

# S4 waterbulletin

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## WATERLIT

WRC offers free search on Internet

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## BESPROEING

Boere bespaar water met rekenaarmodellering

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## SLUDGE MANAGEMENT

New sewage sludge disposal guideline available

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Benefit from the insights of key water industry players

# WATER '98

## The 3rd annual regional resource management summit

**Ensure the most cost effective utilisation of South Africa's water resources.  
Discover the latest and most efficient strategies in water management.**

- Optimise the impact of water regulation in both the public and private sector.
- Set sustainable targets and strategies for water consumption and conservation.
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- Develop integrated water management strategies to serve the needs of all users.
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**10 - 11 March 1998**

**Holiday Inn Crowne Plaza, Sandton Gauteng**

**PLUS**

**Optional Field Trip: Thursday 12 March 1998**

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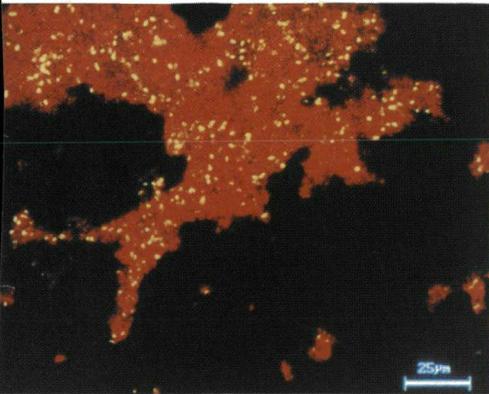
Facilitated by:

Chandu Patel, Project Manager: Winterveld Infrastructure Water Project  
Sipho Mkonto, Project Manager: Prepayment Metering Systems  
Ernest Phasha, Sanitation Engineer, Rand Water

Gain practical information on new management strategies on site

### **ENQUIRIES & REGISTRATION**

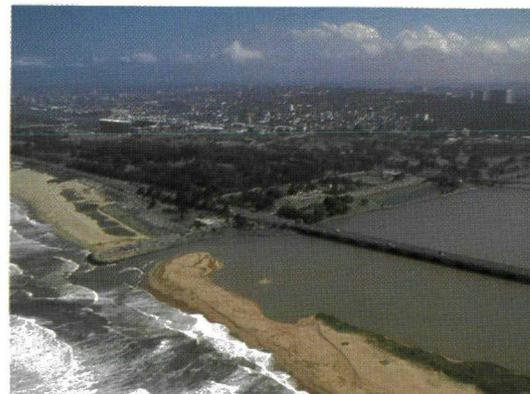
Anthony Moyo. Tel: (011) 463-2802. Fax: (011) 463-6903.



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*Cover: Umgeni River scene in the Valley of a Thousand Hills, KwaZulu-Natal. (Photo: Helene Joubert)*

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# Impressions from the 8th South African National Hydrology Symposium

The theme of the bi-annual conference was "Integrated hydrological sciences for sustainable water resources management". A way of viewing South Africa's readiness for this theme is through the eyes of some Hydrology Honours students from the University of Natal in Pietermaritzburg who attended the conference and had to give their views in an examination question a few days afterwards. What follows are extracts from their answers.

## KEYNOTE

The two opening speakers, Mike Muller, Director-General of the Department of Water Affairs and Forestry ( DWAF ) and Bill Rowlston, Director of Strategic Planning of DWAF, laid a strong foundation for the symposium, outlining the government's commitment to the implementation of the new water law, and challenging the hydrological community to rise to the momentous task of implementing new policy and legislation. Mr. Muller saw sustainable water resources development as part of the Reconstruction and Development Programme implying water development within a framework of sustainable economic and social development. Mr. Rowlston took this vision further in his concept of integrated water resource development, i.e.

- integration of all aspects of the water system, including quantity and quality, groundwater and surface water;
- integration of water systems with related systems such as land and the environment; and
- integration of water development



*The opening speakers at the hydrology symposium. From left: Mr Eberhard Braune, Chairman of Sanciahs, Mr Mike Muller, Director-General of the Department of Water Affairs and Forestry (DWAF) and Mr Bill Rowlston, Director of Strategic Planning of the DWAF.*

factors with other disciplinary facets such as social, political and economic factors.

## PAPERS

The papers that were presented over three days fell broadly into the following themes: Rainfall and floods, water quality, water resources management and integrated management. The general

impression was that most speakers still addressed their subjects in a purely unidisciplinary way, without reference to their role towards improved management of the hydrological cycle and towards economic and social well-being. It is clear that we will still need greater advances in individual fields, such as measurement of rainfall by radar and satellite and improved hydrological models and information systems.



At the symposium banquet Mr Maarten van Veelen, representative of the SA Institution of Civil Engineers, Water Division, presented the prestigious Award for Water Engineering to the team responsible for the publication *Water Resources 1990* or *WR 90* for short. From left are: Dr Bill Pitman (Stewart Scott), Mr Van Veelen, Mr John Hensford (Knight Piesold), and Mr Brian Middleton (SRK). Mr Middleton, in his acceptance speech, dedicated the award to the late Professor Des Midgley "who had contributed so much to *WR 90*".

At the same time we should however strive in all our work towards a more integrated water management and greater consideration of social benefit.

Papers that addressed the integration theme did so mainly in a speculative way because little practical experience had been gained to date, eg:

- The importance of small catchment agencies, to initiate the process of integrated management of water and related land resources;
- The inter-relationship between catchment management processes and role-players at various points in the hydrological system;
- The essentiality of participation down to community level in catchment management (example of soil rehabilitation in KwaZulu/Natal)

□ The importance of interdisciplinary communication and information systems for integrated management; In their analysis of trends in South African hydrology practice, the students made a number of interesting and perceptive observations which also point to our ability to play the required roles in the implementation of this major new phase in South African water resources management. Papers at symposiums to date indicate a trend away from just the physical management of water resources towards planning at the regional and catchment scales. This necessitates a move away from the physical process approaches to ones that take the whole hydrological and environmental system into account. From the papers presented it would appear that government is losing its

capacity for research. Academic institutions still focus mainly on the single discipline research topics. This leaves the new inter-disciplinary field of integrated water resources management wide open - and can the state, universities and consultants rise to meet the challenge? There does not appear to be a shortage of funds, but a general lack of implementation direction, again related to a perceived lack of capacity in government.

The general feeling was that a separate conference needs to be set up for the theme of integrated catchment management, with greater attention to inter-disciplinary practice.

*Compiled by E Braune*

# Obituary: Dr GJ Stander

The water fraternity is mourning the death of one of South Africa's water research pioneers, Dr Gerrie Stander, on 3 December 1997 at the age of 86.

Dr Stander, a man of great vision and creative ability, played a key role in the establishment of a number of water organisations such as the Water Research Commission, the CSIR's National Institute for Water Research as well as the International Association on Water Quality (IAWQ) (previously IAWPR).

Born in the small Free State town Philippolis in 1911, Gert Johannes Stander was educated at Middelburg in the Cape.

He obtained an MSc degree in Chemistry (*cum laude*) at the University of Cape Town and was awarded a PhD at the Chemistry Faculty of the University of the Witwatersrand. His PhD thesis dealt with anaerobic digestion as a method of purification of effluents from fermentation industries. Subsequently he also registered as a professional engineer with the South African Council for Professional Engineers.

## WRC

After obtaining the MSc degree, he joined the Pretoria Municipality as a chemist and later became chief chemist of the Municipality of East London, a position he held until 1948. During that year he accepted an appointment with the South African Council for Scientific and Industrial Research (CSIR). Under his leadership the CSIR's water research programme developed to such an extent that a fully-fledged National Institute for Water Research was established in 1957 and he became its first director. He also played a leading role in the establishment of the South African Water Research Commission in 1971 and became its first Chief Executive Officer, a post he held until his retirement in 1979.

At the international level Dr Stander made significant contributions to water science and technology. In 1962 he was elected a member of the World Health Organisation's Expert Advisory Panel on Environmental Health for a period of five years, and was re-appointed for a similar period in 1973.

He was also a member of the steering committee that founded the International Association on Water Pollution Research (IAWPR) in 1965 and was elected Vice President of the new association in 1966. In 1969 Dr Stander became President of the IAWPR and subsequently had the singular distinction of being re-elected President for three further two-year terms of office.

Dr Stander received honorary memberships from three international organisations: The Water Pollution Control Federation (USA) in 1965, IAWPR in 1974, and the *Abwassertechnische Vereinigung* (Germany) in 1975.

Other international awards to his credit included the Silver Medal of the City of Paris (France); Silver Medal of the *Syndicat des Communes de la Banlieue de Paris pour les Eaux* and the Medal of the Association of Engineers and Architects of Israel. He was also a Fellow of the Institute of Sewage Purification of the United Kingdom.

In South Africa Dr Stander received the National Award of the Associated Scientific and Technical Societies of South Africa in his capacity as leader of the Windhoek water reclamation team in 1970 (for building the world's first plant where treated sewage water was reclaimed for direct re-use), the Gold Medal of Honour of the South African Academy of Arts and Science in recognition of his services to science (1971), the Gold Medal of the South African Chemical Institute (1978) and honorary membership of the Institution of Municipal Engineers of Southern Africa (1979). Three universities accorded him



Dr Gerrie Stander

honorary doctorates: Potchefstroom in 1969, Cape Town in 1974 and the Orange Free State in 1975.

In 1983 Dr Stander received the SA Academy's MT Steyn Medal for his achievements in the field of physical science and technology and in 1987 the State President awarded him with the prestigious Order of Meritorious Service, Class 1: Gold.

To commemorate and honour his achievements a Stander lecture evening is presented biennially by the WRC, CSIR and WISA. Prominent researchers in the water field are invited to deliver papers at this auspicious occasion.

Paying tribute to Dr Stander, Mr PE Odendaal, Executive Director of the Water Research Commission, said: "Gerrie Stander was indeed one of the greats that moved on the water scene. Perhaps his greatest gift was the ability to inspire others, and this legacy will carry his influence far into the future."



## **SUBMISSION OF WATER RESEARCH PROPOSALS TO THE WATER RESEARCH COMMISSION (WRC) VOORLEGGING VAN NAVORSINGSVOORSTELLE AAN DIE WATERNAVORSINGSKOMMISSIE (WNK)**

**D**ie Waternavorsingskommissie rig 'n uitnodiging aan navorsingsinstansies om met die oog op finansiering van die navorsing vanaf 1999, voorstelle vir waternavorsingsprojekte by die WNK in te dien. Nuwe navorsingsvoorstelle moet die WNK voor 30 April 1998 bereik.

### **LET ASSEBLIEF DAAROP DAT GEEN LAAT INDIENINGS AANVAAR SAL WORD NIE.**

Die WNK is tans besig om die standaard WNK-voorleggingsvorm te hersien ten einde voorleggingsprosedures eenvoudiger en meer doeltreffend as in die verlede te maak. Dit word beplan dat diegene wat oor die nodige fasiliteite beskik, die Internet sal kan gebruik om toegang tot die voorleggingsvorms te verkry, dit te voltooi en te versend. Diegene wat nie oor Internetfasiliteite beskik nie, word vriendelik versoek om 'n nuut-ontwerpte harde kopie-vorm te voltooi en per hand, pos of faks in te dien.

### **ONS VERWAG DAT DIE NUWE PROSEDURES TEEN MIDDEL-FEBRUARIE 1998 GEREED SAL WEES**

Sou u belangstel om 'n voorlegging in te dien, vra op daardie tydstip die nodige besonderhede van die WNK aan.

Die WNK sal alle voorstelle wat ontvang word gesamentlik na 30 April 1998 oorweeg. Indien nodig, sal die betrokke WNK-navorsingsbestuurder na die sluitingsdatum met die indier van die voorstel in verbinding tree ten einde onduidelikhede op te klaar en die voorstel af te rond. Hierdie finale voorlegging sal by 'n WNK Raadsvergadering vir goedkeuring ter tafel gelê word en daarna aan die Minister van Waterwese en Bosbou gestuur word vir bevestiging van die Raad se besluit. Diegene wat navorsingsvoorstelle indien, moet asseblief daarop let dat die voorstelle gedurende die evalueringsproses voor 'n koördinerende komitee van kundiges op dié gebied, ter tafel gelê mag word of na eweknieë verwys mag word.

Navorsers word aangemoedig om die WNK se navorsingsbestuurders te nader om inligting te bekom oor beskikbare strategiese navorsingsplanne vir bepaalde waternavorsingsvelde en om moontlike navorsingsvoorleggings met die navorsingsbestuurders te bespreek voor dit aan die WNK voorgelê word.

**Die vroeë indiening van navorsingsvoorstelle sal verwelkom word.**

**T**he Water Research Commission is extending an invitation to research organisations and individuals to submit water research proposals to the WRC with a view to the funding thereof during 1999. Proposals must reach the WRC by 30 April 1998.

### **PLEASE NOTE THAT NO LATE SUBMISSIONS WILL BE ACCEPTED.**

The WRC is presently engaged in revising its standard submission form to make the submission procedures simpler and more efficient than in the past. It is planned that those who have the necessary facilities will be able to access the necessary forms, complete them and send them via the Internet. Those who do not have such facilities should complete and submit a newly-designed hard copy-form by hand, by post or by fax.

