

S4 waterbulletin

ISSN 0258-2244

Volume 21 No 2

March / April 1995

WATER SUPPLY

Water prepayment system investigated

RIVIERNAVORSING

Werkessieverrigting gepubliseer

WATER QUALITY

New guide available for identification of macroalgae

00020090



Department of Civil Engineering University of Pretoria

RURAL WATER SUPPLY

3-7 July 1995

The course aim is to provide information and knowledge that will be required by all parties involved in the development of rural water supplies. The course is designed for those directly involved in the development of rural water supplies, including consulting engineers, members of government and provincial administrations, local authorities, water boards, non-governmental organisations, funding agencies, and other research and training institutions.

Course Contents

Introduction

- the White Paper on Water Supply and Sanitation
- socio-political objectives
- the responsibilities and functioning of Local Water Committees
- the role of national and provincial authorities and water boards
- the role of financing agencies
- the role of non-governmental organisations

Training and capacity building

- effective communication
- education and training in water resource development
- water knowledge transfer to rural communities
- principles of democratic governance and public office
- the roles of elected representatives, administrators and planners
- development of administrative skills
- development of technological skills

Planning and implementation procedures

- water demand and availability assessment
- planning (engineering and financial aspects)
- planning (legal aspects)
- environmental considerations
- implementation (administrative aspects)
- operation and maintenance
- community participation
- administrative and financial control

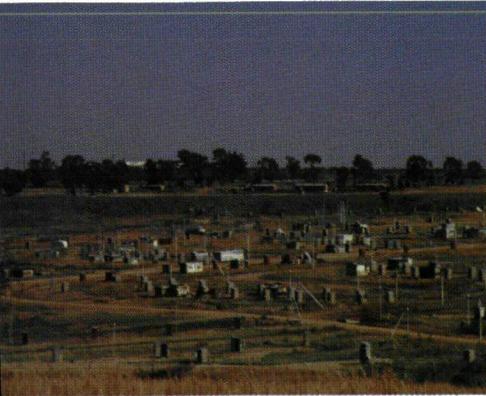
Decision making procedures

- optimisation methods
- the roles of planners and clients
- streamlining the bureaucratic process

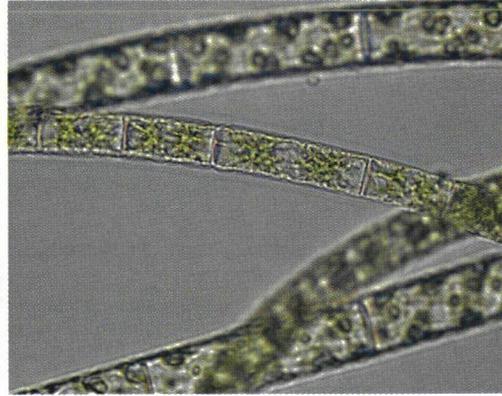
Professor WJR Alexander is the course leader. The course will be presented in English and the course fee is R1500, which includes course notes, teas and lunches.

ENQUIRIES

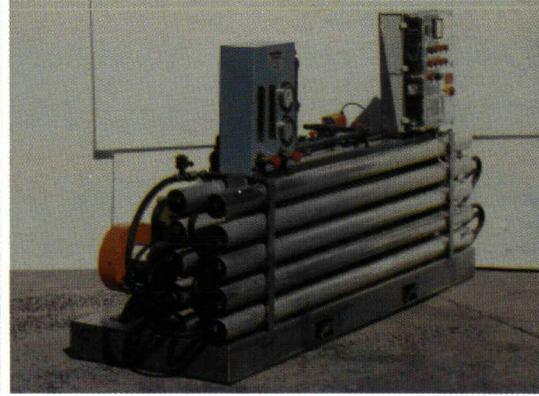
For further information and course registration please contact Mrs Nellie le Roux at the Department of Civil Engineering, University of Pretoria, at: Tel (012) 420 2978 or Fax (012) 43-3589



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Cover: The Jukskei River, northwest of the Johannesburg metropolis. (Photo: Helene Joubert)

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

WASP Technology Transfer Workshops Held

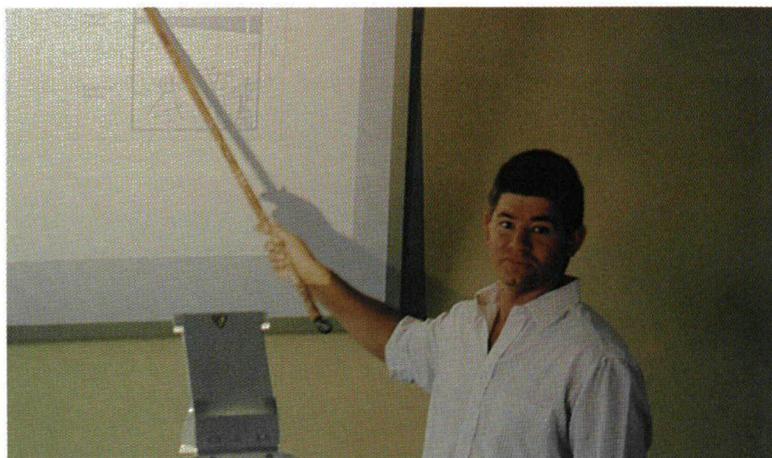
A series of Water Research Commission (WRC) sponsored technology transfer workshops were held throughout the country during February 1995. The aim of the workshops was to introduce the WASP method to people involved in both waste management and groundwater protection.

WASP, which stands for Waste Aquifer Separation Principle, was developed by Roger Parsons of the CSIR and Jeff Jolly of Groundwater Consulting Services (formerly of the Department of Water Affairs and Forestry) for the WRC during the execution of a project entitled **The development of a systematic method for evaluating site suitability for waste disposal based on geohydrological criteria** (WRC Report No 485/1/94).

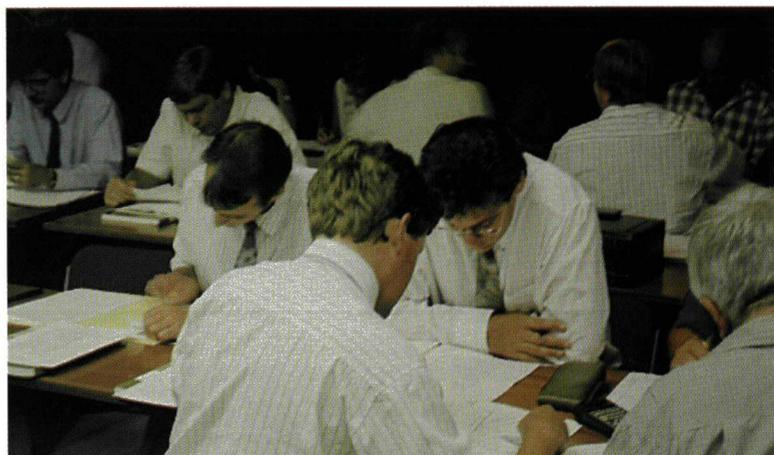
The method is based on the principle that waste sites and aquifers cannot co-exist and that they need to be kept apart. The method considers the threat posed by a waste site, the ability of the vadose zone to act as a barrier and the strategic value of a groundwater resource to its users or potential users. In providing a decision support tool, WASP also considers the reliability of the data used to make the assessment.

Approximately 185 people attended the six half-day workshops held in Stellenbosch, East London, Bloemfontein, Germiston (2) and Pietermaritzburg. A wide range of people from various organisations attended the workshops.

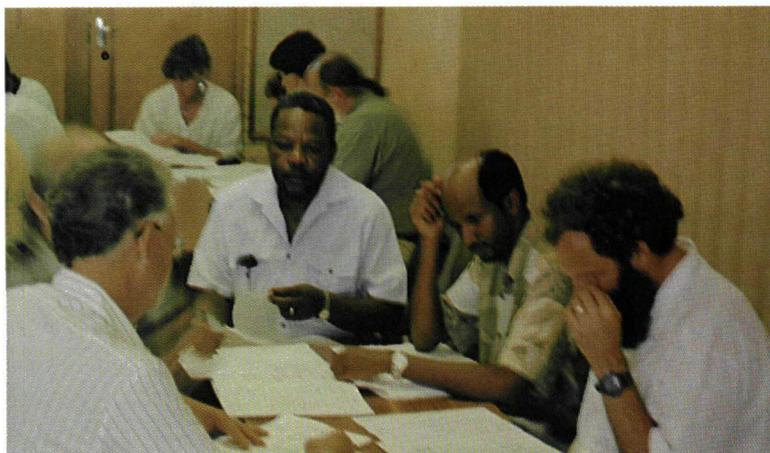
The theory behind the method was presented and the delegates were given the opportunity of actually working through some examples. The hands-on exercises ensured that the delegates got a good feel for WASP and were made aware of the strengths and limitations of the technique. Much good debate was generated concerning the role of WASP in South Africa. A number of people proposed that WASP be extended to include other threats such as those posed by sewage disposal, mining and industry.



Mr Jeff Jolly of Groundwater Consulting services (Cape Town) introducing participants to the WASP procedure.



Delegates at the WASP Workshop.



Empowering the Environment

In the process of delivering infrastructure and services to South Africa's developing communities through the government's reconstruction and developing programme there is the danger of overlooking the environment which could be negatively affected if it is not given due consideration from the outset.

This is the subject which came under the spotlight during a seminar titled "Empowering the Environment", which was hosted by the consulting engineering firm, Stewart Scott Incorporated, at their Sandton office, in conjunction with its Dutch partner, the DHV Group.

"We are concerned that if not enough attention is paid to the environment as part of the development process, more money will have to be spent on rectifying problems later," explained Dr Herman Wiechers, head of Stewart Scott's Environmental Unit.

Dr Wiechers said that a possible way in which to circumvent any neglect to the environment would be by implementing a partnership between the people, the government and the private sector. This forum could act as a platform on which to ensure that environmental issues are properly addressed in developing projects.

DHV, one of the largest consulting engineering firms in Europe, also made valuable input into the seminar. Mr Hans Lodder sketched his company's involvement in empowering the environment in other African countries, including Nigeria, Kenya and Mozambique. He emphasised that sustainable development is a process for which there is no blueprint and that each situation requires its unique solution. A framework for the process to succeed needs to be established, but solutions to environmental problems can best be found at the local community level.

Dr Annemarie Goedmakers, also of DHV, said there is a need to build in mechanisms in the development process to ensure environmental issues are addressed.

"At the same time, it will be necessary to transfer knowledge concerning the environment to local communities to ensure the practical implementation of sustainable development," she said. She added that international aid money and soft loans could be utilised to kickstart the empowerment of the environment as an integral part of the RDP process.



Left: Mr Hans Lodder of DHV Consultants in the Netherlands.

Below:

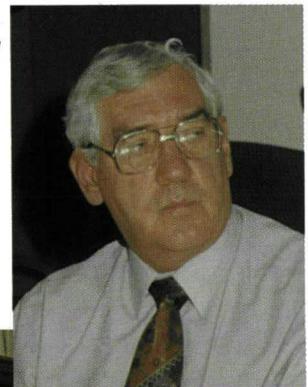
From left: Mr William Alexander (StewartScott), Mr Denis Gibson (Richards Bay Minerals), Dr Annemarie Goedmakers (DHV/StewartScott) and Dr Chris Herold (Stewart Scott).



Right: Dr Colin Cameron, Director-General, Department of Environmental Affairs and Tourism.

Below:

Enjoying the brunch are from left: Mr Purent Katide and Mrs Irena Taviv (Stewart Scott), Mr Molefi Kybuzie (RDP Office, N.Tvl), Dr Tinus Vermeulen (Stewart Scott) and Mr. Kenny Mokoena (SARDET)



RIVERS WORKSHOP PROCEEDINGS published

A joint South African/Australian rivers workshop was held in Cape Town in 1994. In his opening address at the workshop Mr David van der Merwe, deputy executive director of the Water Research Commission, said "The need for river classification and for health indicators has been recognised for some time now, especially from the point of view of conservation and management. To know to what extent information, research and development results from one system can be applied to another, it is important to know how similar or different one river is from another. It is therefore projected that the opportunities for cross-pollination and in-depth discussions that this workshop will provide, will stimulate not only the current projects, but also future research in this regard".

Presently a comprehensive volume of the workshop proceedings, containing the papers presented along with the panel discussions, has been edited and published as a technical transfer report of the Water Research Commission. The publication has been funded jointly by the Water Research Commission (WRC) and the Foundation for Research Development (FRD).

The proceedings entitled ***Classification of rivers and environmental health indicators*** (WRC Report no. TT 63/94) are now available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Foreign order please note: US\$ 35.00 per copy.

This 419 page publication is the result of a joint South African / Australian workshop held in February 1994 at the University of Cape Town. The visit by the Australians grew out of discussions during the WRC/FRD-sponsored 1991 tour of Australia by 12 South African scientists and water managers, and was largely motivated by Professor Barry Hart of Monash University, Professor Jay O'Keeffe of Rhodes University, and Dr Jackie King of the University of Cape Town. The striking similarities between the water resources of the two regions, and the instant rapport between the Aussies and South Africans

provided an ideal foundation for a cooperative venture. The theme for the workshop was river classification (on which there is much research in South Africa) and environmental health indicators (a hot topic in Australia). Contributors to the workshop were selected to represent the views of researchers and managers on different aspects of different geographical areas of the two regions.

The result is one of the most comprehensive reviews of the ideas and research on river classification and health indicators in the southern hemisphere.

