

THE WATER WHEEL

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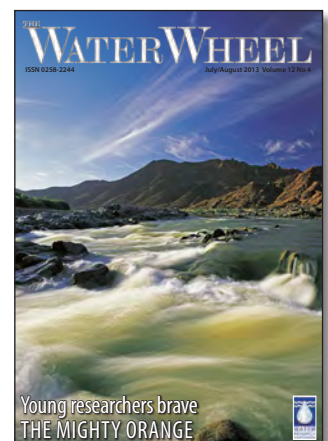
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Cover: *Three young researchers from the University of Cape Town have successfully traversed the Orange River by kayak from source to sea. Read the article on page 14. (Cover photograph by Koos van der Lende/Africa Media Online).*





Mental models for water pricing

South Africans have been in a fierce debate around infrastructure investment shortfalls in public services, such as electricity, roads, housing and water. At the same time, there has been an ever more vigorous dialogue on how these services and infrastructure should be paid for, for example, the Gauteng highway e-toll saga and the ongoing electricity tariff processes, both focusing strongly on the divergence in thinking

on the correct models to use. A new bulk water pricing strategy will soon be gazetted for public comment by the Minister of Water and Environmental Affairs. The finalisation of the raw water tariff model will stimulate a ripple of pricing strategies throughout the system, especially with the move to full implementation of charges for all water users and uses. There is a large body of opinion that supports a higher tariff system in order to sharpen the focus on the scarcity and value of water in South Africa and so entrench a culture of water conservation and demand management. The general outcry in the other direction is that higher tariff structures in the wake of the electricity price hikes, combined with the extremely high food inflation in an environment of slow economic growth and poor employment figures, will simply make water less accessible – this time economically.

The argument is further reinforced by the fact that there are gross inefficiencies in the system. This is clearly illustrated in the latest WRC non-revenue water study (WRC Report No. TT 522/12), which puts South Africa's non-revenue water figure at 36,8% of which only around 25% constitutes physical water loss. At nominal rates the non-revenue water is a R7,2-billion/year of lost revenue. This also means that even in areas where we have efficient reticulation we are losing R2,3-billion/year in revenue through poor water financial management – a combination of metering, billing and

collection deficiencies. One argument is that we should not be talking about increases until these inefficiencies are dealt with. The opposing view is that it requires increased investment to fix the problem, and therefore increased tariffs.

The debate on the margins, like with electricity and e-tolls, will be difficult to resolve amicably. The water pricing debate should be allowed to revisit some of the fundamental principles (see Figure 1).

The first consideration is that of relationship between price and cost. The correlation does not have to be absolute, but it has to be reasonable. The cost calculation has to take a lifecycle perspective of source to use and return to source. There also needs to be an information-rich, sector-by-sector and activity-by-activity differentiation in determining block tariffs that:

1. Subsidises basic needs use,
2. Rewards efficiency practices, and

3. Organises for inefficient and wasteful users to pay high enough tariffs to subsidise the first two categories.

Research can contribute enormously to enable this tariff framework. There is a need for industry sector and activity benchmarks that define the efficiency envelopes from both a water quantity and quality perspective. This would have to be complimented by a sophisticated metering and monitoring infrastructure.

Innovative models using a combination of self-monitoring with official verification would be the methodology of choice in the short term. This suite of interventions would have the net results of higher water use efficiencies, more water availability in the system, a lower pollution burden; all in the environment of the increased water revenues.

The second consideration is that of the long-term view. The National Water Resource

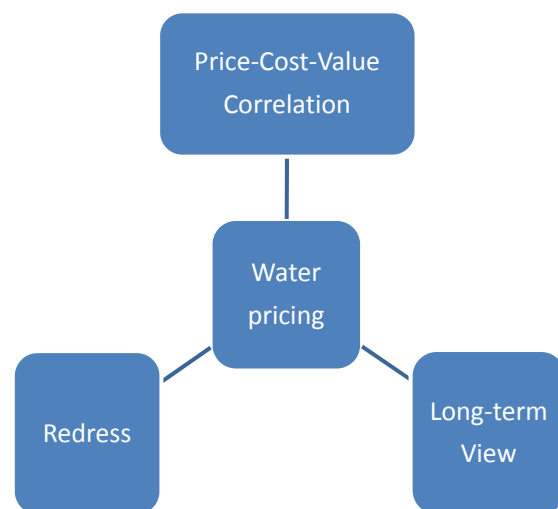


Figure 1 Key considerations in the water pricing debate



Lant van Vuuren

Higher future water tariffs might lead to a higher incidence of municipal service delivery protests.

Strategy 2 and its successors must ensure that South Africa's water capture and storage capacities remain ahead of the curve to ensure that the supply-demand ratio is always greater than one. New infrastructure build must be accompanied by both maintenance and

rehabilitation of existing infrastructure in both the water supply and wastewater treatment domains. The added challenge is to be able to do all of this on lower energy budgets, particularly in wastewater treatment.

The third consideration is that of redress. South Africa

is in the unflattering position of having a very high water Gini coefficient. When we compare the relatively cheap rates for water for most urban domestic and industrial users, with those for folk who do not have formalised services in the peri-urban and rural areas, the differential is stark. The poor of our country that have to walk great distances to rivers, ponds and streams to obtain water, pay the highest costs in our system, if one factors in the opportunity costs associated with these activities.

If one adds the added factors of water quality related risks and the impact of water unavailability on human dignity then the true extent of the large water Gini coefficient becomes apparent. When one extends this analysis to the domain of

lost opportunities associated with economic activity that could not take place due to either the lack of availability or accessibility to water, particularly for the poor and for the marginalised, the need for redress and redistribution as core principles in pricing discourse must be clear and unarguable.

Pricing of water is set to be a core component of South Africa's future water management strategy. It is going to be a central element to the quests to ensure that assurance of supply and the availability of good quality water for growth and sustainable development. If we manage to develop and implement innovative and information rich pricing measures, a water prosperous South Africa is possible and achievable.

Water diary

Young water professionals

July 16-18

The Third Young Water Professionals Conference 2013 will take place in Stellenbosch, Western Cape. The conference is expecting 500 delegates from across Africa and beyond. The conference aims to provide a forum for young researchers and practitioners across the water sector to present and discuss their work and ideas.

Enquiries: Glaudin Kruger (Conference Secretariat); Tel: (028) 316-2905; Email: Kruger@kruger-associates.com or Visit: <http://saywp2013conference.weebly.com/>

Membranes

August 26-29

The 7th International Water Association Specialised Membrane Technology Conference and Exhibition for Water and Wastewater Treatment Reuse will take place in Toronto, Canada. The conference covers the entire range of water-related membrane technology, while providing a platform to present results of the latest research and industrial experience and facilitating close professional linkages among membrane communities and water professionals. Visit: www.mtc2013.org

World water

September 1-6

World Water Week will be held in Stockholm, Sweden, with the theme 'Water Cooperation – Building Partnerships'. Visit: www.worldwaterweek.org

Geology

September 9-11

The Geological Society of South Africa is hosting the GeoHeritage 2013 conference in Oudtshoorn. The Klein Karoo is a domain with a dramatic geological history,

preserved as mountain ranges, deeply incised valleys, ancient land surfaces and caves. The conference includes various excursions to explore this history.

Email: cal@global.co.za or Visit: www.geoheritage.co.za

Aquaculture

September 9-13

The 11th Aquaculture conference of the Aquaculture Association of Southern Africa (AASA) will be held in Stellenbosch in collaboration with the Department of Agriculture, Forestry & Fisheries. The theme for this year's conference is 'Fish Farm to Plate'.

Enquiries: Email: deidre@iafrica.com or Visit: www.conferencesetal.co.za

Water & health

September 15-20

The 17th International Symposium on Health-related Water Microbiology will be held in Florianópolis, Brazil. This is a biennial event organised by the International Water Association Specialist Group on Health-related Water Microbiology. Topics to be covered include water pollution and diseases, microbial source tracking, catchment protection, water reuse and health, microbial biofilms, water and sanitation in developing countries, and microbial risk assessment, among others.

Visit: www.hrwm2013.org

Groundwater

September 17-19

The 13th Biennial Groundwater Division Conference & Exhibition will take place in Durban, with the theme 'Groundwater: A New Paradigm'. Enquiries: Conference Secretariat at Tel: (012) 348-9598; Email: info@gwd.org.za or

Visit: www.gwd.org.za.

Critically endangered frogs find a safe haven at the National Zoo

The National Zoological Gardens of South Africa, in Pretoria, has recently received ten critically endangered Pickergill's reed frogs as part of the first captive breeding conservation programme of these amphibians in southern Africa.

The wild-caught frogs will form part of a breeding programme under the auspices of the African Association of Zoos and Aquaria (PAAZAB). The critically endangered status of these amphibians necessitated the collection of some wild specimens to start the breeding programme. The aim of the breeding programme is to maintain an assurance population in a bio-secure manner, while maintaining the genetic integrity of the captive populations.

This conservation initiative is a collaborative effort between a number of institutions, including Ezemvelo KZN Wildlife, the National Zoo and the Johannesburg Zoo.

Amphibians are the most threatened class of vertebrates. Of the close to 7 000 species on earth, 3 900 are believed to be threatened in some way and 170 species are believed to be extinct.

Pickersgill's reed frogs have been identified as one of South Africa's most endangered amphibians. These tiny frogs (measuring about 3 cm in length) are listed as Critically Endangered by the IUCN's Red List of Threatened Species. In 1996, it was listed as Vulnerable and by 2004 the decline in its numbers had been so rapid that

it was reclassified as Endangered.

This status changed a mere six years later to Critically Endangered as a direct result of, amongst others, habitat destruction of its small

distribution range, habitat fragmentation and drainage of its vital water sources. Some breeding sites are also said to be polluted by DDT used for controlling malarial mosquitoes.

These frogs are endemic to the coastline of KwaZulu-Natal, where there were 19 historically known wild populations.

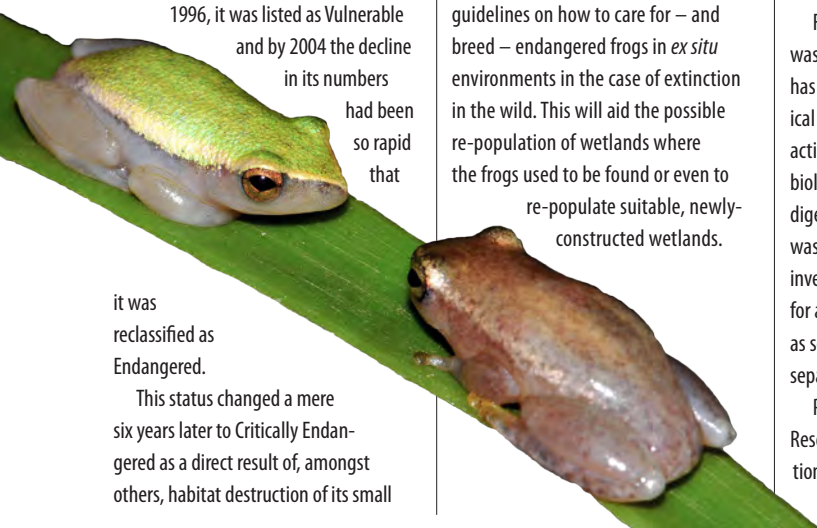
"We are privileged to be playing such an active role in this vitally important conservation project through the receipt of these ten frogs," says Craig Allenby, Marketing Manager of the National Zoo.

A new 'Frog Room' was constructed at the zoo for the sole purpose of housing these rare frogs. The room is bio-secure to prevent the transfer of pathogens to or from the group, in particular the dreaded chytrid fungus and the Rana virus, which have had a devastating influence on frog numbers globally.

As frogs have very porous skin they are extremely vulnerable to changes in water quality, so the Pickergill's reed frogs are given a mix of 'reverse osmosis' water and 'aged water' to maintain optimum conditions for survival and, hopefully, breeding.

Weekly water tests are conducted to ensure water quality. Each enclosure has its own filter system and pumps to keep the water clean, as well as a 'rain chamber' to simulate natural rainfall and maintain the proper humidity levels.

This landmark project will produce guidelines on how to care for – and breed – endangered frogs in *ex situ* environments in the case of extinction in the wild. This will aid the possible re-population of wetlands where the frogs used to be found or even to re-populate suitable, newly-constructed wetlands.



Faecal sludge conference report now available

The conference report for the Second International Faecal Sludge Management Conference, held in Durban in October last year, is now available from the Water Information Network (WIN-SA).

The report is based on information made available at the conference, including individual abstracts and presentations. The conference brought together some 320 policy-makers, scientists and innovators to share ideas and discuss the challenges and opportunities in the business of on-site sanitation.

To order the report, contact WIN-SA at Tel: (012) 330-0340; Email: info@win-sa.org.za or Visit: www.win-sa.org.za



Senior researchers awarded for life-long achievements in water

One of South Africa's most distinguished water researchers, Prof George Ekama, has received the Order of Mapungubwe (Silver) from the South African Presidency for his innovative solutions to enhancing and improving wastewater treatment.

One of the Water Research Commission (WRC) leading researchers since the Seventies, Prof Ekama is a Professor in the Department of Civil Engineering at the University of Cape Town. The Order of Mapungubwe recognises South Africans who have accomplished excellence and exceptional achievement to the benefit of South Africa and beyond.

Focusing on municipal and industrial wastewater treatment, Prof Ekama's work has covered a range of areas, from biological nitrogen and phosphorous removal, activated sludge system modelling, biological sulphate reduction, anaerobic digestion, plant-wide modelling of whole wastewater treatment plans as well as investigating alternatives to desalination for augmenting urban water supply, such as seawater toilet flushing and source separation of urine.

Prof Ekama has held a National Research Foundation A1-rating recognition for more than ten years. He is at the forefront of developments in

wastewater treatment, primarily through his strong research group. Widely published, he has authored more than 150 papers on wastewater treatment in top international journals. He has also supervised 43 Masters and 24 PhD students, thus playing an important role in capacity building in the water science sector.

In related news, leading hydrological and water resource modelling researcher, Prof Denis Hughes, has been awarded the Rhodes University Vice Chancellor's Distinguished Senior Research Award at the university's recent graduation ceremonies. Prof Hughes is the Director of the Institute for Water Research at the same university.

With more than 25 years' experience in hydrological and water resource modelling, Prof Hughes has contributed significantly to the South African water sector. He has led and contributed to numerous research projects funded by the WRC and the Department of Water Affairs.

He currently serves as the national representative and chairman of the South African National Committee for the International Association of Hydrological Sciences (IAHS). He is also the Vice President of the IAHS International Commission on Surface Water.

New head at helm of CSIR environment unit

The CSIR has appointed May Hermanus as the Executive Director of its Natural Resources and the Environment (NRE) research unit. Hermanus assumed her new role on 4 June.

Hermanus is the Director and Adjunct-Professor at the Centre for Sustainability in Mining and Industry (CSMI) at the University of the Witwatersrand where she was responsible for developing a centre of excellence for public education in the fields of occupational safety and health, the environment and sustainable development.

Announcing the appointment, CSIR CEO, Dr Sibusiso Sibisi, said it was an honour for the CSIR to have a person of Hermanus's calibre joining the organisation. "She brings with her vast knowledge and expertise from private and public sector which will add value to our business and also contribute to our mandate of using directed and particularly multidisciplinary research and technological innovation to

better people's lives," he said.

Hermanus holds a degree in geology from the University of Cape Town and an MSc in physical metallurgy. Commenting on her appointment, Hermanus said she was delighted to be joining the CSIR, a premier organisation for technological and scientific innovation, peopled by many path-breaking thinkers. "I have had the privilege of working in interdisciplinary environments for much of my career and look forward to being part of a team producing multi-dimensional solutions and insights to the complex challenges facing our society. In some respects, this move to the CSIR involves, for me, a wonderful sense of continuity in providing further opportunities to interface with colleagues in various industries and tertiary institutions, and also to grapple with the issues of sustainable development. It is a pleasure to step into this new role," she said.

Government, organisations collaborate for biodiversity

Non-governmental organisations, private sector and government entities have united under the umbrella of the new National Biodiversity and Business Network (NBBN).

The aim of the network is to assist businesses from various sectors to integrate and mainstream biodiversity issues into their strategies and operations. It is designed to be an open and inclusive association of like-minded organisations that have recognised the need to raise awareness of, and stimulate conversation about, biodiversity issues among the business community. Founding members include the Endangered Wildlife Trust (EWT), Department of Environmental Affairs, Nedbank, Hatch Goba, De Beers, Transnet, Pam Golding Properties and Pick 'n Pay.

"Government and business are realising that the economic and social development of the country is dependent on healthy ecosystems and biodiversity," noted Dr Marie Parramon-Gurney, EWT Head: Conservation and Business. "The South African

National Development Plan confirms that national economic growth is dependent on the environmental sustainability of our proposed development path. The Plan refers to the need for transformation to ensure environmental sustainability."

South Africa's national resources, including water, wildlife, soil and flora, are essential for the country's development and businesses are, as a consequence, also inextricably linked to the well-being and sustainable use of these resources, NBBN members point out in a statement. "Therefore, the management of natural capital has to become an essential component of the formal risk management and governance of businesses. For organisations to remain competitive, they have to identify their current and future impacts and dependencies on the environment. By doing so in a pro-active and collaborative approach, industry will also be able to identify opportunities related to the management of natural resources."

Major investment to upskill water and energy skills in South Africa

The Stellenbosch University (SU) Water Institute and the Energy and Water Services Sector Education and Training Authority (EWSETA) have signed a Memorandum of Agreement (MoA) to address the critical need for specific technical and management skills in the water and energy sector.