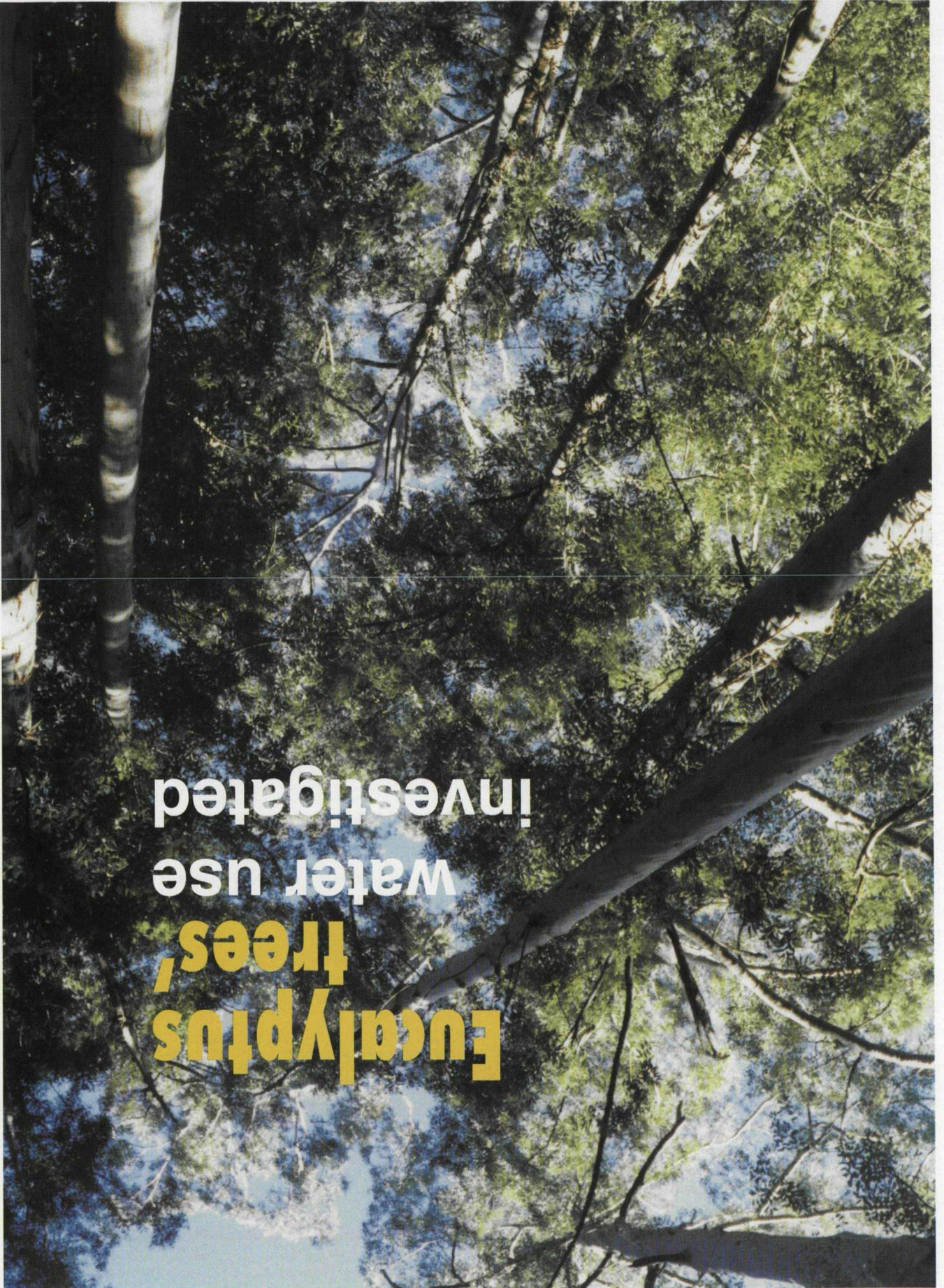
### **WE EXPECT THAT OUR NEW PROCEDURES WILL BE IN PLACE BY MID-FEBRUARY 1998.**

Should you be interested in making a submission, please request the necessary details at about that time.

All proposals received on or before the deadline will be considered jointly after 30 April 1998. Following this date, if necessary, the WRC research manager concerned will liaise with the proposer of a project to clarify any vagueness that may exist in the proposal, and to finalise it. The finalised proposal will then be tabled for approval at a WRC Board meeting and thereafter referred to the Minister of Water Affairs and Forestry for confirmation of the approval. Those submitting research proposals should note that during the evaluation process, proposals may be also tabled before a Coordinating Committee comprising experts in that particular field or sent out for peer review.

Researchers are encouraged to approach WRC research managers for information on strategic research plans in specific fields of water research and to discuss potential research proposals with them prior to submission of the proposals.

**Early submission of research proposals will be welcomed.**



**Eucalyptus  
trees/  
water use  
investigated**



In a report to the Water Research Commission researchers confirmed the hypothesis that an existing model of potential transpiration rates for *Eucalyptus grandis*, which was developed for plantations in high rainfall areas, cannot be used as such to simulate transpiration rates in drier areas as it will lead to overestimates of water use, particularly when soil water deficits limit transpiration rates. *E. grandis*, the most widely planted hardwood species, is frequently grown in areas of relative low rainfall where the trees periodically experience significant soil water deficits.

The report entitled **The Determination of the Relationship between Transpiration Rate and Declining Available Water for *Eucalyptus grandis***, by researchers PJ Dye, AG Poulter, S Soko and D Maphanga, also gives an indication of the complexity of modelling the soil water balance for trees with rooting zones stretching to depths of 15 to 18m and even deeper.

### AIMS

The aims of this study were:

- to determine the relationship between declining soil water availability and transpiration rates by plantation *E. grandis*, and
- to assess the feasibility of modelling the soil water balance in order to estimate the degree of reduction in transpiration under conditions of sub-optimal soil water supply.

Three different sites were selected for investigation, two sites on deep soils in the Frankfort Plantation near Sabie and a third site at Legogote North East near White River. The third site was in an area with a lower annual rainfall and a shallower soil profile.

At each site plastic sheeting was laid on the ground to prevent soil water recharge and to allow the tree roots to induce a continuous progressive depletion of soil water. Measurements of sap flow, trunk growth, xylem pressure potential, leaf area index, stomatal conductance, and soil water contents were recorded at each site.

### RESULTS

Comparison of sap flows, leaf area index, and stomatal conductance between the Frankfort sites and the Legogote site con-

firmed that potential transpiration models developed from trees on sites with high rainfall and deep soils will overestimate water use of trees at drier sites.

According to the report the relationship between transpiration and soil water availability, at the Frankfort Plantation sites, could not be defined as the rooting zone extended well beyond the deepest measurement depth, and the trees showed no more than mild stress symptoms because of their ability to obtain significant quantities of water below 8m.

The researchers say that modelling soil water balance of such deep profiles is considered impractical, especially on the scale of whole catchments, in view of the problem of measuring soil water content at such depth, the heterogeneity of deep subsoil material, the unknown volume of stones, and the likely non-uniform infiltration of water through the deeper strata.

The Determination of the  
Relationship between Transpiration  
Rate and Declining Available  
Water for *Eucalyptus grandis*

PJ Dye ● AG Poulter ● S Soko ● D Maphanga

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

WRC Report No 441/1/97



### CONCLUSIONS

The results demonstrated that the approach used to establish a moderating function to simulate reductions in transpiration during times of significant soil water deficit, is impractical as a consequence of the large variability in soil depth encountered in plantations.

However, the results have provided valuable insights into the relation between trees and soil water. According to the report this has given rise to an alternative strategy for estimating water use by trees subject to a highly variable soil water supply, whereby the annual volume growth increment of the trunk is correlated with the total water use over the same period. The latter approach is being followed up in a separate study with very promising results.

The report **The Determination of the Relationship between Transpiration Rate and Declining Available Water for *Eucalyptus grandis*** (WRC Report 441/1/79) is available from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: tineke@wrc.ccwr.ac.za Foreign orders: US \$20 per copy, via surface mail.

# Computer program predicts and prevents mineral fouling

A user friendly computer program called STRUVITE has been developed, as part of a Water Research Commission project, so that controllers of waste water treatment plants can easily predict both the potential for mineral fouling, and chemical dosing strategies to prevent such fouling. (See the STRUVITE advertisement on page 11.)

"Precipitation of struvite is a common phenomenon in anaerobic treatment of both wine distillery and piggery waste waters, and also sludge waste derived from excess biological phosphate removal systems," says RE Loewenthal from the Department of Civil Engineering at the University of Cape Town, in a final research report to the Water Research Commission on the application of chemical equilibrium for controlling struvite and calcite precipitation in waste water treatment.

He says the reason for this is that these wastes contain higher than usual concentrations of dissolved orthophosphates, free and saline ammonia and magnesium ions, and these species form the components of the mineral struvite.

Struvite precipitation in anaerobic fermentation systems occurs mainly in two areas. First, within the pipe network transporting the treated effluent, particularly where pressure changes occur, for example, at bends and inlets to pumps. Second, on the surfaces close to the inlet and outlet of the secondary settler effecting separation of the treated effluent. The mass of precipitant formed can be so extensive that it may lead to blockages and ultimately to operational failure.

In both of the above instances of struvite precipitation fouling, it would appear that the trigger mechanism is a reduction of the partial pressure of carbon dioxide. A reduction of the partial pressure of carbon dioxide may cause expulsion of carbon dioxide from the aqueous phase and a concomitant increase in pH, giving rise to a state of

super saturation with respect to struvite that is sufficiently high so as to cause precipitation of this mineral.

For the purposes of process control, it would be useful to be able to:

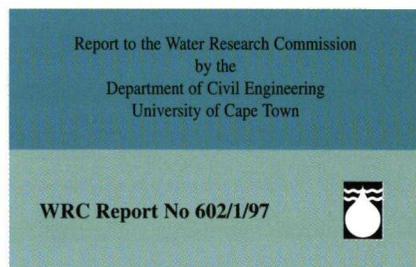
- predict the conditions under which struvite conditions precipitation fouling problems are likely to arise;
- determine the potential mass of struvite which can precipitate, and
- formulate chemical dosing strategies so that precipitation will be negligible in critical areas of the system.

These problems are complex but an approach to their solution can be developed via equilibrium chemistry.



The Application of Chemical Equilibrium to the Control of Struvite and Calcite Precipitation in Waste Water Treatment

RE Loewenthal



## OBJECTIVES

The objectives of this research contract funded by the Water Research Commission therefore were as follows:

- Identify and evaluate the causes of struvite/calcite precipitation and fouling in waste water treatment processes.
- Develop strategies to either control (or prevent) or effect struvite/calcite precipitation using chemical equilibrium modelling.

## RESULTS

A review is presented in the report on the utilisation of equilibrium chemistry to explain the establishment of pH in anaerobic digesters where a number of weak acid systems (acetate, carbonate, phosphate and ammonia systems) are all present simultaneously in solution, that is, a single aqueous phase scenario. This was extended to include a gas phase, with carbon dioxide at some specified partial pressure. Algorithms were developed to predict changes in state (i.e the changes in pH) which arise as a result of the following perturbations:

- a change in pressure - this occurs in practice either at inlet to pumps transporting the waste water or in sedimentation basins designed to effect liquid-solids separation, and
- addition or removal of strong acids and bases specifically applied to adjust pH of the system.

Secondly, algorithms were developed to predict the masses of struvite or calcite which may precipitate (or dissolve) as a result of these perturbations (i.e a three phase equilibrium scenario involving aqueous, gaseous and solid species).

The equilibrium algorithms described in the report were evaluated experimentally in the laboratory. The models correctly predicted the masses of struvite and calcite precipitated due to the various perturbations (i.e due to change in partial pressure of carbon dioxide or the addition of strong acids or bases).

Copies of the report entitled **The application of chemical equilibrium to the control of struvite and calcite precipitation in waste-water treatment** (WRC Report 602/1/97) are available from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, inclusive of surface mail). E-mail orders: Tineke@wrc.ccwr.ac.za

# Navorsers toets SEDIDAFF- eenheid op algryke water

Die eutrofikasie van oppervlakwaterbronne in Suid-Afrika is 'n bron van kommer vir beide die voorsiensers en gebruikers van hierdie water.

Die besoedeling van waterbronne met organiese stowwe en nutriënte het 'n toenemende groei van mikro-organismes soos alge, in hierdie waters tot gevolg wat 'n verskeidenheid probleme by die behandeling van die water vir drinkdoeleindes veroorsaak. Konvensionele watersuiweringaanlegte kan nie die alge doeltreffend verwyder nie en hierbenewens lei aanpassings in konvensionele behandeling deur hoë chloordoseringe om die alge te verwyder tot die vorming van ongewenste neueprodukte in die behandelde water.

Probleme wat gedurende die afgelope vyftien jaar in Suid-Afrika in die behandeling van eutrofe water vir drinkdoeleindes ondervind is, sluit die volgende in: skuimvorming in die aanleg, vlokke wat neig om te dryf eerder as om te besink, hoë chemiese doseringsvereistes, kort filterlopie van weë-filterverstoping, saamkoek van filtersand deur jellieagtige neerslag, en wangeure in die finale drinkwater.

Ten einde hierdie probleme te oorkom sou dit nodig wees om nuwe en onkonvensionele behandelingsmetodes te ontwikkel om 'n kontinue voorsiening van goeie gehalte drinkwater te verseker.

Die gebruik van die flottasieproses om alge uit eutrofe oppervlaktewaters te verwyder is reeds met sukses in Suid-Afrika en Engeland ondersoek. Die proses is later uitgebrei om ook sandfiltrasie in kombinasie met flottasie in te sluit (flottasie-filtrasie) en word tans suksesvol by onder andere die Rietveldam buite Pretoria toegepas.

Alhoewel die flottasie-filtrasieproses-kombinasie doeltreffend gebruik kan word vir die verwydering van ligte, oorewegend organiese sweefstowwe, word probleme ondervind om 'n kombinasie van ligte en swaar vlokke met hierdie proses te verwyder. Hierdie toestande

kom voor in sommige nywerheidsuitvloeiings, asook in oorverrykte oppervlakwaterbronne, soos die Middel-Vaalrivier, laer Apiesrivier, laer Krokodilrivier en sommige Natalse mere waar hoë-troebelheid waters invloed na swaar reënval in die opvanggebied van die bron. Voorbesinking is dan nodig om eers die swaarder deeltjies te verwyder voordat die flottasieproses doeltreffend gebruik kan word om die alge te verwyder. 'n Dubbel suiwingstelsel bestaande uit die normale grootte besinkbak met 1-2 m/h belading, gevolg deur 'n flottasie-filtrasieproseskombinasie, sal uiteraard groot kapitaaluitgawes tot gevolg hê. Daar bestaan dus 'n behoefte om 'n meer kompakte en doeltreffende stelsel daar te stel wat terselfdertyd wesenlike kapitaalbesparings sal teweegbring.

houd, lae-troebelheid gemengde water en hoë-troebelheid gemengde water.

In die loodsskaaltoets is die volgende aspekte ondersoek:

- Die effek van voorbesinking op die doeltreffendheid van flottasie, beide vir hoë-troebelheid water en vir hoë-alginhoud water;
- Die effek van reaksiesone op waartse snelheid en horisontale snelheid in die oorgang van die reaksiesone na die verhelderingsone, op flottasie-doeltreffendheid;
- Die invloed van verandering in voorbesinkingsnelheid, verhelderingsone afwaartse snelheid en hersirkulasieverhouding op die doeltreffendheid van flottasie; en
- Die doeltreffendheid van die snelbesinkingsnelheid vir troebelheid- en algeverwydering.

## RESULTATE

Die navorsers, CD Swartz, DC Whyte, GF Joubert en K Morgan, sê in hulle finale verslag oor die studie wat deur die Waternavorsingskommissie befonds is, dat die snelbesinkingsnelheid op die SEDIDAFF te klein was om goeie besinking van sweefstowwe of troebelheid te lewer, en dat skaal- en stromingseffekte gelei het tot onreëlmatighede in die resultate wat verkry is. Geen stawende gevolgtrekkings kan dus gemaak word oor die mate waartoe voorbesinking voor flottasie die doeltreffendheid van DAF kan verbeter nie.

