SA waterbulletin

ISBN 0258-2244 Volume 26 No 5 September/October 2000

HYDROLOGY
WRC report evaluates dredging in South Africa

FLOODS
Innovative flood disaster management system developed

WATER POLLUTION
Researchers investigate the polluter pays principle

Announcement of the next National Short Course on

THE ROLE AND USE OF BIOLOGICAL MONITORING IN AQUATIC RESOURCE ASSESSMENT

Currently coordinated by:
Institute for Water Research
Rhodes University
Grahamstown

RHODES UNIVERSITY

AIM OF THE COURSE

Aquatic biomonitoring, or response monitoring, is increasingly used as a monitoring and assessment tool in water resource management. This course will provide a basic understanding of the concepts, advantages, uses and limitations associated with different biomonitoring techniques, including field bio-assessment and toxicity bioassays. The course is designed to address the relevant concepts and the interplay between bio-monitoring and resource management, rather than the technical details of how to conduct monitoring. There will be a balance between theoretical lectures (presented by experts from various organisations), hands-on exposure in the laboratory and field, group discussions and problem solving. Presentations and course material will be in English.

WHO SHOULD ATTEND?

Mid-level managers, planners and other officials from government or private institutions who need and want to improve their knowledge and use of biomonitoring in general.

WHERE AND WHEN?

In Grahamstown, 12 - 16 February 2001.

COST

The course fee is R3 500 per person (excluding accommodation) and includes lecture material and use of field and laboratory equipment.

ENQUIRIES

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The national short course was initiated by:
The Institute for Water Quality Studies
(IWQS) of the Department of Water Affairs and Forestry
&
CSIR's Division of Water, Environment and Forestry (Environmentek)

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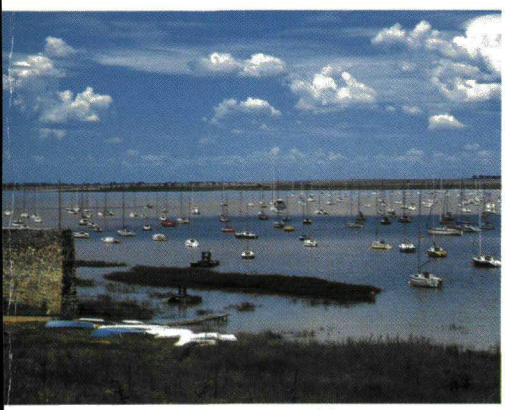

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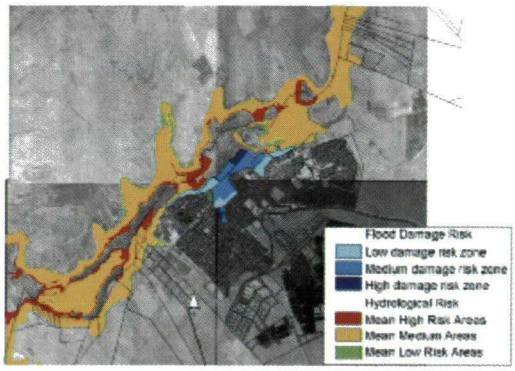

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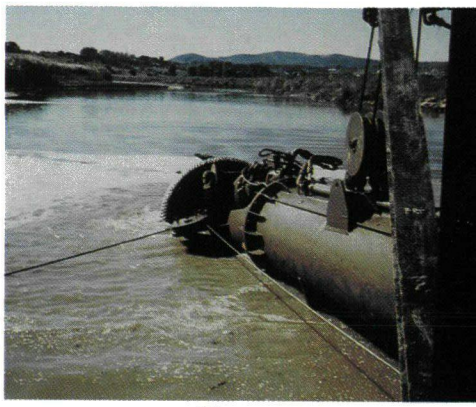

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Cover: A floating dredger pipeline for the disposal of sediment (see page 20).

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. WRC Internet address: http://www.wrc.org.za Editor: Jan du Plessis (E-mail: jan@wrc.org.za). Asst Editor: Helene Joubert (E-mail: helene@wrc.org.za). Ed Secretary: Rina Human (E-mail: rina@wrc.org.za). Layout: Ronel Urquhart - 4Images. Colour Separations: 4Images. Printing: Beria Printers.

PE Odendaal retires from WRC

The Executive Director of the Water Research Commission(WRC), Mr PE (Piet) Odendaal, retired at the end of August 2000 from the Commission's service after a long and distinguished career in the water field.

Odendaal's retirement marks the end of an era at the WRC since he was the last person left at the Commission who helped to establish the organisation in 1971, together with the late Dr Gerrie Stander, Ria Oellerman and Eric Harper.

Born in Johannesburg on 13 August 1935 Odendaal was educated in Bloemfontein. He matriculated at Grey College in 1951 at the tender age of 16 and was awarded the Franklin Dux medal for best academic achievement in that year.

He then studied at the University of the Orange Free State where he obtained a BSc in 1954, BSc Hons (chemistry), cum laude, in 1955 and MSc (chemistry) in 1956. Later in his career he also enrolled at UNISA where he broadened his perspective by obtaining a BA degree in 1966, majoring in philosophy and the history of philosophy, B Comm and BA Hons (communication science), cum laude, in 1971.

He started his professional career as a chemist at Sasol in 1957 and thereafter worked at the Wheat Board. Odendaal joined the then National Institute for Water Research at the CSIR in 1963 and the Water Research Commission in 1971, advancing to the position of Chief Adviser before being appointed Executive Director in 1985.

His international career in the water field began in 1971 when he became Honorary Secretary Treasurer of the International Association on Water Pollution Research (IAWPR). His dedication, diplomacy and firm leadership made him a respected figure in interna-

Piet Odendaal busy with his farewell speech to office staff and colleagues at the Water Research Commission

"Meneer" Odendaal and his right-hand lady at the WRC, his personal assistant for some years, Mrs Nakkie Uys.

tional water circles and he served on many committees and boards, often as founding member or chairman. In 1994 Odendaal was elected Vice-President of the International Association on Water Quality (IAWQ), a position he held until 1998 when he was elected President. In 1999 he was instrumental in bringing about the merger of the two major international water organisations, namely, the IAWQ and the International Water Services Association (IWSA) to form the International Water Association (IWA) which has about 9 000 members in 130 countries. Together with Mr Vincent Bath (Chief Executive of Rand Water), Odendaal was honoured by being elected co-President of the IWA.

In South Africa Odendaal steered the Water Research Commission through a tremendous period of growth. For example, in 1986, after he became Executive Director, the WRC approved only 19 new research projects for the year. In 2000 the number was 108.

In an interview with the Bulletin Odendaal said that South Africa has in the past few decades developed leadership positions in various fields such as biological nutrient removal, water reuse, dry cooling, aquatic ecology, rainfall stimulation and the use of radar to measure rainfall. "These developments have led to better water management both locally and internationally."

Odendaal said internationally the WRC is a unique organisation in the sense that it deals with the total water spectrum. This means that it is possible to recognise the many interfaces between different disciplines in the water field. This integration of expertise and inter-disciplinary approach is where the future of water research and water management lies, since the problems facing water managers and researchers today often are no longer restricted to a single discipline. The concept of integrated catchment management which involves not only technology and the science of hydrology and groundwater but also the humanities, emphasises this notion.

One of the things Odendaal strongly believes in is the idea of a champion. "Nothing happens by itself," he says, "and therefore if you want leadership and results try and identify a champion. Although real champions, or people who can make things happen, are very rare, once a champion has been recognised by his determination, vision or achievements, you must do everything in your power to support and assist these special individuals. Champions serve as an inspiration to others, they develop other people through capacity building, thereby cultivating new champions.

Odendaal confessed that he had no hobbies and that the presidency of the IWA will keep him occupied, at least during the first year of his retirement.

Paying tribute to Odendaal, Dr George Green, the acting Executive Director of the WRC, said,"it would be impossible to overestimate Piet's personal contribution to shaping the WRC as an internationally respected organisation. Although Piet was fond of stating that no one could be expected to have comprehensive knowledge across the entire water sector, his own breadth and depth of knowledge makes him the closest contender I know for such a distinction."

The Deputy Executive Director, Mr DS (David) van der Merwe (right) presents a special farewell gift to Piet Odendaal. The gift was received from the Foundation for Water Research (FWR) in the UK.

Piet Odendaal with his wife, Mrs Cordelia Odendaal, and the Chairperson of the Water Research Commission, Professor Kingston Nyamapfene.

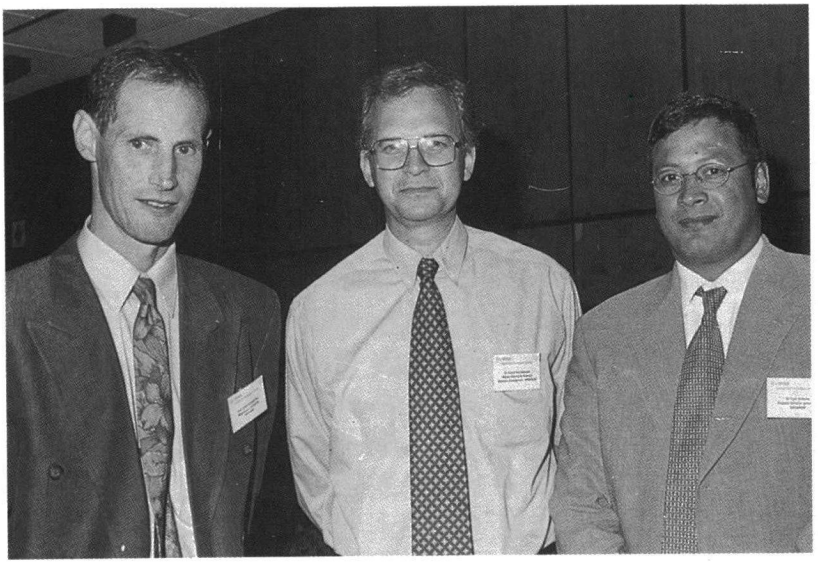
Workshop promotes biological sulphate removal technology

The Anaerobic Processes Division of the Water Institute of Southern Africa (WISA) presented a two-day technology transfer workshop on Biological Sulphate Removal during August at the CSIR in Pretoria. Presentations were given by leading international experts as well as local key role players in this field.

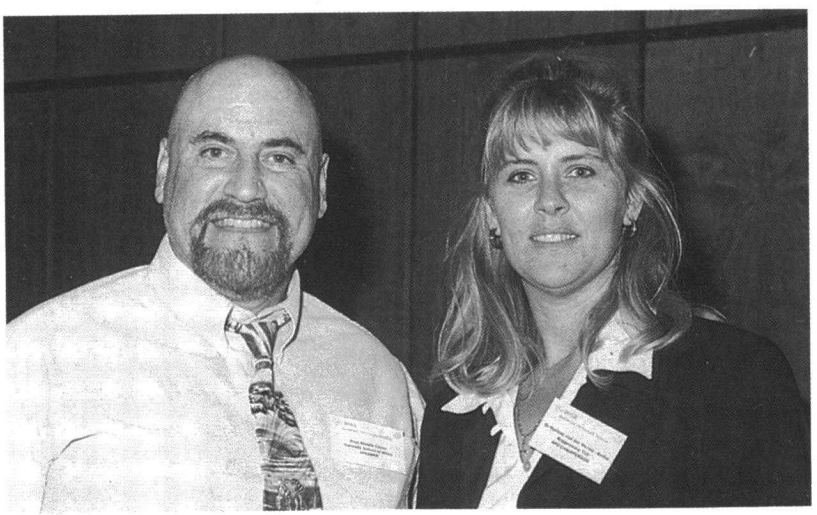
In his opening address Mr Piet Odendaal, former executive director of the Water Research Commission, said the workshop aimed to promote awareness of, and accelerate the application of biological sulphate removal, as biological treatment is the "new hero" compared to chemical treatment.

The workshop focused on the biological technologies and anaerobic processes for the treatment of sulphur-polluted wastewater, particularly acid mine drainage waters. Dr Marlene van der Merwe-Botha, chairperson of the Anaerobic Processes Division of WISA, says the workshop was structured to incorporate a balanced and valuable mix of sulphate removal aspects covering the total spectrum of this important field.

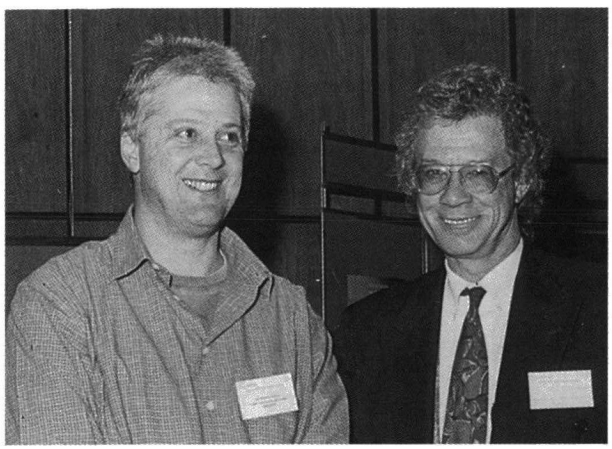
Dr Look Hulshoff-Pol from Wageningen University, in the Netherlands, addressed the basics of sulphur geochemistry and then continued to expound the more applied chemistry and microbiology of sulphate removal. Front-running commercial applications for sulphate in the South African industry were addressed by Prof Peter Rose, William Pulles, Dr Jannie Maree, Prof Dick Loewenthal and Rob Fowles. Carl Schultz presented some experiences with the Pacques Process in the Netherlands, while Dr Ron Cohen of the Colorado School of Mines, USA, presented a lively discussion on sulphate reducing bacteria (SRB) substrate utilisation kinetics.



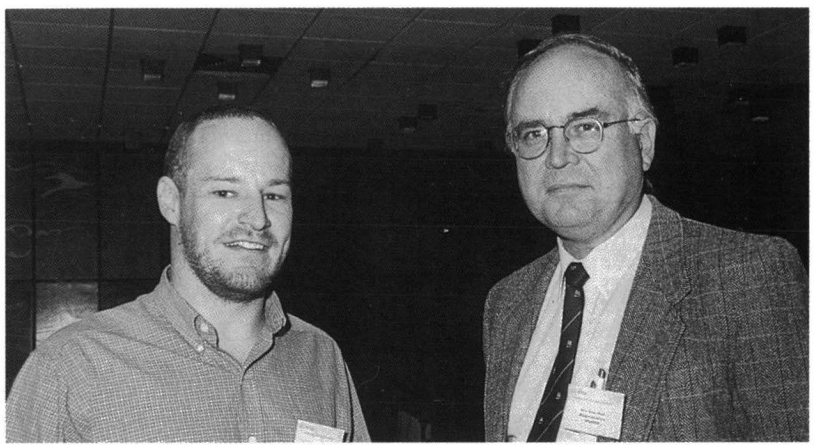
Workshop speakers: Dr L Hulshoff Pol from the Department of Environmental Technology at Wageningen University in the Netherlands with Dr André van Niekerk (Wates, Meiring and Barnard) and Mr Carl Schultz from Paques Natural Solutions, the Netherlands.



Dr Ron Cohen from the Colorado School of Mines, pictured here with Dr Marlene van der Merwe-Botha, chairperson of the Anaerobic Processes Division of the Water Insitute of Southern Africa.



Mr William Pulles, from Pulles Howard and de Lange Environmental Consultants, one of the speakers, pictured here with Mr Greg Steenveld from the Water Research Commission.



Mr Rob Fowles from Foskor Ltd with Dr Jannie Maree from Environmentek, CSIR, also shared their experiences at the workshop. Dr Maree pioneered the development of sulphate removal processes in South Africa.

Left: Neil Rein, a post graduate student attended the workshop along with Prof Peter Rose from Rhodes University. Prof Rose is the initiator of the concept of integrated treatment of sewage sludge and mine water containing sulphate.