To be phased in over the next three years, the main objective of the programme will be to increase the number of students in scarce-skill areas, such as the water and energy sector at Further Education and Training (FET) colleges in South Africa. There are currently more than 300 000 students in FET colleges, and the Department of Higher Education and Training aims to increase the number to a million students in the near future.

According to Errol Gradwell (left in the accompanying photograph), CEO of EWSETA, there are many obvious reasons why the project is important: "There is an urgent need to align the skills mismatch between that required by industry and what is supplied by our education systems. We also need to develop curricula and

qualifications to serve both the short- and long-term needs of the industry at large." Another important objective of the programme will be to up-skill FET lecturers, increase re-skilling programmes for experienced labour, and up-skill middle to senior managers, he explains.

SU Vice-rector (Research and Innovation) Prof Eugene Cloete (right in the accompanying photograph), said that the Water Institute was honoured to be entrusted with the development of this programme. The programme is also in line with the university's vision for 2030, and supports the broader higher education objectives of the country.

According to the MoA, SU will establish a Water and Energy Programme Office to coordinate the overarching project and manage research and development through to the implementation phase. With funding of R5,7-million for phase one of the project, experts from the Water Institute will be roped in to conduct an educational needs analysis for FET colleges over the next 12 to 15 months, with training of FET lecturers starting in 2014 as part of phase 2.



Sasol, WRC cements culture of working together

The partnership between South Africa's foremost integrated energy and chemical company and national water research and development agency is bound to realise the utmost expertise to drive the water-energy-nexus in South Africa.

This is according to Deputy Minister of Water & Environmental Affairs, Rejoice Mabudafhasi. She was commenting on the strategic partnership signed between Sasol and the Water Research Commission earlier this year. She also assured the parties of the support from the Department of Water Affairs (DWA) towards the partnership.

The agreement coincided with the launch of Sasol's Water Sense campaign, aimed at aligning the group's water stewardship practices as its various operations around the world. According to Sasol Executive Director of Sustainability and Business Transformation, Nolitha Fakude, Sasol Water Sense is the international platform from which water-related actions are coordinated and responded to, whether they are water security regulatory risks associated with being a large industrial water user, or

assisting surrounding communities in improving their water management practices.

The group has already started implementing site specific water use efficiency targets for its operations in Sasolburg and Secunda, operations that see it accounting for 4% of the integrated Vaal River system. This represents 80% of Sasol's global water requirements. In this way, the group's total water use decreased from 151 million m³ in 2011 to 148 million m³ in 2012. "We recycled nearly 143 million m³ of water in 2012 compared to 128 million m³ in 2011," Fakude said.

The partnership between Sasol and the WRC will see both parties collaborate on finding new technologies and opportunities to conserve water in South Africa. Speaking at the event, WRC CEO, Dhesigen Naidoo, said: "Through this agreement we want to fortify our science, technology and innovation partnership to ensure a higher input of knowledge and workable technologies to empower responsible water citizenship at all levels so as to ensure a water successful future for our country."

Under the agreement a joint research commission will be established to oversee and monitor the partnership and seek out new opportunities for collaboration on other water conservation matters. Sasol Technology will offer the use of some of its research and development piloting facilities in Sasolburg and Secunda to researchers and academics funded by the WRC for research in conjunction with Sasol Technology teams.

The agreement will include, among others, collaboration in the following key research areas:

- Climate change;
- Water resource availability and accessibility;
- Catchment management and water quality improvement;
- Water footprinting and best

practices for the private and public sectors;

- Water conservation and water demand management;
- Technological development for the treatment and management of water, wastewater and residual byproducts;
- Ecosystem remediation and rehabilitation; and
- Groundwater impacts, vulnerability and remediation.

In related news, Sasol also signed a partnership agreement with the Department of Basic Education in the Free State and DWA. The partnership, known as project Busa Metsi, will seek to minimise water losses at schools and educate learners on the importance of water conservation. A total of 16 schools will



WRC CEO, Dhesigen Naidoo.



WRC CEO, Dhesigen Naidoo with Sasol New Energy MD, Henri Loubser.



Deputy Minister of Water & Environmental Affairs, Rejoice Mabudafhasi.

initially benefit from the project.

“One of the most important pillars to ensure security of

water supply in resource-scarce South Africa is that all water decision-making at all levels are informed by very good water science and technology,” said Naidoo. “The expression to responsible citizenship by Sasol through this water stewardship

is a very important pillar of ensuring South Africa’s water security. And Sasol has gone one step further by using its mechanisms, know-how and talent to help communities and individuals to also be good water citizens. As we already start experiencing the further challenges of climate change, this social compact between responsible corporate citizens with communities is the real bastion against water insecurity in South Africa.”



WRC CEO, Dhesigen Naidoo and Deputy Minister of Water & Environmental Affairs, Rejoice Mabudafhasi.



Sasol Executive Director, Nolitha Fakude.

Water diary (continued)

Water and social media

September 26-27

International Water Conferences, supported by the IWA, is hosting a gathering in Amsterdam to focus on the use of social media and customer connection in the water sector. During this conference international experts will talk about how water companies can use social media. Email: wsm@iwconferences.com or Visit: www.iwconferences.com

Water & development

October 14-17

The next International Water Association Development Congress & Exhibition will take place in Nairobi, Kenya. The conference will focus on practical solutions that work on the ground to achieve universal access to water and sanitation services. Visit: www.iwa2013nairobi.org

Wetlands

October 22-25

The 2013 National Wetlands Indaba will be held at the Cape St Francis Resort, in the Eastern Cape. The theme for this year’s event is ‘Wetlands as Ecological Infrastructure’. Visit: <http://indaba2013.wetlands.zanet>

Green technology

October 20-23

The Membrane Technology Division and Southern African Industrial Water Division of the Water Institute of Southern Africa (WISA) are joining forces to host a Green Technology Conference at the Legend Golf & Safari Lodge, in Limpopo. The theme of the conference is ‘Green technology for today’s industry’. Enquiries: Shelley-Ann Abrahams (registration) at Email: shelley@soafrica.com or Carina du Plessis (sponsorship and exhibition) at Email: carina@soafrica.com or Tel: (011) 463-5085 or Visit: www.wisagt2013.co.za

Municipal engineering

October 23-25

The 2013 Conference of the Institute of Municipal Engineering in Southern Africa

(IMESA) will be held at The Boardwalk Hotel & Conference Centre in Port Elizabeth with the theme ‘Municipal Engineering: Meeting Peoples’ Needs’. Enquiries: Debbie Anderson (Conference Secretariat); Tel: (031) 266-3263; Email: conference@imesa.org.za; Visit: www.imesa.org.za

Large dams

November 5-7

The South African National Committee on Large Dams (SANCOLD) is hosting a conference on ‘Advances in Dam Technology for Water and Energy in Southern Africa’ at the Black Mountain Hotel in Thaba N’chu, Maria Moroka Nature Reserve. Enquiries: Merentia Meyer; Tel: (021) 808-4352; Email: merentia@sun.ac.za; Visit: www.sancold.co.za

Ecosystem health

November 20-21

North West University is hosting its fourth Annual Eco Health Research Forum at Golden Gate Highlands National Park, Clarens. The theme for this year’s conference is ‘Multidisciplinary Reflections on Environment, Health and Well-being Research in Southern Africa’. Enquiries: Yolandi Krone (Conference administrator); Email: yolandi.yevents@gmail.com; Cell: 082 553 6463.

Young water professionals

December 9-11

The Third East African Young Water Professionals Association Conference will take place in Nairobi, Kenya, with the theme ‘Securing our water and energy resources in the face of climate change’. Email: keywpa@gmail.com

Water loss

March 30 –April 2

The International Water Association Water (IWA) Loss 2014 Conference will be held in Vienna, Austria. This is the sixth event in a series of IWA water loss reduction speciality conferences, following on a successful conference held in the Philippines in 2012. Enquiries: Conference Secretariat, Email: 2014committee@iwa-waterloss.org; Visit: www.iwa-waterloss.org/2014/cms/

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WWW.GWD.ORG.ZA



Groundwater: A NEW PARADIGM

Durban | South Africa | 17-19 September 2013
13th Biennial Ground Water Division Conference and Exhibition

The **Ground Water Division** of the Geological Society of South Africa is excited to host its 13th Biennial Conference in Durban this year. The Conference with its strong developmental agenda offers a unique opportunity for students, academics, specialists and decision-makers to be part of this expert forum to be hosted for its 1st time in KwaZulu-Natal. Delegates will not only be afforded insight into regional challenges and solutions, but are invited to join in the discussion panels and networking sessions that form part of the overall exciting Conference programme.



CONTACT US TO FIND OUT ABOUT AVAILABLE SPONSORSHIP OPPORTUNITIES.
Student Sponsorship available to enable more of our students to participate in this Conference!

EXHIBITION STANDS available @R11,400 (incl. VAT) Packages include pricing for 2 exhibitors. **DON'T MISS OUT**

Some highlights of the Conference include:

Pre-Conference Technical Tour

This planned one-day tour will commence with a visit to the Two Streams Research Catchment, one of the few remaining small catchment research areas in South Africa, to be followed by stop-overs at both the Lilani and Shu Shu Thermal Springs.

Short course on groundwater exploration

The course will offer insights (and divulge some expert "secrets") into the different techniques for different environments when exploring for groundwater.

Workshop on Groundwater & Municipalities:

This accredited workshop will introduce delegates to the resource and cover additional topics in sessions on costing and development, monitoring, management and treatment.

WRC Dialogue Session: Karoo Aquifers and Unconventional Gas Exploration

At this dedicated plenary session speakers will share local case studies. A moderated panel discussion will offer a platform for wide participation.



Be sure to attend the parallel sessions structured around the following themes:

Groundwater and the Environment; Groundwater in the SADC Region; Groundwater and Mining, Groundwater Governance; Monitoring, Data & Information Management; Knowledge gaps and Innovations; Groundwater and Springs and Case Studies

EARLY-BIRD REGISTRATION CLOSES 31 JULY 2013!

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Water resources study successfully completes first year

The first year of what promises to be the most accurate national water resource assessment of South Africa yet has been successfully completed. The Water Resources 2012 study (WR2012), funded by the Water Research Commission (WRC), is the sixth comprehensive national water resource assessment to be undertaken in South Africa.

The study is being executed by a consortium of consulting engineering firms, led by Royal Haskoning DHV (RHDHV). Its main objective is to assist decision-makers at all levels of government to make informed choices about policies concerning South Africa's water resources. One of the most important aspects of the study is the improvements being made to the WRSM 2000 catchment model, which is widely used in the South African water resource assessment process.

"The WRSM 2000 model is undergoing some major improvements," reports project leader Allan Bailey from RHDHV. "As this model has links to the models of the Department of Water Affairs for analysing yield of dams (WRYM model) and future planning (WRPM model), it is extremely important that all three models are continually improved.

Enhancements to the WRSM2000 model include the inclusion of a number of statistical graphs for checking the consistency of catchment rainfall and natural streamflow and storage yield; grouping of runoff models with similar hydrology for more rapid calibration; addition of an observed storage trace to the reservoir plot so that reservoirs with only storage data can be calibrated; extended time series output link to the WRYM model which now has the Sami surface water-groundwater interface; time series of groundwater abstractions; and added daily time step functionality for both naturalised runoff at any point in

a network adjusted for land use.

WR2012 will also for the first time create a publicly-accessible, Web-based and interactive reporting system to continually quantify both the surface and groundwater resources of South Africa. According to WRC Research Manager, Wandile Nomqophu, it was originally planned for the website to only be up and running once the project was completed in 2016, but the high level of interest in the information the project has to offer has prompted the Commission to move the date forward. It is now hoped to have the website functional before the end of the year.

Among others, the level of detail of water resources information has been broadened by including more information on reservoirs, land use/water use and other aspects compared to the previous water resource study, WR2005. New spreadsheets have been compiled which provide details of this land use/water use, which will make the future updating easier. The project also intends to incorporate recent work by other consultants on various catchments, and to update all data at least up to the 2009/2010 hydrological year.

Other progress for the year include the creation of land use/water use

spreadsheets for all 19 water management areas, with worksheets with data on dams, abstractions and return flows, irrigation, alien vegetation and afforestation. The project team has also started determining the optimal monitoring requirements in terms of rainfall, observed streamflow and reservoir records.

Bailey has completed courses on the newly improved WRSM2000 model at several universities, with great success. The purpose of the course is to make attendees aware of the various water resource models available, and how to set up and use the WRSM2000 model for a water resources system.

DEARTH OF DATA

Deteriorating monitoring of South Africa's rain and rivers remain the biggest challenge to the successful completion of the project. Spatially representative, long-term consistent records of rainfall and streamflow data are essential for achieving a high level of understanding about water resources. *The Water Wheel* reported on hydrologists' concern last year regarding the steep decline in rainfall and streamflow data in South Africa in recent years. ("Taking on the

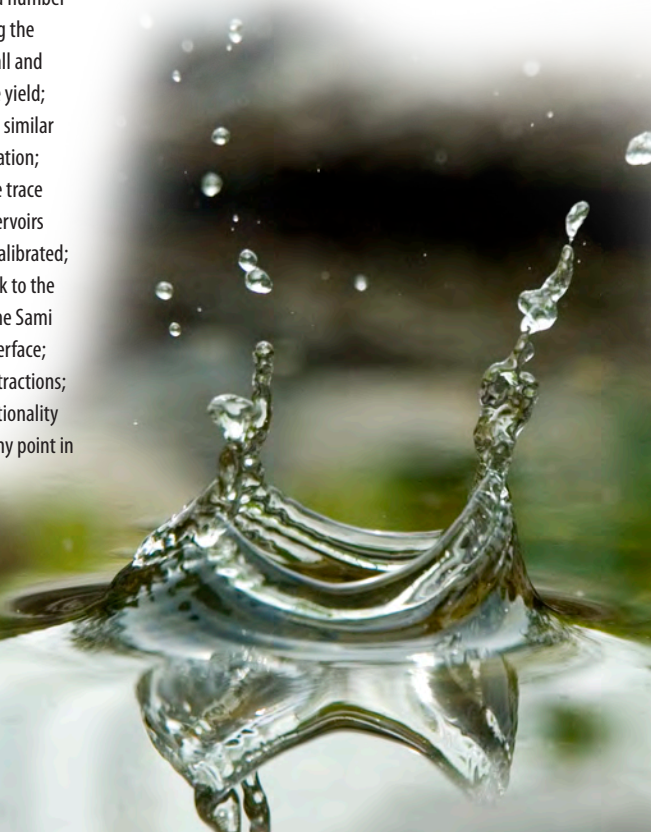
challenges of water resource assessment', *the Water Wheel* May/June 2012).

Good quality data are a serious impediment to the sustainable management of South Africa's water resources, reports Nomqophu. "Not only are the observation networks shrinking, the quality is deteriorating. Apart from the troubling rainfall and streamflow data issues, which have been reported on, the research team has also discovered that reservoir data records – key to analysing the water resources of South Africa – have declined alarmingly, with quite a number of missing data and suspect readings."

The WR2012 project is not the only research project suffering as a lack of quality, reliable data. Other hydrology-related WRC-funded research projects have reported similar concerns, and there have been calls from the hydrology community for the WRC to intervene. Discussions with data collecting agencies have revealed sharp budget cuts for water data collection as well as shrinking human capacity. "The budget figures mentioned are hardly enough to maintain a few data stations, let alone a national observation network," says Nomqophu.

Some data collection agencies, such as the South African Weather Service, have begun selling the data to make up funds to maintain data monitoring networks. Obtaining data for research that is in the interest of the country (for example, climate change) has now become an expensive exercise. It has been recommended that a task team be formed to address the issue, and this recommendation is now being pursued. The WRC is also looking to establish a central home for water data from all its projects where hydrological data is collected.

WR2012 is due for completion in April, 2016.



New from the WRC

Report No. 1906/1/12

A short-term heavy rainfall forecasting system for South Africa with first implementation over the Gauteng Province (LL Dyson; CJ Engelbrecht; K Turner; S Landman)

The project set out to develop an ingredients-based rainfall forecasting system for the summer rainfall areas of South Africa and specifically the Gauteng Province. Daily rainfall climatology was developed for Gauteng in order to better understand heavy rainfall over the province. Several sounding derived parameters were calculated for Irene and this was consequently used to investigate the thermodynamic conditions associated with heavy rainfall over Gauteng. A lightning climatology was constructed over Gauteng and the lightning characteristics associated with heavy rainfall were identified.

Report No. KV 303/12

Microbial pathogens in the Umngeni River, South Africa (J Lin; A Ganesh; M Singh)

As water demands increase, there are some concerns that need to be addressed to ensure protection of public health and the health of the environment. South Africa's water resources have been under increasing threat of pollution due to rapid demographic changes, which have coincided with the establishment of informal human settlements. Public water systems rely on bacterial indicators (i.e. coliforms) for monitoring water quality. However, it has been shown that bacterial indicators are often poorly correlated with the presence of other microorganisms.

Report No. KV 309/12

Soil-plant carbon stocks in the Weatherley catchment eight years after conversion from grassland to forestry (RM Lebenya, CW van Huyssteen & CC du Preez)

Soil and vegetation play a vital role in the global carbon cycle because carbon exchange is affected by both. Thus change in land use may result in either a loss or gain of carbon in the soil-plant system. This study was conducted in the Weatherley catchment in the northern Eastern Cape province, a former grassland area.

Before afforestation, a baseline study on soil organic matter was conducted on the areas designated for a selection of tree species. This study was a continuation of the aforementioned study with the aim to quantify the soil and biomass carbon stocks eight years after afforestation.