Hulle sê waarskynlik die grootste probleem wat ondervind is en wat gelei het tot die wisselvalligheid in resultate is die verandering in rouwatergehalte gedurende toets.

Afskrifte van die verslag getiteld **Die evaluering van 'n proseskombinasie van sedimentasie en flottasie vir waterbehandeling** (WNK-verslag 282/1/97) is gratis beskikbaar vanaf die Waternavorsingskommissie, Posbus 824, Pretoria. E-pos bestellings: Tineke@wrc.cw.ac.za

### Die Evaluering van 'n Proseskombinasie van Sedimentasie en Flottasie vir Waterbehandeling

CD Swartz • DC Whyte • GF Joubert • K Morgan

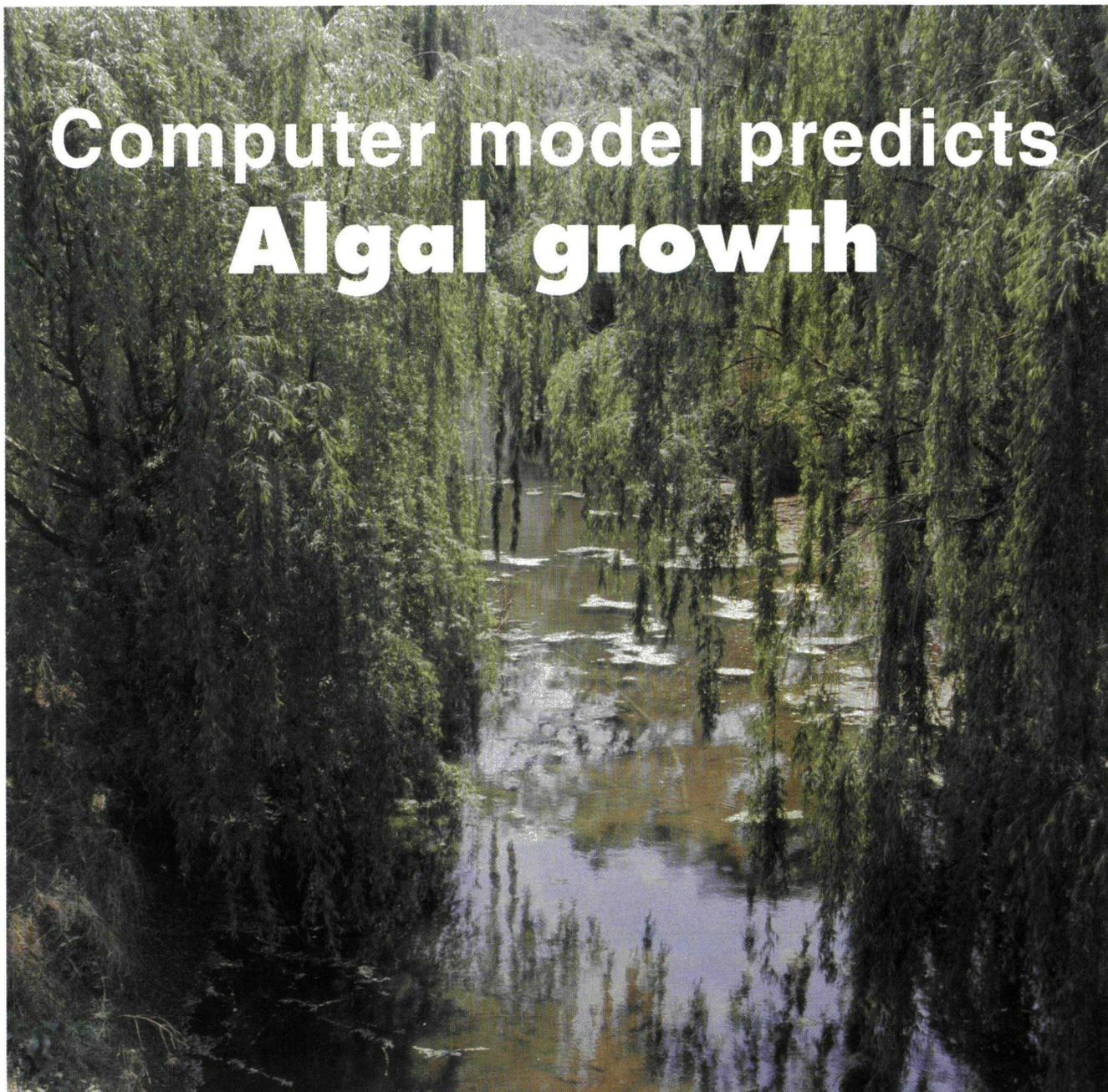
Verslag aan die Waternavorsingskommissie deur die  
Divisie vir Water, Omgewings- en Bosbou Tegnologie  
WNNR



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Navorsers by die WNNR se Divisie vir Water-, Omgewings- en Bosbou Tegnologie het 'n aantal studies op eutrofe waters uitgevoer met 'n loodsskaaleenheid wat die eenheidsprosesse sedimentasie-flottasie-filtrasie kombineer in 'n kompakte eenheid (SEDIDAFF). Daar is gepoog om al die verskillende rouwatergehaltes wat met eutrofikasie verband hou te dek met die ondersoek en hiervoor is die rouwater geklassifiseer as hoë-troebelheid, hoë-algin-

# Computer model predicts Algal growth



*Note the conspicuous patches of algae on the lower Vaal River at Venterskroon.*

A dynamic mathematical model to predict algal growth in the Vaal River has been developed by researchers at the University of the Free State. The Vaal River is the principal source of potable water for Gauteng and adjoining regions, however, it is often plagued with algal blooms, particularly below the Vaal Barrage. These algal blooms adversely affect the water quality and create problems in the water purification plants. The newly developed model has a unique feature which distinguishes between

different types of algae, and is expected to be a very useful tool for water quality management of the river and at water purification plants along the Vaal River.

The research and development of the model, funded by the Water Research Commission, has been documented by the researchers, SW Schoombie, A Cloot and G le Roux, in a report entitled **A Dynamic Model for Algal Growth in the Vaal River** (WRC Report 536/1/97).

**P**ast research has proved the interaction between algae and the environment to be very complex, and has shown that there are no simple solutions to the problem of algal blooms, which are the result of a complex interaction where a number of environmental factors play a determining role. All of the environmental factors affecting algal growth can not be incorporated into one model as it would be too complex to use.

### AIM

However, the researchers' aim was to develop a model incorporating only the dominant environmental factors, which would give an acceptable description of the real situation without unnecessarily complicating the model.

The research aims and requirements set for the model were the following:

The model should be able to:

- predict the occurrence of algal blooms at least at specified points along the river, and at least a few weeks in advance;
- distinguish between different algal species, or at least genera, and give a good indications of which algae would be dominant in the predicted bloom; and
- take into account all those environmental factors which are known to have a major effect on the growth of algae in the Vaal River.

The model has to be:

- based on sound biological, physical and chemical principles, and be compatible with reported observations of the effect of environmental factors on algal growth;
- properly calibrated, using existing data sets; and
- thoroughly tested with respect to its sensitivity to changes in input parameters and its predictive abilities.

The model was to be developed in a format to be implemented as computer software for a desk top computer.

### MODEL DEVELOPMENT

A site-specific, multi-algal species mathematical model was developed which took into account six environmental factors which have a major effect on algal

growth, namely water temperature, underwater light, turbidity, dissolved silicon, dissolved nitrogen and dissolved phosphorus. The model was developed progressively, starting with a basic nucleus comprising only the effects of underwater light and temperature on algal growth. Mathematical expressions which simulate the effect of silicon were added first and then those of the other nutrients.

A unique feature of the model is its ability to distinguish between different algal species, or at least different groups of algae, each consisting of species with similar properties. This makes it possible to predict not only an algal bloom, but also to give an indication of the type of algae which would be dominant.

such a site at Stilfontein, on the lower Vaal River. In the report a full sensitivity analysis and the results of verification tests are given for this model. The sensitivity analysis showed that temperature, underwater light, and the ratio between dissolved nitrogen and dissolved phosphorus are the parameters in the model which affect algal growth most. The calibration at Stilfontein consists of sets of parameter values for fourteen different algal groups. Some of these groups could be correlated with specific algal genera. With this calibration it was possible to make fairly satisfactory predictions.

The other version of the model does take river flow explicitly into account, and was implemented as another FORTRAN program called ALGDYMOD. It is a more complicated model, and would take up more computer time and resources than the stationary model. It is therefore recommended that users who wish to use such a model at a specific site only, should first try ALGSTMOD. If it turns out that the assumption of fairly slow, steady flow on which the stationary model is based, is not applicable at that site, or, if the user wishes to consider an entire stretch of the river, ALGDYMOD should be used.

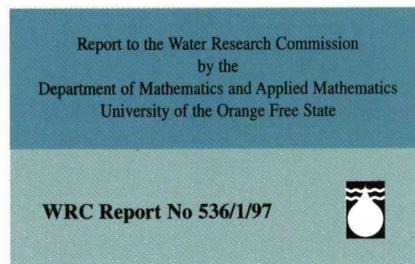
### MODIFICATIONS

However, the model is effectively site dependent, in the sense that when used at a different site in the same river, a recalibration may be required. Due to its site dependence, it needs some modification before it can be easily used as a water management tool for the whole river system, or for significant river stretches.



#### A Dynamic Model for Algal Growth in the Vaal River

SW Schoombie • A Cloot • G le Roux



Report to the Water Research Commission  
by the  
Department of Mathematics and Applied Mathematics  
University of the Orange Free State

WRC Report No 536/1/97



### TWO VERSIONS

Two versions of the model were developed. The first does not take river flow explicitly into account, and is referred to as the stationary model. This version of the model was implemented as a FORTRAN computer program called ALGSTMOD, which should be able to run well on any personal computer with at least an Intel Pentium or equivalent processor.

The stationary model is recommended for predictions of algal blooms at specific sites (e.g. water purification plants), and was calibrated and validated at

The report **A Dynamic Model for Algal Growth in the Vaal River** (WRC Report 536/1/97) is available, free of charge, from the Water Research Commission, Box 824, Pretoria 0001. E-mail order: [tineke@wrc.cwr.ac.za](mailto:tineke@wrc.cwr.ac.za) (Foreign orders: US \$20 via surface mail).

# Old corrosive culprit newly identified

It is vital for operators of industrial cooling water systems to monitor the presence of *Shewanella putrefaciens* as it is a powerful agent of microbially influenced corrosion (MIC), and probably more detrimental than the true sulphate-reducing bacteria (SRB). This is the conclusion of researchers VS Brözel, E McLeod and Z Dawood, in a project report to the Water Research Commission on the role of facultative sulphide-producing bacteria in MIC.

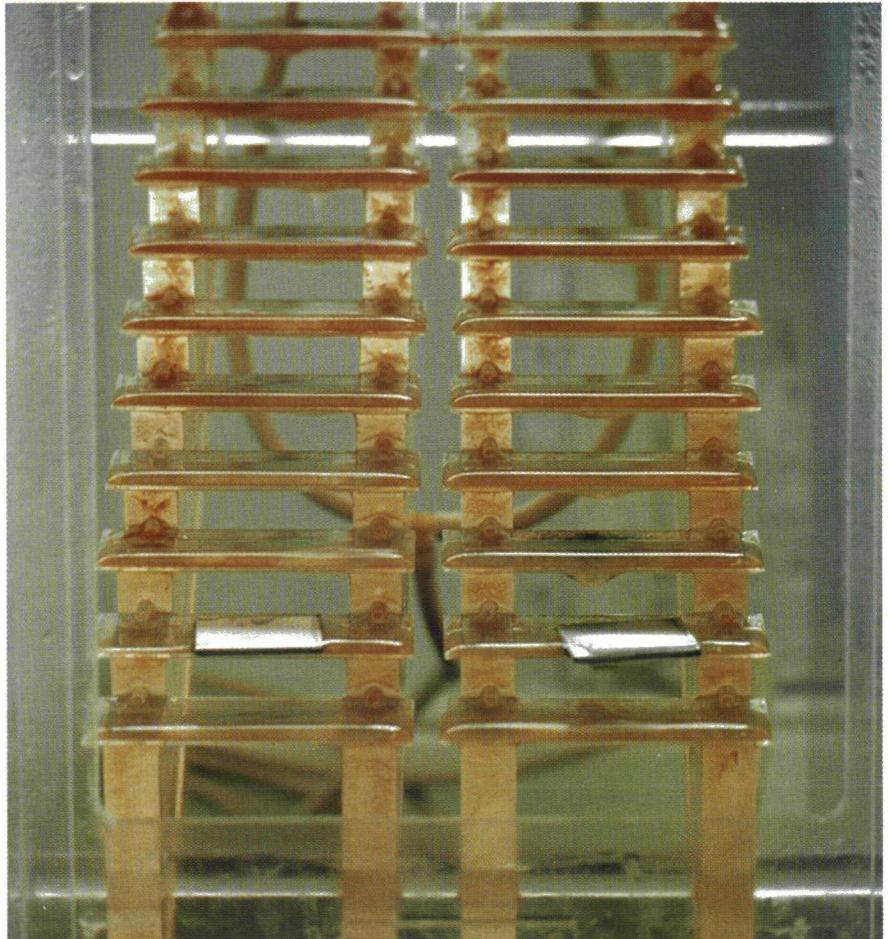
The report entitled **An investigation into the Role Played by *Shewanella* and other Sulphide-Producing Bacteria in Metallic Corrosion in Industrial Water Systems** (WRC Report no 661/1/79) is now available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: [tineke@wrc.cwr.ac.za](mailto:tineke@wrc.cwr.ac.za) (Foreign orders: US \$20 per copy, via surface mail).

**A**lthough sulphate-reducing bacteria (SRB) are currently perceived to be the central role-players in microbially influenced corrosion (MIC), they are a group of strictly anaerobic bacteria which oxidise hydrogen and reduce sulphate and other oxidised sulphur compounds to sulphide. The growth rate of SRB is generally low, and they do not survive exposure to oxygen. Despite various experimental designs, observed corrosion rates have never correlated with pure-culture simulations using sulphate-reducing bacteria.

Laboratory corrosion experiments make use mostly of pure cultures to obtain a better understanding of the mechanism of corrosion of more complex industrial systems. However, the dynamic interaction of different organisms together with a constantly changing environment cannot be simulated in laboratory experiments. Metal loss in the field could be much greater than what has been obtained through pure culture studies.

