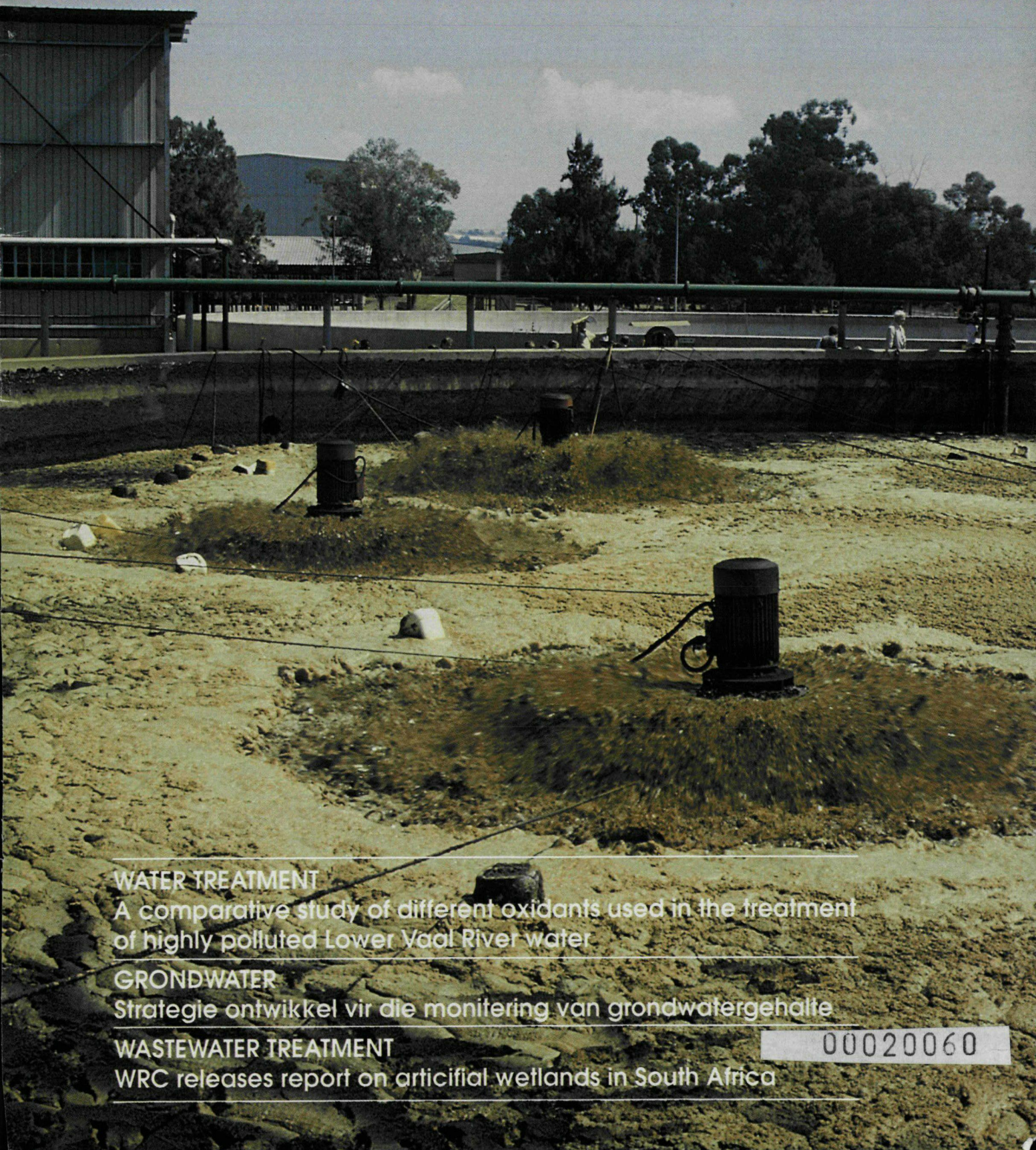


S4 waterbulletin

ISSN 0258-2244

Volume 20 No 3

May/June 1994



WATER TREATMENT

A comparative study of different oxidants used in the treatment of highly polluted Lower Vaal River water

GRONDWATER

Strategie ontwikkel vir die monitering van grondwatergehalte

WASTEWATER TREATMENT

WRC releases report on artificial wetlands in South Africa

00020060

IAIA - SA '94

ANNOUNCEMENT & CALL FOR PAPERS

- The South African Chapter of the International Association for Impact Assessment will be holding its first national conference with the theme

I.E.M. AND RECONSTRUCTION IN SOUTH AFRICA

7 – 9 September 1994

The theme has been chosen to reflect the role that Integrated Environmental Management and Impact Assessments can, and should play in the reconstruction and development of South Africa.

Key speakers will address different aspects of these topics. In addition, people are invited to share their experience of impact assessments - from whatever perspective, be it as a practitioner, a developer, an authority, the media, a non-governmental organisation or as an affected party or community.

A number of interactive and paper presentation sessions are being planned. Case studies will be discussed - including the E.I.A. for RBM's St Lucia proposal (with many of the key figures present) - so that lessons can be drawn and used in future impact assessments.

Persons interested in presenting a paper at the conference are invited to submit an abstract to the address below. Topics for papers could include: the role of NGO's in E.I.A., a comparison between I.E.M. and E.M.P.R., social impact assessments, technology used in E.I.A., environmental law or economics, etc. Preference will be given to case studies and the learning points that have come out of these.

The conference starts with registration and lunch at 12:00 on Wednesday, 7 September, and ends at mid-day on Friday 9 September. The cost of the conference is R250 per IAIA-SA member and R290 for non-members.

VENUE

The conference is being held at Dikhololo Conference Centre, situated about 80 km north-west of Pretoria. The cost of accommodation, which delegates must book directly with the Centre, is about R340 per person (sharing) for the two nights, including breakfast, lunch and dinner. Cheaper rates can be obtained by sharing the larger bungalows with other people. A pamphlet about this beautiful bushveld Centre, and their contact number, will be sent to delegates once the form below has been submitted.

----- Please cut along this line and return to the address below -----

PRELIMINARY REGISTRATION FORM

Name: Tel:

Organisation:

Address:

..... Postal Code

I am interested in attending IAIA-SA '94, please send me more details.

I am interested in presenting a paper on the following topic

Return to: IAIA-SA (Tvl), PO Box 4854, Halfway House 1685.

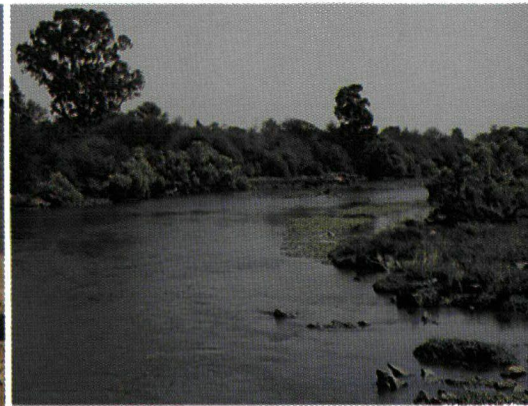
Contacts: Lex Martin Tel (011) 800-5514 Fritz Klöpfer (011) 805 2454.



p 4



p 13



p 18

Contents

GROUNDWATER	10	Strategy developed to monitor SA's groundwater quality
SANITATION	13	Urban sanitation in South Africa reviewed
WASTEWATER TREATMENT	14	Report on artificial wetland use released
WATER TREATMENT	18	Report on a comparative study of different oxidants used in the treatment of Lower Vaal River Water
WATERBEHANDELING	22	Navorsers kyk na moontlikheid van membraankarakterisering
FEATURES	4	Waterfront
	23	SAWIC News
	25	Sanciahs News
	26	News snippets
	29	Conferences and symposia

Cover: The reactor where micro-organisms are cultivated using the abattoir effluent as the growth medium in the protein recovery process at the City Deep Abattoir, Johannesburg (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: Cover to Cover, Pretoria. Colour Separations: Lithotechnik. Printing: Beria Printers.

Johannesburg abattoir opens protein recovery plant

A new process plant where protein is recovered from abattoir effluent was recently opened at the City Deep Abattoir, Johannesburg, by the former Minister of Water Affairs, Mr Japie van Wyk.

The process developed at the University of Pretoria utilises the effluent from the slaughtering floors to cultivate single cell protein in the abattoir effluent purification process. The process is both environment friendly and economically viable.

The project was jointly funded by Abakor and the Water Research Commission (WRC).

One of the many waste products in a abattoir is the blood which invariably ends up as part of the effluent to be treated. The new process plant at Abakor's City Deep Abattoir successfully combines treatment of abattoir effluent with protein recovery and production. The effluent is treated by applying biological and physical processes. In the biological process, known as the sequential batch process, micro-organisms are cultivated using the abattoir effluent as substrate. The organic waste in the effluent is converted into protein by the bacteria. The excess micro-organisms are harvested from the treated effluent to be used as a protein source. This means that single cell protein is produced from non-protein waste and that the effluent water quality improves simultaneously.

BENEFITS

The benefits from this process are considerable. The water consumption of the City Deep abattoir amounts to 2 500 Kℓ per day. The blood-rich effluent amounts to an equally staggering volume. Through this new process the abattoir effluent can be purified to more than 90 per cent and 1,5 tons of protein per day is recovered at the protein recovery plant of City Deep abattoir.

The recovered protein has various applications as a stockfeed supplement.

In the past abattoir effluent brought about enormous pressure on the municipal sewage purification plants. The new process at the City Deep Abattoir results in a clear effluent with a greatly reduced chemical oxygen demand (COD) thus cutting down the pollution load emanating from this facility considerably which in turn brings some relief to ever increasing loads on the municipal sewage infrastructure and will help to extend the life span of the municipal sewage purification plant.

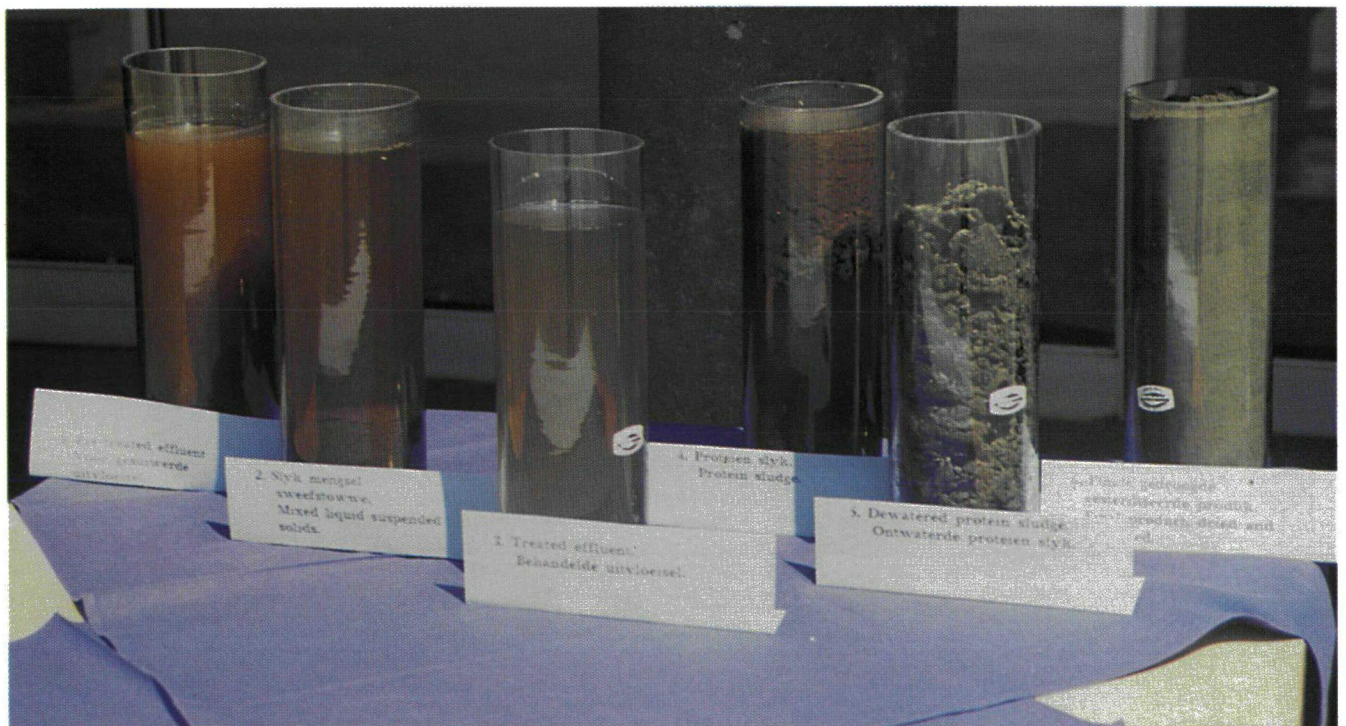
Mr Frans van der Vyver, managing director of Abakor, said if industries get involved in pollution prevention themselves, it would not be necessary for the government to interfere and to enforce laws in order to control pollution.