The speakers discussed the processes in depth, identifying potential as well as limitations, and gave perspective on the way ahead in sulphate removal – both in research and novel practices. The workshop was characterised by interesting and thought provoking discussions, excellent transfer of ideas and information, as well as lively interaction between speakers and the delegates.

The workshop was closed by Dr Marlene van der Merwe-Botha, with the annual general meeting and the election of a new Anaerobic Processes Division committee for the next two year team (2001-2002). The new committee members are Dr Marlene van der Merwe-Botha (Krugersdorp Local Council) Renee van Hoeve (Krugersdorp Local Council), Dr André van Niekerk (Wates, Meiring and Barnard), Dr Jannie Maree (CSIR) and Harma Greben (CSIR), and Bileen Wolmarans (Biwater).

Improving ion-exchange membranes for water treatment

Prof V Linkov

Successful research conducted by Professor Vladimir Linkov of the University of the Western Cape, has resulted in the development of a novel procedure for the coating of standard polymeric electrodialysis membranes, says Dr Gerhard Offringa, research manager at the Water Research Commission (WRC). The coating renders the membranes more resistant to fouling by organic material. The modified membranes will be very useful in applications where organic material is present together with inorganic salts in industrial water and effluents.

Significant progress was also made in the development of ceramic membranes with conductive and catalytic properties for the oxidation of unwanted organic material. Those properties, together with their high stability in aggressive media make these membranes potentially useful for a number of water treatment processes and other uses.

The research project funded by the WRC focused on improved and novel ion-exchange membranes, both polymeric and ceramic-based types, as membrane processes form an important portion of the water treatment market.

In a report to the WRC Professor Linkov says that although electrodialysis (ED) and electrodialysis reversal (EDR) have been used commercially for water demineralisation for more than two decades, the fouling of anion-exchange membranes by organic colloids present in water is a worldwide problem. The fouling has detrimental effects on the lifespan of the membrane, and therefore on the economics of the process. Membrane cleaning and replacement can amount to almost half the cost of producing the demineralised product. The research therefore aimed to find methods to protect anion-exchange membranes against fouling, thereby to extend the in-service lifespan of the membranes. The results of this research could find wide application in water-treatment industries.

The report entitled **Research into polymeric and ceramic-base membranes for use in electromembrane reactors** (WRC Report 844/1/99) is available, free of charge in South Africa, from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: orders@wrc.org.za (Foreign orders: US $20 per copy, via surface mail).

Professor Linkov reports that it is well known that the presence of organic substances in electrodialysis feed waters results in the fouling of anion-exchange membranes by the formation of layers on the membrane surfaces. This causes an increase in the electrical resistance of the membrane and in the voltage drop across the membrane, which in turn leads to an increase in the power consumption. The efficiency of the process is therefore reduced with a concomitant increase in cost.

According to the report chemical and electrochemical pre-treatment techniques can be developed to reduce membrane-fouling problems. Methodology is particularly needed for the treatment of anion-exchange membranes (cation-exchange membranes are not as badly affected by fouling). Other research has shown that the fouling potential of modified anion-exchange membranes can be decreased considerably. Accordingly the availability and use of modified membranes can result in great savings in membranes operating and replacement costs.

Furthermore the transfer number of cation-exchange membranes and the selectivity of monovalent ions over bivalent ions may be increased by modification techniques similar to those used for the modification of anion-exchange

membranes, which would make electrodialysis a feasible process for the production of water for irrigation purposes.

The use of anion- and cation-transfer membranes made from alumina, silica and zirconia would permit the application of the ion-exchange membranes at high temperatures and in harsh chemical environments, over a wide pH range. These membranes should be particularly suitable for the removal of heavy metal ions from hazardous effluents. Such membranes could also be a low-cost alternative to organic-based membranes.

The researcher says that the use of newly developed ceramic membranes would be as supports for electroconductive catalytic layers that are not soluble under anodic conditions. Inorganic membranes produced by this method can combine separation and electrode functions and will therefore be ideal for use in electromembrane reactors. These reactors are highly efficient in water disinfection processes and in the low cost manufacturing of acids, alkalis, hydrogen and halogens. The reactors maintain high specific productivity and low energy consumption, and are both compact and easy to operate.

AIMS

The overall objective of the research was the preparation of novel ion-exchange membranes for electrodialysis, electrodialysis reversal and electromembrane reactor processes, as well as the determination of the membrane characteristics and the evaluation of their suitability for electrodialysis water treatment, particularly of mine water in South Africa.

The specific aims of the research were:

- a) the development of new chemical (modification) and electrochemical pre-treatment methods to improve the fouling characteristics of existing polymeric ion-exchange membranes, and
  b) the preparation of novel ceramic non-fouling membranes.
- development of cation-exchange membranes with increased transfer numbers for monovalent ions.
- fabrication of ceramic ion-exchange membranes with an increased chemical stability.
- incorporation of these novel membranes into electrodialysis and electromembrane reactor units.

METHODOLOGY

According to the report polymeric membranes were modified with a variety of surface active agents, and their fouling resistances were determined in simulated solutions of mining water effluents. Changes in membrane permselectivity due to modification were investigated as well as the use of a pulsing mode to supply current to the membrane cell. The application of anodic oxidation, aimed at destroying organics, was also investigated.

Inorganic ceramic-based membranes were prepared and evaluated for their anti-fouling properties.

RESULTS

The research results and main conclusions are the following:

■ Polymeric anion-exchange membranes with improved fouling characteristics

Aiming to minimise the fouling of existing anion-transfer membranes by organic substances, methods of chemical treatment to modify the membranes were explored. Flat-sheet homogenous Ionics anion - exchange membranes were selected. These membranes were successfully modified with various aqueous polyelectrolyte solutions, by both static and dynamic methods. Static treatment entailed simply immersing the membrane in a solution containing a given concentration of modifying agent (generally a polyelectrolyte). Dynamic treatment comprised the pumping of a solution of the modifier through the concentrate and demineralisation of the electrodialysis apparatus. Very good bonding of the modifier to the membrane was achieved under dynamic conditions.

The researcher found that:

- Saturated hydrocarbons in mine drainage water in concentrations of up to 20 mg/ℓ have no influence on the electrodialysis process when Ionics and NB-8-modified Ionics membranes were used.

- Modification of Ionics membranes with NB-8 led to membranes with the greatest resistance coefficient to fouling by organic substances, followed by LT-27. (NB-8 is a double charged, high molecular mass, sulfo-containing surface-active substance. T-27 is an anionic polyacrylamide flocculant of the "Magnafloc" range).

- Membranes modified with LT-27 had lower resistance coefficients than the membranes modified with NB-8 but could also be used as an effective membrane-modifier, especially in terms of costs as it could be used in a lower concentration than NB-8.

- Anion-transfer membranes modified under static and dynamic conditions had practically the same measured properties.

- The layer of polyelectrolyte, electroprecipitated under dynamic conditions, is quite stable and effectively protects the membrane against fouling for at least twenty days.

Research was not limited to chemical treatment only of membranes to increase the efficiency of the electrodialysis process, electrochemical pre-treatment methods were also used. Current reversal was used and found to result in complete membrane regeneration and the restoration of its electrical resistance and voltage drop.

Changes in the electrochemical characteristics of anion-transfer membranes during the pulsing mode of electrodialysis have revealed that the pulsing mode can effectively reduce membrane fouling by organics. Optimum conditions of pulsing electrodialysis were determined to be polarisation for fifteen minutes and current interruption for three minutes. According to the report it should be noted, however, that the use of the pulsing mode can result in the loss of productivity of the electrodialysis process.

There was a significant decrease in organic fouling of anion-transfer membranes when the feed water was initially pumped through the anodic cell of the electrodialysis apparatus. Organic substances present in the anodic chamber were destroyed by anode reaction-products, and as the concentrations were reduced the organic fouling of the membranes was reduced.

A further simple, and effective method

for the regeneration of membranes fouled by organic substances was chemical processing in a sodium chloride solution, says the researcher.

■ Preparation of novel non-fouling ceramic membranes

Ceramics were selected for their excellent thermal, chemical and mechanical stabilities.

Conclusions drawn from the results of investigations into the preparation of the inorganic ceramic membranes based on the oxides of multivalent metals, are as follows:

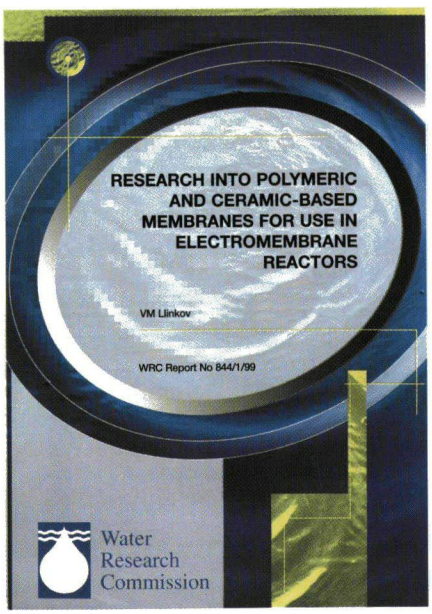
- ❒ Inorganic ceramic membranes prepared on the basis of zirconium dioxide and aluminum oxide have similar properties to the polymeric Ionics membranes, but the diffusion permeability of the ceramic membranes for low-molecular electrolytes are 100 to1000 times less.
- ❒ Modification of ceramic membranes by the incorporation of zirconium phosphate, pyrolytic precipitated carbon and manganese dioxide resulted in decreased membrane permeabilities for water and electrolyte solutions.
- ❒ The modification of ceramic membranes by manganese dioxide resulted in a decrease in their electrical resistance in the electrolyte solutions. This aspect can be useful in the application of these membranes as electrodes in a wide range of electrochemical processes.
- ❒ The modification of a ceramic membrane by zirconium phosphate increased its selectivity for cation transfer, making the membrane suitable for use in electrolyte desalination and solution electrolysis.

Results of the electrodialysis of model solutions of mine water showed that the inorganic membranes have a high stability with regard to fouling by humic acids and surface active compounds. The potential drop across the membranes remained unchanged after more than ten days operation. The effective operation of inorganic membranes in electrodialysis installations requires the use of current pulsing and the reversal of power supply.

■ Cation-exchange membranes with increased transfer for monovalent ions

Results of research into the modification of cation-exchange membranes to enhance their transport of monovalent ions have shown that:

- ❒ the processing or modification of membranes under dynamic conditions influences the relative transfer of mono- and divalent ions through the membranes. The application of the NB-8 modifier, a most effective anti-fouling modifying agent, has practically no influence on the transfer of chloride and sulphate through the NB-8-modified anion-transfer membrane. The permeability of divalent magnesium ions, compared to monovalent sodium ions, does however increase through the modified cation-transfer membrane. This reagent can therefore be used to modify membranes for use in water softening by electrodialysis.



- ❒ Modification of membranes by the polyelectrolyte LT-27 increases their permeability to monovalent ions, eg. chloride through the anion-transfer membrane, and sodium through the cation-transfer membrane. This reagent has a high protection efficiency and could be suitable for modifying membranes intended for use in the electrodialysis of concentrated solutions with high total-hardness values.

■ Potential of ceramic ion-exchange membranes with increased chemical stability

As a result of the high stability of inorganic membranes in aggressive media, including oxidising environments, and their insensitivity to the presence of high-molecular mass electrolytes, they can potentially be used in the following water related fields: utilisation of effluents of galvanic manufacturers or extraction of non-ferrous metals by electrodialysis, electrodialysis of mine waters, electrochemical synthesis of acids and alkalis, preparation of disinfecting solutions, etc.

■ Novel membranes in reactor units

The novel membranes as developed in the research were successfully incorporated into electrodialysis units or installations. The researcher says that experimental apparatus was similar to that used in industry, however, it was used only on bench-scale during the course of the investigation.

■ Comparison

Polymeric membranes (Ionics) unmodified and modified, and phosphate-containing inorganic membranes, developed during the research project were compared for their main anti-fouling characteristics. Inorganic membranes have specific properties that make them superior to polymeric membranes: they are not fouled by organic compounds, and they have a lack of limiting current even at significant voltage drops across the membrane. The transport characteristics of monovalent ions through inorganic membranes are similar to those through polymeric based membranes (Na^+ current efficiency not less than 95 per cent). The transport of divalent ions (Ca^{2+} and Mg^{2+}), however takes place to a lesser extent through the inorganic membranes than through the polymeric membranes. This results in another important characteristic of inorganic electrodialysis membranes, namely their selectivity for monovalent ions.

CONCLUSION

This project research has produced noteworthy results with regard to polymeric and ceramic-based membranes and the development of electromembrane technology, indicating that significant opportunities exist to increase the efficiency of the electrodialysis process for industrial use.

CALL FOR RESEARCH PROPOSALS

WARFSA

Water Research Fund for Southern Africa

The Water Research Fund has been established to support research projects addressing sustainable utilisation of water resources in the Southern Africa region. The purpose of the Fund is to build research capacity among regional institutions and individuals as well as to promote the utilisation of research results in the planning and management of water resources in the sub-region.

Objectives of the Research Fund

- To promote and facilitate the implementation of multi-disciplinary research projects in integrated water resources management in the region.
- To encourage research that leads to better use of precipitation to increase land productivity or availability of water for domestic use.
- To promote the utilisation of research results for decision making aimed at ensuring sustainable development of water resources in the region.

Priority research areas

Research proposals are invited from SADC nationals and residents for research grants that address the following priority research areas.

- Water use, conservation and technologies
- Rainwater harvesting. [Of special interest is the interaction between water harvesting and agricultural productivity, hydrology, ecology and society].
- Social, political and economic issues.
- Policy and legal issues.

Eligibility for grants

The research grants will be available to researchers and/or research teams attached to recognised institutions and will not be accessible to researchers as individuals. Applications should be from SADC nationals and residents. While North-South collaboration will be encouraged, it is important that research projects originate from a SADC country. Maximum allocation per project will be US$ 50 000 for Integrated Water Resource Management (IWRM) projects, and US$ 24 000 for rainwater harvesting projects.