## SULPHATE-PRODUCING BACTERIA (SPB)

According to the report this project was born out of the hypothesis that, as various aerobic bacteria are capable of reducing nitrate, ferrous iron, manganese (IV), dimethyl sulphoxide and other electron acceptors, there should also be aerobic bacteria capable of reducing oxidised sulphur compounds,



*The researchers created a reticulating flow system simulating a continuous flow of artificial cooling water to facilitate biofilm development. Glass coverslips and mild steel coupons were placed on two parallel staircases and irrigated constantly by circulating cooling water from the sump over the staircases. The system, constructed from Perspex, has two removable panels for easy access and a sump accommodating 5l. It was operated as a closed system to prevent evaporation and subsequent cooling of the cooling water to below ambient temperature.*

i.e. sulphide-producing bacteria (SPB). Aerobic bacteria generally have much higher growth rates than do anaerobes, and their metabolic activity is subsequently much higher, potentially leading to higher corrosion rates.

The term "sulphide-producing bacteria" was coined in order to distinguish between the classical sulphate-reducing bacteria (SRB) and the larger physiological group of producers of hydrogen sulphide.

## AIMS

This project was initiated to determine the role played by non-SRB sulphide-producing bacteria in microbially influenced corrosion in industrial water systems.

These were addressed as follows:

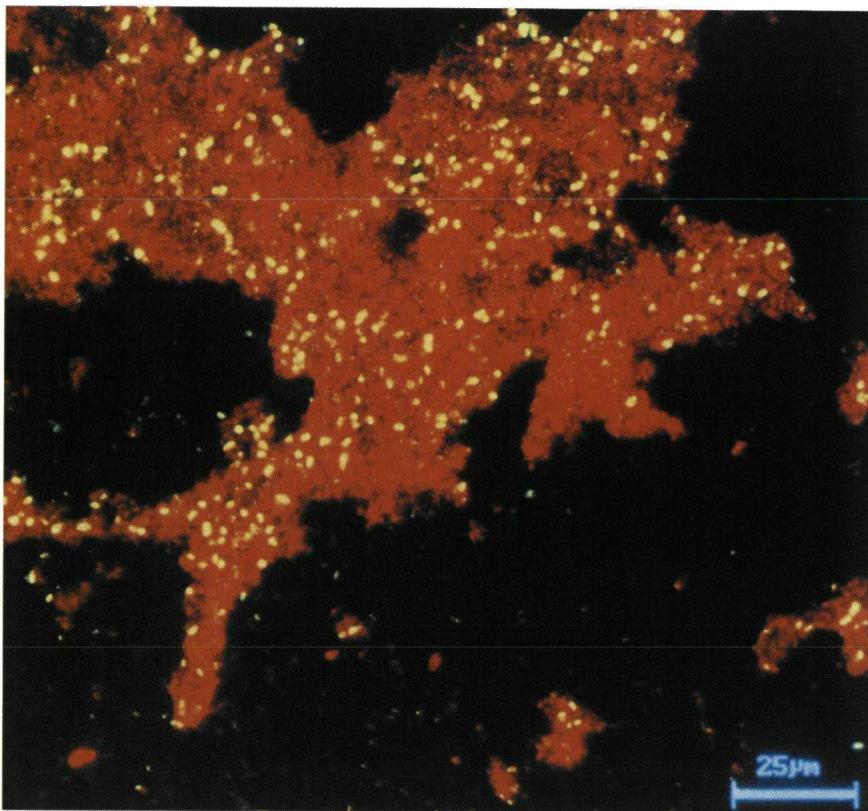
- The occurrence and location within biofilms, in industrial water systems, of non-SRB sulphide-producing bacteria (i.e. *Shewanella*) as well as of SRB, were investigated quantitatively.
- The role by *Shewanella* in the corrosion of ferrous metals was investigated. Three aspects of the metabolic capabilities of *Shewanella* were investigated as possible contributors to microbially influenced corrosion, i.e. hydrogenase activity, iron (III) reduction and sulphide production.

## RESULTS

The results obtained in this research have demonstrated clearly that apart from *S. putrefaciens*, a variety of *Aeromonas* species occurring in industrial cooling water systems have true sulphidogenic properties, producing hydrogen sulphide from sulphite and in many cases thiosulphate. In addition they were capable of reducing ferrous iron and displayed hydrogenase activity.

*S. putrefaciens* was shown to reduce both sulfite and ferric iron using cathodic hydrogen from steel as electron donor. It also corroded mild steel in pure culture, using sulphite as electron acceptor, at a rate three times higher than that of corrosion in the absence of bacteria.

The *S. putrefaciens* isolates reduced sulfite at dissolved oxygen concentration levels under 1.5 mg/l, which



An optical thin section of the 3-day old biofilm showing the spatial distribution of *S. putrefaciens* and *D. vulgaris*. The biofilm was simultaneously hybridized with rhodamine-labeled SPN3 and fluorescein-labeled SRB385. A confocal laser microscope was used to obtain optical thin sections of the biofilms.

An Investigation into the Role Played by *Shewanella* and other Sulphide-Producing Bacteria in Metallic Corrosion in Industrial Water Systems

VS Brözel ● E McLeod ● Z Dawood

Report to the Water Research Commission  
by the  
Department of Microbiology  
University of the Western Cape

WRC Report No 661/1/97



explains why hydrogen sulphide is often detected in highly aerated industrial cooling water systems, even where

biofilm growth is kept to a minimum and biofilms are consequently thin, with few anaerobic zones.

A simulated model cooling water system inoculated with *S. putrefaciens*, *Desulfovibrio vulgaris* (true SRB) and *Pseudomonas aeruginosa*, yielded biofilms in which the SRB did not survive well. *S. putrefaciens* dominated the biofilm together with the aerobic *P. aeruginosa*, showing that the former is better suited to growth in biofilms growing in sulphidogenic or aerated environments than are the SRB.

## CONCLUSION

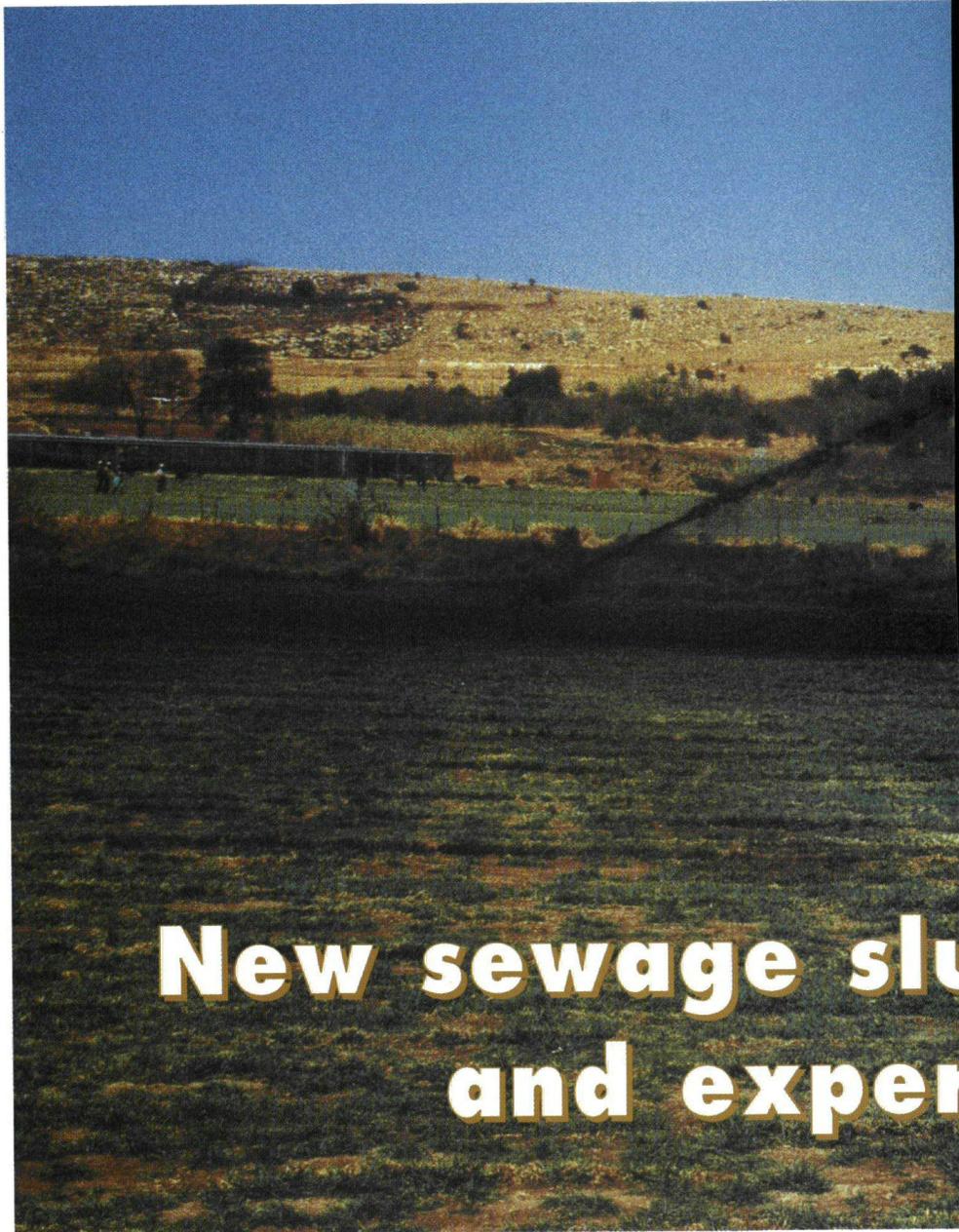
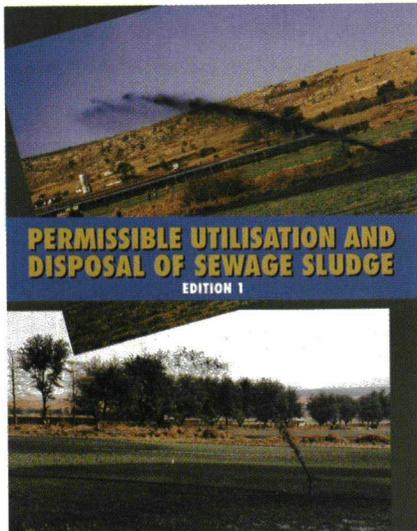
The results have shown that *S. putrefaciens* possesses the metabolic capabilities required to induce MIC, that it enhances the corrosion rate of mild steel and that it outperforms the true SRB in biofilms in sulphidogenic or aerated cooling systems.

The Water Research Commission (WRC) has produced a report called the "Permissible Utilisation and Disposal of Sewage Sludge - Edition 1". The report emanates from a WRC commissioned research project titled "Municipal Sewage Sludge Disposal: Development of Guidelines and Expert Systems". The report consists of the guidelines section and expert system called SLADS (Sludge Land Application Decision Support), which complement each other.

The research project identified the need for a common set of guidelines and prompted the development of the guideline, "Permissible Utilisation and Disposal of Sewage Sludge", through the co-ordinated effort of the WRC, WISA-Sludge Division, the Department of Agriculture and Land Affairs, the Department of Health and the Department of Water Affairs and Forestry. The guide will assist and give direction to all organisations concerned with sewage treatment and promote the safe handling, disposal and utilisation of sewage sludge.

### SLUDGE TYPE

The guide classifies sewage sludge by type and indicates the beneficial uses of sewage sludge, as well as general requirements and precautionary measures according to type of sludge, according to crop types that may be fertilized and other methods of utilisation and disposal. It also indicates the restrictions in the application of sludges related to metal and inorganic content of soil, pH of soil, nitrogen and organic



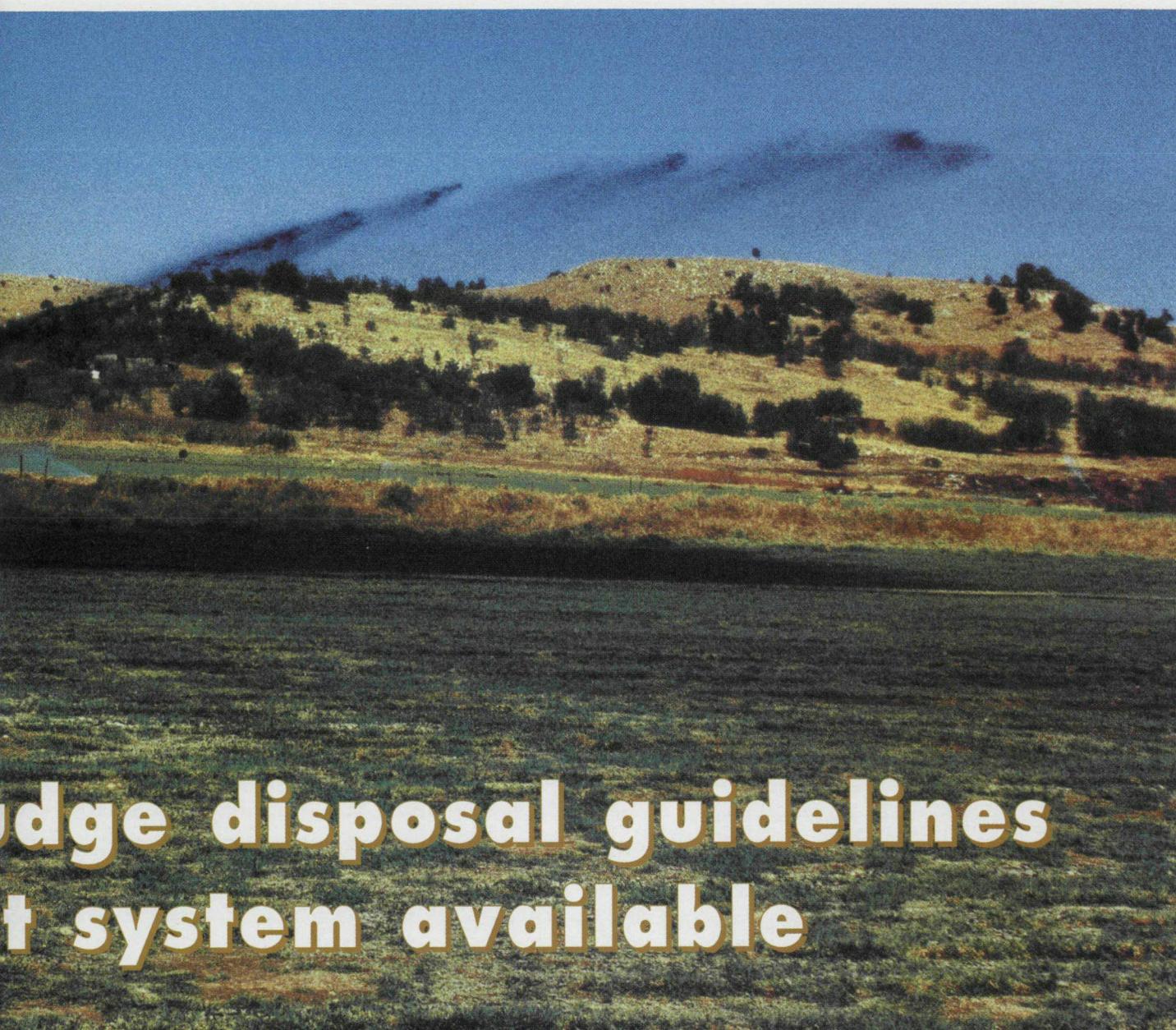
chemicals present in sludge. The guide provides for some control measures in the form of essential items to be included in contractual agreements between producer and receiver of sludge and sludge quality control.

