specific genotypes. If the water requirements of genotypes within the same maturity class do not differ, as suggested by the results of this study, the first important step in future research would be to obtain crop parameters for the most important genotypes belonging to the early and late maturity classes. Although more research is necessary to improve the model, it should already be a valuable tool to assist both advisors and potato producers on a daily basis in deciding when and how much to irrigate their potato crops.

### Response of Potato Genotypes to Different Irrigation Water Regimes

JM Steyn • HF du Plessis • P Fourie

Report to the Water Research Commission  
by the  
ARC-Roodeplaat Vegetable and  
Ornamental Plant Institute  
Agricultural Research Council

WRC Report No 389/1/98



Rooting density in deep soil layers was not related to drought tolerance for the genotypes studied. Although root distribution was slightly changed by water regime, root development does not seem to be a suitable indicator of drought tolerance in potato genotypes. The majority of roots were located in the top 600 mm soil layer for all potato genotypes. The greatest portion of soil water was also extracted from this zone,



# Cross-flow sand filter tested for rural water treatment



*Construction of the water reservoir at Emmaus in KwaZulu/Natal.*

**R**esults of a study, funded by the Water Research Commission, show that the dynamic cross-flow sand filter technology is sufficiently uncomplicated to enable some of the rural communities in South Africa not only to construct the system, but also to operate and maintain the filter to yield drinking water of acceptable quality.

Water clarification is an important step in the production of clean and safe drinking water. But, although the clarification process is well understood and well utilised in First World water treatment facilities, the complexity of the constituent technologies (flocculation, clari-

fication and sedimentation) render it too intricate for operation and control by unskilled personnel, and therefore there is a need for less complicated innovative alternatives which are suitable for operation in rural communities.

One such option is the dynamic cross-flow sand filter, which originated in Argentina some fifteen years ago. The dynamic filter effects clarification in a manner identical to that of a slow sand filter, but unlike the latter, it is to a large extent self-cleaning. The filter cleans itself by allowing an adequate portion of raw water to flow rapidly across the surface of the sand bed so as to re-entrain

deposited turbidity particles into the cross-flow stream. This innovation avoids the frequent cleaning of the filter, which is a tiresome and time consuming operation.

Unfortunately, there is very little documented data and information available on the performance of cross-flow sand filters, and this led to the formulation of a proposal by the CSIR's Water Supply and Sanitation Programme to the Water Research Commission to test the technology under South African conditions and to develop a technical guide for the design, operation and maintenance of the filters.





*A dynamic filter unit in Argentina.*

## ARGENTINA

The researchers, AW Kariuki and F Solsona say in their final report to the Commission that a trip was undertaken to Argentina to obtain first hand information on dynamic filters.

"Information was obtained by discussing the design, operation, maintenance and performance of the filters with engineers and plant operators. A vast amount of important information from the Argentinean experience was collected that would not have been otherwise obtained from literature, of which there is very little available. Dynamic filters in operation were visited and observed, while technical information was obtained on the sizes of the units and wherever possible the original designs."

Information and literature gathered led to the writing of a draft technical guide which was used as the basis for the design of the pilot dynamic filter plant.

## DASPOORT

A pilot dynamic filter plant was designed and constructed at Daspoort Sewage plant premises in Pretoria. A slow sand filter was also set up as a control. Both plants were monitored. Tests carried out on raw water and plant effluents indicat-

ed that the dynamic filter gave comparable results to and sometimes better results than the slow sand filter. In addition, the dynamic filter was tested using



### 1. A Dynamic Cross-flow Sand Filter for Rural Water Treatment

### 2. A Technical Guide for a Dynamic Cross-Flow Sand Filter

AW Kariuki • F Solsona

Report to the Water Research Commission  
by the  
Division of Water, Environment and Forestry Technology  
Water Supply and Sanitation Programme  
CSIR

WRC Report No 539/1/97



blastrite, a byproduct from the mining industry, as a substitute for sand as the filter medium. It was found to give similar plant effluent quality as sand. On the basis of the experience of the pilot dynamic plant filter plant the technical guide was revised.

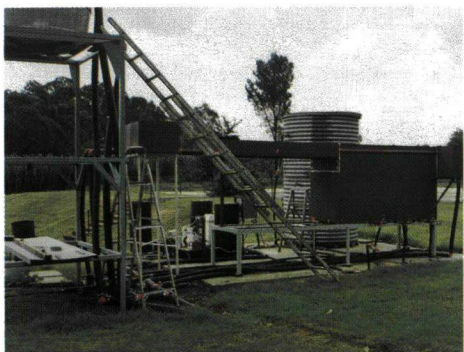
## KWAZULU/NATAL

The community of Emmaus in KwaZulu/Natal was identified as having a suitable site for the construction of a full-scale dynamic cross-flow filter for water treatment. The guidelines in the revised technical guide were used in the design of the Emmaus dynamic filter. This phase of the project faced a number of challenges including mobilising the community, raising of funds for the infrastructure and floods during the construction period in 1996.

River sand purchased locally was successfully used as the filter media. However, before it was selected it was tested and met the prescribed specifications for dynamic and slow sand filter sand. Using locally available sand was advantageous as it was cheaper than graded sand and makes it easier for the community to replace it once new sand is required. This is important for the sustainability of the project.

The dynamic filter was able to significantly remove high levels of turbidity in the raw water. It was also able to tolerate high levels of turbidity without much loss of filter capacity due to the daily cleaning process. Pretreatment may be necessary to meet the minimum drinking water standards level.





*Above and right: The pilot-scale dynamic filter unit built at Daspoort water treatment works in Pretoria.*

For the dynamic filter, the daily cleaning process of raking the filter bed surface affected the removal of turbidity and colour. In matured bed conditions the fluctuations of levels of these parameters in the effluent are less in slow sand filters. This suggests that the biofilm or "schmutzdecke" plays a major role in the removal of turbidity and colour.

The enhancement of the pH and increase of conductivity in effluent from the dynamic filter was similar to that observed in slow sand filters indicating that similar reactions occur within the filter bed.

