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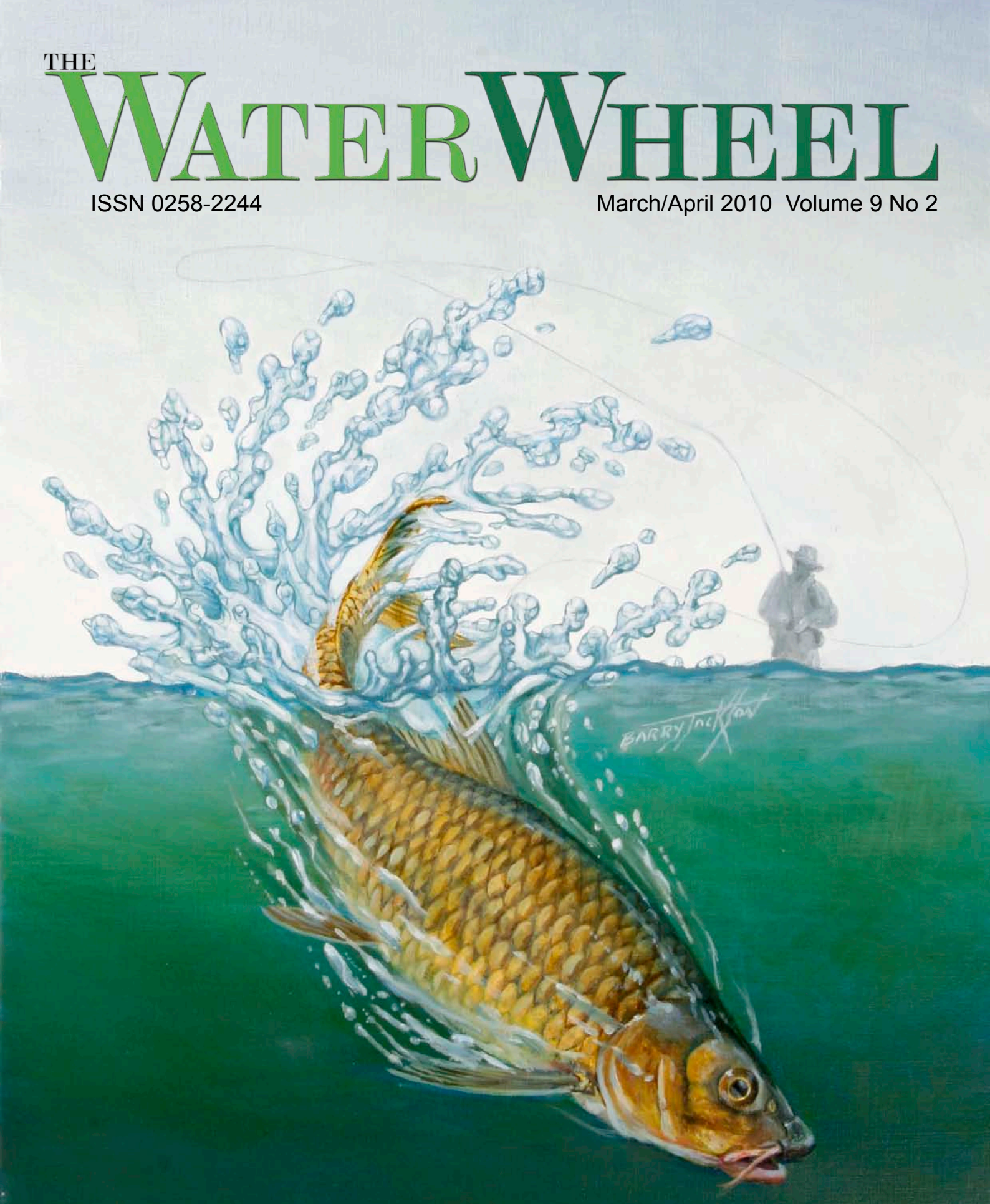

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THE WATER TREATMENT PLANT SPECIALISTS

***Cover**: Is catch and release angling placing undue stress on our yellow-fish? (See page 14)*
Original oil painting by Barry Jackson.

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LETTERS TO THE EDITOR

Draw on institutional memory to solve AMD challenge

This letter is prompted by the most recent series of papers regarding the Wonderfonteinspruit catchment (WCA). I would like to address two issues, namely perceptions and institutional memory.

Perceptions

Most of the reports and papers published on the WCA over the last 20 years refer to "widespread uranium pollution", areas which are "highly polluted with radioactive uranium", and similar emotive phrases, and this is perceived to be caused by tailings dams in particular and the irresponsible actions of the mining industry in general. While I am now retired, and am not directly involved with the WCA, for many years I was involved in related activities in the Klerksdorp area, particularly the Koekemoerspruit.

It is common cause that the mining industry has a presence in the WCA, complete with associated legacies such as interconnected mining related voids, and surface features such as tailings dams and waste rock dumps, all unavoidable consequences of mining. The nature and extent of these features is adequately described in the literature. The fact that these features contain pyrite which results in Acid Mine Drainage (AMD) with the associated acidic leachates containing iron, copper, zinc and other metals is also well known. The chemistry of iron although quite complex in some respects is quite simple in others, and is well understood. This is probably the single most abundant element in affected waters, as illustrated by the Grootvlei decant some years ago.

Uranium is incorrectly perceived to behave in the same way as other elements such as copper and manganese, where solubility is highly reversible and primarily a function of pH. The tailings dams are therefore seen as huge sources of radioactive pollution. Uranium does not behave in the expected way. Mostly it is present as substantially insoluble oxides (UO_2). As anybody who has ever had to leach uranium commercially knows, it takes a strongly oxidising acidic environment to convert the oxides to the uranyl ion (UO_2++), which is readily soluble. Although technically this reaction is reversible, the rates of dissolution and precipitation are very different, and favour precipitation, hence the recent emphasis on sediments. Because of the presence of pyrite in tailings dams, the environment in the core of a tailings dam is highly reducing. The result is that tailings dams, far from rapidly leaking uranium, retain it rather well, if not perfectly. In addition, soil under tailings dams tends to retain uranium. The leakage of uranium from a tailings dam into local water supplies is therefore a very slow process.

There is the perception that radioactivity in general and uranium in particular are extremely toxic with a high "horribleness" factor. The perceived horribleness swamps any attempt to carry out meaningful quantitative risk assessments. Exposure must be avoided at any cost. This has resulted in huge expenditures in other parts of the world, including the USA, where old uranium tailings dams were moved many kilometres to engineered final disposal sites as part of the UMTRA project, and the rehabilitation of the WISMUT site in Germany at an estimated cost of 10 billion (thousand million) Euro, for an area smaller than the Klerksdorp area.

There have been huge advances in the sensitivity of chemical analysis methods. Uranium measurements in the parts per billion range have only become possible fairly recently. The fact that an uranium content above 2 ppb in drinking water may pose a risk to infants is a triumph of technology and statistics. Or are we overdoing it?

I believe that the diffuse pollution load caused by tailings dams is small compared with point sources of pollution such direct discharge of underground water, which is known to contain elevated levels of uranium, and process water spillages. The latter sources clearly fall within the scope of current legislation and must be controlled.

The mining industry has a poor image with respect to environmental issues. This is solidly grounded in history. When the mines were established, it was within a framework of optimal utilisation of mineral resources. As long as water was wet and did not contain visible lumps of brown and smelly stuff it was drinkable. I have met people recently who still believe in this. The mines through the Chamber of Mines have consistently developed and embraced best practice, sometimes perhaps not as effectively as might be desired. Unfortunately this is a complex game where the goal posts are moving all the time.

How safe is safe enough?

I am sorry for the poor regulators who have to make a decision which does not make the greenies, or industry, or anybody else, happy. On the one hand we need industry to create jobs and the products we need to maintain our standard of living, on the other we need to reduce our environmental footprint. Perhaps we have not yet addressed the correct issue, namely that there are already too many people, all of whom are trying to improve their standard of living and hence their environmental footprint, but that is another highly emotional debate.

Institutional memory

In my own naive way, while I was still employed at a mine in the Klerksdorp area, I once collected whatever information I could, related to this area, in the hope that in my retirement I would become the custodian of information during the final closure and rehabilitation. While the following comments apply primarily to my experiences in the Klerksdorp area, they are equally applicable to the WCA. I am now safely retired and no longer participate, I only observe. Within the last few years I was aware of and participated in two major projects.

One of the remaining active mines in the area has compiled a three-dimensional model of the area, showing geological features, and mining related voids among others. This model is ideally suited to answering questions such as "Will the eyes ever run again? (NO)", "If pumping stops, what is the sequence

of flooding of underground voids, and where will underground water finally decant to the environment? (They are still pumping)". It is my understanding that the hardware and software for this model runs on a dedicated computing system, which is not PC based. The person who set up the model is now in retirement.

The Department of Water Affairs (DWA) recently established the behaviour of ground and surface water in the Schoenspruit and Koekemoerspruit catchments, as a precursor for establishing a Catchment Management Agency in the area. The collection of the data was contracted out to a well known consultancy. This project is now more or less on hold. All of which raises a number issues.

- ***Public domain knowledge***

  The mines have been aware of environmental impacts for many years and have initiated numerous monitoring programs. In many cases, the results were not advantageous to the industry, and the standard legal advice was to admit nothing that could result in liability to the mine. A small number of projects have found their way into the public domain, through organisations such as the Institute for Water Quality Studies (IWQS) and the Water Research Commission (WRC), but the bulk of it remains firmly in the private domain. Ultimately it may require a change in legislation to compel mines to make this information available to the regulators as part of a licensing process. How accessible this information will be to interested and affected parties remains to be seen. In many cases, mines and regulators could become co-defendants in compensation claims. The current route to bring information to the public domain would require duplication of work by publicly funded organisations such as the WRC.

- ***Format of information***

  Even within my last 30 years working with computers, much of the information I compiled in electronic format is already partly lost. For example I can no longer read documents written in Multimate, Q&A, Framework and similar word processors. Similarly data stored in spreadsheets such as Lotus 1-2-3 in compressed file format is now unreadable. I have no doubt that readers for these formats are available, but I would need an incentive to convert them to a new format.

- ***Custodian***

  Who will be the custodian of the information, and ensure that the database is maintained and is available to the public?
  - Individual industries?
  - Individuals like myself?
  - Organisations such as the University of the North West?
  - Government departments such as the Council for Geoscience?
  - Consultancies?
  - I believe the answer lies in permanent departments within CMAs, staffed by suitably qualified professional people.

We are a long way away from that, and in the meantime well meaning individuals will generate snapshots which do not integrate into a coherent whole and fall into disuse the moment the well meaning individual leaves.

Gunter Wendel
(Article has been edited for length – Editor)

We need more mines to set an example

I refer to an article in the *Water Wheel* of Jan/Feb 2010 ***(Mine save millions through zero discharge plan)*** in which Eland Platinum (owned by Xstrata Alloys), Brits, will install a plant on site to re-use and convert local water to potable standards; why then is it necessary for Western Utility Corporation's extravagant plan to pump the water from the West Rand and East Rand Aquifers to a central point for processing?

I recall that at the initial EIA application meetings, and at the Western Void Decant Technical Group meeting WUC stated, one of the reasons for the rising water table in the Central compartments at a rate of 0.9m per day, was due to the flooding of the pump station (presumably service delivery neglect). Mintails, Mogale Gold, through Umsizi Consultants, the Witfontein Projects' failed application resulted in it now forming part of the West Pits project with the added slimes from Cooke Mine in addition to the Acid plant Cooke mine EIA application.

Presumably because of Harmony Gold's (through Golders consultants), Super slimes dump applications having not been completed Goldfields Gatsrand Mines Super Dump application through the Durban Consultant for the Kalbasfntein Super Dump is still in the Application stage as well.
West Pits cannot handle the original Mogale Gold slimes, yet now we have Cooks too, besides the original problems with West Pits and its proximity to the Tweelopiesspruit decant.

