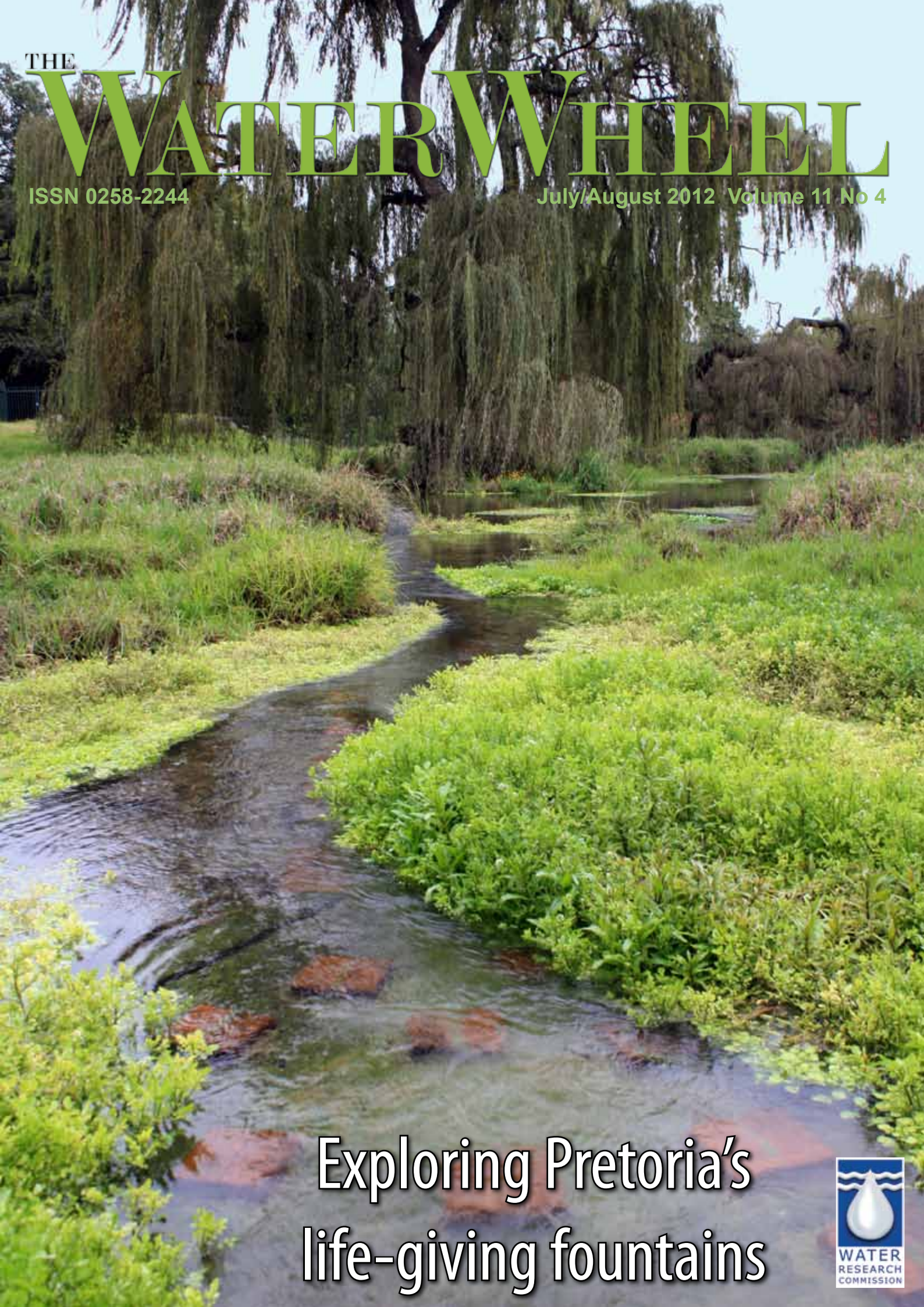

THE WATER WHEEL

ISSN 0258-2244 July/August 2012 Volume 11 No 4

Exploring Pretoria's life-giving fountains

WATER RESEARCH COMMISSION

Short Courses Presented by the Department of Chemical Engineering, University of Pretoria

Water Quality Management and Effluent Treatment

20 – 24 August 2012

The course aims at updating delegates on the most recent strategies for water quality management. It provides useful insights into current and future solutions for water quality and availability problems encountered in this region. This course provides an extensive overview supported by updated reference materials which will be beneficial to both technical staff and decision makers in the field.

Course fee: R10 100 per person.

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10 – 12 October 2012

This short course provides the participant from the engineering environment with sufficient information on all aspects of membrane processes to make informed decisions about the application and operation of reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF), microfiltration (MF) and electrodialysis (ED) for water desalination and industrial water treatment.

Course fee: R6 200 per person.

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29 October – 1 November 2012

The course covers aspects of environmental engineering and management which will be valuable to practicing engineers and scientists in the field. It comprises a knowledge review, discussion forum and case studies.

Course fee: R8 600 per person.

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

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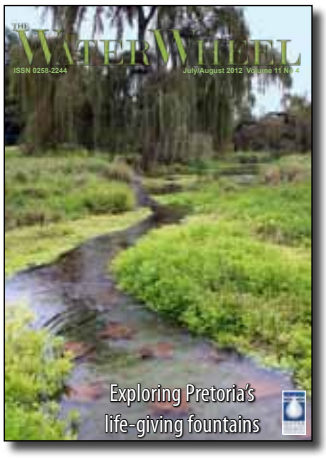


Cover: *A study of Pretoria's early water management confirms the importance of good supply.*
See story on page 18.

WRC CEO, Dhesigen Naidoo

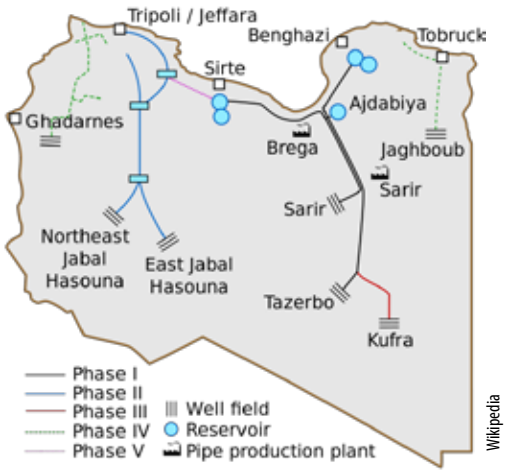
It's a question of infrastructure

Converging the 'discovery' of Africa's groundwater resources, South Africa's infrastructure strategy as part of the New Growth Path and the 100th year anniversary of the national water department.

In April this year the airwaves were abuzz with breaking news from the BBC that scientists at the British Geological Survey had made the great discovery of the vast amounts of water in dry Africa. The article in *Environmental Research Letters* conveys that the mapping of Africa's groundwater resources reveals that the continent has 100 times more water below the surface than on it.

"The century of water management at a national level has been characterised by a global leadership in water infrastructure development."

While this is a valuable contribution to the groundwater resource mapping of Africa – the knowledge is hardly new. We have known for a long while through localised surveys on the continent that there is a very significant water resource in Africa's aquifers and the mother lode sits under the Sahara desert stretching in a large triangle that includes Libya, Chad and Algeria. We also know that many of these aquifers have had very limited recharge and some no recorded recharge at all in modern history – enough to be classified as fossil aquifers. Even so, given the dire state of water availability on the surface many argue that this resource should be tapped into.



Schematic drawing of the Great Manmade River project. The diagram illustrates the more that 2 500 km of pipelines that would transport the water from the desert aquifer to the large Libyan cities.

So how do we get water out from deep underground thousands of kilometres into the desert to where we can usefully use it? It's a question of infrastructure. Libya, under a leader best remembered for other matters, managed to attain this feat in the early part of this century with the Great Man Made River project that pumped out water in the deep desert (the Nubian Sandstone Aquifer System) and piped the water some 2 850 km to be used in three of Libya's largest cities (Tripoli, Benghazi and Sirte).

While the GMMR project represents a high investment infrastructure development option, it talks to scale of investment required to harvest the water resources from some of Africa's large aquifers. For many others, smaller scale infrastructure interventions are possible.

Segments of the massive concrete pipes that were laid to form the man-made river.

We engage this matter at a time when South Africa has announced its intention of supporting the national economic growth effort through a National Infrastructure Programme as part of The New Economic Growth Path. The core of the programme is a portfolio of 17 Strategic Infrastructure Projects (SIPS), the majority of which are either highly water sensitive or in some cases e.g. the Umzimvubu SIP – water centred. An important question in this domain is whether water will be a SIP constraint or can we through research and development facilitate the modality of water as an enabler of development.

We ask this question while South Africa celebrates the centenary of the National Department of Water Affairs which began its genesis as the Department of Irrigation as part of the Union of South Africa government in 1912. The century of water management at a national level has been characterised by a global leadership in water infrastructure development. Dam construction, especially large dams in difficult hydrological environments is an area that has global recognition. The area where South Africa is an undisputed world leader is that of inter-basin transfers. The Lesotho Highlands multiple dam scheme together

with the Trans-Caledon Tunnel transfer is such an example. This mega-scheme has been discussed at length in many international forums and has been instrumental in informing the design of larger schemes elsewhere in the world. We have a strong water infrastructure development history and a recently launched book by a WRC staffer Lani van Vuuren titled *In the Footsteps of Giants – Exploring the History of South Africa's Large Dams* offers an invaluable

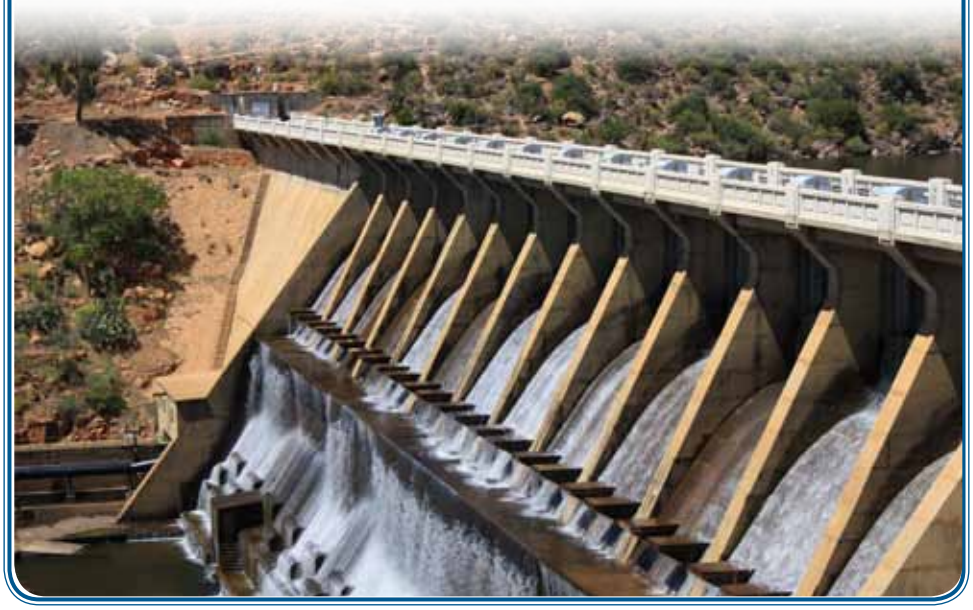
"We must once again look to the possibilities of the Government's National Infrastructure Programme to provide the opportunities we require."

contribution to this narrative. Box 1 also illustrates some examples from a larger portfolio of water infrastructure related projects that the WRC has completed or started.

In June we focused on Youth Month and the several challenges we must as a nation overcome to ensure a sustainable and water secure future. We must once again look to the possibilities of the Government's National Infrastructure Programme to provide the opportunities we require, not only to provide jobs for our unemployed youth – and this is important enough, but also to be able to use the programme to re-inject funds and impetus into training, education and research opportunities to ensure a highly capacitated and enabled skilled workforce of tomorrow that begins with developing the South African youth of today.

Some examples of infrastructure research and development related projects in the WRC portfolio

- **Water Resources 2012** – It is well known that South Africa is a water scarce country – our total mean annual runoff only equals around 50% of the water flowing in the Zambezi River. National water resources assessments have become the blueprint on which South Africa's bulk water infrastructure is based. Having been involved in the country's water resources assessments for more than two decades, the WRC is also funding the latest study, WR2012. The assessment includes an update of all hydrological data, further enhancement to existing hydrological models, revised groundwater data and a monthly time series of present day flow, among others. For the first time WR2012 is also creating a publicly-accessible, Web-based and interactive reporting system to continually quantify both the surface and groundwater resources of South Africa.
- **Dam safety** – South Africa's dam safety record compares favourably with that of developed countries. In the last 25 years not a single Category II or III (high risk) dam for which there had been a licence to construct has failed in South Africa. The WRC has worked closely with the South African National Committee on Large Dams (SANCOLD) to continuously update and improve on guideline documents related to dam safety. Latest outcomes from this cooperation include the guidelines for the determination of freeboard for dams, a review of the SANCOLD guidelines on dam safety in relation to floods, as well as the development of new methods to link the empirical frequency of flood volume exceeding flood peak magnitude.
- **Optimising the transport of water** – The geographically mismatch of the water demand centres and available water resources in South Africa necessitates the transport of water over long distances and high elevation differences. High energy costs and the increasing demand require that the water transfer infrastructure should function optimally. The aims of this study were, among others, to quantify the factors that influence the friction loss in pipelines; establish the relationship between water quality, operating conditions and the hydraulic performance of different liner systems and pipe materials; and develop selection criteria for liner systems and pipe material.
- **Climate change and dam yield** – Most of South Africa's catchments are controlled, either directly or indirectly, by dams. The supply capability of these dams is mostly assessed by means of yield analysis. Yield analysis methodology has been adapted to account for the possible relative changes in reservoir yield under various climate change outcomes. The new methodology was applied to three South African reservoirs, i.e. the Berg River Dam, Midmar Dam in the Mgeni River and Grootdraai Dam in the upper Vaal River in order to test the methodology in climatically diverse areas with expected varying climate change impacts.
- **Steeling pipelines against corrosion –** Steel bulk water pipes are used extensively in South Africa and need to be protected against corrosion, hence the need for internal linings and external coatings. In pressure pipes there are many problems associated with the use of grouted-viscous-elastic linings at joints, bends and fittings. A current WRC study aims, through laboratory trials and investigations, to provide solutions to this unresolved problem experienced by water suppliers, which costs them large sums of money due to failures.



Drier winters could be end for Cape fynbos, UCT researcher warns

Geological evidence from as far as as 1 800 years ago indicates that as the planet warms due to build-ups of heat-trapping greenhouse gases, winter rainfall in the Cape is likely to become scarcer as well.

This is the conclusion of an international team, which includes Prof Michael Meadows of the Department of Environmental and Geographical Science at the University of Cape Town, after studying West Coast sediment cores and ice-core data from Antarctica.

Meadows added that drier conditions and the increased risk of fires could put fynbos at risk of extinction as a result of the projected climate change.

The team obtained sediment cores from Verlorenvlei, an elongated former estuary at Eland's Bay along the West Coast, and used evidence contained in them to reconstruct the history of lake level fluctuations over the past 1 800 years that, in turn, illustrate past rainfall regimes in the region. Their work – funded by the National Science Foundation in the US – has been published in the journal, *Climate of the Past*.

What they found supports an unsettling conclusion that sophisticated climate models have been suggesting for the future of the Cape. As the planet warms, winter rainfall is to become scarcer, primarily because of shifts in the meandering belt of westerly winds that circles Antarctica and brings rainstorms to the region in the winter months.

According to Prof Meadows, the unique, diverse fynbos flora of the Cape could be severely affected. "These plants are tough, as they are already used to dry conditions. But further aridity could make fires more frequent, which could damage the soils and make it even harder for the native plants to survive here. Unfortunately, this is their only native habitat, so such a change might eventually threaten their very existence."

The team's research shows that rainfall increased dramatically at Verlorenvlei during a natural cool period observed globally and known as the Little Age Ice – roughly 700 to 200 years ago. This association of higher rainfall with cooling is consistent with an anticipated link between future temperatures and the position of the westerlies, in which models suggest that global warming can have the opposite effect on local rainfall and essentially drive it away from the African mainland.

"A poleward retreat of the austral westerlies would have serious societal and ecological consequences for the winter rainfall region of South Africa," noted American researcher and lead author of the paper, Curt Stager. "The same also appears to be true for the semi-arid winter rainfall regions of South America and Australia-New Zealand."

Source: University of Cape Town

WRC Research Manager appointed President of Young Water Professionals

The Water Institute of Southern Africa-International Water Association Young Water Professionals (YWP) have a new President.

Water Research Commission Research Manager, Dr Inga Jacobs, was elected President of the YWP, which is now entering its fourth year in South Africa. The organisation features more than 800 members, with provincial chapters in the Western Cape, KwaZulu-Natal, Gauteng as well as in Zimbabwe and Mozambique. Plans are underway to launch the Mpumalanga and Free State chapters this year.