The volume starts with a section on river classification, discussing the nature and purpose of classification and presenting the results of classification research in the fields of water chemistry, hydrology, biology, and geomorphology. The South African contributions are brought together in chapter 6 by Sean Eekhout, who discusses the problems and potential of linking the different classifications presently being developed. The first section is completed by contributions from the Australian contingent on classification tools using riparian vegetation, stream reach analysis, and biological assessment techniques.

The first 8 papers in Section 2 are dominated by papers on the assessment of river health, using a diverse array of physical and biological groups: flow regime; fish; invertebrates; stream habitat; conservation status; water quality; river bed and bank condition; finishing with a paper on estuarine health indicators.

The second half of Section 2 is devoted to papers on river management, particularly from an environmental point of view, and includes a description of a programme for the sustainable management of the rivers of the Murray-Darling - a catchment which is almost as big as the whole of South Africa.

Each of the groups of papers is punctuated by a report of the discussions which followed each session, airing views and criticisms of the previous papers. After the formal papers, the workshop divided into three groups, and each group tackled a pair of topics, aiming to produce a short document summarising the group's views. The results of these deliberations are presented in the third Section of the report, along with questions such as: "How do we decide on what is meant by a healthy river?" "What are the most appropriate biological indicators and rapid assessment methods?" "What criteria should be used to select sampling and reference sites?" "What is a sensible river classification system?" "What Decision Support Systems should be developed to link classification research to management needs?" "How should scale be incorporated into river classification systems?"

"This volume is a fascinating reflection of the latest ideas and research on classification and health indicators. The science of the papers is enhanced by the discussions and workshops, which provide up-to-the-minute critiques of their subjects. The linking of research to management needs is also a great strength of the report," says Professor Jay O'Keeffe (Director: Institute for Water Research).

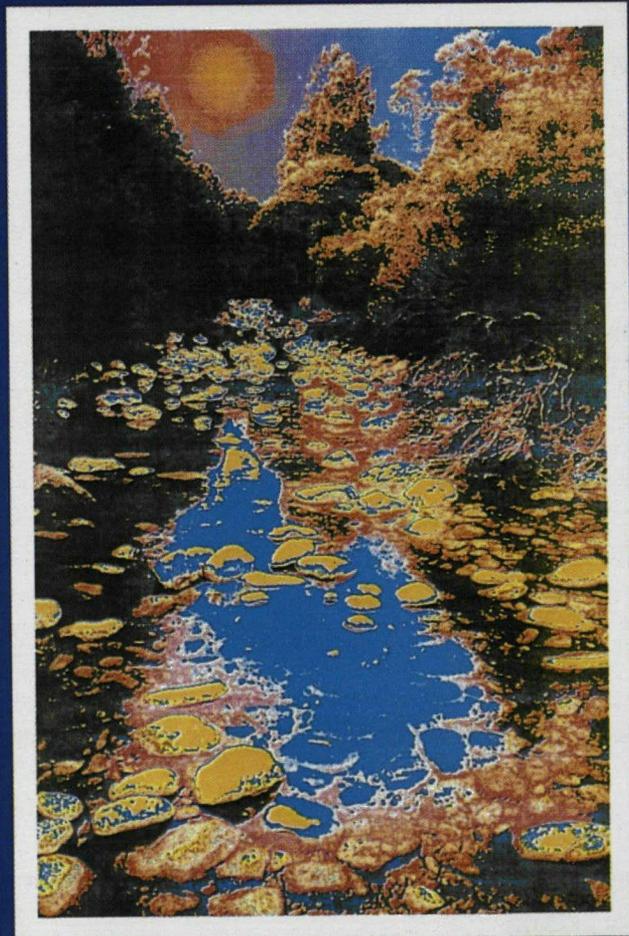
The report was edited by Mandy Uys, an M.Sc. student funded by a WRC Fellowship at the Institute for Water Research. She has done an excellent job, especially with the discussion and work-

shop sections, which she transcribed from tapes, and frequently had to translate into more comprehensible language. Professor O'Keeffe says the Water Research Commission, the Foundation for Research Development, the Australian Land and Water Resources Research and Devel-

opment Corporation, and the Australian Department of Industry Technology and Commerce are to be commended for encouraging, coordinating and funding the workshop and report, which will be an invaluable record for future research and management in these important fields.

Classification of rivers and environmental health indicators

A Joint South African / Australian Workshop



Researchers evaluate water prepayment system

The installation of prepayment electricity metering has progressed at an increasing rate over the past few years, while water supply technology has remained static, says a research team in their report **Prepayment water metering for South Africa** to the Water Research Commission. They point out that in recent years unpaid water accounts have escalated throughout the country as a result of the political, social and economic climate. It has become obvious to water supply authorities that a suitable method for the charge of water services, which is fair but cheap to administer, will have to be found.

The Water Research Commission requested the Technology Research and Investigations (TRI) division of ESKOM to undertake an evaluation and make recommendations with respect to a prepayment water metering system. The project report traces the initial exploratory work to establish the feasibility and specification of either a combined or stand-alone prepayment water and electricity system.

The report, **Prepayment water metering for South Africa** (WRC Report no KV 56/94) by CE Simes, RJ Lings and T Tshivase, is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Please note: Foreign orders will be charged a list price of US\$ 5.00 per copy.

The Technology Research and Investigations team completed a customer needs analysis and identified four different payment methods, namely the present system of mechanical water metering where the meter is read periodically and the water user is invoiced by the supply authority; the kiosk system where water is sold in measured quantities; payment for water as a percentage of electricity used, and prepayment water metering.

CE SIMES
RJ LINGS
T TSHIVASE

PREPAYMENT WATER METERING FOR SOUTH AFRICA

Report to the
WATER RESEARCH COMMISSION
by the TECHNOLOGY GROUP
TECHNOLOGY RESEARCH AND INVESTIGATIONS
ESKOM

WRC Report No KV 56/94

Factors influencing these payment methods and the incentives for pre-payment water metering are discussed in the report. The advantages of a pre-payment water metering system are listed and the various pitfalls which need to be considered, are also discussed.

The researchers propose that the use of pre-payment water metering for supplying rural and underdeveloped areas appears

to be the most viable option at this stage. The research has shown that pre-payment is generally more acceptable in South Africa than post-payment metering. One of the reasons being the difficulty of controlling consumption with a resultant mistrust of the accounts, especially when meters are not read monthly.

According to the report the South African context, with its mixture of first and third world environments, holds excellent possibilities for the development of technologies in the field of pre-payment metering.

The widespread supply of water to rural areas is a challenge which may not be possible without a pre-payment metering system which incorporates three components:

- an electricity metering system
- a water metering system, and
- a control unit.

The report serves as a basis document to identify and establish broad functional requirements, specifications and standards for a future pre-payment water system, which may be combined with existing pre-payment electricity metering technology.

The researchers say that with all the above in mind the following points were considered:

- water metering technology is well established and refined. Metering accuracies are now of the order of half a litre.
- the ability of the water meter to generate a pulse proportionate to flow

rate has been demonstrated. However, the technology is prone to tamper.

- ❑ in order to accommodate the existing installed base of electricity dispensers, it is a requirement that the system allow for retro-fit compatibility.
- ❑ the pre-payment electricity market has already developed suitable credit tokens (typically magnetic or numeric), token reading devices, vending devices, vending stations, encryption algorithms, accounting and control systems.

Consequently the research team identified the heart of the matter as the need to specify a suitable interface between an existing energy dispenser (ED) and a mechanical water meter, which is modified to convert flow rate into pulses.

According to the report the market is

best suited to take advantage of the potential commercial opportunities created through the incorporation of such an interface into existing pre-payment technology. The research team points out that suppliers will be required to provide the hardware and software components within the scope of the standards and specifications as set out under "Normative References" within this report.

The researchers addressed various key issues with regard to specification and design, such as:

- ❑ credit transfer methods, which include aspects such as a card reader or keypad design; tokens (re-useable/single use; plastic /paper card; standard/non-standard size)
- ❑ a controller, which includes aspects such as modular design; choice of measurement techniques; customer display interface; ease of maintenance;

security and diagnostics.

- ❑ point-of-sale vending equipment
- ❑ a master station (which forms the base of overall management of the water dispensing system, monitoring various aspects either via data from vending systems and/or data input from operators), in terms of the master station functions and hardware.

The report also details the technical requirements of a pre-payment system in terms of the different users, be it communal, domestic or supplier. An interface system as indicated by the researchers is defined in the report, as well as the proposed system specification.

In conclusion the researchers specify the functional requirements of the proposed system in detail.



A communal standpipe in a rural area with a mechanical water meter, which is read periodically.

Sludge used as metal biosorbent for industrial effluents

Research results show that activated waste sludges may serve as metal biosorbents from industrial wastewaters. According to the report **Microbiological transformation of metal contaminated effluents**, researchers F Bux, FM Swalaha and HC Kasan, found that all the activated sludges which they investigated were capable of biosorption of metals from single solutions and wastewaters containing mixtures of metal ions. Furthermore, the metals biosorbed onto sludges may be recovered by desorption with appropriate agents to yield

smaller, more manageable volumes of metal concentrates. The latter may then be safely disposed of or metals may be recovered from the concentrates by chemical methods.

The report, **Microbiological transformation of metal contaminated effluents** (WRC Report no 357/1/94), is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Foreign orders please note a list price charge of US\$ 30 per copy.

Legislation governing protection of the environment is becoming progressively stricter. In this era of environmental protection, the environmental biotechnologist is faced with the challenge to become increasingly innovative in the development of appropriate low-cost and efficient technologies for the treatment and reuse of waste products prior to discharge to the environment. The "heavy metals" in effluent have been the cause of particular concern. The toxic and carcinogenic potentials of these metals at low concentrations, as well as the large quantities disposed of to the environment have prioritised them as lead contaminants.

Current technologies for the removal of metals from industrial waste solutions include chemical precipitation, chemical oxidation or reduction, filtration, electrochemical treatment, application of membrane technology and evaporative recovery. However, these methods are often ineffective or extremely expensive. A need exists for the development of cheap, effective biosorbents to treat industrial wastes contaminated with metals. Activated sludges have been shown to

remove metal cations from water systems during the activated sludge process. This ability of sludges warranted further investigation into the potential for it to be developed into an attractive alternative to conventional systems for treatment of metal contaminated wastewaters. Hence, this project concentrated on investigating the ability of activated sludges from ten different plants to biosorb metal-ions from wastewaters, as well as to determine whether sludges could be recycled and metals recovered for possible reuse. Factors such as microbial constituents, mechanisms of biosorption and surface charge of activated sludge were also investigated for their contributions to the biosorptive capability of activated sludges.

AIMS

The main objective of the project was to optimise a bioreactor process which removes metals from effluents and concentrates them for complete biorecovery. To realise the above objective, the following three aims were investigated:

- to survey several domestic and industrial activated sludges to:
 - quantify their microbial populations,
 - analyse their metal content, and
 - develop appropriate sludge pretreatment methods to facilitate metal chelation from sludges prior to their use as biosorbents.
- adsorption and desorption studies in batch culture to ascertain:
 - their metal adsorption capacities, and
 - appropriate methods for metal desorption and recovery from sludges.
- bioreactor studies to optimise the parameters of the biorecovery processes developed.

RESULTS

Activated sludge is comprised of bacteria, fungi and yeasts, algae and protozoa. Ten activated sludge plants in Natal were surveyed for the microbial constituents listed above. Bacteria were enumerated, isolat-

ed and characterised. Filamentous bacteria, fungi and yeasts, algae and protozoa were identified. Gram positive eubacteria were predominant over their Gram negative counterparts and the activated sludge process favoured the survival of sporeformers compared with non-sporeformers. According to the report bacterium Type 0092 and *Microthrix parvicella* were the predominant filamentous bacteria in the ten sludges. Most of the fungi detected belonged to the common genera and yeasts were mostly common pathogens. Twenty six types of algae were found in the ten sludges and sixteen types of protozoa were also detected. The researchers report that the microbiological survey facilitated greater understanding of the microbiology of activated sludge in the Natal region. The survey also showed that there were no notable variations in microbial constituents of the sludges under investigation.

BIOSORPTION

The activated sludge biosorption was not enhanced by pretreatment with a metal chelator or inactivation by chemical or physical methods. The ten sludges were exposed to six metal ions, namely Zn^{2+} , Ni^{2+} , Cu^{2+} , Cd^{2+} , Cr^{3+} and Cr^{6+} , in individual solutions to determine their capacity for biosorption of these metals. The biosorptive capabilities of sludges were quantified to determine an affinity series of metal binding to sludges and to select the sludges which biosorbed the metal ions most efficiently for further study. Batch experiments were also conducted to determine adsorption of metal ions from industrial wastewaters with mixed metal ion content. All sludges exhibited metal biosorptive capability. An affinity series for metal-to-sludge biosorption was found to be, in descending order, $Cu > Cd > Zn > Ni > Cr^{3+} > Cr^{6+}$.

Mechanisms of the metal-to-sludge interactions were investigated to determine how the metal ions were being absorbed onto sludge surfaces. The Langmuir model for monolayer adsorption was fitted to the metal-to-sludge interaction data and adsorption isotherms were plotted. The shapes of these isotherms were indicative of the type of

binding of metal ions to sludge surfaces. The sludges were ranked according to their potential biosorptive capabilities. The researchers report that 97 per cent of the data fitted the Langmuir model, indicating that this model can be used to predict binding mechanisms of metal ions to sludge surfaces.

