THE
WATER WHEEL

ISSN 0258-2244 May/June 2006 Volume 5 No 3

Mine water to drinking water in Witbank

TWO GREAT SHOWS FOR WEST AFRICA

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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.

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LETTERS TO THE EDITOR

Climate change research still foggy

In the March/April 2006 edition, there are a number of issues that are of interest and I comment as follows on two issues which are interlinked.

By its very nature the letter (from AH Charnaud in the March/April 2006 edition of *the Water Wheel*) only scratches the surface, but there are interesting comments. The floods on the Orange River in 1988 were largely generated in the Northern Cape (note the same occurrence this year on an 18-year cycle) and the 1925 flood was one of the biggest to pass Fluitjieskraal just downstream of Vanderkloof. I know that we used this flood in the analysis of the floods for Gariep Dam in 1963/4. The floods your correspondent refers to all appear to be related to the lower Orange and would include the Vaal.

It is worth noting that the Weather Service put out a long-range forecast for the summer rainfall area which predicted average but more probably below average rainfall. At the same time our much maligned (mainly by climatologists) Prof WJ Alexander, Emeritus Professor of Water Resources Engineering at Pretoria University, forecast a wet summer based on his data-based model (not the process models of the climatologists) and it is my understanding that the Department of Water Affairs & Forestry disaster management unit based their contingency plans on the Professor's forecast. It is indeed fortunate that they did.

The climate model of NOAA in the US suggests drastic drying of the Sahel in the next 50 years. This runs counter to previous forecasts for a wetter period. How is it that different models give such vastly different forecasts? Are the climatologists playing games with us to get more research funding? Is the Water Research Commission funding some of such research without asking some really hard questions?

Prof Alexander has shown that the whole of South Africa has become on average wetter by about 9% to 10% over the last 80 years. (A similar finding has been made in the United States). These findings are all based on factual data that has been scrupulously analysed. He has also proposed reasons for the cyclical nature of our large floods as observed by Mr Charnaud in his letter. Using data-based models removes the need for the many assumptions that are inherent in the process models used by the Weather Bureau.

The climatologists appear to use process models almost exclusively but it is very difficult to get details of the assumptions they are making and how they arrive at their predictions. If their models are so accurate can they replicate the findings of Prof Alexander about our rainfall patterns or am I being too optimistic and will they duck the challenge? What are the weather mechanisms that have led to these changes? Do we really know?

The challenge to the climatologists is to stop claiming that all our problems are due to man-made interventions caused by CO_2 emissions. Could they first please explain what gave

rise to all the previous ice ages and the variations in sea level from 70 m above our present level 15 000 years ago to 60 m below our present level 11 000 year ago (approximately the end of the last ice age from which we presumably are still emerging). What are the forces at play and can man in fact make any impact? No one disagrees with the proposition that our climate (in whatever way it is defined – a check in the dictionary gives some interesting variations) is changing as it is a dynamic process and will always vary over time. We only need to ask why Greenland is so named to appreciate this proposition. The environmentalists and climatologists need to meet the challenges and play open cards with the public.

Robert Blyth, PR Eng, Cape Town

The Water Wheel values your opinion.
Write to the Editor at
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fax (012) 331-2565 or
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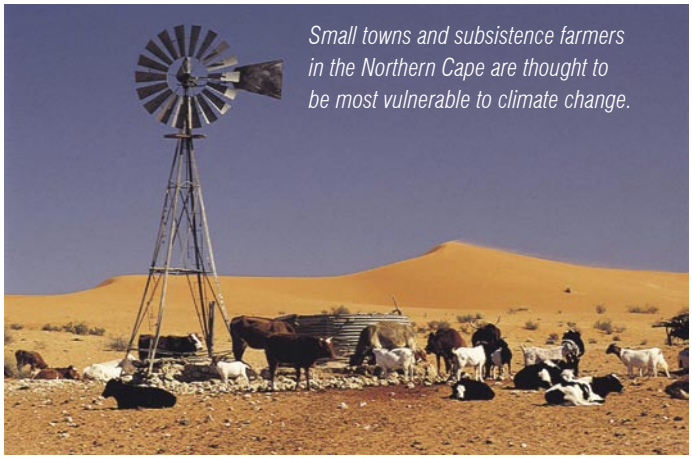
Help for small towns dealing with climate change



Small towns and subsistence farmers in the Northern Cape are thought to be most vulnerable to climate change.

Photo courtesy of SA Tourism

A new publication which can assist small towns, especially in the Northern Cape, deal with the onslaught of climate change, has been published by the Water Research Commission (WRC).

Most climate projection models suggest a decrease in rainfall over the western part of southern Africa in the coming decades. The Northern Cape, where water resources are already scarce, small towns and subsistence farmers are thought to be most vulnerable.

Most rural residents (or 30% of total population) are dependent on groundwater reserves. However, the reliability of groundwater supplies is not adequate due to, among others, restricted resource availability, quality of water, erratic precipitation, drought and water management issues.

The WRC funded study, undertaken by the University of Cape Town, investigated the adaptive capacity of small towns and communities in the Northern Cape to climate variability, specifically drought. In the past, poor planning for emergencies and the lack of structured contingency plans have resulted in water shortages during times of scarce rainfall. An estimated 25% of the towns have, as a result, over-utilised their groundwater resources.

At present, water shortages are dealt with reactively, i.e. by tanking water in from other areas. However, this is not reported to be a sustainable long-term solution.

According to the authors of the WRC report, climate change will add an additional layer of stress to which adaptive strategies and adaptation policies will have to be directed. "There is a need for proactive strategies at local and national level to deal with the impacts of drought and climate change."

The authors note that emphasis should be placed on demand side management. Several strategies are described in the report, including the implementation of dry sanitation systems rather than flush toilets; public information and school education programmes; as well as rising block tariffs and water restrictions.

"Groundwater is likely to be most severely affected, with the groundwater table dropping due to reduced recharge. Strict groundwater management systems should be put in place, with early warning mechanisms to report depleted groundwater reserves. Continual monitoring of the aquifer against climate conditions will provide some knowledge of the future potential under projected climate conditions."

It is also recommended that each local authority develop a locally-based strategy, which follows the multi-criteria analysis tool set out in the report. It is recognised that there is huge deficiencies in capacity in some areas, and this will have to be addressed if the challenges brought on by climate change are to be overcome.

- *To order the WRC Report No 1500/1/06 contact Publications at Tel: (012) 330-0340 or E-mail:* publications@wrc.org.za

Water by numbers

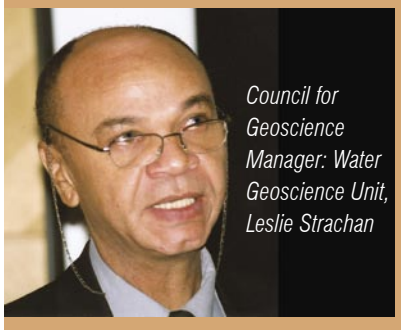
- **1,6 million ℓ/s** – The speed of the Augrabies falls, following the release of water from the overfull Gariep Dam. Usually the waterfall, known as the 'Place of Great Noise' by the indigenous Namas, flows at 30 000 ℓ/s.
- **US$500-million** – The funds being mobilised by the African Development Bank until 2007 to finance clean water projects and a social hygiene programme to benefit rural regions in Africa.
- **40%** – The improvement in access to basic sanitation, according to the Department of Water Affairs & Forestry (DWAF). By March, about 3,91 million households still did not have safe toilet facilities.
- **84%** – The average percent of rural households around the world that participate in agricultural activities, according to the UN Food and Agriculture Organisation. In some areas this figure is as high as 99%.
- **30%** – The black economic empowerment target set by the newly signed construction charter by 1013. The charter further targets a 10% economic interest in the hands of black women.
- **2,8 billion** – The number of people believed to be living in water-stressed and water-scarce parts of the world.
- **83%** – The percentage of bucket systems that have been replaced to date in Gauteng. According to Premier Mbhazima Shilowa, all the 12 000 remaining buckets will have been replaced by June ahead of the 2007 target.
- **R130-million** – The funds set aside by DWAF and the KwaZulu-Natal Department of Agricultural and Environmental Affairs for the eradication of alien plantation in the province.
- **85%** – This is how full South Africa's main dams are, compared with 65% last year. According to DWAF, only the Eastern Cape, Limpopo and the Western Cape have less stored water than the same time last year.
- **14%** – The percentage of South Africa's estimated 800 wetlands which are fully protected.

Polluted mine-water still threatens Gauteng

If the now defunct compartment adjacent to existing gold-mining operations at ERPM on the Central Rand Basin is allowed to fill up with underground water unabated, decanting of polluted mine-water could occur within less than two years, with potential disastrous consequences for the greater Johannesburg metropolitan area.

So reports manager of the Water Geoscience Unit at the Council for Geoscience, Leslie Strachan. He was speaking at a mine-water symposium in Johannesburg earlier this year organised by the Geological Society of South Africa.

At present, ERPM is pumping out about 35 Mℓ/day of water with financial assistance from government to enable mining in the South Vertical Shaft. However, water in the adjacent No 3 Shaft is rising at about 1,3 m a day at a level of about 800 m below surface.



Council for Geoscience Manager: Water Geoscience Unit, Leslie Strachan

Strachan told delegates it was very difficult at this stage to predict exactly when decant would take place, since basin dynamics are not yet fully understood.

One possible solution for the ERPM situation is to construct a 2,5 km shaft and siphon (about 200 m below surface) from the mine's South Vertical Shaft to manage water through controlled decant at a point southwards on the Elsburg Spruit near the Elsburg Dam. The water can then be treated at the dam.

The Council of Geoscience has been undertaking an investigation into this and other mine-water pollution issues on the Witwatersrand on behalf of the Department of Minerals & Energy since 2002. The project aims to, among other, prevent ingress of (clean) water into underground mine workings both from surface and underground sources and recommend solutions to the State to reduce risks associated with minewater in the Witwatersrand area.

It is interesting to note that the West Rand Basin, near the Cradle of Humankind, is the only area included in the study where decanting is taking place at present. Investigations are continuing in each basin, including the identification of ingress areas; development of groundwater geohydrological conceptual models, and the establishment of shaft level and sampling networks.

Turning 'Cinderella' of water sector into princess

The Cinderella of water services, sanitation, came under the spotlight with the first ever National Sanitation Week held in South Africa in March.

The theme of the week was 'Washing Hands for a Healthy Life' with government encouraging its citizens to practice safe health and hygiene habits. "Germs play a major part in the millions of cases of diarrhoea among children under the age of five. Almost 50% of all reported cases diseases are related to poor sanitation," said Minister of Water Affairs & Forestry Buyelwa Sonjica.

R2 m. for flood victims

The North West government has donated more than R2-million to about 300 families affected by recent floods in Taung.

The donation is part of the Social Relief of Distress programme. Only families who do not already receive social grants qualified for assistance.

Meanwhile Africon Consulting Engineers has assessed the extent of damage caused by the floods on behalf of the provincial government. According to the National Disaster Management Committee set up in the area a long-term plan is being formulated to ensure Taung is not susceptible to future floods.