It is widely recognised that capacity building and sustainable knowledge transfer are critical concerns for several sectors in South Africa, including the water sector. The loss of intellectual assets is a major threat to effective water management. The repercussions for the sector include high staff turnover and loss of skills and institutional memory.

Young water professionals are faced with the three-fold challenge of developing their skills; finding mentors to help them to do so; as well as grappling with the added responsibility of re-learning knowledge that could have been retained through sustainable knowledge transfer policies and programmes.Being part of a formal organisation, such as the YWP, could relieve many of these challenges.

Talking about the benefits of the YWP to young water professionals, Dr Jacobs said: "Young people have found the programme immensely supportive in career development, networking, and technical skills training. More importantly, it provides a supportive network of individuals who are going through the same challenges young people face when developing their careers. This might include coping as a female professional in a male-dominated sector, or finding a mentor. Even young professionals in other sectors have joined as this kind of support is not available to them in their respective sectors."

The support for the YWP can be seen in its impressive conference attendance record – 300 participants attended the First Young Water Professionals regional conference held in 2009, with a further 440 delegates attending last year's conference. A number of former YWPs now hold leadership positions within parent bodies, WISA and the IWA.

"Given this incredible track record, it is my hope that we move from a period of establishment and growth to a period of consolidation of the programme through partnerships," Dr Jacobs tells *the Water Wheel*. The YWP is already working with the Department of Water Affairs to provide support to the Africa Youth Summit, taking place in July. "We will host several workshops and activities to share survival tips by young professionals on what to expect from a career in the water sector and to highlight the numerous opportunities," adds Dr Jacobs.

For more information about the YWP, Visit: http://www.sa-ywp.org.za

New leader for Stellenbosch centre investigating invasive species

Prof Dave Richardson has taken up the reigns as head of the Department of Science & Technology/ National Research Foundation Centre of Excellence for Invasion Biology (CIB) at Stellenbosch University.

This follows the resignation of founding Director, Prof Steven Crown, who is to pursue his academic career further in Australia.

"The Centre has been extremely lucky to have had two A-rated researchers working side by side for the past few years, and this has helped us to make an internal appointment of extremely high calibre," noted Prof Eugene Cloete, Dean of the Faculty of Science and a member of the CIB Board.

Prof Richardson has been the CIB's Deputy Director: Science Strategy since 2005 and has, along with Prof Crown, played a leading role in establishing the Centre's reputation as an internationally recognised and most prolific research entity. The Centre also aims to deliver the science and research required to reduce the introduction rate and impact of invasive species.

Prof Richardson, a prolific author and invasive tree specialist, will receive the Herschel Medal from the Royal Society of South Africa in September, which honours his multidisciplinary contribution to science through his internationally recognised work on the ecology and management of invasive species.

Although plants are his primary focus, he has also recently helped to develop risk-assessment protocols for introduced reptiles and amphibians. He also publishes, lectures and consults widely on issues such as invasive species in commercial forestry and agroforestry, the risks associated with using introduced plants in the production of biofuels, and managed relocation.

No water restrictions in KZN for now, says Water Affairs

Water restrictions have been averted in the Kwazulu-Natal coastal metropolitan thanks to a good summer rainfall season, reports the Department of Water Affairs (DWA).

A System Operation Committee, established to monitor the need for water restrictions in the area, concluded that the very short-term water supply situation is not at risk at present, but that it will have to be monitored carefully as even a moderate drought may require water restrictions to manage this very stressed system until augmentation plans are implemented.

At its fourth meeting held earlier this year, the Strategy Steering Committee (SSC) for the Implementation and Maintenance of the Reconciliation Strategy for the KwaZulu-Natal Coastal Metropolitan Area Water Supply System, reviewed and discussed the progress on the interventions recommended in the Strategy to ensure enough water for the area.

Water conservation and water demand management (WC/WDM) has been identified as the first line of defence to deal with water shortages in the area. The current WC/WDM initiatives of the eThekwini, iLembe, Ugu and Msunduzi municipalities have already resulted in a significant saving of water in the KwaZulu-Natal coastal metropolitan area.

"WC/WDM, however, is only effective if it is maintained. Municipalities reported concern about funding available for water demand management initiatives. It was also highlighted that the implementation of WC/WDM measures is to a large degree dependent on a concerted team effort from all parties involved and especially the communities supported by the relevant city councils. Target savings in water losses can only be achieved through buy-in and support from all stakeholders," the department said in a statement.

The building of the Spring Grove Dam, although subject to day-to-day operational challenges, is progressing well and scheduled to deliver its first water by April 2013. Likewise, investigations by Umgeni Water on the planned Lower Thukela Bulk Water Supply scheme to bring additional water from the Thukela River to the North Coast Area is well advanced and on track.

It was also reported at the meeting that recent technical issues related to the raising of Hazelmere Dam have come to light that could influence it as a water supply option. Since the development of the initial Reconciliation Strategy, the dam design team has identified geotechnical issues related to the stability of the raised Hazelmere Dam. This has resulted in an increase in the capital cost to raise the dam wall and an increase in the construction time. This makes the raising of Hazelmere Dam economically less attractive and brings it closer to the more costly schemes, like increasing the capacity of the Lower Thukela Bulk Water Supply Scheme, the re-use of water and desalination of sea water. A process is underway to assess the situation, and depending on the outcome this may impact on the viability of the dam raising option. Developments with regard to this will be reported upon as soon as there is more clarity on the situation.

SANCID 2012 Symposium

South African National Committee on Irrigation and Drainage

SANCID

GENERAL INFORMATION

Date 20-23 November 2012

Theme: IRRIGATION IN A CHANGING ENVIRONMENT

PROGRAMME AND KEYNOTE SPEAKERS

Local and international experts will be presenting their work on critical irrigation and drainage issues under the following sub-themes:

Sub-theme 1	Humans at the forefront of watershed management
Sub-theme 2	Climate change and irrigation: Adaptation and resilience
Sub-theme 3	Impact of irrigation on natural resources and ecology and impact of the natural environment on irrigation
Sub-theme 4	Design and management responses to economic challenges
Special Session	Coping with change: Farmers' perspectives

THE VENUE

The beautiful Alpine Heath Resort is tucked away in the majestic Northern Drakensberg, KwaZulu-Natal. A first class conference venue and luxury accommodation in a relaxing setting will provide the ideal platform to share knowledge, discuss ideas and network.

TECHNICAL TOUR

We will be visiting the Drakensberg Pumped Storage Scheme, a joint venture between Eskom and the Department of Water Affairs which transfers water from the Thukela River to the Sterkfontein Dam. Four reversible turbines situated 156 meters below ground level generate 1000 MW of electricity for the Eskom grid. Delegates will also learn about the functioning of different Eskom power stations.

ABSTRACT SUBMISSION

Submit your 600 word abstracts to SANCID@ufs.ac.za by 31 July 2012.

REGISTRATION FEES

Full registration
Early-bird registration fee R 5 500-00 (before 31 July 2012)
Late registration fee R 6 500-00 (before 1 November 2012)

For further information regarding the **Symposium programme** contact **Michael van der Laan**
(Chairman of the Organising Committee)
E-mail: michael.vanderlaan@sugar.org.za Tel: 076 793 3597

For any additional information regarding **Symposium arrangements (registration and accommodation)** please contact **Lalique Smit** Tel: (051) 436 8145, Fax: (051) 086 275 2869
or E-mail: congress@internext.co.za

Financial support for Cradle research

The Cradle of Humankind World Heritage Site Trust has disbursed its first set of funds for scientific research projects.

A total of R77 803 has been awarded to three researchers conducting research in the Cradle of Humankind World Heritage Site. One of the researchers benefiting from funds is Simone van Tonder, who was awarded R27 803 to conduct further research into the various amphipod species that are found in the Cradle. A student at the University of Johannesburg, Van Tonder proposes to look at cave and groundwater ecology focusing on the distribution and ecological needs of two different types of amphipods or crustaceans that live in the Cradle.

In turn, Michiel Olivier de Kock and Prof Jan Kramers were awarded R50 000 to conduct research into uranium-thorium-heloim geochronology and palaeomagnetic studies in selected fossil-bearing cave sites in the Cradle. Their research will look at major changes in the earth's systems over time and economically important mineral deposits in the fossil-bearing caves in the site.

"The work of these researchers is incredibly valuable, and is adding to our understanding of the fossil bearing caves in Gauteng's only World Heritage Site," commented Cradle of Humankind CEO, Dawn Robertson.

eThekwini turns tough on illegal service users

The eThekwini Municipality is taking a tough stance against residents who continue to use water services illegally.

More than R1,2-million has been recovered to date, with four residents recently being convicted in the Durban, Chatsworth and Umlazi magistrates courts as well as the Durban municipal court for using water and electricity illegally. One of the convictions involved a Kenville resident who owed the municipality over R26 000 for water, electricity and rates. The resident pleaded guilty and, in addition to being fined R500, was ordered to pay all the money due to the municipality.

According to eThekwini Water and Sanitation Head, Neil Macleod, consumers are encouraged to come forward and rectify matters if they are illegally connected to water, before the municipality catches them out. At the time of writing there were 12 cases in different courts across the municipality involving the illegal use of water. Eight cases were on the court roll and four warrants of arrest had been issued in cases where people failed to appear in court.

Some residents of eThekwini continue intentionally to connect water illegally, disregarding the legal implications they could face. Water leaks and illegal water connections are currently costing the municipality around R100-million a year.

Mining applications not true to sustainable development, says NGO

BirdLife South Africa has expressed its increasing concern of what it deems the 'unsustainable use of our country's natural resources'.

In a statement, the organisation notes that, while the increase in mining applications in certain parts of the country may be good news for some sectors of the South African economy, it is questioning the government's commitment to sustainable development as expressed through international obligations. "With South Africa's biodiversity, and ultimately the people of South Africa's future at stake, we need to put pressure on government to ensure that the negotiating position presented by the South African delegation at the Rio+20 meeting is not a façade," the organisation said. "We cannot pretend to be concerned about the environment, and profess to be attending to our environmental commitments on one hand, but on the other allow the destruction and degradation of our natural resources."

BirdLife appealed to government to start giving true meaning to the notion of 'sustainable development' by giving equal recognition to food production, water security, and the conservation of our cultural and natural heritage, especially when assessing development applications, more specifically, mining applications.

"The organisation notes with grave concern the increase in mining applications in the Mpumalanga and Limpopo provinces, and more specifically the earmarking by government of the Waterberg and Soutpansberg regions for mining. These provinces and regions remain critically important from biodiversity, water and food security perspectives, and they also support a variety of threatened and endemic bird species and a number of important bird areas."

Source: BirdLife Africa

Water by numbers

23 000 – The estimated number of registered engineers in South Africa, according to the Presidential Infrastructure Coordinating Commission. Of these, around 5 500 are working in the public sector, including State-owned companies, such as Transnet and Eskom.

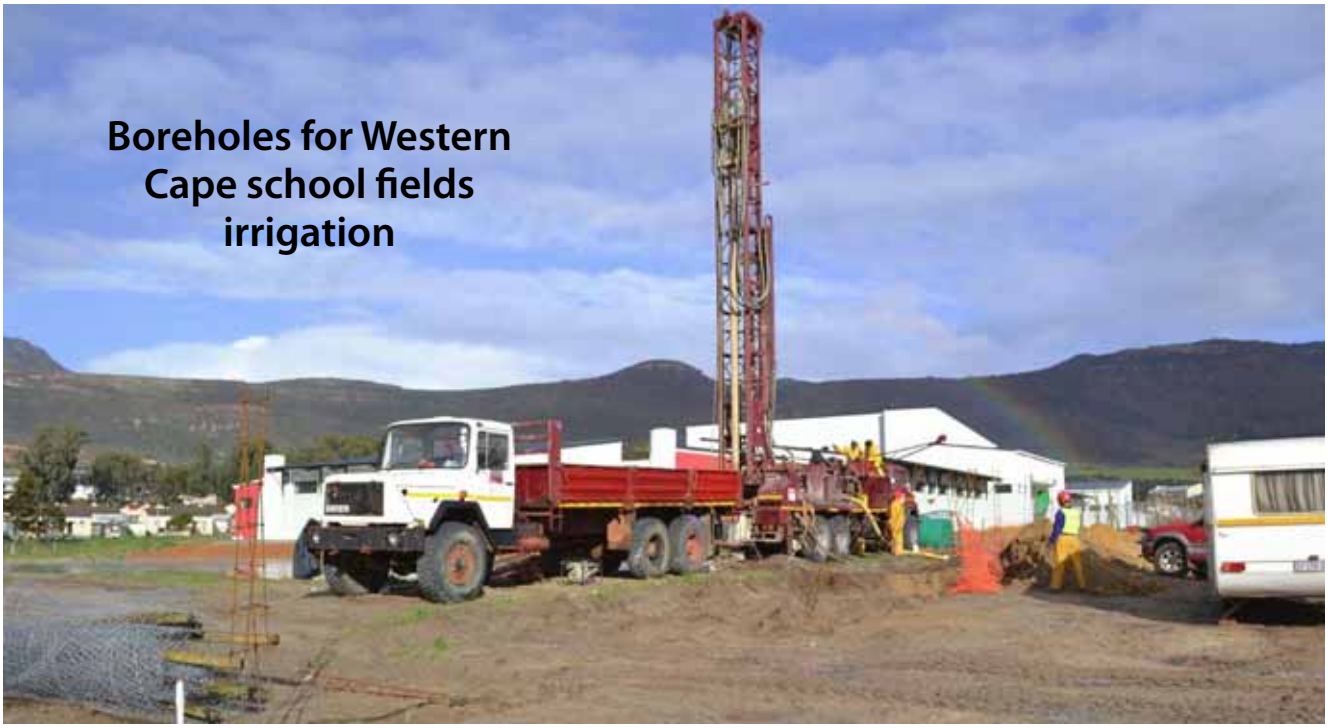
9 – The total number of catchment management agencies that will now be established in South Africa, down from 19. According to the Department of Water Affairs (DWA), the water management area boundaries still needed to be formally amended through the second edition of the National Water Resources Strategy.

R150 000 – The estimated amount spent on replacing stolen toilet flush handles and taps each year by Helen Joseph Hospital in Gauteng, News24 reports.

4 – The number of years that the City of Cape Town has received Blue Drop awards for its water treatment plants – as long as the DWA incentive scheme has been running. The City scored an average 98,14% for its water treatment plants during the last round of assessments, made public in May.

800 – The maximum number of unemployed school leavers and graduates which will be placed in 'biodiversity jobs' by the South African National Biodiversity Institute (SANBI) after the Institute's project to catalyse access to employment and job creation in ecosystem management received funding of R300-million from the Development Bank of Southern Africa.

94,7% – The percentage of South Africa's population that have access to at least basic water supply. Another 710 000 households still need to be served, according to Water & Environmental Affairs Minister, Edna Molewa, who said that the inadequate maintenance of infrastructure – especially at municipal level – remains DWA's biggest challenge.



Boreholes for Western Cape school fields irrigation

As part of efforts by the Department of Transport and Public Works in the Western Cape to reduce the amount of water abstracted from rivers and dams, groundwater resources are being investigated as a means of irrigating sports field and other open spaces at newly built schools in the province.

Consulting engineers and scientists, SRK Consulting, has carried out feasibility studies for 15 new schools in the region to establish whether enough groundwater is available for this purpose. According to Leon Groenewald, principal hydrogeologist at SRK, the firm has carried out feasibility studies for 15 new schools in the region to establish whether enough groundwater is available for this purpose. "Once this is done, we will be in a position to make recommendations about how much water can be sustainably abstracted."

According to Groenewald, eight out of the nine boreholes drilled at the time of writing had sufficient water for irrigation; the sustainable yields of the boreholes range from about 0,83 ℓ/s to about 8,3 ℓ/s. While the initial costs of developing the infrastructure to abstract groundwater is fairly high, about R180 000 to drill each borehole – test the water and install the pump – this is cheaper in the long run than tapping into municipal water for irrigating large areas.

To ensure the highest chance of striking groundwater, it is vital that the investigation includes a hydro census and detailed geophysical survey before drilling begins," said Groenewald. "It is essential that the person interpreting the data from the investigation has experience in these kinds of projects, so that we avoid drilling dry boreholes."

The groundwater investigation is completed in the early stages of the contract so that the yield of the borehole can be assessed, in order to determine the water requirements of the playing fields which if higher than the actual supply, causes a problem. "This problem can be overcome by installing a number of storage tanks," noted Groenewald. "The tanks are filled during the night and drained during the day by the irrigation system, which allows the quantity of water extracted per day to be measured at no more than 20 000 ℓ."

Apart from alleviating the pressure on dams to supply water to these schools, the schools' green areas provide a calming atmosphere and restful surroundings for the learners to relax and talk to one another and to play games. It also improves the aesthetic look of the surrounding suburbs which are often characterised by dull, sandy scenery and helps prevent wind erosion.

