

THE
WATER WHEEL

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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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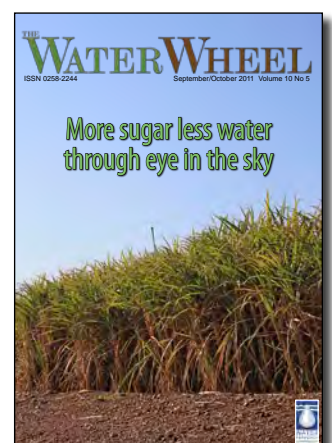
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Cover: A new project, whereby the water use efficiency of sugarcane will be measured through the use of satellites, has started in Mpumalanga. See page 14. Cover photograph by Lani van Vuuren.



SA Weather Service turns ten

The South African Weather Service (SAWS) has celebrated its tenth year as a government parastatal.

According to SAWS CEO, Dr Linda Makuleni, since its inauguration in July 2001, the SAWS has distinguished itself as an authoritative voice for weather, and a custodian of climate information in South Africa. SAWS' technical development is characterised, among others, by the first African lightning detection system with the ability to accurately pin-point lightning strikes within a 600 m radius. The organisation has also recently upgraded its countrywide radar network with 12 Doppler radars enabling it to provide much improved information on severe weather events on a shorter timescale than before.

SAWS has also been commended for its customer service, and has received, over the past three years, an overall rating of 84% from its customers, moving from being just a weather and climate information provider to an organisation which values its clients and customers by providing value-added services and products, noted Dr Makuleni.

The SAWS also places high value on its partnerships with neighbouring

organisations. "Weather knows no boundaries, which is why we have played a leading role in the establishment of the Meteorological Association of Southern Africa (MASA)," said Dr Makuleni. MASA has the goal of promoting international cooperation amongst national weather services in the SADC region in order to contribute to socio-economic development of the region.

Moreover, the SAWS celebrated its recent accreditation as a World Meteorological Organisation Regional Training Centre. It is hoped that this accreditation will, in future, address a great need by providing training facilities to meteorological scientists from South Africa, the African continent and beyond. This accreditation also ties in well with the organisation's partnerships with local universities, such as its 41-year relationship with the University of Pretoria. Since its inception, the SAWS has trained 53 forecasters, 42 researchers and 66 observers, all of whom have been employed by the organisation.

Seen in the photograph are former CEO Donny Madison, Board Member Dr Thembakazi Mali, current CEO Dr Linda Makuleni and former CEO Jerry Lengoasa.



Crocodile West system planning on track – DWA



Significant progress is being made towards ensuring that future requirements in the Crocodile West River system are met, the Department of Water Affairs reports.

Characterised by the sprawling urban and industrial areas of northern Johannesburg and Pretoria, extensive irrigation downstream of Hartbeespoort Dam and large mining developments north of the Magaliesberg, the catchment is one of the most developed in the country making specific management strategies crucial.

As such, at the recent Strategy Steering Committee meeting of the department on the Crocodile West River system key scenarios were evaluated of future water requirements, supply and availability. These had to take into account growth in water requirements due to anticipated developments around the coal reserves close to Lephalale.

A number of initiatives have already been implemented by the Department of Water Affairs and local authorities. This includes the Mokolo-Crocodile Water Augmentation Project where construction of phase 1 (to start this year) will see the augmentation of supply from the Mokolo

Dam through a parallel pipeline from the dam to the Steenbokpan area. Delivery of water is expected in 2013. In addition, water conservation and demand management activities have been undertaken by municipalities in the river system. These include addressing losses through replacement of leak-prone pipelines, leak detection, pressure reduction, rezoning and the improvement of reservoir integrity.

The department will also be engaging with water users to set up a system operating forum with the specific purpose of establishing operating rules for all the significant dams in the system. One of the objectives of the forum will be evaluating and selecting appropriate drought management rules as part of preparedness planning and efficient distribution of the available water.

Despite the challenges, important work is also being carried out to improve the water quality in the Crocodile West River system. The Department of Water Affairs continues to implement the Harties Metse A Me project, to improve among others the water quality in the Hartbeespoort Dam.

Green Drop: now get practical tips

The Water Information Network – South Africa (WIN-SA), together with the South African Local Government Association have developed a handy brochure of hints and tips for municipalities wanting to obtain Green Drop status for their wastewater treatment plants.

The brochure captures the experiences of smaller municipalities who are effectively managing their wastewater treatment plants. The objective of the brochure is to encourage municipalities to consider these practical and innovative suggestions that could assist them to

run their own wastewater business more effectively.

To obtain a copy of the practical hints and tips guide or to make further suggestions, contact Ditshego Magoro at Email: info@win-sa.org.za or William Moraka at Email: wmoraka@salga.org.za



New study eliminates grey areas of household wastewater use



While greywater – the untreated household effluent from baths, showers, basins and laundry – can be a helpful supplement to conventional water resources in household and urban food gardens, its safety for use has been called into question.

A recently published study funded by the Water Research Commission (WRC) and undertaken by the University of KwaZulu-Natal, aimed to answer some of the questions as to the benefits and risks associated with the use of greywater.

More than half of indoor household water use is normally used for non-toilet uses. This percentage represents a large

fraction of household wastewater which can potentially be intercepted and used for beneficial uses. Active promotion of greywater use for irrigation in gardens and small-scale agriculture has the potential, not only to maximise use of limited water supplies, but also to improve food security in low-income settlements. However, before this practice can be promoted the legal status of greywater use for irrigation needs to be clarified and guidance needs to be formulated for users so that small-scale irrigation use of greywater is performed in such a way that it is safe for humans, plants and the environment.

Two products were generated by the WRC study in order to help guide the wise use of greywater: a user-friendly guide and a supporting technical document capturing the scientific information on which the guide is based. It is envisaged that the outcomes of this project will provide municipalities, non-governmental organisations, and householders with greater certainty about how to minimise the health risks and optimise the benefits

associated with the use of greywater.

Some of the issues addressed in the publications pertain to human health, which could be threatened in the process of using greywater for food production. Greywater usually contains significant numbers of microorganisms, which are capable of causing disease. In addition to containing substances which are beneficial to plants (mainly nitrogen and phosphorus), greywater also contains substances that can reduce plant growth or crop yield if present at sufficiently high concentrations, such as salts, sodium and boron.

The biggest challenge lies with non-sewered informal settlements in South Africa where there are limited waterborne services and drainage. In these areas greywater often merges with toilet water and other effluent flows thus creating a toxic mix of contaminated water that poses a danger to human and environmental health. Although the per capita volume of greywater disposed of on the ground in the vicinity of shack dwellings is generally low, greywater

runoff often carries solid and liquid waste contaminants that collect in ponds and are frequently discharged via stormwater systems into wetlands and rivers.

According to WRC Director: Water Utilisation in Agriculture, Dr Gerhard Backeberg, current legislation pertaining to disposal and use of water and waste falls short as a definition of greywater as a separate wastewater stream is lacking. "Clarity is needed for the future by explicit definition of greywater and the beneficial uses to which it may be put. The existing legislation does not specifically exclude use of greywater for irrigation, but there are inconsistencies which arise from the absence of a clear definition of greywater as a subset of domestic wastewater. These issues need to be resolved to clarify the legal position of use of greywater for irrigation.

To download the reports, *Sustainable use of greywater in agriculture and gardens in South Africa – Technical report (Report No: 1639/1/11)* or *Guideline (Report No: TT460/10)* Visit: www.wrc.org.za.

SA must attract more women to science – Minister

South Africa must support its women scientists. This is according to Science Minister, Naledi Pandor.

South Africa's policy of expanding access to higher education institutions has been successful in attracting first-generation black and female students. By 2008, there were, in fact, more female than male graduates.

Yet women tend to study social sciences, the humanities and the arts. To redress this balance the Department of Education has earmarked university funding to encourage more women to take up the physical and natural sciences, particularly engineering. Still only 3 000 of the estimated 35 000 engineers in South Africa are women (compared to the 6 000 female doctors in the country).

According to Pandor, three obstacles to equality still loom large in South Africa, the first being South African students'

persistent poor maths and science skills – a remnant of the legacy of Bantu Education. The second obstacle is that maths and science subjects are still regarded as inappropriate for girls. "The exclusion of girls start at primary school level, when schoolchildren are shown images that perpetuate gender stereotypes and convey the message that science and technology are not for girls," the minister notes. Education researchers have found that advisors tell girls that maths and science are difficult subjects and that arts and humanities may be better choices.

Finally, evidence from classroom studies of co-education schools points to discrimination by teachers. "It suggests that teachers encourage boys to engage with science by allowing them to ask more questions, while ignoring girls, giving them inadequate replies or criticising them for minor errors," says Pandor.

Pandor believes that it is vital that South Africa, along with other countries, does more to increase women's access to scientific knowledge. "Science and engineering are critical for innovation and economic growth, and for tackling the development challenges that face many of the most vulnerable communities in the world."

Some practical interventions are already in place in South Africa, including the provision of equipment grants and special conference funding, postgraduate grants and research fellowships for women, among others. Highlighting the achievements of women scientists is another way of encouraging and inspiring young women to take up careers in the physical and natural sciences.

"Numerical parity will take many years to achieve. But in the words of Tebello Nyokong, a cancer researcher at Rhodes University: Every little thing you achieve

is better than what you started off with; hence, every achievement calls for a celebration."

Source: Scidev.net



Cape Town lays groundwork for water masterplan



The City of Cape Town has laid the groundwork for a far-reaching masterplan to explore all viable water supply alternatives for the Cape metropole.

Cape Town, its neighbouring municipalities and the agricultural sector in the region are supplied with water from the Western Cape Water System, a system of dams and pipelines owned and operated by the City of Cape Town and the Department of Water Affairs (DWA). The City and the department operate the system co-operatively to ensure that the volume of water in the system is maximised during the hydrological year, to the benefit of all users.

"Dam levels are currently lower than previous years due to a lower than average rainfall over the past year. However, with the recent completion of the Berg River Dam and Supplement Scheme, volumetrically there should be sufficient water in the short to medium term for all water users in the region," noted Phil Mashoko, the City's Director: Water and Sanitation.

According to long-term rainfall records, Cape Town's main catchment dams are not yet reflecting any change in long-term rainfall trends, however, the potential impact of climate change has been factored into strategic water resource planning. "Cape Town is a growing city, with a burgeoning population economy and population. Thanks to the implementation of a long-term water conservation and water demand management strategy, Cape Town's water demand is now 27% less than what it would have been if demand had grown at an unconstrained rate from 2000 onwards," said Mashoko. "Our key focus is to reduce per capita demand in order to ensure that existing resources and

infrastructure are used as cost-effectively as possible. This could also significantly delay the need for expensive new water supply schemes."

The City's water conservation and water demand management initiatives include pressure reduction in the reticulation system, leakage management, pipe replacement, wastage reduction by consumers through education and awareness programmes and substituting the use of potable water for sports field and garden irrigation with treated effluent.

The water and sanitation department of the metro is currently investigating a suite of potential resource schemes. These include greater water re-use, desalination of seawater and a much greater use of groundwater. At the same time, DWA is considering a number of surface water options from rivers to supplement the inflow into the Voëlvelei Dam.

The future implementation of a 100 to 200 Mℓ/day seawater desalination plant on Cape Town's West Coast is also being considered, as this is one of the fastest growing areas where additional water supply will be required. Although the costs of desalination have decreased significantly over the last few years, the process remains energy intensive and also carries a significant environmental impact.

The feasibility study into the use of groundwater from the Table Mountain Group Aquifer is well advanced. This vast deep aquifer extends from Vanrhynsdorp through the Western Cape to Port Elizabeth. Due to the potential environmental impacts of large-scale groundwater abstraction, the City has adopted a precautionary approach. A decision on whether to continue with a pilot phase,

Water diary

MINE WATER OCTOBER 3-4

The WISA Mine-Water Division's Annual Symposium will take place at the CSIR International Convention Centre with the theme 'Sustainable Water 2030: A mining industry perspective'. Visit: www.wisa.org.za

IRRIGATION & DRAINAGE OCTOBER 15-23

The 21st ICID Congress on Irrigation and Drainage will take place in Tehran, Iran. The conference will be co-located with the 8th International Micro-Irrigation Congress and the 62nd IEC Meeting. Visit: www.icid11.org

WETLANDS OCTOBER 18-21

The National Wetlands Indaba will be held at the Didima Resort & Conference Centre, in KwaZulu-Natal. The theme for the conference is 'Wetlands: Back to the Future 2010 – Act Today for a Better Tomorrow'. Visit: <http://www.wetlands.za.net/indaba/>

MUNICIPAL ENGINEERING OCTOBER 26-28

The 75th Conference of the Institute of Municipal Engineering of South Africa will be held at Birchwood Hotel and OR Tambo Conference Centre. Visit: <http://conference.imesa.org.za/wp/>

LARGE DAMS NOVEMBER 8-10

The South African National Committee on Large Dams Biennial Conference is taking place at the Gallagher Estate Convention Centre, in Midrand, Gauteng. The theme is 'Management and Design of Dams in Africa'.

Conference topics include reservoir management, dam safety and surveillance, hydropower schemes, water resource management, new dams versus desalination schemes, and dam types and construction material. The deadline for registration and payment is 10 October. Enquiries: Rene Burger; Tel: (021) 808-2100; Email: burger@sun.ac.za or Visit: www.sancold.org.za

GROUNDWATER NOVEMBER 14-16

The Africa Groundwater Academy is hosting two highly acclaimed and widely published presenters, Richard Healy of the US Geological Survey and Bridget Scanlen of the Bureau of Economic Geology (University of Texas at Austin) to lead a short course on estimating groundwater recharge. The course will be hosted in Cape Town. Enquiries: Elanda Botes; Tel: 083 982 3537 or Tel: (012) 348 9598; or Email: africagroundwater@gmail.com

ENVIRONMENTAL HEALTH NOVEMBER 24-25

The School of Basic Sciences at North West University is hosting the Second Annual Eco Health Research Forum at Misty Hills Country Hotel, in Muldersdrift, Gauteng. The theme is 'Polluted Environments: Human Action and Human Health – Some Multidisciplinary Perspectives toward Pro-Active Solutions'. Enquiries: Petra Lawson (conference coordinator); Email: 083 231 6538; Fax: 086 541 1173; Email: conferen-cept@gmail.com; Visit: www.nwu.ac.za/export/sites/default/nwu/vtc/events.html

during which the environmental impact will be fully assessed, was still pending at the time of writing.

"With Cape Town's current demand growth, it is anticipated that the current supply will be sufficient until around 2017, after which a new resource or

supply scheme will be required," said Mashoko. "While six to eight years is a fairly tight timeframe for the implementation of a large water supply scheme, the groundwork is being laid now to ensure that this can be achieved when needed." **Source: City of Cape Town**

Domestic water filters under scrutiny in new project

Recent media reports over the quality of the country's municipal tap water have some running for the hills while others have gone out to purchase domestic water treatment devices.

In fact, small-scale purification systems have become a burgeoning business in South Africa, but are they really as good as their marketing campaigns make them out to be, and do we need them in the first place? A new WRC-funded project hopes to find answers to these questions.

A dizzying array of products exists for home use. Technologies vary from



Doubts over municipal water quality has many people buying home water treatment devices.

www.sxchi

activated carbon filters and reverse osmosis to ion exchange, microfiltration and distillation, to name but a few. Home water treatment devices may use one or a combination of treatment technologies to remove specific contaminants. To date, however, very few independent studies have been published on the capacity of small-scale purification units to remove microorganisms and the majority have only been tested for a single organism or compound and/or a single product.

As a result, the WRC has selected to fund an independent study into these devices. The study is being led by Dr Cathleen Bartie from the National Institute of Occupational Health, with Dr TG Barnard, head of the Water and Health Research Centre at the University of Johannesburg, being the principal researcher on the project.

The study is sourcing a representative number and variety of small-scale water purification units available for domestic use and evaluating and comparing their capacity to remove various contaminants, for example, indicator organisms, enteric protozoans, free living amoebae, amoebae resistant bacteria and viruses from local tap

water. The researchers eventually aim to compile a report and guideline documents to assist users in the selections and use of these devices.