Report No. 1883/1/12

Natural organic matter in drinking water sources: Its characterisation and treatability (J Haarhoff; B Mamba; R Krause; S van Staden; T Nkambule; S Dlamini; KP Lobanga; F Corry)

The design of potable water treatment plants is conventionally based on physical and microbial properties of the raw water, such as colour, turbidity, odour, pathogenic bacteria and others. A relatively recent addition to this list is natural organic matter, normally crudely quantified as total organic carbon. Natural organic matter is, however, not a stand-alone problem, but affects water quality in many ways. It could be responsible for the colour, undesirable taste and odour of natural waters, it is a source of nutrients for heterotrophic bacteria, it inhibits precipitation processes which form the backbone of drinking water treatment, and so on. Without a deeper understanding of natural organic matter in South African raw water supplies, and its treatability by different treatment technologies, water treatment plant design and operation will not be able to deal with increasing natural organic matter levels in a predictable and satisfactory way. This project aimed to close this knowledge gap.

Report No. TT 436/12

Wetland Health and Importance Research Programme Volume 4: Development of a tool for assessment of the environmental

condition of wetlands using macrophytes (F Corry)

This report is one of the outputs of the Wetland Health and Importance research programme, funded by the WRC. The programme represents Phase II of the National Wetlands Research Programme, and was broadly aimed at assessing wetland environmental condition and socio-economic importance. Vegetation has proven useful as indicators of the present environmental state of wetlands. This study was a first attempt at creating a comprehensive phyto-assessment of wetland condition for South Africa.

Report No. 1805/1/12

The development and testing of an integrated hydro-economic model to evaluate the financial impact of curtailment decisions on a farm case study in the Crocodile catchment (B Grové; M Frezghi; A Pott & N Lecler)

In water-scarce South Africa, water is already over-allocated in many catchment areas. Water managers will try to address the over-allocation so as to meet the assurances of water supply required by the various water-user and water-use sectors in the catchment. The Second Edition of the National Water Resource Strategy emphasises the need for 'smart water management' to complement traditional engineering and technology-based approaches to water management. Smart water management entails, among others, the inclusion of business principles and sustainability into water management – with strong stakeholder involvement in the planning

and managing of water resources. An important stakeholder group in the water sector is irrigated agriculture, which accounts for around 62% of all surface- and groundwater use in the country. In many instances, irrigated agriculture is seen as a

potential source of water for reallocation to other water-use sectors due to the perceived inefficiencies and potential to achieve water savings. Currently, the Mhlathuze catchment is undergoing compulsory licensing to reconcile imbalances in that catchment. The research reported in this document contributes towards improved decision-making and operational management at both catchment and water user association level, through the development of an integrated hydro-economic modelling framework. This framework allows water managers to test various catchment-scale water management scenarios on irrigators' security of water supply and the resulting impact on irrigation farming profitability and livelihoods.

Report No. 1898/1/11

Water use optimisation in industry: Development of a mathematical model for wastewater minimisation in a multipurpose batch plant (T Majazi; O Adekola; D Nonyane)

The nature of products produced from batch chemical plants is generally such that the effluent generated is extremely toxic. The quality and purity specifications of products from pharmaceutical industries require that the cleaning operation of the processing units be strictly controlled. Consequently, large volumes of solvents and cleaning agents are commonly used, this leading to high liquid waste volume. From these observations, it is desirable to minimise the production of such effluent at worst and eliminate it at best. Two unique investigations were considered in this report. The aim of the first investigation was to develop a mathematical technique to minimise wastewater generation in multipurpose batch processes operated over a long time horizon, i.e. industrial-scale problems, with significantly reduced computational difficulties. The aim of the second investigation was to develop a wastewater minimisation methodology that incorporates wastewater generation in batch plants.



Report No. 1937/1/11

Beneficiation of agri-industry effluents. Extraction of anti-oxidation phenolics from apple and citrus wastewaters coupled with fermentation of residual sugars to ethanol or other value-added products (SG Burton; C Mupure; KA Horne; S Jones & P Welz)

Fruit processing industries produce a considerable amount of wastewater which must be treated before the water is discharged. Beneficiation of this wastewater has potential economic and environmental benefits. Fruit processing wastewater contains phenolic compounds and polyphenols that have antioxidant activity and other valuable properties. These, and other compounds in the wastewater, have many commercial applications and thus it is worth investigating methods for their recovery. This research, among others, characterised complex wastes from fruit industries; developed and customised new extraction processes for obtaining antioxidants; investigated and optimised fermentation of residuals after extraction; and investigated commercialisation aspects.

Report No. 2017/1/12

User acceptance and functioning of mobile communal sanitation facilities in informal settlements of South Africa (A Lagardien; C Muanda & A Benjamin)

The provision of water and sanitation services to previously unserved communities is a South African development priority. In recent years, a strong drive from the South African government to attain basic water and sanitation throughout the country has been widely applauded and acknowledged in all communities. In order to reach this target, several sanitation technologies, including mobile communal sanitation facilities have been developed and implemented countrywide. However, it has been found that technical innovations often lack sustainability due to a lack of attention, provision and implementation of adequate operational requirements and community involvement. This study draws on local and international experience and investigates the approaches to evaluation in the context of the three case studies in informal settlements in order to develop a framework that can be used

to assess mobile communal sanitation facilities acceptance and functioning from user perspectives.

Report No. KV 299/12

A preliminary study to identify pathology present in fish in the lower Olifants River following a large crocodile mortality event (KDA Huchzermeyer)

Pansteatitis is a nutritional disease that follows on consumption of large amounts of polyunsaturated fats. The reduction in tissue vitamin E levels associated with such a diet is exacerbated where dietary fats have become rancid. In the Kruger National Park (KNP), pansteatitis in fish and crocodiles has been shown to be a serious and increasing problem in large man-made lakes fed by rivers arising in polluted catchments. The objective of this study was to identify the range of pathologies present in fish in the lower Olifants and Letaba rivers within the KNP, to determine the significance of these pathologies in terms of pollution and the development of pansteatitis in crocodiles, to differentiate such pathologies from non-pollution related pathology as would be expected in free-living fish in these rivers and to identify improved sacrificial and non-sacrificial methods of monitoring the fish health in KNP rivers.

Report No. 1527/1/12

Floating media flocculation as re-treatment for capillary ultrafiltration in drinking water treatment (EP Jacobs; SM Bradshaw; B Brika; IH Verster; VL Pillay)

This project resulted from a study conducted at the Nahoon Dam of Amatola Water, where the operability and performance of a locally fabricated capillary ultrafiltration process was evaluated on turbid water. The pretreatment technique used, coagulation followed by floating media flocculation, proved sufficient and the study on drinking water provision using high-turbidity water as feed was successfully concluded. However, problems were experienced in securing filter media suitable for the floating media flocculation process. A follow-up study was then launched to, among others, develop floating media separation (FMS) media of uniform size and fixed negative and positive residual charge; develop

FMS media with enhanced adsorption capacity and different specific gravities; develop compounding formulae including foaming and bubble agents to prepare closed-cell floating media with different specific gravities and enhanced adsorption capacity; and develop a protocol to maximise bed-shear during short-interval backwash to increase the net water production rate of FMS.

Report No. 2005/1/12

Optimisation of waste stabilisation ponds by combining duckweed-based and algal-based systems (G Pockock; H Joubert)

Wastewater stabilisation pond technology is one of the most important natural methods for wastewater treatment, especially in rural areas. This study aimed to develop a conceptual process design for a combined system, based on laboratory-scale experimental work. After conducting a thorough literature review it was found that while there was a wealth of information available on the design considerations for algal pond systems, there was a lack of information on duckweed-based systems, particularly with respect to the optimal growth conditions, expected nutrient uptake rates and recommended harvesting rates for removal of nutrients from the system. This study therefore focused on duckweed-based treatment.

DVD: A Journey into the use of social franchising principles in water services operation and maintenance – The Eastern Cape experience

This three-part DVD provides a quick visual overview of the experiences and lessons from a three-year collaborative project which piloted a social franchising partnership approach to the operation and/or maintenance of infrastructure. Based on pioneering research funded by the WRC, and with funding from Irish Aid and the support of the Eastern Cape Department of Education and Amatole District Municipality, the pilot successfully services (i.e. undertook the routine maintenance) of the sanitation facilities at nearly 400 schools in the Butterworth district, and the toilets of 400 households in Govan Mbeki Village, Idutywa, Eastern Cape.

DVD Nr. TT 517/12

Ethnographic research methods to better understand household water practices (I van den Berg & S Slabbert)

It is, for several valid reasons a challenge to obtain valid, reliable data from rural populations. Research instruments are often not suitable for use among rural communities because of their design. The problem with data collection may be further impaired by the fact that many rural people are functionally illiterate. The WRC initiated a study aimed to test the viability of an ethnographic participative technique, i.e. the use of digital media in the form of a video camera, to do research about water-related issues in rural communities. In addition, its intention was to inform communication and education campaigns aimed at effective water management.

Report No. 1924/1/12

The application of choice modelling techniques to guide the management of estuaries in South Africa – Case studies at the Sundays, Kromme, Nahoon and Gonubie River estuaries (SG Hosking – Editor)

There have developed two complementary schools of thought in South Africa on the management of its estuaries. One, motivated by the National Water Act of 1998, advocates resource directed measures and has its focus of attention on interventions to secure the minimum natural resource requirements for ecosystem functioning. The other view, motivated by the pursuit of efficiency and welfare, advocates for an economic approach to allocating and managing ecosystem goods and services. The latter views the generation of credible values for environmental goods as an important guide to their social management. This project is a contribution to the economic school of thought on managing estuaries. It builds on and extends the research objectives of a previous WRC report and presumes an important management challenge of estuaries to be optimising current welfare



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Prof Tor Ove Leikness of the Department of Hydraulic and Environmental Engineering, Norwegian University of Science and Technology has confirmed his participation as a keynote speaker

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values subject to constraints. The primary aim of this project was to generate information that assists managers toward making efficient choices.

Report No. 1960/1/12

Extreme events: Past and future changes in the attributes of extreme rainfall and the dynamics of their driving processes (CJ Lennard; L Coop; D Morison; R Grandlin)

Extreme rainfall events are often associated with significant societal and infrastructural impacts through human and animal fatalities, damage to or loss of property, loss of agricultural products, and flood insurance claims which are worth millions of Rands annually. Several studies have shown an increase in the intensity of extreme rainfall over many regions of South Africa as well as spatial heterogeneity in these changes, especially in the Eastern Cape, southern Free State and parts of KwaZulu-Natal. This study investigated changes in the characteristics of extreme rainfall by establishing relationships between existing station data and the daily synoptic states. Among others, the project team addressed the dynamical aspect of extreme rainfall in contemporary climate to provide a process-based understanding of observed changes in extreme rainfall, and built a basis for understanding future projected changes.

Report No. TT 480/12

uThukela water infrastructure refurbishment – A case study (H du Preez; A Toerien & P Dama-Fakir)

Significant improvements to existing wastewater treatment plants were achieved by uThukela Water. These improvements were achieved through a combination of refurbishment, retrofitting and replacement of equipment. The purpose of this study was to ensure that the experience gained by uThukela Water during the refurbishment and upgrades at

the wastewater treatment plants of the Amajuba and Umzinyathi Water Services Authorities is documented and disseminated to other municipalities and people working in the water industry.

Report No. 2086/1/12

Assessing the impact of expansion of bulk infrastructure on the capital requirements of water boards (K Walsh)

Water boards were established under the Water Services Act of 1997 to provide bulk water to other water services institutions and to serve as water services providers when contracted by municipalities. A number of recent initiatives have been aimed at expanding the operations of Water Boards. Expanding the areas of activity of water boards will have an impact on their financial viability, most notably on capital expenditure requirements. As a result, the WRC appointed PDG to conduct research on the impact of expansion of bulk infrastructure on the capital requirements of water boards. The project involved two main streams of work. The first stream focused on modelling the impact of expanding areas of activity on the financial viability of water boards; the second on identifying indicators for assessing the ability of water boards to access capital finance, particularly under expansion.

Report No. 1925/1/12

Establishing the fishery potential of Lake Nandoni in the Luvuvhu River, Limpopo Province (PSO Fouché; W Vlok; JC Roos; W Luus-Powell & A Jooste)

It is often stated that inland fisheries can provide an essential contribution to local and regional economies as well as sustain livelihoods. South Africa's reservoirs potentially contain fish that can be utilised as a source of food but historically these fish resources were not considered as a source of protein and as such are not commercially harvested. This project determined the fisheries potential of Lake Nandoni, in Limpopo. The main aims were to gather data on the aspects regarding the biological, ecological and physical aspects of fish in the lake so that this could be used as a guideline for a management plan for inland fisheries.

Report No. 1779/1/12

An economic analysis of the contribution of water use to value chains in agriculture (H Jordaan & B Grové)

Despite the commitment from government and the investments made to assist emerging farmers from small-holder irrigation schemes to be integrated into commercial agri-food chains, actual success stories where emerging farmers are successfully operating in commercial agri-food chains are scarce. The small number of success stories means that the objective to allow farmers to improve their livelihoods through irrigated agriculture is not met. It is noted that access to agricultural water plays a necessary role in increasing productivity, but access to water alone is not a sufficient condition to enhance productivity and alleviate poverty. The farmers have to generate sufficient levels of income from their irrigation activities in order to alleviate poverty. The main objectives of this WRC-funded project were to, among others, develop a conceptual framework based on a literature review on value-chain analysis with specific reference to water utilisation and competitiveness in agriculture; to demonstrate the application of the framework for commercial and emerging agriculture in the horticulture and field crop industries; to determine the research approach, method and models for analysis of value chains with application to commercial and emerging agriculture; and to empirically analyse and model selected value chains.

Report No. 1913/1/12

Modelled sea-surface temperature scenario considerations and southern Africa seasonal rainfall and temperature predictability (AF Beraki; WA Landman; DG de Witt; C Olivier; K Mathole & T Ndarana)

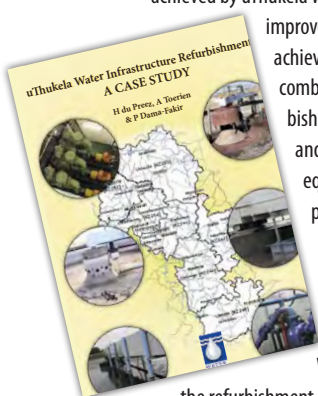
The prediction of a high-impact weather event such as a flash flood or a heat wave for particular days at a certain location several months ahead has no usable skill. However, there is some skill in predicting the anomalies in the seasonal average of the weather. The main objectives of this project were to, firstly, investigate an optimal model configuration that

includes the best available description of the surface boundary conditions as reflected in projected global sea surface temperatures, in order to force atmospheric general circulation models to produce seasonal rainfall and temperature forecasts over South Africa at lead times of several months. Secondly, the project was to develop a global sea surface temperature forecast product that includes probabilistic forecasts of El Niño and El Niña events, and lastly to conduct a comprehensive comparative analysis between a one-tiered and a two-tiered forecasting system.

Report No. KV 302/12

An evolution of the ecological flow requirements of South Africa's estuaries from a hydrodynamics perspective (L van Niekerk; S Taljaard; P Huizinga; AK Theron; SM Bergman; R van Ballegooyen)

An estuary is largely determined by the river flow it receives in all its variability from major floods to low flows. Changes in river flow in principle will affect the functioning and production of an estuary, and ultimately the ecosystem service society derived from them. The recognition that estuaries need freshwater to maintain their health and productivity and the methodology on how to determine their ecological flow requirements is a relatively new field of study. Three main countries have developed environmental flow assessment methods for estuaries, i.e. South Africa, Australia and the USA. Methods have mostly developed from practical applications, a learning-by-doing approach, with most approaches including elements of risk assessment and adaptive management. This document sets out to describe the development of the South African ecological flow requirement methods from a hydrodynamic perspective, with an emphasis on the last decade – 2000 to 2010. The document reviews the historical development of the method. It discusses the approaches to evaluating berm heights, mouth conditions, water levels and salinity ranges. The document concludes with some recommendations for future updates of the estuary ecological flow requirement methods in South Africa.



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Crocodile nerves 'super sensitive' US scientists find



Crocodilians have nerves on their faces that are so sensitive, they can detect a change in a pond when a single drop hits the water surface several feet away.

Alligators and crocodiles use these 'invisible whiskers' to detect prey when hunting. Now, a new study from the Missouri University (MU) has measured the nerves responsible for this function, which will help biologists understand how today's animals, as well as dinosaurs and crocodiles that lived millions of years ago, interact with the environment around them.

"The trigeminal nerve is the nerve responsible for detection of sensations of the face," said Casey Holliday, assistant Professor of anatomy in the MU School of Medicine. "While we have known about these sensitive nerves in crocodiles, we have never measured the size of the nerve bundle, or ganglion, in their skulls, until now. When compared to humans, this trigeminal nerve in crocodiles is huge."

The key to this measurement is a specific hole in the skull. The trigeminal

nerve is rooted inside the skull, but must travel through a large hole before it branches out to reach the crocodile's skin on its face. By examining how the skull size, brain size and ganglion size relate to each other, scientists can estimate how sensitive the face is. Eventually, Holliday hopes to measure this nerve in other ancient and contemporary species to learn more about animal behaviour.

Holliday says that this information will aid future research, including when his team will examine skulls of ancient crocodiles. Understanding this nerve and its functions could also lead to better understanding of the anatomical basis for behaviour in many living animals, including fish, electric eels, platypi and humans. "The same way that we would look at the size of the visual cortex in the brain to understand how well an animal might see, we can now look at the trigeminal nerve in animals to determine how sensitive their skin on their faces is," Holliday said.

The study was published in *The Anatomical Record*.

Call for papers open for international water congress

The Call for Papers is open for the International Water Association World Water Congress & Exhibition to be held in Lisbon, Portugal, on 21-26 September, 2014.