He said that pollution control does not have to be an expensive process either, pointing out that various Abakor projects have been developed locally at a fraction of the cost of overseas concepts.

The Water Research Commission, in collaboration with Abakor, has been involved in several projects pertaining to abattoirs investigating physical-chemical and biological processes which can be used to purify abattoir effluent. Through its involvement in this research the Water Research Commission has made a valuable contribution to utilise effluent and reduce water pollution.

Abakor manages eleven of South Africa's largest abattoirs, handling approximately forty per cent of the country's total livestock-slaughtering.

RIGHT: The former Minister of Water Affairs, Mr Japie van Wyk, along with Mr Piet Odendaal (Executive Director, Water Research Commission) and Dr Fanie van Rensburg (Chairman of Abakor) inspecting the new process plant at City Deep abattoir.



Samples of the effluent at various stages and the eventual single cell protein product.



WRC awards Fellowships

The Water Research Commission has for the first time awarded fellowships for post-graduate study to two South African students. They are Mandy Uys and Srinivasan Pillay – both involved in aquatic science research.

The Water Research Commission recently instituted two post-graduate fellowships to encourage and support the development of expertise in various fields of water research. These two-year fellowships are to be awarded annually, and to benefit the various water research fields, it will be awarded in a different field of water research every year. The fellowships offer a generous financial support to meet all study costs towards a post-graduate degree. The recipient, however, is contractually bound to serve in a research environment at a WRC approved South African university or institution for a period equal to the duration of the fellowship.

AQUATIC SCIENCES

The 1994/95 fellowships were awarded in the field of aquatic sciences considering that the conservation of aquatic ecosystems has become a critical facet of the overall conservation strategy of South Africa. This is due to the ever-increasing pressure being placed on our aquatic systems (rivers, wetlands and estuaries) as a result of increasing urban, industrial and agricultural development along with an increasing abstraction and pollution of the water of these systems.

Potentially serious degradation of these systems can be avoided if we can gain a greater understanding of:

- the structure and functioning of

- the aquatic biota (plants and animals),
- the abiotic environment of water ecosystems, and
- the structure of key biotic components of water ecosystems, their variability as well as effects on aquatic biotas.

Mandy Uys and Srinivasan Pillay who received the 1994/95 WRC Fellowships are both actively involved in aquatic science research.

MS UYS

Miss Uys completed her undergraduate studies in Zoology and Geography at the University of Cape Town. She then went on to a BSc Honours in Zoology at the University of Natal, Pietermaritzburg. Currently she is with the Institute for Water Research at Rhodes University doing research on the invertebrate communities of seasonal rivers which will be the subject of her MSc thesis. Miss Uys's proposed research, under the supervision of Dr Jay O'Keeffe, aims at gathering information on the macro-invertebrate of two seasonal rivers in the Eastern Cape, and comparing their fauna to that of three analogous systems: a naturally perennial river (the Buffalo River), a formerly perennial river which has been impounded (the Letaba River), and a formerly temporary river which now flows continually due to the import of water (the Great Fish River).



Mr Piet Odendaal, Executive Director of the Water Research Commission (WRC) (centre), with Ms Mandy Uys and Mr Srinivasan Pillay who were awarded the 1994/94 WRC Fellowships.

This research will fill a knowledge gap regarding the biota of seasonal rivers, as up to date there has been virtually no research done on the biota of seasonal rivers. This research will also, at least partially, fulfil a much needed predictive role by indicating the changes to be expected when perennial rivers become seasonal, by way of impoundment or abstraction of water, which can be expected to become more common in future.

MR PILLAY

Mr Pillay presently is a lecturer at the University of Zululand. He graduated at the University of Durban-Westville with a BSc, majoring in geography and geology. He also holds the degrees BSc Hons from the University of South Africa (UNISA) and MSc from the University of South Carolina, Columbia, USA. The subject of his MSc thesis was an analysis

and simulation of correlation errors in net flux determination in salt marsh tidal channel systems. He has also been doing research on the streamflow and water quality changes in an intensely cultivated steep catchment on the Natal North Coast, as well as research on the clay mineral analysis of marsh and adjacent riverine sediments. The subject of Mr Pillay's PhD research will be the sediment dynamics of the Mfolozi-Msunduzi estuary system.

The present day separate Mfolozi and St Lucia estuaries were originally part of a common Mfolozi-St Lucia estuary, until the early 1950s when agricultural development on the Mfolozi flats resulted in large amounts of sediment being deposited in this communal estuary. This excessive sedimentation had a catastrophic effect on the estuary and its aquatic life and also prompted the

relocation of the Mfolozi River mouth to the south with a barrier complex now separating these two estuaries. However, the now separate St Lucia and Mfolozi estuaries are in close proximity to one another and still intricately linked as they share a common ebb-tidal delta and change in the one affects the other. Although sediment dynamics of the St Lucia estuary have been studied rather comprehensively, little is known of the Mfolozi estuary.

Mr Pillay's proposed research on the sediment dynamics of the Mfolozi estuary, under the supervision of Prof Tom Mason at the University of Natal, Durban, will make a significant contribution to understanding the processes in these estuaries, as well as to developing meaningful management strategies for the St Lucia-Mfolozi system.

UP Kortkursus bevorder Waterwesebeleid

Die Universiteit van Pretoria se Afdeling Waterbenuttingsingenieurswese het onlangs die eerste van 'n reeks van drie kortkursusse rakende waterkwaliteitsbestuursbeleid en -strategie vir sowat 100 amptenare van die Departement van Waterwese aangebied. Die kortkursusreeks is daarop gerig om die besoedelingsbeheerpersoneel vertrouwd te maak met Waterwese se nuwe beleidsbenadering en klem op geïntegreerde watergehaltebestuur in opvanggebiede.

Die Departement van Waterwese het 'n tyd gelede in die lig van algemeen verswakende waterkwaliteit in Suid-Afrika, besluit om die bestuursbeleid ten opsigte van watergehalte te hersien. Voorheen was die klem op besoedelingsbeheer maar met die jongste hersiening, het die klem na geïntegreerde watergehaltebestuur in opvanggebiedverband verskuif. Waterwese het 'n omvattende dokument saamgestel waarin die beleidsverandering vervat is. Dit berus op Waterwese se oorhoofse doel, naamlik, om die geskiktheid van Suid-Afrika se waterbronne vir gebruik op 'n deurlopende grondslag te handhaaf.

Uit hoofde van hierdie beleidsverandering het die behoefte ontstaan vir die heroriëntering van die betrokke personeel. Waterwese het, in dié verband, die Afdeling Waterbenuttingsingenieurswese van die Universiteit van Pretoria genader om behulpzaam te wees met die opstel van studiemateriaal vir hul interne opleidingsprogram. Daar is voorgestel dat dit in kortkursusse aangebied word, aangesien die Afdeling Waterbenuttingsingenieurswese by UP ingestel is op opleiding.

Die hoofemas van die drie kortkursusse is soos volg:

- ❑ **Kortkursus I:** Omgewingswaterstelsels (waterkwaliteit in opvanggebiede)

- ❑ **Kortkursus II:** Besoedelingsbeheertegnologie, en

- ❑ **Kortkursus III:** Watergehaltebestuur met die klem op bestuurstrategieë.

Die eerste van die kortkursusse handel oor die omgewingswaterstelsel en sluit onder andere die volgende aspekte in:

- benadering, beginsels en wetgewing;
- die voorkoms en beweging van water in die opvanggebied;
- natuurlike watergehalte en die faktore wat dit beïnvloed;
- die mens se impak op die natuurlike waterstelsel;
- watergehaltevereistes; en
- geïntegreerde omgewingsbestuur.

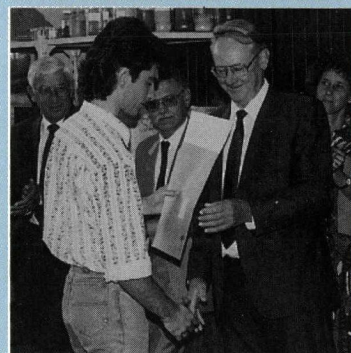
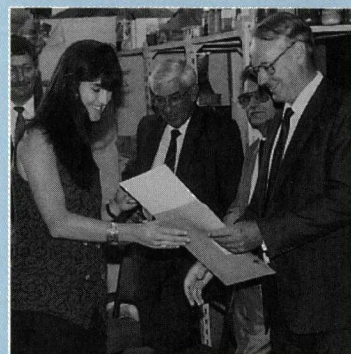
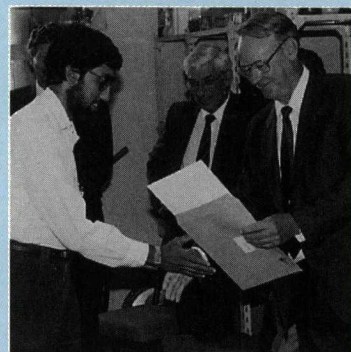
Kennis van die omgewingswaterstelsel is nodig vir geïntegreerde aanwending in enige watergehaltebestuursbenadering om beskikbare water op 'n volgehoue basis geskik vir gebruik te hou.

KLIËNTE-KURSUS

'n Uitvloeisel van die aanbieding van die heroriënteringskursus is dat Waterbenuttings ingenieurswese nou beplan om 'n kliënte-kursus aan te bied vir belangstellendes wat vertrouwd wil raak met Waterwese se nuwe beleid en benadering tot watergehaltebestuur. Veral "kliënte" van Waterwese wat onderhewig is aan besoedelingsbeheer, soos nywerhede, waterrade, plaaslike owerhede, streeksdiensterade, asook raadgevende ingenieurs betrokke by watergebruik en -besoedeling sal baat vind daarby om kennis te dra van en te verstaan wat die Departement beoog met die nuwe benadering en beleid. Die hoofgedagte is deelnemende betrokkenheid by besluite en toepassing van voorkomende maatreëls met betrekking tot watergehaltebestuur, waaronder besoedelingsbeheer ook resorteer.

Hierdie "kliënte"-kortkursus word van 5 tot 9 September 1994 by die Universiteit van Pretoria aangebied. Vir meer inligting sien die advertensie op p 31 van hierdie bulletin.

Mnr Erasmus, Direkteur-generaal van die Departement van Waterwese en Bosbou, oorhandig die sertifikate ...





Teenwoordig by die oorhandiging van kursussertifikate aan Waterwesepersoneel was, van links: mnr NM Krige (Adj. Direkteur-generaal: Ontwikkeling), mnr C Triebel (Bestuurder: Waterbronne), mnr JLJ van der Westhuizen (Direkteur: Watergehaltebestuur), mnr W van der Merwe (Bestuurder: Wetenskaplike Dienste), mnr Johan Botha (Dosent, UP), (voor) Dr CPR Roberts (Besturende Ingenieur: Beplanning), (agter) dr Frik Schutte (Dosent, UP), mnr M Erasmus (Direkteur-generaal, Dept van Waterwese en Bosbou), (voor) prof At Pretorius (Hoof: Afdeling Waterbenuttingsingenieurswese, UP) en (agter) mnr Fred van Zyl (Adj. Hoofingenieur: Watergehaltebestuur).



Besoedelingsbeheer-personeel van die Departement van Waterwese en Bosbou het van oral uit die verskillende streke gekom om die heroriënteringskursus by te woon.

Hulle is in drie kleiner groepe verdeel vir die kortkursusaanbieding.



Strategy developed to monitor SA's groundwater quality

A report on the development of a strategy to monitor groundwater quality on a national scale in South Africa has been published by the Water Research Commission.

The report, prepared by R Parsons and G Tredoux of the Groundwater Programme at Watertek, CSIR, says the project was essentially literature based and was initiated to provide impetus to the monitoring initiative by identifying practical strategies to be employed during the design and implementation of a national groundwater quality monitoring network.

The report is structured as follows: A short overview of the current knowledge of the spatial and temporal variations of groundwater quality in South Africa is presented in Chapter 2. Chapter 3 evaluates current trends and terminology used in the field of groundwater quality monitoring. Chapter 4 presents special considerations and constraints which required attention prior to the development of appropriate strategies to be employed in the design, implementation and operation of a national groundwater quality monitoring network as described in Chapter 5. Owing to the vast amount of literature on similar networks elsewhere, the report says, no attempt could be made to critically evaluate all of the identified networks. Use was rather made of specific examples where required. Chapter 6 presents a summary and discussion of the identified strategies while conclusions and recommendations concerning further work to be undertaken are presented in Chapter 7.

Copies of the report (WRC Report 482/1/93) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: \$20.