Diary

ASSET MANAGEMENT
MAY 17-19
A workshop on strategic asset management and maintenance for the public sector will be held at the Ridgeway Hotel, Randburg. *Enquiries: Steve Matkhutle; Tel: (011) 803-0009; E-mail:* workshops@tci-sa.co.za*; Web:* www.tci-sa.co.za

DESALINATION
MAY 18-21
An international conference on desalination and desalination plant rehabilitation will be held in Sharm-El-Sheikh, in Egypt. Topics to be discussed include thermal desalination processes, brackish water desalination, renewable energy and desalination, and economics of desalination plants, among others. *Enquiries: Desalination Studies & Technology Centre; Alexandria University; Tel: (+203) 591 1152/0096; Fax: (+203) 591 4340/0720; E-mail:* adst@frcu.eun.eg

WATER RESOURCES MANAGEMENT
MAY 23-25
The conference on Integrated Water Resources Management & Challenges of Sustainable Development, to be held in Marrakech, Morocco, is being organised by the International Association of Hydrogeologists. *E-mail:* gire3d@ucam.ac.ma

CAPACITY BUILDING
MAY 24-26
The Third International Water Association Young Researchers Conference will be held at Nanyang International University, in Singapore. The conference aims to provide an international forum at which postgraduate researchers and young professionals working in the water sector can present their research work and network with their peers. *Enquiries: Tom Williams; Tel: +44 (0)20 7654 5500; Fax: +44 (0)20 7654 5555; E-mail:* YRC2006@iwahq.org.uk*; Web:* www.yrc2006.iwa-conferences.org

Diarrhoea killing children in Khayalitsha

Diarrhoea and gastro-enteritis have overtaken HIV/Aids as the biggest killer of children under five years in Khayalitsha, outside Cape Town.

According to news agency Health-e, the child-related deaths related to these diseases have doubled over the last four years. This is mainly due to the critical lack of sanitation. Authorities have been battling to serve residents of this burgeoning settlement, with an estimated 48 000 new arrivals every year.

At least 55% of people in Khayalitsha live below the poverty line, with half of all adults reported to be unemployed. About one in three people have no access to on-site water. Health-e reports that there is an average of 105 people per toilet in Sites B and C in Khayelitsha. In 2004, 280 of 7805 children born died at birth, with 60 children under five dying of diarrhoea in 2004.

Irrigation symposium calls for papers

The South African National Committee on Irrigation & Drainage (SANCID) has called for papers for its symposium, 'the Changing Face of Irrigation in Southern Africa', to take place from 15 to 17 November, at the Aventura Swadini Resort in Mpumalanga.

The irrigated agriculture industry is one where continuous change is a reality. Water users and their support services have in the last decade had to deal with new challenges due to changes both in the policy and the natural environment they operate in. Access to water is being regulated through new water allocation methods; urban development and economic growth is putting additional strain on regional water resources, thereby increasing competition for water and demanding water efficiency; and access to international markets requires strict control measures to be adhered to, to name but a few.

In light of these developments, the SANCID symposium will be used to evaluate the changes that have taken place. Sub-themes include, inter alia, design, technologies and innovation; irrigation management; the institutional environment; human resource development; and natural resources and environmental impacts.

- *Abstracts for papers for the symposium need to be submitted to programme co-ordinator Litha Magingxa at E-mail: magingxal.sci@mail.uovs.ac.za by 16 June, 2006. For more information, contact Isobel van der Stoep at Tel: (012) 420-2174 or E-mail: Isobel.vanderstoep@up.ac.za or visit: www.sancid.org.za*

SLUDGE MANAGEMENT
MAY 29-31
The IWA Specialised Conference on Sustainable Sludge Management: State of the Art; Challenges and Perspectives, will be held in Moscow, Russia. *Enquiries: Tel/Fax: +7 095 101 4621; E-mail: IWAconference@sibico.com; Visit: http://IWAsludge.sibico.com*

AQUATIC RESOURCES
JUNE 19-23
The Southern African Society of Aquatic Scientists together with the Phycological Society of Southern Africa are hosting a joint conference with the theme 'From Source to Sea'. The conference, to be held in Maputo, Mozambique, will focus on aspects related to shared water resources and includes themes on research, conservation and management of aquatic resources in southern Africa. *Enquiries: Dr Richard Greenfield; Tel: (011) 489-2444; Fax: (011) 489-2286; E-mail: rgr@na.rau.ac.za*

SOIL SCIENCE
JULY 9-15
The 18th World Congress of Soil Science will be held in Philadelphia, US. *Enquiries: Soil Science Society of America; Tel: +1 (608) 273-8095; Fax: +1 (608) 273-2021; Web: www.18wcss*

WATER TREATMENT
JULY 10-12
An international conference on 'Decentralised Water Systems' will be held in Australia. The conference, being organised by Murdoch University, will focus on design, operation, maintenance and management of small treatment units and the uptake of decentralised systems. *Enquiries: Dr Kuruvilla Mathew; E-mail: K.Mathew@murdoch.edu.au; Web:" www.etc.murdoch.edu/au/conferences/decent.html*

ASSET MANAGEMENT
JULY 11-14
The First World Congress in Engineering Asset Management will take place at the Conrad Jupiters Conference Centre, in Queensland, Australia. *Visit: www.wceam.org*

EVAPORATION
JULY-17-21
A Water Research Commission project workshop on Evaporation Estimation will be held at the University of KwaZulu-Natal, Pietermaritzburg. There is a workshop aimed at students and one aimed at practitioners. *Enquiries: Bennie Hoosen; Tel: (033) 260-5510; E-mail: hoosenb@ukzn.ac.za; Web: http://fred.csir.co.za/extra/project/evapmon*

ENVIRONMENTAL WATER QUALITY
AUGUST 14-18
The Institute for Water Research at Rhodes University will be hosting a course on the introduction to managing environmental water quality. The registration deadline is 24 July. *Enquiries: Dr Heather Davies-Coleman or Juanita McLean, Tel: (046) 622-2428; Fax: (046) 603-8532; E-mail: course@iwr.ru.ac.za; Web: www.ru.ac.za/institutes/iwr/ucewq*

WRC project sows success in FS

Minister of Water Affairs & Forestry Buyelwa Sonjica has praised the Water Research Commission's (WRC's) rainwater harvesting initiatives which are helping to feed thousands of villagers in Thaba Nchu, in the Free State.

Speaking at Water Week Celebrations in the area earlier this year she said that innovative technologies, such as rainwater harvesting, had the potential to contribute to substantially reducing food insecurity, poverty and unemployment. "We need to use innovation, science and technology to open new horizons for better water use." She also argued for an increase in research into groundwater harvesting methods.

Water harvesting is based on the principle of depriving part of the land of its share of rain (which is usually not used productively)

and adding it to another part where it can be used beneficially. The rainwater harvesting technique developed through WRC-funded research combines the advantages of water harvesting, no-till, basin tillage and mulching on high drought-risk clay soils. The practice reduces total runoff to zero and evaporation from the soil surface considerably, thus increasing crop production in the semi-arid areas with low potential clay soils.

Research has shown that, on average, in-field rainwater harvesting technology increased crop yields by about a third when compared to the use of conventional tillage techniques. Crops such as maize, beans spinach and fruit have been grown successfully in Thaba Nchu. The technique is now being taught to farmers in the Eastern Cape and KwaZulu-Natal.

Maintenance crucial, says DBSA

Growth and development depend not so much on the rapid rollout of infrastructure itself, but rather on the sustainable delivery of the services which that infrastructure makes possible.

This is the main message from the new report published by the Development Bank of Southern Africa (DBSA) on the state of infrastructure and service delivery in South Africa. The *Infrastructure Barometer 2006* was published in March. Commenting on the publication, outgoing DBSA CEO Mandla Gantsho said: "The importance of appropriate and sustainable infrastructure as a foundation for socio-economic development, and particularly in improving the quality of people's lives, is no longer a matter for debate. The focus is on meeting the many challenges of delivery facing South Africa and other countries on the continent."

In 1996, a household consisted of 4,47 persons, and in 2001, it was only 3,8 persons.

Part I of the report focuses on the contribution of infrastructure to growth, through an examination of national level infrastructure sectors – including water and sanitation. Part II, on the other hand, examines the infrastructure requirements of municipalities in general and marginal communities in particular, and introduces a financial model which assesses the financial sustainability of reducing the country's municipal infrastructure backlogs.

Interestingly, the financial modelling of the rollout of municipal infrastructure (to meet national coverage targets) indicates that, in addition to the estimated R140-billion in capital expenditure, municipalities will also need to increase income by 50% over the same period to cover operation and maintenance of the new infrastructure. This suggests that the present trend towards high levels of service will lead to even more serious financial difficulties for many municipalities when operational costs far outstrip revenues.

The report also shows that between 1996 and 2001 households increased by 5,33% against the 2,09% increase in the population. The reason for this increase in the number of households was the change in household size. In 1996, a household consisted of 4,47 persons, and in 2001, it was only 3,8 persons. This finding is critical for planning and for rollout of municipal infrastructure.

Among the other issues addressed in the report include the question of the present realities governing decision making; a series of complex strategies challenges, the maintenance of South Africa's ageing infrastructure stock and dysfunctional institutional arrangements.

- To access the report, go to www.dbsa.org

Boost for water and sanitation in Africa

Efforts to provide Africa's poor with safe water and sanitation has received a boost following the signing of a Memorandum of Understanding between UN-Habitat and the African Development Bank (AfDB).

The two parties will provide grants to the value of about US$217-million over the next five years. It is expected that this will lead to additional opportunities for follow-up fast track loans from the bank of about US$362-million to speed up efforts to reach the Millennium Development Goals on water and sanitation.

Under the terms of the memorandum, the AfDB and UN-Habitat will collaborate in several areas, including raising political ownership, and advocacy in specific areas such as resource mobilisation in urban and peri-urban pro-poor activities in water and sanitation schemes; security, gender and environmental activities.

US$20-bn a year needed for Africa to reach MDGs

Africa needs US$20-billion a year to attain the United Nations Millennium Development Goals of halving poverty by 2015. This was revealed at the Fourth World Water Forum held in Mexico in March.

To date, Africa has developed only 3,8% of its water resources for supply, irrigation and electrical power. This situation implies the need for hefty investment in various areas. This investment must go hand-in-hand with changes in regional and national policy and capability that will pave the way for governance and the appropriate implementation of policies, such as integrated water resources management.

In a report prepared for discussion, the main challenges for the continent with regards to water resources development are said to be:

- The need to obtain financing to expand access to water, sanitation, food security and the production of energy;

- The ability to deal with climate variations and natural disasters;
- Reducing the negative effects of human activity on water resources;
- Increasing agricultural areas; and
- Developing security in production of energy.

Maths helping to save biodiversity

Mathematical formulae normally used by economists and engineers are now being applied in determining which of the world's biodiversity hotspots to save first. ABC Science Online reports that ecologist and mathematician Prof Hugh Possingham and team at the University of Queensland have applied mathematical tools to save as many species as possible. They have developed a method of prioritising hotspots to take into account a range of features apart from how many species an area has. High priority is given to areas where habitat is fast disappearing, little of the area has already disappeared, and where the cost of conserving habitat is low.

World's rivers captured in detail

The World Wildlife Fund has developed data and created maps of the world's rivers to provide researchers with information about where streams and watersheds occur on the earth's landscape and how water drains the land surface.