The organisers are looking for contributions under various session themes to present global best practice, advances in fundamental science, innovative research, policy developments and solutions to challenges faced by water professionals worldwide. Themes include, among

others, cities and basins of the future, protecting human and environmental health, water policy and governance, water reuse and resource recovery, innovative water supply and wastewater technologies, utility management, information and communication technology and new industrial water management, technologies and processes.

The call closes on 30 September, 2013. For more information, Visit: www.iwa2014lisbon.org/

NASA study projects warming-driven changes in global rainfall

A NASA-led modelling study provides new evidence that global warming may increase the risk for extreme rainfall and drought.

The study shows for the first time how rising carbon dioxide concentrations could affect the entire range of rainfall types on Earth. Analysis of computer simulations from 14 climate models indicates wet regions of the world, such as the equatorial Pacific Ocean and Asian monsoon regions, will see increases in heavy precipitation because of warming resulting from projected increases in carbon dioxide levels. Arid land areas outside the tropics and many regions with moderate rainfall could become drier.

The analysis provides a new assessment of global warming's impacts on precipitation patterns around the world. "In response to carbon dioxide-induced warming, the global water cycle undergoes a gigantic competition for moisture resulting in a global pattern of increased heavy rain, decreased moderate rain, and prolonged droughts in certain regions, said William Lau of NASA's Goddard Space Flight Centre and lead author of the study.

The models project for every 1 degree Fahrenheit of carbon dioxide-induced warming, heavy rainfall will increase globally by 3,9% and light rain will increase globally by 1%. However, total rainfall is not projected to change much because moderate rainfall will decrease globally by 1,4%.

The models also project for every degree Fahrenheit of warming, the length of periods with no rain will increase globally by 2,6%. In the Southern Hemisphere, drought becomes more likely in South Africa, northwestern Australia, coastal Central America and northeastern Brazil.

"Large changes in moderate rainfall, as well as prolonged no-rain events, can have the most impact on society because they occur in regions where most people live," Lau said. "Ironically, the regions of heavier rainfall, except for the Asian monsoon, may have the smallest societal impact because they usually occur over the ocean."

Source: NASA

New apps tackle sanitation challenges

Mobile phone and web applications that enable people to talk to local policymakers and allow children to learn through games have won a competition for technological innovation that addresses sanitation problems in developing countries.

The three winners of the World Bank's Sanitation App Challenge – mSchool, SunClean and Taarifa – were selected from ten finalists. Each app was assessed on its originality, quality of user interface, technical feasibility, economic viability, how it tackles an identified problem and the team effort involved in its development.

One of the winners, mSchool, is a text-messaging tool that allows students, parents and teachers to report sanitation breakdowns and repairs required in schools. The tool was developed in Senegal as a platform for monitoring sanitation conditions in schools.

Another winning app, Taarifa, allows people in developing nations to link up with their local government, and is already in use in Uganda. This open-source app allows communities to report and address local sanitation issues by collecting and visualising information, and enables public officials to respond.

The last of the winners, SunClean, was developed by students at the University of Indonesia. It uses games to teach children about waste disposal and hand-washing.

Source: SciDev.net



Team of scientists mapping Africa's abandoned mines

A team of 50 geoscientists are mapping the impact of mining on human and environmental health in sub-Saharan Africa.

The project is being undertaken under the International Geoscience Programme of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), with funding from Sweden.

According to UNESCO magazine, *World of Science*, the team is compiling a database and using geographical information systems to elaborate precise maps of the location of all abandoned mines in sub-Saharan Africa. At selected sites, they will study and document the rate at which specific toxic trace elements are absorbed by the soils, plants, fungi, surface and groundwater, as well as by animals and humans via the food chain.

Samples collected from the site of major derelict mines are being analysed by the laboratories of participating institutions. Different technologies are also being tested to ascertain which give the best results for rehabilitating sites contaminated by trace metals.

On the basis of their findings, the team will then advise governments and local authorities on the best available remediation technologies and on land-use planning. It is also planned to prepare a policy brief and other materials for decision-makers.

Mining operations contribute more than 20% of gross domestic product in sub-Saharan Africa. "Like agriculture, mining is crucial for the region's economy," observes project leader Sadrack Toteu. "Decades of mining has polluted surface- and groundwater, soil and food crops. Moreover, in many countries the danger is compounded by the

lack of a precise inventory of abandoned and derelict mines. The surveys and impact assessments we are conducting will reveal the true extent of metal pollutants across the continent and their impact on human and animal health, the environment and ecosystems.

For more information, Email: sf.toteu@unesco.org

UNESCO opens access to all publications

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has made its digital publications available to millions of people around the world free-of-charge with an open license.

This follows a decision by the organisation's Executive Board in April. UNESCO has become the first member of the United Nations to adopt such an open access policy for its publications. The new policy means that anyone will be able to download, translate, adapt, distribute, and re-share UNESCO publications and data without paying.

"Researchers from all countries, but especially from developing and least developed countries will benefit and capitalise on open access to knowledge," said Janis Karlkins, UNESCO's Assistant Director-General for Communications and Information. "Our new policy will enable us to increase the visibility, accessibility, and rapid distribution of our publications."

By adopting this new publishing policy, UNESCO aligns its practice to its advocacy work in favour of open access and strengthens its commitment to the universal access to information and knowledge.

Starting from July, hundreds of downloadable digital UNESCO publications will be available to users through a new Open Access Repository with a multilingual interface. All new publications will be released with an open license. UNESCO will also seek ways to apply it retroactively, i.e. to works already published.

Some 2,4 billion will lack improved sanitation in 2015

Some 2,4-billion people – one third of the world's population – will remain without access to improved sanitation in 2015, according to a joint report issued by the World Health Organisation (WHO) and the United Nations Children's Fund (UNICEF).

The report, titled Progress on Sanitation and Drinking Water 2013 Update, warns that, at the current rate of progress, the 2015 Millennium Development Goal target of halving the proportion of the 1990 population without sanitation will be missed by 8% – or half a billion people.

While UNICEF and WHO announced last year that the MDG drinking water target had been met and surpassed by 2010, the challenge to improve sanitation and reach those in need has led to a consolidated call for action to accelerate progress. "There is an urgent need to ensure all the necessary pieces are in place so the world can accelerate progress and reach the MDG sanitation target," noted Dr Maria Neira, WHO Director for Public Health and Environment. "The world can turn around and transform the lives of millions that still do not have access to basic sanitation."

Among the key findings of the latest 2011 data, the report highlights the fact that one billion people still defecate in the open, while another 761 million share sanitation facilities and 693 million use facilities that do not meet minimum standards of hygiene.

To access the report and associated data, Visit: www.wwinfo.org.



Water by numbers

90% – The percentage of water-related natural disasters out of 2 557 between 1991 and 2000, according to the United Nations.

480-million – The volume of kilolitres of water lost in Gauteng in the last financial year, costing the province R8-billion, according to questions answered by the Gauteng Local Government and Housing Minister, Ntombi Mekgwe, in the provincial legislature. The main reasons for the loss were a lack of skilled staff, ageing infrastructure, a lack of information, and tariffs not reflecting the full costs of delivering water, it was reported.

2 278-million – The remaining number of households in South Africa that don't have access to safe sanitation, according to the Department of Human Settlements.

20 MW – The capacity of the proposed hydroelectricity plant in the Au-grabies National Park. The proposed project could see hydroelectricity from the Orange River Falls being used to supply electricity to nearby Kakamas, *Beeld* reported.

2 000 – The estimated number of vacancies for civil engineering professionals in local authorities, according to the South African Institution of Civil Engineering. According to the institution, the country's municipalities have been losing an average of 70 to 90 engineering staff per year since the late 1980s.

R671-billion – The amount required over the next ten years to meet South Africa's water infrastructure needs across the entire water value chain, according to Minister of Water & Environmental Affairs, Edna Molewa.



Courtesy Senqu2Sea team

Scientists brave SA's mightiest river to kayak from source to sea

When Irrigation Department Director, Dr Alfred Dale Lewis, explored the lower reaches of the Orange River in December 1913 he walked most of the 400 km-long journey in one of the hottest years on record. Now nearly a century later, three young researchers of the University of Cape Town (UCT) have completed a similar adventure, traversing South Africa's mightiest river in kayaks from its source in the Lesotho mountains to its mouth on the West Coast of South Africa. Lani van Vuuren caught up with them following the completion of their 2 000-km journey.

While not as substantial as its cousin, the Zambezi, to the north, South Africa's largest river has always captured the imagination of those who gazed upon it. Local Khoi named it the Gariiep, meaning 'big water' or 'great river', while the San's name for it meant 'Dragon River'. It was European commander, Colonel Robert Gordon, who gave the river its 'royal' name, naming the river after Dutch ruler, Prince William of Orange, 300 years ago.

For Masters graduate Sam Jack, PhD student, James Puttick, and, statistical science lecturer, Ian Durbach, the river offered the adventure of a lifetime as well as a chance

to undertake rare extensive field research. "The Orange is the iconic South African river – long, ancient and traversing varied and incredibly beautiful scenery, from grass mountain highlands to rocky desert. We wanted to spend an extended period in nature, experiencing a long rather than a technically difficult adventure," explains the team.

VALUABLE RESEARCH

While enjoying the scenery the team also took time to undertake vital on-site research. With funding provided by the Plant Conservation Unit at UCT and the South African Environmental

Observation Network (SAEON) Arid Lands Node the team was able to undertake a true river mega-transect. These snapshots of entire river systems are becoming increasingly important due to the need for baseline monitoring in the face of unpredictable changes due to future climate change.

Photographic data, which consists of high resolution landscape panoramas, were taken at 40 km intervals, while photographs of the riparian vegetation were taken at 2 km intervals. This collection of photographic data forms a priceless baseline for monitoring vegetation and landscape change along the Senqu (as the river is known in Lesotho) and Orange River. The GPS position of photographs will allow future visitors to retake the images or allow comparison with historical images and assessment of the degree of landscape change in terms of, for example, development on the river banks and extent/composition of vegetation.

Diatom samples were also collected as part of a SAEON-sponsored project led by Dr Jonathan Taylor at North West University. Diatom data will hopefully shed some light on the status of present water quality along the length of the river. In addition, numerous diatom sampling locations were selected to coincide with points which had been previously sampled to enable comparisons to be made with regards to changes in water quality over time.

The team also collected water samples for an oxygen isotope project led by Roger Diamond of the Geology Department at UCT. These data are interesting for exploring the different conditions that exist within different tributaries' watersheds during rainfall events.

HIGHS AND LOWS

The team set off from Qachas Nek, in Lesotho, on 14 January and arrived at the Mouth at Alexander Bay just over two months later, on 16 March. They travelled

“The Orange is the iconic South African river – long, ancient and traversing varied and incredibly beautiful scenery.”



An example of dirty unfiltered water (left) and clean filtered drinking water (right).

Courtesy Senqu2Sea team

an average of 40 km a day. An average day would see the team on the river around 08:00 and covering 20 km before breaking for lunch, then another 20 km before the late afternoon glare would force them to start looking for a suitable campsite. “Usually any flattish patch large enough for three would do, there

were few days when we struggled to find a good grassy site,” James tells *the Water Wheel*.

Jack, Puttick and Durbach would then spend the remaining few hours of daylight carrying out the scientific programme and taking care of chores. “There was surprisingly little spare time,” says Durbach.

Local Lesotho youngsters take a closer look at the team's diatom sampling efforts.



Courtesy Senqu2Sea team

While finding a place to spend the night was easy, finding clean water was not. Obtaining sediment free drinking water was a challenge, particularly in Lesotho, where the water in the main channel was heavily silt-laden. This required laborious daily filtering sessions.

The longest stretch paddled in a single day was about 62 km, paddling hard to reach the luxury of the Felix Unite camp near Noordoewer. The team resupplied their foodstocks whenever passing through or close to small towns, generally every three to five days. The longest stretch between resupply points was about ten days from the start of the journey in Lesotho, to Aliwal North.

The team's travel blog reveals many tales of adventure, from broken paddles and lost gear, to hot days, monkey thieves, and thunderstorm nights. The team learnt by bitter experience how to keep their equipment safe and dry – sometimes learning the hard way.

In general, the Orange River proved kind to the kayakers. "Some sections, for example, dams, took longer than expected, but we were generally able to make up time on other sections," Puttick explains. The team portaged around the Gariep and Vanderkloof dam walls; a handful of weirs deemed too dangerous to run; and a couple of waterfalls.

"One can paddle 99% of the Orange River system, but it helps to have some prior knowledge of obstacles along the way, such as

"All this data amounts to a thoroughly and carefully captured snapshot of the Orange River system; it is something we are quite proud of."

weirs with a bad reputation, tricky rapids, the location of waterfalls and the preferred passage through sections where the river is highly braided," notes Puttick. "Navigation through braided sections of the river was sometimes slow and tricky. It forced us to be patient and made us appreciate the wide open channel when it finally arrived at the other end."

The most physically demanding stretches were the Gariep and Vanderkloof dams, due to the lack of flow and occasional headwinds accompanied by choppy water. The stretch from Augrabies to Noordoewer was also tough due to consistently high temperatures (upper 40s)



and hot winds, which often persisted throughout the night.

Any hardship was soon rewarded by breathtaking scenery, from enormous sheer cliffs, stately quiver tree forests, to unusual wild animal sightings and the sight of huge storm systems brewing.

VALUABLE DATA

The team returned home with a mountain of data, which will take some weeks to work through. A total of 61 diatom and water samples were collected; 53 isotope samples taken in tributaries of, and within, the Orange River, well over 1 400 GPS locations of interest, including around 500 water abstraction points and around 700 fish eagle, goliath heron and giant kingfisher sightings.

The team also recorded and photographed the location of all significant bird nesting colonies along the length of the river, as well as mining activity. Hundreds of points record the location of fishing

activity, starting from the town of Aliwal North. In addition, Puttick studiously recorded bird species observed on a daily basis, amounting to a continuous record of species presence along the entire length of the river. These data will form the basis for several popular articles and specific data to be sent to experts in the relevant fields.

A significant observation was the extremely heavy silt load carried by the river during the rainy season, especially in the upper portion. The team happened to pass one of the

tributaries, the Makheleng River, while it was in flood. “It had the colour and consistency of chocolate milkshake,” Jack says. “Sediment inflow such as this is projected to decrease the storage capacity of Gariep Dam by 80% by 2050.”

The team also clearly observed the effect weirs and dams have had



on the natural ecology of the Orange River system, mainly by evening out the natural variability of flow in the river. Apart from influencing the natural aquatic ecosystem, this has impacted the river's ability to flush itself out every few years during flood events. Alien invasive

plants were found to dominate portions of the riparian vegetation in places. Despite these impacts the water quality below the Gariiep Dam appeared reasonably good.

"All this data amounts to a thoroughly and carefully captured snapshot of the Orange River system;

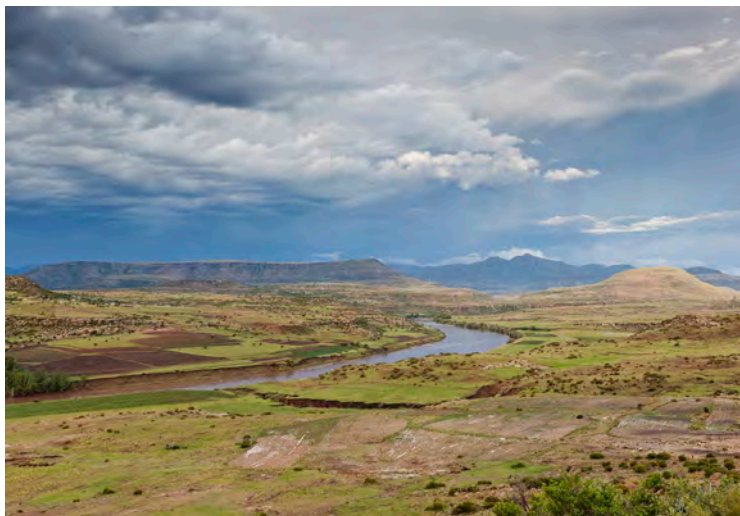
it is something we are quite proud of," says Puttick. "We hope it will be of much use as a baseline dataset and as a resource to current and future researchers of the Orange River system." SAEON and the Plant Conservation Unit at UCT will be primary repositories for the data.

- To read more about the team's exploits visit their Blog at www.senqu2sea.wordpress.com

Top right: Daily water samples reflect how silt loads vary in the river, mostly influenced by precipitation events.