Even though knowledge concerning spatial groundwater quality variation on a national scale is still limited in South Africa, the report says that some progress has been made in this regard during the last five years. The present regional groundwater characterisation initiatives will further enhance groundwater quality characterisation and knowledge. However, almost no information is available concerning temporal changes in groundwater quality. This lack of information makes it difficult to effectively manage South Africa's groundwater resources. A need therefore exists for the establishment of a national groundwater quality monitoring programme, the report says.

The Water Research Commission was approached for funding a one year literature study in order to develop a practical strategy for monitoring groundwater quality on a national scale. The following were identified as important considerations:

- ☐ The purpose of a national monitoring programme;
- ☐ The cost and manpower available for the monitoring programme;
- ☐ The most important areas to be covered (major pollution sources, sole source aquifers, etc.);
- ☐ The variable nature of groundwater over short distances (representativeness);
- ☐ Methods of sampling and frequency, analysis, data storage and information reporting;
- ☐ The possible linkage to national surface water quality monitoring networks.

At the outset it was recognised that practical strategies would be required if a national groundwater quality monitoring network is ever to be established in South Africa. Such strategies will be aimed at conquering the many challenges and problems which need to be overcome. These include the large areas involved, the high degree of spatial variability and the resources required to establish the network. Further it was noted that a national effort will never be perfect. An integrative, building approach and the adoption of some positive philosophies are seen as ways of ensuring that a national monitoring network could become a reality.

The researchers say that from the literature it was found that monitoring networks have rapidly evolved over the last 10 years. Networks are now designed on systems approach which is merely a framework that allows for a logical flow of information. The development of an objective statement was acknowledged to be central in the whole network establishment and operation process. It is important to note, the researchers say, that objective statements are flexible and dynamic so that the



statement can be modified or evolve as circumstances and knowledge change. The following objective statement is proposed for South Africa's national network:

"The objective of a national groundwater quality monitoring network is to provide ambient groundwater quality information on a national scale over the long term so that national water managers and planners have available to them general information pertaining to quality trends and status in both space and time for resource planning and management purposes."

Prior to addressing possible strategies, some special constraints and considerations were appraised. It was found that the responsibility for establishing and funding a national groundwater quality monitoring network rested with the Department of Water Affairs and Forestry. However, it was also found that the State could delegate some of the responsibility for data collection to other organisations such as regional services councils and municipalities. These major water users could also provide assistance and financial support to the network establishment drive.

According to the report current trends in groundwater management in South Africa are seen as positive developments which support the need for groundwater quality information. The need to integrate groundwater quality information with surface water quality information was also recognised. The lack of geohydrological knowledge on a national scale was identified as a limiting factor. In some areas, regional and local information are available to facilitate the establishment of a network. In areas with little or no information, strategies will be required to rectify the shortcoming.

STRATEGIES

Strategies used in the United States of America and Europe to establish large-scale groundwater monitoring networks and groundwater protection programmes were studied. It was found that numerous different approaches could be used and that a set of strategies, as opposed to a single strategy, was appropriate.

Information

The definition of groundwater quality

information was found to be a complex task. The constituents to be included in the monitoring list were found to be subject to a trade-off between groundwater quality information needs and available financial resources. It is proposed in the report that the following general but short list of chemical constituents be used to define trends and water quality for domestic, agricultural and industrial use.

Field Measurement (where possible)	Laboratory Analysis
Temp	EC
EC	pH
pH	Na
T.Alk	K
	Mg
	Ca
	Cl
	SO ₄
	T.Alk
	NH ₄
	NO _x
	DOC
	TDS (calc.)

Resources

The report says from a practical point of view, it is impossible to put a full national monitoring programme in place immediately. A strategy of initiating monitoring in priority areas is deemed essential. As resources allow, the areas being monitored can be extended with time and need. A number of information tools were identified which will facilitate the definition of priority areas to be monitored. These include a groundwater users map, the national aquifer vulnerability map, the geohydrological regions and subregions map, the national EC quality map and, as they become available, the regional geohydrological characterisation maps. The spatial representativeness of the water quality data collected from the priority areas, however, needs to be addressed. As a strategy to overcome the problem of defining priority areas, it was argued that towns currently using groundwater should be used to initiate the network. Such an approach, the report says, offers a number of advantages, particularly financial advantages, and will allow a network consisting of approximately 300 stations to be established relatively quickly and cheaply. The water supply managers can also be used to collect the water samples on behalf of the Department.

Time

The report proposes that a long term commitment must be made towards implementing a national groundwater quality monitoring program. This is on the understanding that it may be some years before the tangible benefits of the initiative become evident. Even though annual or biennial monitoring appeared to be the most common monitoring frequency for national networks, the report suggests that six monthly intervals be used for approximately five years. This strategy is aimed at removing network teething problems relatively quickly and obtaining usable data sooner than if a less frequent sampling interval is used.

Funding

Funding and logistical support was found to be critical. Most of the strategies which were examined were geared to make full use of available resources and keeping costs to a minimum. During the study,

the financial requirements for the establishment of the South African national groundwater quality monitoring network were not determined. However, the Department of Water Affairs and Forestry must make adequate financial and logistical provision for this effort. Further, additional financial and logistical support from other sectors and lower levels of government, which could either make use of the information or are groundwater users, need to be secured, the report says. In line with this strategy the report strongly argues that all hydrological monitoring networks need to be integrated and that an experienced geohydrologist should be used in the groundwater network development and management process.

Review committee

As a means of overcoming the size of the task and ensuring momentum in the initiative, the report proposes that a responsible person and a review committee be appointed. The responsible person will be dedicated to the task and will manage the design, implementation and on-going operation of the network. A masterplan would have to be compiled to guide the process. The responsible persons will be accountable to the review committee. Such a committee could consist of the Groundwater Quality Task Group convened by the Department of Water Affairs. The group will have a number of functions to fulfil, including final decision making, checking that the masterplan and target dates are being adhered to and to lobby various quarters for additional financial support.

Pilot study

Based primarily on experiences in the United States of America, the report suggests that a pilot scale study area be used in the first implementation of the groundwater quality monitoring network. Such a strategy will allow logistical problems to be addressed and teething problems to be solved before embarking on the national establishment.

Technical

The report says between 400 and 1 000 monitoring stations will be appropriate for the groundwater quality network. Existing

R. PARSONS
G. TREDoux

THE DEVELOPMENT OF A STRATEGY TO MONITOR GROUNDWATER QUALITY ON A NATIONAL SCALE

Report to the
WATER RESEARCH COMMISSION
by the
DIVISION OF WATER TECHNOLOGY, CSIR

WRC Report No 482/1/93

boreholes should initially be used, but specially constructed, dedicated boreholes will, however, be ultimately required. A sampling protocol document will be required to define sampling procedures. The selection of laboratories to do the chemical analyses as well as network quality assurance and quality control mechanisms are also considered to be necessary.

Network

Two global strategies are continually promoted throughout the study. An empirical approach and a hierarchical approach are seen as a means of initiating the installation of a national groundwater quality monitoring network. The acceptance of these two approaches has many benefits, particularly during the early stages of network design and implementation. These include easy station selection, simple sampling protocol definition and integration into other networks.

The report concludes with the sobering thought that the establishment of a national groundwater quality monitoring network will not transpire overnight.

"It is a major undertaking which will require hard work, continual learning and dedication."



Urban sanitation in South Africa reviewed

The provision of water and sanitation services to the rapidly expanding urban areas in South Africa is a great challenge facing the country. Yet the country's understanding of the options available for doing this are limited.

In order to assist in improving this understanding, the Water Research Commission provided funds for a project relating to the provision of sanitation in urban areas.

A report summarising the main results and conclusions of the project is now available from the Water Research Commission in Pretoria. The title of the report is **Urban sanitation evaluation (WRC report 385/1/93)** and can be ordered free of charge from the Librarian, Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: \$20.

The research project was officially called "Technical, socio-economic and environmental evaluation of sanitation for developing urban areas in South Africa" and was carried out by Palmer Development Group in association with the Water Research Group at the University of Cape Town. It was structured in the following phases:

□ Phase 1: Overview

A review of international practice in the field of sanitation as well as a review of the current situation with sanitation in South Africa (including the former TBVC states). This included, for each development region in the country, a survey of urban areas to determine who has got access to adequate sanitation, what types of system are being used and how sanitation systems are funded and managed. Questionnaires and interviews were used as tools to collate the information.

□ Phase 2: Evaluation of systems

Various key issues in the implementation of sanitation projects were identified and studied in a series of case studies. The most used sanitation

systems were also evaluated in terms of their cost, acceptance by communities, ease of construction and operation and environmental impact.

□ Phase 3: Guidelines and key areas for action

The key findings of Phases 1 and 2 were summarised in a report and presented to professionals and other interested parties in the sanitation and water sectors at a series of six workshops around the country. On the basis of the work completed and inputs received during the workshops, a draft set of guidelines for the implementation of sanitation projects was developed and key areas for action in the sanitation sector identified.

The orientation of the project has been on technical, socio-economic and environmental aspects. However, the report says, it has not been possible to ignore financial and institutional aspects as they have such a fundamental influence on the provision of sanitation services. To address these important aspects more completely, the Water Research Commission is funding further research into this area.

Report on artificial wetland use released

In 1988 the Water Research Commission (WRC) contracted Sviridov De Waal Inc., in association with the CSIR's Division of Water Technology, to develop engineering guidelines for the treatment of domestic wastewater in artificial wetland systems.

A final report on this project called **Artificial wetland use for wastewater treatment: theory, practice and economic review (WRC report 232/1/93)** has recently been published by the WRC and copies of the report are now available on request.

The report, compiled and written by A Wood and P Pybus, provides a background to the scientific and conceptual engineering basis for the implementation of artificial wetlands for wastewater treatment. It is not meant as a design manual, and should not be considered as such. Overseas price: \$20.

The potential of artificial or constructed wetlands as a reliable and fundamental process for the secondary treatment of wastewater and for nutrient removal has received considerable attention during the past ten years in the USA, Europe and Australia. Interest has been shown recently in the use of wetlands in South Africa with several systems being constructed for a range of effluents with variable degrees of success.

It is generally accepted by researchers that wetland systems have considerable potential and may offer a number of advantages compared to conventional wastewater treatment options. These include:

- ☐ Low operating cost;
- ☐ Low energy requirements;
- ☐ Can be established close to the site of wastewater production;
- ☐ Can be established by relatively untrained personnel;
- ☐ A robust process able to withstand a wide range of operating conditions;
- ☐ Environmentally acceptable offering considerable wildlife conservation opportunity; and
- ☐ Can be readily integrated into existing forms of effluent treatment.

The discharge of wastewaters into constructed wetlands may be considered a viable alternative treatment option, particularly suited to small and medium sized communities in sparsely populated and developing areas.

The study supported by the Water Research Commission also included an economic appraisal to compare the following systems:

- ☐ Treating raw and pretreated raw sewage.
 - Conventional extended aeration activated sludge.
 - Oxidation ponds incorporating anaerobic, facultative and maturation lagoons.
 - Constructed wetlands treating raw sewage.
 - Constructed wetlands with anaerobic pretreatment ponds.
- ☐ Constructed wetlands for the removal of nutrients from secondary treated activated sludge plant and biofilter effluents.
- ☐ Constructed wetlands for suspended solids removal and "polishing" of oxidation pond effluent.

SYSTEM DESIGN

The report says a constructed wetland consists of a shallow, often lined excavation (depending upon acceptance of seepage to the ground system) containing a bed of porous soil, gravel or ash, in which emergent aquatic vegetation is planted (commonly *Phragmites Australis*). The depth of the bed is generally 0,3 to 1,0 m deep and is constructed with a peripheral embankment at least 0,5 m high above the bed to contain storm conditions and accumulation of vegetation and influent solids.

The earlier beds were usually constructed at an incline of two to eight per cent where a soil media was used to ensure adequately hydraulic gradient to encourage passage of the effluent through the bed. Gravel and ash beds may, however, be constructed essentially level, the report says, as long as the length to width ratio is adequate, in relation to the influent flow. The selection of the permeable media represents the dominant factor in ensuring the desired hydraulic path, surface or subsurface, and consequently the treatment efficiency and reliability. It also forms the dominant cost factor for the wetland, particularly if a gravel or ash is required and has to be imported to the site. However, it has been identified that it is rarely possible to compensate for poor permeability by incorporating an incline, in fact, the report says an incline can encourage surface ponding and short circuiting, diminishing treatment efficiency.

TREATMENT MECHANISMS

Although the aquatic plants are the most obvious biological component of the wetland ecosystem, the actual purification is accomplished through a combination of biological, physical and chemical interactions between the plants, the media and the microbiological community. The primary role of the plants is to provide surfaces for bacterial growth, the filtration of solids, the translocation of oxygen to the rhizosphere and improvement of the soil's permeability.