Tests are being conducted under strictly-controlled conditions at the University of Johannesburg where the units are challenged with different combinations of organisms to test the actual removal efficiency of the system. The units are also being challenged with chemicals to evaluate filter capacity to remove these substances. A duplicate of each unit is used as instructed to monitor the efficiency of the unit over time.

Meanwhile a brochure to guide those thinking of purchasing water treatment devices has been published. The brochure includes a flow diagram to guide readers through the decision-making process to help them decide if they need a home treatment device. It also includes a table with a summary of treatment technology available in South Africa.

A crucial message to potential buyers of home water treatment devices is to firstly determine whether they really need it. The 'my water' function on the Department of Water Affairs Blue Drop website (www.dwa.gov.za/bluedrop)



A new brochure guides potential users in the evaluation of home water treatment devices.

allows near everyone to monitor the tap water quality of their town, suburb or street on a daily basis. Another important thing to remember is that good-quality tap water does not necessarily safeguard homes from disease – other factors can also play a role, including sanitation and hygiene practices and contaminated food, for example.

- To download an electronic version of the brochure Visit: <http://wrcwww/Knowledge%20Hub%20Documents/Research%20Documents/water%20filter%20brochure.pdf>

Switzerland-SA strengthen science ties

Science & Technology Minister, Naledi Pandor, has signed a joint statement on Swiss-South African science and technology cooperation with the Head of the Swiss Federal Department of Home Affairs, HE Didier Burkhalter.

At present, there are 16 joint research projects under the Swiss-South African Joint Research Programme in the fields of public health and biomedicine, bio- and nanotechnology and human and social sciences. By the end of 2010, 48 Doctorate and post-doc students were involved in collaborative activities between the two countries. Close to 80 young scholars have benefited from more than 50 joint

research programme exchange projects.

The parties have agreed to bring the current phase (2008-2011) of the joint research programme to a conclusion and to prepare in 2012 for the next four-year phase. Both parties also agreed to include a wider network of institutional actors and to explore new possible common research fields such as renewable sources of energy, energy security and clean technology. The programme framework for the second phase will be conceptualised at the next joint committee meeting, which will take place in South Africa in the first half of 2012.

Over 90% of SA households have access to water

A total of 93% of South African households now have access to at least basic water supply, according to Statistics South Africa (Stats SA).

According to the Water and Sanitation 2002-2010 analysis of the General Household Survey released by Stats SA earlier this year, about four in ten households have access to piped water inside their dwelling. "General access to piped water on site rose steadily, from 27,5% in 2002 to 29,1% in 2010."

Households that accessed wells and springs as main sources of water decreased from 1,4% in 2002 to 0,3% in 2010 with respect to wells, and from

2% in 2002 to 1,6% in 2010 with respect to springs. "Ninety-six percent of formal dwelling units reported to have access to safe water, whether inside the dwelling unit, in the yard, from a neighbour's tap or from a communal standpipe. Only 2,6% of these households still use water from unsafe sources," read the report.

According to Stats SA, the majority of South Africans now enjoy access to safe water supply. There are still provinces with fairly low access, however. The Eastern Cape (74,4%) and KwaZulu-Natal (87,1%) scored lowest in terms of households with access to safe water supply.

Source: BuaNews

When soil forms a shell – the benefit of no-till farming

Even when crop residues are exported from the field, the practice of no-till farming protects soil because it preserves the surface from crust formation.

Planting without ploughing is beneficial practice for several reasons, the main one being soil conservation. If the soil structure as well as other physico-chemical and biological properties of the soil are preserved, it is then assumed that the soil would be more resistant to rainwater erosion.

However, some experts have expressed doubts concerning the benefits of no-till practices being real or obtainable in small-scale farming. This is because, in most instances with small-scale farming, the essential surface cover provided by crop residues left on the ground is absent. Indeed, residues cannot play their part in protecting the soil from raindrop impacts and rain wash when farmers collect them to feed their livestock.

“We have just shown that this cultural practice is beneficial even when the plant residues no longer cover the surface of the soil,” reports Charmaine Mchunu, Masters student from the School of Bioresources Engineering and Environmental Hydrology (BEEH) at the University of KwaZulu-Natal. With BEEH colleagues Prof Graham Jewitt and Prof

Simon Lorentz, along with Dr Alan Manson of the KwaZulu-Natal Department of Agriculture, Environmental Affairs and Rural Development; and Dr Vincent Chaplot of the Institute for Research and Development, she compared the physical, biological and chemical parameters of maize fields under till and no-till for several rainy seasons.

The results are clear: zero tillage reduces soil losses by 68% and organic carbon losses by 52%. The latter is important, since the carbon that escapes from the soil in response to a disturbance (e.g. tillage, rain) will reduce soil fertility, soil water holding capacity and will be added to the atmospheric carbon and thus contribute to the greenhouse effect.

“Rainfall erosivity is actually the number one factor contributing to soil, soil fertility and soil carbon losses that farmers want to minimise. Due to the force and volume of precipitation, the KwaZulu-Natal area, along with many tropical and sub-tropical areas of the world, are at risk,” notes Mchunu.

Plant residues left behind after harvest help to protect the soil against the destructive forces of rainfall. But in the maize fields of the Drakensberg foothills they are reduced to a minimum (less than 10% of the soil surface) and thus are rendered ineffective against



In-situ sampling of soil crusts by University of KwaZulu-Natal student Charmaine Mchunu and a visiting researcher from the Institute for Research and Development.

the erosive impact of raindrops.

In this case, what acts to protect the soil? The answer lies in a phenomenon observed long ago by researchers – surface crusts. “Surface crusts are formed by soil aggregates welded together to form a low permeability layer, thus making the crust more resistant to erosion,” explains Chaplot. This study shows that such a shell allows the maintenance of many soil functions, including the storage of atmospheric organic carbon.

The technique of zero tillage therefore promotes soil conservation by preserving the protective crust, and

thus allows the sustainable use of soils. Used since prehistoric times and by many traditional forms of agriculture, this technique now has new impetus as these benefits highlight its role in the mitigation of desertification and global warming.

The BEEH study formed part of a long-standing research effort at Potshini in the foothills of the Drakensberg mountains, which focuses on smallholder systems innovations in agriculture. This particular project has been funded by the Water Research Commission and the provincial Department of Agriculture.

Special drive to combat water license backlogs

The Department of Water Affairs has launched a special drive to eradicate the current water use license applications backlog.

So-called Project Letsema, run by the Chief Directorate: Regulation, aims to evaluate the water use license applications, some of which are dated as far back as 1998.

Commenting on the progress made by the drive, project leader Portia Makhanya said the initiative has certainly increased the process rate of license applications

in the department. She added that the venture is on target to achieve its goals of strengthening water resource management in the water sector.

Makhanya also confirmed that new applications continue to be received and processed by the department under the backlog eradication project. At the same time, some of the decisions made and communicated to clients on the current project are subjected to queries by water users, entailing reviews.

Dutch funding boosts East London bucket eradication

East London's bucket eradication programme has received a welcome boost in the form of additional funding of R2,1-million from the city's Dutch sister city, Leiden.

The money will be spent on a five-year sanitation project as part of the Dutch city's long-standing partnership with Buffalo City municipality. “We are happy

that Leiden is assisting us in eradicating sanitation challenges. Sanitation is a priority on our list of things we are doing to better people's lives,” said East London Mayor Zukiswa Ncitha.

An estimated R100-million is required to completely eradicate the sanitation backlog in the metro's constituency.

Source: BuaNews

New from the WRC

Report No: KV 263/10

The concept of public trusteeship as embedded in the South African National Water Act, 1998 (E van der Schyff)

With the promulgation of the National Water Act (NWA) of 1998 South Africans witnessed the birth of a new legal concept in South African natural resources jurisprudence. The concept of public trusteeship that initially emerged in the White Paper on a *National Water Policy for South Africa* was formally entrenched in sections 2 and 3 of the NWA. While the concept of public trusteeship is somewhat romanticised in policy the reality is that increasing competition between various water users and the inability to meet growing demands hamper water reforms aimed at addressing equity and redress issues. This study is aimed at analysing the concept of public trusteeship as it is found in the NWA in order to determine the roles, responsibilities and obligations of all the roleplayers in decentralised water management and governance as well as the legal implications that the concept holds for water governance and water users in order to facilitate the development of the visionary 'doctrine of public trust which is uniquely South African and is designed to fit South Africa's specific circumstances'.

Report No: KV 273/11

South African groundwater governance case study (K Pieterse, HE Beekman & M Holland)

This report presents a case study on groundwater governance in South Africa at national and local levels. The case study forms part of a World Bank economic and sector analysis on the paradox of groundwater governance. At the local level, groundwater governance was studied for four highly productive aquifer systems demonstrating various degrees in the implementation of groundwater governance. These systems included the Botleng Dolomitic Aquifer (Delmas area); Gauteng Dolomites (Steenkoppies and Babsfontein compartments); Houdenbrak Basement Aquifer (Mogwadi-Vivo area);

and the Dinokana-Lobatse Transboundary Dolomite Aquifer.

Report No: TT 488/11

A gap analysis of water testing laboratories in South Africa (F Balfour; H Badenhorst & D Trollip)

There are a limited number of laboratories that undertake water quality testing in South Africa. More significantly, many of these laboratories have capacity limitations. The aims of this project were to, among others, conduct a survey of the status, capacity and geographic location of all available laboratories that would be able to conduct the necessary testing on water and wastewater samples in South Africa; identify bottlenecks which hamper functioning and establishing of laboratories; and use the information gathered to develop strategies to address the needs of water quality assessment in South Africa.

Report No: 1819/1/10

Strategic assessment of household on-site water as supplementary resource to potable municipal supply – Current trends and future needs (HE Jacobs; T Wright; C Loubser; JA du Plessis & J Kock)

Water resource managers, water demand managers and water infrastructure planners alike are faced with an acute lack of knowledge regarding on-site household water use as additional water source to potable water supply. The most common on-site household water sources of this nature include groundwater abstraction, rainwater harvesting and greywater reuse. The nature and extent of household water sources application by individual water users in residential areas impacts on all infrastructure elements of the water supply and waste cycle.

Application of a household water source creates an apparent load reduction on piped reticulation systems, treatment works and on water resources. Unfortunately, these extra sources of water are often neglected during urban and resources planning exercises. A critical question is addressed by this research. The main aims of this research project

were to strategically assess the status quo of household water sources; conceptually describe an end-use model incorporating household water sources and assess the theoretical impact of household water sources on the average annual daily water demand; and identify trends and future research needs, among others.

Report No: KV 254/10

The influence of irrigation on groundwater at the Vaalharts irrigation scheme – Preliminary assessment (PMJ Verwey; PD Vermeulen & GJ van Tonder)

The first farmers in the Vaalharts irrigation scheme received their plots in 1938. Today there are 1 200 plots varying in size from 25 to 75 ha, covering a total area of 35 302 ha. Water logging and salinisation problems have been experienced in the area. The quality of the groundwater is deteriorating as can be seen in samples and on site measurements. Therefore several studies have been carried out to explain the apparent macro-scale salt accumulation.

Report No: KV 264/10

Investigating the behavioural drivers of stakeholder engagement and volunteerism in the South African water arena (S Blignaut & AG Choles)

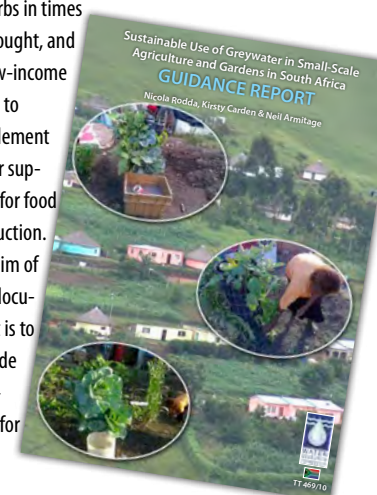
Integrated water resource management (IWRM) is an inherently complex task, especially in South Africa with its

diversity of cultures and socio-economic groupings. The multitude of factors, drivers, personas, agendas and technical challenges that influence and direct the way in which IWRM is conducted leaves many communities that encounter water resource challenges in a precarious position. The reality in South Africa and elsewhere is that public-private partnerships and shifts towards adaptive management and stakeholder engagements are pivotal in ensuring effective IWRM. This study aimed to investigate the drivers of engagement and volunteerism in a community facing an IWRM challenge, with a view to generating an understanding of how volunteerism and engagement levels may be improved.

Report No: TT 469/10

Sustainable use of greywater in small-scale agriculture and gardens in South Africa: Guidance report (N Rodda; K Carden and N Armitage)

Limited supplies of freshwater are a concern worldwide and especially in South Africa where annual rainfall falls well below the world average. Reuse of greywater offers one means of relieving pressure on freshwater supplies. It is established practice in a significant minority of households, especially in low income settlements where water is difficult to obtain and families are under financial pressure to reduce use of all resources. Use of greywater specifically for irrigation is practiced to a lesser extent than for other household uses, but does occur in middle and higher income suburbs in times of drought, and in low-income areas to supplement water supplies for food production. The aim of this document is to provide guidance for

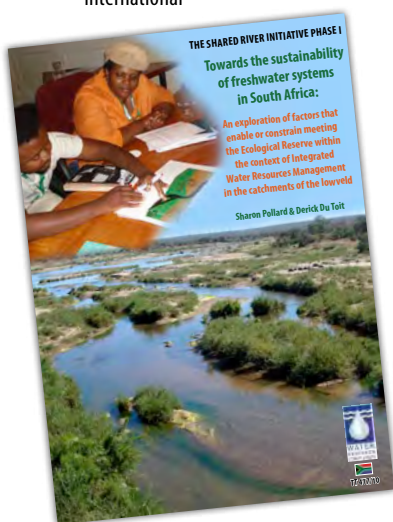


the sustainable use of greywater in small-scale agriculture and gardens in rural villages, peri-urban and urban areas of South Africa. The technical report of the study is also available (**Report No: 1639/1/10**)

Report No: TT 477/10

The Shared Rivers Initiative Phase 1 – Towards the sustainability of freshwater systems in South Africa: An exploration of factors that enable or constrain meeting the Ecological Reserve within the context of Integrated Resources Management in the catchments of the Lowveld (S Pollard & D du Toit)

The Olifants River ceased flowing in 2005 prompting widespread concern and calls for an integrated focus on all of the easterly-flowing rivers of the lowveld of South Africa. Assertions were that despite the enabling legislative frameworks for water reform and environmental flows in 1998, the integrity of most of these rivers has not improved, or continues to degrade both in terms of quality and quantity. Given that all the rivers form part of transboundary, international



systems, the implications were of wider significance than South Africa alone. In response, the Shared Rivers Initiative, an action-research programme funded by the WRC was initiated in 2007. The work reported in this document concerns itself with exploring the progress towards meeting the commitment to sustainability of these lowveld rivers as set out in the National Water Act.

Report No: KV 268/11

Investigation of sulphide oxidation kinetics and impact of reactor design during passive treatment of mine-water (RP van Hille & N Mooruth)

The integrated managed passive (IMPI) process was developed by Pulles Howard & De Lange in association with Rhodes University. It is a semi-passive process, requiring minimal maintenance. The process incorporates a series of degrading packed bed reactors to reduce the sulphate and sulphide oxidation reactors to convert the sulphide to elemental sulphur. The technology has been implemented at a demonstration scale at BHP Billiton's Middelburg coal mine. The work described in this report was commissioned to provide fundamental information that could be used to enhance process efficiency.

