

THE WATER WHEEL

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to forecast rain



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Cover: A completed Water Research Commission study hopes to bring more accurate rain forecasting to the doorstep of South African farmers. See story on p10. (Cover photography by Koos van der Lende/Africa Media Online).





Water security and sustainable growth

On 2 September the Secretary-General of the Organisation for Economic Cooperation and Development (OECD), Angel Gurría, and the Chairperson of the Global Water Partnership (GWP), Ursula Schaefer-Preuss, launched a Global Dialogue on Water Security and Sustainable Growth. The project was launched as a side event at World Water Week, in Stockholm, Sweden.

The dialogue, which will highlight the issue of water security within the post 2015 development framework, will be convened by a high-level panel supported by a research and technical team led by Claudia Sadoff, a World Bank economist on secondment to the GWP for this project. Mr Gurría also used the platform to launch the OECD risk-based water management report titled 'Water Security for Better Lives'. The goal is to use these combined processes to culminate in the launch of a 'Water Security and Sustainable Growth' report at the 7th World Water Forum in Korea in 2015 and provide guidance to the post-Millennium Development Goal (MDG) dialogue.

This is yet another marker in an international water conversation that is now being led from an economic trajectory perspective. The catalytic point perhaps was the World Economic Forum (WEF) identifying water security as a primary business risk in the 21st century. This has been further reinforced with extreme weather and other water-related natural disaster events recently,

which have all had fundamental repercussions for the global economy.

The interconnectedness of the global economic pathways has also meant that a water disaster in South Asia could easily halt production in a Canadian assembly plant because of the dependency on the global supply chain. The risk-based approach has now several citations of high recovery costs when the risk indicators were ignored. A more famous example is that of the City of New York and Hurricane Sandy. The eventual clean up and repair cost was in the region of US\$75-billion for the city alone. Five years before the hurricane, there were risk reports that recommended a US\$5-billion investment in disaster mitigation and resilience measures.

When we consider examples closer to home, we should consider both historical examples we can learn from and examples where we can still

shape the future in a manner that ensures economic growth within a context of maintaining the resource integrity. Let us first look at the challenge of acid mine-water. We sit in 2013, chronologically, downstream of two centuries of mining practices that had very little consideration for environmental sustainability or resource integrity. Two hundred years down the line, the gravity has hit home in the starkest manner with the potential poisoning of the major life sustaining aquifers.

I think that we accept that at the very beginnings of the gold and coal rushes, the absorption capacity of the environment were not considered, and even if they were, it would have been deemed to be sufficiently robust to absorb the mining strains. Secondly the technology availability to both harvest the ore and leach the minerals were crude, very toxic, but probably still cutting edge for its time. The same excuses

were not valid in the middle of the 20th century when the South African mining activities defined the global benchmark for mining production in volume and Rand value, but not by far sustainable development practice.

Looking to the future, unconventional gas mining is currently a hot topic in South Africa. At the front of the queue is the harvesting of shale gas in the environmentally sensitive Karoo region of South Africa. In addition to its environmental sensitivity, the Karoo is also one of the driest parts of the country, and currently the water intensive hydraulic fracturing or fracking methodology is being examined as the mining methodology of choice to harvest the Karoo shale gas.

In a country that is energy stressed and being increasingly challenged because it is a net large importer of oil, shale gas holds much promise. This will become an important case study for the shaping of the initiative on the back of among many other factors a risk based approach that has the water security issues at the forefront.

We have already forged very useful scientific relationships between the scientific community, the government players and the principal business partners. If this relationship expands into the other domains of decision-making and regulation, we have every chance to create in South Africa a global best practice in fracking and a very important case study contribution to the global discourse on water security and sustainable growth.



If given the go-ahead unconventional gas mining in the Karoo could become an important case study for future development.

New diploma course in freshwater technology

From 2014 the Department of Zoology in the School of Mathematical and Natural Sciences of the University of Venda is offering a National Diploma in Freshwater Technology.

The Diploma is a three-year qualification for which the theoretical content and basic practical work is presented as short courses in blocks during the academic year to allow employed students to attend. Work integrated learning will form part of the curriculum from the second year of study, and will involve work placement of the candidates.

According to the university's Prof Paul Fouché, the Diploma is intended to equip students for a career in freshwater biology and freshwater resource management by training them as technical staff with a practical working knowledge of aspects

such as freshwater resource assessment. "Modalities also exist that will allow the students to continue with a BSc (Biodiversity and Conservation) degree at the university should they comply with admission requirements of the School of Mathematics and Natural Sciences."

To be considered for registration, candidates should be possession of a National Senior Certificate with a minimum of 30% in the language of learning, coupled with an achievement rating of 3 (Moderate Achievement, 40-49%), or better in four of the recognised 20-credit NSC subjects and a four in either life sciences/biology, agricultural science or physical science.

For more information, visit: www.univen.ac.za or contact Prof Fouché (Email: Paulus.fouche@univen.ac.za)



Partnership to boost Vaal water user efficiency

Industrial giant Sasol has teamed up with the South African Irrigation Institute (SABI) on a project aimed at boosting irrigation water use efficiency in the Sand-Vet Water User Association area.

The Sand-Vet irrigation area, where wheat, maize and potatoes comprise 78% of the crops under irrigation – has a total scheduled quota of over 106-million m³ of water per year, with over 200 farmers in the area.

The Sasol-SABI Sand-Vet Irrigation Project is seen as a pioneering agricultural water efficiency initiative. "The project builds on work Sasol has been doing for the last two years in the agricultural community along with SABI," comments Sasol New Energy Senior Manager: Sustainable Water, Bob Kleynjan. "Around 60% of the country's freshwater is used for irrigation purposes. Thus a focus on irrigation farmers is important in any approach to water conservation."

In this project Sasol and SABI will be

working closely with farmers to quantify water use and savings as a result of locally-relevant interventions. "The results are to be presented periodically at information days with farmers and stakeholders in the district. Communicating the results and meaning of the project to the farmers is also a vital part of the work," says Kleynjan.

Work to be undertaken under this project includes provision of irrigation scheduling advice and monitoring services to improve water management practices. According to SABI technical executive officer, Isabel van der Stoep, the results of the first series of system evaluations, which took place in June, have shown that although uniformity of water application can be improved, the application efficiency of the systems were good. Detailed feedback will be provided to the water users during a farmers' day in September and biannually thereafter.

Report finds green investments in SA will enhance water supplies

Improving the management of natural resources and investment in the environment could significantly increase the availability of water resources.

This is according to a new report released earlier this year by Water & Environmental Affairs Minister, Edna Molewa. The study, *South African Green Economy Modelling*, shows that investing in a low-carbon, resource efficient green economy is fundamental for South Africa's sustained economic growth and well-being.

The study was undertaken by the United Nations Environment Programme (UNEP). It assesses the impacts of green investments in four of the country's key economic sectors: agriculture, energy, transport and natural resource

management. Based on Government's current targets and expenditures, the report identifies possible opportunities for achieving government targets in each of these four sectors.

"This report is evidence of South Africa's green economy leadership as it continues to seek new information that will help guide its forward-thinking programmes and policies," said UNEP Executive Director, Achim Steiner. "By undertaking this modelling exercise, South Africa is also contributing to the global discussion on how countries can measure progress towards their sustainable development aspirations."

To download the report, Visit: www.unep.org/greeneconomy/

New sanitation solutions launched in Africa

UK manufacturer, Dunster House, has launched its sanitation solutions in the African market.

The company has designed the 'eco composting toilet' as an alternative option, which allows users to recycle waste for use in compost or as plant fertilizers. The toilets are built as timber outhouses, with a urine diversion system to enable the collection and storage of waste for future use.

Company Director, Chris Murphy, explains that there are a variety of potential uses and locations where a waterless toilet can be implemented. "Without the need for water our composting toilets offer a sustainable solution for many rural or remote locations where sewer and water connections are too expensive or unavailable."

The toilet has been designed to separate waste to allow for users to collect it for potential recyclable purposes if the correct procedures are followed. Two waste collection bins are provided underneath the toilet, which can be swapped to allow for the drying process once the first

bin is full. Urine can be diverted into a separate container or into a soak-away in the ground outside of the building.

"Urine is high in nutrients, such as nitrogen and phosphorus, which if diluted correctly could be used as a valuable fertiliser supplement while growing plants, whereas faeces can be reused if dried for a significant period of time to eliminate pathogens," says Murphy.



Communities should unite to change political agenda, SAHRC vice-chair urges

Communities should overcome their differences and unite to bring water and sanitation issues to the attention of authorities in the coming election year.

So said South African Human Rights Commission (SAHRC) Vice Chair, Pregs Govender. She was delivering the keynote address at the third Albertina Sisulu Memorial Lecture, organised by the University of Pretoria in partnership with the Water Research Commission in August this year.

"Elections are an opportune time for ensuring that those with power listen to people they might never listen to," said Govender. "Communities should use this time to collectively change the [political] agenda and so improve people's lives."

Water and sanitation have become important focus areas for the SAHRC. Investigations into the apparent lack of proper water and sanitation in five Free State municipalities concluded that communities were not receiving their

Constitutional right to access to water and sanitation.

At the time of writing, the Commission was conducting nationwide water and sanitation investigations. In all provinces, communities have voiced their frustration over lack of water and sanitation, Govender revealed. "When holding a map of the old apartheid South Africa against those areas where water and sanitation delivery challenges remain, the apartheid geology with its homelands appears like a ghost from the past. Those same people who were considered 'second-class citizens' under the old regime are still vulnerable today."

South Africa had 'ticked the box' in terms of meeting the United Nations Millennium Development Goals to halve the number of citizens without access to water and sanitation by 2015, yet there were still millions of people whose lives had not changed since South Africa's democratisation nearly 20 years ago, noted Govender. "The question needs



to be asked as to why it required people flinging faeces in Cape Town for the us to realise the plight of so many poor people in this country? Communities must not be afraid to claim their rights as they stand in the Constitution. Our dignity is inherent, it cannot be taken away from us."

Full professorship for WRC researcher

South African society need to encourage a love of science and a dedication to asking probing questions.

This is according to Prof Fred Ellery, Head of the Department of Environmental Sciences at Rhodes University. He was delivering his inaugural lecture as a full professor.

Prof Ellery has spent much of his working life examining the structure and functioning of wetlands in southern Africa, with a particular emphasis on the links between wetland ecology, hydrology geomorphology and biogeochemistry, and how these affect and are affected by human interactions with wetland systems. Many of these studies have been funded by the Water Research Commission (WRC).

Understanding wetlands within the landscape context in which they are situated, including the human

dimension of landscapes, is crucial if these freshwater ecosystems are to be managed sustainably, he believes. "There is not one person who does not interact with the landscape in a substantial way. The landscape has a seductive voice, inviting us to ask questions. Our understanding of the landscape depends on the questions we ask," he said.

"Humans are coupled with natural systems, forming a social ecological system. It is not something you can get away from," noted Prof Ellery. "Our current understanding does not match the complexities of these complex systems. They can be understood but they are non-linear. Asking deep questions unearths important answers."

Prof Ellery's research has allowed him to work across spatial and temporal scales and develop a broad

understanding of wetlands. His current work focuses on geomorphic elements.

Sharing some of his tips for successful research, Prof Ellery said that it was vital to acknowledge but not get lost in it. "It is important to make observations and reflect on the greater system and significance. Our world is increasingly complex and we need to engage with those complexities."

Apart from his involvement in various books and research reports, including the WRC's Wetland Management Series, Prof Ellery has been heavily involved in post-graduate supervision, supervising and co-supervising 27 Masters students and six PhD students.

For his efforts in wetland conservation and research Prof Ellery has received International Mire Conservation Group Honorary Lifelong Membership as well as the Mondri Wetland Award.

Water by numbers

783 million – The estimated number of people worldwide who don't have access to improved drinking water sources, according to the World Health Organisation and the UN Children Fund.

57% – The percentage of 700 South African engineers surveyed who feel that the current engineering degree does not train students sufficiently. An overwhelming 82% of respondents to the PCI Survey believe that not enough is being done to attract new engineers to the profession.

51 million m³ – The volume of unlawful water use that has been curbed in the Vaal River to date by the Department of Water Affairs (DWA). The department is aiming to eliminate a total of 175 million m³ of unlawful use by 2014.

17 – The numbers of years Graham Pirie has been at the helm of Consulting Engineers South Africa. Pirie retired in June.

R700-billion – The estimated funding required for water provision over the next ten years, according to DWA Acting Director General, Trevor Balzer. At the time of writing the country had budgeted for about 45% of this figure, leaving a R385-billion gap.

1.5% – The rate at which dam levels are dropping every week due to current high water consumption in the Nelson Mandela Bay metropolitan area, according to DWA.

340 000 – The number of pupils in the Eastern Cape that attend a school without proper toilets, according to the Democratic Alliance. Official Education Department data pins the number schools without proper sanitation at 1 098.

10 000 – The estimated number of girls who have benefited to date from the Techno-Girl programme, an initiative of the Department of Women, Children and People with Disabilities in partnership with several organisations.

Enthusiastic response to third South African YPW conference

There is a bright future ahead for the South African water sector judging by the quality of presentations at the Third Southern African Regional Young Water Professionals (YWP) Conference, held in Stellenbosch in July. The YWPs is a programme of the International Water Association and the Water Institute

of Southern Africa (WISA). The Water Research Commission was once again one of the main sponsors and exhibitors at this important event on the regional water calendar. Close to 400 delegates, representing 13 countries attended this year's conference, which had the theme 'Water-Africa-Youth'.

A total of 74 oral and 111 posters were presented. Attendees represented a number of specialities across the water sector, with representatives from consulting companies, research councils and institutions, universities, government departments, and non-governmental organisations in attendance.



One of the social events during the conference was a 'water olympics', in which delegates enthusiastically participated.



Close to 400 people attended the YWP conference.



Dr Sudhir Pillay of the WRC won the award for best platform presentation. He declined the prize – a trip to the international YWP Conference in Taiwan – which then transferred to second-place winner, Geoff du Toit.



Jacqueline Thomas (right) won the award for best poster presentation. YWP international Chair, Dr Tobias Barnard, and conference organising committee Chair, Nora Hanke, awarded the prize.



Prof Eugene Cloete, Vice Rector: Research and Innovation at Stellenbosch University, delivered the keynote address during the opening plenary session.



Bronwyn Camden-Smith received the award for best Mine Water Paper. Here she is with WISA Mine Water Division representative, Bashan Govender.

New from the WRC

is that the long-term increasing trend of unaccounted-for salt flows to the surface water systems indicates control of salt storage and storage is the key factor for environmental sustainability. The economics of desalination and waste storage are driven by the cost of water and the management of post close liabilities. Volume I (**Report No. TT 544/12**) is the *Inception Report*, while Volume II (**Report No. TT 545/12**) provides an *Inventory of Inland Salt Production and Key Issues for Integrated Cleaner Production for Waste Salt Management at the Highveld Mining and Industrial Complex*. In turn, Volume III (**Report No. TT 546/12**) provides insight into the *Development and Assessment of Technological Interventions for Cleaner Production at the Scale of the Complex*; Volume IV (**Report No. TT 547/12**) is a *Governance Assessment* and Volume V (**Report No. TT 548/12**) links technologies to governance.

