

S4 waterbulletin

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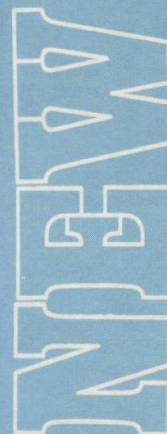
Die Watervorsingskommissie het 'n projek by die Universiteit van die Oranje-Vrystaat gefinansier waar weerdata gebruik word om die besproeiing van winterkoring te skeduleer. Hierdie metode verseker dat besproeiingsboere die beskikbare water so doeltreffend moontlik gebruik en het hulle gehelp om op Hartswater goeie oeste te maak ten spyte van die streng waterbeperkings in die gebied.



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The WRC announces the second impression (1987) of

Agrohydrology and -climatology of Natal



by **RE Schulze**

A study that evaluates the influence of available water on the agricultural potential of Natal.

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The approach used in this survey has been founded on four basic principles:

- ☐ The 'driving forces' of all agricultural growth and potential are the availability of moisture and solar energy, the latter energy index being described by temperature. Analyses of precipitation and temperature therefore form a vital component of this survey.
- ☐ It is the interaction of precipitation and temperature (as expressed through evapotranspiration) on crops with certain growth characteristics and cultivated in soils with given properties that determine the productivity of a given area. These interactions are best analysed by a water balance (i.e. soil moisture budgeting) approach, and a basis for this has been the development of the ACRU Agrohydrological Model.
- ☐ The climatic statistic most commonly available to agriculturalists is the mean annual precipitation (MAP) of a locality. As far as possible agrohydrological and -climatological indices have therefore been related to MAP in maps and nomographs prepared for the user.
- ☐ Climatological variables are measured at irregularly spaced fixed points (e.g. climate stations) but are most frequently required for planning at localities where no measured data are available. The primary agrohydrological variables (precipitation, temperatures, soils information) were therefore estimated by interpolative techniques at intersections on a square grid of side 10 km over Natal. From the 1002 grid point values computer maps were constructed.

The manual consists of two parts: a basic and an applied information section.

* BASIC INFORMATION SECTION

Comprises detailed user maps of Natal for

- Rainfall
- Rainfall variability
- Drought indices
- Temperature, showing minimum and maximum temperatures
- Potential evaporation

* APPLIED INFORMATION SECTION

Deals with

- Agricultural productivity potential within Natal
- Aspects of veld and pasture management and production
- Dry land crop production potential
- Water requirements for irrigation
- Optimum areas for commercial timber production

While scientific methods form the basis of the various analyses undertaken, the endeavour has been to present results at the level of the user, namely, the extension officer, agricultural consultant and the farmer. For this reason nomographs as well as worked examples have been given where relevant.

This manual is best used as a tool for regional, comparative planning and some care has to be exercised in making use of information at farm level.

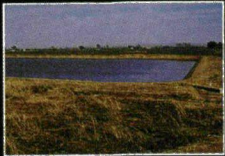


waterbulletin

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Besproeiingskedulering van winterkoring.
Sien bl 18.

SA waterbulletin

SA WATERBULLETIN
VOLUME 13 NO 5
OCTOBER/OKTOBER 1987

contents

SA Waterbulletin is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organization 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.

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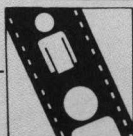
SA Waterbulletin is 'n tweemaandelikse tydskrif oor water en waternavorsing wat uitgegee word deur die Suid-Afrikaanse Waternavorsingskommissie (WNK), 'n statutêre organisasie wat in 1971 by Wet gestig is.

Intekening is gratis. Stof in dié publikasie weerspieël nie noodwendig die oorwoë menings van lede van die WNK nie, en mag hergebruik word met erkenning van die bron.

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Groundwater and gather in

A symposium combining the Fourth Biennial Symposium of the Ground Water Division of the Geological Society of South Africa and the Third National Hydrological Symposium of the South African National Committee for the International Association of Hydrological Sciences (SANCIAHS) was held at Rhodes University from 6 to 9 September this year.

The overall theme of the symposium was Southern African Water Resources. The hydrological sciences symposium was organised in the spirit that expertise and understanding of surface and ground water aspects of hydrology need to be integrated to provide the optimum solution for many of the water resource problems of Southern Africa.

The papers of the proceedings represent a broad spectrum of activity in the areas of hydrological research, planning and management that is taking place in South Africa today. The three major groups of organisations: consulting engineers, government departments and academic institutions were all well represented in the speakers' affiliations. This broad spectrum of expertise is important because each of these organisations has a vital role to play in the development of techniques and in the practical application of methods designed to solve water resource problems.

In addition to the papers presented, discussions were held and excursion visits were undertaken to sites of research in the Great Fish River and Lower Sundays River areas.

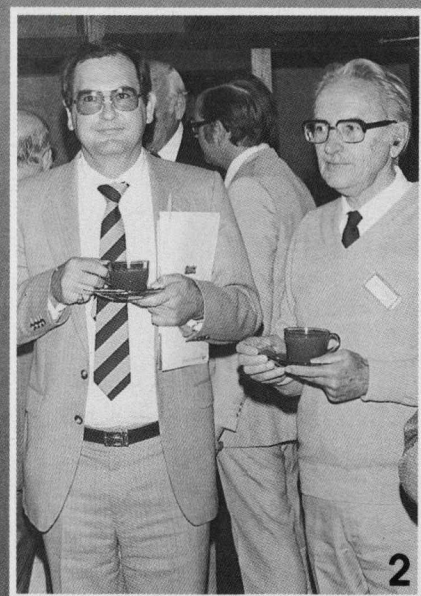
According to the organisers, the objectives of the symposium were met while combining the two symposia in this way, which resulted in the successful interaction between groundwater and surface water experts.

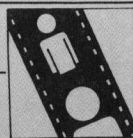


1 From left: Dr JH Moolman (University of Stellenbosch), Dr DA Hughes (Rhodes University) and Mr HM du Plessis (WRC).

2 From left: Dr PJT Roberts (WRC) and Prof DC Midgley (Watermeyer, Legge, Piesold & Uhlmann).

3 From left: Mr M Levin (AEC), Dr GJ van Tonder (UOFS), Mr JP Verwey (UOFS) and Mr E Lukas (UOFS).



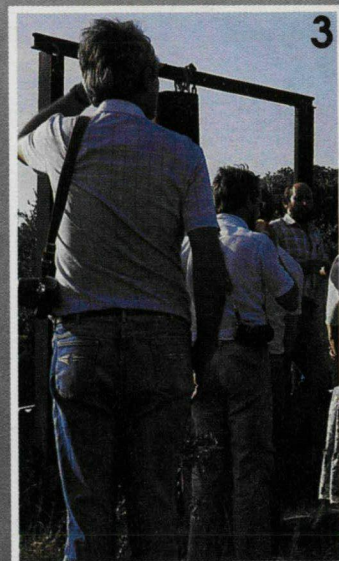


hydrology experts Grahamstown

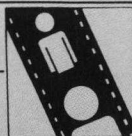
1 A view of the Lower Sundays River Government Water Scheme which currently consists of 9 000 ha of irrigated land.

2 Mr Stone underlines the significance of the artesian boreholes on the Amanzi Estate near Uitenhage. The boreholes are mainly used for the irrigation of citrus on the Estate and supply a high quality water with exceptionally low TDS.

3 At Bushmans River Mouth Mr Andrew Stone, lecturer at the Department of Geology at Rhodes University and leader of the excursion, explains how water is obtained from shallow coastal aquifers. The conditions for aquifer exploitation at Bushmans River Mouth are particularly favourable because of the thickness and coarseness of the saturated sands.



The published proceedings of the symposium in two volumes are available from: The Hydrological Research Unit, Rhodes University, P O Box 94, Grahamstown. 6140. Telephone (0461) – 24014.



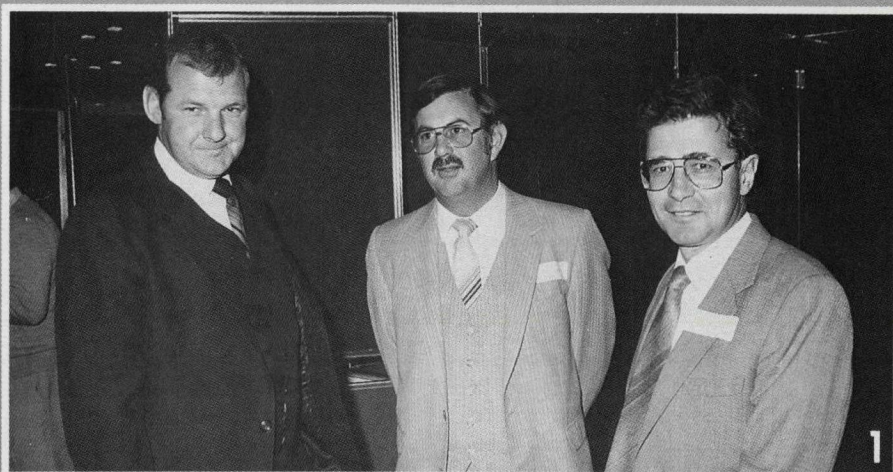
Hartbeespoortdam – Quo Vadis?

'n Simposium getiteld Hartbeespoortdam – Quo Vadis? is op 1 September by die WNNR gehou. Die doel van die simposium was:

- om nuwe verwikkelings rakende die dam te hersien.
- om die ekologiese en sosiologiese probleme van hierdie opgaardam te bespreek, en
- om beplannings en bestuursmoontlikhede vir die toekoms te ondersoek.

Altesaam veertien referate is by die simposium gelewer waarvan die onderwerpe gewissel het van die Departement van Waterwese se bestuursbeleid vir eutrofikasiebeheer, die behandeling van eutrofe water en die impak van die nuwe fosfaatstandaard op die trofiese stand van die dam tot die ekologiese en gesondheidsprobleme in die dam en die situasie van die boere op die Hartbeespoortstaatswaterskema.

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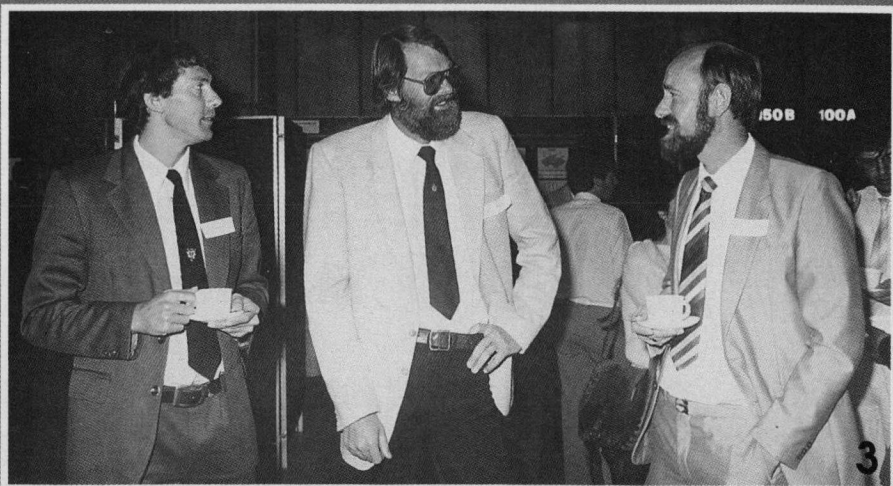


1 Van links: Mnr PG Pretorius (Hartbeespoort Stadsraad), mnr CF Harding (Hartbeespoort Stadsraad) en dr P de Villiers (Burgemeester, Hartbeespoort).

2 Van links: Dr LC Hensman (Stewart, Sviridov & Oliver) en dr JG Prins (Bruinette, Kruger & Stoffberg).

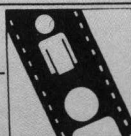
3 Van links: Mnr H Benkenstein (Departement van Omgewingsake), mnr CA Bruwer (Departement van Waterwese) en mnr WMD Fourie (Departement van Omgewingsake).

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Tegnologie-oordrag in besproeiing



1 Van links: mnr D S van der Merwe (WNK) en mnr H Hamman (Departement van Landbou en Watervoorsiening).



'n Werksessie oor tegnologie-oordrag in besproeiing is van 22 tot 24 September 1987 by die Navorsingsinstituut vir groente en sierplante te Roodeplaat gehou. Die sessie is gereel deur die Koördinerende Komitee vir Besproeiingsnavorsing (KKBN).

'n Groot aantal referate is gelewer waarin die belangrikheid van suksesvolle tegnologie-oordrag indringend bespreek is.

Die deelnemers was uit verskeie sektore afkomstig en het onder andere boere, landbouvoorligters en navorsers ingesluit.

Werksgroepe is op die eerste dag van die sessie gevorm wat aanbevelings ten opsigte van die volgende onderwerpe moes doen:

- ☐ Geskiktheid van tegnologie vir oordrag aan die betrokke teikengroepe en vir toepassing daarvan.
- ☐ Ontleding van die probleme in die bestaande kommunikasiekanale en -metodes.
- ☐ Ontleding van die probleme betrokke by die aanvaarding van tegnologie deur ontwikkelde besproeiingsgemeenskappe.
- ☐ Ontleding van die probleme betrokke by die aanvaarding van tegnologie deur ontwikkelende besproeiingsgemeenskappe.

Die groepe se aanbevelings is op die laaste dag van die werksessie tydens 'n gesamentlike sitting van al die afgevaardigdes bespreek en voorstelle is geformuleer vir verdere besproeiingsnavorsing en die uitskakeling van kwelpunte in die kommunikasieproses tussen alle vlakke in die besproeiingswerkveld.

2 Van links: Prof E le F Terblanche (Universiteit van Stellenbosch), mnr J Hayward (Ontwikkelingsbank) en mnr J G Rossouw (Departement van Ontwikkelingshulp).

Information on sources of available on computer

The first phase of a new secondary information system for hydrology has recently been completed with the publication of an updated Register of Southern African Hydrological Data Sources. The Register which was first issued in 1982 has been updated and computerised by the South African Water Information Centre (SAWIC) at the request of the Water Research Commission and forms one of three data bases containing information of relevance to hydrology, namely, the register of data sources, a register of current and past hydrological research projects and a master plan for hydrological research.

Mr Dave Cousens, Senior Adviser of the Water Research Commission, says the Register of Southern African Hydrological Data Sources is the first of the three data bases to become fully operational. The SAWIC is at present developing the data base containing the Register of current and past hydrological research projects while the master plan for hydrology consisting of research needs and priorities has been computerised by the Water Research Commission but is not yet linked to the total information system. The new computerised Register of Southern African Hydrological Data Sources contains information on data sources, the organisation responsible for the data and who to contact should a user need to obtain more information.

The compilers of the Register, Mrs AG James and Mrs HLM Fuller of SAWIC, arranged the information in such a way that the user should find information sources quickly and with relative ease.

Each entry includes the name, address and telephone number of the data source and information is also provided on costs (if any), restrictions and any other facts which may be relevant to users.

Information on hydrological parameters is presented in the form of tables which include details on geographical locations, frequency of data collection, instrumentation used, etc. Geographical areas are defined by means of an alpha-numeric grid map. The use of both a grid and a location index in the Register should aid the user in finding what hydrological parameters were determined in a particular area.

The information used to compile the Register was obtained from questionnaires which were circulated to various private organisations, government departments, municipalities, neighbouring states, provincial departments, public cor-

porations, statutory organisations and universities. In this way the SAWIC hoped that most data sources would be located. Several questionnaires were not, however, returned and thus not all organisations collecting hydrological data are represented. The SAWIC therefore invites all organisations who have been excluded from the Register to contact the South African Water Information Centre so that their information can be considered for inclusion in the data base.