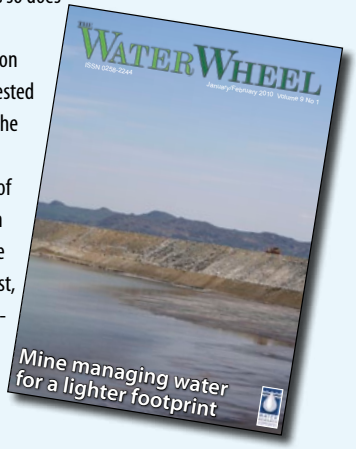
The installation cost factor recently quoted in a local newspaper was R1,5 billion. Can anyone therefore please answer the following, considering that the original reason was the fact that Rustenburg and that area did not want the polluted AMD decant waters from the West Rand's Tweelopiesspruit:

- Why has emergency pumping not taken place at Central and if so, where is this water going as then pumps is available and operational?
- Insufficient information in respect of the 'damage' done underground in respect of the penetration over the years of mine tunnelling through the various dykes/faults in particularly the Witpoortjie fault. Since December 2009 additional seismic problems at Gold Fields caused loss of production.
- WUC according to the media say they have approval from Gauteng Government but this matter rests with the Departments of Water and Environmental Affairs, have they approved?
- WUC in the same Media content said that they do not yet have a buyer for the potable water so generated and this after spending R1,5-billion. It makes no sense coming from them, to whom cost was the basic argument criteria
- To what extent has the recent seismic activity influenced this situation?
- If a smaller mining group can set up such a pump station purification facility, why can smaller units not be installed on the West Rand, Central and East Rand as it is obvious that the excuse of cost is most certainly not a factor?

Furthermore, the local pollution continues virtually uninterrupted, aided by the above-average recent rains and leachate from the old slimes dumps without paddocks. Yet the combined water use of only the Wonderfontein valley operations far exceed that of those for the Brits operations so does the Eastern compartments.

This entire WUC operation confirms that it represents vested interest to the detriment of the entire West Rand. I have to remind you that the actions of the apartheid government in allowing the emptying of the West Rand squifers in the past, today proves to be an unmitigated disaster.

Eugene Viljoen



New tool teaches public about municipal water management

The Centre for Applied Legal Studies (CALS) and Mvula Trust have published a new water budget monitoring education tool for municipalities.

According to authors Paul Berkowitz, Jackie Dugard, Laila Smith and Kate Tissington, the organisations' work on municipal tariffs and local government budgeting processes has clarified that in order for engagement and participation by civil society and communities to take place – essential to ensure accountability by local government and to maximise service delivery – it is essential to understand the budget processes of municipalities and how these processes affect service delivery.

This requires an understanding of the rights of access to information and to public participation, as well as a basic understanding of law, economics and financial accounting relevant to analysing municipal tariffs and financial statements. This educational tool is intended to provide such knowledge in order to assist civil society to interpret budget information, as well as other documents related to service delivery.

While the education tool focuses on water specifically, the same principles can be applied to other basic services, e.g. electricity and sanitation. "The more people understand municipal budgets and service delivery frameworks, the more they are able to ensure good functioning and accountable government, to the benefit of all," the authors say.

The booklet is divided into five modules: analysis of tariffs; basic financial accounting and budget documents; asset management; equitable share and municipal infrastructure grant; and water quality management and water education. In addition, a training outline serves as a guide to civil society wanting to train members on the five modules. There is also a questionnaire for municipal officials to be used as a checklist once participants have gone through the modules.

To download the tool Visit: http://web.wits.ac.za/NR/rdonlyres/C4147F19-053D-40F1-BB8F-7AF57E1C1485/0/Educationaltool_Sept_16.pdf

Minister calls for environmental ambassadors

Deputy Minister of Water & Environmental Affairs Rejoice Mabudafhasi has called on the water and environment community to do more to raise the profile of the environment among South African citizens.

Speaking at the World Wetlands Day celebration in Pretoria in February, the minister said that while South African researchers and scientists were doing sterling professional work with regards to environmental matters, they needed to become more involved in their communities on a personal level to spread the conservation message. "We need people to go to their children's schools, to stand up in their churches and spread the message of the importance of the environment."

Such action was especially needed for wetlands, which perform invaluable ecosystem functions to humankind. South Africa has over 115 000 wetlands, covering over four million hectares. However, up to 60% of the country's wetlands have been damaged or destroyed by human impact.

"The continued loss of wetlands due to urban development is of grave concern," noted Mabudafhasi. "Urban expansion and development seems to be continuing without sustainable urban planning and due consideration of wetlands in urban areas and the floor attenuation, stormwater management and recreational functions that wetlands offer."

Mabudafhasi said her department was concerned over the many coal-mining applications in areas with unique wetlands. "Activities in wetlands are taking place without the necessary water-use licences and environmental authorisation from the relevant authorities."

World Wetlands Day is celebrated on 2 February.

Ntsikeni Nature Reserve in KwaZulu-Natal has become South Africa's 20th Wetland of International Importance under the Ramsar Convention on Wetlands. The wetland, reported to be the largest high-altitude wetland in South Africa, is an important breeding habitat for the critically endangered wattled crane and Eurasian bittern, among others. Here receiving the certificate from the Deputy Minister of Water & Environment Affairs Rejoice Mabudafhasi (right) is Vuyiswa Radebe, Senior Conservation Manager of Ezemvelo KZN Wildlife (left); while Wilma Lutsch, Director: Biodiversity Conservation at the Department of Environmental Affairs (middle) looks on.

WATER DIARY

CIVIL ENGINEERING
MARCH 16-18
'Engineering Planet Future' will be hosted by the South African Institution for Civil Engineering at the CSIR International Convention Centre in Pretoria. The conference will look at sustainable civil engineering beyond 2010. *Enquiries: Carlamani Conferences & Events, Tel: (012) 662-4476; Visit: www.engineeringplanetfuture.co.za/index.asp*

RURAL WATER SERVICES
APRIL 13-15
Organised by the Thematic Group on Scaling up Rural Water Services and the Ugandan Ministry of Water and Environment, this symposium will be held in Kampala, Uganda. *E-mail: ruralwatersymposium@irc.nl or Visit: www.irc.nl/url/35331*

WATER
APRIL 18-22
The Water Institute of Southern Africa's Biennial Conference and Exhibition will take place at the Durban International Convention Centre. *Visit: www.wisa.org.za*

South Africa joins year-long celebration of biodiversity

South Africa has joined the global community in the celebrating the richness of its plant and animal species and fighting against biodiversity loss.

The United Nations has declared 2010 the Year of Biodiversity and in February, South African under the departments of Water and Environmental Affairs launched its own year dedicated to the preservation of its species. "The International Year of Biodiversity is a once in a lifetime opportunity for use to raise local awareness of the importance of biodiversity for our health, wealth, food and survival," said Minister of Water & Environmental Affairs Buyelwa Sonjica. "Biodiversity is the basis for human development; this is particularly true for the poor, as they are the most vulnerable from the effects of biodiversity loss. This is because many of our communities are directly dependent on biodiversity and ecosystems."

South Africa's freshwater especially requires urgent attention. Due to the semi-arid nature of most of the country, our rivers are vulnerable to over-exploitation and modification, which has implications for aquatic ecosystem functioning and biodiversity. An integrity assessment of South Africa's rivers conducted several years ago demonstrated that 26% are already critically modified, with another 48% moderately modified.

According to the latest State of Environment report, published in 2005, the water management areas in the south of the country (Berg, Breede and Gouritz), and those associated with the middle and upper Vaal River are most in need of protection. This means that these rivers run the risk of irreversibly losing the ability to support their biodiversity components (natural habitat, plants and animals). These ecosystems have lost so much of their original natural habitat that ecosystem functioning has broken down and species associated with the ecosystem have been lost or are likely to be lost.

The remaining main river ecosystems are either endangered (18%), vulnerable (12%) or least threatened (16%). Formal protected areas in South Africa focus primarily on conserving terrestrial ecosystems and, in the process, inadvertently capture portions of river ecosystems that run through them. Little emphasis has been placed on proclaiming protected areas for the primary purpose of conserving entire river lengths (mostly this is not practical) or that encapsulate important catchment areas.

Statutory reserves or conservation agreements protect only 7% of the total river length in South Africa (not including privately-owned areas). About a third of South Africa's main rivers define the boundaries of protected areas rather than occur within protected areas, and therefore cannot be considered protected.

According to Sonjica, more scientific knowledge is required to improve decision-making around

biodiversity and highlight the importance of the different plant and animal species. "It is also important that indigenous knowledge be captured."

However, the minister pointed out that environmental conservation could not take precedence over the provision of basic services. "Rural development remains a priority for the South African government. The rural areas are often where the biodiversity hot spots are. When people are hungry they will not care about the importance of conservation of a butterfly. Therefore development and conservation must go hand in hand."

SMALL WATER SYSTEMS
APRIL 19-22
The International IWA Congress on Sustainable Solutions for Small Water and Wastewater Treatment Systems will be held in Girona, Spain. *E-mail: S2Small2010@lequia.udg.cat or Visit: www.udg.edu/s2small2010*

WATER ENGINEERING
APRIL 28-30
Water Africa 2010, an international trade exhibition for goods and services for the water and wastewater engineering sectors in Africa, will take in Nigeria. *E-mail: info@ace-events.com or Visit: www.ace-events.com*

WATER TREATMENT
JUNE 2-4
Ecwatech 2010 will be held in Moscow, Russia. This IWA Specialist Conference is themed 'Water and Wastewater Treatment Plants in Towns and Communities of the 21st Century: Technologies, Design and Operation. *Visit: www.iwaconference.ru*

Year 2010 starts with plea to protect world's ecosystems

The world's species are being lost at an unprecedented 1 000 times the natural progression. To highlight the role nature's rich diversity plays in our lives, the United Nations has declared 2010 the International Year of Biodiversity. According to the Secretariat of the Convention on Biological Diversity, biodiversity, the variety of life on Earth, is essential to sustaining the living networks and systems that provide us all with health, wealth, food, fuel and the vital services our lives depend upon. Yet, human activity is causing the diversity of life on Earth to be lost at a greatly accelerated scale.

The Convention covers all ecosystems, species and genetic resources, linking traditional conservation efforts to the economic goal of using biological resources sustainably, setting principles for the fair and equitable sharing of the benefits from the use of genetic resources, notably for commercial use and covering the rapidly expanding field of biotechnology, and addressing technology development and transfer, benefit-sharing and biosafety.

A recent UN-backed Economics of Ecosystems and Biodiversity study estimated loss of natural capital due to deforestation and degradation at between US$2-trillion and US$4,5-trillion a year – a staggering economic cost of taking nature for granted. "It is estimated that for an annual investment of US$45-billion into protected areas alone, we could secure the delivery of ecosystem services worth some US$5-trillion a year," the report noted. "When compared to current financial losses on the markets, this is not a big price to pay. Sound ecosystem and biodiversity management, and the inclusion of natural capital in governmental and business accounting can start to redress inaction and reduce the cost of future losses."

Fighting hunger with solar power in Benin

A two-year study on the efficacy of solar-powered drip irrigation systems in Benin in West Africa has found this technology to be a cost-effective way of busting hunger and enhancing income.

Promotion of irrigation among small landholders is frequently cited as a strategy for poverty reduction, climate adaptation and promotion of food security in Africa. However, relatively little has been written about the role of irrigation in poverty reduction in sub-Saharan Africa.

To address this lack of data, a team of researchers from Stanford University in the US, led by Dr Jennifer Burney, monitored three 0,5 ha solar-powered drop irrigation systems installed in the Kalalé district on northern Benin. The systems, which use photovoltaic pumps to deliver groundwater, were financed and installed by the Solar Electric Fund, a non-governmental organisation.

The researchers found that the three solar-powered irrigation systems supplied on average 1,9 t/month of produce, including tomatoes, okra, peppers, eggplants, carrots and other greens. Women who used solar-powered irrigation became strong net producers in vegetables with extra income earned from sales.

The researchers also conducted a survey asking respondents about their ability to meet their household food needs. Seventeen percent of the project beneficiaries said they were "less likely to feel chronically food insecure."

In terms of nutrition, vegetable intake across all villages studied increased by about 150 g/per person/day during the rainy season. But in villages irrigated with solar-powered systems, the increase was 500 to 700 g/per person/day. Most of this change occurred during the dry season.

The research team concluded that, despite higher up-front costs, using solar power to pump water can be more economically sustainable in the long run than irrigation systems run on liquid fuels, such as gasoline, diesel or kerosene. "When considering the energy requirements for expanded irrigation in rural Africa, photovoltaic drip irrigation systems have an additional advantage over liquid-fuel-based systems in that they provide emissions-free pumping power."

"Overall, this study indicates that solar-powered drip irrigation can provide substantial economic, nutritional and environmental benefits," the researchers said. The study has been presented in the January 4, 2010, online edition of the *Proceedings of the National Academy of Sciences*.

