LETTERS TO THE EDITOR

More than one mechanism for water licensing

In the article on pages 30 to 31 of the March/April 2008 edition of the *Water Wheel* (The Business of Compulsory Licencing) Mr Peter van Niekerk argues strongly that using a market mechanism to effect the equitable allocation of water holds great advantages over a purely administrative system like the compulsory licencing process.

During these arguments one has to take into account Principle 7 of the Fundamental Principles and Objectives for a New Water Law for South Africa which states that "the objective of managing the quantity, quality and reliability of the nation's water resources is to achieve optimum, long-term, environmentally sustainable social and economic benefit for society from their use". Further the Constitution of the Republic states that there is a commitment from the nation to reform in order to bring equitable access to the water resources.

One cannot argue against Mr Van Niekerk's concerns on the complex nature of the compulsory licencing process to affect this. In the same vein, one can also not argue against his viewpoint of the simpler process of a market for entitlements and thereby effecting equitable allocation (but unfortunately over a longer period). One should ask the question whether we can afford such a longer period, and the answer is probably no.

The market mechanism is a slow approach to water reform (but a necessary one with great benefits) and is based on a willing-seller willing-buyer concept (in spite thereof that state authorisation is necessary to give effect to a transaction). For the mechanism to be effective, the State should actively intervene, and the interventions should not only be economical in nature. Mr Van Niekerk mentions some of these.

The problem is what to do with water uses that were undertaken legally when the National Water Act commenced (the so-called "existing lawful water uses"), which may be continued with subject to the conditions and obligations attached to that use until it is replaced with a licence, if these conditions and obligations do not meet the relevant objectives. As the Acts reads at the moment this could only be achieved by following the compulsory licensing procedure (as the market mechanism may take too long and only addresses the water uses involved in the trading).

The compulsory licensing process forms part of a bigger process to achieve water allocation objectives. It is a mechanism to transfer existing lawful water uses to licences, and while doing that water reform actions may (or should) also be taken. Thereafter, all the licences should be reviewed regularly to give effect to the relevant objectives.

It is submitted that not the one or the other mechanism should be considered to give effect to the Fundamental Principles and Objectives for a New Water Law and the Constitution, but both, either separately or jointly, including other mechanisms such as

- voluntary surrendering of an existing lawful water use for a licence (even for a lesser use), usually if there is a benefit for the user to do so;
- enforcing water conservation and water demand management principles;
- expropriating entitlements to use water;
- increasing water tariffs resulting in voluntary sale of entitlements;
- reviewing and amending or replacing the conditions of licences; and
- developing the water resources.

Each of these mechanisms has a specific role to play, depending on the circumstances, and the argument should not be which is the best but which of these together and in what sequence are the best in a specific case. In certain cases, for example where intensive water application practices are used for irrigation, objectives could probably only be achieved if all the water users concerned are holders of licences and not just existing lawful water users. Therefore all the existing lawful water uses should be transferred to licences, probably by implementing the compulsory licencing process. In spite thereof, objectives could still be achieved, for example through authorizing the use of water by new users resulting in that less water is available for the existing users (due to changes in the assurance of supply) so that they have to implement water conservation measures to ensure that their undertakings are not adversely affected.

The organisations involved should therefore apply their minds to decide which of the various mechanisms should be used in a specific case and how. Applying the minds should not be a once off decision but a process.

Lastly, most (if not all) of the mechanisms have their practical and administrative shortcomings, which should be rectified by the necessary amendments to the National Water Act. If not, water reform is going to remain a nightmare.