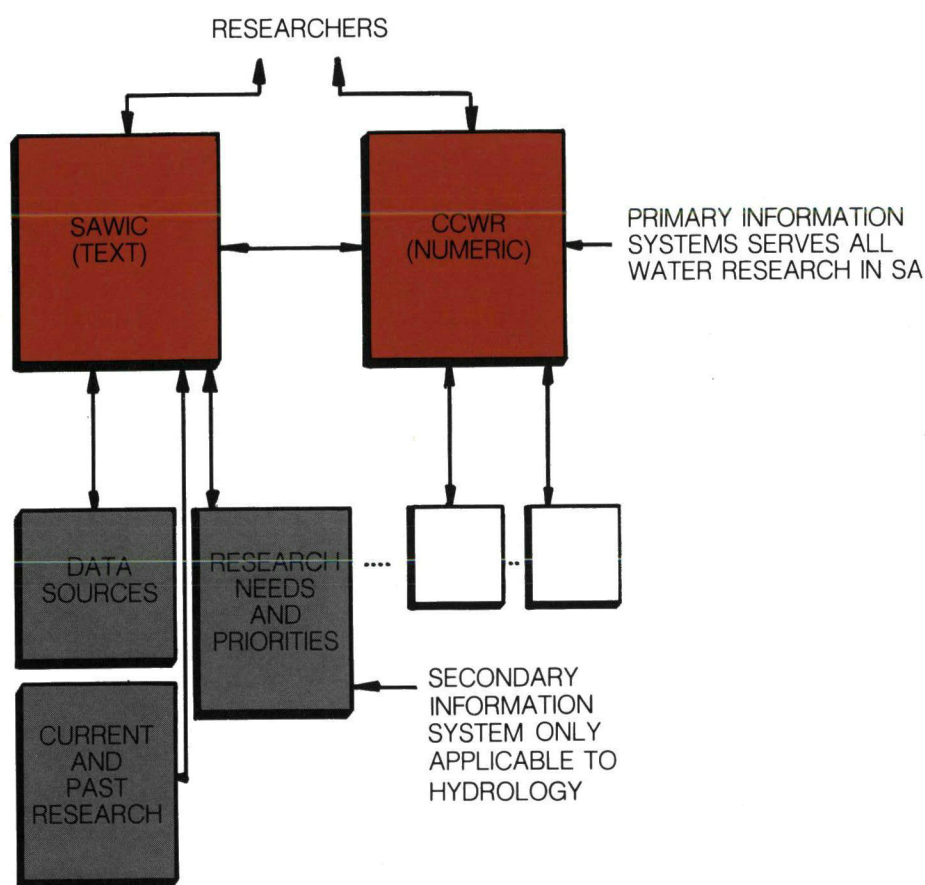
The Register is available in hardcopy (in the form of a computer print out), microfiche and also via the computer networks from SAWIC at the CSIR and the Comput-



Mr VA Shaw, Chief Director of the National Institute for Informatics at the CSIR, presents a computer print out of the new Register of Southern African Hydrological Data Sources to the Executive Director of the Water Research Commission (WRC), Mr PE Odendaal. At the happy occasion are from left: Dr MJ Pieterse and Mr DWH Cousens, Senior Advisers of the WRC, Mrs HLM Fuller, South African Water Information Centre (SAWIC), Mr Odendaal, Mr Shaw, Mrs AG James, SAWIC, and Mr MR Steyn, Manager of the SAWIC.

hydrological data now

A diagram showing how information is distributed to South African water scientists via the South African Water Information Centre and the Computing Centre for Water Research.



INFORMATION DISSEMINATION

ing Centre for Water Research at Natal University.

Persons interested in making use of the information in the Register can contact Mr Morkel Steyn at the South African Water Information Centre, P O Box 395, Pretoria, 0001 or telephone (012) 8412911 x 3083, or contact the Manager, Computing Centre for Water Research, c/o University of Natal, P O Box 375, Pietermaritzburg 3200, telephone (0331) 63320 X 177/178. Telex 643292.

Mr Cousens who has been the main driving force behind the establishment of the new system, says the system with its data bases is being developed to help with the planning and coordination of hydrological research in South Africa.

The Water Research Commission, he says, is responsible for the coordination of Water research in South Africa in general. One of the things the Water Research Commission does to carry out this task is to establish research support services

such as the establishment of information systems.

Until now the Water Research Commission has assisted with the establishment of two such primary information systems, namely, SAWIC which manages WATER-LIT – a bibliographical data base and the Computing Centre for Water Research (CCWR) – a numeric information system.

While SAWIC and the CCWR are linked by the CSIR computer network so that information can be transferred between them, the CCWR is also connecting into other major South African computer networks. In this way the information systems link up various research organisations, like the CSIR, universities, government departments, etc and the capability now exists of transferring much of the research information, both bibliographical and numeric, to the water research community via the computer networks.

Mr Cousens says anyone planning to do research basically needs to know three things:

- What research has already been done, what is currently being done in his field of interest and the results of such research;
- what research ought to be done i.e. research needs and priorities; and
- where to obtain the data for his planned research.

To help researchers in the field of hydrology find the right answers to these questions, Mr Cousens decided to develop a comprehensive system consisting of three data bases:

- ☐ A data base containing all the information on hydrological data sources in South Africa
- ☐ A data base containing information on current and past research in hydrology, and
- ☐ A data base containing research needs and priorities for hydrological research.

By integrating the information from these three data bases with that of SAWIC and the CCWR and making it available through the computer networks Mr Cousens hopes to enhance the coordination of hydrological research in South Africa thereby increasing research productivity.



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Fighting SA's Salinity Problem

The increasing salinity of South Africa's water resources is the biggest water pollution problem facing the country today. Mr J v R Stander of the Department of Water Affairs (DWA) outlines the DWA's policy towards this growing threat.

The quality of the Republic's major water resources, supplying the main industrial and economic centres of the Republic, has gradually deteriorated over the last number of decades especially with respect to salinity.

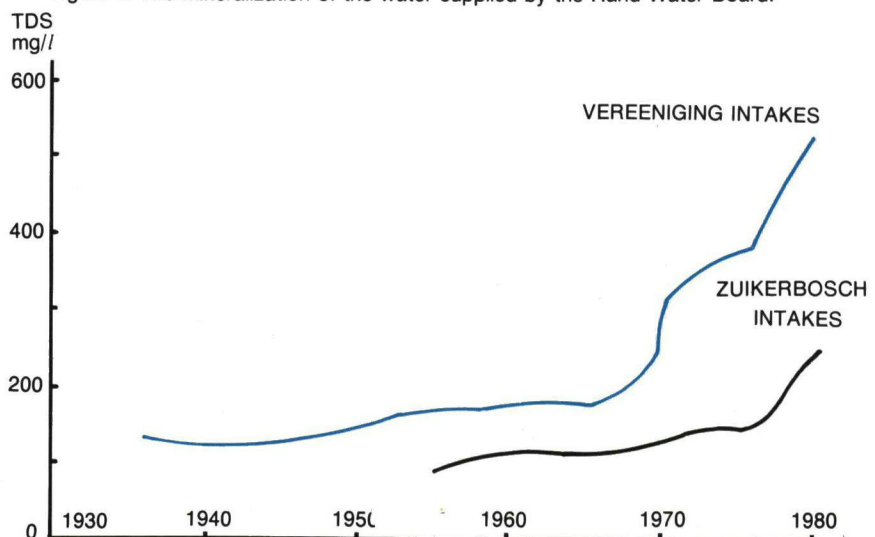
To illustrate this, one can refer to a familiar example viz. the quality of the water supplied by the Rand Water Board. The RWB supplies a region which accounts for more than half of the gross domestic product of the RSA and is the

country's largest user of water for urban, industrial and mining purposes. The mineralization of this water supply is illustrated by Figure 1.

Many other examples of serious mineralization could also be quoted.

The mineralization of the RSA's most important water resources is regarded as the single biggest pollution problem facing the Department of Water Affairs today. In time, water quality may become a more important factor than the quantity, with

Figure 1: The mineralization of the water supplied by the Rand Water Board.



regard to the availability of water in some areas, particularly the interior. To illustrate this, consider the water use quality criteria for certain uses.

Table 1 indicates the water quality criteria in TDS for a few urban and industrial uses.

TDS concentration in mg/l		
up to 500	up to 750	up to 1 200
Textiles Paper Manu- facturing Domestic	Food proces- sing	Soft drinks Chemical In- dustry Petroleum In- dustry

Table 1

In the case of the Vaal Barrage water for example, the TDS level is already in excess of the tolerable limit for the first category of uses. Furthermore the gradual build-up of salinity is on a critical path w.r.t. the tolerable limits for most other industrial uses.

Added to this concern, is the fact that the RSA is a water deficient country and industrial effluent return flow forms a considerable supplementary source of water. For example, approximately 65 per cent of the water supplied to the southern PWV region is returned to streams as effluents. This indirect recycling as well as internal recycling of effluents in industry, add significantly to the mineralization process. Consequently, increasing quantities of fresh water inputs into the supply system are required to satisfy the various quality criteria demands.

However, there is an already determined limit to the availability of fresh water resources to meet these demands as a viable method that could provide control over the mineralization process and result in improved water utilization in industry.

SOURCES OF THE SALINITY PROBLEM

Pollution sources are popularly categorised as either being point sources or diffuse sources.

In order to decide which control measures would be most effective to apply to any source of TDS, the origin of each individual source must be identified.

The main individual sources of TDS are due to the following phenomena:

- ☐ Natural phenomena, for example in the Karoo, where the leaching of salts from the shales gives rise to highly saline base flows.
- ☐ Agricultural activities. This could add significantly to the salinity problem. Due to evapotranspiration, salts build up in soils under irrigation and have to be leached regularly. Dry land farming results in accelerated release of natural salts from soils. Changing land-use patterns and the use of fertilizers and pesticides may also be contributing factors.
- ☐ Urban and industrial (including mining) activities. The main sources of TDS due to this category of activities are:
 - ☐ Underground water pumped by mines
 - ☐ Run-off and seepage from urban and industrial (including mining) areas
 - ☐ direct municipal and industrial effluents.

It is the Department's viewpoint that desalination by membrane processes is becoming a viable technique that could economically be applied to point sources such as the last category of direct effluents.

Other control measures which will not be discussed here, could be applied in the case of diffuse sources, such as natural, agricultural, urban and industrial run-off.

REASONS FOR INCREASING SALINITY

There are various reasons for this phenomenon in the RSA. Without attempting to place them in order of relative significance or give blame to any contributor to the problem, some of the reasons are listed below:

- ☐ The TDS standard for effluent returns is too lenient and too simplistic. (General)
- ☐ Previous water pollution control legislation and policies were not strict enough.
- ☐ Cost of fresh water is too low.
- ☐ Lack of co-operation by effluent dischargers to meet legal requirements.
- ☐ Irresponsible and negligent attitudes of effluent dischargers.

- ☐ Ignorance of realities of a worsening situation and short term planning by effluent dischargers.
- ☐ Relatively high costs of desalination techniques.
- ☐ Lack of private initiative to address a common effluent problem on a joint or regional basis.

REQUIREMENTS AND PROVISIONS OF THE WATER ACT WITH RESPECT TO INDUSTRIAL EFFLUENTS

In view of the general decline of the quality of many of the RSA's water sources, and the greatest concern being the increasing salinity, the Water Act and effluent standards were amended during 1984.

The main requirement of section 21 is that water used for industrial purposes be purified to meet prescribed standards before discharge into a river. The standard for TDS is expressed in terms of conductivity.

A maximum increase of 75 milli-Siemens per metre above that of the intake water is generally applicable.

A special standard of no more than 15 percent increase in conductivity above that of the intake water is applicable in the case of a number of selected rivers.

In both cases of the General and Special Standard Rivers, there is also an upper limit to the conductivity of any seepage from an industrial or mining area viz 250 milli-Siemens per metre. An important provision of this section is that in case of an industrial effluent being discharged into a local authority's sewer, exemption of the standards referred to above, is implied.

An undesirable consequence of this exemption could be that a back door for dilution and discharge of highly saline effluents is opened.

For such cases, however, section 21 provides that the Minister may direct that such exemption be withdrawn. In such a case the Water Act's effluent standards will apply regardless of any agreement by a local authority to accept the industrial effluent into its sewers.

Section 22 is mainly aimed at control over diffuse sources of pollution such as

contamination of urban and industrial run-off. However, bad management practices with point sources of pollution (direct effluents) often result in diffuse sources of pollution. This section therefore provides for control in this respect as well. The most important provision of this section is that regulations may be made to control whichever activity or situation that may give rise to water pollution, other than direct effluent discharge.

Regulations covering a host of situations have been drafted and will hopefully be promulgated in the very near future. The most important part of the proposed regulations is the set of wide measures specified for the prevention of diffuse pollution due to bad effluent handling and disposal practices.

This set of regulations will be most applicable for the control over the handling and disposal of saline effluents and brines into the environment.

Specific provision is made in the regulations for disposal by evaporation in ponds and irrigation.

Section 24 basically enhances the requirements and provisions of sections 21 and 22.

It provides for additional requirements that may be imposed in order to better

achieve the objectives of sections 21 and 22.

The most important provision of this section is that the Minister may direct that the manufacture, marketing or use of any substance, which in the opinion of the Minister of Water Affairs could cause water pollution, be restricted or terminated. This provision could be applied to reduce the quantities of chemicals and salts added in manufacturing processes with the result that process effluent TDS is also reduced.

MANIFESTATIONS OF THE SALINITY PROBLEM

High levels of salinity in water supplies have a wide range of serious consequences to the various user sectors of such water. Increasing salinity renders water less suitable for urban and industrial supply, to the extent that additional costs could be incurred by the user.

Studies co-ordinated by the Water Research Commission indicated that the cost to the community could amount to far in excess of R100 million per annum depending on the concentrations of TDS in the case of the PWV region.

In order to fully appreciate the extent of a salinity problem in any particular region, the following factors should be quantified and considered:

- ☐ volumes of effluents involved
- ☐ concentrations of TDS in effluents
- ☐ nature of salinity (types of contaminants)
- ☐ the amount of dilution, either naturally or intentionally
- ☐ impact on receiving water quality
- ☐ water use quality criteria of the various user sectors in the region
- ☐ location of pollution source (interior or at coast, high or low rainfall area, etc.)
- ☐ water availability/supply situation in area (hydrological factors).

In considering these factors it becomes clear that there could be no general or simplistic policy for dealing with the salinity problem.

It is also clear that the policy should not be rigid but flexible to suit a wide variety of situations. The danger of such a policy is, however, that it could become vague and non-specific. This is equally as undesirable as a rigid policy.

POLICY GUIDELINES WITH RESPECT TO THE SALINITY PROBLEM

In view of the flexibility required of such a policy, it is preferable to rather state policy guidelines. The Department's guidelines in this instance are the following:

- ☐ the "polluter pays" principle applies
- ☐ long term or permanent solutions to salinity problems should be implemented by effluent dischargers. Short term solutions merely to remain within bounds of the law are unacceptable
- ☐ although it is generally not a solution to transfer a problem from one location to another, salinity sources should be transferred to the coast, or to areas of lesser impact on important water sources, whenever practical
- ☐ evaporation in ponds and irrigation of highly saline effluents are mostly regarded as short term or temporary solutions and then only for relatively smaller quantities of effluent
- ☐ salinity control measures should be applied at the source of the salinity problem
- ☐ Dilution and blending options are also

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Increasingly, it will be required of polluters to undertake and fund monitoring programmes and ecological impact studies in order to assess the environmental effects of their saline discharges.

regarded as short term or temporary solutions for saline effluents. Releasing large volumes of freshening water for dilution/blending purposes is inherently wasteful and successful only as long as there are adequate supplies of fresh water. This salinity control measure should best be reserved for ameliorating salinity due to diffuse sources

- ☐ The promulgated standards for conductivity have had limited success. It should therefore not be assumed by dischargers of saline effluents that the laid down standards could be exploited to their maximum limits.
- ☐ The General Standard will in future be less "generally" applied. The merits of individual situations will be considered in more depth and if deemed necessary, the special provisions of sections 21, 22 and 24 of the Water Act employed to require higher standards in any specific case.
- ☐ Effluent dischargers with the assistance and participation of whichever authorities concerned in a particular region, should join forces to develop central or regional desalination and brine disposal facilities.
- ☐ Stricter control will in future be exercised over discharge of highly saline effluents into local authority sewers.
- ☐ The foregoing policy guidelines equally apply for brine disposal, except that evaporation in ponds could prove to be an acceptable long term solution, provided that satisfactory control measures are applied.

