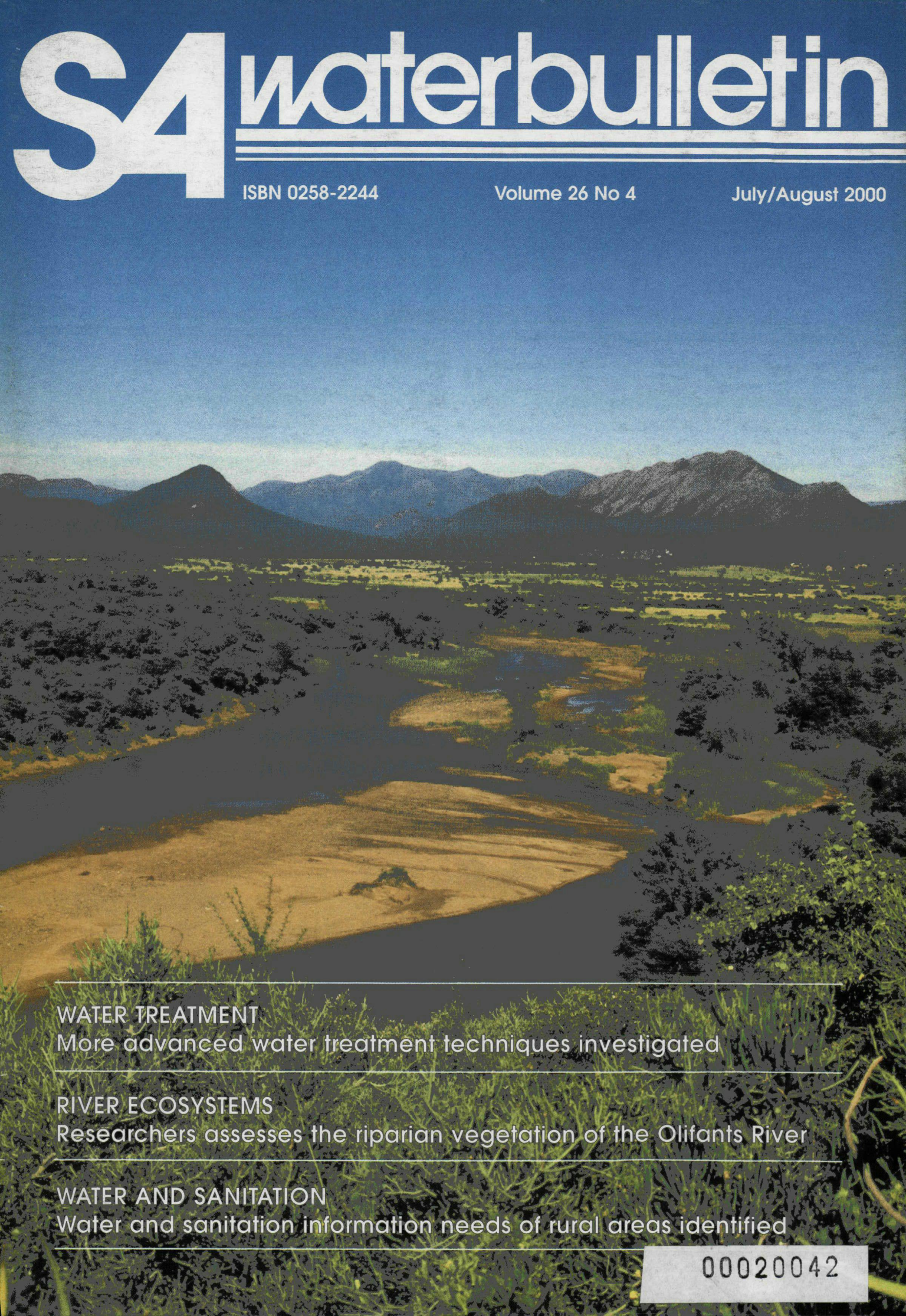
SA waterbulletin

ISBN 0258-2244 Volume 26 No 4 July/August 2000



WATER TREATMENT
More advanced water treatment techniques investigated

RIVER ECOSYSTEMS
Researchers assesses the riparian vegetation of the Olifants River

WATER AND SANITATION
Water and sanitation information needs of rural areas identified

UNIVERSITY OF THE NORTH &
NATIONAL COMMUNITY WATER AND SANITATION TRAINING INSTITUTE

B.SC. DEGREE in COMMUNITY WATER SERVICES AND SANITATION

Effective management of water and sanitation services within the current legal framework is one of the greatest challenges facing South Africa. Sustainability of water and sanitation services is governed by factors such as proper planning, level of community participation, use of appropriate technology, application of appropriate economic and financial principles, degree of development of human resources involved in the process, understanding of the dynamics involved in comprehensive and integrated developmental processes, understanding of the legal frameworks, and many others. This new B. Sc. programme is a comprehensive degree programme that addresses all the issues surrounding efficient and cost-effective management of water and sanitation services at planning, design, implementation and operational levels. The programme is a modular-based programme. The graduates of the three-year programme should be able to manage an integrated and holistic developmental process with a focus on community water and sanitation in a cost-effective and efficient manner. The programme is offered and accredited jointly by the National Community Water and Sanitation Training Institute and the University of the North.

COURSE MODULES

First Year:
Introduction to South Africa's water resources
Roles & responsibilities in water service provision
Basic relevant chemistry and physics
Accounting
Financial Management
Management of social infrastructure I - III
Principles of management
Participatory methodologies
Introduction to sanitation
Sanitation and diseases
Basic mathematics
Computer literacy
Introduction to monitoring and evaluation
Environmental impact assessment

Second Year:
Principles of the development of surface water resources
Principles of the development of groundwater resources
Economics of water
Sustainability
Planning of community water and sanitation projects
Implementation of community water and sanitation projects
Introduction to water treatment processes
Introduction to wastewater treatment processes
Off-site sanitation
On-site sanitation
Solid waste management
Principles of design, construction, operation and maintenance I - III
Rural Development
Communication

Third Year:
Groundwater and surface water pollution and remediation
Project Management
Contract design and administration: Planning
Implementation of contracts
Introduction to Statistics and Applied research methods
Data collection and MIS
Project Appraisal and selection
Gender & Equity in water and sanitation
Human Resources Management I - II
Local governance
SMME I - II
Field Operation
Mini-Dissertation on an aspect of Community Water services and Sanitation

DURATION OF THE PROGRAMME

The 3-year programme is offered both full time and part time.
In compliance with the National Qualification Framework various exit points are provided.
Year Level 1: 120 credits Exit Level = Certificate
Year Level 2: 120 credits Exit Level = Higher Certificate
Year Level 3: 120 credits Exit Level = B.Sc.Degree

COURSE FEES

Tuition fees for the year 2001 is R9 800.00 of which R4 900.00 is payable in the first semester. This amount excludes accommodation. Accommodation is available on Campus at R5 630.00 per annum (R2 815.00 per semester).

REGISRATION

Application forms are available upon request.
Closing date for submission of application forms: 30 November 2000.
A surcharge will be levied for late registrations.

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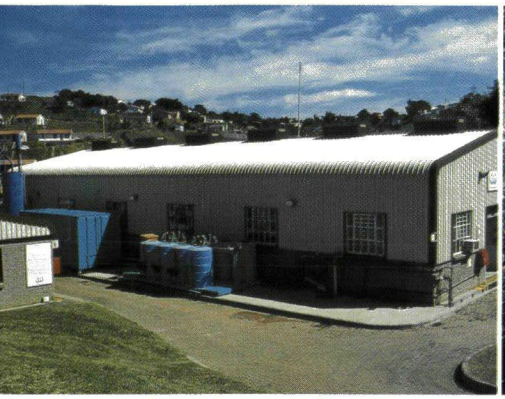

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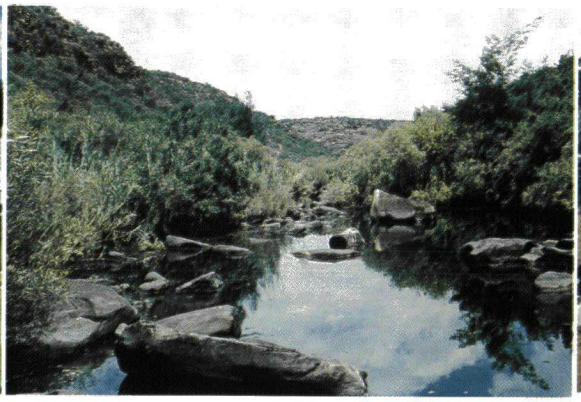

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Contents

Cover: The Olifants River becomes a well-matured river in Mpumalanga. (Photo: Willem Myburgh)

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.

WRC publishes new keys on aquatic invertebrates

The Water Research Commission has published the first of a series of ten *Guides to the Freshwater Invertebrates of Southern Africa*. The complete set of ten guides, which contain identification keys to most of the fresh- and brackish-water invertebrates found in Southern Africa, is expected to be of great use and value for aquatic science in this region. These guides are to fill the gap in identification tools available to scientists, managers and scholars concerned with the assessment and management of water resources. The publication of this series emanates from a WRC project entitled: The Invertebrates of South Africa - Identification Keys, and was motivated by the scarcity of identification guides suitable for use by both specialists and non-specialists.

The principle aim of the series is a synthesis of the existing knowledge on the identification of fresh water invertebrates into a standard format that is accessible to users who wish to identify taxa beyond their field of expertise.

The series is the fruit of many years of collaboration and much effort by South African scientists, together with the valuable contributions from a considerable number of international scientists.

Several years ago a number of aquatic scientists from around South Africa initiated a project in which the specialists closely collaborated to produce keys for the identification of freshwater invertebrates. The keys produced with great effort were, however, not published as a publisher could not be found. Many of these draft keys have been used by scientists in an unpublished form, but their general unavailability was unsatisfactory, says Dr Steve Mitchell, research manager at the WRC.

A project proposal to the WRC arose from the 1996 Annual General Meeting of the South African Society of Aquatic Scientists (SASAQS) under the leadership of Dr Chris Dickens with a view to publishing the keys. A subsequent questionnaire to the members of SASAQS, most of whom are scientists and managers working with the natural aquatic environment, revealed a great need for published keys to the aquatic invertebrates of South Africa, as the available keys are inadequate for their needs and work, therefore placing a decided constraint on their contributions toward the management of the aquatic resource. Most of the respondents reported that they were unable to identify invertebrates adequately, with concomitant consequences to their work for not having suitable keys.

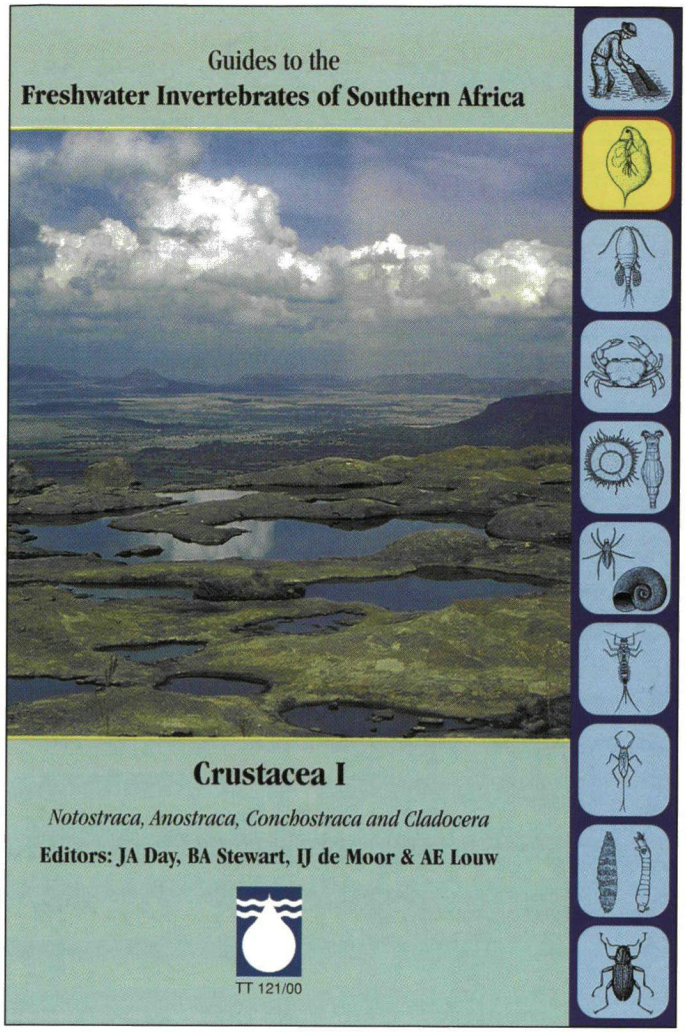
GAPS

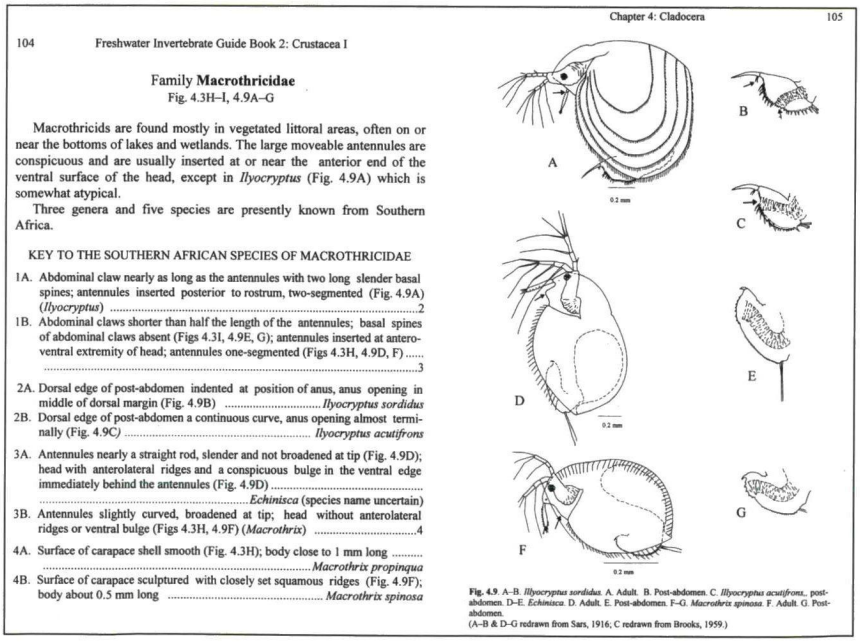
As an example of gaps, Dr Mitchell points out that the Anostracan group of the Southern African freshwater invertebrates was last comprehensively dealt with in 1929, although new species have been described since then. The newly published key in Volume 2 is updated and reflects the current identification and information available.