HydroSHEDS provides hydrographic information in a consistent and comprehensive format for regional and global-scale applications. It offers a suit of geo-referenced data sets, including stream networks, watershed boundaries, drainage directions and ancillary data such as flow accumulations, distances and river topography information.

Data for many international river basins are patchy, and remote areas are often poorly mapped. For some regions of the world, such as the Congo Basin in Africa and part of the Amazon Basin in South America, HydroSHEDS will provide the first high-resolution digital river maps produced for these large areas.

Data is freely available for non-commercial use and can be accessed at www.worldwildlife.org/hydrosheds or http://hydrosheds.cr.usgs.gov

Snippets

- CSIRO, in Australia, has launched an online **Water Quality Calculator** to help manage irrigation water quality to sustain crop production. Visit www.cotton.crc.au/CottonLOGIC/WQC/
- Achim Steiner has been named the new head of the **United Nations Environment Programme**. Steiner, who hails from Germany, was DG of the World Conservation Union.
- **Climate change** could become a major source of global conflict over the next 30 years, with countries battling for control over water supplies, British Defense Secretary John Reid has warned. He said military planners have already begun considering the consequences of climate change for British forces over the coming three decades.
- Botswana is still struggling to control a **diarrhoea** epidemic that has reportedly claimed the lives of more than 470 children. Contaminated water, unhygienic practices, poor sanitation, infant feeding-bottle contamination and ongoing person-to-person transmission has apparently all contributed to spreading the disease.
- Researchers at the University of Hawaii have reportedly developed a new, inexpensive **filtration system** that removes not only bacteria but also heavy metals from water. The new product, dubbed MicroNose, comprises granules made of clay, iron and other materials.

Millions of litres saved through Cape project

The City of Cape Town is saving about 5,7 million litres of water a day (the average daily water consumption of 38 000 people) following the commissioning of a R30-million water recycling plant at Chevron (previously Caltex).

The plant, a joint-venture project between the oil refinery and water company Improchem, draws treated effluent from the nearby Potsdam Wastewater Treatment Works in Milnerton for reuse in the oil refining process. The water is purified to near drinking water quality using clarification, ultrafiltration and reverse osmosis after which it is supplied to the refinery as steam and cooling water. Not only is this saving the city water, but it also reduces the amount of treated effluent discharged from the Potsdam works to sea via the ecologically sensitive Milnerton lagoon. It is reported that this project, initiated a few years ago, has inspired Chevron to launch a new R110-million upgrade for its own wastewater treatment plant within the next few months, pending approval from environmental authorities. Through this upgrade, the company hopes to bring the refinery in line with international best practice for wastewater treatment, while reducing public concerns with regards to odour and visual impact of the Chevron effluent at sea.

At this stage it is envisioned that the upgrade will include the construction of a 6 000 m^3 equalisation tank to remove contamination spikes; two moving bed biological reactors (MBBRs) and ancillaries; and operation of the existing retention basin on empty to provide 2 000 m^3 additional surge control.

The MBBR bioreactors are the core components of the upgrade. The mechanism used in the MBBRs is an accelerated biodegradation process involving specially designed carrier media kept in suspension by blowing air through the reactor. The carrier media provide a large surface area on to which the biological microorganisms can attach, and affect the acceleration breakdown of hydrocarbons.

The MBBRs will overflow to two clarifier/thickeners to remove solids from the effluent. The resultant filter cake will contain about 40% dry solids and be produced in quantities of about 5,2 m^3/day to be stored in removable skips. The remaining treated effluent will be pumped to sea via the existing sea outfall.

Dam reaches halfway mark

Construction on the concrete-faced rockfill Berg River Dam project is more than 50% complete, reports the Berg River Dam Project Joint Venture.

The dam will be the highest concrete-faced rockfill dam in South Africa. Construction started on the dam last year after the Berg River was successfully diverted through a temporary intake structure and conduit. At the time of writing, the contractors were preparing for the first face slab construction.

Company shorts

- Mzimkulu Msiwa, previously general manager: operations, has taken over as acting CEO of **Umgeni Water** after the unexpected resignation of Gugu Moloi. Moloi, who took over the reigns from Cromet Molepo in 2002, has sighted personal reasons for her surprise departure, one year ahead of her contract.
- South Africa's largest steel plant **Mittal Steel's** Vanderbijlpark mill has launched its new R222-million zero-effluent discharge main treatment plant. The plant ensures that no process water is released beyond the boundaries of the mill.
- **CSIR** has launched its new corporate identity. With a positioning statement that reads, "our future through science", the organisation hopes to develop a distinctive brand to support its recent reconfiguration with a renewed focus on science and research.
- Construction on the Vaal River Sub-system Augmentation Project (**VRESAP**) is well underway following the sod turning ceremony in March. The R2,5-billion emergency project, which will supply water mainly to Eskom and Sasol, will be completed by July 2007.
- The **ERWAT Laboratory** has once again been awarded the Department of Water Affairs & Forestry tender for the supply of laboratory analysis services for Gauteng. The contract is reportedly worth some R2,365-million a year.

Water on the Web

www.iclei-europe.org/logowater
This is the website of the LoGo Water project, an European Union funded project that brings together African and European researchers along with local governments from southern Africa, to jointly contribute to support local governments to improve water resources management in the region.

www.idadesal.org
This is the official website of the International Desalination Association, which commits itself to the development and promotion of the appropriate use of desalination and desalination technology worldwide. Apart from IDA news, the website offers features information on several desalination plants around the world.

www.onefish.org
The oneFish Community Directory is an Internet portal providing access to information on fisheries and aquatic research and development. An open-access environment is provided whereby individual researchers, as well as research institutions and organisations, can publish their research output directly on the Web.

www.yearofplanetearth.org
The United Nations General Assembly has proclaimed the year 2008 to be the United Nations International Year of Planet Earth. This is aimed at, among others, reducing risks for society caused by natural and human-induced hazards; discovering new natural resources and making them available in a sustainable manner; determining the non-human factor in climate change; and detecting deep and poorly accessible groundwater resources.

UNIVERSITY OF PRETORIA, DEPARTMENT OF CHEMICAL ENGINEERING WATER UTILISATION DIVISION

2006 SHORT COURSES

SC 1: INDUSTRIAL WASTE MANAGEMENT	**5 – 7 Jun**
SC 2: MEMBRANE PROCESSES	**2 – 4 Aug**
SC 3: WATER QUALITY MANAGEMENT AND EFFLUENT TREATMENT	**4 – 8 Sept**
SC 4: OPERATION OF WATER AND WASTEWATER TREATMENT PLANTS	**16 – 20 Oct**

LECTURER: **Prof. C.F. Schutte** **Prof. E.N. Chirwa** **Prof. J.J. Schoeman** (Invited lecturers from industry)
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SC 1 Industrial Waste Management (presented over a period of three days)

COURSE CONTENT:

- Introduction to Waste Management
- Common Hazardous Wastes: Nomenclature, Industrial Uses, Disposal Histories
- Common Hazardous Wastes: Properties and Classification
- Source Analysis
- Partitioning, sorption, and Exchange at Surfaces
- Volatilisation
- Abiotic and Biotic Transformations
- Contaminant Release and Transport from the Source
- Concepts of Hazardous Waste Toxicology
- Hazardous Waste Risk Assessment
- Approaches to Hazardous Waste Minimization, Remediation, Treatment and Disposal
- Minimum Requirements for the Handling, Classification and Disposal of Hazardous Wastes
- Minimum Requirements for Waste Disposal by Landfill
- Minimum Requirements for Monitoring at Waste Management Facilities

Course fees: R3950 per person.
(For three or more participants from the same company, the fee is reduced to R3500 per person)

SC 3 Water Quality Management and Effluent Treatment (presented over a period of five days)

COURSE CONTENT:

Background aspects
- S.A. water sources, hydrology and geohydrology.
- Basic water microbiology.
- Basic water chemistry.
- Biological, chemical and physical water quality parameters.
- Point and diffuse sources of pollution.
- National Water Act and other regulatory requirements

Treatment processes
- Overview of water and wastewater treatment processes.
- Flow of material and mass balances.
- Physical-chemical treatment processes.
- Municipal wastewater.
- Biological treatment processes.
- Sludge treatment and disposal.

Course fees: R5750 per person.
(For three or more participants from the same company, the fee is reduced to R5000 per person)

SC 2 Membrane Processes (presented over a period of three days)

COURSE CONTENT:

- General background of reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and electrodialysis reversal (EDR).
- Principles of operation.
- Membrane and module types and characteristics.
- Mass transfer, flux and rejection and recovery.
- Performance evaluation.
- Pretreatment requirements and processes.
- Membrane fouling and cleaning.
- Membrane evaluation and autopsies.
- Cost considerations.
- Practical design of processes using selected software programs.
- Membrane bioreactors (MBR)
- Applications and case studies

Course fees: R3950 per person.
(For three or more participants from the same company, the fee is reduced to R3500 per person)

SC 4 Operation of Water and Wastewater Treatment Plants

COURSE CONTENT:

The course is presented over a period of five days: the first two days will cover drinking water quality and water treatment processes, while the last three days will cover effluent quality and wastewater treatment processes.

Drinking water treatment
- Basic water chemistry.
- Drinking water quality requirements
- Process description and functioning of drinking water treatment processes
- Operation of treatment processes
- Process and plant optimisation and trouble shooting
- Residue treatment and disposal.

Wastewater treatment
- Basic water microbiology.
- Wastewater quality parameters and discharge regulations
- Overview of wastewater treatment processes.
- Operation of activated sludge processes
- Process and plant optimisation and trouble shooting
- Sludge treatment and disposal.

Course fees: There are different options regarding attendance of this course
- Attend only the water treatment part (first 2 days) at R2950 per person
- Attend only the wastewater treatment part (last 3 days) at R3950 per person
- Attend full course (whole week) at R 5750 per person

For three or more participants from the same company, the fee for the whole week is reduced to R5000 per person.