Young guns select earth sciences consultancy for top professional training

Specialist earth sciences consultancy, Umvoto Africa, has been selected as the best company in South Africa in southern Africa for your water professionals to develop their skills.

The company, which has around 20 full-time staff as well as four interns, competed successfully against much larger organisations to receive this prestigious award from the Water Institute of Southern Africa (WISA). The 2012 South African Young Water Professionals Development Award was announced at the WISA biennial conference in Cape Town earlier this year.

Among the initiatives that contributed to the award were Umvoto's intern programme, initiated in 2002 to offer practical work experience and academic and professional training to students. To date, 52 interns from Africa and abroad have worked at Umvoto for periods ranging from a few weeks to up to six months.

"Umvoto believes that technical knowledge alone is not enough to guarantee a professional contribution in a chosen field," reports MD Rowena Hay, who founded the consultancy 20 years ago. "Most school leavers and graduates

are not adequately skilled, technically or socially, to enter the workplace and make a positive contribution to the organisation and society. Umvoto's experience has shown that the importance of business and project management skills, together with ethics, personal and project financial management, are fundamental for scientists if they are to contribute meaningfully and effectively at the science-society interface."

In the photograph, young water management engineer Len von Scherenberg shows off the professional development award from WISA.

Consultants body opposes call for State-owned construction company

Consulting Engineers South Africa (CESA) has expressed its opposition to the call by Minister Tokyo Sexwale to create a State-owned construction company.

Speaking on behalf of their 470 member firms, CESA President, Naren Bhojaram, stated that the State should not set up structures in competition with the private sector. "They should be creating a platform and a conducive environment for the private sector to excel."

He contended that this is what will grow the economy and create jobs. "We already have too much political interference in public tenders, whether direct or indirect."

CESA also strongly disagrees with President Jacob Zuma's statements in a recently parliamentary debate where he lends support to politicians being involved in private companies. According to CESA, it finds this practice fundamentally compromising and lacking in transparency.

Bhojaram believes that the State should focus on its priorities, including the following for the built environment sector: ensuring that experienced technical staff is brought back into government to manage infrastructure projects; sorting out corruption; sorting out the procurement process in the built environment sector generally, but specifically for professional service providers, by recognising quality or functionality as essential; and inviting the private sector to come up with innovative ideas for infrastructure development by recognising and streamlining the unsolicited bid and public-private partnership process.

Source: CESA

KZN wastewater works boasts improved hydraulic efficiency

SSI Engineers and Environmental Consultants have completed a contract for the eThekwini Water and Sanitation Department to optimise the hydraulic efficiency of the Amanzimtoti Wastewater Treatment Works (WWTW).

The project was initiated in the wake of several large new commercial developments in the catchment area. In addition to accommodating the increased flow, a major benefit is a significant improvement of the quality of the effluent discharged into the eZimbokodweni River, particularly during peak wet weather conditions.

Modifications to the plant presented an opportunity to include a pilot project to determine the viability of enhanced methane generation based on the co-digestion of high strength toxic waste with sewage sludge. This involved the replacement and upgrading of various electrical panels and control equipment and for the construction of the necessary plant and equipment to accommodate the pilot project.

The pilot study is a collaborative venture undertaken by the municipality and the Pollution Research Group from the Chemical Engineering Department of KwaZulu-Natal with funding from the Water Research Commission.

SSI's Gordon Druce, who managed the design, tender and construction stages of the project, explained that the existing plant was not operating at its hydraulic capacity primarily due to design limitations and the configuration of various sections of the plant, which restricted the overall process capability of the plant.

"The improvements that were implemented enhanced the hydraulic efficiency through the works with improved flow division and settling capacity. Similarly, the activated sludge treatment process has been enhanced through the elimination of short-circuiting and the improvement in the uniform distribution of flow into the parallel lanes of the aeration tanks," noted Druce.

The project involved the construction of an additional inlet channel at the head of the works, extensions to various flow division structures, new inlet launders to the existing aeration tanks and the augmentation and upgrading of some existing pipework and new interconnecting pipework on both the east and west plants. In addition, new structures on the east plant include a primary settlement tank, a mixed liquor flow division chamber and two secondary clarifiers.

Construction work took place within the confines of an operating treatment works, presenting the consulting firm and the contractor, Icon Construction, with the complexities of having to design and construct new structures and interconnecting pipework in and around existing infrastructure and services, while minimising the impact on the routine operation of the works. Pre-planned short duration shut downs of various components took place to facilitate tie-ins and connections.

"The contractor had to plan and execute cut-ins into the existing system and ensure that spillages were avoided or limited to amounts that are manageable through temporary containment on site, thus preventing any possible environmental infringements," said Druce. "Also challenging was the fact that, with new construction work required in and around existing services, many old and relatively fragile asbestos cement pipes needed to be exposed by hand to prove their positions and levels and, in many instances, supported and protected during excavation."

Most detailed maps yet of Africa's groundwater

A scattergun approach to borehole drilling in Africa is likely to be unsuccessful.

This is the message from a group of UK researchers who have, for the first time, quantified the amount, and potential yield, of groundwater across the whole of Africa.

They estimate the total volume of groundwater to be around 0,66 million km^3 – more than 100 times the available surface freshwater on the continent – and hope that the assessment can inform plans to improve access to water in Africa, where 300 million people do not have access to safe drinking water.

The results have been published in the 20 April edition of the journal, *Environmental Research Letters.*

The researchers, from the British Geological Survey and University College London, warn that high-yielding boreholes will not be found using a scattergun approach and a more careful and exploratory approach that takes into account local groundwater conditions will be needed, which they hope their new study will encourage.

Their results show that in many populated areas in Africa there is sufficient groundwater to supply hand pumps that communities can use for drinking water. These hand pumps can deliver around 0,1 to 0,3 litres per second. Opportunities for boreholes yielding 5 ℓ/s or more are not widespread and limited to specific areas, such as countries in the north of Africa.

Central to the researchers' methods was the collation of existing national hydrogeological maps as well as 283 aquifer studies from 152 publications. The vast amount of data was compiled into a single database in which the researchers were able to make their calculations.

The amount of groundwater present in a certain region is reliant on the interplay between the geology of the area, the amount of weathering and the amount of rainfall experienced both in the past and the present. All of these factors were considered to estimate the volume and potential yield of groundwater in each aquifer.

As a result of population growth in Africa and a planned increase in irrigation to meet food demands, water use is set to increase markedly over the next few decades. Climate change will pose a huge threat to this increase; however, groundwater responds much more slowly to increasing climatic variability as opposed to surface water, so will act as a buffer to climate change.

The lead author of the study, Dr Alan MacDonald said: "Groundwater is such an important water resource in Africa, and underpins much of the drinking water supply. Appropriately sited and developed boreholes for low-yielding rural water supply and hand pumps are likely to be successful and resilient to climate change. However, high-yielding boreholes should not be developed without a thorough understanding of the local groundwater conditions."

Geophysicists develop new method to identify 'sea level fingerprints'

Researchers from the University of Toronto, Harvard and Rutgers universities have reportedly found a way to identify the 'sea level fingerprint' left by a particular sheet of ice – and possibly enable a more precise estimate of its impact on global sea levels.

As the Earth's climate warms, a melting ice sheet produces a distinct and highly non-uniform pattern of sea-level change, with sea level falling close to the melting ice sheet and rising progressively farther away. The pattern for each ice sheet is unique and is known as its sea level fingerprint.

"Our findings provide a new method to distinguish sea-level fingerprints in historical seal levels, from other processes such as ocean waves, tides, changes in ocean circulation and thermal expansion of the ocean," said Carling Hay, a PhD candidate in the Department of Physics at U&T and lead author of a study published in the *Proceedings of the National Academy of Sciences*. "It may indeed allow us to estimate the contributions of individual ice sheets to rising global sea levels."

Scientists around the world are trying to estimate both the current rate of sea level rise and the rates of ice sheet melting, and yet little work has been done to combine the two problems and answer these questions simultaneously.

Hay and colleagues, Jerry Mitrovica and Eric Morrow of Hansard University and Robert E Kopp of Rutgers University, sought out statistical techniques that had not previously been applied to this problem, and began developing the new method using data analysis techniques common in other fields such as engineering science, economic and meteorology. The researchers then tested and refined the method by applying it to synthetic data sets – i.e. data sets with the same amount of noise as real data, but with known melting signals. The tests provide important guidance for the application of the method to actual sea-level records.

"We are now applying our methodology to historical sea level records to provide a new estimate of total sea level rise and the melt rates of the Greenland and West Antarctic ice sheets, over the 20th century," said Hay. "Preliminary results show intriguing evidence for acceleration of globally averaged sea level rise in the second half of the period, along with simultaneous rise in temperature. Once our study of historical records is complete, the next step will be to incorporate satellite-based measurements of sea-level changes."

Source: University of Toronto

Common fungicide wreaks havoc on freshwater ecosystems – study

Chlorothalonil, one of the world's most common fungicides used pervasively on food crops and golf courses, is lethal to a wide variety of freshwater organisms, according to researchers from the University of South Florida.

Biologists Taegan McMahon and Jason Rohr, co-authors of the study published in the journal *Ecology Letters,* report that chlorothalonil killed amphibians, snails, zooplankton, algae, and aquatic plants below estimated environmental concentrations previously deemed safe by the US Environmental Protection Agency. The loss of these herbivores and plants freed the algae from predation and competition, which eventually resulted in algal blooms that were similar to the effects of eutrophication.

"Some species were able to recover from the chemical assault, but the ecosystem was fundamentally changed after its exposure to chlorothalonil," Rohr said. The four-week study was conducted in a series of 300-gallon tanks used to mimic pond conditions.

It follows a 2011 laboratory study conducted by McMahon and Rohr that found that ecologically-relevant concentrations of chlorothalonil killed four species of amphibians.

"Although our new study is the only reported community- and ecosystem-level experiment on chlorothalonil, our results are consistent with several direct toxicity studies conducted in the laboratory and with observations in the field," McMahon said. Chlorothalonil kills molds and fungus by disrupting cellular respiration, an essential process for most multicellular organisms on the planet. Like the infamous DDT, chlorothalonil is a member of the organochlorine chemical family. Fifty years after the ban on most forms of the pesticide DDT, chlorothalonil is one of a few organochlorine pesticides still registered for use in the US, Europe and Australia.

In addition to reducing biodiversity and altering ecosystem functions, chlorothalonil reduced the decomposition of waste, an important service that freshwater ecosystems provide to humans, McMahon added. "Interest in the relationship between biodiversity and ecosystem functions stems at least partly from the concern that anthropogenically-driven declines in biodiversity will reduce or alter the benefits offered by ecosystems," Rohr said. "Surprisingly, however, this is one of the first studies to actually manipulate an anthropogenic factor and link it to changes in ecosystem functions mediated by declines in biodiversity. This is important because many species in ecosystems might contribute little to ecosystem functions or are functionally redundant with other species, and thus declines in biodiversity do not always affect the functions and services of ecosystems."

New study chronicles the rise of agriculture in Europe

An analysis of 5 000-year-old DNA taken from the Stone Age remains of four humans excavated in Sweden is helping researchers understand how agriculture spread throughout Europe long ago.

According to Pontus Skoglund and colleagues from Uppsala University in Sweden, the practice of farming appears to have moved with migrants from southern to northern Europe.

Agricultural know-how was not the only thing that early European farmers introduced to the region. Based on their genetic data, Skoglund and the researchers say that Europe's first farmers eventually mixed their genes with the hunter-gatherers who lived there – a relationship that set the stage for today's modern European genome.

"We analysed genetic data from two different cultures – one of hunter-gatherers and one of farmers – that existed around the same time, less than 400 km away from other," Skoglund explained. "After comparing our data to modern human populations in Europe, we found that the Stone Age hunter-gatherers were outside the genetic variation of modern populations but most similar to Finnish individuals, and that the farmer we analysed closely matched Mediterranean populations."

These findings likely have something to do with the expansion of farming across Europe, according to the researchers. "When you put these findings in archaeological context, a picture begins to emerge of Stone Age farmers migrating from south to north across Europe," noted Skoglund. "And the result of this migration, 5 000 years later, looks like a mixture of these two groups in the modern population."

Most experts agree that the agricultural way of life originated about 11 000 years ago in the Near East before it reached the European continent some 5 000 years later. But this new study helps scientists understand the impact of that agricultural revolution on human diversity. "The results suggest that agriculture spread across Europe in concern with a migration of people," said Skoglund. "If farming had spread solely as a cultural process, we could not expect to see a farmer in the north with such genetic affinity to southern populations."

The researchers suggest that Europe's early, intrepid farmers travelled north across the continent, settled in the northern regions and eventually mixed with resident hunter-gatherer populations. Consequently, the genomes of most modern Europeans were likely shaped by this prehistoric migration that first brought farming to the continent, they conclude.

Researchers map fish species at risk from dams

Dams are believed to be one of the biggest threats to freshwater organisms worldwide: they disrupt normal patterns of water and sediment flow, impede migration, and alter the character of spawning and feeding grounds.

A shortage of data has until now prevented a thorough global assessment of the threat dams pose to fish species, however, a study described in the June issue of the journal, *BioScience*, attempts just that.

The report by Catherine Reidy Liermann of Umeå University, Sweden, and three co-authors, analysed 397 ecologically distinct freshwater regions around the world and plotted the occurrence of dams greater than 15 m high. This approach enabled the researchers to assess the amount of obstruction the dams caused.

The authors then examined location data for fish species believed to be at risk of extinction because they are restricted to a specific region or because they have to migrate up rivers as part of their lifecycle. This allowed the researchers to identify regions where dams pose the biggest risk to fish species. Factoring in where there has been additional habitat alteration – a known risk for many fishes – allowed the authors to further refine their list of the danger zones.

The results pointed to the Murray-Darling province in Australia, southern Italy, the Lower and Middle Indus basin, West Korea, the Upper Paranà (southern Brazil), the South Atlantic coast of the United States, and Mobile Bay ecoregions as having notable numbers of fish species at risk and heavy dam construction. Much of the Danube, Iberia and the Southern Temperate Highveld in South Africa are also on the list. These 18 ecoregions, according to the co-authors, "merit immediate conservation attention." Eels, shads, lampreys, sturgeons and salmonids stand out as being especially vulnerable.

The authors explain that their findings will help researchers and planners in identifying important regions where conservation is feasible because the watercourses are relatively unobstructed and are home to at-risk species. The results also flag regions where restoration – possibly even including dam removal – is desirable if fishes are to be conserved.

New from the WRC

Report No: 1561/1/11

Persistent organic pollutants (POPS) in the water environment (C Roos; R Pieters; B Genthe & H Bouwman)

Currently, South Africa's available freshwater resources are nearly fully utilised and under severe stress. The quantity and quality of available water will increasingly become a limiting resource, and supply will become a major factor restricting the country's future socio-economic development. The Stockholm Convention on Persistent Organic Pollutants (SC POPs), of which South Africa is a party, carries a number of obligations and expectations. Based on the obligation to develop a National Implementation Plan, the State is obliged to reduce or terminate all sources of POPs within the SC provisions. This therefore implies that a state should know the environmental levels of these POPs whereby priority sources and hotspots can be targeted for interventions. This study, therefore, focused on a group of highly persistent, toxic pollutants which is ubiquitous in terrestrial and aquatic environments all over the world. Here, the research team characterised the scale and significance of certain organic pollutants, especially persistent organic pollutants in selected water bodies of South Africa, specifically targeting sediments as matrix, which are the main reservoirs of these pollutants in aquatic environments.

Report No: TT 507/11

Guidelines on water services infrastructure risks management (U Jack; P de Souza & G Mackintosh)

Recent national studies have highlighted that the operation and maintenance of water services-related infrastructure is in many cases not ideal with, for example, 65% of water services authorities (WSAs) performing maintenance on a crisis management basis (i.e. no scheduled maintenance). Infrastructure asset management has been identified as an effective means

of enabling such water services institutions to efficiently monitor and manage their systems within the constraints of limited resources. In particular, water services-related infrastructure needs to be managed within an integrated social, economic and environmental context. This guideline document has been developed to assist water services institutions to conduct vulnerability and risk assessments with the purpose to identify, prioritise and manage vulnerabilities and risks associated with their water services infrastructure.

Report No: KV 277/11

A guide to complexity theory and systems thinking for integrated water resources research and management (S Pollard; D du Toit & H Biggs)

The objective of this project was to explore progress in and barriers to the internalisation of complexity in integrated water resources management, and to do this through a scoping synthesis of early lessons. In essence then the report seeks to provide a guide to complexity for integrated water resources management and research endeavours based on the issues identified from interviews with key stakeholders. In these interviews with academics and practitioners, a number of issues were raised regarding the internalisation of complexity and we hope that these have been addressed.