Report No. 1478/1/12
Sustainable techniques and practices for water harvesting and conservation and their effective application in resource-poor agricultural production (N Monde; JJ Botha; LF Joseph; JJ Anderson; S Dube & MS Lesoli)

The WRC contracted a consortium made up of teams from the University of Fort Hare and the Agricultural Research Council to undertake research on sustainable techniques and practices for water harvesting and conservation and their effective application in resource-poor agricultural production. The research was conducted in the Eastern Cape. In this province, as in most parts of South Africa, households rely on purchasing food from urban markets as their main food security strategy. This is primarily due to the failure of cropping activities and low animal productivity due to erratic rainfall. Understanding opportunities for collecting, storing and conserving water is, therefore, vital for improving the

contribution of agriculture to household food security. This then was the main objective of the work commissioned by the WRC. The study area consisted of the Khayaletu and Guquka villages in the Tyhume Valley, just below the escarpment of the Amatola Mountains. In-field rainwater harvesting techniques have been shown to have a positive effect on agricultural production elsewhere in South Africa and these were, therefore, selected for evaluation for possible use in the semi-arid areas of the Eastern Cape.

Report No. 2020/1/12
Delineating river network quinary catchments for South Africa and allocating associated daily hydrological information (AM Maherry; MJC Horan; LB Smith-Adao; H van Deventer; JL Nel; RE Schulze & RP Kunz)

Nested hierarchical catchments or hydrological unit boundaries are being used as planning units in planning, management and implementation decision-making in water resources. In South Africa, these catchments, which are endorsed by the Department of Water Affairs, range from primary, through to secondary and tertiary, with the smallest operational unit being the quaternary catchment. Until recently, the latter was the finest spatial level of data resolution. Substantial datasets and information are linked to these scaled catchments. This project was initiated to produce a fifth level quinary catchment GIS layer with linked hydrology for which the precursors were altitudinal and river network quinary catchments.

Report No. 2024/1/12
Hylarsmet: A hydrologically consistent land surface model for soil moisture and evapotranspiration modelling over South Africa using remote sensing and meteorological data (S Sinclair & G Pegram)

For flood forecasting, catchment management and planning, crop modelling

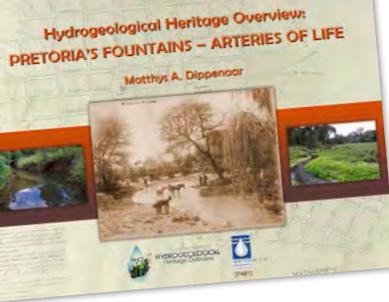
and drought monitoring, accurate and timely updated estimates of soil moisture (SM) and actual evapotranspiration (Eta) are valuable, but until recently, have only been available at isolated sites and during relatively short-lived monitoring campaigns. Obtaining good estimates of these variables continuously in detail over large areas has not been feasible until the advent of remote sensing. A previous WRC project dealt with these issues and provided a firm foundation to build on. The product was a suite of detailed, spatial, real-time estimates of SM and Eta which were routinely calculated in real time. It showed great promise, but tests showed that there was much room for improvement, as the errors in the input data streams hampered the quality of the product; this deficiency which was outside the ambit of the previous project was addressed in this project to make the product useful in practice.

Report No. TT 554/13
Linking property rights, ecosystem services and water resources: An introduction

(D Hay; B Nkhata; K Harris; C Breen & J Crafford)

A team of researchers conducted a research project for the Water Research Commission.

The project was entitled 'Embedding property rights theory in cooperative approaches to the management of aquatic ecosystem services in South Africa'. In conducting the research, engaging with other researchers and stakeholders, and compiling various reports four things became apparent, namely that well-defined property rights can make an important contribution to



Report No. SP 44/13

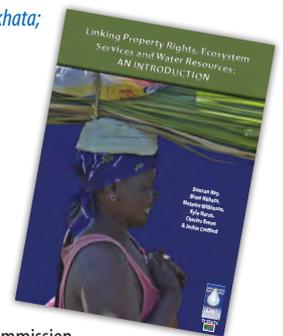
Pretoria's Fountains – Arteries of Life (Matthys Dippenaar) - Also available as multimedia DVD

A new publication, celebrating the role of groundwater in supplying South Africa's capital city, has now been published. The colourfully illustrated book, *Pretoria's Fountains – Arteries of Life*, is the first in a planned series by the WRC aimed at illustrating the role groundwater plays in meeting not only rural but also urban water demands. The book is also available in electronic format, which includes a short film. With groundwater usually being a hidden resource, Pretoria's springs offer a rare visual glimpse of this important water resource, which has served the South African capital dutifully for over 150 years.

Report No. TT 544/12 to TT 548/12

An assessment of the key factors that influence the environmental sustainability of a large inland industrial complex (DEC Rogers, GG Mvuma; AC Brent; SHH Oelofse & KL Godfrey)

This project investigated the key factors that influence the environmental sustainability of a large inland industrial complex, namely the Secunda Industrial Complex. The main finding for this study



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Project to create SA's first mine-water atlas kicks off

A multi-year project to develop South Africa's first mine-water atlas is currently underway.

Mining has been an integral part of the South African economy for over 100 years. The industry employs close to 500 000 workers and contributes 18% to the country's gross domestic product. The mining sector is also a large user of water in certain areas, with the water pollution problems associated with mining becoming well publicised in recent years.

Relatively small volumes of water are used by mining compared to other industrial sectors, but water is needed for extraction and concentration of metals and non-metallic minerals. Water is also used to generate electricity required for crushing ore, on-site processing, smelting, refining and other aspects of treating resources to improve their properties. The crucial difference between mining and other industries is the severe and long-term nature of its impact on the aquatic and terrestrial environments – an impact which is widely acknowledged, but has not been mapped in South Africa.

The *South African Mine Water Atlas* is intended as a comprehensive reference of the extent of mine-influenced water in the country, both on the surface and underground. The project, which is funded by the Water Research Commission (WRC), is being led by consulting firm Golder Associates. Once completed, it will be the most comprehensive document of its kind in South Africa.

"The Atlas will be a significant and timely contribution that can inform the implementation of commitments made in the past two years," reports WRC Research Manager, Dr Jo Burgess. "Decision-makers will also be able to look to the atlas for background information and tools to assist in fulfilling commitments made in other recent events and declarations." It is hoped that the general public and water professionals will also find this publication educational and beneficial.

While the first chapters will provide an introduction to mine-water and its geological, hydrological and legal context, the following chapters will provide the geographical foundations of water quantity, quality and distribution across South Africa. The Atlas will use

various measures to illustrate South Africa's hydrological characteristics by charting and mapping water resources at the provincial scale. Topics to be covered include water resources, water distribution, and the physical setting within which water is found. These features will be overlaid with a map of mining and mineral refining activities in order to understand the locations at which surface and groundwater, and mining collide.

In the next chapters, challenges and opportunities facing South Africa will be examined as it strives to improve the quantity, quality and protection and use of its water resources. Each of the mining-affected provinces will be presented by discussing the challenge, the situation, the constraints and the opportunities.

The final chapter will be a province by province look at water availability and withdrawals, as well as water use by the mining sector. In addition, two of the most important water issues in each province will be identified and discussed.

It is reported that all of those who have taken part in the initial stages of

the project have been extremely positive and enthusiastic – both private and public organisations alike. A significant challenge of the project is getting access to the large amount of data residing with private consultants and the mining companies themselves. "This is where the WRC's mode of operation in using reference groups to evaluate and monitor its research projects is crucial," notes Dr Burgess. "If we didn't have a collegial reference group full of people willing to share whatever data they can, the Atlas could not become a reality."

To date, contributions and pledges have been received from the Department of Water Affairs, Coaltech Research Association, the Chamber of Mines, Golder Associates Africa, CSIR, Anglo Gold Ashanti, SLR Consulting, Glencore, Anglo Platinum, BHP Billiton, The Department of Environmental Affairs, and the Council for Geoscience. "All of these organisations are being extremely generous with in-kind support of this project, and are sharing as much as they can," says Dr Burgess.

The project is set for completion in 2016.



the equitable, efficient and sustainable allocation of the benefits derived from water resources; that the concept of property rights is poorly understood in South Africa; that water resources supply a host of ecosystem services; and that failure to develop and apply appropriate property rights regimes compromises attainment of the intentions of the

National Water Act. This document aims to introduce property rights, ecosystem services and associated concepts as they relate to water resource management; to illustrate their importance and relevance to the South African situation, and to do so simply in a way that promotes a broad altitudinal and river network quinary catchments.

Report No. 2199/1/12

A pulse study on the state of water research development in South Africa (A Pouris)

This report forms part of one of the first attempts in South Africa to obtain a quantitative account of key research and development trends in the country's water sector. The report elaborates on the indicators that will be useful for monitoring

and assessing the state of water research in South Africa as well as bibliometric and patent indicators developed for water research and invention in the country. South Africa's water research is ranked 19th in the world while the total country is ranked 33rd. Environmental sciences are identified as the most important sub-discipline in the field of water resources.



COME RAIN OR COME SHINE?

Study contributes to more accurate forecasting

While many of us follow the weatherman only to know find out whether we need to wear a jacket to work, for South Africa's agricultural community receiving the right type of forecast at the right time can mean the difference between success and failure. Lani van Vuuren takes a look at a Water Research Commission (WRC) funded project aimed at improving rain forecasting for the country's farmers.

Agriculture is the foundation of many developing economies, including South Africa. For this reason it is crucial that South Africa ensures a healthy agricultural industry that continues to contribute to the country's gross domestic product, food security, social welfare and job creation.

The country only has about 1,5% of land under irrigation on about 16% of land, with remaining crop farms being dependent on rainfall. In a country which receives less than half the global average yearly precipitation, and where this rain

falls erratically over the seasons, South African farmers have necessarily learnt to be adaptive in order to survive. Making the right decisions at the right time on the ground is made more difficult in light of increasing frequency of extreme weather patterns and the threat of global climate change.

This makes accurate rainfall forecasting essential for South African farmers, especially in an era where globalisation is bringing increasing competitiveness to the market, input costs are getting higher and profit margins

smaller, notes Prof Emeritus, Roland Schulze, of the University of KwaZulu-Natal Centre for Water Resources Research, who led the WRC project. "In a climate-dependent sector, such as agriculture, rainfall forecasting is used to make on-farm decisions on just about everything, from what and when to plant, how to manage crops, apply pesticides and when to harvest."

"Essentially, it is important for farmers to know when sufficient rainfall has occurred to refill soil-water content for correct planning and operation of activities, such as time of planting and scheduling of irrigation," adds WRC Executive Manager for Water Utilisation in Agriculture, Dr Gerhard Backeberg. "These rainfall forecasts can therefore reduce risks associated with daily and seasonal variability of rainfed and irrigated farming activities for food production, by reducing costs and/or increasing income."

Forecasts have the potential to reduce agricultural risk in the long term, while improving farmers' water use efficiency, thereby allowing them to compete more successfully with competing water demands. Weather-based decisions are made based on different forecast timescales, from near real-time predictions (i.e. 'now casts') to forecasts covering a time period of a few days, a week to a month or a season. Commercial farmers, who are more likely to have access to resources such as the Internet, make extensive use of forecasting products – not only from South Africa, but also from those originating in other countries.

MULTI-ORGANISATIONAL PROJECT

The WRC project, which was undertaken over five years and co-funded by the Department of Agriculture, Forestry and Fisheries, aimed to develop and test techniques and models to improve the way information is

presented to South African farmers to better aid them in their decision-making.

The project involved various organisations and disciplines, with the final report featuring no fewer than 23 contributors. The benefit of this arrangement, according to Prof Schulze, was that every researcher brought with them their own individual skills from their own organisation, allowing for a great diversity of expertise and approaches to meeting the research objectives. Forecast modellers from 'competing' organisations now found themselves working together, and so gained a new respect and appreciation of each other's work. No less than 5 Masters and three PhD students successfully undertook their studies through the project.

Of course, having so many researchers working on the project brought with it challenges as well. "Apart from the heavy administrative burden – which took valuable time away from research – getting everybody onto the same page proved quite an exercise," notes Prof Schulze. This also meant that the research budget for each individual organisation, although collectively rather large by WRC standards, was spread rather thinly.

Nevertheless, it is believed that the end product brings much additional knowledge to the rainfall forecasting sector in South Africa.

FORECASTING IN SOUTH AFRICA

Various organisations undertake weather forecasting using several technologies, programs and models. These forecasts are generally of an excellent quality, judging by the sampling of weather forecasting methods and models presented in the final WRC report on rain forecasting for agriculture.

Of course, predicting the weather carries with it inherent uncertainties. The report presents some of the elements that contribute towards forecast uncertainties and techniques developed to minimise forecast errors, followed by a description of some commonly used verification techniques for assessing forecast quality.

According to the final report, operational forecasting systems require continually updated daily climate input data. These are specifically daily rainfall, maximum and minimum temperatures as well as other parameters for application in soil water, irrigation scheduling and crop-yield models.

The regular availability of these data per catchment and farming region in South Africa presents a challenge in the updating and quality control of climate databases for application in forecasting, the project



South African farmers are considerably adaptable to the country's variable climate.

team found. As a result, two major initiatives as part of the WRC project were the updating and quality control of the Agricultural Research Council database and as part of the database of the South African Weather Service (SAWS).

The case studies presented in the final report illustrate the wide benefits to farmers of using weather forecasting. Research as to the assessment of the impact of weather/climate information into agricultural decision-making were undertaken in the Modder/Riet catchment (Free State), Upper Olifants (Mpumalanga), Berg/Breede (Western Cape) and Mgeni, in KwaZulu-Natal. These catchments differ greatly in terms of soil types, vegetation composition, crop suitability, climatic conditions and farming systems, and were used for different purposes within this research.

The research does point to the need, however, for packaging forecasting information in such a way that it meets farmers' individual needs in a specific point in time. "An effective, operational agrohydrological forecasting system should provide the right information, at the right time, to address the needs of decision-makers and operational users," the final report notes.

Furthermore, the way in which forecasting information is disseminated is important. While commercial farmers prefer email as the

medium of dissemination (rather than the Internet, which may be slow in remote areas), resource poor farmers prefer the following channels: cellphones, radio, and word of mouth (i.e. through extension services).

Ideally, forecast information should be available in local languages, and interpretation must be included with the forecasts so that it is understandable and relevant to the user (in this regard the education level of the user is an important consideration). The research team recommends a so-called 'nested' forecast – which covers forecasts for daily, weekly, monthly and seasonal requirements. New WRC-funded research in this regard is planned for the 2015/16 financial year.

Another major recommendation emanating from the project is the need for adequate and sustained funding (from multiple sources) to be made available for one organisation in South Africa, which is responsible for collation and uniform quality control of climate databases.

"Apart from investing in additional research by the WRC, these recommendations must preferably be responded to by service providers, such as the SAWS," notes Dr Backeberg. "If these recommendations can be implemented, the information and knowledge made available will benefit farmers by improving productive water use,

SIX BASIC INGREDIENTS FOR WEATHER FORECASTS TO BE SUCCESSFUL IN AGRICULTURAL DECISION-MAKING

- The forecasts have to be accurate at a local scale
- The forecasts have to be timely
- The forecasts have to be understood by all the various sectors making up the farming community
- The economic benefits of applying forecasts need to be clearly demonstrated
- The forecast systems have to be operational for the various sectors in agriculture for a range of lead times from days through weeks to a season ahead
- The archiving of forecasts and other research products is crucial

competitive food production and sustainable profitability in a global market environment."