Dr Mitchell says that there is an obvious need to have current, updated keys available. "A set of good quality keys to South African invertebrates would free local scientists working with the aquatic resource to move ahead and be more effective. The WRC's publication of these keys is a turning point in aquatic invertebrate research in South Africa."

The well-illustrated keys will be published in a set of ten volumes as Guides to the Freshwater Invertebrates of Southern Africa. These keys have been widely reviewed, and put to practical use by undergraduate and honours students in university laboratories. This process has ironed out problem areas and has resulted in the robust and well-tested keys to be published in the guides. The guides do not contain keys only, but also deal in brief with the biology and ecology of the various invertebrate groups.

Geographically the guides cover the Southern African region south of (and including) the Cunene River catchment in the west and the Zambezi River catchment in the east. Although the emphasis with regard to collection and distribution of the freshwater invertebrates is more focused on catchments south of the Limpopo River, distribution records from much further afield have been included to cover a much wider region of Africa. The authors and editors of this series hope that the publication of the guides will stimulate greater collection and in turn lead to the upgrading of geographical information on the diversity of freshwater invertebrates in Southern Africa.





104 Freshwater Invertebrate Guide Book 2: Crustacea I

Family **Macrothricidae**
Fig. 4.3H–I, 4.9A–G

Macrothricids are found mostly in vegetated littoral areas, often on or near the bottoms of lakes and wetlands. The large moveable antennules are conspicuous and are usually inserted at or near the anterior end of the ventral surface of the head, except in *Ilyocryptus* (Fig. 4.9A) which is somewhat atypical.

Three genera and five species are presently known from Southern Africa.

KEY TO THE SOUTHERN AFRICAN SPECIES OF MACROTHRICIDAE

1A. Abdominal claw nearly as long as the antennules with two long slender basal spines; antennules inserted posterior to rostrum, two-segmented (Fig. 4.9A) (*Ilyocryptus*) 2

1B. Abdominal claws shorter than half the length of the antennules; basal spines of abdominal claws absent (Figs 4.3I, 4.9E, G); antennules inserted at antero-ventral extremity of head; antennules one-segmented (Figs 4.3H, 4.9D, F) 3

2A. Dorsal edge of post-abdomen indented at position of anus, anus opening in middle of dorsal margin (Fig. 4.9B) ..... *Ilyocryptus sordidus*

2B. Dorsal edge of post-abdomen a continuous curve, anus opening almost terminally (Fig. 4.9C) ..... *Ilyocryptus acutifrons*

3A. Antennules nearly a straight rod, slender and not broadened at tip (Fig. 4.9D); head with anterolateral ridges and a conspicuous bulge in the ventral edge immediately behind the antennules (Fig. 4.9D) ..... *Echinisca* (species name uncertain)

3B. Antennules slightly curved, broadened at tip; head without anterolateral ridges or ventral bulge (Figs 4.3H, 4.9F) (*Macrothrix*) 4

4A. Surface of carapace shell smooth (Fig. 4.3H); body close to 1 mm long ..... *Macrothrix propinqua*

4B. Surface of carapace sculptured with closely set squamous ridges (Fig. 4.9F); body about 0.5 mm long ..... *Macrothrix spinosa*

Chapter 4: Cladocera 105

Fig. 4.9 A–B. *Illyocryptus sordidus*. A. Adult. B. Post-abdomen. C. *Illyocryptus acutifrons*,. post-abdomen. D–E. *Echinisca*. D. Adult. E. Post-abdomen. F–G. *Macrothrix spinosa*. F. Adult. G. Post-abdomen.
(A–B & D–G redrawn from Sars, 1916; C redrawn from Brooks, 1959.)

Useful references, given at the end of each chapter covering a specific freshwater invertebrate group and key, will help the user to find important publications and valuable sources of information on that particular group. A comprehensive glossary of terms, and an explanatory glossary of place names, complete each volume and should be of great value to the non-specialist user. The B5 format of the guides is a handy size for use both in the laboratory and in the field.

VOLUMES

The ten volumes containing the various keys will be as follows:

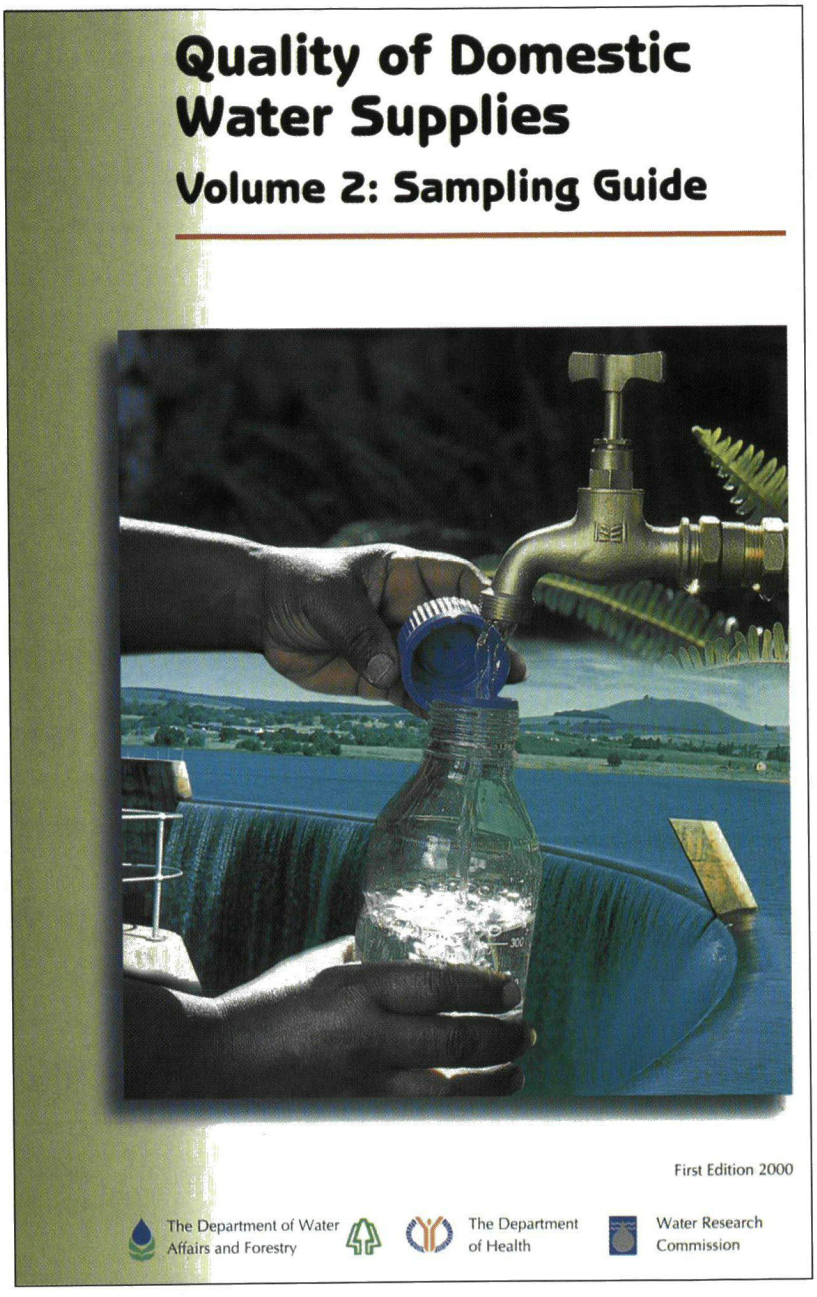
- ❒ **Volume 1** - Introduction
- ❒ **Volume 2** - Crustacea I
  (containing the keys to the Notostraca, Anostraca, Choncostraca and Cladocera)
- ❒ **Volume 3** - Crustacea II
  (containing the keys to the Ostracoda, Copepoda, Branchiura)
- ❒ **Volume 4** - Crustacea III
  (containing the keys to the Bathynellidae, Amphipoda, Isopoda, Spelaeogriphacea, Tanaidacea and Decapoda)
- ❒ **Volume 5** - Non-Arthropods (containing the keys to the Protozoa, Porifera, Bryozoa, Cnidaria, Rotifera, Nematoda, Polychaetes, Platyhelminthes, Turbellaria, Oligochaetes and Hirudinea)
- ❒ **Volume 6** - Arachnids and Molluscs
- ❒ **Volume 7** - Insecta I
  (containing the keys to the Plecoptera, Ephemeroptera and Odonata)
- ❒ **Volume 8** - Insecta II
  (containing the keys to the Hemiptera, Megaloptera, Neuroptera, Lepidoptera, Trichoptera and Orthoptera)
- ❒ **Volume 9** - Insecta III
  (containing the key to the Diptera)
- ❒ **Volume 10** - Insecta IV
  (containing the key to the Coleoptera).

Volume 2 - Crustacea I, is the first of the guide series to be published. Volume 1, the introduction to the guides series, will be the last volume to be published at the conclusion of the series. The whole set of guide volumes is expected to be completed and published by the end of 2002.

Copies of **Volume 2 of the Guides to the Freshwater Invertebrates of Southern Africa** (TT 121/00) are available at R50.00 each, from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: orders@wrc.org. za (Foreign price: US $25 per copy, postage included.)

Water sampling:

Guide now available



Volume 2 of the series on the Quality of Domestic Water Supplies has been published. The Volume 2: Sampling Guide follows on the highly acclaimed Volume 1: Assessment Guide.

The aim of the series is to provide the necessary information on sampling, analysis, assessment and interpretation of the quality of domestic water supplies, in a clear and user-friendly format.

The guide series is the result of a joint venture of the Water Research Commission, the Department of Water Affairs and Forestry and the Department of Health. A number of consultants from other institutions and the private sector have also contributed to Volume 2.

The purpose of the newly published Sampling Guide is specifically to provide information on the correct procedure to be followed to collect a representative water quality sample from a water supply intended for drinking and domestic use. Wrong sampling techniques affect the accuracy and reliability of analytical results and therefore lead to misleading conclusions on the quality of a water supply. Volume 2 should prove to be most useful as it provides well-defined guidelines to proper water sampling.

The contents of Volume 2 - Sampling Guide is set out in four parts, namely:

- ❒ general information on the objectives and concepts of domestic water quality sampling,
- ❒ planning of the sampling programme,
- ❒ preparing for the sampling exercise, and
- ❒ sampling collection (with helpful illustrations).

A sampling data sheet and an equipment checklist are given as appendices.

The Guide is intended for use by:

- ❒ water resource developers - to assess whether a raw water source is suitable for supply or what treatment is required,
- ❒ water supply agencies - who must determine if the water which they supply is fit for use, or if their treatment process needs to be adjusted,
- ❒ environmental health officers - who must collect samples for assessment of the safety of domestic supplies,
- ❒ educators - to build an understanding of the importance of collecting water samples in the correct manner, and
- ❒ the public - to provide them with the information on how to collect a water sample in the correct manner for analysis in order to determine the quality of a water supply.

Copies of **Quality of Domestic Water Supplies: Volume 2 - Sampling Guide** (TT 117/99) are available, free of charge, (in Southern Africa) from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: orders@wrc.org.za (Foreign order price: US $15 via surface mail.)

SANFLOW (version 1.5) - user guide published

The Water Research Commission has published a document that provides details of the South African Night Flow Analysis Model (SANFLOW), developed by R McKenzie from the company Water Resources Planning, in conjunction with colleague S Langenhoven. The model is based (to a large degree) on research and work undertaken in the United Kingdom (UK).

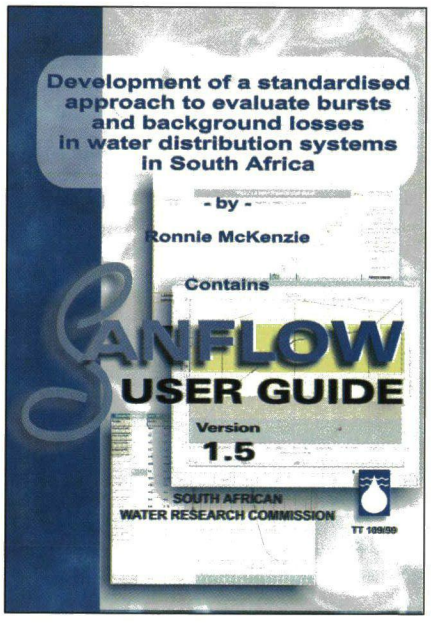
According to the authors the South African research, started at the point where the UK researchers left off in 1996 and has taken the development of the concept to a new level of presentation and reliability. Equivalent commercial models in the UK are generally priced in the order of R5 000 compared to the SANFLOW model which is available through the Water Research Commission (WRC) free of charge.

To obtain a copy of the model download the software from the WRC's website at http://www.wrc.org.za. To obtain a copy of the SANFLOW Guide, titled **Development of a standardised approach to evaluate bursts and background losses in water distribution systems in South Africa** (WRC report TT 109/99), order from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US$ 25 - via surface mail).

In 1996 the Water Research Commission (WRC) identified the need to control the level of unaccounted-for water in South Africa and initiated several studies to address various issues associated with leakage from potable water distribution systems. It was clear at the time that this would become a major issue as a result of proposed new legislation governing the supply of potable water through water distribution systems.

One of the studies supported by the Water Research Commission was the development of a standardised approach to evaluate burst and background losses in water distribution systems in South Africa with the aim of developing a new model based on the "Burst and Background Estimate" (BABE) techniques as applied in the water sector of the United Kingdom. The BABE philosophy is currently used in many parts of the world where it is widely recognised as a simple and pragmatic approach to the very complex and often confusing problem of determining leakage from potable water distribution systems.

The resulting SANFLOW (South African Night Flow Analysis) model was developed together with Mr Allan Lambert



from Bristol Water Consultancy Services, who developed and refined the original BABE concepts. The model does not include all of the features of similar UK models but does incorporate several new features.