The dynamic filter was able to significantly reduce faecal coliform densities at rates similar to slow sand filters. This was despite the frequent disturbance of the sand bed during the raking operation. This confirms observations of similar filters in Argentina.

The operation and maintenance procedures of the dynamic filter were simple and straightforward and were understood and carried out by the plant operator who had limited formal education and skills.

The major advantages of the dynamic filter over the slow sand filter are its ability to tolerate high turbidity peaks, long filter runs and much simpler operation

and maintenance requirements. Thus the dynamic filter is an alternative to the slow sand filter in those situations where there is adequate water for cross flow and the topography is suitable to divert water by gravity to a nearby filter.

### DISADVANTAGES

According to the report the filter is unfortunately not suitable for all rural communities. This is due to the following factors:

□ As the volume of water required to flow across the filter should at least be five times (preferably ten times) greater than the volume of drinking water to be produced, the rural community should

have access to a water stream of which the minimum flow rate should at least be five times greater than the water consumption rate of the community.

□ For the required raw water feed rate to the filter to be self-sustaining (avoiding pumping of the feed) the water stream (and the community) should be located in a mountainous area.

Copies of the report together with the technical guide, entitled **A dynamic cross-flow sand filter for rural water treatment** (WRC report 539/1/97) are available from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, via surface mail)





## WRC to start subject-related alerting service

**T**he WRC will shortly launch a subject-related alerting service, using electronic mail to:

- ☐ Provide details on new WRC projects
- ☐ Announce new WRC project reports
- ☐ Inform members about coming WRC workshops, seminars and conferences
- ☐ Alert on topical issues

In this issue of SA Waterbulletin, a form on which prospective members can indicate their interest for the individual subject area groups, has been included. Please complete this form (there is no restriction on the number of subject groups you may enter) and mail or fax it (mark for attention: Martha Pretorius) to the WRC at the following numbers:

**Mail address:**

Water Research Commission  
PO Box 824  
0001 PRETORIA

**Fax number:**

(012) 331 2565

## New Internet Address for WRC

**O**n 1 August 1998, the Water Research Commission's Internet WWW site changed to a new address:

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

If you have marked the WRC site as one of your Bookmarks or Favourites (depending on your individual Internet browser), please remove the old site address and replace with the new address.

## New e-mail address for all WRC staff

**A**ll e-mail addresses of WRC staff members changed on 1 August 1998. For the new e-mail addresses, please consult the list on the next page. You are also advised to change your electronic address books accordingly. New e-mail addresses for some of the WRC staff may also be found on the WRC web site.



# WRC e-mail address list

**Executive Director:**

Mr Piet E Odendaal  
odendaal@wrc.org.za

**Deputy Executive Directors:**

Dr George C Green  
gcgreen@wrc.org.za  
Mr David S van der Merwe  
david@wrc.org.za

**Research Managers:**

Dr Gerhard R Backeberg  
backeberg@wrc.org.za  
Mr Jay N Bhagwan  
jbhagwan@wrc.org.za  
Mr H Meiring du Plessis  
meiring@wrc.org.za  
Mr Hugo Maaren  
hugo@wrc.org.za  
Dr Steve A Mitchell  
steve@wrc.org.za  
Dr Nozi Mjoli  
nozi@wrc.org.za  
Dr Innocent M Msibi  
msibi@wrc.org.za  
Mrs Annatjie PM Oelofse  
annatjie@wrc.org.za

Dr Gerhard Offringa  
offringa@wrc.org.za  
Mr Greg N Steenveld  
greg@wrc.org.za

**Publications and Information:**

Mrs Ingrid Buchan  
ingrid@wrc.org.za  
Mr J du Plessis  
jan@wrc.org.za  
Mr Arno du Toit  
arno@wrc.org.za  
Ms Rina Human  
rina@wrc.org.za  
Ms Helene Joubert  
helene@wrc.org.za  
Ms Francette Myburgh  
fmyburgh@wrc.org.za  
Mrs Martha Pretorius  
mpretorius@wrc.org.za  
Mrs JA Shelwell  
jshelwel@wrc.org.za  
Mrs T van der Schyff  
tineke@wrc.org.za  
Mrs Drinie van Rensburg  
drinie@wrc.org.za

**Committee secretariat:**

Mr Frank Marais  
frank@wrc.org.za  
Mrs Charmaine Smit  
charmain@wrc.org.za  
Mr Werner van Greuning  
werner@wrc.org.za  
Mrs Una Wium  
una@wrc.org.ac.za

**Secretaries:**

Mrs Nakkie Uys  
nakkie@wrc.org.za  
Mrs Gerda Kruger  
gerda@wrc.org.za  
Mrs Reinette Kruger  
reinette@wrc.org.za  
Mrs Ralda de Wet  
ralda@wrc.org.za  
Mrs Anna du Bruyn  
adubruyn@wrc.org.za  
Mrs Sandra Fritz  
sandra@wrc.org.za  
Ms Rina Human  
rina@wrc.org.za  
Mrs Zagry Scholtz  
zagry@wrc.org.za

Mrs Linda Smit  
linda@wrc.org.za  
Mrs T van Loggerenberg  
tokkie@wrc.org.za

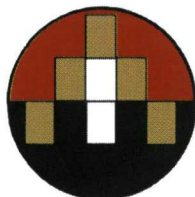
**Administration and Finances:**

Mrs Tina de Klerk  
tina@wrc.org.za  
Mr Okkie du Rand  
okkie@wrc.org.za  
Mr Albert Fritz  
albert@wrc.org.za  
Mr Casper Meyer  
cas@wrc.org.za  
Mr Pieter Smit  
smit@wrc.org.za  
Mr Reg Sutton  
reg@wrc.org.za  
Mr Jannie Venter  
venter@wrc.org.za

**Other:**

library@wrc.org.za  
sancid@wrc.org.za  
docreqst@wrc.org.za  
wrcit@wrc.org.za

# TECHNIKON



# PRETORIA

Department of Physical Resources: **Water Care**

## SHORT COURSES

**OPERATION OF ACTIVATED SLUDGE PLANTS**

Process principles and microbiology, Operational aspects of conventional, extended aeration and nutrient removal processes. Operational problems: Bulking scum, etc.