- To order the report, *Development and applications of rainfall forecasts for agriculturally-related decision-making in selected catchments of South Africa* (**Report No. TT 538/12**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za; or Visit: www.wrc.org.za to download a free copy. □



Weather forecasting influences practically all on-farm decision-making, such as which crops to plant and when.



Courtesy of thekwini Municipality

Pressure reducing valves help Durban central business district curb water loss and save electricity.

OF WATTS AND DROPS – New compendium switches on the lights for SA energy efficiency in water

Over the last few winters South Africans have become well acquainted with the flashing messages across their television screens warning of imminent power disruption as a result of a stretched network. And as it has become all of our responsibility to save electricity where we can, the time is now ripe for the South African water sector to implement its own energy efficient methods. Article by Lani van Vuuren.

The energy required for water and wastewater treatment and supply has become a significant cost item for municipalities and water utilities, not only due to the need to expand services to an ever-increasing population, but also as a consequence of the implementation of new technologies to meet stricter potable water and effluent quality standards.

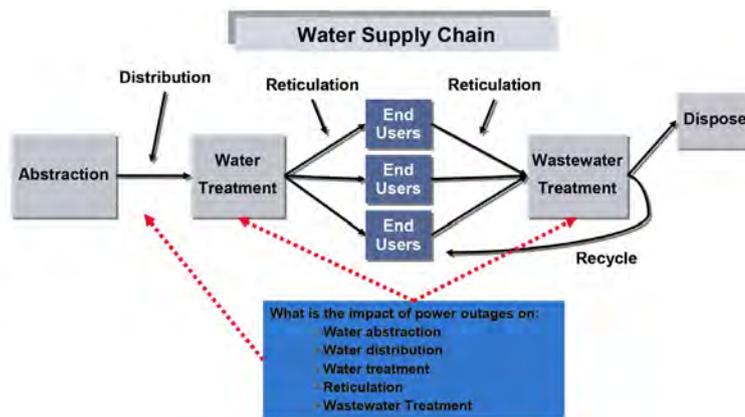
Figures are not available for South Africa, but in countries such as the US, water and wastewater facilities account for up to 4% of the country's annual electricity consumption. The US Department of Energy estimates that their water and wastewater treatment sector is the third-largest energy consuming sector in the country.

While South Africans were for decades accustomed to cheap

electricity rates, this is no longer the case. The water sector has not been immune to the power outages and steep tariff increases experienced from 2007. This has gradually prompted an inward reflection at the way energy is consumed by water treatment and supply processes.

Numerous factors influence the amount of energy utilised in the water supply chain, including the stage of the water supply chain, technology utilised, the use of pump versus gravity feeds as well as the quality of the water being treated. It is thus not possible to calculate how much electricity is needed, on average, to treat a megalitre of water or wastewater. It can be said, however that wastewater treatment is by far the largest consumer of energy (between 200 and 1 800 kWh/Mℓ treated). Water treatment, on the

Areas of impact of power outages in the South African water.



other hand, typically reflects lower energy consumption figures at 150 to 650 kWh/Mℓ treated.

GLOBAL FOCUS

The need to improve energy efficiency in the water sector has prompted the Global Water Research Coalition (GWRC), an international alliance of 12 leading research organisations, to include water and energy as a priority area of their joint research agenda. One of the first projects coalition members have embarked on under this research focus is the compilation of an energy efficiency compendium of global best practices and case studies.

Four reports are expected to be received from Australasia, Europe, South Africa and the USA. Once all four continental reports are available they will be compiled into the global compendium.

One of the first energy efficiency reports to be published, that of the

UK, concludes that overall energy efficiency gains of between 5% and 15% may be achieved, with up to 25% energy efficiency improvement in wastewater treatment processes (mainly activated sludge processes). The report further indicates that renewable energy, mainly in the form of combined heat and power (CHP) from sludge biogas, could contribute significantly to the net energy demand of the water industry. The US compendium has also been completed.

SOUTH AFRICAN FIRST

Earlier this year, the Water Research Commission (WRC) launched the energy efficiency compendium for the South African water industry at the Fourth Municipal Water Quality Conference, held at Sun City. The scope of work covered the principal activities of water and wastewater businesses, and focused on the identification of current best

practice, tools and technologies.

“While it is important to learn from international best practice, it is equally important to document South African specific case studies to allow for greater learning across all municipalities (large and small),” notes WRC Research Manager, Dr Jo Burgess. “The compendium provides enormous benefit to the sector through comprehensive guidance on energy efficiency, reduced energy use and cost, as well as a reduction in carbon footprint. There may also be benefits in communication of status and expectations of the industry’s contribution to national and global energy and carbon reduction targets.”

The WRC compendium provides clearly documented examples which those in the sector can read, digest and tailor to their own situations. Municipalities can start using the guidelines for energy conservation and energy generation in their strategic planning processes, and include specific targets for energy efficiency in their operations in their water services development plans.

The study evaluated both incremental improvements in energy efficiency through optimisation of existing assets and operations, as well as substantial improvements in energy efficiency from the adoption of new technologies. The compendium also highlights new processes, plant types and systems, which realise more substantial energy gains.

Water and wastewater treatment plant surveys were conducted to document case studies and examples of best practice. This is the first time that such a compendium has been made available to the South African water sector.

LONG ROAD AHEAD

Contrary to countries such as the UK and US, South Africa has not been actively pursuing and implementing energy savings projects on a large scale. This made finding suitable case studies and operational data challenging.



An outside view of the pressure reducing valve chamber, part of advanced pressure management in Durban’s central business district.

Courtesy of eThekweni Municipality



Shaun Deacon



The combined heat and power (CHP) plant, which uses biogas, during construction and upon completion at Johannesburg Water's Northern Wastewater Treatment Works. Through CHP generation, the water and wastewater utility anticipates that it can initially produce about 60% of its wastewater treatment works' electricity requirements.

Nevertheless, the compendium provides useful and successful case studies from several municipalities around South Africa, including (among others) eThekweni, Tshwane, Johannesburg, Emfuleni, Amatola and Overstrand.

“South African local authorities range from being completely oblivious to extremely sensitive to the need for energy efficiency, including the majority who are aware but not necessarily seeing it as a priority,” notes Dr Burgess. “Municipalities who are grappling with services provision have certainly not been able to prioritise energy efficiency.”

The compendium guidelines and best practices can and should be used as a basis for development of energy efficiency and energy conservation targets for the South African

water sector, maintains Dr Burgess. These targets can then be implemented, encouraged and regulated through the Department of Water Affairs' Blue Drop and Green Drop programmes.

Based on the information that is now available describing to what extent cost and energy savings can be made using different interventions, energy efficiency should form a major criterion when planning new or upgrading existing water supply and sanitation projects, and it is recommended that funding programmes should use specific targets in the decision-making process.

In cases where new systems need to be built, an awareness of the best practices in terms of energy efficiency will enable municipalities to get their systems right the first

Energy consumption range for the South African water supply chain

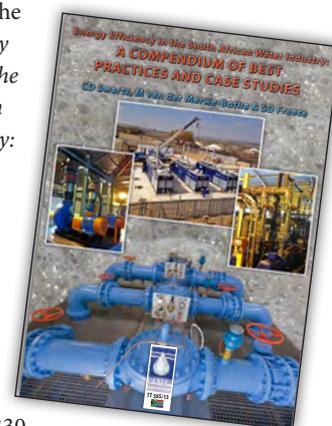
Process	kWh/Mℓ	
	Min.	Max.
Abstraction	0	100
Distribution	0	350
Water treatment	150	650
Reticulation	0	350
Wastewater treatment	200	1 800

time, rather than needing to retrofit energy efficiency measures. “In many cases that have been documented in the compendia, we have seen that energy efficiency has formed part of a broader improvement process in which water and wastewater treatment works have been made water efficient, energy efficient and cost efficient all at the same time,” says Dr Burgess. “This is because in a majority of cases the driving force behind energy efficiency improvements has actually been a desire to reduce operating costs, and energy consumption reduction has been an indirect benefit.”

With the new WRC compendium only a phone call or mouse click away, there is no more excuse for municipalities to remain in the dark regarding energy efficiency.

To order the report, *Energy efficiency in the South African water industry: A compendium of best practices and case studies* (Report No. TT 565/13) contact

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THERMAL SPRINGS generate heated interest

A new multi-faceted research project funded by the Water Research Commission (WRC) is shedding light on one of South Africa's most under-utilised resources.

Article by Petro Kotzé.

For many South Africans, the only reference to a thermal spring is childhood memories of a splash in a heated Aventura pool. Indeed, a number of hot springs have been developed for recreational and tourism purposes and at some, water is bottled and sold for therapeutic purposes. Yet, elsewhere in the world, in addition to the increasing popularity of spas and the growing natural health industry, thermal spring waters are increasingly being used for power generation, industrial processing, agriculture, aquaculture, bottled water and the extraction of rare elements. In 2005, 72 countries reported

on the direct use of geothermal energy. The plethora of new uses for this resource has resulted in an unprecedented resurgence of interest.

Locally, thermal springs remain some of our natural resources that have been researched the least, and are mostly under-utilised. While the potential uses of thermal springs in South Africa are varied, decision-making is hampered by the lack of information available. A recently-completed multi-faceted research project is aiming to change this. It has resulted in some interesting findings, and researchers hope it will result a number of the springs

being put to good use – some of which can result in high-income generating developments.

The topic lies close to the heart of project leader, Prof Jana Olivier (University of Pretoria professor extraordinaire, University of South Africa (UNISA) emeritus professor), who first became interested in the topic in the 1980s. When she joined UNISA in 2001 and was asked to suggest a project in which all members of the geography department could participate, her obvious choice was thermal springs, “a hitherto under-researched natural resource.”



The research team currently studying thermal springs in South Africa are Peter Nyabeze, Prof Jana Olivier, Dr Isaac Rampedi, Dr Ernest Tshibalo, Jaco Venter, Tshupo Motlakeng and Nelia Jonker

This work has been continued under the current WRC research project, under the auspices of UNISA and in collaboration with the Council for Geoscience. This time, it focused more on the scientific aspects. This WRC-funded study was completed earlier this year, and the report is being finalised.

The principal aim of the project was to determine the optimal uses of thermal springs in South Africa. In order to accomplish this, researchers investigated a number of issues. Firstly, they determined the physical and chemical characteristics of local thermal springs, since there is little or no current knowledge on these properties. Secondly, they looked at their current uses and whether these comply with existing water use regulations. Then, what alternative types of development could be instituted at the springs and what novel uses, products and knowledge can be generated from the research.

“What was great about this project is that it was truly multidisciplinary and inter-institutional,” says Prof Olivier. She adds that it involved subject fields such as geology (including geophysics, geochemistry, structural geology and isotope studies), microbiology, geography, environmental sciences and more. “Although we could have submitted separate smaller projects, it was felt that a single, large, multidisciplinary project was the most exciting. It allowed us the opportunity to view this resource in a holistic manner and to share information generated amongst many participants.”

THERMAL SPRINGS IN SOUTH AFRICA

Defined as a naturally occurring spring with temperature exceeding 25°C, almost 80 thermal springs have been identified in South Africa by the time that the project started. Since there is no evidence of recent volcanic activity, it is generally

assumed that all thermal springs in South Africa are of a meteoric origin. Geological studies have also shown conclusively that the origin of each individual thermal spring can be attributed to the local presence of deep geological structures such as folds, fractures, faults and dykes that provide a means for the circulation to depth and the return of the heated waters to the surface.

For the purpose of the project, researchers visited most of the identified thermal springs in South Africa. “We conducted numerous field trips to collect water samples,” says Prof Olivier, “and drove thousands and thousands of kilometres during the three-year project.” She says that some of these trips were “hair-raising,” taking them down deserted roads and often following vague directions. “The project has really been a voyage of discovery,” she says. Often relying on locals to provide them with directions and stories of the springs, Prof Olivier says every single person that helped with information deserved to be thanked for contributing to the success of the project.

Finally, they were also able to conduct research on six as of yet unrecorded thermal springs. Four are in the Kruger National Park and two in Limpopo, at Siloam and Minwamadi. At the thermal spring in Siloam, near the Siloam hospital, the water temperatures measured 71°C; one of the two hottest in the country. The other is at Brandvlei, located in the Brandvlei Correctional Centre grounds in the Western Cape. This one flows at a tremendous rate of 126 l/s, and the scalding water creates a thick layer of steam over the pool in winter months – “an awesome sight.”

RESEARCH FINDINGS

According to Prof Olivier, the project has resulted in a huge amount of knowledge in a number of areas that were previously unfamiliar. It was, among others, the first

time that research has been conducted on the bacterial microbiology of South Africa’s thermal springs.

Some of the results have been surprising. For example, some of the springs contain thermophilic bacteria (a thermophilic organism is one that can survive at high temperatures) that have previously only been found in other countries and ecological settings. One of these, *Zavarzinella*, has only been found in Siberian peat bogs. “Our springs might thus be rich in novel species,” notes Prof Olivier. Furthermore, enzymes extracted from thermophiles have considerable industrial potential.

Researchers also looked at the algae found in the springs. “We found weird and wonderful algae in thermal spring waters,” says Prof Olivier. Some might be used as indicator species for specific minerals while others might be archaic (typical of a previously dominant evolutionary stage) in origin.

A database containing the physical and chemical properties of most thermal springs was also compiled. Researchers could then use this information to determine whether current uses are appropriate for human and animal use.

They found that many thermal springs in South Africa have high levels of fluorine and bromine, which may have health impacts if the

“It was found that all springs in South Africa are suitable for one or more alternative uses.”

(From left) Two local youths show the original project team the way to Minwamadi. They are Dr Ernest Tshibalo, Prof Memory Tekere, Elna van Niekerk, Prof Jana Olivier, Jaco Venter and Peter Nyabeze.



Neila Jonker

Studying springs can be dangerous work especially when it takes you into the heart of the Kruger National Park.



water is consumed. Some also show unacceptably high concentrations of potentially hazardous minerals such as mercury, notes Prof Olivier. The exact source, whether it is from the spring itself or pipes and other infrastructure, is not known. However, owners of some of the resorts should take cognisance of these findings.

The highlight of the research project was identifying potential uses for thermal spring waters based on their thermal capacity of the actual minerals in the water. “It was found that all springs in South Africa are suitable for one or more alternative uses,” she says.

Researchers investigated a

number of alternative uses. These include its suitability for bottling, aquaculture (particularly Tilapia, spirulina and oysters), the extraction of minerals, generating electricity, cosmetics or health treatments such as balneotherapy.

A perfect example of where a thermal spring can be used to create an industry is at Sagole, a small dilapidated thermal resort in Venda. According to Prof Olivier, there is the potential to generate a gross income of more than R70 000 per month if all the boron, strontium and titanium could be extracted. These elements can be used in the production of a plethora of uses, such as glass and, ceramics, cleaning product, insecticide, neurotransmitter, toothpaste, gemstones and many more.

Developing a new industry from the thermal spring could stimulate small businesses and improve the living conditions of the surrounding community. At some springs, more than one potential use has



A researcher testing the water of one of the thermal springs in the Kruger National Park.

been identified, which could lead to a cascade of uses with money potentially being generated at each tier of development.