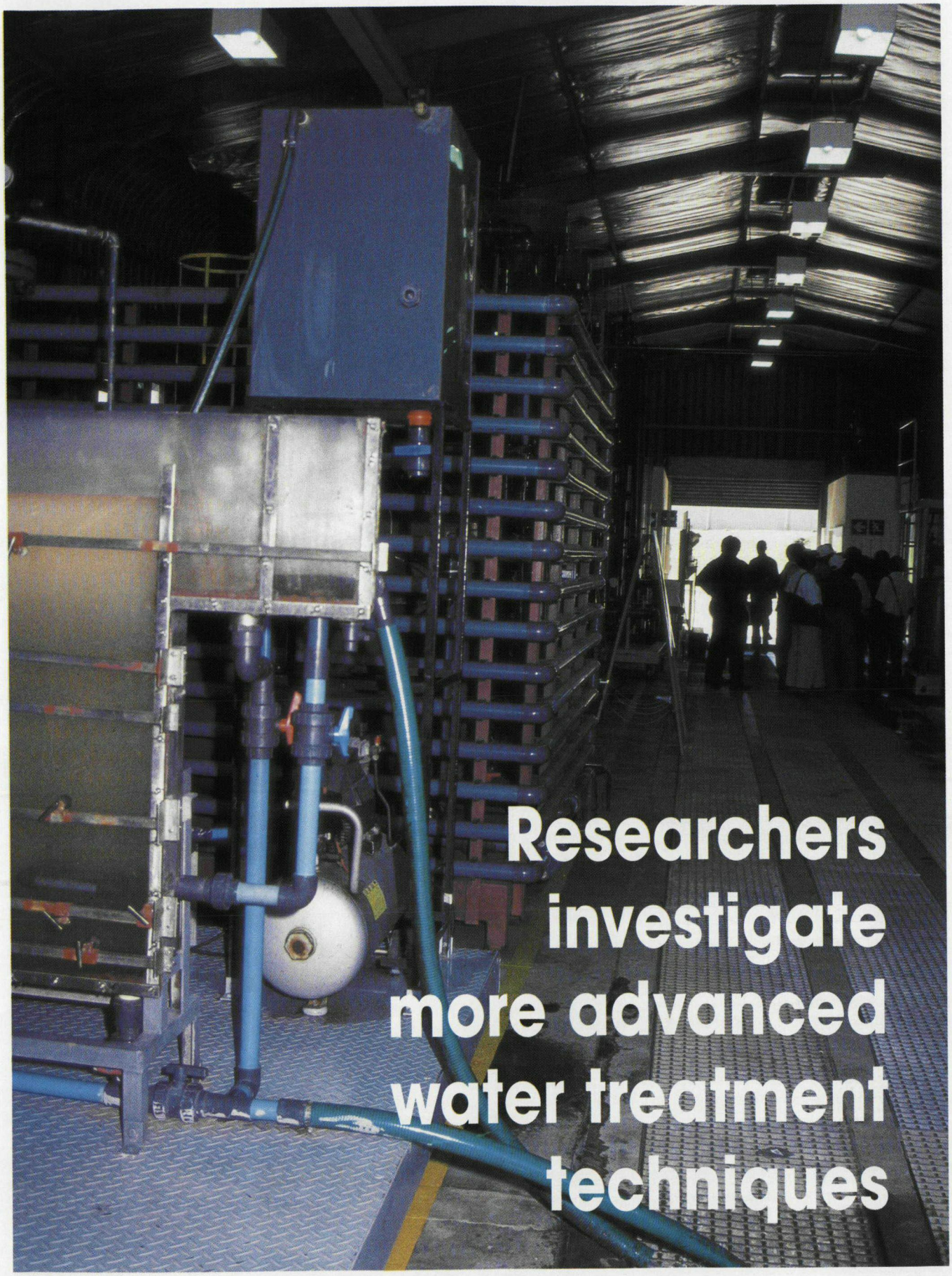
The SANFLOW model is designed to help water suppliers to determine the level of leakage in a particular zone metered area from the analysis of recorded minimum night flows. It is a very simple and straightforward model requiring minimal data and will help water suppliers to identify key problem zones quickly and effectively. It is one of several tools that are available to assist water suppliers in managing their systems to reduce unaccounted-for water.

GUIDE

The project report is essentially a user guide supporting the SANFLOW model and is presented in six sections, details of which are the following:

- Section 1 - Background
- Section 2 - Purpose of document
- Section 3 - Introduction of the BABE procedures
- Section 4 - Background to night flow measurements
- Section 5 - Using SANFLOW
- Section 6 - Acknowledgements

The document effectively provides the background and a comprehensive description of the BABE procedures on which the SANFLOW model is based. It also serves as a user-guide to the SANFLOW model and includes a tutorial section to assist new users in getting started with their first night flow analysis.



Researchers investigate more advanced water treatment techniques

Umgeni's research facility at Wiggins Waterworks in Durban.

In a water scarce country such as South Africa, where there are rapidly growing informal settlement communities, generally possessing poor sanitation services, as well as discharges to rivers by industries and agricultural runoff, deteriorating water quality is a serious problem. It was therefore realised that it may become necessary in the future to use more advanced water treatment processes to produce potable water of an acceptable quality.

Two researchers at Umgeni Water, MJ Pryor and SD Freeze, conducted a series of laboratory tests into the effects of ozone and peroxone on various raw water types, whilst pilot-scale tests were carried out to assess advanced treatment processes employing ozone and granular activated carbon (GAC).

In a report released by the Water Research Commission in Pretoria the researchers say the objectives of the study were, inter alia, to assess the effect of ozone on the coagulant demand and background organics of waters containing two predominant taste and odour causing algal species in Southern Africa, namely *Microcystis* sp. and *Anabaena* sp., and to investigate the difference between inorganic and organic coagulants in treating eutrophic waters after ozonation. Other important objectives were to determine the effect of hardness to organic carbon ratios for both pre- and intermediate ozonation; determine the significance of ozone to organic carbon ratios; assess the effect of ozone on background organics and biodegradation at laboratory and pilot scale as well as the effect of peroxone relative to ozone and the use of Pica carbon as a means of reducing the need to regenerate granular activated carbon used for water treatment.

The researchers developed design criteria for granular activated carbon, detailing the sizing parameters and important properties specific to South African conditions.

Copies of the report, summarising all the research results, are available free of charge (in South Africa) from the Water Research Commission, PO Box 824, Pretoria 0001. The document is titled *The treatment of eutrophic water using pre- and intermediate ozonation, peroxone and pica carbon* (WRC report 694/1/00). Overseas price: US$ 20 (via surface mail).

The researchers say design engineers require specific information when deciding whether to implement granular activated carbon (GAC) for water treatment, or whether to retrofit existing sand filters. On the other hand, operations personnel require specific information on the effective operation of plants involving ozone and GAC. For this reason laboratory or pilot-plant trials are necessary to determine the performance of filtration and adsorption systems for controlling levels of pollutants.

LABORATORY INVESTIGATION

Laboratory tests were conducted on three basic water types, namely

- ❒ Eutrophic water containing predominantly *Microcystis* or *Anabaena* species (dissolved organic carbon (DOC) approximately three to 10 mg/ℓ);
- ❒ Clean water low in organic content (DOC approximately three to 8 mg/ℓ); and
- ❒ Industrially polluted water (DOC approximately 10 to 20 mg/ℓ).

Since a constant source of eutrophic water was not available during the period of this investigation, the levels of algae were increased by spiking Inanda Dam water with cyanobacterial scums containing predominantly either *Microcystis* or *Anabaena*. Inanda Dam water without any algal cell addition was used as the second water type, while water from the Sterkspruit River, a stream which runs through the industrial area of Hammarsdale and which is contaminated with industrial effluents, was used for the third water type. Tests were performed to assess the effect of pH on ozonation by adjusting the pH to 7, 8 and 9, using either hydrochloric acid or sodium hydroxide. In all other tests the pH of the water was adjusted to 8.

RESULTS

- ❒ Ozonation was found not to have a significant effect on trihalomethane formation potential, total organic carbon or dissolved organic carbon, although decreases in total organic carbon and dissolved organic carbon of up to 25 per cent were possible depending on the nature and concentration of the natural organic matter present in the water.
- ❒ Biodegradable dissolved organic carbon was found to increase with increasing ozone concentration, generally stabilising at ozone to dissolved organic carbon ratios of between 0,3 and 0,5.
- ❒ Ozone proved effective in reducing UV absorbance and the micro-pollutants of atrazine, geosmin and 2-MIB.
- ❒ Colour removal using ozone was generally effective with reductions of 40 to 60 per cent possible at ozone to dissolved organic carbon ratios of 0,1 to 0,4.
- ❒ Reductions obtained in disinfection by-product precursors, pesticide/herbicide contaminants, taste and odour compounds and natural organic matter using enhanced coagulation were

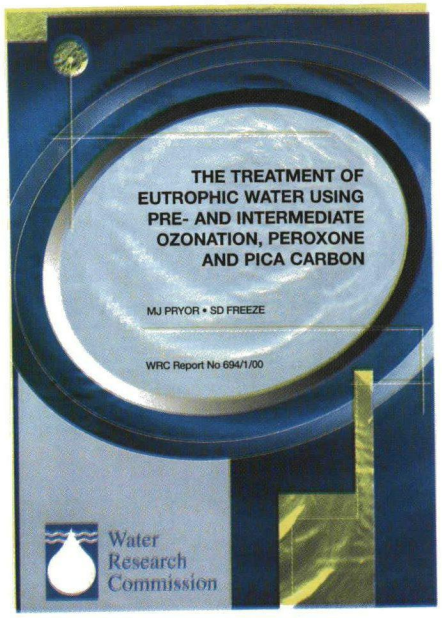
compared to those achievable using ozone or advanced oxidation followed by GAC.

- Enhanced coagulation was found to be very effective for the removal of trihalomethane formation potential (up to 40 per cent reductions), total organic carbon and dissolved organic carbon (up to 60 per cent reductions), biodegradable dissolved organic carbon (70 to 90 per cent reductions), colour (up to 50 per cent reductions) and algal cells (more than 90 per cent reductions) using coagulant doses two to five times the optimum dose in terms of turbidity removal.

PILOT PLANT INVESTIGATION

A pilot plant was constructed at the Umgeni Water Process Facility at the Wiggins Waterworks to assess the benefits of using GAC in conjunction with ozone for water treatment. The use of ozone prior to GAC is reported to have significant benefits in reducing the need for frequent regeneration of the carbon by promoting biologically activated carbon (BAC).

The raw water from the Inanda Dam was treated by coagulation and sand filtration. A portion of the water was then filtered directly using GAC. The rest of the water was ozonated prior to GAC filtration. This allowed direct comparison of GAC filtration with and without ozonation. Two types of carbon were assessed in the GAC pilot plant - a wood-based carbon (PICA), considered to be beneficial in promoting biological activity and a coal-based carbon specifically designed for the adsorption of organic contaminants.



SUMMARY OF RESULTS OF PILOT-SCALE INVESTIGATION

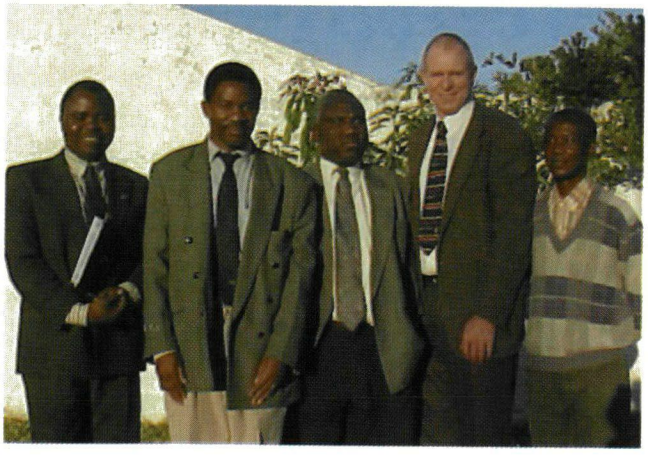
A number of conclusions could be drawn from the pilot-scale experiments:

- GAC can effectively be applied for the adsorption of taste and odour compounds as well as pesticides and herbicides (e.g. atrazine) from surface water. This is particularly beneficial in the treatment of eutrophic waters where the extent of the taste and odour problems cannot be overcome using powdered activated carbon alone. At high concentrations powdered activated carbon becomes prohibitively expensive and impractical.
- The combination of ozone and GAC showed significant advantage and provided a more reliable treatment process than GAC alone.
- PICA carbon when used specifically as biologically activated carbon did not appear to be beneficial for the application at Umgeni Water in terms of the removal of natural organic matter and little or no biological activity was observed on any of the types of carbon investigated. The lack of biological activity was most probably due to a long retention time in the impoundment prior to the water entering the works. Although levels of biodegradable dissolved organic carbon of up to 1 mg/ℓ were measured in the raw water, much of this was removed by coagulation and sand filtration.
- Coal-based carbons performed significantly better than the PICA carbon for the removal of organic micro-contaminants due to a higher bulk density and larger adsorption capacity.
- GAC provides a benefit in the reduction of chlorine demand and once installed at a works should be utilised continuously to gain benefit even when the extent of eutrophication and pesticide problems is insignificant.
- Careful selection of GAC is required to be able to select the type of carbon which is most suitable to the treatment objective of the works. Where biological activity is observed, the use of PICA carbon may prove to be beneficial for the reduction of biodegradable dissolved organic carbon, but where the adsorption of contaminants is the main objective the most suitable carbon should be selected.

Typical situations where ozone and granular activated carbon (GAC) may be applied are:

- In the oxidation of iron and manganese in raw water using ozonation.
- For the removal of organic carbon, using pre-ozonation, conventional treatment and GAC filtration (preferably preceded by ozonation).
- For the removal of algae by pre-ozonation, conventional treatment and granular activated carbon filtration.
- To reduce taste and odour compounds and other micro-pollutants such as pesticides and herbicides, ozone and GAC filtration being suitable processes for these applications.
- For the inactivation of microbiological contamination, especially pathogenic protozoa such as cryptosporidium and giardia, which ozone is effective in removing.
- To reduce disinfection by-product precursors, using ozone and GAC.

Joint project launched



A joint project between the African Water Issues Research Unit (AWIRU) at the University of Pretoria and the Zambian National Institute for Scientific and Industrial Research (NISIR) was launched in July.

The project focus is on water demand management and social adaptive capacity. The aim is to gain an understanding of how African traditional societies adapt to water demand management strategies, which will help government agencies to make policies culturally appropriate. The Water Research Fund for Southern Africa (WARFSA) is funding this project. Pictured left are: Mr Chitaku Mucheleng'anga , research partner in the project and a member of NISIR, Mr SC Banda, head of Research and Development, NISIR, Dr NCH Lubaba, deputy director of the NISIR, with Mr Tony Turton, head of AWIRU, and Mr NB Mwansa, deputy head of the Zambian Water Resources Research Unit.