In addition to biological processes, wetland systems are capable of removing significant amounts of pollutants by physico-chemical mechanisms. Ion exchange and precipitation processes within soil and ash media will result in a substantial reduction in certain ions. For example, co-precipitation of phosphate with iron, aluminium and calcium can dramatically reduce phosphate levels. Heavy metals may be precipitated with sulphides in zones where sulphate reduction occurs, and the formation of organo-metallic compounds may also represent an active mechanism for pollution removal.



INTERNATIONAL EXPERIENCE

The reed bed method of wastewater treatment is well established in Europe and the United States. Systems are now being installed in South America, Asia, the Far East and Australia. Many units have been constructed on the "root-zone" principles developed in West Germany whereby the wastewater passes horizontally through the media in which the plants are established. Other systems incorporate surface flow, comparable to natural wetlands, or vertical flow (upflow and downflow) through the media, or combinations of individual wetland units to optimise the removal of pollutants (modularisation of systems).

Practical application rates for the treatment of municipal wastewaters range from 40 to 200 m³ per ha per day for hydraulic loading and 30 to 400 kg BOD₅ per ha per day for organic load.

A considerable variation in design and operation criteria, a lack of understanding of the process and factors influencing the behaviour of the system and the impact of climatic conditions is apparent resulting in widely disparate performance data relative to confirmed design criteria.

SOUTH AFRICAN EXPERIENCE

The report says research to date with pilot scale units has demonstrated that constructed wetlands can meet the General Standard in terms of COD and suspended solids at overall loading rates of 2 000 m³ per ha per day when polishing oxidation pond effluents and secondary effluents, and 500 to 1 000 m³ per ha per day for raw, septic or settled domestic sewage.

A loading rate for simultaneous nitrogen removal of 300 to 500 m³ per ha per day is considered adequate, being lower than required for COD removal in order to ensure an adequate availability of oxygen. Phosphate removal is intimately associated with the physio-chemical characteristics to the media. Clay or iron-rich soil types and waste ash can achieve significant removal of phosphate to below 1 mg per litre phosphate at loadings as high as 2 000 m³ per ha per day second-

Table 1: Alternative systems treating raw sewage

	Activated sludge (Rand)	Oxidation ponds (Rand)	Wetland with anaerobic ponds (Rand)
Net total civils	672 000	618 000	1 121 000
Net total mechanicals	173 000	35 000	35 000
Net total electricals	41 000		
Allow for contingencies	89 000	65 000	116 000
Allow for price adjustment	133 000	98 000	173 000
Engineering fees, etc.	219 000	149 000	157 000
	1 327 000	965 000	1 602 000

Table 2: Summary of present worths (R X 1 000)

Discount rate	0,0%	2,0%	4,0%	6,0%	8,0%	10,0%
a) Activated sludge	7 724	6 069	4 945	4 160	3 595	3 177
b) Oxidation ponds	4 605	3 662	3 023	2 576	2 254	2 014
c) Wetlands with anaerobic ponds	6 210	5 000	4 172	3 590	3 168	2 852
Wetlands with nutrient removal	5 257	4 129	3 361	2 824	2 437	2 151
Wetlands for effluent polishing	4 948	3 884	3 161	2 656	2 291	2 021

dary effluent, though gravel and sand are relatively inefficient as phosphate absorbent media.

ECONOMICS

According to the report the estimated present day costs for the alternatives for treating raw sewage as well as those for improving secondary effluents of poor quality are shown in table 1.

The present worth of each scheme has been calculated for the projected cash flow over a period of 30 years. It has been assumed that the systems will operate at full load over this whole period. A complete range of discount rates has been used to take into account different economic conditions. See table 2

The discount rate does not effect the relative worth of the four schemes that are compared.

The oxidation pond system has the

lowest present worth. This is not surprising as the quality of the effluent from an oxidation/maturation pond system will not comply with the General Standard as set out in Government Gazette Notice no 991 of 18 May 1984. The presence of algae will raise the concentration of suspended solids and with it the chemical oxygen demand and oxygen absorbed values to between two to three times the permitted standard. E. coli counts of less than 1 000 per 100 ml are the best that can be expected. The cost of additional wetlands to improve the effluent to an acceptable standard will bring the present worth of this system to values very similar to that for a constructed wetland preceded by anaerobic ponds.

The report says too little is known as to the adsorptive capacity of phosphate deficient media, the period and phosphate load that can be reached prior to saturation and loss of adsorptive capacity. For economic comparative

Wetland system treating secondary effluent

	Wetlands for nutrient removal (Rands)	Wetlands for effluent polishing (Rand)
Net total civils	614 000	603 000
Allow for contingencies	61 000	60 000
Allow for price adjustment	92 000	90 000
Engineering fees, etc.	95 000	94 000
	862 000	847 000

purposes the researchers have assumed this will be ten years. They have also assumed the use of clinker which has a high adsorptive capacity and is very porous. The use of clays which have good adsorptive properties would for hydraulic reasons increase the size of the beds enormously although not necessarily the cost, provided local clays could be suitably used.

The effluent polishing system is to improve the quality of secondary effluents from biofilter plants or from an oxidation pond system. It has been designed as an "add-on" to an existing oxidation pond system and not in combination with such a system as differing results could be expected.

CONCLUSIONS

The report says there is still a great deal

to be learnt and understood concerning the very complex reactions taking place within an artificial wetland system. Design criteria are at this stage very tentative and the required effluent quality objectives may not be met at the design loading rates. The report says that experience overseas in this regard has been most erratic. The costs of the wetland systems are relatively high as the result of the assumption that suitable porous media would have to be imported and obtained from commercial sources. Should local circumstances be favourable, great savings can be made in minimising excavation and making best possible use of the local resources in order to achieve the required design. Such an approach may take up more land than more expensive designs would require.

Despite the imponderables, artificial wetland systems nevertheless have a

A WOOD
P PYBUS

ARTIFICIAL WETLAND USE FOR WASTEWATER TREATMENT THEORY, PRACTICE AND ECONOMIC REVIEW

Report to the
WATER RESEARCH COMMISSION
by the
DIVISION FOR WATER TECHNOLOGY, CSIR and
STEWART SCOTT INC.

WRC Report No 232/1/93

place in sewage treatment technology. They are not suitable for treating raw sewage, but can be used successfully to treat raw sewage which has either passed through an anaerobic pond system or some form of primary treatment, i.e. with septic tanks. The construction should whenever possible be appropriate making maximum use of local materials and resources.

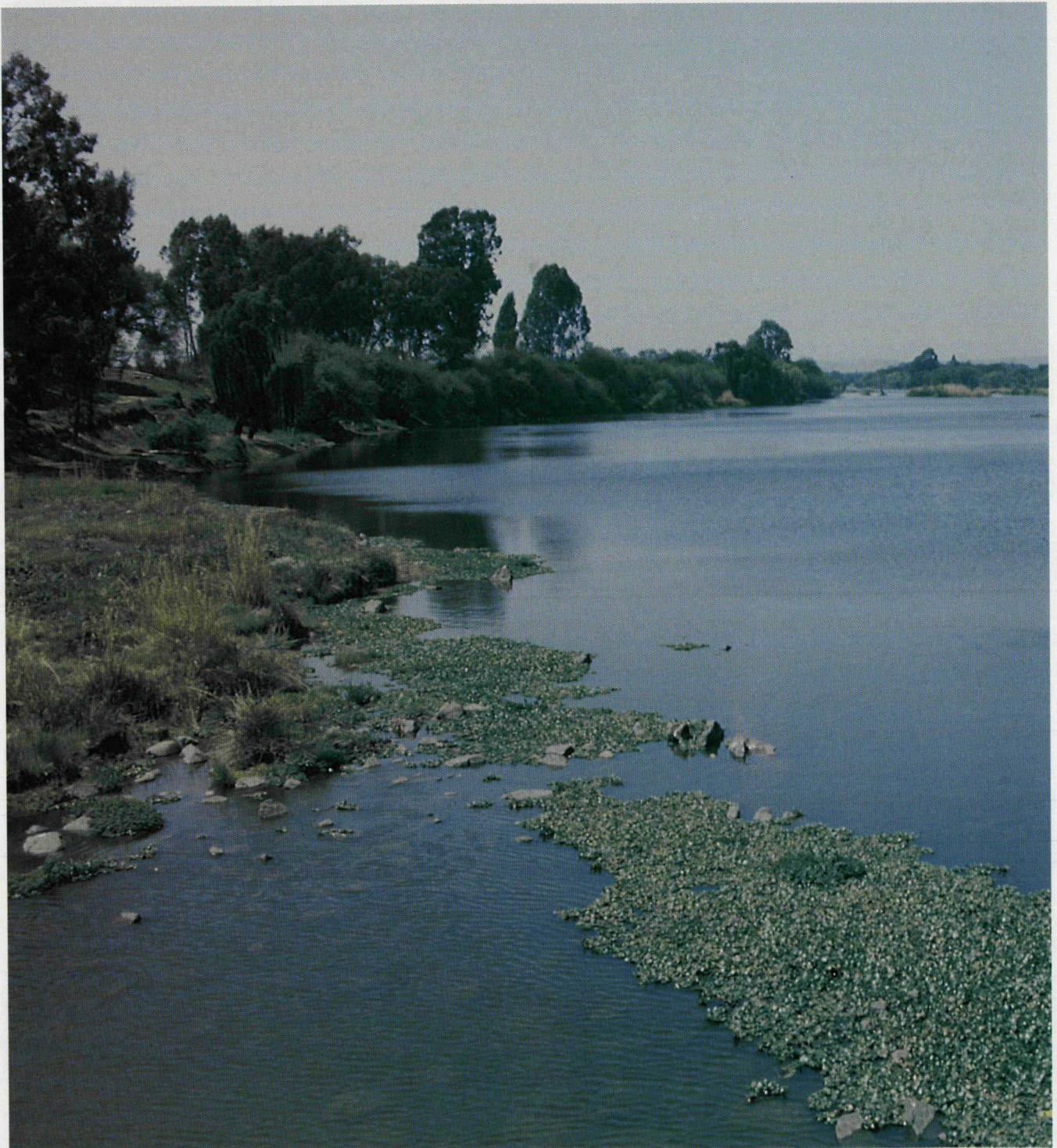
The report says factors not taken into account in the design of these pond and wetland systems are the water losses to the main soil body which will occur. These losses may be very significant where the ponds are constructed over semi-permeable materials of very low natural moisture content. Initial filling of the systems may take many months or even years in saturating the local soil body. In European practice use has been made of geomembranes to line the pond systems. These would become prohibitively expensive and could not be justified unless the effluent has a high economic value.

Artificial wetlands are complex biological physical systems that are as yet little understood. In consequence, the report concludes, the design criteria are tentative only. The successful application of one set of criteria on a particular site does not mean that the same set will be applicable elsewhere. Nor should they be regarded as an alternative low cost sanitation system as they presuppose a water borne sewerage scheme with a concomitant water supply.



Experimental reedbeds at Daspoort Wastewater Treatment Works in Pretoria.

Report on a comparative study of different oxidants used in the treatment of Lower Vaal River Water



A research project sponsored by the Water Research Commission has attempted to focus on water treatment in the Lower Vaal River regions where the increased levels of pollution emanating from the PWV area is resulting in particular water treatment problems to the water authorities and municipalities who rely on the Vaal River for their water supply.

The project was carried out by IA Pearson and CD Swartz of the CSIR's Division of Water Technology in collaboration with the Western Transvaal Regional Water Company and Floccotan (Pty) Ltd.

Some of the problems being encountered are algal blooms at certain times of the year, high manganese levels, high trihalomethanes (THMs) in the final treated water, tastes and odours and continued biological activity in the distribution pipelines. THM levels are often above the present USA limit of 100 µg/l. Algal blooms cause rapid changes in raw water pH and the algae are difficult to remove from the water in the treatment process. Manganese too is difficult to remove by conventional means and chlorine is much less effective as an oxidant and disinfectant at the higher pH's encountered.

According to the researchers the use of alternative oxidants to chlorine was seen as a possible way to overcome some of these problems. The Western Transvaal Regional Water Company on the Lower Vaal River was already using ozone for pre-oxidation on one leg of their water treatment plant at Stilfontein. It was possible to compare the water quality from the two legs of the plant, that is, with chlorine and ozone pre-oxidation respectively. In addition a pilot plant which had been "moth balled" was available to carry out further comparative work. The use of chlorine dioxide as a pre-oxidant was implemented on the pilot plant so that comparisons could be made with the two legs of the main plant. The researchers say it was expected that chlorine dioxide would result in substantially less trihalomethanes being formed in the treatment process. Other benefits of the use of chlorine dioxide were also expected.