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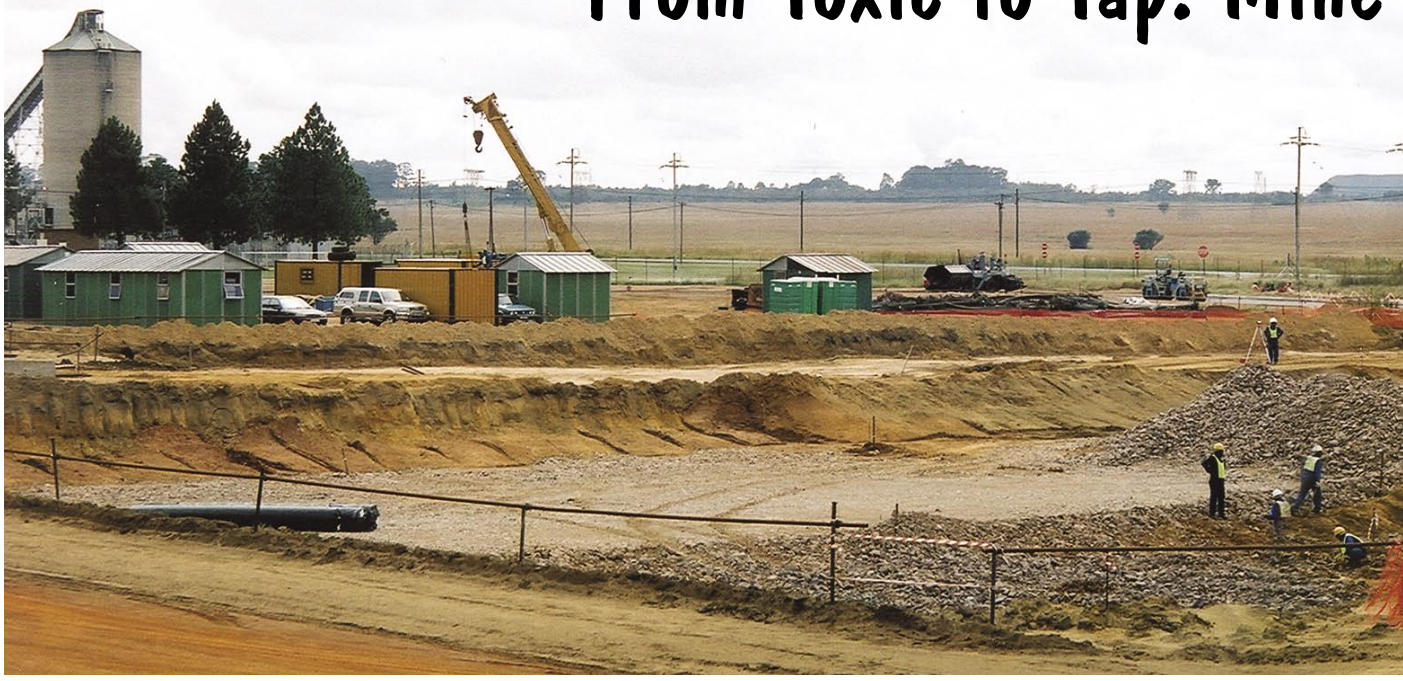
From Toxic to Tap: Mine-



A historic project to convert polluted mine-water into quality drinking water is moving ahead in Emalahleni (Witbank), Mpumalanga. The R300-million joint initiative between Anglo Coal and Ingwe Collieries will see the treatment of 20 Mℓ/day of acid mine drainage (AMD) from three collieries for sale to the Emalahleni Local Municipality. *Lani Holtzhausen* reports.

When travelling through the Highveld in Mpumalanga, there is no doubt why South Africa is the third-biggest coal producer in the world. Mine after mine tells of the legacy of this area, in which up to 90% of the country's saleable coal is mined.

However, more than a century of open-cast and underground mining has impacted on the surrounding environment. Coal mining has a significant effect on the hydrological cycle, with surface water working its way into underground voids and becoming polluted as it comes into contact with exposed sulphur-bearing pyrite.

It is reported that the accumulation of water in active mines has already increased to the extent that it hampers mining activities and poses a potential safety risk. Where mining activities have ceased, the underground workings are filling with water.

Collieries exploiting the Northern Witbank Coalfields have to continuously pump out this water to reach the coal seams. According to South African environmental law, this water has to be suitable for release back into the environment, and may need to be managed and treated before being released so as to reduce pollution of the country's scarce water resources. This has become even more important in the Upper Olifants catchment, where many of these mines are situated, as the area suffers from a chronic shortage of water.

With future mining developments earmarked for the short to medium term in the Middle Olifants and Steelpoort catchments, which are situated downstream of the Upper Olifants catchment, it has been recognised that the water that is available requires crucial management.

A NEW APPROACH

A few years ago, having exhausted all other water management options Anglo Coal and Ingwe Collieries agreed to cooperate to find a long-term solution. The result of years of research and development is the Emalahleni Water Reclamation Project which, for the first time in South Africa, will see the abstraction and treatment of mine-water from existing and old mines to a level that is fit for use by the local municipality. It is anticipated that water will be treated from Anglo Coal's Kleinkopje and Greenside collieries, as well as Ingwe's South

-Water Becomes a Commodity

Witbank Colliery, a defunct operation where mining stopped in 1969.

While the sale of the water will allow the mining companies to offset some of the costs of treating the water, it seems this project has come just at the right time for the Emalahleni Local Municipality. According to Emalahleni head of department: water services Lindela Tshwete the municipality, which is the water services authority for the Witbank area is already exceeding its allocated amount of water from the Witbank Dam, its sole bulk water resource, drawing some 80 to 90 Mℓ/day at present.

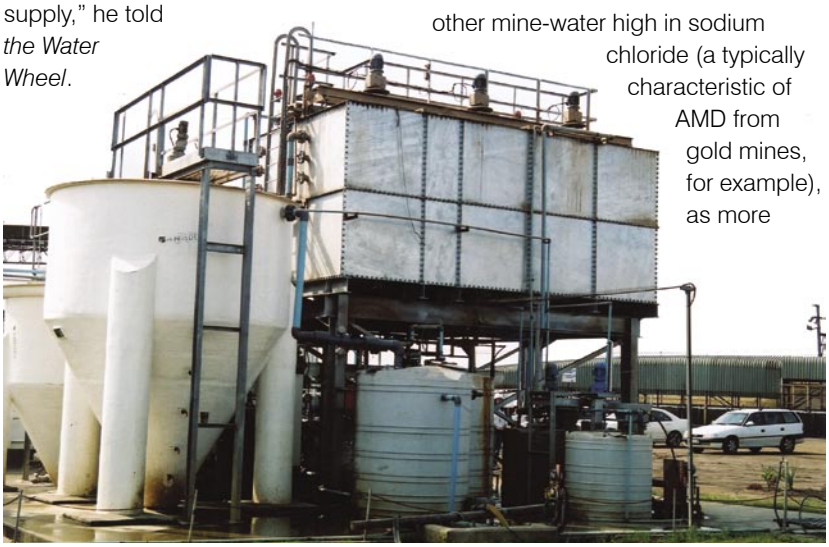
Tshwete reports that the municipality has decided to buy into the Emalahleni Reclamation Project rather than the Vaal River Eastern Sub-System Augmentation Project (VRESAP), which is also being constructed at present, for a number of reasons. "Buying bulk water from the VRESAP pipeline would have cost about twice as much as water from the mines. In addition, we would have received raw water from the pipeline, which would then first have to be treated. The water received from the reclamation project, on the other hand, will already be of good drinking water quality."

Anglo Coal senior project manager Peter Gunther reports that the municipality requires an additional 20 Mℓ/day of water which the mining companies can easily provide with this project. "Studies have shown that the mined out voids in the area could hold more water than the Witbank Dam, resulting in the mines being a huge potential source of water supply," he told *the Water Wheel*.

Above: *The construction site of the first 20 Mℓ/day mine-water to tap water reclamation plant being constructed outside Emalahleni (Witbank), Mpumalanga at present.*

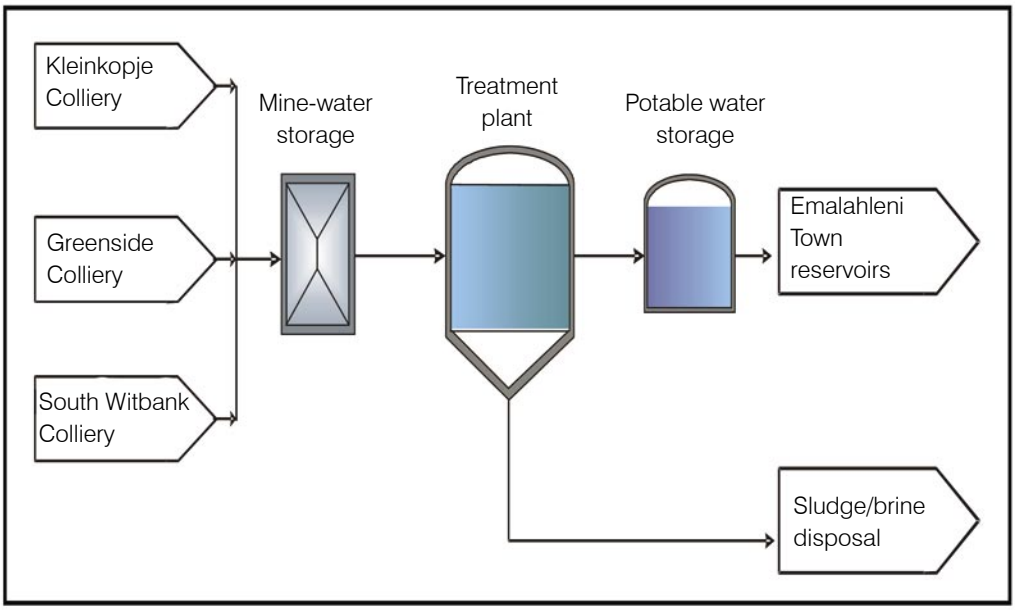
THE TREATMENT PROCESS

Most mines in this catchment area have a water quality associated with calcium-magnesium-sulphate. This makes the water more treatable than other mine-water high in sodium chloride (a typically characteristic of AMD from gold mines, for example), as more



Flows of 120 m³/day were achieved at the demonstration plant.

treatment processes can be used to desalinate the waters.



Main components of the Emalahleni Mine-water Reclamation Project.

Following the evaluation of a number of possible water treatment technologies, Johannesburg firm Keyplan's design was selected. A 120 m³/day demonstration plant was established at Landau Colliery to prove the efficacy of the technology over a trial period of three months. One of the most important criteria was to achieve a high yield. "We were initially aiming for a yield of 95%, but actually succeeded in achieving a yield of 98% during our trials," reports Gunther. This not only increases the output from the plant, but minimises the volume of waste that has to be dealt with.

Following approval in September, construction of the main plant started in November last year. Water will be collected at the three mines and conveyed via three separate pipelines to two storage facilities at the treatment site. To cater for seasonal fluctuations the two storage dams will have a combined capacity of 46 Mℓ. The acidic water will firstly undergo a neutralisation process using CSIR's lime/limestone treatment process. This increases the pH allowing metals such as iron, aluminium and manganese to precipitate out.

Following clarification, the water will be treated using ultrafiltration (UF) to remove any remaining metals. This process will also remove any bacteria that might be in the water. About 500 UF membranes will be installed. This will be followed by reverse osmosis using spiral membranes to remove remaining salinity. Just under 1 200 RO membranes will be used. The membrane treatment process is repeated three times to ensure maximum yield and maximum brine concentration. Two identical process trains are being established, each capable of producing a minimum of 14 Mℓ/day.

The treated water will be stored in two 10 Mℓ/day dome-shaped concrete reservoirs before being pumped to an Emalahleni municipal reservoir about 9 km away for distribution to consumers. To ensure an uninterrupted supply all critical mechanical and electrical components required to keep the plant at full capacity must have an installed standby.

The process will produce about 100 m³/day of brine and 100 t/day of gypsiferous waste. The brine will be exposed of in evaporation ponds with a capacity of 330 000 m³. All necessary regulatory steps have been followed to establish these hazardous ponds which will be double plastic-lined to eliminate any seepage.

An on-site laboratory will provide analyses of the water for process purposes that will also be used to check for some basic parameters of the potable water before it is pumped to the municipality.

The CSIR lime/limestone process is used to increase the pH of the water prior to ultrafiltration.

