SA girl wins prize
- p 5

Life in groundwater
- p 8

Fighting alien invasive plants
- p 18

Windhoek water reclamation plant
- p 24

THE WATER WHEEL is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament. Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

Cover photograph: Drinie van Rensburg

Editorial offices:
Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa. Tel (012) 330-9025. Fax (012) 331-1136.
WRC Internet address: http://www.wrc.org.za
Editor: Jan du Plessis, E-mail: jan@wrc.org.za. **Editorial Secretary:** Rina Human, E-mail: rina@wrc.org.za
Layout: Drinie van Rensburg, WRC. E-mail: drinie@wrc.org.za

SEWAGE TREATMENT

SABS publishes new standard for septic tanks - SABS 1904

The discovery of the septic tank is generally credited to a Frenchman, John Louis Mouras, who during the 1860s, constructed a masonry tank into which sewage, kitchen wastes and rainwater from a small dwelling in Vesoul, France, were collected before passing into a cesspool. Twelve years later the tank was opened and found, contrary to expectation, to be almost free of solids. As a result of this discovery, a series of experiments were conducted in collaboration with a priest, Abbe Moigno, a scientific authority. The satisfactory completion of these experiments induced Mouras to patent his invention on 2 September 1881. In the USA the household septic tank was first used in 1883 by Philbrick, and in England its use dates back to 1895 when Cameron introduced the system.

It is uncertain when household septic tanks originated in South Africa. Communal septic tanks were first used in 1898 by the British authorities at military camps, and it is probable that single household systems were introduced about the same time.

The prime function of a septic tank is only to condition the incoming raw sewage so that the solids are largely separated from the water, and are then subsequently degraded to base nutrients over time. In order for the septic tank to perform its full purpose as a wastewater treatment system, the effluent emanating from the tank must undergo further treatment and disposal.

STANDARDS

For many years, septic tanks were built *in situ* from conventional building materials such as bricks, cement and appropriate aggregates. SABS 0252-2: 1993, was subsequently produced to standardise the design principles of such built *in situ* septic tanks.

It is now known that the constructed septic tank has cost and design shortcomings, not least of which is the time taken to build it *in situ*. There is also the problem of how to effectively seal the joint between the brickwork and floor slab and pipe entry and exit points, in order to prevent the inflow of ground water and the seepage of sewerage. The additional development of cracks in the floor and walls through differential soil settlement, result in the lowering of the water level in the tank thus depleting the effective zone for bacteriological breakdown of the solids. Furthermore, the formation of sulfuric acid in the sewer atmosphere within the tank, results in the destruction of the plaster through implosion, the resultant exposure and eating away of the mortar joints in the brickwork and the degradation of acid soluble cement materials such as the precast concrete roof.

SABS 1904

The world-wide development and ever-increasing general use over the past thirty years of prefabricated septic tanks that eliminate the problems associated with septic tanks built *in situ*, has necessitated the production in South Africa of an appropriate SABS standard for prefabricated septic tanks. SABS 1904 is the important result.

As the scope states, the standard "specifies the requirements for prefabricated septic tanks and ancillary equipment used for the partial treatment of domestic wastewater".

The standard will be of interest to all engaged in the manufacturing, installation and large-scale use of septic tanks.

To order the standard, please contact Magda Timmerman of Standards Sales by telephone (012) 428-6198, fax (012)344-1568, or e-mail timmermm@sabs.co.za .

For more information on the standard, please contact Gavin Pryce Lewis of Calcamite Sanitary Services (Pty) Ltd by telephone (031) 764 2529, fax (031) 764 5012, or e-mail prycelew@mweb.co.za

JASWIC CHANGES WEB SITE

The Joint Acceptance Scheme for Water Services Installation Components (JASWIC), has moved their lists of accepted water and sanitation components from the Water Research Commission's server to a new web address at www.clock.co.za.

JASWIC, an interest group whose committee functions to the mutual benefit of its members and the community at large, aims to assist the SABS in the setting and maintaining of national standards for water supply and sanitation by maintaining a schedule of acceptable water services installation components for use by water service authorities, water service providers and consumers. JASWIC also develops training curricula and standards and is involved in information exchange. Please visit JASWIC at www.clock.co.za.

Gardening gets "reel"

A young South African's water-wise project is transforming lives in impoverished communities, and winning international acclaim

The Trinity Day Care Centre in Kya Sands, north of Johannesburg, has no running water and access to only a few bare patches of land. Yet, they will soon be harvesting a bumper crop of fresh produce from the small vegetable garden they have created with the help of the Reel Gardening concept.

Claire Reed received the Junior Water Prize award from Sweden's HRH Crown Princess Victoria at a ceremony on 12 August, in Stockholm.

Just kilometres away from Trinity, in the township of Diepsloot, resident Kenith Mahlanga is almost ready to do the same. Although he speaks no English, and has a learning disability, it took only one demonstration for him to learn and implement the Reel Gardening system. His source of food has now become a possible future source of income.

WATER PRIZE

What started off as a part-time project by high school student Claire Reid, is not only ensuring sustainable nourishment for people like Kenith and the 40-odd children at the Trinity Centre, but it has also gained global recognition. In August this year, Claire's project won the Junior Water Prize from the Stockholm International Water Institute. The award – given annually for an outstanding water science research project by a person or group of people under the age of 20 - was announced during World Water Week in Stockholm. The nominating committee, in its official motivation, awarded the prize to Claire for "an innovative, practical, easily applicable technique for planting and successfully germinating seeds in water-scarce areas to improve urban and peri-urban livelihoods".

REEL GARDENING

What makes Reel Gardening unique and so applicable in communities such as Diepsloot, is that it enables people to produce healthy crops with about 80% less water and seed cost. The concept is so simple that planting and maintenance can be explained through one demonstration, thereby overcoming any language or education barriers.

Claire, who is a pupil at St Theresa's Mercy School in Gauteng, explains how Reel Gardening works:

"Using a flour and fertiliser paste, seeds are stuck onto newspaper strips at measured intervals, and left to dry. This 'seed tape' is then wound into reels.

"The strips are planted in furrows, with one edge of the newspaper left visible, just above the soil. Seeds can then be watered by pouring small amounts of water along the newspaper strip, e.g., using a two-litre cooldrink bottle. The newspaper absorbs the water, reducing water leakage into the soil, and concentrating moisture around the seed. By keeping the seeds damp for longer, and by providing some protection from the cold, the newspaper helps the seeds to germinate

A SOUTH AFRICAN FIRST

Founded in 1995, the prestigious Stockholm Junior Water Prize is an annual event which recognises outstanding water-related research focusing on topics of environmental, scientific, social or technological importance. The international honour is given to an individual or group who, like their 26 co-competitors, has been awarded the top prize among national competitions. These national winners travel to Stockholm from as far afield as Israel, Australia and the Ukraine. This year, China, Cameroon and Russia joined as first-time entrants.

Claire's Reel Gardening project qualified for entry, after winning gold at this year's Eskom Expo for Young Scientists and she won the South African Youth Water Prize sponsored by the Department of Water Affairs and Forestry (DWAF).

The Junior Water Prize includes a US$5 000 scholarship and a blue crystal waterdrop sculpture. Claire received the award from Sweden's HRH Crown Princess Victoria at a ceremony on 12 August, in Stockholm.

"The Stockholm Junior Water Prize has established itself as the 'world championship' on water research for youth," says committee chairman Dr Johan Rockström. "This is a great achievement, but more importantly, it is filling an enormous gap. There are simply far too few arenas of tribute of young excellence in managing our finite and precious natural resources."

DWAF

In South Africa the Department of Water Affairs and Forestry is implementing a national education initiative in schools called the 2020 Vision Water Education Programme. Part of the Programme is the South African Youth Water Prize competition which is held annually and in which the winner qualifies to compete in Stockholm, Sweden, as South Africa's representative in the International Youth Water Prize Competition.

For more information, please contact Ms Tammy Daniel, the national co-ordinator, at DWAF. Tel: 021 405 2200; E-mail: DanielT@dwaf.gov.za.

faster than in traditional planting methods. The bacteria from the decomposing flour paste also releases nitrogen into the soil, thus boosting growth."

On average, says Claire, the Reel Gardening method produces more plants from the same amount of seeds, possibly because the strip eliminates the threat of birds eating the seeds.

"When measured over a two month period, Reel Garden plants also showed up to 20% better growth than seedlings planted in the traditional manner," she says.

"The whole process is environmentally friendly, and because seed tape is stored in reels, it can be sold by the metre in large or small quantities. At an estimated price of between 14 cents and 18 cents a seed, this makes it extremely cost effective for a subsistence farmer who can't afford to buy whole packets of seeds (around R9 each) at a time."

For Joseph, the caretaker at Trinity Day Centre, this seemingly simple concept is making a world of difference. With a gardening rake, one water bottle, and virtually no money, he has created a small oasis that is helping to the feed his community. Something which – thanks to Reel Gardening – we might be seeing a lot more of in the future.

Seeds are pasted with a flour/fertiliser mixture, onto newspaper strips.

Newspaper strips are then air-dried before being rolled up into reels, for easy storage and distribution.

Seeds strips are planted in furrows, with one edge of the newspaper left visible, just above the soil.

Kenith, a Diepsloot resident and proud Reel Garden "graduate", is seen here in his vegetable garden with Claire Reed (far left), and members of the Anne's Rotary Club, Randburg, who helped to facilitate the Reel Gardening experiment.