**Date:** 14 - 18 September 1998

**Closing date:** 28 August 1998

**Fee:** R2 200

**BASIC CHEMICAL WATER ANALYSIS**

Laboratory Techniques, Sampling, Data Processing, Calculations, Analytical Procedure, and Practicals

**Date:** 30 November - 4 December 1998

**Closing date:** 16 November 1998

**Fee:** R2 200

**ENQUIRIES:** Mochzell Potgieter at Department Physical Resources, Technikon Pretoria,  
Private Bag X680, Pretoria 0001. Tel: (012) 318-6232 Fax: (012) 318-6233



# Predicting pollution loads from sulphide-containing waste materials

A report outlining the development of a model to predict pollution loads from coarse sulphide-containing waste materials is available from the Water Research Commission in Pretoria.

**Section 1** of the report, compiled and written by AR James of Steffen, Robertson and Kirsten CE Inc, describes the processes which give rise to contaminated drainage from coarse sulphide-containing wastes and the development of a modelling approach which is considered appropriate and practical for this type of waste materials. An approach is proposed which utilises a combination of a physical model and a computer based mathematical model. The physical model is used to simulate a range of processes for which the development of a rigorous mathematical model is not an achievable objective, or, for which the requirements of data collection are potentially too onerous to be of practical use in industry.

**Section 2** describes the computer based mathematical model, Salmine version 1.0, which has been developed as the main focus of this project. The model is available on computer diskette.

The results of simple field drum tests, carried out at two mines to evaluate kinetic test methods appropriate to coarse wastes, are documented, together with the results of trial laboratory kinetic tests using humidity cells. Some proposed modifications to the humidity cell kinetic test are proposed to enable

the determination of several empirical parameters, required as input to the Salmine model.

model and the application and implementation of the proposed kinetic test apparatus and procedure.

**Section 3** is concerned exclusively with the third objective of the project, namely the practicality of subaqueous disposal of sulphide-containing materials, as a drainage quality control technology under South African conditions. The mechanisms of oxygen flux to an inundated waste, namely diffusion of dissolved oxygen through the water and advective transport of dissolved oxygen are reviewed. The effect of inundation of the waste on the mobility of stored oxidation products is discussed. It is concluded that for subaqueous disposal to be effective, the sulphide-containing waste should be inundated as soon after mining as possible to reduce the build up of stored contaminants, which will be mobilised once the water is inundated. Several practical methods to inundate sulphide-containing wastes for both opencast and underground mines are proposed. It is recommended that these options be considered in future, at the mine planning and development stage.

## The Prediction of Pollution Loads from Coarse Sulphide-Containing Waste Materials

AR James

Report to the Water Research Commission  
by  
Steffen, Robertson and Kirsten CE Inc

WRC Report No 559/1/97



It is concluded that the prediction of drainage characteristics from coarse wastes is extremely complex, but that the model has the potential to provide a useful tool to evaluate the effect on the drainage characteristics of alternative control options. The model has not been adequately verified. The verification of the model requires that it be tested against a large scale column, in which all processes simulated in the model will be active. It is recommended that future research focus on the verification of the

Copies of the report entitled **The prediction of pollution loads from coarse sulphide-containing waste materials** (WRC Report 559/1/97) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 30, via surface mail).



# Something new from membrane technology

**P**rovision of point-source water by air-gap membrane distillation, is the title of a report to the Water Research Commission by researchers RD Sanderson, C Aldrich, L Lorentz and BF Chemaly. They say that membrane distillation is a rapidly growing field gaining wide attention from membrane experts in many countries. Membrane distillation is defined as a process by which the water in a salty water solution is evaporated through a porous membrane; the vapour condenses on a coolant surface on the other side of the membrane. The main function of the membrane in membrane distillation is as a physical support for the vapour-liquid interface.

According to the report there is a need for a small device that can provide potable water to hikers, campers and particularly people living in the many remote rural areas in South Africa where the available water is either brackish or contaminated. The researchers say that companies such as Eskom may also be interested in this technology, as they need pure water for washing electrical insulators at remote substations.

## AIMS

The main aims included the following:

- ☐ To develop a small, collapsible membrane distillation bag which can be used in emergencies to produce daily requirements (1-10 litres water per day) of sterile, desalinated water, by the use of solar or other forms of heat energy.
- ☐ To develop a larger, mobile, air-gap distillation membrane unit, operated by solar heat and air-cooling, which can be used on farms to desalinate brackish borehole water in quantities of 100 or more litres per day.

However, the overriding problem the researchers had to consider was the size of the unit that can be made with the sealing technology now available. Bags do not maintain their shape as they become distorted to a teardrop shape when filled with water, and large stresses are imposed on the seams if the bags are not laid flat. A working unit would, therefore, be a trade-off between the best membranes and seam technology versus size. Emphasis should be on the use of a multiplicity of small units, similar to that of a quilted bedspread, says the report.

By increasing the brine water temperature and by decreasing the cooling water temperature, the mass flux was maximised. There was an experimental relationship between the mass flux and temperature of the brine feed. The air-gap and the concentration of the brine solution did, however, also affect the mass flux.

Both a fundamental model and an empirical model were derived for the transport phenomena in air-gap membrane distillation. The fundamental model was inclined to deviate from the experimental results, especially at high feed concentrations and at high temperatures. These deviations are possibly due to the fact that the permeability was assumed to be concentration independent, and to the vapour pressure extrapolated for salt concentrations above 26% (mass). On a typical South African summer's day, water can reach temperatures as high as 52°C. A brine water temperature of this magnitude could result in a mass flux of about half a litre per hour per 400 cm<sup>2</sup>. In instances where this process might be applied in emergency to obtain fresh water, a flux of this magnitude would be adequate in the short term. Furthermore, the salt rejection of this process varied between 99.69% - 99.94% and, for a continuous system, no fouling occurred over short periods of time.