Results from the demonstration plant indicated that the pH levels of the water was boosted from 2,9 to between 6,5 and 7,5. The total dissolved solids count was reduced from as high as 4 500 mg/ℓ to 135 mg/ℓ while the sulphate content was reduced from 3 500 mg/ℓ to 80 mg/ℓ. The treated water is within the SABS 241 Class 0 drinking water quality limit.

FIRST FOR SOUTH AFRICA

It has been a long and interesting journey for the two mining companies since the signing of their cooperation agreement. Ingwe project engineer Wendy Mey says the fact that two competing mining companies have cooperated to find a solution that will not only benefit the environment, but also surrounding communities, is a milestone in itself.

At the time of writing the reclamation plant was 20% complete. It is hoped to complete construction before the end of 2006, with commissioning starting in early 2007. By the third quarter of that year, the plant should be fully operational.

Meanwhile negotiations are being finalised with the Emalahleni Local Municipality, with the final I's being dotted and T's being crossed on the water supply contract. Gunther notes that throughout the project regular consultation has ensured that the local authority's interests have been recognised. Tshwete confirms that the municipality has been part of the process from the start, and has praised the mining companies' efforts in establishing a good relationship with its prospective client.

In addition, a series of community meetings have been held to appease any fears the people of Emalahleni might have with regard to drinking treated mine-water. Tshwete says communities have been well informed, and a regular newsletter, in which people can comment on the project, and where queries can be answered, has been suggested to allay any future concerns.

After the pre-treatment process the water is clarified before being sent through the ultrafiltration membranes.

Spiral reverse osmosis (RO) membranes are used to remove salinity in the water. Up to 500 RO membranes will be installed on the main plant.

Getting all the regulatory requirements in place has been quite a challenge. A water supply licence has never been issued for treated mine-water in South Africa before, for example. According to Gunther, all the relevant authorities have been represented on the project steering committee to ensure the process goes as smoothly as possible.

A similar project is now in the pipeline for the Steve Tshwete (Middelburg) area, where similar mine-water management issues are being experienced. Mey notes, however, that it will not merely be a case of replicating the technology. The area faces different challenges, for example, there are more open-cast mines, and the water will have to be piped further. Studies are ongoing to find the best solution for this area.

It is anticipated that a regional water supply company may eventually be established to manage the distribution of the water treated by the water reclamation projects. It is hoped that these projects, as well as similar future initiatives, will provide a long-term solution to South Africa's mine-water problems.

All photographs courtesy of Corinne de Kock

An investigation by the Department of Water Affairs & Forestry (DWAF) has uncovered a ticking health time-bomb in the Free State as dozens of mismanaged sewage treatment systems are discharging disease-causing pollutants into the surrounding environment. Lani Holtzhausen reports.

In the Free State, a significant proportion of the municipal wastewater systems are pond based (60), with some 47 using so-called waste stabilisation ponds alone. These are usually located in the smaller towns, several of which still use bucket sanitation.

Waste stabilisation ponds, known locally as oxidation ponds, are internationally accepted low unit cost wastewater treatment systems suited especially to smaller communities. The ponds are large shallow basins enclosed by earthen embankments wherein the raw sewage is treated by entirely natural processes involving bacteria and algae. Such a wastewater treatment system would consist of several ponds. The ponds are closed systems and according to South African laws are not allowed to discharge into the environment.

HEALTH HAZARD

Recently, complaints from communities living close to some of these systems prompted DWAF to investigate the state of these systems in the Free State. What they uncovered is quite disconcerting. More than half of the 47 systems are illegally discharging disease-carrying water into the environment, either the open veldt or nearby streams and rivers. This was revealed at the EnviroWater conference, held in Stellenbosch in February. In addition, 13% of the ponds are used for irrigation, in many cases, illegally.

DWAF water pollution control officer Corinne de Kock told delegates that grab samples collected at the final ponds revealed that the water would definitely have an impact on human health as all of the samples tested for faecal coliforms exceeded maximum allowable South African standards. In addition, 66% of the samples tested for ammonia exceeded the maximum allowable standards of 2 mg/ℓ while levels of up to 170 mg/ℓ of nitrate were measured. “It is clear that in many instances, these pond systems

are an unacceptable risk to human life and the environment," said De Kock.

DISREGARD TO MAINTENANCE

In all of the cases, no fault could be found with the design of the systems. In fact, 70% of the pond systems were found to be well designed. Rather the poor water quality and poor state of the systems stemmed mainly from poor operation and maintenance as well as poor community awareness.

"In the worst cases, trucks merely dumped raw sewage, mostly the contents of the sanitation buckets, into the ponds and drove away. There were no operators on site, and no fencing or secure access, allowing free access to the ponds."

This while oxidation pond systems are not traditionally difficult to operate and maintain. "It is quite simple really. Screenings both at the inlet and within the ponds need to be cleared and then either burned or taken to an appropriate dumping site. In addition, vegetation needs to be cleared from the embankments," explained De Kock. "On-site operators need protective clothing and, most importantly, the systems have to be fenced off to prevent nearby communities from close contact with the ponds."

In many cases, however, this was not the case. While there are exemplary pond systems, maintenance was sorely lacking in many cases. "In the worst cases, trucks merely dumped raw sewage, mostly the contents of the sanitation buckets, into the ponds and drove away. There were no operators on site, and no fencing or secure access, allowing free access to the ponds."

When maintained properly oxidation ponds are acceptable low unit cost ways of treating domestic sewage.

People were found walking on the embankments, while children played in the water. Animals, like cattle were found to be deliberately kept on some of the sites to graze and drink. Most communities were not aware of the potential hazard of these systems.

In the cases where there were operators, they were poorly resourced in terms of operational equipment and the necessary protective clothing. One operator was found clearing screenings from the ponds with his bare hands. Furthermore, operator facilities were sorely lacking at most pond sites.

"This assessment has shown that while waste stabilisation ponds play a very important role and appropriate waste treatment function in the Free State, they are in many instances failing in their primary objective of effective abatement of environmental pollution," said De Kock. "In fact, some of these systems are ticking health time-bombs. They are endangering surface water and groundwater resources on which many people depend for drinking water. In some water-scarce areas the communities are dependent on one or two boreholes. It is the only water they have got."

An investigation of oxidation ponds in the Free State has revealed that more than half are illegally discharging disease-carrying water into the environment.

"In many cases, the managers of the local authorities in question either seemed unaware of the problems or apathetic. There seems to be a severe lack of capacity and finances to deal with these issues."

Will anything be done to rectify the situation? "In many cases, the managers of the local authorities in question either seemed unaware of the problems or apathetic. There seems to be a severe lack of capacity and finances to deal with these issues," noted De Kock. Some local authorities told the investigating team that they were waiting to upgrade to conventional sewage treatment systems. "However, if they cannot even manage a supposedly simple system, how will they manage a more complex one?" asks De Kock.

DWAF has offered its assistance to the municipalities in question in an effort to rectify the situation. A basic operations and maintenance manual for oxidation systems has also been compiled to assist municipalities in this regard.

Top right: *Animals, like cattle, were found to be deliberately kept on some of the sites to graze and drink.*

Middle right: *All of the pond samples tested for faecal coliforms exceeded maximum allowable South African standards.*

Bottom right: *At the sites where there were operators they were often poorly resourced in terms of operational equipment and the necessary protective clothing. This operator was found cleaning the scum of the ponds with his bear hands.*

Old Dortmund tanks were revamped to act as the biological sulphate reducing reactors. All the tanks are covered to prevent the escape of hazardous sulphurous gases.

A 10 Mℓ/day full-scale plant to treat toxic mine-water from the Grootvlei gold mine using primary sewage sludge has been commissioned at ERWAT's Ancor Wastewater Treatment Works on the Far East Rand. *Lani Holtzhausen* reports.

The plant, constructed at a cost of R15-million, is treating sulphate rich acid mine drainage using the Rhodes BioSURE Process, a patented cost-effective biological treatment option developed over nearly a decade with funds from the Water Research Commission. This is reported to be the first full-scale plant of its kind in the world.

Polluted mine-water from underground mine workings is becoming an increasing problem in South Africa as more mines close down resulting in water, both from the surface and underground, filling up the worked out shafts and becoming polluted with heavy metals and minerals. Grootvlei, one of the last remaining operational gold mines on the Far East Witwatersrand Basin, pumps about 75 Mℓ/day of water from its No 3 shaft to gain access to its gold reserves.

FINDING A SUSTAINABLE SOLUTION

Situated near the ecologically sensitive Blesbokspruit Ramsar site, the mine has actively sought sustainable ways reduce ingress into its workings and to cost-effectively treat the water it pumps out. After careful evaluation of several technologies, the BioSURE process was selected.

For the last two years, the technology has been tested through a 2 Mℓ/day pilot plant situated at Ancor. Construction started last year on the full-scale modular plant using existing abandoned infrastructure at the wastewater treatment works dating back from the 1950s and 1960s.

In essence, the BioSURE technology is a biological sulphate reduction process where sulphate rich water is placed together with primary sewage

sludge which acts as a carbon donor source in a reactor to create conventionally-treatable biosolid waste.

THE TREATMENT PROCESS

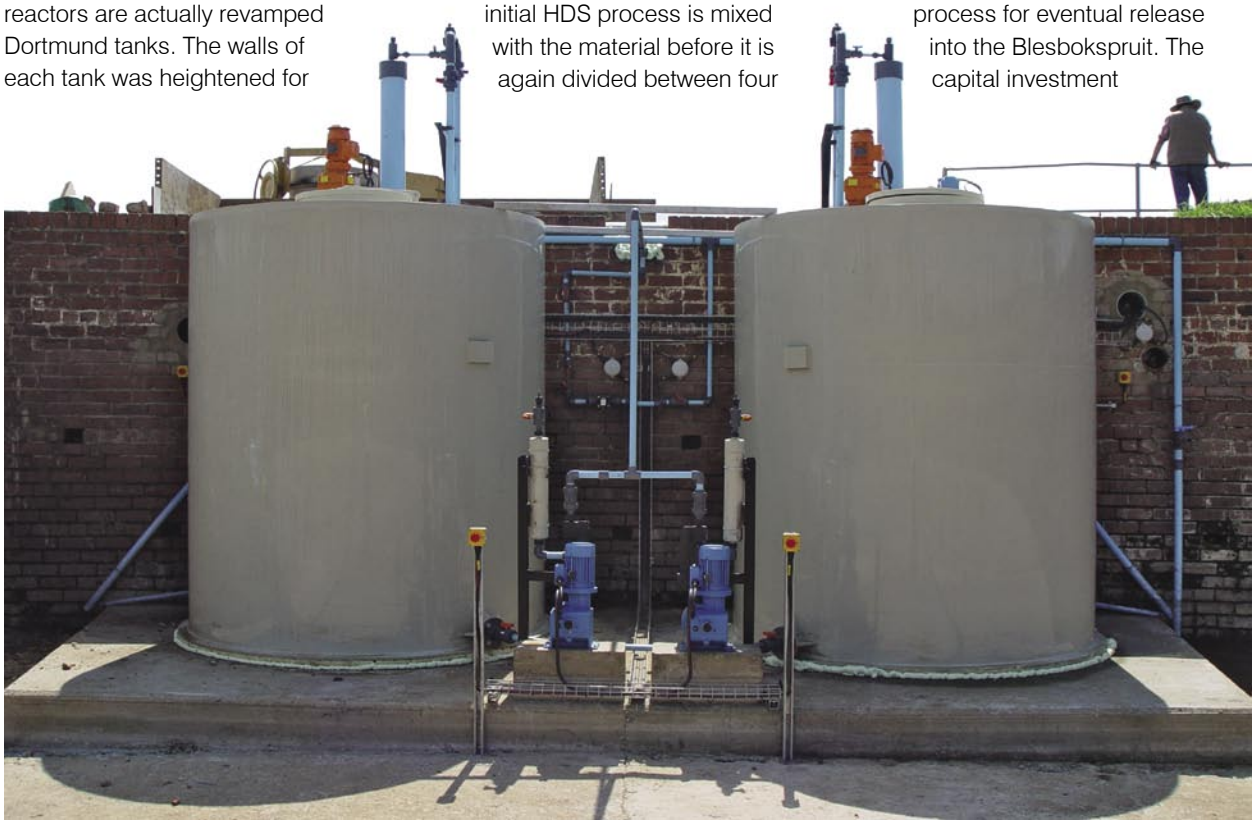
ERWAT project manager Leon Naudé reports that, being a first, the construction process was quite challenging, as the team had no reference and the process had to be fine-tuned while being built. He explains that, first, the pumped mine-water is treated at a high-density separation (HDS) plant to remove iron and condition pH levels. Then it is pumped two kilometres via a newly-constructed 10 Mℓ capacity pipeline to the Ancor works.