Claire Reid demonstrates the Reel Gardening method to Joseph, caretaker at the Trinity Day Care Centre in Kaya Sands. The Centre's only access to water is the nearby Jukskei River. The limited water needed for successful Reel Gardening has enabled the centre to grow fresh vegetables for the first time.

One of the first experimental crops of beans grown by Claire Reid using the Reel Gardening method.

There's Life in Groundwater

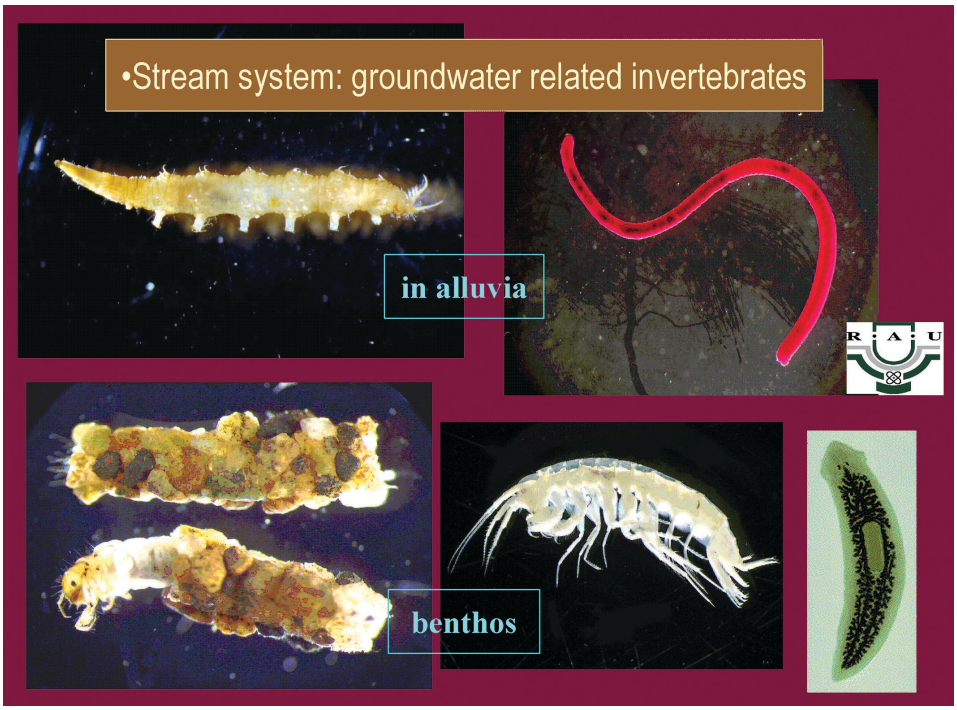
In bodies of water beneath the surface of the Earth, are living organisms that need to be protected. It has taken dedicated scientific research and state-of-the-art technology to shed light on these organisms. Edith Webster reports.

Sayomi Tasaki, a freshwater invertebrate zoologist-research scientist based at the Rand Afrikaans University (RAU) and focusing on groundwater ecology, working with the Water Research Commission and affiliated to the Department of Water Affairs & Forestry, abseils into a cave to investigate groundwater fauna.

Modern technology has enabled scientists to discover thriving communities of tiny living organisms in groundwater beneath the surface of the Earth, including aquifers in parts of southern Africa. And, as subterranean karst wetlands are defined as groundwater-dependent systems (Ramsar Convention, Iran 1971), these ecosystems should be protected.

Blind amphipod (a 4 to13 mm stygobite) found in the Koelenhof Cave - Kromdraai Conservancy. Stereodigital Photograph: Sayomi Tasaki. Courtesy: RAU, Department Of Zoology

Dr Heather MacKay, research manager at the Water Research Commission (WRC), says scientists, already armed with knowledge of the unusual animals in aquatic habitats, are focusing on the small fauna (micro-organisms and invertebrates) living in aquifers. Sometimes these organisms occur in small fractures within rock strata or in the interstitial spaces within shallow, unconsolidated rock just beneath the streambed – the hyporheic zone.



Pictures of groundwater-related invertebrates found in Gauteng stream systems

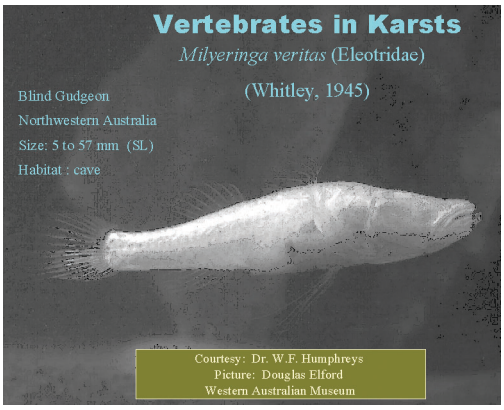
"Amphipods, for instance, are sometimes found when a borehole is drilled. They appear at various depths within the borehole water – there are usually greater concentrations at the bottom of the borehole – having migrated there via fractures or spaces in the rock," she says.

"Drillers have often noted this as a curiosity: occasionally small animals would be found in water brought up from the borehole."

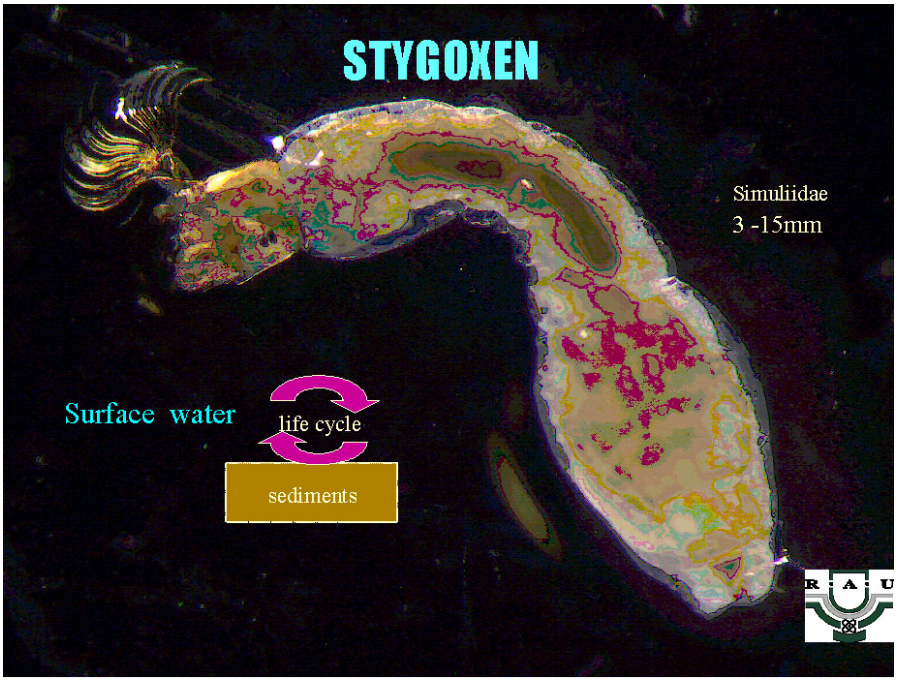
But, as they are living organisms, they are not merely a "curiosity", even though their linkages with and importance to other aquatic and terrestrial ecosystems are not yet well understood at all.

According to Dr MacKay many of these underground aquatic habitats are very sensitive to impacts such as pollution seeping down from the land surface as a result of, for example, agriculture, urban development or over-abstraction of groundwater.

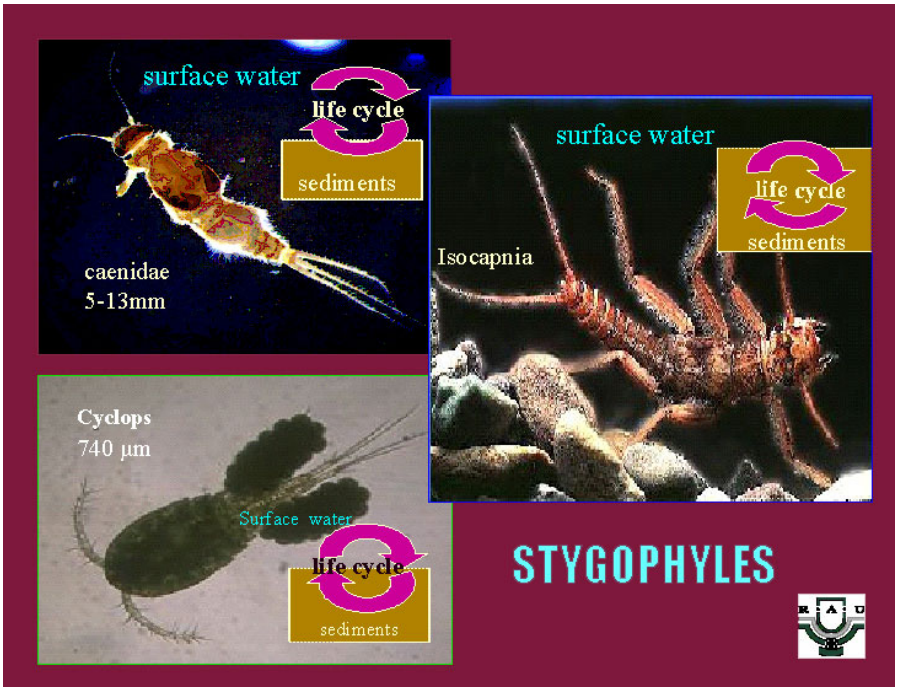
Now, using sophisticated technology, such as a video camera that can be dropped down a



The Blind Gudgeon found in caves in Northwestern Australia



STYGOXEN - a group of animals occurring accidentally in groundwaters



STYGOPHILE - a group of animals living within surface water-groundwater interfaces (benthos, alluvia, interstitial)

borehole, organisms are being closely monitored in underground ecosystems – they simply couldn't be reached before scientists were availed of state-of-the-art equipment.