## Provision of Point-Source Water by Air-Gap Membrane Distillation

RD Sanderson • C Aldrich • L Lorenzen •  
BF Chemaly

Report to the Water Research Commission  
by the  
University of Stellenbosch

WRC Report No 591/1/97



## RESULTS

An air-gap membrane distillation unit was designed and assembled. Using a two level, four factor full factorial design, it was found that the variables, such as temperature of the brine, the air-gap width and the temperature of the cooling water had the most significant effects on the production rate of desalinated water.

The report **Provision of Point-Source water by Air-Gap Membrane Distillation** (WRC Report 591/1/97) is available free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. (E-mail: library@wrc.org.za) Foreign orders: US \$25 per copy, via surface mail.



# SA trees don't tell easily ...

The report assessing the potential for using stable carbon isotope ratios of wood charcoal as a climate indicator, by researcher EC February of the SA Museum, has been published by the Water Research Commission. The report discusses the procedures necessary for an assessment of a new method for climate reconstruction using wood charcoal excavated from archaeological deposits. This research project has also contributed to tree ring chronologies for South African indigenous woody species as well as a better understanding of the relationship between  $\delta^{13}\text{C}$  values of wood cellulose and rainfall (of live trees), however, it unfortunately contributed little more information towards the ultimate goal of reconstructing the rainfall history of South Africa.

Previous research indicated that  $^{13}\text{C}/^{12}\text{C}$  ratios are good indicators of water available to plants, as with increased water stress stomatal closure results in reduced  $\text{CO}_2$  uptake which in turn results in more positive stable carbon isotope values. This project's aim was to determine, by systematic analysis of this relationship in six developmental steps, whether or not stable carbon isotope ratios of charcoal recovered from well-dated archaeological sites could be useful in providing reliable proxy rainfall data beyond the reach of the historic record.

## DENDROCHRONOLOGICAL ASSESSMENT

The main species of wood represented in the archaeological deposits were identified. However, prior to isotopic analysis of a modern sample of this species the dendrochronological potential of two *Podocarpus* species and a *Widdringtonia* were assessed. The results of this analysis indicated that with a 25% margin of error, age determination of *Podocarpus* sp. is possible. Ring width indices did not however correlate significantly with rainfall variables. Furthermore, a combination of poorly defined, locally absent and converging rings made cross-dating between different trees from the same locality an

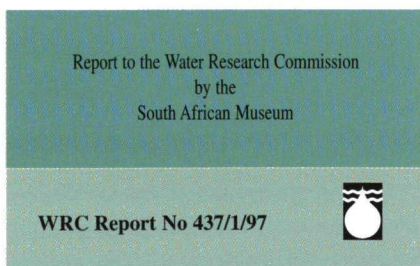
impossible task. Mr February says that dendrochronological research in South Africa has focussed for too long now on the various *Podocarpus* species, as the research and conclusions outlined in this report shows that such a focus is unwarranted.

In 1980 other researchers demonstrated the dendrochronological potential of *Widdringtonia cedarbergensis*. This report confirms their original hypothesis that, unlike the various *Podocarpus* species, *Widdringtonia cedarbergensis* forms a new ring on an annual basis that is identifiable in cross section as a separate individual ring. The very clear annual rings formed by *Widdringtonia cedarbergensis* make this species ideal for an assessment of the relationship between  $\delta^{13}\text{C}$  values of wood cellulose and annual rainfall.



### An Assessment of the Potential for Using Stable Carbon Isotope Ratios of Wood Charcoal as a Climate Indicator

EC February



On analysis, however, the  $\delta^{13}\text{C}$  record from the pooled trees at the De Bos site in the Cedarberg Mountains near Cape Town did not correlate significantly with the rainfall record. What this  $\delta^{13}\text{C}$  record does show is a strong correlation between stable carbon isotope ratios of tree rings and atmospheric  $\text{CO}_2$  levels. This correlation is manifested by less negative  $\delta^{13}\text{C}$  values from 1900 to 1947 and a clear decrease from then to 1977

which is very similar to the data obtained by other researchers. This project presented only the second  $\delta^{13}\text{C}$  chronology from the southern hemisphere, and the first with annual resolution, to show a decline in  $\delta^{13}\text{C}$  ratios over time.

## RAINFALL INDICATOR

The project aimed to assess the potential for using stable carbon isotope ratios of charcoal as a rainfall indicator. To meet this objective an understanding of the relationship between rainfall and stable carbon isotope ratios of wood cellulose is necessary.

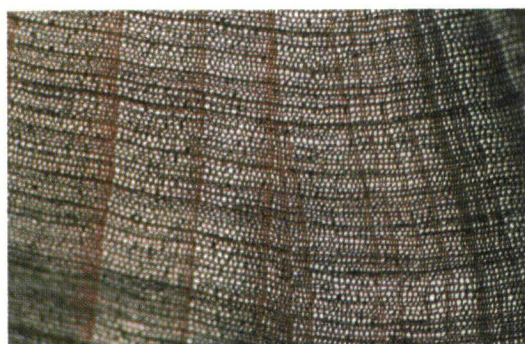
To gain a better understanding of the relationship between  $\delta^{13}\text{C}$  values, wood cellulose and water consumption of trees, samples of *Eucalyptus* which had been experimentally grown under controlled conditions were obtained from the CSIR division FORESTEK. The results of this section of the project indicate that for *Eucalyptus grandis* and the hybrid *Eucalyptus grandis x nitens* carbon isotope ratios become more negative in the wetter treatment as well as with increased water consumption. These results indicate that there is some justification for pursuing the use of  $\delta^{13}\text{C}$  values of wood cellulose in rainfall reconstructions provided that the trees chosen for analysis are sensitive to changes in rainfall and that atmospheric isotope correlations are understood.