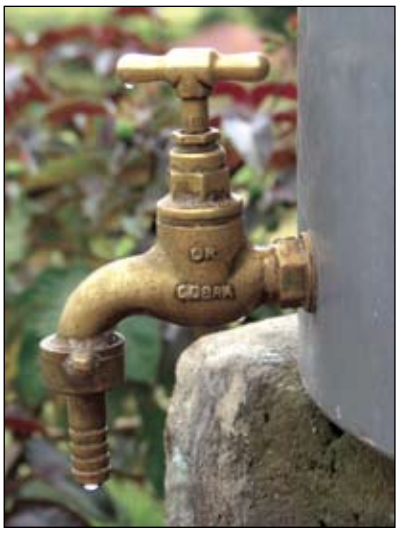
Hubert Thompson, Pretoria

WATER ON THE WEB

www.eol.org
This free Internet encyclopedia, the Encyclopedia of Life, is part of a US$100-million, 10-year project aimed at listing all the creatures and plants on the planet. About 30 000 species have been listed to date. The project is led by the US Field Museum, Harvard University, Marine Biological Laboratory, Missouri Botanical Garden, Smithsonian Institution and Biodiversity Heritage Library – a group that includes London's Natural History Museum, the New York Botanical Garden and the Royal Botanic Garden in Kew, England.

www.dewpoint.org.uk
The DEW Point Resource Centre generates and disseminates knowledge on behalf of the UK Department for International Development (DFID) and their development partners in environment, water resources, water and sanitation and climate change. The website provides a range of free information databases for the wider development community. Topics include bioenergy, climate change, environment, hygiene, technology, water and sanitation and water resources.

FBW reaches 70% level



More than 72,5% of poor people receive a free basic water allocation of 6 kℓ per household a month, reports Minister of Water Affairs & Forestry Lindiwe Hendricks.
She was responding to a question asked in Parliament in March. "The 6 kℓ does not, however, provide sufficient water for water-borne sanitation. Several municipalities are providing an additional allocation free of charge or at a lower rate to cater for flush toilets to poor people," she said.

With regard to Free Basic Sanitation, Hendricks told Parliament that a revised strategy would be submitted to Cabinet for approval by the second quarter of this year. "Once approved, Free Basic Sanitation must be rolled out gradually, taking into account municipal managerial capacity, financial viability, ability to operate and maintain systems, billing at affordable levels, acceptable payment levels and proper use of the Equitable Share."

The minister further cautioned that not all municipalities were the same and all had different levels of capacity and financial resources. "They will have to approach Free Basic Sanitation in line with their implementation capacity," she noted.

New manual for detection of phytoplankton

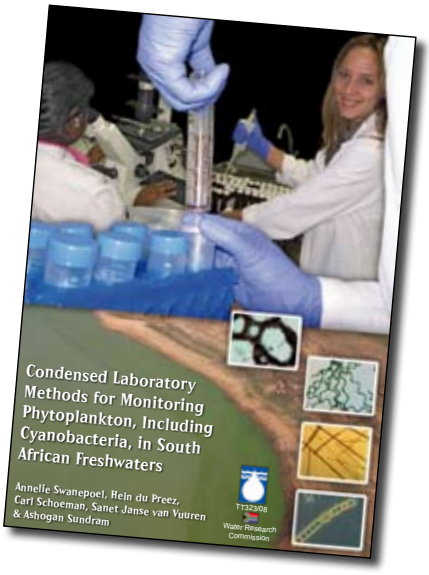
A condensed laboratory methods manual to monitor phytoplankton, including cyanobacteria, in South African water resources has been published by the Water Research Commission (WRC).

Reservoirs provide the bulk of South Africa's raw, potable, irrigation and livestock water. These reservoirs are variously impacted by eutrophication arising from their catchments. Associated with these conditions is the excessive development of phytoplankton, especially cyanobacteria.

The monitoring of phytoplankton, cyanobacteria and their related organic compounds is essential to the production of water safe for human and animal consumption. A need for a comprehensive methods manual for phytoplankton was identified during encounters with South African laboratories tasked with water quality monitoring.

Most of the smaller laboratories do not possess the capacity and/or expertise to develop methods essential for the effective monitoring of phytoplankton. To address this, a project was initiated in association with the WRC that resulted in the publication of this methods manual. It is envisaged that this publication will aid to the much needed capacity building in the South African drinking water industry.

To order the report (**Report No: TT 323/08**) contact publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za



Funds to save Vaal from pollution

The Gauteng Provincial Government has allocated R50-million towards investigations into wastewater spillages into the Vaal River.