DESORPTION

After equilibration with metal ion, sludges were exposed to desorbing agents in batch processes to determine whether metals biosorbed to sludge surfaces were recoverable. Two acids, namely acetic and hydrochloric acid, were used to desorb metal ions from sludge surfaces. The researchers found both agents to be efficient at removing the metals



MICROBIOLOGICAL TRANSFORMATION OF METAL CONTAMINATED EFFLUENTS



Report to the
WATER RESEARCH COMMISSION
by the
WATER RESEARCH PROGRAMME
UNIVERSITY OF DURBAN-WESTVILLE

WRC Report No 357/1/94



adsorbed onto sludge surfaces. Desorption was also found to be agent-dependent rather than sludge dependent. Desorbents were found to be selective with regard to the efficiency at which they removed metal ions from sludge surfaces.

SLUDGE SURFACE CHARGE

The researchers investigated sludge surface charge to determine whether biosorptive capability is associated with the sludge surface charge. Three methods were employed to ascertain surface charge namely streaming current, millivolt quantification and colloid titration. All sludges were found to demonstrate a net negative charge. There were differences in the magnitudes of these charges. The millivolt quantification method was recommended because of the convenience and speed of analysis.

LAB REACTORS

According to the report adsorption and desorption of metal ions from synthetic and industrial wastewaters were further optimised in batch laboratory scale reactors. Activated sludge was found to adsorb metal ions optimally at the highest concentration of sludge tested namely 25 000 mg/l. The optimal time of adsorption was found to be 90 minutes at 600 rpm in a 30 l volume. Desorption by hydrochloric acid was found to be more efficient than desorption by acetic acid. The optimal time for desorption was 15 minutes at 300 rpm in a 10 l volume. Multiple cycles of adsorption and desorption, however, revealed that sludge adsorptive capabilities decreased markedly after desorption. This led to the assumption that sludge adsorptive surfaces were disrupted by desorbing agents. Adsorption of metals from industrial wastewaters indicate that adsorption efficiency of metals is associated with pH. Zinc was shown to be adsorbed most efficiently at alkaline pH while Cu, Ni and Cr^{3+} were found to be most efficiently absorbed at an acidic pH.

Sludges can be used as biosorbents of metal ions and these metals may be desorbed and recovered from their surfaces. Microbial analysis of sludges did not indicate a relationship between predominant populations and sludge adsorptive capabilities, hence, no comparisons could be made between the two. Sludge surface charge showed a greater correlation with biosorptive capability, possibly indicating that sludge biosorption is more of a physicochemical rather than a microbiological phenomenon.

Environmental impact of high density on-site sanitation considered

The use of on-site sanitation in high density applications in a region of scarce water resources, as is being considered for the large metropolitan areas in South Africa, is a significant departure from existing approaches, says AB Fourie and MB van Ryneveld (University of the Witwatersrand) in their project report to the Water Research Commission.

In this report on the environmental impact of on-site sanitation, the researchers also point out that simplistic guidelines consisting of a few, easy to follow rules are unable to take account of the multitude of

variables that influence the potential environmental effect of on-site sanitation. However, the researchers emphasise that the opportunity now exists for the actual planning of high density use of on-site sanitation, particularly in the fast-growing urban areas.

The report entitled "Environmental impact of on-site sanitation: A literature review with particular application to South Africa (WRC Report KV 57/94) is available, free of charge, from the Water Research Commission, Box 824, Pretoria 0001. Please note: Foreign orders will be charged a list price of \$20 per copy.

Provision of basic services to the rapidly growing population of South Africa is and will continue to be high on the country's agenda in the coming years. Water and sanitation provision are crucial amongst these services.

At the recent Water and Sanitation 2000 workshop it was shown that the cost of providing waterborne sewerage for all would be unaffordable for the country, and that provision of Ventilated Improved Pit (VIP) latrines for about half of the urban population (as at the year 2000) is the kind of strategy that the country needs to be looking at. The environmental impact of such a strategy is obviously of considerable concern.

Against the background of this concern, there appears to be limited understanding by the general public, as well as by many professional people in South Africa of the pollution risk from on-site sanitation; more specifically a limited understanding of the nature, extent and consequences of contamination from on-site sanitation. Allied to this is the erroneous assumption that there is no pollution risk associated with waterborne sewerage.

The lack of understanding of the pollution risk from on-site sanitation may be attributed to:

- the relative newness of the problem in South Africa (there are relatively few

on-site sanitation systems currently in use, particularly in urban areas),

- the limited amount of research done to date on this particular subject in South Africa, and
- limited access to results of research world wide on this subject.

Additional factors are the complexity of the problem as well as the lack of clear and unambiguous information on the problem. The environmental impact of on-site sanitation is a multi-disciplinary topic, covering a wide number of fields including water quality, health, microbiology, geohydrology and risk assess-



The longterm effects of on-site sanitation are too significant to ignore, but quite difficult to determine.

ment. The researchers say there appears to have been little work done which integrates these different fields.

AIMS

With this project the researchers attempted to:

- Establish the current state of knowledge on this subject at both local and international level;
- Appraise existing guidelines in this regard;
- Clarify the objectives that guidelines for environmental impact of on-site sanitation should; address, with particular reference to South Africa;
- Provide a means of disseminating this knowledge;
- Identify further research work that may be required.

The researchers defined a framework of key issues to be addressed in this study. These are:

- What is on-site sanitation and what is it intended to do?
- What do sanitary wastes consist of?
- What are the health risks associated with sanitary wastes?
- What are the risks to the environment associated with sanitary wastes?
- Contamination from other sources.
- Safe contaminant levels.

The fate of contaminants in the sub-surface.

Guidelines for environmental impact of on-site sanitation. These key issues and questions relevant to each issue are fully discussed in the report.

Their research included:

- conducting an updated review of local and international literature on the environmental impact of a on-site sanitation,
- detailing case studies which are relevant to South Africa, and
- reviewing existing computer programs for the modelling of contaminant migration such as that which occurs from on-site sanitation, as a means of quantifying the pollution risk.

The research report is aimed primarily at professionals with a technical background in the disciplines involved, although it is likely to be of interest to other sections of the community. (It is not aimed primarily at community groups. The key issues in the report will need to be communicated to such groups by a specific separate report.)

Nevertheless all who have an interest in the wise use of South Africa's water resources will benefit from the results of this research in that it will enable more informed choices to be made with respect to the provision of water supply and sanitation.

SCENARIO'S

The researchers say that, according to available literature, existing approaches to on-site sanitation appear to follow one of two routes. Both of which limit the use of on-site sanitation to certain settlement densities:

- In developing countries, where water-borne sewerage is largely unaffordable, substantial improvements in health are obtained by the use of on-site sanitation. Possible pollution of the groundwater somehow appears less significant in the face of the alternatives (high standards for a few, and minima coverage for the rest of the population). Consequently, contamination of the groundwater is not considered unless the groundwater is to be used for drinking purposes.
- In developed countries, where water-borne sewerage is largely affordable, on-site sanitation is used primarily for reasons of convenience, but also on the assumption that there is no associated pollution risk. Where on-site sanitation has been used on a large scale (as in the case of septic tanks in the USA), it has been at relatively low densities.

The situation in South Africa straddles the two scenario's. South Africa does not have the financial resources of a highly developed country; and at the same time it is a water scarce country concerned not to pollute the water it does have.

Use of on-site sanitation on a large scale in an area of scarce water resources is a significant departure from existing approaches. Although the literature does give certain indications on some aspects of relevance to the South African situation, there remain many areas where relevant information is scarce, and where further research is thus required.

A B FOURIE
M B VAN REYNEVELD

ENVIRONMENTAL IMPACT OF ON-SITE SANITATION
A LITERATURE REVIEW WITH PARTICULAR
APPLICATION TO SOUTH AFRICA

Report to the
WATER RESEARCH COMMISSION
by the
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF THE WITWATERSRAND

WRC Report No KV 57/94

NITRATE POLLUTION

Literature indicates emphatically that there is a risk of groundwater contamination from on-site sanitation. The risk of contamination from bacteria and viruses, as long as they are not washed out onto the surface, is very low. However, pollution by way of nitrate contamination is very likely. (Consideration of mass balances alone indicates that this is the case.) The primary concern therefore is nitrate pollution.

It is not clear to what extent nitrate can be denitrified in the soil to produce nitrogen gas which will escape into the

atmosphere (and hence not pollute the groundwater). It is also not clear to what extent this process can be artificially induced.

The rate of movement of nitrate in the subsurface is heavily dependant on a number of local geological factors, which need to be determined for each particular site. An advance on current approaches suggested in this review is the calculation of a residence time in the unsaturated zone, instead of a blanket categorisation of allowable distances between the source of the contamination zone and groundwater withdrawal points.

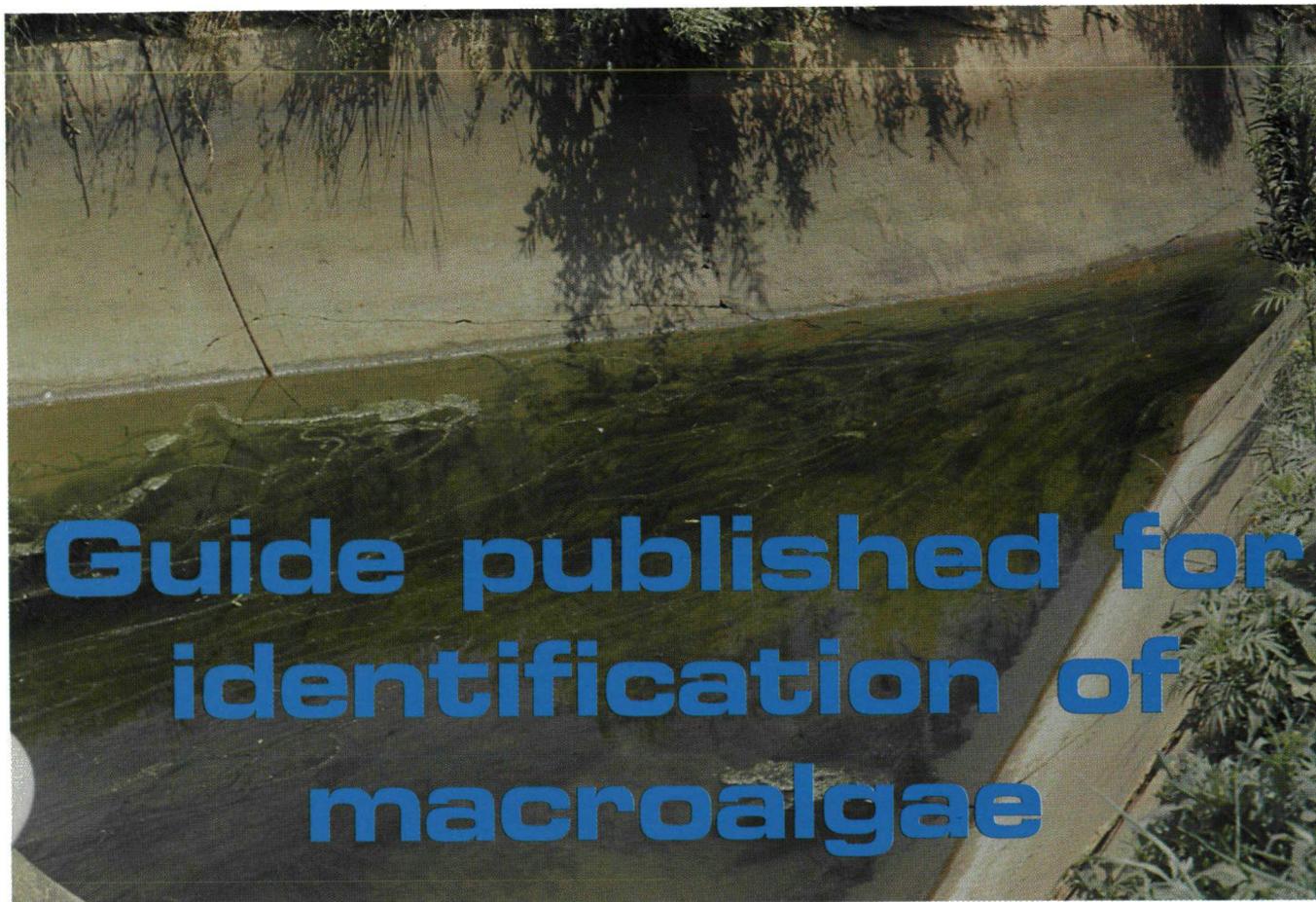
Once the nutrients get into an impoundment, their effect on the ability of the water body to support life is also dependent on a number of factors (including whether the impoundment is nitrogen or phosphorus-limited).

In summary the researchers say that the long term effects are too significant to ignore, but quite difficult to determine.

EVALUATION STRATEGY

The approach and evaluation strategy with regard to on-site sanitation, as recommended in the report, is a multi-facetted one:

- Determine appropriate compliance requirements; (if groundwater is to be used for drinking purposes, then there will be a particular compliance requirement, whereas if surface water resources are the primary concern, and protection of the groundwater is not a consideration, some other compliance requirement will prevail).
- Use the 'residence time' approach rather than the 'allowable distance' approach to determine possible microbiological pollution risk.
- Use the mass balance approach to determine the nitrate pollution risk.
- Institute field monitoring in order to provide early warning of contaminant build up.



Guide published for identification of macroalgae

Problem growth of *Cladophora* sp. in an irrigation canal.

Water supply schemes in South Africa have become increasingly prone to problems, including the world-wide phenomenon of excessive growth of algal and aquatic macrophytes. Excessive algal growths, mainly of the plancktonic microalga *Microcystis aeruginosa* and the filamentous macroalga *Cladophora glomerata*, have increasingly been reported in South Africa, and the success in dealing with these algal growths are usually temporary and limited due to the cost of control measures, say researchers Margaret Anne Joska and Prof John Bolton (Phycology Laboratory, University of Cape Town) in their report to the Water Research Commission.