Since management of sewage sludge disposal falls in the ambit of all three departments, the guide will be referred to for all permit applications, ensuring the effective management of sewage sludge in meeting environmental health objectives in the future. Local authorities of the district in which sewage sludge originates will be primarily responsible to ensure compliance with these guidelines, which is also extended to all other parties concerned with treat-

ing, handling, transporting, processing, selling, alienating, utilising or disposing of sewage sludge.

### COMPUTER SOFTWARE

Complementing the guidelines is an expert system (decision support software) called "SLADS", developed for the WRC by Environmentek-CSIR. The expert system provides a fully fledged computer-based decision support related to sludge application to land, facilitating the interpretation of guidelines so as to help users to plan and manage sludge-to-land application and similar tasks in environmentally effective ways. SLADS is capable of the following functions :



# Sludge disposal guidelines SLADS system available

❑ *Sludge permitting aid:* This aspect addresses sludge-to-land permit requirements, incorporating the latest guidelines, methodologies and permit regulations for sludge application to land.

❑ *Site/area identification aid:* This helps in identifying suitable areas for sludge application as well as planning/design measures and set back distances from environmentally sensitive features, incorporating planning constraints such as topographical features and other aspects. The information is based on the latest guidelines and overseas literature.

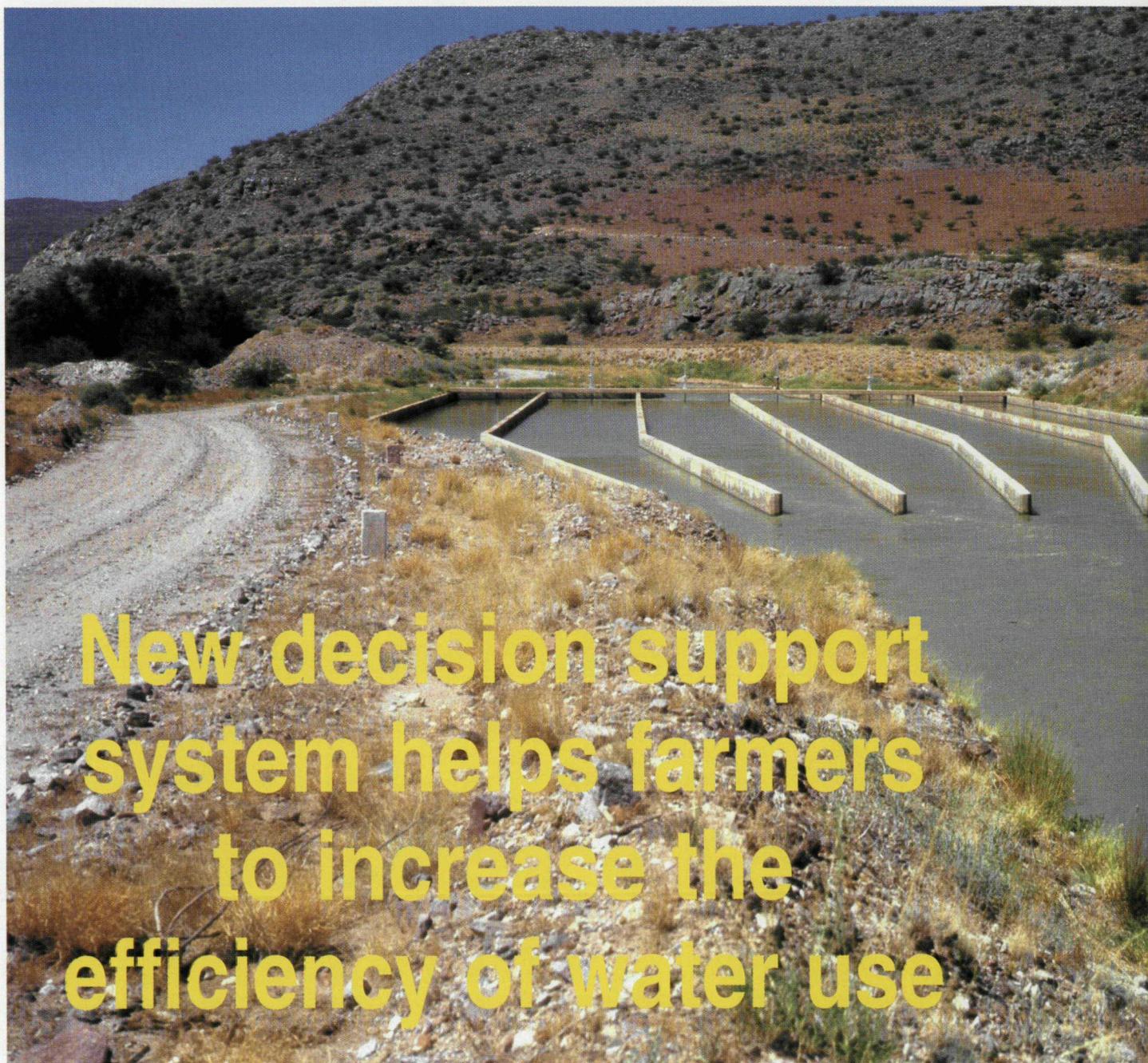
❑ *Site-suitability ranking tool:* When two or more alternative sites or areas need to be assessed, the site/area relative-evaluation aid or ranking tool assists through a process of weighting-and-rating algorithm to assess the impact importance and site relevance for comparative evaluation purposes.

❑ *Surface water balance and runoff storage estimation aid:* This assist in determining the capacity of the land to accept liquid sludge on a monthly basis taking into account the effect of precipitation-evaporation, disposal area and liquid sludge volume data and size of available land. The output is the monthly surface "water balance" values and storage requirements for contaminated

runoff.

The development of the guidelines is assuredly an example of co-operative government and collaboration with the private sector. The SLADS software is a unique tool that further enhances the use of the guidelines.

The guidelines and software document **Permissible Utilisation and Disposal of Sewage Sludge** is available from the Water Research Commission, c/o Tineke van der Schyff, Tel : (012) 330 0340 Fax: (012) 331 2565  
Email: [tineke@wrc.cwr.ac.za](mailto:tineke@wrc.cwr.ac.za)  
(Overseas price, inclusive of surface mail: US\$30).



## New decision support system helps farmers to increase the efficiency of water use

Researchers from the Department of Agricultural Economics at the University of the Free State presented the Water Research Commission with a three volume project report on agricultural water management. The main goal of the research project was "the development of methodologies to analyse and improve the economic efficiency of water and energy use in typical farming systems in humid and semi-arid areas under centre pivot irrigation at whole farm level, taking into account the dynamic environment in which irrigation occurs, as well as the farmers' attitude towards risk".

The report consists of the following three volumes - available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001:

☐ Volume I: The development of a decision support system for increasing the economic efficiency of water and energy

use for irrigation at whole farm level in central RSA, taking risk into account. Authors: LK Oosthuizen, JA Meiring, JHF Botes, DJ Bosch and P Breytenbach (WRC Report 347/1/96). Overseas price: US\$ 20.

☐ Volume II: Increasing economic efficiency of water and energy use for irrigation at whole farm level in the Winterton area. Authors: LK Oosthuizen, JHF Botes, DJ Bosch and P Breytenbach (WRC Report 347/2/96). Overseas price: US\$ 30.

☐ Volume III: Die ontwikkeling van 'n besluitnemingsonders-teuningstelsel vir die ekonomiese evaluering van risiko-bestuur op plaasvlak en die toepassing daarvan in die half-droë gebiede benede die PK le Rouxdam. Authors: LK Oosthuizen and JA Meiring. (WRC Report 347/3/96). An English summary is provided for each of the six chapters.



The research was carried out in two irrigation areas in South Africa - the irrigation area with water provision from the Vanderkloof Dam and the Winterton irrigation area. The Vanderkloof State Water Scheme covers an area of almost 20 000 ha which are mainly irrigated by centre pivot systems, while in the Winterton area approximately 7 000 ha are irrigated by about 100 land owners.

In the research data were collected by different means. In both areas an initial mail questionnaire was later followed up by questionnaires which were completed during personal interviews with

farmers. Farmers and experts were involved throughout the process by means of group discussions carried out in the research areas. Organisations supplied secondary data.

A first step in the research was to define and apply a procedure to identify representative farms for the research areas. Representative farms were constructed on the basis of each area's fixed-resource situations, variable resources and the capital structures of farmers in the areas. These representative farms were used throughout the research as basis for further economic analyses at whole farm level. This ensured that the results were reliable and applicable to farmers in the area.

The risk attitudes of irrigation farmers in both areas were also determined. With information on the risk preferences of farmers in the respective areas, the value of information and preferences strategies for specific groups of decision makers could be empirically determined.

In the Vanderkloof Dam area the research mainly focussed on determining the importance of alternative risk sources and management responses, formulating risk management strategies and developing a decision support system for the evaluation of risk management. Research in the Winterton area comprised the development of a procedure to calculate the value of irrigation information, which included a model to optimise irrigation management decisions. The influence of pumping restrictions on irrigation efficiency was evaluated, emphasizing the possible advantage of ESKOM's time-of-use electricity option.

## RESULTS

□ A procedure to develop representative farms was developed and implemented to ensure that economic analyses could be executed at whole farm level. This procedure was implemented in both the Vanderkloof Dam and the Winterton area.

□ The perceptions of irrigation farmers regarding the importance of risk sources and ways to manage risks were determined. The risk of variable producer prices and risks pertaining to climate, were viewed as the most important risk sources, while debt management was

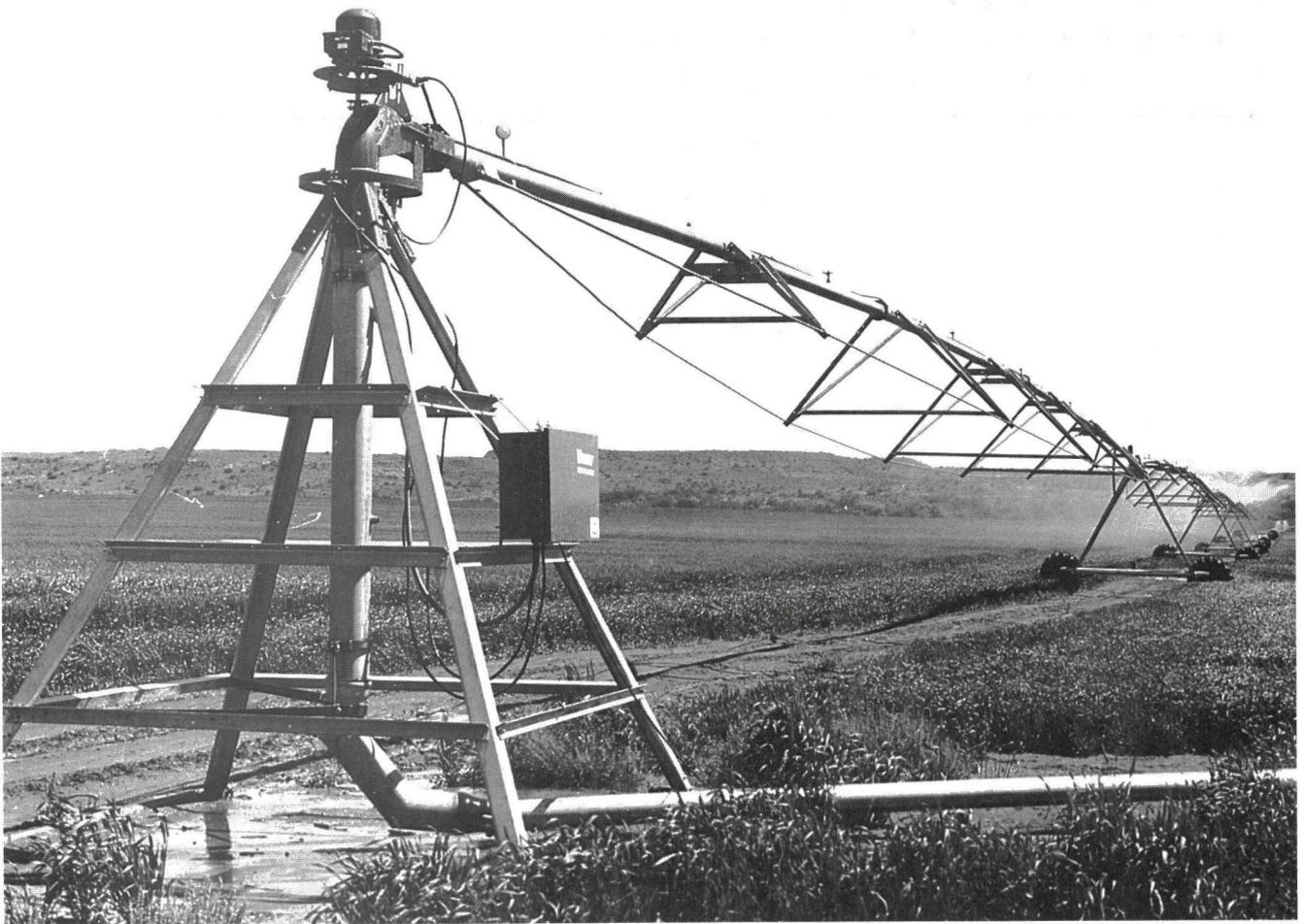
viewed as the most important way to counteract risk. These results corresponded with findings in USA studies and formed a basis for the formulation of alternative risk-management strategies. These results also directed the manner of risk simulation in the development of decision support systems.

□ A decision support system consisting of three modules was developed which solved the problem of the lack of aids for practical and timely support to risk management at farm level. This comprehensive system which can be used in a wide variety of farming situations could make a substantial contribution to extension and research.

□ In both the research areas farmers' risk preferences varied from risk seeking to risk-neutral with more of the Vanderkloof Dam farmers in the extreme categories. These results indicated that policy makers should consider such preference differences in the successful implementation of alternative management strategies. Farmers in the Winterton area tended to be more risk-averse towards wealth risk than towards annual income risk.