Sayomi Tasaki, a freshwater invertebrate zoologist-research scientist based at RAU, focusing on groundwater ecology and working with the WRC and the Department of Water Affairs & Forestry, has found various groundwater-related invertebrates (scientifically referred to as stygoxen, stygophyle and stygobite), including the blind *Sternophysinx* amphipod group, in the area around The Cradle of Humankind (the Kromdraai Conservancy region).

The *Sternophysinx calceola*, which does not have eyes, senses movement by detecting sound waves via phonoreceptor appendages on its antennae. It has thus evolved to survive in groundwater habitats devoid of light.

"In South Africa, these eyeless crustaceans can be found in water up to 170 m below ground," says Tasaki.

"These stygobites are aquatic animals totally adapted to live their entire life cycles in absolute darkness, below ground," she explains.

"Because of the fine nature of their evolutionary development, they are extremely well tuned to their environments, becoming a sort of natural indicator of system integrity."

Tasaki says studies of such fauna can, at least, reveal the composition of aquifers and, thereby, provide important information that can guide efforts to protect aquifers from pollution and over-utilisation.

Ongoing studies of stygofauna continue throughout the world. In northwestern Australia, scientists have found blind fish (completely devoid of skin pigment) in the Cape Range and Barrow Island. Some European countries are using meiofauna (minute stygal invertebrates) in their studies of the

hyporheos – the transactional zone, or interstitial waters, between streambed sediments and groundwater.

"Stygal communities actively participate in the food chain; consuming and being consumed; they reproduce, interact and react in accordance to fluctuations in the composition of the system," Tasaki points out.

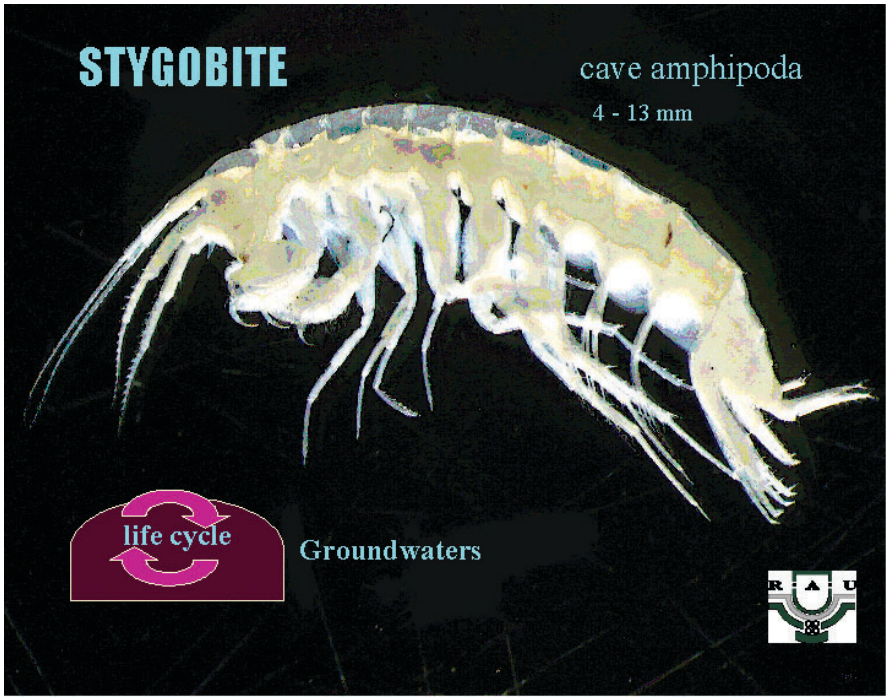
"All subterranean fauna, therefore, deserve consideration as each group has a different role in terms of its interrelationship with the broader environmental system."

Tasaki is studying groundwater-related invertebrates in order to provide a better understanding of catchments and, thereby, make a valuable contribution to water management in South Africa.

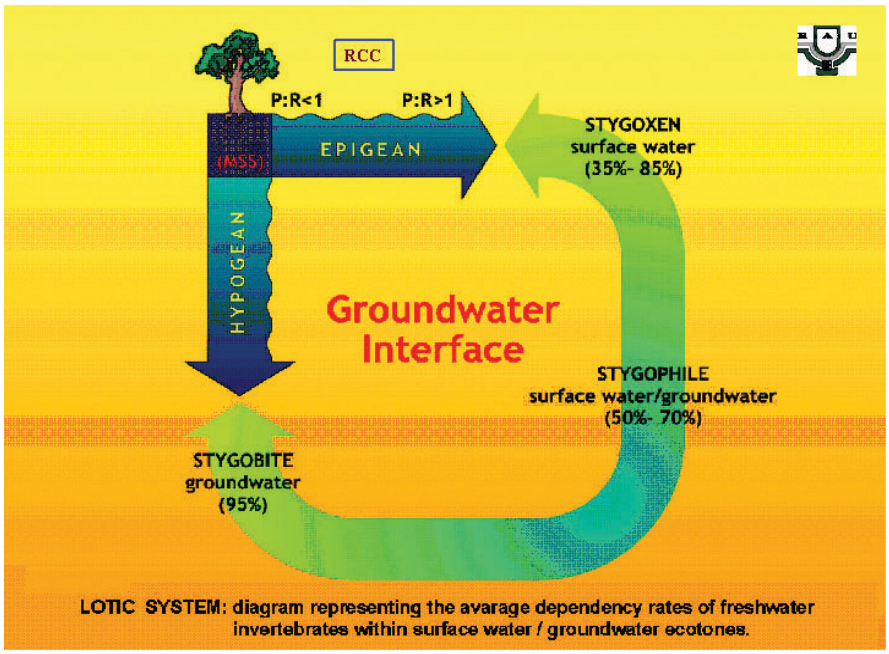
Her research is

- identifying links and pathways for ecological processes between surface water and groundwater systems,
- refining the understanding of these systems in order to support conservation and protection of groundwater-dependent ecosystems,
- potentially providing a water quality assessment model using groundwater invertebrates,
- assessing the quality of groundwater discharge, and
- detecting the occurrence and transmission of organic pollution in aquifers.

For more information, contact Sayomi Tasaki at RAU's Zoology department, (011) 489-2441.



STYGOBITE - group of animals entirely adapted to live in subterranean aquatic systems



LOTIC SYSTEM - representation of fauna classification and average groundwater dependency rates in a lotic system

Seterodigital pictures: S. Tasaki
Design of slides: H. Hoets and S. Tasaki
Department of Zoology - RAU

More Money for Research

Sue Matthews reports

The Working for Water programme had already received numerous awards and accolades when it was given a wake-up call a few years ago by one of the country's top A-rated botanists.
"The botanist told me that Working for Water was operating in a scientific vacuum," said Christo Marais, who heads up the Scientific Services division. Speaking at the start of the programme's inaugural research symposium, held at Kirstenbosch in Cape Town during August, Dr Marais reported that Working for Water had reacted to this constructive criticism by allocating a portion of its budget to research, recognising the need to expand the knowledge base on which management decisions were made.

The core business of Working for Water has always been to control invasive alien plants, but it was thanks to its potential as a job-creation initiative that it was launched in 1995, with a R25 million allocation of RDP poverty-relief funding. Since then the programme has cleared alien invasives from about a million hectares of land at 303 sites, created employment for more than 20 000 workers, and today has a budget of over R400 million.

For the last two years the annual research allocation has been about R15 million - representing 2.5% of the programme's total budget – but this is to be increased to R23 million for the year ahead. It is also supplemented by funding from other sources, contributing an additional 20% to the total research budget. In fact, it is highly likely that Working for Water will soon enter into a partnership agreement with the Water Research Commission to support research of common interest.
"Both parties have approved the agreement in principle, and contractual details are currently being negotiated," explains Dr Gerhard Backeberg, a research manager at the WRC. "Essentially, the intention is that Working for Water will allocate a portion of its research funding to the WRC, which will manage some projects on its behalf."

Research funded by Working for Water is conducted in six broad

Dense stands of invasive alien plants are a fire hazard, stoking the flames to a raging inferno. Seeds of alien species seem better able to survive these very hot fires than indigenous species.

themes, each guided by a review panel made up of experts in the field. The themes focus on:

- **Hydrological research**, aimed at assessing the impact of clearing operations on the hydrological cycle and understanding the processes involved, so that predictive models can be developed
- **Ecological research**, which investigates the ecology of invasive alien plants and their impact on ecosystem functioning
- **Biological control research**, including the initial identification of new biocontrol agents, the quarantine period to assess their potential impact and safety, and the evaluation of their effectiveness after release through ongoing monitoring
- **Social development research**, which focuses on the socio-economic impact of Working for Water on its beneficiaries
- **Operational research**, designed to improve the efficiency and effectiveness of Working for Water's activities, particularly through the development of secondary industries, and
- **Resource and development economics research**, to enable Working for Water to make informed decisions that would maximise the social, environmental and economic benefits associated with its activities.