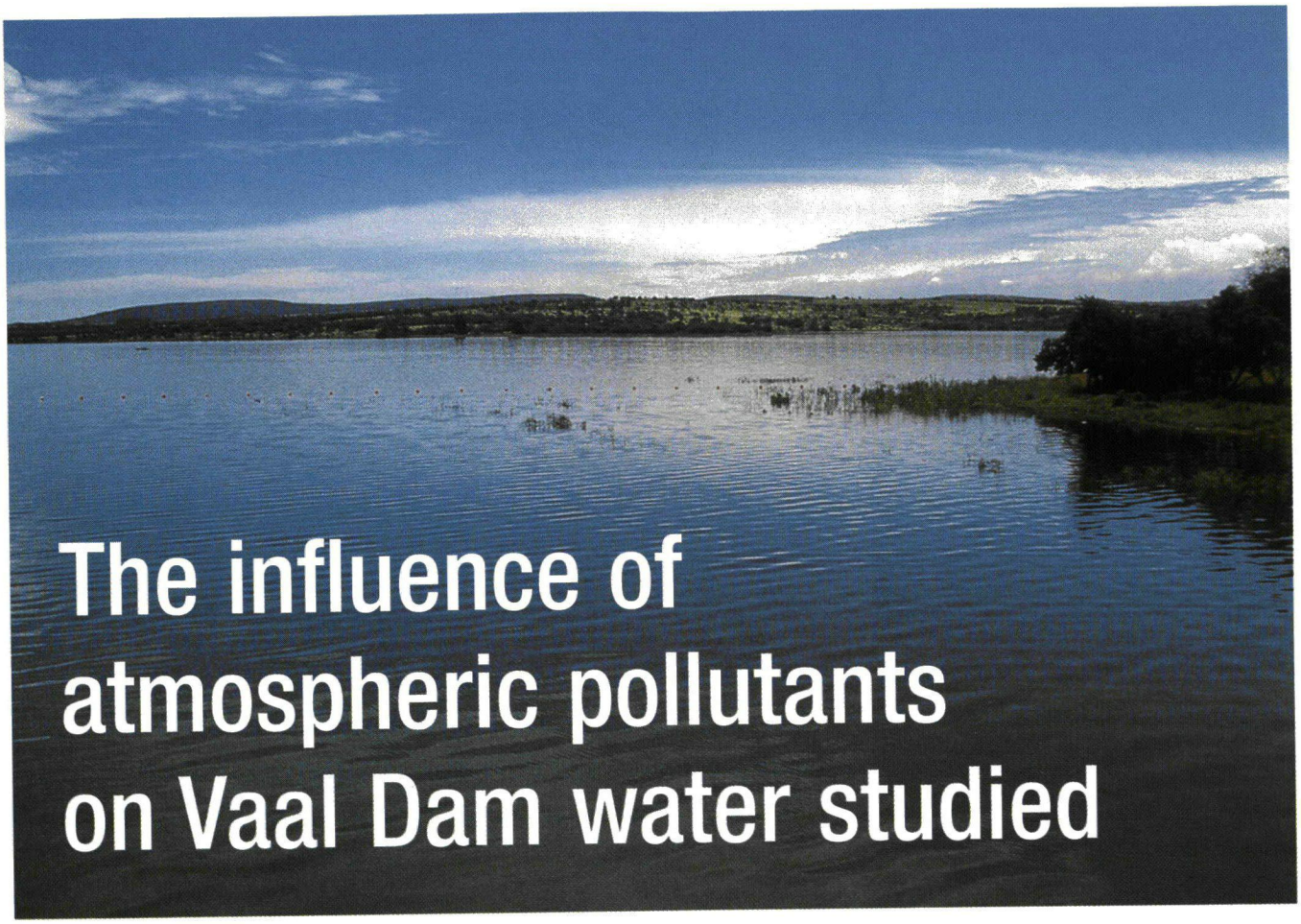
The Fund Management Agency

The Research Fund is managed by the Institute of Water and Sanitation Development (IWSD), Harare, Zimbabwe, with initial funding from Sida.

Applications / Enquiries

Deadlines for applications is 20 December 2000 (for consideration in March 2001).
Enquiries and requests for application forms and procedure should be directed to:

Institute of Water and Sanitation Development
P.O Box MP422 · Mount Pleasant · Harare · Zimbabwe
Tel.(09263) - 4 - 73-5017/26/35 · Fax.(09263) - 4 - 73-8120 · E-mail: jndamba@iwsd.co.zw



The influence of atmospheric pollutants on Vaal Dam water studied

The results of a study concerned with the relationship between atmospheric deposition and water quality in a small upland catchment are available from the Water Research Commission in the form of a final report.

The main purpose of the study was to use a small undisturbed catchment to investigate the fate of pollutants from the atmosphere, and thus try and develop an understanding of the influence of atmospheric deposition on the water quality of the Vaal Dam.

The researcher, RW Skoroszewski from the Division of Water Quality at the CSIR in Pretoria, says the study was unique in many ways. "It was the first calibrated local study designed specifically with the aim of assessing the effects of atmospheric deposition on water quality in Southern Africa. Internationally it is unique in that it is the first study to examine a catchment with a relatively low runoff, high evaporation, a seasonal stream and periodic drying out of the catchment with long periods of no rainfall."

Atmospheric deposition occurs in two forms, namely wet and dry deposition. Wet deposition includes the atmospheric pollutants dissolved in the rainfall, whereas dry deposition is the fallout of particles and the adsorption of gaseous sulphur dioxide (or more simply, all deposition that is not 'wet'). The emphasis in this study has been placed on the sulphate component. Nitrogen compounds are largely taken up in biological processes, whereas sulphate tends to be more inert.

STUDY AREA

The study was undertaken in the Suikerbosrand Nature Reserve, which is approximately 80 km south- east of Johannesburg. The study site was a 32.5 ha catchment with a quartz/sandstone geology and a loamy soil with an average depth of 15 cm.

Approximately 54 per cent of the catchment is exposed rock with the remaining 46 per cent being predominantly grassland interspersed with areas of bare soil.

Data were collected over two 'wet periods' and one 'dry period' between October 1992 and March 1994 - Period A (October 1992 to March 1993), Period B (April 1993 to September 1993) and Period C (October 1993 to March 1994). Rainfall recorded varied between 491.5 mm for period A to 843.5 mm for period C.

TECHNIQUES

The wet deposition was sampled using an automatic wet sampler. which is a standard method widely used throughout South Africa and internationally.

The dry deposition was determined using bulk samplers, rock runoff plots, ambient sulphur dioxide measurements, surface runoff and stem collar runoff. Most of the techniques employed for dry deposition estimates were of total deposition whereby the amount of wet deposition was extracted to give the net dry deposition. The exception to this was the estimation of dry deposition using sulphur dioxide measurements in which deposition velocities for sulphur dioxide

of 0.3 and 1.3 cm/sec respectively for winter (period B) and summer (periods A and C) were used to calculate the potential deposition rates.

The collection of rock runoff was a unique method of estimating dry deposition and worked successfully with at least 94 per cent of the potential runoff collected.

In the calculation of the dry deposition in the catchment, three of the techniques were employed, namely, the rock runoff estimates for 54 per cent of the catchment which was exposed rock, and a combination of ambient sulphur dioxide (gaseous deposition) and net bulk deposition (particulate deposition) for the remaining 46 per cent of the catchment which was covered in primarily grassland.

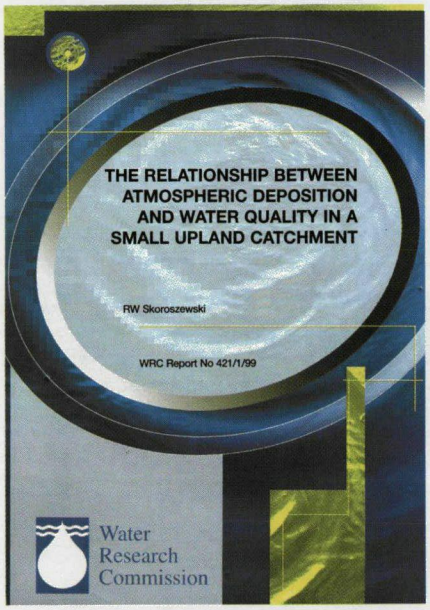
A V-notch weir was constructed at the site to collect and measure the runoff.

FINDINGS

The main findings of the study were that the total atmospheric deposition rates of sulphate to the site were 31.2 kg per ha per year (period A) and 8.6 kg per ha per year (period B) and 45.0 kg per ha per year (period C). This is within the range expected for the region.

The proportion of dry deposition to total atmospheric deposition was 62 per cent (period A), 91 per cent (period B) and 39 per cent (period C). These proportions of dry deposition to total deposition were related to the amount of rainfall - the higher the rainfall, the lower the percentage of dry deposition and vice versa.

The stream at Suikerbosrand was a seasonal stream and only flowing after storm events of at least 20 mm. The flows were characterised by being of short duration and high intensity (average time of flow was 130 hours). In many of the flows the commencement of flow was often less than one hour after the rainfall causing the event.



The total outputs of sulphate from the catchment were 2.8 kg per ha (period A) and 7.6 kg per ha (period C). No flow was recorded in period B. These represented approximately nine per cent (period A) and 17 per cent (period C) of the total inputs of sulphate into the catchment. Comparing two overlapping annual cycles (periods A and B and periods B and C), 93 per cent of the total estimated sulphate inputs into the catchment were not exported from the catchment in the first annual cycle and 86 per cent were not exported in the second. The loads were either retained in the catchment or recirculated into the atmosphere as dust.

The total dissolved salt loads from the catchment were 10.7 kg per ha per year (period A) and 413.9 kg per ha per year (period C) as calculated from the electrical conductivity.

The most important variable of atmospheric origin in the surface waters of the catchment were sulphate and nitrate. Sulphate salts were responsible for 54 per cent (period A) and 44 per cent (period C) of the catchments' total salt load. Nitrate on the other hand contributed 14 per cent (period A) and nine per cent (period B) of the total catchment salt load. The sulphate load was considerably higher than the 10 per cent reported for the Vaal Dam catchment. The effect of these high proportions of sulphate and nitrate and the total flow of the Suikerbosrand stream were, however, insignificant in the total load and flow of the Vaal Dam. Sulphate and nitrate play a much more important role in the load of the Suikerbosrand catchment and other similar upland catchments than for the Vaal Dam catchment.

Suikerbosrand is probably the most sensitive undisturbed upland catchment in the region. The Suikerbosrand catchment is an unusual catchment and cannot be considered to be representative of many upland catchments in the region. It should be considered to be an extreme case in terms of sulphate and nitrate loads.

A preliminary investigation of the wind patterns at the catchment revealed the levels of sulphur dioxide to be greatest when the wind direction was from nearby source areas (the Johannesburg/Vosloorus/Kelvin Power station area, and the Witbank/Mpumalanga Power Station area).

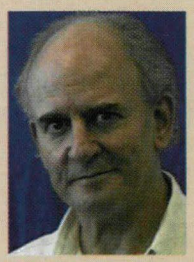
Copies of the final report summarising all the results, entitled **The relationship between atmospheric deposition and water quality in a small upland catchment** (WRC Report 421/1/99) are available free of charge in South Africa from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US$ 20, via surface mail).

SANC IAHS

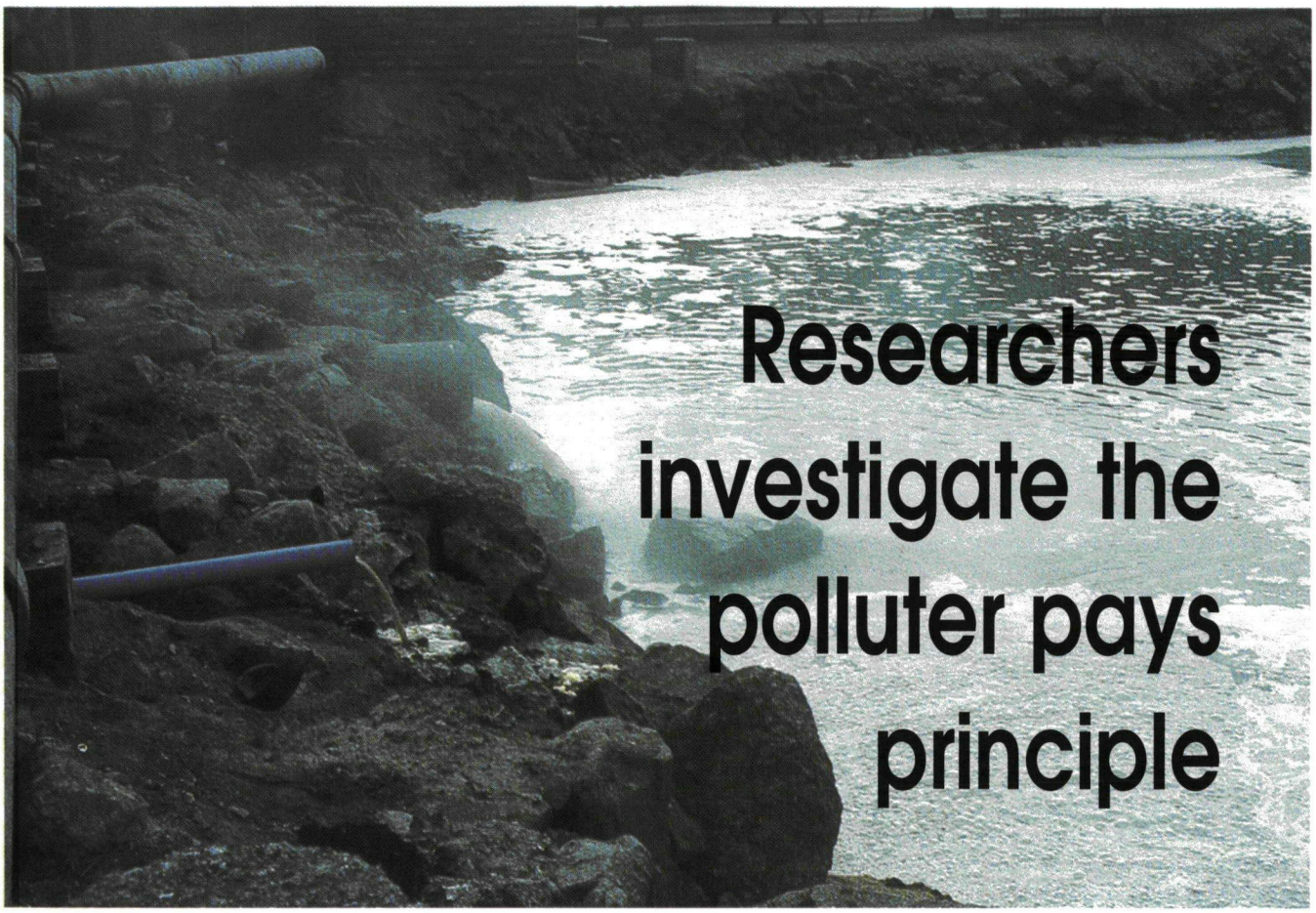
Prof Geoff Pegram elected

Please note that Prof Geoff Pegram was elected to the SANCIAHS commitee, and not Guy Pegram, as reported om the July/August 2000 issue of **SA Waterbulletin.**

Prof Pegram is Professor of hydraulic engineering in the Department of Civil Engineering at the University of Natal, Durban. His expertise lies in hydraulic and hydrologic modelling, stochastic hydrology and radar rainfall modelling.



Prof Geoff Pegram



Researchers investigate the polluter pays principle

The initial response of governments around the world to environmental issues relied on the command-and-control approach. This generally involved prescribing to industries the technology or process that must be used. However, after years of implementing such systems the experience of many countries began to indicate that the command-and-control approach often failed to provide cost effective and efficient solutions for environmental management. The problems with the command-and-control approach eventually gave rise to a new approach to environmental governance provided by the discipline of environmental economics. This approach suggested that it was possible for flexible, economics-based measures to achieve acceptable levels of environmental benefit with simpler administration and lower control costs. In the context of pollution control this approach became known as the "Polluter Pays Principle".

This is said in a report published by the Water Research Commission on the philosophy and methodology for the implementation of the polluter pays principle. The report was prepared and written by I Taviv and C Herold of Stewart Scott Inc in conjunction with S Forster, J Roth and K Clement of Development Planning and Research cc.

The authors say the use of economic measures for environmental management is particularly attractive for the South African situation, which has elements of both the first and the third worlds.

SOUTH AFRICA

"As a developing country, South Africa cannot afford expensive environmental protection systems. Such systems need to be self-sufficient and must generate their own revenue. At the same time, South Africa has a relatively well-developed infrastructure and level of knowledge and skills. These two factors mean that the introduction of a wastewater charges system to improve water quality, warrants consideration and investigation.

The Water Research Commission (WRC) began to investigate the subject of economic instruments for water quality management several years ago through a project entitled "The application of economics to water management in South Africa". A follow-up project entitled "The potential for the use of economic instruments to protect the quality of water resources in South Africa" was completed in 1996. These studies analysed the full range of economic instruments which could be utilised and simulated an application of pollution permit trading using the Witbank Dam catchment as a case study. The project from which this current report emanates follows on the past research, but specifically focuses of the philosophy of the polluter pays principle, modelling the implementation of wastewater charges in a specific catchment and examining implementation issues associated with such a system.