Report No: 1845/1/11

A comparison of the cost associated with pollution prevention measures to that required to treat polluted water resources (SHH Oelofse; S Roux; W de Lange; BK Mahumani; W le Roux; M du Preez; HA Greben & M Steyn)

Pollution of water resources is largely as a result of human activity and therefore could be prevented to a large degree. The quality of our water resources is deteriorating and downstream water users have to deal with the pollution impacts caused by upstream uses. This situation has resulted in a debate as to whether it will not make more economic sense for water users to treat water for use rather than to meet discharge standards. The hypothesis that pollution prevention is preferable as compared to a pollution clean-up regime, but also that unnecessarily strict regulation will have negative consequences for the economy, was tested. It was therefore necessary to determine the cost of pollution prevention as well as the cost of pollution to downstream users. Four prominent water pollution issues, namely salinisation, nutrient enrichment, microbial degradation and sediment migration, were identified as the focus of this research.

Report No: 1313/3/11

Development of chronic toxicity test methods for selected indigenous riverine macroinvertebrates (WJ Muller; AR Slaughter; N Ketse; HD Davies-Coleman; E de Kock & CG Palmer)

Toxicity tests are accepted worldwide as suitable for managing environmental water quality within water resources management and in South Africa this trend has been followed. Water quality guidelines are most often derived from acute toxicity test results, and from using results derived from a range of species from different trophic levels in freshwater ecosystems. There are concerns that most ecotoxicological tests are too simplistic to reflect real-life dose-response relationships, since most ecotoxicological tests have evolved more from the field of toxicology than ecology. The aims of this project were to, among others, develop chronic toxicity test methods for indigenous riverine invertebrates using non-lethal experimental and end-point assessment criteria; use the newly-developed toxicity test methods for indigenous invertebrates to evaluate the current method of determining water quality criteria for the ecological Reserve; assess effluent standards by testing the new toxicity test method; and undertake a scoping study of the use of stress proteins and morphometric analyses.

Report No: KV 293/11

An overview of surface water quality in the Olifants River catchment (PJ Ashton; JM Dabrowski)

The Olifants River is one of South Africa's major river systems and is an important tributary to the Limpopo River. It is also recognised as one of the hardest working rivers in South Africa. The need for this study arose during discussions between the WRC and the CSIR. It was clear that while a lot of information was available on water quality issues across the Olifants River catchment, much of this information was contained in a variety of confidential project-specific documents, consultancy reports, theses and papers. This study collated and evaluated all available water quality data as a basis for an overview of water quality across the entire Olifants River catchment, and has also identified many of the likely sources of poor water quality. This will enable water resource decision-makers in central, provincial, and local government, industry and agriculture to define those areas that require priority attention and urgent remediation.

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Report No: 1738/1/11

Health impact of water, sanitation and hygiene services in relation to home-based care for people living with HIV and AIDS in the Limpopo province (N Potgieter & M du Preez)

The objective to meet the water and sanitation needs of people living with HIV and AIDS underestimates some of the biggest challenges in basic access. The people with the greatest needs often are the most disenfranchised and have the fewest resources available for solving problems in sustainable ways. Limpopo was considered as one of the poorer provinces and presented a worst case scenario with regards to education standards, water provision services and economic development when compared to other provinces. The aims of this project were therefore to investigate home-based care practices with regards to the experiences of care givers looking especially at water, sanitation and hygiene aspects and to perform a health risk assessment of the water used for domestic purposes in households in the caring for those living with HIV/AIDS.

Report No: 1741/1/09

Review of sanitation policy and practice in South Africa from 2001 to 2008 (N Mjoli)

The South African government has prioritised the provision of basic water and sanitation services. Between 2001 and 2008, about 73% of the population had access to basic sanitation services and the basic sanitation backlog was reduced to 27%. This represented significant progress in the eradication of the basic sanitation infrastructure backlog. In spite of all these efforts, there were, however, still millions of households that lacked access to a basic sanitation service level. The main objectives of the study were, among others, to investigate the understanding of current sanitation policy and programmes relating to the subsidy, ownership of infrastructure, responsibility for O&M, responsibility for monitoring issues of new pits etc, among national government departments; local government; service providers; and communities; and to provide recommendations for bridging understanding on policy, responsibilities and practice.

Report No: 1893/1/11

Determining vulnerabilities and risks of water services infrastructure (U Jack; P de Souza & G Mackintosh)

Despite the availability of numerous asset management texts, a general current lack of effective asset management (and associated water service delivery) still exists at many water services institutions (WSIs). A need therefore exists to further support WSIs through the provision of simple, easy to use guidelines and tools which enables WSIs to initiate good asset management practice at their institutions. To address these needs this study was commissioned with the aim of developing guidelines to assist water services institutions to identify and prioritise the vulnerable areas and risks associated with their water services; translating the developed guidelines into software tools; and testing and piloting the developed guidelines and tools, subject to voluntary participation at a number of institutions, among others.

Report No: 1813/1/11

How does the HIV and AIDS epidemic in South Africa impact on water sanitation and hygiene sectors? (E Makaudze; M du Preez & N Potgieter)

The overall aim of this project was to gain a better understanding of the special needs of people living with HIV and AIDS in respect of water, sanitation and hygiene and the impact these needs have on provision of such services. The impact of HIV and AIDS is, however, not confined to family communities only but is rather spread and felt at every fabric of society, including places of work. Hence, part of the study was to highlight broadly the impact of HIV and AIDS at municipal workplaces and gain insights from the responsible authorities how the disease is constraining service delivery with water, sanitation and hyiene sectors.

Report No: 1850/1/11

An assessment of the toxicity of cyanobacteria in the Kruger National Park (MG Masango; RG Matshoga; G Catharina; H Ferreira; & M Sandvick)

It is possible that significant numbers of wild animals succumb to cyanobacterial poisoning every year as no formal data on mortality are recorded. The major problem in diagnosis of cyanobacterial poisoning in wild animals is that carcasses of these animals are usually found decomposed or partially consumed by scavengers and therefore the cause of death can seldom be established. The lack of continuous assessment of the surface waters for cyanobacteria and their toxins in the Kruger National Park is a major challenge. Assessment of the surface water for cyanotoxins occurs only when there are deaths of wild animals in the Park, and sometimes the levels of cyanobacterial toxins of the nearby rivers/dams to which the animals were exposed, may have changed completely by the time of sampling, thus not reflecting the toxin levels that may have caused mortality. The main aim of this project was to generate information on the extent to which cyanobacteria (blue-green algae) and their toxins affect wildlife in the Kruger National Park.

Report No: 2099/P/11

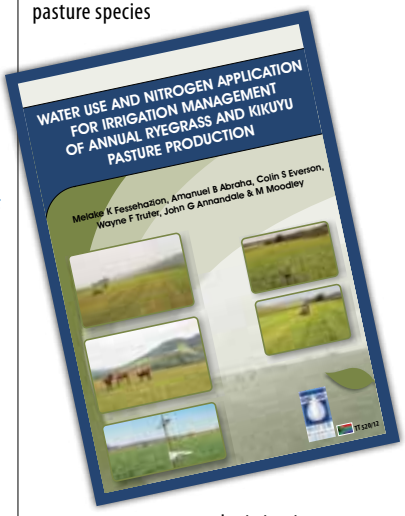
Literature review for the applicability of water footprints in South Africa (E Hastings & G Pegram)

In South Africa and other water-scarce countries, tools which can inform efficiency and raise awareness and create dialogue with people not previously involved in water debates are potentially very useful. Water footprints have the potential to contribute in this way, bringing new and important decision-makers into the water debate in a way that is intuitive and cuts across sectors. Additionally, water footprints create an opportunity for companies to join a global process of disclosure, understand risk and integrate an understanding of water into planning decisions. With this potential, the concept of water footprint has gained significant traction in the past 10 years in the private and public spheres across a variety of sectors. The purpose of this project was to understand how water footprints may contribute to sustainable management of water in South Africa, primarily in the industrial sector, and to explore linkages between water and energy and the concept of water offsetting.

Report No: TT 520/12

Water use and nitrogen application for irrigation management of annual ryegrass and kikuyu pasture production (MK Fessehazion; AB Abraha; CS Everson; WT Truter; JG Annandale & M Moodley)

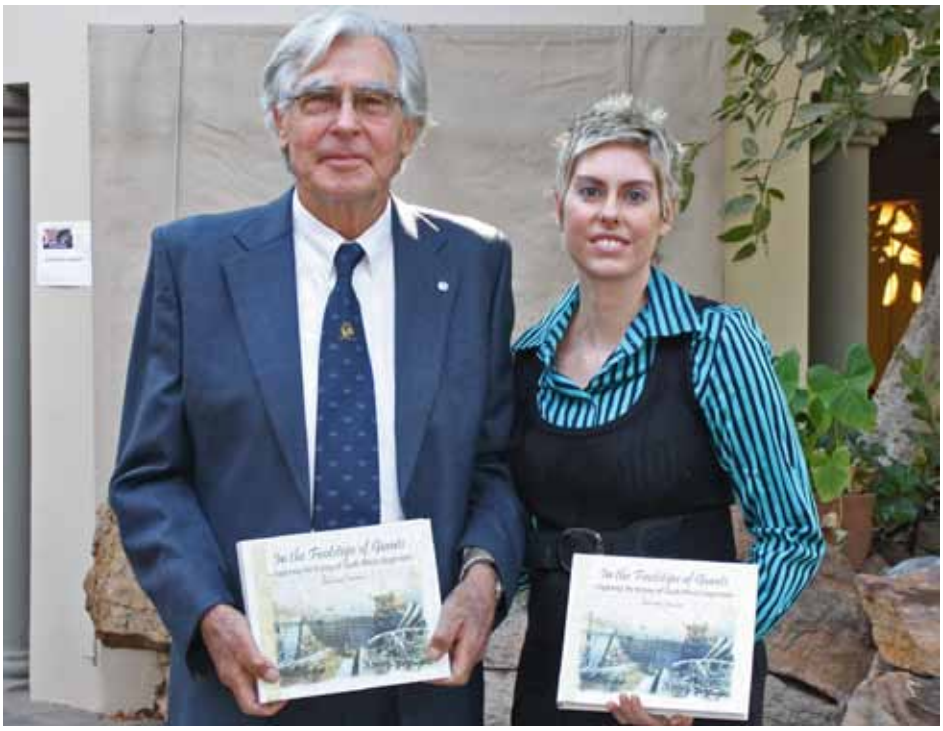
To meet the increasing demand for animal protein as human populations increase, there is a need to increase water (and land) productivity. Natural veld cannot fulfil this need alone and must be supplemented with irrigated and fertilised planted pastures. This requires intensive use of fertilisers and water, which leads to a higher cost of production and a greater risk of environmental pollution. In South Africa, annual ryegrass (*Lolium multiflorum*) and kikuyu (*Pennisetum clandestinum*) are the most widely grown pasture species



under irrigation. They are mainly used in dairy farming enterprises. The main aims of this project were to promote efficient irrigation management of grass pastures by synthesizing available knowledge and generating new knowledge for improve water use efficiency by pastures. Among others, detailed field trials were undertaken at Cedara, Pietermaritzburg, and the University of Pretoria's Hatfield Experimental Farm. Also available as part of this project is *Irrigation guidelines for annual ryegrass pasture* (**WRC Report No: TT 521/12**).

SA's engineering giants help launch WRC's book on history of large dams

***Four years after** Water Wheel Editor, Lani van Vuuren's journey started into the history of South Africa's large dams, her book has finally been published by the Water Research Commission (WRC).*



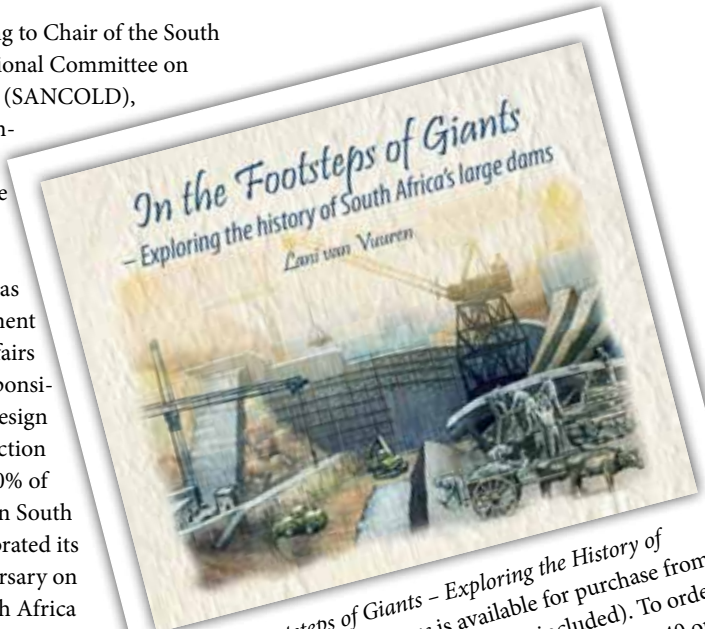
Inga Jacobs

Keynote speaker at the launch, Honorary President of ICOLD, Dr Theo van Robbroeck, with Footsteps *author, Lani van Vuuren.*

The glossy, 340-page publication, *In the Footsteps of Giants – Exploring the History of South Africa's Large Dams*, was launched in Pretoria earlier this year. Developed around the water history articles that have featured in this magazine since 2008, the book takes the reader on a journey through the history of South Africa's largest dams, starting with the traditional attitudes and indigenous knowledge around water resources prior to European settlement and ending with a glimpse into the future of dam building in the country.

"The South African water story is one that is yet to be completed and the book is an important contributor towards fulfilling that story," says WRC CEO, Dhesigen Naidoo. "It examines the beginnings of water history in this country and provides a useful platform to examine some of the drivers of development of South Africa's water infrastructure, which has been celebrated around the world."

According to Chair of the South African National Committee on Large Dams (SANCOLD), Danie Badenhorst, the launch of the book comes at an opportunity time, as the Department of Water Affairs (DWA), responsible for the design and construction of around 80% of large dams in South Africa, celebrated its 100th anniversary on 1 July. "South Africa has developed a large percentage of its water resources and there will



* *In the Footsteps of Giants – Exploring the History of South Africa's Large Dams* is available for purchase from the WRC at a price of R150 (postage included). To order the book contact Publications at Tel: (012) 330-0340 or Email: orders@wrc.org.za.

Hlengiwe Cele

Left: *Footsteps author, Lani van Vuuren, WRC Director: Water-Centred Knowledge: Dr Heidi Snyman, and WRC Multimedia Publisher, Drinie van Rensburg, who designed the book.*

Right: *WRC CEO, Dhesigen Naidoo at the launch of the book.*

Inga Jacobs

be limited dam developments in the future. We need to look after our multibillion Rand dam assets by way of maintenance and rehabilitation."

Footsteps explores the reasoning behind the construction of the country's massive water storage structures, the laws that guided their development, and the people and institutions that made them possible. Woven in between are the tales behind some of the country's most iconic dams and dam engineers. This is the first time that such a publication has been on offer for a wider audience in South Africa.

"Far from being mere earth and concrete structures, our dams serve as monuments of our past and beacons on our path to socio-economic prosperity. Behind each dam lies a tale of imaginative thinking, daring spirit and resolve to make South Africa a better place to live in," writes Van Vuuren. "South Africa's dams history goes back at least five centuries. Many of our strategically most important dams were built with nothing more than bare hands and sheer determination. This book is not only dedicated to the pioneering engineers who dared to dream big, but also to the thousands of labourers who toiled in sun and dust to turn dreams into reality as well as the families who supported them."

Keynote speaker at the launch, Honorary President of the International Commission on Large Dams (ICOLD), Dr Theo van Robbroeck, captivated the audience with his recount of experiences as an engineer with the DWA and the mentors that shaped his career. He started working for the department as a young recruit in 1957. What made his address even more enthralling was the fact that many of his former colleagues – the very engineers that designed and built the country's foremost dams, pumped storage scheme and inter-basin transfers – were present in the room.

"The older I get the more I come to realise how lucky civil engineers were to have lived and worked at a time when exciting huge projects were undertaken: think of two brand new harbours – Richards Bay and Saldanha with the accompanying railways for mineral exports; major road works such as the Ben Schoeman and the Cape Town and Johannesburg freeways; giant coal-fired power stations and last but not least, mammoth water projects," said Dr Van Robbroeck. "Apart from the Orange River Project, there were the Tugela-Vaal/Drakensberg, the Lesotho Highlands Water Project (LHWP), the Riviersonderend-Berg River project, the Palmiet and Steenbras pumped storage schemes, etc. As we in South Africa know so well, there would not be a modern economy without our dams."

As South Africa gears up to tackle more impressive water infrastructure projects, such as Phase II of the LHWP, it is hoped that the lessons captured in this book will go a long way to ensure the sustainable development and management of the country's large dams going forward. "Until we can find a reliable alternative to dams as a way to store water in South Africa it is up to the new generation of dam builders to devise and implement schemes to sustainably manage our water resources, which must be matched by a commitment to retain or conserve as far as possible the fragile ecosystems on which they are constructed," says Van Vuuren.