Mixing and splitter tanks at the new 10 Mℓ/day BioSURE mine-water treatment plant at ERWAT's Ancor Wastewater Treatment Plant.

The pipeline enters the works from a northerly direction. This mine-water is then mixed together with primary sewage sludge in a mixing tank from where a splitter box directs the material to eight biological sulphate reducing reactors or bioreactors. It is interesting to note that these bioreactors are actually revamped Dortmund tanks. The walls of each tank was heightened for an increased capacity of about 1,25 Mℓ/day per tank. All tanks, manholes, etc have been sealed to prevent the escape of any hazardous sulphurous gases.

The overflow water, now rich in sulphide is pumped through the main pump station to another mixing box. Here, iron slurry, a byproduct from the initial HDS process is mixed with the material before it is again divided between four reactor clarifiers for sulphide removal. The overflow water from these reactors now contains reduced sulphate levels and virtually no sulphide.

From here the material is pumped to Ancor's biofilters for removal of remaining Chemical Oxygen Demand (COD) and ammonia following the conventional sewage treatment process for eventual release into the Blesbokspruit. The capital investment



The polymer dosing station.

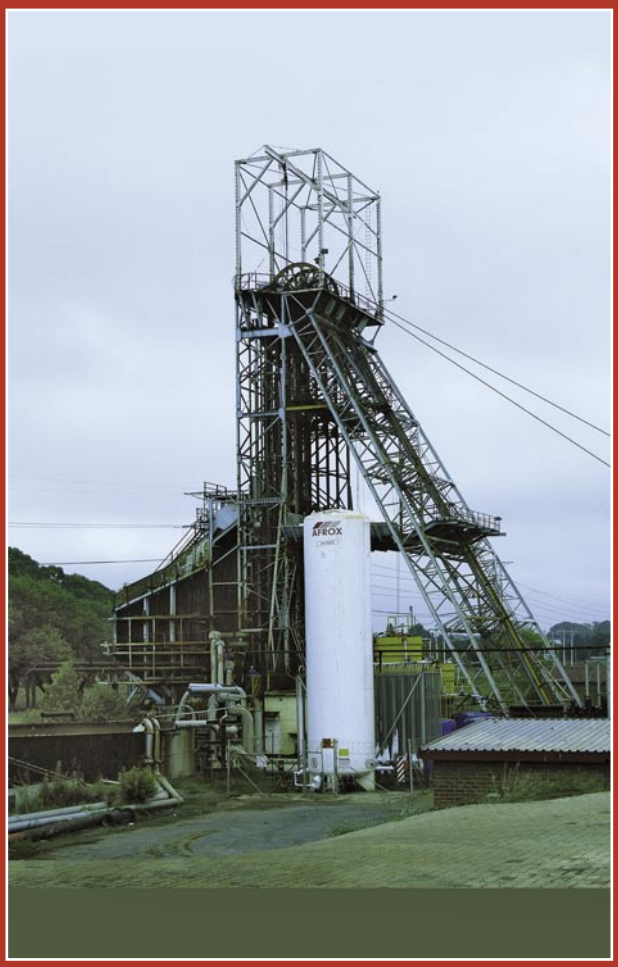
cost was carried by Grootvlei, and ERWAT is operating the plant on behalf of the mine.

Naudé tells *the Water Wheel* that all mechanical equipment has been installed on an on-duty and standby basis to ensure a smooth continuous process. At the time of writing the plant was gradually being ramped up to full capacity. "We are quite pleased with the outcome of the process," says Naudé. "This might prove the long-term sustainable answer mines have been looking for."

ERWAT, which holds a licence for the BioSURE process, is now looking at similar technology to treat other industrial sulphate-rich industrial effluent, such as tannery effluent.

The final water pump station.

PROJECTS PROGRESS TO REDUCE INGRESS AT GROOTVLEI



Apart from treating its mine-water, Grootvlei has embarked on several projects in an effort to reduce the volume of water pumped from underground.

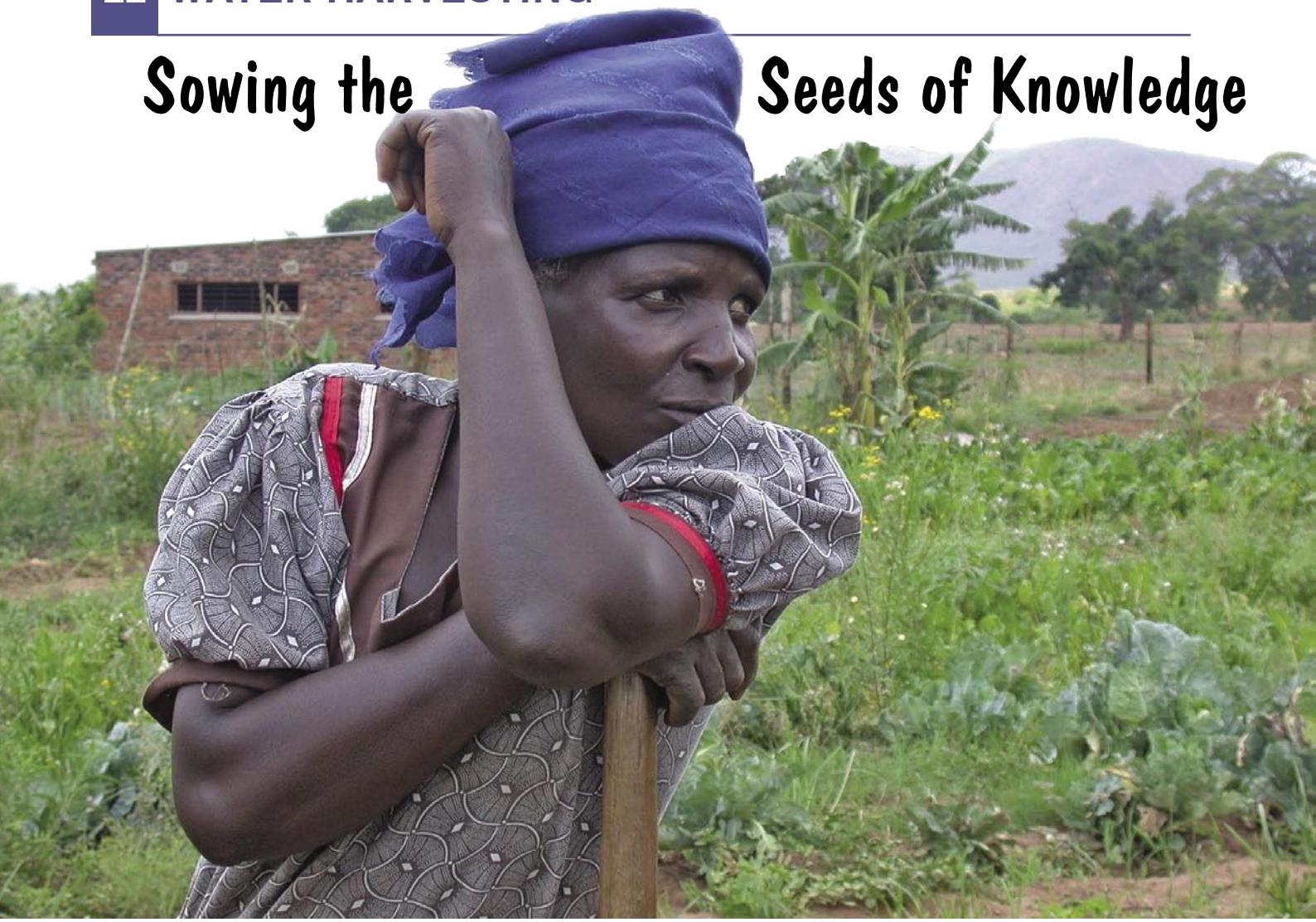
Construction of the first project to reduce seepage from surface water is nearly complete. This involves the diversion of the Blesbokspruit in the vicinity of the West Pit opencast complex to reduce infiltration from constant upstream industrial discharge. It is anticipated that this project, valued at R9-million, will reduce surface ingress by between three and five million litres a day.

The next focus area will be surface ingress at the No 8, 4 and 1 shaft complex. Underground water quality and flow measurements indicate that industrial discharges upstream of this area are affecting the volume and quantity of underground seepage.

Speaking at a mine-water symposium in Johannesburg earlier this year organised by the Geological Society of South Africa, group environmental manager Irene Lea said that, because of this third parties had to be involved in finding a solution. "We have made proposals to the Department of Water Affairs & Forestry and the Department of Minerals & Energy in this regard. They acknowledge that the process must be facilitated by government, and have subsequently proposes that a sub-committee be formed to which all stakeholders participate."

It is hoped that this committee will be initiated soon so that the process can be taken further.

Sowing the Seeds of Knowledge



It has been recognised that, while water-efficient production technologies, such as rainwater harvesting, can improve the plight of the poor, the mere creation of optimum techniques are not enough. The Water Research Commission (WRC) is now funding research, undertaken by Rural Integrated Engineering, into the best ways of disseminating this knowledge to the rural communities who can benefit most.

Improving food security among the poorest communities in South Africa remains one of the government's most important development thrusts. It is estimated that 35% of the country's population or 14 million people are vulnerable to food insecurity and that 43% of households suffer from food poverty. There is thus a dire need to introduce measures that will contribute towards increasing household food and/or income.

One of the overarching principles of the government's integrated food security strategy is that food insecure communities should be made agents of their own development. While research into smallholder farming has increased substantially in the last decade, much of the information generated has not been packaged for use by resource-poor, ill-educated community members.

The WRC project, which started last year, intends to develop training guidelines for food insecure households, and develop training material incorporating indigenous farming knowledge in efforts to improve present farming practices and systems. Research efforts have been focused on rural villages in the former homelands in KwaZulu-Natal, Eastern Cape and Limpopo.