Each of these themes was the focus of a plenary session at the symposium, which reviewed findings from research projects conducted between 2001 and 2003. Since the negative impacts that invasive alien plants have on water supplies are cited as a major justification of the Working for Water programme, it was fitting that the symposium kicked off with the hydrology session.

How much hard evidence actually exists to back up the claims that controlling invasive alien plants will increase water yields though? The oft-quoted statistic is that invasive vegetation uses an estimated 3.3 million cubic metres of water annually - enough to supply 36 000 people with a subsistence water allowance of 25 litres of water per day for an entire year.

Some of the invasive alien vegetation cleared by Working for Water is used in its Secondary Industries programme to make value-added products such as garden furniture, décor items, toys and charcoal.

But this estimate is based on experiments conducted in the 1990s in commercial pine and eucalypt plantations, situated in high-rainfall catchments. Working for Water-funded hydrological research has therefore focussed in the last two years on studying impacts on water resources in naturally invaded areas.

EXPERIMENTS

In the Eastern Cape, Western Cape and KwaZulu-Natal, experiments are underway to assess streamflow responses to the clearing of black wattle (as well as gums at the Western Cape site) from catchment areas and riparian zones, while in the Northern Cape a project is investigating changes in groundwater resources after clearing of mesquite thickets. Evapotranspiration measurements are also being conducted in stands of black wattle in different habitats. Results to date, together with various modelling studies, have indicated that clearing in riparian zones can be expected to yield twice as much water as that in upland zones. Furthermore, since invasive alien plants reduce dam yields, clearing operations started without delay can postpone the need for new water supply schemes, and offer the best financial advantages.

Research findings could also be used to improve clearing methods used by Working for Water teams. Current practice is to stack invasive alien trees after felling and leave them on site, but some of the ecological research presented at the symposium brought this practice into question. A number of speakers warned that the stacks represent a concentrated fuel source, and burn with such intensity during fires that the heat destroys much of the seedbank in the soil, compromising post-fire regeneration.

SEEDLING GROWTH

One project - which investigated the recovery of vegetation after the January 2000 fires that burned 8 000 hectares of the Cape Peninsula – suggested that in some circumstances the cut wood should be removed altogether. A year after the fires, the research team surveyed seedling growth at 52 moni-

Insects used in biological control of alien invasive plant species.
Top: Neodiplogrammus quadrivittatus; *bottom left:* Algarobius prosopis; *bottom right:* Trichiologaster acaciaelongifoliae

toring sites set up in areas previously covered by indigenous fynbos, alien-invaded or alien-cleared vegetation, and found that alien species had recovered better than fynbos where the fire had been very hot. The data also indicated that important components of fynbos, such as restios and grasses, were eliminated by severe fires in cleared, stacked alien vegetation, and these effects were more marked on deep sand and granite-derived soils than on rocky sandstone slopes. For this reason, the researchers recommended that when alien woody plants, more than 3 m high, are cleared, the cut wood should be removed, and follow-up clearing should be carried out regularly to maintain a low fuel load. For her succinct presentation on this research project, Susan Botha was awarded the prize for best paper delivered at the symposium.

BIOLOGICAL CONTROL

Another group to receive well-deserved recognition at the symposium were the research scientists specialising in the field of biological control. The Weeds Division of the Plant Protection Research Institute was recently hailed at the National Science and Technology Forum's award ceremony – dubbed the "Science Oscars" - as the organisation that has made the most significant contribution to science, engineering and technology in South Africa over the last decade.

As the main funder of biocontrol research in South Africa, Working for Water shares in the glory of this award. The biocontrol theme gets the largest share (40%) of the programme's research-funding pie, and all indications are that this is money well spent.

Starting in 1913, when a cochineal insect was introduced to control the cactus *Opuntia vulgaris*, more than 90 biocontrol agents have been released in South Africa to control 47 invasive alien plant species. Over half of these have been completely (25%) or substantially (32%) successful, a quarter of them need more time before their effectiveness is judged, while 18% are considered failures, having achieved only negligible results.

Recently, Working for Water conducted a cost-benefit analysis of biocontrol on six weed species, taking into account the funds spent on biocontrol research, the extent to which the weeds would have spread without biocontrol, and the costs associated with such spread in terms of losses of water, land value and ecosystem services.
"The results showed that biocontrol offers enormous returns on investment," said the CSIR's Brian van Wilgen, who acts as science advisor to Working for Water.
"Biocontrol research is extremely cost-effective, and is deserving of increased investment."

EMERGING WEEDS

A list of priority projects and target weeds has now been decided on for future research effort. On the basis that early action has been shown to save time and money in the long run, the list includes five so-called emerging weeds – species still in the early stages of invasion. These are the pom pom weed (*Campuloclinium macrocephalum*), parthenium (*Parthenium hysterophorus*), yellow bells (*Tecoma stans*), American bramble (*Rubus cuneifolius*) and balloon vine (*Cardiospermum grandiflorum*).

Working for Water intends refining the cost-benefit analysis framework and using it as a guide for identifying other priorities for research. Such prioritisation is crucial, because as the programme's Biennial Research Report concludes:

Sue Matthews

Fleshy galls on the long-leaved wattle Acacia longifolia *are evidence of biocontrol at work. The bud-galling wasp* Trichiologaster acaciae-longifoliae *lays its eggs in immature flower buds on the plant. After the eggs hatch, the larvae secrete chemicals that cause the buds to develop into round, fleshy galls. These not only prevent seed production in the affected buds, but also deprive other plant parts of nutrients and water.*

"The Working for Water programme's Research Management Unit faces a number of significant challenges with regard to its future activities. It operates within a poverty-relief programme, and as such it has to justify expenditure on research that would otherwise go directly into the pockets of needy people."

"The constant tension between the demand for immediate poverty relief in the short term, and the need to conduct research that will arguably enable the programme to deliver even larger and more effective benefits in the medium to longer term, has to be carefully managed."

AGROFORESTRY
Poised to Grow Economy and Save Water

The planting of trees that do not deplete available water could be the key to prosperity for South African farmers. Edith Webster reports.

Competition for resources, particularly water, is central to the ongoing fight for survival. Without water, there's simply no arable land and, therefore, no food.

That's why the Water Research Commission (WRC) is behind research by Dr Colin Everson, senior scientist at Environmentek CSIR, and his team on *The Effect of the Introduction of Agroforestry Species on the Soil Moisture Regime of Traditional Cropping Systems in Rural Areas* (WRC Report No. 780/1/02).

During winter periods in the Upper Thukela region there is an acute shortage of grazing for cattle.

Winter is dry in the Upper Thukela region of KwaZulu-Natal. Farmers find this a particularly difficult season as, without adequate rainfall, they suffer shortages of fodder, land and water.

Agroforestry – the planting of "fodder trees" beside the traditional maize crop – may solve problems associated with the feeding and productivity of dairy cattle but agroforestry could also place undue stress on the precious water resource.

"Efforts to introduce agroforestry systems to small-scale farmers in the Upper Thukela region have largely been delayed in the past. The main reasons being that there was a general belief that agroforestry species reduced the water supply and caused low crop yield – community members had a strong

The green leafy material of Acacia karroo *provides an additional source of protein for cattle when the natural veld is dormant.*

perception that, in times of drought, trees were responsible for the drying up of streams – and farmers have not participated in the planning of research trials and adapting them to the needs of the people," says Dr Everson.

That perception has changed since trees like the *Acacia karroo*, *Lucaena leucocephala*, *Morus alba* and *Gleditsia triacanthos* have been planted on certain farms. The trees supplement cattle nourishment, provide firewood for the farming communities and, sold as timber, generate extra income for the farmers.

"Fodder trees with a high nutrient content have been used in other parts of Africa to increase animal production. Growing trees together with crops can greatly enhance productivity of rural farming systems as tree roots can exploit water and nutrients below the shallow roots of crops. Trees can also increase productivity through soil nitrogen fixation and the provision of fodder," Dr Everson points out.

The alley cropping system showing the trees interplanted with maize.

The potential of agroforestry being discussed with neighbouring communities.

To reassure the farmers that agroforestry would be economically viable, the research team had to first examine the level of competition for water between the trees and crops. They found that all four fodder tree species planted on the trial farms did not compete with the maize crop for water.

Where to now? Initially anxious about the threat to the water resource, the WRC has now realised the urgent need to alleviate poverty in the Upper Thukela.

"We could take agroforestry further by, for example, contributing to SMME (small, medium and micro enterprise) development," says Dr Sizwe Mkhize, research manager and head of the WRC's Water and Society Cross-Cutting Domain.

"Small-scale dairy farmers could grow the trees for their own needs as well as the requirements of other farmers who find the cost of manufactured cattle fodder prohibitive. Fruit-bearing trees could also be planted to feed people."

The WRC has decided to fund additional research into agroforestry as it could have application in drier areas, other than the Upper Thukela, such as parts of the Limpopo and Eastern Cape provinces.

Water Saving Simulation Model

Article by John Fair

Irrigation water is not only becoming more expensive, but it is also – more importantly – becoming an increasingly precious commodity. No wonder the government has introduced new water laws, albeit unpopular with those who are the prime producers of our country's wealth – our farmers.