Naidoo adds: "The book tells us that we should not rely on one solution. While we have this wonderful legacy of building large-scale infrastructure, our future lies in using that same ingenuity and innovation that helped us be a dam-building giant in the world to apply similar kinds of paradigms and know-how in the areas of water conservation and water demand management. *Footsteps* organises to pitch a series of questions about our water past, our water present and our water future that we would like researchers to examine further. The water story in South Africa continues to be an interesting one, and one more milestone has been reached with this wonderful book." ❑

After 150 years PRETORIA'S FOUNTAINS still a source of life

Lani van Vuuren

Water from the Upper Fountain discharges partially into the Apies River. This fountain has been providing the city with water for nearly 160 years.

South Africa's capital city, Pretoria, is still dependent on the crystal clear waters of the fountains that have sustained it since the start of its existence. However, as the early history of the city proves, even a good source of water requires strong municipal governance. Article by Johannes Haarhoff, Petri Juuti and Harri Mäki.

The city of Pretoria was found in the immediate vicinity of an artesian water source. This source (called the Fountains to this day) is an unusually strong and consistent source – the only water source for Pretoria from 1855 until 1935. Moreover, it yielded (and still does today) water of very good quality.

Pretoria was registered as a town on 16 November, 1855. The Commandant-General of the Transvaal Republic, Marthinus Wessel Pretorius, considered it the ideal location for the establishment of a new capital due to its abundant water supply and the natural contours of the area. His motivation for registration was that it was 'well situated to build a city with large and unlimited available area and water'. The town would be called Pretoria in honour of his father, Andries Pretorius, the Voortrekker leader prominent in South African history after his role in Natal between 1838 and 1848.

The water source was in the form of two springs located in the small Fountains Valley on the farm *Groenkloof*. Although the springs are in the same dolomitic strata, the area is divided into separate compartments by a number of prominent dykes. The two springs in Fountains Valley emanate from separate western and eastern fountain compartments, divided by the Fountains Dyke.

The two springs discharged into the Apies River, which strongly gushed northwards. This added another strategic reason for the location of Pretoria, as the important wagon trail to Delagoa Bay crossed the Apies River close by. This site, with its abundant water and natural grazing, had been a popular overnight stop for the early transport riders and travellers prior to the formal settlement of the town

EARLY WATER SUPPLY

The two springs in Fountains Valley are about 4 800 m from the current Church Square in Pretoria and the elevation difference is about 50 m. This provides a fairly steep gradient of almost 1% to lead the water by gravitation from the springs to the vicinity of Church Square, where the first inhabitants of Pretoria settled.

The first municipal works of the new settlement was digging of a water furrow from Fountains Valley in the direction of Church Square. The furrow was completed in 1855 followed by a holding dam at the springs. The initial dam and channel must have been rather hastily built, as the government entered into a contract in 1860 to rebuild the dam and the furrows, the latter now being specified to be 900 m wide and 450 m deep.

The local water regulations forbid anyone to take water from the furrow before it entered the town, or to pollute the water by washing or otherwise. By 1864 the maintenance needs of the water system warranted the appointment of a water superintendent and by 1874 the maintenance duties were performed by the water superintendent aided by bandits from the local prison, supplemented by private contractors for larger improvements and extensions.

This was the only service provided to the inhabitants. There was no means for the disposal of stormwater, which rendered the roads impassable during rainy periods. Moreover, the stormwater overflowed in the water furrows and polluted the water supply. Dumping of wastewater and sewage into the furrows were common, causing many people to dig private wells on their properties.

The first public meeting in Pretoria to ask for an own municipality was held in 1864. Permission from central government was almost immediately granted and the first municipal authority took office on 2 May, 1864. When the new municipality requested the central government to pay over all license monies collected from Pretoria residents in order to establish some municipal funding, the central government cynically refused. It left the authority no option to voluntarily disband itself and hand its powers back to the central government on 20 September that year.

CONDITIONS DURING THE FIRST BRITISH OCCUPATION

The independence of the Transvaal republic was interrupted when Theophilus Shepstone proclaimed British authority over the Transvaal on 12 April, 1877. Just 42 months later the British occupation ended abruptly when the main British force was overrun on the mountain top of Majuba on 27 February, 1881.

This short British annexation saw the influx of the military and business opportunists, which resulted in the white population of Pretoria rising sharply from 1 500 in 1877 to 2 000 in 1878. The sanitary conditions of the city, already poor before the British came, got worse. The British military authority started with good intentions by appointing a Pretoria Municipal Board in 1877.

This Board, imposed by an unpopular authority, never got off the ground. A military officer, Colonel Montgomery, took the initiative and cleaned the water furrows and lined some of them with brick. Eventually he had to stop the work as no money was forthcoming from the military government. The failure of the British military authority to improve conditions may be blamed on their relatively short stay in Pretoria, but the conditions actually deteriorated during its stay.

PUBLIC HEALTH AND CONCESSION POLICY

After the Transvaal Republic regained its independence in 1880, the municipal management reverted to that before the annexation by the British, namely a city under the control of a magistrate, reporting to central government. Pretoria continued to grow and complaints regarding the water supply and water furrows mounted. The attempts to improve matters were

FAST FACTS ABOUT PRETORIA'S WATER

- The original name of Pretoria's fountains were Zubuhlungu, meaning 'that which hurts', on account of the sharp dolomitic stones from which the water used to spring. It was later named 'Bronkhorstfontein' after the first white family that settled there.
- The original name for the Apies River is Mbibana or Tshwane.
- The original town of Pretoria, established in 1855, only had nine families, all living around the present-day Church Square.
- While Pretoria's Upper and Lower Fountains are less than 500 m apart, they are completely independent of each other, being separated by a dyke.
- Together, the Upper and Lower Fountain still supply close to 40 Mℓ/day to the central business district. The water is of such good quality that no treatment is required, however, the water is chlorinated prior to reticulation.

Lani van Vuuren

Left and below: *The monument in Pretoria's Fountains Gardens which is dedicated to this historically important water source.*

minor and peripheral – certainly not the deep reforms required.

In 1882, for example, the major improvement was only to allocate a dedicated cart and oxen to assist the bandits with the maintenance of the water system. These were supervised by a prison warden who reported to a part-time health inspector.

In 1886, gold was discovered in Johannesburg about 90 km to the south of Pretoria, leading to an immense gold boom with explosive population growth. This new settlement, also operating in a legal vacuum as far as legislated municipal structures were concerned, suffered its own share of problems regarding its water supply, sanitation and public health. Inevitably, some of the new economic activity spilled over to Pretoria, where a similar jump in population was experienced.

The central government responded to Pretoria's problem (and also that of Johannesburg) by mobilising the resources of the private sector through a concession policy. The concession for water supply was granted in 1889 to LG Vorstman. This was ceded six months later to the Pretoria Water Works Company Limited, at the exact time of an enteric fever outbreak.

The concession was awarded to supply clean water to Pretoria for the next 50 years. It was, however, subject to cancellation after 10 years, and thereafter every three years. The concessionaire started by building a collection chamber in Fountains Valley into which the two springs discharged, to form one combined water source. From the collecting chamber, the water was led with a steel pipeline with a diameter of 304 mm and 380 mm to the town.

Once in town, the pipe fed into a reticulation network made of cast iron pipes. It was soon found that pipes in the reticulation network were too small and they were gradually replaced with larger ones. It is interesting to note that all these pipes had to be transported by wagon from Charlestown in Natal, the nearest railhead to Pretoria in 1889.

The activities of the Company met the expectations. The public seemed to be content with the level of service provided by the concessionaire and the few complaints were not serious enough to endanger the concession. This attitude changed rapidly when the Pretoria Water Works Company decided in 1898 to install a few meters for individual consumers, to enter into individual contracts with the owners and to raise the price of water.

The public responded en masse by means of a petition with 1 060 signatures. The resulting commission of enquiry recommended that the concession should be cancelled and by December 1898 negotiations were started about the transfer of the assets and the re-employment of key personnel. As these negotiations were proceeding, war clouds began to gather over the Transvaal again and when war was declared with Britain on 11 October 1899, the transfer had not yet taken place.

The Pretoria Water Works Company remained responsible for the supply of water to Pretoria and the company was instructed to appoint eight men to guard the springs in Fountains Valley.

Gerrit Burger

Above right: *Water from Grootfontein is pumped to the Rietvlei Water Treatment Plant from where it is mixed with treated water from the plant and distributed to residents in the area. Despite being several metres deep, the water is so clear that one can see to the bottom.*

Below: *The Grootfontein collection chamber is an inconspicuous building which gives away little of the treasure it houses.*

Lani van Vuuren

SECOND BRITISH OCCUPATION 1899-1902

Before the British forces occupied Pretoria on 5 June 1900, it had already been decided by the British that the occupied cities should get 'genuine municipalities' as soon as possible. When Pretoria was occupied, Lord Milner lost no time to describe the conditions in the city, with predictable political opportunism, as scandalous.

The guiding principle during the military occupation was that only the minimum municipal improvements were to be made. The war was anticipated to be over within a few months, but the occupation turned out to last for two years.

The Pretoria Water Works Company, whose water supply concession was on the verge of being terminated when the war started, continued to supply water throughout the war. The population continued to grow during the war and water supply remained a critical issue.

Some improvements had to be made due to their urgency. At Fountains Valley, the collecting chamber was expanded and a new steam-powered pump station was built to supply the military barracks in Roberts Heights. An additional pipeline, 600 mm in diameter, was laid by the military from Fountains Valley to supplement the first pipeline laid in 1890.

PRETORIA TRANSFORMS INTO A MODERN CITY

By the middle of 1902, peace was finally reached and Pretoria found itself under British rule. No time was wasted to establish a 'genuine municipality' promised before the war. A city council was proclaimed in 1902 with the powers to levy taxes on the residents to provide an own municipal income base.

The councillors, however, were not elected, but nominated by the Governor from a list of prominent citizens. It was clear from the start that the views of the nominated councillors were not adequately taken into account. In a strong measure of protest, the council resigned on 1 May 1903. Hereafter the process to constitute a properly elected, democratic town council was started and the first elections were held on 28 November, 1903.

Almost 50 years after its birth, following much effort and misery, Pretoria finally had its own elected town council to guide it on a new path of municipal development and improvement. After the war the population of Pretoria continued to grow steadily. The inexorable growth in population and the spread of its municipal area, while trying to catch up with the service backlog inherited from the previous authorities, presented a formidable challenge to the town council during the first few decades of the 20th century

In 1902, the central government resumed negotiations with the Pretoria Water Works Company regarding the ending of their concession and the transfer of the water supply infrastructure to the town. After finality had been reached, the agreement was presented to the town council for ratification. The town council, having decided earlier as

Lani van Vuuren

This pump station in Fountains Valley was erected by British Forces during the South African War to pump water from the Fountains to Voortrekkerhoogte. The original steam pumps could deliver 0,9 Mℓ/day of water.

Lani van Vuuren

Pretoria's main river, the Apies, so named for the historical presence of bands of monkeys frequenting its banks, was canalised in 1909 following a series of drownings.

a matter of principle to revoke all concessions to bring the provision of services under its direct control, ratified the agreement after some conditions had been added

The transfer took place some time after May 1903, bringing the water concession, planned for 50 years, to an end after only 14 years. After the war, the water system was in a sad state. Although the two springs in Fountains Valley provided more water than required, the other components were lacking.

The bulk conveyance system from Fountains Valley, already enlarged during the war as an emergency measure, was enlarged in 1907 with a new pipeline of 250 mm, and again in 1911 with a concrete pipeline with diameter of 914 mm across two concrete arch bridges. The water mains were empty for part of the day due to insufficient storage, which prompted the building of new reservoirs.

In 1907 three storage reservoirs of 227 m^3 each were built, and the much larger Findlay reservoir with capacity of 11 382 m^2 was completed in 1916. The reticulation did not extend to all areas of the town and some dwellings had to be served by water cart. The extension of the reticulation system became an ongoing project. During 1907, water mains were installed at a remarkable monthly rate of 1 030 m.

Lani van Vuuren

The Sterkfontein water source is located within an industrial area, yet provides ultraclean water to the residents of Centurion.

HIGH PER CAPITA USE OF WATER

The springs of Fountains Valley provided, at first, a superabundance of water to the town. The public fully exploited this luxury, evidenced by a brochure from 1903: "Pretoria is one of the prettiest towns in Africa. Today water runs down every principal street, and is used to irrigate the town... There could be no better watered town in the world than Pretoria."

The first reliable measurements of the actual water use was made by August Karlson, an exceptionally well qualified engineer who became the manager of the Pretoria Water Works Company in 1898. The per capita water use in Pretoria around 1901 was 358 ℓ/pp/day. Of this volume, 26 ℓ/pp/day were taken from the modest pipe reticulation which was started a few years earlier, with the balance taken from the furrows.

WATER DEMAND MANAGEMENT

From the above, it is obvious that the high per capita water demand of Pretoria was a concern long before the limits of the springs in Fountains Valley had been reached. If the demand could be curtailed, the capital needs for bulk supply pipelines and storage reservoirs could be postponed. Ways were therefore sought to reduce the demand.

While Karlson was a strong advocate of the idea that proper water supply and water metering go hand in hand, the town council did not pursue metering with vigour after it took over the services of the Pretoria Water Works Company. By 1922, there was practically no restriction of domestic consumption and the only meters were installed for government institutions, hotels, large business premises and recently incorporated suburbs.

A total of 1 500 meters were in use in 1923, as opposed to 2 500 in

WRC PROJECT TO CAPTURE HISTORY OF PRETORIA'S FOUNTAINS

A new Water Research Commission (WRC) funded project, led by the University of Pretoria (UP) aims to record the capital city's early water history.

Pretoria is one of several cities and towns in South Africa fully or partially dependent on groundwater. The two springs in the Fountains Valley immediately to the south of the city were certainly the reason why the early white settlers, the Bronkhorst brothers, selected this site to establish their farm and eventually, why the ZAR decided to move its seat of government here. Yet, few Pretoria residents are even aware of the importance of this unobtrusive source.

"Through this project we hope to illustrate the role groundwater can play in meeting not only rural water demands but also urban demands," reports WRC Research Manager, Dr Shafick Adams. "While groundwater development has been placed high on the list of future water supply options for many areas, it remains underappreciated by the public and policy-makers alike."

The Hydrological Heritage Overview project, as the WRC project is known, is recording Pretoria's development around its groundwater sources, including historical abstraction volumes and water quality, where available. "Pretoria is an excellent example of the use of groundwater for urban water supply," notes project leader Matthys Dippenaar, of UP's Geology Department. "For the people of Pretoria we hope that this project will create some awareness and appreciation, that they will realise just how important water is in our lives. For fellow scientists, we aim to provide improved access to historical data. Additionally, this project may help create awareness in the field of groundwater science and help secondary and tertiary institutions with valuable study material."

In addition to the Fountains, which supply around 40 Mℓ/day to the central business district, Pretoria has two other springs delivering water to its residents. Water (7,2 Mℓ/day) from Grootfontein, by far the most impressive fountain, is pumped to the Rietvlei Water Treatment Works and mixed with treated water from the works. On the other end of the city, Sterkfontein provides 9,7 Mℓ/day to the residents of Centurion. All of the springs are still providing water of the highest quality, despite development mushrooming around them and, as a result, do not need to be treated prior to reticulation (although chlorine is added to the water before being piped).

The City of Tshwane has graciously agreed to supply all available historical data and maps for inclusion into the project. In addition to site visits, the project team is also visiting archives, museums, and libraries for additional information.

With groundwater usually being a hidden resource, Pretoria's springs offer a rare visual glimpse of the Cinderella of waters resources in South Africa. An interesting aspect of the project is the use of multimedia to record the sight and sound of the fountains.

"The young generation is much more likely to be fascinated by video material – think of social media, like Facebook and YouTube for example, than hard copy reports or technical talks. The idea behind using videography is therefore to make the interesting case study of Pretoria's springs accessible to the younger generation while simultaneously creating an awareness of hydrological science," notes Dippenaar.

Once the project has been completed, the material will be made available to as wide an audience as possible. The project is expected to be completed in the first quarter of next year.

1902. It was clear that comprehensive metering was not a priority since the election of an own municipality. The prevarication of the town council on the question of water metering can be somewhat excused while the springs in Fountains Valley were coping with Pretoria's demand. Sooner or later, however, it was evident that the yield of water from Fountains Valley, which had served the town so admirably since 1855, would fail to meet the growing demand.

The overexploitation of the springs had thus started by around 1920. This time, the need for demand management was much more serious and water metering returned as a cheaper and more attractive option than developing a new supply to cater for the unbridled water demand. Pretoria finally introduced comprehensive water metering during February 1927. The installation of the meters was carried out over 18 months and completed in July 1928. On the positive side, the introduction of metering gave rise to little or no complaint from the residents of Pretoria, very different from the uproar of 1898.