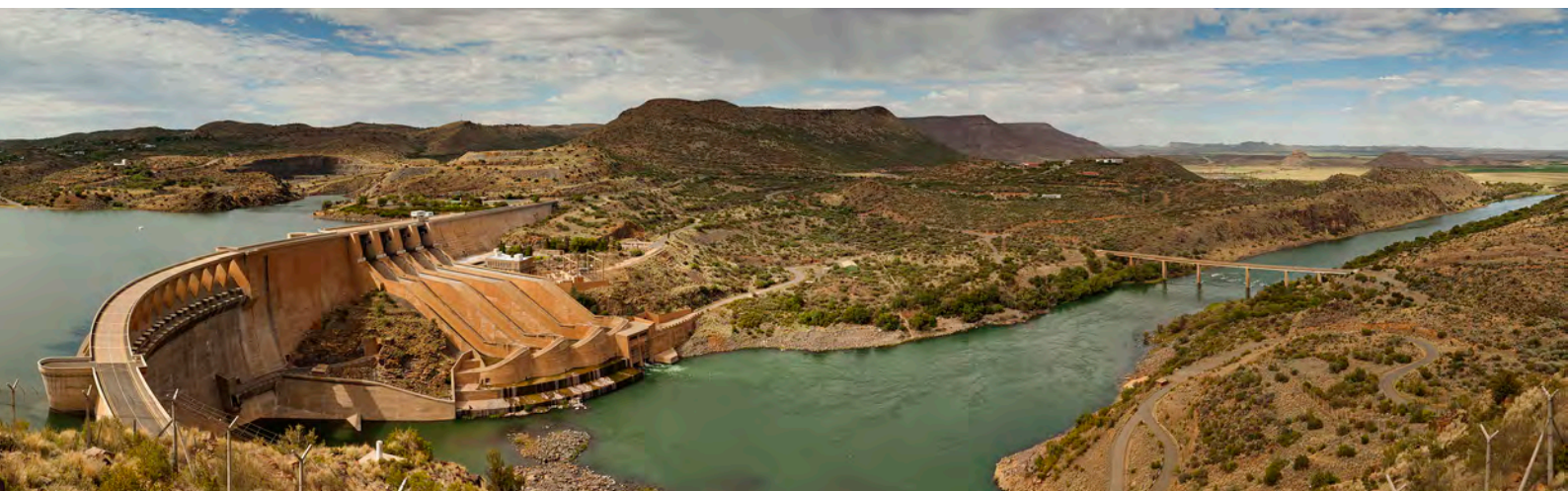
Middle right: The team was struck by the scenery in Lesotho which indicated a heavy utilised land, with heavy siltation into the river as a result of erosion.


Below: The Vanderkloof Dam wall – the highest in South Africa. Dams provide vital water for agriculture, human consumption and hydroelectricity but have a major effect on the downstream ecology and natural cycles of the Orange River.



LESSONS LEARNT AFTER TRAVERSING SOUTH AFRICA'S LARGEST RIVER

- Even a task which seems insurmountably large – like navigating a river more than 2 000 km long – is possible if one just chips away one small piece at a time.
- South African people remain generous and willing to help complete strangers at the drop of a hat.
- Humour and laughter are the best elements of a long journey. They help relieve tension and anxiety and bond people together.
- There is beauty and purity in a simpler life, closer to nature. Our country is enormously diverse, in people and cultures, in landscapes, vegetation, and geology.
- Never leave home without your harmonica.



An aerial photograph showing a river with a thick, bright green layer of algae or sediment covering its surface. The river flows through a dense, lush green forest. The water's color contrasts sharply with the surrounding vegetation.

Investing in ecological infrastructure for our FUTURE WATER SECURITY

The South African government has promised massive infrastructure roll-out as part of its objective to improve the lives of its citizens. Aquatic scientists have called on authorities not to disregard the services of the country's natural 'infrastructure'.

Article by Petro Kotzé.

“Ecological infrastructure is the nature-based equivalent of built or hard infrastructure, and is just as important for providing services and underpinning socio-economic development.”

It is no secret that South Africa faces challenges to guarantee future water security. Government is gaining ground on providing basic needs like freshwater (the percentage of households with no access to piped water decreased to 9% in 2011), but a booming population growth will add more burden to an already stressed system. According to the 2011 census, the country’s population has increased with 7 million people in the last decade alone. The latest report of the Department of Water Affairs’ (DWA’s) Green Drop certification programme, published in 2011, once again highlighted the challenges most municipalities face in terms of achieving excellence in sewage treatment and management. Only 40 sewage treatment works achieved Green Drop awards, with 20 of the previous 33 recipients ‘falling off the wagon’ and losing their Green Drop status.

Furthermore, projections would have it that there will be a 32% increase in water demand in South Africa within the next few decades, while 98% of our surface water has already been allocated. These challenges are exacerbated by deteriorating water quality and failing infrastructure.

To address these difficulties, the South African government is planning to invest in massive infrastructure development. A National Infrastructure Plan was announced in 2012, which intends to transform our economic landscape while simultaneously creating significant numbers of new jobs, and strengthening the delivery of basic services. The 20-year plan involves as much as R4-trillion to be spent on infrastructure development projects. This includes R573-billion for water provision infrastructure and R30-billion to rehabilitate abandoned mines.

Development of such magnitude is often seen as a competing interest to that of our environment – development of the one must necessarily be at the cost of the other. “Yet, it cannot be an either-or choice,” says

Dr Jeanne Nel, principal scientist at CSIR Natural Resources and the Environment (NRE). Earlier this year she delivered the keynote address at the Grasslands Partners Forum. Her address touched on some of the work undertaken as part of the CSIR’s Project on Ecosystem Services (ProEcoServ) funded by the Global Environment Facility (GEF) and coordinated by the United Nations Environment Programme. The topic addressed the importance of ecological infrastructure as an integral part of the answer to future development in South Africa.

WHAT IS ECOLOGICAL INFRASTRUCTURE?

Ecological infrastructure refers to functioning ecosystems that deliver valuable services to people,

such as freshwater, climate regulation, soil formation and disaster risk reduction. It is the nature-based equivalent of built or hard infrastructure, and is just as important for providing services and underpinning socio-economic development. Key elements of ecological infrastructure are located in rural areas where the restoration or maintenance of these systems contributes to rural livelihoods. Sectors such as farming and tourism will be bolstered, but the actions of restoration and maintenance in itself already involves direct job creation.

Yet, the infrastructure provided by healthy ecosystems is often not recognised. These include healthy mountain catchments, rivers, wetlands, coastal dunes and nodes and corridors of natural habitat, which together form a network of



Jeanne Nel



Nebo Jovanovic

interconnected structural elements in the landscape. Strategic investment in ecological infrastructure lengthens the life of existing built infrastructure and can reduce the need for additional built infrastructure – often with significant cost savings. Examples include river or filter strips that absorb pollutants and provide habitat for our biodiversity or healthy rivers that can fix themselves by absorbing pollutants.

A CATCHMENT IN TROUBLE

The Olifants River catchment, stretching across Mpumalanga and Limpopo, is a prime example of a system where considerable investment is needed to improve water quality and service delivery. It also serves as an example of where investment in a combination of ecological and built infrastructure could support the various improvements that are needed.

This catchment is exposed to extreme degrees of pressures from multiple sources. While South Africa is the fifth-largest coal producer in the world, the bulk of this production is from the Witbank coalfields. This catchment is home to the second-largest irrigation scheme in South Africa. Over half of the

vegetables of a major food company are grown here, and the area supports a R1-billion export market in crop production. Land uses here include intensive feedlots and the catchment supports large quantities of animals, resulting in huge amounts of animal waste.

There are also widespread impacts due to abandoned opencast coal mines, which release acid water containing toxic heavy metals that need to be removed. The impact of the mining outflow is far-reaching. Dose response studies by the CSIR's Dr Bettina Genthe show increased cancer risk, while a higher reporting of more general medical symptoms are evident in mining areas. As a result of the decreasing water quality, the treatment of water for drinking and power generation is very expensive.

Agricultural and urban outflows, rich in nutrients (particularly phosphorus and nitrogen), have also caused large algal blooms in water bodies (eutrophication). Today, many of the dams in the area are eutrophic or borderline eutrophic. The sources of these high nutrients are both point-sources such as wastewater treatment works and non-point sources (due to runoff that ends up back in the river after flowing over fertilized fields or intense feedlots with lots of dung).



Above: Abandoned opencast coal mines can result in widespread impacts, including acid water with toxic heavy metals that need to be removed. Photographed is the heavily impacted Brugspruit.

Left: Left to right, Dr Sibusiso Sibisi (CSIR CEO), Dr Harrison Pienaar (CSIR NRE) and Johan Beukes (CoalTech Research Association) get their feet wet in a very hard-working part of the upper Olifants River as CSIR water quality researcher, Tsungai Zengeya, demonstrates his fish-sampling techniques.

Right: Ideally, the phosphorus loadings of sensitive river stretches should be reduced first.



Jeanne Nel

WHAT SOLUTIONS CAN SCIENCE OFFER?

Dr Nel presented various options where science can help provide the solution to these problems. “Compared to just monitoring water quality, which has been the previous focus and really only describes a depressing problem, our research now offers new, tangible and strategic things we can actually do about the problem”, she says.

MAINTAIN EXISTING ECOLOGICAL INFRASTRUCTURE

Using the Freshwater Ecosystem Priority Areas (FEPAs) identified for all of South Africa provides a good starting point for pinpointing valuable ecological infrastructure in the Olifants River catchment. FEPAs identified in the catchment often pinpoint the smaller tributaries (e.g. Blyde and Mochlapiitse rivers), which tend to be in better condition than the hard-working Olifants River mainstem. These smaller tributaries not only provide excellent opportunities for conservation, but also support the sustainability of hard-working rivers further downstream, such as the Olifants mainstem, by diluting poor water quality and ‘flushing’ pollutants. Rather than degrade the few remaining FEPAs we have in the Olifants, we should see them as existing ecological infrastructure whose healthy

functioning provides an opportunity to complement built infrastructure solutions through filtering and flushing pollutants.

Indeed, throughout South Africa, the use of healthy tributaries to support hard-working mainstem rivers is an important realisation. The National Freshwater Ecosystem Priority Areas project (NFEPA) – the project that identified priority rivers and wetlands – found that 57% of tributaries in South Africa are in a good condition, compared to only 35% of large mainstem rivers. Another important aspect highlighted by this project is the need for a more strategic planning approach to resource utilisation. Of particular concern is the proliferation of mining and prospecting rights applications in ecological sensitive areas that are critical for the provision of valuable ecosystem services, such as good quality water. The lodging of applications in headwaters of catchments that are a national source of drinking water and which are also important conservation areas is of grave concern. This is especially critical considering that only 8% of South Africa’s land area generates 50% of the country’s river flow.

UNDERSTAND THE DRIVERS OF PHOSPHORUS LOADING AT CATCHMENT SCALE

“There are multiples pressures that contribute to the phosphorus

loading in a system,” explains Dr Nel, and fixing point sources in an ad hoc manner is not necessarily the most strategic way to go about restoring water quality.

Dr James Dabrowski from the CSIR NRE has applied the Soil Water Assessment Tool (SWAT model) to help identify the sources of phosphorus loading at a catchment scale. The model estimates phosphorus loads originating from point and non-point sources in each sub-catchment. While the model is still in the process of being refined, preliminary results indicate that non-point sources can be as important a source of phosphorus as point sources.

If the national effluent standard of 1 mg/l ortho-phosphate at sewage works was met, the phosphate loads in the Witbank and Loskop Dams can, for example, be reduced by almost a half. A further reduction to the international standard of 0.1 mg/l does, however, not result in a substantially lower reduction. In this instance, the potential positive effect of reduced phosphorus loading at point-sources (sewage works) is masked by the amount of phosphorus that originates from non-point sources.

Once this dynamic is understood, science can help to develop the most effective phosphorus reduction strategies. “The key is to understand the load and be strategic about it,” Dr Nel says. The solution is thus not necessarily only investing in built infrastructure like sewage works, but also in initiatives such as enforcing setback lines when agricultural activities take place next to rivers. Ideally, the phosphorus loads of sensitive river stretches should be reduced first. “Go to the catchment and find the most offending areas and target them first,” advises Dr Nel.

Guidance is also offered by the phosphorus sensitivity index developed by Dr Paul Oberholster of CSIR NRE. According to this index, bedrock streams are particularly sensitive, while sand or mud bottomed rivers are less sensitive. The sensitive

Activities, such as farming, mining and industrial development, affect the ability of rivers to filter and flush pollutants, resulting in poor quality water. People in rural poor areas often benefit least from the economic development, but suffer the consequences most.



Jeanne Nel

areas where attention should be given first would logically include areas where sewage works discharge into, or cattle drinking points and feedlots are located close to, cobble or bedrock streams.

RESTORE WETLAND FUNCTIONS

Wetlands filter out sediment and pollutants. A team of CSIR water quality specialists, led by Dr Klaudia Schachtschneider, are now also studying the uptake of heavy metals by indigenous wetland and riparian plants in the upper Olifants.

“We are hoping to build on this work through a project funded by CoalTech Research Association focused on the restoration of the Zaalklappruut wetlands located in a mining-impacted area”, says Dr Nel. Together with CoalTech Research Association, researchers from South African National Biodiversity Institute, CSIR and the Water Research Commission are bringing their knowledge together, in order to restore this wetland. Impacted by acid mine drainage (AMD), this wetland was selected on the basis of helping to protect the Wilge River from AMD. Work is set to proceed soon. The restoration work will include planting indigenous wetland plants that can filter out heavy metals.

“We are hoping to extend our work on heavy metal uptake to developing a practical manual or guideline for restoration practitioners on indigenous plants that can effectively remove heavy metals, says Dr Nel. “CSIR is only now beginning its practical work on plant uptake of nitrogen and phosphorus.”

It thus seems as if indigenous plants that sequester nutrients can help with technical solutions, particularly in rural areas. Here, limited knowledge and funds are often constraints to operational maintenance of high-tech infrastructure. Combining them with ecological solutions might provide a cost-effective long-term option.

SETTLING PONDS FOR SEWAGE WORKS

In the Tubatse sewage works in the rural areas of Limpopo, the settling ponds have not been cleared of plants. If there was cement lining in the past, it is now cracked and has disappeared in places. “We think that plants that have established there are fulfilling the very important function of filtering out nutrients,” says Dr Nel. The water flowing into the sewage treatment works is rich in nutrients, but the water flowing out is ‘not too bad’. By changing these systems more towards artificial wetland systems (with plants and no underlying cement) researchers might be able to come up with a more effective systems in the future for low-resourced, rural areas. “We also may be able to develop microbial and phytoplankton supplements to improve efficiency of the systems, especially when plants are dormant in the winter.”

MAKE BETTER USE OF ARTIFICIAL WETLANDS

Wetlands are less expensive to construct than traditional built infrastructure and only require periodic maintenance. The system reuses and recycles water and provides a habitat for plants and animals. Such a project also has the potential to create job opportunities.

For wetlands – natural or artificial – to deliver the best results, you

need a big area and low flow, and we have that here in South Africa, says Dr Nel. “Development often hems wetlands in but we must not foreclose on using space – we need it to get the most out of wetlands.”

SWITCH FROM FERTILIZERS TO MICROBES

While this suggestion does not directly relate to the use of ecological infrastructure, this switch would help support ecosystem functioning by not loading the ecosystems with too much nutrients.

“Some prominent farmers in the Olifants River catchment have already made the switch,” notes Dr Nel. “This helps plants to utilise natural organic phosphorus in the soil, so there is no need for added fertilizer.” Compost tea, for example, stimulates microbial action which stimulates root and plant growth.

In conclusion, Dr Nel maintains that for any of these suggestions to be effective, they need to be incorporated into development planning. The key is investment in both ecological as well as built infrastructure. “Wouldn’t it perhaps be wise to allocate some money to ecological infrastructure as part of the Presidential Infrastructural Plan?”

“We must also be smarter with the water that we have,” Dr Nel continues. “Water should be put at the centre of the decision when trade-offs are made between development decisions.” □



Jeanne Nel

Areas where attention to the reduction of phosphorus loads should be given first include cattle drinking points and feedlots.

A common language for describing inland aquatic ecosystems in South Africa



A common language for the description of wetlands and other inland aquatic systems in South Africa, which can be used for a number of different applications, has been published in the form of a User Manual. This lays down guidelines for using a nationally applicable classification system that has been developed for wetlands and other inland aquatic ecosystems. Petro Kotzé spoke to Dean Ollis of the Freshwater Consulting Group, one of the many people involved in the development of the classification system, to find out more about the system in general and the User Manual.

Fresh off the printing press (published this April), the challenge is now to spread the word far and wide so as to facilitate acceptance of the system across a wide spectrum of potential users. Yet, says Ollis, the classification system should be seen as “a living work in progress that will be continuously improved.”

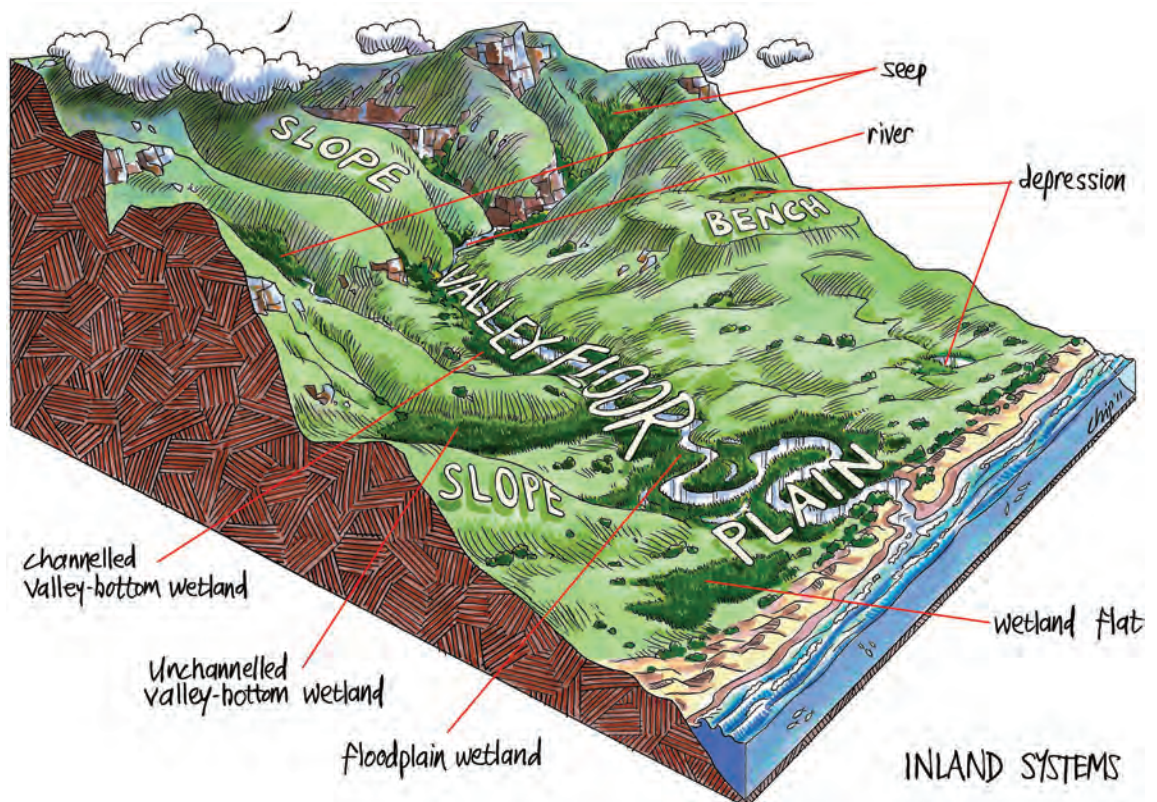
The project started in 2005 when the Water Research Commission (WRC) and the South African National Biodiversity Institute (SANBI) commissioned the development of a prototype National Wetland Classification System for the South African National Wetland Inventory. It culminated in the development of a preliminary classification system. In late 2007, a follow-up project was initiated by SANBI to further develop and refine the classification system, and an updated version was presented at the end of 2009. Towards the end of 2010, the compilation of the User Manual was commissioned. Compiled by the Freshwater Consulting Group, many people

and organisations assisted with the development of the classification system.