An earlier project (February 1992) had identified *Combretum apiculatum* as the most common woody species in the archaeological deposits in the Northern Province while this project has identified *P. roupelliae* as the most common species from two archaeological sites in the Drakensburg. A  $\delta^{13}\text{C}$  analysis of the cellulose content of the wood of a number of samples of *Combretum apiculatum* across a rainfall gradient indicates that  $\delta^{13}\text{C}$  values of wood cellulose can be significantly correlated with rainfall. However, the results of an isotopic analysis of a *Protea roupelliae* sample suggested that not all woody species exhibit the same traits, as it showed no significant correlation between isotope values and rainfall. Furthermore, there was a consistent fractionation of the car-

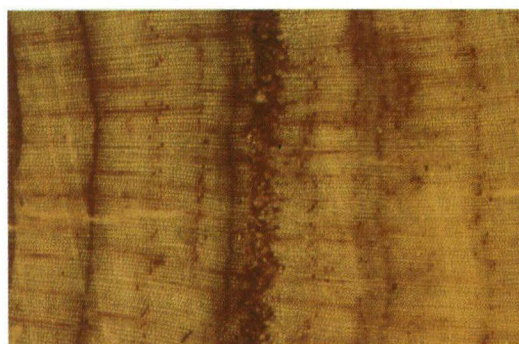




Cutting discs from live trees at De Bos, for research.



*Podocarpus* sp. section showing converging rings.



Frost ring in *Widdringtonia* sp. section.

bon isotope with increased temperature. This fractionation affect means that the primary objective of this study, rainfall reconstructions based on  $\delta^{13}\text{C}$  values of wood charcoal from archaeological sites, is not viable.

## CONCLUSION

Results which have emanated from this research indicate that the charcoal identification and relative abundance described in the report is a simple method for determining environmental change which does give information for palaeoclimatic interpretation that is independent of and will clarify data obtained by other independent methods such as xylem analysis.

The assessment of the dendrochronological potential of two *Podocarpus* species, discussed in chapter four of the report, should finally lay to rest the use of this species in dendrochronological research in South Africa. While the establishment of two further chronologies to add to the one already estab-

lished by Dunwiddie and La Marche (1980) makes a real contribution to the development of dendrochronology in South Africa. The research potential of *Widdringtonia* is extremely important for any further research attempts to develop a high resolution rainfall record for South Africa. More dendrochronological research using this species is a definite priority not only for developing a ring width index chronology related to rainfall but also for an assessment of the anthropogenic impact on atmospheric  $\text{CO}_2$ .

The results of the stable carbon isotope analysis of *Eucalyptus* species suggests a strong relationship between  $\delta^{13}\text{C}$  values and water use. These findings are not only useful for verifying the relationship between isotope values and water use but may be useful in cloning programmes where the main purpose is to identify drought tolerant and productive species that will ensure forest production in low areas.

Finally, similar research projects work-

ing with  $\delta^{13}\text{C}$  values and either archaeological or soil samples, should note that it is important that all charcoal should be removed from such samples prior to analysis because of the unknown fractionation factor.

## Archiving of data

All the data as well as the slide, wood, charcoal and cellulose collections generated by this project will be appropriately stored for future retrieval at the South African Museum in Cape Town.

The report **An Assessment of the Potential for Using Stable Isotope Ratios of Wood Charcoal as a Climate Indicator** (WRC Report 437/1/97) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. (E-mail: library@wrc.org.za) Foreign orders: US \$20 via surface mail)



# SA WATERKALENDER

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

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

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

Legend:

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

See conferences and symposia pages for events.

1998

JANUARY	FEBRUARY	MARCH	APRIL
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Die Waternavorsingskommissie plaas hierdie kalender om te help met die koördinerings van watergebeurtenisse in Suid-Afrika.

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

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

Gids:

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

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

1999

JANUARY	FEBRUARY	MARCH	APRIL
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2000!



SOUTHERN  
AFRICA

1998

## NATURAL RESOURCES

SEPTEMBER 18 - 24

A world congress on land use and the sustainable development of natural resources will be held at Sun City.

Enquiries: Glenda Cohen, Summit Conferences, 21 Toscana Concourse Crescent, Lone Hill, Sandton 2062. Tel: (011) 465-8418. Fax: (011) 465-8419.

## INDUSTRIAL WASTEWATER

SEPTEMBER 28 - OCTOBER 2

A short course on the management and treatment of process water and industrial wastewater will be held at the University of Pretoria. See advertisement on page 2.

## PROJECT MANAGEMENT

OCTOBER 5 - 9

A short course on the Logical Framework Approach for project management will be held for water sector professionals in Harare, Zimbabwe.

Enquiries: The Manager, Institute of Water and Sanitation Development, 7 Maasdorp Ave, Alexandra Park, Harare, Zimbabwe. Tel: 263-4-735017; 735026. Fax: 263-4-738120.

## SHORT COURSE

OCTOBER 6 - 7

A short course on water quality modelling in water supply systems will be held at the Rand Afrikaans University in Johannesburg.

Enquiries: Zelna van Aswegen. Tel: (011) 489-2599. Fax: (011) 489-2466. E-mail: zelna@scotty.rau.ac.za.

## WASTECON '98

OCTOBER 13 - 15

This international conference will be held at the World Trade Centre in Kempton Park and is intended to explore new perspectives in waste management, particularly those applicable to the southern African region. Topics will include management aspects such as auditing, reporting, monitoring, environmental management systems, legal institutional and policy developments, alternative and appropriate technologies and public participation.

Enquiries: Piet Theron or Sonja Havenga at the Institute for Waste Management. Tel: (011) 787-1151. Fax: (011) 787-1086.

## AIR FLOTATION

OCTOBER 20 - 21

A short course on dissolved air flotation in water treatment will be held at the Rand Afrikaans University in Johannesburg.

Enquiries: Zelna van Aswegen. Tel: (011) 489-2599. Fax: (011) 489-2466. E-mail: zelna@scotty.rau.ac.za.