Other possible options for brine disposal are:

- ☐ consumptive use, e.g. in manufacturing processes, ash quenching, etc.
- ☐ isolation, encapsulation or co-disposal on dumps for hazardous wastes
- ☐ evaporation to dryness followed by incineration or land disposal
- ☐ deep well injection
- ☐ creation of dead lakes
- ☐ transport to the coast and discharge into the sea
- ☐ creation of salt water lakes for recreation
- ☐ by-products manufacture and recovery of chemicals.

Finally and most important, the necessity and extent of desalination required in a particular instance will be determined by factors such as:

- ☐ the nature (contaminants) of the saline effluent
- ☐ possible impact of saline effluent discharge on receiving water quality and river ecology
- ☐ water use quality criteria for the receiving waters and interests of downstream users
- ☐ cost-effectiveness of desalination methods in any particular application
- ☐ cost-benefit of applying desalination in any particular instance (socio-economic implications).

STRATEGY FOR DEALING WITH THE SALINITY PROBLEM AT POINT SOURCES

- ☐ The Department intends to apply its policy more strictly and make more use of the special provisions of certain sections of the Water Act previously referred to, in order to control the discharge of saline effluents more efficiently.
- ☐ The Department will closely monitor receiving waters for the effective evaluation and adaption of pollution control strategies and policies.
- ☐ gradually implement stricter control over industrial discharges of highly saline effluents into municipal sewers,
- ☐ increase its encouragement and support of impact and feasibility studies as well as research and development in the field of desalination.
- ☐ The Department will give special attention and support to the search for and establishment of safe sites for the disposal of brines.
- ☐ It will be increasingly required of polluters to undertake and fund monitoring programmes and ecological impact studies in order to assess the environmental effects of their saline discharges.
- ☐ The Department will continue to undertake and fund studies for the development of river basin management systems.
- ☐ Taking a more distant view into the future, the large-scale implementation of desalination technology could create serious brine disposal problems. This may require initial State or Regional Services Council involvement in the establishment and operation of region-

al facilities, which could be privatised as soon as it becomes economically viable.

- ☐ State or Regional Services Council involvement will require funding. It is a possibility that an effluent levy system, based on the salinity of effluents discharged into the water environment, could be introduced to generate the capital funds required for the establishment of such regional facilities.

CONCLUSIONS

- ☐ The increasing salinity of the country's major water sources is the biggest pollution problem at present.
- ☐ Industry's future is dependent on the abatement of this problem.
- ☐ A strategy will have to be adopted which will ensure that further deterioration in salinity be stopped, in certain rivers the quality even be improved and acceptable qualities maintained in future.
- ☐ As soon as desalination techniques are considered economically viable, industries will be required to implement these techniques to remove salts from effluents.
- ☐ The Department is closely involved in research and development in this field. As an investment in their own future industry is recommended to become seriously involved as well.
- ☐ In view of the complexity and implications of the salinity problem, the Department relies on the co-operation and assistance of the researcher and the industrialist in the development of a policy which will ensure the industrial and economical future of the RSA. It should be fully realised that the critical factor for industrial and economical survival is the availability of water which in turn is very much dependent on a quality suitable for various urban and industrial uses.
- ☐ Finally, a policy of low cost solutions for present-day problems will undoubtedly result in the build-up of an enormous debt burden for the future generation, who will then have to seek for solutions at exorbitant or prohibitive costs. What an awesome guilt this would be to the administrator, the researcher and industrialist to carry to his grave.



Die Percy Stewart-rioolsuiweringsaanleg buite Krugersdorp met die slykwegwerkingsplaas in die agtergrond.

Besproeide rioolslyk bring 'n bonus

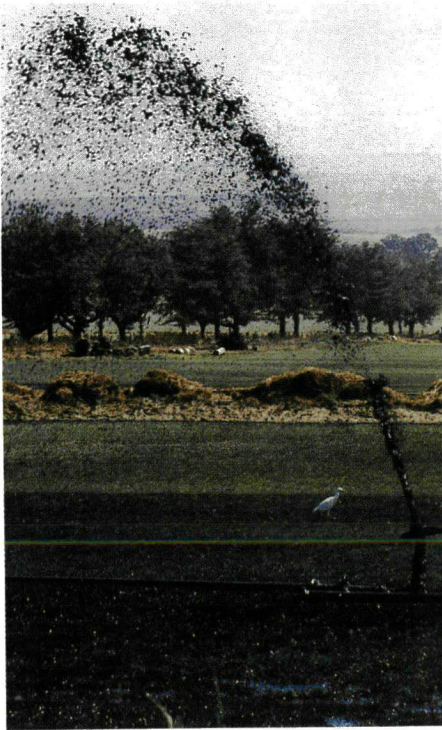
Die Stadsraad van Krugersdorp het met die aanlê van twee slykwegwerkingsplase daarin geslaag om rioolslyk, wat 'n moeilike afvalproduk is om van ontslae te raak, te omskep in iets nuttigs en lonends.

Die plase wat soos besproeiingsplase bedryf word, grens aan die dorp se twee rioolwatersuiweringsaanlegte, die Flip Human en Percy Stewart-rioolwerke. Albei is tussen 70 en 80 hektaar groot en word tans hoofsaaklik vir die aanplanting van kitsgras gebruik.

Volgens mnr Koos Richards, stadsingenieur van Krugersdorp, was die belangrik-

ste rede vir die aanlê van die plase die hoë koste van slykverwerking.

"Die meeste maniere om slyk te verwerk is geweldig arbeidsintensief en duur," sê mnr Richards, "en jy sit altyd met die probleem, veral volgens Suid-Afrika se streng gesondheidswetgewing en die talle beperkings op die gebruik van veral gedroogde slyk, dat dit baie moeilik is om van die eindproduk ontslae te raak. "As ons 'n vergelyking tref tussen die normale slykwegwerkingsprosesse en die slykwegwerkingsplase wat ons hier by Krugersdorp ontwikkel het, sit ons kleingeld in ons



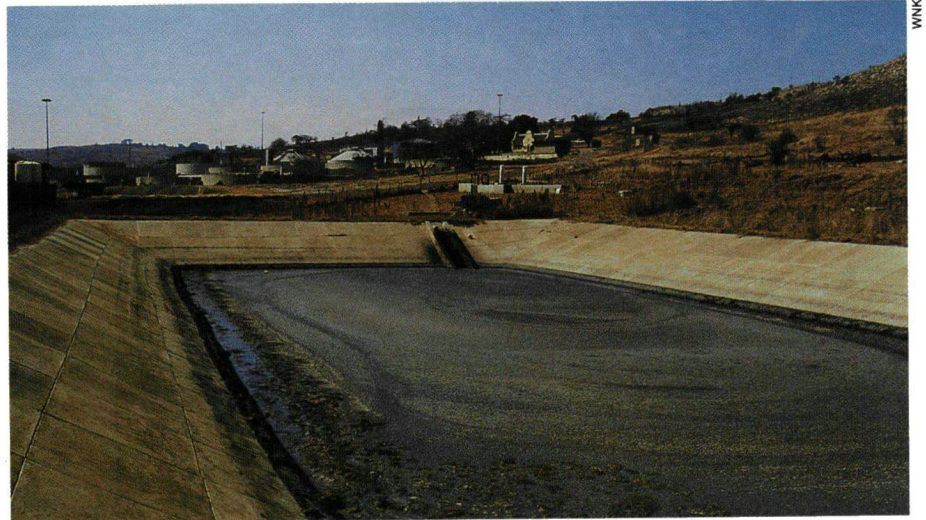
Een van die slyksproeiers in aksie. Daar is geen reukprobleem nie.

sak," sê mnr Richards. Hy sê die hoofdoel van die plase was egter om van die slyk van die rioolwerke ontslae te raak en die feit dat die Stadsraad in die proses dit ook kon regkry om 'n nuttige en 'n lonende eindproduk te lewer, was 'n bonus.

"As 'n mens 'n vergelyking sou tref tussen die bou van droogbeddings en die skep van 'n infrastruktuur vir 'n slykwegwerkingsplaas is daar nie 'n baie groot verskil nie," sê mnr Richards. "Die twee stelsels vergelyk baie goed ekonomies en die enigste nadeel is net dat daar natuurlik baie meer grond nodig is vir die plaas."

Die Stadsraad was gelukkig dat hulle by albei hulle rioolwerke voldoende "plaasgrond" gehad het waarop hulle die plase kon aanlê.

Hoe 'n groot stuk grond is nodig vir die aanlê van 'n slykwegwerkingsplaas? Volgens mnr Richards maak hulle gebruik van 'n onderlinge praktiese reël van een hektaar grond vir elke megaliter inkomende rioolwater. Dit is wat nodig is om sinvol te kan boer. Krugersdorp het op die oomblik meer grond beskikbaar as wat hulle nodig het aangesien die huidige hoeveelheid inkomende riool by die Flip Human-werke 27 megaliter beloop en by Percy Stewart 20 megaliter.



Die slykopgaardam sorg dat die rioolwerke en die boerdery onafhanklik van mekaar bedryf kan word. Die dam het 'n houkapasiteit van 14 tot 21 dae en die boer moet die slyk daaruit besproei. Wanneer die slyk besproei is, is die hele land swart en is skoon besproeiingswater nodig om die slyk deur die gras te was.

Die eerste slykwegwerkingsplaas is by die Flip Human-rioolwerke ontwikkel en daarna die een by Percy Stewart. By albei die plase het die Stadsraad die totale besproeiingsontwikkeling gedoen en die hele infrastruktuur vir slykwegwerking geskep deur pypleidings in te sit en pompstasies en damme te bou.

Tog is die plase nie gewone besproeiingsplase nie omdat daar alternatiewe pyplyne vir slykbesproeiing en skoon water bestaan. Daar is ook 'n besondere pompstasie nodig om die slyk te kan pomp.

Die slyk graveer vanaf die verteerders sonder enige verdere behandeling na 'n opgaardam op die plaas. Hiervandaan word dit op die lande besproei deur middel van swaartekrag en pompe.

Die gedagte was om die verteerde slyk in sy vloeibare vorm as 'n kunsmis te gebruik – iets waarvoor dit baie geskik is aangesien die slyk baie voedingstowwe vir plante bevat.

Omdat die grond aan die Stadsraad behoort, is die plase op tender uitgesit en die hoogste tender aanvaar. Die oorspronklike tenderbedrag drie jaar gelede, het nagenoeg R20 000 beloop en dié huurgeld styg elke jaar met tien persent.

Die Stadsraad verhuur die grond vir 'n tydperk van nege jaar en elf maande, wat aan die boere genoeg tyd gee om enige vaste strukture wat hulle op die plaas wil aanbring te bou.

KITSGRAS

Mnr Richards sê die plase is op die oomblik vir die boere baie lonend, veral as hulle kitsgras op die plaas verbou.

Die gras verkoop teen tussen R1,30 en R1,40 per m² en die boer kry gemiddeld vyf snysels per tweejaarsiklus. Dit gee aan hom 'n potensiele bruto-opbrengs van nagenoeg R2,5 miljoen per jaar op die plaas, sou hy die volle 80 hektaar met kitsgras beplant.

Die boere hoef ook nie soos by 'n normale grasplaas kunsmis toe te dien nie – iets wat 'n aansienlike besparing van 24c tot 25c per vierkante meter meebring.

Behlawe kitsgras is daar ook verskeie ander gewasse wat die boer kan aanplant. Mnr Richards sê die Stadsraad het geen beperkings op die boere gelê nie en die enigste beperking op dit wat hy mag plant of nie is dié wat vervat is in die gesondheidswet. Dit beteken dat die boer nie iets mag kweek wat normaalweg rou geëet word nie.

Een van die belangrikste beginsels volgens mnr Richards om die slykplaas te laat werk, is dat die besproeiingsgedeelte en die rioolwerke absoluut onafhanklik van mekaar moet kan funksioneer.

"Anders gebeur dit maklik dat die werkebestuurder die slykplaas by die boer oorneem of die boer neem die rioolwerke by die werkebestuurder oor, afhangende

van watter persoon die sterker persoonlikheid het.

"Of die boer sê hy kan nie vandag slyk vat nie want hy is besig om plantjies uit te plant. Die werkebestuurder is dan in die moeilikheid want wat maak hy nou met die slyk?"

"Daarom het ons 'n slykopgaardam gebou om die rioolwerke en die plaas onafhanklik van mekaar te kan bedryf. Wanneer die slyk in die verteenders gereed is om afgetrek te word, word dit na die opgaardam gepomp. Die dam het 'n houkapasiteit van veertien tot een en twintig dae en die boer moet uit hierdie opgaardam besproei. Met ander woorde die twee operasies, slykaftrekking en besproeiing geskied totaal onafhanklik van mekaar. Die opgaardam maak dit ook vir die boer moontlik om gedurende 'n tyd soos Kersfees sy plaas te sluit en met vakansie te gaan. Hy sorg dat die dam leeg is voordat hy vertrek en die werkebestuurder kan nou rustig vir daardie tydperk die werke bedryf sonder om met 'n slykprobleem te sit."

Mnr Richards sê hulle het oorspronklik nie opgaardamme gehad nie maar somer direk op die plaas besproei. "Die nadeel was dat jy dan die hele tyd moet bedryf."

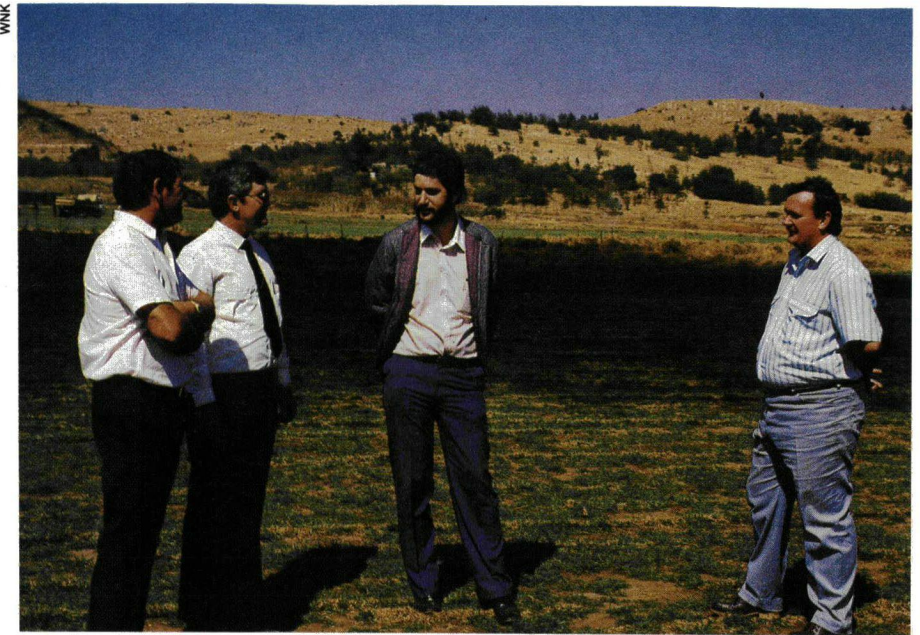
PROBLEME

Hy sê die Stadsraad het baie skoolgeld betaal met die aanlê van die eerste plaas by die Flip Human-rioolwerke.

"Die tweede plaas by Percy Stewart is in hierdie stadium 'n beter besproeiingsplaas as die eerste een omdat ons die foute wat ons by die eerste een gemaak het nie weer by die tweede een herhaal het nie."