RESULTS

The results of the study indicated that while some parameters showed a signifi-

	ClO_2 ClO_2	ClO_2 Cl_2	Cl_2 Cl_2	O_3 ClO_2	O_3 Cl_2
THM formation	*	***	*****	**	*****
Chlorophyll removal	*****	*****	*****	*****	*****
Algal cell damage	*****	*****	*****	*****	*****
Manganese removal	*****	*****	*****	*****	*****
Iron removal	*****	*****	*****	*****	*****
TOC removal	*	*	*	*	*
Biofouling control	**	**	**	-	-
Disinfection	*****	*****	*****	*****	*****
Operational costs	*	**	*****	*****	*****
Capital costs	*****	*****	*****	*	*
Total costs	*	**	*****	**	**

Table 1: Results of the different treatment sequences

Note: The three streams with chlorine and ozone as pre-oxidants were also treated with between 0,1 and 0,8 mg/l of potassium permanganate to aid manganese removal in particular.

* implies low efficiency or high costs

***** implies high efficiency or low costs

, * and ***** are relative positions between these two extremes

cant improvement of the treatment process for eutrophied source waters, others were less significant. The additional costs associated with the use of alternative oxidant combinations would need to be carefully assessed against the benefits which will be achieved before a decision on the use of such alternatives is taken.

Table 1 indicates the relative performance of the various combinations in terms of the parameters measured.

The results from the use of different combinations of oxidants at Stilfontein on the Lower Vaal River can be summarised as follows:

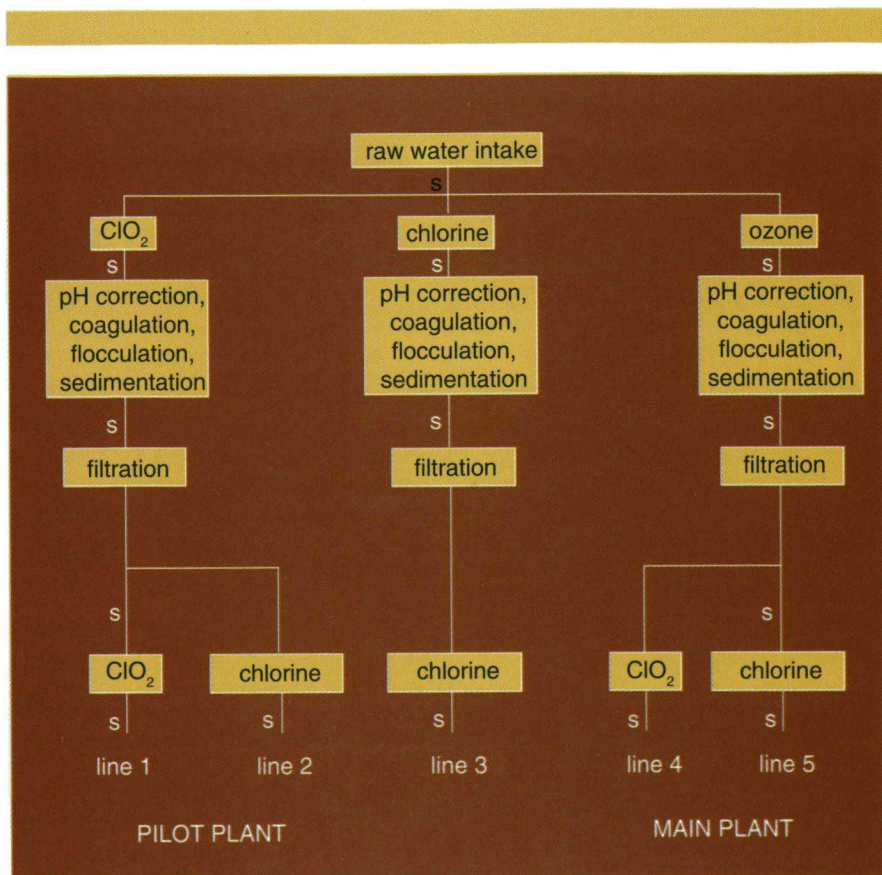
□ **Chlorine dioxide pre-oxidation - chlorine dioxide post-disinfection (ClO_2 - ClO_2):** THM formation is significantly minimised (when compared to the other treatment lines) to values well within the 100 µg/l level (average of 20 µg/l). Algae deactivation and subsequent chlorophyll removal are very effective. Manganese and iron removal are good – without the aid of potassium permanganate. Biofouling is controlled to a limited extent in the raw water lines. Disinfection is excellent. Running costs, however, are extremely high, about R110/Ml.

□ **Chlorine dioxide pre-oxidation - chlorine post-disinfection (ClO_2 -**

Cl_2): THM formation is minimised to values at the 100 µg/l level. Algae deactivation and subsequent chlorophyll removal are very effective. Manganese and iron removal are good – without the aid of potassium permanganate. Biofouling is controlled to a limited extent in the raw water lines. Disinfection is excellent. Running costs are also very high due to the high cost of chlorine dioxide.

□ **Chlorine pre-oxidation - chlorine post-disinfection (Cl_2 - Cl_2):** THM formation is high with values well above 100 µg/l level (average 155 µg/l). Algae deactivation and subsequent chlorophyll removal are very effective. Manganese and iron are good – but with the aid of potassium permanganate. Biofouling is controlled to a limited extent in the raw water lines. Disinfection is excellent. Running costs are low, about R13/Ml.

□ **Ozone pre-oxidation - chlorine dioxide post-disinfection (O_3 - ClO_2):** THM formation is low (average of 57 µg/l), although slightly higher than for the chlorine dioxide pre-oxidation and post-disinfection treatment configuration. This is primarily due to the fact that no free chlorine is added to the water. However, chlorine dioxide and ozone will convert bromides to free bromine and hence result in some THM formation. In addition the ozone



Pilot and main plant treatment block diagram (note: s refers to sampling points)

treated stream on the main plant is not totally isolated from the chlorine treated stream, and hence some of the THMs measured may have resulted from the chlorine treated stream. Ozone was the most effective for chlorophyll removal, despite cell damage often appearing to be only slight. Manganese and iron removal are good, again in combination with potassium permanganate. Biofouling is not controlled with pre-ozonation and may even be slightly enhanced. Excellent disinfection was achieved. Running costs are medium when compared with the other treatment options. Capital costs for the generation of ozone are very high and make a significant impact on the overall cost of ozone treatment. However, the total costs (about R67/M) are significantly less than when chlorine dioxide is used for pre-oxidation.

- **Ozone pre-oxidation – chlorine post-disinfection ($O_3 - Cl_2$):** THM formation is the highest of all the treatment combinations (average of 160 $\mu g/l$) although only slightly higher than the chlorine pre-oxidation and

post-disinfection treatment configuration. Ozone, as found in other studies reported in the literature, increases the formation of THMs when post-treated with chlorine. This is most likely due to the modification of the organics present when exposed to ozone, so that they become more susceptible to THM formation. However, the effect when compared to chlorine pre-oxidation is only slight. Chlorophyll removal was very good through pre-ozonation. Manganese and iron removal, with the aid of potassium permanganate, are very good, maintaining levels well below 0.1 mg/l. Biofouling is the same as for ozone treatment. Disinfection was excellent and running costs low. However, capital costs for the generation of ozone are very high and make a significant impact on the overall cost of ozone treatment (about R48/M).

CONCLUSIONS

- The use of chlorine dioxide does result in a substantial reduction in the

formation of THMs when treating enriched Lower Vaal River water for domestic use. In particular, the combinations $ClO_2 - ClO_2$ and $O_3 - ClO_2$ resulted in THM levels well within the 100 $\mu g/l$ level which is set as the maximum in the USA.

- When chlorine dioxide was used as a pre-oxidant with chlorine for final disinfection, THM levels were relatively high (100 $\mu g/l$). The literature has reported that the $ClO_2 - Cl_2$ combination can result in substantial THM reductions. However, the high total organic carbon levels in the raw water (10 - 15 mg/l) is probably responsible for the higher than expected THM levels in this stream.
- Pre-ozonation does appear to increase the trihalomethane formation potential of the water obtained from the Vaal River at Stilfontein. Hence post-chlorination of ozone treated water results in even higher THM formation than for the $Cl_2 - Cl_2$ treatment.
- The presence of bromides in the raw water will result in some formation of THMs, even when only ClO_2 is added for oxidation and disinfection.
- Algal cells were successfully removed by all the treatment lines being evaluated. Chlorophyll removal of more than 95 per cent was consistently achieved. Overall, ozone treated water gave slightly better chlorophyll removal than chlorine or chlorine dioxide.
- Algal cell damage and internal bleaching was evident for all pre-oxidants. Overall, chlorine dioxide appeared to result in more severe damage than the other two oxidants.
- Manganese was substantially removed by all treatment lines, although better results were obtained on the ozone-potassium permanganate and chlorine-potassium permanganate treatment sequences. Levels of >0.1 mg/l were not found in the final water.
- Iron, although less successfully removed than manganese, was generally within the limits in the final waters (i.e. <0.1 mg/l).
- Organic carbon was not significantly removed in any treatment process. However, some modification of the organics present was taking place as a

I A PEARSON
C D SWARTZ

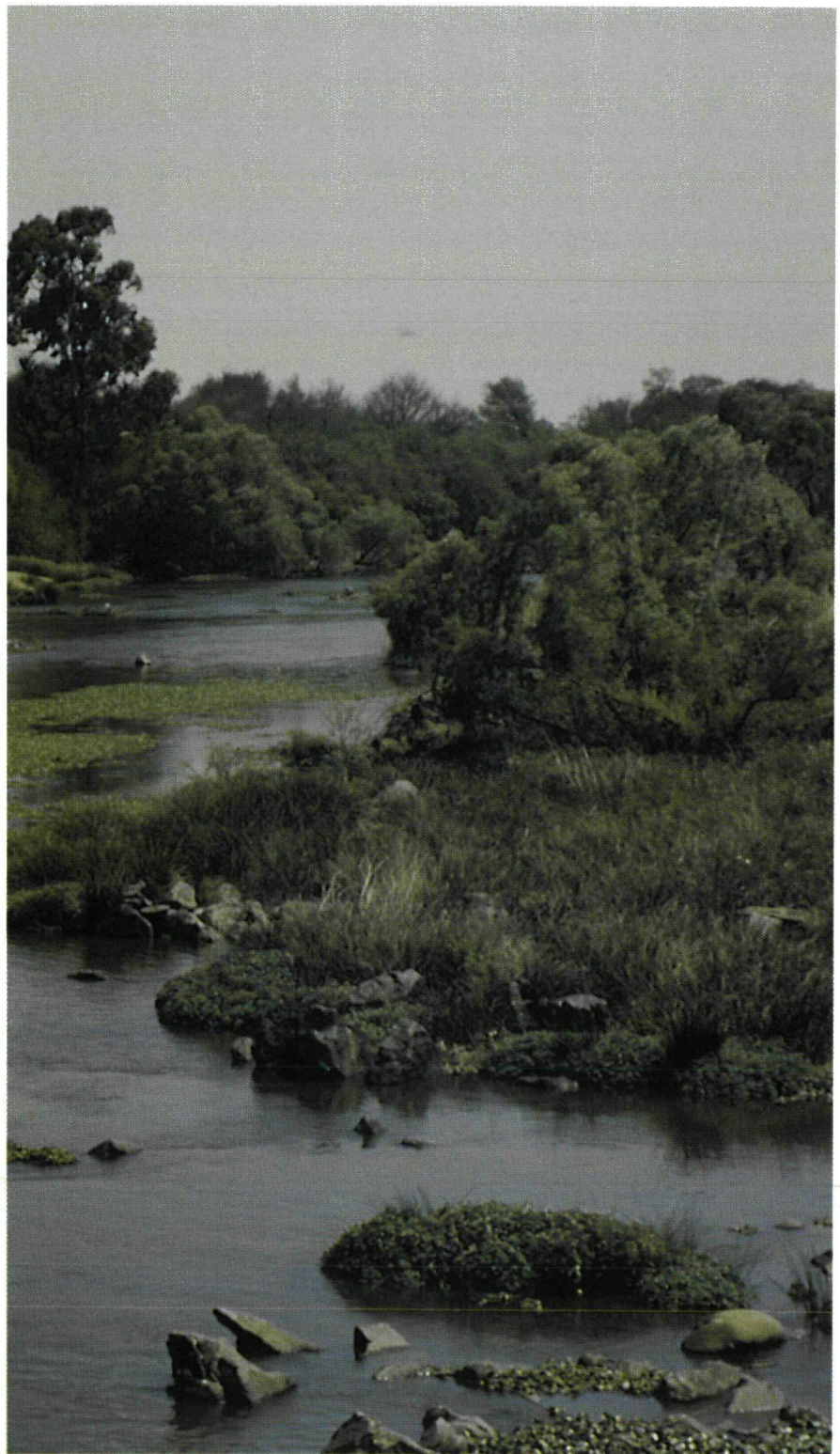
**A COMPARATIVE STUDY OF CHLORINE DIOXIDE AND
OTHER OXIDANTS IN POTABLE WATER TREATMENT**

Report to the
Water Research Commission
by the
DIVISION OF WATER TECHNOLOGY, CSIR

WRC Report No 247/1/93

result of the different oxidation treatments. Chlorine addition tended to result in chlorine addition type reactions, whereas ozone and chlorine dioxide tended to result in oxidation of the organics (i.e. breaking of some of the bonds).