The project has already led to umpteen scientific publications and presentation at conferences, while four post-grad students have obtained their masters or PhD degrees during the course of the project. Yet, they have just managed to scrape the surface of discovery of this natural resource. Prof Olivier says much more research is required and more people must come on-board in order to develop these resources to the benefit of entrepreneurs, existing businesses and local communities.

While the project has highlighted opportunities that are there to be grasped, Prof Olivier says that it has forced them to think out of the box in terms of how these natural resources can be used. It is hoped that, following the completion of the final report, a symposium workshop can be organised to present the findings to stakeholders that could potentially fund developments.

“Much more research is required and more people must come on-board in order to develop these resources to the benefit of entrepreneurs, existing businesses and local communities.”

THE STORIES THAT FLOW FROM THE SPRINGS

Every thermal spring has a story. During the course of the WRC project, the research team learnt of many. These often related to how the springs were found, what they were used for and the reasons why some have disappeared from the scene while others are flourishing. As a result, Prof Jana Olivier and her team have obtained funding from the National Heritage Council through the Kara Heritage Institute to research the rich indigenous knowledge (IK) of some of the springs.

There is no lack of interesting material to support such a project. The fountain at Montagu was apparently discovered when a Boer-trekker injured his hand, and it began to fester. He stuck his injured hand into water that was bubbling from a rock, after following a stream to its source. The water was piping hot and after bathing his hand in the water for the next couple of days, it soon healed. Word of this miracle quick spread and instantly made the Montagu fountain famous.

The Bath at Cistrusdal, on the other hand, was accidentally discovered in the 1930s when an ox stepped in a hole. When the herder tried to rescue the trapped animal, they discovered the hot water, which led them to the spring.

Originally established as a military post under the auspices of the Dutch East India Company, it has undergone numerous changes of ownership until 1903 when the spring was sold to James McGregor, the great grandfather of the current owner.

Dr Ernest Tshibalo (a UNISA team member who obtained his PhD on alternative uses of the thermal spring at Sagole) tells that the local community at Warmbaths (Bela Bela) used the hot spring for the cleansing of evil spirits, invoking charms and during initiation ceremonies.

At others, ancient practices are still in use today, like the extraction of salt. Baleni Camp is situated on the banks of the Klein Letaba River, on land belonging to the Mahumani Traditional Authority. The economy here is dependent on traditional salt mining. The 42°C thermal spring, the main salt source, is also a sacred site for the Tsonga community and visitors can wash away their bad luck in it. During winter months guests can watch locals making salt from the crystals that are deposited from the Soutini spring.

Prof Olivier cautions that many of the springs have considerable customary and spiritual significance, which could support an argument to rather keep them in their pristine state in some instances.

Rotorua in Zealand is famous for its spectacular geysers and thermal activity. It has been used to build a thriving industry, and an extensive range of rejuvenating spa therapies are offered by the area's numerous wellness centres.



Irrigation water metering – It's plain good sense



Water metering has become an important weapon in the arsenal of South African farmers who want to remain productive in a tightening market. In this first of a two-part series of irrigation water metering, Lani van Vuuren takes a look at the latest offering from the Water Research Commission (WRC) which provides guidance for sustainable on-farm and on-scheme irrigation water measurement.

While irrigation water measuring is still not widespread in South Africa, emerging trends suggest that water meters are becoming increasingly important tools to aid farmers. “There is an increasing realisation that it makes absolute business sense to accurately and reliably measure water use in order to reduce and cost and thereby increase profitability,” notes WRC Executive Manager: Water Utilisation in Agriculture, Dr Gerhard Backeberg.

The financial returns to an irrigator are strongly correlated with the volume and pattern of irrigation water application (not only through the cost of water but also that of electricity). Moreover, there

are a number of new technologies which offer better information and decision-support to irrigators, making water use management more convenient and accurate.

In addition to the benefits to farmers, the implementation of irrigation water metering has been encouraged through the National Water Act and the National Water Resource Strategy (the first as well as the second version, the latter published earlier this year). The Department of Water Affairs (DWA) has also announced its intention to publish new regulations for water measurement, which could see more strict enforcement of water metering.

In anticipation of this trend the WRC has funded research in the area of irrigation water measuring and metering for over a decade. The knowledge generated through this process has clearly demonstrated the application and benefits of water metering in agriculture.

“The whole purpose of the investment in research and technology transfer in this area by the WRC has been to show that water metering technology is available, and to provide guidelines for managed implementation of irrigation water measuring,” explains Dr Backeberg. “With correct incentives

of volumetric water use charges to recover operation and maintenance cost for water supply, there is no doubt that irrigation water use measuring will expand in future. While the enforcement of regulations for water measurement will ensure compliance, this should be seen as a last resort. Preferable is the realisation that irrigation water measurement is good business practice.”

Efforts have been made to involve farmers and/or managers of water user associations and irrigation boards in all the research and technology transfer projects of the WRC. “This has certainly raised awareness and gradually changed the attitude [of the farming sector] towards measuring or metering of irrigation water use, certainly for those individuals and organisations involved in these projects,” notes Dr Backeberg.

The Commission’s latest water metering-related project, which was co-funded by the Department of Agriculture, Forestry & Fisheries, facilitated a process towards effective implementation of water measurement at river, irrigation scheme and farm level in South Africa. In order to achieve this, end users of water-measurement technology were made aware and convinced to adopt the technologies.

Specific attention was given to technical requirements and financial justification for implementation of the technologies for water measurement. Purposeful capacity building and training of end-users formed an important aspect of this work. Different target groups were involved in the project, from individual farmers and water managers on schemes to manufacturers of metering equipment and government officials, among others. The final output of this technology transfer project is a final report that documents the implementation process, the lessons learnt and guidelines towards general implementation of irrigation water measurement.

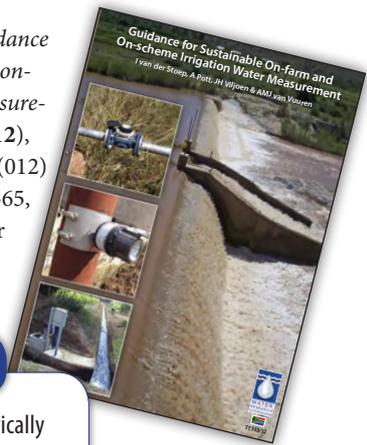
As with all efforts to encourage uptake of research-based knowledge, in particular with reference to technologies and management practices for water measuring and metering, the most important requirement is to appreciate the complexities of the adoption process. This project again highlighted the need to use different communication channels to disseminate available knowledge, allow progression of time from awareness to persuasion to implementation and ongoing adaptation. It also recognises the role of demonstration for observing and evaluating the benefits of irrigation water measuring.

The WRC will now be finding partners to exploit and disseminate the available knowledge (including correctly managed implementation) and technologies on irrigation water measuring and metering. For this purpose, a short-term research project will be initiated later this year with a team comprising representatives of roleplayers such as the South African Irrigation Institute, Agricultural Research Council, AgriSA and the South African Association of Water User Associations.

“The challenge now is to exploit the commercial benefits on farms and irrigation schemes, which will be to the economic advantage of the water sector as a whole,” Dr Backeberg points out. “International

evidence shows that the lead time for research-based knowledge to become applicable and accepted in the market takes 25 to 35 years. Perseverance and a continuous drive to support exploitation of available knowledge to implement water metering and measuring over the next 10 to 20 years is therefore essential.”

To order the report, *Guidance for sustainable on-farm and on-scheme irrigation water measurement (Report No. TT 550/12)*, contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565, Email: orders@wrc.org.za or Visit: www.wrc.org.za 



KEY MESSAGES EMANATING FROM THE PROJECT

Assign the responsibility for implementation to a skilled person

A knowledgeable and skilled person employed by the water user association or irrigation board is required if water measurement is to be implemented successfully. Such a person should preferably have a technical background and be involved with the process of implementation right from the start.

Preparation is key

Any possible technology that is being considered for wide-scale application should first be evaluated on a trial basis to obtain first-hand experience with its installation, operation and maintenance requirements. This can prevent inappropriate, costly systems from being purchased that may later become redundant.

Commit to an implementation plan

Any project should be planned and

implemented as simply and practically as possible – unnecessary complication is a threat to successful project implementation. This can only be achieved if knowledgeable implementing agents manage the projects through careful planning and in-depth assessment of the situation presenting itself.

Install the most appropriate technology that can be afforded

Research undertaken over the last ten years has shown that suitable technologies and devices are available for the measurement of irrigation water, even in challenging situations with regards to aspects such as water quality and installation conditions. Failure of measuring devices or systems can usually be blamed on incorrect selection, application, installation or maintenance rather than on the technology itself.



Rainwater harvesting from tanks – Useful yes, but can you drink it?

Rainwater harvesting has been applied with great success in some rural communities in South Africa to grow subsistence and commercial crops, but is this alternative technology suitable for urban households? A team from Stellenbosch University (SU) set out to answer this question. Article by Lani van Vuuren.

As demand for water grows in South Africa, alternative sources are actively being sought to augment conventional water supply. While domestic rainwater harvesting has been put forward as one such an alternative water supply, little information is available in South African on whether harvested rainwater is safe for human use or even how local communities feel about using the water from such an alternative source. Domestic rainwater harvesting involves the collection and storage of water from rooftops and diverse surfaces.

To bridge this gap in knowledge, a team from the SU Department of Microbiology teamed up with the SU Department of Sociology and Social Anthropology to survey the quality of water from a community with rainwater harvesting tanks, and

to collect information on if and how this water is being used. The project is funded by the Water Research Commission.

STUDY SITE

The study site selected was the Kleinmond Housing Scheme. This innovative low-cost housing project, conceptualised in 2007 in collaboration between the Department of Science & Technology, CSIR, the Western Cape Provincial Department of Human Settlements and the Overstrand Local Municipality, comprises 410 housing units. Various technology innovations have been applied in the houses, including modular masonry material, reinforced ring beams, prefabricated plumbing etc., with each house equipped with a 2 000 l rainwater harvesting tank.

The SU team tested the chemical and microbial quality of rainwater collected from the rainwater tanks of 29 houses over six months. In addition, 68 households were interviewed to investigate the acceptance and perception on the use of the domestic rainwater harvesting tanks.

WATER QUALITY TEST RESULTS

The results obtained for the chemical analysis indicated that the rainwater quality was within potable, chemical standards. Metals, cations and anions that were analysed for in the harvested rainwater samples were all below the recommended drinking water guidelines.

However, the microbial analysis showed that the presence of the following group of indicator organisms



Stellenbosch University tested the chemical and microbial quality of rainwater collected from the rainwater tanks of 29 houses over six months.

Courtesy Stellenbosch University

exceeded the recommended drinking water guidelines: total coliforms, Enterococci, faecal coliforms, and heterotrophic bacteria. The presence of several opportunistic pathogens, including *E. coli*, *Cryptosporidium* and *Salmonella*, were also detected. In short, the water from the rainwater harvesting tanks in Kleinmond is not fit for human consumption, and prior treatment is required before the water source can be used for drinking purposes.

The main causes of contamination are dirt and faeces (from birds and small animals) on the roof surface, which fall into the tank. Other sources of rainwater contamination include leaf debris and organic material washed into the tank, animals or birds that fall into uncovered tanks as well as breeding mosquitoes.

At the Kleinmond Housing Scheme, it was found that many of the households placed their garbage bags on top of the tanks to protect them from being ripped open by stray dogs. These garbage bags could easily contaminate the rainwater, especially if the tanks are leaking, or broken and/or the lid is absent. This general lack of awareness of contamination hazards highlights the importance of training users in the proper use and maintenance of the technology.

It has been recommended that some form of pre-treatment be installed to make the rainwater safe for drinking. As a follow up to this part of the project, the SU team is now investigating the use of solar water pasteurisation and filtration systems for the treatment of harvested rainwater.

USER ACCEPTANCE OF RAINWATER HARVESTING

Interestingly, the SU user survey indicated that the majority of community members of the Kleinmond Housing Scheme instinctively steered clear of using the water from their rainwater harvesting tanks for drinking purposes. About two-thirds

of the respondents do not use the water in the tank for drinking, while by far the majority of those who use it for drinking, do so only sometimes (24%). The majority of respondents who do drink the water pre-treat it first. One mother reported that her baby developed a rash after rainwater was used to bath him, while others said that drinking the water was ‘bad for your stomach’.

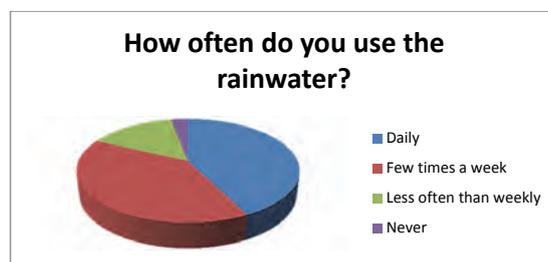
The majority of respondents indicated that they use the harvested rainwater for household chores instead, such as laundry, cleaning, and gardening. One respondent was even applying his rainwater to help run his small car wash business.

While not generally using the harvesting rainwater for drinking purposes, almost all users (bar one respondents) saw the tank as being of huge benefit to them, particularly as they now used less municipal water, which put money back into their pockets. In addition, the tanks became a convenient asset during times of municipal water disruption.

Rainwater tanks are not a ‘fit-and-forget’ technology, and require regular maintenance and upkeep. Unfortunately, most tank users at Kleinmond admitted that they did not know how to maintain their tanks although they did indicate a willingness to learn. Thankfully at the time of data collection, the majority of rainwater tanks were found to be in good condition, with only some tanks showing signs of leakage, missing lids, broken pipes or taps. Most of these faults had been reported to the municipality, which, according to the SU project team, indicates some hesitancy to take ownership of the tanks. A training programme has been recommended to empower users in the proper use and maintenance of the tanks.

The user survey concluded that the rainwater tank users of Kleinmond were in favour of the technology, and that it did bring them several benefits, even though they could not drink the rainwater without some form of prior

Regularity with which rainwater harvesting is used at Kleinmond Housing Scheme



Purposes for which rainwater is used at Kleinmond Housing Scheme

Do you use rainwater for the following?	N	%
Laundry	62	92
Cleaning	47	70
Gardening	31	46
Bathing	30	44
Drinking	16	24
Cooking	13	19

treatment. With the right precautions domestic rainwater harvesting can be viable alternative form of water supply in South Africa.

Below top: The storage of garbage bags on rainwater tanks can lead to contamination.

Below bottom: The study area was the Kleinmond Housing Scheme, where every house has been fitted with a rainwater harvesting tank.



Courtesy Stellenbosch University

Since 1947 there have been 300



international water agreements

against 37

conflicts between states over water

Every year we withdraw 3,800 cubic km of freshwater



In response to the indigenous people's mobilization and protests, a convention was signed between the ministry and the Mazahua movement, but only for rather short-term measures.

The interpopulation in this way which did needs (ac production possibility and had their envi

To avoid or resolve water-related conflicts in indigenous communities, indigenous people should be involved in the management of water resources on their territories and their water rights, as well as their social and cultural values should be recognized.

The Waters of the Mazahua

One-third of the water consumed in Mexico City metropolitan area comes from Mazahua indigenous people territories thanks to a 300 km-long system of dams, canals, tunnels, treatment plants and pumps.