□ The illustration of the procedures and instruments developed in this research, resulted in informative empirical results. From a risk-management viewpoint, the maintenance of different levels of fixed liabilities had the most important results, with only a debt:asset ratio of 30 per cent which could be viewed as safe for farmers in the area. Doubling of the irrigation area from 60 to 120 ha meant a cash flow advantage for farmers. Preferential crop-rotation systems in the Vanderkloof Dam area included wheat and lucerne as well as either lucerne or maize. The decision to take out insurance against hail was influenced by the particular crop-rotation system. Although no insurance increased the total risk at farm level, risk-seeking farmers in the area did not ensure against hail. The incorporation of a mutton sheep enterprise in the Vanderkloof Dam area was also dependent on the farmers' risk preferences. Because livestock enterprises already became risky with a debt:asset ratio of 30 per cent, risk-averse farmers preferred to practice irrigation only.

□ The research also determined that the two maize crop-growth simulation models IBSNAT and PUTU irrigation



*Pumping restrictions influence both yields and the amount of water used for irrigation.*

seemed suitable to analyse the economics of crop production under diverse production conditions in South Africa. The results show that risk preferences could influence the selection of a crop model.

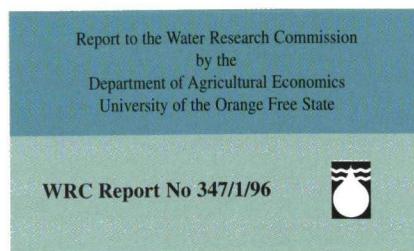
□ An irrigation, economic and crop-growth simulation model as well as an efficient search procedure and optimising model were successfully linked and used to evaluate the role of information for an irrigation farmer under conditions of limited and unlimited water supply. The use of the dynamic model indicated that more sophisticated irrigation information could increase the expected net returns due to the attainment of near maximum yields with simulations saving on irrigation water use. Results further indicated that specific soil information could account for between 97 and 99 per cent of the returns generated by information strategies using future weather information. The results prove



**Development of a Decision Support System for Increasing the Economic Efficiency of Water and Energy Use for Irrigation at Whole Farm Level in Central RSA, Taking Risk into Account**

Volume 1

LK Oosthuizen ● JA Meiring ● JHF Botes ● DJ Bosch ● P Breytenbach



that information is a partial substitute for soil quality and water availability. The maximum amount that irrigation farmers

in the Winterton area without water restrictions could pay for the best information varied between R136/ha and R330/ha, depending on their risk preferences. With water shortages, this value increased with at least 49 per cent. Thus the detrimental results of limited water were to a large extent decreased by better information.

□ Pumping restrictions influenced both yields and the amount of water used for irrigation. The average maize yield decreased but the average amount of water administered when pumping time was restricted, increased because irrigation commenced at higher soil-water levels. These results were, however, dependent upon the soil type and the capacity of the system. Such a strategy can therefore only become profitable if reductions in the cost of electricity are made possible as is the case with the Ruraflex option which supplies cheaper electricity outside peak hours.

# Water balance modelling of ecotopes investigated

**R**eliable plant growth models can make an important contribution towards promoting rainfall use efficiency, and therefore sustainable land use and food security. However, according to a recent report to the Water Research Commission, the water balance subroutines of the main crop models currently used in South Africa are not reliable under all circumstances.

The report **Modelling the Water Balance on Benchmark Ecotopes** by researchers M Hensley, JJ Anderson, JJ Botha, PP van Staden, A Singels, M Prinsloo and A du Toit, emanated from a project funded by the Water Research Commission in terms of a research contract with the Agricultural Research Council.

## AIMS

The aim of this project was to attempt to improve the reliability of plant growth models, and then use them to make long-term predictions to quantify risk. The following were the original aims as set out in the project:

- To obtain the necessary data over a period of three years at eight benchmark crop ecotopes to test and adapt selected crop models so that they are capable of making reliable long-term predictions of the water balance and of crop yield.

- To use the calibrated models along with long-term climatic data, to obtain for each benchmark ecotope:

- long-term cumulative distribution functions of yield - to serve as quantitative estimates of risk;
- long-term predictions of runoff and deep drainage - to provide surface and subsurface hydrological information.

- To accumulate knowledge about how to adapt crop models to give reliable results for ecotopes with a wide range of characteristics - to improve the efficiency of extrapolation to unknown ecotopes.

## ECOTOPES

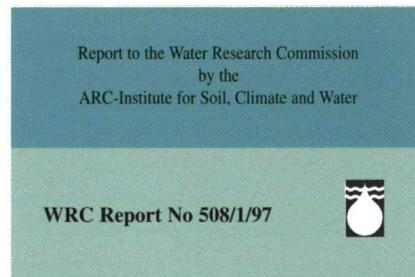
An ecotope is a specific three dimensional unit of the landscape determined by the climate, topography and soil.

According to the report the value of the ecotope concept lies in the fact that it defines all the factors which influence the productivity of land. Benchmark ecotopes, representing a wide range of ecotope characteristics, were selected for this study so that the results obtained could be effectively extrapolated. The ecotope first name is a geographical place name that provides a general idea of prevailing climate and topography, while the second name identifies the soil in terms of the South African Soil Classification System.



Modelling the Water Balance  
on Benchmark Ecotopes

M Hensley • JJ Anderson • JJ Botha • PP van Staden  
• A Singels • M Prinsloo • A du Toit



The following benchmark ecotopes were selected for the study:

- maize ecotopes: Setlagole/Clovelly, Wolmaransstad/Hutton, Kroonstad/Avalon, Bethal/Hutton, Bethal/Avalon and Ermelo/Longlands.
- wheat ecotopes : Bultfontein/Clovelly and Petrusburg/Bloemdal.

Yield and detailed water balance measurements were made at each of the eight benchmark ecotopes over three growing seasons. Comparisons between measured and simulated results showed that although both the DSSAT3 and PUTU maize and wheat models sometimes gave reliable yield predictions, they were sometimes also very unreliable. Soil water content pre-

dictions were better than those of yield, but also at times unsatisfactory.

## MODEL WEAKNESSES

According to the report adjustments to the models are needed to improve reliability, and the following model weaknesses have been exposed:

- the lack of a subroutine to deal with waterlogging in maize ecotopes,
- the lack of a subroutine for the absence of secondary roots in wheat,
- the inability of PUTU to predict high yields on the Bethal/Hutton and Bethal/Avalon ecotopes,
- the excessive maize root water extraction rate frequently simulated by DSSAT3 during the last part of the growing season,
- unsatisfactory runoff subroutines for both models,
- unsatisfactory stress prediction subroutines, especially in DSSAT3,
- the lack of a subroutine to cater for lateral water movement in the root zone.

## CONCLUSIONS

Although long-term cumulative probability functions (CPF's) of yield were computed and clearly reflect the relative production risks between the ecotopes studied, model reliability needs to be improved and the compilation of CPF's repeated before they can be considered as reliable assessments of risk. The same applies to long-term predictions of runoff and deep drainage.

According to the report the expertise gained with regard to the water balance processes at the ecotopes studied, will be most valuable in future applications of crop model technology to promote rainfall use efficiency on a wide range of ecotopes.

The report entitled **Modelling the Water Balance on Benchmark Ecotopes** (WRC Report 508/1/79) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: tineke@wrc.ccwr.ac.za (Foreign orders: US \$20 per copy, via surface mail).

# STRUVITE

*A user-friendly computer program for control of pH and mineral precipitation in anaerobic digestion.*

Fouling due to struvite and/or calcite precipitation is a common phenomenon in anaerobic treatment of both sludges derived from biological nutrient removal processes and waste waters from many industrial processes (for example, treatment of spent wine and piggery wastes.)

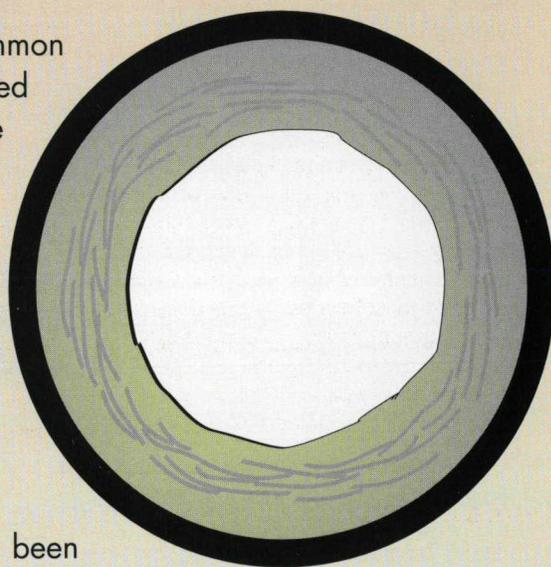
These problems arise predominantly in the recirculation pipe network and in the effluent discharge system. Usually this is due to pressure changes through pumps and/or carbon dioxide exchange with a gas phase (the atmosphere).

A user-friendly computer program called STRUVITE has been developed in the Department of Civil Engineering at the University of Cape Town as part of a Water Research Commission project. The program offers the user a rapid solution to a range of problems which may be encountered in anaerobic treatment. These include predicting the following:

- Chemical dosage to adjust the effluent to a desired state;
- Mineral (calcite and struvite) precipitation potentials, and
- The effects on pH and mineral precipitation potential of both change in either total pressure or partial pressure of carbon dioxide or temperature and chemical dosing.

**The cost of the program is:**

- South African users: R100
- Foreign users: US\$100



The program is available on request from Professor RE Loewenthal  
Department of Civil Engineering, Private Bag, Rondebosch 7701.

**Tel: (021) 650-3499 Fax: (021) 689-7471**  
**E-mail: dick@engfac.uct.ac.za**

# Waterlit Database now on the Internet

Free searching until end of March 1998

The Water Research Commission has decided to make their *Waterlit* bibliographic database available for searching through the organisation's Internet site. This facility will become available at the beginning of 1998 when free searching of the database will be offered to users until the end of March 1998. From 1 April 1998, free searching of *Waterlit* will still be available to **South African** users, while all overseas users will have to subscribe to the database on an annual basis. The subscription cost for overseas users will be **US \$500.00 per year** allowing unlimited searching of the database during that period.

## Registration

During the first three months of 1998, no registration will be required. After that, all users of the database will have to register, including South Africans using the free searching facility. Pre-payment for subscribing to *Waterlit* will be required from overseas users before a password providing access to the database is allocated.

## Searching the database

Two options are available when searching the database:

- Assisted search
- Expert search

## Assisted search

The Assisted Search facility (see Figure 1) is available to inexperienced searchers and to those not familiar with the *Waterlit* database design and properties. The official *Waterlit* Thesaurus is linked for consultation when selecting a suitable search term or phrase. Names of authors, organisations, companies, etc. can also be selected from the complete database list ('Select names' facility).

To demonstrate the assisted search facility, a search was undertaken

(Figure 1), asking the database for references to all publications on irrigation scheduling for vegetables dating from 1990 to 1997, of which GS Bredell was the author. The result of the search in condensed format is displayed as Figure 2. When requested to see *More*, the full entry for the relevant publication as retrieved from the database appears (see Figure 3).

## Expert search

The Expert search facility (see Figure 4) is available to experienced searchers familiar with Boolean search logic. The three horizontal bars on the right provide a range of options from which the appropriate field preferences (title, author, key terms, etc.) may be selected. The display of expert search results is similar to that of the assisted search facility.

## Document supply

Copies of documents listed on *Waterlit* and retrieved via a search of the database, may be ordered from the libraries or document collections quoted under **Holdings** (see Figure 3). For this particular document authored by GS Bredell, copies are available from the Water Research Commission as document number C2186, while the copy in the collection of the Department of Water Affairs and Forestry carries the number of WPAM6854 WA057.

## Contact names

Please direct your comments and/or queries to any of the following:

### Martha Pretorius

E-mail: mpretori@wrc.ccwr.ac.za

### Francette Myburgh

E-mail: fmyburgh@wrc.ccwr.ac.za

## WATER RESEARCH COMMISSION

PO Box 824

0001 PRETORIA

Tel. (012) 330 0340

**Waterlit Database Assisted Search**

About Waterlit Search Help Go to Expert Search

Subject Words/Phrases irrigation scheduling Thesaurus  
 AND - Words or Phrases vegetable crops Thesaurus  
 Author(s) or Organization bredell, g.s. Thesaurus Select Names

Publication Year from (yyyy) 1990 through (yyyy) 1997

Search Clear Display Results  
 Back to Menu Exit

Records retrieved: 1

Figure 1: Assisted Search

Back to Search Back to Menu Exit  
 Change Format Show Selections Clear Selections

Retrieved 1 records. Displaying items 1 - 1.

**Titles and Authors**

| Select                   | Title   | Author(s)  | See More |
|--------------------------|---|--|----------|
| <input type="checkbox"/> | Irrigation research and development for horticultural crops | Van Zyl, J.L.; Bredell, G.S. Agricultural Research Council, PO Box 8783, Pretoria 0001, South Africa | More     |

Figure 2: Display results

Back to DISPLAY Change Format

Record: 253645

Accession No. WL01470671

Title Irrigation research and development for horticultural crops

Author(s) Van Zyl, J.L.; Bredell, G.S. Agricultural Research Council, PO Box 8783, Pretoria 0001, South Africa

Source Proceedings of the Southern African Irrigation Symposium. Water Research Commission Report: TT 71/95 4 to 6 Jun 1991 Durban, South Africa p 98-109 (12 pages)

ISBN 1-86845-166-6

Publication Date Apr 1995

Publisher Water Research Commission, PO Box 824, Pretoria 0001, South Africa

Language English

No of References 82

Descriptor(s) Crop irrigation; Horticulture; Vegetable crops; Research and development; Irrigation practices; Drip irrigation; Microirrigation; Irrigation scheduling; Irrigation systems; Evapotranspiration; Tensiometers; Water requirements; Plant growth

Identifier(s) Fruit crops; South Africa

Section(s) W241 (Irrigation) W242 (Agricultural practices)

Document Type Conference paper

Holdings Water Research Commission (Pretoria) C2186. Dept of Water Affairs (Pretoria) WPAM6854 WA057.

Exit

Figure 3: Full record display

**Waterlit Database Expert Search**

Search Help About Waterlit To Assisted Search

Enter Keyword(s) or Phrase(s) using the Boolean operators AND, OR and NOT to define search logic, as well as proximity operators, such as ADJ or W/3 (within 3 words) to specify positional requirements, and Select Fields to search.