In their report entitled Preliminary investigation into algal weeds in inland waters the researchers conclude that problem algal growths are not necessarily associated with the most obviously polluted systems, as different algae have different requirements for rapid growth. However, worldwide certain common algal weeds are indicators of potential problems in systems, with elevated levels of nutrients.

The researchers have also compiled a Guide to common filamentous freshwater macroalgae in South Africa as a separate appendix to the report. The guide consists of an identification key with some line drawings to help with the identification of genera, and as well as descriptions and discussion of the various genera along with colour plates illustrations. The researchers aimed at making the identification key "user friendly" for those who do not have botanical training and described only 22 genera of the commonly occurring freshwater filamentous genera which they felt sufficient for general identification purposes.

The report entitled **Preliminary investigation into algal weeds in inland waters** (WRC Report no 426/1/94) and the separate Guide to common filamentous freshwater macroalgae in South Africa (TT 66/94) are available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Foreign orders please note: a list price of US\$ 20 for the report and US\$20 for the guide, will be charged.

The researchers were approached in 1991 by a civil engineering firm who wished to have some freshwater algae identified. These algae were apparently causing problems with water flow in the irrigation system off the Breede River in the Robertson district. In the preparation of the report to the firm the researchers became aware of the extensive problems that some species of freshwater algae are causing in South African water impoundments and irrigation schemes.

Massive algal growth in irrigation schemes cause restriction of water flow, and fragments of algae block the irrigation jets. Scenescent algal growths decay and are aesthetically displeasing, especially where impoundments are used for recreational purposes. A major causative factor for these growths is the eutrophication of rivers and water impoundments.

Eutrophication is here considered to be an increase in the nutrient status of the water, usually caused by man. Most eutrophic conditions in South Africa are due to increased amounts of phosphorus and nitrogen derived from untreated or partially treated sewage, industrial effluent or agricultural runoff.

Water management problems in South Africa, such as increasing pollution both organic and inorganic, are on the increase. Algal weed species produce large growths under these conditions, not only because the increase in plant nutrients (phosphorus and nitrogen) support their growth, but also because some forms are often resistant to certain forms of inorganic pollution.

Prior to this study very little research has been done regarding the ecological conditions which favour the growth of algal weeds in South Africa. According to the report algal 'weeds' are those algae, usually specific species, whose growth has become excessive due to the fact that the normal habitat has been altered favouring their over-abundant growth. Impoundments, irrigation canals and polluted rivers are common sites for these algal 'weeds'.

In many overseas countries the algal weed species which cause problems are being identified and their life cycles and conditions for excessive growth investigated. Control methods (manual, chemical and biological) are being assessed under the varying conditions prevailing in different

countries, says researchers Joska and Bolton.

AIMS

The aims of this project were:

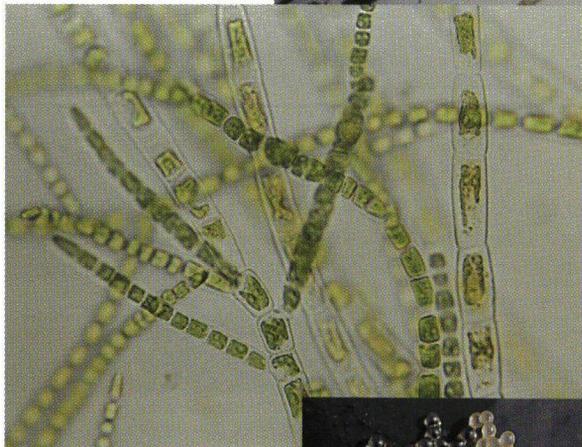
- to summarise existing literature on algal weeds (freshwater macroalgae) in the inland waters of South Africa, highlighting potentially detrimental species;
- to liaise with interested parties and organisations and carry out fieldwork to investigate the extent to which macroalgae are problem organisms in freshwater systems.
- to carry out a preliminary study of the

problem macroalgae and their habitats, and collate existing information with the project research to produce an identification guide to these plants, with preliminary descriptions of the aquatic conditions that favour their growth, as well as current knowledge on control measures.

- to generate expertise on the identification and management of economically significant freshwater algae.

A literature review showed that to date very little ecological work has been done with regard to freshwater macroalgae in South Africa. South African microalgae, particularly phytoplankton of dams

Cladophora sp. showing the branching pattern



Stigeoclonium sp.



Hydrodictyon sp. showing a net-like filament, left, and "frog's eggs", right.

and rivers are the subject of other studies, however this project was confined to filamentous macroalgae. According to the report overseas research has shown that the problem filamentous algae (algal weeds) can, in fact, indicate a decline in water quality. In natural conditions diverse freshwater algae are generally present and do not form obvious detrimental growths.

The researchers found that only a few specific algae are "problem" species, worldwide. These species also occur in South Africa. According to their report the major problem macroalgal weed in South Africa is *Cladophora glomerata*, which form the bulk of large growths in the Crocodile and Kalkfontein irrigation systems. However, in the Cape Province algal weed problems are caused by other species such as *Oedogonium capillare* in the Breede River canal system, and *Nitella* species in silted sections of the Olifants River canal.

Where these excessive algal growths have occurred in South Africa two methods of control have been used: manual removal and, on an increasing scale, the use of copper sulphate. Both methods have advantages and disadvantages as mentioned in the report, and the ecological impact of copper sulphate is not fully understood. However, algae will always return as algae produce spores which have a resistant outer layer that enable the spores to survive unfavorable periods or unsuitable growth conditions.

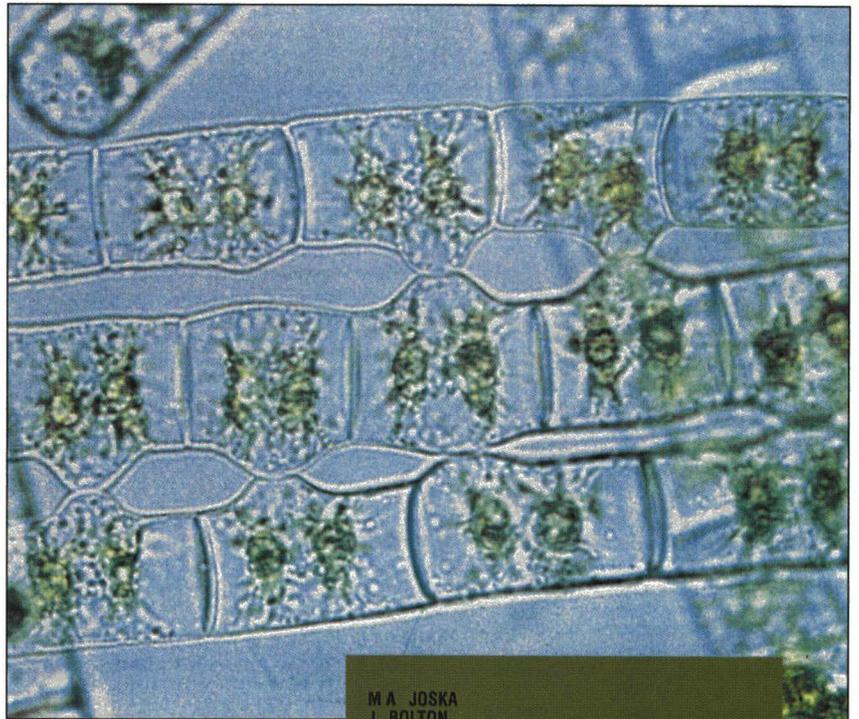
The life cycles of the algae and their various reproduction and growth forms are described in the field guide of the commonly occurring macroalgae in South Africa, which Joska and Bolton have compiled from their research as an appendix to the report.

The researchers say that an ongoing programme of sampling in South Africa should eventually lead to a more detailed knowledge of which species occur where, and importantly, the conditions of the water at the time of sampling. As knowledge of the specific conditions for 'weedy' algal growth is gained it should become possible to predict excessive algal growths before they occur.

The researchers say that their contact with the Department of Water Affairs, Irrigation and Water Boards in the course of this project have broadened their knowledge with regard to the algal problems and the treatment thereof, and have also made them aware of the need for research particularly with regard to the management of algal growths.

GUIDE TO COMMON FILAMENTOUS FRESHWATER MACROALGAE IN SOUTH AFRICA.

Margaret Anne Joska
and
John J Bolton



M A JOSKA
J BOLTON

PRELIMINARY INVESTIGATION INTO ALGAL WEEDS IN
INLAND WATERS

Report to the
WATER RESEARCH COMMISSION
by the
BOTANY DEPARTMENT
UNIVERSITY OF CAPE TOWN

WRC Report No 426/1/94

RESEARCHERS INVESTIGATE THE DEVELOPMENT OF TOLERANT MEMBRANES

Membrane processes can make a most valuable contribution to restore or improve the quality of water resources and aqueous effluent streams, because they offer a viable technology for the re-use of water.

This is the view of two researchers, RD Sanderson and MJ Hurndall, from the Institute for Polymer Science at the University of Stellenbosch in a report to the Water Research Commission on the development of tolerant membranes.

The researchers say since the inception of the polymeric semi-permeable membrane the demand for reverse osmosis, ultrafiltration and later nanofiltration membranes developed rapidly.

REVERSE OSMOSIS

Reverse osmosis is a process for the separation of substances in a solution. It

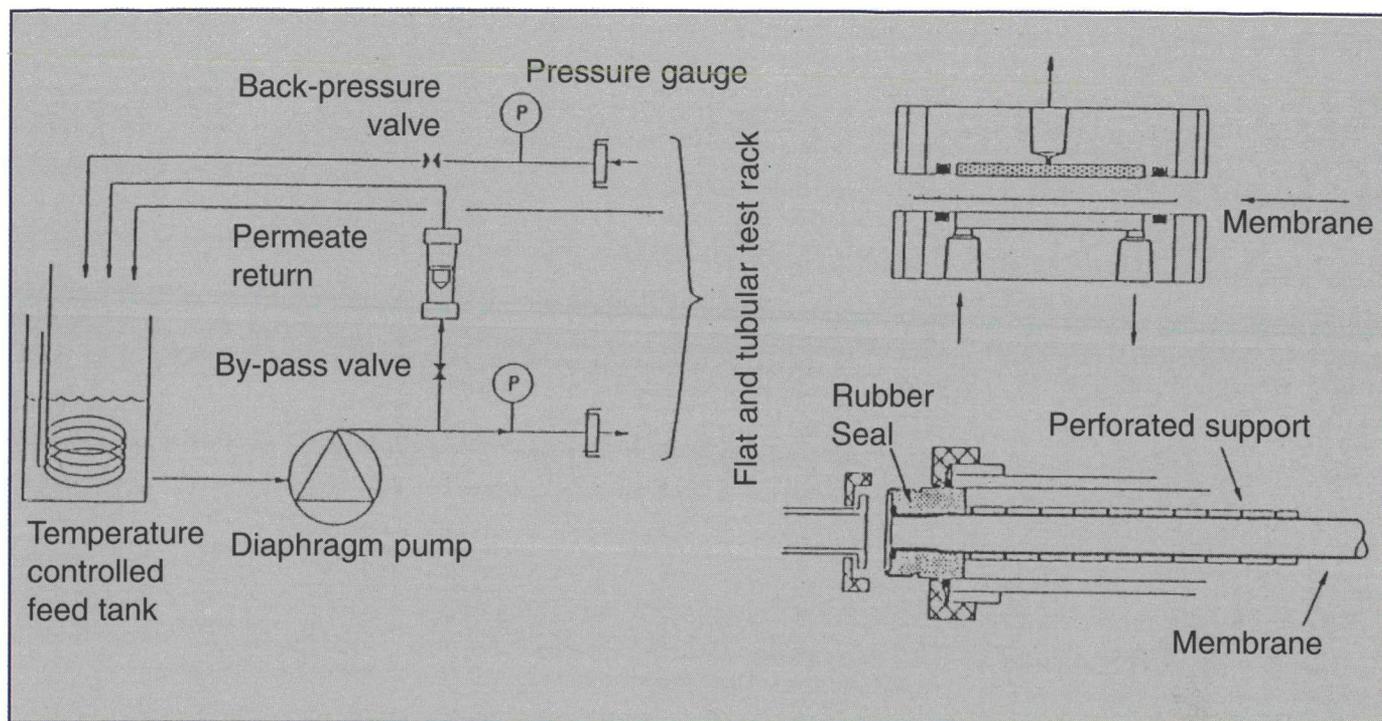
is the process whereby water is forced, by pressure, through a semipermeable membrane, counter to the normal direction of osmotic flow.

The heart of the reverse osmosis process is the semipermeable membrane which must allow passage of the water but not of the dissolved solids. Both the chemical nature and porous substructure of the membrane surface together govern the mechanism of reverse osmosis separation.

The researchers say historically, cellulose acetate has been the most important polymer used in the development of membranes suitable for reverse osmosis applications. More recently, ultra thin film composite membranes, comprising a thin semipermeable film deposited onto a finely porous ultrafiltration supporting membrane, have been produced by interfacial polymerisation, or in situ polymerisation.

NANOFILTRATION

Nanofiltration is a term that has recently been introduced to describe a membrane process that is distinguished by the differential retention of ions. It is a pressure-driven process that lies between conventional reverse osmosis and ultrafiltration since the pore size of nanofiltration membranes (1 - 15 nm) lies between that of reverse osmosis (arguably no pores) and ultrafiltration (5 - 20 nm). The researchers say the salt-retention mechanism of nanofiltration membranes may be due to one or more forces, namely, charge (coulombic) interaction, hydrated-ion size-exclusion or dielectric interaction. A typical nanofiltration membrane such as the Film Tec XP45, has a sodium chloride retention of 50 per cent and a magnesium sulphate retention of 97,5 per cent. When these results are compared with those of a typical reverse osmosis membrane (Film Tec FT30) which has retentions of



A schematic diagram of membrane evaluation equipment.