Van die probleme wat hulle ondervind het, was die volgende: met die verskillende tipes slyk by die Flip Human-rioolwerke het die slyk in die opgaardam gesegregeer. Die oorsaak van die probleem was dat die dam te vlak en te groot was. By Percy Stewart het hulle die probleem reggestel deur 'n dieper dam met 'n kleiner oppervlakte te bou.

Hulle het ook by Flip Human geweldig baie probleme met die viskositeit van die slyk ondervind. Hoewel daar streng volgens die vervaardigers van die pompe se pompkurwes gewerk is, het dit gou geblyk



Van links: Mnr Gerrie Roos, besturende direkteur van Bergland Instant Lawn, in gesprek met mnr Koos Richards, stadsingenieur van Krugersdorp, mnr Hennie Duvenhage, hoofseikundige van Krugersdorp en mnr Johan van der Linde, werkebestuurder by die Percy Stewart-aanleg.

dat die praktiese en teoretiese viskositeit van die slyk verskil het en die antwoorde wat van normale pompkurwes verkry is tot die verkeerde keuse van pompe gelei het.

Verder moet 'n mens, volgens mnr Richards ook baie versigtig wees met die inlaat- en uitlaatstrukture van die damme.

"Die pompe moet deeglik onder die dam se vloervlak wees aangesien jy die hele tyd ten volle ondergedompelde toestande vir jou inlaat nodig het."

By Percy Stewart het hulle ook baie meer opsies in die pompstasie toegelaat as by Flip Human.

"Dis baie belangrik dat jy alle opsies met die pompstasie moet kan doen," sê mnr Richards. "Jy moet skoon water deur die slykpomp kan pomp, jy moet water met die skoonwaterpomp kan terugpomp deur die inlaat tot in die slykdam, jy moet die slyklyne met skoon water kan uitspoel asook enigiets anders wat mag nodig raak."

"As jy byvoorbeeld nie die slyklyne skoon spoel nie, kan dit gebeur dat metaangas in die besproeiingspype opbou," sê mnr Richards.

"Ons het byvoorbeeld reg aan die begin by Flip Human die geval gehad dat daar metaangas in die pypleine ontwikkel het. En toe een van die arbeiders besig was om die pype te koppel, steek hy toevallig 'n sigaret aan en daar ontplof die hele spul!"

Dit is ook baie belangrik dat die boer die plaas reg sal bedryf met die slykwegwerking. As die boer byvoorbeeld die slyk kolle gooi en die slyk dam op, kan dit baie probleme veroorsaak en terselfdertyd ook die boer se gewasse vernietig.

Mnr Richards sê die Percy Stewart-rioolwerke ontvang sowat 60 persent huis-houdelike en 40 persent nywerheidsuitvloeisel, terwyl die syfers by die Flip Human-werke net andersom is. By Percy Stewart kry hulle ook die uitvloeisel van die Davis Gelatien-fabriek wat volgens mnr Richards van die swakste afloop is wat 'n nywerheid kan lewer. Die fabriek stort baie kalk en die uitvloeisel het 'n hoë organiese lading. Die uitvloeisel het egter geen uitwerking op die boere se gewasse nie.

Hy sê hulle is baie versigtig om nie die grond te besoedel of uit te put in die proses van slykwegwerking nie en daarom het die Stadsraad 'n aantal rooi vlae in die ooreenkoms met die boer ingebou. Die boer moet byvoorbeeld twee keer per jaar grondmonsters na Onderstepoort wegstuur vir 'n volledige ontleding. Indien daar enige afwykings in die grond is, moet die boer dit op sy eie koste met kunsmatige kunsmis regstel.

Volgens mnr Richards het die slyk die bykomende voordeel dat daar met die besproeiing 'n slykklag bo-op die grond opbou "en dit is in hierdie slyklaag dat die

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Mnr Gerrie Roos wys hoe die gras lyk nadat dit losgesny is. Amper geen bogrond gaan verlore nie.

gras afgesny word. Dit beteken dat daar baie min van die bogrond weggewerk word wanneer die boer die gras uithaal.

"Indien die slyklagie nie daar was nie, sou die boer met elke grassnysel ongeveer vyf tot ses millimeter van die bogrond weggewerk het en oor 'n tydperk van 10 tot 15 jaar kan dit baie nadelig wees vir die plaas."

"Ontledings van die gras toon dat dit op 'n droë basis 'n proteïeninhoud van 22 persent bevat. Dit vergelyk goed met lusern, hoewel die aminosuursamestelling van kikoejoegras swakker as dié van lusern is. Die gras is ook baie ryk aan stikstof," sê mnr Roos.

Hy sê gedurende die somermaande moet die gras gereeld gesny word en hulle gaan nou ook begin om hierdie grassnysels te benut. Vir dié doel is 'n masjien gebou waarmee hulle die los grassnysels van die grond af kan opsuig. Die masjien het 'n groot waaier, soortgelyk aan die waarmee hulle lug ondergronds by 'n myn inblaas, wat ondersteboe gemonteer is en wat die gras opsuig en binne-in 'n sleepwa blaas waaroor 'n skaduweedoek gespan is. Die wind gaan deur en die gras bly agter.

Hy sê dit is die beste om die grassnysels saam met iets soos *Eragrostis* vir veevoer te gebruik.

Een van die diersoorte wat op die gras gedy is volstruise. Mnr Roos sê 'n volstruis vreet basies net soveel gras as 'n merinoskaap maar anders as 'n skaap blaas die volstruise nie op nie.

Behalwe die kitsgrasverbouing het mnr Roos ook verskeie doekhuise op die plaas

by Percy Stewart opgerig waarin hy blomme, hoofsaaklik loofplante soos varings, kweek wat hy na Europa toe uitvoer.

Met die blomboerdery doen hulle nie werklik besproeiing met die slyk nie aangesien die skoon slyk geneig is om die blomme te brand. Voor die blomme geplant word, versadig hulle die grond so te sê met slyk. Daarna word die slyk met 'n kapploeg in die grond ingewerk en die blomme geplant. Die blomme word dan met skoon water besproei.

Mnr Roos sê met die blomboerdery is die bruto omset per hektaar tussen R70 000 en R80 000 per seisoen.

Aangesien daar ook minder grond aan die grasrolle is, is hulle ligter en kan die boer meer gras op sy trokke laai.

WATERKWOTA

Mnr Richards sê die Raad het probleme met die Departement van Waterwese om 'n permit te kry vir die besproeiingswater wat hulle op die plase gebruik. Hulle het op die oomblik 'n waterkwota by albei die plase gekry maar die Departement het reeds gesê dat daar in die toekoms strenger na die kwota gekyk gaan word. Die kwota is basies die jaarlikse reënval wat uitwerk op tussen 760 en 960 mm water per vierkante meter versprei oor die plaas.

Mnr Richards sê hulle het 'n sekere volume gesuiwerde water nodig om die slyk te kan weg werk. Veral by kitsgrasverbouing word daar op verskeie stadia van die groei van die grasmat slyk toege-

dien. Wanneer die boer die slyk besproei, is die hele land swart en dan het hy skoon besproeiingswater nodig om die slyk deur te was, selfs al het dit die vorige dag gereën.

Indien die Departement die waterkwota sou terugtrek, sal hulle nog die normale slykwegwerking kan doen deur byvoorbeeld die slyk vir 'n paar weke lank op die grond uit te gooi en dit daarna in te ploeg en 'n gewas soos mielies te plant, maar dit sal glad nie so 'n ekonomiese boerdery wees soos tans waar daar water beskikbaar is nie.

Mnr Richards sê dat as 'n mens die aantal werksgeleenthede in aanmerking neem wat geskep word vir elke volume waterenheid verbruik op die plaas (120 swartes en vier blankes is by Percy Stewart in diens) dan behoort so 'n slykwegwerkingsplaas amper as 'n nywerheid beskou te word en nie as 'n normale besproeiingsplaas nie.

Hy sê hulle sit voorts met die tegniese probleem dat die Stadsraad nie mag besproei nie terwyl die boer, omdat die grond nie aan hom behoort nie, weer nie kan aansoek doen om as 'n besproeiingsboer geklassifiseer te word nie.

Die Departement Waterwese besoek die plase gereeld om seker te maak dat daar nie van die slyk in enige openbare strome beland nie.

Om hierteen voorsorg te tref het die Stadsraad stormwateropvangdamme aan die onderpunt van elkeen van die plase gebou. Sou daar dus gedurende 'n abnormale reënstorm water van die plaas afloop, sal dit in dié damme opgevang word.

Behalwe vir die kenmerkende metaanreuk van verteerde slyk is daar geen onaangename reuke op die plase merkbaar nie.

Die slyklaag op die grond is ook so yl dat vlieë nie daarin kan broei nie. Hulle kan wel in die slyk eiers lê maar die slyk word so vinnig droog dat die eiers nie kan ontwikkel nie.

Volgens een van die boere, mnr Gerrie Roos, wat ook die besturende direkteur van Bergland Instant Lawn is, is daar tans 'n uitstekende mark vir kitsgras en verkoop hulle selfs in die winter gras.

Hy sê die kwaliteit van die gras is by die Percy Stewart-plaas seker beter as op enige ander plek aan die Rand. Die gras is in die laatwinter nog groen en dit is grootliks te danke aan die bemestingskwaliteite van die slyk en die ligging van die plaas.



'n Teorie waarmee 'n besproeiing-skeduleringsstrategie beplan kan word, is deur die Departement Landbouweerkunde aan die Universiteit van die Oranje-Vrystaat ontwikkel. Die mikpunt van die projek was om die kundigheid te ontwikkel om aan koringboere in die Vrystaatstreek 'n diens te kan lewer wat sal verseker dat hulle die beskikbare water so doeltreffend moontlik gebruik.

Professor Jimmy de Jager, hoof van die

Departement Landbouweerkunde en leier van die projek, sê die navorsingspan het in 'n voorafgaande projek 'n wiskundige model geformuleer waar weerdata gebruik word om besproeiing te skeduleer. Weersomstandighede is 'n belangrike faktor as die waterbehoefte van 'n gewas bepaal moet word en daarom is die model verder verfyn en ook in die praktyk geëvalueer. Die model staan bekend as PUTU-9.

Die Penman-Monteith-formule wat in

Engeland ontwikkel is, is as basis vir die ontwikkeling van PUTU-9 gebruik. Die Penman-formule maak van weerdata gebruik om die totale verdamping vanaf die oppervlakte van 'n plant te bereken. Die formule is met enkele wysigings in die skeduleringsprogram opgeneem en die betroubaarheid daarvan is weer eens beklemtoon.

Die streng waterbeperkings wat die besproeiingsboere in die Vaalhartsskema se-



Koringboere baat by nuwe skeduleringsmodel

Koring wat op mnr Japie Smit se plaas op Hartswater met die besproeiingskeduleringsprogram gekweek is.

dert 1983 opgelê is, het hulle genoodsaak om 'n meer wetenskaplike benadering tot besproeiingskedulering te volg.

Volgens mnr Japie Smit van die plaas Eureka in die Hartswaterdistrik, het boere begin besef dat 'n deeglike kennis van sekere gewasfaktore wat verband hou met die tempo van waterverbruik, van die grondtipe waarop die gewas verbou word en van die invloed wat die weer op die waterbehoefte van die gewas het, nodig

is om doeltreffend te besproei. Die verminderde kwota water wat aan die boere toegestaan is vir besproeiing (huidiglik slegs 50 persent van die boere se oorspronklike hoeveelheid) het die boere gedwing om deeglike oorweging te skenk aan die besproeiingsmetodes en die beraamings van waterbehoefte wat in die verlede van toepassing was. Dit was dan ook die beweegrede vir mnr Smit se betrokkenheid in prof De Jager se projek.

Hierdie besproeiingsnavorsing, wat deur die Waternavorsingskommissie gefinansier is, is uitgevoer op die proefterrein op die Weskampus van die Universiteit van die Oranje-Vrystaat terwyl die toepasbaarheid van die projek in die praktyk getoets is aan die hand van proefnemings wat by 20 boere in die Hartswater-omgewing met die stelsel uitgevoer is.

'n Mikroweerstasie en 'n verskeidenheid meters is op die kampus van die UOVS

aangebring om weerdata soos windsnelheid, lugvog en temperatuur te meet. 'n Lisimeter, bestaande uit 'n 10 m² bak, 2 meter diep en wat 50 ton weeg, is gebou. Koring is in die bak geplant en deur die bak te weeg, kon uurliks bepaal word wat die waterverlies uit die bak is. Só kon die navorsers die waterbehoefte van die koring asook die verdamping uit die bak monitor. Die vrywaterverdamping is met 'n klas A-verdampingspan gemeet en 'n infrarooi termometer is gebruik om die blaartemperatuur vas te stel. Die inligting wat op die manier ingesamel is, is noukeurig aangeteken en op 'n rekenaar vasgelê.

Op Hartswater is 'n outomatiese weerstasie op mnr Smit se plaas aangebring.

Dit het bestaan uit 'n rekenaar wat telefonies weerdata aan die navorsers by die Universiteit kon deurgee. Alhoewel Hartswater nie met die aanvang van die projek oor 'n outomatiese sentrale beskik het nie, kon die verbinding tog bewerkstellig word deur op spesifieke tye die rekenaar aan die telefoon te koppel en die data deur te stuur aan die navorsers wat in Bloemfontein gereed gestaan het om dit te ontvang.

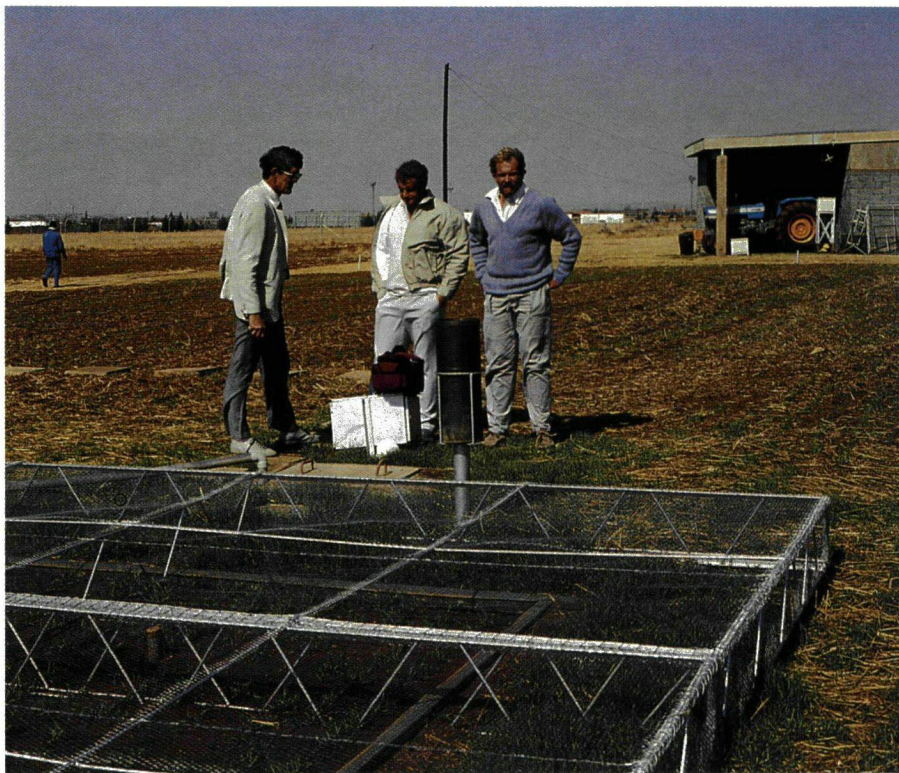
Op grond van hierdie weerdata en met inagneming van die gewasfaktore van die koring en die klei-inhoud van elke boer se grond, is 'n besproeiingskedule vir spesifieke akkers op elke plaas bepaal. Hierdie skedule is noukeurig deur die boere toegepas. Die doel hiermee was om te bewys

dat weerdata gebruik kan word om oor 'n lang afstand besproeiing te skeduleer.