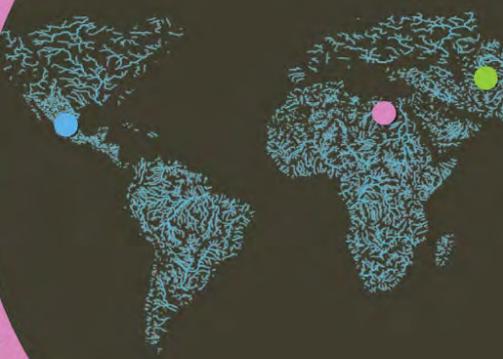
The Nile Basin Initiative launched in 1999 "seeks to develop the river in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security". But discord over the Nile treaties has continued.

However, only Egypt and Sudan are legally entitled to dam the river based on a series of treaties that have strained relations in the basin for over 50 years. Today, the shortages of water have prompted countries including Uganda, Sudan, Ethiopia and Kenya to question the treaties.

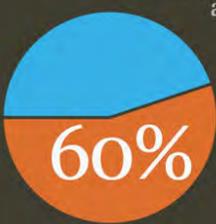
Tensions over the Nile River

The Nile river basin is home to over 160 million people and includes ten countries that rely significantly on its waters, since most have no effective rainfall, but also for fishing and hydroelectricity generation.

Despite tensions, no armed conflict has arisen in the modern era and countries understand that water is a means for greater cooperation. While a new agreement that satisfies all parties has not been found yet, countries have improved information sharing and scientific and technical cooperation, which is crucial to the sustainability of the river.



There are 276 international river basins and transboundary aquifer systems in the world



of these lack any type of cooperative management framework

The Water Convention

Major industrial accidents may cause far-reaching transboundary effects and may lead to accidental water pollution.

The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) is intended to strengthen national measures for the protection and ecologically sound management of transboundary surface waters and groundwaters.

The Convention obliges parties to prevent, control and reduce transboundary impact, use transboundary waters in a reasonable and equitable way and ensure their sustainable management. Initially negotiated as a regional instrument in UNECE region, the Convention was amended in 2003 to allow accession by all the United Nations Member States.



2 Million Tonnes

of sewage and industrial and agricultural waste is discharged into the world's waterways every year

Water: Cooperation or Competition?

The following factors often lie at the root of water tensions:

SCARCITY

when the demand for water exceeds the supply, creating competition between the different water uses

NEGLECT OF TREATIES

when provisions set by international agreements over freshwater are questioned or intentionally overlooked by certain parties

OVER-ABSTRACTION

when the permanent or temporary removal of water from rivers, canals, lakes, reservoirs or aquifers for human uses may put the water systems at risk

DIVERSION

when water from rivers or other surface sources is diverted from its course for various purposes through the construction of dams and other infrastructure

POLLUTION

from diffuse sources (e.g. agriculture, urban areas) as well as point sources (e.g. municipal sewage and industry) or following an accident

By 2007, it had declined to 10% of its original size after the rivers that fed it were diverted by Soviet irrigation projects. Impacts include the pollution of surrounding land, lack of fresh water for the population, health problems, destruction of crops due to soil salinity, and the collapse of the fishing industry.

In 1992, the five countries of the basin - Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan and Kyrgyzstan - formed the Interstate Commission for Water Coordination of Central Asia. In 1994, they pledged 1% of their budgets to recover the sea. In 2005, Kazakhstan completed a dam project to replenish the North Aral Sea. In 2008, the water level had risen by 24 m from its lowest level in 2007.



The Aral Sea disaster

In 1960 the Aral Sea was one of the four largest lakes in the world with an area of 68,000 square km. Local fisheries represented annual catches of 40,000 tonnes and the area was surrounded with biologically rich marshes and wetlands.

■ The Aral Sea in 1960
■ The Aral Sea today



Today, salinity has dropped, and fish are again found in sufficient numbers for some fishing to be viable but vast parts of the Aral Sea have been lost forever.



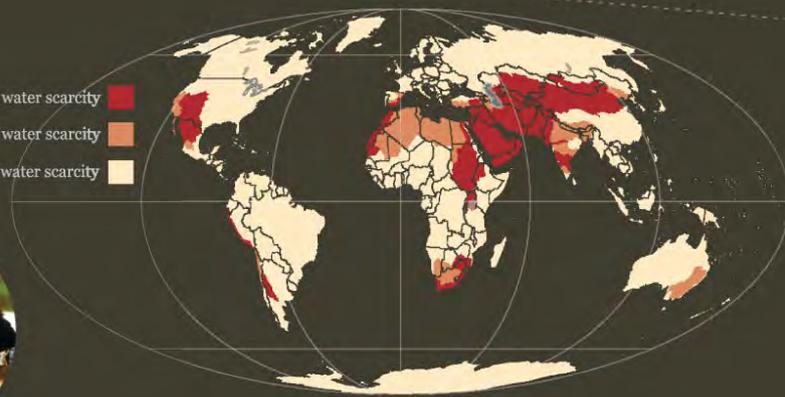
Urban-rural tensions in Zhengzhou, China

39% of Zhengzhou's population live in the city and 61% in the surrounding rural area. Groundwater represents about 70% of the water supply, 50% of which is used for agriculture, 31% for industry and 17% for domestic uses.

Groundwater remains over-exploited despite attempts to conserve water, and the city competes with rural areas for water use. Rural communities feel at a disadvantage especially because they cannot generate comparable financial returns.

Institutional frameworks are needed for ministries and agencies with differing mandates and goals to share information on the state of groundwater resources and the impacts of use.

Co-management would ensure that more surface water and treated wastewater is used for agriculture while urban users have priority over groundwater.



By 2030

47%

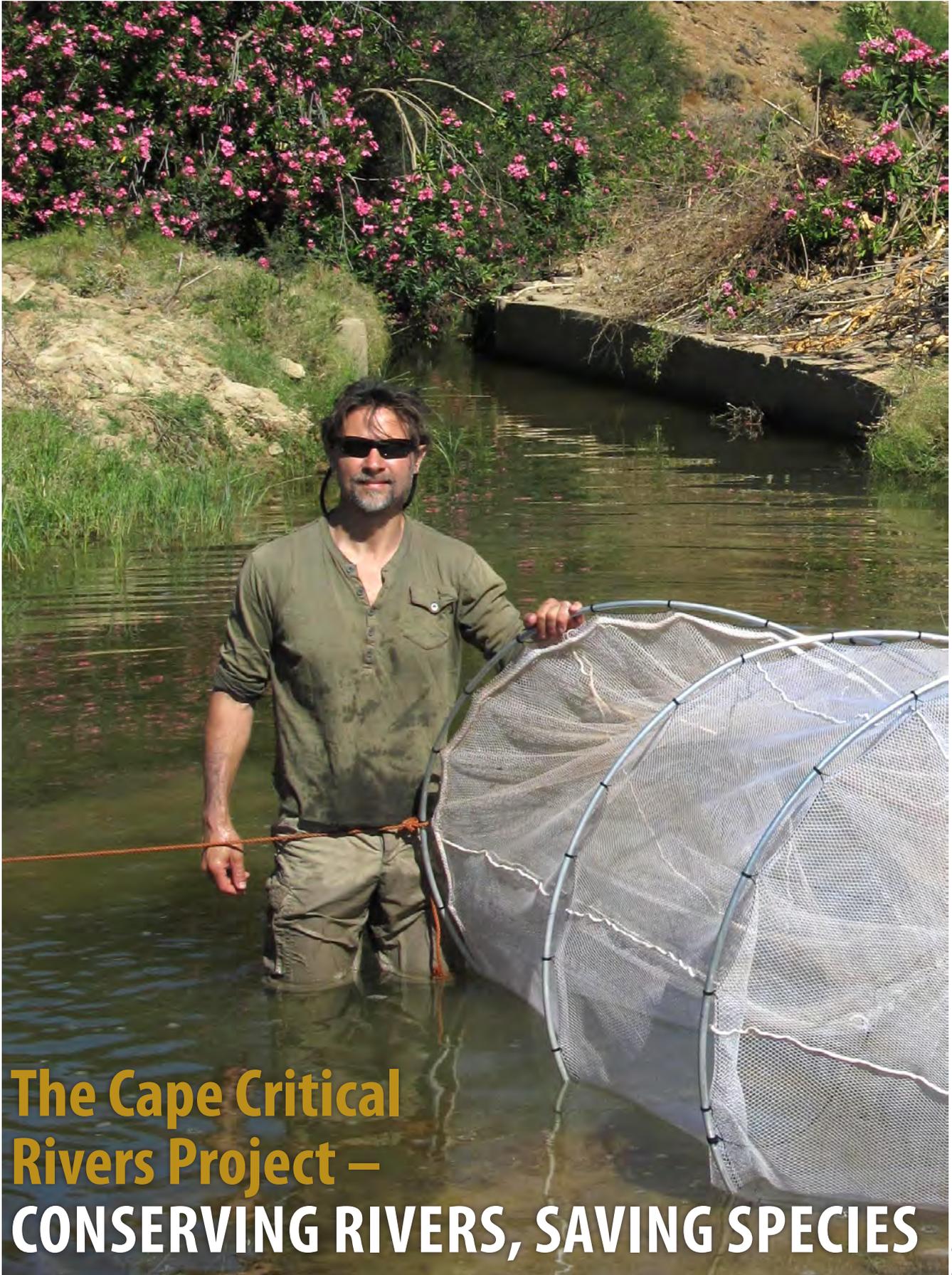
of the world population will be living in areas of high water stress

Every Second the urban population grows by **2** People

1.6 Billion People

live in countries with absolute water scarcity





**The Cape Critical Rivers Project –
CONSERVING RIVERS, SAVING SPECIES**

Bruce Paxton

The perilous state of two freshwater fish species in the Cape floristic region has spawned a partnership project to protect them and the rivers they inhabit. Article by Sue Matthews.

The Cape Critical Rivers Project is being steered by the Endangered Wildlife Trust, which has taken up the reins in response to capacity constraints at the provincial conservation agencies. The project has its origins in Biodiversity Management Plans for Species, or BMP-S, which have been drafted for the threatened Clanwilliam sandfish (*Labeo seeberi*) and Barrydale redfin (*Pseudobarbus burchelli*).

Norms and standards for the development of BMP-S, aimed at ensuring the long-term survival in nature of the species concerned, were published under the National Environmental Management: Biodiversity Act in March 2009. To date, final versions of BMP-S have been gazetted for only three species – the black rhino, Albany cycad and the medicinally valuable geranium *Pelargonium sidoides* – with a draft BMP-S for the African penguin gazetted for comment.

Dr Bruce Paxton of the Freshwater Consulting Group was lead author of the BMP-S for Clanwilliam sandfish, developed for the Northern Cape

Department of Environment and Nature Conservation (DENC) and Cape Nature in the Western Cape, with funding from WWF-SA's Table Mountain Fund. The Clanwilliam sandfish is one of eight fish species that are endemic to the Olifants-Doring catchment, which straddles the two provinces, and all eight are on the IUCN Red List of threatened species.

Dr Paxton initially studied the distribution and threats facing three of these species – the Clanwilliam sandfish, Clanwilliam yellowfish and sawfin – back in 2001, and explains that the reason for selecting the sandfish for a BMP-S was because existing conservation initiatives aimed at protecting these other two high-priority species would not be effective for the sandfish.

While apparently abundant in the upper and middle reaches of the Olifants River in the 1930s, the fish has not been recorded there since 1958, and now occurs only in the Doring River and some of its tributaries. Although the construction of the Clanwilliam and Bulshoek dams on the Olifants River are partly to blame – having disrupted spawning migrations and degraded instream habitat – it was predation by invasive alien fish, such as smallmouth bass and bluegill sunfish, that exacted the heaviest toll.

Adult sandfish are today restricted

to the northern reaches of the Doring River main stem, and juvenile fish surviving long enough to recruit to the adult population are known to occur only in the Koebee-Oorlogskloof tributary, where bass and bluegill have not penetrated very far upstream. In fact, the river canyon in the Oorlogskloof Nature Reserve, a DENC-managed reserve just south of Nieuwoudtville, is considered to shelter the only viable breeding population of the species. So imagine the consternation when it was discovered in 2010 that another alien fish, banded tilapia, which had been introduced to the municipal Nieuwoudtville Dam, had escaped during a flood, and had invaded sandfish breeding habitat in the Oorlogskloof River!

“While apparently abundant in the upper and middle reaches of the Olifants River in the 1930s, the fish has not been recorded there since 1958, and now occurs only in the Doring River and some of its tributaries.”

This was the trigger for developing the BMP-S, which was completed in October 2011. However, by July of this year it had not yet been submitted to the Department of Environmental Affairs for approval and gazetting, largely due to the DENC's concerns about their capacity to implement it.

“The DENC has only one aquatic scientist for the entire province,” explains Dr Paxton. “Also, the sandfish is not an economically important species, so it is not high on their list of priorities. But in the interim, by working with the Endangered Wildlife Trust we are managing to get a number of the actions in the BMP-S done.”

Some 300 km south-east of the Oorlogskloof canyon, as the crow



Jeremy Shelton

Left: Dr Bruce Paxton of the Freshwater Consulting Group.

Right: The Barrydale redfin is now recognised as a genetically distinct lineage of these Burchell's redfin.

flies, is the Tradouw River's spectacular ravine, which provides a passage through the Langeberg mountains, separating the Klein Karoo interior from the coastal plain. Here the critically endangered Barrydale redbfin, now recognised as a genetically distinct lineage of Burchell's redbfin *Pseudobarbus burchelli*, faces a real risk of extinction. It is known to occur only in the upper reaches of the Tradouw River and the adjacent Huis River above the town of Barrydale, and is subject to a suite of threats. Not only do all three of the invasive species mentioned earlier occur in the Barrydale redbfin's range, but its habitat has been degraded by pollution, bulldozing of riverbanks, and excessive water abstraction.

In this case the drafting of the BMP-S was undertaken by Cape Nature and the South African Institute of Aquatic Biodiversity, based in Grahamstown. It has not yet been finalised, but progress on implementing its conservation actions is expected to accelerate with the Endangered Wildlife Trust's appointment of a field officer for the Cape

Critical Rivers Project.

"I have been working on the project since July, doing the on-the-ground extension work," reports Alwyn Lubbe. "Much of this involves raising awareness about the threat of exotic species to our indigenous fish populations. I will be visiting individual farmers, but also engaging with farmers' associations and water boards."

"The impression I have got so far is that people are very much aware of the importance of conserving the natural system, which they depend upon from an agricultural point of view. They don't mean to do any harm, but want fish in their farm dams for various reasons – fish eat nuisance algae and mosquito larvae, and they also provide food and recreation. The people I've spoken to are receptive to lower risk alternatives, but we need to think about how to give them viable ones," notes Lubbe.

Dr Paxton notes that the project has a broader objective than Clanwilliam sandfish and Barrydale redbfin conservation, as it is looking at the implementation of the ecological Reserve, but focusing in on

ivers that support threatened fish species. Apart from the Tradouw and Koebee-Oorlogskloof systems, it includes the whole of the Koue Bokkeveld.

"The Koue Bokkeveld supplies the Doring River, especially over low-flow periods, and it is one of the most highly developed agricultural areas in the Western Cape, being a very important export area for deciduous fruit such as apples and pears," he says.