98 per cent and 99 per cent for sodium chloride and magnesium sulphate respectively, and a typical ultrafiltration membrane that does not reject these salts at all, the distinction between the three membrane types, namely reverse osmosis, nanofiltration and ultrafiltration, is clear.

Nanofiltration membranes are mainly employed in water softening operations, as these low-pressure membranes show a higher selectivity towards divalent, rather than monovalent ions, in feed solutions of mixed ion contents. These membranes may also be used in the removal of low molecular mass organic species from waste streams.

GROWING ACCEPTANCE

The steady rise over the years in the world-wide installed capacity of pressure-driven membrane operations reflects the increased acceptance by industry of these operations for treatment of aqueous streams: both for water and product recovery, for the treatment of effluents and for the production of potable water.

The researchers say the same trend had been observed in South Africa where there has been a slow, but steady expan-

sion in the use of pressure-driven membrane operations in water purification applications: both in the spheres of water supply and effluent treatment. Illustrative of this, amongst other examples, is the production of potable water from brackish borehole-supplies at Bitterfontein in the north western Cape and the use of membranes for salt removal to improve the water balance at the Lethabo power station. These are based on cellulose acetate membrane technology.

It must be expected, however, that the present, well established cellulose acetate membrane technology must have a finite life, and the researchers say, new and improved membranes are required. The new membranes will not only add new technological advantages, but will be able to replace existing membranes in existing plants. Almost all commercial membranes to date, especially the high-retention amine-type membranes, show a limited tolerance towards the presence of chlorine. In the search for new and improved membranes for reverse osmosis and related applications, the researchers say attention must therefore be given to the incorporation of tolerance into the membranes by chemical modifications of membrane materials.

INVESTIGATION

The researchers main objective with this investigation, funded by the Water Research Commission, was to generate a family of low-pressure thin-film membranes, useful for water desalination. Two classes of membranes were to be considered, namely:

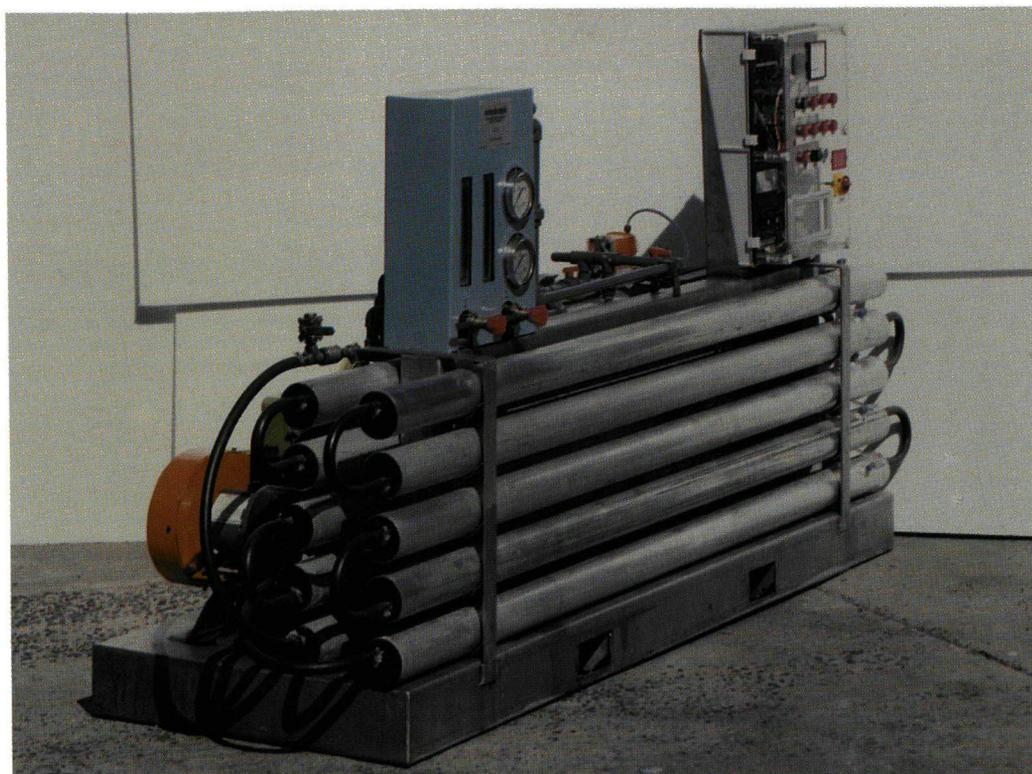
- ❑ a medium to high sodium chloride retention reverse osmosis membrane, exhibiting 85 to 95 per cent retention at operating pressures of 1 500 to 2 000 Kpa, and
- ❑ a low to medium sodium chloride retention nanofiltration membrane, exhibiting 40 to 60 per cent retention at operating pressures of 500 to 1 000 Kpa.

RESULTS

All the results and technical details of the investigation are fully summarised in the final report presented to the Water Research Commission. The researchers' main conclusions were the following:

- ❑ Polyvinylalcohol membranes:

The first phase of the research programme focused on various ways to



A reverse osmosis plant

insolubilise the polyvinylalcohol membrane coating, thereby creating a permanent gel-layer membrane. Both flat-sheet and tubular polyvinylalcohol membranes could be made by using either of three different insolubilisation crosslinking techniques, namely

- (i) heat treatment in the presence of sulphuric acid as catalyst;
- (ii) the formation of blends of polyvinylalcohol and maleic acid-alt-maleic acid anhydride; or
- (iii) insolubilisation by crosslinking with potassium peroxydisulphate.

□ After extensive investigations into the effects of fabrication variables on membrane performances, the researchers recorded the following typical results:

- (i) Polyvinylalcohol in the presence of sulphuric acid catalyst showed a (2 000 ppm) sodium chloride retention of 70 to 85 per cent at an operating pressure of 2 MPa and a permeate flux of 700 to 800 litres per square metre per day. The membrane's (500 ppm) magne-

sium sulphate retention was more than 90 per cent at the same operating pressure but with a slightly lower flux of 600 litres per square metre per day. These results, the researchers say, indicated that this membrane system could function as a medium retention and medium flux reverse osmosis membrane at relatively low operating pressures, even in the absence of an additional interfacially formed salt-retention barrier.

- (ii) The performance of the polyvinylalcohol and polymethyl vinyl ether-alt-maleic acid anhydride varied with the pH of the feed solution, due to the fixed charge character of these membranes.

Membranes prepared from a solution with a specific ratio of components and heat cured in the presence of sulphuric acid catalyst exhibited sufficiently high permeate flux for use as a gel sub-layer for reverse osmosis membranes. At a pH of 11, these membranes showed more than 60 per cent (2 000 ppm) sodium chloride retention at an operating pressure of 2 MPa and a permeate flux of 600 to 900 litres per square metre per day.

- (iii) Polyvinylalcohol-potassium persulphate gel layer membranes were created suitable for nanofiltration applications. Many variables had an effect on the performance of these membranes, most notable of which was the maturation time of polyvinylalcohol-potassium persulphate coating solutions.

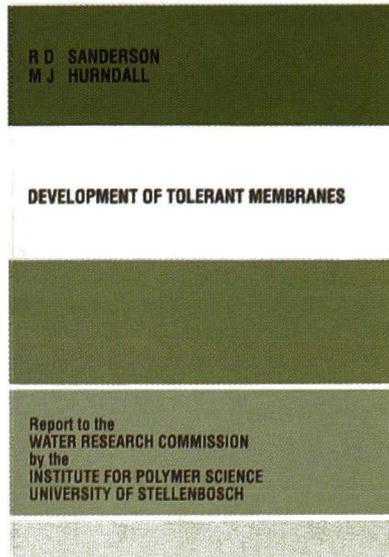
Membranes made by the insolubilisation of polyvinylalcohol with potassium persulphate (and after an 18 days maturation period) gave the following typical performances: a 50 per cent retention of (2 000 ppm) sodium chloride at an operating pressure of 2 MPa and permeate flux of 480 litres per square metre per day. At the same pressure and permeate flux the (1 000 ppm) magnesium sulphate retention was 75 per cent.

- The polyvinylalcohol-potassium persulphate membranes were evaluated on an industrial effluent of an oversaturated feed solution of calcium sulphate (10 000 ppm calcium sulphate), to study their long-term performance and ability to resist fouling. These membranes exhibited a retention of about 62 per cent and flux of about 1 440 litres per

square metre per day and remained stable over a period of 600 hours.

- Laboratory tests on cooling-water blow-down from the SASOL II plant were also carried out with the polyvinylalcohol-potassium persulphate membranes, comparing them to cellulose acetate membranes. Retentions of the polyvinylalcohol-based membranes ranged from 50 to 80 per cent and fluxes of up to 240 litres per square metre per day were recorded after 40 hours testing. Cellulose acetate membranes exhibited a significantly higher retention.
- The cross-linked polyvinylalcohol-gel membranes were used as a base upon which polyamide membranes were deposited to attain higher retention performance from polyvinyl-based membranes.
 - (i) The deposition of an ultra-thin poly-piperazine isophthalamide skin on the surface of an insolubilised polyvinylalcohol sub-layer resulted in increased salt retention, but not without adverse effects on the permeate flux. Typical results of these membranes are 80 per cent retention and fluxes of less than 240 litres per square metre per day (2000 ppm sodium chloride; 2 MPa; 20°C) and at the same flux 75 per cent retention with 1 000 ppm magnesium sulphate (2 MPa; 20°C).
 - (ii) Composite ultra thin film membranes could also be made without the insolubilisation of the polyvinylalcohol prior to the deposition of the polyamide skin. This could be achieved by the interfacial reaction of a mixture of polyvinylalcohol and an amine (in aqueous solution) with a suitable multifunctional acid chloride (in an organic solvent). Good results were obtained by the reaction of an aqueous solution containing polyvinyl-alcohol (0,25%), piperazine (0,25%) and sodium hydroxide (0,5%) with a solution of isophthaloyl chloride in hexane (1%), namely, more than 80 per cent retention with a flux of 960 litres per square metre per day (2 000 ppm sodium chloride at 3 MPa and 20°C).
- The researchers say that poly-2-vinylimidazole (or PVI) can be used as precursor material in interfacial reactions to

make efficient reverse osmosis membranes. These could be made in flat-sheet and tubular forms. The use of PVI, with its nitrogen atoms being pendent to the hydrocarbon chain, resulted in some increase in chlorine-tolerance of the membranes. This chlorine-tolerance was greater than that of membranes made with the aliphatic polymeric precursor PEI (NS-100/1 membranes), but not as great as that of membranes made from the aromatic precursor phenylenediamine (FT-30 membranes).



Exposure of PVI ultra thin film membranes to chlorine is not advisable, the researchers say. However, it is proposed that exposure of poly-2-vinylimidazole (PVI) (isolated by freeze-drying) (FD) and crosslinked with 3-chlorosulphonylbenzoyl chloride (SCI) membranes to 5 ppm chlorine at pH 6 to 7 for a short period of time would be tolerated. Prolonged exposure to chlorine results in irreversible decline in retention.

Maximum performance of PVI-FD/SCI tubular membranes have been recorded in the pH 6,5 to 7 range. These membranes can be safely used over a pH range of 4,5 to 8,5.

- By the incorporation of various hydrophilic additives such as piperazine, PVAL or HA-1, into a PVI-precursor solution, ultra thin film membranes were obtained which were considered adequate for low-pressure applications (less than 2 000 kPa).
- The researchers say that the Institute

for Polymer Science was approached by the company Membratex to supply polyvinylalcohol membranes, then under development, for field trials by DEBEX Desalination. The objective was to desalinate brackish water to potable standard in compliance with SABS specifications. The feedwater contained calcium sulphate and sodium chloride at a total dissolved solids content of approximately 3 000 mg/l. The water was at a temperature of 38°C and contained no free chlorine. The membranes were required to have a high salt retention (more than 90 per cent sodium chloride) at relatively low pressures (2 - 3 MPa).

Results show that polyvinylalcohol membranes were up to specifications, when tested as single tubes (about 95 per cent retention and 600 litres per square metre per day at 3 MPa). Reverse osmosis performances of the modules, was markedly lower: it decreased to about 40 per cent retention with a corresponding increase in flux.

This was found to be due to the failure of a few of the membrane tubes in the module. The cause of this failure may be the module assembly technique. The researchers say in their final report that at this stage of the research they have a good knowledge and understanding of the chemistry and membrane fabrication variables to make polyvinylalcohol, amine-modified-polyvinylalcohol, poly-2-vinylimidazole (PVI) and modified PVI membranes, most of which are repeatable and fulfil the contract requirements of medium to high retention reverse osmosis membranes and low to medium retention nanofiltration membranes. For the sake of simplicity, a table has been drawn up in the WRC report to summarise for the reader the various types of membranes which have been investigated, the progress made, research still to be undertaken and recommendations.

The report entitled Development of Tolerant Membranes (WRC Report 361/1/94) is available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: (US)\$25.

South African Hydrology and International Participation

World Meteorological Organisation

South Africa's rights and privileges were restored with WMO in June 1994. Mr Gerhard Schulze was nominated as South Africa's Permanent Representative to WMO and Stéfan van Biljon, Director of Hydrology, as Hydrological Advisor.