Die wiskundige model wat vir die proewe gebruik is, het voorsiening gemaak vir drie besproeiingstrategieë waarvan die boer dan een moes kies. Hy moes naamlik besluit of hy wou besproei

- om die grootste moontlike opbrengs te behaal
- om die doeltreffendste watergebruik toe te pas of
- om so veel as moontlik van sy plaas te benut.

Vir enigeen van die drie moontlikhede kon 'n besproeiingskedule beplan word.



Prof Hennie van Zyl, mnr Abraham Singels en mnr Tabo Maree van die UOVS by die lisimeter wat in die projek gebruik is.

RESULTATE

Volgens die metode wat in die projek ontwikkel is, is dit moontlik om met behulp van die rekenaar te voorspel wanneer vogstremming by die gewas gaan intree. Die klei-inhoud van die grond gee die navorsers 'n goeie idee hoeveel water nog vir die plant beskikbaar is en daar kan dan voorspelling gemaak word en die boer kan sy beplanning daarvolgens inrig. So kan selfs vyf dae vooruit voorspel word wanneer dit weer nodig sal wees om te besproei. Wanneer die wind, byvoorbeeld, sterk waai en verdamping dus vinniger as gewoonlik plaasvind, kan die navorsers met behulp van die windsnelheid wat by die weerstasie aangeteken word, bepaal wanneer die boer die gewas sal moet besproei om verwelking te voorkom.

Die grondsoort wat op elke plaas aangeref word, speel ook 'n belangrike rol in die skedulering van besproeiing. 'n Sub-roetine in die wiskundige model maak voorsiening vir die klei-inhoud van die verskillende lae op 'n spesifieke akker en voorspel hoe die grond onder besproeiing gaan reageer.

'n Finale verslag oor hierdie navorsingsprojek getiteld: Navorsing oor 'n koringbesproeiingskeduleringsdiens vir die Vrystaatstreek, is beskikbaar by die Waternavorsingskommissie, Posbus 824, Pretoria 0001.

DIENS

Professor De Jager sê met die nuwe diens wat aan besproeiingsboere gelewer sou kon word, sal 'n weerstasie in 'n gebied opgerig word. 'n Groot aantal plase wat binne 'n radius van tot 50 km van die weerstasie val, sal dus op dié manier van 'n besproeiingskeduleringsstasie voorsien kan word. Daar sal ook voorsiening gemaak word vir die moontlikheid dat die akkers op 'n plaas verskillende eienskappe kan hê, soos byvoorbeeld 'n verskil in klei-inhoud of dat dit 'n ander bemestingsprogram ontvang het.

Die PUTU-9 model wat deur professor De Jager ontwikkel is, kan ook voorsiening vir die gebreke in verskillende besproeiingsstelsels soos spilpuntstelsels, kruipspuite, ens. maak deur te kompenseer vir water wat verlore mag gaan as gevolg van die ontwerp van die verskillende stelsels. Verwantskappe tussen windsnelheid en verdamping- en sproeiverliese by spilpuntstelsels kan byvoorbeeld in die model ingebou word. Vir elke akker sal

Mnr Japie Smit by die tuisgemaakte verdampingspan wat hy gebruik om vrywaterverdamping te bereken.

dan 'n individuele besproeiingskedule uitgewerk kan word.

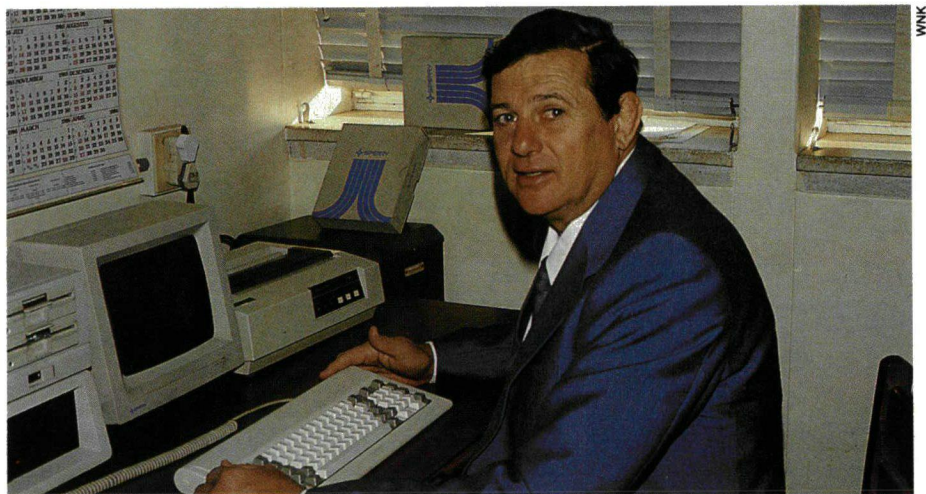
Die weerstasie wat vir 'n groep plase opgerig word, sal sowat R11 000 kos. Waar as alternatief 'n neutronvogmeter, byvoorbeeld, alleen gebruik word om besproeiing te skeduleer, is die koste nagenoeg R16 000 en kan die toestel vir slegs enkele plase tot nut wees.

"Ons navorsing het getoon dat die gebruik van 'n weerstasie sonder twyfel die gerieflikste en die goedkoopste manier vir die boere is om hulle koringbesproeiing

doeltreffend te skeduleer," sê professor De Jager.

"Die eerste voordeel wat die stelsel vir die boer inhou, is dat hy sy bestaande besproeiingsmetode sonder enige wysigings kan gebruik. Mnr Japie Smit gebruik byvoorbeeld al jare lank hewelpype vir die vloedbesproeiing van sy winterkoring en hy het gevind dat hierdie metode nou net so goed gewerk het as voorheen toe hy nie sy skedulering volgens die navorsers se inligting beplan het nie."

Die tweede voordeel wat die PUTU-9



Prof Jimmy de Jager demonstreer die rol wat die rekenaar in die besproeiingskedulering speel.



besproeiingskeduleringsstrategie inhou, is dat die boer nie belas word met die insameling van data nie. Die tipe gewas en wanneer dit geplant is, die klei-inhoud van die grond en enkele feite oor hoe die grond en die gesaaides tot dusver besproei is en die betrokke reënvalsyfers, is al inligting wat die boer moet verskaf.

Aangesien die Penman-formule vir verskillende gewasse aangewend kan word, sal die PUTU-9 model ook mettertyd na gewasse soos mielies, lusern en sojabone uitgebrei word. Boere uit verskillende landboustreke van Suid-Afrika sal dan voordeel uit die besproeiingsnavorsing kan trek.

Die volgende fase van die projek sal 'n uitgebreide tegnologie-oordrag behels waar boere oor die stelsel se voordele ingelig sal word. Die goeie oes wat reeds deur mnr Smit op Hartswater behaal is, het grootliks daartoe bygedra dat boere in die projek begin belangstel en die voordele daarvan beseef.



Cheyenne flats with Kiowa in the background.

Flats: Separate meters set to save water

The efficient use of water and the prevention of waste are vitally important in South Africa because of limited natural water resources.

The introduction of water restrictions and tariffing systems in order to reduce wastage of potable water, is often practised in urban areas. Metering of water supplied to houses has long proved to be an effective means of curbing excessive use of water by the occupants.

In the case of multi-dwelling complexes where the amount of water used is metered through a single bulk meter, water restrictions and tariffing systems have had only limited success. Occupants of apartment blocks which are bulk metered are far less motivated to conserve water than are the occupants of houses that are individually metered, even when the local authority applies a pricing system which is designed to discourage waste. Individual meters for separate dwelling units in apartment blocks are, however, seldom provided in South Africa while overseas only a few countries, such as Israel apply the practice.

An investigation into the effects of individual metering and billing of apartments is

now nearing completion. The work was undertaken by the National Building Research Institute (NBRI) of the CSIR and financed by the Water Research Commission (WRC).

Twin blocks of flats, Kiowa and Cheyenne in Pretoria, were selected for the investigations, each block containing 36 apartments.

Kiowa was selected to be retrofitted with individual water meters while Cheyenne was used as a control. One Caretaker is responsible for both buildings.

Because the water piping in Kiowa is inaccessible, it was necessary to fit remote read-out meters. One duct serving six apartments was however very confined and the alteration to the piping necessary to install individual meters impractical. It was decided to serve these six apartments with a single meter. One meter is also used to serve the laundry, servants' toilet and an external tap.

A total of 32 Kent PSM-Outreader generator type meters with remote counters were ordered from the United Kingdom at a cost of R256,20 each. The meters were checked for accuracy by officials of the Pretoria water branch using the Council's assizing equipment. All meters were found to be well within the assize limits.

Tenders for the installation of the meters only were called and the lowest of three received was accepted at a cost of R32,81 per meter. The meters were installed during December 1985.

The task of installing the 32 remote counters in two lockable cabinets situated on the ground floor and the interconnecting cables, was undertaken and completed by the NBRI staff during January 1986. The total cost of the retrofit operation worked out to R350 per meter.

To ensure accuracy the bulk meters for both Kiowa and Cheyenne were replaced by the Council during February 1986.

The council commenced reading meters in the middle of March 1986 and water accounts (combined with electricity) were rendered towards the end of April.

The quota per flat set by the City Council for determining the water tariff for the individual meters is, 0,3 kl/d for one bedroom flats and 0,4 kl/d for two bedroom flats.

The first set of accounts received by tenants in April 1986 showed that 14 had

exceeded the quota, three of these having used more than double their quota. Since the introduction of individual metering in Kiowa the number of units exceeding the quota is generally from two to four.

The initial result of introducing individual meters was the identification of points at which water was being wasted. During the investigation an underground leak occurred at Cheyenne and the dramatic effect of this undetected leak on water consumption was clearly demonstrated.

Comparisons of water consumptions during the project are as follows:

Average consumption for Cheyenne - March 1986 to February 1987 (July, August and September excluded due to leak)	386 //apartment/day
Average consumption for Kiowa - May 1986 to February 1987	282 //apartment/day
Difference between 386 and 282 expressed as a percentage of 386 //apartment/day: (Percentage saving)	27 per cent
Original quota for Kiowa (bulk metering)	406 //apartment/day
Difference between 406 and 282 expressed as a percentage of 406 //apartment/day: (Percentage saving)	31 per cent

A survey was carried out to establish the tenants' reaction to the separate metering of water. Virtually all the tenants in Kiowa were greatly in favour of this system and some tenants in Cheyenne, where bulk metering still applies, have requested the caretaker to arrange for separate meters to be installed there as well.

Considerations such as the cost to augment water treatment plants, the long term availability of abundant water supplies in addition to the benefits described above should all contribute to the decision criteria.

In view of the potential for saving water by supplying multiple dwelling complexes with individual meters, the researchers recommended that the National Water Supply Regulations should include the following:

- ☐ Water supply piping in multiple dwelling units should be designed such that individual units could be separately metered on the basis of one meter per unit if the owner or local authority should require to do so; and
- ☐ where it is required by the local authority, such units shall be fitted with separ-

ate meters on the basis of one meter per dwelling unit.

CONCLUSIONS

The following conclusions were drawn from this investigation:

- ☐ Water restrictions and a rising tariff structure have a limited effect on controlling water consumption in bulk-metered apartment complexes.

- ☐ Individual metering of apartments in a multiple-dwelling complex identifies any water-wasters who, under a bulk-metered system, would remain anonymous.
- ☐ Individual metering and billing highlights the existence of, and motivates the tenants to attend to, leaking water fittings in multi-dwelling complexes.
- ☐ The saving in water consumption achieved with individual metering and billing is between 20 and 30 per cent of the bulk metered consumption for multi-dwelling complexes.
- ☐ Tenants of individually metered apartments prefer this system to bulk metering of multi-dwelling complexes.
- ☐ The provisions of individual meters would result in increased costs to the local authority which would not generally be totally offset by savings in water consumption due to the meters.
- ☐ A comparison of the sum of the individual water meters with the total of the bulk meter will very quickly indicate the existence of an underground leak and also the volume of the leak as well as giving an indication of when the meters begin to drift outside the assize limits.

Waterbenuttingsingenieurswese: waar wetenskaplike en ingenieur ontmoet

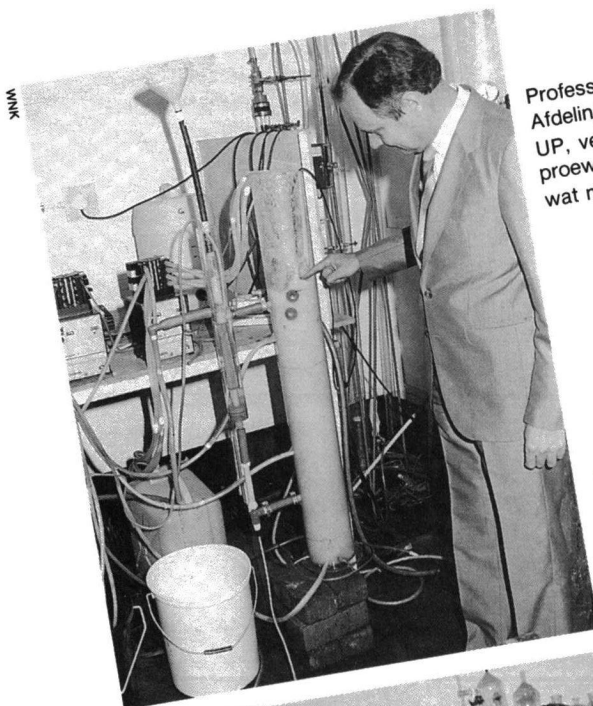
"Hoewel Suid-Afrika bedeele is met 'n verskeidenheid waardevolle natuurlike hulpbronne is daar een belangrike hulpbron wat deurgaans te kort skiet, naamlik water.

"Om die beste van hierdie bepaalde hulpbron te maak, verg streng omgewingsbeskerming, fyn beplanning en 'n deeglike kennis van suiweringsprosesse. Hiervoor is 'n multidissiplinêre kundigheid nodig wat sy wortels vind in chemie, biologie en ingenieurswese."

So gesels professor WA Pretorius, bekleër van die Randwaterraad Leerstoel in Waterbenuttingsingenieurswese aan die Universiteit van Pretoria, oor die grondslae van waterbenuttingsingenieurswese as 'n studierigting in die waterveld.

Volgens professor Pretorius is daar geen ander universiteit in Suid-Afrika wat kursusse in waterbenuttingsingenieurswese op voorgraadse vlak in 'n omgewingsgerigte geheel aanbied nie. Daarom is die Randwaterraad Leerstoel in Waterbenuttingsingenieurswese in 1970 met 'n borgskap van die Randwaterraad by die Universiteit van Pretoria se Departement Chemiese Ingenieurswese ingestel om hierdie tekortkoming op nagraadse vlak te oorbrug. Met die kursus word aan ingenieurs en wetenskaplikes die geleentheid gebied om hulle kennis aan te vul en hulle beter te bekwaam vir 'n loopbaan in waterbenuttingstechnologie.

Professor Pretorius sê die Afdeling Waterbenuttingsingenieurswese bied nagraadse kursusse aan wat kan lei tot honneurs- en magistergrade. Hierdie kursusse is ingestel om die voorgraadse kennis aan te vul van mense wat reeds die ekwivalent het van 'n BIng (verkieslik in siviele of chemiese ingenieurswese) of 'n BSc (verkieslik met chemie of mikrobiologie as hoofvakke).



Professor WA Pretorius, hoof van die Afdeling waterbenuttingsingenieurswese, UP, verduidelik hoe 'n sif in een van die proewe gebruik word om alge te kweek wat maklik oesbaar is.



Van links: Mnr J van Leeuwen, professor WA Pretorius en mnr J Botha in die laboratorium van die Afdeling waterbenuttingsingenieurswese aan die Universiteit van Pretoria.