## SEASONAL CLIMATE

OCTOBER 28

A half-day symposium on numerical seasonal climate predictions will be held by Barrie Hunt, Program Leader: Climate Modelling, CSIRO, Division of Atmospheric Research, Australia, in the CEFIM Auditorium at the University of Pretoria.

Enquiries: Hannes Rautenbach. Tel: (012) 420-2469. E-mail: raut-cj@postino.up.ac.za.

## ATMOSPHERIC SCIENCES

OCTOBER 29 - 30

The 14th annual conference of the South African Society for Atmospheric Sciences (SASAS) will be held in the Sanlam Auditorium of the University of Pretoria.

Enquiries: SASAS Conference Secretariat (Ammie Wissing), c/o Conference Planners, PO Box 36782, Menlo Park 0102. Tel: (012) 348-4493. Fax: (012) 348-1563. E-mail: wissing@iafrica.com.

## GROUNDWATER

NOVEMBER 4 - 6

The Groundwater Division of the Geological Society of South Africa will present a course - An introduction to Groundwater - at the Schonland Research Centre of the University of the Witwatersrand in Johannesburg.

Enquiries: The Secretariat (att: Maureen Ruane), Groundwater Division, PO Box 75728, Lynnwood Ridge 0040. Tel/Fax: (012) 83-1545.

## ENVIRONMENTAL AUDITING

NOVEMBER 9 - 13

The ISO 14001 environmental management and auditor training course will be held at the Eskom conference centre in Midrand. The course is accredited by EARA UK and presented by Aspects International UK.

Enquiries: Crystal Clear, PO Box 1982, Bramley 2018. Tel: (011) 882 3368. Fax: (011) 882 3395. E-mail: crystalclear@pixie.co.za

## NEW WATER POLICY

NOVEMBER 11 - 13

A conference on the implications of the new water policy - problems and solutions, will be held in Cape Town.

Enquiries: Royal Society of South Africa, PO Box 24022, Claremont 7735. E-mail: roysoc@psipsy.uct.ac.za

## WATER HYACINTH

NOVEMBER 16 - 19

The first global working group meeting for the biological and integrated control of water hyacinth under the auspices of the International Organisation for Biological Control (IOBC) will be held in Zimbabwe, Harare.

Enquiries: HG Zimmermann, Plant Protection Research Institute, Private Bag X134, Pretoria 0001. Tel: (012) 329-3276. Fax: (012) 329-3278. E-mail: riethgz@plant2.agric.za

1999

## COASTAL ENGINEERING

APRIL 19 - 23

The 5th international conference on coastal and port engineering in developing countries with the theme "Sustain ability in Coastal and Port Engineering" will be held in Cape Town.

Enquiries: COPEDEC 99, PO Box 452, Stellenbosch 7599. E-mail: deidre@iafrica.com. Tel: (021) 886-4496. Fax: (021) 883-8177.

## WATER AFRICA

MAY 18 - 20

The Water Africa exhibition and conference will be held in Cairo, Egypt. The conference theme will be "Reconciling policy and practice: water and wastewater after 2000". **Call for papers.** Synopses of 200 - 300 words should reach the organisers by 31 October 1998. Full papers will be required by 31 January 1999.

Enquiries: Tracey Nolan, Water Africa, 37 Upper Duke St, Liverpool L19DY. Tel: +44 (0)151 709 9192. Fax: +44 (0)151 709 7801/3262. E-mail: africon@robart.demon.co.uk

## SASAQS

27 JUNE - 1 JULY

The 35th conference of the Southern African Society of Aquatic Scientists (SASAQS) with the theme "Research, conservation and management of aquatic resources in Southern Africa" will be held in

Swakopmund in Namibia.

Enquiries: Shirley Bethune or Kevin Roberts, Department of Water Affairs, Private Bag 13193, Windhoek, Namibia. Tel: 00264 61 296 +3025 or +3240. Fax: 00264 61 2963023. E-mail: bethunes@mawrd.gov.na OR robertsk@mawrd.gov.na

## AIEPS '99

JULY 4 - 8

The African international environmental protection symposium incorporating the fourth Southern African anaerobic digestion symposium will be held at the Imperial Hotel in Pietermaritzburg.

Enquiries: Dr Richard A Daneel, Soil and Pollution Research Services CC, Suite 101, Postnet X6, Cascades 3202. Tel: (0331) 962-696. Fax: (0331) 962-696. E-mail: soil&pol@sprs.co.za

## DROUGHT MANAGEMENT

SEPTEMBER 20 - 22

An interdisciplinary international conference on integrated drought management - "Lessons for Sub-Saharan Africa" will be held at the CSIR Conference Centre in Pretoria. **Call for papers.**

Enquiries: Conference Planners, PO Box 82, Irene 0062. Tel: 667-3681. Fax: 667-3680. E-mail: confplan@iafrica.com

## CORROSION

SEPTEMBER 26 - OCTOBER 1

The 14th international corrosion congress with the theme "Co-operation in Corrosion Control" will take place in Cape Town. A trade exhibition will also be held for the duration of the congress.

Enquiries: The Secretary, The Corrosion Institute of Southern Africa, PO Box 966, Kelvin 2054. Tel: (011)8025145. Fax: (011) 8043484. E-mail: norust@futurejhb.co.za

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## IRRIGATION

OCTOBER 22 - 27

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

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



## OVERSEAS

1998

## RIVER BASINS

SEPTEMBER 13 - 16

The 8th river basin conference - Management of large river basins will be held in Budapest, Hungary.

Enquiries: TRIVENT Conference Office, Szamoca u6/b, H-1125 Budapest, Hungary. E-mail: trivent@mail.elender.hu Fax: +36-1-156-6240.

## WASTEWATER TREATMENT

SEPTEMBER 14 - 16

A conference on advanced wastewater treatment, recycling and reuse will be held in Milan, Italy.