REPORT

The report is structured in the following way:

❒ Chapter 2 presents the philosophy of

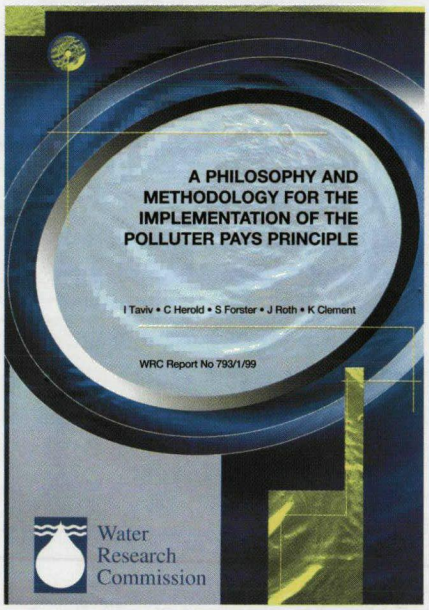
the polluter pays principle and provides an essential policy foundation for the introduction of pollution charges.

- Chapter 3 briefly summarises the international experience with various pollution control approaches over time. More specifically it documents the move towards the polluter pays principle and the introduction of pollution charges in a number of other countries. The lessons learnt from this process are noted.

- Chapter 4 examines the background to water pollution control in South Africa in the context of both water resources management and integrated environmental management. By highlighting issues such as the policy review of water tariffs and the general trend towards economic and self-financing approaches to environmental management, this chapter provides the legal foundation for the introduction of wastewater charges in South Africa.

- Chapter 5 broadly considers the limitations of a wastewater charge system. More specifically it considers the typical problems that would be encountered with non-point pollution, the economic justification for pollution charges and striking an acceptable balance between the need to encourage economic development and the importance of improving and protecting the quality of the nation's scarce water resources.

- Chapter 6 presents the case study of the Witbank Dam catchment. It focuses on the problem of sulphate pollution, most of which enters the drainage system by way of non-point pollution from upstream coal mines. It contains a description of the available data for the study period and explains how it should be processed to prepare an input into the wastewater charge system.



- Chapter 7 contains an estimation of the direct cost impacts of sulphate pollution for the Witbank Dam catchment. It covers agricultural, domestic, municipal and industrial water users. It also estimates costs of abatement, including the costs of treating sulphate-rich water to acceptable standards.

- Chapter 8 looks at the hypothetical design of a wastewater charge system specifically for Witbank Dam. It introduces a model to simulate the application of charges and different options for estimating contribution of non-point source pollution. The modelling results for different pollution loading scenarios (wet and dry hydrological years) are also presented.

- Chapter 9 considers the fate of the revenues generated by the hypothetical application of a wastewater charge system in the Witbank Dam catchment, and how these might be used to indirectly compensate downstream water users, improve water quality generally in the catchment, and to reimburse the administrators of the charge system.

- Chapter 10 takes the Witbank Dam case study further by examining the practical aspects of implementing a wastewater charge system. This examination includes the possible impact on investment and considers the various institutional options. A way of phasing in the charge system is proposed.

- Chapters 11 and 12 offer some conclusions on the research study and make recommendations for future work.

Copies of the report entitled **A philosophy and methodology for the implementation of the polluter pays principle** (WRC report 793/1/99) are available free of charge in South Africa from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: US$ 25 (via surface mail).

Urgent plea for rainfall data

The School of Bioresources Engineering and Environmental Hydrology of the University of Natal in Pietermaritzburg is involved in a Water Research Commission project entitled the Development of An Improved Gridded Database of Annual, Monthly and Daily Rainfall.

The primary objective of this project includes the establishment of a daily and a monthly rainfall database for South Africa and the neighbouring countries. The South African Weather Bureau (SAWB) has an extensive rain-gauge network across South Africa but there are areas that have a sparse rain-gauge network.

A plea is made that organisations and individuals supply this project with rainfall data that will enhance these proposed databases. Could the coordinates of the rain-gauges and the monthly or daily rainfall records please be sent to:

Steve Lynch
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University of Natal
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Scottsville, 3209
Tel: (033) 2605412 • Fax: (033) 2605818
E-mail: lynchs@nu.ac.za

A new and unique approach for flood disaster management

In this article Dr L.A. DU PLESSIS of the Department of Agricultural Economics, University of the Free State, gives a brief overview of the Water Economics and Environmental Studies (WATEES) group's approach to flood disaster management.

Researchers say that the negative consequences of disasters can be prevented or at least mitigated if governments plan for pro-active disaster management activities. The new Bill on Disaster Management, released in January 2000, emphasises prevention and mitigation actions whereas the old Civil Protection Act only emphasised reactive actions. However, to date, no appropriate support management tools existed to support all levels of government in the practice of disaster management. After more than 25 years of research, financially supported by the Water Research Commission, a consortium of experts has been established. The consortium known as the Water Economics and Environmental Studies (WATEES) group, has developed a unique continuous flood disaster management system that provides information and data before, during, and after flood events. This information will empower national, provincial and local governments to make correct and timely decisions and to formulate appropriate development policies. The main aim of this paper is to discuss the unique approach developed for the effective and efficient pro-active flood disaster management and development control.

Disasters can have tremendous negative consequences such as a negative impact on the welfare of communities and also on food security. The World Bank has indicated that the losses due to disasters as a percentage of the gross national product (GNP) are 20 times greater in developing countries than in developed countries. South Africa experienced the negative consequences of cyclone Eline in February 2000. Thousands were left homeless, 50 per cent of South African farmers' exports were destroyed and more than R3 billion damages to roads and infrastructures occurred.

Research has shown that 75 per cent of disasters could have been prevented through better planning, awareness and research based on reliable information.

Appropriate decision-support management tools and aids have been developed by the Department of Agricultural Economics at the University of the Free State to assist all levels of governments in flood disaster management. Information generated by the computer models can also be used to formulate appropriate development policies for various regions.

FLOOD DISASTER MANAGEMENT SYSTEM

The WATEES consortium group have developed a continuous flood disaster management system to assist and empower all levels of government, national, provincial and local government, in preventing and mitigating the negative impact of floods disasters and excessive stormwater.

The consortium of experts, namely Water Economics and Environmental Studies (WATEES), was formed by the Department of Agricultural Economics of the University of the Free State, in collaboration with SRK Consulting and CADNET Consulting.

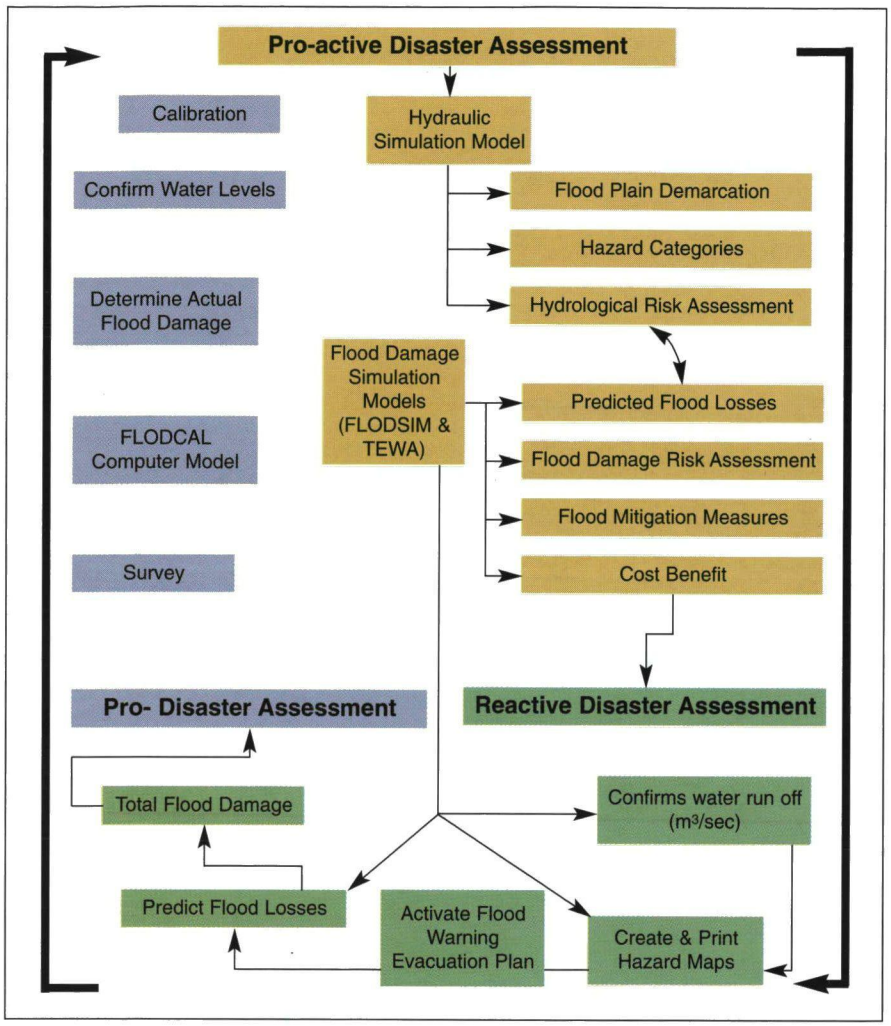


Figure 1: Integrated and comprehensive Flood Disaster Management System

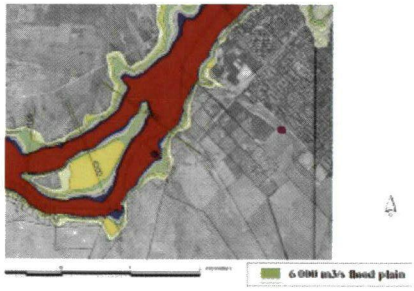
Figure 1 is a diagrammatic illustration of WATEES's unique procedures for flood disaster management.

PRO-ACTIVE PHASE

Various stages, as set out below, are involved in the pro-active phase of the flood disaster management system.

❒ Flood plain demarcation

The first step is to demarcate the flood plain. A misconception exists that flood plains can be demarcated by using historical flood lines. The impact and extent of any future flood will not be the same as historical floods. It is important to also take into account the flow of all possible tributaries and new infrastructure development when demarcating the flood plain. The first step is to develop flood lines ranging from the smallest to the largest flood that could occur in a region. The flood lines, classified in terms of depth of inundation, are used to demarcate the flood plain as on Map 1.

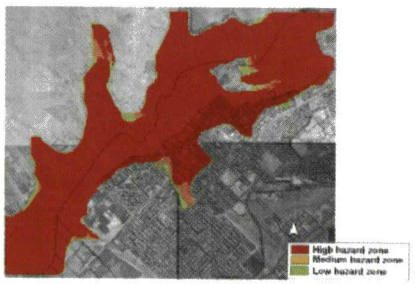


Map 1: Flood plain demarcation

❒ Flood hazard categories

The next stage entails the identification of hazard zones for each potential flood event. The relationship between the depth of inundation and velocity of the water is used to classify the flooded area into low, medium and high hazard areas. Once the hazard zones are identified, appropriate evacuation plans can be formulated accordingly. Building and development codes can also be deduced from these hazard categories.

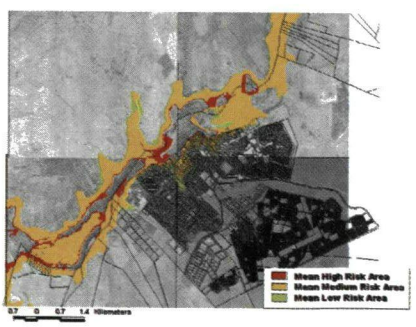
Map 2 is an example of a high, medium and low flood hazard zones for a possible 16 000 m³/s flood event. Similar maps can be developed for other possible flood events.



Map 2: Flood hazard categories

❒ Hydrological risk assessment

At this stage the flood plain is divided into grid cells (created by GIS-software) to enable the user to determine a mean risk value for the flood plain. Maps can then be developed, indicating the hydrological risk areas. These maps can be used as an aid to identify areas of potential liability claims and to prioritise the implementation of mitigation measures to reduce the hydrological risk. As an example, Map 3 indicates the high, medium and low hydrological risk zones. The hydrological high risk zones are areas not suitable for any development. In the medium risk areas development is possible with certain reservations. Any development can take place in the low hydrological risk zones. It is important that the risk implication should be indicated to developers when developing in these areas.



Map 3: Hydrological risk assessment

❒ Flood damage assessment

The hydrological and flood damage simulation models FLODSIM and TEWA are applied in this stage to predict the potential flood damage for all possible flood events.

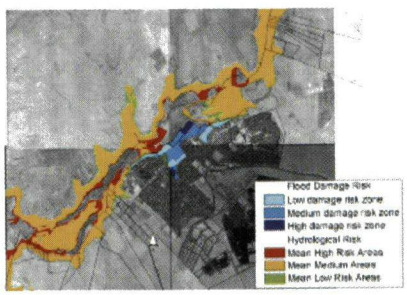
Figure 2 is a diagrammatic outline of a typical flood damage analysis done at this stage. After flood plain demarcation a survey is necessary to classify the flood plain into irrigation, residential, commercial, industrial and informal land-use types.

Loss function for each land-use type is important input required by FLODSIM and TEWA. (Loss function define the relationship between flood damage and certain characteristics of a flood.) Other data inputs also required are hydrological, topographical, land-use and economic data. With all this data inputs the flood damage simulation models are able to calculate the direct tangible flood damage for each flood event.

Now it is possible to predict the mean annual damage (MAD), which is required to execute the flood damage risk assessment in the next stage.

❒ Flood damage risk assessment

After determining the potential flood damage and corresponding MAD, it is possible to identify flood damage risk areas. A mean digital terrain model (DTM) is created by combining all predetermined flood events to identify the low, medium and high flood damage risk zones. Map 4, is an example, and can be used to prioritise possible flood mitigation measures to prevent and/or mitigate all negative impacts and risks of floods.



Map 4: Flood damage risk assessment

❒ Evaluation of mitigation measures

Identified mitigation options in the previous phase can be evaluated by using a cost-benefit analysis. The execution of a cost-benefit analysis requires the MAD and costs of different mitigation options. A multi-criteria decision analysis is used for the evaluation of different scenarios as required for the evaluation of cost-effective mitigation measures.