WATER BY NUMBERS

- **US$9-million –** The value of the grant received from the World Bank's GEF Trust Fund for development, empowerment and conservation in the Isimangaliso Wetland Park. The funds will go towards the improvement of ecosystem functioning of Lake St Lucia and the uMfolozi River system.
- **32 –** The number of South African wastewater treatment works out of around 970 that comply with requirements for safe discharge, according to the Democratic Alliance (DA).
- **630 –** The number of homes in Queensland, Australia which mistakenly received recycled water into their drinking water supplies. Following resident complaints about the taste and smell of the water, it was discovered that the recycled plant and potable supplies from a new treatment works had been mixed up.
- **R1,1-billion –** The monies owed to South Africa's water boards by municipalities all over the country as at July 2009. This figure comprised more than R630 000 of current debt and about R526 000 of arrears.
- **US$1,02-billion –** China's planned spending over the next two to three years to fight water pollution. The money will be targeted at the construction of wastewater treatment plants, water distribution systems and rainwater recycling facilities.
- **43% –** This is how much Israel's water bills are set to rise by January 2011. The country's Water Authority Council announced that domestic water bills would go up by 25% on January, by a further 16% from July and another 2% on 1 January 2011. The revised price include the costs of providing desalinated water and upgrading the water and wastewater infrastructure.

'Boutique' farms created to combat African lake's depleted fish supplies

In a unique project to combat depleted fish supplies in Lake Victoria, researchers from the Hebrew University of Jerusalem and Makerere University in Kampala have established 'boutique' fish farms in small villages around the lake's shore in Uganda. Local fishermen used to fish carp and perciform fish near the shores of the lake, as food for their families. However, 50 years ago the Nile perch was introduced into Lake Victoria in order to increase local fisheries. The Nile perch is a predator and started to eat most of the other fish.

While the Nile perch became the primary export of the countries around the lake depleted supplies over the last ten years of the smaller fish around the shores of the lake on which local fishermen subsisted meant that the local population was deprived of their main source of protein. Furthermore, fishing the larger Nile perch was unfeasible for local fishermen as the fish resided in the middle of Lake Victoria and larger fishing boats were required to fish them.
To combat this increasing problem, Prof Berta Levavi-Sivan of Hebrew University found a way to spawn several species of African carp and cultivate them in fish farms around Lake Victoria in Uganda. The project, which has been running for five years, is being financed by USAID, in collaboration with Dr Justus Rustaisire from Makerere University in Kampala.

Last year, the developers of the project began establishing ponds in small villages around the shores of Lake Victoria, stocking them with fish from the fish farms – thus enabling the local population to eat carp. The project has since developed and now, four large fish farms, whose owners were trained in Israel, produce enough fingerlings to populate small ponds in villages around the lake.

Prof Levavi-Sivan hopes that soon, every village around the shores of the lake will have its own boutique fish farm and that the project will be expanded to include other countries in Africa. "We succeeded in inducing spawning in the carp – and these 14 villages are the success story of the project."

More financial aid for African water projects

The European Union and the African, Caribbean and Pacific States (ACP) have established a new Water Facility.

A total of €110-million has been made available under this facility. Calls have been made for proposals under the theme 'Water, Sanitation and Health Promotion for the Millennium Development Goals.' Another €40-million has been set aside for projects under the theme 'Partnerships for Capacity Development in the ACP Water and Sanitation Sector' with €40-million going to a pooling mechanism to co-finance medium-size water and sanitation infrastructure projects with other European donors and development financing institutions.

For more information, Email: Europeaid-water-facility-helpdesk@ec.europa.eu

Scientists use light to purify water – in the dark

Chinese and US scientists have used nanotechnology to develop a more efficient way of using light to purify water – even in the dark.

Light is often used as a water purifier and existing methods rely on processes stimulated by ultraviolet (UV) light. But UV accounts for just 5% of daylight so a method using visible light – which accounts for almost half – is more desirable.

Now researchers from the Shenyang National Laboratory for Materials Science in China and the University of Illinois have developed a photocatalyst that uses visible light to kill bacteria. The catalyst is made from a grid of titanium oxide fibres impregnated with nitrogen. When light photons hit the grid a positive charge is created which splits water molecules, producing a substance deadly to microbes.

The photocatalyst becomes more efficient when nanoparticles of the metal palladium are added as these hold the positive charge for longer. The researchers believe this purification technique could find a broad range of environmental applications, from water treatment plants to devices used to disinfect water in homes. And because it works in the dark, it could be used overnight or during power cuts.

There is still some concern over the cost of this technology due to the price of palladium – especially for developing countries.

Source: SciDev.Net

New book celebrates aquatic life in Africa's Okavango Delta

A new book featuring one of the most globally-important and species-rich wetlands, the Okavango Delta, has been unveiled.

Published by IUCN and the Harry Oppenheimer Okavango Research Centre (HOORC) of the University of Botswana, with financial support from the European Union and the UK Darwin Initiative, the publication, *Okavango Delta: Floods of Life*, is designed to inspire the region's decision-makers to preserve this valuable delta, which provides so many goods and services, in addition to its natural beauty.

"Wetlands are one of the most threatened ecosystems in the world and the impacts on them often pass unnoticed until the damage is done. Freshwater species, such as the invertebrates and the fishes highlighted in this book, can serve as valuable tools for monitoring these impacts," says Dr William Darwall, Manager of the Freshwater Unit for IUCN's Species Programme.

Right now the Okavango Delta is relatively unscathed, reports Dr Darwall. "But Botswana and its neighbouring countries – particularly Angola and Namibia – need to work together to ensure the rivers that feed this delicate ecosystem are monitored and measures are taken to protect the diverse flora and fauna found there."

Beginning with an explanation of the functioning of the Delta, the new book describes the catchment areas in Angola and the passage of the Okavango River through Namibia, and goes on to reveal the physical, hydrological and ecological processes governing the working of the Delta itself. Subsequent chapters reveal the value of the Delta in terms of its diversity of plants and animals, and their use and reliance by people is revealed through many wonderful photographs and descriptions. Finally, current and future threats to the Delta are reviewed, and a range of management actions for ensuring the future of the Delta are discussed.

To purchase the book go to www.earthprint.com/productfocus.php?id=IUCN2311&q=OKAVANGO

Countries finally come together to protect African lake

Africa's Lake Chad has finally been recognised as a wetland of international significance.

This follows the declaration by the Cameroon Republic that its portion of Africa's fourth-largest lake is being declared a Wetland of International Importance under the 1971 Ramsar Convention on Wetlands. This follows similar declarations by Niger and Chad (both in 2001) and Nigeria (2008). Cameroon's announcement will also clear the way for Lake Chad to become the largest of the world's few recognised transboundary international wetlands, where countries make a formal agreement for joint protection and management of shared aquatic ecosystems and their resources.

Technically described as an inland delta, Lake Chad covers 2,6 million hectares vital to countless birds as well as endangered otters, gazelles and elephants. The catchment is home to over 20 million people, with the majority dependent on the lake and other wetlands for fishing, hunting, farming and grazing. However, the Lake Chad basin is recognised as highly challenged by climate change, desertification and unsustainable management of water resources and fisheries.

Source: WWF

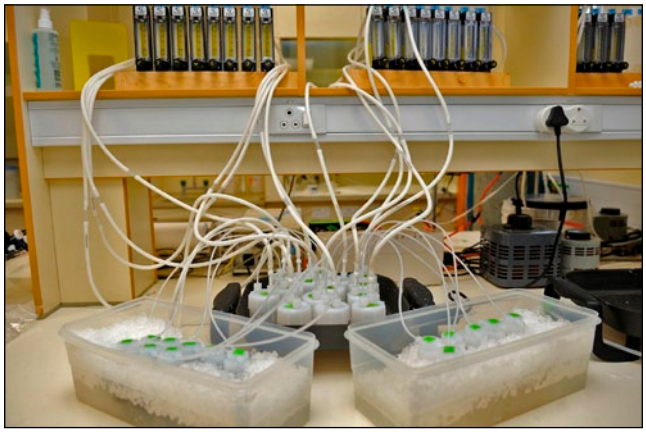
SA lab sheds light on state of mercury in aquatic environment

Mercury is the most toxic and common pollutant in aquatic ecosystems worldwide.

However, its sources, fate and transport in the environment is complex. This means the sampling and analytical procedures associated with mercury species determination require great care to yield reliable data.

Thankfully, this expertise is available in South Africa. The mercury laboratory, established in 2008 at the CSIR (Stellenbosch) is able to conduct such advanced analytical methods. The laboratory forms part of the Water Ecosystems and Human Health Research Group.

Researchers conduct ultra-trace level measurements of both total mercury and methylmercury here in several sample matrices including water, sediments and biological tissue. The laboratory has been specifically designed for low-level analytical mercury detection. Methods employed include those approved by the US Environmental Protection Agency, such as the 'mercury in water by oxidation purge and trap' method as well as cold vapour atomic fluorescence spectrometry.



The laboratory also boasts a direct mercury analyser for the determination of total mercury in sediment and biological tissue. An ambient mercury vapour analyser for the determination of gaseous total mercury is also available.

Accurate and reliable determinations of total mercury and methylmercury require attention during sample collection and processing. To reduce contamination, the laboratory has a Class 100 clean-room dedicated to the handling and storage of sample collection bottles (all of which are Teflon) and for the detection of total mercury in aqueous media. Admittance to the clean-room requires gearing up with shoe covers, lab coats and head gear.

The facility is well ventilated with filtered air that is replaced every nine minutes or so. It also includes a laminar-flow station and fume hood, with high-purity 18 mega-Ohm.cm water supplied to the laboratory.

The laboratory has also contributed to the building of capacity in mercury analysis by providing an opportunity for several students engaged in higher degrees at universities to conduct their analyses for mercury in water, sediment and biota samples.

Source: CSIR

SA's largest desalination plant on the horizon

The Albany Coast Water Board's desalination plant is set to become the biggest plant of its kind in the country.

The reverse osmosis (RO) plant, situated at Bushmans River Mouth next to Kenton-on-Sea in the Eastern Cape, is currently receiving a facelift. Once completed, it will have a throughput of 1 800 m^3/day, making it the largest desalination plant in South Africa.

VWS Envig won the contract for the refurbishment of the plant in August. The project involves maintaining a supply of potable water while the existing plant is being overhauled, the supply of a new RO skid, as well as the integration and optimisation of existing plant equipment. The project also includes the implementation of energy-savings devices to improve efficiency and reduce operational costs, as well as the running and maintenance of the plant for a year. "The upgrade of the desalination plant is an important project, as it serves the Ndlambe Municipality, which in turn services a population of around 50 000 people," reports Gareth Kearns, Project Engineer at VWS Envig.

The project has been challenging as the contractor's design team needed to consider means by which to implement modern solutions and technologies into existing plant infrastructure. Kearns explains: "With a greenfield project it is easy to stipulate, design and build facilities which meet the exact requirements of the equipment being installed. A brownfield project, on the other hand, requires adaptation of equipment and installation techniques to meet the requirements of the existing infrastructure."

The existing desalination plant has been serving the Ndlambe Municipality for well over a decade. At present, the plant has three RO trains, mounted on separate skids, in various states of operational functionality. The supplied solution effectively reduces the total number of skids, while bringing the plant up to its specified delivery rate of 1 800 m^3/day. The solution combines the existing RO1 and RO2 trains and places them onto a single skid. This new skid will utilise an existing 160 kW Grundfos pump, as well as an energy recovery device, and a new 15 kW booster pump to force saltwater through the RO membranes. "The new skid represents a massive energy saving for the Albany Coast Water Board," reports Kearns.

"We have also installed a pressure exchanger which utilises the wastewater brine stream, which exists the system under high pressure to reintroduce energy into the RO process. Pressure exchangers are economical devices, which convert waste energy, in the form of high pressure, back into usable energy with an efficiency of 96,7%," he continues. "In a similar fashion, we have introduced a turbine-based energy recovery device to the smaller new RO3 train. The turbine device, while not as efficient as a pressure exchanger, still manages to convert pressure back into energy at an impressive 56% efficiency."

The implementation of the energy recovery devices and the pressure exchanger will reduce the RO plant's energy requirements by almost 30%, making the plant more economical and cost-effective to run.