National River Health Programme
- provincial plan for Mpumalanga

In this article Dirk Roux of Environmentek, CSIR, discusses the current implementation plan developed for Mpumalanga as a case study and model within the context of the national River Health Programme (RHP)

The design of the national River Health Programme (RHP) was initiated by the Department of Water Affairs and Forestry (DWAF) in 1994. The main purpose for the programme is to serve as a source of information regarding the ecological condition, or integrity, of river ecosystems in South Africa. The programme primarily makes use of indices for measuring biological and habitat integrity to enable an integrated assessment of the condition of the river as a whole.

A model of shared ownership was advocated during the design phases of the programme, to ensure that a critical level of institutional participation is achieved. Subsequently, the Department of Environmental Affairs and Tourism (DEAT) and the Water Research Commission (WRC), together with the DWAF, became joint national custodians of the programme. At a provincial and local level, Provincial Champions and Provincial Implementation Teams (PITs) became responsible for implementation initiatives.

PROJECT

The WRC supported a pilot-scale implementation project from 1997 to 1999. The aims of the project were to:

- allow testing and refinement of programme components;
- allow integration of programme components;
- facilitate the identification of additional developments that may be required;
- demonstrate the worth of the programme; and
- provide broad guidelines to facilitate the eventual implementation and maintenance of the programme.

This pilot project focused on the main rivers of Mpumalanga, namely the Crocodile, Sabie and Olifants Rivers. A number of new concepts, tools and processes were developed during the project. A further outcome was an improved understanding of the practical and operational factors that influence the sustainable implementation of the RHP. Based on the knowledge and insights that were gained, basic implementation scenarios were derived and an implementation plan was compiled for Mpumalanga.

Implementation scenarios

Two main influencing factors were considered for deriving basic implementation scenarios. These are scientific soundness and technical relevance of the RHP, and the degree to which the programme addresses and satisfies stakeholder needs (Figure 1).

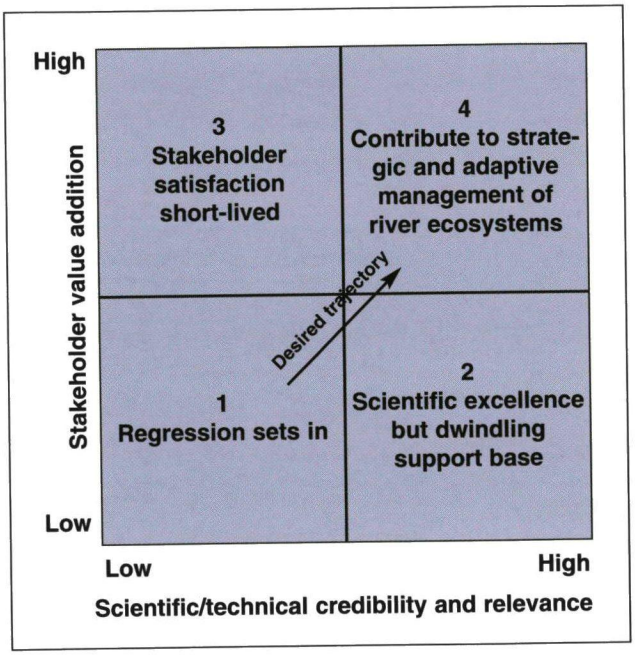


Figure 1: Scenarios for RHP implementation.

❒ **Scenario 1: Regression sets in**

If both the scientific/technical credibility and the value that the RHP presents to its stakeholders are low, then the RHP has no future. However, this scenario is very unlikely as the philosophical foundation and the tools and methods of the RHP have been built on sound scientific principles. Also, stakeholder requirements were always considered primary guiding factors during the design phases of the RHP.

❒ **Scenario 2: Scientific excellence but dwindling support base**

The RHP is recognised for its scientific and technical excellence, but stakeholders are not really experiencing the value of the programme. Too little resources and attention are directed to understanding and satisfying the needs of the non-technical stakeholder community. These end users of river health information lose their enthusiasm for the RHP and redirect their support to other initiatives that show better promise of addressing their needs.

❒ **Scenario 3: Stakeholder satisfaction short-lived**

Scenario 3 represents a future where all attempts are made

to understand and satisfy stakeholder needs but insufficient resources are allocated to technical development and improvement. Initial support by stakeholders is replaced by scepticism as the gaps in the programme's science-base become evident. The end result is very similar to that of scenario 2.

- **Scenario 4: Contribute to strategic and adaptive management of river ecosystems**
  The influencing factors of adding real value to stakeholder needs while remaining technically and scientifically relevant are recognised and pursued with sufficient resources. As a result the various stakeholder segments (natural resource managers, private sector, relevant politicians, public at large) are satisfied and supportive of the programme and the scientific credibility of the RHP is demonstrated through appropriate research and application outputs. This scenario is characterised by constant interaction between scientists, managers and policy makers, the aims of which are to:
  - facilitate reconciliation of perspectives,
  - develop a deep understanding of each other's needs and limitations,
  - learn across disciplines and cultures,
  - adaptively improve over time to ensure continued scientific and managerial relevance.

IMPLEMENTATION PLAN FOR MPUMALANGA

An implementation plan was compiled to guide the RHP initiative in Mpumalanga towards scenario 4 (Figure 1), and to ensure that the WRC funded pilot project would successfully mature into an internalised provincial operation. The implementation plan focuses on four issues that will be critical to this process, namely purpose, tools and methods, networking, and capacity.

PURPOSE

A common purpose and direction must guide the agencies that will be responsible for implementing and maintaining the RHP in Mpumalanga. This common purpose and direction should be based on a shared vision and operational objectives for the provincial initiative.

The vision that was formulated for Mpumalanga is "to maintain a model for the regional implementation of the RHP that serves as a national example".

This vision implies adherence to the existing national objectives of the programme. However, the following provincial objectives were added:

- Understand and satisfy the dynamic information needs of stakeholders: It is of critical importance to develop a deep understanding of the programme's stakeholder segmentation and the evolving information needs within each segment.

- Achieve ongoing development and improvement of programme components: The technical composition of the RHP will have to continuously evolve and improve to effectively respond to improved understanding and changing needs.

- Refine and optimise monitoring, assessment and reporting operations: Operational activities should improve in terms of overall efficiency - complexity and cost must decrease and the expertise must be in place to make the implementation of the RHP a relatively simple and routine function.

- Impact positively on the management of water resources: River health information must be creatively packaged and actively disseminated into the arenas where decisions are made.

- Demonstrate leadership: It is important to transfer new insights and knowledge gained within the province to the rest of the country. This can be achieved by regularly reporting on progress through the national coordinating committee (NCC) and the existing communication mechanisms (e.g. newsletter) of the RHP.

TOOLS AND METHODS

The suite of tools and methods that were initially adopted for the Mpumalanga study consisted of the Index of Habitat Integrity (IHI), the South African Scoring System (SASS) based on invertebrate organisms, the site-based Habitat Quality Index (HQI) (later substituted by the Integrated Habitat Assessment System (IHAS)), the Fish Assemblage Integrity Index (FAII), and the Riparian Vegetation Index (RVI). The intention was, as a first priority, to master and effectively apply the above protocols. As a second priority, further indices could be incorporated once such indices are added to the pool of developed and tested products.

The Mpumalanga initiative has followed an approach of learning-while-doing, especially through actual surveys of the Crocodile, Sabie and Olifants Rivers. To ensure that the RHP goes beyond the collection of data and to facilitate ongoing learning and adaption, an "adaptive RHP implementation cycle" was developed (Figure 2). Effective implementation of the programme can only be claimed once each of the components in the cycle has been executed properly. The duration of each cycle should not be longer than 18 months, and the information dissemination component should preferably be completed within 12 months of data collection. New knowledge that may be acquired during an implementation cycle must be transferred and incorporated into the next cycle.

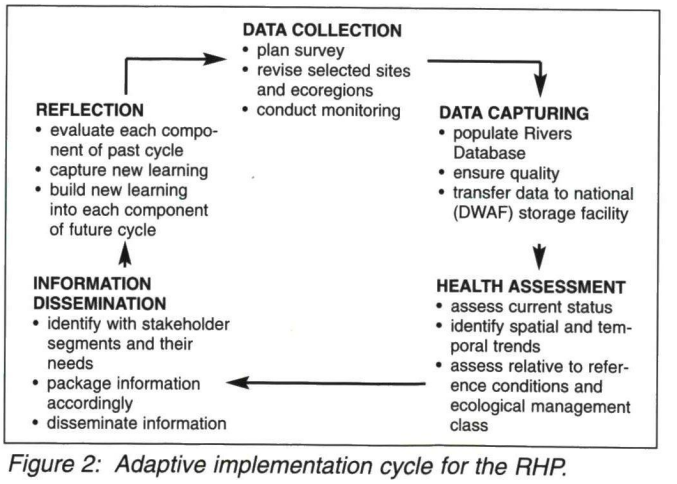


Figure 2: Adaptive implementation cycle for the RHP.

NETWORKING

The river systems dealt with in this pilot project are shared by three provinces: Mpumalanga, Northern Province and Gauteng. These systems can also be divided into two Water Management Areas, the Inkomati and the Olifants. Furthermore, at least ten institutions were involved in this study, and can be expected to remain involved with, or as stakeholders of, biomonitoring activities in the Inkomati-Olifants region.

A model of informal networking has evolved between participating individuals and institutions during the three year pilot project. This networking model should be extended by an across-the-board commitment from key implementation agents. However, in real life there are many real and perceived barriers that hamper effective co-operation in natural resource management.

COP CONCEPT

The concept of a "community-of-practice" (COP) is suggested as the mechanism for allowing mutually beneficial collaboration across boundaries. Essentially a COP is a group of people or institutions related by processes or needs, rather than by formal structural or functional relationships, to solve a common problem. Within such communities, people and organisations freely share their individual resources, knowledge and skills to enhance the speed and quality of the learning that takes place in the group.

The COP suggested for Mpumalanga allows three distinct "positions" within the community that participants can occupy (Figure 3):

- The *guiding team* essentially fulfills the leadership function and consists of the drivers or lead agents of the initiative. As a result these are also the relatively permanent members of the COP. In Mpumalanga this position will be populated by the Mpumalanga Parks Board (MPB), Kruger National Park (KNP) and the DWAF Regional Office. Catchment Management Agencies, once in operation, would substitute the current DWAF regional office on the guiding team.
- The *strategic partners* constitutes those individuals and organisations with whom a long- term relationship will be mutually advantageous. This includes relevant departments of provincial government, implementation agencies of neighbouring provinces, water authorities from neighbouring countries with whom river systems are shared, as well as universities and institutions participating in related long-term research programmes.
- The *tactical partners* would have a relatively short residence time in the community, based on the requirement of a specific expertise. These partners may be professional service providers or consultants and would typically be used where a temporary or longer-term expertise-gap exists, for example in project coordination, selection of reference sites, management of data or compilation of a report.

As with "membership" of the COP, roles and responsibilities will be highly dynamic. However, the basic roles and responsibilities of the guiding team can be identified as the following:

- Provide leadership in terms of the stated vision and operational objectives;
- Ensure coordination within the network of participants through ongoing communication;
- Plan operational activities in detail and in advance;
- Facilitate the execution of operational activities, including data collection, data capturing, health assessment, information dissemination and reflection;
- Report to the National Coordinating Committee of the RHP, on a regular basis, regarding activities and advances within the Mpumalanga COP.

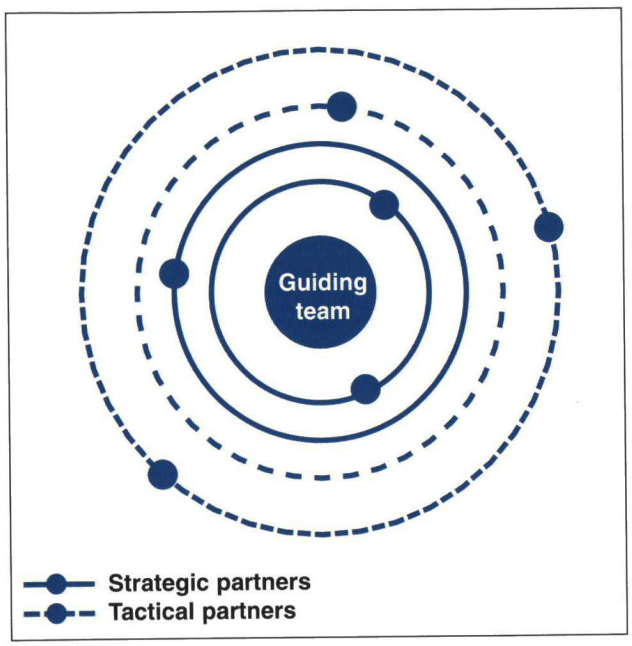


Figure 3: A community-of-practise for implementing the RHP at provincial scale.

CAPACITY BUILDING

The pilot project has facilitated significant capacity building of human resources. Skills and technologies were actively transferred during the field surveys from the various specialists to the organisations constituting the Mpumalanga Guiding Team. Collectively, this Guiding Team is now self-sufficient regarding the technical expertise required to maintain the RHP. Human resource development is, however, an ongoing activity and each participating organisation should also assess its own position and respond to expertise gaps within its own staff profile.

An assessment of the current as well as desired competencies within each of the guiding team organisations is presented in Table 1. This simple competency assessment matrix can also be used to set career development and staff profiling goals, and to monitor progress regarding human resource development within an organisation.

A three stage competency scale is used, where:

Stage 1 - indicates that an organisation depends on assistance from outside to conduct the particular activity;

Stage 2 - reflects an ability to execute the work independently;

Institution	Competency Stage (current/desired)					
	SASS	FAII	RVI	IHI	Data Management	Reporting
MPB	1/2	3/3	3/3	2/2	1/2	1/2
KNP	2/2	3/3	1/2	2/2	1/2	2/2
DWAF*	1/2	1/2	1/2	1/2	1/2	2/2

* *Only the Mpumalanga regional office is assessed, recognising that at a national level the DWAF enjoys Stage 3 competency in all the mentioned areas.*

Table 1: Competency assessment matrix.

Stage 3 - implies that the organisation is providing national leadership in the particular field.