- It was not possible to limit the formation of chlorine dioxide by-products (chlorite and chlorate) and still achieve adequate treatment of the Vaal River water when chlorine dioxide is used as the pre-oxidant. Chlorine dioxide doses of up to 3,5 mg/l are required for pre-oxidation and 1 mg/l for post-disinfection, resulting in combined chlorite and chlorate levels of up to 3,5 mg/l. This is far in excess of the recommended maximum of 1 mg/l.
- Chlorine and chlorine dioxide were able to reduce the formation of biological slimes in the pipelines following pre-oxidation. However, ozone addition enhanced the formation of bacterial slime layers after a short distance from the point of ozone addition. Chlorine and chlorine dioxide were able to limit bacterial slimes more easily on stainless steel and PVC surfaces than on mild steel surfaces.
- The cost of using alternative oxidants to chlorine was found to be substantially higher. Overall costs for oxidation and disinfection were in the ratio 1.0 : 3.5 : 5.0 : 6.0 : 8.5 for the treatment lines Cl_2 - Cl_2 : O_3 - Cl_2 : O_3 - ClO_2 : ClO_2 - Cl_2 : ClO_2 - ClO_2 .



Copies of the report summarising this research project - **A comparative study of chlorine dioxide and other oxidants in potable water treatment (WRC report 247/1/93)** - are available free of charge from the Librarian, Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: \$20.

Navorsers kyk na moontlikheid van membraankarakterisering

'n Behoefte het op die gebied van membraantegnologie ontstaan om maklik meetbare, vergelykende en betroubare parameters te vind vir verskillende tipes membrane, aldus navorsers aan die Departement Chemiese en Meganiese Ingenieurswese van die Potchefstroomse Universiteit vir CHO.

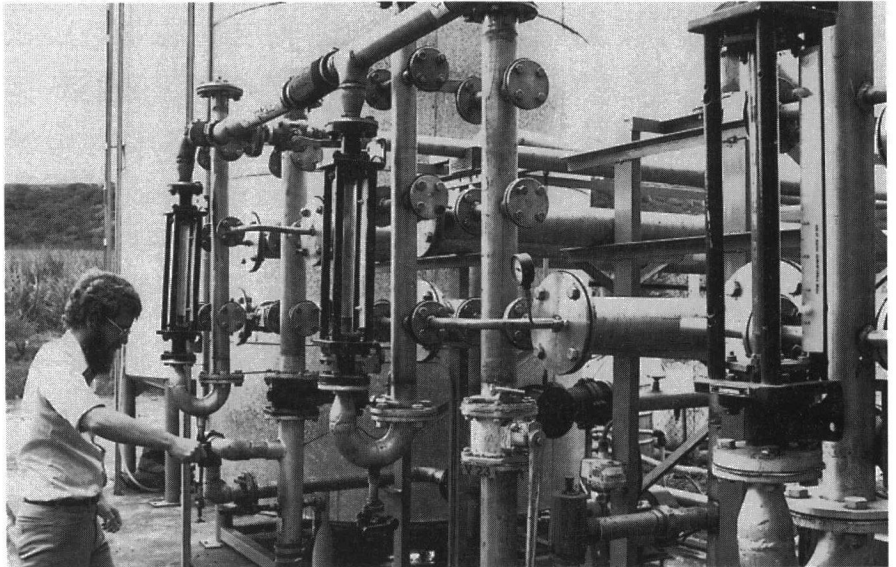
Die navorsers, JJ Smit, JP Meyer en OJ van der Schijff, sê in 'n kontrakverslag aan die Waternavorsingskommissie oor membraankarakterisering dat die gebruik van sintetiese membrane vir die ontsouting of suiwing van water reeds wêreldwyd goed gevestig is.

Tot dusver het membraantegnologie hoofsaaklik staat gemaak op die daarstelling en ontwikkeling van sintetiese membrane wat eksperimenteel geëvalueer en gekarakteriseer is. Daar bestaan egter 'n behoefte om maklik meetbare en betroubare vergelykingsparameters vir die membraantegnologie te vind. Dit is ook nodig om vir die ontwerp van 'n volledige membraanstelsel die volgende aspekte te optimaliseer:

- ☐ Die behouering waarin en waarmee die membraan bedryf moet word;
- ☐ Die dinamiese vervorming van die membraan;
- ☐ Die uitwerking van sulke vervorming op die membraan se deurlaatbaarheid, asook die polarisasiekonsentrasie in die grenslae en die optimale bedryfsiklus om onomkeerbare plastiese kompressie te verhoed;
- ☐ Die bepaling van vloe-, druk- en temperatuur-eienskapsprofile in die stelsel, asook in die membraan self.

METODES

Die navorsers sê 'n uiters kragtige berekeningsvloeiemeganika rekenaar-pakket is gebruik om die massa-oordrag, momentum-oordrag, chemiese reaksies



en vloe deur 'n vooraf geselekteerde membraanstelsel te ondersoek.

Die meting van bepaalde elektrochemiese eienskappe van 'n verteenwoordigende membraan kan moontlik tot die karakterisering van so 'n membraan onder dinamiese toestande lei. Vloei in en deur 'n membraan kan met behulp van berekeningsvloeiemeganika geoptimeer word.

Die navorsers sê snelheidsprofile, drukprofile, viskositeitswaardes en temperatuur word gebruik om die stelsel in makrovloei te ondersoek, te rasionaliseer en te optimaliseer, terwyl elektrochemiese impedansie-spektroskopie gebruik word om die porositeit van membrane onder dinamiese toestande te bepaal.

RESULTATE

- ☐ 'n Hidrodinamiese karakteriseerbare sel is ontwikkel vir die elektrochemiese metings en die plasing van die meetelektrodes is geoptimeer.
- ☐ Die formaat en geskikte materiaal vir die vervaardiging van elektrodes is ondersoek.

- ☐ Die geskiktheid van die opstelling van die toerusting vir die elektrochemiese karakterisering van die membrane is bestudeer.
- ☐ Eindige element analise is gebruik om die deformasie van die membraan te ondersoek.
- ☐ Tegnieke in berekeningsvloeiemeganika is gebruik om vloei-verdeling, spannings en vervormings van 'n holvels-membraan suksesvol numeries te bepaal.

As gevolg van die sukses van hierdie voorlopige uitvoerbaarheidstudie is 'n opvolgprojek deur die Waternavorsingskommissie gefinansier. Dit sal die navorsingspan in staat stel om in die volgende twee jaar 'n meer omvattende projek volledig af te handel.

Afskrifte van die verslag getiteld '**Uitvoerbaarheidstudie op membraankarakterisering deur elektrochemiese metings en membraanoptimalisering met berekeningsvloeiemeganika** (WVK verslag 431) is gratis beskikbaar vanaf die Waternavorsingskommissie, Posbus 824, Pretoria 0001.



ENVIRONMENTAL INFORMATION AS A STRATEGIC TOOL

With the re-admission of South Africa to world markets, businessmen and industrialists are becoming aware that the environment is one of the most important issues which will have to be considered in the near future. New terms such as Environmental Impact Assessment (EIA), Waste Minimisation, Clean Production, Best Available Technology Not Entailing Excessive Cost (BAT-NEEC) and Environmental Audit are in common use and it is essential to understand how international environmental regulations are likely to affect South African businesses.

Many aspects of a company's business will have to be re-evaluated in the light of new environmental requirements. At the planning stage of a new project for example, this could include the manufacturing processes, waste/effluent control, product registration, and the image of the company. Up-to-date information on such requirements should also be of great value for trouble-shooting, monitoring new developments and competitive advantage.

The South African Water Information Centre (SAWIC) recognises that water should be regarded in the context of the total the environment, and staff liaise closely with sources of environmental information in order to provide information which is relevant and up-to-date. This information is gleaned from a range of local and international sources including scientific and technical journals, newspapers, trade journals, computerised databases, a wide selection of technical reports, including those of the USA Environmental Protection Agency (EPA), the World Bank and the European Economic Community (EEC) and contact with environmental experts.

Typical requests for information include:

- ☐ General information on the environment as a whole. This includes references relating to water, air, soil, waste and the marine environment.
- ☐ Assistance with the preparation of

state-of-the-environment reports by identifying relevant information sources for:

- geographical regions
- catchment areas
- urban regions, etc.

- ☐ Information on the long- and short-term environmental effects of:

- water pollution
- air pollution
- soil contamination
- waste generation
- human activity

- ☐ The effects that proposed environmental legislation may have on:

- industries
- city councils
- provincial authorities

- ☐ Relevant information (in particular for companies preparing for an environmental audit) on:

- clean production
- waste management
- wastewater management
- pollution prevention
- recycling and the re-use of materials

- ☐ New regulations which have come into effect since South Africa's ratification on the Basle Convention on the handling of hazardous wastes. These deal with:

- waste handling
- waste treatment
- waste transportation
- waste disposal

You are more than welcome to contact the staff of the South African Water Information Centre (SAWIC) to discuss your requirements for information on water or environmental issues at Tel. (012) 841-3083/2048).

Institute of Hydrology

HYRAD

A radar rainfall preprocessing, calibration, forecasting, catchment averaging and display system for hydrological use.

The Institute of Hydrology in the United Kingdom has recently integrated its radar rainfall preprocessing, calibration, forecasting and catchment averaging procedures into a single software package called HYRAD. HYRAD employs these procedures as the Radar Hydrology Kernel of a Windows 3.1 based radar data reception, processing and display system.

The system supports the following functions:

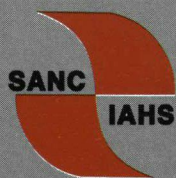
- Radar preprocessing to correct for static anomalies and transient clutter.
- Radar calibration by raingauges.
- Radar rainfall forecasting, using either calibrated or uncalibrated fields.
- Calculation of rain-fall fields from raingauge networks data alone.
- Calculation of catchment average rainfalls from uncalibrated, calibrated or forecast radar rainfall or raingauge network data.
- Static and rapid replay of radar images (uncalibrated, calibrated or forecast) along with overlay information on raingauge location, river networks, catchment boundaries, coastlines and other feature data.
- Real-time reception of 2 km, 5 km network and other radar types. A radar data archiving facility.

For VAX (or UNIX) applications a client-server architecture is used in which the Radar Hydrology Kernel and data reception and archiving software run on the VAX (or UNIX) computer. A PC (desktop or portable, colour or monochrome) running under Windows 3.1 provides a menu-driven management and visualisation interface.

For further information, please contact:

Bob Moore, Institute of Hydrology, Maclean Building, Wallingford, OXON, OX10 8BB,
United Kingdom.

Tel: 0491 38800. Fax: 0491 32256.



NATIONAL HYDROLOGY SYMPOSIUM 1995

By now everyone should be aware that the next SANCIAHS National Hydrology Symposium is to be held in Grahamstown during 4 - 6 September, 1995. The initial organisation of the symposium is well advanced and the First Announcement was distributed with the previous issue of SA Waterbulletin. The local organising committee (staff of the Institute for Water Research at Rhodes University) are very grateful to the WRC and particularly the editorial staff of SA Waterbulletin for allowing us to distribute the symposium announcements in this way. The overall theme will be **Hydrology and Water Resources in Southern Africa** and we hope to attract as many participants from the rest of the region as possible.

The format of the previous National Hydrology Symposia have all been very similar and the seventh will not deviate greatly from the pattern. However, there will be a few minor changes to try and improve further on what has come to be one of the main events on the South African hydrological calendar.

The first change relates to the publication of the proceedings. The local organising committee recognise the importance of the delegates being able to take away with them a copy of the papers presented at the symposium. However, the publication costs are increasing every year and pushing up the registration fee for the symposium. We are also moving closer to (or have arrived in) the era of 'electronic media' and therefore intend to distribute the proceedings on disk. We

haven't decided exactly how yet, but are looking into it.

The second change relates to the format of the sessions. A number of participants in previous symposia have remarked on the limited amount of formal time that is usually available for discussion. This is usually due to a very full programme of papers. In an attempt to increase the amount of time for group discussion and feedback on presentations we have decided to extend the 1995 symposium by half a day and not bother with a field visit. We have also decided to have two types of parallel sessions or workshops. The first type will be verbal paper sessions (as normal), while the second will be short presentations of poster type papers within a session which will include poster viewing time, a summary by a rapporteur as well as time for general discussion.