Expression 1: irrigation adj scheduling BI - Basic Index  
 AND  OR  NOT

Expression 2: (vegetable or horticultural) adj crop? TI - Title  
 AND  OR  NOT

Expression 3: bredell AU - Author or Editor

Limit search results [AND] by:

Publication Year from (yyyy) 1990 through (yyyy) 1997

Records retrieved: 1

Search Now Display Results Back to Menu Clear Exit

Figure 4: Expert search

# Report on the second IRC workshop



*Rural settlements in the Umgeni catchment.*

**T**he IRC International Water Supply and Sanitation Centre, an independent, non-profit organisation in the Netherlands, together with the United Nations Development Programme, initiated a project to evaluate "golden rules" or principles for effective water resources management by assessing and documenting practical international experiences.

The first workshop was held in the Netherlands in November of 1996 (SA Waterbulletin January/February 1997), followed by an evaluation workshop that took place in November of 1997 in the Netherlands which reviewed levels of awareness and adherence to these

principles, and developed follow up activities to promote integrated water resources management (IWRM) in the drinking water supply and sanitation sector and the broader context.

The principles for effective resources management were selected from the 1977 Mar del Plata conference, the 1990 New Delhi conference, the 1991 Nordic Freshwater Initiative and the 1992 United Nations conference on environment and development at Rio de Janeiro (Agenda 21). The key principles include:

- The importance of water source and catchment protection;
- Adequate water allocation needs to be agreed upon between the different stakeholders within a national framework;
- Efficient water use as being essential and often an important water source;
- Management needs to be taken care of at the lowest appropriate levels;
- The involvement of all the stakeholders is required;
- Striking a gender balance is needed as activities relate to different roles of men and women;
- Skills development and capacity

building are the key to sustainability, and

□ Water is to be treated as having an economic and social value.

To achieve the objectives of the evaluation workshop, participants from 15 projects were assessed through a participatory approach on how they applied part or all of the selected key principles in their reviewed projects. The countries that participated in the project included Zambia, South Africa, Ghana, Guatemala, Colombia, Nepal and India.

## SOUTH AFRICA

Two contrasting, but promising approaches in water resource management were selected from South Africa:

□ The Tonga Water Supply Project, a collaborative project between the Department of Water Affairs and Forestry and the Mvula Trust to improve the water supply to eleven communities along the Nkomazi basin in the Mpumalanga Province was evaluated by the Mvula Trust.

□ Umgeni Water evaluated the Mgeni Catchment Management Plan. The Mgeni river is one of the most developed catchments in South Africa providing water to over 3.5 million people and supporting an area which is responsible for about 65 per cent of the total economic production in the KwaZulu-Natal Province. The river is experiencing extreme pressures on the resource quality and quantity and the plan aims to ensure water is managed in a sustainable way to provide an adequate supply which is fit for all current and future water users.

## FINDINGS

Amongst the lessons learnt from the evaluation were the following:

□ **Source protection and conservation.** A preventative approach is crucial

to avoid the costly subsequent measures required to rehabilitate and treat water. Activities will involve inter-sectoral programmes and co-ordination mechanisms to integrate water use; programmes to prevent over-exploitation, pollution and degradation; and demand management in terms of efficient use and protection of quality and quantity.

□ **Management, stakeholder involvement and gender.** There is currently a heavy dependence upon centralised administration throughout the planning, construction and implementation of water projects, often proven to be inadequate in addressing local management problems. There is a need for government to change its role as provider to that of facilitator of services to enable users, local institutions and the formal and informal sectors to play a direct role. This can be achieved by creating a common platform for decision-making and enhancing the pivotal role of women in integrated water resource management.

□ **Capacity-building and the economic value of water.** There is consensus that institutional weakness and malfunctions are major causes of inefficient and ineffective national water services. There is a clear need for progress at various levels: at the *sectoral level* - creation of an enabling environment with appropriate policy and legal frameworks; at the *institutional level* - development of a sound planning and management process to allow collective skills to be used effectively; and *comprehensive* development of human resources and promotion of water issues.

Water may be considered a social good, a 'basic right for all' and an economic good, since the supply and safe disposal of waste has a cost. There is a need for a shift towards demand-based management systems, such as financing mechanisms characterised by flexible tariff structures and cross-subsidisation where necessary.

## THE WAY AHEAD

During the evaluation period, a new water law has been developed for South Africa. This embodies many of the internationally accepted principles of water resource management to ensure that water is shared on an equitable basis, so that the needs of those without access to water in their daily lives are met, so that the productive use of water in the South African economy is encouraged, and so that the environment which provides us with water and which sustains our life and the economy is protected. It will be important to evaluate whether the adoption of the new policies will result in tangible improvements in water resource management. The methodologies developed in this study could provide a valuable platform upon which to monitor their success.

Project findings will therefore be documented and disseminated to wider audiences to ensure sharing of experiences between water resource managers. A summary of the final IRC report can be found on the IRC website (<http://www.oneworld.org/ircwater/>). Projects reviewed are to be revisited and re-evaluated against the same set of principles as a performance monitoring process. The development of an action learning research proposal to practice participatory water resource management on sub-catchment basis, is complete. On a national or regional level, workshops on stakeholder analysis of water resource management issues are planned by the IRC and funded by the European Union.

Mr Ken Jeenes and Mr Cecil Chibi of the Mvula Trust and Ms Eiman Karar and Dr John Howard of the Water Quality Department of Umgeni Water represented their respective organisations in the project. The workshop was facilitated by Peter Bury, David Saunders, Esther de Lange and Elizabeth Lucas of the IRC.

*Report received from Ms E Karar, Umgeni Water*

# Water Law Review Process

- reprints available of popular discussion document

Readers can now again order copies of the popular publication on the South African Water Law Review Process. The document outlines the philosophy and practise of integrated catchment management, with a particular focus on the South African situation and requirements. The existing situation in South Africa is examined and possible reasons for the successes or failures that have been achieved to date are highlighted.

The core concepts contained within the integrated catchment management

approach are examined, together with the processes and institutional arrangements required for success. The document evaluates and comments on the ways in which a flexible integrated catchment management process links together all of the different stakeholders, helps to identify critical issues, and then directs appropriate attention to these issues. The interplay between environmental, social and economic issues is emphasized, together with the institutional, practical, legal and information requirements that are necessary for success.

Although the publication focuses mainly on water resource management issues, a number of other concerns, such as land use management and institutional arrangements, are also examined because they impact on water resources and influence management decisions.

Copies of the publication (WRC Report TT 81/96) are obtainable free of charge from the Librarian, Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$30).

## OVERVIEW PUBLISHED OF BIOLOGICAL WASTEWATER TREATMENT SYSTEMS

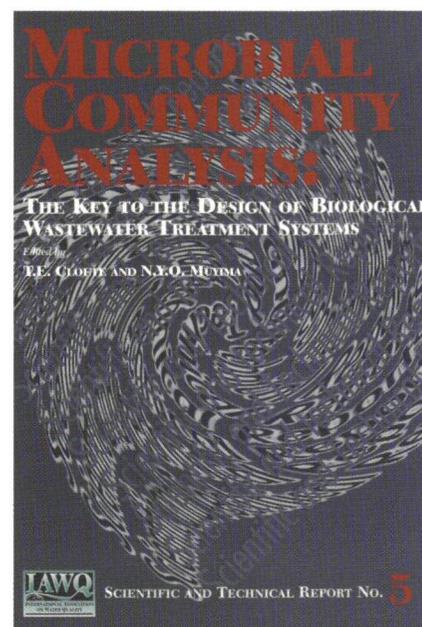
Contributions of four South African scientists, TE Cloete, FA Ekama, NYO Muyima and MC Wentzel, have been included in the latest IAQW scientific and technical report (no 5) entitled "Microbial Community Analysis: the key to the design of biological wastewater treatment systems".

Edited by TE Cloete and NYO Muyima, this book surveys the vast amount of theoretical and practical knowledge on the design of biological wastewater treatment systems. It describes the different types of biological wastewater treatment systems, the role of microbial diversity in these systems and how this affects design and operation methods for studying microbial community dynamics and the mathematical modelling of these systems. The final chapter deals with the actual design parameters

used for different biological wastewater treatment plants.

The book will be of value for students, wastewater treatment plant operators, sanitary engineers and those who regularly conduct environmental monitoring and consulting. Written and edited by leading researchers, practitioners and instructors, this book is certain to become a landmark in its field.

The book is published by the International Association on Water Quality in its Scientific and Technical Report series. Copies can be obtained from the IAQW, Duchess House 20 Mason's Yard, Duke Street, St James's, London SW1Y 6BU, England. Tel: +44 (0) 171 839 8390. Fax: +44 (0) 171 839 8299. E-mail: IAQW@compuserve.com



## University down under wishes to expand its contacts to South Africa

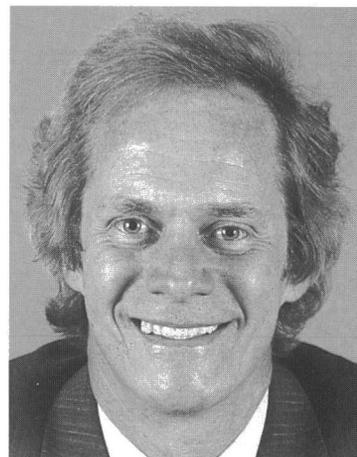
Professor Hans van Leeuwen, Vice-Dean of Engineering at the University of New England (UNE), Armidale, Australia, has been visiting various universities in South Africa during December and January. Professor van Leeuwen, formerly from the University of Pretoria, is exploring the prospects of collaboration with the universities of Pretoria, South Africa (UNISA), Vista and Cape Town.

Professor Van Leeuwen says that the UNE is keen on establishing links with South African universities in the areas of engineering, environmental sciences, basic sciences and agriculture. He says that there are various opportunities for funding within Australia and the international community for development projects in South Africa. Examples are the Australian Centre for International Agricultural Research and the International Development Programme funded by AusAid. Such projects could

best be tackled between an Australian university and South African universities and other organisations, but need to demonstrate mutual benefits for both countries. The focus need not only be on research - establishing short courses for community development is another worthwhile objective.

The University of New England is a medium-sized, rural university, situated halfway between Brisbane and Sydney. It has substantial experience in rural development projects and it also runs one of the largest distance education programmes in Australia.

Professor Van Leeuwen is personally most interested in environmental engineering projects and is presently involved in research into the recovery of metals, proteins and other valuables from wastes, and in the disinfection of ships' ballast water for coastal protection.



*Prof Hans van Leeuwen*

Professor Van Leeuwen can be reached by e-mail: [jvanlee@metz.une.edu.au](mailto:jvanlee@metz.une.edu.au) or by fax at 0961 267 732009. His postal address is Environmental Engineering, UNE, Armidale 2350, NSW, Australia.

## AWWARF requests research proposals

The American Water Works Association Research Foundation (AWWARF), a non-profit organisation dedicated to advancing the science of water, announces the selection of 44 new research projects approved for funding in 1998.

AWWARF sponsors practical, applied research for the drinking water community and, since 1986, has managed research projects worth over \$100 million. The new research projects cover topics including utility management, treatment chem-

istry, customer issues, distribution system water quality, and source water quality and monitoring.

Requests for proposals will be issued for 35 of the new projects and will be available on the AWWARF web site ([www.awwarf.com](http://www.awwarf.com)) in early March 1998. For additional information, please contact AWWARF at 303-347-6211 or 303-347-6117.

# 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



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Die Waternavorsingskommissie plaas hierdie kalender om te help met die koördinering van watergebeurtenisse in Suid-Afrika.

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

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

Gids:

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

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

## 1999

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| 23 | 24 | 25 | 26 | 27 | 28 | 29 |   |   |   |   |   |   |
| 30 | 31 |    |    |    |    |    |   |   |   |   |   |   |

| S  | M  | T  | W  | T  | F  | S  |   |   |   |   |   |   |
|----|----|----|----|----|----|----|---|---|---|---|---|---|
|    |    |    |    |    | 1  | 2  | 3 | 4 | 5 | 6 | 7 | 8 |
| 9  | 10 | 11 | 12 | 13 | 14 | 15 |   |   |   |   |   |   |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |   |   |   |   |   |   |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |   |   |   |   |   |   |
| 30 | 31 |    |    |    |    |    |   |   |   |   |   |   |

| S  | M  | T  | W  | T  | F  | S  |   |   |   |   |   |   |
|----|----|----|----|----|----|----|---|---|---|---|---|---|
|    |    |    |    |    |    | 1  | 2 | 3 | 4 | 5 | 6 | 7 |
| 8  | 9  | 10 | 11 | 12 | 13 | 14 |   |   |   |   |   |   |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |   |   |   |   |   |   |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |   |   |   |   |   |   |
| 29 | 30 |    |    |    |    |    |   |   |   |   |   |   |

| S  | M  | T  | W  | T  | F  | S  |   |   |   |   |   |   |
|----|----|----|----|----|----|----|---|---|---|---|---|---|
|    |    |    |    |    |    | 1  | 2 | 3 | 4 | 5 | 6 | 7 |
| 8  | 9  | 10 | 11 | 12 | 13 | 14 |   |   |   |   |   |   |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |   |   |   |   |   |   |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |   |   |   |   |   |   |
| 29 | 30 | 31 |    |    |    |    |   |   |   |   |   |   |

**SOUTHERN  
AFRICA****1998****ENVIRONMENTAL  
MANAGEMENT****MARCH 2 - 6**

An international (ISO 14001) environmental management and auditing course will be held at the ESKOM Conference Centre in Midrand, Gauteng.

Enquiries: The Organisers, Crystal Clear, PO Box 1982, Bramley 2018. Tel: 011-8823368. Fax: 011-8823395. E-mail: crystal.clear@pixie.co.za

**WISA '98****MAY 4 - 7 1998**

The biennial conference and exhibition of the Water Institute of Southern Africa (WISA) will be held in Cape Town.

Enquiries: Conference Planners, PO Box 36782, Menlo Park 0102. Tel: (012) 348-4493. Fax: (012) 348-1563. E-mail: wissing@iafrica.com

**AQUACULTURE****SEPTEMBER 13 - 19**

An international conference on African fish and fisheries - diversity and utilisation will be held in Grahamstown in the Eastern Cape. The objectives of the conference are to address and discuss issues surrounding African fish biodiversity and sustainable utilisation of marine and inland fisheries resources and to consider recent advances in aquaculture in Africa.

Enquiries: JLB Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140. Tel: +27 461 311002. Fax: 0461-22403. E-mail: fishcon@ru.ac.za Website: <http://www.ru.ac.za/affiliates/jlb/fishcon>

**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 appropri-

ate technologies and public participation.

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

**1999****CORROSION****SEPTEMBER 26 - OCTOBER 1**

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

**Call for papers.** Deadline 31 July 1998.

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

**OVERSEAS****1998****MARCH 7 - 11**

The premier Asian technical conference and exhibition on international wastewater and water quality technology, WEFTEC Asia, will be held in Singapore.