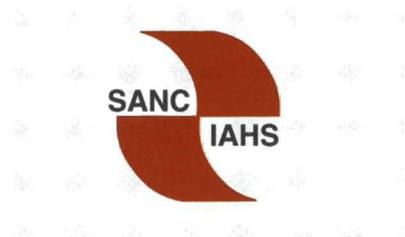
WMO, with its head office in Geneva, has a Hydrology and Water Resources Department. Presently Mr Dieter Kraemer is the director of the Department.

The objective of the Hydrology and Water Resources Department is to provide a world wide service to operational hydrology. This is achieved through organising international symposia and workshops, publication of scientific material, promoting guidelines to be followed in hydrological practice and establishment of minimum criteria, for instance in design of gauging structures, to ensure the capture of high quality data.

WMO is actively engaged in technology transfer. This is known as HOMS, the acronym for Hydrological Operational Multipurpose System. HOMS contains descriptions of hydrological instruments, technical manuals or computer programs, material which has been made available for inclusion in HOMS by the hydrological services of member countries of WMO from techniques which are used in their normal operations. HOMS promotes the philosophy that technology must not be only ready for use but should be tried and tested to ensure reliability.

Conference on Water Resources: Policy and Assessment

This conference was convened by WMO and the United Nations Economic Commission for Africa in Addis Ababa, Ethiopia from 20 to 25 March 1995. This conference was a follow-up to the World Bank/UNDP Sub-Saharan Africa Hydrological Assessment Project and was attended by Stéfan van Biljon who also delivered a keynote address on basic monitoring systems and the economic worth of data and water. Eberhard Braune, Director of Geohydrology (Dept of Water Affairs) was co-author of the paper.



Major findings of the Sub-Saharan Hydrological Assessment were:

- a decline in the size and quality of hydrological services
- a lack of skilled manpower
- inadequate maintenance of equipment
- security problems and
- weaknesses in groundwater studies.

Economic difficulties and a lack of aware-

ness of the economic value of hydrological data were the main factors contributing to the decline of hydrological services.

In Africa population stress on water and the scarcity of water have jeopardised food security, control of water pollution and protection of the environment. The capabilities of many African countries to perform water resources assessment have been found to be inadequate. Uncertainty and a lack of knowledge about available water resources frequently impede effective development policy.

The objectives of the conference were:

- identification and consideration of essential factors pertaining to the economic and social development by African institutions responsible for water resources assessment
- generating awareness among policy makers in Africa of the economic value of information generated by water resources assessment to national and regional development
- adoption of a strategy and an action plan for sustainable development of water resources monitoring and assessment capabilities.

The main pillars of a proposed strategy for the future are the following:

- There should be unequivocal evidence of a national initiative for a demand driven activity.
- Water Resources Assessment should be planned and implemented within the capacity of the national economy.

- ❑ The political will to cooperate on the river, lake and groundwater basin at the sub-regional, regional and international levels should be enhanced and backed by concrete action.
- ❑ Direct linkages should be established with other water resources management strategies, such as the strategy currently being prepared by the World Bank for Sub-Saharan Africa.
- ❑ There should be a willingness of the agencies in charge of water resources information systems to improve their efficiency, productivity and to take initiatives and participate in the water resources development process.
- ❑ Donors and UN agencies involved in the water sector should coordinate their activities in the region and align their support as much as possible along the lines of the strategy.
- ❑ A world wide campaign should be launched to promote the proposed strategy, improving the awareness of the problems and highlighting water resources assessment programmes adopted by African countries.

A detailed action plan was then formulated. The main topics of the action plan are:

- ❑ management capacity building,
- ❑ promotion of awareness (primarily of clients regarding responsible agencies and the services they can provide),

- ❑ sustainable financial base comprising optimization of activities in relation to funds available from government and complementary funds in terms of cost recovery for services rendered, (A warning is sounded at poor quality data which has negative economic value.)
- ❑ integrated approach to water resources assessment based on evolution of the market for water resources data, information and services and national objectives for water supply, pollution control and protection of the environment,
- ❑ regional and sub-regional initiatives, responses and collaboration,
- ❑ the role of external support agencies (should be directed towards sustainability of services rather than short term project oriented aid).

World Hydrological Cycle Observing System (WHYCOS)

WMO and the World Bank found that considerable difficulties exist in assembling global hydrological data sets in near real time. This data are required for studying global climate change, environmental protection and for investment in sustainable water resources development. Several countries were found to be cutting back on hydrological networks and services. This means that knowledge of the world's water resources is getting worse when the global demand for water is accelerating. In contrast, meteorologists have ready access to large

volumes of global data, much of it in real time through WMO's World Weather Watch. A World Hydrological Cycle Observing System has been proposed, with an initial aim of monitoring 1000 of the world's largest rivers, starting in Africa with a 100 station network.

South Africa proposed that the flood warning system for the Bloemhof dam catchment, consisting of 20 field stations for monitoring river stage, water quality variables and weather data be incorporated in HYCOS. This was accepted by WMO and EUMETSAT (the management organization of METEOSAT). It is expected that the monitoring system would be operational not later than September 1995. WMO and EUMETSAT were requested approval for a further 26 data collection platforms to monitor important rivers country wide.

Near real time information will be relayed via METEOSAT, a geostationary satellite. Information will be received at the Directorate of Hydrology, processed and distributed on the General Telecommunications System and the Departmental local and wide area networks. Information will also be regularly archived. An electronic archiving system is presently developed as part of the Hydrological Information System (HIS).

For further information, please contact Stéfan van Biljon at telephone (012) 2992707, fax (012) 3261488 or e-mail: SAA@DWAFF-PTA.PWV.GOV.ZA

Call for volunteer professional advisers

The British Executive Service in South Africa (BESSA) is a volunteer adviser service helping private and public enterprises and organisations to develop in South Africa.

BESSA sends volunteer advisers to assist organisations which cannot afford consultants to improve efficiency, enhance local capacities and the quality of life and to

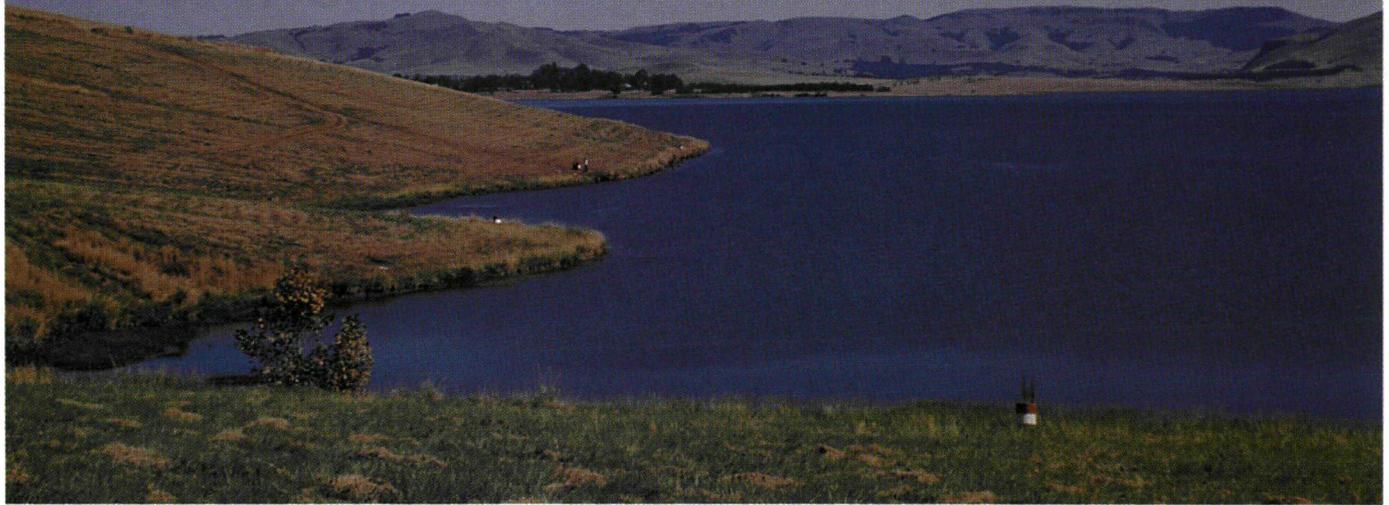
promote employment. Volunteers come from over 3 000 registered advisers in the United Kingdom and from a pool of more than 100 people registered in South Africa so far.

All are experienced, qualified and professional people, mostly retired, but including some on secondment, vacation or sabbatical. The assistance given, is targeted, prac-

tical and sustainable. Long term linkages are being developed through follow up visits and the ability of volunteers to act as mentors for deserving client organisations.

If you would like to be placed on the register, or you would like further information, please contact BESSA at PO Box 2705, Rivonia 2128. Tel (011) 803-5297 or Fax (011) 803-5298.

WATER QUALITY INDEXES DEVELOPED AS MANAGEMENT TOOLS



In 1992, the Water Quality Department of Umgeni Water developed separate water quality indexes to assist in the assessment and presentation of river and impoundment water quality from the more than 100 river and 8 impoundment sampling sites in its operational area. A water quality index is a measure of water quality for a sample, represented by a single number or symbol, derived from any selected number of water quality variable results.

The usual procedure is to:

- Assign a numerical value to each variable result (dependent on the concentration from a pre-determined relationship between the numerical value and variable concentration).
- Multiply each value by a pre-determined weighting factor for each variable (weighting factor dependent upon the considered importance of the variable).
- Sum of products is divided by the sum of the weighting factors to give a weighted score, the water quality index.

- A description of quality is given to the water quality result, for example, ranging from excellent to unsatisfactory.

VARIABLES

For the river water quality index, the variables E. coli, soluble and total phosphorus, total organic carbon, conductivity, suspended solids, turbidity, nitrate and ammonia were selected to give a general measure of water quality status. The additional variables such as total algae, taste and odour causing algal genera, filter clogging algal genera and chlorophyll a were added for the impoundment water quality index. As may be seen, the emphasis is changed from a general measure of the pollution status for river samples to one including variables that can give rise to treatment problems at water works for impoundment samples. The variable:score relationships were based on statistical analysis of historical data and the weightings on perceived water quality problems. For example, for the river water quality index E. coli, has the high-

est weighting whereas for the impoundment water quality index, taste and odour causing algal genera have the highest weighting.

MAPS

Monthly maps showing the water quality index of stretches of river from the sampling sites up to the next higher one as different colours and described as classes A to E, excellent to unsatisfactory respectively, are produced from analysis of weekly samples. The impoundments are classified in a similar manner. A computer programme extracts data from the laboratory information management system database and calculates the water quality index automatically, while a link to the Department's GIS configures the maps. This very concise information incorporating a large number of analyses is routinely reported to management, together with a tabulation of changes in site water quality indexes that have occurred since the previous month with the variables responsible for the changes.

LONGTERM TRENDS

The maps show a clear spatial representation of differences in water quality along river reaches, throughout catchments and at different locations in the impoundments where there are multiple sites. In this manner, problem areas are easily identified as

are seasonal differences, and it is expected that long-term trends will also become clear when sufficient information has been collected. Application of the indexes is relatively new and they will be undergoing continuous refinement and improvement through experience gained and contact with other organisations. To date, they

have proved to be very useful tools in the assessment of water quality in rivers and impoundments.

For further information contact D Simpson or J Howard, Umgeni Water, PO Box 9, Pietermaritzburg 3200. Phone: (0331) 961233/454365.

WORLD FISHING FLEETS DOCUMENTED

Fishing fleets from 65 countries harvest in waters other than their own, according to a six volume study from NOAA in the USA.

Water Newsletter (310594) reports that the International Affairs Office spent more than a year compiling data for the study.

"World Fishing Fleets" contains an executive summary and volumes covering Africa, Asia, Latin America, the Baltic States, Eastern Europe and the Commonwealth of Independent States as well as Western Europe and Canada. It is available as a set (PB94-140811/GBA) for \$95 from NTIS, 5285 Port Royal Rd, Springfield, VA 22161. Tel: 703-487-4650. Volumes are also available separately.

River pipefish is now extinct in Eastern Cape

The first extinction of a fish species in Africa this century has been recorded in the Eastern Cape with the extinction of the river pipefish (*Syngnathus watermeyer*), according to Professor Mike Bruton, Director of the JLB Smith Institute of Ichthyology at Rhodes University in Grahamstown. This is also one of the few vertebrate extinctions on the continent this century.

He says the staff of the Institute are mounting a special effort to confirm finally the extinction of this small but important Eastern Cape fish.

The river pipefish is a small estuarine species which was first described by JLB Smith in 1963 on the basis of specimens collected by Mr F Watermeyer and a Mr Galpin (a local farmer). It reached a length of 13 cm and occurred in, namely, three Eastern Cape rivers: the Bushmans, Kasouga and Kariega rivers. (Another pipefish, the longsnout pipefish

(*Syngnathus acus*) is common in these rivers and used to co-exist with the river pipefish.)

Professor Bruton says the river pipefish has never been common and recent surveys by Dr Alan Whitfield of the Institute, have revealed that it no longer occurs in the habitats where it was first recorded.

"In accordance with the IUCN Red List, a species is extinct if it has not definitely been located in the wild in the past 50 years. However, this species is now only known by museum specimens".

The building of weirs and dams on the rivers, together with extensive freshwater extraction for domestic and agricultural use has altered the natural flow of the rivers and affected sedimentation patterns and salinity levels in these estuaries, as have the construction of road bridges over the Bushmans and Kariega rivers.

New director appointed

Dr Paul Skelton has been appointed as Director of the JLB Smith Institute of Ichthyology at Rhodes University, Grahamstown, to succeed Professor Mike Bruton.

Dr Skelton has been Curator of Freshwater Fishes in the Institute since 1984. He is a leading authority on African freshwater fishes and is the author of the recently published book **A Guide to the Freshwater Fishes of Southern Africa**.