The suggested format will allow for about 10 papers over three plenary sessions, 30 verbally presented papers over 8 sessions held in parallel, and 40 poster paper type presentations over 6 parallel sessions. This indicates that we will be able to accept about 80 abstracts compared to the 94 papers and posters given at Pietermaritzburg in 1993. Each session or workshop will have a clearly identifiable theme in an attempt to further concentrate and stimulate discussion. The actual themes chosen will be very much determined by the scope of the subject matter covered in the submitted abstracts. At a later date we will be

looking out for session chairpersons who are willing to act as rapporteurs and stimulate discussion.

The first announcement provides all the details about deadlines, which I would like to remind prospective authors, will be strictly adhered to. We are trying to attract some exhibitors (equipment, computer hardware and software, etc.) to attend and are also on the look out for potential sponsors to try and keep down the costs. As we are aware that Grahamstown is somewhat off the beaten track, we are also investigating the possibility of keeping airfares to a minimum through group travel arrangements, as well as looking at offering transport from Port Elizabeth. More details on such arrangements will be available later when we issue the second announcement.

Either myself or Mrs Juanita Mclean can be contacted at the address, telephone or E-Mail given below for further information, comments (constructive please) or suggestions. We look forward to receiving your abstracts and to seeing you all in Grahamstown once again.

Denis Hughes

Institute for Water Research
Rhodes University
P.O.Box 94,
Grahamstown, 6140
Tel: 0461-24014
Fax: 0461-24014 (ask for fax)
E-Mail: Prof. Hughes: denis@iwr.ru.ac.za
Mrs Mclean: juanita@iwr.ru.ac.za

SA HYDROLOGY OUTREACH INTO AFRICA

Professor Roland Schulze and Jeff Smithers of the Department of Agricultural Engineering at the University of Natal were invited to Kenya in May to participate in an international workshop on "Natural Resources Systems Modelling". Their week long trip was made possible by the Rockefeller Foundation and the Swiss Science Foundation, who sponsored the work-

shop. Kenya's Laikipia Research Programme has initiated a programme aimed at developing computer simulation management tools for sustainable resources management centred around hydrology, water resources allocation and crop production. The workshop aimed at identifying model user needs, demands and constraints, at formulating expectations of model users and developers

and at exchanging information on existing models, opportunities and constraints. Between them Schulze and Smithers gave four papers and demonstrated the capabilities of the ACRU model for Kenya's water problems in the Laikipia Province. A Ph.D. student from Kenya is joining the Department of Agricultural Engineering, University of Natal later this year.

US dewatering system sold in SA

The US Som-a-Press dewatering process which can be used on many different materials, is now available in South Africa.

Designed for plants with sludge flow rates up to 18 000 l/h, its applications include municipal sewage sludges, pulp and paper mill, textile mill and food processing sludges, cattle and dairy waste, dewatering of air flotation froth and spent grain stillage (alcohol and beer).

A skid-mounted Som-a-system includes a polymer conditioning system, one or two enclosed Som-a-presses, control panel, piping, valves, instrumentation and an optional sludge-feed pump. The press and its outer housing is made from 304 stainless steel and all parts are easily accessible.

Electronic control includes complete system operation: from feed pump to press speed adjustment.

With just one moving part, the press is the heart of the Som-a-system, providing almost maintenance free operation. The

feed enters the inlet flange and a variable speed auger carries the waste stream vertically along a dewatering barrel with most of the free liquid discharging through screen openings.

As solids are conveyed upwards, they build up, forming a plug. The solids are pushed from the discharge chute by a revolving plug cutter and fall directly into a haul-away truck or conveyor. The pressate passes through screens to the baseplate where it discharges through a nozzle.

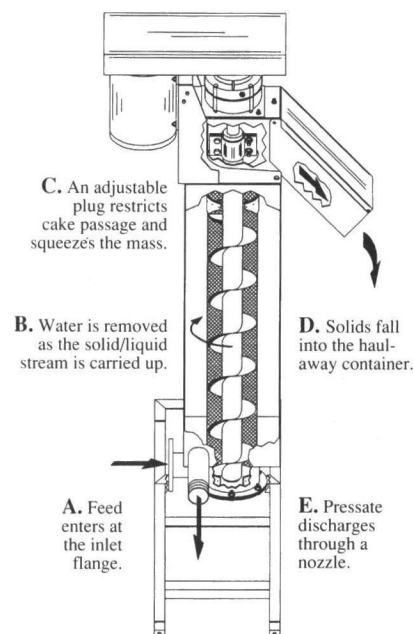
Continuous wash water is not required in the system which reduces water consumption considerably. The screen surfaces are cleaned by a fibre brush.

Space requirements are kept to a minimum and the system can be trailer mounted.

For further enquiries, please contact :

Mr P Sampson, Delkor Technik (Pty) Ltd,
PO Box 52864, Saxonwold 2132.

Tel (011) 444-1260. Fax (011) 444-2317.



A diagrammatic illustration of the Som-a-Press dewatering process.

Cancer drug tested

A cancer-fighting compound from the sea could become an anti-tumour drug, according to Water Newsletter (161293).

Bryostatin 1, obtained by grinding and purifying a small sea creature called *Bugula neritina*, can halt the proliferation of human leukemia cells growing in a petri dish and can shrink skin tumours in mice, the publication says. In a recent trial, various doses of the drug were given to 35 people who had advanced malignant tumours. Bryostatin 1 showed a trace of effectiveness in two malignant melanoma cases – treatment showed tumours shrank by at least 50 per cent and remission lasted up to ten months in one case.

Bryostatin 1 stimulates activity of protein kinase C, an enzyme that regulates cancer cell growth, and may also trigger the immune system's attack on malignant cells.

Fusegates for Shongweni

Umgeni Water has placed an order with the French firm Hydroplus International for fusegates to equip the Shongweni Dam near Durban.

According to Stewart Scott, the consulting engineers, this 66 year old dam must be upgraded to comply with revised dam safety standards. The Hydroplus fusegates will make it possible to triple the capacity of the spillway without significantly reducing the full supply level of the reservoir. The fusegates will be 100 per cent built in South Africa.

During the 1994 ICOLD congress on large dams, which will be held in Durban, delegates will have the opportunity to visit this prestigious project.

Leachate collection network protects groundwater

A sophisticated network of leachate collection and monitoring systems will ensure that there is very little chance of Waste-Tech's hazardous waste disposal facility at Chloorkop, near Johannesburg, presenting any threat to groundwater resources.

This was the message from a paper recently delivered at the Environmental Management and Technology Development conference held in Johannesburg.

Examining measures taken to ameliorate the environmental impact of the facility, Jeremy Boswell and four co-authors said contaminant escape to groundwater would be prevented by a multiple layer protective clay liner system, leachate collection and removal drains, leachate detection layers and an extensive system of monitoring boreholes.

Sewage effluent used as process water

The Sappi fine paper mill in Port Elizabeth successfully installed a system for reclaiming secondary sewage effluent as process water.

Sappi decided to make use of this water source because Port Elizabeth is located in a low rainfall region and is often subject to water restrictions which negatively affects the local industry.

As the city's secondary treated sewage effluent is available to industry at about half the cost of distributed potable water, Sappi decided to upgrade this water to paper making standard.

An effluent treatment plant with a capacity of 3 500 m³/day was designed and installed by Explochem Water Treatment (Pty) Ltd. The treatment objectives are the removal of phosphates, suspended

	Dye Effluent	Latex Effluent	Product
pH	4 - 5	7	7
Suspended solids mg/l	1 500	5 500	100
COD mg/l	21 000	28 000	2 700
Colour Hazen	10 000 (approx)	300	100

solids and colour to a fine paper making standard. Treatment consists of a three-step process: chemical coagulation with alum and pH correction, dissolved air flotation and rapid gravity sand filtration.

The plant has been operating effectively with about 95 per cent availability. The actual concentration of phosphate in the

feed is about five times the design concentration, but this had been successfully accommodated by increasing the alum dose. The DAF sludge is discharged to sewer in order to prevent buildup of phosphates in the system.

The qualities of the feed and production flows are presented in the table above.

First report published on all SA marine and coastal research.

The Department of Environment Affairs published the first report ever in which coastal and marine research undertaken during the last 15 years in South Africa is documented. The report **A management perspective of marine and coastal research carried out in South Africa** gives a holistic picture of all coastal research, excluding research done by the Sea Fisheries Institute.

Almost 1 000 research projects on marine and coastal research from 1975 to 1991 in are discussed. Analyses of the research and its relevance from a management perspective are made for the South African oceanic environment and the entire coastal environment.

The report is available free of charge from the Department at tel (012) 310 3842.

Water purification: Iodine replaces chlorine

A new water purifying system uses iodine instead of chlorine to disinfect water. Invented and engineered by Gerald V. Colombo of Umpqua Research Company (Myrtle Creek, OR, USA) the system was originally designed for use in NASA's long space missions.

Water Newsletter (160594) reports that until this system was invented, iodine was not convenient for large-scale purification efforts because it is solid at room temperature and not very soluble. In the new system, iodine is suspended in a bed of tiny plastic beads made of an ion-exchange resin. Water is disinfected as it passes through the beads. The unit recharges the resin bed by diverting water through a channel of iodine crystals to produce a concentrated iodine solution. The solution is then funnelled to the beads, which soak it up.

The Newsletter says that Vector Environmental Technologies, Inc. (Sparks, NV) has been sublicensed to sell the units. The technology can be used in remote areas to purify drinking water without chlorine.

"You can't just go out and look at fishes, as you can with mammals and birds, so most South Africans know very little about our freshwater fishes," says Dr Paul Skelton, the author of the recently published book "The complete Guide to Freshwater Fishes of Southern Africa".

Dr Skelton is Curator of Freshwater Fishes at the JLB Smith Institute of Ichthyology at Rhodes University, Grahamstown.

The book, the first in the field since 1967, was written to give an informed and comprehensive account of our freshwater fishes. It is not aimed at ichthyologists, although they will find it a useful reference, but as a guide to anyone interested in fishes.

It is the first book of its kind to be published in Afrikaans as well as English and is available in both soft and hardback.

"Most people know that there are plenty of fishes in our rivers," Dr Skelton said. "However, many would be able to identify only about twenty species, because they have no detailed knowledge about what they are looking at."

The book covers Southern Africa from the Kunene, Okavango and Zambezi and includes Zambia, Angola, Zimbabwe and part of Malawi and countries to the south. More than 240 extremely diverse fish species are covered. The strength of the book is that it is profusely illustrated. There is an accurate colour drawing for each species and size, while angling sizes and range are indicated for each. There are also distribution maps. The painstaking paintings of the fishes were done by Liz Tarr and Dave Voorveldt.

The book has been published by Southern Books and is available throughout the country.

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.
- x 3rd SA Water Event scheduled for these dates.

See conferences and symposia pages for events.

Die Watnavorsingskommissie 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
Faks: (012) 331-2565

Gids:

- Een SA Watergeleentheid vir hierdie dae.
 - 'n Tweede SA Watergeleentheid gereël vir dié datums.
 - x 'n Derde SA Watergeleentheid gereël vir dié datums.
- Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

1994

APRIL 1994

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

MAY 1994

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

JUNE 1994

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

JULY 1994

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

AUGUST 1994

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

SEPTEMBER 1994

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

OCTOBER 1994

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

NOVEMBER 1994

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

DECEMBER 1994

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



1995

JANUARY 1995

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

FEBRUARY 1995

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

MARCH 1995

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

APRIL 1995

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

MAY 1995

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

JUNE 1995

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

JULY 1995

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

AUGUST 1995

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

SEPTEMBER 1995

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

OCTOBER 1995

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

NOVEMBER 1995

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

DECEMBER 1995

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

SOUTHERN AFRICA 1994

CORROSION CONTROL AUGUST 29 - 31

The sixth international corrosion conference entitled "Cost effective corrosion control into the 21st century" will be held at the Elangeni Hotel in Durban.
Enquiries: SA Corrosion Institute, PO Box 77, WITS 2050. Tel (011) 802-5145 Fax: (011) 804-3484.

AQUACULTURE SEPTEMBER 21 - 23

The third congress of the Aquaculture Association of Southern Africa entitled Aquaculture '94, will be held at Berg en Dal Rest Camp, Kruger National Park.
Enquiries: Mrs Suzette van Wyngaardt, Blyde River Aquaculture, PO Box 408, Hoedspruit 1380. Tel & Fax: 01528- 35250. E-mail address: ihth@hippo.ru.ac.za.

WASTECON '94 SEPTEMBER 27 - 29

A conference on waste management will be held in Somerset West, Western Cape.
Enquiries: WASTECON '94, PO Box 1303, Cape Town 8000. Tel (021) 400 2423 Fax (021) 25 3848.