Daar word ook van tyd tot tyd algemene opleiding verskaf in die vorm van kort kursusse (somer- en winterskole) oor 'n

verskeidenheid aktuele waterbenuttingsonderwerpe. Sulke kursusse kan deur ingenieurs, wetenskaplikes en tegnisi byge-

woon word, maar lei nie tot 'n graad nie. Sertifikate word wel aan die einde van so 'n kursus, wat gewoonlik vyf dae duur, uitgereik. Verder word ook voorgraadse opleiding verskaf deur die aanbidding van steunvakke in die departement chemiese en siviele ingenieurswese en stads- en streeksbeplanning.

Die Afdeling beskik oor moderne fasiliteite en toerusting wat gebruik kan word om navorsing te doen vir magister- en doktorsgrade en het 'n vaste personeel van drie ingenieurs. Behalwe prof Pretorius is daar nog twee senior lektore, naamlik mnr J van Leeuwen, wat 'n chemiese ingenieursagtergrond het en mnr J Botha met 'n siviele ingenieursagtergrond. Al drie het aansienlike praktykervaring in die water- en afvalwaterveld.

Van die vakke wat in die Afdeling aangebied word, sluit onder andere in watermikrobiologie, waterbenuttingstrategie, waterchemie, vasteafvaldisponering, watersuiwering en -behandeling, waterver-sorgingsondersoeke, rioolwatersuiwering, nywerheidsafvalwaterbehandeling en aanlegontwerp.

Die kursus dek heelwat meer as net water. Dit neig eintlik na omgewingsingenieurswese wat uit nagenoeg ses verskillende aspekte bestaan, naamlik, waterbronne of watervoorsieningsingenieurswese, waterkwaliteitsingenieurswese, lugbesoedeling, vasteafval, energienavorsing en gesondheidsingenieurswese. Al hierdie verskillende aspekte is geïntegreer met mekaar en kan nie geskei word nie. Wanneer water, byvoorbeeld, gesuiwer word, ontstaan daar vasteafval in die vorm van slyk en as 'n rioolplaas stink, is dit 'n vorm van lugbesoedeling.

Op die oomblik is daar jaarliks gemiddeld sowat 25 studente wat die honneurskursus volg. Die honneursgraad strek op 'n deeltydse basis oor twee jaar en voltyds oor 'n jaar. Die eerste jaar word hoofsaaklik daaraan gewy om die studente wat uit verskillende vakgebiede kom dieselfde vakinhoud en agtergrond te gee sodat 'n "chemikus en 'n ingenieur dieselfde taal kan praat". Die tweede jaar is 'n toegepaste jaar waar daar hoofsaaklik op die ingenieursaspekte van wateraangeleenthede gekonsentreer word.

Die regulasies vir die magistergraad is van volgende jaar af gewysig. Studente sal dan 'n keuse hê of hulle na die honneursopleiding wil navorsing doen en 'n M-verhandeling skryf en of hulle eerder nog

addisionele vakkursusse wil volg met net 'n geringe navorsingstaak. Die vakkursusse hoef nie noodwendig almal by die Afdeling aangebied te word nie, maar kan ook by ander departemente in die ingenieursfakulteit wees. Die dosente sê baie studente verkies hierdie benadering tot die magistergraad, omdat dit dikwels vir hulle moeilik is om hulle werksaamhede te onderbreek om voltyds navorsing te doen.

Daar word 'n redelike duidelike onderskeid gemaak tussen meestersgraad- en doktorsgraadnavorsing. Die meestersgraadnavorsing behels gewoonlik 'n direkte, praktiese ondersoek terwyl die doktorsgraadnavorsing meer fundamenteel van aard is en 'n nuwe bydrae tot die wetenskap en ingenieurswese moet lewer.

Professor Pretorius sê hulle verkies dat studente die navorsingswerk op een van drie maniere aanpak:

- ☐ Indien die student reeds by 'n instansie werksaam is, word hy gevra om op 'n probleem wat hy binne sy werksveld geïdentifiseer het navorsing te doen. Die werkgever betaal in die geval gewoonlik vir die navorsing en wanneer die student sy graad behaal, gaan hy terug na die werkgever toe met 'n verslag en kennis wat hy dadelik kan toepas.
- ☐ Die student doen navorsing oor enige onderwerp wat hom interesseer en betaal self daarvoor, of
- ☐ Die universiteit gee 'n navorsingsprojek aan die student en finansier die werk met fondse wat deur middel van projekvoorleggings verkry word van instansies soos die Waternavorsingskommissie, die Stigting vir Navorsingsontwikkeling by die WNNR of plaaslike owerhede.

Die algemene neiging in die Afdeling se navorsingswerk die afgelope tyd is om nie alleen alternatiewe stelsels van watersuiwering te ondersoek nie, maar om veral ook te konsentreer op twee hoofrigtings, naamlik:

- ☐ Die ontwikkeling van watersuiwerings-tegnieke waarmee die omgewing nie besoedel word nie, en
- ☐ Die herwinning van neweprodukte uit afvalwater.

Eersgenoemde is iets besonder aangesien elke watersuiweringsproses, veral chemiese watersuiwering, altyd 'n residu nalaat.

Vier gebiede waar daar in die Afdeling al redelik baie navorsingswerk gedoen is, is:

- ☐ Osonering in watersuiwering en afvalwaterbehandeling – die proses laat geen skadelike residu na nie en bied verskeie kwaliteits- en bedryfsvoordele.
- ☐ Die kristallisering van fosfate uit rioolwater waar behalwe suiwering ook 'n nuttige neweproduk verkry word. Professor Pretorius glo dat die fosfaat wat tans in rioolwater is in die toekoms in sakke as kunsmis verkoop sal kan word.
- ☐ Die toepassing van geïnduseerde korrosie in afvalwaterbehandeling waar metale in water opgelos word vir koagulasie en flokkulasie sonder om die soutgehalte van die water te verhoog – soos dit wel gebeur wanneer konvensionele koagulante gebruik word.
- ☐ Die herwinning van neweprodukte uit nywerheidsafval in die vorm van enkel-selproteïene.

Die dosente reken dat een van die grootste hoogtepunte gedurende die afgelope 17 jaar waarin die Afdeling bestaan, die ontwikkeling was van die sifbeginsel om filament-organismes selektief te kweek vir die ekonomiese produksie van enkel-selproteïene.

Dié dinamiese seleksiemetode word gebruik vir die kweek van alge wat maklik geoes kan word sonder die byvoeging van chemikalieë. Die stelsel word tans uitgebrei na heterotrofe organismes. Hierdie organismes sal dit moontlik maak om byvoorbeeld by nywerhede soos SASOL die grootste gedeelte van hulle organiese besoedeling – 20 000 tot 30 000 ton per jaar – in proteïene te omskep.

Sedert die instelling van die kursus is altesaam 99 naagraadse toekennings al in die Afdeling verwerf. Hiervan was 79 honneursgrade, met 56 in ingenieurswese en 23 in wateromgewingsleer. In waterbenuttingsingenieurswese is ook sewe meesters- en ses doktorsgrade toegeken en in wateromgewingsleer ses meesters- en een doktorsgraad. Tans is sowat 35 persone in die afdeling besig met nagraadse studie.

Persone wat belang stel om meer inligting oor die kursus in waterbenuttingsingenieurswese te bekom, kan in verbinding tree met die Hoof van die Afdeling deur te skryf aan professor WA Pretorius, Departement Chemiese Ingenieurswese, Universiteit van Pretoria, 0002 of hom te skakel by (012) 420-2198.



VIRUS DETECTION IN WATER

A kit using "gene probes" has been developed to detect viruses in water that is a "thousand times more sensitive than serological tests," according to Charles Gerba, a University of Arizona microbiology professor. The gene probe he developed with a team of researchers is a piece of either DNA or RNA. Jonathan Beard writes in *New Scientist* (5-28) that this snippet binds to the corresponding sequence of base pairs of a gene in the sample of target virus.

According to Gerba, viruses are much more resistant than bacteria to water treatment techniques such as chlorination, ozone or chloramines. The researchers started up a company called Probit, with funding from the University's Division of Industrial Cooperation, and aim to provide kits selling for about \$50 that will provide results within two hours. They have developed probes for dozens of types of viruses, including polio, meningitis and childhood diarrhea.

Water Newsletter 15687

NEW SYSTEM PROTECTS GROUND WATER EFFECTIVELY

An innovative sampling method, developed by Daniel Ronen of the Israel Hydrological Service, and Prof M Magaritz, of Israel's Weizmann Institute, can alert water authorities to impending pollution of underground aquifers. Procedures used until now only yield information after the ground water in a given area has been polluted – much too late for remedial action to be effective.

Since pollution almost always reaches aquifers from the surface, the two researchers thought that it would be useful to monitor underground bodies of water from the surface. At this level, they believed, it would be possible to detect the approach of harmful substances, long before they manage to pollute all of the reserve.

They designed a plastic pipe with slits at different levels that can be inserted into the soil, reaching down just past the water table. Inside the pipe are several dozen individual membrane covered chambers, well separated from each other. Each of

these can be entered only by the water at its specific depth.

The detailed analysis of water samples, each extracted from the soil at a clearly defined depth, yields vital information. Chemicals just beginning to enter the aquifer are identified long before they can build up dangerous concentrations. This often makes it possible to pinpoint their source and to take the necessary corrective action while it can still be effective

Aqua 586

BARNARD ONTVANG MEDALJE IN VSA

By die onlangse stigtingsvergadering van die nuwe Waterinstituut van Suidelike Afrika is bekend gemaak dat dr James Barnard, 'n senior vennoot van die raadgevende ingenieursfirma Meiring en Vennote in Pretoria, vanjaar die gesogte Thomas R Camp-medalje van die Water Pollution Control Federation (WPCF) in Amerika sal ontvang. Die oorhandiging vind tydens die WPCF se kongres in Philadelphia plaas.

Thomas R Camp was 'n wêreldberoemde Amerikaanse raadgevende ingenieur, 'n uitstaande konsultant en dosent en teg-

niese outeur wat veelvuldige bydraes op die gebied van waterbesoedelingsbeheer gelewer het.

Die Thomas R Camp-medalje is in 1964 ingestel en word jaarliks toegeken indien daar verdienstelike kandidate is wat met 'n besondere toepassing van basiese navorsing of fundamentele beginsels op die gebied van uitvloeielsuiwering gepresteer het. Dr Barnard se besondere bydrae behels die biologiese verwydering van plantvoedingstowwe wat algegroei in damme stimuleer indien dit nie uit rioolwater verwyder word nie – 'n uitbouing van 'n inisiatief wat by die Nasionale Instituut vir Waternavorsing van die WNNR ontwikkel is.

Die medalje word baie selektief toegeken en sedert die instelling daarvan het die eer nog maar slegs 16 persone te beurt geval. Verskeie van hulle was al in Suid-Afrika en sluit bekende persone in soos proff McCarty, Eckenfelder, McKinney, Jenkins en Von der Emde. Laasgenoemde is afkomstig van Oostenryk en het verlede jaar die medalje ontvang.

'n Aspek van hierdie toekenning wat vir Suid-Afrika van daadwerklike belang is, is die pluimpie wat dit vir Suid-Afrika se eie waterywerheid en raadgevende ingenieurspraktyk in die besonder inhou: Die ontvanger van hierdie toekenning het hier op eie bodem genoegsame geleentheid en ruimte vir innovering en toepassing kon vind om vir erkenning tussen wêreldleiers gereken te word.

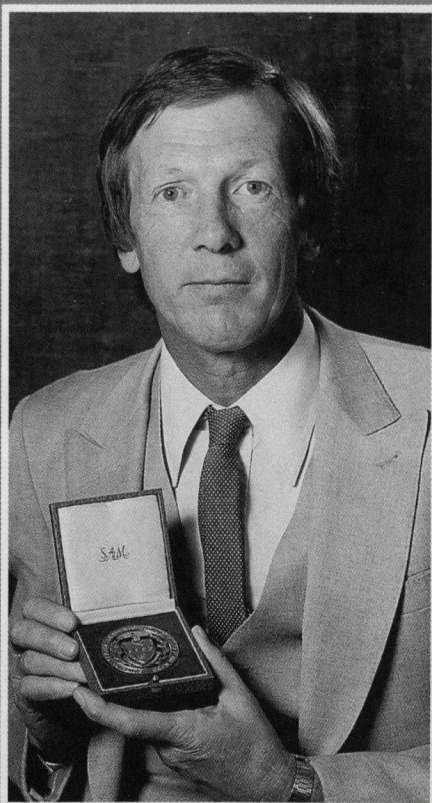
Dr Barnard het in 1985 ook die Goue Medalje van die Suid-Afrikaanse Akademie vir Wetenskap en Kuns ontvang vir sy unieke bydrae tot die biologiese verwydering van fosfate uit uitvloeielsels.

James Laing Barnard is in 1935 gebore en het op Parow skoolgegaan. Sy eerste graad het hy in 1956 aan die Universiteit van Stellenbosch behaal. Daarna het hy aan verskeie universiteite, ook in die VSA studeer, en sy PhD in 1971 met lof aan die Vanderbilt Universiteit ontvang. Sy konsultasiedienste is vandag wêreldwyd in aanvraag en hy word dikwels genooi om lesings in lande soos die VSA en Australië aan te bied.

Hy is getroud met Maryna Minnaar van Suidwes-Afrika. Die egpaar het 'n dogter wat tans aan die Universiteit van Kaapstad met nagraadse studie besig is.

Die meegaande foto is geneem toe dr Barnard die Goue Akademie-medalje in 1985 ontvang het.

BERNARD CLARK





CONCLUSIONS OF THE SYMPOSIUM "WATER 2000"

"Everyone, man and woman, throughout the world, must be able to have access to good and safe drinking water as a necessity of life. It is a responsibility of world organisations to collaborate to this end in a spirit of total solidarity. In addition responsible authorities have an obligation to create the right conditions to enable everyone, everywhere to have the benefit of using and disposing of water without damage to the environment."

This is one of the conclusions approved by representatives from 35 countries attending the Symposium "Water 2000" at Nice in France celebrating the 40th Anniversary of the International Water Supply Association.

Other conclusions are:

"The protection of the environment is a matter of life and death for humanity and attention should, above all, be focused on the prevention of pollution. This is absolutely necessary in order to ensure safe water supply for the future.

We must be aware of the limits of technology and the need to restrict technical development where it leads to no further benefit to mankind and where it may even be dangerous in a technical, ecological or in an economical sense.

Research in the field of water supply, as far as qualitative aspects are concerned, should be mainly directed to the long term impact of micro-pollution on the health of all forms of life.

Research in the field of water treatment should be focused on those technologies which present the least ecological inconveniences. Investigations concerning the use of new materials, especially for water distribution, are very important.

Future increase in the application of high technologies and computer systems, including data processing and automation should be directed to benefit water supply management and lead to improving the service provided to the customer. Expert systems are appropriate tools to contribute to this objective.

The technology transfer from developed regions of the world to newly industrialized or developing countries must be oriented to a selective transfer as a function of the real and practical needs of the country concerned. Openness and preparedness

to provide assistance plus a strong interest and desire to receive assistance, are fundamental conditions for any success."

The 17th IWSA Congress will take place at Rio de Janeiro (Brasil) from 12 to 16 September 1988.

AANGESTEL

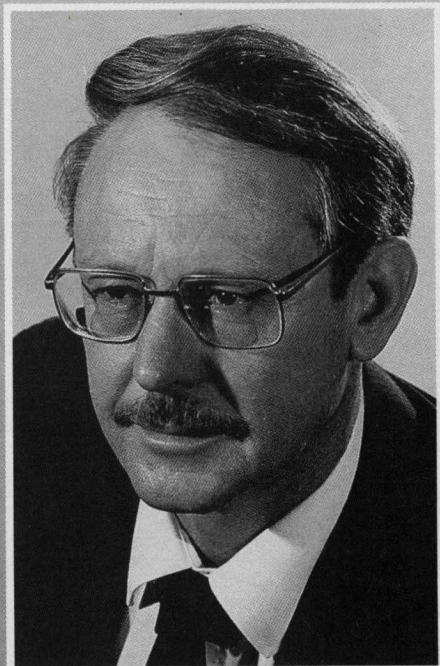
Mnr J Botha wat onlangs die pos van senior lektor by die afdeling waterbenuttingsingenieurswese van die Universiteit van Pretoria aanvaar het.