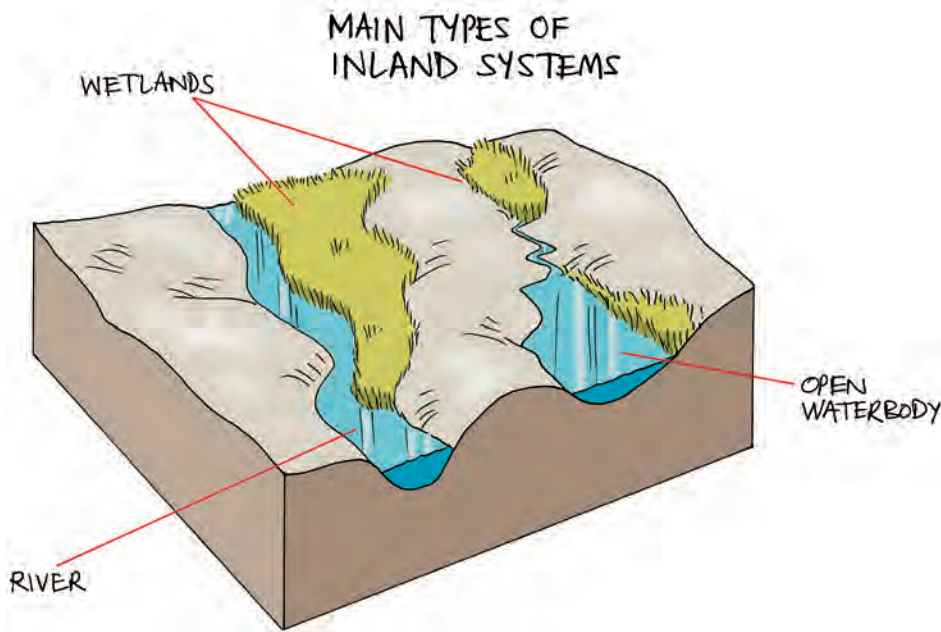
WHICH ECOSYSTEMS DOES THE CLASSIFICATION SYSTEM COVER?

First called the ‘National Wetland Classification System’ the name was changed to its current form due to confusion around the definition of the term ‘wetland’, specifically due to the different definitions according to the Ramsar Convention of 1971 and South Africa’s National Water Act of 1998.

Originally, the classification system was developed around the Ramsar definition, which defines wetlands as “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.” This thus encompasses rivers, lakes and other



An illustration of the seven primary hydrogeomorphic units and their typical landscape settings.



Above: The three main types of inland systems – rivers, wetlands and open waterbodies.

Typical unchannelled valley-bottom wetlands. The Maloti-Drakensberg area (below left) and the Kamiesberg Uplands of the Northern Cape (below right).

open waterbodies, estuaries, shallow marine systems as well as wetlands as more commonly defined.

The National Water Act defines wetlands as “land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil.” This definition includes only a subset of the

ecosystems encapsulated in the Ramsar definition.

In the final version of the classification system, as presented in the User Manual, a ‘wetland’ has been defined according to the above-mentioned definition in the National Water Act. The scope of the classification system, however, covers all aquatic ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than approximately six metres (i.e. all ecosystems

encompassed by the Ramsar definition of ‘wetland’).

Ollis says that the title has thus been changed to refer to both wetlands and other aquatic ecosystems to avoid confusion as to what is covered in the classification system, which includes rivers, wetlands and open waterbodies.

HOW DOES THE CLASSIFICATION SYSTEM WORK?

“We attempted to keep the classification system as simple as possible, without losing scientific rigour,” says Ollis, “in order for it to be understood and utilised by a wide range of potential user-groups.”

The classification system follows the hydrogeomorphic (HGM) approach to classification, which uses hydrological and geomorphological characteristics to distinguish primary units. In essence, the approach attempts to group aquatic ecosystems in a way that explains how they function. This is in contrast to the more traditional approach by which the primary units of aquatic ecosystems are distinguished on the basis of structural features (such as size, depth,



Donovan Korte

Dean Ollis

vegetation cover and presence of surface water) – in other words, how they look.

“A shift towards the HGM approach is consistent with local and international trends, largely because geomorphology and hydrology are recognised as the fundamental features that determine the existence of wetlands and other aquatic ecosystems and how they function,” says Ollis.

The classification system has six levels, with more detailed information required at each successive level.

At Level 1, a distinction is made between inland, marine and estuarine systems using the level of connectivity to the open ocean as a discriminator of the biophysical character of each. Work on the classification of marine and estuarine systems will be continued at a later stage.

At Level 2, for inland systems, the regional setting is categorised. This reflects a combination of biophysical attributes within landscapes that operate at a broad, bio-regional scale, rather than specific attributes such as soils or vegetation. “First, in 2009, we used eco-regions as specified by the Department of Water Affairs, but these were found to be too restrictive.” In the latest version of the classification system, provision is also made for the use of the National Freshwater Ecosystem Priority Areas (NFEPA) WetVeg groups or of any spatial framework that is of most relevance to a particular application.

Ollis says that the classification system thus incorporates some flexibility into how it can be used. “Level 2 is very broad and flexible mainly because research about what the best spatial framework is for a particular application or for specific broad aquatic ecosystem types must still be done. This is an important area for future research.”

At Level 3 the landscape setting is categorised. A distinction is made between four landscape units on the basis of the broad-scale topographic position: slope, plain, valley floor

or bench. “The assumption is that aquatic ecosystems function slightly differently in different landscape settings,” says Ollis, “but again, this has not really been tested and is a good angle for future research.”

The core of the classification is Level 4, says Ollis. Here, the HGM Units are defined primarily

according to: **landform**, which defines the shape and localised setting of a wetland; **hydrological characteristics**, which describe the nature of water movement into, through and out of the wetland; and **hydrodynamics**, which describe the direction and strength of flow through the wetland. Together these

*A seep with channelled outflow (**below**) and a seep without channelled outflow (**bottom**), both situated in the Lesotho Highlands.*



Dean Ollis



Ross Holland

factors affect the geomorphological processes acting within the wetland such as erosion and deposition, as well as biogeochemical processes.

Although Level 5 of the classification system (the hydrological regime) is not applied in a strictly hierarchical manner, it is applied as the final step in distinguishing one functional unit from another. The criteria used to consistently distinguish between the hydrological regime categories are referred to as secondary discriminators.

“The hydrological regime tells you how long the water stays there for, and by this stage of the classification system we can really get a good idea of how an inland aquatic ecosystem is functioning. Criteria here include the inundation period and saturation levels of wetlands and, for rivers, whether they are perennial or non-perennial.”

At Level 6, six ‘descriptors’ are included for the characterisation of inland aquatic ecosystems, on the basis of consistent criteria relating to biophysical features. They are geology (lithology); natural vs. artificial; vegetation cover; substratum type; salinity; and pH.

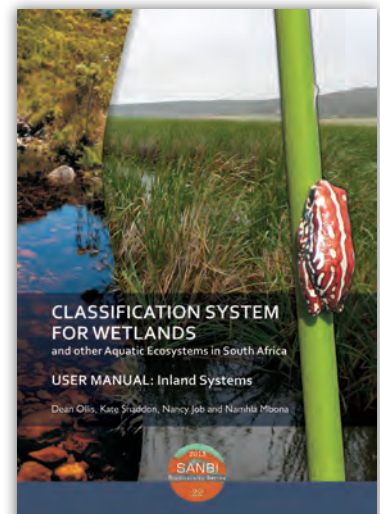
“This would generally require some kind of site visit and

fieldwork,” says Ollis, “and it provides a really detailed level of information about the physical characteristics of an aquatic ecosystem.”

WHAT IS NEXT?

The classification system has already been used to some extent, says Ollis, for example in the National Freshwater Ecosystem Priority Areas project and the wetland component of the National Biodiversity Assessment 2011. The core of the classification system (HGM types) is also very similar, and partly based on the wetland classification system used in the Wetland Management series of publications that includes WET-Health and WET-EcoServices. “Because much of the terminology we used is already known, the classification system should be picked up quite easily.”

As for development of the system itself, Ollis says that it has been designed to incorporate future knowledge. A ‘massive’ amount of research is still needed on how wetlands and other inland aquatic ecosystems function, if this really is dependent on the landscape setting or whether it is captured by the



The User Manual for the application of the Classification System to inland aquatic ecosystems is available from SANBI and can be found at the Kirstenbosch and Pretoria Botanical Gardens bookshops, as publication #22 in SANBI’s Biodiversity Series at R90 a copy. Email: bookshop@sanbi.org.za or Tel: (012) 843-5001.

HGM types and so forth, says Ollis. As such, the classification system is seen as a good framework for future research topics. □



South Africa's wetlands are havens for scores of fauna and flora.

How the classification system is applied: Classification of the Oudebos seepage wetland

The Oudebos seep is a relatively pristine wetland in the Kogelberg Nature Reserve near the seaside town of Kleinmond. As it is not located along the coast and does not have a direct connection to the open ocean, it can easily be classified as an Inland System at Level 1 with a high degree of confidence.

- **Level 2:** The selected spatial framework at Level 2 was DWA Level 1 Ecoregions. This was ascertained by using GIS to overlay the locations of the wetland (as points) on the GIS shapefiles for DWA Level 1 Ecoregions obtained from DWA's Resource Quality Services website (www.dwaf.gov.za/iwqs/gis_data/ecoregions/get-ecoregions.asp). The Oudebos seep is located in the Southern Folded Mountains Ecoregion.
- **Level 3:** The landscape setting of this wetland is clearly a 'slope' with a gradient much steeper than 0.01. This has been determined with a high degree of confidence from the contour lines on the relevant 1:50 000 scale topographical maps and visual observations made during site visits.
- **Level 4:** The Oudebos seep is a wetland located on a relatively steep slope that is characterised by diffuse, unidirectional, down-slope (dominantly subsurface) water movement, at least periodically (as confirmed by a number of site visits to these wetlands in different seasons). It is, as such, an archetypical Mountain Fynbos hillslope seep and is thus classified as a seep at Level 4A with a very high degree of confidence. At Level 4B, the seep was classified as being 'without channelled outflow' in terms of its outflow drainage characteristics,

due to the confirmed absence of an outlet channel.

- **Level 5:** The hydroperiod for Oudebos seep was classified as mostly 'seasonally inundated' with small portions of the wetland considered to be 'intermittently inundated'. In terms of saturation period within 500 mm of the ground surface level, the hydroperiod of Oudebos seep was further classified as mostly 'seasonally saturated' with small portions that are 'permanently saturated' or 'intermittently saturated'. The confidence level of the classification of the saturation and inundation period is high due to the availability of subsurface water level and soil moisture data, and observations of the wetness characteristics of the wetland that were made during a number of site visits at different times of the year.
- **Level 6:** The optional descriptors included are 'natural vs. artificial', salinity, pH, substratum type, vegetation cover type and geology/lithology. The Oudebos seep is classified as entirely natural, because it is clearly

a naturally-occurring wetland that exists independently of any human influence. In terms of geology the Oudebos seep is classified as consisting entirely of the Peninsula Formation (Table Mountain Group). In addition, the seep is classified as entirely vegetated. In terms of substratum type, for the Oudebos seep, the substratum type was only categorised at the surface, due to lack of detailed observations of the soil profile at different depths. The upper substratum was classified as consisting mostly of sandy soil with small proportions of pebbles/gravel and boulders also present at the surface. This was based on field-observations and the use of a soil auger. The salinity was classified as entirely fresh and the degree of confidence high because the categorisation was based on the collection of conductivity measurements. The pH of the Oudebos seep was classified as entirely acid based on soil and water pH measurements collected from the wetland.



Misguided technology choices throwing fat in municipal fire



Inappropriate technology choices made by ill-informed local authorities could further harm the already beleaguered South African municipal wastewater treatment sector and the efforts of the Department of Water Affairs (DWA) Green Drop programme. This is one of the findings of a newly published investigation, funded by the Water Research Commission (WRC), into the drivers of wastewater technology selection in municipalities. Lani van Vuuren reports.

Poor wastewater treatment not only threatens the health of surrounding communities, but also the ability of South Africa's receiving water systems to continue supporting people and ecosystems. It is not only the management, operation and maintenance aspects of wastewater treatment that are of importance to ensure performance, but perhaps more importantly, what kind of wastewater technology is implemented in the first place, and whether this technology suits the municipality which will be responsible for managing it. The WRC project assessed the appropriateness of the technology choices of a selected number of municipalities compared

to the current ability of the municipalities to implement and administer their choices.

A total of 18 representative wastewater treatment plants were selected for the study. The selection was aimed at representing the sector as best possible, and various criteria were used to choose the works, including the full spectrum of discharge options, a spread that represent vulnerable versus capacitated municipalities, vulnerable versus less vulnerable receiving environments, and technology type of the wastewater treatment plants, among others. According to project leader Dr Marlene Van der Merwe-Botha, Director of Water Group Holdings,

the project was quite challenging as it touched on subject matter of a sensitive and controversial nature, with diverse opinions held by the various sector players. "The use of an unyielding scientific approach assisted to an extent in removing a subjective stance," she tells *the Water Wheel*.

OUT WITH THE SIMPLE IN WITH THE COMPLEX

The results indicate a general trend towards the replacement of low- to medium-level technologies (such as oxidation pond systems) with more sophisticated wastewater treatment technologies. Activated sludge plants (a more sophisticated wastewater treatment technology), for example, are set to increase from a current percentage of 61% to around 78% of municipal wastewater works in future. Opting for higher-level technologies is not inappropriate per se, bar the fact that not all municipalities are equipped to sustainably manage such advanced systems,

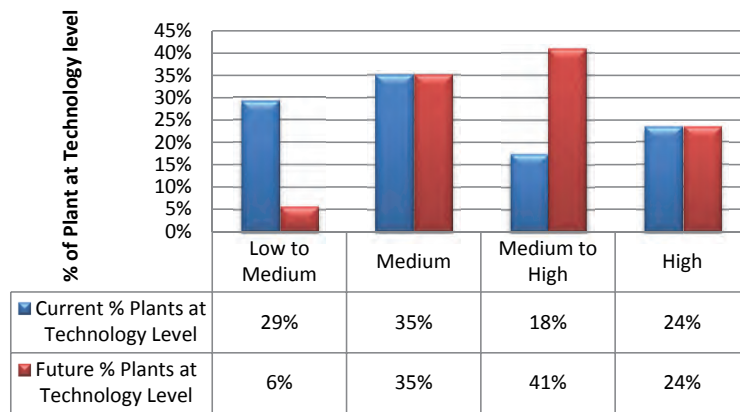
specifically with regard to skills and financial resource availability.

Among the main concerns raised by the WRC study is the identification of the trend for these very advanced technologies to be pushed as 'preferred solutions' in especially small towns and villages without full analysis of the long-term sustainability of the technology choice. Key issues being ignored include aspects of affordability, operations and maintenance, energy requirements and the human capacity and competencies required to manage these systems.

"These decisions are made against an already beleaguered environment delaying the very symptoms that are causing wastewater treatment plant failure," notes WRC Executive Manager: Water Use and Waste Management, Jay Bhagwan. "If the issue of inappropriate technology choices by local authorities is not addressed as a matter of urgency, it is going to put greater pressure on the country and the fiscus due to rising costs of energy and materials, underscored by the poor revenue base which already exists in most of these small municipalities."

Inappropriate technology choices can lead to a barrage of challenges, such as infrastructure failure, discharge of untreated or poor quality effluent, increased burden on the municipal budget, frustration of operators and maintenance crew, and even prosecution of individuals and reputational damage to the municipal entity.

"During the study we observed a tendency for local authorities to select very advanced treatment processes in the place of failing existing systems. Such advanced technologies are often seen as a silver bullet to cure a municipality's wastewater treatment woes," notes Bhagwan. "By not addressing management, operations and management issues which caused the initial wastewater treatment failure in the first place, municipalities are setting themselves up for repeated failure no matter what kind of technology they implement."



Left: Technology level trends of known planned upgrades.