Report No: TT 485/11

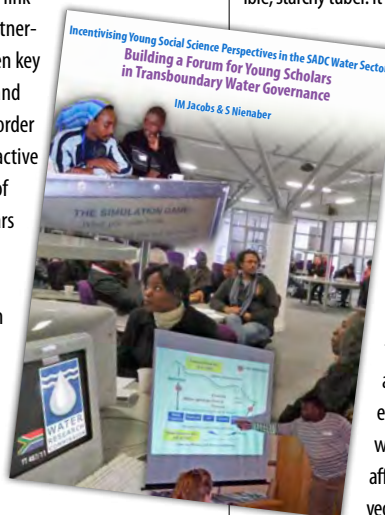
Cleaner Production: A guidance document for the mining industry in South Africa (SJ Barclay; G Trusler; H von Blottnitz; CA Buckley; B Kothuis & C Janisch)

This Cleaner Production guidance document has been prepared under a WRC project investigating the introduction of cleaner production technologies to the South African mining sector. This project was conducted from 2004 to 2008, and investigated the use of cleaner production tools such as quick scan assessments, lifecycle assessments, and cleaner production forums to encourage and motivate the mining industry to implement cleaner production in order to reduce their environmental impact and increase profitability. The aim of the guidance document is to assist the mining industry and its regulators, in determining the benefits of implementing cleaner production and the methodology involved. Case studies and examples are incorporated to demonstrate how cleaner production has been implemented successfully in mining companies, both locally and internationally, and checklists are used to guide the user through each stage of the cleaner production process.

Report No: TT 487/11

Incentivising young social science perspectives in the SADC water sector: Building a forum for young scholars in transboundary water governance (JM Jacobs & S Nienaber)

This report documents the progress of a one-year WRC-funded consultancy awarded to the CSIR during 2010-2011. The project aimed to establish and build collaborative linkages and partnerships between key institutions and networks in order to create an active community of young scholars interested in transdisciplinary research collaboration and information exchange on the topic of trans-



boundary water governance. The YSF project therefore focused its attention on southern African water issues and their governance implications around specific themes, with the explicit goal of producing an agenda for future research. This report examines the degree to which it achieved these objectives.

Report No: 1735/1/10

Refinement of the decision support system for metalliferous mine residue disposal facilities (N Bezuidenhout and B Randell)

This project aimed to refine an earlier decision support system (DSS) developed for mine residue disposal facilities developed with WRC funding. Among others, this project aimed to develop a performance demonstration protocol (i.e. guidance that can be used to demonstrate the acceptability of a particular technique, technology or approach); align the DSS to current legislation; and undertake specialist studies of specific knowledge gaps identified during the development of the first order DSS in order to better understand the aspects and to provide better guidance in the DSS for users.

Report No: KV 260/10

The impact of Madumbe (Colocasia esculenta) cultivation on the evaporation of a Cyperus latifolius marsh in KwaZulu-Natal (C Everson and M Mengistu)

The madumbe is an important food plant

in the hot regions of the world. Known by a number of different names (idumbe, taro, cocyam and dasheen) they are grown mainly for the underground, easily digestible, starchy tuber. It is one of the most

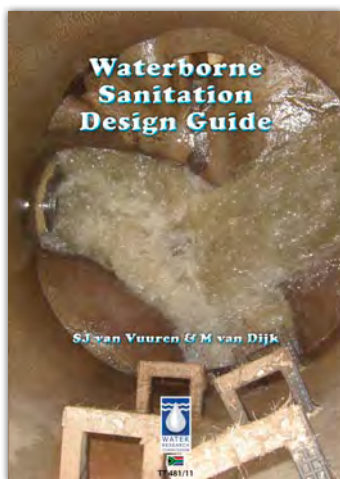
widely grown traditional crops in Mpumalanga and KwaZulu-Natal, as well as in areas of the Eastern Cape and Limpopo provinces. A key component of the water budget of a wetland is the loss of water to the atmosphere (so-called evapotranspiration), which may be strongly affected by the particular vegetation growing in the wetland. *Cyperus*

latifolius marsh is one of the wetland vegetation types occurring most extensively in KwaZulu-Natal, the Pondoland region of the Eastern Cape and in Mpumalanga and Limpopo. Madumbes have a high tolerance to water logging and are often cultivated in *C. latifolius* marshes. In a first for South Africa, this study investigated the evapotranspiration of *C. latifolius* and madumbe areas, together with monitoring of the water table in the wetland.

Report No: 1553/1/11

The introduction of cleaner production technologies in the South African mining industry: A summary report (G Trusler and S Mzoboshe)

The mining industry has played a major role in the development of South Africa and has the capacity to do so for many more years. Despite its role in the economy the mining industry is also the largest producer of solid waste in the country and a major contributor to water quality degradation in many of South Africa's important catchments. The overall objective of this project was to introduce cleaner production technologies in the mining industry. Among others, the project aimed to conduct a scoping level situation analysis of the mining industry to identify the present level of cleaner production activities; identify existing water-related threats that could be alleviated by cleaner



production technologies; and introduce the concept of waste minimisation clubs to the mining sector.

Report No: 1839/1/10

Towards the development of IWRM implementation indicators in South Africa (S Braid & A Görgens)

This document reports the findings of a solicited project to conduct a comprehensive literature review of both international literature and selected national legislation and policy in terms of how integrated water resource management (IWRM) has been conceived and applied; develop indicators for assessing how IWRM will impact on the lives of women and the poor and apply these indicators to South African case studies; and build research capacity locally and internationally on approaches to implement and monitor IWRM.

Report No: TT 481/11

Waterborne sanitation design guide (S.J. van Vuuren and M. van Dijk)

Historical records include many references to engineering feats undertaken by ancient civilisations to collect and convey water. In South Africa, the first waterborne sanitation system, with sewers, was used in the Great Karoo town of Matjiesfontein, founded in 1884 by the Scot, James Douglas Logan. The first flushing toilet was installed in his home. The sanitary sewer system is a

major capital investment made by a community. The system's function is only vaguely recognised by the public due to its underground installation, except for the manhole covers or when the system doesn't function properly. Sanitation systems are essential to protect public health and welfare in all development areas. Every community produces wastewater of domestic, commercial and industrial origin. However, the proper planning and construction of these sanitation systems alone does not provide a guarantee that the general health of the population will improve. A holistic approach to healthcare is required, with the provision of suitable sanitation being just one of the necessary components thereof. In order to develop a guide for the design and operation of waterborne sanitation for South Africa a good understanding of the existing waterborne sanitation standards and specifications is required. A number of local authorities were visited and data gathered in order to determine the various standards applicable throughout South Africa. Information has been synthesised from a wide variety of sources and tailored to South African conditions. The guide provides a complete overview of all waterborne sanitation systems used in South Africa.

Report No: TT 482/11

Waterborne sanitation operation and maintenance guide (S.J. van Vuuren and M. van Dijk)

The function of a waterborne sanitation system is to collect and convey wastewater in a hygienic manner. Operation and maintenance of this sewer system means making sure that all its components are kept in good operating conditions. Planners, designers, the construction team and the administrators have a joint duty in providing an efficient system. The aim of this guide is to highlight the procedures, practices and policies in the operation and maintenance of waterborne sanitation systems. To provide further classification and background information, photographs, videos, software and

additional literature were included on the accompanying DVD, *SewerAid*.

Report No: 1628/1/11

Prediction of how different management options will affect drainage water quality and quantity in the Mpumalanga coal mines up to 2080 (T.J. Coleman; B. Usher; D. Vermeulen; N. Scholtz and S. Lorentz)

The Witbank and Middelburg Dam catchments are extensively mined. The water quality has deteriorated in the catchment. The water sources of the catchment are further threatened by the future decants that are expected from the mines post closure. The mines will be closing over the next 20 years. Thereafter the mine workings will fill and start decanting. Among others, this study aimed to evaluate the available management options that can be used to reduce mine drainage and/or improve its quality on the Mpumalanga coalfield; compile the currently available information and acquire additional information as required to model the long-term water quality and quantity emanating from the mines in the coalfield; and establish an integrated modelling suite that simulates the change in the coalfield as affected by different management options.

Report No: 1808/1/11

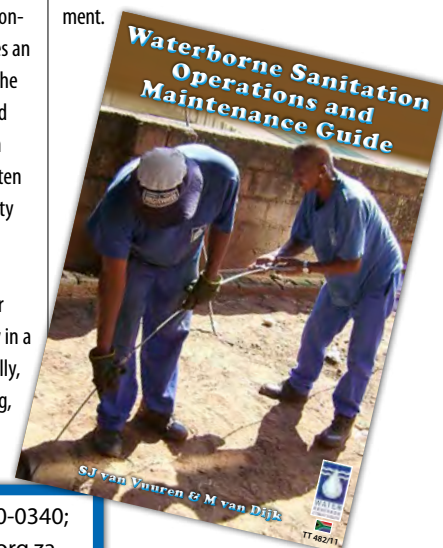
Definition of process zones and connectivity in catchment scale NPS processes (S. Lorentz; J. Miller; P. Lechler; G. Mackin; M. Lord; J. Kollongei; J. Pretorius; K. Ngeleka; N. Zondi & J. le Roux)

Successful prediction of agricultural non-point source pollution (NSP-P) requires an understanding and quantification of the sources and pathways of sediment and nutrients in the landscape and stream network. The migration of NSP-P is often dominated by controls and connectivity features in the catchment, and so this work aims at observation, description and quantification of the processes for water, sediment and nutrient delivery in a research catchment, or more specifically, the Mkabela catchment near Wartburg, KwaZulu-Natal.

Report No: 1871/1/11

Investigating the mechanism and processes used in setting water service tariffs (P. Hosking; K. Jacoby; G. Sharp & J. Hosking)

Water is an indispensable natural resource – vitally necessary to sustain life, the environment, food production, a key element in maintaining hygiene and a sustainable and environmentally attractive option for electrical power generation. Prosperity in South Africa depends, among other things, on the sound management of water, but with expanded aspirations and political commitments, municipalities and central government in South Africa have found themselves in a challenging situation with respect to the provision of water services for the last decade. The municipalities depend heavily on central government assistance to meet their mandate to provide water services to the local communities they serve. Water service tariffs are associated with the supply of potable water and with the managing and sanitising of the used (waste) water. The primary aim of this study was to estimate the customer valuations of municipal water services provided within the context of a water tariff setting framework. Among others, the investigations were required to determine service options for alternative combinations of water services provided in three municipalities in the Eastern Cape; assess the marginal value of water service delivered to customers, by use of the choice experiment method; and draw conclusions about the tariff-service connection in the light of the results of the choice experiment.



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Loss of top animal predators has massive ecological effects



US researchers have discovered that the decline of large predators and herbivores in all regions of the world is causing substantial changes to Earth's terrestrial, freshwater and marine ecosystems.

In a paper, 'Trophic Downgrading of Planet Earth', published in the journal *Science*, the researchers show that the loss of apex consumers from ecosystems may be humankind's most pervasive influence on nature. The study, conducted by an international team of 24 scientists, illuminates the patterns and far-reaching impacts of predation and herbivory on the structure and dynamics of global ecosystems. The researchers relied on both experimental and observational evidence.

"By looking at ecosystems primarily from the bottom up, scientists and resource managers have been focusing on only half of a very complex system," notes co-author Dr James Estes, professor of ecology and evolution at the University of California at Santa Cruz. "There is an urgent need for interdisciplinary research to forecast how a continued loss of top-level consumers will further harm the planet's ecosystems."

The paper documents some of the negative effects that the widespread loss of these animals has already had on Earth's biosphere, climate, biodiversity and vegetation:

The reduction of lions and leopards from areas of sub-Saharan Africa caused the baboon population to swell. This

unexpectedly increased transmission of intestinal parasites from baboons to humans as the primates were forced to forage closer to human settlements;

As large ungulates recovered from a devastating rinderpest epidemic in the Serengeti in Africa, herbivory increased, and the frequency of wildfire declined in that region;

Industrial whaling in the 20th century resulted in the loss of large numbers of plankton-consuming great whales, which are now known to sequester carbon into the deep sea through deposition of faeces. The result has been the transfer of about 105 million tons of carbon into the atmosphere that would have been absorbed by whales, contributing to climate change.

"We must assume going forward that significant changes to the ecosystem are occurring when large predators and herbivores are removed from the top of the food web, and, thus, that efforts to manage and conserve nature must include these animals," notes co-author Dr Ellen Pikitch of the Institute for Ocean Conservation Science at Stony Brook University, New York. "An old paradigm has shifted, and those who question this theory now have the burden to prove otherwise."

Parties come together to promote green future for Africa

The African Development Bank (AfDB) and global conservation group World Wide Fund for Nature (WWF) have teamed up to promote green economy and development issues in Africa.

Both organisations signed a cooperative framework to this effect in Geneva in July. The heads of the two organisations agreed to highlight the growing links between environmental protection and sustainable development, and the need to work on such issues as climate adaptation and mitigation, biodiversity and ecosystems.

AfDB President Donald Kaberuka emphasised the bank's strong

commitment to sustainable development and climate change mitigation and articulated the potential of this partnership: "This cooperative agreement is not built on financial interest but truly on the synergistic potential and comparative advantage of the two organisations and their capacity to echo Africa's voice."

The partnership will address some of Africa's most urgent sustainability issues, with an initial collaboration that focuses on three areas: developing win-win partnerships with emerging economies and strengthening South-South cooperation; catalysing knowledge-sharing and knowledge products for green growth and sustainable development; collaborating on energy and water resource management as well as climate change.

"We are confident that our partnership with AfDB will deliver tangible results for people across Africa and the ecosystems upon which their future depends," said Jim Leape, DG of WWF International. The two leaders agreed to focus first and foremost on a few concrete, practical and innovative initiatives, targeted to their strategic directions. They plan, for example, to collaborate on a joint publication taking stock of Africa's biodiversity and footprint, to be released in time for the Rio+20 Earth Summit in 2012. They also plan to leverage support for a successful outcome at the upcoming climate change negotiations in Durban this December.

Source: WWF

Indian Ocean pirates hinder climate observations

Australian scientists have sought the help of the United States and Australian navies to plug a critical gap in their Argo ocean and climate monitoring programme caused by Somali pirates operating in the western Indian Ocean.

"We have not been able to seed about a quarter of the Indian Ocean since the increase in the piracy and that has implications for understanding a region of influence in Australian and south Asian weather and climate," reported CSIRO

Wealth from Oceans Flagship scientists Dr Ann Thresher. Over 30 nations contribute to the multi-million Australian dollar Argo project, in which 3 000 robotic instruments provide near real-time observations of conditions such as heat and salinity in the top 2 000 m of the ocean.

Australia ranks second among countries based on the number of profilers providing data, with more than 325 profilers reporting to international data centres from the Indian, Pacific and Southern Oceans and the Tasman Sea. At nearly 2 m in length the drifting profilers, or 'floats', are programmed to drift at 1 000 m for ten days, then fall to 2 000 m and sample as they ascend to the surface to upload their data to satellites.

Although the Argo project offers shipping and defence benefits, its primary objective is to monitor ocean heat and salinity patterns that drive the climate and monsoonal systems which bring rain to Australia. Dr Thresher said the programme was heavily reliant on commercial shipping and research and chartered vessels to deploy the instruments. "With the region north of Mauritius being a no-go area for most vessels due to piracy activity, we have approached the US and Australian navies to assist us in deployments of around 20 profilers, including ten provided by the UK Argo project.

A 20-m South African yacht, *Lade Amber*, is under charter to CSIRO and has successfully deployed 7 instruments near Mauritius in the Western Indian Ocean. Her working area, however, was severely restricted by pirate activity in this area and the positions of several profilers had to be changed to accommodate these restrictions. She will deploy another 15 instruments as she transits between Mauritius and Fremantle, where she will pick up another 39 floats for deployment northwest of the Australian North West Shelf – an area thankfully free of piracy.

Source: CSIRO



Humanity can and must do more with less – UNEP

By 2050, humanity could devour an estimated 140 billion tons of minerals, ores, fossil fuels and biomass per year – three times its current appetite – unless the economic growth is ‘decoupled’ from the rate of natural resource consumption, warns a new report from the United Nations Environment Programme (UNEP).

Developed countries’ citizens consume an average of 16 t of those four key resources per capita (rising up to 40 t/year in some countries). By comparison, the average person in a country such as India consumes only 4 t per year. Already the world is running out of cheap and high-quality sources of some essential materials such as oil, copper and gold, the supplies of which, in turn, require ever-rising volumes of fossil fuels and freshwater to produce.

According to UNEP’s International Resource Panel, improving the rate of resource productivity faster than the economic growth rate is the notion behind ‘decoupling’. That goal, however, demands an urgent rethink of the links between the resource use and economic prosperity, buttressed by a massive investment in technological, financial and social innovation, to at least freeze per capita consumption in wealthy countries and help developing nations to follow a more sustainable path.