On the positive side of the balance sheet, however, the Water Research Commission (WRC) are offering irrigation farmers a wonderful and very valuable water saving simulation model at a give-away-price. For a mere R500 you can install a sophisticated computer model which has the potential to bring about substantial savings in the amount of water required to produce any given crop. Although the model is sophisticated it is, nevertheless, user friendly. It has been named SWB (Soil Water Balance) and was developed by the University of Pretoria with WRC funding.

Free State farmer Paul Farrell at his automatic weather station

What is the optimum amount of water required to produce a crop? This is a question that most irrigation farmers grapple with on a daily basis. Too little water means crop losses. Too much water is not only more costly but it also pulls down yields. Efficient use of water is a tricky balancing act. It is like walking on a tightrope – it is so easy to fall off on either side of the wire. The SWB model is much more than a safety net; it is like a broad gangway; one on which farmers can confidently walk, knowing that they will produce top crops with the minimum amount of water.

Paul Farrell in maize

COMPUTER THE IDEAL TOOL

A computer is the ideal tool for handling all the variables, and interactions involved in the decision-making process to determine the correct amount of water to apply. It is well neigh impossible for the human brain to put it all together in a flash. The word flash is appropriate because effective irrigation requires daily, and in some cases hourly, decisions. Consider just some of the factors involved.

- The crop needs. Not just the type of crop but also it's stage of growth.
- Evaporation and transpiration rate, which are affected by numerous factors such as solar radiation, temperature, relative humidity and wind speed.
- The ability of the soil to absorb and hold water.
- The amount of effective rain.

Intelligent use of water can prevent this sort of disaster in citrus

The computer puts all this together but, of course, it requires the right information. To provide this, sophisticated equipment is required. The most expensive is an automatic weather station (AWS) that transmits most of the relevant information to the computer. This radio weather station is moveable and can be placed in a position that is best suited to the crop being irrigated – this is an important aspect in getting the best results from SWB model.

To reduce costs it is possible to link SWB to regional weather stations. This can be done by phoning in for data or logging on to the Internet. It is also possible for several farmers to purchase a single AWS. The downside of such cost saving moves is, however, loss of accuracy because the weather factors involved can differ quite substantially over relatively short distances.

Apart from the weather station, soil water measurements are desirable. For this purpose relatively inexpensive tensiometers that must be read, to expensive neutron probes that can be directly linked to the computer can be used.

Paul Farrell Jnr, of Paul Farrell Farming in Bethlehem, uses SWB to help him manage his irrigation schedule. The use of SWB is enabling him to optimise the use of their limited water resources, and crop yields are excellent.

Paul Farrell Jnr, of Paul Farrell Farming in Bethlehem, uses SWB to help him manage his irrigation schedule. He is very pleased with the model, but points out that it does not eliminate the need for measurements. Paul says that SWB works for all types of irrigation systems, but it is just good sense to make use of the more efficient ones, such as the dripper lines. This is why Farrell Farming has installed surface dripper lines on 180 ha.

The use of SWB is enabling Paul Farrell Farming to optimise the use of their limited water resources and crop yields are excellent. Many other irrigation farmers could also benefit markedly by installing the system. After all, why look a virtual gift horse in the mouth?

Farmers interested in SWB can contact:

Dr. Martin Steyn
University of Pretoria
Tel 012 420 4585
Fax 012 420 4120
e-mail: jmsteyn@postino.up.ac.za

Jack Armour - A Young Prize-Winning Researcher

It is not often that a person is known by their second name, but that is the case with Robert Jack Armour. That, however, is not the only remarkable thing about this young man. After he qualified with a B.Sc. (Agric) degree from the University of the Free State (UFS) he decided to try his hand at being manager of a pig farm and also a tourist guide in Southern Africa. But it seems as if he has found his niche in the world of Agricultural Economics, because not only did he recently obtain his M.Sc. (Agric) degree in this field *cum laude*, but he also won a prize for his dissertation from the South African Agricultural Economics Association for the best Agricultural Economics Masters dissertation in the country.

Not bad for this born Free Stater who never intended to pursue a post-graduate qualification in Agricultural Economics, but was inspired by another agricultural economist, Prof. Giel Viljoen from the UFS, who convinced him to work in this field.

MASTERS

Jack has a unique way of doing things, as is evident when one reads through his dissertation. It is not often one comes across a Masters dissertation where every chapter is introduced by a quotation from popular literature pertaining to the importance of water in agriculture; ranging from Alan Paton's *Cry the Beloved Country* to the Bible.

In the dissertation, Jack developed and applied models to determine the long-term financial and economic viability of irrigation farming in the Lower Vaal and Riet Rivers.

"With my dissertation, I wanted to evaluate the relationship between

Robert Jack Armour

changing water quality, soil conditions and crop production and also determine the impact on yield, crop choice, agronomic and water management practices, expected incomes and costs. I wanted to use these findings to develop models for typical farms in different river reaches, and apply these models to test the outcome of alternative scenarios regarding internal water quality management practices and external policy measures," he summarises his study.

IRRIGATION

But what prompted his interest in this particular field of study? Jack explains: "Global climate change and the imminent threat of droughts or floods, means that irrigated agriculture is here to stay, because of the stability of supply it contributes to national food security. In Sub-Saharan Africa, the potential irrigated area is estimated at 33 million ha, with the presently irrigated area accounting for only 13% of this. With Sub-Saharan Africa by far having the highest population growth rate in the world, food shortages in this region loom in the not too distant future. Mechanised, water efficient, irrigation agriculture is a potential solution to this problem. However, tremendous pressure will be placed on expanding the potentially irrigated area and increasing the productivity of existing schemes to meet nutritional needs. This could be disastrous for the environment, and consequently for the sustainability of such schemes, if the necessary precautions are not taken."

SALINITY

In his research, he mentions that irrigation water quality and particularly salinity, reaches levels in the Lower Vaal and Riet River that are harmful to certain crops. Saline irrigation water however irrigated onto soils is transpired as pure water, leaving the salts behind in the soil. These salts accumulate over the long term and reach levels rendering soils sub-optimal for crop production. One way to manage salt build-up in soils is to apply excess irrigation water to leach the accumulated salts out of the soils.

The increasing use of water, and by implication returnflows, in the course of economic growth and development, contributes to fluctuation and the gradual deterioration of water quality. This occurrence is a particular problem in the Vaal River system, where water quality worsens as river flow reduces. Even if water quality does not worsen progressively over time, it is expected that the irrigability of soils can be affected, which in turn impacts on the financial sustainability of crop production.

"The question I asked myself, and on which I based my study, was to what level the causes and consequences of fluctuating water quality could be

managed by adapting on-farm production practices and introducing policy instruments. I was also interested to find out which farm, regional and policy level management options are most suitable to address the water quality problem in the Lower Vaal and Riet Rivers," he says.

In his study, he refers to data gleaned in 1995 which claims that around 110 000 ha of irrigated land in South Africa was affected by waterlogging and/or salinisation. In the Orange Vaal Irrigation Board (OVIB) service area, which was also the area on which Jack based his research, 13% of the 8 091 ha irrigation water rights allocated in the OVIB area are slightly affected by salinisation and waterlogging to the extent that agricultural production can still take place albeit with restricted production potential and choice. However, a further 10% of the OVIB area is severely affected to such an extent that agricultural production can no longer take place without special remediation actions such as artificial drainage or gypsum being applied. That is nearly a quarter of the irrigated zone in the study area affected by salinisation and a trend of declining water quality.

SALMOD MODEL

Throughout the study, the contradiction in improved water use efficiency and increased leaching for salinity management had to be finely balanced. On the one hand, water is a scarce resource and should be preserved. On the other, a certain "wasting" of water is necessary in order to leach out salts that build up in soils through the process of irrigation. This prompted Jack to develop a financial optimisation model, named SALMOD (Salinity and Leaching Model for optimal Irrigation Development), to solve the apparent paradox between saving and wasting water.

SALMOD was constructed using GAMS (General Algebraic Modelling System) and consists of a simulation and optimisation section that calculate the optimal crop enterprise, management and resource use combinations that maximises farm returns under different water quality, management and policy scenarios.

Some interesting results were learned from the SALMOD scenarios. For instance, it showed that leaching was financially viable for most farmers used in the case studies and that accepting lower yields on soils with insufficient leaching capacity is also financially viable. Furthermore, it can be financially viable for farmers with a limited area of poorly-drained soils to install artificial drainage.

However, the worst-case scenario concerning salinity conditions showed that farmers with small plots and a limited choice of crops they can plant wouldn't easily afford artificial drainage installation costs from irrigation income alone and could go out of production.

"SALMOD is proving to be a valuable farm level salinity management tool. It is also potentially useful at regional and national level for determining the farm level financial impacts of various water quality and quantity scenarios where the farmers are affected by irrigation water salinity," Jack says proudly of the product of many long and laborious days and nights of work.

The Water Research Commission has also played a role in helping Jack to complete his dissertation. They have partly sponsored his salary for the past four years, which enabled him not only to complete his Masters, but also to travel to the United States as part of his research.

Although his dissertation can be viewed as a significant contribution to irrigation farming in South Africa, he feels that more work needs to be done.

"The purpose of the National Water Act (39 of 1998) is to ensure that the Nation's water resources are protected, used, developed, conserved, managed and controlled. Further research to ensure the financial sustainability of irrigation schemes in South Africa is essential to ensure national food security and employment in some otherwise barren area of the country."