It is possible to determine an optimal point between cost and benefits to apply flood mitigation measures for an area under investigation (see Figure 3). With little flood mitigation measures, the losses due to floods will be very high. However, beyond the optimal point, unnecessary flood control will cause the costs to exceed the benefits. This approach has already been applied successfully in Gauteng Metro area and

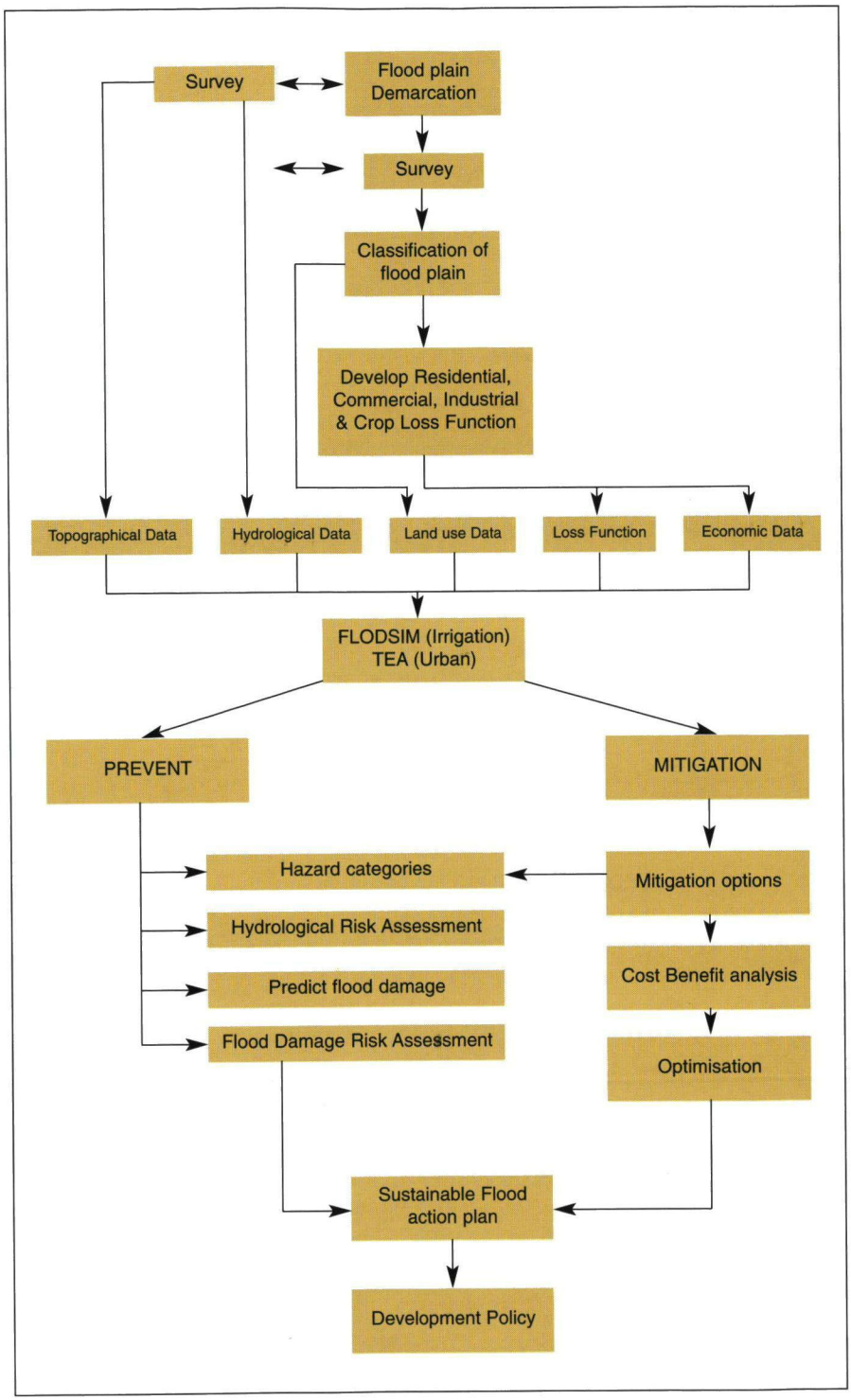


Figure 2: Typical Flood Damage Analysis

Flood disaster causes much damage and effects great losses.

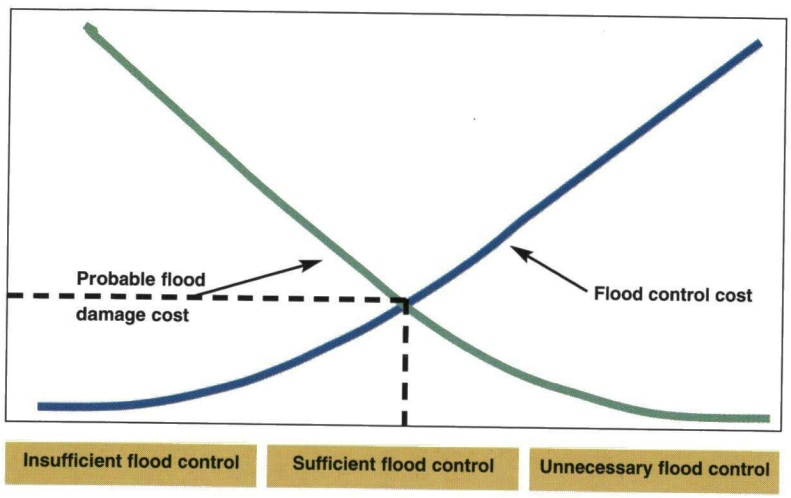


Figure 3: Cost benefit analysis to prevent and to mitigate flood damages

saved the province more than R20 million in the upgrading of stormwater systems.

Once the optimal cost-benefit ratio has been determined, it is possible to develop a phased remedial works programme and capital cost for governments. This provides important information to phase capital costs over a time period. It is then possible to budget for capital costs over more than one financial year. It further indicates what must be done first in high priority areas to mitigate and prevent flood damages.

PRO-ACTIVE FLOOD ACTION PLAN

The above-mentioned six stages are all integrated into a report, which serves as a pro-active flood action plan This flood action plan will also indicate:

- an appropriate development line, and
- guidelines for development policy for provincial and local governments.

It is also necessary to reduce the risk of flooding as a result of river morphology. The new Water Act makes provision for the 100-year flood line as a development line for all regions. However, using the 100-year flood line as a development line is a rigid approach and does not take into account all the possible risks as specified. It will be necessary to formulate additional guidelines and policies to control development in flood prone areas. With the WATEES approach it is possible to formulate an appropriate development policy to ensure a pro-active approach and enable authorities to prevent and mitigate.

REACTIVE FLOOD DISASTER PHASE

Useful contributions can be made during the reactive flood disaster phase. With inputs of an actual flood event into FLODSIM and TEWA, it is possible to create and print hazard maps (similar to Map 2) based on the actual flood. These maps can be used to activate the flood warning and evacuation plan. The potential losses of real floods can also be determined with FLODSIM and TEWA, which can give a broad indication of what the potential damage of a real flood will be. With more data available, predictions of flood damage will improve. It is recommended that calibration of the simulation models be conducted after the occurrence of floods.

POST FLOOD DISASTER PHASE

It is important not to execute a detailed survey directly after the flood as the emotional shock of respondents can lead to over-estimating the negative impact of flood disaster. The opposite is also true where real losses will also be known after a period of time and flood losses can thus be under-estimated. Timing of a survey is therefore critical. The user-friendly computer model FLODCAL can be used for executing this phase. FLODCAL consist out of various questionnaires and adds up the various flood damages of all victims to determine the total impact of a real flood in a region.

The secondary objective of FLODCAL is to use the results to calibrate the hydraulic model and flood damage simulation models (FLODSIM and TEWA). It is also important to document other important aspects of real floods, e.g. water levels and time of the highest water level. This will help during the prediction/pro-active phase to simulate negative impacts of floods more accurately.

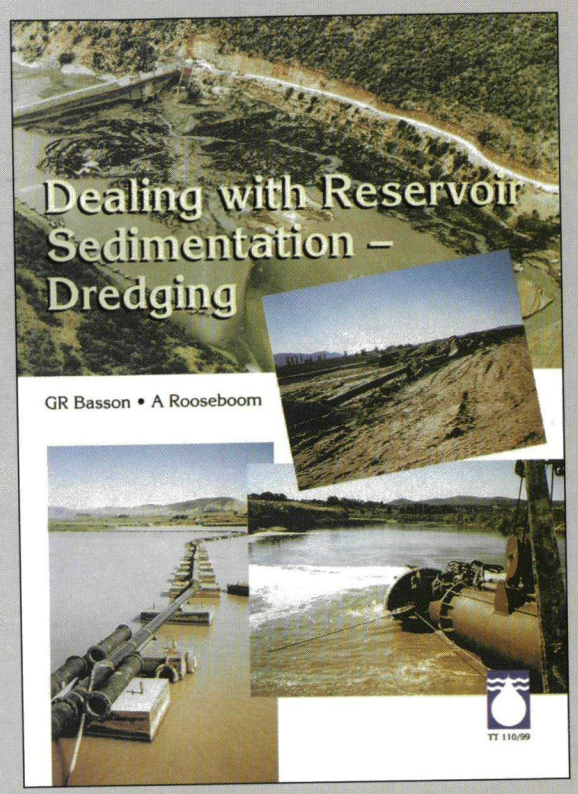
CONCLUSION

The WATEES approach together with the computer models and aids developed by the Department of Agricultural Economics, University of the Free State, seems to be relevant to help all levels of government to execute the Bill on Disaster Management, namely to prevent and to mitigate. The adoption of this new unique approach by government authorities and non-governmental organisation will not only lead to sustainable development practices, but will also increase the welfare of communities and help to insure food security.

Dredging evaluated

Reservoir sedimentation limits the life span of reservoirs and the ensuing loss of storage capacity is a worldwide problem. One of the methods used to regain lost storage due to sedimentation is dredging, which involves the excavation of soil material, or sediment deposits, from underwater. Dredging is a highly specialised technology mostly used in ports, waterways and mining. Reservoir dredging, however, also takes place on a routine basis in many reservoirs all over the world, but mostly on a small scale at localised intakes, or storage dredging in small reservoirs say researchers GR Basson and AR Rooseboom in a report to the Water Research Commission. They say that the dredging of reservoirs in South Africa has, to date, been on a limited scale, only in small reservoirs, due to the high cost of dredging compared to the construction of new or enlarged storage.

The report **Dealing with Reservoir Sedimentation - Dredging** (WRC Report TT 110/99) aims to provide water resources planners and managers with information on the available technology to cope with the problems of reservoir sedimentation, as well as the economical aspects of dredging. The report reviews reservoir dredging practices worldwide, as well as locally, assessing the various techniques for reservoir dredging and the specific boundary conditions involved. The main focus of the report is on the economic feasibility of dredging of specific South African reservoirs, compared to alternative options for the control of sedimentation.



The report TT110/99 is available free of charge (in South Africa) from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: orders@wrc.org. za (Foreign orders: US$60 per copy, via surface mail.)

In the development and operation of water resources many variables play a role in the decision support system. One of the major factors is the economic feasibility of a project. The cost of dredging reservoirs has been relatively high compared to the creation of additional or new storage, or alternative sediment control methods in most countries where it has been implemented. However, in recent years technical developments and a more scientific approach in the dredging industry have narrowed this gap to a point where dredging has to be considered as a major technique for controlling sedimentation. The application of this technology is particularly valid in semi-arid to arid regions where catchment or hydraulic sediment control methods cannot be implemented successfully. Limited suitable new dam sites, socio-economic considerations when raising a dam, and environmental concerns related to the construction of especially medium to large-scale dams, are all factors favouring reservoir dredging.

EQUIPMENT

An overview of the general available dredging equipment and the specific applications thereof, together with reservoir specific equipment and new developments is given in the report. Specific issues such as the disposal and possible use of dredging material, as well as environmental concerns associated with the dredging of reservoirs, are also discussed.

According to the report case histories have indicated that the selection of the correct dredging equipment, especially for reservoir dredging, is essential (eg. boundary conditions such as consolidated clay which make the use of a cutter a necessity).

The dredging industry is highly specialised, as each project has its particular purpose designed dredging equipment, taking soil properties, water depth, environment and logistical constraints into account. It is therefore difficult to recommend a specific dredger for general reservoir dredging application.

However, the researchers say that the cutter-suction and bucket-wheel dredgers with floating pipelines do meet most of the requirements for reservoir dredging and should be considered in dredging depths of less than 30 metres. For deeper applications there are specialised grab or fluidisation-pump systems available.

Siphon dredging systems with a cutter head could result in a considerable cost savings by eliminating the use of pumps. However, these systems are limited by the available head, required transport distance, limitations on water loss and environmental concern with downstream disposal. It is indicated in the report that with proper management of sediment-water releases, the system can be used to the benefit of the environment by restoring the sediment regime. The researchers say that siphon dredging should be considered in more detail in the light of the current First World tendency to construct smaller reservoirs.

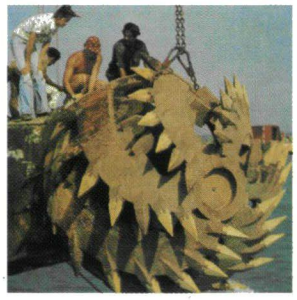
The report says that most of the problems encountered in reservoir dredging, such as large depth, consolidated debris and disposal limitations, have been experienced at dredging operations elsewhere, and a considerable amount of knowledge on reservoir dredging is readily available.

ECONOMICAL ANALYSIS

The use of dredging as a method to control reservoir sedimentation has often been discarded due to the high costs historically associated with dredging. However, the report thoroughly addresses the economic aspect of dredging, as from the local South African experience it is shown that

Above: Dredging at Mbashe in the Eastern Cape.

Right: The Mbashe dredger (jet pump technology).



Cutter-head.

Cutter suction dredger.

Cutter-suction and bucket-wheel dredgers with floating pipelines meet most of the requirements for reservoir dredging.

Bucket-wheel dredger.

dredging costs could be in the same order as alternative methods to deal with reservoir sedimentation.

An economical dredging analysis of some of the reservoirs in South Africa most affected by sedimentation was done by evaluating the water demand and current yield, comparing dredging with an alternative method to achieve the required demand in terms of cost, and calculating a net present value of dredging and the alternative (such as raising the dam wall) to increase reservoir capacity.

GENERAL CONCLUSIONS

- To obtain the same yield benefit, a much smaller volume can be dredged compared to the alternative of a raised dam to create additional storage.
- Dredging of all the sediment is not necessary; the required volume is determined by the water demand, run-off reservoir basin characteristics, volume of sediment, etc.
- At some reservoirs a dead storage zone for sedimentation has been provided for, with the lowest water release valves located above this zone. Dredging of the dead storage zone can therefore not be considered because the water cannot be utilised.
- The general assumption in water resources planning that sedimentation fills the dead storage zone with a horizontal surface level, should be analysed in more detail for existing reservoirs and final designs of new dams to evaluate the impact of loss of live storage due to sedimentation. According to the report allowance in future for sedimentation of reservoirs can still be made, but the design of dead storage specifically for sedimentation should be discarded.

COSTS

Historical dredging costs in South Africa and a dredging cost analysis of three reservoirs were evaluated and the researchers' conclusions are the following:

- Although difficult to generalise, the required dredging unit costs need to be in the order of less than R1,50 /m^3 of sediment excavated.
- The use of electric power instead of diesel power should seriously be considered in any dredging project, because it can more than halve the unit dredging costs.
- Local expertise and links with international dredging firms in the dredging industry have grown in recent years, and unit dredging costs are lower than before.
- To buy a dredger and carry out dredging often seems a viable option to government bodies. However, dredging is a highly specialised industry and items such as special training and maintenance are often underestimated, resulting in higher dredging costs than would be if carried out by a contractor. Experience seems to indicate that government-owned equipment is also used until it is obsolete and highly expensive to run.
- The cost of disposal of sediment should not be underestimated as it could easily make up 20 per cent of the total cost of a dredging project.

"The combined skills of outstanding researchers and water practitioners, and a rich tradition of excellence in teaching, ensure that the programmes and services of the University of Natal are both relevant and practical."

– Professor Ahmed Bawa,
Deputy Vice-Chancellor Academic

Further Information

Contact can be established with any of the water-related groups which, if appropriate, will provide referral to other resources either within the University or elsewhere. In addition to existing programmes, customised products and services may be considered.

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4041

Website for the University of Natal's water activities is: www.water.nu.ac.za

International Telephone Calls
to South Africa should be prefixed by +27 and the first zero should be omitted (the area code for Pietermaritzburg is 33 and for Durban is 31)

AMANZI
WATER
METSI

WATER WATER

Capabilities of the University of Natal South Africa

University of Natal
Durban & Pietermaritzburg Campuses

The Importance of Water

Water is an essential natural resource, without which no life as we know it could exist. Water fulfils a basic human need, yet it must also sustain agriculture, industry and the environment.

Rain falls variably, both in time and in space. Notwithstanding periodic floods, most of South Africa is semi-arid. The country receives on average 475 mm of rain per year (a little more than half the world average). Moreover, the rainfall and the subsequent run-off are distributed unevenly. Areas of greatest demand are often areas with low supply, necessitating the storage and transfer of water. This pattern is reflected in much of the rest of Africa and elsewhere. As demand escalates, it has been forecast that this century may see wars fought over natural resources and that some countries, including South Africa, risk running out of water in the next 25 years.

The successful management of water as a strategic resource will require a combination of scientific, economic, social, engineering and environmental skills. In the South African context, new water legislation drives the development of new models of water management. Communities must become more actively involved in developing and operating water and sanitation systems, and in managing water catchments. The upliftment and empowerment of previously disadvantaged communities presents a significant challenge.