During a visit to sections of the Vaal River in April, Local Government MEC Dorothy Mahlangu said some of the major causes of the spillages were big industries operating in the Vaal area who "dump waste such as animal skins and animal carcasses in stormwater pipelines." Regular sewage spillages have also been experienced from failing municipal sewerage infrastructure.

According to the MEC communities also needed to be educated on how the sewerage system worked as some of the spillages were caused by people blocking wastewater pipelines with foreign objects. "We need to work with the police with regard to the offenders and the companies that contaminate the river. Most importantly, we need to discourage communities to contaminate the water," she commented.

According to Johnny Thabane, Member of the Emfuleni Local Municipality Mayoral Committee, the Department of Water Affairs & Forestry (DWAF), the Department of Provincial and Local Government and the municipality have lobbied Treasury for funds to upgrade the municipality's troublesome Rietspruit Wastewater Treatment Plant and Leeuwkuil Water Treatment Works. DWAF has already contributed R9,5-million towards the elimination of troublesome pumps and upgrading of the two treatment works.

National wetlands conference calls for papers

There has been a call for papers for the 2008 National Wetlands Indaba, to be held in Skukuza, Kruger National Park, on 28 to 31 October.

The Indaba is a cross-disciplinary gathering of practitioners involved with the conservation and sustainable use of South Africa's wetland resources. These include scientists, decision-makers, researchers,

conservationists, and educators hailing from various organisations.

The theme for this year's Indaba is 'Healthy Wetlands – Healthy People', adopted from the theme for Wetlands Day 2008. In line with the theme there will be discussions on the benefits that can be derived from wetlands from both the direct, positive effects on human health on maintaining healthy wetlands – such as the provision of food, clean water, medicinal plants etc. – and the direct negative effects of mismanaging wetlands that result in the impairment of communities' health and well-being.

Abstracts for papers, workshops and poster may be submitted no later than 31 July. Submissions can be made to André Beetge from Working for Wetlands; Tel: 084 240 2264; Fax: (013) 262-8140; E-mail: abeetge@mweb.co.za or beetge@sanbi.org

Research boost for alien busters

A long-term collaborative research agreement has been signed between Working for Water (WfW) and the Department of Science & Technology and National Research Foundation's Centre for Excellence for Invasion Biology (CIB), based at the University of Stellenbosch.

At the signing of the collaborative agreement between the DST-NRF Centre of Excellence for Invasion Biology (CIB) and Working for Water (WfW) were (front) WfW Director Mandisa Mangqalaza; CIB Deputy Director: Science Strategy Prof Dave Richardson, (back) CIB Post-Doctoral Associate Dr John Wilson and CIB Deputy Director: Operations Sarah Davies.)

The agreement is designed to improve the government initiative's effectiveness of alien plant clearing operations in rural and urban freshwater catchment areas. The research to be done by the CIB will address the integrated management of alien invasive species. It will incorporate training of postgraduate students, particularly at the doctoral level, and short courses on invasive species ecology and management for environmental managers in government agencies.

The management of alien invasive species is best done by integrating a range of tools to control or halt the spread of the species and developing strategies to prevent the introduction or establishment of new populations. The CIB-WfW research programme, and the students that form part of it, will support these efforts by undertaking targeted applied research, for example, using genetic techniques to identify the source of South African invasive plant populations, and ecological techniques to compare the biodiversity impacts of different alien clearing methods.

The research programme will include in-depth research to improve the effectiveness of biological control (i.e. the use of natural enemies, often herbivorous insects, to control invasive species) using molecular techniques and to understand the impacts of biological invasions on freshwater and terrestrial ecosystems.

"Partnerships of this kind are exactly what are required to reduce the rates and impacts of biological invasions in South Africa, and the CIB looks forward to a close and fruitful working relationship with the WfW programme," commented CIB Director Prof Steven Chown.