Enquiries: ATW98, Scientific Secretariat, DIIAR - Sezione Ambientale, Piazza Leonardo da Vinci 32, 20133, Milano, Italy. Tel: +39 2 23996416. Fax: +39 2 23996499. E-mail: milano98@amb1.amb.polimi.it

## ENVIRONMENT-WATER

SEPTEMBER 16 - 18

The first inter-regional conference on environment-water - innovative issues in irrigation and drainage will take place in Lisbon, Portugal.

Enquiries: Portuguese National Committee of ICID, Instituto da Agua, Av. Almirante Gago Coutinho 30, 1000 Lisboa, Portugal. Fax: 351-1-8473023. E-mail: lenamar@inag.pt

## UDM '98

SEPTEMBER 21 - 24

A conference with the theme Developments in urban drainage will be held in London, UK. This conference is the fourth in a series of specialist conferences on aspects of urban drainage.

Enquiries: Dr D Butler, Imperial College of Science, Technology and Medicine, Dept of Civil Engineering, Imperial College Road, London SW7 2BU, UK. Tel: +44 171 594 6099. Fax: +44 171 225 2716. E-mail: d.butler@ic.ac.uk

## TISAR '98

SEPTEMBER 21 - 25

The third international symposium on artificial recharge of groundwater will be held in Amsterdam, the Netherlands.

Enquiries: Symposium Secretariat, Buerweg 51, 1861 CH

Bergen, the Netherlands. Tel: +31 72 5899062. Fax: +31 72 5899040. E-mail: R.R.Kruize@inter.nl.net

## GROUNDWATER

SEPTEMBER 21 - 25

An international conference and special workshops on groundwater quality: remediation and protection (GQ 98) will be held in Tübingen, Germany.

Enquiries: Conference Secretariat GQ'98, c/o Lehrstuhl für Angewandte Geologie, Sigwartstr 10, D-72076 Tübingen, Germany. Tel: +49 (0) 7071-297-4692 OR: 297-6468. Fax: +49 (0) 7071-5059. E-mail: mike.herbert@uni-tuebingen.de

## IRRIGATION

SEPTEMBER 21 - 25

A workshop with the theme Young professionals's role in the development of irrigation and drainage will be held in Sofia, Bulgaria.

Enquiries: Bulgarian National Committee on Irrigation and Drainage, 136 Tzar Boris III Blvd., 1618 Sofia. PO Box 384, Bulgaria. Tel/fax: (+3592) 55-11-41.

## WATER MANAGEMENT

SEPTEMBER 24 - 25

A conference on the application of models in water management will be held in Amsterdam, the Netherlands.

Enquiries: NVA/SIC Conference Secretariat, Buerweg 51, 1861 CH Bergen nh, the Netherlands. Tel: (+31)72-5899062. Fax: (+31)72-5899040. E-mail: R.R.Kruize@inter.nl.net.

## WASTE MANAGEMENT

SEPTEMBER 23 - 25

A symposium on water management problems in agro-industries will be held in Istanbul, Turkey.

Enquiries: Prof Derin Orhon, Environmental Science Division, Istanbul Technical University, ITU Insaat Fakultesi, 80626 Ayazaga, Istanbul, Turkey. Tel: +90 212 285 3793. Fax: +90 212 286 2786.

## IAH

SEPTEMBER 27 - OCTOBER 2

The 18th IAH congress - Gambling with groundwater - physical, chemical, biological aspects of aquifer-stream relations, will take place in Las Vegas, Nevada, USA.

Enquiries: John van Brahana, IAH Las Vegas, USGS, 118 Ozark Hall, University of Arkansas, Fayetteville AR 72701, USA. E-mail: jbrahana@jungle.uark.edu Tel: +501-575-2570. Fax: +501-575-3846.

## WETLAND SYSTEMS

SEPTEMBER 27 - OCTOBER 2

The 6th international conference on wetland systems for water pollution control will be held in Sao Pedro, Brazil.

Enquiries: Dr Samia Maria Tauk-Tornisielo, Centro de Estudos Ambientais/UNESP-Av 24-A, 1515, Bela Vista. CEP 13506-900, Rio Claro SP Brazil. Tel/fax: +55 19 534 2358. E-mail: cea@life.ibrc.unesp.br

## WEFTEC '98

OCTOBER 3 - 7

The Water Environment Federation 71st annual programme for technical professional development will take place at the Orange County convention centre, Orlando, Florida, USA.

Enquiries: Weftec '98, c/o Galaxy, PO Box 3918, Frederick, MD 21705, USA. Fax: 1-301-694-5124.

## BIOFILMS

OCTOBER 8 - 10

A conference on the microbial ecology of biofilms: concepts, tools and applications will be held at Lake Bluff, Illinois, USA.

Enquiries: Dr Bruce E Rittmann, Northwestern University, Department of Civil Engineering, 2145 Sheridan Road, Evanston, IL 60208-3109, USA. Tel: +1 847 491 8790. Fax: +1 847 491 4011. E-mail: b-rittman@nwu.edu

## URBAN WATER

NOVEMBER 2 - 5

The 11th IWSA-ASPAC regional conference and exhibition on integrating the urban water cycle will be held in Sydney, Australia.

Enquiries: Convention Secretariat, PO Box 388, Artarmon, NSW 2064, Australia. E-mail: awwa@peg.apc.org Tel: +61-2-9413-1288. Fax: +61-2-9413-1047.

## WETLANDS

NOVEMBER 8 - 14

The 2nd international conference on wetlands and development will be held in Dakar, Senegal.

Enquiries: Wetlands International, Marijkeweg 11, PO Box 7002, 6700 CA Wageningen, The Netherlands. Tel: +31 317 474711. Fax: +31 317 474712. E-mail: post@wetlands.agro.nl

## MARINE POLLUTION

NOVEMBER 16 - 18

The third Middle East conference on marine pollution and effluent management will be held in Kuwait.

Enquiries: Dr Saleh M Al-Muzaini, Environmental Science Dept., Kuwait Institute for Scientific Research, PO Box 24885, Safat 13109, Kuwait. Tel: +965 4818712. Fax: +965 4845350.