HOUSEHOLD GARDEN PRODUCTION

The first step has been to identify current practices and constraints in household food production. It is reported that in the coastal areas that have a high rainfall, particularly the

former Transkei, rural production has become more important, and there has been a re-engagement among rural households of their agricultural resources.

The application of rainwater harvesting and intensive gardening can make a real difference, but the villagers require a helping hand in the initial stages.

It is believed that this re-engagement is mostly as a result of increasing levels of poverty and large-scale retrenchments of migrant and formal economy workers. Consequently, households have been forced to depend more on rural agricultural resources and on household subsistence production.

Yet, it appears that farming and even gardening still play a negligible role in the survival strategies of people who are residents in the rural village. These villages are essentially 'suburbs' of distant commercial and industrial centres with a critical role being played by urban wages and state transfers. Household incomes are depressingly low and there are no reserves to take care of domestic crisis or to finance initiatives.

It seems from case studies that dry land; field-based arable production does not rate highly in villagers' livelihood strategies. Household composition, often dominated by old people and young children, militate against field-based arable production. In villages subject to betterment planning, increased risks of theft, personal security considerations and stock damage mean that arable production in fields remote from the residences are being considered too risky.

The more intensive inter-cropping of maize, vegetables and fruit and other food crops in fenced gardens next to homestead is the most widely practiced. This homestead gardening is highly varied and differentiated, from the desperate sub-subsistence survival case to the more effective surplus, storage and exchange examples.

THE ROLE OF WATER

One way of increasing production is through water harvesting, which is essentially based on the principle of depriving (natural or artificially) part of the land of its share of rain (which is usually not used productively) and adding it to another part where it can be used beneficially.

This involves, among others, capturing the water that falls on the roof of the homestead and storing it in an underground tank. In addition, during a rainstorm runoff water from the rest of the plot can be gathered in

Disseminating information regarding optimum water harvesting techniques to rural communities is essential if food insecurity is to be overcome.

With an estimated 35% of households suffering from food poverty, there is a dire need to introduce measures to increase household food and income.

Household gardening is probably the only viable aspect of village-associated agriculture that can make a significant contribution to the livelihood strategies of individual households.

Harvesting rainwater, here through the use of underground reservoirs, is one way of increasing household food production, but community members need training.

drains made across the slope and taken down to the vegetable garden. This water can then be used to water the garden during dry spells during the rainy season or to make vegetable production possible in the dry season.

Harvesting and storing water, however, is only half the battle. Unless vegetables and fruit can be grown intensively so that there is high production of top-quality products the effort required will not be justified. It is also important that purchased inputs be kept to a minimum since cash is such a scarce commodity.

This implies the application of production methods based on organic principles, as well as the use of intercropping (growing different plants, for different seasons, on the same piece of land) and companion planting (mixing plants that help each other grow well), to name but a few.

THE ROLE OF LOCAL GOVERNMENT

It is believed that household gardening, in conjunction with limited livestock production, is probably the only viable aspect of village-associated agriculture that can make a significant contribution to the livelihood strategies of individual households. However, it appears that this has yet to be appreciated by many policy makers.

Rural development is the direct responsibility of the local government. The promotion of the technology of agricultural water use in homestead farming systems for improved livelihoods would seem to be in line with the current deployment of community development workers. These multi-skilled public servants are being deployed in communities to help people access government services and poverty alleviation programmes.

After training, these workers are expected to have the ability to plan, manage, implement, monitor, and evaluate programmes in a wide array of developmental disciplines, including water supply, agriculture, infrastructure development, and health.

The application of rainwater harvesting and intensive gardening can make a real difference, but the villagers require a helping hand in the initial stages. This is a challenge for the community development workers and all concerned with the plight of the villages.

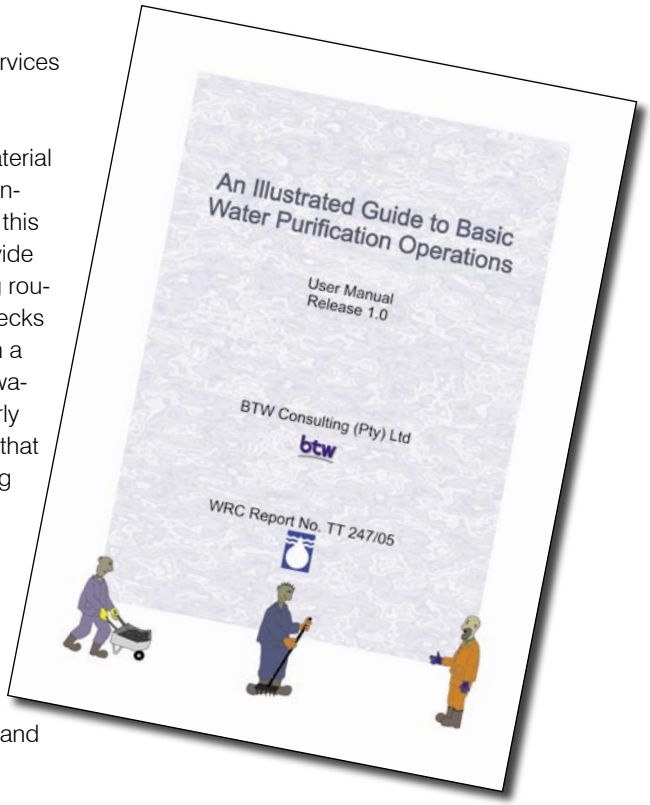
The intention is that the guidelines being developed under the WRC project will support the activities of these community development workers.

Cartoons Teach Water Plant Operators

Lack of available skills, especially in rural areas, has often been blamed for poor quality of drinking water. In an effort to improve skills levels, the Water Research Commission (WRC) has published a new basic training manual to assist water treatment plant operators.

The manual, *An Illustrated Guide to Basic Water Purification Operations*, is aimed mainly at entry-level water treatment plant operators, particularly those operating small and geographically isolated plants. "The people responsible for operating water treatment plants play an important and determining role in ensuring that the quality of our daily water supply conforms to the required standards," notes WRC CEO Rivka Kfir. "In this regard skills development and training of water treatment plant operators is a vital component of a consistent and effective service – especially in small water treatment facilities based in rural areas where support services are not often readily available.

A dearth of suitable training material especially for rural operator training prompted the WRC to fund this project. The guide aims to provide persons involved in conducting routine maintenance tasks and checks on water purification works with a better understanding of basic water purification activities. It clearly emphasises the important role that these operators play in ensuring that safe drinking water is supplied to all communities. It is intended for use by water care operators and attendants, water care managers and educators.



An example of a page in the manual.

Chapters are divided clearly according to the water purification process, from abstraction, chemical dosing and flocculation to disinfection, sludge treatment beds and storage. In addition, glossaries are provided explaining basic water treatment terms in different languages, including isiZulu, isiXhosa, Venda, Sepedi and Setswana.

Particular attention has been given to the needs of operators who have limited literacy skills. It has been developed in an illustrated colour format, with wide use of cartoons, to increase understanding of the underlying fundamental concepts to basic water purification works.

An electronic slide presentation on CD is also available for training purposes.

- To order *An Illustrated Guide to Basic Water Purification Operations* **(TT 247/05)** contact Rina Winter or Judas Sindana at WRC Publications at Tel: (012) 330-0340 or E-mail: publications@wrc.org.za

The new 15 000 m³ balancing dam is one of the most expensive features of the R70-million project.

Engineers Take on Mother Nature at Hartebeest-fontein

How do you upgrade a sewage treatment works while ensuring continuous operation during one of the most severe rainy seasons in years? Just ask the project team at ERWAT's Hartebeestfontein Wastewater Treatment Plant where improvements totaling R70-million are currently being undertaken. Lani Holtzhausen reports.

Located to the east of Kempton Park, on the East Rand, the Hartebeestfontein works was originally established in 1977 comprising three 10 Mℓ/day treatment modules. The plant treats wastewater from the industries in Spartan and Isando as well as households in the Kempton Park area.

Wastewater is processed using a two-stage activated sludge process. Each stage is a complete processing unit comprising aeration, clarification and sludge return. The primary stage is aimed mainly at Chemical Oxygen Demand (COD) removal, while the secondary stage is for nitrification.

In 1986, a side-stream Phostrip (biological phosphate removal) plant was retrofitted. This was followed by the addition of a third inlet works module in 1992 and a single 15 Mℓ/day treatment works, resulting in the works' total present capacity of 45 Mℓ/day. In 1995, a tertiary treatment system was designed and implemented to handle chemical dosing to allow for more effective phosphate removal.

IMPROVING EFFLUENT STANDARDS

The sewage treatment works has historically been subjected to unusually high peak flows, at times affecting the ability of the works to treat incoming sewage optimally. This, in turn, has affected the quality of the final effluent released into the Swartspruit. Since this discharge point is about 20 km upstream of the Rietvlei Dam, a major drinking water supply source for the Tshwane municipal area, it was crucial that something be done about the situation, reports ERWAT project manager Leon Naudé. "The current project will not merely improve the quality of the treated effluent, but allow the works to meet the standards set by the Department of Water Affairs & Forestry for 2010," he told *the Water Wheel.* The capacity of the works remains adequate, however, and will not be increased at this stage.

Design has been undertaken by process consultant Bill Alexander, while the civil and structural aspects have been tasked to consulting engineering company ARQ. Grinaker-LTA has been appointed as the main contractor, with ERWAT undertaking the mechanical and electrical work.

BALANCING THE LOAD

One of the main features of the project (and also one of the most expensive), has been the construction of a new 15 000 m³ balancing dam to equalise the incoming load. The dam was completed towards the end of last year, and has already been incorporated into the existing sewage treatment works. In addition, the project includes the conversion of the vulnerable sludge age system from short to long, with aeration capacity being added for better biological nutrient treatment.

What makes the project especially challenging is the fact that construction and rehabilitation work is ongoing while the plant is in operation. "We cannot leave the area without a sewage treatment plant so only one or two modules are shut down at a time to allow the treatment process to

continue," explains Naudé. As soon as infrastructure has been completed, the modules are connected back on to the system. The project team therefore works closely with the operators of the plant.

The geotechnical aspects of the project have caused several headaches for the project team to date. The prevailing dolomitic conditions at Hartebeestfontein have constrained construction at times as site engineers investigate the best way to protect the integrity of the infrastructure, Eli Coetzee of ARQ reports from the site. "Special attention has had to be paid to the foundations of the extensions and design of the drainage system. Infiltration of water into underground structures has to be minimised. This is being accomplished by adding impenetrable layers inside the concrete works, for example, the balancing dam features a multiseam system," he says.

Drilling samples have shown that past leakages have created underground voids at parts of the site, threatening the integrity of some of the infrastructure. At the time of writing, investigations were continuing to find the best sustainable solution.

Coetzee notes that the patience of the project team has further been tested by recent heavy rains, turning the site into a giant mud pool at times. The rains also filled up emptied tanks, preventing the effective search for leakages and making necessary rehabilitation work difficult. Despite these challenges, though, the project team remains optimistic that construction will be completed before the end of the year.

At about 50% complete, improvements in the quality of the released effluent can already be observed. There is no doubt that the project will bring much needed improvement to the performance of the Hartebeestfontein Wastewater Treatment Works.