WATER BY NUMBERS

- **R3,1-billion** – The money budgeted by the Gauteng Housing Department for the coming financial year for the eradication and formalisation of the remaining informal settlements in the province.
- **9** – The number of major water resource capital projects at the planning stage at present to be constructed in the next five to ten years at a cost of R12-billion, according to the Minister of Water Affairs & Forestry Lindiwe Hendricks.
- **1391** – The year toilet paper was first made for the Chinese emperor, according to WaterAid. The British Perforated Paper Company first produced toilet paper in Great Britain in 1880.
- **4%** – The proportion of Africa's total annual renewable water resources which have been developed for irrigation, water supply and hydropower use to date, according to the African Development Bank. About 340 million Africans lack access to safe drinking water.
- **98%** – The proportion of the Egyptian population who have access to piped water.
- **R1,4-million** – The amount for which the eThekwini Municipality is suing a Durban waste disposal company for allegedly dumping waste in a council pipeline, which caused pollution in the Umhlatuzana River.
- **US$1,2-billion** – The value of a project by Mexico City authorities to refurbish the city's sewerage system. A total of 160 km of sewerage pipes will be renovated under the project.
- **160** – The number of water treatment plants operated by international food group Nestlé.
- **866** – The number of inspectors working for the so-called Green Scorpions across the country.
- **US$500-billion** – The projected financial cost of a hurricane to US coastal cities by 2020. Despite the increasing hurricane threat, construction continues unabated along the country's Atlantic and Gulf coasts. Hurricane Katrina, which swamped New Orleans, was the costliest natural disaster in US history, with damages of US$80-billion.

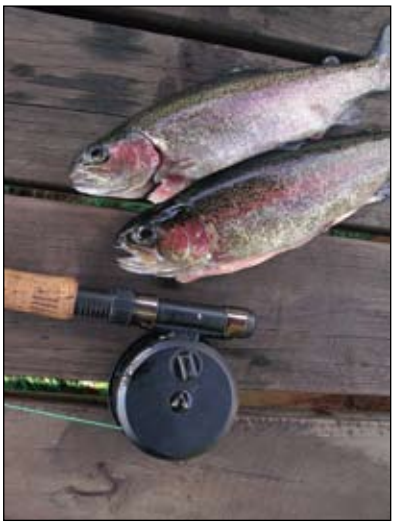
SA identified as alien fish hotspot

South Africa has been identified as a 'species-invasion hot-spot' in an international study into exotic freshwater fish species in natural environments.

The country is one of several areas identified around the world where non-native species make up more than a quarter of the freshwater fish species recorded. The recently published study was undertaken by an international research team comprising scientists from Canada, Belgium and France. The other hotspot areas are the Pacific coast of North America and Central America, Patagonia, southern and western Europe, Madagascar, central Asia, the south of Australia and New Zealand.

The study demonstrated that human activity is the main driving factor behind the establishment of exotic fish species populations in river ecosystems. Data was examined on the presence of around 10 000 freshwater fish in 1 055 river basins covering both 80% immersed lands and 80% of globally recorded freshwater fish species.

The team also sought to determine the extent of the relative influence of the particular characteristics of each ecosystem and human activities on the diversity of the non-native fish species. Three hypotheses were



tested: namely the biotic resistance, biotic acceptance and human activity.

The first suggests that a higher diversity of freshwater fish in the host ecosystem acts as a barrier to the establishment of non-native fish species populations. The second postulates conversely that, for a given ecosystem, non-native species diversity follows that of native species because favourable conditions for the latter are also suitable for the newly-arrived species. As for the third, its takes account of the different indicators at river-basin scale (gross domestic product, percentage of land urbanised, population density), that can yield determination of the relation between anthropic pressure and non-native species diversity.

The three hypotheses' relative weight was measured using statistical methods. For the whole set of river basins investigated, the environmental conditions of fluvial ecosystems were found to have practically no influence on the exotic species diversity. On the contrary, it is the human factors, and especially the intensity of economic activities, which determine the number of non-native species present in a river basin.

These results thus suggest that the economic development foreseen in the developing countries should be accompanied by a rise in the number of non-native freshwater fish species. Given that biological invasions are considered as one of the main causes of biodiversity loss, such a scenario would probably be detrimental to the aquatic biodiversity conservation of these regions.

Interestingly, the study indicates that exceptional river basins, such as the Amazon Basin in South America and that of the Congo in central Africa, are still hardly affected by species introduction.