Mnr Botha was voorheen adjunk-stadsingenieur van Middelburg asook hoofnavorsingsbeampte en senior ingenieur gemoeid met gebou dreinerings, riolering en sanitasie by die Nasionale Bounavorsingsinstituut van die WNNR.



APPOINTED

Mr Mark Dent of the University of Natal has been appointed as manager of the Computing Centre for Water Research (CCWR) in Pietermaritzburg. Mr Dent obtained an MSc in Agricultural Engineering in 1978 and joined the staff of the Department of Agricultural Engineering at the University of Natal in 1979. Since then he has been involved actively in a number of water research projects under the leadership of Professor Roland Schulze. Mr Dent has been the acting manager of the CCWR since its inception in 1986.



DEPT WATERWES

BEVORDER BY DEPT VAN WATERWES

Mnr Tinus Erasmus, besturende ingenieur: watervoorsiening van die Departement van Waterwese, is vanaf 1 September bevorder tot adjunk-direkteur-generaal waterbenutting van die Departement.

Mnr Erasmus het in Maart 1961 die graad BSc Meg Ing aan die Universiteit van Pretoria behaal. Hy is sedert 1961 verbonde aan die Departement van Waterwese in die meganiese afdeling en het deur die range gevorder tot die pos van assistent-hoofingenieur. Dié pos het hy beklee tot 1975.

Gedurende hierdie tydperk het mnr Erasmus die Staatsbevoegdheidsertifikaat as meganiese ingenieur vir fabriek, BSc Meg Ing Honneurs en die registrasie as professionele ingenieur behaal. Hy het ook in 1974 diens gedoen as parlementêre ingenieur van die Departement.

In 1975 word mnr Erasmus bevorder tot hoofingenieur: besproeiing en ingenieursdienste en in 1982 tot besturende ingenieur: watervoorsiening.

Mnr Erasmus is tans lid van die OVS Goudvelde-waterraad asook die Adviesraad insake Natuurbewaring.

Vanwee sy lang verbintenis met die waterveld, het mnr Erasmus 'n lewendige belangstelling in water, boerdery, die Suid-Afrikaanse waterreg en natuurbewaring.

Mnr Erasmus is getroud en het drie kinders.



BELEIDSVERSLAG AAN MINISTER OORHANDIG

Die 75-jarige bestaan van die Departement van Waterwese is op 26 Augustus op luisterryke wyse in Pretoria gevier. By dié geleentheid is 'n verslag oor die bestuur van die waterhulpbronne van die Republiek van Suid-Afrika aan mnr GJ Kotzé, Minister van Omgewingsake en van Waterwese, oorhandig.

In sy toespraak het Minister Kotzé die belangrikheid van hierdie beleidsdokument van die Departement van Waterwese en die omvattendheid daarvan beklemtoon.

Mnr Kotzé het gesê dat die groeiende

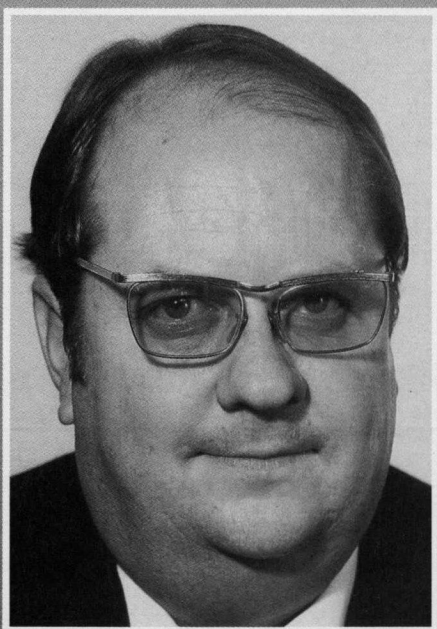
bevolking en die toenemende verstedeliking nuwe probleme skep wat die hoof gebied moet word. 'n Groot opvoedings-taak lê voor om waterbesoedeling deur die publiek en nywerhede te voorkom en die water doeltreffend aan te wend vir die benutting en die instandhouding van ons bedreigde omgewing.

In die verslag word duidelik gestel dat die Departement se primêre funksies die oorhoofse nasionale waterbronbeplanning en die beheer oor die onttrekking en gehalte van die water is. Mnr Kotzé het gesê dat die Departement van Waterwese die sentrale regering se privatiseringsbeleid heelhartig steun en dat die Departement

baie van sy funksies reeds ingekort, afgeskaal of selfs gestaak het.

Mnr Kotzé meen dat dié bestuursverslag vir die publiek, ontwikkelaars en besluitnemers insig in die beleid, standpunte en strategieë van die Departement van Waterwese vir die toekoms sal gee.

Eksemplare van die verslag, wat in beide Engels en Afrikaans beskikbaar is, kan bestel word vanaf die Direkteur-generaal, Departement Waterwese, Privaatsak X313, Pretoria 0001 (vir aandag Elize Fleetwood), telefoon (012) 299-2634. Die verslag kos R50,00 (AVB ingesluit) en die bedrag moet saam met die bestelling gestuur word.

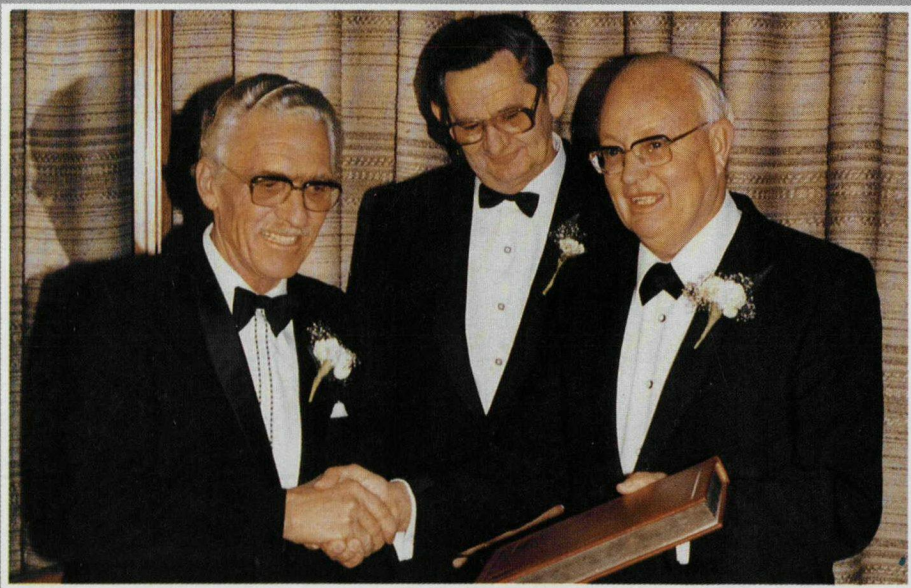


DOKTORSGRAAD ONTVANG

Dr AF (Anton) Prinsloo, voormalige redakteur van die SA Waterbulletin het onlangs die doktorsgraad (D Litt et Phil) van die Universiteit van Suid-Afrika ontvang. Die titel van sy verhandeling is Die besproeiingstegnolek as vaktaal.

Dr Prinsloo het aan die Afrikaanse Hoër Seunskool in Pretoria gematrikuleer en daarna die grade BA (met lof) en MA aan Unisa verwerf.

Op 1 September vanjaar is dr Prinsloo wat voorheen aan die Buro van die Woordboek van die Afrikaanse Taal op Stellenbosch verbonde was, by die SAUK aangestel as taaladviseur: Afrikaanse diens.



DEPT WATERWESSE

TROUT INDICATE RAW WATER QUALITY

A system that uses the breathing rate of trout as an indicator of changes in raw water quality is being made available from WRc Inc., a subsidiary of the UK's Water Research Centre. Graham Evans, inventor of the trout process, called it a sort of "trip wire" for detecting pollutants. Eight rainbow trout living in tanks through which untreated water passes are monitored with electrodes and computers. If the level of contaminants in the water changes, the changed breathing rates of the trout tip off plant operators that samples must be taken for further testing. Evans said it would be extremely complicated to make detection instruments for each of the pollutants potentially present in raw water. The

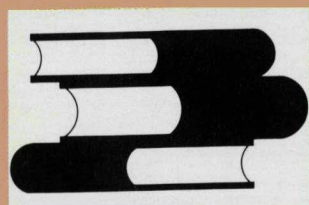
trout system will not identify the pollutant, but it will indicate something is wrong. Evans said the system is also suitable for monitoring the quality of treatment plant effluent. This is already happening in Amherst, N.Y., where a wastewater treatment plant has stocked its effluent channel, a pond and sand filters with brown and rainbow trout and fathead minnows. The fish are left to forage on the organisms in the effluent. Some fish are said to have shown a 4-fold weight gain in less than two years. The process supervisor wants to start an "ultimate biomonitoring program," wherein the plant superintendent and a town supervisor would, once a month, make a meal of the trout grown in effluent.

WATER NEWSLETTER 31687

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All the errors in the original that were listed in the "Addendum to the Surface Water Resources of South Africa" have been corrected in the reprint. In addition, typographical errors and errors reported by users have been remedied.

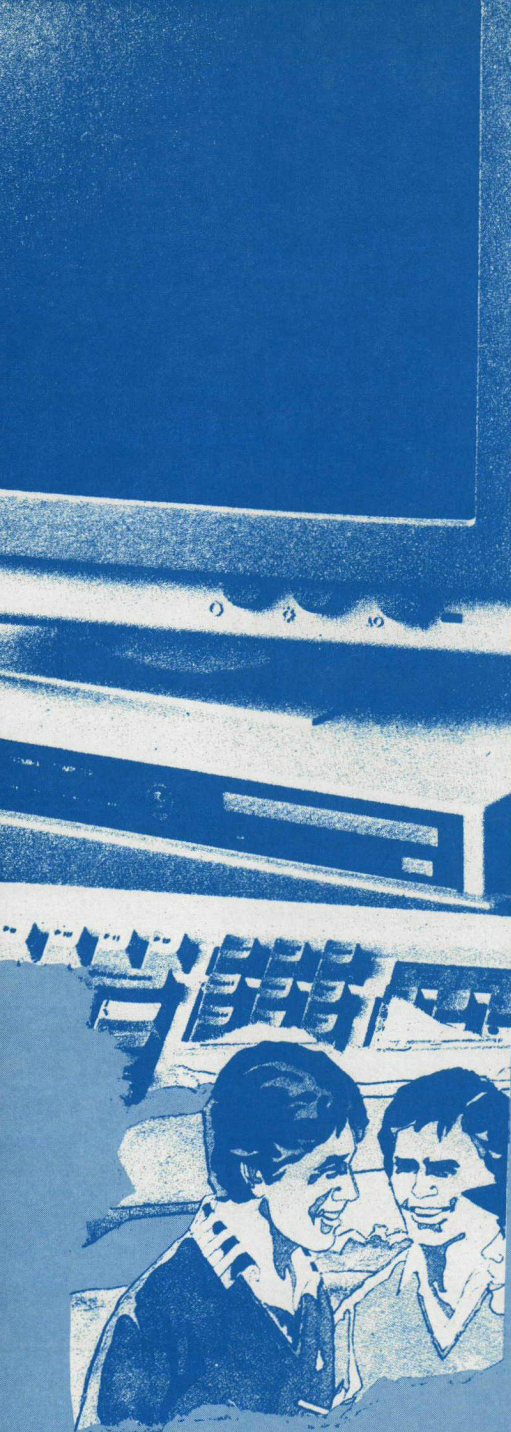
Appendices D & F1 are reprinted two-to-a-page to reduce bulk. The original page numbers, however, are retained.

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A one week short course on design of water quality monitoring systems

OBJECTIVES

The short course will introduce the systems approach to water quality monitoring which involves determining information expectations, translating these into design criteria, designing a monitoring programme, analysing the data accumulated and reporting the information in the format required to meet information expectations.

The short course will present detailed procedures for designing a water quality monitoring network which has the objectives of determining ambient water quality and assessing trends, determining pollutant loads, and monitoring compliance to standards. Design procedures apply to both fixed station and special monitoring conducted in surface and ground water. The short course will cover this variety of monitoring situations by focusing on basic, common components of all water quality monitoring programmes. Most of the examples illustrating use of the design procedures utilize effluent, stream and ground water quality monitoring. Following an overview of the entire monitoring system, the course will cover the selection of water quality variables to measure, location of sampling sites and calculation of sampling frequency.

Because the course will concentrate on the basic principles of monitoring it will also be of value to persons involved in the study and management of the terrestrial, marine and atmospheric environments.

PARTICIPANTS

The short course is aimed at persons actively involved with the design, operation and/or management of water quality monitoring programmes for surface and ground water, and those that make use of information obtained from monitoring programmes in decision-making. The short course assumes that attendants will have little or no background in statistics. Each attendant will be furnished with a text book that includes most of the material presented during the course. Attendees should bring a calculator as it will be needed during the problem solving sessions.

INSTRUCTORS

Dr ROBERT C. WARD, Associate Dean and Professor of Agricultural and Chemical Engineering, Colorado State University, Fort Collins, Colorado

Dr THOMAS G. SANDERS, Associate Professor of Civil Engineering, Program Leader, Environmental Engineering, Colorado State University, Fort Collins, Colorado

Dr DIRK GROBLER, Specialist Researcher, Group Leader of Management Information Systems Group, National Institute for Water Research, CSIR, Pretoria

Dr JACKIE GALPIN, Chief Researcher, Operations Research and Statistics Division, National Research Institute for Mathematical Sciences, CSIR, Pretoria

GUEST LECTURERS

Mr HENDRIK BEST, Manager, Scientific Services, Department of Water Affairs, Pretoria

Mr WOUTER VAN DER MERWE, Director, Directorate of Water Pollution Control, Department of Water Affairs, Pretoria

Dr HENK VAN VLIET, Deputy Director, Hydrological Research Institute, Department of Water Affairs, Pretoria

Mr JAN SCHUTTE, Assistant Director, Directorate of Hydrology, Department of Water Affairs, Pretoria

WHERE

Conference Centre, CSIR, Pretoria

COURSE OUTLINE

Monday
Introduction
Water quality variables as stochastic processes
Systems approach to water quality monitoring
Basic concepts of probability and sampling
Problem session - calculations in probability
Evening social

Tuesday
Detection of changes in water quality
Problem session - calculations for detecting trends
Location of sampling sites
Design considerations for ground-water monitoring
Problem session - location of sampling sites

Wednesday
The S.A. water law and monitoring implications
Trends in water quality management policies in S.A.
Representative sampling
Sampling frequency
Chemical and Biological analysis of water samples - quality control and detection limits

Thursday
Factors in water quality variable selection
Contrasting monitoring to determine ambient water quality to determine for flux determination
Department of Water Affairs Hydrological Information System
water Information and Ground-water Microcomputer data analysis
Evening social

Friday
Practical implications of monitoring programme design
Quantifying information expectations as design criteria
Course summary followed by discussion of water quality monitoring problems

ADDRESS ALL CORRESPONDENCE TO:

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National Institute for Water Research
CSIR
P.O. Box 395
PRETORIA 0001 Tel.: (012) 841-3956
REGISTRATION

Please register for attending this short course by filling out and returning the post card.

Please avoid disappointment by registering as soon as possible because we can accommodate a maximum of 50 people which will be accepted on a first come first served basis. We have already had considerable interest expressed in this short course by a large number of people. Please do not send any money with your registration. We will let you know if you have been accepted for the short course at which stage you can send the course fees.