JAARVERSLAG BESKIKBAAR

Die elfde jaarverslag van die Raad vir die Omgewing is onlangs beskikbaar gestel. Professor Roelf Botha, Voorster van die Raad, sê die verslag bied, onder andere, 'n oorsig van die beraadslagings en advies aan die Minister oor 'n nasionale omgewingsbestuurstelsel vir Suid-Afrika, die rol van die nuwe provinsies daarin, die HOP en die omgewing, 'n vaartbelynde prosedure vir die bepaling van omgewingsimpak en geïntegreerde opvanggebiedbestuur.

Eksemplare van die jaarverslag kan verkry word deur skriftelik navraag te doen by mnr Brian Egan, Sekretaris: Raad vir die Omgewing, Privaatsak X447, Pretoria 0001.

Waterbewaringsveldtog geloods

Die Minister van Waterwese en Bosbou, professor Kader Asmal, het onlangs op die Verenigde Nasies se Wêreldwaterdag 'n waterbewaringsveldtog vir Suid-Afrika aangekondig.

Dit volg in die lig van nog 'n jaar van kritiese watertekorte wat Suid-Afrika in die gesig staar.

'n Klein loodskomitee sal volgens 'n woordvoerder van die Departement saamgestel word om die veldtog te bestuur en programme te finaliseer.

Elemente van die veldtog behels onder andere:

- ❑ 'n Nasionale konferensie in Julie 1995 ter voorbereiding van 'n Nasionale Waterbewaringsbeleid wat later in die vorm van 'n Witskrif gepubliseer sal word.
- ❑ 'n Nasionale plakkaatkompetisie vir skole met geborgde pryse.
- ❑ 'n Spesiale toekenning vir die stad of

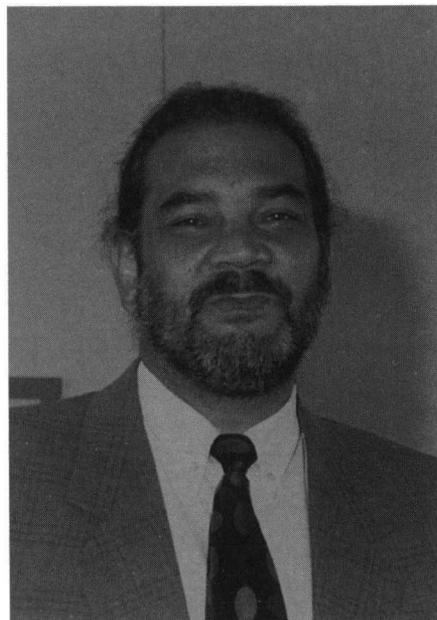
dorp in Suid-Afrika wat die beste daarin slaag om water te bewaar en waterverliese te beperk.

- ❑ 'n Spesiale navorsingsfonds vir wateraanvraagbestuur wat deur die Waternavorsingskommissie gevestig en bestuur sal word.
- ❑ Spesifieke byeenkomste om aangeleenthede wat betrekking het op landbou, die ekonomiese invloed van wateraanvraag, waterverliesbestuur, munisipale watergebruik, ensovoorts, te bespreek, mag na die konferensie gereël word.

Die veldtog is van uiterste belang vir Suid-Afrika se toekomstige ekonomiese welvaart aangesien daar nie voortgegaan kan word om hierdie beperkte hulpbron te ontgin asof daar nie 'n dag van môre is nie.

Die veldtog is nou verwant aan die waterreg-hersieningsproses wat tans deur die Departement onderneem word.

CO-OPTED MEMBER



Professor CT Johnson, Dean of the Science Faculty at the University of the Western Cape, has been co-opted as a member of the Water Research Commission.

METEOROLOË SPAN SAAM VIR LANGTERMYN WEERVOORSPELLINGS

Verskeie instansies het die afgelope paar jaar begin om voorspellings uit te reik oor maandelike seisoenale reënvalpatrone. In 'n poging om nouer samewerking tussen hierdie groepe te bewerkstellig, het die Suid-Afrikaanse Weerburo die Suid-Afrikaanse Langtermynweervoorspellingsforum (SALWF) gestig.

Die doelstellings van die SALWF is onder andere:

- ❑ Die identifisering van gesaghebbende langtermyn weervoorspellingsgroepe in Suid-Afrika.
- ❑ Om samewerking tussen navorsers en voorspellers op hierdie gebied aan te moedig.
- ❑ Die uitruiling van idees oor langtermynvoorspellings, en
- ❑ om so ver moontlik eenstemmigheid te bereik oor die vooruitsigte vir die huidige of die komende reënvalseisoen.

Die volgende groepe is tans lede van die SALWF:

- ❑ Die Klimaat en Weernavorsingslaboratorium, Universiteit van Kaapstad;
- ❑ Die Klimatologiese Navorsingsgroep, Universiteit van die Witwatersrand;
- ❑ Die Dinamies-eksperimentele Maandelikse Vooruitskouingsgroep, SA Weerburo;
- ❑ Die Raadgewende Meteorologiese Navorsingsgroep, Universiteit van Pretoria; en
- ❑ Die Navorsingsgroep vir Statistiese Klimaatstudies, SA Weerburo.

Hierdie inisiatief is in ooreenstemming met die Konvensie ter bestryding van woestynindringing in lande wat droogte en woestynwording, veral in Afrika, ervaar en sal per geleentheid deur Suid-Afrika onderteken sal word. Woestynindringing en droogte veroorsaak geweldige armoede in Afrika en langtermyn voorspellings sal die beplanning en produktiwiteit op landbougrond help verbeter.

ECOTOXICOLOGY INTEREST GROUP ESTABLISHED

A need was identified for contact between people working in the emerging field of environmental toxicology, says Dr Steve Mitchell, Research Manager at the Water Research Commission (WRC).

This led to the WRC hosting an initial workshop where people had the opportunity to present their current research interests. This was followed by a workshop at the 1994 SASAQS conference. Subsequently, informal contact was made with the Society of Environmental Toxicology and Chemistry (SETAC) and the newly formed Australasian Society for Ecotoxicology.

Dr Mitchell says the next step is to facilitate contact between the small number of widely scattered people working in this field.

"This will give us a base from which to expand contact with other people in Africa and to establish regular contact with international groups.

"The mechanism for this will be the establishment of an electronic discussion group with the following E-mail address: ECOTOXA@dwaf-hri.pwv.gov.za. This has not yet been established, but hopefully will be soon, Dr Mitchell says.

He says the initial contact group will be:

- Dr Chris Dickens, Umgeni Water, Tel (0331) 41-1111, Fax (0331) 41-1084;
- Mr Rob Hattingh, Richards Bay Minerals, Tel (0351) 90-3111/3232 Fax (0351) 90-3480/3435);
- Dr Steve Mitchell, Water Research Commission, Tel (012) 330-0340 Fax (012) 331-2565);
- Mr Dirk Roux, Institute for Water Quality Studies, Tel (012) 808-0374 Fax (012) 808-0338;
- Dr Tally Palmer, Institute for Water Research, Tel (0461) 22428, Fax (0461) 24377;
- Ms Laetitia Slabbert, Watertek, CSIR, Tel (012) 841-3953, Fax (012) 841-4785), and

- Mr Magiel Steynberg, Rand Water, Tel (011) 682-0911, Fax (011) 682 0444.

"We would like to use existing conferences for sessions and workshops on ecotoxicology. Initially, SASAQS Water Quality Interest Group will act as the host for this group."

The initial focus of ECOTOXA will be to:

- Facilitate contact between interested people;
- Promote toxicity based effluent monitoring and regulations;
- Promote the science of risk evaluation using ecotoxicological methods;
- Promote formal training within the multidisciplinary science of ecotoxicology; and
- Promote contact with industry.

If you are interested in joining this discussion group, please notify one of the initial contact group members.

ON-SITE LATRINE EMPTYING SERVICE AVAILABLE

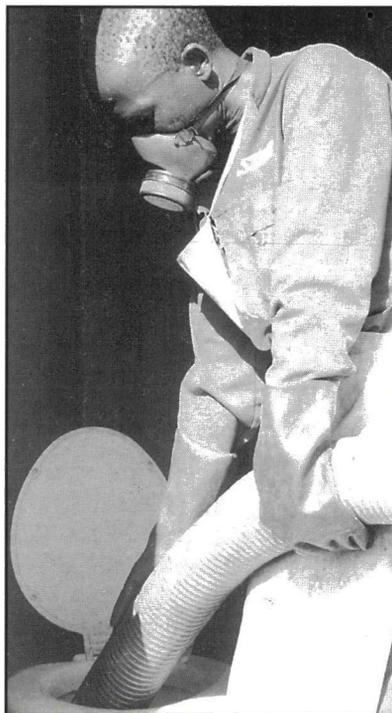
Sani-tech who specialises in the provision of on-site sanitation have recently expanded their range of services. Operating from ten branches countrywide, Sani-tech is best known for hiring out and servicing portable chemical toilets. Now the servicing of ventilated improved pitlatrines and anaerobic digesters/aquaprivies has been added to Sani-tech's range of services.

In response to a large number of enquiries, Sani-tech has prepared guidelines for servicing of ventilated improved pitlatrines (VIP's) and anaerobic digester toilets (aquaprivies) to assist provincial and local authorities and their consultants in planning the practical aspects of latrine servicing.

Copies of the Guidelines are available from:

Market Division,
Sani-tech (Pty) Ltd,
PO Box 12690,
JACOBS 4026.

Tel: (031) 485334 Fax: (031) 485371.



NEW REVERSE OSMOSIS SYSTEM SHOWS IMPROVED PERFORMANCE

A new reverse osmosis system is treating wastewater at four times the rate of conventional spiral-wound systems and can treat water containing dissolved solids at 150 000 mg/l, according to Water Newsletter (310794).

The configuration of the disc tube system as offered by Rochem Environmental Inc. in Houston, USA, allows for a flow path 1 000 times the size found in a conventional unit.

A 280 gallon/minute unit at the French Ltd Superfund Site in Texas is reducing the volatile organic compounds and heavy metals in contaminated water from about 3 000 ppm to less than 30 ppm.

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.

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

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

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

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

Sien Konferensies-en Simposiumbladsy vir aangeduide geleenthede.

1995

JUNE 1995							JULY 1995							AUGUST 1995									
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1996

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MAY 1996							JUNE 1996							JULY 1996							AUGUST 1996												
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SEPTEMBER 1996							OCTOBER 1996							NOVEMBER 1996							DECEMBER 1996							
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SOUTHERN AFRICA

1995

AQUATIC SCIENCES JUNE 27 TO 30

The Department of Zoology and Entomology and the Institute for Water Research at Rhodes University will host a joint symposium on all aspects of zoology and aquatic sciences.

Enquiries: Professors Ric Bernard, Alan Hodgson and Jay O'Keeffe. Tel: (0461) 318-530/526/532 Fax: (0461) 24377.

RURAL WATER SUPPLY JULY 3 - 7

A short course on rural water supply will be held at the University of Pretoria. The objective of the course is the provision of information and knowledge that will be required by all parties involved in the development of rural water supplies. The course will include discussion periods, practical exercises and demonstrations.

Enquiries: Mrs Nellie le Roux, Department of Civil Engineering, University of Pretoria, Pretoria 0002. Tel (012) 420-2978 Fax (012) 43-3589.

RESOURCE MODELLING JULY 5 - 10

The '95 world conference on natural resource modelling will be held at the University of Natal in Pietermaritzburg.

Enquiries: Professor John Hearne, Department of Applied Mathematics, University of Natal, Private Bag X01, Pietermaritzburg 3209. Fax: (0331) 260 5599 Tel: (0331) 260 5626.

FLUORIDE AND FLUOROSIS AUGUST 10

A workshop on fluoride in the natural environment and fluorosis in humans and animals - the status of South African research - will be held in the Manyane Centre, Piliansberg National Park, North West Province. Enquiries: Mr Lewis McCaffrey, Department of Geological Sciences, University of Cape Town, Ronde-

bosch 7700. Tel (021) 650-2912 Fax (021) 650-3783. Email: lmcc@geology.uct.ac.za

HYDROLOGY SEPTEMBER 4 - 6

The 7th national southern African hydrological symposium will be held in Grahamstown.

Enquiries: Prof Denis Hughes, Institute for Water Research, Rhodes University, Grahamstown 6140. Tel (0461) 24014 Fax (0461) 25049. E-mail: Denis @ iwr.ru.ac.za.

IWSA SEPTEMBER 9 - 15

The 20th biennial congress and exhibition of IWSA will be held in Durban. Enquiries: Mrs Ginny Eslick, Congress International, 18 Rapson Road, Morningside, Durban 4001. Tel (031) 233 494. Fax (031) 232 405.

GROUNDWATER SEPTEMBER 25 - 27

A conference and exposition on groundwater recharge and rural water supply - Groundwater '95 - will be held at the Volkswagen Conference Centre in Midrand. Enquiries: Conference Co-ordinator, Groundwater Division, GSSA, PO Box 75728, Lynnwood Ridge 0040.

ACTIVATED SLUDGE PLANTS OCTOBER 16 - 20

A short course on the operation of activated sludge plants will be presented by the Water Utilisation Division of the Department of Chemical Engineering at the University of Pretoria.

Enquiries: Prof WA Pretorius Tel (012) 420-3566 Fax (012) 43-6683.

ANAEROBIC PROCESSES OCTOBER 25

The first open meeting and mini-workshop of the Water Institute of Southern Africa's Anaerobic Processes Division will be held in Midrand. The theme of the workshop is "Experiences with anaerobic processes in South Africa".