The trend towards urbanisation may help as well, experts note, since cities allow for economies of scale and more efficient service provision. Densely-populated places consume fewer resources per capita than sparsely populated ones thanks to economies in such areas as water delivery, housing, waste management and recycling, energy use and transportation, they say.

“People believe environmental ‘bads’ are the price we must pay for economic ‘goods,’” notes UN Under Secretary-General and UNEP Executive Director Achim Steiner. “However, we cannot, and need not, continue to act as if this

trade-off is inevitable. Decoupling is part of a transition to a low carbon, resource efficient Green Economy needed in order to stimulate growth, generate decent kinds of employment and eradicate poverty in a way that keeps humanity’s footprint within planetary boundaries.”

According to Steiner, next year’s Rio+20 meeting represents an opportunity to accelerate and scale up these ‘green shoots’ of a Green Economy, which are emerging across the developed and developing world.

To access the report, *Decoupling Natural Resource Use and Environmental Impacts from Economic Growth*, Visit: http://www.unep.org/resourcepanel/decoupling/files/pdf/Decoupling_Report_English.pdf

Namibia’s satellite centre to warn of disaster threats

A new satellite data centre in Namibia will help farmers prepare for droughts, floods, bushfires and pests.

The Earth Observation and Satellite Applications Research and Training Centre (EOSA-RTC) was launched earlier this year in collaboration with the African Monitoring of the Environment for Sustainable Development programme. It is located at the Polytechnic of Namibia and comprises a satellite receiving station and data centre, which will provide data useful for agriculture.

The data, which will be provided free to farmers’ associations and government departments, will include water indices, rainfall estimates, and maps of soil moisture content. Reliable data is essential to preparing for natural disasters. Earlier this year Namibia was hit by record floods, although rainfall is generally scarce.

“Rain is important for Namibia. Mistakes based on wrong information can be costly. For subsistence farmers, it can mean the difference between having food or not,” notes Marina Coetzee, a researcher at EOSA-RTC. “We will use the satellite to detect and map unknown small water bodies. We will also store normalised different vegetation indices

and then further process them into a variety of value-added products.”

Namibian researchers have already been assessing raw data obtained directly from satellites. However, the new centre will now provide specific, useful indices coming from the data, making interpretation easier.

Source: *SciDev.Net*

Bangladesh and the Netherlands to share flood research

Flood-prone Bangladesh and the Netherlands have revealed plans to exchange research findings and share experience on managing floods.

A five-year research programme worth US\$1-million aims to strengthen the capacity of institutions and communities to deal with moderate and extreme floods. The programme is being hosted by the Wageningen University and the Bangladesh University of Engineering and Technology.

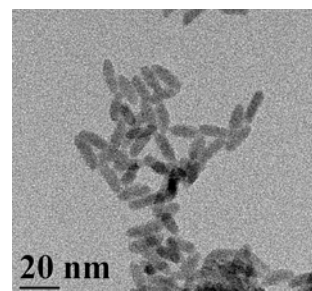
It will allow the scientists to share experiences and come up with a framework that will link disaster risk reduction, climate change adaptation and flood management. Funds will go towards four PhD research projects that will analyse flood policies and strategies in the two countries, and one project aimed at putting research findings into practice through local workshops.

Source: *SciDev.Net*

Quantum dots degrade in soil, releasing their toxic guts – study

Quantum dots made from cadmium and selenium degrade in soil, unleashing toxic cadmium and selenium ions into their surroundings, a University of Buffalo study has found.

The research, accepted for publication in the journal *Environmental Science and*



Technology, demonstrates the importance of learning more about how quantum dots – and other nanomaterials – interact with the environment after disposal, says Prof Diana Aga, who led the study. Quantum dots are semiconductor nanocrystals with diameters of about 2 to 100 nanometres. Though quantum dots are not yet commonly used in consumer products, scientists are exploring the particles’ applications in technologies ranging from solar panels to biomedical imaging.

According to Prof Aga, as the use of quantum dots increases, so will their presence in the environment. “We can conclude from our research that there is potential for some negative impacts, since the quantum dots biodegrade. But there is also a possibility to modify the chemistry, the surface of the nanomaterials, to prevent degradation in the future,” she notes.

Working in the laboratory, the research team tested two kinds of quantum dots: Cadmium selenide quantum dots, and cadmium selenide quantum dots with a protective, zinc-sulphide shell. Though the shelled quantum dots are known in scientific literature to be more stable, Prof Aga’s team found that both varieties of quantum dots leaked toxic elements within 15 days of entering soil.

In a related experiment designed to predict the likelihood that discarded quantum dots would leach into groundwater, the scientists placed a sample of each type of quantum dot at the top of a narrow soil column. The researchers then added calcium chloride solution to mimic rain. It was found that almost all of the cadmium and selenium detected in each of the two columns remained in the top 15 mm of the soil, indicating that, under normal circumstances, quantum dots resting in top soil are unlikely to burrow their way into underground water tables.

Source: *University of Buffalo*

IMPROVED WATER USE ONLY A SATELLITE AWAY

Sugarcane growers in one of the country's most overexploited catchments will soon have the aid of cutting-edge satellite technology to improve their water-use efficiency and up their production.

Article by Lani van Vuuren.



When travelling through the Inkomati area, in Mpumalanga, one cannot help but notice the rich variety and quality in produce grown. Bananas, citrus and sugarcane are but some of the products providing a feast for the eye for kilometres on end. However, while this might fool one into thinking that the area is as rich in water as it is in crops this is simply not the case. In fact, Inkomati is one the most water-stressed catchments in the country, with many users, including towns and villages, the Kruger National Park and South African neighbour Mozambique and Swaziland, vying for their share.

Escalating demand from expanding rural settlements, the need to meet environmental requirements as well as the obligations to the country's downstream neighbours, means that the catchment's largest water user – irrigated agriculture – is under pressure not only to improve water use efficiency to free up resources for other sectors, but also to expand its own operations to allow it to feed a growing nation.

INNOVATIVE TECHNOLOGY

A new project co-funded by the Water Research Commission (WRC) and the Department of Agriculture, Forestry & Fisheries will assist specifically sugarcane growers in the region to do just that and more through the application of the latest remote sensing technology, which uses satellite data to measure fundamental evapotranspiration and growth processes.

Fancy words, but how does it work? Project leader, Dr Caren Jarman from the University of KwaZulu-Natal explains: "Basically, remote sensing simply refers to the capturing of information from a distance, in this case satellites. The satellite takes a picture more or less in the same way as a camera does as it moves over an area, except it captures much more information than is visible to the naked eye, specifically

also thermal infrared and near infrared information, which is what we are interested in." This is because the temperature of a crop or plant often reflects the stress it experiences at a given time. Just as a person perspires to cool down, when plants transpire actively, their temperatures are lower (i.e. stomata open) compared to plants experiencing stress (stomata closed).

A number of algorithms have been developed over the years that use a combination of this type of satellite data along with extrapolated field data (from local weather stations) to estimate evaporation from a surface (in some cases, equivalent to crop water use). The research team will specifically be applying the SEBAL (Surface Energy Balance Algorithm for Land) model, which has been well established in water resource management internationally and tested successfully during a pilot project involving grape farmers in the Western Cape (the so-called GrapeLook project).

The WRC has in the past invested in research to measure and model crop water use. However, it is suggested that further investigations

should be conducted in South Africa to conclusively confirm the accuracy of remote sensing when compared to established methods of estimating crop water use, such as SAPWAT.

The project team will specifically focus on assessing crop water use (i.e. transpiration) of the sugarcane, but also on the water use efficiency (or crop water productivity), in other words, how much produce is produced per unit of water. "In this area different irrigation systems are used, including pivot, dripper and overhead systems. One can use this type of information to assess if any improvements can be made in terms of the use of water," explains Dr Jarman.

INFORMATION AT YOUR FINGERTIPS

At the time of writing a website was being established specifically for the project to be up and running by October this year. Data maps will be placed on the site at a weekly interval along with related information such as rainfall, evaporation, evapotranspiration deficit

Sugarcane is one of the major crops of the water-stressed Inkomati catchment.



Lani van Vuuren



Lani van Vuuren

Above: Sugarcane from the Inkomati basin contributes to nearly 20% of total sugar production in South Africa.

Below: Young shoots of sugarcane standing under irrigation outside Malelane, in Mpumalanga.

(the difference between evaporation losses and the potential evaporation of the crop), crop production (biomass) and derivatives (rainfall minus evaporation). Organisations participating in the research, including farmers, irrigation consultants and the catchment management agency, will be able to assess how much water was used by the sugarcane over a week period in relation to the irrigation applied by the farmer.

“Uniformity of evaporation losses over an irrigation block can be

assessed using the data and adjustments made,” notes Dr Jarmain. “The evapotranspiration deficit data, in turn, can be used to determine if plants in a specific block are experiencing any water stress and adjustments to irrigation systems and/or applications can be made accordingly. The fact that all information is provided spatially is very valuable, since farmers generally strive towards uniformity over an irrigation block.”

There are several challenges in this regard, firstly the timely delivery

of good quality (i.e. cloud-free) remote sensing data. “For an operational system to deliver information at a weekly time-step, a good quality image needs to be captured each week and be delivered soon after data capture so that the processing can be performed in time,” explains Dr Jarmain. The project also hopes to promote this approach, and therewith gain participation, from as many sugarcane farmers as possible.

TSB Sugar, one of the leading producers of sugar in the country, has already confirmed its support for the project. According to Dr Pieter Cronjé, Manager: Grower Affairs, it is hoped that this technology will contribute to highlighting areas requiring more attention. “The northern sector of the sugar industry is highly dependent on irrigation, and any system that can assist in the strategic management of a scarce resource will contribute to sustainability. The Inkomati area also features some large estates where production is monitored very thoroughly, and the space-based system will enable managers to pin-point inefficiencies more accurately while explaining lower than expected yields, thus guiding management interventions.”

Dr Cronjé explains that the optimum production of sugarcane requires a significant amount of water. Water use measurement among sugarcane farmers in the area vary from no measurement at all to remote sensors with data logging and transmission to a central point. Unfortunately, irrigation is still mostly based on irrigation systems’ design capacity rather than might be required by the plant or soil at any given point in time. “As a result we have experienced gross over-irrigation on several farms. TSB Sugar has been running an awareness campaign in this regard for several years. Where proper irrigation scheduling has been applied, production has improved up to 15%. We anticipate that the WRC project will further aid



Lani van Vuuren

in highlighting these inefficiencies and lead to a better management system.”

ENHANCING CAPACITY

From a research point of view the project has several important aims, firstly to present this novel technology to South African irrigation farmers. Dr Jarmain is of the strong opinion that this technology has the potential to assist farmers to improve their production, however, cooperation is required between farmers and researchers to ensure that the information is presented in a way that is most useful.

At the same time, very little expertise in this technology in South Africa currently exists, and the project will be exposing students to this type of remote sensing and its potential for water management in South Africa. Lastly, Dr Jarmain notes that many national departments can benefit from data generated using this type of technology. “Illustrating to the departments of Water Affairs as well as Agriculture, Forestry & Fisheries how this type of information can be used can greatly increase the use of this type of data. This obviously relates directly to capacity building.”

A similar study is also being planned for irrigated grain crops in the Middle-Orange River catchment as part of this project. The WRC project is also set to benefit from an upcoming European Union study, WATPLAN, which will be conducted simultaneously in the Inkomati catchment. This research project is aimed at integrated SEBAL estimates of crop water use to catchment scale, thereby ensuring that international obligations in terms of water delivery and management, is met.

Remote sensing technology will only improve over time in terms of how many satellites are available, how frequently data is captured, at which resolution data is captured and the costs at which the data is made available, maintains

Dr Jarmain. “Hopefully in a few years’ time satellite constellations will be available that can capture data daily at high resolutions, finer than the frequency currently used (30 m by 30 m).”

NATIONAL IMPORTANCE

For a large country such as South Africa, with huge variations across the landscape this technology can really add value not only for determining water use of agricultural crops (dryland and irrigated) but also of invasive alien plants, natural veld and forestry, to name but a few. Data can be shown in the form of maps or integrated at field, farm, region, catchment, province or whichever scale is required. ‘Water accounts’ can also be determined at different scale, especially catchment level.

It is clear that the application of this technology has far greater potential than just improving crop production, as WRC Director: Water Utilisation in Agriculture, Dr Gerhard Backeberg, points out: “The last reliable assessment of the area of different crops under irrigation in South Africa was published by the WRC 15 years ago (WRC Report No: KV96/96). It is important to determine the current area under irrigation, cropping patterns and water use across all farming types and irrigation schemes. In order to improve the efficiency of consumptive water use it is essential to increase beneficial crop transpiration and limit non-beneficial soil evaporation within the water balance. By achieving this, the productivity, competitiveness, profitability and sustainability of food production under irrigation will improve.”

“The accessibility of satellite images ensures data flow on changes in water use. The most important benefit is to monitor how changes in land use and consumptive water use affect water availability in different catchment areas,” Dr

Backeberg continues. “In addition, a data platform is generated with a range of applications. This, in turn, creates opportunities for service providers such as irrigation scheduling and soil fertilisation advice, plant disease and electricity cost control. Apart from more productive agricultural water use, many new business and employment opportunities will therefore arise in rural economies.”

Readers interested in participating in the project, Water Use Efficiency of Irrigated Agricultural Crops Determined by Satellite Imagery (WRC Project No: K5-2079) can contact the Editor for further information. □

THE SOUTH AFRICAN SUGAR INDUSTRY

South Africa is one of the world’s leading producers of high-quality sugar, with about 35 300 registered sugarcane growers farming predominantly in KwaZulu-Natal, Mpumalanga and the Eastern Cape.

Sugar is manufactured by six milling companies with 14 sugar mills operating in the main cane-growing regions. The industry produces about 2,2 million tons of sugar per season, of which 60% is marketed in the southern African Customs Union. The remainder is exported to countries in Africa, Asia and the Middle East.

The sector makes an important contribution to the local economy, and directly employs around 77 000 people – this represents a significant percentage of the total agricultural workforce in the country. When considering those indirectly employed by the sector it is estimated that about one million people in South Africa depend on the sugar industry for a living.

Source: South African Sugar Association



BLUE DROP:

Slow but steady progress
in restoring SA's drinking water quality



The results of the 2011 Blue Drop certification programme, in which the country's municipal drinking water treatment systems are evaluated, have been made public.

Lani van Vuuren summarises the results.

An innovation of the Department of Water Affairs (DWA), the Blue Drop certification programme for drinking water treatment systems was introduced along with the Green Drop certification programme for wastewater treatment plants in 2008 as an incentive-based regulation system to improve municipal drinking water quality and wastewater management. According to Minister of Water & Environmental Affairs, Edna Molewa, South Africa's municipalities are increasingly embracing the programme. This is evident in the fact that 914 water supply systems were assessed this year compared to 787 in 2009.

The certification programme works by measuring and comparing the results of the performance of water services authorities and their providers. Specially appointed assessors visit each water treatment plant, and score it according to a list of set criteria. Municipalities are subsequently awarded (or penalised) upon evidence of their excellence (or failure) according to the minimum standards of requirements that have been defined.

This year, 66 water supply systems were awarded Blue Drop Certificates (compared to 38 systems in 2010). It is interesting to note the increased number of awards despite the fact that some municipalities were unable to hold on to their Blue Drop status and the fact that requirements are becoming more stringent with every assessment cycle. At the same time, the number of water supply systems that achieved scores of more than 50% increased to 536 or 50%, compared to 47% in 2010.

The process has once again proved that municipalities do not necessarily have to be metro-sized with the latest technologies to produce drinking water of excellent quality. In fact, some of the best

performers of the year have been smaller local authorities. Rather, the secret to success seems to be committed and diligent technical staff supported by dedicated councillors. The increased political support on the ground level for the Blue Drop certification process could also be seen in the number of local councillors who participated in the recent Third Municipal Water Quality conference, held in Durban.

"In my view our incentive-based regulatory approach has succeeded in raising overall awareness that will lead to sustainable improvement in the management of drinking water quality across the country," said Molewa. "We now have 100% municipal coverage. This means that for the first time, the Department of Water Affairs as the national regulator has a complete database of exact strengths and gaps per municipality and per water supply system from where gradual and sustainable improvement can be monitored."