FEE

The course fee is estimated at R550 which includes tuition, all class materials, the course text, daily refreshments and lunch, and two evening functions.

ACCOMMODATION

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DEVELOPMENTS IN HYDRAULIC ENGINEERING -3

Edited by P Novak

This book, the third of a series, represents an authoritative, comprehensive and up-to-date review written by specialists familiar with the background of their subjects, who are active in the field and have significantly contributed to their respective fields.

The first book of the series dealt with computational hydraulics in the hydraulic design of structures, the finite element method in the design of hydraulic structures, computational methods in the analysis and design of closed conduit hydraulic systems, sediment transport problems in irrigation systems design and developments in the design of irrigation structures.

The second book of the series dealt with vibrations of hydraulic structures, gate vibrations, aeration at hydraulic structures, spillways of high dams and energy dissipation at high dams.

This, the third book of the series, contains seven chapters. The first two chapters deal with physical principles of dispersion in rivers and coastal waters. The theory of dispersion and numerical solution of the resulting basic equations are reviewed in the first chapter and the author concludes that the theoretical analyses, although they do not produce quantitative results which are directly usable in engineering modelling, provide solid theoretical support of mixing due to differential advection as an equivalent gradient diffusion process. This is then followed by the development of working depth-averaged dispersion equations and an evaluation of mixing coefficients. In the second chapter, a few selected numerical techniques for the prediction of contaminant as a function of time anywhere in the flow field of interest are presented and analysed.

These are given for riverine dispersion problems and in the final section of this chapter the question of dispersion of non-conservative pollutants is addressed.

The third chapter of the book deals with sea outfalls and addresses such aspects before dis-

charge to sea, types of outfalls, site surveys for outfall design, design procedures, choice of materials, methods of construction and post construction monitoring.

The fourth chapter is a chapter on flood routing and although, as the author points out, powerful computer hardware and software techniques are available for the solution of flood routing problems using computational hydraulic models, the chapter is dedicated to exploiting the potential of the simpler models to describe flood behaviour in natural rivers.

Chapter five is written for river engineers in the Northern hemisphere who are confronted during the winter period with problems due to the occurrence of ice on rivers and covers such aspects as ice formation, ice forecasting, the effect of ice on discharge capacity and ice control.

Chapter six, entitled Inland Waterways, deals with transport by inland navigation in general, multi-purpose utilisation of waterways, lock design, boat lifts and inland ports and for loading and unloading of vessels. This chapter is essentially a descriptive one and like the previous chapter is well illustrated with good detailed drawings.

The final chapter in the book is a largely descriptive chapter on ports and harbours and addresses the fundamental questions in design. For the design of a harbour, this includes a knowledge of the wave climate and how this affects a particular harbour layout. Wave processes such as diffraction, refraction, shoaling, reflections and harbour resonance are also briefly described. Other aspects covered in the chapter include scale models, mathematical models, breakwater construc-

tion and protection, navigation aspects and sediment motion resulting in harbour siltation. The chapter is well illustrated with photographs (particularly of scale models) and drawings.

The text is very well supplemented by an abundance of references at the end of each chapter and many useful illustrations about throughout. This is a very suitable book for the practicing coastal and river engineer and will serve as a useful reference for post graduate civil engineering hydraulics students.

J.E. McGlashan

1985 318 pages

Price £40.00

ISBN 0 85334 375 6

Available from Elsevier Applied Science Publishers Ltd., Crown House, Linton Road, Barking, Essex IG11 8JU, England.

From Pergamon Press, Headington Hill Hall, Oxford OX 3 OBW, UK

DEVELOPMENTS
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Developments in Hydraulic Engineering - 3

Edited by
P. NOVAK

ELSEVIER APPLIED SCIENCE PUBLISHERS

MARINE POLLUTION BULLETIN – the international journal for marine environmentalists, scientists, engineers, administrators, politicians and lawyers. Edited by RB Clark, Department of Zoology, University, Newcastle-upon-Tyne, NE 1 7 RU, UK. The journal covers all aspects of the fight for life of the lakes, estuaries, seas and oceans.

OIL IN FRESHWATER: CHEMISTRY, BIOLOGY, COUNTER-MEASURE TECHNOLOGY

Proceedings of the Symposium on oil pollution in freshwater, Edmonton, Alberta, Canada, 15-19 October 1984. Edited by JH Vandermeulen, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada and SE Hudey, University of Alberta, Edmonton, Alberta, Canada.

510 pp 100 illus approx 1500 lit refs Aug 1987 0 08 031862 2 Hardcover approx US \$110.00



URBAN DRAINAGE CATCHMENTS

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URBAN DRAINAGE MODELING

Proceedings of the international symposium on comparison of urban drainage models with real catchment data, UDM'86, Dubrovnik, Yugoslavia, 8-11 April 1986. Edited by C Maksimovic and M Radojkovic, University of Belgrade, Yugoslavia.

450 pp 200 illus 1986 0 08 032558 0 Hardcover US \$120.00

WATER QUALITY INTERNATIONAL – the new news magazine of the international association on water pollution research and control. Editor: W Horobin: International association on water pollution research and control, 1 Queen Anne's Gate, London, SW 1H 9BT, UK. Featuring: Articles on international water pollution control, new products, news and technical features, international conference diary, IAWPRC news and information, expert opinion on key issues, products and services directory, conference digest.

From D Reidel Publishing Company, c/o Kluwer Academic Publishers, Distribution Center, P O Box 322, 330 AH Dordrecht, The Netherlands. Tel: (0) 78-172811.

MODELLING GROUNDWATER FLOW AND POLLUTION by Jacob Bear. Albert and Anne Mansfield Chair in Water Resources, Technion – Israel Institute of Technology and Arnold Verruijt. Delft University of Technology. The Netherlands. This textbook is

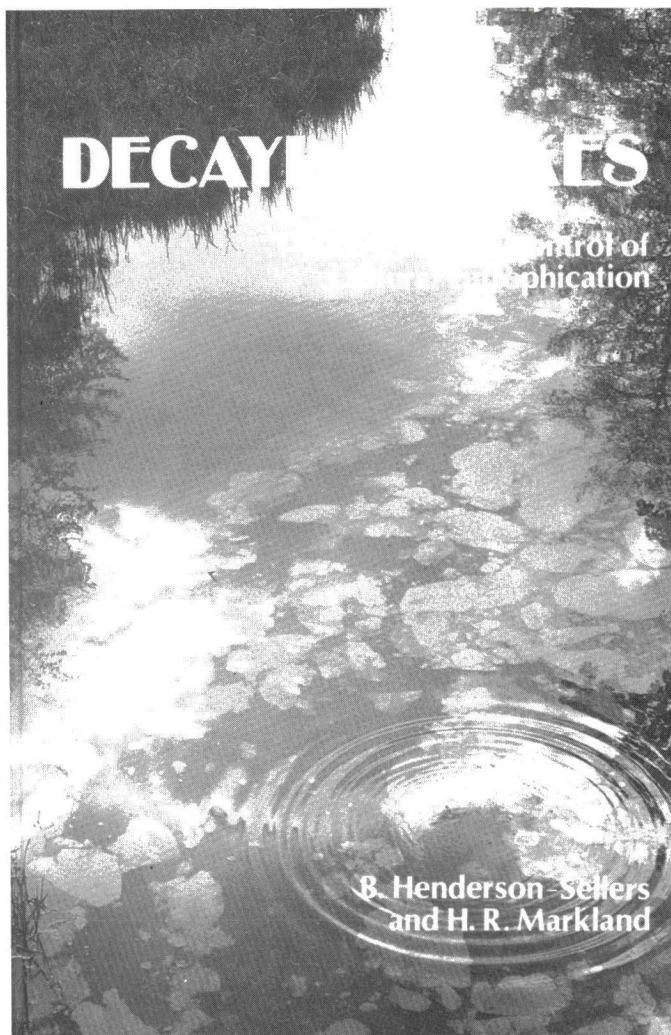
devoted to the building and use of mathematical and numerical models for the analysis of groundwater flow, and the transport of pollution by moving groundwater. A large part of the book is concerned with actual numerical models, mainly based on the finite difference and finite element methods. A large number of complete computer programs, in BASIC, are included. The programs can be run on personal computers and are both educational and "semi-professional". Programs are presented for steady and unsteady 2-D flow in non-homogeneous aquifers, for flow through dams, for transport of pollutants by advection and by dispersion, and for salt water intrusion problems.

1987 580 pp Hardbound £67.00
ISBN 1-55608-014-X Paperback
£24.00 ISBN 1-55608-015-8.

A 5 1/4" diskette containing the source code and compiled version of the programs described and listed in this book is available from: IGWMC – Indianapolis: Holcomb Research Institute, Butler University, 4600 Sunset Avenue, Indianapolis, Indiana (USA) 46208. Phone: 317/283-9458. The programs are written in Microsoft BASIC with colour graphic adapter, and operating system PC DOS 2.0 or later. Diskette programs can be copied and modified by user. The cost of the diskette is US \$10 and includes postage and handling.

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REGULATED RIVERS: RESEARCH AND MANAGEMENT – a new quarterly international journal devoted to river research and management. Subscription details: Volume 1 (4 issues), US \$110.00. Subscription prices include postage, packing and handling charges.



DECAYING LAKES – THE ORIGINS AND CONTROL OF CULTURAL EUTROPHICATION

by B Henderson-Sellers and H R Markland

The natural phenomenon of eutrophication normally occurs over a period of centuries, though some lakes have recently experienced a dramatic increase in this rate, creating eutrophic conditions within decades or less. Elevated nutrient levels in water allow biomass productivity to increase, causing water quality to deteriorate. This accelerated eutrophication is caused mainly by man's activities in the catchment area.

The book provides a comprehensive introduction to the subject of eutrophication of lakes and reservoirs and is divided into three main parts. The first looks at the

basic causes and control strategies; the second introduces the current conflict between the natural environment and man's disturbance of it through the discharge of leached agricultural fertilizers and treated wastewater; the third part presents the current scientific basis of understanding the processes of eutrophication and its control.

The book is the first of its kind and will be of value to environmental scientists, aquatic ecologists, water engineers, and the public authorities responsible for water distribution and quality.

1987 254 pages
Price Not available
ISBN 0471 91218 2

Available from John Wiley & Sons, 1 Wiley Drive, Somerset N J 08873, USA.



TECHNIKON PRETORIA

A series of short courses on basic atomic absorption spectrometry, basic gas chromatography and basic water analysis will be held in Pretoria from 16 to 20 November 1987. All the courses are designed for persons with or without previous training in the techniques. All the courses will be presented separately.

Enquiries: Chemical Sciences, 420 Church Street, Pretoria. 0002. Telephone (012) 28-3811.

ICA

A symposium on instrumentation, control and automation in water and wastewater management will be held on 19 November 1987 in the CSIR Conference Centre, Pretoria.

Enquiries: Division of Water Technology, P O Box 395, Pretoria. 0001. Telephone (012) 841-2231 (Mrs R Oellermann).

AMERICAN SYMPOSIA

The fifth national drainage symposium, a national symposium on conservation systems – optimum erosion control at least cost and on-site sewage treatment – the fifth national symposium on individual and small community sewage systems will all be held from 14 to 15 December 1987 in Chicago, USA.

Enquiries: Jon Hiler, Meetings Coordinator, ASAE HEADQUARTERS, 2950 Niles Road, St Joseph, MI 49085-9659.

WASTEWATERS

An international specialised conference on the microbiology of waters and wastewaters will be held in Irvine, California, USA from February 8 to 11, 1988. The conference will be a scientific forum in which the latest research and practise in the microbiology of all aspects of waters and wastewaters will be reported.

Enquiries: Professor David Jenkins, Department of Civil Engineering, 607 Davis Hall, University of California, Berkeley, CA 94702, USA.

VALVES AND ACTUATORS

A conference on the developments in valves and actuators for fluid control will be held in Manchester, England, from 28 to 30 March 1988. Includes accompanying exhibition.

Enquiries: Mrs Lorrain Grove, Confer-

ence Organiser, 2nd Valves & Actuators, BHRA, The Fluid Engineering Centre, Cranfield, Bedford, MK43 OAJ, UK.

ANAEROBIC DIGESTION

The fifth international symposium on anaerobic digestion will be held in Bologna, Italy, from 22 to 26 May 1988. Interested authors are invited to submit abstracts for consideration.

Enquiries: Dr ER Hall, Environment Canada, Wastewater Technology Centre, 867 Lakeshore Road, P O Box 5050, Burlington, Ontario, Canada, L7R4A6.

WASTE TREATMENT

An international conference on alternative waste treatment systems will be held at Massey University, Palmerston North, New Zealand from 26 to 27 May 1988.

Enquiries: Dr Rao Bhamidimarri, Coordinator, Pollution and Waste Treatment Programmes, Department of Biotechnology, Massey University, Palmerston North, New Zealand.

WATER RESOURCES

The sixth IWRA Congress on water resources will be held in Ottawa, Canada, from 29 May to 3 June 1988. The theme is Water for World Development.

Enquiries: The Secretariat, Sixth IWRA World Congress on Water Resources, University of Ottawa, 613 King Edward Avenue, Ottawa, Ontario, Canada K1N 6N5

REVERSE OSMOSIS

A symposium on the advances in reverse osmosis and ultrafiltration will be held in Toronto, Canada, from 5 to 11 June 1988.

Enquiries: Dr S Sourirajan/Dr T Mat-suura, Division of Chemistry, National Research Council of Canada, Ottawa, Ontario, Canada K1A0R9.

POLLUTION

The 8th International symposium on environmental pollution will be held from 9 to 10 June 1988 in Toronto, Canada.

Enquiries: Dr DV Bhatnager, Alena Enterprises of Canada, Cornwall, Ontario, K6H5V7, Canada.

DRINKING WATER

The third national conference on drinking water with the theme "small system alternatives" will be held in St John's, Newfoundland, Canada, from 12 to 14 June

1988. Authors are invited to submit abstracts for consideration.

Enquiries: Chairman, Third National Conference on Drinking Water, P O Box 205, St John's, Newfoundland, Canada A1C 5J2.

LARGE DAMS

The 16th International Congress on large dams organised by ICOLD will be held from 13 to 17 June 1988 in San Francisco, USA. Topics include reservoirs and environment, embankment dams, new developments in concrete dams and design floods and operational flood control.

Enquiries: HL Blohm, Secretary, ICOLD, 88 Steering Committee, Bechtel Civil Inc, P O Box 3965, San Francisco, CA94119, USA.

IAWPRC

The IAWPRC's 14th biennial conference and exhibition will be held during July 1988 in Brighton, England. South African companies are invited to participate in the exhibition.

Enquiries: IAWPRC, 1 Queen Anne's Gate, London SW1H9BT, England. Telephone 01-2223848, Telex 918518 WAS-SOC. Attention IAWPRC.

WATER QUALITY

A conference on water quality and management for recreation and tourism will be held in Brisbane, Australia, from 10 to 15 July 1988.

Enquiries: R Sadler, Working Group Secretary, P O Box 388, North Quay, Brisbane, Queensland, Australia 4000.

POLMET 88

An international conference on pollution in the metropolitan and urban environment will be held in Hong Kong from 28 November to 2 December 1988. Papers are invited for the technical sessions which will include:

Environmental management practice, Industry and environment, air quality management. Poise planning and control, wastes management and water quality management.

Enquiries: Polmet 88 Secretariat, c/o Hong Kong Institution of Engineers, 9/F Island Centre, No 1 Great George Street, Causeway Bay, Hong Kong.

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A large, stylized blue water splash graphic that dominates the background of the advertisement. It features several interconnected, flowing shapes that resemble water droplets or splashes, with some smaller droplets scattered around. The splash is rendered in a vibrant blue color with white highlights and shadows, giving it a three-dimensional, liquid appearance. It is positioned behind the text, framing it on the left and right sides.

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