Enquiries: Water Environment Federation, WEFTEC '98 Registration, 601 Wythe Street, Alexandria VA 22314-1994 USA. Fax: 1 703 684 2471. E-mail: confinfo@wef.org

**SEWAGE SYSTEMS****MARCH 8 - 10**

A symposium on individual and small community sewage systems will be held in Orlando, Florida, USA.

Enquiries: Susan Buntjer. Tel: 616-428-6327.

**WATER MANAGEMENT****MARCH 11 - 13**

A symposium to evaluate and discuss the technological, economical, social and ecological feasibility and the implementation of sustainable urban water management systems.

Enquiries: Dr Hans Alderink, Wageningen Agricultural University, Dept of WKAO, PO Box 8080,

NL-6700 DD Wageningen, The Netherlands. Fax: +31 317 484411. E-mail: Hans.aalderink@wkwa.wkao.wau.nl

**ACTIVATED SLUDGE****MARCH 16 - 18**

A seminar on the modelling and microbiology of activated sludge processes will be held in Kollekolle, Denmark.

Enquiries: MiaCon, Dept of Environmental Science and Engineering, Building 115, Technical University of Denmark, DK-2800 Lyngby, Denmark. Tel +45 4525 1613. Fax: +45 4593 2850. E-mail: bn@imt.dtu.dk

**RIVER SYSTEMS****MARCH 25 - 27**

A conference with the theme "Man and River Systems - the functioning of river systems at basin scale" will be held in Paris, France.

Enquiries: F Bourgain, Conference Secretariat, ENPC, 28 rue des Saints-Peres, 75007 Paris, France. E-mail: bourgain@paris.enpc.fr Tel: +33-1-44-582822. Fax: +33-1-44-582830.

**WATER-ROCK  
INTERACTION****MARCH 30 - APRIL 3**

The 9th international symposium on water-rock interaction will be held in Taupo, New Zealand.

Enquiries: Dr Greg B Arehart, WRI-9 Editor, Wairakei Research Centre, Inst of Geological and Nuclear Sciences, Private Bag 2000, Taupo, New Zealand. E-mail: editor@ruamoko.gns.cri.nz Fax: +64 7 374 8199

**FLOOD CONTROL****APRIL 20 - 22**

An international workshop on non-structural flood control in urban areas will be held in Sao Paulo, Brazil.

Enquiries: General Secretary, Av Brigadeiro Luis Antonio, 317-jc33, 01317 901, Sao Paulo, SP/Brazil. E-mail: urban-floods@edu.usp.br Tel: +55 11 604 6412. Fax: +55 11 604 3406.

**STORM DRAINAGE****MAY 4 - 6**

A conference on innovative technologies in urban storm drainage (Novatech 1998) will be held in Lyon, France.

Enquiries: GRAIE, BP 2132, 69603 Villeurbanne Cedex, France. Tel: +33 472 438368. Fax: +33 472 449277. E-mail: graie@urgchu.insa-lyon.fr

**DRINKING WATER****MAY 10 - 13**

The first international symposium on technology, operation and economics of providing safe drinking water in small systems will be held in Washington DC, USA.

Enquiries: NSF International, 3475 Plymouth Road, Ann Arbor, MI, USA 48105. Fax: 202-289-2149. E-mail: cotruvo@nsf.org

**CHLORINATED  
COMPOUNDS****MAY 18 - 21**

The first international conference on remediation of chlorinated and recalcitrant compounds will be held in Monterey, California, USA.

Enquiries: The Conference Group, 1989 West Fifth Avenue Suite 5, Columbus, Ohio 43212-1912 USA. Tel: 614-424-5461. Fax: 614-488-5747. E-mail: 102632.3100@compuserve.com

**WATER QUALITY****MAY 20 - 23**

An international conference on water quality management in national parks and other protected areas will be held in Primosten, Croatia.

Enquiries: Bojan Zmaic, Rakusina 1, 10000 Zagreb, Croatia. E-mail: bzmaic@zg.igh.hr Tel: +385-161-19-588.

**ECWATECH-98****MAY 25 - 30**

The third international congress and exhibition on water, ecology and technology will take place in Moscow, Russia.

Enquiries: The organising committee, PO Box 173, Moscow 107078, Russia. Tel/fax: +7 (095) 207 6360 E-mail: ecwatech@sibico.msk.ru

**RADAR****MAY 27 - 30**

An international conference on ground-penetrating radar will be held in Lawrence, Kansas.

Enquiries: Richard Plumb at Tel. 913-864-7735.

**WATER RESOURCES****JUNE 3 - 6**

An international conference on world water resources at the beginning of the 21st century: Water - a looming crisis? will be held in Paris, France.

Enquiries: UNESCO, Division of Water Sciences, 1 rue Miollis, 75732 Paris Cedex 15, France. Fax: +33-145-68-5811.

**WATER QUALITY**

JUNE 8 - 12

A short course on the Design of Water Quality Monitoring Networks will be presented at the Colorado State University, USA.

Enquiries: TG Sanders, Dept of Civil Engineering, Colorado State University, Fort Collins CO 80523. Tel: (970) 491-5448. Fax: (970) 491-7727. E-mail: TGS@enr.colostate.edu

**MEMBRANE SCIENCE**

JUNE 9 - 12

An international conference on membrane science and technology (ICMST '98) will be held in Beijing, China.

Enquiries: Mrs Yanqiao Shi, ICMST'98, c/o Institute of Chemistry, Chinese Academy of Sciences, Zhongguancun, Beijing 100080, China. Fax: +86-10-62569564 OR: 62559373.

**IWSA**

JUNE 17 - 18

An IWSA specialised conference on master plans for water utilities will be held in Prague, Czech Republic.

Enquiries: Mr Lubomir Macek, Faculty of Civil Engineering, CTU Thakurova 7, CZ 16629 Praha 6, Czech Republic. E-mail: macek@fsv.cvut.cz Tel: +420 2 2435 4608. Fax: +420 2 2435 4607.

**IAWQ**

JUNE 21 - 26

The 19th biennial conference of the International Association on Water Quality will be held in Vancouver, BC Canada.

Enquiries: IAWQ, Duchess House, 20 Mason Yard, Duke St., St James's, London SW1Y 6BU, United Kingdom. Tel: 44 (0) 171-839 8390. Fax: 44 (0) 171-839 8299.

**MINERAL WATER**

JUNE 24 - 27

An international symposium on mineral and thermal groundwater will take place at Miercurea Ciuc, Romania.

Enquiries: Romanian Association of Hydrogeologists, Symposium Secretariat, c/o Iulian Popa, 6 Traian Vuia Str, R-70139 Bucharest, Romania. Fax: +40-1-212-3385.

**WATER AFRICA '98**

JUNE 30 - JULY 2

An international exhibition and conference "Water Africa 98" will

be held in Nairobi, Kenya.

Enquiries: African Conference, 37 Upper Duke Street, Liverpool L1 9DY, England. E-mail: africon@robart.demon.co.uk Tel: +151 709-9192. Fax: +151 709 7801.

**GROUNDWATER**

JULY 12 - 16 1998

An international conference with the theme Future groundwater resources at risk will be held in Changchun, China.

Enquiries: Professor Lin Xueyu, Changchun University of Earth Sciences, Changchun, Jilin 130 026, China. Fax: 86 431892 8327.

**ACTIVATED SLUDGE**

JULY 13 - 17

A short course entitled Activated Sludge Process Control will be presented in Estes Park, Colorado.

Enquiries: TG Sanders, Dept of Civil Engineering, Colorado State University, Fort Collins CO 80523. Tel: (970) 491-5448. Fax: (970) 491-7727. E-mail: TGS@enr.colostate.edu

**FOG COLLECTION**

JULY 19 - 24

The first international conference on fog and fog collection will be held in Vancouver, Canada. Scientific sessions will include: Fog physics and chemistry; Fog - vegetation interactions; Fog deposition to temperate forests; Fog deposition to tropical forests; Fog contributions to sub-surface water supplies; Construction and use of fog collectors; Measurement of fog fluxes and collection rates and the Assessment of the role of fog in specific ecosystems.

Enquiries: Dr Robert S Schemenauer, Conference chair, Environment Canada. Tel: (416) 739-4606 Fax: (416) 739-4211. E-mail: robertss@armph3.dow.on.doe.ca

**IRRIGATION**

JULY 20 - 25

The 10th Afro-Asian regional conference on irrigation and drainage will be held in Bali, Indonesia.

Enquiries: Dr A Hafied A Gany, c/o Director-General, Water Resources Development, JL Pattimura 20, Kebayoran 12067, Indonesia. Tel: +62-21-739-6616. Fax: +62-21-726-1956.

**BRACKISH WATER**

JULY 23 - 24

An international workshop on the

use of saline and brackish water for irrigation - implications for the management of irrigation, drainage and crops will be held in Bali, Indonesia.

Enquiries: ICID Workshop, Dr R Ragab, Institute of Hydrology, Wallingford Oxon. OX10 8BB UK. Tel: +44 1491 692303. Fax: +44 1491 692424. E-mail: R.Ragab@ua.nwl.ac.uk

**STOCKHOLM WATER**

AUGUST 10 - 13

The 8th Stockholm water symposium with the theme "Water - the key to socio-economic development and quality of life" will be held in Stockholm, Sweden.

Enquiries: Symposium Secretariat, SE-106 36 Stockholm, Sweden. Tel: +46 8 7362021. Fax: +46 8 7362022. E-mail address: sympos@siwi.org

**CLIMATE & WATER**

AUGUST 17 - 20

The second international conference on climate and water will be held in Espoo, Finland.

Enquiries: Risto Lemmela, HUT/Water Res. Eng., Huhtatie 12, 04300 Tuusula, Finland. Tel: +358 9 275 3835. Fax: +358 9 451 3827. E-mail: rlemmela@ahiti.hut.fi

**HYDROINFORMATICS**

AUGUST 24 - 26

This is the third in a series of conferences held every two years on all aspects of data and information management related to hydrology. It will be held in Copenhagen, Denmark.

Enquiries: Dr Vldan Babovic, Danish Hydraulic Institute (DHI), Agern Alle 5, 2970-DK Horsholm, Denmark. Tel: +45 45 179133. Fax: +45 45 762567. E-mail: vmb@dhi.dk

**IAHR**

AUGUST 26 - 28

The biennial conference of the International Association of Hydraulic Research (IAHR), African Division, is to be held in Hurgada on the Red Sea, Egypt. Theme: Coping with water scarcity. Topics: Integrated management in arid zones; Environmental impact; Surface and groundwater hydraulics and Alluvial hydraulics. Enquiries: Hydraulics Research Institute, Delta Barrage 13621, Egypt. Fax: (202) 218-9539 or Professor D Stephenson, PO Box 277, WITS 2050. Fax: (011) 403-2062.

**WEDC**

AUGUST 31 - SEPTEMBER 4

The 24th WEDC conference with the theme "Sanitation and water-for all" will be held in Islamabad, Pakistan.

Enquiries: WEDC, Loughborough University, Leicestershire LE11 3TU UK. Tel: +44 (0) 1509 222885. Fax: +44 (0) 1509 211075.

**POLLUTION**

AUGUST 31 - SEPTEMBER 4

The 3rd IAWQ specialist conference on diffuse pollution will be held in Edinburgh, Scotland.

Enquiries: Caryl Jackson, Scottish Environment Protection Agency, Erskine Court, the Castle Business Park, Stirling, FK9 4TR, Scotland. E-mail: cjackson@sepa.org.uk Tel: +44 1786 457700. Fax: +44 1786 448040.

**WETLANDS**

SEPTEMBER 98

A conference on wetland systems for water quality control will be held in Sao Paulo, Brazil.

Enquiries: Dr Samia Maria Tauk-Tornisielo, Centro de Estudos Ambientais/UNESP, Avedida 24-A, 1515 Bela Vista, CEP 13506-900, Rio Claro (SP), Brazil. Tel: +55 019 534 7298. Fax: +55 019 534 2358. E-mail: cea@life.ibrc.unesp.br

**WATERSHED MANAGEMENT**

SEPTEMBER 7 - 10

An international symposium on comprehensive watershed management (ISWM-'98) will be held in Beijing, China.

Enquiries: Mr Tan Ying, IRTCES, PO Box 366, Beijing 100044, China. Tel: +86-10-68413372. Fax: +86-10-68411174. E-mail: irtces@public2.bta.net.cn

**HEALTH RISKS**

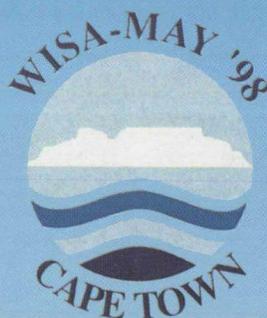
SEPTEMBER 7 - 10

The 2nd international symposium on assessing and managing health risks from drinking water contamination will be held in Santiago, Chile.

Enquiries: Dr EG Reichard, USGS, 5735 Kearny Villa Road, Suite O, San Diego, CA 92123, USA. E-mail: egreich@s101pcasnd.wr.usgs.gov Fax: +56-2-689-4171.

# THE WATER INSTITUTE OF SOUTHERN AFRICA (WISA)

## BIENNIAL CONFERENCE AND EXHIBITION



**CAPE TOWN SOUTH AFRICA**

**4 to 7 May 1998**

### CONFERENCE TOPICS

- Anaerobic processes
- Aquatic ecosystems
- Collection and reticulation systems
- Community based projects
- Consumer education
- Developing communities
- Education and training
- Environmental aspects
- Groundwater management
- Health related aspects
- Industrial water and effluent treatment
- Infrastructure and management in the water industry
- Laboratory services
- Landfills and leachate management
- Marine disposal
- Membrane development and operation
- Mine water quality management
- Nutrient removal
- Plant operation
- Potable water treatment
- Public participation
- River basin management
- Sludge management
- The role of the water scientist
- Urban runoff
- Wastewater technology
- Water distribution
- Water quality management

### EXHIBITION

An exhibition - a showcase for all water related industries - will be held concurrently with the conference. Manufacturers, suppliers, consultants and contractors who supply goods and services to the water industry are invited to apply for an exhibition stand.

### ENQUIRIES

The Conference Secretariat: Conference Planners, PO Box 36782, Menlo Park 0102.  
Tel: (012) 348-4493 Fax: (012) 348-1563 E-mail: [wissing@iafrica.com](mailto:wissing@iafrica.com)

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**For further information contact the Water Research Commission,  
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e-mail [rina@wrc.ccwr.ac.za](mailto:rina@wrc.ccwr.ac.za).**