PH.D. AND TOURISM

Jack has already started working on his Ph.D., in which he will continue his work in this field. He feels that God has placed him in the perfect environment to continue his studies and make a real contribution to his community. He currently resides in Ficksburg in the Eastern Free State with Claire, his wife of two years, a medical doctor. Here, he has shared his knowledge with farmers in the region, giving advice and speaking at public events. He hasn't lost his enthusiasm for tourism, but is now looking for ways to combine it with his interest in agriculture.

"I would like to develop a short course in agricultural tourism. The central parts of South Africa is mainly agricultural land, and many tourists travel through it, without knowing much about what they see on the land."

Much remains to be done. But Jack's work can be summarised in the quotation from Ezekiel 47 he uses to conclude his dissertation: "*Swarms of living creatures will live wherever the river flows. There will be large numbers of fish, because this water follows there and makes the salt water fresh; so where the river flows everything will live.*"

Multiple Barriers Ensure Safe Potable Water From Reclaimed Sewage – Windhoek, Namibia

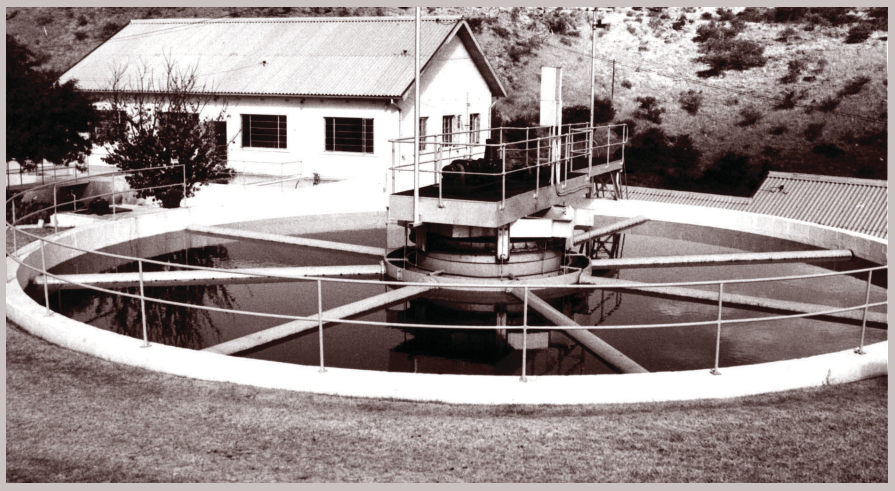
The Goreangab Water Reclamation Plant in Windhoek is internationally renowned as the first and only plant in the world to reclaim domestic sewage for potable use as a supplement to Windhoek's very scarce raw water resources.

Leading edge process technology was integrated into the design of the new 21 Mℓ/d Goreangab Water Reclamation Plant, which was completed in 2002. It is internationally renowned as the first plant in the world to reclaim domestic sewage for drinking water purposes. After 32 years it continues to be the only plant in the world to do so.

SCARCE RAW WATER RESOURCES

Namibia is the most arid country in Southern Africa and continuously faces serious water challenges. The initial Goreangab Water Reclamation Plant was built by the City of Windhoek in 1968 to reclaim water directly from domestic sewage effluent as a supplement to Windhoek's very scarce raw water resources. The plant can be fed from two sources, these being the Gammams Sewage Treatment Plant and the Goreangab Dam. The raw waters are blended and treated as a single stream. In general, the objective is to utilise a larger portion of the effluent from the sewage treatment plant than water from the Goreangab Dam.

LOOKING BACK AT THE BEGINNING...



The original water reclamation plant in Windhoek was developed by the National Institute for Water Research (NIWR) of the Council for Scientific and Industrial Research (CSIR) during the 1960s. The design and operation was based on the results of a pilot plant operated by the NIWR in Windhoek over the period 1964 to 1968.

After the Water Research Commission (WRC) was established in 1971 it immediately embarked on an ambitious research programme to expedite the development of the technology of water reclamation and to study the health effects of such water.

A research facility was constructed by the CSIR at Daspoort water treatment works in Pretoria and the Windhoek plant was modified from time to time to incorporate advantages gained from the latest research results with financial assistance from the Water Research Commission.

In 1976 the Windhoek plant was upgraded and extended, again with financial support by the WRC. At the inauguration ceremony Dr GJ Stander, the then chairman of the WRC, stressed the significance and the value of the ground-breaking research at Windhoek with a quotation from an American scientist who (at a conference in 1969) said: "*Windhoek will become famous as the first city in the world to reclaim wastewater on a regular basis for direct domestic reuse. This plant has been in operation since spring 1969 and the peoples of the world have taken little notice of its existence.*

"*Yet, in this same year that saw science and engineering land a human on the face of the moon, science and engineering also brought direct water reuse into reality. The question is, which event will have more intimate impact on our lives and those of our children?*"

HEALTH CONCERNS

Due to pollution in the catchment area of the dam, the quality of the water had deteriorated over the years to such an extent that conventional treatment methods could no longer be applied. The two sources had to be combined and treated in a single extended and upgraded new Goreangab Water Reclamation Plant.

During the early nineties, the need arose to augment the plant significantly and to upgrade its treatment train with the latest technology to address the most recent health concerns.

GFJ, South African consulting engineers, formed a consortium with Fichtner in Germany and Multi-Consult in Namibia and the *FMG Goreangab Joint Venture* was awarded the technical responsibility for this challenging project.

NEW TECHNOLOGY

Since the commissioning of the first reclamation plant in 1968 a huge amount of new information on various aspects of water treatment became known. Experience obtained from the old plant, information from pilot plant studies and

The High Lift Pumping Station consists of two pumpsets. The pumping station further houses the raw waterpumps with the raw water inlet works to the right of the pumps, just below the clear water reservoir. Several on-line instruments are situated in the building for quality control purposes.

knowledge of current technologies had to be integrated into a process design which eventually lead to a reclamation Plant producing water of a final quality which is sustainably fit for human consumption.

RESEARCH AND DEVELOPMENT

The new treatment plant was designed using data from 400 days of pilot testing and a comprehensive review of international practices.

This research and development part of the project played an important role in eventually determining the process train and establishing important design parameters. In this regard, research was focused on the optimal removal of organics and harmful pathogens from the water. This was achieved by operating an ozone/activated carbon pilot plant, a membrane pilot plant and performing some full-scale studies on the old plant with regard to the precipitation of organics at various pH levels.

Following the research part of the project, water quality concerns were categorised into the following:

- Physical and Organoleptic
- Macro Elements
- Microbiological
- Disinfection By-products

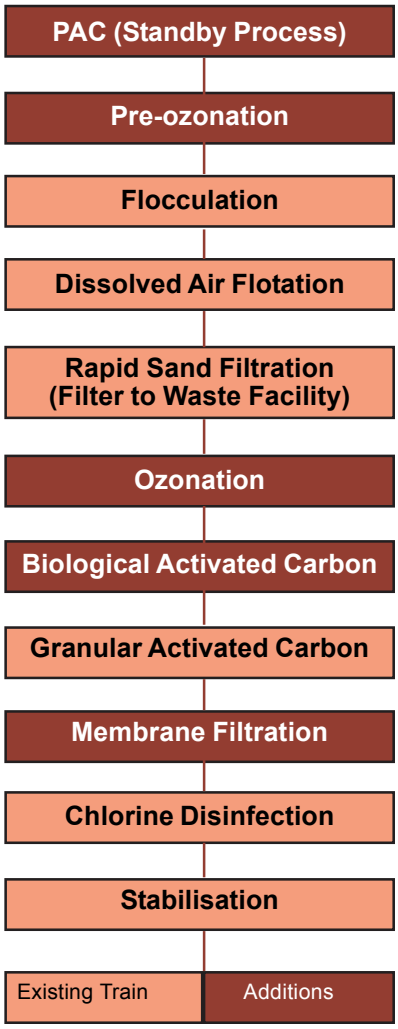
BARRIERS

The process design was one of a 'multiple barrier' process where individual barriers were established for each of the groups mentioned above. With a major emphasis being placed on a safe final product, three barriers were set for pathogens like *Cryptosporidium* and *Giardia*. The reduction in organic content before chlorination to reduce the formation of trihalomethanes (potentially carcinogenic) also necessitated three barriers. Employing this approach for each concern would ensure a final water complying with the stringent standards required.

Following the establishment of a design philosophy, the processes required to create the multiple barriers had to be identified and sequenced into a final process design. The old plant was taken as a starting point for processes currently employed and a detailed evaluation of the existing plant indicated that the old treatment train comfortably provided one treatment barrier against physical and organoleptic parameters through Dissolved Air Flotation (DAF), settling, and filtration and two barriers against most microbiological and biological parameters (two chlorination steps).

To enhance the multiple barrier concept further, the following specific adaptations and additions to the original process were implemented:

- Powdered Activated Carbon (PAC) dosing, should one of the



Note: Sedimentation and secondary chlorination were omitted from the existing train

key processes such as ozone, membrane or Granular Activated Carbon (GAC) filtration fail. This process will only be an operational barrier.