New Activities

Innovation is a driving force of the University, as it strives to meet the changing need of society and remain a socially responsive institution.

Among the newer activities are:

- MBA in Water Management: this programme is unique to Africa and is offered by the School of Business Pietermaritzburg both full and part-time. Individual modules are available as short courses.
- Masters in Environment and Development: the Centre for Environment and Development now offers a new specialisation in water resource management.
- ICP-MS: a state of the art capability for analysing elements and contaminants in water, operated by the School of Geological and Computer Sciences in Durban.
- South African Youth Water Prize: initiated by the University of Natal in collaboration with the Department of Water Affairs and Forestry, various role-players in South Africa and the International Junior Water Prize of the Stockholm Water Festival.

Linkages

Partnerships are a dominant approach, whereby the University aims to provide an integrated range of services. In addition to internal collaborations, relationships exist between the University of Natal and major water role-players, nationally and internationally, including:

- Council for Scientific and Industrial Research (CSIR).
- ESKOM
- South African Sugar Association
- SAPPI
- Department of Water Affairs and Forestry (DWAF)
- Mondi
- Umgeni Water and Umgeni Water Services
- Water Research Commission (WRC)

Geological and Computer Sciences, School of (UND): provides courses in water resources and pollution studies, and expertise in the hydrological cycle, groundwater exploitation, physical and chemical properties of water, water-rock interactions, and pollution and water management; with a specialised interest in the coastal zone. Contact: Professor Allan Wilson, tel: (031) 260-2516, fax: (031) 260-2280, e-mail: wilsona@nu.ac.za.

Government and Policy Studies, Centre for (CENGOPO) (UNP): offers postgraduate degrees and short courses in policy analysis, governance and management; with a specialist interest in water policy networks and public-private partnerships. Contact: Professor Ralph Lawrence, tel: (033) 260-5980, fax: (033) 260-5230, e-mail: lawrencer@nu.ac.za.

Law, School of (UNP): provides general expertise in environmental law with specialist interests in the conservation of natural resources, water and pollution control. Offers various Certificate, Diploma and Masters courses. Contact: Professor Michael Kidd, tel: (033) 260-5382, fax: (033) 260-5015, e-mail: kidd@nu.ac.za.

Natural Resources, Institute of (UNP): as an Associate Institute of the University of Natal, the INR provides expertise in applied research and management of water resources, the development of decision-support tools for estuaries and fresh water management; and water conservation in the rural and agricultural arenas. Contact: Dr Patrick Sokhela, tel: (033) 346-0796, fax: (033) 346-0895, e-mail: ceo@nu.ac.za.

Pollution Research Group (UND): promotes cleaner production using process engineering tools, with expertise in membrane technology, waste minimisation, water and effluent management, biological effluent processing, sonochemistry, computational fluid dynamics and life-cycle analysis. Contact: Professor Chris Buckley, tel: (031) 260-3375, fax: (031) 260-1118, e-mail: buckley@nu.ac.za.

Water in the University of Natal

Water Related Skills are widely distributed throughout the University of Natal: a broad-based institution located on two campuses in Durban (UND) and Pietermaritzburg (UNP), serving about 22 000 students.

The University of Natal is a leading institution in the water field, both nationally and internationally. It provides various undergraduate and postgraduate programmes and courses. In addition, staff of the University and its associated units have specialist skills which are highly regarded and extensively used in research, consulting and community services in such fields as agriculture, catchment management, community development, conservation, environmental management, forestry and infrastructural development. Such skills include:

- Acid mine drainage
- Biological analysis; biological treatment, processing and bio-remediation
- Chemical analysis; cleaner production
- Dam feasibility studies; decision support; demand management
- Ecology; estuarine management
- Flood and drought forecasting and protection; fluid dynamics
- Geographic and spatial information systems; geology and hydrogeology
- Hydrology and applied hydrology (e.g. agriculture and forestry)
- Information management; irrigation
- Law; life-cycle analysis, limnology
- Management; meteorology and applied meteorology (e.g. agrometeorology); modelling
- Natural resource management
- Policy and governance; pollution control and effluent management
- Waste minimisation and treatment; water quality and treatment; water management; wetlands.

WATER SPECIALISATIONS

ANALYTICAL FACILITY (UND): a unit of the School of Geological and Computer Sciences, the facility houses a Perkin-Elmer Elan 6100 ICP-Mass Spectrometer, a state-of-the-art tool for the elemental analysis of water, and both natural and industrial contamination, to very low detection levels. Contact: Professor Allan Wilson, tel: (031) 260-2516, fax: (031) 260-2280, e-mail: wilsona@nu.ac.za.

APPLIED ENVIRONMENTAL SCIENCES, SCHOOL OF (UNP): the Soil-Plant-Atmosphere Research Unit specialises in micrometeorology and agrometeorology (plant-water and soil water-relations), in which it offers a postgraduate programme. General expertise includes hydrology, microbiology, bio-remediation, GIS and integrated natural resource management. The treatment of toxic sludge from water treatment works forms a particular field of research. Contact: Professor Mike Savage, tel: (033) 260-5510, fax: (033) 260-5426, e-mail: saesacad@nu.ac.za.

BOTANY AND ZOOLOGY, SCHOOL OF (UNP): provides specialised expertise in biological limnology, with particular reference to man-made lakes and integrated catchment management, which knowledge is also built into a number of courses. Contact: Professor Rob Hart, tel: (033) 260-5117, fax: (033) 260-5105, e-mail: hartr@nu.ac.za.

BIORESOURCE ENGINEERING AND ENVIRONMENTAL HYDROLOGY, SCHOOL OF (UNP): a leading and the largest university hydrology research group in South Africa with an applied environmental focus specialising in process studies, land-use impacts, design hydrology and integrated water resource assessment; offers a BSc Degree in Hydrology as well as post-graduate training. Contact: Prof Roland Schulze, tel: (033) 260-5489, fax: (033) 260-5818, e-mail: schulze@aqua.ccwr.ac.za.

BUSINESS, SCHOOL OF (UNP): provides programmes in economics, commerce and management including the MBA in Water Management and specialist skills in resource economics. Contact: Ms Debbie Vigar, tel: (033) 260-5899, fax: (033) 260-5219, e-mail: vigard@nu.ac.za.

CIVIL ENGINEERING, SCHOOL OF (UND): provides specialist skills in rainfall modelling, stream flows, water storage and flood attenuation, and postgraduate courses in applied hydrology and flood hydrology, for which the contact is Prof Geoff Pegram, tel: (031) 260-3057, fax: (031) 260-1411, e-mail: pegram@nu.ac.za.
For expertise in environmental fluid dynamics, dispersal of contaminants in rivers, effects of river outflows, and remediation of industrial sites, contact: Dr Derek Stretch, tel: (033) 260-1064, fax: (031) 260-1411, e-mail: stretchd@nu.ac.za.

COMPUTING CENTRE FOR WATER RESEARCH (UNP): as a Water Research Commission facility hosted by the University of Natal, the CCWR promotes communication and co-operation within South Africa's water research community. Contact: Dr Mark Dent, tel: (033) 260-5177, fax: (033) 260-6288, e-mail: dent@aqua.ccwr.ac.za, web: www.ccwr.ac.za.

ENVIRONMENT AND DEVELOPMENT, CENTRE FOR (UNP): provides a specialised course in water resource management as part of the Master's in Environment and Development; and provides expertise in rehabilitation and management of rivers and riparian zones; wetland, estuary and river management; freshwater requirements of aquatic systems; IEM and water resources development; and transboundary water resource management. Contact: Dr Nevil Quinn, tel: (033) 260-5664, fax: (033) 260-6118, e-mail: quinnnw@nu.ac.za.

REGISTRATION FORM

I would like to attend the 12 to 16 Feb 2001 course:

Surname: .....

Name: ..... Title: .....

Position held: .....

Postal address: .....

.....

.....

Telephone: .....

Fax: .....

E-mail: .....

A cheque for my course fee and accommodation is enclosed / I will make arrangements for payment of the course fee and accommodation before the start of the course.

Signature: .....
(accepting that I will attend the entire course)

Complete and return registration form and cheque to:

Patsy Scherman or Nikite Muller
Institute for Water Research
Rhodes University
Grahamstown 6140
Tel: (046) 622 2428 / 603 8532
Fax: (046) 622 9427
E-mail: patsy@iwr.ru.ac.za
nikite@iwr.ru.ac.za

DEADLINE DATE IS 12 JANUARY 2001

CONDITIONS OF ENROLMENT

Please complete and sign the registration form and return to Patsy or Nikite at the IWR. Because of the practical components of the course, the number of enrolments will be limited. Receipt of a completed registration form and arrangements for payment will secure your place in the course. Excess names will be kept on a waiting list.

Each participant will receive a copy of the course manual. Certificates will be awarded to participants, subject to successful completion of the course.

CANCELLATION POLICY

All withdrawals are subject to a R200.00 non-refundable processing fee. A 50% refund will be issued for withdrawals later than one calender month prior to commencement of the course and no refund will be issued for withdrawals on or after the commencement date. Full refunds will be issued if the workshop is cancelled.

ACCOMMODATION

Accommodation has been booked at the Settler's Inn Motel (the workshop venue) at a cost of R300 per person per night (Monday to Thursday night; a total cost of R1200). Additional costs for lunches on the first and last days are not included in the cost. Participants are requested to pay the full accommodation fee (R1260) to the IWR.

PAYMENT

Cheques should be made payable to Institute for Water Research and mailed to Patsy or Nikite.

Announcement of a National short-course on

THE ROLE AND USE OF BIOLOGICAL MONITORING IN AQUATIC RESOURCE ASSESSMENT

Course for 2001

12 to 16 February
at
Settler's Inn Motel, Grahamstown

Initiated by:
CSIR's Division of Water, Environment and Forestry Technology (Environmentek)
&
The Institute for Water Quality Studies (IWQS) of the Department of Water Affairs and Forestry

Currently coordinated by:
The Institute for Water Research
Rhodes University
Grahamstown

RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

AIM OF THE COURSE

Aquatic biomonitoring, or response monitoring, is increasingly used as a monitoring and assessment tool in water resource management. This course will provide a basic understanding of the concepts, advantages, limitations and results associated with different biomonitoring techniques, including field bio-assessment and toxicity bioassays. The course is designed to address the relevant concepts and the interplay between biomonitoring and resource management, rather than the technical details of how to conduct the monitoring.

WHO SHOULD ATTEND?

Mid-level managers, planners and other officials from government or private institutions who need and want to improve their knowledge and use of biomonitoring in general.

METHOD OF PRESENTATION

There will be a balance between theoretical lectures (presented by experts from various organisations), hands-on exposure in the laboratory and field and group discussions and problem solving. Presentations and course material will be in English.

COURSE FEE

The course fee is **R3500** per person and includes lecture material and use of field and laboratory equipment. Accommodation has been arranged at the Settler's Inn Motel (where the course will be held) at a cost of R300 pp/night: this fee includes meals and teas; there is an additional cost of R60 for lunches on the first and last days (Total R1260). The full fee (R3500+R1260) must be paid prior to commencement of the course.

OUTLINE OF THE COURSE

Day 1: Management of aquatic resources

- New water resources policy
- Integrated catchment management
- Ecological goals for rivers
- Ecology in water resources management

Day 2: Biological methods and assessment

- Water quality criteria
- Biomonitoring principles
- Habitat assessment
- Macro-invertebrates
- Fish community assessment
- Riparian vegetation index
- Algae and diatoms
- *Field practical*

Day 3: Biomonitoring methods, data management and case studies

- Hydrology
- Geomorphology
- Data presentation and databases
- Decision support systems
- The Rivers database
- Case studies
- *Laboratory practical*

Day 4: Aquatic toxicology

- Sediment toxicity testing
- Standard organisms in toxicity testing
- Indigenous organisms in toxicity testing
- Bioaccumulation
- Ecotoxicology
- Ecological Risk Assessment
- *Laboratory practical*

Day 5: Environmental law and community involvement in biomonitoring

- Environmental law
- Community involvement
- Water stories

(Course details and programme will be forwarded to you at a later date).

Enquiries:

Dr Patsy Scherman or Dr Nikite Muller
Institute for Water Research
Rhodes University
Grahamstown
Tel: (046) 622 2428 or (046) 603 8532
Fax: (046) 622 9427
e-mail: patsy@iwr.ru.ac.za or
nikite@iwr.ru.ac.za

Venue for the 2001 course

The Settler's Inn Motel is situated approximately 1km out of Grahamstown, on the N2 to Port Elizabeth (a map will be supplied with course details). To ease travel arrangements to and from the venue, the course will commence at mid-day of the first day and conclude by mid-day on the last day.

Call for Papers

UNESCO International Hydrology Programme
4th International Conference on FRIEND

FRIEND 2002

18-22 March 2002
Cape Town, South Africa

Theme

Bridging the gap between research and practice

Aim

The aim of the conference is to present the results of the UNESCO Flow Regimes from International Experimental and Network Data (FRIEND) research programme which has stimulated international cooperation in the field of hydrology. The focus is bridging the gap between knowledge, research and practical applications.

Topics

- Hydrological data - policy, international rivers, databases, real time and dissemination.
- Managing hydrological risk - floods, surface and groundwater droughts.
- Water scarcity, over-exploitation and poverty reduction.
- Sustaining water-related ecosystems - definitions, methodology, and operation.
- Continental hydrology - regimes, water sharing, teleconnections, snow, ice, international basins.

Papers

Papers are invited, according to the above topics, which demonstrate how advances in hydrology can be used for the development of integrated river basin management to ensure the sustainable development of water resources. Examples of research results incorporated in operational hydrology and water resource planning, including decision support systems, numerical and statistical models and visualisation techniques are welcome. Papers are encouraged from a broad range of institutions including operational hydrological agencies, water users, policy makers and research scientists.

Should you be interested in presenting a paper or poster please send an extended abstract (two pages) to the conference secretariat. Authors should indicate whether the paper is for oral presentation or a poster, and under which topic it resorts. Papers will be selected following a review of abstracts submitted and will be prepublished in the IAHS conference publication series. Papers may be submitted and presented in English or French.

Target dates

** Please note that the dates below may be rescheduled.*
30 November 2000 - Receipt of abstracts (conference secretariat)
28 February 2001 - Authors notified of accepted abstracts
30 April 2001- Second conference circular
30 May 2001- Submission of papers
30 September 2001 - Early registration (20% discount)

Enquiries

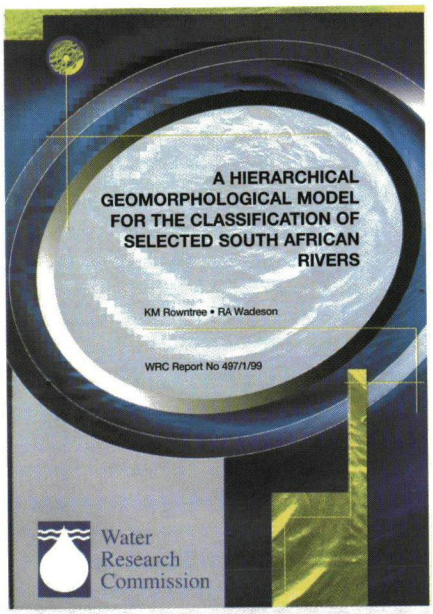
For further information please contact Juanita McLean at the Conference Secretariat:
FRIEND 2002
Institute for Water Research
Rhodes University
PO Box 94, Grahamstown, 6140
Tel: (046) 622-4014 • Fax: (046) 622-9427 • E-mail: Juanita@iwr.ru.ac.za

friend

SANC IAHS

New reports published by the Water Research Commission

The following reports are available (free of charge in South Africa) from the Water Research Commission in Pretoria. To order a copy, please contact the librarian, WRC, PO Box 824, Pretoria 0001. Tel: (012) 330-0340. Fax: (012) 331-2565. E-mail: orders@wrc.org.za

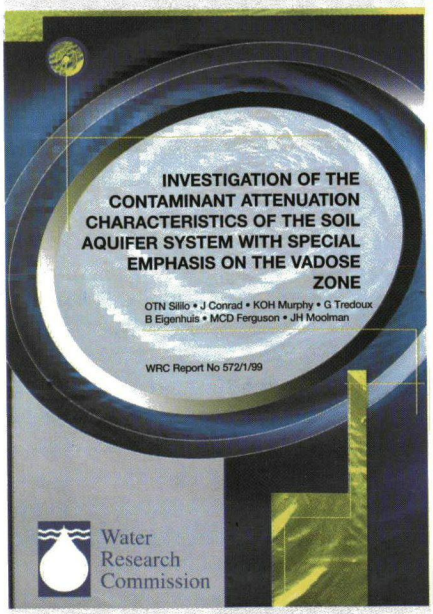


Report 497/1/99 - A hierarchical geomorphological model for the classification of selected South African rivers. Report to the Water Research Commission by the Geography Department at Rhodes University.