Other capacity-related issues of importance are:

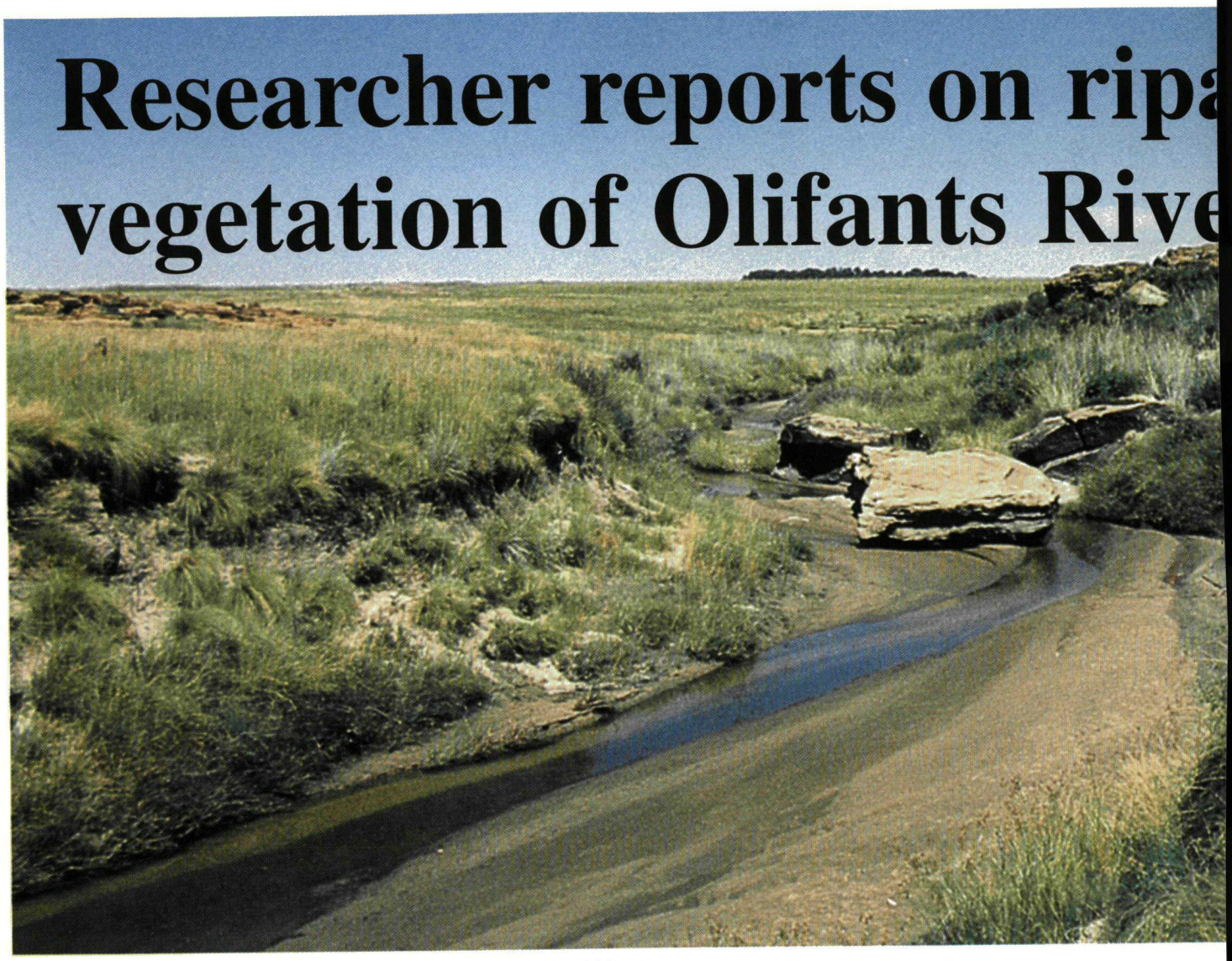
- ❒ Ongoing maintenance, improvement and standardisation of sampling equipment;
- ❒ Access to appropriate hardware and software to harness the potential of electronic information and communication technology. In this regard, the implementation of an electronic discussion group and an Extranet (that can be accessed and contributed to by a number of authorised organisations - as opposed to an Intranet) could prove to be valuable "connectors" of the members of a COP;
- ❒ The Rivers Database is anticipated to become the primary data storage and management mechanism to be used at regional levels and each participating organisation should master the use of this system;
- ❒ The use of Geographic Information System (GIS) technology is most suited for presentation of river health information. Existing GIS capability and available presentation templates should be used as a basis for expanding the provincial competency in reporting, and hence satisfying the information needs of stakeholders.
- ❒ An estimation of the cost associated with maintaining the RHP provides a financial perspective and paves the way for alliances with funding partners. Funds are required to ensure:
  - effective participation of strategic and tactical partners;
  - that appropriate equipment, hardware and software can be obtained;
  - that expenses for travel, accommodation and subsistence can be met;
  - that personnel can attend training courses and engage in further education;
  - the ability to produce professional communication products (slides, brochures, posters, etc.).

CONCLUSION

The formation and formalisation of a Mpumalanga COP is still in an experimental stage. The implementation plan for Mpumalanga will only result in the desired outcome if all the relevant institutions accept joint responsibility, at both the technical and management levels, for implementing the RHP. It is recommended that this process be supported and facilitated from a national level to ensure that this model evolves into a practical arrangement for shared custodianship of the RHP with a view to further generic application in South Africa.

For further enquiries and information please contact Dirk Roux at Environmentek, CSIR on tel. (012) 841-2911 or e-mail: droux@csir.co.za

Researcher reports on ripa vegetation of Olifants Rive



Near the origin of the Olifants River: the riverbed in the grassland biome.

Riparian vegetation forms an integral part of any river system. Knowledge of the functioning of the riparian zone vegetation in the different river ecosystems in South Africa is scant. However, destruction of the riparian zone destabilises the river edges and results in excessive erosion of the edges with a concomitant higher silt load in the river. In a report to the Water Research Commission researcher Willem Myburgh of the Range and Forage Institute (Agricultural Research Council) takes a closer look at the riparian vegetation of the Olifants River system from an ecological perspective.

South Africa has only a few rivers which are currently not overutilized, degraded or polluted. Many previously perennial rivers are utilised to such an extent that they only flow seasonally. The Olifants River is the second largest river in the former Transvaal (now the Northern Province and Mpumalanga) and drains 4,1 per cent of the Republic of South Africa. This former perennial river system is currently so heavily utilised that long stretches, especially downstream of the Mokgomo Matlala dam (Arabie dam), are characterised by pools linked by narrow streams at the end of the dry season.

The Olifants River system is regarded as one of the most polluted rivers in the region. It is stated that the acidity of portions of the Olifants River in the Highveld of Mpumalanga is so high (pH 2-3) that the river cannot support living organisms. The mining and industrial sector and agricultural sector are two primary users whose activities impact directly on the Olifants River system. In the past, research done by agricultural organisations focused mainly on specific agricultural activities and related matters, normally within catchments of river systems. Research projects often addressed a specific problem within a certain localised area. The initiation of this project was inter alia an attempt to obtain a holistic perspective of the current state of the riparian zone and to identify the impacts that could lead to the further degradation of the riparian zone and the river system itself.

OBJECTIVES

The objectives of this study were to:

- identify and describe the homogeneous vegetation units associated with the macro channel of the Olifants River system in terms of floristic composition and associated habitats at a spatial scale of 1:250 000;
- map these vegetation units;
- identify management units within the river system;
- identify exotic and invader plants associated with the riparian zone as well as quantifying the extent thereof;
- evaluate the influence of a flood on the riparian vegetation of the Olifants River system;
- identify activities of the agricultural and other sectors posing a threat to the Olifants River system;
- compile an overview of the relevant environmental legislation that control activities in the catchment and the river system;
- evaluate the current status and suggest a desired future state for each plant community; and
- formulate management guidelines and recommendations which could lead to the minimisation of impacts on the river system, especially the riparian vegetation.

METHODOLOGY

The project was conducted over a period of four years. Initially, in a pilot study, data were gathered at forty different sites. The information recorded at these sites included: the width of the macro-channel of the river, riverbanks, active and other channels as well as plant species, dominant growth forms and photographic records. The processed data as well as 1:50 000 Topographical and 1:250 000 Geological and Land Type maps were used to determine the heterogeneity and extent of the river system. The Olifants River system was then stratified into homogeneous units using geology and altitude.

The number of samples allocated to each homogeneous unit was determined according to the length of the river represented by the unit. A total of 155 variable length transect sample plots were used to record floristic and habitat data over a period of three years. The data were processed using the PHYTOTAB-PC computer program package.

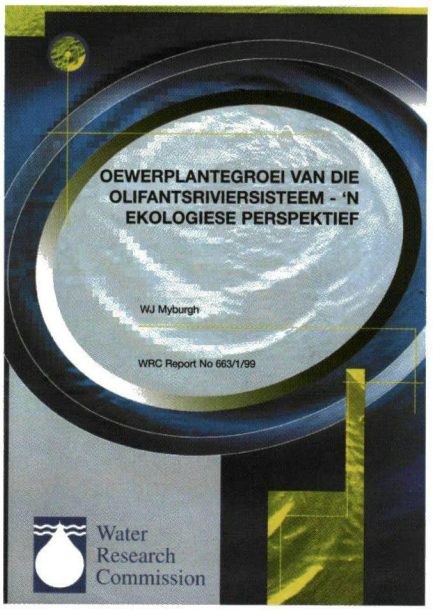
RESULTS

PLANT COMMUNITIES

The riparian vegetation of the Olifants River can broadly be divided into two types according to the structure of the vegetation associated with the macro-channel, namely, the areas where woody cover is absent or restricted to a few dwarf shrubs (grassland biome) and the areas characterised by a dense woody component (savannah biome). The term biome defines the characteristic plant formation of the largest land vegetation community unit which is easily recognisable in a region.

A total of eight plant communities were identified in the macro-channel of the Olifants River associated with the grassland biome. The river bed of this part of the Olifants River varied from a mere six metres to 32 metres in width. The narrower sections of the river bed had no distinct riparian zone, with the exception of a few grass, sedge and herbaceous pioneer species directly bordering the water edge. The broader sections of the river bed downstream had a well defined riparian zone.

A total of 173 plant species were recorded in the riparian zone of the Olifants River within the grassland biome. Almost 15 per cent of these species are exotics. Only two plant species, namely the shrub *Sesbania punicea* and the herbaceous *Cirsium vulgare*, are declared weeds according to current legislation. The declared invader *Acacia dealbata* dominates large portions of the river bank downstream of Doringpoort dam and should be considered a serious problem.



Nine plant communities were identified in the riparian zone of the Olifants River associated with the savannah biome. Four of these plant communities include variations which unfortunately could not be mapped at the scale at which the survey was conducted. The width of the river bed here varied from 17 metres to 210 metres. The Olifants River in the Lowveld is a mature, well-developed river system, characterised by various channels, islands and former islands dominated by woody species.

EXOTICS AND INVADER PLANTS

A total of 450 plant species, which included 51 exotic species, were record-

A section of the Olifants River running through the savannah biome.

Well-developed riparian vegetation on the mature Olifants River.

ed within the riparian zone of the Olifants River associated with the savannah biome. Declared weeds recorded include the shrubs *Lantana camara, Sesbania punicea, Solanum mauritianum,* the dwarf shrub *Rubus cuneifolius* and the herbaceous *Cirsium vulgare, Datura stramonium, Xanthium spinosum* and *Xanthium strumarium.* The current state of invasion by the trees *Melia azedarach, Nicotiana glauca,* the shrub *Ricinus communis,* the dwarf shrub *Senna occidentalis* and the herbaceous *Flaveria bidentis* pose a threat to the biodiversity of the Olifants River System associated with the savannah biome, including the stretch of river within the Kruger National Park.

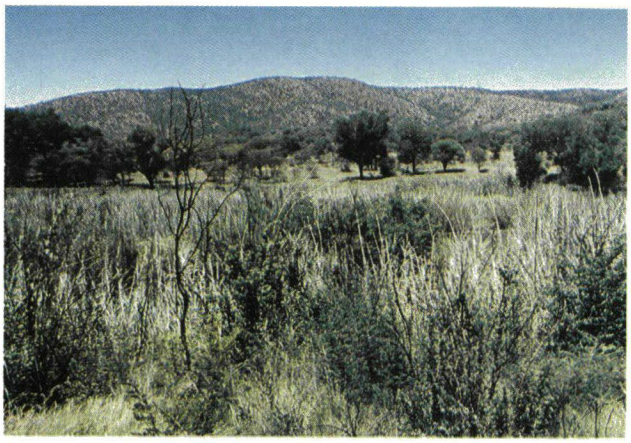
The problems with regard to exotic vegetation and the control thereof in the Kruger National Park can only be addressed if the various authorities and private riparian owners upstream become actively involved in eradication programs. The lists of declared weeds and invaders as stipulated in tables 3 and 4 of the Act on Conservation of Agricultural Resources (Act 43 of 1983) are, however, incomplete and should be revised after consultation with the relevant role players and organisations.

NATURAL DISTURBANCE

Floods, which are considered a natural disturbance, form an integral part of the functioning of river systems. Floods occurred in the Olifants River during 1996 due to heavy widespread rain in the catchment. Storage dams overflowed and fluvial landforms with associated vegetation were altered, especially in the areas directly down stream of weirs and low water bridges. The flood event led to the resampling of sites sampled during 1995 as well as during the 1998 season in order to compare these sites as a means of quantifying the influence of the floods on the floristic composition of the riparian zones of the river system. The analysis of these data identified trends and lead to various conclusions:

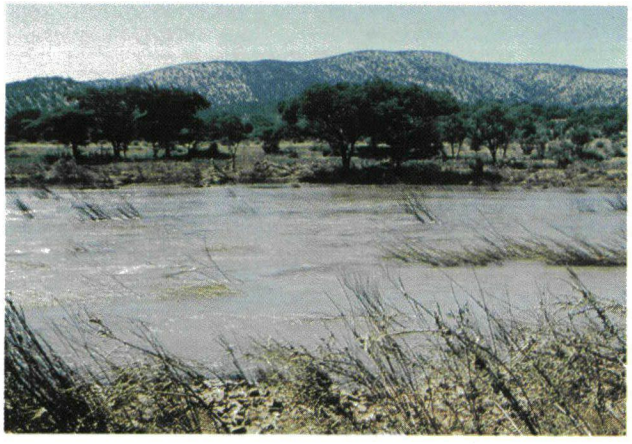
- ❒ plant species associated with the low-lying fluvial landforms showed the most significant decrease in crown cover, crown diameter and frequency,
- ❒ the flood tended to reduce the total number of plant species associated

Erosion within the catchment of the Olifants River.



***Before:** A sample site on the Olifants River as photographed during the 1995 growth season.*

A clearance of riparian vegetation on the river banks for informal agricultural purposes.