The water demand immediately dropped by 15% but not nearly as much as some of the early hopefuls had predicted. This meant that the savings by water metering brought very little or no time for authorities and water shortage remained acute. The development of additional water supply for Pretoria was inevitable and urgent. During November 1927 the municipality continued with the planning of a supplementary water scheme at Rietvlei. This scheme, which solved the water problem, was commissioned in 1934.

- This article is based on, 'A case for strong municipal governance: the water supply of Pretoria 1855-1935', by the same authors, which appeared in *the South Africa Historical Journal*, in April 2012. To access the original article Visit: http://www.tandfonline.com/doi/pdf/10.1080/02582473.2011.647318 ❑

Drinie van Rensburg

BLINK AND THEY MIGHT BE GONE

– latest biodiversity assessment highlights dangers to SA's wetlands

Wetlands are South Africa's most threatened ecosystem, with nearly half of the country's wetland types critically endangered. This is one of the main findings of the latest National Biodiversity Assessment (NBA), officially launched earlier this year. Compiled by Lani van Vuuren.

The recently completed NBA 2011 provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The main purpose of the document, launched by Minister of Water & Environmental Affairs, Edna Molewa, in iSimangaliso Wetland Park, earlier this year, is to provide a regular high-level summary of the state of South Africa's biodiversity. It is intended for decision makers both inside and outside the biodiversity sector.

The latest assessment process was led by the South African National Biodiversity Institute in partnership with a range of organisations, including the Department of Environmental Affairs, CSIR, and South African National Parks. It follows on from the National Spatial Biodiversity Assessment 2004. This time round the scope of assessment has been broadened to include key thematic issues as well as a spatial assessment. Among others, the NBA 2011 also deals with species of special concern and invasive alien species, while presenting new work on geographic areas that contribute to climate change resilience.

CRITICALLY ENDANGERED

Wetlands are particularly important for South Africa considering its semi-arid characteristics. Wetland ecosystems are vital for purifying water and regulating water flows, acting as sponges that store water and release it slowly, filtering pollutants and easing the impacts of droughts and floods in the process. They also support a rich diversity of species, which have both intrinsic and economic value.

Progress in the last couple of years in terms of the development of a National Wetland Inventory and a national wetland classification system meant that, for the first time, the NBA includes a national assessment of wetland ecosystems. Much of the data used for the biodiversity assessment was gleaned from the National Freshwater Ecosystem Priority Areas project (for more on this project, see 'SA's first freshwater priority areas atlas launched' in *the Water Wheel* January/February 2012).

Unfortunately, it does not paint a rosy picture. The NBA found wetlands to be the most threatened of all South Africa's ecosystems, with 48% of wetland ecosystem types critically endangered. Around 300 000 wetlands remain, making up only 2,4% of the country's surface area. While available historic data on South Africa's wetlands are rare, it is estimated that more than 50% of the country's original wetland areas have already been lost in substantial parts of the country.

Since a single wetland ecosystem type can include some wetlands that are in good ecological condition and others that are in poor condition, the NBA does not simply assess the condition of wetlands. Rather it takes the analysis further to look at the proportion of each wetland ecosystem type that remains in good ecological condition, giving an assessment of ecosystem threat status for wetland ecosystem types.

Consistent with the picture for river ecosystems, there is a band of critically endangered and endangered ecosystems along the escarpment belt and around major cities. The pattern in wetland ecosystem threat status is frequently influenced by the condition of rivers. (Similarly, destruction of wetlands impact river condition as the former then no longer filters and traps pollutants before it ends up in the river). Disturbingly, 65% of South Africa's wetland ecosystem types are currently threatened (48% critically endangered, 12% endangered and 5% vulnerable), making wetlands the most threatened of all ecosystems.

"The NBA found wetlands to be the most threatened of all South Africa's ecosystems, with 48% of wetland ecosystem types critically endangered. Around 300 000 wetlands remain, making up only 2,4% of the country's surface area."

Floodplain wetlands have the highest proportion of critically endangered ecosystem types, followed by valley-head seeps and valley-bottom wetlands. These wetland classes, especially floodplain wetlands, are often associated with highly productive lands and are often the ones that are dammed, drained of bulldozed for agricultural purposes. Other threats to wetlands include road construction, forestry plantations, dumping of solid waste, mining and toxic waste disposal.

Coal-mining, which provides most of South Africa's energy supply and earns foreign exchange through exports, presents a particular challenge for wetland health. The close proximity of many shallow coal seams to wetlands means that opencast coal mines frequently destroy hundreds of hectares of wetlands to remove the coal beneath them, compromising the water purification and flood prevention role that wetlands play and exacerbating the problem with water quality that already exist in heavily-mined catchments.

Until the 1980s, agricultural policy in South Africa deliberately encouraged draining and cultivation of wetlands. Although this has changed and there is much more awareness today about the value of wetlands, the loss of wetlands that resulted cannot entirely be reversed.

Only 11% of wetland ecosystem types are well protected, with 71% not protected at all, reflecting the fact that wetland ecosystems have not been taken systematically into account in establishing and expanding land-based protected area. This means that there is clearly scope for the protected area network to play a bigger role in protecting South Africa's wetlands.

Roger de la Harpe/Africa Media Online

Red hot poker plants (Kniphofia praecox.) provide a colourful display in a wetland close to Howick, KwaZulu-Natal.

Wetland ecosystem types in the Lowveld region and northern KwaZulu-Natal are relatively well protected by the Kruger National Park and iSimangaliso Wetland Park respectively, while the mountain catchment areas in the Western Cape provide protection for some wetland ecosystem types. Unfortunately, wetland ecosystem types in the arid interior are strikingly under-protected.

"As long as they have not been irreversibly lost to cultivation or concrete, many wetlands that are in poor condition can be rehabilitated to at least a basic level of ecological and hydrological functioning."

A wetland in the Cederberg Wilderness Area is decorated with colourful mosses. Only 11% of the country's wetlands fall within protected areas.

As with rivers, protected areas alone are unlikely ever to do the full job of protecting wetlands, which are vulnerable to impacts in their catchments beyond the boundaries of protected areas. This highlights the importance of integrated water resource management in securing the quality, quantity and timing of freshwater flows on which the functioning of wetlands depends. For all wetlands, keeping a buffer of natural vegetation intact around the wetland can go a long way towards reducing the impacts of damaging land-use practices in the catchment.

According to the authors of the NBA, the poor state of wetlands has direct implications for water quality and quantity, as well as the country's ability to adapt to climate change. Fortunately it is not all gloom and doom. Wetlands are more resilient than many other ecosystems. As long as they have not been irreversibly lost to cultivation or concrete, many wetlands that are in poor condition can be

THE TYPES OF WETLANDS FOUND IN SOUTH AFRICA

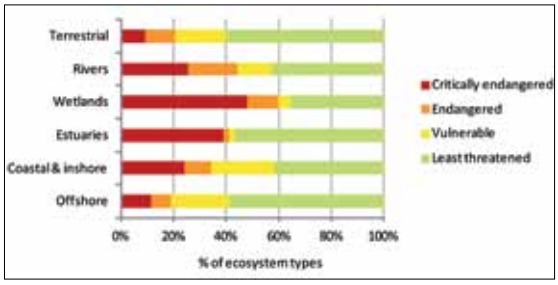
- **Seeps** (wetlands on slopes formed mainly by the discharge of sub-surface water)
- **Valley-headed seeps** (seeps located at the head of a valley; often the source of streams)
- **Channelled valley bottoms** (valley floors with one or more well defined stream channels)
- **Unchannelled valley bottoms** (valley floors with no clearly defined stream channel)
- **Floodplains** (valley floors with a well-defined stream channel, gently sloped and characterised by floodplains features, such as oxbow depressions)
- **Depressions** (basin-shaped areas that allow for the accumulation of surface water)
- **Flats** (extensive areas characterised by level, gently undulating or uniformly sloping land with a gentle gradient)

Source: NBA 2011

Nigel Dennis/Africa Media Online

Roger de la Harpe/Africa Media Online

A Zulu woman cuts Ncema grass in the iSimangaliso Wetland Park for the weaving of mats. Many rural communities in South Africa depend on the products and services of wetlands.



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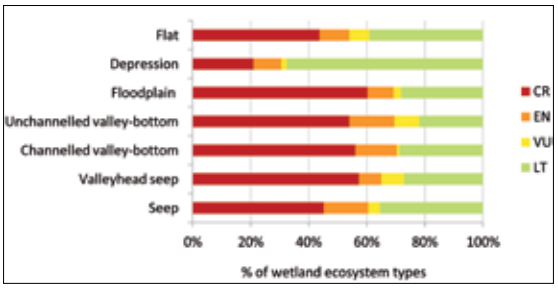

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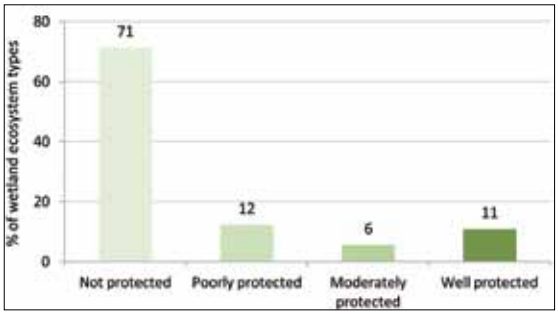

NBA 2011

***Top left** – Comparison of threat status for terrestrial, wetland, estuarine, coastal and inshore and offshore ecosystems. Wetlands are the most threatened of all South Africa's ecosystems, with 48% of wetland ecosystem types critically endangered.*

***Middle left** – Ecosystem threat status for wetland ecosystem types, by hydro-geomorphic class of wetland. Floodplain wetlands have the highest proportion of critically endangered types, followed closely by valley-head seeps and valley-bottom wetlands.*

***Bottom left** – Summary of ecosystem protection levels for wetland ecosystem types. Wetlands are severely under-protected, with only 11% of wetland ecosystem types well protected.*

rehabilitated to at least a basic level of ecological and hydrological functioning, thus restoring ecosystem services such as water purification and regulation of water supply.

The Working for Wetlands programmes does just this, providing jobs and contribution to livelihoods at the same time. In addition to rehabilitating wetlands, priority wetlands that are still in good ecological condition should be kept that way, the NBA authors say.

"The solution to protecting a representative spread of wetland ecosystem types lies in a combination of measures for on-site protection, and measures implemented upstream and in the surrounding catchment to secure the quality, quantity and timing of water upon which the wetland's character and functioning depend…Biodiversity stewardship programmes are making significant contributions to the protection of terrestrial ecosystems through the declaration of contract protected areas on land which remains in private or communal lands. An explicit freshwater focus within biodiversity stewardship programmes could extend this contribution to wetlands as well," the NBA concludes.

To access the *National Biodiversity Assessment 2011 Synthesis Report*, and the technical reports for terrestrial and freshwater systems, as well as estuaries and marine environments, Visit: http://bgis.sanbi.org/nba/project.asp ❑

Cape Town study confirms that TOILETS COUNT, PEOPLE MATTER


Jonathan Hilligan

Communities living on the periphery of service delivery often have no option but to share communal sanitation facilities. A research team from the University of Cape Town (UCT) investigated the patterns of usage and the negotiation process surrounding such facilities in one informal area in Cape Town. As they discovered, providing sustainable sanitation solutions in such areas is a much more complex issue than often thought. Article by Jonathan Hilligan, Andrew Spiegel and Neil Armitage.

The municipal elections in 2011 and the politicking around the so-called 'open toilets' of Makhaza (Western Cape) and Moqhaka (Free State) highlighted the challenges South Africa still faces around sustainable sanitation provision in many parts of South Africa. Like many other cities and towns across the country, the City of Cape Town (CoCT) is faced with a problem of how to provide adequate sanitation services to its more than 200 informal settlements.

While basic services have been provided to many, they often fail to meet residents' expectations as a consequence of poor operation and maintenance programmes or inadequate user consultation. One informal settlement in Cape Town, Barcelona, has provided a specific set of geographical conditions which have compounded the problems associated with sanitation delivery and required an alternative approach to conventional gravity-based sanitation provision.

UNIQUE SETTLEMENT

The settlement itself is unique as it is situated directly atop a capped and abandoned solid waste site. The site, originally an open piece of ground with a small dam, was used as a municipal dump site until the late 1980s. It was originally earmarked for the development of a sport stadium – but Barcelona was established instead in 1992, initially as a 'temporary' settlement.

The year 1993/94 saw an influx of people onto the site who staked out plots and began to build houses on the capping layer of gravel covering the solid waste below. By 2010, the settlement had a population of around 6 600 people living on 28 ha of land. At this time the settlement was serviced by 367 container toilets and 157 pit latrines.

The solid waste poses technical difficulties as regards the installation of conventional waterborne sanitation specifically in relation to the composition of the ground and the potential risks involved in excavating land fill including differential settling. As a result of these challenges, Barcelona was selected by CoCT, and the UCT Urban Water Management (UWM) Group, a research team comprising civil engineering and social students, as a potentially good site to pilot alternative sewerage technology under a project funded by the Water Research Commission.

Often alternative sewerage systems fail because of socially-related issues rather than the technology itself. The UWM group recognised

the intrinsic value, both in terms of research data, and potential alternatives to directing a sanitation service approach, in exploring the social dimension of access to basic services. Thus the team conducted research in Barcelona over six weeks, recording people's daily experiences with their current sanitation service. A handful of those experiences are related here.

RESEARCH FINDINGS

Mawethu* is a quietly spoken 32-year-old man living with his girlfriend in a single room house adjacent to a large church building in the centre of the settlement and itself bordering Barcelona's Community Centre. He said that he preferred his privacy and seldom interacted with other residents. However, the location of his home, and its proximity to two container toilets, made this difficult.

Mawethu's front door opens onto the path running along the outside the church fence resulting in a steady stream of traffic. The toilets are cleaned once or twice a week, but because of the high number of users, the toilets filled must faster than the others, and often reach overflow level before being collected and emptied by CoCT's agents.

According to Mawethu, the toilets are very unpleasant to use as they often emit a terrible smell because of their overfull state. Locking the toilet closest to his house had the unintended effect of passers-by constantly bothering him for the key. He eventually abandoned this action.

In an effort to prevent the toilets from filling up so quickly, Mawethu then scribbled on the inside wall of the closest toilet that it should not be used for urination. His scrawled message, however, resulted in male passers-by urinating against the outside of the container instead, exacerbating the stink. He consequently uses the toilet as little as possible preferring to wait till he was at work to use the toilet there.

While Mawethu has relatively free access to two toilets, he often has to use toilets elsewhere in the settlement or at work, especially when those closest to his house are full. Having to share the facilities with so many people indicates that it is difficult to guess what level or quality of service is available to a household simply by assessing household members' proximity to a toilet.

FROM SOME TO NONE

While Mawethu has problems concerning the public sharing of facilities, some residents have no regular access to private or to public sanitation facilities. Survey results provided by a local non-governmental organisation indicate that around 87 households have no access to a toilet and practise open defecation. Yet the same survey indicates that there are nominally enough toilets in the settlement to satisfy the minimum five households to one toilet ratio established by the national government.

Atini, a relative newcomer to Barcelona, reported having had occasionally to practice open defecation. He explained that this is because all the toilets adjacent to his house have already been appropriated and locked by neighbours or other residents. His neighbours only sometimes, reluctantly, lend him a key. When the keyholders are absent, it leaves him with no alternatives but to defecate on the nearby road reserve alongside the N2 highway.

"Any facility provided in complex social milieus have to consider that working on the basis of crude ratios of toilets to households or of proximity to facilities is insufficient, as this fails to recognise residents' own perceptions of ownership and custody and the social relations associated with these perceptions."

Atini's experience of sanitation services in Barcelona provides a unique glimpse into the highly contested spaces generated through unequal access to facilities. Atini's access to the facilities near his home is impeded through other residents' appropriation of those facilities for private use. Atini suggested that eventually he might gain access to one of the locked toilets close to his house. However, he claimed that as a new resident in the settlement this might be difficult as he had not yet established close relationships with his neighbours.

Jonathan Hilligan

A row of container toilets along a road in Barcelona. Providing sanitation to this informal settlement, located in Cape Town, is made difficult by the fact that it is located on a former municipal dump site.

* *Pseudonyms have been used to protect the identity of the participants.*

Jonathan Hilligan

This container toilet is shared between five households. Each household has a key to the toilet.

Atini asserted that all residents living within a certain proximity to a toilet should have access to it, and that toilets should not be 'owned' by any resident. However, many residents did not share his sentiments about such ownership and several indicated in interviews that, since there were insufficient toilets for each households to have its own, they preferred shared 'ownership' of a single toilet over publicly accessible communal facilities.