Speaking at the Third Municipal Water Quality Conference, where the results were made public, DWA Chief Director: Water Services, Helgard Muller, said that a general positive trend could be seen in the results. This was very encouraging for the regulator. "The challenge now is to work with those municipalities who are consistently underperforming and bring them up to standard. This will require a concerted effort by the department and the municipalities concerned."

While DWA would not hesitate to take legal action against municipalities who put their constituents at risk by providing sub-standard quality drinking water, this was a lengthy and expensive process, noted Muller. "Court cases can drag on for years, and while they are ongoing inhabitants of a particular town or city are still subjected to substandard

services. The challenge is to find a way of resolving problems quickly and efficiently."

PROVINCIAL RESULTS

Residents of the Western Cape can rest assured that their drinking water is of top quality after the province scooped 29 Blue Drop awards in the recent round of assessments out of a total of 66 Blue Drops awarded. This is 21 more than its nearest competitor. Interestingly, while the City of Cape Town boasted the highest provincial Blue Drop score (98%), it is the smaller Witzenberg Municipality that walked away with the highest number of awards (5).

While it did not achieve as many Blue Drops for its water treatment systems, municipalities in Gauteng, where close to 40% of the country's drinking water is treated and supplied through 32 supply systems, did achieve the highest overall provincial score (95%) compared to the Western Cape's 94%. Significantly, Gauteng has no critical systems (i.e. scoring lower than 33%).

Third on the provincial performance log is KwaZulu-Natal, who managed 7 Blue Drops and a provincial score of 80%. eThekweni Metro was the best achiever in the province, with a score of 96%. Unfortunately, the province's high overall score is skewed

"For the first time, the Department of Water Affairs as the national regulator has a complete database of exact strengths and gaps per municipality and per water supply system from where gradual and sustainable improvement can be monitored."

THE BLUE DROP TOP TEN MUNICIPALITIES

1. City of Johannesburg
2. City of Cape Town
3. Ekurhuleni Metro
4. Witzenburg Local Municipality
5. West Coast District Municipality
6. Tlokwe Local Municipality
7. George Local Municipality
8. Mogale City Local Municipality
9. Bitou Local Municipality
10. Emfuleni Local Municipality

as the high-scoring municipalities are balancing a few very low scores, which DWA has noted with concern. Still, seven systems obtained Blue Drops compared to only one last year, while 138 systems scored more than 50% with 22 systems scoring more than 90%.

The Eastern Cape is fourth on the national list of performance, with Buffalo City (East London) coming out tops with a score of 91%. While the province did manage to raise four Blue Drops, overall performance declined somewhat compared to 2010. According to DWA, 44 systems in the Eastern Cape require attention, and the overall business of drinking water quality management is “not in a healthy space.” It is encouraging to note, however, that the percentage of systems which scored less than 33% have decreased from 74% (in 2010) to 49%.

The Maluti-a-Phofung municipality is the best performer in the Free State, with a score of 89%. Through the Blue Drop process, municipalities in this province are renewing their operational baselines and reprioritising their plans with the aim of raising their current performance status in terms of municipal drinking water quality management. The Free State continued its upward trend from last year, with the province scoring 64% compared to only 40% in 2009. Despite this improvement, however, the majority of systems in the province still scored below 50%, which is not

a commendable position. The good news is that 24% of systems now fall in the ‘excellent’ and ‘very good’ categories, compared to only 5% in 2010.

Lower on the provincial log is Limpopo, where Polokwane achieved the best score (92%). While the overall impression is one of commitment to the certification process, there are still pockets of poorly performing municipalities, according to DWA. A total of 18 systems in this province require urgent attention, however, on the other side of the scale 30% of systems are now in an excellent or very good state (up from 0% in 2009).

The North West provincial score is slightly down from 2010 – from 66% to 62%. Tlokwe Municipality achieved the highest score (97%), with a total four Blue Drops being awarded in the province. A positive development is the fact that 67% of systems scored more than 50%.

Municipal water system performance varied from excellent to good in the Northern Cape, with Frances Baard municipality achieving the highest score (95%). The province shows one of the most progressive inclines in Blue Drop performance since 2009, and DWA is encouraged by the quality of evidence that has been submitted by a number of municipalities. Unfortunately, the province is still lagging slightly behind, and did not manage to attain any Blue Drops this year, although two systems managed scores above 90%.

According to DWA’s assessment Mpumalanga is one of the few provinces which do not seem to be on par with objectives to ensure continued improvement – the province showed a drop in provincial score from 65% to 57%, resulting in it being in last place on the national log. “Renewed effort and resources will have to be applied to turn around this undesirable trend.” As in the other provinces Mpumalanga also has star performers, like Steve Tshwete Local Municipality who managed a score of 97%. A total of 8 Blue Drops were awarded in the province.

The department has now set its sights on improving those systems that scored least in the assessment. “I will engage at political level with the newly-elected mayors and councillors of such municipalities, while officials of my department will apply the necessary regulatory measures and support tools to rectify the situation,” noted Molewa.

Assessments will be undertaken again this year and revealed at next year’s biennial conference of the Water Institute of Southern Africa.

To see the results for your municipal area, Visit: www.dwa.gov.za/bluedrop or http://www.ewisa.co.za/frame.aspx?url=misc/BUE_GREENDROPREPORT/bluedropindex.htm

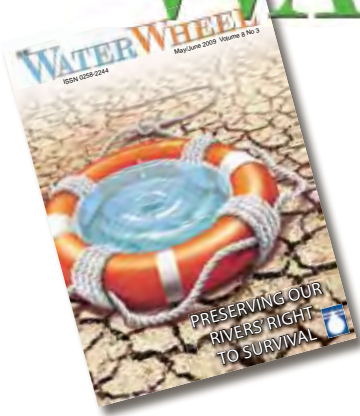
Look out for the November/December edition of *the Water Wheel* when we will provide an overview of the Green Drop certification results. □

COMPARATIVE ANALYSIS OF PROVINCIAL PERFORMANCE

Province	Provincial Blue Drop score	Blue Drop awards 2011
Gauteng	95%	7
Western Cape	94%	29
KwaZulu-Natal	80%	7
Eastern Cape	77%	4
Free State	64%	3
Limpopo	64%	5
North West	62%	3
Northern Cape	62%	0
Mpumalanga	57%	8

Source: 2011 Blue Drop Report

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Taking back the 'lost' wetland



Verlorenvlei lies 25 km north of Lambertsbaai, close to the fishing village of Elandsbaai.

Community and governmental agencies are cooperating to overcome the challenges facing one of the South Africa's most important wetlands – Verlorenvlei. Article by Petro Kotzé.

Along the West Coast, about 25 km north of Lambertsbaai lies arguably one of the most important wetlands in the country. Close to the fishing

village of Elandsbaai, the 1 500 ha Verlorenvlei strikes an impressive sight. While it faces a number of challenges, the wetland is an interesting example of how governmental organisations, landowners and residents can work together towards sustainable existence around this special ecosystem.

Forming the centre point of the Sandveld, Verlorenvlei is one of the country's few coastal freshwater

lakes and comprises a coastal lake and reedswamp connected to the sea by a small estuary. Its catchment area is bound by the Swartberg and Olifantsrivierberge in the east and by the Piketberg in the south, but even though it is fed by three rivers, it is mainly groundwater driven, making it a very slow-moving system. The region displays high floral species diversity typical of an ecotone area (the region of transition between two

biological communities, karroid and fynbos). Furthermore, the wetland is regarded as one of the ten most important wetlands for wading birds in the south-western cape, being a particularly important wading area for the white pelican (*Pelecanus onocrotalus*) as well as a number of threatened bird species. The wetland's international importance was confirmed when it was proclaimed a Ramsar site in 1991.

“After three years of stakeholder engagement, the Sandveld potato producers unanimously voted in favour of working in partnership with the Greater Cederberg Biodiversity Corridor towards building a best practice strategy.”

A number of people depend on, and make use of the wetland for urban, agricultural or industrial uses. It is used as natural veld grazing for sheep and cattle and water is pumped to irrigate the surrounding fields that have been established on the privately-owned farms. Many of the local farmers are dependent on water-intensive potato farming, as well as the dryland crop rooibos harvested for tea. Recently, the wetland's catchment area was also earmarked as a potential tungsten mining site (see sidebar).

Life on and around the vlei, however, has resulted in severe biodiversity and underground water losses. A desktop study conducted in 2006 by CapeNature looked at sequential aerial photographs of the Sandveld between 1989 and 2004 and calculated that the rate of change (natural vegetation being lost to agriculture) was averaging a staggering 2,7 ha per day. Further challenges include the impact of alien vegetation in the upper catchment on water flow while the estuary mouth is frequently closed due



A desktop study conducted in 2006 by CapeNature concluded that the rate of change in the Sandveld between 1989 and 2004 was around 2.7 ha per day.

Cape Nature

to sediment build-up and restricted water movement.

The loss of the area's rich biodiversity and habitat, pressure on the freshwater resource and climate change (being part of an area identified as most at risk to suffer from induced warming and rainfall change) add further burdens. But, despite the pressure on the ecosystem, the people depending on the wetland still have to make a living in the semi-desert surroundings of the Sandveld. It was thus decided that urgent intervention was needed to mitigate the destructive consequences of sustaining life on the vlei.

The issue at Verlorenvlei, says Cape Nature's Jenifer Gouza (Programme Manager: Corridors, Biospheres and World Heritage Sites), is essentially one of sustainability. "It is about balancing the socio-economic needs with the environmental needs," she adds.

FIXING VERLORENVLEI

Urgent efforts to relieve the pressure on groundwater resources and mitigate biodiversity losses were tackled by the Greater Cederberg Biodiversity Corridor (GCBC) (a landscape scale corridor initiative). With CapeNature driving



In order to tackle the problem of alien vegetation, the GCBC, with Working for Wetlands embarked on rehabilitation intervention in 2006.

Cape Nature

MINING – A REALITY IN THE VERLORENVLEI CATCHMENT?

Local landowners and residents are continuing their fight against possible open-cast tungsten and molybdenum mining in the Moutonshoek Valley (the catchment area of Verlorenvlei). In the most recent development landowners received letters from Bongani and Withers Environmental as notification that Bongani Minerals was awarded a Prospecting Right for tungsten in the Verlorenvlei catchment on 1 July 2011.

According to the Verlorenvlei Coalition, which was formed to oppose the mining application, Bongani Mineral's first application to prospect was refused in 2005. When a second application to prospect was brought forward, the licence was granted, but was challenged by a judicial review brought on procedural grounds. This right lapsed before the review could go ahead but just before this happened, Bongani Minerals lodged a mining right application in 2009, based on the technicality that they still owned the prospecting right for Riviera Tungsten.

The coalition maintains that the disputed mineral deposit, Riviera Tungsten, is a belt of low grade and widely dispersed tungsten ore in the Moutonshoek valley. They add that mining the ore would pose a serious threat to precious water resources, as it would require blasting through the Krom Antonies River of the surface, as well as two vital aquifers.

The mining right debacle reached the media again earlier this year, when the *Mail & Guardian* published an article questioning the integrity of the department's mineral prospecting rights process. In the article, the acting regional manager who presided over the prospecting rights application at the time was said to be in a close relationship with one of the directors of Bongani Minerals.

Landowners' legal counsel and the Verlorenvlei Coalition will now lodge an appeal against the prospecting approval with the Minister of Mineral Resources, Susan Shabangu.



FARMING IN THE SANDVELD

“We understand that the water issue is a very sensitive one,” says Jacobus Smit, whose family has been farming in the Sandveld for decades. “People have been farming here for 300 years and the water quality has not substantially degraded, but,” he agrees, “the water quantity is a different story.” Smit says that the first farm in the area was officially leased around the 1700s and that water abstraction up until 1978 has been relatively modest, because it had to be pumped with a diesel pump.

However, during the past 20 years, following the arrival of Eskom electricity and centre pivots in the 1980s, the area saw a massive increase in potato farming, and as a result, water usage. By 2008 it was estimated that this industry’s total turnover was R400 million per year, employing about 3 250 people, also making it one of the most important food and employment providers in the Western Cape. Almost all irrigation is dependent on groundwater.

Smit explains that the centre pivot circles are rotated every four years to prevent the outbreak of diseases, but that

they have not yet successfully planted any other food crops in the interim periods. Few crops can survive in the almost sterile soil. Consequently, not only is wind erosion problematic (even though some farmers do plant grain in the circles) but to feed a growing market, new land to plant potatoes is forever needed. Furthermore, to compensate for the soil’s low water holding capacity and the potatoes’ water needs, Smit explains that, to irrigate effectively, you have to water twice every 24 hours.

In some areas, like the upper-catchment area of Verlorenvlei in the Moutonshoek Valley, where Smit farms, water usage has dropped since 1998, when farmers started planting other crops like citrus and lucerne.

Smit is adamant that most of the farmers in the area are well aware of the importance of the vlei that they are very much dependent on, as well as the significance of its sustainable use. “We have to be,” he adds, “people here have to farm responsibly and efficiently, because nature ensures that those who mess up won’t survive.”



Rooibos is one of the main crops grown in the Sandveld.



SA Rooibos Council

implementation, the initiative's aim is to introduce people to sustainable ways of using their land and the natural resources of this unique and diverse region.

Gouza explains that through the GCBC, CapeNature has been able to engage with both the potato and rooibos tea industries to encourage best practice farming in the area. "The aim of this engagement with the industries was to support sustainable farming through the development of best practice guidelines to support participant farmers,"

"The best practice projects have evolved beyond our expectations and we are encouraged by the fact that the industries have taken up these initiatives to support long-term sustainability goals."

she elaborates. The idea was that, in time, farmers would voluntarily pursue ecologically-friendly farming practices.

After three years of stakeholder engagement, the Sandveld potato producers unanimously voted in favour of working in partnership with the GCBC towards building a best practice strategy. A Rooibos Biodiversity Initiative (RBI) pilot study was also set up with 20 producers spread over the areas of Niewoudsville, Vanrhynsdorp, Gifberg, Nardouwsberg, Biedouw Valley, Clanwilliam, Graafwater, Citrusdal, Piketberg, Redelinghuis and Elandsbaai.

As a result, the Best Practice Guidelines were developed and now form the basis of an auditing and certification system which provides credibility for the efforts made by

producers to support the RBI. The first of these annual audits were completed in December 2008. The RBI has since evolved into Right Rooibos (the current logo under which best practice is implemented), a change indicative of the move from a largely environmental focus to a more sustainability-driven focus taking environmental, social and economic elements into account.

In 2007, Best Practice Guidelines for potato production in the Sandveld were also produced. Collectively, the two best practice projects have yielded more than 50 participating farmers. The potato industry has also identified usage of certain resources, such as water, to focus on. "This is critical for the industry given climate change projections that the area will be drier and warmer," she says.

In order to tackle the problem of alien vegetation, the GCBC, with Working for Wetlands embarked on rehabilitation intervention in 2006. This programme has been "critical" in dealing with the alien invasive problem, says Gouza. It involves the clearing of invasive alien vegetation, the removal of impediments to water flow, reducing sedimentation as well as an awareness campaign. In order to secure priority biodiversity, stewardship agreements with some of the Sandveld landowners have also been undertaken.

Furthermore, in 2009 the Bergriver Municipality, which manages the upper-catchment area of the vleis (Moutonshoek Valley), became the first B-grade municipality in South Africa to become a member of the Local Action for Biodiversity (LAB) programme. This is a global urban biodiversity initiative launched by ICLEI (Local Governments for Sustainability) in partnership with the IUCN (International Union for the Conservation of Nature). ICLEI is an international association of more than 1 200 local governments from around the world that have made a commitment to sustainable development.



Petro Kotzé

According to Gouza, another key accomplishment that has recently taken place is the establishment of the Verlorenvlei Estuary Forum, an essential governance mechanism to ensure that relevant stakeholders are represented and that the estuary is managed properly. The Forum, representative of all relevant government authorities and interest groups in the Verlorenvlei region is the body ultimately responsible for the implementation of the Estuary Management Plan (EMP). The EMP is a 'living' document, continuously refined through implementation but embedded in overarching national, regional and local plans.