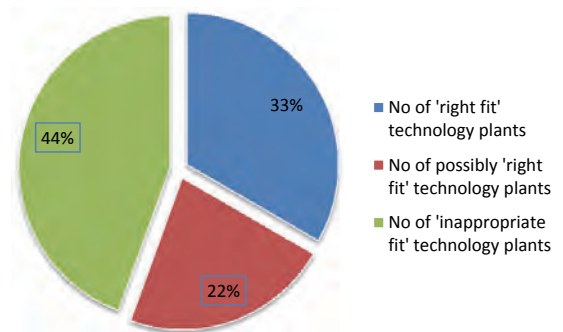
Below: Appropriateness ('right fit') of level of technology regarding the particular circumstance of operations and sustainability of the municipality.

Adds WRC Research Manager, Dr Valerie Naidoo: "Simply put, a municipality that is unable to manage a [simpler] pond or biofilter configuration to a level of excellence will be equally unable to manage [more technically difficult] activated sludge and biological nutrient removal configurations or combinations thereof."

In evaluating the technology choices of the sample of representative municipalities, the WRC study scrutinised aspects such as sensitivity of the receiving natural resource, legal requirements, capacity of the municipality to operate the system, as well as the availability of funding to operate and maintain the technology. Of the 18 wastewater treatment plants assessed, 8 plants (44%) may have opted for less suitable technologies when considering their resource base, capacity to manage and effluent quality requirements.

When applying the 44% statistic to a comparative national base (consisting of 850 municipal plants) there could be more than 370 wastewater treatment plants in the country where inappropriate technologies have been implemented. This number is significant enough to support further investigation and measures to mitigate this as a key risk to sustainable and improved performance in the municipal wastewater services sector, the final report points out.

The WRC project team found that in only a few cases were alternative options investigated before



a technology choice was made. No information was provided as to cost comparisons between options. More often than not it was (often incorrectly) assumed that the municipality had the resources to sustainably operate the new or upgraded plant. In addition, few municipalities prioritised green economics in their decision-making process (e.g. the beneficial use of waste products).

Although not stated directly in any of the documents scrutinised, it is further suspected that socio-environmental requirements, as reflected by the Department of Water Affairs' wastewater treatment plant authorisation process, place municipalities in situations where they are under pressure to select technological

"By not addressing management, operations and management issues which caused the initial wastewater treatment failure in the first place, municipalities are setting themselves up for repeated failure no matter what kind of technology they implement."

While some municipalities have the technical and financial capability to successfully manage high-technology wastewater treatment works, many local authorities do not.



options which are not financially or operationally sustainable.

“This blind drive towards achieving uniform compliance for wastewater discharge is not solving the problem, but is fuelling a greater disaster in the making,” says Bhagwan.

A call is made to regulators to take a holistic and strategic view of the implementation of the proposed wastewater treatment technologies based on the sustainability of the business of wastewater services, and to adopt design principles appropriate to the rural and/or small municipalities, providing leadership through their sector support and approval units.

OVER-RELIANCE ON CONSULTANTS

It is recognised that in a complex field, such as municipal wastewater treatment, consultants have an invaluable role and contribution to make as specialists and advisors. While competent municipalities generally use consultants within this context with optimal results, municipalities with little to no technical skills have generally become over-reliant on consultants – often blindly following their advice. This leaves municipalities vulnerable and at risk of being exploited,

thus leading to the implementation of inappropriate (and usually more expensive) technology options.

From the study it has become apparent that in a number of cases, especially in smaller municipalities, the technology decision is driven by the consultant rather than being undertaken jointly by an investigative team of municipal officers and consultants. In some cases, investigations into the range of technologies available are not done at all. As a result of budget constraints or supply-chain management policies within municipalities, competitive tendering is often weighted towards price rather than technical proficiency or experience, often forcing consulting firms to cut price by using existing designs that may not be tailored around the specific municipal circumstance.

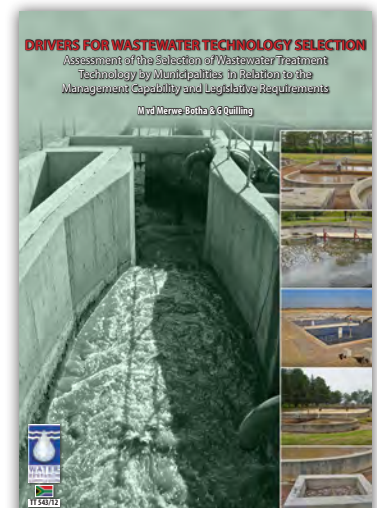
This over-reliance on consultants by local authorities is considered unhealthy, especially as these private companies are not held accountable when systems fail (they are only held accountable for the design). “As long as financial instruments, such as the Municipal Infrastructure Grant and other grant programmes, do not tighten performance evaluation criteria, weak municipalities will continue to be exploited by those unscrupulous practitioners who work towards short-term gain rather than

long-term sustainable solutions,” notes Bhagwan.

The report concludes with specific recommendations assigned to the relevant role-players to work towards a future that embraces and promotes responsible and appropriate technology choices that will sustain service delivery, public health and the environment in the long run. It is hoped that this snapshot view of the issues involved in technology drivers and choices will go a long way towards raising awareness in the sector.

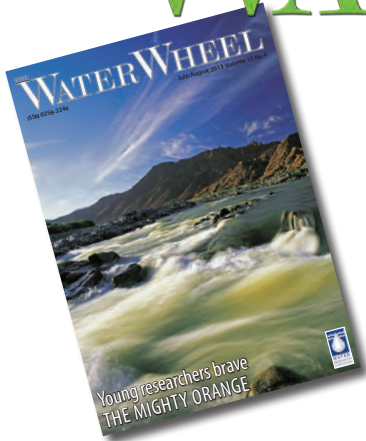
Dr Van der Merwe-Botha concludes with a message to local government and wastewater practitioners: “It is important to note that 0.2% of effort and cost go into planning, 19% into construction of the infrastructure and 44% into the maintenance and operation of the chosen technology. Make the 0.2% count in order to give best benefit to the 44%.” □

“There could be more than 370 wastewater treatment plants in the country where inappropriate technologies have been implemented.”



To order the report, *Drivers for wastewater technology selection – Assessment of the selection of wastewater treatment technology by municipalities in relation to the management capability and legislative requirements (Report No. TT 543/12)* contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.

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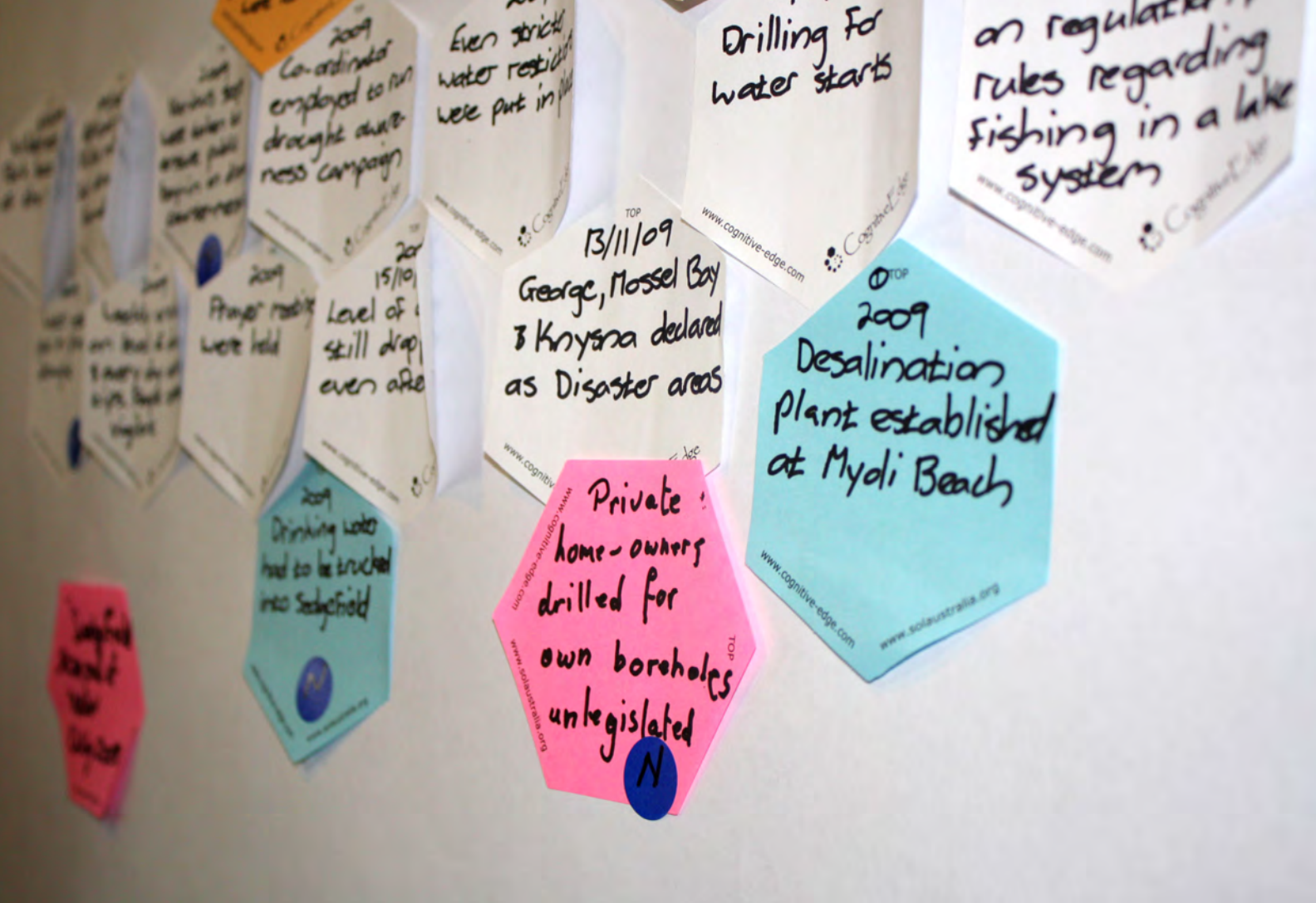
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Exploring the science of involved citizenship

South Africa's National Water Act (NWA) encourages citizens to play an active role in the way in which the country's water resources are managed and distributed. Authorities agree that effective stakeholder engagement is crucial to sustainable water resource management. But why do stakeholders choose to become involved in the water affairs of their catchment and, more essentially, what compels them to stay involved? These are some of the questions a current Water Research Commission (WRC) study hopes to answer. Article by Lani van Vuuren.

It is becoming increasingly important to understand the interdependence between people and ecological systems as pressures rise to manage shared resources equitably and sustainably. The challenges regarding the effective and equitable management of water resources in South Africa could potentially be addressed more effectively if there was an understanding of what drives and inhibits stakeholder engagement.

The Wilderness Lakes and Swartvlei systems, in the Southern Cape, have sustained communities for thousands of years. Various groups make use of the lakes and adjacent catchment area. Agriculture, forestry and municipalities all abstract water from the various rivers feeding into the lake systems, while communities use the resource for cultural practices, subsistence and recreational

fishing. People also use the lakes and associated estuaries for other recreational uses, such as boating and skiing.

ALLOWING PEOPLE TO TELL THEIR STORIES

The various stakeholder groups represented in the areas (varying from government authorities, tourism and nature protection organisations to retired professionals and poor communities) as well as the long histories of engagement over the lakes have motivated the selection of these systems as study areas for the WRC research project. The research, led by independent consultancy, The Narrative Lab, is investigating how citizens become and remain engaged in decision-making regarding the management of their natural resources and to

“Although water is a technical issue, we have seen how open, collaborative and visionary leadership styles spark higher engagement levels in citizens.”

determine if they feel empowered and if they have sufficient knowledge to engage.

The project team uses narrative research techniques to capture the experiences of stakeholders. “Simply put, we use narrative as a vehicle through which we surface the mindsets, perceptions, values and beliefs that govern people’s behaviour,” says project leader Aiden Choles, MD of The Narrative Lab. “Narrative is a helpful research tool as it cuts through the surface of opinions and simple analyses people give, and uncovers a more substantive description of how they see the world and choose to act in it. We then analyse the database for drivers and patterns within the stories that inform us about what governs people’s behaviour with regards to a complex phenomenon, such as water resource management.”

THEMES AND ISSUES PERTAINING TO ENGAGEMENT

The project team found stakeholders eager to participate both in the Swartvlei and Wilderness study areas. “The management of water at these sites is really a hot topic. People have some very strong opinions about what is happening, or not happening at Swartvlei and Wilderness,” notes Choles. “We also find that stakeholders enjoy being listened to – this is where giving people space to tell their stories is helpful.”

Initial interviews and consequent workshops with various stakeholder groups in the study areas revealed



a number of themes and issues pertaining to engagement. Nelson Mandela Metropolitan University George Campus helpfully provided the location for the workshops. Workshops were facilitated in such a way as to also offer an opportunity for the stakeholders to provide feedback on these results. Attendance included representatives from various forums, associations, sport clubs, government departments, spiritual groups and businesses.

Participants held active discussions around stakeholder maps and timelines created for each study area.

The first identified theme is the apparent significant role of key individuals. It seems some people have a knack to spur on increased levels of engagement. “We have seen how influential personal leadership styles and characters are for citizen engagement,” notes Choles. “Although water is a technical issue, we have seen how open,

Top and above: Stakeholders discussing a stakeholder map drawn up for one of the study areas.



Above: Stakeholders spent much time in the workshops discussing the timelines of significant events in the study areas.

Below: Project team members discussing stakeholder engagement in one of the study areas. (From left to right) Masters student Aneri Vlok, project leader Aiden Choles, project member Sonja Bignaut, WRC Executive Manager Dr Inga Jacobs and project member Chrislia van Tonder.

collaborative and visionary leadership styles spark higher engagement levels in citizens.”

Others, through their power of authority, simply influence a resource as a result of their authoritative position. Stories abound in the area, of the influence of PW Botha over the Swartvlei, for example. There project team recorded various anecdotes about how the former statesman insisted on the opening of the river mouth whenever his rose bushes were in danger of being flooded.

The second key theme is that of the continuity of a forum. “Stakeholders seem to have quite different reasons for becoming and staying involved. From a forum perspective, the need to be informed and available when called upon for public opinion seems to be an important motivation,” explains Choles. “Individuals have different reasons for joining forums and getting involved, some do it for practical reasons, for example when their houses get flooded, while others join because

of a strong belief in the principles of democracy.”

An interesting observation made by workshop participants was how the arrival of social media had changed forums – people no longer needed to attend meetings, but could stay informed through traditional channels such as newspapers and newer mediums such as Twitter and Facebook. As people’s lifestyles became busier they also tended to have less time for stakeholder engagement. At the Wilderness and Swartvlei study sites a significant proportion of active stakeholders are retired professionals.

Another important theme is access to the natural resource. In the study areas private land ownership has made it difficult for some stakeholders to access the water resource, which has prompted engagement in the hope to attain access.

The project team observed how difficult it was for some stakeholder groupings found it to understand the perspective of other stakeholders. “The ability to be aware of your own stakeholder grouping and its associated agenda is critical for self-awareness for engagement processes to be healthy,” explains Choles. The workshops also confirmed the old adage of ‘the person who shouts the loudest gets the most attention’, with some stakeholders struggling to find a voice in engagement.

In the end the project team hopes to equip citizens in South Africa with principles, suggestions and guidance on how to stimulate stakeholder engagement in areas with water resource challenges. “Addressing water challenges cannot simply be left to the authorities,” says Choles. “Our issues are deep and complex enough to warrant more dedicated stakeholder engagement. Also, there are citizens who are eager to assist but perhaps don’t know how best to go about it themselves and/or how to get their fellow citizens to journey with them.” □



A role model in research and development

In the field of science and technology, Professor Alison Emslie Lewis, who heads up the Department of Chemical Engineering at the University of Cape Town (UCT), is a top achiever who has dedicated most of her academic career to research and development. Debbie Besseling spoke to this 2012 Women in Science Award winner about her significant contribution to the development of science in South Africa.

Tell us about work and projects undertaken in the Crystallisation and Precipitation Research Unit in the Department of Chemical Engineering at UCT?

The Crystallisation and Precipitation Research Unit is hosted by the Department of Chemical Engineering, which falls within the Faculty of Engineering and the Built Environment. The aim of the research unit is to advance existing fundamental knowledge in the fields of crystallisation and precipitation. Since precipitation processes are currently very empirically based, we are continuously working on improving the scientific understanding of these processes for scale-up, optimisation and control. Our research is mainly concerned with projects related to the mineral processing industry. Specific projects involve improving the precipitation of platinum, rhodium, nickel, copper, cobalt, iron, magnesium and calcium, but we also have many projects that focus on water-related issues.

Briefly tell us about your PhD?

I completed my PhD in 1993. I was lucky enough to have two A-rated scientists (and great people) as supervisors for my PhD. Prof. George A Ekama, who is a well known civil engineer and Prof. BD (Daya) Reddy, who is an applied mathematician. My PhD was therefore a combination of

both civil engineering and applied mathematics.

What would you like to highlight as some of the successes of your career?

I've had a very traditional academic career. I did an undergraduate chemical engineering degree, which was followed by a Masters in chemical engineering, that was very much focused on mathematics and mathematical simulation. In between, I worked for a couple of years as a process engineer for South African Nylon Spinners. I returned to do a PhD in mathematical modelling for biological systems. Thereafter, I did a post-doctorate with Prof. Ekama for a year-and-a-half and was then appointed to my academic job in chemical engineering. In summary, my career has therefore been very much as an academic, except for the brief period that I spent in industry.

The Women in Science Award for 'Distinguished Woman in Physical and Engineering Science' was the latest of a string of awards. Tell us about the others?