Enquiries: Contact Mr JR Hoffmann at Wates, Meiring and Barnard. Tel (011) 315-0316, Fax (011) 315 0317.

WATER CARE NOVEMBER 29 & 30

The 4th Western Cape water care seminar and trade fair will be held at the Faure Water Treatment Plant, Faure.

Enquiries: Seminar secretary, Peter Novella, tel: (021) 4002-437 Fax: (021) 253-848.

1996

WISA ' MAY 20 - 23

The WISA '96 conference will be held at the Feather Market Centre in Port Elizabeth. Enquiries: Conference Planners, PO Box 82, Irene 1675. Tel (012) 63-1681. Fax (012) 63-1680.

AQUATIC SYSTEMS JULY 15 - 19

A conference on aquatic systems will be held at the Vic Falls Hotel in Zimbabwe. Call for papers. See page 32 of this Bulletin.

HYDRAULIC RESEARCH AUGUST 5 - 7

The International Association for Hydraulic Research - African Division's biennial congress with the theme "From flood to drought" will take place at Sun City. Papers are invited on topics including Problems of temporal distribution, Water schemes due to uneven spatial distribution, Environmental and sociological problems in arid regions and Innovative ways of conserving water. Enquiries: Miss Genevieve Stephenson, Conference Office, PO Box 327, WITS 2050. Tel (011) 716-5091 Fax (011) 339-7835.

ISIAME '96 NOVEMBER 4 - 8

An international symposium on industrial applications of the Mössbauer effect will be held in Johannesburg. Call for papers.

Enquiries: Prof Herman Pollak (Chairman), Mössbauer Laboratory, Department of Physics, University of the Witwatersrand, Private Bag 3, Johannesburg 2050. Tel: (011)716-4053 Fax: (011) 339-8262. E-mail: 005KLKS@ WITSVMA. WITS.AC.ZA

OVERSEAS

1995

WATER NETWORKS JUNE 5 - 9

A short course on the design of water quality networks will be held at Colorado State University, Fort Collins, Colorado, USA.

Enquiries: TG Sanders, Environmental Engineering, Department of Civil Engineering, Colorado State University, Fort Collins CO 80523. Fax: (303) 491-7727 Tel: (303) 491-5448.

COASTAL ENVIRONMENT JUNE 13 - 15

The Black Sea regional conference on "Environment protection technologies for coastal areas" will be held at the International House of Scientists, St Constantine Resort in Varna, Bulgaria.

Enquiries: IAWQ - Bulgarian National Committee, c/o USB - Mrs TS Angelova, Oborishte St 35, Sofia 1504, Bulgaria. Tel (+359-2) 43 01 28, 44 11 57. Fax (+359-2) 44 15 90.

ENVITEC JUNE 19 - 23

The international trade fair for Environmental Protection and Waste Management Technologies will be held in Düsseldorf, Germany.

Enquiries: Messe Düsseldorf, Postfach 10 10 06, D-40001 Düsseldorf. Tel (0211) 45 6001. Fax: (0211) 45 60668.

RAINWATER JUNE 19 - 25

The 7th international conference of the International Rainwater Catchment Systems Association will be held in Beijing, China.

Enquiries: Dr Mou Haisheng, Dept of Hydrology, Institute of Geography, CAS, Building 917, Datun Road, Anwai, Beijing 100101, PR China. Tel (86) 1 4914289. Fax (86) 1 4911844.

CONTAMINANTS IN WATER

JUNE 29 - 30

A conference on hazard assessment and control of environmental contaminants in water will be held in Copenhagen, Denmark.

Enquiries: Dr Niels Nyholm, Laboratory of Environmental Sciences and Ecology, Building 224, Technical University of Denmark, DK-2800 Lyngby, Denmark.

POLLUTION EVENTS

JULY 24 - 26

An inter-disciplinary symposium on uncertainty, risk and transient pollution events - Acute Risk to the Aquatic Environment will be held in Exeter, UK.

Enquiries: Dr JD Boyle, School of Engineering, University of Exeter, North Park Road, Exeter EX4 4QF, UK.

DIFFUSE POLLUTION

AUGUST 14 - 18

A symposium on diffuse (non-point) pollution will be held in Prague, Czech Republic.

Enquiries: Ing Vladimír Chour, Hydroprojekt AS, Taborska 31, CZ 140 43 Praha 4, Czech Republic.

LARGE WATER BODIES

AUGUST 22 - 25

An international conference on long-term changes of large water bodies will be held in Visby, Gotland, Sweden.

Enquiries: IHP/IAWQ Conference Secretariat, Dept of Water and Environmental Studies, Linköping University, S-581 83 Linköping, Sweden. Tel: +46 13 282286. Fax: +46 13 133630.

BIOFILM STRUCTURE

AUGUST 30 - SEPTEMBER 1

A workshop on "biofilm structure, growth and dynamics - need for new concepts" will be held in Noordwijkerhout, the Netherlands. Enquiries: Mark van Loosdrecht, Julianalaan 67, 2826 BC Delft,

the Netherlands. Tel: +31 15 781618. Fax: +31 15 782355

WATER & SANITATION

SEPTEMBER 4 - 8

The 21st WEDC conference on the sustainability of water and sanitation systems will take place at the international conference centre, Kampala, Uganda.

Enquiries: Prof John Pickford, WEDC, Loughborough University LE11 3TU, England.

SEWER SOLIDS

SEPTEMBER 6 - 8

A seminar on sewer solids - characteristics, movements, effects and control will be held in Dundee, Scotland, UK.

Enquiries: Maureen Golden, WWTC, University of Abertay Dundee, Bell St, Dundee, DD1 1HG, UK.

SANITATION SYSTEMS

SEPTEMBER 18 - 19

A symposium on technology transfer - achieving high performance at low cost in environmental and sanitation control systems will be held in Salvador, Bahia, Brazil.

Enquiries: Francisco Fontes Lima, CETREL SA, Caixa Postal 011, CEP 42.810-000 Camaçari, Bahia, Brazil. Fax: +55 (71) 832 2562.

WATER MANAGEMENT

SEPTEMBER 26 - 30

A symposium on integrated water management in urban areas will be held in Lund, Sweden.

Enquiries: Dr Janusz Niemczynowicz, Dept of Water Resources Engineering, University of Lund, PO Box 118, S-221 00 Lund, Sweden.

WASTEWATER RECLAMATION

OCTOBER 17 - 20

The 2nd international symposium on wastewater reclamation and reuse will be held in Iraklio, Crete, Greece.

Enquiries: Mrs T Furnaraki, Municipal Enterprise for Water Supply and Sewerage of Iraklio, 1 Vironos Str., 71202 Iraklio, Greece. Tel: +30-81-229913, 225833 Fax: +30-81-22 9991

WEFTEC '95

OCTOBER 21 - 25

The Water Environment Federation's 68th annual conference and exposition will be held in Miami Beach, Florida, USA.

Enquiries: Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994 USA. Fax 1-908-885-6417.

LAKE MANAGEMENT

OCTOBER 23 - 27

The 6th international conference on the conservation and management of lakes will be held in Tsukuba and Tsuchiura, Japan.

Enquiries: The Secretariat, Kasumigaura '95, 1-5-38 Sannomaru, Mito, Ibaraki 310, Japan. Tel +81-292-24-6905 Fax +81-292-33-2351.

WASTEWATER PLANTS

OCTOBER 30 - NOVEMBER 1

The 3rd international specialised conference on design and operation of small wastewater treatment plants will be held in Kuala Lumpur, Malaysia.

Enquiries: Mrs Lorraine Meiring, Water Research Commission, PO Box 824, Pretoria 0001. Tel (012) 330-0340. Fax (012) 331-2565.

WASTEWATER

OCTOBER 30 - NOVEMBER 1

An IAWQ/IWSA workshop on the "Separation of microorganisms from water and wastewater: Theory and practice/ New developments and opportunities" will be held in Amsterdam, the Netherlands.

Enquiries: Amsterdam Workshop '95, International Association on Water Quality, 1 Queen Anne's Gate, LONDON SW1H 9BT UK. Tel +44-71-222-3848 Fax +44-71-233-1197.

1996

MICROBIAL PHYSIOLOGY
JANUARY

An advanced course on microbial physiology and fermentation technology will take place at the Delft University of Technology, the Netherlands.

Enquiries: Dr LA van der Meer-Lerk, Kluyver Laboratory, Julianalaan 67, 2628 BC Delft, the Netherlands. Tel: 31-(0)15-785140 Fax: 31-(0)15-782355.

BATCH REACTOR TECHNOLOGY

MARCH 18 - 20 1996

A conference on sequencing batch reactor technology will be held in Munich, Germany.

Enquiries: Prof. Dr-Ing. Peter Wilderer, Lehrstuhl für Wassergüte und Abfallwirtschaft, Technische Universität München, Am Coulombwall, D-85748 Garching, Germany. Tel: +49 (089) 3209 3700. Fax: +49 (089) 3209 3718.

HYDROGIS '96

APRIL 16 - 19

An international conference on the application of geographic information systems in hydrology and water resources management will be held in Vienna, Austria.

Enquiries: HydroGIS '96, c/o Austropa-Interconvention, PO Box 30, A-1043 Vienna. Tel: +43(1) 588 00110 Fax: +43(1) 586 7127.

FOREST INDUSTRY WASTEWATERS

JUNE 10 - 13

The 5th IAWQ symposium on forest industry wastewaters will be held in Vancouver BC, Canada.

Enquiries: The organiser, Forest Industry Wastewaters symposium, c/o Venue West Conference Services, 645 the Landing, 375 Water Street, Vancouver BC, Canada V6B5C6. Tel: +1 604 681 5226. Fax: +1 604 681 2503.

**THE WATER INSTITUTE OF
SOUTHERN AFRICA'S
WATER CARE AND SLUDGE
MANAGEMENT DIVISION**

PRESENTS

***THE 4th WESTERN CAPE WATER CARE
SEMINAR AND TRADE FAIR***

WHEN: *29 & 30 NOVEMBER 1995*

WHERE: *FAURE WATER TREATMENT PLANT, FAURE*

The programme is currently being arranged but will include early registration, viewing of exhibits and a meet and greet on the first day commencing at 16:00.

The second day will commence at 08:00 and will include a technology transfer seminar in which nine papers relating to various aspects of water, waste-water treatment and sludge management will be presented. There will also be a trade fair as well as a plant tour of the recently completed Faure water treatment plant. The day will end with a braai and refreshments.

Although the fees for the event will still be finalised it will be most affordable and all inclusive (attendance, proceedings and refreshments).

ENQUIRIES: For further information, please contact the seminar secretary, Peter Novella, at telephone (021) 4002-437 or fax (021) 253-848.

Vic Falls Conference on Aquatic Systems

Monitoring and Managing our Precious Resources

The Vic Falls conference on aquatic systems is organised jointly by the Southern African Society of Aquatic Scientists (SASAQS), the River Basin Management Technical Division of the Water Institute of Southern Africa (WISA), the Water Engineering Division of the South African Institute for Civil Engineers (SAICE) and the Aquatic Ecosystem Health and Management Society.

OBJECTIVES

The Vic Falls conference on aquatic systems aims to * provide a multidisciplinary overview of aquatic ecosystems and resource management and utilisation, * encourage the provision of quality information relevant to the African context, and * help build and strengthen links to bridge the gap between managers and scientists, with their colleagues from overseas and elsewhere in Africa.

PAPER CALL

Scientists, environmental managers and professionals from appropriate disciplines are invited to submit extended abstracts (maximum 2 pages) for consideration by the selection committee. Poster papers may also be presented.

Authors whose papers are selected for oral presentation will be required to submit full manuscripts by the appropriate deadline. These will be edited by a panel of referees and will be published, along with one page abstracts of each poster, as the formal conference proceedings.

CONFERENCE THEMES

The organising committee have identified themes they feel are important for discussion at the Vic Falls conference:

- Water supply and sanitation in developing countries.
- Biomonitoring and toxicology: testing, experimentation, regulation and policy.
- Indicators and measures of ecosystem health.
- Management of lakes and fresh water supply reservoirs.
- Estuarine ecology and management.
- Sustainable management of aquatic systems.

- Information systems for water resource management.

These themes will provide the basis for presentations at the conference. Parallel sessions are planned to accommodate the anticipated number of speakers.

PAPER DEADLINES

Your two page (A4) extended abstract should be submitted by 30 June 1995. Abstracts should be typed in single space A4 format in Helvetica 12 point font. All margins should be 2,5 cm. Please indicate authors and affiliation.

EXHIBITIONS

Organisations and individuals are invited to exhibit (books, software or equipment) or advertise.

FEES

Conference fees (excluding accommodation) will be in the region of R1 500. A complete package including conference fees, airport transfers, accommodation and social programmes, is being prepared. It is estimated to cost about R2 500. Delegates are expected to make their own travel arrangements to reach Victoria Falls.

ENQUIRIES

■ General & Administrative:
Ms Lesley Stephenson,
Conference Secretary,
PO Box 327, WITS 2050.
Tel (011) 716-5091
Fax (011) 339-7835
E-mail: Stephenson@ egoli.min.wits.ac.za.8

■ Technical:
Dr Peter Ashton
Division of Water Technology, CSIR,
PO Box 395, Pretoria 0001.
Tel (012) 841-3293
Fax (012) 841-4785.

Mr Gavin Quibell
Institute for Water Quality Studies,
Dept. Water Affairs and Forestry,
Private Bag X313, Pretoria 0001.
Tel (012) 808-0377
Fax (012) 808-0338.

5-19 July 1996
Elephant Hills Hotel
Victoria Falls, Zimbabwe

**First Announcement
and Call for Papers**