In 2006, the Olifants-Doring catchment was one of the first in the country to have a completed Comprehensive Reserve Determination and, as of 2012, has been classified according to the Water Resource Classification System.

"We want to use the Koue Bokkeveld sub-catchment area as a case study, so we have installed two loggers – one on the Twee River, which is home to the critically endangered Twee River redbfin, and the other on the Riet River – both of which flow via the Groot River into the Doring River. The loggers are piezometers that measure water pressure as a



Martine Jordaen of CapeNature and volunteer, Klaus Menck, view their first sandfish after five days of sampling the Doring River.

Bruce Paxton

substitute for water depth. We have put them in a stable cross-section of the river, and will then model the hydrology as a 'quick and dirty' way of getting data. Of course, one can get much more accurate readings from a gauging weir, but we feel there is no way to monitor the reserve effectively if we need a million Rand for each river in the country! We have put in a proposal to the Water Research Commission for a project that would allow us to contract in the necessary specialists for the hydraulic modelling."

Loggers have been installed in both of the other study systems too. In the Tradouw area the two loggers in the Huis River have revealed that so much water is being abstracted for use in Barrydale that about a kilometre of redfin habitat has been lost. In the Oorlogskloof, flows are being monitored to increase understanding about conditions needed to maintain a breeding population of sandfish.

"During our next survey of the Doring catchment in September, we are to identify a tributary system that is free of invasion by bass and bluegill, where we can translocate sandfish and establish an extra breeding population," notes Dr Paxton. "One of the areas we are looking at is the Biedouw River, as juvenile sandfish were seen there two years ago by Riaan van der Walt, CapeNature's freshwater stewardship manager in the area. It is also one of 13 Western Cape rivers that have recently been identified as priority rivers for alien fish eradication."

Translocation was one of 14 actions identified in the BMP-S, and has become one of the highest priorities. "First we need to get a handle on the population genetics though, and Dr Ruhan Slabbert from the University of Stellenbosch has expressed interest in doing that. The other actions aimed at increasing understanding of the fish's biology will probably be put on the backburner, because at this stage the urgency of the conservation measures outweigh them."



Bruce Paxton

"People are very much aware of the importance of conserving the natural system."

"The big question is whether the fish will stay in the river once we introduce them, because the Clanwilliam sandfish is primarily a mainstem species that migrates over long distances," adds Dr Paxton. "It is an experiment, and the Cape Critical Rivers Project provides us with the opportunity to do it."

The EWT Cape Critical Rivers Project is funded by SOS-Save our Species (an IUCN, GEF and World Bank coalition) and the Elizabeth Wakeman Henderson Charitable Foundation. □

Above: The project team surveying the Doring River at Uitspankraal, near the confluence of the Biedouw River. Thirty years ago, when sandfish were still abundant, this was an important breeding site.

Below: The remote Koebee River in the Northern Cape. The last remaining viable population of sandfish can be found upstream, in the Oorlogskloof.



Bruce Paxton



Olive wastewater: Turning salty into sweet

A project funded by the Water Research Commission, which involved the development of a pilot treatment system for table olive brine wastewaters, has shown that the technology is effective for treating such highly polluted brine wastewaters. Debbie Besseling speaks to project leader Dr Clive Garcin of the Centre for Bioprocess Engineering Research (CeBER), at the University of Cape Town, to learn more.

Olives are produced in large quantities and present environmental disposal problems. They are exceedingly bitter, and need to be cured to make them palatable before consumption. The curing process involves placing the olives in a brine solution whereupon a spontaneous lactic acid and/or yeast fermentation takes place.

The brining process takes from 3 to 12 months, depending on cultivar and type of olive (green or black), and is associated with various washing and rinsing steps. This results in noxious darkly-coloured and acidic wastewaters with a high organic load (COD < 70 g/l), high phenolic content (< 5 g/l), and high salinity (~10% NaCl, three times more than sea water). It is a water-intensive process, where up to 10 kl of water is consumed per ton of olives processed.

The high polyphenolic content makes the wastewaters toxic to microbial communities and plants, which means they cannot be disposed of in municipal treatment systems or the environment, or used for irrigation. They are generally disposed of in evaporation ponds, where the water is lost and problematic sludge accumulates. The wastes do, however, contain

high concentrations of valuable low molecular weight antioxidants with diverse beneficial properties on human health.

Specific objectives of the project were to:

- Recover the antioxidants as a value-added product for beneficiation of the wastewaters
- Recover purified brine water for re-use in the table olive production process
- Minimise the amount of waste for disposal.

The pilot plant constructed was constructed at the Buffet Olives farm in Dal Josaphat, near Paarl. It is one of the biggest and oldest commercial olive farms in South Africa. Conceptualisation, design and construction of the pilot plant were performed during the first year. Installation, plumbing, commissioning, operation and evaluation took place during the second year. Six months of operational data was collected to satisfy the project requirements, although the plant remains running to this day.

ABOUT THE MODULAR TREATMENT SYSTEM

Dr Garcin explains the modular treatment system and its two

main unit operations: membrane separation and chromatographic adsorption: "Wastewater coming from the olive production factory is diverted from the evaporation ponds and collected in temporary storage tanks. The wastewater is then pre-filtered to remove suspended solids, after which it is processed through the membrane system using a high pressure pump. The membrane system retains the high molecular weight darkly-coloured polyphenolic compounds, while the water, antioxidants, salt and other organic compounds (such as organic acids) pass through as permeate.

"The concentrated polyphenolic compounds are discarded to waste in the evaporation ponds in a minimised volume, and the permeate stream is then passed through a

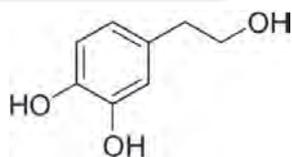
chromatography column containing a selectively adsorbent resin, to which the antioxidants attach. The water, salt, and other components pass through the column. After ozonation, to remove residual organics,

Below: The containerised olive wastewater treatment plant set up at Buffet Olive Farm, outside Paarl.

Bottom: The processing equipment inside the container.



ABOUT HYDROXYTYROSOL



Hydroxytyrosol (3,4-dihydroxyphenylacetic acid) is the predominant antioxidant component in the crude extract. It is one of the most powerful known naturally occurring antioxidants, and occurs in high quantities only in olives. It is thought to be at least partially responsible for the beneficial aspects of the 'Mediterranean diet', where there is a low incidence of cardiovascular disease and cancer. Besides for powerful antioxidant activity and free radical scavenging, it has been extensively researched and has been shown to have a diverse array of beneficial effects upon human health, including cardioprotection, anti-cancer, neuroprotective and anti-inflammatory properties.

“The elegance of the process is that the same two basic unit operations produce purified water for recycle, a valuable by-product, and a minimised waste stream.”

this brine solution is suitable for re-use in the factory.”

“The antioxidants are then released and recovered from the column by passing an ethanol solution through it; this is evaporated to obtain a crude antioxidant extract, and the ethanol solution is condensed and recovered for re-use. The crude extract is then purified

and processed in the laboratory into a market-ready powdered product. The elegance of the process is that the same two basic unit operations produce purified water for recycle, a valuable by-product, and a minimised waste stream,” says Dr Garcin.

Processing capacity for a given plant size and wastewater feed composition were determined, as were product yields and quality.

CHALLENGES ENCOUNTERED

There were many challenges during the project as Dr Garcin explains: “Obtaining costly equipment from overseas was tedious and subject to many bureaucratic delays. Installing the container in which the system was built in an olive orchard without damaging any of the trees

was difficult, but was successfully achieved. Testing and commissioning of the system presented the usual problems of identification, fixing, and re-testing.”

There was quite a complicated programmable logic controller (PLC) system devised to operate valves, pumps, and other equipment, such that the plant could operate automatically, while manual operation of the system was also possible. Foul rainy weather made the collection of factory discharge difficult, and extreme heat was encountered during some particularly hot summer months (the record was 48°C outside and 56°C inside the container).

Being a natural product, the wastewaters from olive processing were highly variable in terms of their composition, depending on olive cultivar, fermentation process, whether the olives were green or black, and a whole host of other factors. This made the processing and analysis thereof difficult.

The pilot plant demonstrated that the process is feasible and financially viable, and therefore the overall objectives were met.

THE PROJECT TEAM

A number of parties were involved in the project. The proprietors of the Buffet Olives farm graciously hosted the research project on-site (and continue to do so); they made space available and access to their wastewater possible through infrastructure modifications, and provided free electricity and clean water. The WRC provided funding for the project. Atl-Hydro (a local consulting firm) assisted with the construction, installation and commissioning of the system. The whole project was executed under the auspices of CeBER, who also provided the laboratory and analytical facilities necessary for process evaluation and downstream processing of the antioxidant product.

The material, equipment and construction (capital) cost of the



The olive wastewater storage and pretreatment unit.



ABOUT THE BUFFET OLIVE FARM

Buffet Olives are cultivated and processed on a 300 hectare farm situated in the foothills of the Drakenstein Mountain range. Granite based soils in combination with a Mediterranean climate create the ideal conditions to grow the superior olives.

Five main cultivars are grown commercially by Cape Olive Trust, namely Sevillano or Gordal, Barouni, Manzanilla, Kalamata and Mission.

When the olives first start to form

on the tree they contain no oil, only a mixture of organic acids and sugars. By the magic of nature a transformation gradually occurs as the olive ripens. A chemical process, called lipogenesis, slowly turns the acids and sugar into oil, as the olives turn from the palest green through to rose and violet and black. Olives can be picked at any stage during the process, and the degree of ripeness will determine its taste.

Left to right: Brine wastewater feed, recovered purified brine, crude liquid antioxidant extract, crude powdered extract, purified liquid extract, purified powdered extract.

plant was approximately R350 000.

Commenting on the future plans for the technology Dr Garcin says: "A spin-out company has been established to exploit the intellectual property technology generated during the project and commercialisation thereof is well underway".

Thereafter it is intended to roll out the technology to other olive producers, and investigate other possible applications of the technology. The process is, however, only feasible if there are value-added products to be obtained from a waste stream.

To order the final project report, *Pilot-scale treatment of table olive brines: Beneficiation, purification and water recovery for re-use (WRC Report No. 2010/1/12)* contact Publications at Tel: (012) 330-0340; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.



A role model in water services regulation

Department of Water Affairs (DWA) Deputy-Director: Water Services Regulation, Ntombizanele Mary Bila-Mupariwa, shares what it takes to regulate South Africa's water service delivery sector. Article by Debbie Besseling.

Bila-Mupariwa works in a challenging environment in which service delivery and client service are paramount objectives. Her current position at DWA is where her significant experience in water quality, wastewater treatment processes, her understanding of local government and environmental management has allowed her to provide decisive and confident leadership skills and build teams that continuously add value and exceed community's expectations.

Bila-Mupariwa started her career as a laboratory technician, which has been followed by a strong career history in the DWA. "In 1996 I joined the DWA's then Institute for Water Quality Studies (now Resource Quality Studies (RQS)) as a learner laboratory technician. In 2008, I joined the DWA in Limpopo, (Nsami Dam in Giyani) working as a learner technician, whilst conducting my in-service training," says Bila-Mupariwa.

When her husband secured a job in Cape Town she joined South African Breweries in 2000 as a quality control technician on a temporary basis. In 2001, she volunteered at the City of Cape Town to work on one of the largest wastewater treatment works (WWTW) in order to gain more experience, and later joined the City of Cape Town's Scientific Services as a lab technician.

"In 2002 I joined the DWA in the Western Cape Regional Office



as a water pollution control officer (WPCO) where I was promoted to a Senior WPCO. In 2006, I joined PetroSA as an environmental officer. In 2007, I moved back to the DWA, in the Western Cape as a Principal WPCO. In 2010, I was promoted to the Deputy Director: Planning Support. That is when my family decided to move back to Gauteng, and I requested a transfer to the DWA National Office in Pretoria under the Directorate: Water Services Regulation," explains Bila-Mupariwa.

Currently, in her position as Acting Director: Water Services Regulation, Bila-Mupariwa is responsible for overseeing three sub-directorates: Technical Regulation (Blue Drop and Green Drop Programmes), Economic Regulation (RPMS Programme) and

Contract Regulation (Enforcement Protocol).

This position includes a number of strategic functions that relate to managing the Technical Regulation sub-directorate, which include the following key-outputs:

- Managing the sub-directorate budget in terms of the Public Finance Management Act (PFMA) and Treasury Regulations.
- Regulating water services authorities (WSA) on water services provisioning according to legislated norms and standards for the sector.
- Ensuring the implementation of Section 9 of the National Water Services Act.
- Providing technical regulation advice to the internal and external holders.

- Providing project management support in the Directorate.
- Supervising personnel.
- Providing strategic support to the Directorate.
- Moderating the Blue and Green Drop Certification to the municipalities nationally.
- Managing, developing, monitoring and evaluating the implementation of strategies and the action plan on drinking and wastewater management.

Bila-Mupariwa has been extensively involved in the Department's Blue and Green Drop certification programmes since their inception. She provides an insight into how these initiatives have progressed since 2008: "Both of these programmes form part of an incentive-based regulation approach. The programmes have enjoyed some success, and have certainly triggered a major paradigm shift within the drinking water and wastewater service sphere. From 2009 there has been significant improvement in the number of Blue Drop and Green Drop awards and Blue Drop and Green Drop scores nationally," says Bila-Mupariwa. However, she admits that there are some towns that require improvement and further support in order to deal with the challenges that they are currently experiencing.

The general processes in the auditing and assessment of municipalities for Blue and Green Drop certification involves a number of tasks. The first process that takes place is the training of inspectors for assessments (inspectors include the departmental officials and professional services providers (PSPs)). Once the inspectors have qualified, they are allocated municipalities that they have to assess.

The initial assessments entail the consultative audits which are the desktop exercise whereby water services institutions (WSI) are expected to provide documentation as proof of compliance after

which there will be site inspections of the water treatment systems or wastewater treatment systems. All inspectors are required to submit all the score cards and the technical inspection reports to national moderators.

Subsequent to that, moderated scorecards are sent back to the WSI to prepare for the confirmation assessments. The confirmation assessments are where the WSI's are given the opportunity to provide more information where necessary, as well as to confirm whether the data/information captured by the inspectors is accurate. After the confirmation assessment scorecards are submitted back to the national moderators for the final moderation in order to compile the reports.

A number of challenges are being encountered in the Blue and Green Drop certification programmes. These include a lack of sufficient information from some of the WSIs; commitment and competency in water managerial positions; skilled process controlling; competent plant managers; high staff turn-over within municipalities (skills) and unsatisfactory plant operation and maintenance.

QUALITY DRINKING WATER AND WASTEWATER

Bila-Mupariwa explains the key factors in ensuring quality drinking water and wastewater. "The department realises the need for local government support in areas where there is a drive to comply, however, the lack of capacity and resources compromise local government performance. DWA continues to be involved in multi-department sector support and capacity building initiatives. The major interventions by the department include the Regional Bulk Infrastructure Grant (RBIG) which ensures that rundown infrastructure is rehabilitated; the Rapid Response Unit that ensures the rectification of mechanical and civil infrastructure faults, as well as the Municipal Water Infrastructure Grant. In addition, strengthening the enforcement protocol by the department is of priority."