The plant is expected to be ready for beneficial operation by the end of March 2010. VWS Envig will then operate and maintain the facility for a 13-month period under an operations and maintenance contract.

Groundwater quality questioned in North West villages

Researchers at North West University's School of Environmental Sciences and Developmental (Microbiology) have expressed their concern over the quality of groundwater serving communities in the province.

More than 80% of rural people in the North West depend on groundwater as their sole source of drinking water. In many cases, the water is accessed directly from borehole to tap, without any intermediate disinfection, although in some areas chlorine is added to groundwater stored in reservoirs.

Previous studies have indicated that many of these groundwater sources show excess levels of nitrate and salts (e.g. calcium, magnesium and phosphates). These high nitrate and salt levels are already a health concern for the rural people of the North West.

Lani van Vuuren

Researchers have expressed concern over the microbial quality of groundwater samples in the North West.

A project team from the School of Environmental Sciences and Developmental (Microbiology), under the leadership of Prof Carlos Bezuidenhout investigated the microbial quality of groundwater in selected areas in the North West. "Aquifers in the province are exposed to pollution from mining, agricultural and other anthropogenic activities. It thus makes sense to generate data about the microbial quality of groundwater in this province, focusing on indicator bacteria," notes Prof Bezuidenhout.

One study in which 49 sites were samples, showed disturbing results. Thermo-tolerant coliform bacteria were detected in 59% and, among these 29% were positive for *E. coli*. Furthermore, more than 50% of all the sites tested positive for faecal streptococci and 88% for staphylococci.

These bacteria are all indicators of pollution and possible contamination by disease-causing faecal pathogens. Consistent exposure to these pathogens can result in outbreaks of water-related disease such as those which have occurred at Delmas and Bloemhof. Immuno-comprised individuals are especially at risk.

"The presence of these indicator bacteria in the groundwater sources are of grave concern," says Simone Ferreira, a student working on the project. "Detection of any of these organisms in treated municipal water is unacceptable, and should therefore be unacceptable in the water that so many people use directly from the ground."

It is felt that groundwater in the North West can no longer be managed in a nonchalant manner, and the researchers have called on authorities to investigate the causes of pollution and to treat the polluted sources as a matter of urgency.

The study was presented at the 2009 Biennial Groundwater Conference, which took place in Somerset West in November.

water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

PUBLIC NOTICE

GAZETTING OF TWO GENERAL AUTHORISATIONS FOR SECTION 21(c) AND (i) WATER USES IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The National Water Act, 1998 (Act No. 36 of 1998)[NWA] requires that a water use set out in section 21 of the NWA may be authorised by means of a general authorisation. Two such water uses are: activities entailing the impeding and diverting of flow of water in a watercourse and altering of the bed, banks, course and characteristics of a watercourse. (Section 21(c) and (i)).

The Acting Director-General: Water Affairs approved two general authorisations in terms of section 39 of the NWA for section 21(c) and (i) water uses of the NWA on 07 December 2009, namely:

1. General authorisation for a water use in terms of section 21(c) and (i) for the purpose of rehabilitating a wetland for conservation purposes by a specific category of persons (A new general authorisation); and
2. From 1st January 2010 the Replacement of the general authorisation contained in Schedules 1 and 2 of Government Notice No. 398 dated 26 March 2004 as published in Government Gazette No 26187 in respect of water uses 21(c) and (i))

Both general authorisations are subject to a set of conditions and precautionary practices including the sustainable use and the protection of the resource quality in a water resource.

A campaign to notify the broader public, other authorities and stakeholders regarding the publication of these general authorisations through press releases in major news papers, advertisements in publications and posting of a notice on the DWA website was undertaken. Comments were recorded, evaluated and processed according to departmental procedure – the outcome of which has culminated in these final two general authorisations.

The general authorisations are published in Government Gazette No. 32805, Notice No. 1198 and 1199 respectively, dated 18 December 2009. The documents are available electronically on the Department's website: http://www.dwa.gov.za/documents/

New from the WRC

Report No: TT 417/09

Review of Regulatory Aspects of the Water Services Sector (D Malzbender; A Earle; H Deedat; B Hollingworth & P Mokorosi)

Frequent incidents of non-compliance with potable water quality standards, the discharge of raw sewage into river systems and the deterioration in water supply system assets through operating deficiencies and lack of maintenance, has increasingly brought into focus the question of the regulatory framework for water and sanitation services. The WRC initiated research to inform the debate and provide independent research on the topic.

Report No: TT 419/09

A Planning Framework to Position Rural Water Treatment in South Africa for the Future (CD Swartz)

Drinking water supply in rural areas is mostly not sustainable. The quantity of water available for drinking purposes is seriously impacted upon by global climate change, population growth and urbanisation, while the quality of existing supplies is also deteriorating, resulting in ever increasing problems with finding suitable and sustainable treatment technologies to produce adequate quantities of safe water for household use. This project was therefore undertaken to study the factors impacting on rural water treatment in South Africa, propose adaptive strategies to address these impacts, and develop a planning framework that can be used to position rural water treatment for the future.

Report No: TT 421/09

Enabling Effective Learning in Catchment Management Agencies: A Philosophy and Strategy (D Roux; K Murray & E van Wyk)

It is the responsibility of catchment management agencies (CMAs) to manage water resources in their respective water management areas. The nature of the functions they have to perform and the complicating and complex internal and external realities with which they operate create very demanding circumstances. It is therefore imperative that CMAs are effective learning organisations. Among others, this document puts forward a series of learning ideals which provide a sound philosophical basis for both organisational and individual learning.

Report No: TT 395/09; TT 386/09 & TT 397/09

Guidelines to Facilitate Legal Compliance with Respect to Industrial Waste Management (NL Oosthuizen & J Bell)

Understanding legal responsibilities with respect to waste management can be daunting. Compliance requirements pertaining to waste is contained in a wide array of legislation, across all tiers of government and administered by numerous government departments. This series of guideline documents sets out to provide waste generators, waste contractors and authorities with the necessary tools to assess waste practices by breaking down the complex requirements into simple and easy to understand language. Volume 1 deals with managing your wastes to achieve legal compliance (and industry guide); Volume 2 deals with achieving legal compliance for intermediate waste contractors while Volume 3 contains information on auditing waste generators and intermediate waste contractors to assess and monitor legal compliance (an authority's guide).

Report No: KV 213/09

The Effect of Water Temperature on Aquatic Organisms: A Review of Knowledge and Methods for Assessing Biotic Responses to Temperature (H Dallas)

The importance of water temperature in aquatic ecosystems, particularly river systems, has been recognised for some time. Studies have broadly focused on reporting and understanding the thermal regime, including water temperature modelling; documenting anthropogenic causes of thermal changes and the ecological consequences of these changes; and developing methods for estimating thermal tolerance ranges. This report, offers, inter alia, a literature review aimed at consolidating information pertaining to water temperature in aquatic ecosystems; information on site selection for the installation and testing of temperature loggers; as well as issues to be considered and criteria to be used when selecting sites for temperature monitoring.

Report No: TT 403/09

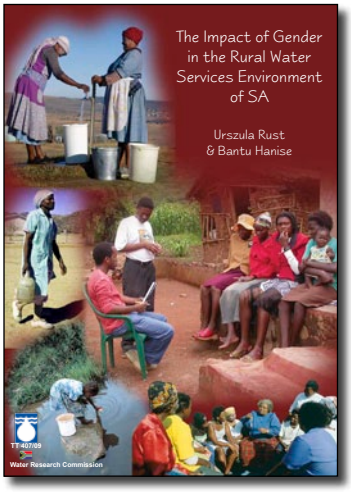
Integrated Algal Ponding Systems and the Treatment of Domestic and Industrial Wastewaters (C Wells; D Renders & PD Rose)

This report forms part of a wider study on the biotechnology of saline wastewater treatment that has also investigated various aspects of mine water salinity. Both saline wastewaters and inadequately treated sewage present major threats to the sustainability of the national water resource in South Africa and the ability to deal with the problem is, in an important measure, technologically dependent. Apart from the ability to deal with these problems, the capacity to do so is also central to solutions which are sustainable over the long term. The aims of the study were to investigate the economic, social, technical and technological feasibility of treating sewage reticulated in saline water, including nutrient removal and disinfection, for urban and rural communities.

Report No: TT 407/09

The Impact of Gender in the Rural Water Services Environment of SA (U Rust & B Hanise)

Gender equality and access to basic water services are complexly interlinked objectives for both poverty alleviation and sustainable development. In South Africa, research shows that despite the emphasis on mainstreaming gender equality in the water services sector (and the concomitant policies and structures), the lives of poor women in this sector are not substantively being transformed. This study was therefore aimed at deriving principles that would enhance the impact of gender mainstreaming in the water services sector, and at evaluating current South African guidelines according to these principles.



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First SA study on stress levels of CAUGHT AND RELEASED FISH

For the first time a South African study is being undertaken to determine the effect on fish of 'catch and release' angling in the country. Lani van Vuuren reports.

'Catch and release' fishing – where the fish is released almost immediately after capture – has become a popular conservation strategy among recreational anglers across the world, including South Africa. It is specifically promoted for the conservation of scarce and/or overfished species.

In recent years, however, a global debate has started among fishing circles questioning the benefits of this approach. The most physically demanding form of exercise stress in fish is capture by angling, and researchers have called for caution against the overzealous implementation of catch and release angling in light of the lack of knowledge regarding the sub-lethal effects and post-release mortalities this approach may have on individual fish species. It has been proposed that species-specific guidelines be developed taking into account the inter-specific diversity of fishes and variation in fishing techniques.

As a result of this debate, the body of literature evaluating the impacts of catch and release has expanded rapidly. To date, the majority of these studies have focused on freshwater fish in North America, specifically rainbow trout and largemouth bass.

LACK OF LOCAL KNOWLEDGE

In 2008, the Centre of Aquatic Research (CAR) at the University of Johannesburg kicked off a project with funds from the Water Research Commission to investigate the effects of catch and release angling on smallmouth yellowfish in the Vaal River. This is the first time a study of this nature has been undertaken in South Africa, and it is one of very few studies targeting fish species found in Africa.

The Vaal-Orange smallmouth yellowfish or ***Labeobarbus aeneus*** is a highly-prized game fish for sport anglers in the Vaal River. Their proximity to the Gauteng heartland is the keystone of the yellowfish fly-fishing industry in South Africa, however, all forms of angling have targeted this species with great success.

"The ultimate success of catch and release angling depends on ensuring high release survival rates. If we are uncertain on the effects of catch and release on a specific species how can we promote it as an effective conservation tool?"

Smallmouth yellowfish are opportunistic feeders, eating a variety of food types from plant material to aquatic insects, crabs, shrimps and small fish, with adult fish attaining a mass of about 9 kg. They are a slow-growing species with a low egg-to-mass ratio and only become sexually active when they are between four and six years old (depending on the system and sex of the fish).

Catch and release of yellowfish species is being actively and successfully promoted in the Orange-Vaal River system. However, as Ruan Gerber, a Masters student, supervised by Prof Nico Smit at CAR points out, to date there has been no real understanding of the potential effects of this type of angling on this specific species. "The ultimate success of catch and release angling depends on ensuring high release survival rates. If we are uncertain on the effects of catch and release on a specific species how can we promote it as an effective conservation tool?"

Speaking at the Young Water Professionals Symposium, held in Pretoria earlier

Research by the Centre of Aquatic Research at the University of Johannesburg shows that catch & release fishing has a greater effect on smallmouth yellowfish than thought.

All photographs courtesy Centre of Aquatic Research

this year, Gerber noted that around 5 000 sport anglers target smallmouth yellowfish in the Upper Vaal River each year, catching a (very conservative) estimated 320 000 fish each year.

A SOUTH AFRICAN FIRST

Gerber and his team of fly-fishermen collected data from 96 fish caught and released from the Vaal River during a period of six months using standard fly-fishing techniques. Following capture the fish were anaesthetised for two minutes, blood samples taken, weighed, and measured before being revived and released. For each fish caught the times to land fish and handling procedure (hook removal) were also recorded. The landing and handling times were combined to determine a total angling time.

The levels of glucose, cortisol and lactate (known stress biomarkers) were measured for each fish to determine the physiological effect of angling time, fish size and water temperature (influenced by the time of year). To serve as controls, 16 randomly selected fish were kept for 72 hours in a 15 000 ℓ pool filled with river water.