WATER DIARY

GROUNDWATER
JUNE 25-28

An International Conference on Groundwater and Climate in Africa will be held in Kampala, Uganda. The conference, co-organised by the University College London, Directorate of Water Development (Uganda) and UNESCO-IHP, seeks to bring together water and climate scientists, government departments, the private sector and the donor community to share knowledge and expertise and thereby improve present understanding of the impact of climate variability and change on groundwater resources in Africa. *Enquiries: Richard Taylor; E-mail: r.taylor@geog.ucl.ac.uk; or E-mail: info@gwclim.org; Visit: www.gwclim.org*

YOUNG PROFESSIONALS
JULY 16-18

The Fourth IWA Young Water Professionals Conference will take place in Berkeley, California, in the US. The conference will focus on all aspects of the water cycle, water and wastewater technology, engineering and management. *E-mail: 2008ywpc@iwahq.org.uk Visit: http://www.iwa-ywpc.org/templates/ld_templates/layout_654239.aspx?ObjectId=654242*

DISTRIBUTION
AUGUST 17-20

The 10th International Conference on Water Distribution System Analysis will be held in the Kruger National Park (Skukuza). The conference will be hosted by the University of Johannesburg. *Enquiries: Carla de Jager; E-mail: wdsa2008@uj.ac.za; Visit: www.uj.ac.za/wdsa2008*

RIVERS
AUGUST 29-SEPTEMBER 7

The 2008 River Festival will take place in Brisbane, Australia. *E-mail: info@riverfestival.com.au or Visit: www.riverfestival.com.au*

WATER
SEPTEMBER 7-12

The IWA World Water Congress & Exhibition will be held in Vienna, Austria. The conference aims to bring together water professionals to advance their common goal of sustainable water management. *Enquiries: E-mail: 2008vienna@iwahq.org.uk; Visit: www.iwa2008vienna.org*

SANITATION
SEPTEMBER 24-26

The International Network for the development of Sustainable Approaches for Large Scale Sanitation in Africa (NETSSAF) will be hosting an international conference on Sustainable Sanitation in Africa in Ougadougou, Burkina Faso. *Visit: www.netssaf.net/170.0.html*

Scientists discover 'rain-making' bacteria

A US Montana State University (MSU) professor and his colleagues have found evidence suggesting that airborne bacteria are globally distributed in the atmosphere and may play a large role in the cycle of precipitation.

The research of David Sands, MSU professor of plant species and plant pathology, along with his colleagues Christine Foreman, an MSU professor of land resource and environmental sciences, Brent Christner from Louisiana State University and Cindy Morris, was published in Volume 319 no 5867 of the international journal *Science*, published on 29 February.

The researchers' study show that most active ice nuclei are actually biological in origin. Nuclei are the seeds around which ice is formed. Snow and most rain begin with the formation of ice in clouds. Dust and soot can also serve as ice nuclei. However, biological ice nuclei are different from dust and soot nuclei because only these biological nuclei can cause freezing at warmer temperatures. The bacteria were found all over the world, including the US, Australia, South Africa, Morocco, France and Russia. The team's research also show that most ice-nucleating bacteria as associated with plants and some are capable of causing disease.

While the implications of a relationship between rain and bacteria could be enormous, they are yet to be proven, said Prof Sands. For example, a reduced amount of bacteria on crops could affect the climate. Because of the bio-precipitation cycle, overgrazing in a dry year could actually decrease rainfall, which could then make the next year even drier.

To access the *Science* article, go to www.sciencemag.org

'Virtual water' innovator wins international prize

Prof John Anthony Allan from King's College London and the School of Oriental and African Studies has been named the 2008 Stockholm Water Prize Laureate. Prof Allan pioneered the development of key concepts in the understanding and communication of water issues, and how they are linked to agriculture, climate change, economics and politics.

The professor introduced the 'virtual water' concept in 1993, which measures how water is embedded in the production and trade of food and consumer products. For example, behind a cup of coffee lies 140 ℓ of water used to grow, produce, package and ship the beans. That is roughly the same amount of water used by an average person daily in England for drinking and household needs.