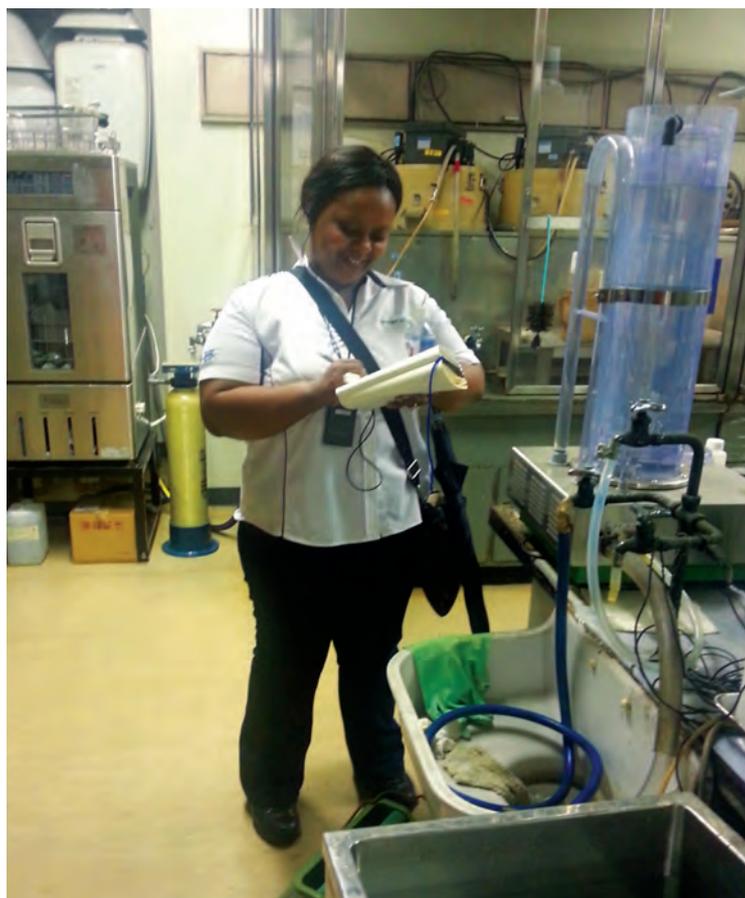
DWA CURRENT PROJECTS

In terms of improving water and wastewater quality services, the DWA is involved in a number of

Zanele undertaking an assessment for the Green Drop certification process.



Zanele working in the lab.



projects and initiatives. Currently they are pursuing the quaternary catchment-based risk abatement, the main objectives of which are to create ownership and accountability of the water resource shared by all WSIs (municipalities) concerned.

Overall the aim is to get all municipalities and public/private users alike to acknowledge and accept the responsibility they have to the water resource they are sharing. Another project, involves the enforcement protocol where WSIs are found to be uncooperative, and the appropriate regulatory activities will be initiated.

Furthermore, DWA together with Japan (Ministry of Industry and Tourism (MLIT)) has a co-operation agreement in place which allows local municipal officials to receive training funded by Japan. The current programme focuses on supporting municipalities to improve their Green Drop and Blue Drop status.

The programme will run for three years, starting in 2013. The first group has recently returned from the Japan International Cooperation Agency (JICA) two week training programme.

Bila-Mupariwa speaks about the team involved in the certification programmes which comprises of DWA officials (national and regional officials) as well as a team of PSP experts comprising experienced engineers and scientists. "The team is committed and enthusiastic about achieving the objectives of the certification programmes, and some of the inspectors have been part of the programme since its inception in the initial stages," says Bila-Mupariwa.

ACADEMIC PROFILE

Bila-Mupariwa holds a National Diploma in Water Care from the Pretoria Technikon, as well as a B-Tech in Environmental

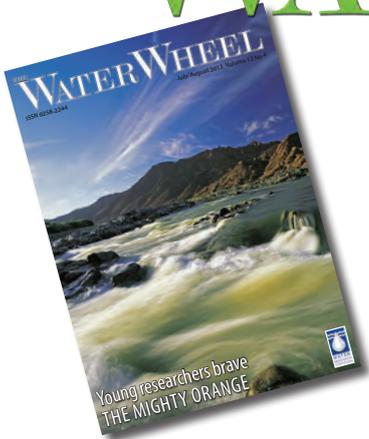
Management from Cape Town Technikon and a post graduate diploma in Integrated Water Resources Management from the University of Western Cape. Bila-Mupariwa is currently finalising the thesis for her Masters in Integrated Water Resources Management, from the University of Western Cape which is about the impact of the Blue Drop and Green Drop certification within WSIs. She is a member of the Water Institute of Southern Africa (WISA) and is a certified scientist with the South African Council for Natural Scientific Professionals (SACNASP).

A WOMAN IN WATER

Speaking as a woman in this sector, Bila-Mupariwa discusses her experience. "It has not been an easy journey for me, but rather an interesting one, especially with regard to the treatment works. This is due to the fact that this area has traditionally been dominated by male process controllers. It has been exciting to be one of the women breaking into this field. There is never a dull moment when you are at the treatment works given the challenges that one faces with regard to the processes. In order to make it in this challenging world you need to respect people from all levels, and the world will respect you back (smile and the world will smile back at you). I have learnt to play the ball and not the man. As a woman you need to work twice as hard to prove that you can do it.

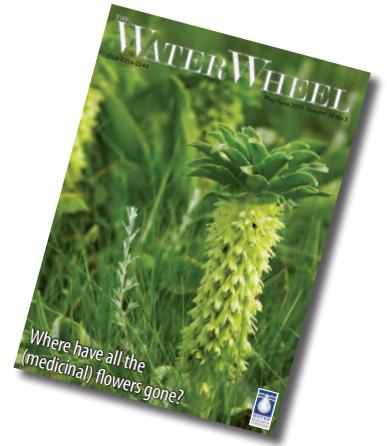
I am passionate about my work. I know that I am contributing to making a difference in my country by ensuring that the public receives good drinking water quality, and making sure that our scarce resources are protected. For me, I subscribe to Eleanor Roosevelt's quote – 'A woman is like a tea bag; you never know how strong it is until it's in hot water.' My strength and passion are in the water sector." □

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Viewpoint – Why has the South African National Water Act been so difficult to implement?



The South African National Water Act (Act 36 of 1998) was hailed by the international water community as one of the most progressive pieces of water legislation in the world, yet, 15 years down the line, implementation of the Act has been only partially successful. Former Deputy Director-General: Policy and Regulation of the Department of Water Affairs (DWA) and current Chair of the Water Research Commission, Barbara Schreiner, sets out some personal reflections on the challenges facing the implementation of this remarkable piece of legislation and on the failure to achieve the initial high ambitions within the South African water sector.

The NWA was aimed at fundamentally reforming the previous Water Act of 1956 which was not only racially discriminatory in how water was allocated, but was based on the legislation of water-rich Europe which was not appropriate for a water-scarce country such as South Africa. Central to the NWA of 1998 is the principle that water is a scarce natural resource that belongs to all of the people of South Africa, and that it must be used beneficially and in the public interest.

The Act is premised on balancing the three legs of social benefit, economic efficiency and environmental sustainability, and sets out the legal framework for the national government to protect, use, develop, conserve, manage and control water resources in the country. It also incorporates the principle of subsidiarity – management of water resources at the lowest appropriate level, through catchment management agencies (CMAs).

It is not possible, in the scope of this article, to deal in detail with all of the aspects of the NWA or all of the challenges that have hampered its successful implementation. As a result, I will outline some of the key challenges as I see them. Let me begin, however, by outlining briefly some of the key aspects where implementation of the NWA has been inadequate.

INSTITUTIONAL ARRANGEMENTS

On the institutional front, the Act makes provision for the establishment of CMAs, the transformation of existing irrigation boards into water user associations, and the possible establishment of

an agency to manage the national water resources infrastructure. Neither of the first two processes has yet been completed: only two out of a proposed nine CMAs have been established since 1998, and the transformation of irrigation boards has not yet been completed.

REALLOCATION AND EQUITY

Equity in both access to water and the benefits derived from water (through water allocation reform) is a key principle of the legislation, and yet, 14 years down the line, remarkably little has been achieved in this regard. The biggest users of water remain white commercial farmers.

LICENSING OF WATER USE

The process of issuing licences to water users has seen serious challenges and delays, hampering much needed economic growth in the country. It has been found that prior to a recent project aimed specifically at removing the backlog in water use licences, some licence applications had been with the department for up to eight years without being finalised. In parallel, the system of registering water use across the country is not up to date and reflects incorrect water use figures, resulting in significant billing and revenue collection challenges and difficulties in ensuring compliance with registered water use.

PROTECTION OF AQUATIC ECOSYSTEMS

While internationally recognised methodologies for determining the water requirements

of aquatic ecosystems have been developed by South African scientists, and these have been used to determine the requirements in more than half of South Africa's water resources, ensuring achievement of such requirements in practice has been much more difficult.

What then, have been the drivers that have resulted in failure to deliver effectively on the legislation?

LEADERSHIP, TRANSFORMATION AND POWER

The major restructuring of the South African water legislation was made possible by the transfer of power from a white minority to a democratically elected government representing *all* the people of South Africa. As a result, there was a fundamental shift of power that undermined previous power blocs that had worked against major changes in the water legislation, such as the changing of riparian rights to time-bound authorisations to use water.

This change in power, however, also played out in a number of ways within the then Department of Water Affairs & Forestry (DWAF). Prior to 1994, DWAF had been a highly technical department, where the technical staff (engineers, scientists, lawyers, etc) was almost entirely white men. After 1994, the drive to transform the public sector resulted in an employment equity approach that saw large numbers of black and female appointments into the department.

An unintended consequence was the outflow of white officials with years of technical experience, many of them into the consulting world. In their place a number of people were appointed who, because of the apartheid legacy, had limited technical training or experience in the water sector. The drive to appoint black staff across government and the private sector from a limited pool of people with technical

“The process of issuing licences to water users has seen serious challenges and delays, hampering much needed economic growth in the country.”

training also saw high levels of staff turnover in the department as officials with two years' experience were offered promotions into other departments or the private sector. The result saw, amongst other things, a transfer of skills from the department to the private-sector consulting community, increasing the dependence of the department on consultants to support the implementation of the new policy and legislation.

Actual implementation, however, remained in the hands of the civil servants, with all the challenges arising from lack of experience, lack of technical capability and high staff turnover. An added complication in this picture is the challenge of path dependency – the challenge of turning around the focus of a department where technical skills remained, at least for a period, primarily in the hands of a group of people who did not necessarily share the political vision of government or the departmental leadership.

Compounding the political divisions was the fact that despite political change, the economy remained firmly in the hands of a white elite, still equipped with significant bargaining power and skills, access to the seats of power, and to legal support when necessary. By contrast, the poor black majority, and particularly the rural poor have limited, if any, access to these types of power, thus limiting their ability to take up the fight for access to water.

The issue of the capacity of the department to implement the new legislation has been compounded by leadership challenges at both ministerial and director-general levels. For

a variety of reasons, including issues of competency and internal politics, in the past nine years, the department has had three directors-general and two acting directors-general. The current director-general has been suspended after only one year of being in the position. Ministerial turnover has also been high, with three ministers holding office (in four terms) during the same period. This high rate of leadership change has not served the effective implementation of the NWA.

THE PERFECT VS. THE PRACTICAL

A second critical challenge in the implementation of the NWA was achieving the correct balance between technical or scientific excellence and the ability to manage a process. So, for example, the aquatic ecosystem scientific community of South Africa, working closely with experts in the department, developed internationally recognised

Little has been achieved in improving equitable access to water.



Pippa Hetherington-Africa Media Online

and path-breaking methodologies for determining the water requirements of the ecological Reserve. In this process, there was considerable engagement between managers and scientists about what was required to achieve scientific rigour and what was required for adaptive management decisions, with scientists initially arguing for a much higher level of scientific investigation than managers felt there was the time or resources to implement. As a result, a practical approach was developed which allowed for different levels of comprehensiveness of ecological Reserve determinations.

This, however, was followed by a further challenge – the challenge of turning monthly flow regimes into licence requirements and into actual practice on the ground. In many cases Reserve determinations have not been achieved in the field.

TOO MUCH TOO FAST

A third, critical challenge was that the department, as a result of the sweeping changes in the water sector and the country as a whole, found itself trying to implement a vast swathe of new functions simultaneously. Thus, despite the NWA having been written in a manner that allowed phased implementation, the reality was that the department was faced with an overwhelming implementation challenge with limited resources.

A great deal of effort was put into planning the implementation of the new legislation, with the establishment of something called TINWA – the team for the implementation of the National Water Act. Under TINWA, a number of task teams were developed to focus on the implementation of particular elements of the act. As implementation progressed, however, it became clear how much the task had been underestimated.

The pressure to implement the NWA at speed was driven by a number of factors, including the

urgent political need to address the racial socio-economic inequities arising from the apartheid era, and the need to resolve significant water challenges such as balancing supply and increasing demand and ensuring appropriate water quality.

In addition, after 1994, the department took on a water services function that had not previously been part of the department's functions, including running a massive national community water supply and sanitation programme. This programme came with a major budget, which required significant technical capacity for implementation. While new capacity was brought into the department, technical staff was also drawn from the water resources functions of the department, further depleting the capacity to implement the water resources legislation.

Technical positions have proven difficult to fill in many cases, and positions in critical management and technical areas have remained vacant for too long, with acting officials in place.

DECISIONS AND ACCOUNTABILITY

A final weakness in the implementation of the Act has been the failure to stick to and speedily implement decisions taken. A case in point relates to the establishment of CMAs. The first National Water Resources Strategy (NWRS) set out the legal basis for the establishment of 19 catchment management agencies across the country. However, establishment of the CMAs has been poor, and to date, only two are actually functioning. The decision has now been made to establish nine, rather than nineteen, and to ensure that they are established within a limited timeframe.

Two critical factors allowed the establishment of CMAs to fall behind the original schedule proposed in the NWRS. The first was that those responsible for the

establishment of the CMAs (heads of regional offices) were not held accountable for not achieving their targets. Lack of capacity in the regional offices was often cited as a reason for not achieving targets, but proper performance management and accountability were weak. The culture of the organisation, for example, led to a large number of managers receiving annual performance bonuses, despite targets not being reached.

The second was the questioning of decisions taken. Despite the NWA giving the mandate for the establishment of the CMAs, some years into the process, senior management members in the department questioned the wisdom of establishing such bodies, and to all intents and purposes the establishment process was put on hold until further work had been done on the matter.

The debate around CMAs reflected a larger debate that was happening in the country around the 'agentisation' or 'corporatisation' of government. The trade union movement and left groupings in government were concerned about the growing transfer of government functions, and government employees, into parastatal organisations and agencies. This process, seen as part of the neo-liberal approach to the role of the state, was distrusted partly because it was seen as a move towards privatisation of some of these bodies, and partly because it moved government employees out of the protection of direct public-sector employment. On the other hand, the argument was that CMAs would be more directly accountable to water users in the catchment than a government department because they would have both direct stakeholder representation in their governance structures, and a direct accountability line to water users in that their financial sustainability would depend on stakeholders paying their water use charges.

Resolving this debate dragged

“The issue of the capacity of the department to implement the new legislation has been compounded by leadership challenges at both ministerial and director-general levels.”

out over years, with the establishment process put into a kind of limbo waiting for a decision that was delayed and delayed and delayed. It is only recently (2012) that the minister took a clear and firm decision to go ahead once again with the establishment of the nine CMAs over the next three years. However, there is still an unresolved debate about what functions will be delegated to CMAs and over what time frames. The power to authorise water use is at the centre of this debate.