The blood parameters tested from the angled smallmouth yellowfish exhibited decrease glucose, increased cortisol (in some individuals) and increased plasma lactate concentrations with increasing angling time (confirming that the longer it took to land the fish the more stress it was experiencing). Interestingly, the fish showed stress even after short angling durations (upwards of one minute).

BIG FISH, BIG STRESS

As can be expected there was a very positive correlation between fish size and angling time, raising suspicion that larger smallmouth yellowfish are experiencing more constant stress as they are caught and released throughout a season. "These larger individuals would most likely be repeating spawners and deliver the largest contributions to the growth and replenishment of the population during spawning periods," said Gerber.

This is significant as the main season that smallmouth yellowfish are targeted by fly-fishermen is from mid-September to mid-April. These times correspond to their spawning season, which lasts from late-September through to mid-March, depending on the river temperature and flow. If fish are stressed in such a way by angling that their spawning behaviour is affected (which has been reported in fish species elsewhere) catch and release could, in fact, be negatively affecting fish populations rather than helping to conserve the species.

"Many studies have also demonstrated that fish may stop feeding following a stress event such as angling, and this can result in decreased growth. Higher cortisol levels may also lead to a suppressed immune system, thus leaving fish susceptible to disease during the recovery period," noted Gerber. Recovery took as long as 24 to 72 hours after capture (depending on the biomarker).

Following capture the fish were anaesthetised for two minutes, blood samples taken, weighed, and measured before being revived and released.

CATCH & RELEASE ANGLING AROUND THE WORLD

In countries such as the UK catch and release has been performed for more than a century by coarse fishermen to protect target species from disappearing in heavily fished waters. The practice has increasingly caught on and many salmon and trout rivers are now considered 'no kill' zones.

In the US, catch and release was first introduced as a management tool in the state of Michigan in 1952. Today, conservationists are strongly advocating catch and release as a way to ensure sustainability and to avoid overfishing of fish stocks.

In other countries, such as Australia and Canada, catch and release has caught on more slowly, only really becoming widespread from the 1970s and 1980s. In Canada, catch and release is now mandatory for some species. The country also requires, in some cases, the use of barbless hooks to facilitate and reduce injury.

Interestingly, not all countries advocate catch and release. For example, in Switzerland, catch and release fishing has been banned from 2009, with the country's anglers now obliged to take a course on 'humane methods' for catching fish.

Source: Wikipedia

Sport anglers catch upward of 320 000 smallmouth yellowfish in Upper Vaal River each year.

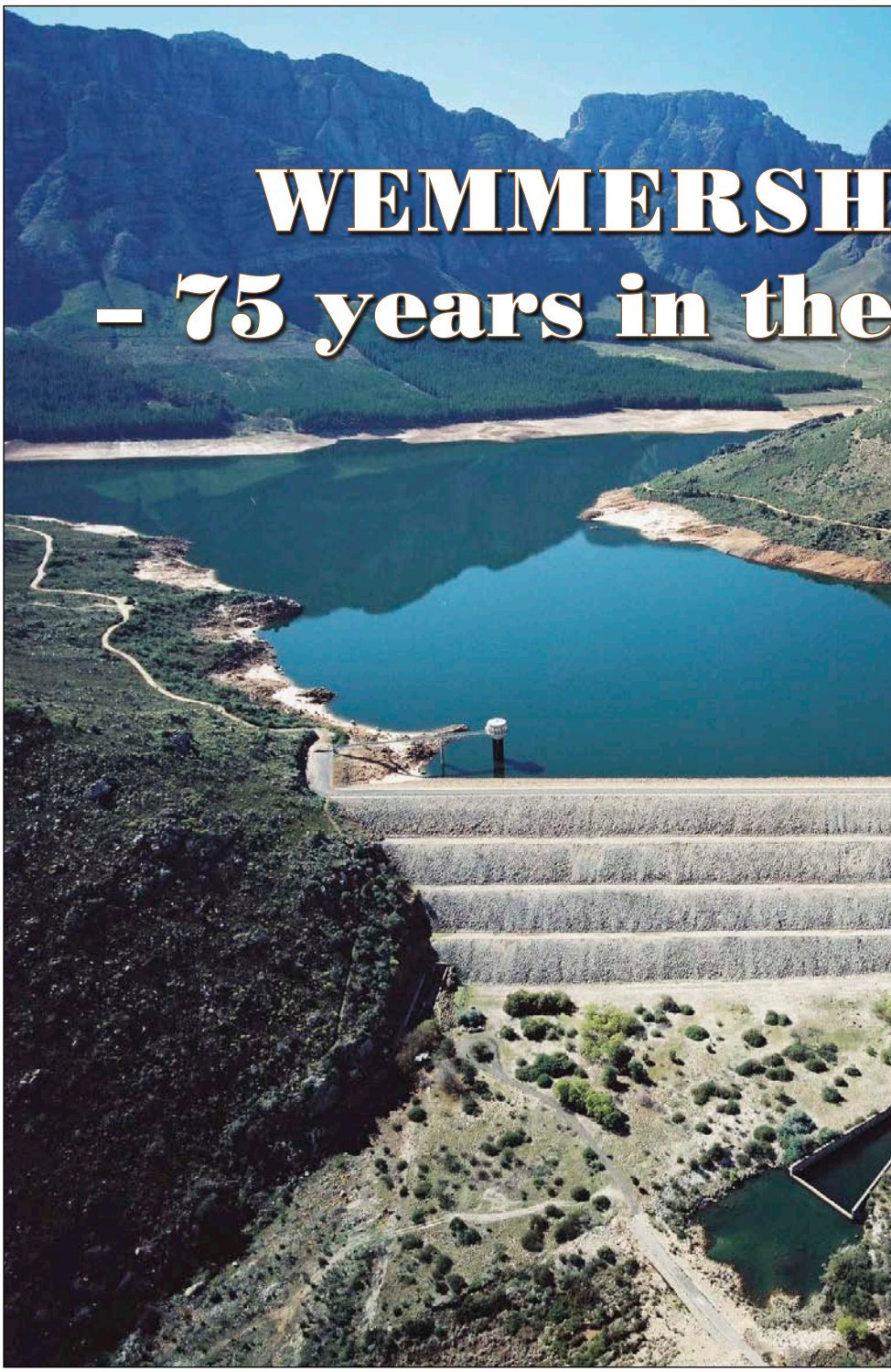
A smallmouth yellowfish being revived prior to release.

Water temperature did have an effect on stress hormone levels. Captured fish showed higher energy levels at intermediate temperatures than at low (11°C) and high (27°C) temperatures. The lactate response found in fish from this study, show that smallmouth yellowfish angled at lower and intermediate temperatures have the smallest response, while fish angled at the upper temperatures have the greatest response to angling. "Therefore, fish angled at higher water temperatures are put under greater stress and as a result under greater risk of a wide range of sub-lethal impacts and even mortality than fish angled at lower water temperatures," reported Gerber. Although the effect of air exposure was not assessed during this study, it is important to note that it may also play a role in the stress response of angled fish.

According to Gerber there is no doubt that smallmouth yellowfish do experience stress when captured and that guidelines are urgently needed to ensure fish experience as little stress as possible. "Catch and release angling is a valuable tool for conserving fisheries resources, but only if it is done correctly."

Additional reading: To find out more about yellowfish in South Africa try, *State of Yellowfish in South Africa* (**WRC Report No: TT 302/07**). To order, contact Publications at Tel: (012) 330-0340 or Email: orders@wrc.org.za. To download a free copy, Visit: www.wrc.org.za.

WEMMERSH – 75 years in the



It took close on 75 years from the time the thought of constructing a dam in the water-rich Wemmers River Valley, in the Western Cape, was first uttered to finally bringing the project to fruition. Lani van Vuuren takes a peak at how this dam came to be built.

Today, the Wemmershoek Dam still plays a critical role in the bulk water supply to Cape Town and surrounds. But it took several decades from the time the engineering project was first contemplated to being executed by the City of Cape Town, to whom the dam still belongs.

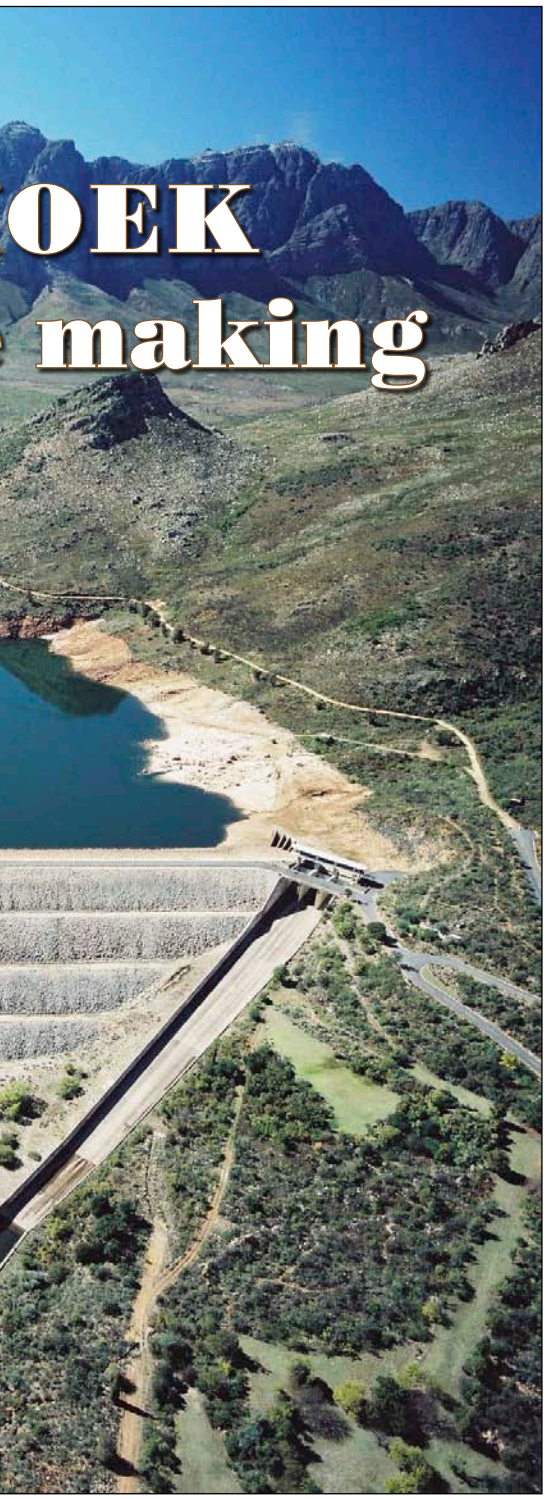
In a report dated 1882 the hydrographic surveyor to what was then known as the Cape Colony drew attention for the first time to the possibility of developing the Wemmershoek catchment. The relatively small, mountainous catchment area, surrounded by spectacular peaks, drew attention particularly due to its abundant winter rainfall.

Water shortages have been an occurring theme throughout the history of the Cape. No sooner had one crisis been averted than the next scheme had to be implemented to meet rising demand. This was again the situation following the Anglo-Boer War. In 1904, John Parker, Chairman of the Joint Water Committee wrote: "The rapid development and expansion not only of the City, but of the neighbouring suburbs in the last decade has placed the need for an increased supply of water in the position of first importance, demanding immediate and serious consideration. An adequate water supply is the most important municipal question at present before the people of the Cape Peninsula; without exaggeration it is a matter of life or death to many of its inhabitants."

INITIAL INVESTIGATIONS BEGIN

In 1899, the Woodstock Municipal Council, following investigations by consulting engineer Thomas Stewart, already started buying up properties in what was then known as Oliphants Hoek (Wemmershoek) with the view of constructing a reservoir there with a capacity of 3 million gallons (13 638 m^3).

In 1904, Cape Town City Engineer, J Cook, submitted a report on various water supply schemes, among others,



City of Cape Town

More than 50 years after its construction, Wemmershoek continues to be a crucial source of bulk water to the residents of Cape Town, which owns the dam, and surrounding towns.

Steenbras, Palmiet, Twenty-Four Rivers, Wemmershoek and Franschhoek (today known as the Berg Water Project). However, with Woodstock having already 'claimed' the Wemmershoek scheme, Cape Town's attention turned first to Franschhoek and then to Steenbras after it became clear that Table Mountain, from which it was receiving its main water supply at the time, had reached its limits for develpment.