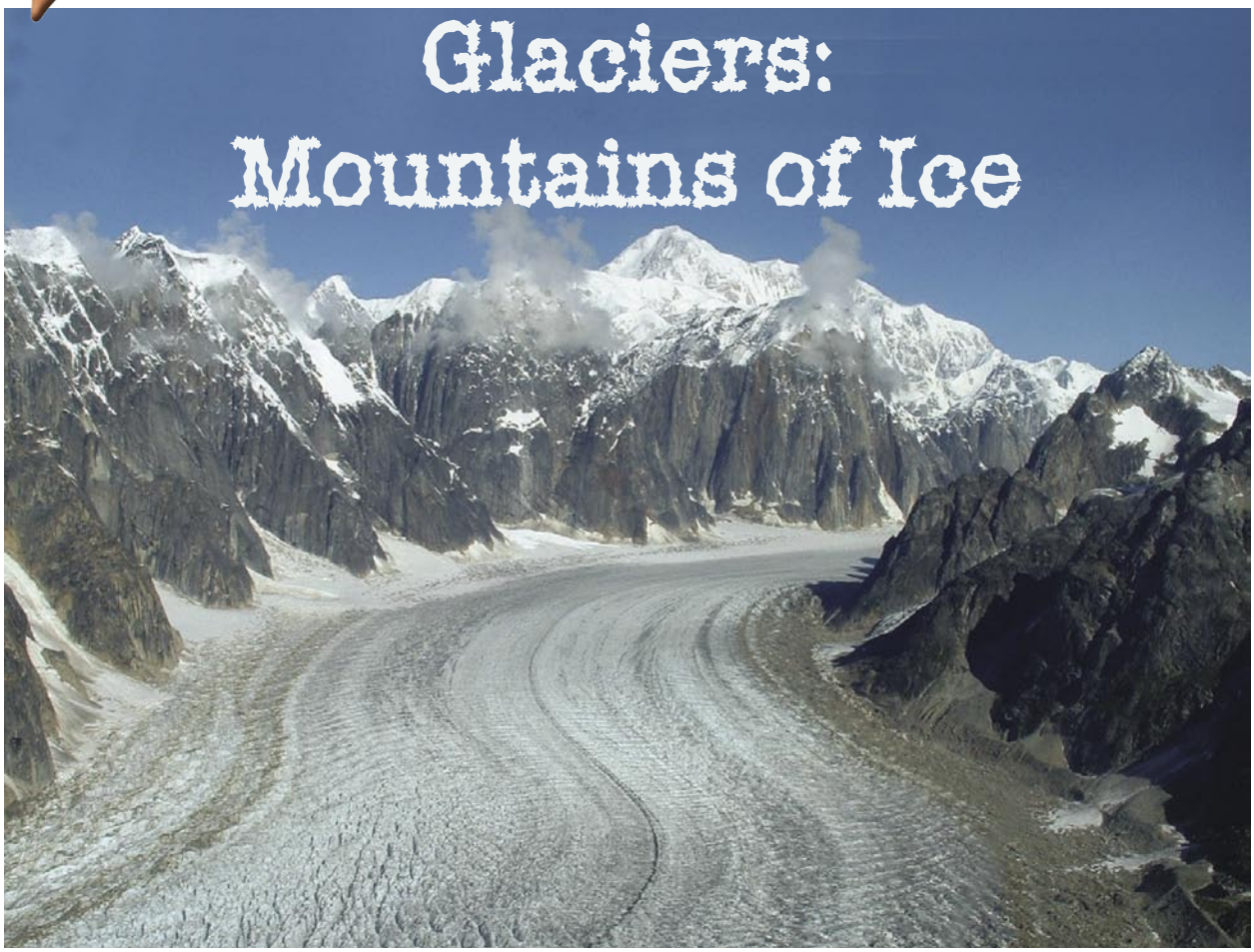
Construction of one of the new aeration basins underway at the Hartebeestfontein Wastewater Treatment Works.

The old aeration basins of modules one and two which are now being converted into anoxic and anaerobic zones.

The new aeration basin for module four which features a diffused air system.

WATER Kidz

Glaciers: Mountains of Ice



Does the word 'glacier' make you think of a mountain of cold ice and snow? This is because glaciers require very specific climatic conditions. Most are found in regions of high snowfall in winter and cool temperatures in summer. These conditions ensure that the snow that accumulates in the winter isn't lost during the summer.

While most of the world's glaciers are found near the Poles, they exist on all of the world's continents, even Africa. The glaciers of Africa are limited to three specific geographic locations; two volcanoes (Mount Kenya and Kilimanjaro) and one mountain group (the Ruwenzori).

DID YOU KNOW?

The Kutiah Glacier in Pakistan holds the record for the fastest glacial surge. In 1953, it raced more than 12 kilometres in three months, averaging about 112 metres per day.

Glaciers begin to form when snow remains in the same area year-round, where enough snow accumulates to transform into ice. Each year, new layers of snow bury and compress the various layers. This compression forces the snow to re-crystallize, forming grains similar in size and shape to grains of sugar. Gradually, the grains grow larger and the air pockets between the grains get smaller, causing the snow to slowly compact and increase in density.

After about two winters, the snow turns into firn – an intermediate state between snow and glacier ice. At this point, it is about half as dense as water. Over time, larger ice crystals become so compressed that any air pockets between them are very tiny. In very cold glacier ice, crystals can reach several hundred millimetres in length. For most glaciers, this process takes over a hundred years.

Under the pressure of its own weight and the forces of gravity, a glacier will begin to move, or flow, outwards and downwards. Valley glaciers flow down valleys and continental glaciers (ice

GLACIER FACTS

- About 10% of land area is covered with glaciers at present.
- Glaciers store about 75% of the world's freshwater.
- Glacierised areas cover about 15 million square kilometers.
- Antarctic ice is more than 4 200 metres thick in some areas.
- If all land ice melted, the level of the sea would rise about 70 metres worldwide.
- Glacier ice crystals can grow to be as large as baseballs.
- Almost 90% of an iceberg is below water – only about 10% shows above water.

GLACIER SPEAK

Ablation: Loss of ice from a glacier caused by melting of vaporisation.
Arete: Sharp, narrow ridge formed as a result of glacial erosion from both sides.
Calving: The process by which ice breaks off a glacier's terminus. (Usually the term is reserved for tidewater glaciers or glaciers that end in lakes, but it can refer to ice that falls from hanging glaciers)
Crevasse: Open fissure in the glacier surface.
Esker: A sinuous ridge of sedimentary material (typically gravel or sand) deposited by streams that cut channels under or through the glacier ice.
Firn: Rounded, well-bonded snow that is older than one year.
Glacier terminus: The lowest end of a glacier. Also called the glacier toe or glacier snout.
Mountain glacier: A mountain or alpine glacier is a glacier that is confined by surrounding mountain terrain.
Ogives: Alternate bands of light and dark ice seen on a glacier surface.
Sintering: The bonding together of ice crystals.
Sublimation: The change of state from ice to water vapour or water vapour to ice.
Sun cups: Ablation hollows that develop during intense sunshine.
Surging glacier: A glacier that experiences a dramatic increase in flow rate, ten to one hundred times faster than its normal rate. Usually surge events last less than a year, but periodically, it can last between 15 and 100 years.
Tarn: A small mountain lake or pool.
Valley glacier: A mountain glacier whose flow is confined by valley walls.

sheets) flow outward in all directions from a central point. Glaciers dramatically impact their surrounding environment by reshaping the underlying and surrounding landscape as they move, through both erosion and deposition.

Not all glaciers move slowly. For example, surging glaciers experience dramatic increases in flow rate, sometimes travelling as much as ten to one hundred times faster than the normal rate of movement.

At some stage glaciers will stop growing and start to move in retreat. As large glaciers retreat, the underlying ground surface is typically scoured to most materials, leaving only scars on the underlying surface. Glacier retreat results from increasing temperature, evaporation and wind scouring. As long as snow accumulation equals or is greater than melt and ablation, glacier health is maintained.

Over the past 60 to 100 years, glaciers worldwide have tended toward retreat. Alpine glaciers, which are typically smaller and less stable to begin with, seem particularly susceptible to glacial retreat. Whether this is due to a predictable climate trend or because of increased human impacts on global climate remains to be determined.

Glaciers are a natural resource on which many people depend. For example, the people living in the city of La Paz, Bolivia, rely on glacial melting from a nearby ice cap to provide water during the significant dry spells they experience. In Switzerland's Rhone Valley, farmers have irrigated their crops for hundreds of years by channelling meltwater from glaciers to their fields.

More recently, scientists and engineers in Norway, Canada, New Zealand and the Alps have worked together to tap into glacial resources, using electricity that has been generated in part by damming glacial meltwater. In Japan, there are tremendous amounts of snow, but no glaciers. Because the country endures frequent droughts, scientists are now examining ways to create artificial glaciers that could provide more water for people.

- For more information about glaciers visit the US National Snow & Data Centre's glaciers website (http://nsidc.org/glaciers)

Learners go on Bug Hunt

In celebration of World Water Day on 22 March, learners from Pretoria and Pietermaritzburg were invited to hunt for bugs in their local streams as they learned about river monitoring and the importance of ecosystem health.

A number of indices or guides are used to calculate the ecological state of a river. One of these is the South African Scoring System, also known as SASS, which is based on the presence of families of aquatic invertebrate fauna (for example, snails, worms, crabs, insect larvae, mussels and beetles) and their sensitivity to water changes. Their lifecycles are short, so changes in the composition and structure of aquatic invertebrate communities are often the first signs of change in overall river condition.

While learners in Pietermaritzburg assessed a stream in the botanical gardens, learners in Pretoria assessed the Moreletaspruit, a highly urbanised stream. Ramogale Sekwele of the Institute of Natural Resources assisted the Pietermaritzburg learners, while the Pretoria learners were taken through the process by Colleen Todd of Resource Quality Services at the Department of Water Affairs & Forestry and Piet Muller of the Gauteng Department of Agriculture, Conservation and Environment.

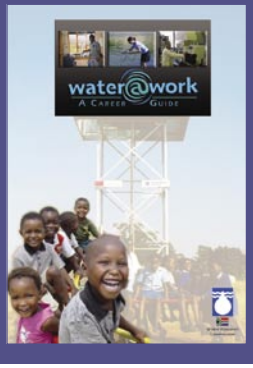
Learners hunting for bugs in an effort to determine the health of the Moreletaspruit. The fair to poor state of the stream demonstrated the challenges faced by urban environmental managers with regard to increased stormwater runoff, sediment, and increased risk of pollution from industrial and domestic sewage as due to increased development in the city.

Colleen Todd of Resource Quality Services at the Department of Water Affairs & Forestry demonstrates the assessment technique in the Moreletaspruit, Pretoria.

Learners made use of the mini-SASS scoring system, a simplified version of the original technique developed specifically for school groups and others who are not sufficiently skilled to carry out a full SASS assessment.

The objective of the exercise was two-fold: to make learners aware of environmental issues, especially river health, as well as enlightening learners about the various careers that are possible in the South African water sector, especially as far as bio-monitoring is concerned.

For more on this and other careers in water, see *Water@Work* available from the Water Research Commission. To obtain a copy phone
Tel: (012) 330-0340 or
Fax: (012) 331-2565 or
E-mail: orders@wrc.org.za



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