HOLDING THE KEY

Barcelona resident, only known as Mawethu, in front of his house with one toilet to the left and another to the right in the shadow of a neighbour's house.

An example of such sharing of a toilet is the case of Martha, a middle-aged woman living in a household with her husband and two children. They share one container toilet with five neighbouring households. Each household has its own key for the toilet stall padlock so that effectively the toilet is shared by 18 people.

Martha and her neighbours decided to padlock the toilet as it is on a footpath and often used by passers-by. The decision, according to Martha, was made informally among two of her closest neighbours. Once the toilet was locked other neighbours who were familiar with Martha and the other key holders quickly requested access to the toilet. Access was then extended on the basis of the residents' proximity to the toilet (no more than one house away).

Much like Mawethu, Martha and her neighbours had hoped that by locking the toilet it would reduce the rate at which the container filled up. Yet, she complained that because so many people used the toilet, it was often left very dirty. Unhappily, but out of a sense of necessity, she now takes personal responsibility for cleaning the toilet, a service she provides in addition to the CoCT's agents' regular cleaning of the toilet when the container is emptied. Her relationship with her neighbours is now strained, as she feels they do not respect her by not cleaning up after themselves when they use the toilet.

Moreover, Martha complained that the cleaners responsible for emptying the container toilet often does not clean it properly, leaving behind seats stained with waste or an only partially empty container. She suggested that the emptying service be provided more than once a week. Martha did concede that locking the toilet has a drawback in that if no key holders are present when the servicing team arrives – which apparently does not happen according to a regular schedule – the container remains full until the next collection. Luckily, this happens seldom.

Martha's experience stands in contrast with that of Athini. Where the latter's problem stems from having no claim to a specific toilet because of a lack of interpersonal relationships and social standing, Martha's comes from having too many individuals sharing a single toilet. Yet both individuals' experiences provide insight into the complexity of the relationships surrounding sanitation provision. These experiences suggest that any facility provided in complex social milieus, such as Barcelona, have to consider that working on the basis of crude ratios of toilets to households or of proximity to facilities is insufficient, as this fails to recognise residents' own perceptions of ownership and custody and the social relations associated with these perceptions.

FINDING AN ALTERNATIVE

The quality of services available to residents was a recurring theme in many interviews. Kenilwe, a young mother living with her husband and two small children presented a narrative similar to that of many other residents who have

Jonathan Hilligan

Jonathan Hilligan

These concrete structures have been left empty by residents taking the container toilets inside for use as seating in their own privately-dug pit latrines.

chosen to construct and use pit latrines rather than the container toilets. In her case a container toilet which she shared with her neighbour was located less than 5 m from the back of her house, but it was inconveniently placed for servicing. Since it was 'hidden' behind a neighbour's house and off the main path, it was often skipped and left full and dirty.

Kenilwe's response has been to remove the container toilet from its concrete stall and to have her husband dig a pit latrine alongside their home, covering it with a corrugated iron structure attached to their house. Her next-door neighbour has followed suit. Following negotiations it was decided that Kenilwe would keep the container toilet while her husband would assist their neighbour to dig the neighbour's pit latrine.

After their pit latrine was established, Kenilwe cut out the bottom out of the existing container so it could serve as a seat for the pit latrine, leaving the existing concrete structure standing empty. The concrete structure next to it is also empty; it now supports a satellite dish while still being used as a crude urinal.

According to Kenilwe, her pit latrine was a "much better" form of sanitation than the container toilet since it required no servicing or emptying, and therefore stank less than the container toilet. She also preferred the fact that it belonged to her family – they did not have to share it with anyone. By rejecting the container toilets and digging their own pit latrines, many residents of Barcelona have taken responsibility for their own sanitation.

MAIN FINDINGS

Each of the examples noted above provides a unique perspective on Barcelona's current level and quality of sanitation provision. Common to each experience is some degree of dissatisfaction with the current municipal services and facilities. But the sources of that dissatisfaction vary widely and reflect a large range of factors. They include, among others, the physical location of the resident's house in relation to sanitation, the social relationships between residents and their neighbours, the number of residents sharing a facility, residents' ability to provide themselves with alternatives and, finally, general dissatisfaction with servicing and maintenance of the provided facilities.

Residents' reactions to these challenges are also noteworthy, ranging as they do from appropriating public toilets and padlocking them to rejecting these toilets completely and digging their own pit latrines.

During each interview a planned pilot sanitation project was explained to respondents. Each explicitly expressed a preference for a full flush system, although some had reservations regarding the location of the pilot project's toilet blocks, and the fact that they would be communal. Once the pilot project toilets have been installed, the project team aims to revisit the settlement with the same approach to record the experiences, including problems, associated with the pilot sanitation system. It is hoped that such research will assist in the improved planning and execution of future sanitation services.

This research outlined above suggests that, if service providers carefully consider the manner in which recipients relate to provided services, they will be able to better understand the factors that are often neglected in favour of solely technology approaches.

Documenting people's on-the-ground experiences offer insight into a range of possibilities which should be taken into account when planning and providing a sanitation service that is explicitly based on a 'people-centred approach'.

- This article is based on a paper originally presented at the WISA 2012 Biennial conference. ❑

Courtesy CSIR

Land use is dominated by agricultural practices at the Wilge River site.

Discovering the secrets of THE OLIFANTS SEDIMENTS

The polluted Upper Olifants River, in Mpumalanga, has been the focus for many studies in recent years. However, a group of researchers from the CSIR are now also studying an element of the system which has to date been largely overlooked, namely the sediment. Article by Chantel Petersen, Nebo Jovanovic, Bettina Genthe.

The Upper Olifants catchment and its tributaries have been a research focus of late due to its combined status of being one of the hardest working rivers in South Africa and also one of the most polluted. A large research project which was led by the CSIR and funded by non-governmental organisation, the Olifants River Forum, was initiated as a result (For more information on the overall study see 'All eyes on Olifants as experts search for answers', *the Water Wheel* May/June 2010).

Representative sites in the catchment were chosen, samples were collected and analysis of water chemistry, as well as biological indicators such as fish, macroinvertebrates, protozoa, phytoplankton, benthic algae and riparian vegetation have revealed the critical variables (heavy metals from acid mine drainage, high total phosphate concentrations from partially/untreated sewage effluent) driving pollution in the Upper Olifants catchment. Furthermore water samples were also tested for endocrine disrupting compounds, bacteria, viruses and pathogens, which impact human health.

So although most aspects of the aquatic ecosystem were covered by the project, one that was lacking was sediment. Sediment is an important component of an aquatic ecosystem in that it provides habitat, feeding and spawning areas for aquatic fauna such as fish and benthic

macroinvertebrates. Excess sediment can in itself be a deterioration of water quality and impact on river ecology but it can also be a means of attachment of pollutants such as nutrients or metals by adsorption and transport of pollutants.

Poor land management practices and catchment activities such as changes in landuse may cause erosion, siltation of rivers, unstable river banks and beds and with this mobilisation of sediment associated with pollutants. The sediments often act as a 'sink' for pollutants, which can be released back into the water column during disturbance, whether natural or anthropogenic.

Sediment monitoring programmes are generally lacking in South Africa and this limits the understanding of factors controlling sediment dynamics, the link between river processes and the land and with it effective and sustainable catchment management. So while it was known that pollutants (metals, nutrients) were associated with sediments in the Upper Olifants system and that it impacted water quality (eutrophication, sedimentation), a knowledge gap existed in the understanding of the transport mechanisms involved.

Questions that were raised included: how are sediments reaching streams and how are they transported instream? Where are they stored and how do river form, shape and type influence this? Are there mitigation measures in place and what role do they play (e.g. riparian buffer strips)? One way of trying to answer these questions is by using geomorphological techniques.

Geomorphic processes have become important in river management as they can be used in understanding the physical transport, storage and deposition of sediment-bound pollutants in water resources. These methods were applied in the Upper Olifants catchment with the aim to monitor and model sediment and geomorphic processes, their response to landuse and varying river flows and to use the information to prioritise the impacts of landuse management associated with in-stream sediment-bound pollutants to water resources.

Two sites in the Upper Olifants catchment were chosen, one on the Koffiespruit River and another on the Wilge River, both tributaries of the Olifants River, flowing into Loskop Dam. Although the sites have similar land uses they differ in their geological, geomorphological and vegetation biomes, which will result in different process controlling factors.

Characterisation of the two study sites are under way with much of the baseline data such as flow and water quality data available from the Department of Water Affairs and spatial data such as soil erosion and sediment yield compiled by the Agricultural Research Council (Institute for Soil, Climate and Water). This data will be essential to the modelling process.

"Sediment is an important component of an aquatic ecosystem in that it provides habitat, feeding and spawning areas for aquatic fauna such as fish and benthic macroinvertebrates."

Courtesy CSIR

*Clear differences can be seen between the Wilge (**below**) and Koffiespruit (**left**) sites. Geomorphologically the Wilge site occurs in the upper foothills and the Koffiespruit site in the lower foothills, which results in different factors controlling processes such as in-stream sediment transport and possible contaminants.*

Top right: *The Koffiespruit, a tributary of the Upper Olifants River.*

Middle right: *Bank erosion was evident throughout the Koffiespruit study reach. This section of river also displayed the most physical channel changes between the two sampling events.*

Bottom right: *Trampling occurring on the left hand bank of the Wilge River. Cattle occasionally drink from the river causing localised bank instability, a spource of sediment to the river.*

Courtesy CSIR

Courtesy CSIR

Courtesy CSIR

Monitoring of the sites began during 2011 with two rounds of sampling completed.

Sampling included cross-sectional surveys of the two river reaches, which provides a two dimensional view of the river channel and floodplain. The cross-sections also provide a means for the collection of long term geomorphological data in a quantitative and repeatable manner. The bedloads (sediment moving on or near the bed) were sampled to determine the distribution of bed material sizes.

This allows for the determination of the flow hydraulics and the flow competence ability to transport bedload, which allows for the prediction of how channels will behave. The finer sediment carried in suspension will be monitored by sensors equipped to record turbidity, nutrients (e.g. phosphates) known to result in eutrophication and other water quality parameters. It is hoped that the sensors will be installed at the gauging weirs to continuously log data so as to relate changes in the parameters to the discharge data from the Department of Water Affairs gauging weirs.

Preliminary results showed that the Wilge River reach remained relatively stable between the surveys whereas the Koffiespruit River displayed channel widening and erosion including bank scouring and slumping as well as trampling by animals throughout the study reach. Results on the bedload sediment samples are still being processed but this will allow the characterisation of sediments in the channel, which can be used to determine the resistance of the channel to change and the type of flows required for sediment movement.

Vegetation surveys and electrical resistivity tomography surveys (dry and wet season) are to be completed during 2012. Vegetation surveys will provide information on bank stability and electrical resistivity tomography is a geophysical technique which will provide information on the subsurface, soils and geology as well as show the preferential pathways for water, which can be correlated to borehole data for the area obtained by the Department of Water Affairs.

All monitored data will be used for model calibration and scenario analysis performed to identify key land use impacts and effective mitigation measures focussing on the selected sites. The tools and models produced in this project will contribute to improved catchment management in the Upper Olifants catchment, and the experiences may be applicable to other catchments in the same region. ❑

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WATER FOOTPRINT – Improving business water use, step by step

The water footprint has gained a global foothold since its introduction a decade ago. Lani van Vuuren explores this tool and its potential application in the corporate world.

These days it is not uncommon for people to know exactly how much water it takes to produce a glass of red wine (about 120 ℓ), a kilogram of rice (2 500 ℓ) or even an average-sized pizza (1 260 ℓ). The so-called water footprint concept, first introduced in the Netherlands in 2002, is now used internationally to create awareness around the water consumption and pollution of consumer products, within catchments and even countries.

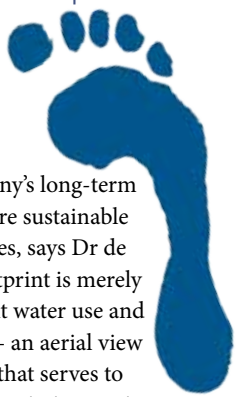
Like similar tools which raise awareness around water use efficiency, the water footprint is becoming increasingly important, especially for South African corporations as they find themselves having to share a scarce resource with the socio-economic needs of a growing population as well as having to meet ecological requirements.

But what is the water footprint and how does it work? According to a new Water Research Commission (WRC) report on the applicability of water footprints in South Africa, a water footprint is an indicator of freshwater use that considers the direct and indirect water required to produce a project, measured over the full supply chain. The report, authored by Elizabeth Hastings and Dr Guy Pegram forms part of a larger WRC project lead by Pegasys Strategic Management into adapting water footprints for South Africa.

"The water footprint concept was developed to raise awareness that for inclusive sustainability management, one should beyond direct water use as the only impact a process, product, producer or consumer has on the water cycle," explains Dr Marieke de Groen of SSI Water Management. The consulting engineering firm now offers water footprint services to South African companies. "As such the water footprint includes the consumption of surface and groundwater (so-called 'blue' water), evapotranspiration of rain water ('green' water), as well as the effect of effluent ('grey' water)."

BENEFITS TO PRIVATE SECTOR

According to Hastings and Dr Pegram, water footprints have the potential to bring new and important decision making into the



water debate in a way that is intuitive and cuts across sectors. "Additionally, water footprints create an opportunity for companies to join a global process of disclosure, understand risk and integrate an understanding of water into planning decisions. With this potential, the concept of water footprints has gained significant traction in the past ten years in the private and public spheres across a variety of sectors."

Much of the corporate risk literature discusses that because corporates use water in operations, they may face water risk in terms of physical limitations, reputational risks, social risks or regulatory risks. Water footprint adds another dimension to this in that it highlights the importance of supply chain water risk, as it indicates not only direct water use but also indirect water use such as that required by raw materials (think of cotton that needs to be grown to manufacture jeans, for example). "Companies are now beginning to understand that the most significant water risk may fall outside of their internal operations and instead be located in their supply chains," the WRC report authors say.

A further benefit is the potential use of the water footprint as a benchmarking tool to understand supply chain water use as a starting point, and track improvements. Water footprinting could assist with benchmarking products within a company or between companies.

In South Africa, where water scarcity is a persistent reality that most companies have to grapple with, using tools such as the water footprint can help them identify their level of vulnerability to current and future water availability, while evaluating the potential contribution of a more environment-friendly way of operation in terms of risks, costs and good stewardship, notes Dr de Groen. "In addition, since water is shared among various users in a catchment, companies can also use the water footprint to determine what their share of water use is and how this is influencing the livelihoods of communities in the areas where the suppliers of the companies are located."

At present, the food and beverage and textile sectors are most active with water footprint assessments, as the tool helps to understand significant upstream supply-chain risks. These are industries with a large reliance on agricultural inputs, which use significant volumes of water. Consumer products and the cosmetics sector, which have large downstream water implications, are also becoming interested.

The WRC report notes that the water footprint concept has not found traction to date in industries such as chemicals or mining. This is most likely due to the fact that direct water use and wastewater from operations are the most significant concerns, rather than water use elsewhere in the supply chain.

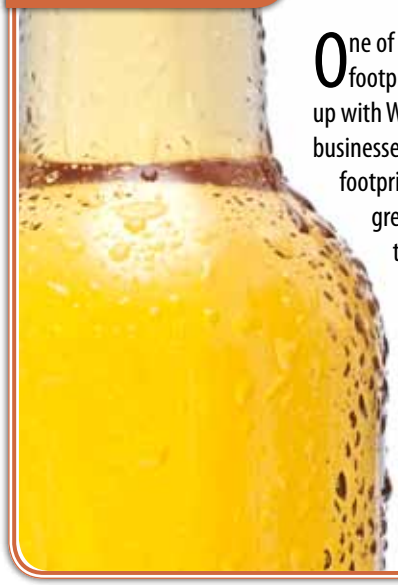
LONG ROAD TO SUSTAINABILITY

It is important for companies to note that undertaking a water footprint exercise alone will not solve its water issues. In fact, calculating the water footprint is but the first step in a company's long-term journey towards more sustainable use of water resources, says Dr de Groen. "A water footprint is merely a snapshot of current water use and effluent generation – an aerial view of current activities that serves to highlight where the main impact is on water use. It still requires detailed assessment as to whether this water use or water pollution is a problem. Once these hotspots have been identified, a company will have to undertake more detailed analysis to enable improvement in these areas."

The challenge is not only to work on potential risks for the quantity and quality of the water supply to the company, but also to determine the environmental, economic and social impact of water consumption of the company. "This will require local assessment of water availability, water demand, water efficiency and water risks. A company that values sustainability will use company risks and opportunities, as well as external impacts in choosing between mitigation measures," notes Dr De Groen.