In 1907, Woodstock and three other municipalities, Mowbray, Claremont and Rondebosch successfully promoted a Private Bill, which gave them the right to construct a relatively small reservoir in the Wemmershoek catchment. Initial investigations kicked off with rainfall and river gauging, and a series of trial pits were dug at the present dam site.

The project, however, was beyond the financial capacity of the interested local authorities. In 1913, the rights to the scheme devolved on the Municipality of Cape Town when it amalgamated with eight surrounding municipalities, including the four Councils that had promoted the original Bill.

At the time of unification recurrent water shortages were already posing a serious problem. Detailed investigations of possible new sources were undertaken as a matter of urgency not only at Wemmershoek but also at Steenbras, which had emerged as its most serious rival as the new source of supply. In 1916, the Board of Engineers recommended that Steenbras be developed.

A referendum among ratepayers between Steenbras and Wemmershoek followed. Steenbras won the poll and the Council of Cape Town adopted the Steenbras Scheme in 1917. This dam was eventually completed in 1921.

WEMMERSHOEK REVIVED

The Wemmershoek Scheme remained on the backburner until after the Second World War when it became apparent that a new water supply would soon be necessary for Cape Town. Investigation of several possible schemes showed that Wemmershoek would be the most economical source of supply except perhaps Riviersonderend. Since, however, the latter was to be pursued by National Government as an irrigation scheme, it was decided to pursue the Wemmershoek Scheme instead.

Cape Town started taking steps to obtain, through Parliament, amplification of the powers it had originally been granted so as to permit development of the catchment's full potential yield. The Private Bill promoted for this purpose was finally passed by Parliament in 1951. An important requirement of the Act was that the City was not to construct the dam in stages, but was to build it immediately to full height.

A Board of Engineers was appointed to control the project. The Board comprised recently appointed City Engineer Solly Morris and renowned consulting engineer Ninham Shand, assisted by Technical Secretary BD Kark. At the invitation of Shand

WEMMERSHOEK DAM FACTS AND FIGURES

Year of completion: 1957
Catchment area: 84,2 km^2
Type: Earthfill
Length of crest: 518 m
Height above lowest foundation: 55 m
Volume content of dam: 2,9 million m^3
Full supply capacity of reservoir: 58,6 million m^3
Annual yield: 51 million m^3 (99% assurance of supply)
Surface area at full supply capacity: 296 ha
Spillway type: Gate-controlled discharge with chute
Maximum discharge capacity of spillway: 1 065 m^3/s (controlled)

Ewisa/Dirk van Driel

Wemmershoek Dam was initially designed to be a mass concrete dam, but later a design incorporating a rockfill embankment with a clay core and filters was proposed, saving some half a million pounds in foundation costs.

former head of the US Bureau of Reclamation, Dr John Savage, became the third member of the Board.

Construction of large earth dams had not been customary practice in South Africa at the time, with traditional mass concrete construction being commonly employed. Initially Wemmershoek Dam was designed to be a mass concrete dam, but Shand proposed a rockfill embankment with a clay core and filters – an engineering design that had taken off in the US. Dr Savage supported Shand's proposal, and the design was implemented accordingly, saving some half a million pounds in foundation costs.

Morris had this to say about the design in a paper published in 1959: "With the tremendous advances in earthmoving equipment and the increased knowledge made available from intensive studies in soil mechanics, there is little doubt that construction of dams in earth will be extended."

RACE AGAINST TIME

The raising of Steenbras Dam during the early 1950s bought Cape Town some time, but it was still a race against time to complete Wemmershoek Dam to avert a major water crisis. The main contract for construction was awarded to George Wimpey & Co of London on April 1953, and work on the site commenced in June of that year. Nearly all the constructional plant – to a value of £784 000 – was purchased new for the project. Most of it was delivered to the site before, or during the first summer of construction. JG Welsh was appointed Resident Engineer on Wemmershoek Dam, while JA Shaw was the Resident Engineer on the Wemmershoek Pipeline, which formed an important part of the overall scheme.

At the peak of construction 1 286 people were employed on the dam site. Work proceeded day and night in two shifts. Face shovels were used for excavation, except in places where access was unduly difficult; in these areas draglines were used.

Work on the dam was dealt a significant blow when on 19 May, 1954, the Wemmers River Valley experienced its highest flood ever occurred. The peak flow was assessed at about 453 m^3/s. Direct losses were covered by all-risk insurance, but the resulting delay – which was not insurable, was far more serious. The flood also led to a reconsideration of spillway design capacity.

The dam was finally completed in 1957.

MAIN DESIGN ASPECTS

The dam wall consists of an embankment-type structure composed of river gravel and boulders with sloping clay core, rising 55 m above original ground level. The length along the top of the embankment is 518 m and the maximum width at the bottom is 335 m. Interestingly the amount of material handled was more than twice that contained in the Great Pyramid of Egypt. At the time of its construction, the Wemmershoek Dam was the largest dam of its kind in southern Africa.

The central clay core totals a quarter of the volume of the dam and was placed in layers 152 mm in thickness and rolled ten times with 37-t rubber-tyred rollers drawn by tractors. Before placement of the clay could start, it was necessary to prepare a foundation sufficiently strong enough to prevent percolation of water under pressure through the ground.

This engineering problem was solved by excavating a trench more than 18 m deep through river alluvium until sound rock was reached. Holes were then drilled to a depth of a further 30 m or more and grout was pumped into them. The cement grout percolated into the surrounding rock and set solid, the rock foundation of the site was thus rendered practically impervious. This screen

City of Cape Town

grouting was also extended to each flank of the dam.

The spillway comprises three radial gates, each 8,5 m wide by 8,2 m high, which discharge into a chute channel 30 m wide, 4,6 m deep and 396 m long. At the base of the chute channel is a specially designed bucket which disperses the water through a ski jump during big floods. The spillway gates were originally designed to be hoisted by electric motors, with standby petrol engines provided for each hoist in the event of power failure.

City of Cape Town

***Top**: The intake tower is 7,3 m in diameter and 55 m high. Water is drawn from the intake tower through pen-stocks at various levels.*
***Left:** At the time of construction in the 1950s, Wemmershoek Dam was the largest in South Africa.*

City of Cape Town

***Above**: Wemmershoek has a gate-controlled discharge spillway with a chute. The spillway has a maximum discharge of 1 065 m³/s.*

***Below:** Another view of the spillway. Here the radial control gates can clearly be seen.*

Ewisa/Dirk van Driel

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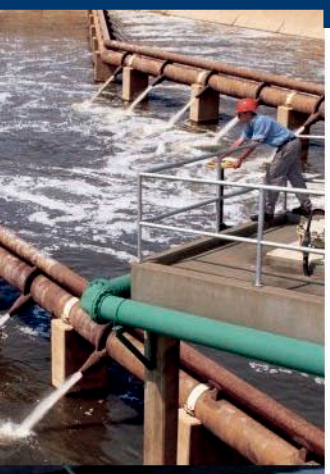
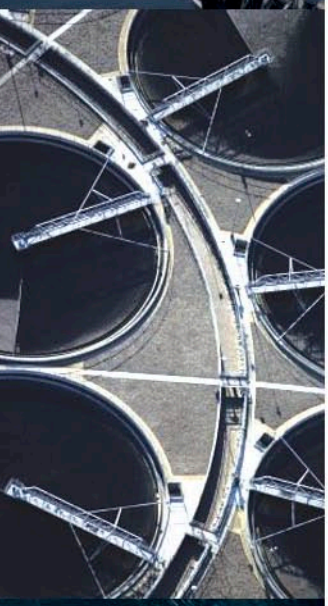
- Thanks to eWISA and the City of Cape Town for photographs

The intake tower is 7,3 m in diameter and 55 m high. Water is drawn from the intake tower through penstocks at various levels and supplied to a treatment plant situated at the base of the Wemmershoek Dam through twin pipelines laid in a diversion culvert underneath the dam.

When Wemmershoek Dam was constructed a compensation agreement involving an exchange of water rights for agricultural use, between Wemmershoek Dam and the Riviersonderend/Berg River Government Water Scheme (constructed in the 1980s) was made, and a 10 million m³ annual release is made into the Berg River from the Riviersonderend Scheme in lieu of that from the Wemmershoek Dam.

More than 50 years after its construction, Wemmershoek continues to be a crucial source of bulk water to the residents of Cape Town and surrounding towns.



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New strategy to light path for sustainable groundwater use

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South Africa has huge volumes of groundwater available for potential development, but, just like the country's surface water resources, it needs to be managed holistically to ensure that any use is sustainable. The National Groundwater Strategy, currently under development, hopes to achieve just that.

For decades groundwater was considered the 'poor cousin' of water resources in South Africa. Its mysterious and hidden nature, coupled with an overall lack of knowledge about the country's aquifers, resulted in groundwater development being largely confined to small, rural areas of South Africa.

The problem has been compounded by groundwater's historic status as a 'private' water resource under the country's former national water laws. Prior to 1998 groundwater was legally the property of the owner of the land under which it was found, making it difficult to assess and manage regionally. "Indeed, the State had little control over groundwater, except in certain areas where groundwater had been declared part of a subterranean government water control area," explains Jude Cobbing of Water Geosciences Consulting.

While South Africa's surface water resources are nearly fully allocated, at present only a small fraction of the national groundwater resource is used. The latest groundwater resource assessment shows that South Africa has about 10 000 million m^3/year of groundwater available for development (under normal rainfall conditions) of which only 2 000 m^3/year is being used at present. This compares to the yield of nearly 3 000 m^3/year obtained from the Vaal River system through its series of dams and inter-basin transfers.

"Groundwater's role in South Africa is often underestimated – two thirds of our population depend on groundwater for their domestic needs," notes Cobbing, who was speaking at the Biennial Groundwater Conference held at Somerset West last year. "Although most large-volume water users rely on surface water, the majority of small water supplies, which are critical to livelihoods, health and dignity, depend on groundwater."

Groundwater is also essential to the water supplies of towns such as Beaufort West, Prince Albert, Graaff Reinet, Atlantis and Musina. Even large cities such as Pretoria and Johannesburg are partly dependent on groundwater.

IMPROVING GROUNDWATER'S STATUS

The need to raise groundwater's status to equal that of surface water in meeting the country's growing water demand

has been recognised. To this end, the Department of Water Affairs has selected a team comprising hydrogeologists, integrated water resource management managers and policy and strategy development experts to build a National Groundwater Strategy.

The aim of the strategy is to capture the understanding, position and value of groundwater so that it can fulfil its role as equal partner in integrated water resource management and use. The strategy will identify strategic objectives and develop an associated implementation matrix that will consider phasing and sequencing, operationalisation, financial requirements, funding options, human resources mobilisation and risks. A monitoring and evaluation scheme will also be developed.

Importantly, the strategy will also inform the National Water Resource Strategy (NWRS), which is now due for revision. "If groundwater is not included in the NWRS in a way that is proportionate to groundwater's current use and potential in South Africa, it will be difficult to ensure strategic and political support for better development of the resource," said Cobbing. "The greatest challenge facing the groundwater sector in South Africa is the present lack of skills and resources. Without high-level support from strategy documents such as the NWRS the sector has little hope of recovering to fulfil its potential."

BUILDING ON THE PAST

This is not the first attempt at a national strategy for groundwater. In 2001, the need for a consolidated and strategic groundwater input to the first National Water Resource Strategy was identified. The resultant project identified a suit of strategies for areas such as institutional arrangements, human resources and capacity building. That information, along with the Framework for a National Groundwater Strategy (published in 2007) is being used as building blocks for the new groundwater strategy.

The focus to date has been on laying the foundations of knowledge and information regarding groundwater in South Africa. A number of stakeholders have been identified and workshops have been held across the country. Reviews covering groundwater resource assessment methodologies, institutional strength and weaknesses, and capacity and training have also been undertaken.