- The settling step was shown to add very little benefit to the phase separation already achieved by DAF and could be excluded without any compromise to the overall plant performance.
- Ozone was added as an additional step before GAC for its ability to destroy cysts, particularly *Giardia* and *Cryptosporidium*; further to oxidise organics, iron and manganese.
- Biological Activated Carbon (BAC) to enhance dissolved organics removal without the regular high cost of regeneration of GAC.
- Membrane filtration provided an additional barrier for both the biological parameters and the physical parameters.
- The removal of iron and manganese was specifically addressed, especially in view of its fouling effect on the membrane process.

The ultrafiltration unit process, which acts as a final barrier against harmful pathogens

This philosophy resulted in the process train as shown in the diagram and described hereafter.

PROCESS TRAIN

The major features of the plant are:

- PAC dosing as a standby barrier for dissolved organics removal.
- The provision of pre-ozonation for oxidation of iron and manganese. To achieve this, some of the ozonation capacity is available at the inlet box.
- An acid dosing system (experimental) for flexibility when the pH needs to be adjusted for better organic precipitation.
- A ferric chloride dosing system as well as a polymer dosing system for flocculation.
- Two flocculation units with flexibility to vary the mixing intensity.
- A DAF system for removal of algae and other suspended particles.
- Sand filtration with upstream dosing of potassium permanganate and caustic soda to facilitate manganese oxidation and removal in the filters.
- An ozone facility, including the ozone injection units, the ozone contact tank, and a Pressure Switch Adsorption (PSA) plant for oxygen production. This is a barrier to *Cryptosporidium* and *Giardia* and also oxidises organics and makes it more susceptible for adsorption onto the activated carbon.
- A granular activated carbon facility following ozone consisting of three separate steps – the first step to be used as a biological carbon facility and two GAC units to be used as an adsorption facility. The lowering of organic content is a priority as this has further implications during final chlorination.
- An ultrafiltration unit process as a final barrier against cysts and the further lowering of organic content and turbidity.

- A chlorine dosing step with a contact time of one hour, and a residual of at least 1 mg/ℓ free chlorine when leaving the plant.
- Final stabilisation to obtain a calcium carbonate precipitation potential of 4 mg/ℓ is achieved using caustic soda.

AUTOMATION

Automated processes, which require limited operator intervention and a monitoring Supervisory Control and Data Acquisition (SCADA) system, which stores a number of critical parameters for control purposes are important features of the plant.

QUALITY CONTROL

Due to the sensitive and multi-disciplinary nature of this Turnkey Project, the Consultant employed site personnel on a full time basis. Personnel from FMG supervised construction and ensured that all quality control documents were completed. Specialist personnel were utilised for each discipline namely civil, mechanical, electrical and instrumentation/control. Inspections were done on the membranes in Holland and on the PSA Plant in Italy. The Client and Consultant in Johannesburg witnessed a factory acceptance test on the SCADA.

The Contractor had to prove all intermediate and final guarantee values during a four week trial period. These guarantee values dealt with all aspects of the project, from process related values such as water quality constituents to engineering issues such as the correct backwash rates and final water production rates. During this period the Consultant's personnel checked that all guarantee values were met. The reclamation plant was accepted as fully functional towards the end of 2002 and the Plant was officially inaugurated on 2 December 2002.

WATER QUALITY

The water quality produced meets the quality guidelines of the World Health Organisation, Rand Water (South Africa) and the Water Quality Guidelines for Namibia. Water samples are taken on a four hourly basis after each treatment process for analysis to ensure compliance with the stringent standards required. Health standards in Windhoek have been monitored closely since the inception of direct reclamation in 1968. No known water related outbreak of disease has been experienced.

COSTS

The cost of providing water from the Goreangab Plant is less than the alternative of developing further dams, conveyance and treatment systems in distant catchments. The environmental impact of dam construction and inter catchment transfer systems are also avoided.

The project was awarded at a value of N$92 million (R92 million) and the client made provision for contingencies of just over N$5 million. The project was completed for N$95 million resulting in a saving of more than N$2 million (N$1 = R1). The project was financed by the Kreditanstalt für Wiederaufbau (KfW) in Germany, the European Investment Bank (EIB) and the City of Windhoek.

Potable reuse is an indispensable element of the Windhoek water system and has proven to be a reliable and sustainable option. Water of exceptional quality can consistently be produced from treated domestic sewage.

For more information, please contact Charl van der Walt at GFJ Consulting Engineers, Pretoria.
Tel: (012) 342 1234
E-mail: charl.vdwalt@gfj.co.za

SOUTHERN AFRICA & AFRICA 2003

ENVIRONMENTAL COURSES

A series of environmental courses on the new environmental law, implementing environmental management systems and audits, water quality management, environmental risk assessment, air quality management, the legal framework for managing water in South Africa, etc will be held throughout the year by CEM (the Centre for Environmental Management) at the University of Potchefstroom (PU for CHE).
Enquiries: Mrs Dydre Greeff/Mrs Madel Lottering.
Tel: (018) 299 2714 or (018) 299 2725.
Fax: (018) 299-2726.
E-mail: aokdg@puknet.puk.ac.za or aokml@puknet.puk.ac.za
Web: http://www.puk.ac.za/education/shortcourses/environment.html

ENVIRONMENTAL MANAGEMENT OCTOBER 7-9

A short course on environmental management will be held at the Post-Graduate Centre of the University of Pretoria.
Enquiries: Ms Marina Nell.
Tel: (012) 420 5010.
Fax: (012) 362 5285.
E-mail: marina.ce@up.ac.za

MINE WATER NOVEMBER 3-5

A conference with the theme "Implementing sustainable development in mining: From talk to action" will be held at the Indaba Hotel in Sandton.
Enquiries: The Conference Administrator – attention: Ms Ammie Wissing, Conference Planners, PO Box 36782, Menlo Park 0102.
E-mail: wissing@iafrica.com
Tel: 012-348 4493.
Fax: 012-348 1563.

2004

WATER SUPPLIERS FEBRUARY 19-24

The Union of African Water Suppliers (UAWS) will be holding its 12th bi-annual African congress in Accra, Ghana.
Enquiries: Mr Dennis D Mwanza, Water Utility Partnership (WUP), 05 BP 2642, Abidjan, Cote d'Ivoire.
Tel: +225 21 2408 28.
Tel (direct line): +225 21 2408 13.
Cell: +225 070199 01.
Fax: +225 21 75 8656/7.

WASTEWATER JUNE 27-30

An IWA specialist conference on water and wastewater management for developing countries will be held at Victoria Falls in Zimbabwe.
Enquiries: Innocent Nhapi, Department of Civil Engineering, University of Zimbabwe, Box MP167, Mount Pleasant, Harare, Zimbabwe.
Tel: 263 (0) 4 303288.
E-mail: wamdec2004@eng.uz.ac.zw
Web: www.uz.ac.zw/engineering/civil/wamdec2004

OVERSEAS

GROUNDWATER MAY - DECEMBER 2003

The Centre for Groundwater Studies (CGS) in Australia will be organising short courses on groundwater related themes throughout the year. CGS courses can be counted towards a Master of Science in Groundwater Hydrology degree offered by Flinders University in Adelaide, Australia.
Enquiries: Trevor Pillar
Tel: 61 8 8201 5632.
Fax: 61 8 8201 5635.
E-mail: cgs.training@groundwater.com.au
Web: www.groundwater.com.au

DESALINATION SEPTEMBER 28 - OCTOBER 2

The International Desalination Association's conference and workshop on integrated membrane systems for brackish water, seawater and wastewater desalination will be held in Paradise Island, Bahamas.
Enquiries: AMTA/IDA
Tel: 760 643 1750.
Fax: 760 643 1761.
E-mail: amtaorg@aol.com
Web: www.membranes-amta.org

BENCHMARKING SEPTEMBER 29 - OCTOBER 2

A conference on the global developments in water industry performance benchmarking will take place in Perth, Australia.
Enquiries: Office of Water Regulation.
Tel: +61 (08) 9213 0100.
E-mail: benchmarkingwater@wrc.wa.gov.au
Web: www.wrc.wa.gov.au/owr/

SEDIMENTS SEPTEMBER 30 - OCTOBER 3

The 2nd international conference on the remediation of contaminated sediments will take place at the Palazzo del Cinema, on the island of Lido, Venice, Italy.
Enquiries: The Conference Group, 1580 Fishinger Road, Columbus, OH 43221, USA.
E-mail: info@confgroupinc.com
Tel: 614 488 2030.
Fax: 614 488 5747.
Web: http://www.battelle.org/environment/er/conferences/sedimentscon/default.stm

WATER RESOURCES OCTOBER 5-9

The 11th world congress on water resources - water resources management in the 21st century will be held in Madrid, Spain.
Enquiries:
E-mail: wwater2003@cedex.es
Web: www.cedex.es/iwracongress2003/

WASTE MANAGEMENT OCTOBER 6-10

The 9th international waste management and landfill symposium will be held in Cagliari, Sardinia, Italy.
Enquiries: Professor R Cossu, Image Department, University of Padua, Via Loredan 20, 35131 Padova, Italy.
Tel: +39 049 8726986.
Fax: +39 049 8726987.
E-mail: eurowaste@tin.it or info@sardiniasymposium.it

WEFTEC 2003 OCTOBER 11 – 15

The Water Environment Federation's 76th annual technical exhibition and conference will be presented in Los Angeles, California, USA.
Enquiries: WEF
Tel: 1-703 684 2452.
Fax: 1-703 684 2401.
E-mail: confinfo@wef.org
Web:www.weftec.org/