Water, or the lack of it, is bound to become an increasingly important conversation point within company Board rooms in the near future. As the tightrope between water supply and demand is pulled tauter companies will have take more deliberate steps towards improved sustainability. ❑

FROM WATER DROPS TO DROPS OF BEER



One of South Africa's international players to have their water footprint assessed recently is SAB Miller. The company teamed up with WWF to determine where water is being used in its businesses as well as the context of water use. The total net water footprint for the brewer's South African operations (excluding grey water) was found to be 421 billion litres – equivalent to 155 ℓ of water for every litre of beer produced. The local cultivation of crops was found to be the dominant water consumer at 84,2% while another 14,1% of the water footprint was derived from the cultivation of imported crops. This means that 98,3% of the water footprint of the company is related to the growth of crops. SAB Miller is now considering how it can reduce its risk by exploring water savings initiatives for barley farming.

FROM POLICY TO PRACTICE – Delving into WRM on the ground

Janosch Förster

A broken water reservoir in the Crocodile (West)-Marico water management area.

South Africa's water resource management legislation and policy is among the most progressive in the world, but is it making a difference to the lives of people on the ground? This is the subject of a current study by Monash University's International WaterCentre (IWC).

Supporting some 6,7 million people, the Crocodile (West)-Marico Water Management Area is one of the most populous water management areas in South Africa. This is also the study area selected by PhD researcher Janosch Förster, who is analysing the South African government's integrated water resource management policy, its implementation means and impacts on the vulnerability of local livelihoods.

"Integrated water resource management (IWRM) has become an internationally-renowned and dominant paradigm of water management," explains Förster. "It aims at a holistic way of managing water resources, trying to integrate economic, environmental, political and social factors. However, the socio-political side of water management is highly under-represented in IWRM literature and practical attempts to implement water governance based on this philosophy.

Therefore, Förster hopes that his research will fill in the gap IWRM research by identifying how this theoretical framework could be adapted to form a more effective concept for poverty alleviation and socio-economic development of marginalised poor people in countries such as South Africa.

Förster's project involves the review of relevant government policy documents and legal acts. During this year, he will also be undertaking field research in the Crocodile (West)-Marico catchment, mainly comprising in-depth and focus group interviews with key stakeholders. This includes interviews with large- and small-scale irrigation farmers, relevant national and regional government officials, members and candidates of and for the local parliament, non-governmental organisation employees working on IWRM within the catchment, representatives from the water-related scientific community in South Africa and, crucially, members of local communities.

The current project is an expansion of earlier fieldwork undertaken as part of Förster's Masters Degree in Integrated Water Management Studies at IWC, completed last year. This study mainly involved interviews with relevant stakeholders in South Africa's Crocodile (West)-Marico catchment.

According to the post-grad student, the greatest initial challenge of his research was gaining the trust of people living within his research catchment, particularly the members

of the rural community of Koffiekraal – a major focus area of his studies. "When we first arrived in Koffiekraal, we went to meet with one member of the tribal council whom my research colleague already knew, but he was not there and we were not able to reach him by cellphone. Without him we were practically unknown to the community, and were thus treated as foreigners trying to extract knowledge for work not thought of as valuable by the community. So – reasonably – we were sent away. In the end, as we thought of leaving we got hold of the tribal council member, who allowed us back into the community to ask our questions."

Another difficult task has been pinning down government officials dealing with water governance issues, who have either been too busy or not interested in being interviewed. "Again, luck was on my side in the end. I was invited by one of the local irrigation farmers to attend a meeting of the water user association and nearly all of the government officials I had tried in vain to contact were present there."

Findings from Förster's Masters study showed that South Africa's present water policy did not assist local livelihoods due to a mismatch of political mandate and practical capacity. "Among other initiatives, early government programmes run by non-governmental organisations for the achievement achieved safe water for 6,5 million people in rural areas between 1994 and 2001," noted Förster. "Since then, however, the programmes have lost momentum."

From the results of the study it is obvious that water availability for productive purposes in rural areas is not an official priority in the Crocodile(West)-Marico catchment. The desktop research also indicates that the problem of unequal access to water for productive purposes remains unsolved not only in this water management area, but throughout the country as a whole. That is the first major barrier to the socio-economic development of marginalised poor communities, notes Förster.

"Despite the progressive water legislation, newly established water governance institutions have failed to involve localised marginal low-income groups in the research area in the decision-making process for water management," Förster continues. "Moreover, to some extent they have cemented old power inequalities." This is because marginalised groups do not have the capacity or knowledge to participate adequately and raise their voice.

Janosch Förster

Standing in front of the Marico River are Monash PhD student Janosch Förster with political scientist Sysman Motloung, who among others has served as translator.

According to Förster, newly-established institutions have also failed to involve localised marginalised low-income groups, such as black communities in the research area, in the process of decision-making regarding water management. "There was almost no communication between water authorities and communities. That presents a major barrier to the socio-economic development of marginalised poor communities."

The project is partially financed by the IWC and supported by Monash University South Africa. ❑

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'End of an era' as old KNP river research accommodation demolished

Andrew Deacon

The River Park Homes in 1990. The homes have recently been demolished after outliving their usefulness.

The water sector has bid farewell to an era following the demolition of the so-called 'River Park Homes' at Skukuza, temporary accommodation which served for more than a decade as headquarters for aquatic scientists undertaking river research in the Kruger National Park. Article by Lani van Vuuren.

During the last decade of the 1990s, the River Park Homes accommodated a constant flow of aquatic and other scientists studying the rivers of one of Africa's most iconic national parks. The structures were originally donated by the Department of Water Affairs (DWA) and built at the start of the Kruger National Park Rivers Research Programme (KNPRRP). This programme, which ran between 1990 and 2000, was a highly successful, multi-disciplinary, multi-organisational programme aimed at addressing major concerns about water quantity and quality of the perennial rivers flowing through the Kruger National Park.

It was largely as a result of the effort of former South African National Parks (SANParks) programme manager, Dr Andrew Deacon, that the homes were erected. "At the time I was the logistical coordinator of the KNPRRP, and accommodation was becoming a logistical nightmare since river researchers started to pour into the park to participate in the project," he tells *the Water Wheel*. "On my request the park homes were obtained from DWA by the KNPRRP Management Committee, led by Dr Peter Reid of the Water Research Commission. In my opinion the homes contributed greatly to the success of the programme."

The construction of the homes were supervised by Drs Deacon and Willem Gertenbach, also formerly of SANParks. The first caretaker was Gerhard Strydom, who went to much effort to turn the temporary structures into a real home by planting trees and shrubs. The second caretaker was Dr Pieter Kotze, also known as Piet 'Vis'.

Dr Dirk Roux, SanParks Freshwater Conservation Specialist, who was a junior scientist in the mid-1990s, remembers the River Park Homes as a place to meet with, and learn from, South Africa's greatest thinkers around rivers and river ecology. "It was amazing to see how scientists from different institutions as well as water resource managers worked together to enable improved understanding and more informed management of rivers. Working together included sessions of intense debate, which typically continued long into the night when the participants would move from the lounge area to the communal fireplace for the daily braai."

For Professor Emeritus at the University of KwaZulu-Natal's Department of Environmental Sciences, Charles Breen, the River Park Homes served as a monument to the efforts of aquatic scientists to engage in interdisciplinary research and to be acknowledged for their own contributions. "At the time that the homes were built, the tradition of wildlife research, and more particularly, large animal research, was so entrenched in SANParks and collaborating institutions that research and researchers on aquatic systems had an uphill struggle to gain acceptance," he explains.

"As a result, most of the aquatic researchers felt somewhat alienated from what some considered

Andrew Deacon

Right: *The homes' first caretaker, Gerhard Strydom.*

Far right: *Former Water Research Commission Research Manager, Dr Peter Reid.*

'mainstream research' in the Kruger National Park. The River Park Homes for the first time gave a formal identity to aquatic scientists in the park. This was a very significant step in progress toward overcoming the feeling of alienation that dominated at the start."

As the work of the KNPRRP gained recognition the meaning of the River Park Homes changed subtly. However, while river researchers were increasingly accepted into the fold and gained access to accommodation in the research camp, the homes remained a symbol for many of the struggle that attended attempts to break down disciplinary barriers in research. "I guess, for me the park homes were, in a way, a monument to the efforts of aquatic scientists to engage interdisciplinary research and to be acknowledged for their contributions," says Prof Breen.

Wild animals form the centre of many a story of the river park homes (they were sited in a national park after all). Dr Roux shares one such a story: "I was part of a meeting that continued late into the evening in the lounge area of one of the homes. Among the participants, were Profs Jay O'Keeffe and Kevin Rogers. Sitting around the table our deliberations were frequently interrupted by a hissing sound.

"We looked out the window, but could not work out where the sound was coming from, until Kevin realised it was not coming from outside the house, but from inside. More specifically, the sound was coming from a box under the window right next to him! It turned out to be a snake."

Ever so calm, the group called on Nick Zambatis of SANParks to remove the snake while they

Dirk Roux

Right: *If this braai area could talk it would probably have quite a few stories to tell.*

Far right: *An empty shell was all that remained in the end of the former accommodation for senior academics and water affairs staff.*

Andrew Deacon

Andrew Deacon

continued their meeting. Taking one look at the snake, Nick declared it to be a black mamba and promptly ordered everyone to retreat to a safe distance. "This 'safe distance' turned out to be three metres, and there we stood in a semi-circle watching Nick capture the two metre-long reptile with his snake-catching tool and throw it out the door. Afterwards, Nick said that he did not realise that the snake was quite so large. Did he know, he probably would not have attempted to catch it himself!"

Dr Deacon shares another story which involved a visit to the homes by Dr Salomon Joubert, a former Park Warden of the Kruger National Park. "Arriving back one night Dr Warden found a pride of lions in front of the park home gates. Since it was a narrow area situated between fences, he had to drive them out of the enclosed area with his vehicle before he could get out to open the gate to the homes."

The KNPRRP contributed much to the foundation of the National Water Act and, particularly, the policy around the Reserve. Having a place where people could meet face-to-face and interact and negotiate on neutral ground was critical, notes Dr Roux. "These homes served that purpose for many years. Many individuals continued with this culture of small-group retreats to work on an issue of concern even after the River Park Homes era."

While the homes are now no more, it is hoped that the spirit of cooperation and memories they brought to the South African water sector will live on. Hamba kahle, River Park Homes. ❑

Above left: *Former SANParks Scientific Services manager and instigator of the River Park Homes, Dr Andrew Deacon.*

Above: *Dr Pieter Kotze, also known as Piet 'Vis' was the second caretaker of the homes.*

Dirk Roux

Far left: *Inside the river park homes prior to their demolition. Meetings used to take place in the far corner.*

Left: *It is out of this door that a black mamba was once removed from the homes.*

Water students give back on World Water Day

Monash University

To celebrate the importance of water in our lives students from Monash South Africa studying towards a Masters of Philosophy in Integrated Water Management turned their attention to the Modderfontein Spruit in celebration of World Water Day earlier this year.

Teaming up with organisations such as the Endangered Wildlife Trust, Wildlife and Environmental Society of South Africa, Ecotone Freshwater Consultants, Plastics South Africa and Canoeing South Africa, the students conducted a river health assessment exercise, helped to clean the stream, and monitor invasive plant species found along the river banks on World Water Day earlier this year.

The Modderfontein Spruit passes through the privately-owned Modderfontein Reserve, the second largest urban conservation area in Gauteng. The spruit and other feeder streams form part of the Crocodile (West) Marico Water Management Area.

Modderfontein Reserve is home to some 290 bird and animal species, including the African fish eagle, long crested eagle, crimson breasted shrike, mangoose varieties and African clawless otter. It has aesthetic, historical, and environmental values that support the life and well-being of the surrounding urban area. While the reserve is not completely open to the public, it is envisaged that following a restoration programme, the reserve will

house environmental educational and recreational facilities.

A river health assessment exercise was conducted on this day using MiniSASS – a standardised method of monitoring river health. MiniSASS is a simplified version of the South African Scoring System (SASS), a method that looks at the collection of aquatic macro invertebrates present in a river to determine the overall health of that river system. The principle is that a healthy river will host sensitive macro invertebrates which cannot survive even a light disturbance in quality, while only tolerant species will survive in polluted systems.

Unfortunately, the result of the Modderfontein study was not too satisfying, with results indicating poor to very poor water quality conditions. It is difficult to isolate the source of water pollution, particularly at Modderfontein as it might either come through the underground seepage, not to mention the degree of network complexity – the river network receives stormwater from no less than 11 locations, for example. Further research is recommended on trace pollutants from upstream and downstream sources.

While celebrating World Water Day, it was also a great opportunity to bring to people's attention the invasion of the plant *Acacia baileyana*, commonly known as the Cootamyndra wattle at the Modderfontein spruit. The plant is among the 180 species of invasive alien plants that have been reported in South Africa, covering around 8% of the surface area of the country. These invasive species pose a threat of extinction to the indigenous biodiversity from their habitats, while using significant volumes of scarce water resources.

Cootamundra wattle originates from Australia, and grows in open woodland, stony, hilly country, on clay or clay loam derived from grains. In foreign countries the plant has profound effects on native flora, threatening already vulnerable indigenous species by consuming much oxygen, light, and water from the native vegetation and soil, thus making the soil too dry to support other plant species.

Within the Modderfontein reserve, the invasive plant has the potential to contribute to significant reduction of the stream flow as well as the general reduction of the integrity and capacity of an ecosystem to produce goods and services. Despite these negative effects, the plant can be grown for ornamental purposes, used as fuel wood and its seedlings can also be used a green manure.

In an attempt to control this alien species two groups were constituted; one group working on the mechanical removal of the tree with a tree popper and the other group using selective herbicide. Using a knapsack sprayer, the herbicide was sprayed on the leaves of smaller plants.

Commemorating World Water Day at Modderfontein highlighted the relative difficulty of sustainable water management in urban contexts with competing multiple socio-economic activities. For example, while on site the students had to endure blasting from a nearby explosive testing ground, while the Gautrain railway has been established alongside the reserve. The stream's location within an urbanised realm, coupled with the fact that the Modderfontein Spruit is fragmented by dams, adds to its poor water quality.

Urban conservation areas should be viewed as symbols of environmental awareness to the public and the foundation to building an alternative and better urban future. Hence, conservation areas need healthy river systems to sustain healthy ecosystems and diverse species. ❑

Monash University

Above: *The Monash University Integrated Water Management Masters students who spent their World Water Day giving back to the Modderfontein Spruit. From left to right are Indrawan Prabaharyaka (from Indonesia), Quinex Chiluwe (Malawi), Jackton Obala (Kenya) and Machaya Chomba (Zambia).*

Below: *Monash University Masters student, Quinex Chiluwe, undertaking a river health assessment exercise using the MiniSASS method.*

Monash University

Thousands flock to WISA 2012

The biennial conference of the Water Institute of Southern Africa (WISA) again proved why it is considered a highlight on the South African water calendar. This year's conference, held in Cape Town in May, attracted well over a thousand delegates. A number of topics were covered under the conference theme 'water footprints', including capacity building, education and training; industrial water and effluent; domestic water and wastewater treatment; aquatic ecosystems and governance and institutional affairs, to name but a few. The latest Blue Drop and Green Drop Awards evening was also held during the conference where the best performers in municipal water and wastewater treatment were awarded by the Department of Water Affairs.

All photographs by Lani van Vuuren

Vusi Mahlaba, Pamela Mabece, Vanessa Naidoo, and Solomon Tsheleo, all from Eskom.

Bayanda Zenzile of the Department of Water Affairs (DWA); Zixolisile Gqodo of Intsika Yethu Municipality; Zanele Mapatwana of DWA and Ronald Mambwe of the Cape Peninsula University of Technology.

As usual the WRC stand proved very popular.

Jo Modise and Bobby Naidoo of Vaal University of Technology; Zamakuhle Chauke of the City of Cape Town; and Mahlomola Mehlo of Magalies Water.

Dr Günter Lempert of Aquarius; Dr André van Niekerk of Golder & Associates and Francois le Roux of Ovivo Aqua SA.

SOUTH AFRICAN NATIONAL COMMITTEE ON LARGE DAMS SHORT COURSE

SANCOLD

1 – 3 August 2012

Pietermaritzburg

Advanced Technologies for Construction of Dams and Environmental Considerations during Implementation

About the Short Course

The South African National Committee on Large Dams (SANCOLD) Short Course will be held at the Protea Hotel Hilton, in Hilton, KwaZulu-Natal, between Wednesday 1 and Friday 3 August 2012.

SANCOLD invites all from Africa and the wider family of ICOLD to participate in the short course which will include technical presentations and a technical visit.

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

Programme

Overview
The short course will commence on Wednesday morning 1 August. On Wednesday and Thursday there will be presentations by keynote presenters and of technical papers. A technical visit to the Spring Grove Dam has been arranged for Friday 3 August 2012.

Registration

Short course registration is now open.

In order to register for the short course please complete and return the Registration Form, with payment, by no later than 16 July 2012.

Please note that:
Prices for attendance are detailed on the registration form.
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, please do not hesitate to contact:

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or

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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

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