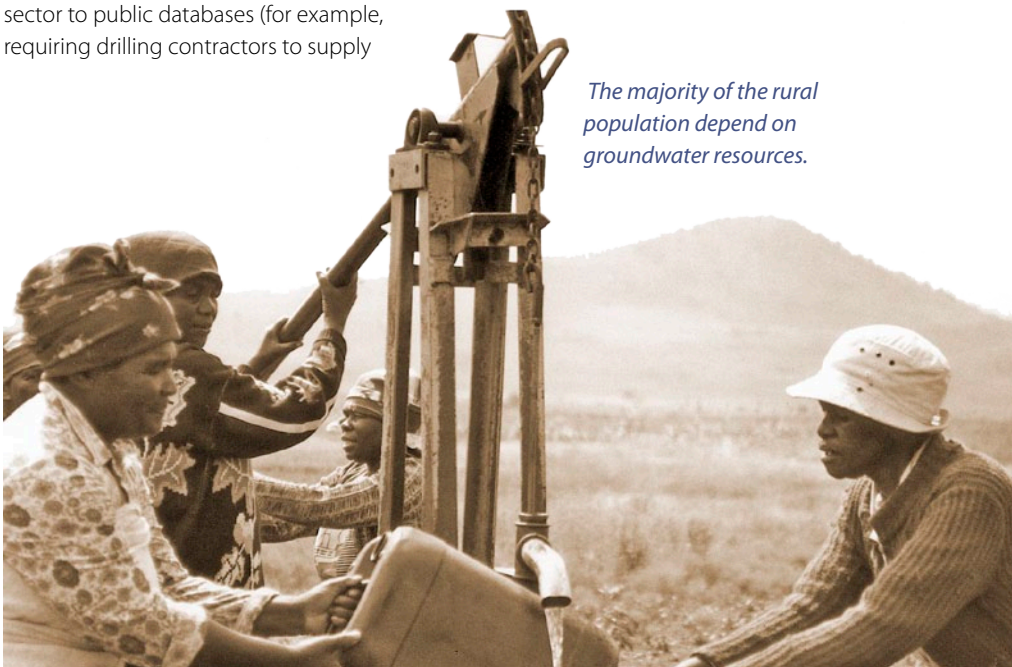
RECOGNISING THE CHALLENGES

These reviews have uncovered several major challenges experienced by the country's groundwater fraternity. Perhaps one of the significant of these is the lack of adequate capacity in the field of hydrogeology not only in the national department, but in South Africa as a whole. "This impacts negatively on all functions of groundwater operations and management as well as on the efficiency of water resource management institutions," notes Dr Kevin Pietersen of Water Geosciences Consulting and part of the national groundwater strategy team. "Adequate capacity plays a very important role in the realisation of the successful implementation of the National Groundwater Strategy."

Another issue is that of groundwater assessment and storage of data. Groundwater data in South Africa is stored in several public sector databases, and also by many private groundwater contractors, drillers and consultants. Increasing the submissions of data by the private sector to public databases (for example, requiring drilling contractors to supply details of boreholes) is a vital issue to ensure information concerning groundwater is available nationally. Integration and upgrading of existing public sector groundwater databases is also necessary.

Just like surface water resources, groundwater resources are vulnerable to threats such as acid mine drainage and other forms of pollution, over-abstraction and mismanagement, and climate change. Groundwater's role in terms of environmental functions is often overlooked. Many ecosystem services have a direct linkage with groundwater storage, recharge and discharge. However, the interdependencies between ecosystem services and groundwater are not yet recognised and valued in decision-making and in the management of water resources and river basins. "Groundwater is generally interpreted as falling outside the function of the Ecological Reserve, except where groundwater discharges sustain surface water bodies," notes Dr Pietersen. This is something that requires careful reconsideration.

With the building blocks in place, the national groundwater strategy team are now working towards putting together the actual National Groundwater Strategy, which will soon become available for review. It is hoped that this strategy will go a long way in ensuring the sustainable use of groundwater resources in South Africa.



The majority of the rural population depend on groundwater resources.

Guy Stubbs

Hundreds gather for first young water professionals conference in Africa

More than 350 people gathered in Pretoria, South Africa for the First Regional Conference of the Southern African Young Water Professionals (YWP) in January. Lani van Vuuren attended the event.

Organised by the Southern African Young Professionals Programme under the auspices of the International Water Association (IWA) and the Water Institute of Southern Africa (WISA), the conference was the first of its kind in Africa and the largest YWP conference to be held in the world to date.

Young water professionals from across the region and representing various spheres within the sector enthusiastically embraced the opportunity to network with both peers and prospective employers. According to Conference Chair and President of the SA YWP, Dr Jo Burgess, the large interest in the conference was mainly due to the huge amount of passion among young southern African scientists and engineers to improve the region's water and sanitation services, render its development sustainable and protect its natural environment.

"Fulfilling the present and future needs of the water and wastewater industries require the continuous development of a workforce which is adequate in size, capable in skills and strong in leadership. Young professionals are the future of the sector yet there is no other body in the world that gives young water professionals a voice and a place to meet, either virtual or physical. The YWP programme is fully inclusive, with no agenda regarding gender, location, race or nationality. Any and all individuals with an interest in any aspect of water, and especially those with a need to find a community of colleagues to belong to, are welcome."

The conference comes less than a year after the establishment of the South African YWP Programme. The first year of the programme focused on creating effective communication networks, including chapters in various provinces, to inform South African young water professionals. These activities culminated in the Southern African YWP conference.

The conference identified a great need for young water professionals in southern Africa to network. "It is daunting when

you are new in your career to suddenly be without the guidance of lecturers and supervisors, to be expected to be a fully functioning professional, when you have little experience behind you," notes Dr Burgess. The YWP Programme provides opportunities to join a formal mentoring programme and to meet with peers – two ways of reaching a sympathetic, advisory audience with whom young people in the sector can bounce around ideas and seek advice comfortably.

The conference offered young water professionals a valuable opportunity to present their work on a range of subjects, from water resource management, treatment and re-use to health-related aspects and basic water supply and sanitation. The abstracts were all thoroughly reviewed, resulting in presentations of exceptional quality. Experienced water professionals were also at hand to impart words of wisdom to the young crowd.

Awards were given to the Best Presentation and Best Poster. Joint winners Geoff du Toit of Aurecon and Olawale Olanrewaju of the University of the Witwatersrand snatched the WISA President's prize for Best Poster, while Dr Tobias (TG) Barnard won the Best Presentation Award. Dr Barnard, of the University of Johannesburg, will go on to present his work at the International YWP Conference to be held in Sydney, Australia, in July.

The southern African water sector has never been as exciting, or as challenging as it is today, said keynote speaker Gareth McConkey. "Young people are offered more opportunities than ever before, but they are also inheriting a myriad of problems while having to deal with future uncertainties, such as climate change." McConkey noted that water professionals today were taking on more responsibility at a younger age and he encouraged young people to seek out mentors and to learn from whichever sources they could find. He also noted that employers needed to do more to create enabling environments in which young employees could learn and develop.

Lani van Vuuren

Conference panellists Prof Brian O'Connell of the University of the Western Cape; Neil Macloud of Ethekwini Water & Sanitation and Prof Anthony Turton of the University of the Free State.

Prof Anthony Turton of the University of the Free State said that it would be up to young water professionals to provide the heroic vision and leadership required to adequate address issues facing the sector. "Historically, the South African water sector, while being extremely sophisticated, has been very conservative. We drastically require new ways of thinking to solve our water problems – young water professionals will have to help the sector in that regard."

Today's southern African young water professionals have much to offer the world. "We have a vibrant generation of people committed to protecting public and environmental health, to considering all viewpoints when they tackle a problem, a willingness to collaborate and, above all, a tremendous amount of energy and enthusiasm," notes Dr Burgess.

The conference highlighted a number of challenges for young water professionals – not necessarily specific to any particular technology or topic, but rather focused on less tangible aspects. Chief among these were the need for better, cleaner, faster communication, especially between scientists/engineers/social scientists and the need to create a spirit of collegiality and pride in the sector. "Another oft-repeated request was for the sector to retain its older generations, whose decades of experience are crucial and whose wisdom is draining out of the sector," reports Dr Burgess.

Despite these challenges, the conference vibrated with a high level of positive energy right up to the last session

Lani van Vuuren

Joint winners of the Best Posters Olawale Olanrewaju of the University of the Witwatersrand and Geoff du Toit of Aurecon.

Lani van Vuuren

Winner of the Best Paper Award Dr Tobias Barnard of the University of Johannesburg, with IWA YWP President Kati Ruzicka.

of the last day. "The conference was buzzing right up to the last moment – we had to chase people out of the auditorium once the conference was over!"

For more photographs of the conference, turn to page 34.

THE WATER WHEEL

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Is water the new oil?

Current knowledge and thinking around water issues will not be enough to solve South Africa's water challenges of the near future. So writes Dr Anthony Turton, Director of Touchstone Resources and Professor at the Centre for Environmental Management at the University of the Free State.

The simple truth is that human population growth is outstripping our supply of freshwater. The total volume of water on Earth is 1,4 billion km^3. Of this a staggering 97,5% is saltwater found in the sea. The remaining 2,5% of the global water reserves (35 million km^3) is fresh water. This total volume (35 million km^3) is found in three separate forms: 68,9% is bound up in glaciers and permanent snow cover; 30,8% manifests as groundwater, soil moisture, swampland and permafrost; leaving the remaining fraction of 0,3% as water in rivers and lakes.

The result is that the only freshwater useable to humans is around 200 000 km^3, which is shared with aquatic ecosystems, and this amounts to less than 1% of all freshwater resources on the entire planet. This is a staggeringly small number.

If one homes into the population element and links that to water availability, then a truly terrifying picture starts to emerge. Work done in the late 1980s by famous hydrologist Prof Malin Falkenmark developed into what is now known as the water crowding index (WCI). This is an indicator of the number of people dependent on a standard unit of water (1 million m^3), and has shown that a value exceeding 1 000 represents a reasonable upper limit that can be supported in a sustainable way within the current constraints of existing technology. To expect to survive above this limit thus becomes dependent on the levels of technology available in that given situation.

The value of 2 000 was seen to represent the 'water barrier' beyond which economic development was impossible in terms of the technology then available. Dr Peter Ashton, principal scientist at the CSIR, has produced a set of data that translates Falkenmakr's findings into the South African situation as it exists in the four basins shared with other neighbouring states.

This is presented as Table 1, and it shows that in all cases the WCI was already above the critical 1 000 level in 2000, with the Limpopo being a stunning 4 219, over four times higher than what Prof Falkenmark considers to be sustainable and more than double what she called the 'water barrier'. When extrapolated to 2025 this becomes even more serious, with the Limpopo system approaching 5 000 and all of the others close to 2 000.

These are serious numbers indeed. South Africa is at the very tipping point of environmental constraints to future economic growth and thus social stability. To explain the concept of a tipping point: ecosystems perform in way that is reasonably predictable most of the time. This is known technically as linearity where two variables are known to be linked in a specific way, which means we can predict future behaviour based on various observations.

This is true to a point, beyond which non-linearity starts to occur. This means that the previous relationship between two variables is no longer relevant, because that relationship changes so fundamentally that predicting an outcome with any degree of accuracy becomes statistically more difficult (if not impossible). This is referred to as the 'tipping point' because it is at this moment in time that change is so drastic that the future condition will differ fundamentally from the previous condition.

It therefore becomes technically impossible to solve tomorrow's problems with today's science that is based essentially on yesterday's knowledge. Taken one step further it means that any country approaching an environmental tipping point will need to develop a scientific capacity that differs fundamentally from what it already had, simply because the old science becomes somewhat irrelevant to the new circumstances.

Water, by virtue of its growing scarcity, is thus set to become the new oil, but there are also fundamental differences between the two. Water is a flux whereas oil is a stock, and this difference has major ramifications once we start to grasp them. This means that water will become commodified (even if most non-governmental organisations and trade unions resist the notion), because ultimately the laws of demand and supply will prevail and the scarcity will determine the value.

However, because water is a flux, this will drive recycling and reuse, which is simply impossible in the case of oil. The sooner progressive governments realise this and move to intervene in terms of legislation and regulation, rather than obstruction and denial, the better for national economic development and thus the well-being of all.

This is our challenge in terms of water investment – we need infrastructure, but we also need intellectual capital in the form of new technologies and ideas – because as we upgrade our old infrastructure, we will also need to implement new processes that remove endocrine disrupting chemicals, microcystins and other contaminants like heavy metals and radioactivity from gold mining.

The problem is that water is a flux, but we manage it as a stock. Thus our solution lies in changing our management approach, and thus public perceptions to embrace this new reality. Being a flux it can be recycled, so in future effluent management will become as important as water resource management, simply because effective recycling will allow it for future economic growth. We therefore have to get the efficiencies right in order to remain competitive as a national economy functioning under conditions of endemic scarcity.

WHAT IS THE GLOBAL OUTLOOK FOR PRICING AND REGULATION?