Virtual water has major impacts on global trade policy and research, especially in water-scarce regions, and has redefined discourse in water policy and management. By explaining how and why nations such as the US, Argentina and Brazil 'export' billions of litres of water each year, while Japan, Italy and Egypt 'import' billions, the virtual water concept has opened the door to more productive water use.

National, regional and global water and food security, for example, can be enhanced when water intensive commodities are traded from places where they are economically viable to produce to places where they are not. While studying water scarcity in the Middle East, Prof Allan developed the theory of using virtual water, via food, as an alternative water 'source' to reduce pressure on the scarcely available domestic water resources there and in other water-short regions.

Unlocking the secrets of *E. coli*

Using new genetic techniques, scientists are unlocking the secrets of how *E. coli* bacteria contaminate food and make people sick.

Michigan State University, in the US, has developed a new technique to test the DNA of *E. coli* bacteria by examining very small genetic changes called single nucleotide polymorphisms or SNPs. Using SNPs, scientists analysed 96 markers, making genetic analysis of pathogenic bacteria possible at a rate never before accomplished.

"It used to take three months to score one gene individually," explained Prof Thomas Whittam of the National Food Safety and Toxicology Centre at MSU. "Now, we are working on a new, more rapid system that can do thousands of genes per day."

UN calls for improved climate observations

The United Nations weather agency, the World Meteorological Organisation (WMO), has called for improvements to climate observation technologies to help people and economies adapt to climate change, climate variability and extreme weather.

The call was made on World Meteorological Day, celebrated on 25 March. The theme for this year was 'Observing our Planet for a Better Future', highlighting the necessity of monitoring meteorological and hydrological phenomena to aid countries in their quest to achieve sustainable economic development. Natural disasters are increasingly impacting developing countries, the WMO pointed out, with nine out of ten of them being linked to hydrometeorological hazards – a phenomenon that has collectively caused 1,2 million deaths and US$900-million in damages between 1980 and 2000. WMO Secretary-General Dr Michel Jarraud urged developed nations to help poorer countries through the transfer of technology and providing access to satellite information. He also appealed for the "building of human capacity", or training the next generation to operate sophisticated equipment.

PPP brings hope to Rwandan communities

A community water project inaugurated in Kirehe, Rwanda, offers a new model of cooperation between religious communities and public and private sectors in pursuit of human development.

"This is a historic milestone for inter-faith cooperation and public private partnerships (PPPs) in Africa," remarked Rev Dr Ishmael Noko, General Secretary of the Lutheran World Federation (LWF) and president of the Inter-Faith Action for Peace in Africa (IFAPA) at the project's inauguration in March. The project will bring safe water to up to 21 600 people in the sector of Gatore in Kirehe district. International corporate giant Nestlé S.A provided financial and technical support for the project, which is implemented through the LWF Department for World Service programme in Rwanda.


The IFAPA project will provide more than 21 000 people with safe water.

The provision of piped water services in Gatore supplements existing water infrastructure and contributes to ensuring access to water and sanitation facilities in the region. This is expected to have a significant impact on health, hygiene and economic output in Kirehe. Under the oversight of the Inter-Religious Council of Rwanda, the IFAPA Water Project is managed by a local water users committee. Women are reported to play a key role in ensuring community ownership and good management of the project.

Saudi Arabia boosts nanotech research

Saudi Arabia is to launch several new centres to boost nanotechnology research in the region.

The Saudi Arabian national research and development organisation and international research organisation IBM Research announced an agreement earlier this year to establish the Nanotechnology Centre of Excellence at the King Abdulaziz City for Science and Technology in the capital, Riyadh, reports SciDev.Net.

The centre will collaborate with IBM Research to identify and develop promising opportunities in nanotechnology. It will create research materials for solar energy and nanomembranes for the desalination of seawater. Researchers will also investigate new methods for recycling plastic materials.

Water treatment in a box

VWS Envig offers a range of water treatment package plant technology products. Package plant technology is characterised by its compactness, cost-effectiveness and mobility and is suitable for use in remote locations.