Other awards include the 'Highly Commended' Certificate, British IChemE Sustainable Technology Award, for the project on eutectic freeze crystallisation for treatment of hypersaline brines (won in 2010), and the National Research Foundation (NRF) President's

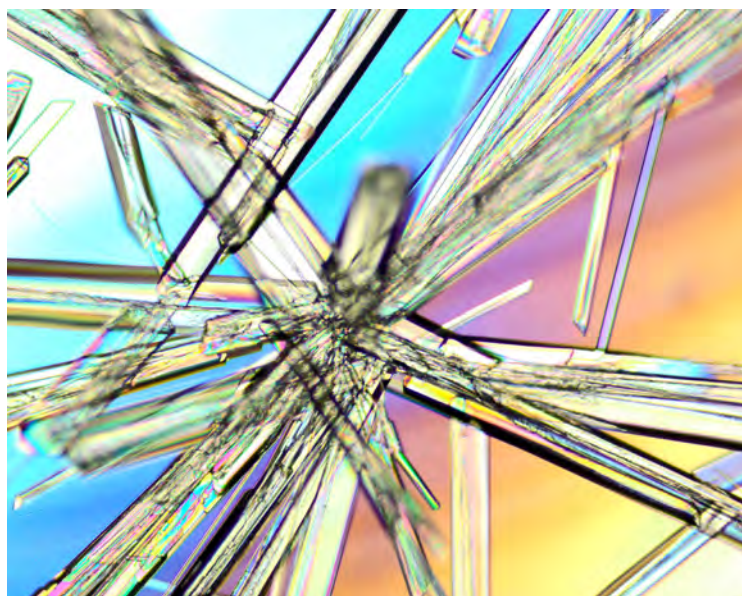
Award for 'Champion of transformation in research' (2010). In 2009, I achieved a B2 NRF rating.

If we talk about innovation and research in the water sector, what are some of the projects that the Crystallisation and Precipitation Research Unit has been involved in?

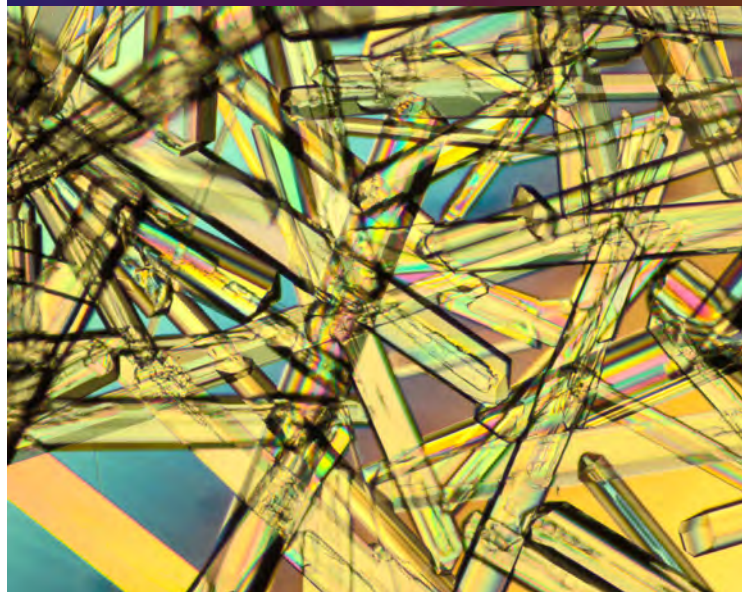
I have always had an interest in both environmental and water issues, which is why I pursued water treatment subjects in my post-graduate degrees. However, when I started the research unit, I was told that it would be difficult to get funding for research in water and was advised to undertake research on the actual processes involved. As a result I got involved in research in



Some of the crystals created by the Crystallisation and Precipitation Research Unit.



Marcos Rodriguez Pascual



platinum and rhodium precipitation and crystallisation, but always kept an interest in water treatment alive, mostly through projects related to the treatment of acid mine drainage. The topic of water treatment has been a constant theme through the research that I've been involved in.

Then, in 2007, we started our work in eutectic freeze crystallisation, which is a novel technology for treating acid mine drainage and hyper-saline brines. That has been a very exciting innovation in water research in our laboratory.

Tell us about the work of some of your students?

There have been a range of students that I have worked with and they are all special in what they have accomplished. In the early days (early 2000s), crystallisation and precipitation was a new research area in this department. Those early students probably taught me more than I taught them, but we learnt together in this field.

Jeeten Nathoowas was one of those students, and his work was on the topic of crystallisation in membranes during water treatment. Another student that I would like to mention was Shilpa Seewoo, whose work was on morphology control in gypsum precipitation. There are so many other projects that I could mention, quite a few of them in the field of water treatment.

There have been a number of PhDs that I would like to highlight, namely Freenman Ntuli, whose work focused on the mechanisms of precipitation in the reduction of nickel via hydrogen and, Mfandaidza Hove – iron precipitation in acid mine drainage. Both of these PhDs graduated in 2008.

More recently, there have been projects in the field of eutectic freeze crystallisation as well as projects in precipitation of sparingly soluble salts, which is relevant for the removal of metals from acid mine drainage.



Courtesy UCT



About the Crystallisation and Precipitation Research Unit

Industrial crystallisation research was initiated in the Department of Chemical Engineering in 2000 and the Crystallisation and Precipitation Research Unit was formally accredited by the university in 2006. The aim of the Research Unit is to **advance existing fundamental knowledge** in the fields of crystallisation and precipitation, especially related to the South African and international **mineral processing and extractive metallurgy** industries.

a new a group of students who are committed to using their degrees to solve the pressing global challenges of the day – and one of these is water. There are opportunities and a huge potential for students, graduates and engineers to start getting involved in solving water problems. □

Ode to the Crystallisation and Precipitation Research Unit

In my journey so far into crystallisation
I've spent many hours in profound consternation
It's not just a question of molecular organisation
Or local supersaturation; or a simple growth equation

It's the subtle interaction of the crystallising particle
With the fluid, the impeller, and almost any other article,
And the chemistry involved can also be quite frightening
And add to it the fact that the rates are all like lightning.

And even taking measurements can be quite intimidating
Those tiny little particles are incredibly frustrating
And when it's under pressure – how do you find the rate?
And when it's all reacted – well then you are too late.

But when we plot the data and we see a little trend
Or the population balance gives us something to defend
Or we write a little model and amazingly! it fits
Then we can get quite excited at this living by our wits.

We stay up late and work too hard, forget to socialise
In solving all the mysteries of these things that crystallise.

Alison Lewis

Top: Prof Alison Lewis surrounded by her students and above: students working in the lab.

What is your message to students entering the field of civil engineering or chemical engineering?

Minister of Science and Technology, Derek Hanekom, who spoke at the UCT Engineering and the Built Environment graduation ceremony earlier this year, highlighted how the country needs qualified engineers. We all have a moral and ethical imperative to contribute to the development of our country. We also encourage students to pursue post-graduate studies.

What, in your opinion are the challenges that we face in the water sector?

I think there are huge challenges in the water sector. What is interesting is that chemical engineering used to draw a lot of students who were out to get a professional degree and make a good living. Now there is

“We all have a moral and ethical imperative to contribute to the development of our country.”

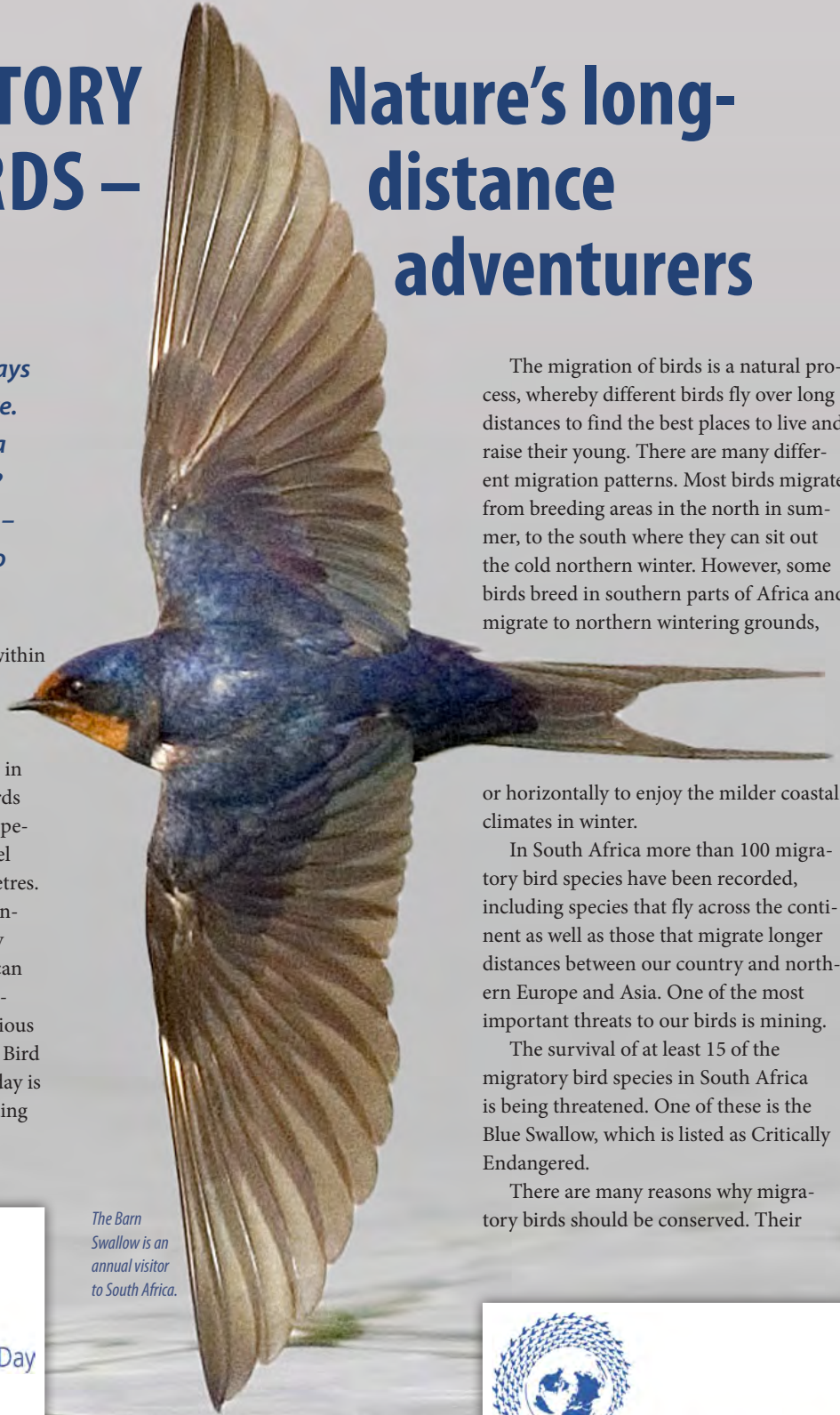
MIGRATORY BIRDS –

Nature's long- distance adventurers

With long-haul flights these days we can travel almost anywhere. But imagine you had to cross a continent on your own steam? Many of our feathered friends – some no bigger than mice – do exactly that.

The annual migration of birds within and across continents remains one of the world's greatest natural wonders. Every year, a special two-day celebration is held worldwide in honour of the estimated 50 million birds (around 19% of the world's total bird species) that take flight every year to travel hundreds or even thousands of kilometres.

The Day is organised by the Convention on the Conservation of Migratory Species of Wild Animals and the African–Eurasian Migratory Waterbird Agreement – two treaties that represent various countries. This year, World Migratory Bird Day was held on 11 and 12 May. The day is celebrated in over 65 countries, including South Africa.



The Barn Swallow is an annual visitor to South Africa.

The migration of birds is a natural process, whereby different birds fly over long distances to find the best places to live and raise their young. There are many different migration patterns. Most birds migrate from breeding areas in the north in summer, to the south where they can sit out the cold northern winter. However, some birds breed in southern parts of Africa and migrate to northern wintering grounds,

or horizontally to enjoy the milder coastal climates in winter.

In South Africa more than 100 migratory bird species have been recorded, including species that fly across the continent as well as those that migrate longer distances between our country and northern Europe and Asia. One of the most important threats to our birds is mining.

The survival of at least 15 of the migratory bird species in South Africa is being threatened. One of these is the Blue Swallow, which is listed as Critically Endangered.

There are many reasons why migratory birds should be conserved. Their



World Migratory Bird Day

Multimedia resources

To learn more about South African birds:

- www.birdlife.org.za
- www.witsbirdclub.org.za (South Africa's oldest bird club)
- www.sanparks.co.za/groups/birders/ (for bird watching in South Africa's national parks)



World Migratory Bird Day

To learn more about migratory birds:

- www.worldmigratorybirdday.org
- www.youtube.com/watch?v=bTvqXVFQlIs
- www.unep-aewa.org/
- www.migration.net/

beauty and behaviour are a source of joy and inspiration for millions of people. In almost all cultures, flocks of birds have announced the arrival of spring for centuries, and the yearly rebirth of nature associated with it. In ancient times, the social acceptance of birds as messengers of life was accompanied by the knowledge that migration had an important role to play in the functioning of nature and its processes.

Migratory birds are specially engineered to fly fast and across long distances. However, their journey is often an exhausting one during which they push themselves to their limits. The Red Knot, for example, which is just under a ruler-length long (24 cm), breeds in Siberia and overwinters on the west coast of Africa, some even going down to South Africa. During its migration the bird loses about half its body weight of 220 g.

Migratory birds therefore rarely fly to their destination non-stop but interrupt their journey frequently. Similar to human transport systems of harbours, airports and roads, migratory birds depend on these international networks of natural sites for food, safety, breeding and moulting, as well as stopover areas which act as refuelling stations between breeding and non-breeding areas.

Unfortunately, human activities have resulted in the destruction of many of these resting spots. If we don't step in and protect what is left, we could lose some of our travelling feathered friends to extinction within the next few decades. The main message of this year's World Migratory Bird Day was that we as countries, organisations and communities, need to work together to ensure that migratory birds can continue to travel, refuel and reach their destinations. □

SA Bird of the year 2013: The elusive white-winged flufftail

The South African Bird of the Year for 2013 is about the size of a sparrow, is rarely seen and so secretive that more than 130 years after its discovery in South Africa very little remains known about it.

The critically-endangered white-winged flufftail is endemic to Africa, and travels between Ethiopia and South Africa. The little bird favours high-altitude wetlands, and it is speculated that the white-winged flufftail migrates between these two countries, arriving at suitable habitat within South Africa in summer. However, this has not been proved.

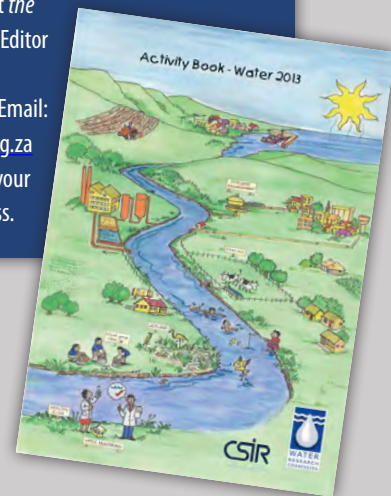
The bird is ground breeding, and has very specific habitat requirements regarding altitude, grass type, water level and temperature. There are only a handful of sites in the country where the white-winged flufftail can be found.

(Source: BirdLife SA & Middelpunt Wetland Trust)

- To learn more about the white-winged flufftail and its wetlands habitat Visit: <http://www.birdlife.org.za/events/bird-of-the-year> or Watch: <http://www.youtube.com/watch?v=m0rEbNf80lo>

CSIR-WRC Activity Book back by popular demand

The Water Research Commission (WRC) has republished the popular CSIR WRC Water Activity Book. Suitable for children ages 7 to 14, the book contains various water-related activities, including water word search games, water snakes and ladders, among others. It is a useful tool to have in the classroom to explain, for example, water pollution and the impact of alien invasive plants. To get your free Activity Book, contact the *Water Wheel* Editor at Fax: (012) 331-2565 or Email: laniv@wrc.org.za and provide your postal address.



European Roller



Red-footed Falcon

A couple of Southern African birds that take part in the annual migration to the Northern Hemisphere.



European Bee-eater



Woodland Kingfisher



Wood Sandpiper

Komati Water Scheme Augmentation Project inaugurated

Minister of Water & Environmental Affairs, Edna Molewa, officially inaugurated the multibillion Rand Komati Water Scheme Augmentation Project in Mpumalanga at the start of National Water Week earlier this year. The scheme is dedicated to supply water to Eskom's Matla and Duvha

power stations. The Matla power station reservoir will, in turn, also provide water to the Kusile power station, currently under construction. TCTA was directed in 2008 by the Department of Water Affairs to finance and implement the project, which has since been completed in time and within budget. Speaking at

the inauguration, Molewa said that the augmentation scheme would resolve water-supply challenges to Eskom's Duvha and Matla power stations through the additional yield of 57 million m³ a year that would be supplied. A new 58,6 km pipeline with a capacity of 1 684 m³/s was also constructed as part of the project.

All photographs by Lani van Vuuren



Minister of Water & Environmental Affairs, Edna Molewa.



Inside the new Komani pump station, constructed as part of the Komati Water Scheme Augmentation Project.



The Rietfontein Weir forms part of the network of water infrastructure to bring water to the Duvha and Matla power stations.



Entertainment on the day was provided by song and dance groups from the surrounding local communities.

SOUTH AFRICAN NATIONAL COMMITTEE ON LARGE DAMS CONFERENCE



5 – 7 November 2013
Thaba 'Nchu

SANCOLD

Advances in Dam Technology for Water and Energy in Southern Africa

About the Conference

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

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

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

Programme

Overview

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

Registration

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

Please note that:

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

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

Mrs Merentia Meyer

Tel: +27 21 808 4352

E-mail: merentia@sun.ac.za

or

Marechia Basson

Tel: 079 4909 210

E-mail: msb@aspt.co.za

Water Research Commission



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

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

Impact areas address the following key issues:

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

www.wrc.org.za