***After:** The same sample site after flooding occurred during 1996. Note the decrease in vegetation caused by the flood.*

with the macro-channel directly after the period of flooding,

- the total number of plant species recorded two years after the flood occurred, are higher than before the flooding,
- the most significant difference in floristic composition due to the flood is within the herbaceous layer due to opportunistic annual or pioneer species,
- the geomorphology of the macro channel influenced the degree of disturbance caused to the vegetation by the flood, and
- man-made structures such as low-water bridges, weirs, pumphouses and cultivated lands tended to increase the disturbance caused by floods on the macro-channel with the associated riparian vegetation.

ACTIVITIES AND IMPACTS

During the survey the major impacts encountered and which were deemed responsible for the degradation of the riparian zone, were recorded. The most significant impacts recorded within the riparian zone and the adjacent land are due to activities of the mining and industrial sector and agricultural sector. Other activities recorded, which negatively impact on the vegetation and the Olifants River system as a whole, are the development of holiday resorts and houses, farmsteads, the homes of workers and other activities of the local population such as the collection of fire wood, sand and stone for building purposes and the illegal netting of fish. These impacts were evaluated against current relevant environmental legislation to determine whether any of these activities transgressed the law. The management recommendations and suggestions made by the researcher could lead to the minimisation of impacts caused by the agricultural sector.

DATA STORAGE

The floristic and habitat data recorded during the survey (fieldwork phase) of this study is archived as part of a databank on PC at the Plant Ecology Division of the ARC-RFI for future reference. The plant species identified and collected during the survey are mounted, labeled and filed in the Roodeplaat Herbarium (ROO) at ARC-RFI for future reference. The plant names were imported into the Roodeplaat-Herbarium's specimen data bank.

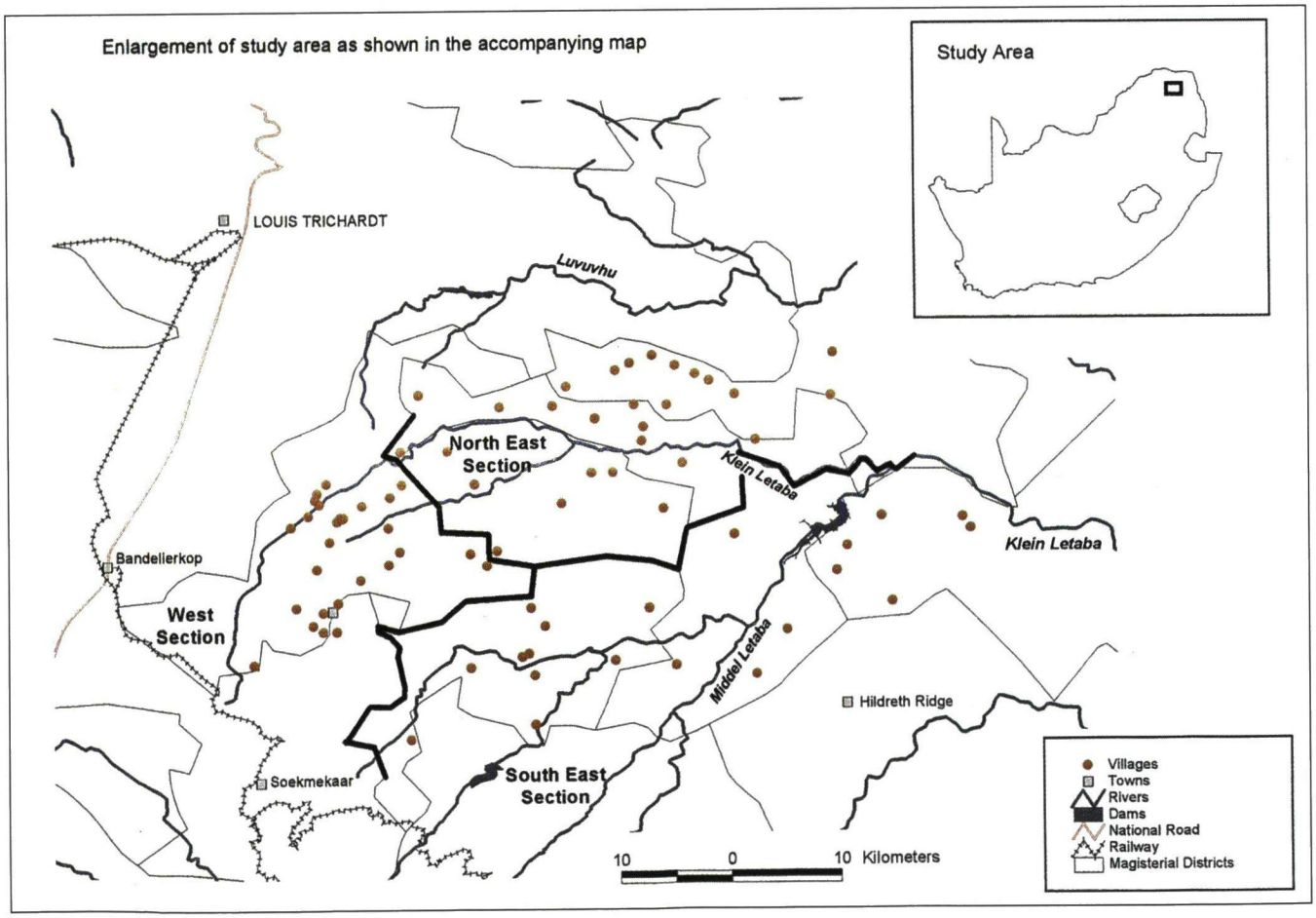
The report entitled **"Oewerplantegroei van die Olifantsrviersisteem - 'n ekologiese perspektief"** (WRC Report 663/1/99) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: orders@wrc.org.za (Foreign orders: US $35 per copy, via surface mail.)

Researchers identify information needs on water and sanitation infrastructure in rural areas

Considerable progress has been made in understanding the water and sanitation information needs of rural communities in South Africa. This information can enable villagers to operate and maintain their water services systems in an effective and sustainable manner.

According to a report released by the Water Research Commission in Pretoria researchers from the CSIR's Division of Water, Environment and Forestry technology, DG Hazelton and J Harris, have developed a methodology for involving communities in collecting baseline data on water and sanitation before new water projects are initiated.

The project was conducted during a time of rapid and dramatic changes in the water services environment in South Africa and a major national effort was focused on water services delivery. The Department of Water Affairs and Forestry led the initiative to create the framework within which delivery - supplying water and sanitation services to approximately 14 million people - would occur. While that framework included the design of a database for water services delivery in rural areas the researchers ensured that, before any



Location of the pilot study area.

field work was undertaken, their project was integrated with the Department's long term strategy of developing an information management system.

The aim was to develop a pilot GIS database on community water and sanitation provision and investment in a sub-region of Northern Province which could be replicated countrywide if successfully implemented in this region.

The purpose of the database was:

- ❒ to assist decision-makers to plan and prioritise the water and sanitation needs of the region;
- ❒ to assist communities to increase their level of involvement in and awareness of being an integral part of the overall development initiatives in the country with a concomitant increase level of commitment and responsibility;
- ❒ to assist in the development of an early warning system at the local or provincial level to detect water and sanitation problems within an area or specific community (this would include problems arising from the onset of drought, the loss in efficiency of equipment, the breakdown of system components or potential health hazards);
- ❒ to assist decision-makers to monitor implementation progress, implementation constraints and the effectiveness of different investment policies.

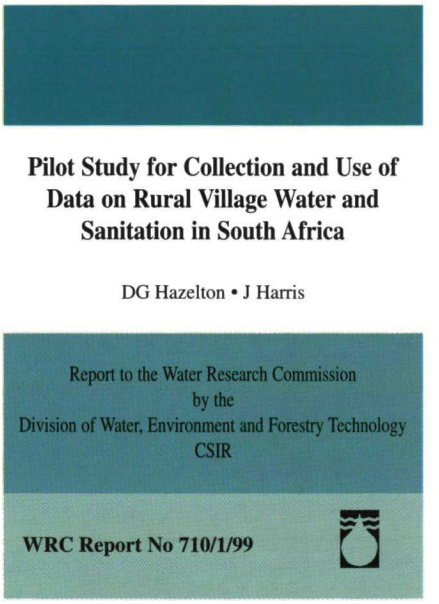
The methodology followed was:

- ❒ to establish the existing situation, both locally and internationally;
- ❒ to develop specifications for the database portion of the information system;
- ❒ to develop data collection procedures emphasising contributions at village level, and
- ❒ to implement the data collection procedures on a pilot scale.

The study area comprised about 120 communities with a population probably in excess of 100 000 people. The report says agreeing on the location of the pilot study proved a major problem.

"There was particular concern about the implementation being seen as favouring one district at the expense of other areas."

The area finally selected is in the centre of the Northern Province and combines parts of Northern, Lowveld and Central Districts. The boundary is roughly a triangle formed by the towns Elim and Soekmekaar and the confluence of the Klein and Middle Letaba rivers. The area includes communities supplied with water from bulk surface water schemes and others supplied from ground water sources.



MAIN RESULTS

The literature survey showed that there was a real need for the type of pilot study planned as part of the project. There was also a need for further development of a water and sanitation monitoring management tool that could provide relevant decision support in South Africa.

Data analysis from the pilot study area showed that additional skills development appeared to be necessary to help ensure that villages were able to operate and maintain water systems adequately. The communities showed a lack of understanding of the role of financial management in operating sustainable water systems. All 120 villages in the study area were ranked as having below RDP level of water and sanitation services.

GUIDELINES

The following guidelines for developing community based information systems were proposed from this research:

- ❒ Information system must be planned and developed with representatives of the target communities.
- ❒ It is essential to ensure that all data gathered at the local level are useful at the community level, i.e., it is not just for higher level structures only.
- ❒ Data collection forms must be simple and understandable, and at the same time enable easy estimation of performance based on key performance indicators.

The following aspects must be taken into consideration to improve sustainability of water system:

- ❒ Target communities must be involved in all decisions regarding their water supply schemes.
- ❒ Assist communities to acquire skills necessary for operation, maintenance and management of their schemes.
- ❒ Assist communities to liaise with Department of Water Affairs and Forestry, Local Government and other stakeholders in the area to plan a strategy for carrying out minor and major maintenance repairs.

Focus of the data collection effort at village and community level has assisted communities to become more involved in their own development and by providing additional information on conditions in similar villages, the research has assisted each village to become more aware of other development initiatives in the country.

Data collected in the project have been made available to the Department of Water Affairs and Forestry. The database is currently available as a hard copy to consultants working in the Northern Province.

Copies of the report entitled **Pilot Study for Collection and Use of Data on Rural Village Water and Sanitation in South Africa** (WRC report 710/1/99) 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).

New Sanciahs committee elected

The Sanciahs committee elected for the next four year term (2000 - 2003) was announced at the ninth South African National Hydrology Symposium held in Cape Town at the end of 1999. Most of the committee members are representatives of various international commissions under the banner of the International Association of Hydrological Sciences (IAHS). The Sanciahs committee are as follows:

Prof Denis Hughes

Prof Hughes is the present Chairman of Sanciahs. He is also the national representative for IAHS on the South African International Commission of Scientific Unions (ICSU) secretariat. Prof Hughes is the Director of the Institute for Water Research at the University of Rhodes and specialises in hydrological and water resource modelling and the application of such models within the Southern African context. His research interests include the impact of development on future water availability and the development of methodologies for the estimation of the environmental reserve for rivers.
Tel: (046) 622-4014
E-mail: denis@iwr.ru.ac.za

Hugo Maaren

Mr Maaren is Research Manager at the Water Research Commission responsible for the field of catchment hydrology and integrated catchment management. His speciality is land-use hydrology. He is well known amongst the hydrology fraternity as he has been actively serving Sanciahs as Secretary for many years now.
Tel: (012) 330-0340
E-mail: hugo@wrc.org.za

Dr Peter Ashton

Dr Ashton is a water quality and water resources specialist at Environmentek, CSIR. He has a special interest in the role of aquatic ecological issues in decision-making processes for conflict prevention or resolution, and also the management of water resources in shared river basins. Presently he is also the Vice-president of the IAHS International Commission on Water Quality (ICWQ).
Tel: (012) 841-3293
E-mail: pashton@csir.co.za

Prof Gerrit Basson

Prof Basson is Head of the Water Division at the Department of Civil Engineering of the University of Stellenbosch. He has several years' experience with consulting engineers mainly in the fields of hydraulic engineering and water resources planning. He is the representative of the IAHS International Commission on Continental Erosion (ICCE).
Tel:(021) 808-4355
E-mail: grbasson@ing.sun.ac.za

Jean Boroto

Mr Boroto is Chief Engineer: System Operations at the Department of Water Affairs and Forestry (DWAF). He studied at the universities of Kinshasa (Democratic Republic of Congo) and Stellenbosch. He has worked at the CSIR and for consulting engineers before joining DWAF. His interests are water resources management, international water sharing, and hydrological and hydrodynamic modelling. He also serves on some of the committees on shared rivers with neighbouring states. He is co-representative of the IAHS International Commission on Surface Water (ICSW).
Tel: (012) 336-8244
E-mail: BorotoJ@dwaf.pwv.gov.za

Prof André Görgens

Prof Görgens is Professor in water resources engineering and hydrology at the University of Stellenbosch, and a director of Ninham Shand Consulting Engineers. In recent years he has been active in conceptual and institutional development initiatives in the field of integrated water resources management and, particularly, catchment management. He is the Secretary of the IAHS International Commission on Water Resources Systems (ICWRS).
Tel: (021) 808-4356
E-mail: agorgens@ing.sun.ac.za

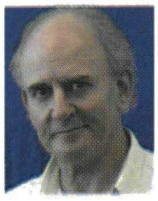
Phil Hobbs

Mr Hobbs was with the Directorate of Geohydrology of the Department of Water Affairs before taking on the challenges of a consultant. He has also lectured part-time in hydrogeology at the Pretoria Technikon. He is the representative of the IAHS International Commission on Groundwater (ICGW).
E-mail: hobbs@xsinet.co.za

Dr Graham Jewitt

Dr Graham is Senior Lecturer in forest hydrology at the School of Bioresources Engineering and Environmental Hydrology at the University of Natal, Pietermaritzburg. His research interests are forest hydrology and hydro-ecology together with integrated water resources management. He is the representative of the IAHS International Commission on Surface Water (ICSW).
Tel: (033) 260-5490
E-mail: JewittG@ageng.unp.ac.za