Authors: KM Rowntree and RA Wadeson
Overseas price: US$ 35 (via surface mail)

South African rivers are under stress from a number of directions: direct abstraction of water, impoundments and associated interbasin transfers, gravel and sand abstraction, increased sediment inputs from eroded catchments and channelisation are amongst the actions which impact directly on the physical channel. The channel, together with the flow of water, sediment and nutrient, provides the physical habitat for aquatic ecosystems so that any disturbance of the channel morphology will also affect the availability of habitat. The study of channel form and channel forming processes is encompassed by the science of fluvial geomorphology, the application of which is fundamental to any assessment of the impact of river related developments, or attempts to redress former impacts through river restoration programmes.

This report considers a number of relevant geomorphological concepts within a South African context and presents a geomorphological framework within which the impacts of water management on channel form and associated ecological processes can be assessed. The hierarchical framework enables the linkages between the catchment and channel to be modelled over a range of spatial scales. Examples in the report of how this model can be applied to river management include the Buffalo River in the Eastern Cape, the Sabie River in Mpumalanga and the Olifants River in the Western Cape.

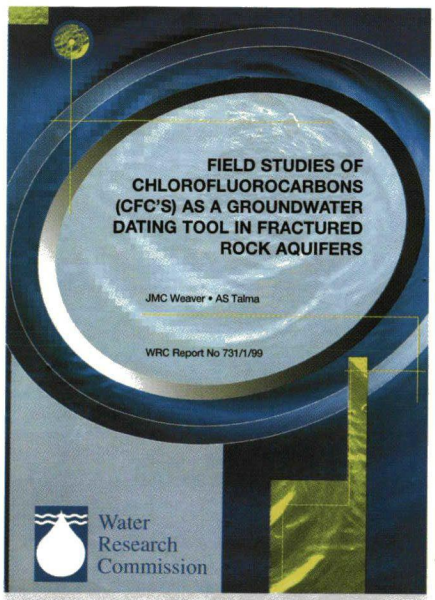


Report 572/1/99 - Investigation of the contaminant attenuation characteristics of the soil aquifer system with special emphasis on the vadose zone. Report to the Water Research Commission by the Division of Water, Environment and Forestry Technology, CSIR (Cape Water Programme) in conjunction with the Department of Soil and Agricultural Water Science at the University of Stellenbosch.

Authors: OTN Sililo, J Conrad, KOH Murphy, G Tredoux, B Eigenhuis, MCD Ferguson and JH Moolman
Price: US$ 25 (via surface mail)

In view of the importance of groundwater as a potential source of water supply, both for domestic and industrial uses, every effort must be made to minimise the deterioration of its quality due to human activities. The vulnerability of a groundwater aquifer to pollution is directly linked to the hydraulic characteristics of the aquifer overburden as well as the attenuation or "purification" capacity of the soil. During infiltration through soils and transport in aquifers, many contaminants are naturally attenuated. However not all subsurface environments are equally effective in this respect.

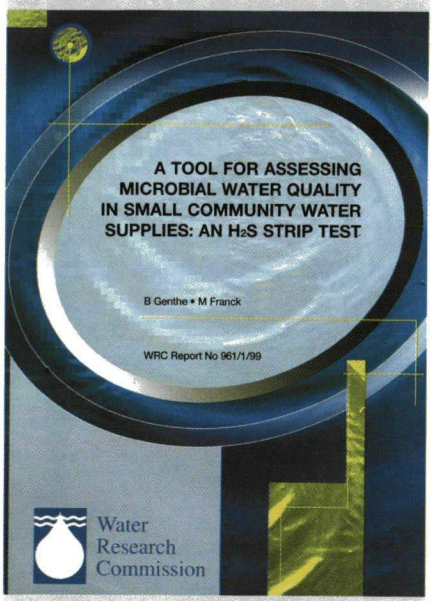
The report emanates from an investigation, funded by the Water Research Commission, to determine the contaminant attenuation capacity characteristics of various soils, aquifers and the subsurface environment as a whole for specific contaminants. The aim was to provide a useful tool for planners, policy makers and pollution control authorities to assess groundwater pollution risks. A methodology was also developed in this study for generating vadose zone attenuation maps for the Western Cape and the authors recommend that this methodology be applied to the whole of South Africa.



Report 731/1/99 - Field studies of chlorofluorocarbons (CFC's) as a groundwater dating tool in fractured rock aquifers. Report to the Water Research Commission by the CSIR's Cape Water Programme, Stellenbosch, and Quaternary Dating Research Unit, Pretoria.

Authors: JMC Weaver and AS Talma
Overseas price: US$ 20 (via surface mail)

The chlorofluorocarbon gases, CFC-11, CFC-12 and CFC-113 were developed during the 1930s. These gases are volatile organic compounds which are chemically relatively stable and safe, and have been widely used in society. Due to their solubility in water they can also be used for tracing and dating young groundwater as well as recently formed ocean water masses. The levels of CFC dissolved in water reflect the atmospheric concentration at the time of the last contact of water with the atmosphere. For groundwater, the method rests on the assumption that groundwater at the water table will be in equilibrium with atmospheric air, including its CFC component following the laws of solubility. Once water moves into the saturated zone below the water table, it will not be able to acquire or lose any additional CFC gas. The CFC quantity in the water will be characteristic of the atmospheric CFC level prevailing during the last contact with the atmosphere. This forms the basis of CFC DATING of groundwater.

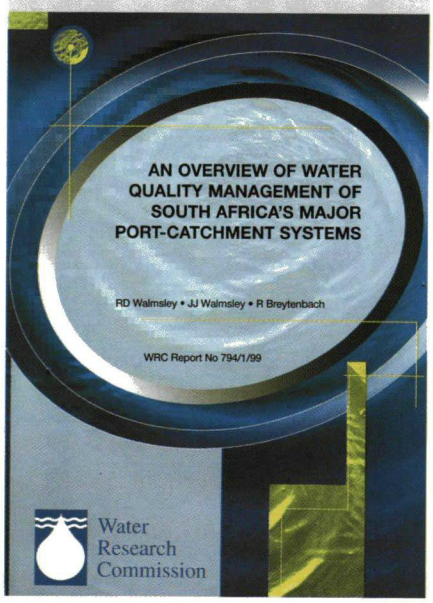


Report 961/1/99 - A tool for assessing microbial water quality in small community water supplies: an H_2S strip test. Report to the Water Research Commission by the Division of Water, Environment and Forestry Technology at the CSIR.

Authors: B Genthe and M Franck
Overseas price: US$ 20 (via surface mail)

Water supplies in small communities in South Africa have been shown to have notoriously poor water quality with reports of 80 per cent of samples tested failing drinking water quality guidelines. This emphasises the need to have a rapid and reliable method which can be used by field workers, environmental health officers and community water committees to identify where potential problems exist in the drinking water quality management process.

The report documents the evaluation of a method based on an H_2S strip test which turns the water sample black if it is contaminated. The method therefore provides an easy and visual method for assessing water quality. The method has also been tested for its relationship with coliforms and coliphages and a significant correlation between the H_2S strip test and the indicator organism was found. The apparent benefit of this method is its ability to conduct the test at room temperature. This would allow water samples to be collected and an assessment of the water quality could be carried out in the field without transporting it to a laboratory.



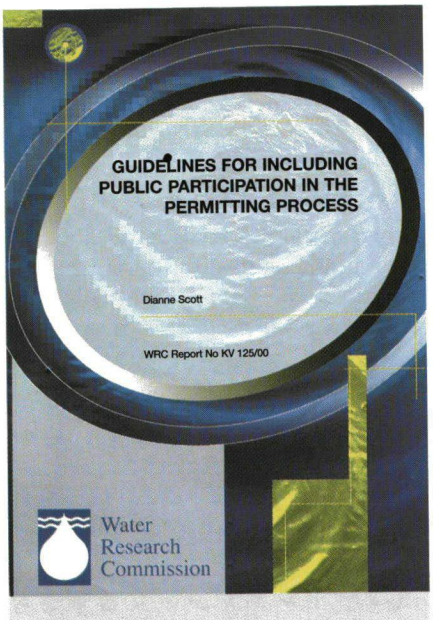
Report 794/1/99 - An overview of water quality management of South Africa's major port-catchment systems. Report to the Water Research Commission by Steffen, Robertson and Kirsten.

Authors: RD Walmsley, JJ Walmsley and R Breytenbach
Overseas price: US$ 20 (via surface mail)

The report describes the results of a research project designed to:

- review the state of the art on general water quality problems in ports and the policies (international and national) related to their control;
- conduct a review and situational analysis of water quality issues pertinent to South African ports and their adjoining catchments;
- review the current status of water quality management systems in South Africa's major harbours and their associated catchments; and
- identify and highlight areas that require attention, particularly with regard to policies and practices on research, monitoring and information transfer.

The report is divided into distinct sections, each of which provides information and opinions of the status of the above.



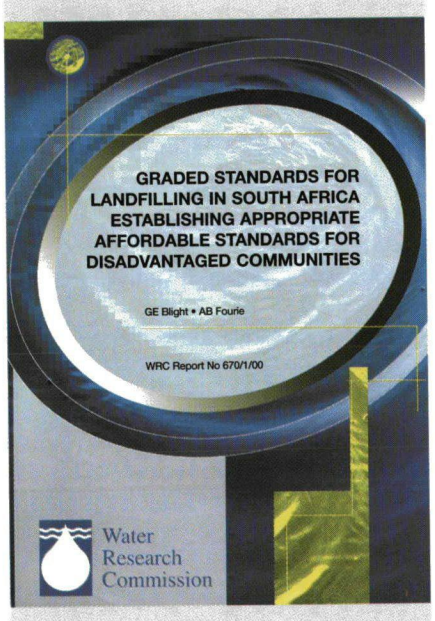
Report KV125/00 - Guidelines for including public participation in the permitting process. Report to the Water Research Commission by the Department of Geographical and Environmental Sciences, University of Natal.

Author: Dianne Scott
Overseas price: US$ 10 (via surface mail)

Increasingly, in South Africa and internationally, decision-making in relation to environmental issues requires statutory procedures of public participation to be followed. Many of these procedures are in the initial stages of being implemented, and the participatory processes are experimental in nature.

The report consists of three sections, namely, the introduction, guidelines and background information to the report.

The report aims to provide a set of guidelines for the Department of Water Affairs and Forestry which could be used as the basis for the establishment of a range of participatory processes. The guidelines provide the basis for devising a set of "minimum requirements" that would be necessary to ensure equitable public participation and democracy in environmental decision-making. Adherence to the guidelines would allow members of the public and citizens to have access to environmental decision-making around issues that impact on their well-being and living environments, in partnership with the regulating bodies and developers (public or private).



Report 670/1/00 - Graded standards for landfilling in South Africa establishing appropriate affordable standards for disadvantaged communities. Report to the Water Research Commission by the Department of Civil Engineering, University of the Witwatersrand.

Authors: GE Blight and AB Fourie
Overseas price: US$ 25 (via surface mail)

A committee was formed by the Department of Water Affairs and Forestry in 1990 to formulate a system of minimum requirements which represents a set of graded standards for siting, design, operation and closure of landfills. The stated objective of the minimum requirements was to ensure that the most cost-effective means are used to protect the environment and public health from the adverse impacts of solid waste disposal.

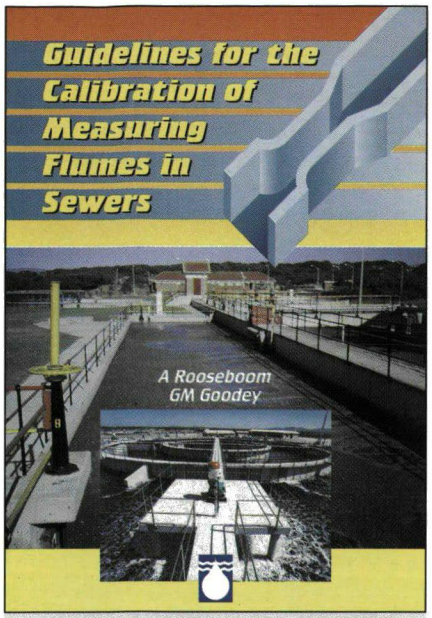
At the time of finalising the first edition of the minimum requirements, it was obvious that further research was needed to support the concepts embodied in the document. In particular, the climatic water balance procedure needed further investigation to justify it, and particularly if it would apply to small landfills where control, compaction and covering were of a low standard.

Previous research had been carried out on landfills serving predominantly developed (or first world) communities. It was known that the composition of this waste was very different to that of waste generated by undeveloped (or third world) communities. Would the minimum requirements prove adequate and suitable for both types of waste?

To investigate these two aspects, it was decided to undertake two separate investigations. The first would involve sampling and testing the soil adjacent to a number of small landfills serving small town communities in a range of climatic conditions. The second would investigate and compare the effects of differing waste compositions on leachate and gas quality.

The study of soil pollution adjacent to five small to medium unlined and one large unlined landfill has shown that pollution arising from the landfills is minimal and very localised at the immediate perimeter of the landfills. Hence the climatic water balance classification used in the minimum requirements document appears to be justified.

A study of the effect of waste composition on leachate and gas quality considered two types of waste: waste from a poor community and waste from a more affluent community, near Johannesburg on the East Rand. The results showed clear differences in the pollution potential of leachate from the two wastes as well as differences in the time taken to reach methanogenesis. However, the differences did not prove large enough to warrant differentiating standards of waste disposal for the two types of waste.



Report TT 111/99 - Guidelines for the calibration of measuring flumes in sewers Report to the Water Research Commission by Sigma Beta Consulting Engineers

Authors: A Rooseboom and GM Goodey
Overseas price: US$ 25 (via surface mail)

Measuring flumes are most commonly used in sewage works to measure flow. Standard equations for calibration curves are available to calculate flow through these measuring flumes but these equations are subject to measuring flume compliance with certain specifications.

At the East Rand Water Care Company (ERWAT) countless flow-measuring flumes which have been designed and constructed by different organisations do not comply with specifications or have other defects. Thus the accuracy of flow metering at these measuring flumes is questionable. The impact of deviating dimensions, such as inlet shape and roughness in the flume itself, as well as submergence of the flume, on the accuracy of flow metering is of particular concern.

Extensive tests were conducted in the Hydraulics Laboratory of the University of Stellenbosch to try and establish calibration coefficients, enabling ERWAT and other organisations to accurately calibrate all their measuring flumes. This research work has led to the compilation of the Guidelines. Information has been included on the measurement of discharges in pipes which flow partially full under uniform flow conditions. This information may be used to measure discharges by means of velocity recorders in cases where it is not practicable to install (more accurate) flumes.