Within the international water sector the Dublin Principles apply. These are expressly mentioned in the South African National Water Act. In terms of these principles water is a finite resource that has economic value and it therefore means that we have to manage it as such. This fails in practice, however, where major political pressures exist in the form of water as a human right, often underpinned by strong demands for free water.

This impacts on the financing of water infrastructure and unless this thorny issue is resolved, we are likely to remain in the

Table 1: Current (2000) and projected (2025) populations and water resources available (including water transfers) in the South African segments of the transboundary river basins with values for the WCI for each basin

Basin	2000			2025		
	Population ('000s)	Available water ($10^6 m^3 yr^{-1}$)	WCI	Population ('000s)	Available water ($10^6 m^3 yr^{-1}$)	WCI
Orange-Senqu	11 319,0	9 568	1 183	19 502.0	10 816	1 803
Limpopo	10 905.9	2 585	4 219	18 790.4	3 778	4 974
Incomati	1 122.4	723	1 552	1 933.8	837	2 310
Maputo	1 165.7	847	1 376	2 008.5	849	2 366

quagmire we currently find ourselves in. The way to change that is to work on public perceptions, because a changed public perception that free water today means no quality water tomorrow; or worse still, poor human health tomorrow, will mobilise political support for change.

The most likely drivers for this in my professional opinion are the following:

- The whole issue of acid mine drainage as it is currently unfolding in Johannesburg is driving a growing public awareness campaign. Associated with this is human health risk linked with radionuclide and heavy metal contamination downstream of gold-mining activities, the most notable being the Wonderfontein Spruit;
- The emerging issue of endocrine disruption, specifically as it manifests in babies being born with both male and female genitalia arising from the use of DDT to control malaria in Limpopo has the potential to become a storm of public protest if left unmanaged;
- The current failure of many municipalities to maintain their water care works in a way that is capable of returning quality water back into the hydrological cycle.

FUTURE SOURCES AND THE ROLE OF NEW WATER

'New water' is the best approach for South Africa and other water constrained countries in the SADC region. Two elements of this are likely to become critical. The first is sewage management, which as it now stands, is hopelessly inadequate if we are to have a reasonable chance of growing our national economy. Our current approach is to see water as a stock and then discard it once it has been used once.

The solution lies in seeing water as a flux and thus enabling reuse. This can best be achieved by moving sewage plants off the balance sheets of municipalities, where they currently reflect as a cost centre, onto the income statements of local authorities where they should reflect as a revenue generator instead. The key to revenue generation is treating water to a level where it can become industrial grade process water and thus a valuable economic resource, rather than simply waste to be discarded.

The economics will drive this as potable grade water becomes more costly and starts to impact negatively on industrial processes needing water. This will see a new market for cheaper industrial grade process water and it will be in this market that revenues will be generated for wastewater treatment plants.

In Perth, Western Australia, an experiment is currently underway that will take processed sewage and inject it into groundwater aquifers were it will be stored for future use. In Brisbane, a different but equally useful approach is underway. This approach has considerable scope in South Africa.

South Africa's approach to strategic storage, which is currently done in the form of large dams, will also change over time. For example, in the Orange River basin, only 5% of the water that falls as rain eventually ends up as water in the river and thus useable to our national economy. In the South African portion of the Orange River basin, this figure is just over 3%, which means that 97% is lost to evaporation. The total storage capacity of all dams in the basin is around 270% of the actual flow of the river. Clearly we have reached the end of the dam-building era in the Orange, which is our most important national water resource.

Again, if we apply our flux thinking, then alternative strategic storage is likely to take place in a way that reduces evaporative losses. One method is to store water in aquifers in a process known as groundwater recharge, and I see this as becoming a major area of commercial interest in the near future. Another method is to store water in mine voids, which transforms the acid mine drainage problem from a mining issue into a strategic storage and national economic development issue instead.

This creates new water by reducing evaporative losses and if we get this right the numbers are massive – think of the 97% currently being lost in the Orange River basin alone – and then ask what we could do with only 5% of this as a useable resource? But this will need government support in the form of policy and legislation if it is to succeed.

TAPPING INTO NEW TECHNOLOGIES

Albert Einstein told us that the level of ingenuity needed to solve a problem exceeds the level of ingenuity that created the problem in the first place. This means that no single institution will be able to solve our national water problem. Partnerships, and only partnerships, will be needed.

I therefore see a new form of public-private relationship starting to emerge, building on the failures of earlier attempts at doing the same thing. Government will play a new role as regulator and legislator, enabling these partnerships to emerge. A new form of corporate identity will have to be considered for the management of sewage works, managed like a franchise operation would with skills and core processes being developed at the centre and then applied in the radial offshoots of the new entity.

The national science councils, especially the CSIR and Water Research Commission, will need to be invigorated for their role as technology generators, and where appropriate technology will have to be sourced from overseas. South Africa will have to become technology leaders in endocrine disruption and microcystin management, simply because our levels are so high that few other countries in the world are likely to develop the type of technology we need to survive as a viable economy within the severe water constraints we have.

*This paper was first presented at the **Water Investment World Africa 2009** conference, which took place in Gauteng in November last year.*

WATER Kidz

Rivers: Life-giving veins of the Earth

Like the veins in a human body, so the rivers of the world criss-cross the Earth's surface. But instead of blood, these arteries carry life-giving water.

Rivers come in lots of different shapes and sizes – from large gushing torrents of water to small creeks and streams. Although river water makes up only about 0,2% of all the fresh water on Earth, it plays a very important role in human lives.

People need rivers. Human and economic well-being are directly or indirectly dependent on the goods and services provided by river systems. For example, we obtain drinking water and water for irrigating crops from rivers, we may fish, harvest reeds, have picnics on the riverbanks or perform baptisms in the river pools. Rivers are also important sporting areas (think about the Duzi marathon that is held in the uMngeni River in KwaZulu-Natal every year).

Rivers also help drain rainwater and provide habitats for many species of plants and animals. As they make their way to the sea, rivers help shape the features of the Earth. In many countries, rivers are travel routes for people and provide power for hydroelectric plants.

Just as a tree trunk has a main trunk and many branches, a river system is made up of a main river and all its tributaries, or smaller streams. The point where two rivers join is called a confluence. Rivers both carve the land and build it up. As rivers flow, they cut into the land. This is called erosion. Rivers cut both down into and across the earth. As rivers cut into the earth, they grind up rocks and churn up small rocks and soil. Over time, rivers change the land they flow over by carving new patterns for themselves.

Unfortunately, the river landscape worldwide is constantly changing due to the construction of dams and weirs for water supply and hydroelectric power generation. Rivers also receive effluent from sewage treatment works and industry, as well as diffuse pollution from, for example, agriculture and urban centres (stormwater runoff from parking lots, roads, etc). All of these activities can have an impact on water quality.

SOUTH AFRICA'S RIVERS

Compared to other countries, South Africa is not endowed with many large rivers. In fact, being among the 30 most water scarce countries in the world, our rivers are rather small. The total runoff from all of South Africa's rivers is about equal to that of the Zambezi River, one of the largest rivers in Africa. Despite this fact, rivers remain our main source of fresh water. In other words, most of the purified water that comes out of our taps at home as well as the water used to power industries and mines, is sourced from nearby rivers and streams.

Most of South Africa's rivers are ephemeral, which means that they only flow during part of the year, usually during the rainy season. None of our rivers are navigable. Due to the semi-arid nature of most of South Africa, our rivers are vulnerable to overexploitation and modification, which has implications for aquatic ecosystem functioning and biodiversity.

South Africa's largest river is the Orange River, which carries more than 20% of the total river flow of the country.

RIVER-RELATED WORDS

Ephemeral river: Rivers that only flow during parts of the year.
Perennial river: Rivers that flow throughout the year.
Riverbed: The bed of a river is the surface upon which it flows.
Riverbank: Riverbank refers to the side of the river.
Runoff: This includes all the water flowing into the river after a rainfall event, as well as groundwater which may feed the river throughout the year.
Headwater: This is where the river starts or its source. The river flows to its mouth (usually towards the sea or other large body of water).
Course: The course of the river is its path, which follows the line of lowest elevation between the source and the end of the stream.
Catchment: Also known as a watershed or a river basin, this refers to the entire land area drained by a river system (or the entire land area that a river gets its water from).

Leslie van Veenhuysen

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South Africa's rivers offer some of the most spectacular scenery in the world.

Including the Vaal River (its largest tributary), the Senqu in Lesotho and the Fish River in Namibia (76 000 km^2), the Orange River catchment is 682 059 km^2 in size, covering most of Gauteng (mining, industry, urban), the Free State (mining, agriculture) and the Northern Cape (agriculture). The river itself is more than 2 000 km long.

Another very important river for the country is the Vaal River, which supports the country's economic heartland. The industrial areas supported from the Vaal River produce more than 50% of South Africa's wealth and more than 80% of the country's electricity requirements – more than 50% of all the electricity generated in Africa. From the Vaal River water is also supplied to some of the largest gold and platinum mines in the world.

Unfortunately, our rivers – just like most of the rivers of the world – are facing tremendous environmental problems. This is so bad that, in some cases, our rivers have become unsuitable for basic uses such as fishing and swimming. When our rivers become polluted, or altered by means of dams built in them, they can no longer support the ecosystems dependent on them.

Today, less than a third of our rivers are still in a pristine or natural state. Most of rivers have been largely modified. We need to realise that protecting and conserving rivers – our main source of drinking water – is critical for our future survival.

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Most of South Africa's rivers are ephemeral, which means they only flow during certain times of the year.

www.sxc.hu

Rivers do not only offer us fresh water to drink, they are also places of fun and activity.

WEB RESOURCES

www.factmonster.com/ipka/A0001779.html for a list of the principal rivers of the world, including name, source, location, outflow and approximate length.
www.waterencyclopedia.com/Re-St/Rivers-Major-World.html for information on the major rivers of the world.
www.dwaf.gov.za/iwqs/rhp/naehmp.asp for information on the environmental health of South Africa's rivers.
http://geography.howstuffworks.com/terms-and-associations/river4.htm for basic information on rivers.

THE LONGEST RIVERS IN THE WORLD

River	Country	Kilometres
Nile	Burundi, the Democratic Republic of Congo (DRC), Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda	6 670
Amazon	Brazil	6 404
Chang jiang - Yangtze	China	6 378
Mississippi-Missouri (river system)	US	6 021
Yenisei-Angara (river system)	Russia	5 540

Source: www.waterencyclopedia.com

Conference for young water professionals a roaring success

An extremely successful Regional Conference of the Southern African Young Water Professionals was held in Pretoria in January. The conference attracted a record 351 delegates – more than any other YWP held in the world to date. The atmosphere was one of high energy and enthusiasm – right up to the last day. For more feedback on the conference, read the article on p26.

The conference was organised by (from left to right) Cilla Taylor, Gary Burgess, Jo Burgess, Manglin Pillay, Renay van Wyk, Henry Roman and TG Barnard.

Above: *Zinzi Mboweni from the Department of Water Affairs and Simphiwe Chabalala of the University of Pretoria.*
Below: *BH Cele, Nesta Makhedama and Mzukisi Woqhamza, all from the Department of Water Affairs in the Western Cape.*

Above: *Philani Msimango of the Department of Water Affairs (DWA); Wilberforce Mfitundinda of Uganda; Rudzani Khameli of the Department of Agriculture, Forestry & Fisheries (DAFF); Mpho Makhavhu of the DWA and Ramabulana Ndwamato of the DAFF.*
Right: *Olawale Olanrewaju of the University of the Witwatersrand; Thulani Dlamini of the Durban University of Technology; and Wilhelmina Moeng of Siyanda District Municipality.*

Water Demand Management in SADC

Building a Water Demand Management (WDM) culture in the Southern African Development Community (SADC) region to ensure effective and sustainable use of water.

Programme Objectives

Promoting greater acceptance and consolidation of pro-poor WDM practices.

Implementing WDM activities.

Creating confidence among credit institutions to fund WDM projects.

Programme Services

Support Services: Promoting a favourable environment in which WDM actions can take place.

Project Development Services: Assisting clients in preparing bankable WDM projects.

Finance Facilitation Services: Supporting innovative and sustainable financing mechanisms.

Please contact the Programme Implementation Unit (PIU) for further information on the WDM Programme.

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A SADC regional programme implemented by DBSA and funded by Sida

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WDM
WATER DEMAND MANAGEMENT

Water Research Commission

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

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

Impact areas address the following key issues:

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

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