Prof Guy Pegram



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. Apart from rainfields and rainfall modelling his research interests include river flood hydraulics, flood prediction and forecasting, as well as large reservoir system reliability. He is the representative of the IAHS International Commission on Remote Sensing and Data Transmission (ICRSDT).
Tel: (031) 260-3057
E-mail: Pegram@nu.ac.za

Prof Roland Schulze

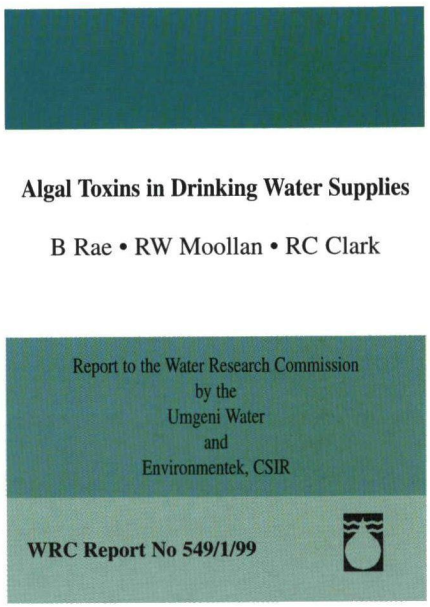
Prof Schulze is Professor of hydrology and Programme Director of hydrology at the School of Bioresources Engineering and Environmental Hydrology at the University of Natal, Pietermaritzburg campus. His fields of expertise are agrohydrological simulation model development, modelling hydrological impacts of land use, agroclimatic mapping, modelling impacts of climate change, and integrated catchment management. He is the representative of the IAHS International Commission on Atmospheric-Soil-Vegetation Relations (ICASVR). He is also serving on the SA Scientific Committee for Global Change.
Tel: (033) 260-5489
E-mail: schulze@aqua.ccwr.ac.za

Dr Vladimir Smakhtin

Dr Smakhtin is a hydrology and water resources scientist at Environmentek, CSIR. His key interests are catchment processes modelling, water resources assessment, low-flow estimation and analysis, development of streamflow analysis techniques, the identification of information needs and provision of hydrological information for ecological purposes, and the assessment of catchment development impacts on streamflow. He is the co-representative of the IAHS International Commission on Surface Water (ICSW).
Tel: (012) 841-4178
E-mail: vsmakhtin@csir.co.za

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 549/1/99 - Algal toxins in drinking water supplies. Report to the Water Research Commission by Umgeni Water and Environmentek, CSIR.

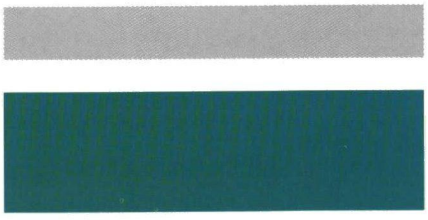
Authors: B Rae, RW Moollan and RC Clark
Overseas price: US$ 25 (via surface mail)

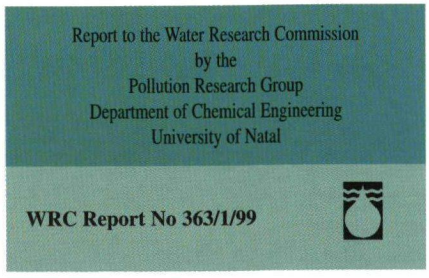
Previous investigations conducted in South Africa have found that microcystin toxins can persist even after conventional water treatment processes, and the concern that these toxins may enter drinking water supplies prompted this investigation.

The objective of the project was threefold:

- ❒ to investigate sensitive and reliable methods for the detection of algal toxins;
- ❒ to monitor critical impoundments (such as Inanda and Vaal dams) for at least a year, and
- ❒ to research various remedial actions for the safe and effective removal of these toxins from water supplies.

Investigated processes were ozonation, chlorination and adsorption by activated carbon. All three treatment processes have been reported in the literature for the removal of microcystin toxins. Laboratory bench-scale experiments were performed using various water matrices and two types of toxin standards, namely, pure microcystin toxins and a toxic *Microcystis* extract containing microcystin-LR. While the use of the pure toxins would provide data for the removal of the toxins *per se*, the use of the toxic *Microcystis* extract, as a toxin standard, provided information on the removal of microcystin toxin in the presence of associated organic compounds that are normally found with a toxic algal bloom.





Report 363/1/99 - The use of small-scale equipment for evaluating water treatment plants. Report to the Water Research Commission by the Pollution Research Group, Department of Chemical Engineering, University of Natal.

Author: CJ Kaiser
Overseas price: US$ 25 (via surface mail)

Water treatment involves the complex interaction of processes such as mixing, coagulation, flocculation, sedimentation, clarification and disinfection. Tools have been developed to simulate full-scale water treatment plants to optimise and monitor the processes in terms of the chemical dosages and physical parameters. These tools include residence time distribution studies, the construction of pilot plants, small-scale units and laboratory tests (jar tests). One of the important criteria linking these small-scale systems to the full-scale plant is the residence time distribution (RTD) studies. The RTD is obtained from the computational analysis of tracer test results and gives the overall flow pattern of the treatment process by indicating the distribution of time that fluid elements spend in the process. For the optimisation of a full-scale plant, residence time distribution can be used to identify non-ideal flow patterns such as dead space, and for linking the full-scale plant to the small-scale and laboratory-scale tests.

The aims of this research project were, *inter alia*:

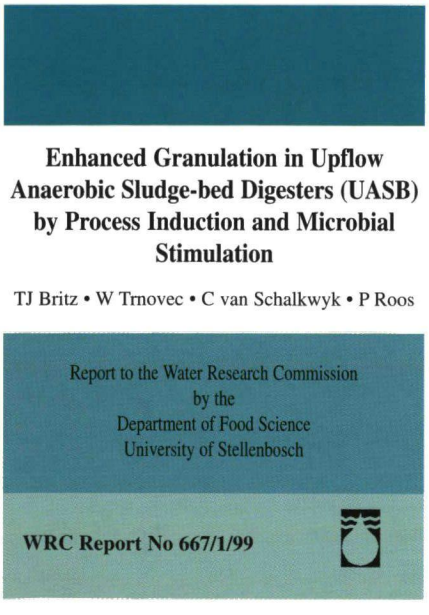
- ❒ The production of a Guide which would enable water authorities to construct small-scale equipment which would behave in a similar fashion to the existing potable water treatment plant; and

- ❒ The investigation of changes to improve the performance of existing potable water treatment plants by making physical modifications to the small-scale equipment.

The Steering Committee also targeted specific areas of study which involved the use of (i) residence time distribution (RTD) studies for water treatment optimisation, (ii) a review of literature on the topic of flocculation and plant simulation, and (iii) the use of small-scale and laboratory-scale systems for water treatment optimisation.

The work was undertaken in three separate areas and is therefore discussed in the report in terms of the comparison between the jar test and the full-scale plant, the design and construction of a small-scale system, and the use of residence time distribution to determine the flow patterns of systems. On a larger scale, however, the three levels of process optimisation are linked by the need for understanding the flow patterns.

The report says the project served to:
- ❒ indicate important parameters in the design and construction of small-scale water treatment systems;
- ❒ highlight important factors in the planning and execution of the jar test; and
- ❒ identify and promote the use of tracer test studies and residence time distribution analysis for understanding flow patterns in water treatment plants.

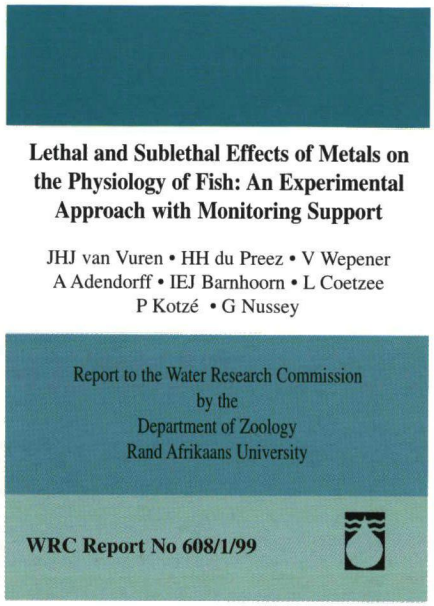


Report 667/1/99 - Enhanced granulation in upflow anaerobic sludge-bed digesters (UASB) by process induction and microbial stimulation. Report to the Water Research Commission by the Department of Food Science at the University of Stellenbosch.

Authors: TJ Britz, W Trnovec, C van Schalkwyk and P Roos
Overseas price: US$ 25 (via surface mail)

Over the last few years a renewed interest has arisen in the anaerobic digestion process. The direct treatment of waste waters was greatly stimulated by the development of the upflow anaerobic sludge blanket (UASB) process and its successful full-scale application. However, one of the main problems still remaining in the application of the UASB process is the extensively long start-up periods needed for the development of an effective granular bed. The aim of this study was therefore to try and enhance granulation in the UASB system and to promote a more rapid start-up procedure. This was done by:
- ❒ Setting-up and operating a series of batch systems simulating UASB operating parameters. The granule growth was monitored in terms of yield and metabolic activity. Environmental "stress" conditions were applied to the batch systems and the influence of these as granule stimulants, evaluated. Three waste waters were used as treatment substrates and included synthetic effluents with either glucose, sucrose or lactate as carbon source, a canning industry effluent and a petrochemical effluent containing only volatile fatty acids. The best conditions for granulation were identified and optimised.
- ❒ Setting-up operating UASB laboratory-scale digesters using a synthetic and a carbohydrate rich canning industry wastewater as treatment substrates. The induction of specific 'stress' conditions and their influence as granule stimulants, was evaluated. Changes in the environmental conditions included: organic and hydraulic overloading; changes in C:N:P ratios; as well as the addition of cysteine.

Furthermore, based on the data obtained from the batch- and laboratory-scale bioreactors, a UASB anaerobic biological model was constructed and evaluated on a 50 litre pilot-scale UASB reactor and start-up procedures were established as part of the batch-, laboratory- and pilot-scale digestion systems.



Report 608/1/99 - Lethal and sublethal effects of metals on the physiology of fish: An experimental approach with monitoring support. Report to the Water Research Commission by the Department of Zoology at the Rand Afrikaans University.

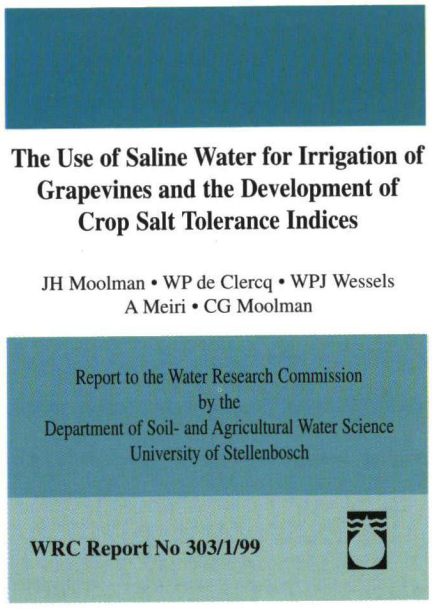
Authors: JHJ van Vuren, HH du Preez, V Wepener, A Adendorff, IEJ Barnhoorn, L Coetzee, P Kotzé and G Nussey
Overseas price: US$ 35 (via surface mail)

The Olifants River system in Mpumalanga is often described as one of the most polluted systems in South Africa and is commonly known as "the battered river". Increasing agriculture and mining activities, industrial development and urbanisation in the river's catchment area have systematically impacted over the years on the water quality of the Olifants.

Against this background a research project was carried out to:

- ❒ Investigate the anthropogenic impacts on the water and sediment quality in the Olifants River;
- ❒ Investigate, under controlled laboratory conditions, the sublethal effects of metal pollution on fish;
- ❒ Provide information that could be used to improve water quality guidelines for metals; and
- ❒ To train manpower in water quality management and the assessment of the detrimental effect of pollutants on aquatic life, especially fish.

Evaluation of the data for the macro and trace elements (metals) in the water at selected sites in the Olifants catchment indicated that many of the concentrations exceeded the water quality guidelines of the Department for aquatic ecosystems. The report says this is alarming because many of these constituents have negative impacts on aquatic life, thereby posing a potential threat to ecosystem health.



Report 303/1/99 - The use of saline water for irrigation of grapevines and the development of crop salt tolerance indices. Report to the Water Research Commission by the Department of Soil and Agricultural Water Science, University of Stellenbosch.

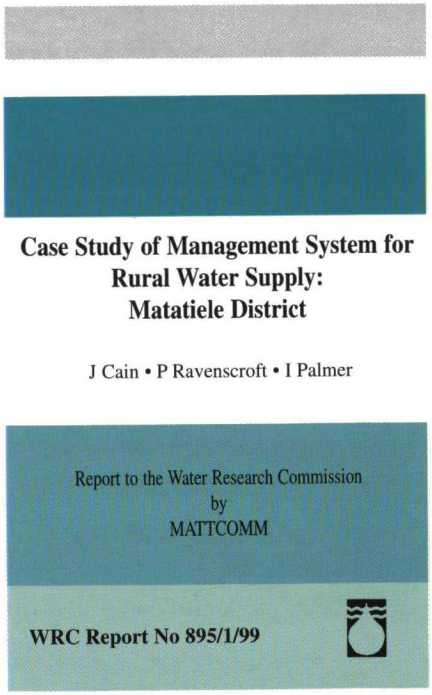
Authors: JH Moolman, WP de Clercq, WPJ Wessels, A Meiri and CG Moolman
Overseas price: US$ 30 (via surface mail)

The authors embarked on a five year research project, financed by the Water Research Commission, to study the use of saline water for irrigation purposes and to do an assessment of crop salt tolerance criteria.

The Breede River valley, where much of the research work was carried out, is an important agricultural area for the production of high value crops under intensive irrigation. It has a wide and dynamic crop mix, but is primarily a wine-producing area. Over the past 30 years an awareness of increasing salinity levels in the Breede River during summer months has grown considerably and gave rise to concern about the sustainability of using the water for the irrigation of these high value salt-sensitive crops.

The report says it is reasonable to assume that agriculture will in future not only have to bring about substantial water savings, but will also have to rely increasingly on water of a poorer quality than at present. International research has shown that salinity effects on the yield and quality of agricultural crops are of primary importance and this study also contributed to a substantial improvement in the knowledge of salinity injury to wine grapes under field conditions.