## WATER RESOURCES

NOVEMBER 16 - 19

An international conference on water resources variability in Africa during the 20th century will take place in Abidjan, Ivory Coast.

Enquiries: Abidjan '98 ORSTOM, 06 BP 1203 Cidex 1, Abidjan 06, Côte d'Ivoire. Tel: (225) 45 00 74/45 41 70. Fax: (225) 45 00 76/24 65 04. E-mail: servat@orstom.rio.net OR: 101727.2773@compuserve.com

## DRINKING WATER

NOVEMBER 24 - 28

An international conference on "water, sanitation and health: resolving conflicts between drinking water demands and pressures from society's wastes" will be held in Bad Elster, Germany.

Enquiries: Inst. Wasser-, Boden- und Lufthygiene, Ms Gertrud Schlag, PO Box 330022, D-14191 Berlin. Fax: +49 30 8903 1233 or 1830. Tel: +49 30 8903 1808. E-mail: gertrud.schlag@uba.de

## WATER &amp; SANITATION

NOVEMBER 30 - DECEMBER 3

The 10th ITN Africa conference - water and environmental sanitation in low income urban areas will be held in Nairobi, Kenya.

Enquiries: Executive Director, NETWAS International, PO Box 15614, Nairobi, Kenya. E-mail: netwas@nbnet.co.ke Tel: +254-02-890555. Fax: +254-0208-90554.

## GROUNDWATER

NOVEMBER 30 - DECEMBER 11

The annual Australian Groundwater School, including two workshops - "Ecosystem dependence on Groundwater" and "Modelling Water and Solute Transport in the Unsaturated Zone" will be held in Adelaide, Australia.

Enquiries: Centre for Groundwater Studies, c/o CSIRO Land and Water, Private Bag 2, Glen Osmond, SA 5064 Australia. Tel: 61 8 8303 8700. Fax: 61 8 8303 8730. E-mail: cgs@adl.clw.csiro.au. Web address: http://www.clw.csiro.au/CGS





# ONE DAY WORKSHOP

## NEW DEVELOPMENTS in MICROBIAL ANALYSIS of DRINKING WATER QUALITY using MOLECULAR TECHNIQUES

Organised by the Departments of Microbiology and Plant Pathology, and  
Medical Virology, University of Pretoria  
and sponsored by the Water Research Commission

The workshop aims to create a broader understanding of recently developed methods for the rapid microbiological analysis of drinking water. The objective is to bring together all parties involved such as researchers, analysts, health authorities and water quality managers.

The programme will consist of presentations by the guest speaker Dr C Fricker of Thames Water, UK, as well as local speakers sharing their experiences and work. Group discussions on the implications of these developments for the water supply industry are also planned.

**Date:** 23 September 1998

**Venue:** Conference Centre,  
University of Pretoria

**Enquiries:**

Mr Fanus Venter  
University of Pretoria

Tel. (012) 420-4100

Fax (012) 420-3266

E-mail: fanus@  
scientia.up.ac.za



Dr Colin Fricker of  
Thames Water Utilities  
(Britain) will discuss  
new detection methods  
and their advantages,  
international and local  
experiences with a new  
detection method, and  
also give a practical  
demonstration.

**Date:** 22 September 1998

**Time:** 14h00 (Registration) for 14h30

**Venue:** University of Pretoria,  
Conference Centre (Tyndall Road)

All interested persons are invited to attend.

Please RSVP to the sponsors:

Att: Marion Castel, Vine-Vet (Pty) Ltd

Tel: (011) 792-1212

Fax: (011) 792-3073

E-mail: vinevet@global.co.za

## HALF-DAY SEMINAR

NEW APPROACHES to the DETECTION of INDICATOR ORGANISMS in WATER



# LAUNCH MEETING INVITATION

## NEW COMPANY... to PROMOTE EXPORT of S.A. WATER EXPERTISE and TECHNOLOGY

12 October 1998

Parktonian Hotel, Braamfontein, Johannesburg

The Minister of Water Affairs and Forestry, Prof Kader Asmal, will preside at a press conference at 12:00, to be followed by a lunch and the launch meeting at 14:00.

### SA Excellence ...

South Africa enjoys an excellent reputation for the quality of our water research, willingness to embrace and enhance new technologies, as well as the quality of water engineering and water utilisation in our country. Little has come by way of financial return from this excellence. Individual firms and businesses have made valiant attempts to promote their expertise and products but the outside world is competitive and inroads have been limited.

### ... steps forward

The new company will be a combined thrust to market South African expertise internationally. An exploratory meeting was held with representatives of the Water Research Commission, Eskom, and certain government departments, research councils, and water boards. A decision was taken to form an organisation that will take initiative in promoting the marketing of South African water-related expertise and technology in countries around the world.

### Company

The exact form of the organisation has not been finalised. It will most probably be a company not "for gain" in order to make it eligible for governmental assistance. In the present circumstances this will not be direct financial assistance, but rather in giving public credibility to the company, providing support at the diplomatic level and patronage of its activities.

### Format

The company will be privately owned and managed. It will have to be financially self-supporting through its activities and the contributions of its shareholders.

### Directives

The launch meeting on 12 October 1998 will determine the broad principles for the operation of the organisation and thereafter elect a steering committee to formalise the proposals and establish the organisation.

### RSVP:

If you or your organisation, be it large or small, public or private company, partnership or individual, wish to attend the meeting, please fax the following information to the Water Research Commission:

- Name
- Organisation
- Postal address
- Tel. number
- Fax number
- Type of expertise technology, products, etc. that your organisation would be interested in exporting.

### Enquiries/Information to:

Attention: Mrs Nakkie Uys  
The Executive Director  
Water Research Commission  
PO Box 824, PRETORIA, 0001  
Tel (012) 330-0340  
Fax no (012) 330-1935

Please note: A maximum of two persons per organisation to attend.  
R.S.V.P. before 1 October 1998.