According to Wayne Taljaard, General Manager: Engineered Systems, package plants are a viable alternative to traditional full-scale water treatment plants. "The range of package plants encompasses all the conventional treatment processes, including clarification, sand filtration, reverse osmosis, and ion exchange. Several package plant models also contain innovative treatment elements tailored for particular applications. The main advantage of using this technology, however, relates to its modularity and ease of operation."

The company designs and assembles the plants according to customer specifications. The plants are skid mounted and occasionally installed in containers. They are then shipped to the customer ready for operation.

These plants are extremely cost-effective and, because they are preassembled, installation costs on-site are kept to a minimum. They are designed for minimal operator intervention and make use of robust equipment that is able to withstand adverse conditions in remote areas," said Taljaard.

VWS Envig's package plants have been installed on mines throughout Africa, in remote towns, air force bases and industrial plants. One such an installation took place in Zambia for Lumwana Mining Company. With the construction of a new copper mine underway, a potable water treatment plant was required to serve the campsite occupied by the mine's employees. The plant, which has a capacity of 350 m³/day, has been operational since 2006. A similar plant to accommodate the growth taking place at the mining site was delivered late last year.

Uitenhage wastewater plant upgrade completed

Specialist consulting engineering and project management group SSI has successfully commissioned a R21,5-million extension to the Kelvin Jones Wastewater Treatment Works outside Uitenhage, in the Eastern Cape.

Originally built in 1986, the existing plant reached full capacity in 2000 and the Nelson Mandela Bay Municipality subsequently approved its extension through a new 10 Mℓ/day module. This brings the total capacity up to 24 Mℓ/day, which is sufficient to manage the municipality's wastewater treatment requirements in the Uitenhage area for the foreseeable future. At the same time, the existing plant was modified to harness a stepped aeration process to provide flexible operating alternatives for phosphate and nitrogen removal.

Project manager Marius van Aardt explains: "Shortly before this contract was awarded, the Department of Water Affairs & Forestry promulgated new effluent standards for the Swartkops River catchment to improve water quality. The new regulations limited phosphorus concentration to 1 mg/ℓ and nitrogen to 15 mg/ℓ in the final effluent. These new standards required a redesign of the treatment process, effectively converting a conventional activated sludge treatment system into a stepped aeration process capable of removing phosphates and nitrogen."

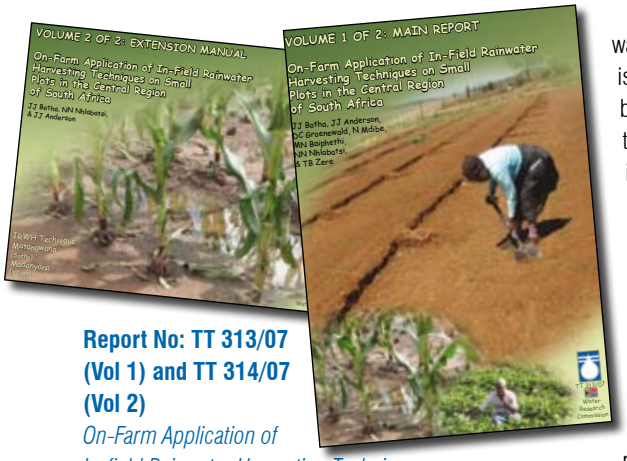
Challenging aspects of the contract included the poor state of the soil, the high groundwater table in the area, as well as the fact that the alterations had to be made to the plant while it remained in operation for 24 hours a day. The civils contractor on the project was URSA Concrete cc, the main mechanical and electrical contractor was Lektratek Water Technology and the electrical subcontractor was Service Electrical.