The results contained in this report can be used by the Department of Water Affairs and Forestry to improve the salinity management of the Breede River and to better plan and manage irrigation expansion along the Breede River. The report can also be used locally and internationally to provide improved guidelines for irrigation water salinity criteria under conditions of full-scale as well as supplemental irrigation of grapevines.

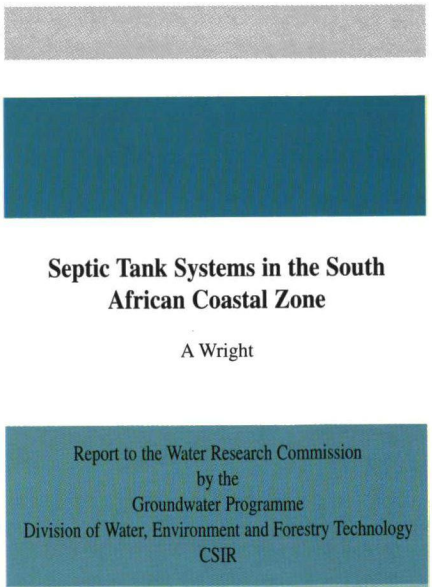


Report 895/1/99 - Case study of management system for rural water supply: Matatiele District. Report prepared for the Water Research Commission by the Maluti Water and Community Engineering Services and the Palmer Development Group (MATTCOMM).

Authors: J Cain, P Ravenscroft and I Palmer
Overseas price: US$ 20 (via surface mail)

The project was undertaken to develop appropriate operation and maintenance management arrangement options for rural water supply projects. The management options were based on grass-roots input from communities and local stakeholders involved in such projects and were developed within the framework set out by the South African Water Services Act.

An important part of this process was to assess existing management arrangements at completed rural water supply projects to improve the understanding of on-the-ground issues affecting project management and to draw lessons based on this analysis. All the completed rural water supply projects that met RDP standards in the Matatiele district were studied.



Report 597/1/99 - Septic tank systems in the South African coastal zone. Report to the Water Research Commission by the Groundwater Programme, Division of Water, Environment and Forestry Technology, CSIR

Author: A Wright
Overseas price: US$ 20 (via surface mail)

Septic tank and soakaway systems are the most commonly used method of

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
School of Bioresources Engineering and Environmental Hydrology
University of Natal
Private Bag X01
Scottsville, 3209
Tel: (033) 2605412 • Fax: (033) 2605818
Email: lynchs@nu.ac.za

Unique database on water and sanitation in developing countries now online

Researchers, students, and information gatekeepers can now freely access a unique bibliographic database on water supply and sanitation in developing countries, IRCDOC, on the Internet at: http://www.irc.nl/ircdoc.

IRCDOC includes nearly 13 000 references to documents collected by Documentation Unit of the IRC International Water and Sanitation Centre since 1984 and a growing number of documents available on the Web. The majority of the collection consists of (unpublished) grey literature and includes 2 000 books, 5 400 reports, 2 750 journal articles and conference papers, 650 training manuals, 350 reference works and 170 videos and slide series. IRCDOC is updated monthly while about 1 000 new references are added to the database each year.

Information can be retrieved by title, author, subject, series and publisher. The results can also be filtered by language, media type and year of publication. About 20 per cent of the database records have an abstract.

Photocopies of limited numbers of non-copyright documents, which are not available on the Internet, can be provided at cost:
http://www.irc.nl/products/documentation/delivery.html

For more information see the IRCDOC web page at http://www.irc.nl/ircdoc. or contact Cor Dietvorst, at e-mail: dietvorst@irc.nl.

domestic waste water treatment in the South African coastal zone. Although the technology is well established and a wealth of technical information exists on the subject, the perception, however, exists that this method of on-site sanitation is both second rate and ineffective. To understand the technology better the Water Research Commission provided funds for the CSIR to undertake an 18 month study to define the issues related to septic tank systems in the coastal zone and develop documents for the transfer of existing technical knowledge to the user level.

Top honours for tap water

British experts, tasting an array of expensive bottled waters for a consumer magazine, awarded top marks to a humble sample of tap water from Thames Water, a less-than-fashionable utility.

Some of the water sampled costs more than £1 (R10.44) a litre. Thames Water will fill a medium-sized bath for around 12 pence.

Source: The Economist (http://economist.com)

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.

2000

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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.

2001

JANUARY

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AUGUST

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OCTOBER

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NOVEMBER

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DECEMBER

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SOUTHERN AFRICA

2000

IRRIGATION
OCTOBER 22 - 27
The 6th international micro-irrigation congress together with the 51st IEC meeting of the International Commission on Irrigation and Drainage (ICID) will be held in Cape Town.
Enquiries: The Congress Secretariat, PO Box 36815, Menlo Park 0102. Tel: (012) 344 0390. Fax: (012) 344 5643. E-mail: reservations@parkgables.co.za.

AGROCHEMICALS
OCTOBER 25 - 26
A workshop on the control of adverse impacts of fertilizers and agrochemicals will take place in Cape Town, South Africa.
Enquiries: Prof A Mermoud, Institute of Soil and Water Management (IATE), Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland.
Tel: +41-21-693-3726. Fax: +41-21-693-3739. E-mail: andre.mermoud@epfl.ch

ENVIRONMENTAL AUDIT
OCTOBER 30 - NOVEMBER 3
An ISO 14001 Environmental auditor training course will be held at the Eskom Conference Centre in Midrand. The course is accredited by EARA UK and presented by Aspects International UK.
Enquiries: Crystal Clear. Tel: (011) 882-3368.

GROUND WATER
NOVEMBER 1 - 3
A course - an introduction to ground water - will be presented at the University of the Witwatersrand in Johannesburg.
Enquiries: The Secretary, Ground Water Division, GSSA. Tel: (012) 803-1545. E-mail: gwd@icon.co.za.

VAAL RIVER
NOVEMBER 7 - 8
The Vaal River Conference 2000 will be held at the Vaal Riviera Resort near Vanderbijlpark.
Enquiries: Lesley Stephenson, Division of Continuing Engineering Education, University of the Witwatersrand, PO Box 327, WITS 2050. Tel: (011) 716-5091. Fax: (011) 339-7835. E-mail address: stephenson@egoli.min.wits.ac.za Website address: www.cee.co.za

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: 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: conference@wisa.co.za

OVERSEAS

2000

WATER RESOURCES
OCTOBER 2 - 6
An international workshop on integrated water resource management will be held in Denver, Colorado, USA.
Enquiries: Ms Leanna Principe, International Affairs Team, D-1520, US Bureau of Reclamation, PO Box 25007, Denver, Colorado 80225. Tel: 303-445-2127. E-mail: lprincipe@do.usbr.gov. Website address: http://www.usbr.gov/international/trn-integrated.htm

MEMBRANES
OCTOBER 3 - 6
An international conference dealing with membranes in drinking and industrial water production will be held in Paris, France.
Enquiries: IWSA Secretariat, 1 Queen Anne's Gate, London SW1H 9BT, Great Britain. Tel: +44 171 957 4567. Fax: +44 171 222 7243. E-mail address: IWSA@dial.pipex.com

RIVER BASINS
OCTOBER 9 - 12
An international workshop on runoff generation and the implications for river basin management and modelling will be held in Freiburg, Germany.
Enquiries: IAHS/ICT Workshop 2000, University of Freiburg, Fahnenbergplatz, D-79098, Freiburg, Germany. E-mail address: uhlenbro@uni-freiburg.de Tel: +49 761 203 3546 Fax: +49 761 203 3594.

CLIMATOLOGY
OCTOBER 16 - 20
ECAC 2000: the third European conference on applied climatology will take place in Pisa, Italy.
Enquiries: Antoinetta Falci, CNR-IATA, via Caproni n.8, 50145, Florence, Italy. Tel: +39 055 301504. Fax: +39 055 308910. Web address: http://www.lamma.rete.toscana.it/ecac2000/

POLLUTION
OCTOBER 16 - 18
The IEP 2000 conference on issues in global change - conflicting demands on water, air and land resources in a changing global environment will be held in Lisbon, Portugal.
Enquiries: Gill Heaton. E-mail: gill.heaton@virgin.net Web: http://www-elsevier.nl/locate/iep 2000

WASSER BERLIN
OCTOBER 23 - 25
Congress Wasser Berlin 2000 will be held in Berlin.
Enquiries: The Organiser, Wasser Berlin, Messedamm 22, 14055 Berlin. Tel: +49 30 3038 2085. Fax: +49 30 3038 2079. E-mail: wasser@messe-berlin.de Web site address: http://www.messe-berlin.de

WATER MANAGEMENT
OCTOBER 24 - 25
A conference with the theme "Water management for the 21st century - learning from the 20th century experience" will be held in Berlin, Germany.
Enquiries: IWA Headquarters, Wasser Berlin Conference Alliance House, 12 Caxton Street, London SW1H 0QS, UK. E-mail:

hannah.clark@iwsa. org.uk Tel: +44 207654 5500 Fax:+44 207654 5555.

WATER QUALITY
NOVEMBER 5 - 8
The AWWA 2000 water quality technology conference will be held in Salt Lake City, UT, USA.
Enquiries: Clare Haas, AWWA, USA. E-mail:chaas @awwa.org Tel: +303 347 6194 Web: http://www.awwa.org/tande/awwaconf.html

WEDC
NOVEMBER 5 - 8
The 26th WEDC conference with the theme "Water, sanitation and hygiene - challenges of the millennium" will be held in Dhaka, Bangladesh.
Enquiries: Prof John Pickford, WEDC Loughborough University, LE11 3TU, England. E-mail address: j.a.pickford@lboro.ac.uk Fax: +44 1509 211027.

CLIMATE
NOVEMBER 6 - 10
The 2nd SPARC general assembly on stratospheric processes and their role in climate will be held in Mar del Plata, Argentina.
Enquiries: SPARC Office. Fax: +33 164 474316. Web: http:// www.aero.jussieu.fr/~sparc/

WATER POLLUTION
NOVEMBER 11 - 16
The 7th international conference on wetland systems for water pollution control will be held in Lake Buena Vista, Florida, USA.
Enquiries: Mandy Padgett, University of Florida, Institute of Food and Agricultural Sciences, USA. E-mail: mrp@gnv.ifas.ufl. edu Tel: +352 392 5930. Fax: +352 392 9734. Web address: http://www.ifas.ufl.edu/~conferweb/wpc/

WATER SUPPLY
NOVEMBER 15 - 17
The 5th international symposium on water supply technology will be held in Kobe, Japan.
Enquiries: Secretariat, c/o Congress Corporation, Congress Bldg, 3-6-13 Awajimachi, Chuo-ku, Osaka 541-0047 Japan. Tel +81 6 6229 2595. Fax +81 6 6221 3071 E-mail address: wst2000@congre.co.jp

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: convlink@wantree.com.au. 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, ICI-WRM 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

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 address: 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/non-point 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 address: 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 2nd 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: 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 70414 4750. Fax: +31 70 414 4798.

HYDROGEOLOGICAL MAP SERIES
OF THE REPUBLIC OF SOUTH AFRICA
1: 500 000

Prepared by the Department of Water Affairs and Forestry

The following South African 1 : 500 000 General Hydrogeological maps and brochures are available as from April 1999

MAPS:

- 2330 Phalaborwa
- 2730 Vryheid
- 2928 Durban
- 3126 Queenstown
- 3324 Port Elizabeth
- 2522 Vryburg
- 2526 Johannesburg
- 3321 Oudtshoorn
- 3317 Cape Town
- 2530 Nelspruit
- 2726 Kroonstad

BROCHURES:

- 3126 Queenstown
- 3324 Port Elizabeth
- 3321 Oudtshoorn
- 2526 Johannesburg

The General Hydrogeological maps provide a synoptic overview of the hydrogeological character of the area by processing groundwater-related data according to a standard legend.

Each single A0 map sheet comprises:

MAIN MAP:

Groundwater occurrence (borehole yields and aquifer type) superimposed on a lithological background
(Scale 1 : 500 000)

INSET MAPS:

- Distribution of borehole data (Scale 1 : 2 000 000)
- Elevation above sea level (Scale 1 : 2 000 000)
- Mean annual precipitation (Scale 1 : 2 000 000)
- Groundwater quality (Scale 1 : 1 500 000)

SCHEMATIC CROSS-SECTION:

A schematic illustration of typical modes of groundwater occurrence (Not to scale)

ACCOMPANYING BROCHURE:

Provides additional information concerning groundwater occurence and related matters

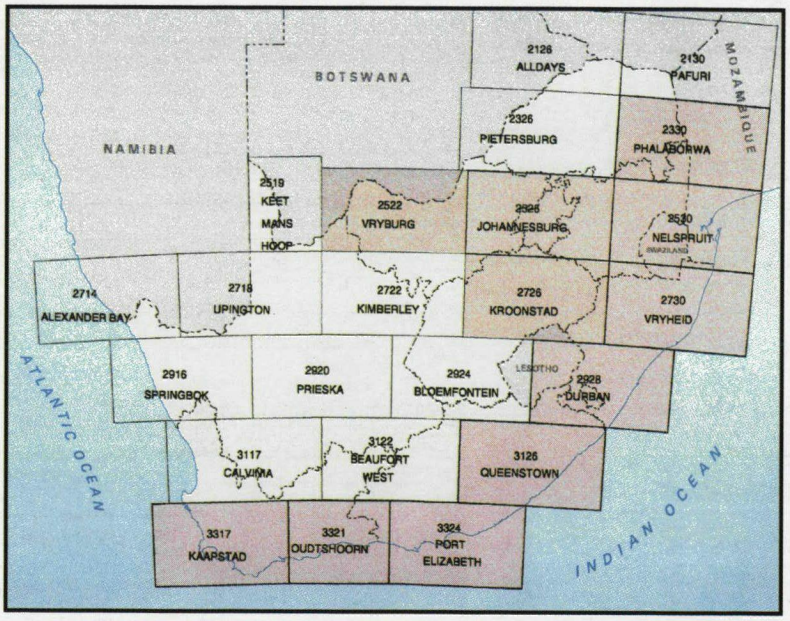
Price:

R50.00 per map
R50.00 per brochure } (VAT, postage and packing included)

Copies of the maps and brochures are obtainable from:

Ms. M. van Wyk
Department of Water Affairs and Forestry
Directorate: Geohydrology
Emanzini Building R310
173 Schoeman Street
Pretoria
0001

Tel: (012) 336 7849
Fax: (012) 328 6397
E-mail: WB3@dwaf.pwv.gov.za



Website: http://www-dwaf.pwv.gov.za

2001

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