A standard measuring flume has been calibrated accurately. This flume may be used in up- or down-scaled versions for accurate flow measurement under a wide range of conditions. All laboratory tests and findings are described and briefly explained in this publication.

ICID JOURNAL -
Name change & Call for papers

The ICID Journal is the official journal of the International Commission on Drainage (ICID). The objectives of the Commission is to advance the science and art of irrigation, drainage and flood control.

ICID journal is a prestigious peer-reviewed publication and enables ICID to accomplish its objectives of publishing original papers on scientific, engineering and socio-economic issues associated with irrigation and drainage in a clear, concise and uniform style that is easily understood by an international audience.

From January 2001, the ICID Journal will be published with a new name - "Irrigation and Drainage" through John Wiley & Sons Ltd with papers in English and French languages, under full editorial responsibility of ICID.

Says the Chair of the Editorial Board, John Hennessy, "the contract with Wiley is a 'partnership' for the mutual benefit and future development of ICID and Wiley. This means that Wiley cannot create a successful future for the Journal without major inputs from the ICID family." He extended an invitation to authors in the irrigation and drainage fields to submit material for publication to the editor .

"A successful journal depends 'first and foremost' on the steady supply of good quality papers and a respected expert and objective peer-review process," Hennessy says.

The Journal is becoming a quarterly publication for the first time in its history. To promote the Journal "Wiley are "publishing" a free online sample copy on the internet. This includes a typical selection of recent papers presented in the new format for 2001."

Hennessy says that authors "want ever more 'author-friendly' access and faster means of getting into print. Wiley are developing 'Early View' which will be an innovative initiative to put papers from the Journal online as soon as they are accepted by the editor. When introduced, the papers will be fully referenced, paginated and citable thus allowing the papers to be published in advance of the print dates."

Authors wishing to submit articles, commentaries or reviews for publication should send three copies of their manuscript to Mr SP Goyal, Managing Editor, ICID Journal, International Commission on Irrigation and Drainage, 48 Nyaya Marg, Chanakyapuri New Delhi 110021, India. Tel: 611 5679 or 611 6837. Fax: 91-11-611 5962. E-mail: icid@icid.org. For a "Guide to Authors", visit the website http://www.icid.org/jour-cont.html

Subscription rate: One year (one volume - four issues) US$ 60.00, postage free.

SA WATERKALENDER

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

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

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

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

See conferences and symposia pages for events.

2001

JANUARY

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

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

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

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

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

2002

JANUARY

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SOUTHERN AFRICA

2000

HYDROGEOLOGY
NOVEMBER 26 - DECEMBER 1
The International Association of Hydrogeologists' (IAH) XXX Congress 2000 with the theme Groundwater: Past achievements and Future challenges will be held at the University of Cape Town.
Enquiries: Conference Secretariat, IAH 2000, Conferences et al, PO Box 452, Stellenbosch 7599. Tel: (021) 886-4496. Fax: (021) 883-8177. E-mail: deidre@iafrica.com. Web address: http://fred.csir.co.za/conferences/iah/

2001

SASAQS 2001
JULY 1 - 6
The 36th conference of the Southern African Society of Aquatic Scientists will be held at Aventura Eco Eiland in the Northern Province. The theme will be "Aquatic ecology and resource management in Southern Africa".
Enquiries: Mr P Fouche. Tel: (01596) 28383. E-mail address: pso@caddy.univen.ac.za

AFRIWATER EXHIBITION
AUGUST 15 - 17
The international African water, waste & environmental exhibition will be held at Gallagher Estate, Midrand.
Enquiries: Craig Newman, TML Reed Exhibitions. Tel: (011) 886-3734. Fax: (011) 789- 6497.
E-mail: craign@tmlreed.co.za

AFRIWATER SEMINARS
AUGUST 15 - 17
The Water Institute of Southern Africa will organise a series of half-day seminars on pertinent topics at the Gallagher Estate in Midrand.
Enquiries: Roelien Bakker, WISA. Tel: (011) 805 6368. Fax: (011) 315 1258. E-mail address: conference@wisa.co.za

SANITATION
AUGUST 20 - 24
The 27th WEDC conference with the theme "People and systems for water, sanitation and health" will be held in Lusaka, Zambia. Call for papers.
Enquiries: Professor John Pickford, WEDC, Loughborough University LE11 3TU, England. Fax: (44) 01509 211027. E-mail: j.a.pickford@lboro.ac.uk

OVERSEAS

2000

REMEDIATION
DECEMBER 4 - 8
The 2000 contaminated site remediation conference will be held in Melbourne, Victoria, Australia.
Enquiries: The Conference Secretariat, PO Box 257, South Perth 6951, Western Australia. Tel: +61 8 9450 1662. Fax: +61 8 9450 2942. E-mail address: convlink@wantree.com.au or Web: http://www.clw.csiro.au/CGS/conf/2000CSRC/

GROUNDWATER
DECEMBER 13 - 16
A conference on groundwater - a transboundary, strategic and geopolitical resource - will be held in Las Vegas, Nevada, USA.
Enquiries: Bob Masters. E-mail: rmaste@ngwa.org Web address: http://www.ngwa.org/education/agwse2.html

WATER RESOURCES
DECEMBER 19 - 21
An international conference on integrated water resources for sustainable development will be held in Roorkee, India.
Enquiries: Dr B Soni, ICIWRM 2000, National Institute of Hydrology, Roorkee-247 667, India. E-mail: iciwrm@cc.nih.ernet.in Tel: +91 1332 72106. Fax: +91 1332 72123. Web: http://www.nih.ernet.in

2001

RECYCLED WATER
FEBRUARY 1 - 2
An international water reuse workshop on recycled water - a proven alternative resource - will be held in Los Angeles, California, USA.
Enquiries: Valentina Lazarova, Lyonnaise des Eaux CIRSEE, 38 rue du president Wilson, 78230 Le Pecq, France. Tel: (+33) 1 3480 2251. Fax: (+33) 1 3053 6207. E-mail: valentina.lazarova@lyonnaise-des-eaux.fr

SEWERS
FEBRUARY 5 - 8
The 2nd international conference on interactions between sewers, treatment plants and receiving waters in urban areas (INTERURBA II) will be held in Lisbon, Portugal.
Enquiries: Conference Secretariat. E-mail: gaby@civil.ist.utl.pt Tel: +351 1841 8365. Fax: +351 1849 7650.

SLUDGE
MARCH 25 - 28
A symposium on sludge management entering the 3rd millennium - industrial, combined and water works residues will be held in Taipei, Taiwan.
Enquiries: Dr DJ Lee, Department of Chemical Engineering, National Taiwan University, Taipei 106, Taiwan. E-mail: djlee@ccms.ntu.edu.tw Tel: +886 22362 5632. Fax: +886 22362 3040.

ODOURS
MARCH 25 - 29
The 2nd IAWQ symposium on odours with the theme "Measurement, regulation and control techniques" will be held in Sydney, Australia.
Enquiries: Dr John Kaiyun Jiang, Centre for Water and Waste Technology, School of Civil Engineering, University of South Wales, Sydney 2052, Australia. E-mail: johnj@unsw.edu.au Tel: +61 2385 5452. Fax: +61 2313 8624.

WETLANDS
MAY 27 - JUNE 1
The 22nd annual meeting of the society of wetland scientists will be held in Chicago, IL, USA.
Enquiries: Web: http://www.sws.org/chicago/

WATERSHED MANAGEMENT
JUNE 10 - 15
A symposium on diffuse/nonpoint pollution and watershed management will be held in Milwaukee, USA.
Enquiries: Professor Vladimir Novotny, Institute for urban environmental risk management, Marquette University, Milwaukee, WI 53201-1881, USA. E-mail: novotny@execpc.com Tel: +414 288 3524. Fax: +414 2887521.

ACTIVATED SLUDGE
JUNE 13 - 15
A conference on microorganisms in activated sludge and biofilm processes will be held in Rome, Italy.
Enquiries: Prof C Tandoi, CNR Water Research Institute, via Reno 1, 00198 Rome, Italy. E-mail: tandoi@irsa1.irsa.rm.cnr.it Tel: +61 73365 4645. Fax: +61 7 3365 4620.

TOXICOLOGY
JULY 8 - 13
The 9th international congress on toxicology will be held in Brisbane, Australia.
Enquiries: Congress secretariat. E-mail: ictx2001@im.com.au Fax: +61 73369 1512.

FOG COLLECTION
JULY 15 - 20
The second international conference on fog and fog collection will be held in St John's, Newfoundland, Canada. The conference will focus on the physics, chemistry, meteorology, forecasting and remote sensing of fog; fog deposition and the interaction of fog with vegetation; dew research, fog collection projects in developing countries and the negative effects of fog on commercial offshore activities.
Enquiries: Dr Robert Schemenauer (Conference Chair), PO Box 81541, 1057 Steeles Avenue West, Toronto, Ontario M2R 2X1, Canada. Fax (1 416) 739 4211. E-mail address: robert.schemenauer@ec.gc.ca

ANAEROBIC DIGESTION
SEPTEMBER 3 - 5
A conference on anaerobic digestion titled AD2001 will be held in Antwerp, Belgium.
Enquiries: Lood FM van Velsen, NVA, PO Box 70, 2280 AB Rijswijk, the Netherlands. Tel: +31 24 3284282. Fax: +31 24 3604737. E-mail: sf@haskoning.nl

ACTIVATED SLUDGE
SEPTEMBER 10 - 12
The 5th Kollekolle seminar on activated sludge modelling with the theme "Modelling and the microbiology of activated sludge processes" will be held in Kollekolle, Denmark.
Enquiries: Ms Mia Clausen, Miacon c/o Department of Environmental Science and Engineering, Building 115, Technical University of Denmark, DK-2800, Lyngby, Denmark. E-mail: mc@imt.dtu.dk Tel: +45 4525 1613. Fax: +45 4593 2850.

Water Institute of Southern Africa
Membrane Technology Division

4TH WISA-MTD SYMPOSIUM AND WORKSHOP

25-28 March 2001
Stellenbosch, South Africa

WISA-MTD invites you to attend the 4th Biennial Symposium and Workshop to share in the exciting and innovative science of membrane development.

The aim of symposium and workshop is to provide an opportunity for contact and information exchange about new developments, operational experience and application possibilities of this fast-growing technology.

The workshop will be conducted by Prof Tony Fane of the UNESCO Centre for Membrane Science and Technology, University of New South Wales, Australia.

SYMPOSIUM

The symposium theme is **Membranes - Science & Engineering.**
Topics to be addressed are:
- membrane & module development
- membrane process development
- membrane reactors
- electrochemical membranes
- pilot and scaled applications
- process engineering
- fouling abatement
- modelling

WORKSHOP

The theme of the workshop is **Membranes - Art, Science & Engineering**
The workshop presentations by Prof Tony Fane will focus on:
- Introduction of membrane science and technology
- Basic principles of performance
- Engineering aspects of membrane systems
- Membranes in water and environmental applications.

ENQUIRIES

For further information please visit the symposium website: www.sun.ac.za/mtd/
or contact:
Dr EP Jacobs
Institute for Polymer Science
University of Stellenbosch
Tel: (021) 808 3178
or
Dr G Offringa
Water Research Commission
Tel: (012) 330 0340

University of Natal
Civil Engineering Programme

Training Seminar
on
Control, Management and Treatment of Landfill Emissions

University of Natal, Durban
6-8 December 2000

Presented in association with the Institute of Waste Management, under the auspices of the Water Research Commission and the Department of Water Affairs.

The seminar will be presented by overseas and local experts in the field of landfill science. The seminar addresses all issues from landfill bioreactor processes through to final treatment, utilisation and discharge back to the natural environment. The main focus of the seminar will be on leachate generation and landfill gas emissions, with afternoon discussion workshops. A technical tour to the largest landfills in the Durban Metro will be arranged for Friday 8 December.

Topics:

Understanding of landfill processes
Legal framework governing waste disposal

Leachate generation:
- degradation processes
- quality characterisation
- modelling of leachate production
- hydraulic properties of waste
- drainage and collection
- leachate treatment and passive systems
- Southern African requirements

Landfill gas:
- generation and extraction
- modelling of gas production
- hazard to communities
- monitoring of fugitive gas emissions
- biogas reuse and energy strategies
- modelling of landfill odours

Case studies
Anaerobic treatment of industrial effluents

Overseas presenters:

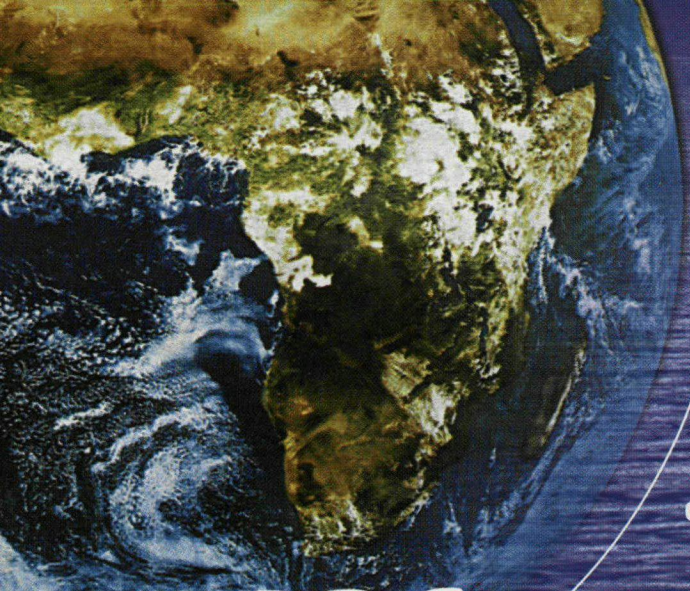
Prof Raffaello Cossu (Univ. of Padua, Italy)
Prof Don Mavinic (Univ. of British Columbia, Canada)
Mr Howard Robinson (Enviros Aspinwall, UK)
Bob Cough (Enviros Aspinwall, UK)

Registration and fees:

Please direct your enquiries for registration and information on the applicable seminar fees to Mrs Tina Warby (see below).

Enquiries:

Mrs Tina Warby
Civil Engineering Programme
School of Civil Engineering, Survey and Construction
University of Natal
Durban 4041
Tel. (031) 260-3058
Fax. (031) 260-1411
E-mail: Warby@nu.ac.za



Expand your horizons ...

This unique degree combines the very best in scientific research with industry requirements to make the scientists of today the managers of tomorrow. The programme will equip you with the knowledge and practical skills to become a specialist in the complex and diverse field of water resource management.

MSC WATER Resource Management

Strategic advantages

Empowering people to become key players in the management of one of South Africa's most limited natural resources

Course presenters

The course is presented by leaders in the field from the University of Pretoria, the CSIR and other industrial partners

Course content

The success of this course is based on a multidisciplinary approach, combining theory and research with real life team-building and project management experiences. Fields covered include:

- Environmental paradigms; - governance; - analysis, assessment and modelling
- Water quality management; water conservation and demand management; water supply and sanitation
- At least one of the following elective course modules: International Environmental Law; Philosophy of the Environment; Ecotourism; Polar and Mountain Environments
- A practical group project
- Course duration: one year full time or two years part time

Admission requirements

Candidates must be in possession of a four-year degree qualification (BSc Hons) or equivalent and appropriate subjects in water-related issues. Final admission is subject to approval by the Director of the Centre for Environmental Studies and the Head of the Department of Microbiology and Plant Pathology.

Contact details:

Prof. TE Cloete
Head: Department of Microbiologyand Plant Pathology
University of Pretoria
Tel.: (012) 420 3265
Fax: (012) 420 3266
e-mail: mikro2@scientia.up.ac.za

Prof. A.S. van Jaarsveld
Director: Centre for Environmental Studies
University of Pretoria
Tel.: (012) 420 2017
Fax: (012) 420 3210
e-mail: asvisarsveld@zoology.up.ac.za

University of Pretoria

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