WATER DIARY (continued)

DESALINATION
OCTOBER 20-22
A conference titled 'Membranes in Drinking Water Production and Wastewater Treatment' will be held in Toulouse, France.
Visit www.mdiw2008.com

GROUNDWATER
OCTOBER 14-17
A symposium on Coupling Sustainable Sanitation and Groundwater Protection will take place in Hannover, Germany. The symposium will focus on applicable solutions for the protection of groundwater against anthropogenic domestic effluents in the context of developing countries.
Enquiries: Dr Thomas Himmelsbach; Tel: +49-511-6433794; E-mail: symposium2008@bgr.de

New from the WRC



Report No: TT 313/07 (Vol 1) and TT 314/07 (Vol 2)

On-Farm Application of In-field Rainwater Harvesting Techniques on Small Plots in the Central Region of South Africa (JJ Botha; JJ Anderson; DC Groenewald; N Mdibe; MN Baiphethi; NN Nhlabatsi and TB Zere)

Research has shown that rural communities can benefit greatly from the use of in-field rainwater harvesting (IRWH). This technique has the potential to reduce total runoff and evaporation considerably, resulting in increased yields due to increased plant-available water. The WRC has contributed to IRWH research for a number of years. In this project the technique was implemented in a number of rural communities around the towns of Thaba Nchu and Botshabelo over two years. The project was aimed at exchanging the technology as effectively as possible and to assist and support the farmers and extension officers with the application of the IRWH technique. The research output comprises two parts: The main report is captured in Volume 1 while Volume 2 is an extension manual to aid in the teaching of the IRWH technique.

Report No: 1368/1/07

Water Conservation through Energy Conservation (D Fraser; K Ndwandwe; P Basnal; A Isafiade; NS Nyathi; T Majozi; CJ Brouckaert and BM Brouckaert)

Industries with thermal processes (as opposed to electrical processes and excluding electrical power generation) are a significant sub-class of the industrial water-use sector. Energy which is consumed in excess has to be dissipated. This is frequently through the use of wet cooling towers, where the excess energy is used to evaporate water. This results in a two-fold problem for the environment: firstly, the evaporated water is lost from the national water cycle and, secondly, the salts contained in the cooling water remain behind for discharge or disposal as cooling tower blow-down. The overall aim of this project was to promote water and energy savings in the South African process industry through more efficient use of both process water and cooling and heating utilities. This was to be achieved by creating awareness of potential water and energy savings in the process industry and through the development and promotion of tools incorporating water and thermal pinch and mathematical modelling for the optimisation of water and heat exchanger networks.

Report No: KV 205/08

Hydrological Information Requirements and Methods to Support the Determination of Environmental Water Requirements in Ephemeral River Systems (DS Hughes)

This consultancy project was designed to provide hydrological data analysis support for a large WRC project undertaken by the University of the Free State on the environmental water requirements (EWR) in non-perennial systems. The first component was to identify the hydrological issues that are considered of ecological importance within EWR determinations for non-perennial river systems. The second component was to establish appropriate hydrological models, calibrate or calculate their parameters and critically assess the initial results. The models were tested on the Seekoei River, a tributary of the Orange River.

Report No: 1687/1/08

The Determination of Annual Phosphorus Loading Limits for South African Dams (William R Harding)

Managing dams such that levels of eutrophication do not exceed thresholds above which problems are encountered should be a primary focus of South African water resource management. The fundamental point of departure in any eutrophication assessment is to be able to determine the relationship between the level of nutrient loading, in particular phosphorus, and the in-lake condition. A number of simple relationships exist for predicting in-lake phosphorus conditions based on hydro-morphological data and catchment land use. Such models, supporting screening level assessments, have not been tested for their relevance in South Africa, i.e. across a range of impoundment types. Given the importance of having such workable models available it was therefore important that their local relevance be determined. This project has, for the first time, undertaken a preliminary testing of a suite of models across a set of 30 dams.

Report No: 1603/1/08

On-line Real-time Enzymatic Biosensor System for the Rapid Detection of Faecal Contamination of Water Intended for Drinking Purposes (B Pletschke; C Togo and J Limson)

Inadequate sanitation frequently results in the channelling of untreated sewage and faecal material into marine and freshwater catchment areas and riverine systems. Current tests to detect pathogens (or rather indicator microorganisms i.e. total faecal coliforms, *E. coli* etc.) are in place to detect and quantify the presence of faecal contamination, but these require laborious and time-consuming processes. In this project the use of a sequential flow injection analysis system with a spectrophotometric detector or in combination with an electrochemical detector was tested to determine whether this was the cheapest and most rapid method to detect faecal contamination in water resources.

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