Gouza says that CapeNature has undertaken the rehabilitation work of the wetland in the short and medium term. Yet, the long-term sustainability of the wetland and its catchment area rests in the hands of those that benefit most from it: the landowners and residents that live in close proximity to it. From CapeNature's side, their long-term commitment is tied to stewardship agreements with some of the farmers in the Sandveld and surrounding the

wetland. "The best practice projects have evolved beyond our expectations and we are encouraged by the fact that the industries have taken up these initiatives to support long-term sustainability goals," she says. With continued stakeholder participation, the next set of sequential aerial photographs of the Sandveld will hopefully show evidence that the rate of change is swinging in favour of some of the Sandveld's, and the Verlorenvlei wetland's natural vegetation yet again. □

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Petro Kotzé

Above left: The scenic Moutonshoek Valley, in the Verlorenvlei's catchment area, has been earmarked as a possible tungsten and molybdenum mining site.

Left: Water is pumped to irrigate the surrounding fields that have been established on the privately owned farms.

Groundwater and surface water interaction: FROM THEORY TO PRACTICE



All photographs courtesy of IGS

Historically, groundwater (GW) and surface water (SW) have been viewed, and managed, as two separate entities. Most water resource management plans focus on the latter, but the constant development of land and water resources has made it clear these systems affect each other both in resource quantity and quality. Article by Petro Kotzé.

Recent research has shown that development is not the only reason why it is important to understand how surface water and groundwater interact. Climate change is likely to affect the availability and distribution of both, so increasingly this interaction

is playing a bigger role for water resource management.

In the simplest terms, if we don't know if, and how much water infiltrates from a river into an aquifer, we don't know how much water to allocate from the river to a particular user. In a water-scarce country like South Africa, explains Prof Gideon Steyl, research fellow at the Institute for Groundwater Studies (IGS) at the University of the Free State, we might increasingly have to look towards groundwater as a sustainable source of water. If this is the case, knowledge of the interplay between these systems is imperative.

In order to understand the mechanisms of this interaction, observational data is integral but,

lacking in South Africa. Even more so, the available data is mostly segmented into purely atmospheric, surface hydrology or geohydrological data for specific areas. Mostly, no significant overlap exists between the surface and sub-surface hydrological data in order to ascertain a relationship between these two systems. Up until now, there has also not been a local test-site to rectify the situation.

Fortunately, this state of affairs is changing. Researchers from the IGS are tackling a multi-disciplinary project, investigating the multiple processes involved in surface water and groundwater interactions. These include surface hydrology, evapotranspiration, geohydrology and vadose zone hydrology (also known

as the unsaturated zone, it is the portion of Earth between the land surface and the zone of saturation). The three-year study, which started earlier this year, is focusing on gathering all available data necessary to enable the group to identify important processes and field measurement methods. This knowledge can later be applied to more test sites.

A UNIQUE APPROACH

The study area is situated close to the Krugersdrif Dam in the Southern Free State, between the R64, S264 and the S328 roadways. Underlain by Beaufort Group formations with dolerite dykes intruding in certain areas, it is intersected by the Modder River from an easterly to a westerly direction. Flow in the river is controlled from the Krugersdrif Dam sluice gates, either at regular intervals or if water levels drop significantly downstream.

This is the ideal site for a number of reasons, explains Prof Steyl, who is leading the study. Among others, water seeps freely from the surrounding formations into the river at some places, which indicates that there is movement of groundwater into the river system. The area has escaped relatively unscathed from pollution and over-development and also features a shallow water table.

The study covers the river, the riparian and background zones, and brings together specialists in the areas of surface hydrology, evapotranspiration, geohydrology and vadose zone hydrology. Prof Steyl adds that he also aims to involve a geophysicist (who, through the use of magnetic measurements of the area, can establish a well defined concept of the interaction of the dykes on the subsurface movement of water in the study area). Funded by the WRC, with support from the IGS, Department of Water Affairs (DWA) and local farmers and property owners, it is the first study of its kind to merge this variety of

“In the long term, it is hoped that the data will be developed into a set of ‘checkpoints’ that can be used by water resource managers to determine the amount of water that is available for use in a system.”

disciplines. In essence, the data will sketch a complete picture of all the elements involved in the interaction between water in the atmosphere, groundwater and surface water.

In order to obtain this data, the project involves a number of tests and observation locations. Firstly, boreholes are drilled in triangles, enabling participants to determine the local gradient in the riparian zone and the general area on both sides of the river. To date, researchers have constructed 40 holes, in two areas of about 4 km x 2 km and 1 km x 2 km. The holes are also of different depths so that both the surface and deep aquifer system can

be characterised to determine if the river system is connected directly with the riparian zone or general area.

Prof Steyl explains that the next step is chemical analysis of water from the boreholes and river. Tests include macro- and micro-chemical analysis and, in a novel approach, isotopes, “something that’s a bit unusual for us,” he admits. The adage of this method enables them to pick up if a substantial volume of water from certain boreholes ends up in the river.

Researchers will furthermore apply geophysics (down-hole investigations and profiling) to establish local geological features and borehole characteristics, as well as pump tests to determine both local and regional hydraulic properties. An added advantage is that knowledge of the Free State’s rock formations and isotopic composition will be gained, as not many of these types of studies have been done in that specific area. Further research includes the monitoring of the water levels in both the river and boreholes over a

The study area is situated close to the Krugersdrif Dam in the southern Free State.





Above: (From left) Prof Gideon Steyl of the Institute for Groundwater Studies at the University of the Free State on site with PhD student Modreck Gomo and MSc students Khakliso Leketa and Shakhani Teboho.

Right: Dr Eddy van Wyk of the Department of Water Affairs inspecting a dolerite dyke showing the fractured zones in the rock face at the western site.



few years (to determine fluctuations due to seasonal changes and river flow volumes).

Then, the unsaturated zone will be studied. This entails a soil profile analysis and determining the infiltration rates at the specified sites. Prof Steyl adds that there are many ways in which water can move through this zone. The techniques to be applied include physical measurements of how water moves through this zone, and through to the aquifer when it rains. Porous cups will be used not only to evaluate the flow of water in the subsurface, but also the chemical composition as it drains to lower levels. A second method will include geophysical methods. These rely on, among others, capacitance and resistivity of the subsurface environment. The project team has already had some success during the heavy rainfall that the area experienced in June. "If we can get this aspect of the project right," notes Prof Steyl, "we will definitely have world-class data available."

Once the geophysical data are added, the team would theoretically have a 'picture' of all the elements at play in the aquifer. This is then combined with evaporation and climatic (analysis of the rainfall and temperature fluctuations at the river and background area) data.

In addition, the site is used as a training ground for post-graduate students at the IGS. Two students have already completed their MSc theses on the project, while it is expected that at least 60 geohydrologists (training and active in the field) will visit the site over the duration of the project. It is also expected that personnel from the DWA will visit in order to assist with the development of regional management plans during the course of the investigation.

RIISING TO THE CHALLENGE

A study of this nature is not without its challenges. Indeed, one of its biggest strengths counts among

them. “Analysing and interpreting the results in way that all the different parties agree on is easier said than done,” admits Prof Steyl. In addition, correctly determining the recharge potential in the unsaturated zone, and obtaining sensible hydrological data (Prof Steyl’s background is in chemistry and geology) is not easy.

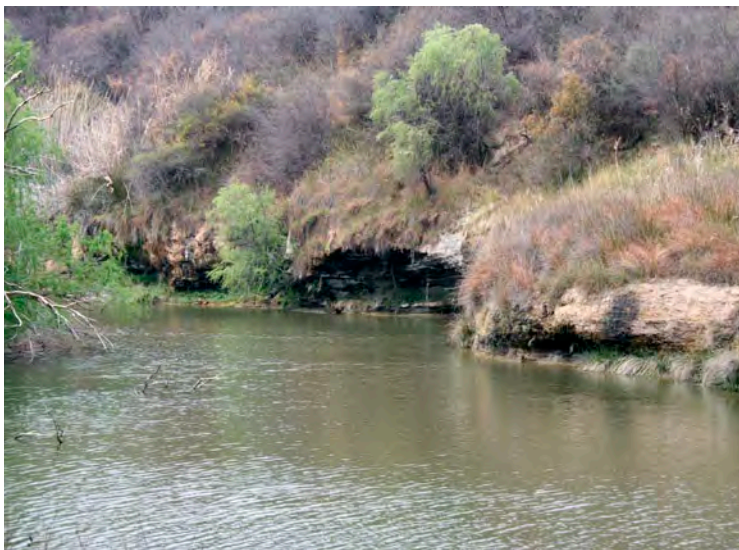
He also admits that the research area is small, and that the data are very site specific. The evapotranspiration data, for example, are dependent on the types and distribution of flora on the site. It is thus hoped that the study might be continued for a further three years, in order to apply the mechanisms defined in the current study areas to other areas. Eventually, Prof Steyls and his team want to apply the results to areas representative of every groundwater and surface system. In the long term, it is hoped that the data will be developed into a set of ‘checkpoints’ that can be used by water resource managers to determine the amount of water that is available for use in a system.

The project has already yielded interesting results in the geohydrology arena, which might have remarkable consequences for water resource management. Among these, notes Prof Steyl, are that the two sides of the Modder River are completely different worlds, not only geologically and chemically, but also isotopically. For example, while the one side of the river consists of basic sand formations, the other is made up mostly of chalk. Furthermore, it looks as if the river comes down much slower on the one side than the other.

Without a doubt, a study of this unique nature will continue to generate exciting results, not only for the researchers involved, but for those involved in water resource management who will eventually apply the results. Possibly more important is that it is the first step in the right direction, and that the generated data will go a long way towards filling a worrying gap that currently exists in the area of groundwater and surface water interaction. □



Top left: The study site is intersected by the Modder River from an easterly to a westerly direction. Flow in the river is controlled from the Krugersdrift Dam sluice gates.



Middle left: Water seeps from the surrounding mudstone formations into the river, which indicates that there is a movement of groundwater into the river system.



Bottom left: MSc student Khakliko Leketa collects borehole samples for further lab analysis at the University of the Free State Soil Analysis Laboratory.

South African Military Water Diviners in Kenya during World War II



The South African Engineering Corps played an imperative role in keeping enemy forces at bay in East Africa during the Second World War by delivering critical infrastructure, including water. Article by Deon Visser.

Italy's potential entry of the Second World War in support of Germany created serious challenges for Britain and her allies in the Mediterranean, the Middle East and Africa. Italy could close the Mediterranean, while her air and naval forces based in Eritrea

and Italian Somaliland could also threaten Allied shipping in the Red Sea. In addition to capturing Egypt and the vital Suez Canal, Italy could furthermore try to take the Sudan, Kenya and Tanganyika, and even advance into the Union of South Africa.

The British military commitments in Europe and Egypt left them with hardly any resources to meet their defensive needs in East Africa. Britain consequently turned to the Union of South Africa to make up most of her shortfalls in East Africa. The Union Defence Force (UDF)

Proposed tank and drum type water carriers, SAEC (5 X standard 65-gallon (295 litres) petrol drums).

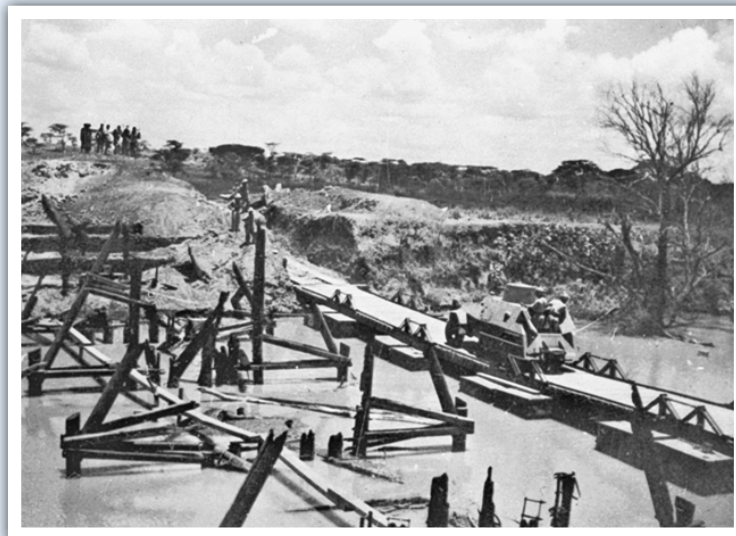
deployed the entire 1st South African Division, as well as several air force squadrons and various support elements to East Africa, including several units of the South African Engineers Corps (SAEC). The arrival of the South African forces enabled the British to take the offensive against the Italians at the beginning of 1941 and defeat them in less than five months. In this the SAEC played a crucial role because, as Neil Orpen observes in his book *South African*

Forces World War II, I: East African and Abyssinian Campaigns, East Africa's two most formidable military obstacles were a lack of water and roads.

Harold M. Fridjhon of the South African Department of the Interior's Bureau of Information strongly emphasised the defining role of water in African warfare in a manuscript he submitted to the *Outspan* in July 1943, stating: 'Water has always been the decisive factor in the strategy of African warfare'. From the earliest recorded wars... the design of African battles can be traced from waterhole to waterhole... And the advent of lorried infantry, masses of huge trucks, armoured cars and tanks has not modified the problem of water-controlled strategy; it has aggravated it. Today there are not only men to be watered but also machines... Under duress men can go for several... days without water, but radiators must constantly be kept full lest several thousands of pounds worth of fighting machinery become just so many tons of useless scrap.'

CRUCIAL ROLE OF SAEC WATER SUPPLY FUNCTION IN MILITARY OPERATIONS

The Kenya-Italian East Africa frontier covered approximately 2 000 km, much of which ran through unmapped, roadless and extremely arid areas. To conduct operations from Kenya against the Italians, the British were consequently completely dependent upon the South African Engineer Corps moving ahead of the fighting forces to create lines of communication for the latter to advance. The engineers had to develop water supplies, construct camps and depots and build roads, bridges and railways to keep the troops moving, to facilitate the flow of supplies and equipment to the front and to allow the evacuation of casualties to the rear areas. To carry out these tasks, the UDF established several highly specialised



Top left: A pontoon bridge constructed by the South African Engineering Corps at Bole, East Africa.



Middle left: South African infantry patrol in East Africa.



Bottom left: A standby flight of Fury aircraft, 2 Squadron, South African Airforce in East Africa. The runways at some airfields had to be sprayed with water to prevent the dust from choking man and machine.

SAEC units including road construction, motor transport, and survey and water supply companies.

Staffed mainly from the Department of Irrigation and the Mines

Department, who had worked together for 35 years to refine the location and exploitation of underground water in the Kalahari desert and other arid areas in South Africa,



Top: The crew of a SA Armoured Marmon-Herrington Mark II armoured car carrying out maintenance on one of its Vickers machine guns in East Africa.

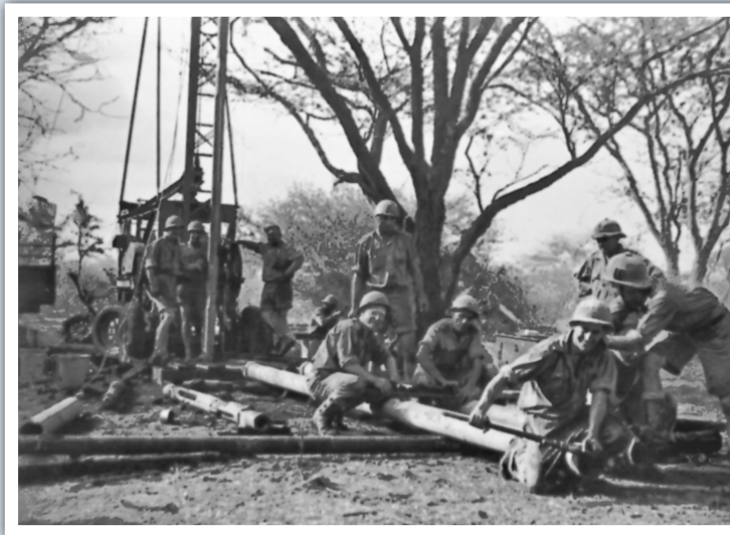
Above: Man, beast and machine competed for fresh water. In this picture a SA Armoured Marmon-Herrington Mark II armoured car be seen in East Africa, with cattle belonging to the local population in the foreground.