ENVIRONMENTAL MANAGEMENT OCTOBER 18 - 21

The 2nd Southern African international conference on environmental management will be held at Victoria Falls in Zimbabwe.
Enquiries: SAICEM 2 Secretariat, c/o PO Box BW 294, Borrowdale, Harare, Zimbabwe. Tel (263) 4 739 822. Fax (263) 4739 820.

MEMBRANE TECHNOLOGY OCT 31 - NOV 2

The first WISA Technology Division workshop and seminar on the preparation, performance and practice of permselective membranes will be held at Van Sta-

dens River Mouth resort, East Cape.
Enquiries: Dr Ed Jacobs (Secretary), Institute for Polymer Science, University of Stellenbosch. Tel (021) 808 3172.

ICOLD NOVEMBER 1 - 5

The 62nd executive meeting of ICOLD will be held at the Elangeni Hotel in Durban.
Enquiries: Mrs Ginny Eslick, ICOLD 1994 Organising Committee, PO Stamford Hill, 4025 Durban. Tel (031) 233 494 Fax (031) 232 405.

ICOLD NOVEMBER 6 - 11

The 18th ICOLD congress will be held at the Durban Exhibition and Conference Centre.
Enquiries: Mrs Ginny Eslick, ICOLD 1994 Organising Committee, PO Stamford Hill, 4025 Durban. Tel (031) 233 494 Fax (031) 232 405.

ANALYTICA '94 DECEMBER

The second national symposium on analytical science will be held early in December 1994 in the Western Cape. Theme: "Toward the Welfare of Man and his Environment".
Enquiries: Dr IM Moodie, ANALYTICA '94, c/o PO Box 19070, Tygerberg 7505. Fax (021) 932-4575.

1995

GROUNDWATER APRIL 3 - 7

The Centennial Conference of the Geological Society of South Africa will be held in Johannesburg.
Enquiries: Tel & Fax (012) 47 3398.

RIVER MANAGEMENT MAY 14 - 19 1995

The IAWQ conference on river basin management will be held in the Kruger National Park.
Enquiries: Dr Ben van Vliet, Watertech, CSIR. Tel (012) 841-2237 Fax (012) 841-4785.

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.

OVERSEAS

1994

AFRICAN FISHERIES AUGUST 1 - 5

The first African fisheries congress will be held in Nairobi, Kenya.
Enquiries: Professor S Dadzie, Department of Zoology, University of Nairobi, PO Box 30197, Nairobi, Kenya.

WATER MANAGEMENT AUGUST 9 - 13

The fourth Stockholm water symposium with the theme "Integrated land and water management - challenges and opportunities" will be held in Stockholm, Sweden.
Enquiries: The Symposium Secretariat, Stockholm Water Symposium 1994, Stockholm Water Company, S-10636 Stockholm, Sweden. Tel +46 8736 2021. Fax +46 8736 2022.

MEMBRANES AUGUST 29 - SEPTEMBER 2

The 7th international symposium on synthetic membranes in science and industry will be held in Tübingen, Germany.
Enquiries: DECHEMA e.V. Exhi-

bitions and Congresses, Theodor-Heuss-Allee 25, PO Box 150104, D-6000 Frankfurt am Main 15. Tel (069) 7564-241/242/243 Fax (069) 75 64-201.

OZONE AUGUST 30 - SEPTEMBER 2

The regional conference of the International Ozone Association (IOA) will be held in Zurich, Switzerland.
Enquiries: The Organising Committee, c/o Zurich Water Supply, Hardhof 9, CH-8023 Zurich. Tel +1/435 2111. Fax +1/435 2557.

MUNICIPAL WATER AUGUST 31 - SEPTEMBER 2

The 13th national conference on municipal and rural water supply will be held in Poznan, Poland.
Enquiries: Conference Secretariat, Polish Association of Sanitary Engineers & Technicians, ul. Wieniawskiego 5/9, 61-712 Poznan, Poland. Tel (48) 61 536 805 (285). Fax (48) 61 536 490.

RIVER BASIN SEPTEMBER 13 - 16

An international conference on Integrated River Basin Development will be held in the UK.
Enquiries: Ms Jacqueline Watts, HR Wallingford Ltd, Wallingford, Oxfordshire OX10 8BA, UK. Tel +44-491-(8)-35381 Fax +44-491-(8)-26703.

HYDROINFORMATICS SEPTEMBER 19 - 23

The first international conference on hydroinformatics will be held in Delft, the Netherlands.
Enquiries: Organising Committee, Attn Adri Verwey, IHE, PO Box 3015, 2601 DA Delft, the Netherlands. Tel +31-15-151 814/811 Fax +31-15-122 921

MINE WATER SEPTEMBER 19 - 24

The 5th international mine water congress will be held in Nottingham, UK. Theme: Mine water and the environment.
Enquiries: The Secretary, IMWA Conference, c/o Department of Mineral Resources Engineering, University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom. Tel (0602) 514076 Fax (0602) 678494.

ENVIRONMENTAL CONTAMINATION

SEPTEMBER 20 - 23

The second international symposium and exhibition on environmental contamination in Central and Eastern Europe will be held in Budapest, Hungary.

Enquiries: Roy C. Herndon, Symposium Co-Chairman, Florida State University/CHAERSE, 2035 East Paul Dirac Drive, 226 HMB, Tallahassee, Florida 32310-3700, USA Tel (904) 644-5524 Fax (904) 574-6704. E-Mail: buda94@chaerse.fsu.edu

IRRIGATION

SEPTEMBER 20 - 24

An international conference on irrigation management transfer will be held at Wuhan University in Wuhan, China.

Enquiries: Dr Sam H Johnson, PO Box 2075, Colombo 1, Sri Lanka. Fax: 94-1-866854. Tel 94-1-867404. E-mail: IIMI 157:CGII29.

PARASITES & WATER

SEPTEMBER 26 - 28

A conference on Protozoan Parasites and Water will be held at the University of York, UK

Enquiries: IFAB Communications, Institute of Applied Biology, University of York, York YO1 5DD. Tel 44 (0)904 432940. Fax 44 (0)904 432917.

NUTRIENT REMOVAL

OCTOBER 4 - 6

The second Australian conference on biological nutrient removal from wastewater will be held in Albury, NSW, Australia.

Enquiries: AWWA - BNR2 Secretariat, Albury - Wodonga Convention Bureau, PO Box 323, Albury, NSW, Australia 2640.

Attention: Mr WGC Raper. Fax (intl) 613 542 2386. Tel (intl) 613 542 2387.

FISH ASIA '94

OCTOBER 26 - 29

The second Asian aquaculture and fisheries exhibition and conference will be held at the World Trade Centre in Singapore. Enquiries: ITP Services Pte Ltd., 2 Jurong East St 21 #05-19/22 IMM Building, Singapore 2260. Fax +65 296 5384.

SOIL SCIENCE

NOVEMBER 13 - 18

The annual meeting of the Soil Science Society of America will be held in Seattle, Washington, USA.

Enquiries: SSSA, 667 South Segoe Road, Madison, WI 53711-1086. Tel 608-273-8080. Fax 608-273-2021.

ANAEROBIC PROCESSES

NOVEMBER 23 - 25

An international meeting on "Anaerobic processes for bioenergy and environment" will be held in Copenhagen, Denmark.

Enquiries: Mia Clausen, Department of Environmental Engineering, Technical University of Denmark, Building 115, DK-2800 Lyngby, Denmark. Tel +45 45 399308. Fax +45 45 932850.

OVERSEAS 1995

DESALINATION

DECEMBER 1 - 2

An international conference on desalination and water reuse will be held at Murdoch University, Perth, Western Australia. Enquiries: Dr K Mathew, Remote Area Developments Group, Institute for Environmental Science, Murdoch University, Murdoch WA 6150, Western Australia. Tel: 61-9-332 2896 Fax: 61-9-310 4997.

WASTE MANAGEMENT

FEBRUARY 1995

The third conference on appropriate waste management technologies for developing countries will be held in Nagpur, India.

Enquiries: Professor P Khanna, Indian Association for Environmental Management, NEERI, Nehru Marg, Nagpur 440020, India.

HYDRO-SCIENCE

MARCH 22 - 26

The second international conference on hydro-science and

engineering will be held Beijing, People's Republic of China.

Enquiries: Mr Tan Ying, ICHE '95, IRTCES, PO Box 336, Beijing 100044, People's Republic of China.

AWWA

APRIL 2 - 6

The Australian Water and Wastewater Association's 16th Federal Convention will be held in the Convention Centre at Darling Harbour, Sydney, Australia.

Enquiries: The Secretariat, PO Box 388, Artarmon, NSW 2064, Australia. Tel +61 2 413 1288. Fax +61 2 413 1047.

MICRO-IRRIGATION

APRIL 2 - 6

An international micro-irrigation congress entitled "Micro-irrigation for a changing world: conserving resources; preserving the environment" will be held in Orlando, Florida, USA.

Enquiries: Allen Samajstria, University of Florida, Agr. Eng. Department, Gainesville FL 32611, USA. Tel (904) 392-9295. Fax (904) 392-4092.

WATER TREATMENT

MAY 15 - 17

An IWSA specialised conference on advanced water treatment and integrated water system management into the 21st century will be held in Osaka, Japan.

Enquiries: Water Osaka '95, c/o Osaka Municipal Water Works Bureau, 6-28 Minami-ogimachi, Kita-ku, Osaka 530, Japan. Tel 06 (363) 7301. Fax 06 (363) 7362.

GROUNDWATER QUALITY

MAY 15 - 18

An international conference on groundwater quality: remediation and protection (GQ 95) will be held in Prague, Czech Republic.

Enquiries: Conference Secretariat GQ 95, c/o Guarant, Opletalova 15, 110 00 Prague 1, Czech Republic. Tel +42 2 2421 0650 or 2421 0735 Fax +42 2 260 130.

OZONE

MAY 15 - 19

The 12th Ozone World congress will be held in Lille, France.

Enquiries: Mme Michele Rizet, IOA International Coordinator, c/o Societe des Eaux du Nord, 217 blvd. de la Liberte Lille, B.P. 329, 59020 Lille CEDEX, France. Tel 33-2049 4000. Fax 33-2049 4052.

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.

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.

WASTEWATER RECLAMATION

OCTOBER 17 - 20 1995

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

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



WATERBENUTTINGSINGENIEURSWESE

Universiteit van Pretoria

bied aan

Watergehaltebestuur en beheer van punt- en diffuse bronne van besoedeling

5-9 September 1994

Vyfdagkursus met die oog op watergehaltebestuur in die Nuwe Suid-Afrika. Klem word gelê op veranderde beleid en nuwe vereistes ten opsigte van die bestuur van punt- en diffuse bronne van besoedeling.

Onderwerpe sluit in:

- ◆ Watergehalte en impak op omgewing
- ◆ Natuurlike suiwing en assimilatiewe kapasiteit
- ◆ Verskillende benaderings ten opsigte van watergehaltebestuur
- ◆ Geïntegreerde omgewingsbestuur (IEM)
- ◆ Ontvangende watergehaltedoelwitte (RWQO)
- ◆ Wetlike vereistes
- ◆ Gevallestudies
 - Mynbou
 - Nywerhede
 - Plaaslike owerhede
 - Ontwikkellende gemeenskappe

Die kursus is gerig op:

- ◆ Persone verantwoordelik vir bestuur van punt- en diffuse besoedelingsbronne
- ◆ Bestuurders verantwoordelik vir watergehalte
- ◆ Ingenieurs en wetenskaplikes
- ◆ Raadgewende ingenieurs

Beperk tot 40 kursusingangers per geleentheid (indien aanvraag groter is, kan die kursus herhaal word)

Kursus word afwisselend in Afrikaans en Engels aangebied

Koste per kursusinganger R1 500 (kursusliteratuur, sertifikate en middagete ingesluit)

Vul toepaslike poskaart in hierdie Bulletin in en pos aan:

Die Hoof, Afdeling Waterbenutting
Dept. Chemiese Ingenieurswese
Universiteit van Pretoria
0002 PRETORIA

Navrae: Dr C F Schutte/ Mev H du Toit Tel: (012) 420-3571/420-3566 Faks: (012) 43-6683

KORTKURSUS

CORROSION INSTITUTE OF SOUTHERN AFRICA

presents

Sixth International Corrosion Conference



29 – 31 August 1994

Elangeni Hotel, Durban

Session themes are:

Corrosion economics

Corrosion of concrete

Marine and atmospheric corrosion

New developments in corrosion technology

Piping and pipelines

Corrosion monitoring and inhibitors

For further information please contact the secretary of the
Corrosion Institute of Southern Africa:

PO Box 966
KELVIN
2054

or
Tel no (011) 802 5145
Fax no (011) 804 3484