CONTAMINATED SOILS OCTOBER 20-23

The 19th annual international conference on contaminated soils, sediments and water will take place at the University of Massachusetts in Amherst, MA, USA.
Enquiries: Denise Leonard
Tel: 413 545 1239.
E-mail: info@UMassSoils.com
Web: www.UMassSoils.com

WATER-RELATED DISEASES NOVEMBER 1-8

The 1st annual international scientific conference on water-related diseases, sponsored by the Global Council on Water Diseases, will be held in Abuja, Nigeria.
Enquiries: Please visit the conference website: http://www.gcowd.com

WASTEWATER NOVEMBER 12 -14

The 4th international symposium

on wastewater reclamation and reuse will be held in Mexico City, Mexico.
Enquiries: Blanca Jimenez, Instituto de Ingenieria, UNAM, Apartado Postal 70-472, Ciudad Universitaria, 04510, Mexico, D.F. Fax: +525 622-3433. E-mail: iwa@pumas.iingen.unam.mx
Web: http://www.iwahq.org.uk/template.cfm?name=wwrr4

GROUND WATER DECEMBER 9-12

The National Groundwater Association's 2003 Ground Water Expo will be presented in Orlando, Florida, USA.
Enquiries: NGA, Dept 481, Columbus, OH 43265-0481.
Tel: 800 551 7379/614 8987791.
Fax: (614) 898 7786.
E-mail: ngwa@ngwa.org
Web: http://www.ngwa.org/convention/national.html#2003

WATER HISTORY DECEMBER 11-14

The 3rd conference of the international water history association will be held in Cairo, Egypt.
Enquiries: Alv Terje Fotland.
E-mail: a.fotland@iwha.net
Tel: +47 55 589315.
Fax: +47 55 589892.
Web: http://www.iwha.net/

2004

WASTEWATER JANUARY 26-29

A conference on wastewater treatment for nutrient (nitrogen and phosphorus) removal and reuse will be held in Bangkok, Thailand.
Enquiries: Dr Ajit Annachhatre, School of Environment, Resources and Development, Asian Institute of Technology, PO Box 4 Klong Luang, Pathumthani 12120.
Tel & Fax: 662 524 5644.
E-mail: ajit@ait.ac.th

SMALL SYSTEMS FEBRUARY 11-13

The 6th IWA Specialist Conference on Small Water and Wastewater Systems will be held in Fremantle, Western Australia.
Enquiries: Dr Kuruvilla Mathew, Environmental Technology Centre – Murdoch University, South Street, Murdoch, WA, 6150, Australia.
Tel: +61 (0) 8 9360 2896.
Fax: +61 (0) 8 9310 4997.
E-mail: K.Mathew@murdoch.edu.au

WASTEWATER TREATMENT FEBRUARY 11-13

The 1st international conference on On-site Wastewater Treatment and Recycling will be held in Fremantle, Western Australia.
Enquiries: Dr Kuruvilla Mathew, Environmental Technology Centre – Murdoch University, South Street, Murdoch, WA, 6150, Australia.
Tel: +61 (0) 8 9360 2896.
Fax: +61 (0) 8 9310 4997.
E-mail: K.Mathew@murdoch.edu.au

DRAINAGE MARCH 21-24

The 8th international drainage symposium together with the 10th national symposium on individual and small community sewage systems, will be held in Sacramento, California, USA.
Enquiries: American Society of Agricultural Engineers, 2950 Niles Road, St Joseph, MI 49085.
Tel: 269 429 0300.
Fax: 269 429 3852.
E-mail: AS31@umail.umd.edu
Web: http://www.asae.org/meetings/sew04/index.html

ENVIRO 04 MARCH 28 - APRIL 1

The Enviro Convention and Exhibition is an event incorporating six conferences dealing with sustainable industry, water (planning for the future), waste, sustainable energy, business of the environment and advances in odour management. It is a biennial event and will be held in Sydney, Australia.
Enquiries: Event Manager, Quitz Pty Ltd, PO Box 632, Willoughby NSW 2068 Australia.
Tel: +61 (0)2 9410 1302.
Fax: +61 (0)2 94100036.
E-mail: quitz@bigpond.net.au
Web: www.enviroaust.net

AUTOMONET APRIL 19-20

An international conference on automation in water quality monitoring - networks for surveillance, early warning and process control strategies and techniques of real time water quality assessment - will be held in Vienna, Austria.
Enquiries: Bernadette Ebner, KUONI Incoming Service GmbH, Wahringer Str 2-4/40, A-1090, Vienna, Austria.
Tel: +43(0)1 319 7690-26.
Fax: +43(0)1 3191180.
E-mail: bernadette.ebner@kuoni.at

FILTRATION APRIL 19-23

The 9th world filtration congress, sponsored by the American Filtration and Separations Society, will be held in New Orleans, Louisiana, United States.
Enquiries: Ms Kathy Hemming
Tel: 1 703 538 1000.
Fax: 1 703 538 6305.
E-mail: Kathleen.hemming@verizon.net
Web: www.afssociety.org

PIPES APRIL 19-22

A conference called Plastic Pipes XII will be held in Milan, Italy.
Enquiries: Michael Ball, PPI
Tel: (202)462 9607.
E-mail: mball@plasticpipe.org
Web: www.plasticpipe.org

WATERSHED 2004 JULY 11-14

The Water Environment Federation (WEF) will sponsor an international speciality conference in Dearborn, Michigan, USA, on integrated resource management and environmental protection using watershed approaches.
Enquiries: WEF, 601 Wythe Street, Alexandria, VA 22314-1994, USA.
Tel: 703 684 2400 x 7010.
E-mail: watershed04@wef.org

HYDROLOGY JULY 12-16

This conference – Hydrology: Science and Practice for the 21st Century – will be held in London, United Kingdom, and is designed to bring together hydrologists involved in scientific research and operational practice to address key issues affecting hydrology in the new century.
Enquiries: For more information, please visit the website: www.hydrology.org.uk/bhs2004/welcome.htm

ANAEROBIC DIGESTION AUGUST 29 - SEPTEMBER 2

The 10th World Congress – Anaerobic Digestion 2004 - with the theme: Anaerobic Bioconversion for Sustainability will be held in Montreal, Canada.
Enquiries: Mrs Marie Lanouette, National Research Council Canada, 1200 Montreal Road, Building M-19, Ottawa, ON, Canada K1A0R6.
Tel: (613) 993-0414.
Fax: (613) 993 7250.
E-mail: ad10.2004@nrc-cnrc.gc.ca
Website: www.ad2004montreal.org

WORLD WATER SEPTEMBER 20-24

The International Water Association (IWA) will hold its 4th world water congress in Marrakesh, Morocco.
Enquiries: AMEPA
Tel: +212 3763 2093.
Fax: +212 3763 7682.
E-mail: sehi@elan.net.ma
Web: http://www.iwahq.org.uk/

Stinki-Buster Family Bursts Onto Environmental Scene

They're here to stay and fight every practice that is detrimental to water and people's health!

The Stinki-buster family first appeared on a colourful poster in Mogale City (Krugersdorp) during National Water Week in March this year. The concept is that Blinki represents all that is good and clean, especially as far as water and health are concerned, and Stinki stands for dirty, contaminated water and an unhealthy environment. The family, developed for Rand Water was created to eliminate all the Stinkis in the community.

THEATRE

Along with the poster came a theatre group from Ivory Park. They illustrated the bad environmental practices that are encountered in communities, while educating the spectators as to how to ensure good practices. The two main characters, Stinki – the embodiment of all that is bad and Blinki, the water-wise, paying for services, protagonist, treat the spectators to digestible solutions to environmental nightmares! But, the whole Stinki-buster family is involved in the daily running of community life with its hazards and challenges, doing the right thing! They apply all the water-wise principles endorsed by Rand Water's Water-wise campaign with the grandfather as the Solomon (wise man) of the environment. Together, the family is 'busting' all the Stinkis in the community.

SNAKES AND LADDERS

And then came the game! The traditional 'Snakes and Ladders' was used as model. This board game using the Stinki-buster characters works as follows: *If you do the right and positive things regarding water you will climb the ladders of success, but if you succumb to wasting water or other negative behaviour such as pollution, wasting water, you will be swallowed by the nasty snakes!* Says Willie Potgieter of Water Resources Planning (WRP), this game is a very effective educational tool that can be used in many learning areas of outcomes-based education in a classroom environment. While playing, learners can pick up the important life skills that can lead to sustainable living. Through this game, our precious water resources are getting the exposure needed to ultimately ensure water-wise living.

COLOURING BOOK

The Stinki-buster family did not forget our little people. For the purpose of getting the water messages to the pre-schoolers and lower grades, a beautiful bright colouring book was created. It depicts Stinki and Blinki and the rest of the family doing their daily chores. This book aims to assist learners to better understand good and bad practices for water use. With the assistance of a teacher/adult person these concepts can be conveyed to the little ones while they are busy with a creative action, also acquiring "water-wise" life skills.

The use of these materials in a project run by Rand Water in Sedibeng has been very successful in so far as it is really changing people's lives for the better! Learners are prepared to associate with the friendly Blinki (and the Stinki-buster family), rather than to team up with the destructive Stinki and its crew.

For more information, contact WRP, tel: 012 346-3496;
e-mail: williep@wrp.co.za