Right: Members of the 36th Water Supply Company, South African Engineer Corps sinking a borehole in Kenya, East Africa.

the 36th Water Supply Company and the 42nd Geological Survey Section brought much experience and highly advanced knowledge and equipment to East Africa. The 42nd Geological Survey Section located sites for boreholes, whereafter the 36th Water Supply Company moved in, sunk a borehole and installed pumps and pipelines. At the same time the Road

Construction companies built roads to allow the Motor Transport Companies to pump the water into tankers and transport it to the front.

The 36th Water Supply Company deployed its drills along the four important access routes to the Kenya Italian frontier, namely the Kitale-Lodwar-Lokitaung road, the road to Marsabit, which crossed the Kaisut and Chalbi deserts, the Wajir-Buna road and the road to Garissa. The engineers sank numerous boreholes along these routes, while they also cleared out and improved many existing wells, dug many new wells, built dams and purified water from several dirty lakes and waterholes. This resulted in a significant increase in the water supply in Kenya as the following few examples will illustrate: at Marsabit the SAEC raised the available water supply from about 27 000 litres per day to more than 236 000 litres per day within four weeks; at Laisamis the engineers struck water at 88 metres with a yield of 545 litres per hour, while a borehole sunk on the Habaswein-Muddo Gashi track yielded almost 2 000 litres per hour; and when the South African forces captured El Yibo in mid-January 1941, the engineers pushed up the yield of 450 litres of poor water per day from the local wells to over 84 000 litres of potable water per day in no time.



IMPACT OF WATER EXPLOITATION ON LOCAL COMMUNITIES

The British District Commissioner in the Northern Frontier District of Kenya appealed to the South African forces in December 1940 'that provision be made [at Marsabit] for allowing the natives their usual access (or alternatives) to water sources being taken over by the military authorities'. This request was motivated by both humanitarian and military motives, for the British could hardly afford to turn the local population against their war effort. The military needed Kenyan manual labour and recruits for the King's African Rifles.

Placing military needs first, the South Africans, however, sometimes denied the locals their usual access to water sources and directed them to alternative sources.

The SAEC indeed took the needs of the local population into consideration. Reporting on the available water sources around Marsabit, Major G.F. Newby recommended that 'The Village Well... be ignored because it forms the source of supply of the inhabitants'. He subsequently reported that the well was allocated 'only for [the] D[istrict] C[ommissioner], villagers and occasional small units'. Of the estimated 45 500 litres of water yielded per day by the springs at Tass the SAEC allocated 32 000 litres for military usage and 13 500 litres for 'native purposes.' Captain A.S. Posthumus recommended that the wells in the Segunti Valley, which was the main water source for the cattle at Marsabit, 'should be left for its present purpose unless [the] water supply position deteriorates to any great extent'.

Placing military needs first, the South Africans, however, sometimes denied the locals their usual access to water sources and directed them to alternative sources. Captain Posthumus, for instance, suggested that the wells in the Segunti Valley ‘may be able to carry the cattle which should be evacuated from Lake Paradise and Balessa Bangoli’ to make more water available to the military. At Woroma ‘arrangements were concluded with the Kenya Police that all camels be removed from this area and watered at Balessa Karauwi’. Such arrangements certainly inconvenienced the local population and disrupted their normal activities. The extent to which this happened might be revealed by research in the Kenyan national archives and interviews with survivors in the affected areas, as well as with South African veterans of the campaign in East Africa. Fieldwork in some of the areas in question is, however, not without risk as a result of the violence associated with cattle-rustling and piracy. People involved in these criminal activities are heavily armed with AK47s, hand grenades, mortars and other modern weapons, which make it somewhat risky for researchers to move around.

LEGACY OF SAEC'S ENDEAVOURS IN KENYA

Introducing a summary of Major E.W. Dohse's presidential address to the South African Society of Civil Engineers, the official news magazine of the South African Forces, *The Nongqai* of May 1943 states: “War, judged by normal standards, is a wasteful undertaking, but when peace comes again many men of the S.A. Engineering Corps will experience a feeling of satisfaction in the constructive work of lasting value which they have done during their war service. Since the epic days of the Abyssinian Campaign all South Africans have heard with pride of the achievements of our engineers.”

The wartime endeavours of the



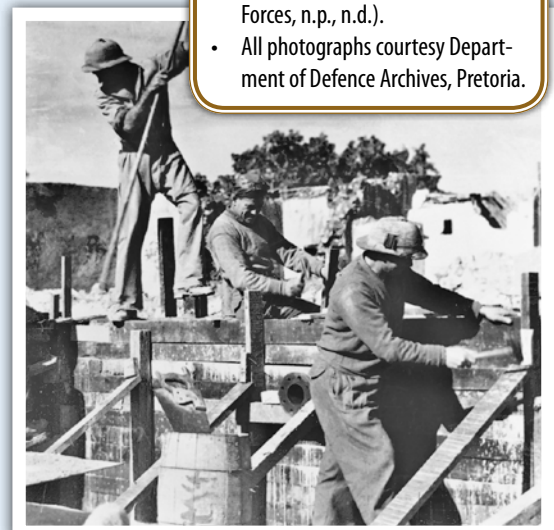
Above: Members of the 36th Water Supply Company, South African Engineer Corps, assisted by men from the South African Native Military Corps, lay a water pipeline at Benghazi, North Africa.

Below: Members of the 36th Water Supply Company, South African Engineer Corps, repair reservoirs damaged by bombs and shell fire.

SAEC indeed had lasting value for Kenya. The roads and bridges built by the SAEC provided the basis for the post-war development of Kenya's transport infrastructure. By improving the yield of existing sources, digging scores of new wells and sinking numerous boreholes in Kenya, often in places where no water was available before the war, the SAEC produced a significant increase in Kenya's available water supply. This, in principle, created some potential for post-war development. The question is to what use was this newly-created water supply put? Were the new or improved water sources in locations where they could be gainfully exploited for economic development? Again research in the Kenyan national archives and interviews with survivors in the affected areas may provide answers to these questions.

- Lieutenant Colonel GE Visser is an associate professor of Military History at the Faculty of Military Science, Stellenbosch University (South African Military Academy).

Readers who are able to shed light upon the impact of the SAEC's water supply activities on Kenyan (or other African) societies during the war, and/or the post-war utilisation of the extra water supply created by the SAEC are kindly invited to forward such information to the Editor. Relevant photographs are extremely welcome. □



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- All photographs courtesy Department of Defence Archives, Pretoria.

Traditional water sources – Lifeline in a time of need

Traditional water resources are proving the only lifeline to poor rural communities in the scenic coastal region of north-eastern KwaZulu-Natal amidst failed local service delivery and drought conditions. Althea Grundling investigates the importance of traditional sources of water to a community in the grip of a nine-year drought.



Althea Grundling

Maputaland in north-eastern KwaZulu-Natal is well known for its beautiful beaches on the warm Indian Ocean and picturesque lakes such as Kosi Bay. The Maputaland Coastal Plain stretches from Mtunzini in the south, northwards into Mozambique, with the Indian Ocean to the east and the Lebombo Mountains to the west. It falls within the Maputaland-Pondoland-Albany biodiversity hotspot, which is an important centre of plant endemism and is home to the iSimangaliso Wetland Park, South Africa's first World Heritage

Site that was rewarded this status in December 1999.

The area is characterised by sandy soils with rapid infiltration rates and a low soil water-holding capacity that forms the Maputaland Coastal Aquifer. Very little rainwater has recharged the aquifer over the last decade, and this has negatively influenced the wetlands in the area. The once expansive grasslands, forests and unique wetlands and peatlands (see *The Water Wheel* of July/August 2010) are facing increased threats from uncontrolled activities such as grazing lands and the encroachment

by local farmers into peat swamp forests by slash-and-burn activities and draining these unique and threatened ecosystems. The expansion of plantations and groundwater abstraction pose serious threats to the wetlands of the Maputaland Coastal Plain.

Living in this remarkable landscape is the friendly and always helpful Tsonga people of the Tembe Tribe. This is one of South Africa's poorest communities, which almost entirely depend on the land and wetlands for their survival. Since 2002 the region has experienced a drought

with below-average rainfall. The current rainfall (average of 580 mm/year from 2002-2010) is far below the long-term average annual rainfall of 760 mm/year (measured over the past 22 years). Many families are therefore suffering from a shortage of water for domestic, irrigation and livestock use. While tourists experience the region as a tropical paradise, dry wells and low groundwater levels are quite common at present, stressing the day-to-day struggle for clean drinking water.

Service delivery by the local municipality continues to fail in its efforts to supply reliable sources of domestic water. As a result of a massive borehole pump and pipeline initiative, the KwaNgwanase area has some hope of reliable water supply in the future if the groundwater levels can be maintained, but there remains many communities in the area that have no expectation to receive water from this source. Instead, these communities continue to struggle and depend primarily on traditional and natural water sources such as wells, streams, lakes, fountains and wetlands.

A LOCAL LIFELINE

Withdrawing water from shallow wells in the sandy aquifer is common practice among the Tembe people. Traditionally it is the women and children that draw water and carry it some distance for use at their homes. Water is also drawn from wells and boreholes to irrigate vegetables in the cultivated fields nearby or to water cattle and other livestock. Wetlands are important natural resources that are crucial to the survival of the inhabitants of this area not only in terms of fishing, harvesting of wetland vegetation and subsistence cultivation but also for precious drinking water. The need to access water and the lack of practical health and safety measures has been identified during research studies in the area.

Declining groundwater levels have forced the Tembe people to dig



Althea Grundling

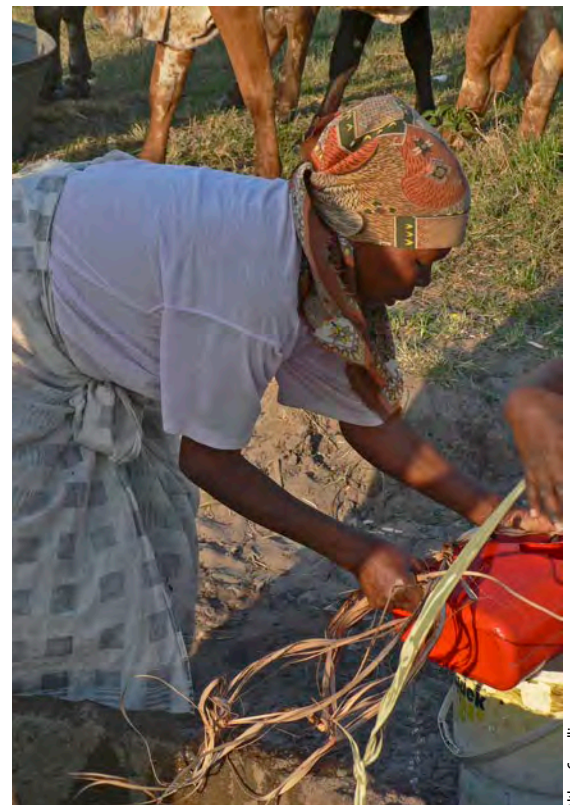
Above: Children collecting water from a well fitted with a hand pump. A broken rubber washer (although relatively easy and cheap to replace) has rendered many of these wells in the area useless.

*Below: A local woman using Lala Palm (*Hyphaene coriacea*) leaves to make a rope.*

their wells deeper each year. Areas surrounding deepened wells can be very dangerous due to collapsing walls and edges of the wells. Unlined wells are also collapsing, not only blocking access to the water but rendering these wells potentially life threatening. Well sites are not always clearly marked or fenced-off and misbehaviour leads to wells and boreholes being polluted by litter. In some cases homemade ropes from Lala Palm (*Hyphaene coriacea*) leaves are used to draw water and hand pumps are not in use due to poor maintenance.

Maintenance on wells, boreholes and pumps is a high priority. There is a continual need for nylon rope, buckets and water containers as well as spare parts and tools to maintain hand pumps. The following practical measures could greatly enhance access to and sustainable use of these natural water sources:

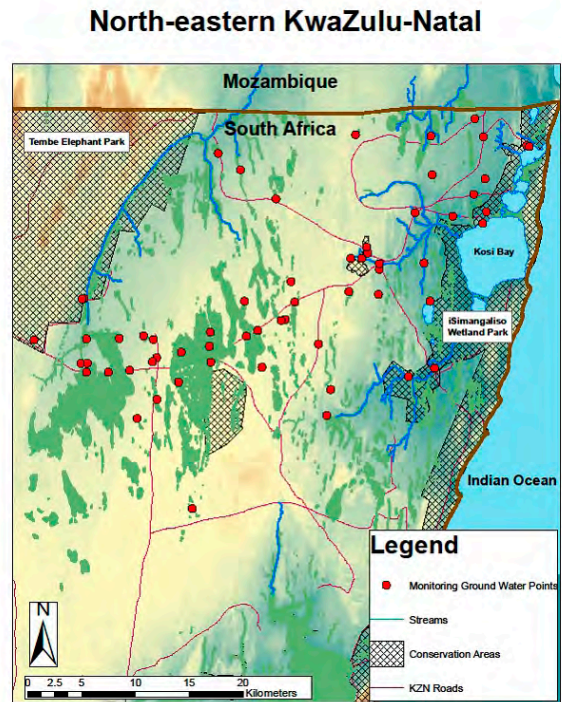
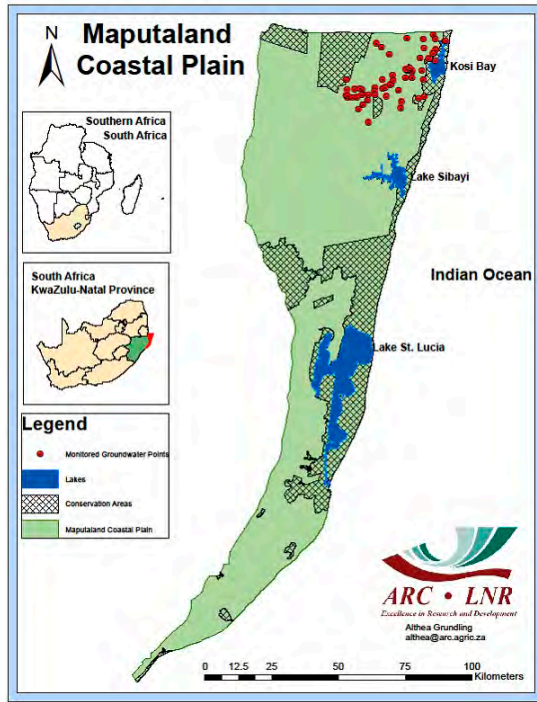
- Erect notice boards indicating well sites.
- Stabilise walls and edges of the wells and line deep wells.
- Fence off wells with a gate that can be closed.
- Address the problem of littering in wells and boreholes.



Althea Grundling

Below: Local communities are very dependent on the environment, such as harvesting wetland vegetation for weaving and thatching.

Bottom: Kosi Bay. While one of the most scenic areas in South Africa, the persistent drought in north-eastern KwaZulu-Natal has brought much hardship to the local rural people.



Althea Grundling

- Train local community members so that they can maintain their own hand pumps.


Research studies conducted in this area form part of an Agricultural Research Council – Institute for Soil, Climate and Water (ARC-ISCW) project funded by the Water Research Commission to investigate the regional environmental factors and wetland processes on the Maputland Coastal Aquifer. Groundwater levels were *inter alia* monitored and measuring points include natural features such as lakes, pans, rivers, wetlands and springs as well as anthropogenic

features such as wells, boreholes and drains.

The research has shown that groundwater levels have a direct relationship with surface water bodies such as wetlands, streams and lakes and reiterated the fact that there is a lack of groundwater monitoring information and a strong and crucial need for a groundwater monitoring network in the area. From the observations made over the past decade there is a steady decline in the groundwater levels and it will take an extreme rainfall event or at least five years of above-average rainfall to replenish the



Maputaland Coastal Aquifer.