LESSONS?

The discussion above begs the question: what can be learned from this experience?

Firstly, there is the Volkswagen vs. the Rolls Royce issue. The NWA was hailed internationally as the Rolls Royce of IWRM legislation. But implementation has proved extremely difficult. It would, perhaps, have been better to write a Volkswagen piece of legislation, one that is more suited to the technical and human resource capabilities of a developing country.

Linked to this is the issue of focusing on getting the basics right. In the process of implementing a sophisticated and nuanced piece of legislation, and all the challenges outlined above, many of the basics like maintaining the monitoring infrastructure, and ensuring compliance with licence conditions, have been poorly addressed. The challenge of implementing IWRM is that it can result in a shotgun focus, trying to do everything at once. Where there is limited capacity, which is true in all developing countries, it is, in my opinion, better to focus on the *key* challenges in the particular context, than to strive to do it all at once.

Finally, I think it is important to recognise that capacity resides in a number of places in society, not only in government. To address the issue of capacity, participatory water

management should result not only in consultation with stakeholders, but in partnerships with key players from the local to the national level. Such key players include community-based organisations, water user associations, catchment management forums, non-governmental organisations, the academic, scientific and research communities, and the private sector, whether in consulting firms or private enterprises. Harnessing the capacity and commitment of these stakeholders in determining water management priorities, finding innovative solutions, implementing actions, and monitoring implementation can go a long way to bolstering the capacity needed to protect, develop, conserve and manage the nation's water resources.

DWA is currently amending the NWA to address some of the

challenges that have arisen during implementation over the past 15 years. Without, however, addressing the significant implementation challenges raised in this paper, there is unlikely to be substantial improvement in delivery of the intended policy outcomes.

It is, therefore, critical that the department develop a proper implementation plan, based on available resources, and with clear deliverables and time frames against which managers can be held accountable. Such a plan needs to be both ambitious and realistic and serve to guide implementation, building on the lessons of the past 15 years.

- This is a shortened version of an article published in *Water Alternatives* 6 (2): 239-245, www.wateralternatives.org 



Lani van Vuuren

Ensuring the practical protection of South Africa's aquatic ecosystems have proven difficult.

Hands-on learning at Rhodes

BIOLOGY INTERNSHIP PROGRAMME



Rhodes University interns on site at New Years Dam.

Julie Grotzer

Rhodes University's Biology Internship Programme is proving that, while being surrounded by modern day conveniences and technological prosperity, young people can still have fun connecting with nature.

Words by Dr Jaclyn Hill.

It was Canadian naturalist, David Suzuki, who said: "We can't blame children for occupying themselves with Facebook rather than playing in the mud. Our society doesn't put a priority on connecting with nature. In fact, too often we tell them it's dirty and dangerous."

This is a fair point – particularly in this age of ever advancing technology, were the majority of youth have a stronger emotional attachment to their mobile phone than to any garden, river, ecosystem or coastline.

It is the youth, however, who are fundamental to the preservation of our natural resources, and who will make or break the environmental policies and programmes currently being developed in South Africa.

The youth are the lynchpin of environmental stewardship, and without them South Africa's terrestrial and aquatic ecosystems face an uncertain future. How then do we motivate young learners to become environmental stewards? How do we promote public awareness of the real challenges facing South Africa's natural resources, and instil a passion for science, learning and awareness in our youth, encouraging them to become world leaders in science?

That is the question Rhodes University has attempted to address with the Biology Internship Programme; a collaborative effort between the university's Department of Zoology

and Entomology, the South African Institute for Aquatic Biodiversity (SAIAB), and Victoria Girl's High School in Grahamstown.

Spearheaded by Dr Francesca Porri of SAIAB and life sciences teacher, David Stoloff, the Biology Internship Programme was initiated in 2009. Learners in Grade ten to twelve complete an application form at the beginning of the year, in which they motivate for their participation in the programme. The life science teacher supports each motivation by adding comments before it is submitted. At the end of the year, the students who qualify receive an attendance letter from SAIAB and Rhodes University.

Initially five top science achievers were selected from Victoria Girl's High School to complete internships in the Department of Zoology and Entomology. Here they work

alongside university researchers in multiple areas of aquatic science during their April, July and September vacations.

The primary concept of the internship programme is to facilitate the interaction of high school students with aquatic scientists in a hands-on approach to learning in order to enhance the quality of pupils at high school level, but also to boost excellence within tertiary education with the aim of forming responsible, motivated and enthusiastic young scientists.

Since its inception the programme has grown to include not just Victoria Girl's High School, but also Graeme College and Ntsika Secondary School, with the Department of Zoology and Entomology now hosting up to 15 students during every vacation period. Students work a minimum of 30 hours per year, and are paid a small hourly stipend for their time.

The Biological Control Unit (BCU) at Rhodes University, led by Prof Martin Hill, has become involved in the programme in a big way. "The programme allows us to showcase our work to some very keen high school scientists, fostering an enthusiasm and perhaps even inspiring some learners to pursue a career in science," says Prof Hill.

Much of the research undertaken at BCU involves aquatic water weeds and the insect agents employed to control them. Primarily funded through the Working for Water Programme, the laboratory's main research focus includes understanding the ecology of invasive and alien plants, such as the notorious water hyacinth, water lettuce, parrot's feather, red water fern and a host of other exotics. Research is undertaken on how to control these water weeds through the release of host-specific insects.

"To most of these students, it is a completely new form of learning, and they jump at the opportunity to get their hands dirty."



Grant Martin

Interns getting their hands dirty at the mass rearing facility at the Biological Control Unit greenhouse.

Dr Julie Coetzee, Dr Grant Martin, Dr Iain Paterson and Dr Jackie Hill all work on various aspects of aquatic weed interactions at the BCU, and have enjoyed the time spent on working with the high school interns. "It has been a rewarding experience, teaching in a hands-on interactive environment. To most

of these students, it is a completely new form of learning, and they jump at the opportunity to get their hands dirty," notes Dr Coetzee.

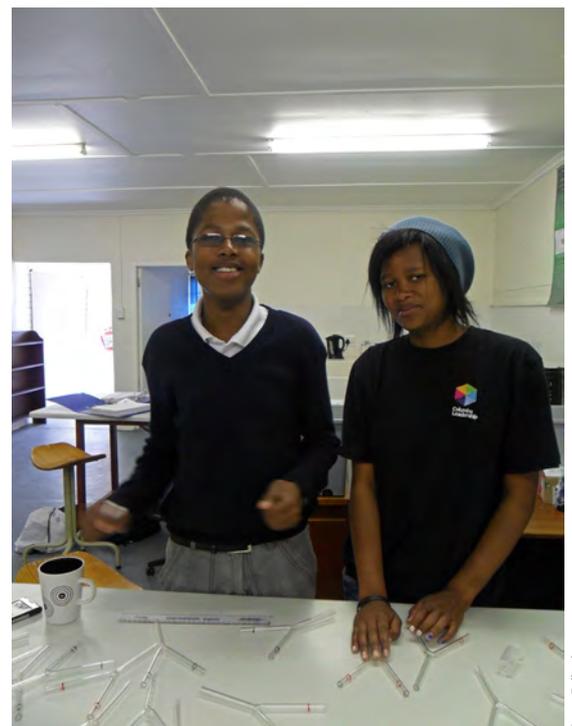
The programme has proven a real inspiration to the learners. Apart from Victoria Girl's High School being ranked a top school in the Eastern Cape partly as a result of the internship programme (*Fairlady*, June 2013), two of the interns have gone on to achieve top projects at the 2013 Eskom Expo for young scientists.

"I really liked the hands-on part of the internship, allowing me to learn by doing and to interact with scientists and other people at the university," comments 2013 intern Ekhona Ntloko. "It really opened my eyes to the career opportunities available." This is exactly the outcome the programme is aiming for, notes Stoloff. "We really want

to encourage these learners to get excited about science."

With work and dedication, Rhodes University, SAIAB and the Grahamstown high schools hope to continue to grow the Biology Internship Programme with the aim of ensuring a strong tradition of science in South African public schools, to promote tertiary education and to instil a sense of environmental stewardship in the Grahamstown school community. □

Two interns getting a closer look at Y-tube insect experiments at the Biological Control Unit.



Tanya Fullard

(RISE)ing up for water education in Africa

Africa's water challenges calls for the continent to develop its own skilled body of expertise. Sukhmani Mantel and Denis Hughes introduce one academic network that is aiming to do just that.

A student from the Institute of Water Research undertaking invertebrate sampling.



The development of solutions to sub-Saharan Africa's water resource problems is currently hindered by a shortage of trained personnel, especially at high levels of academic and professional expertise. This gap is frequently filled by consultants from outside the region, who may contribute to the solution of specific problems, but do little to contribute to longer-term development of capacity within the region.

With this need in mind, the Sub Saharan Water Resources Network (SAAWRN) was launched in 2008 with funding from the Regional Initiative in Science and Education (RISE) programme of the Carnegie Corporation of New York. The programme is aimed at strengthening higher education in the science and engineering fields by increasing the number of skilled Doctorate and

Masters persons in Africa. The network is one of five African networks funded by the Carnegie Corporation.

SAAWRN's focus has been on fundamental and applied science that can contribute to solutions to the diverse problems facing the region in terms of securing adequate (in terms of quantity and quality) water supplies that are environmentally sustainable. There are many water-related pressures facing the region, including declining observation networks (and therefore a decline in the information available for management), declining human capacity, increasing resource use, and the very real possibility of increasing resource variability associated with future climates.

As the region strives toward improving both political and economic stability, the importance of

providing secure water supplies will assume increasing significance. If this is neglected, there is the potential for conflicts within communities (through a lack of water and sanitation services provision) as well as between countries (through a lack of agreement on transboundary sharing of water resources).

Prof Denis Hughes (Director of the Institute of Water Research or IWR at Rhodes University) is the Academic Director of SSAWRN, a network that comprises four university nodes. Besides IWR, the other three institutions are the Okavango Research Institute at the University of Botswana, Department of Geology at Eduardo Mondlane University in Mozambique, and the School of Veterinary Medicine and Animal Resources at Makerere University in Uganda.

RESEARCH AREAS AND GRADUATES

Water resource science should be seen as a multi- and interdisciplinary science that addresses the problems and issues associated with managing water resources, including surface and groundwater quantity, water quality and related ecological dependencies, water use and its management. There are many research opportunities in the field of water resource science within sub-Saharan Africa, covering many basic disciplines, including civil engineering, geography, hydrology, ecology, water chemistry, geology and environmental science.

The students at SSAWRN are conducting projects that are aligned to applied research, and that address the solutions to identified socio-economic problems affecting various countries, thus creating a bridge between academia and society. In the past five years, the network has recruited 27 students (and three post-doctoral students) from ten different African countries. A total of seven PhD students and six MSc students have graduated in the disciplines of hydrology, water resources science, natural resource management and hydrogeology.

NETWORKING: OPPORTUNITIES AND LIMITATIONS

Some of the benefits that the students and the institutions have derived by being part of a network include growth in the profile of indigenous African research in the field of water resources, largely through the outputs of the students, as well as successful applications to other funding bodies. The latter has allowed the students to expand the resources available to them to complete their studies and launch their careers.

The students also benefit from disseminating research ideas and results at regional and international

conferences and workshops. This contributes to their academic confidence, increases their exposure to other scientists and boosts the reputation of their host institutions. Finally there is the sharing of research, resources and co-supervision of students, which have fostered a multi-disciplinary approach to water resource science research.

The SSAWRN has encountered some limitations that are being addressed where possible. Some of these present lessons for other water institutions. As examples, the broad subject scope of the students projects and the limited number of available supervisory staff has limited co-supervision possibilities across the network nodes, primarily due to the small numbers of experienced supervisors, who already have heavy workloads. The high costs of travelling within the region are a major stumbling block in bringing supervisors and students together more than once or twice a year.

Language barriers have also limited co-supervision possibilities for students from French or Portuguese speaking countries. Some of the students have identified the need for additional short training courses at the start of their studies to fill any gaps in their academic skills. The diverse standard for training across

Africa makes this particularly problematic for students registering for a thesis-based postgraduate degree. In this regard, there are two taught masters programmes that will be commencing over the coming year at Eduardo Mondlane University and Rhodes University that offer advanced disciplinary and trans-disciplinary courses, short courses on postgraduate research and writing, and address issues of language (where possible).

FUTURE OF THE NETWORK AND STUDENTS

The majority of the network graduates have joined universities as post-docs or departmental staff members in Democratic Republic of Congo, Uganda, Zimbabwe, Mozambique, Botswana and South Africa. There is continued networking between some of the graduates that have returned to their home countries.

Following the six years of RISE funding, the SSAWRN network will be entering the final phase of its three-year funding by the Carnegie Corporation in 2014, and more graduates will be joining the ranks of academics, researchers and practitioners in the near future as a realisation of the network's vision. □

Recent Rhodes graduates Sitabile Tirivarombo, Paul Mensah and Irene Naigaga.



Teaming up for Mandela to clean local wetland

Staff from the Water Research Commission (WRC) teamed up with the Agricultural Research Council to contribute their 67 minutes on Mandela Day to cleaning the Colbyn Valley wetland, in Pretoria. The initiative was also supported by Tshwane Ward Councillor,

Siobhan Muller, various divisions of the City of Tshwane, as well as the Friends of Colbyn Valley and Transparent Financial Services. About 90 people participated in the initiative, collecting around 130 garbage bags and a shopping trolley full of trash. The Colbyn Valley land was donated to the

Tshwane Municipality by the University of Pretoria, and is in the process of being declared a nature reserve. A rare example of peatland (in South Africa), the wetland is vulnerable to a number of impacts due to its urban location, but remains a valuable biodiversity and water resource.



WRC Research Manager, Bonani Madikizela, doing his bit to clean the wetland.



The group who participated in the wetland cleanup.



The Colbyn Valley wetland is a rare example of peatland in South Africa.



WRC staff who participated in the cleanup.



Some of the trash collected on the day.

SOUTH AFRICAN NATIONAL COMMITTEE ON LARGE DAMS CONFERENCE



SANCOLD

5 – 7 November 2013
Thaba 'Nchu

Advances in Dam Technology for Water and Energy in Southern Africa

About the Conference

The South African National Committee on Large Dams (SANCOLD) Conference will be held at the Black Mountain Hotel in Thaba 'Nchu, Maria Moroka Nature Reserve between Tuesday 5 and Thursday 7 November 2013.

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.

Programme

Overview

The conference will commence on Tuesday morning 5 November. On Tuesday there will be presentations by keynote presenters and of technical papers. There will be a special programme for the young engineers during the first two days of the conference. The conference dinner will be held on the Wednesday evening. A technical visit to the Metolong Dam site, in Lesotho, has been arranged for Thursday 7 November. Valid passports are required to enter Lesotho.

Registration

Conference registration is now open. Registration forms, with payment, have to be received no later than 7 October 2013.

Please note that:

Payment is required by cheque or by bank transfer; confirmation of registration will be given after payment has been received in full. The registration fee does not include accommodation.

If you have any queries regarding registration and for further detailed information, please visit www.sancold.org.za or contact:

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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