It is important to raise local awareness on water as a scarce resource on the Maputaland Coastal Plain and the fact that the pressure to utilise the groundwater resource is increasing. The local communities are vulnerable and due to limited alternative options, they often fall back on the natural resources, such as groundwater through wells. Certain commercial activities such as plantations are detrimental to the water source and other more beneficial and appropriate economic activities such as sustainable farming systems (outside sensitive wetland areas) and tourism initiatives need to be promoted. Working for Wells is one of the promising initiatives that have been identified by the author at the ARC-ISCW and any interested persons who would like to contribute towards this awareness raising and training initiative are welcome to contact her through *the Water Wheel* Editor. 



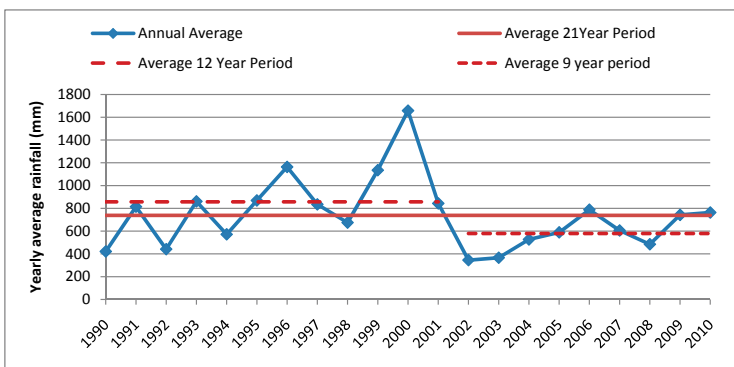
Piet-Louis Grundling

Above: Althea Grundling (right) and research assistant Siphwe Mfeka measuring groundwater levels in wells.

Right: The project team came across various precarious traditional water sources. As the water table drops the community is forced to dig deeper after water.



Althea Grundling



DASPOORT – Still performing after a century



Pretoria's Daspoort Wastewater Treatment Works might have infrastructure built nearly a century ago, but this has not prevented it from still providing a crucial service to the city. Compiled by Lani van Vuuren.

South Africa's administrative capital, the City of Pretoria was founded in 1855. The town came to prominence in 1852 when it was sited as the capital of the former Transvaal Republic, succeeding Potchefstroom in that role. Almost immediately it became a centre of government, and retained that function through to 1910 when it was formally declared the administrative capital of the Union of South Africa.

By 1904, the population of Pretoria had reached nearly 40 000. At this time, town engineer HD Babcock submitted the first plans for a sewerage system to the Town Council. His plans included a water-care works. His proposals were not fully accepted. The Daspoort Wastewater Treatment Works was eventually built between 1913 and 1920 to the design of Town Engineer F Walton Jameson (nicknamed 'Jacaranda Jim' for his introduction of the trees to Pretoria). Constructed on the southern banks of the Apies River, the plant is situated adjacent to the central business district, and today is one of ten sewage treatment plants serving the residents of Pretoria.

Wastewater from the central Pretoria area is collected in a main outfall sewer that runs alongside the Apies River past the Daspoort wastewater treatment works to the Rooiwal wastewater treatment works. The first works at Daspoort comprised screens, grit removal channels, primary sedimentation tanks (Dortmund tanks), 16 biological filtration units, and separate sludge digestion in rectangular tanks. Sixteen biological filters were constructed to form four units of four biological filters each. The design capacity was two mega-gallons per day (equivalent to 9 Ml/day).

The performance of these biological filters today, after nearly 90 years of service is a fitting tribute to a great South African pioneer in the science of wastewater treatment. Jameson was also responsible for the appointment in 1920 of the first chemist as manager of a watercare works in South Africa, namely Mr M Lundie.



Right: An old church at the works site is all that remains of the original community that was relocated to make way for the Daspoort plant in 1913.

Below: The original biological filtration units are still in use.

Opposite page: The final effluent before being released into the Apies River. Much water is also used at the works to irrigate the lawns etc.



All photographs by Lam van Vuuren

Scarcely ten years later, the four units proved inadequate to treat the waste load. By 1933, the wastewater flow average 9 Mℓ/day. The establishment of ISCOR in that year necessitated the laying of a separate sewer from the west and two biological filters were erected with a design capacity of one mega gallon a day (4,5 Mℓ/day), as well as four 12-metre diameter sludge digesters.

In 1945, following the Second World War, two more biological filters were constructed with a total capacity of two gallons per day (9 Mℓ/day), and the last biological filter was built in 1947 to bring the total designed treatment capacity to six mega gallons per day (27,5 Mℓ/day). With this last biological filter, two 27 m diameter Dorr digesters were also constructed, bringing the total digestion capacity up to 12 000 m³.

Daspoort supplied cooling water to the Pretoria West power station from 1952. For supplying the cooling water, extra humus tanks, a balancing tank, collecting tank, five rapid gravity sand filters for 12 Mℓ/day and a pump station were added at a cost of about R240 000.

For the next 20 years, no further extensions were made at Daspoort except to the sand filters and the balancing dams, but the Rooiwal Wastewater Treatment Works was built to treat the constantly increasing wastewater flow from the city.

Between 1973 and 1976 the biological treatment capacity at the Daspoort WWTW was increased from 27 Mℓ/day to 64 Mℓ/day. The activated sludge reactor which was then constructed, included screening, grit removal tanks, primary settling tanks (Dortmund), activated sludge aeration by 27 mechanical surface aerators in nine aeration tanks, and secondary settlement in six flat-bottom tanks with mechanical scraping and hydraulic suction lift of the activated sludge. This wastewater treatment works was then designed to produce an effluent conforming to the General Standard without tertiary treatment.

In the 1970s the Water Research Commission ran the Stander Water Reclamation Plant at Daspoort. The plant, which had a capacity of 4,5 Mℓ/day, was used for research and development and served as a

prototype for large-scale water reclamation processes.

Following the publication of the Special Standard for Phosphate in 1984, one of the three activated sludge reactors was retrofitted in 1986. After successful retrofitting, it took nine years to retrofit the other two activated sludge reactors. This work was finally completed in 1995. Since that time Daspoort has mostly complied with the phosphate standard. In 1997, the first ultraviolet (UV) light disinfection of wastewater plant in South Africa was commissioned successfully at Daspoort.

The plant has a current capacity of 55 Mℓ/day. In 2009, Daspoort became one of the few wastewater treatment plants nationally to obtain a Green Drop (unfortunately it lost its status in the latest round of assessment). Still, after nearly a century of operation, the works is still providing a valuable service to one of the country's largest cities.

- Thanks to Kerneels Esterhuyse for information (additional source: www.sahistory.org.za/places/pretoria#) □

The Daspoort Wastewater Treatment Works has served the City of Pretoria for close to a century.





SANCOLD

South African National Committee on Large Dams Biennial Conference **MANAGEMENT AND DESIGN OF DAMS IN AFRICA** 8-10 November 2011

About the conference

The South African National Committee on Large Dams (SANCOLD) conference will be held at the Gallagher Convention Centre in Midrand, between Tuesday 8 and Thursday 10 November, 2011.

SANCOLD invites all from Africa and the wider family of ICOLD to participate in the conference, which will include technical presentations, a technical visit and an exhibition.

This is an ECSA Continuing Professional Development (CPD) accredited event. This Conference is a Category 1 activity and offers 3.0 credits.

Conference Topics

- Reservoir management (flood control, warning and routing, sedimentation, water quality, IFRs and environmental flood releases, etc.)
- Dam safety and dam surveillance
- Dam rehabilitation
- Hydropower schemes
- Water resources management and water quality (acid mine drainage, etc)
- New dams versus desalination schemes
- Site selection: geotechnical and environmental aspects
- Dam types and construction material
- Spillway, energy dissipation, outlet designs and operation

Programme overview

The conference will commence on Tuesday morning 8 November. On Tuesday there will be presentations by keynote presenters and of technical papers. The conference dinner will be held on the Tuesday evening. Technical visits to the Bospoort and Rust de Winter dams have been arranged for Wednesday 9 November. There will be further presentations of technical papers on Thursday with the Conference concluding in the afternoon.

Registration

Conference registration is now open. The registration and payment deadline is **10 October 2011**.

Enquiries: Mrs Rene Burger; Tel: +27 21 808-2100; Email: burger@sun.ac.za OR Marechia Basson; Tel: 079 490 0210; Email: mas@aspt.co.za OR Visit: www.sancold.org.za

East London reigns supreme in NATIONAL WATER COMPETITION

Regional finalists from all over the country again converged on the Sci Bono Discovery Centre in Johannesburg to participate in the Aqualibrium Schools Water Competition.

The competition, hosted every year by the South African Institution of Civil Engineering, was sponsored this year by TCTA. Khudu Mbema, Senior Manager: Transformation and Sustainability at TCTA expressed the organisation's delight to be involved in such an event. He said it gave learners a platform to experience real-life issues regarding water supply and the challenges water engineers had to grapple with every day. In addition to sponsoring the competition, TCTA also offers bursaries to prospective engineering students.

The competition was originally devised by Prof Kobus van Zyl (currently at the University of Cape Town) and his engineering students at the University of Johannesburg. This year's regional winners came from as far afield as Cape Town, East London, Pietermaritzburg, Richards Bay, Middelburg (Mpumalanga) and Port Elizabeth to battle for top honours. For many of the students it was their first trip to Johannesburg.

Water distribution systems supply safe and clean drinking water to people and are therefore of utmost importance. The teams taking part in the competition are tasked to design a model water distribution network to distribute three litres of water equally between three points on a grid, using two different diameter pipes and connection pieces. The learners are judged on how well

they execute the task, working on a penalty point system.

This year's competition varied slightly from previous years. Instead of being allowed only three tries in an hour the learners were allowed to try as many different network designs as they wanted within their allotted 60 minutes. Once their time was up and the teams had their final design, water was run through their systems and their networks adjudicated.

This year's champions were the learners from Stirling High School in East London. Team members Danielle Botha, Richard Goosen and Michael Harvey managed a win with 148 penalty points. In second place was the team from Domino Servite Secondary School in Pietermaritzburg, with Tembisa West Secondary School in



Standing left to right: Manglin Pillay, CEO of SAICE, Danielle Botha from Stirling High School in East London, Mbangiseni Nephumbada, Acting Deputy Director General of the Department of Water Affairs, Ilse Kemp from Stirling High School and Khudu Mbema, Senior Manager: Transformation and Sustainability at TCTA
Kneeling: Richard Goosen and Michael Harvey from Stirling High School in East London.

NEW WEBSITE FOR ASPIRING ENGINEERS

A new website has been developed for young aspiring engineers wanting to learn more about the subject.

The site, www.ingenius.org.za, takes visitors on an exciting ride through the world of engineering, with the aim of showcasing the profession as a potential career choice. Ingenius was originally established by the Engineering Council of South Africa in partnership with others to advance the engineering profession.

Browse through different sections to see how the engineering sector has shaped South Africa or learn about current, real-life engineering projects on the go in the country. The website also features a calendar of events and a list of fun activities. In addition, the site offers study and career advice for those wanting to study engineering.

For those who want to stay in touch with competitions etc, a free SMS-service is offered.

third place. The learners won cash prizes for themselves and their schools.

According to SAICE, the competition plays an important role in creating awareness of the importance of engineering – particularly water engineering – to society and encourages young people to take mathematics and science at school. “Engineers are MAD – they Make A Difference. No other career can change the lives of thousands of people so dramatically through, for example, a water supply scheme, as can engineering,” said SAICE’s Marie Ashpole, the lead organiser of the event. As a direct result of the competition four students are currently studying civil engineering – all from previously disadvantaged backgrounds.

For more information on the competition, contact Marie Ashpole at Tel: (011) 805-5947; or Email: marie@saice.org.za

Learners from the Khombindlela High School in KwaZulu-Natal debate the design of their water network.



Lani van Vuuren

The learners from Hoërskool Akasia watch their network closely during adjudication.



Lani van Vuuren

Prof Kobus van Zyl of the University of Cape Town explaining the rules of the competition.



Lani van Vuuren

Adrienne-Louise Engelbrecht, Shannon du Preez and Caren Hermanus of the Cape Academy for Maths Science & Technology hard at work on their water network. The network model has a possible 20 billion combinations.



SAICE

Municipal water quality conference a resounding success

More than 800 delegates attended the Third Municipal Water Quality Conference in Durban earlier this year. The event coincided with the launch of the latest Blue Drop and Green Drop Awards

by the Department of Water Affairs. The Water Research Commission used the opportunity to officially launch its Water Risk Abatement Plan Guideline (Report No. TT 489/11), which proved

particularly popular. The so-called W₂RAP is a world-class initiative which helps municipalities manage the risks of wastewater treatment to raise and sustain wastewater performance.

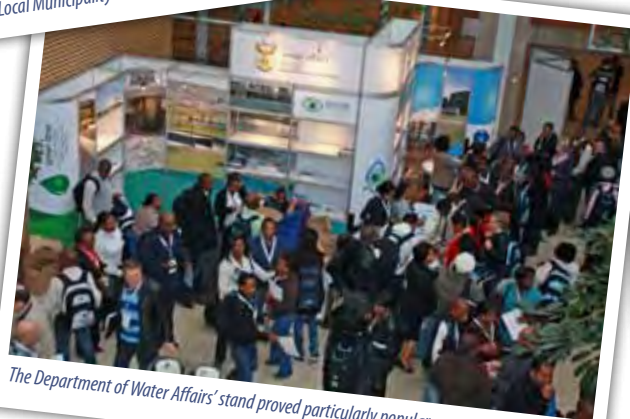
(All photographs by Lani van Vuuren)



Glynn Kuziva Pindihama of the University of Venda; Johannes Magana of Steve Tshwete Local Municipality and Themba Mahlangu of the University of Johannesburg.



Miriam Motlata of Kungwini Municipality; Eulicia Mphothuto of DWA Gauteng; Nopmi Motheni of DWA Gauteng and Persia Lebo Makgopa of Kungwini Municipality.



The Department of Water Affairs' stand proved particularly popular.



DWA's Leonardu Manus explains the Blue Drop certification process.



Raymond Bukubukwana of Amatole Water; Vusi Ndaki of Amatole Water with WISA President Anderson Mancotywa.



Victor Sambo and Ipotseng Mokino, both from DWA North West.



Master of Philosophy in Integrated Water Management

The course is designed to prepare a next generation of research leaders to address complex and interlinked water management issues. The course is delivered through the IWC Africa Water Research Node at Monash South Africa and draws on international experts from four world class universities.

The course

- Full time over two years and part time over four years
- International students can only study on a full time basis
- Small intake of students to allow personal coaching and mentoring
- Internationally recognised degree endorsed by four leading Australian universities

Scholarships

Tuition fee scholarships are available from Monash South Africa (See More information) and the International River Foundation. Please download an application form from the website <http://www.riverfoundation.org.au/programs> and return to Natalie Baker (natalie@riverfoundation.org.au) by 30 September 2011.

Learning objectives

At the end of the course students will be able to:

- appraise freshwater ecosystems as complex social-ecological systems
- evaluate the imperative of sustainable development in relation to the planning and management of water resources

- design an integrated water resource management plan
- execute an integrated water management research project
- prepare an academic paper ready for submission to a scientific journal

Water leadership for the future

The degree comprises an interdisciplinary coursework semester consisting of four compulsory units and a research project. The masters research thesis will form the bulk of the course weighting, while the coursework component introduces students to some of the complex underlying concepts, such as, social and economic factors which affect sustainable water management.

Admission criteria

- A four-year qualification or equivalent honours degree
- 70% achievement or higher in this qualification
- Proficiency in written and spoken English

It is recommended that applicants have a science background, research aptitude, an interest in multi-disciplinary water issues and some work experience.

More information

Tel: 011 950 4130

Email: linda.downsborough@monash.edu

Web: <http://www.monash.ac.za/research/water-research-node>

Deadline: 30 September 2011

Water Research Commission



The Water Research Commission (WRC) is South Africa's dynamic hub for water-centred knowledge, innovation and intellectual capital. The WRC provides leadership for water research development in:

- Water Resource Management
- Water-Linked Ecosystems
- Water Use and Waste Management
- Water Utilisation in Agriculture
- Water-Centred Knowledge

Impact areas address the following key issues:

- Water and Society
- Water and Economy
- Water and the Environment
- Water and Health

www.wrc.org.za

