

New from the WRC

Report No. 2108/1/14

Removal of metal ions from industrial effluents and acid mine drainage by metal sulphide precipitation (M Nduna & A Lewis)

The purpose of this research was to further the understanding of metal sulphide precipitation in the treatment of acid mine drainage and metal ion impregnated industrial wastewater. During the process of metal sulphide precipitation the physico-chemical properties of the precipitant material had a significant effect on the overall viability of the metal removal process. The aim of the work was to ascertain the conditions necessary for optimal metal ion removal.

Report No. TT 596/14 and TT 597/14

Conduit hydropower power plants and Conduit hydropower development guide (SJ van Vuuren; M van Dijk; I Loots; B Barta & BG Scharfetter)

South Africa is facing an energy crisis which places additional importance of harvesting all available feasible renewable energies. While the country is now well endowed with the best hydropower conditions large quantities of raw and potable water are conveyed daily under either pressurised or gravity conditions over large distances and elevations. These two reports capture the knowledge gained under various WRC studies into conduit hydropower. A decision support system and associated tool (HydroAID) was also developed to facilitate the development process of a conduit hydropower plant.

Report No. 1982/1/13

Primary producers as sinks for nitrogen and phosphorus in the Great Brak Estuary (GC Snow & LRD Human)

The Great Brak Estuary is a temporarily open/closed estuary on the southern Cape coast that frequently experiences blooms of filamentous green macroalgae.

This is indicative of an estuary in a poor ecological state. The main aim of this project was to identify the sources and determine the loads of nitrogen and phosphorus entering the estuary through point source discharge, diffuse discharge, atmospheric deposition and remineralisation from organic material trapped in the sediment. The study also sought to determine the biomass and cover of macrophytes and macroalgae in the estuary; measure the nitrogen and phosphorus content in living plant material; describe the environmental conditions in the estuary that favour macroalgal blooms; and provide recommendations to be included in the Great Brak Estuary Management Plan.

Report No. TT 601/14

Environmentally sustainable beneficiation of brewery effluent: Algal ponding, constructed wetland, hydroponic vegetables and aquaculture (CLW Jones; PJ Britz; R Scheepers; S Power; A Cilliers & R Laubscher)

This project aimed to develop a sequence of effluent treatment methods using existing technologies, such as algal ponding and constructed wetlands, to develop a unique, low cost, low-tech, environmentally sustainable industrial water treatment process. It also aimed to combine these technologies with the production of algae, vegetables and fish in such a way that the end result was not only treated industrial effluent, but also the production of recovered water available for reuse and/or used for producing valuable downstream products.

Report No. 1930/2/14

Methods for the determination of the ecological Reserve for estuaries Version 3 (J Turpie – Editor)

This document describes, and serves as a manual for, the accepted approach

for the determination of the ecological Reserve for estuaries, which is the quality, quantity and timing of freshwater inflows that is guaranteed for each estuary. It is intended for use by managers and scientists involved in organising and carrying out Reserve Determination studies on estuaries.

Report No. 2037/1/13

Hyperspectral remote sensing to detect biotic and abiotic stress in water hyacinth (Eichhornia Crassipes) (Pontederiaceae) (SW Newete; BFN Erasmus & MJ Byrne)

Water hyacinth is the most notorious aquatic weed in the world. Various methods are prescribed to control it, however, this requires regular monitoring of the weed's physiological status in relation to the habitat, in order to evaluate the success of the intervention. This report investigates remote sensing as one such a monitoring tool.

Report No. 1923/1/13

Influence of regional environmental factors on the distribution, characteristics and functioning of hydrogeomorphic wetland types on the Maputaland Coastal Plain, KwaZulu-Natal, South Africa (AT Grundling; EC van den Berg & ML Pretorius)

The Maputaland Coastal Plain stretches from the town of Mtunzini in the south to Kosi Bay in the north and continues north towards the town of Cabo Santa Maria. Not only are the wetlands in this plain important for the maintenance of the rich biodiversity of the area, but they are equally important for the local communities as a key resource in subsistence agriculture. This aim of this project was to understand the regional environmental factors that control the distribution, characteristics and function of different wetlands types on the Maputaland Coastal Plain including interactions with the underlying Maputaland Coastal Aquifer.

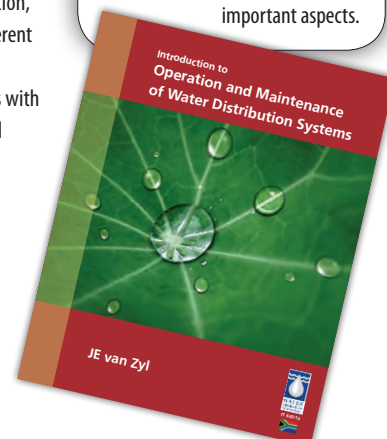
New guide book aimed at improving operation and maintenance of water supply systems

A reliable supply of clean and safe water is the first and most critical municipal service that people require. South Africa has made great strides in addressing the inequalities of the past in the provision of water, but unfortunately the focus on expanding service provision has often been at the expense of adequate operation and maintenance of existing infrastructure. This has resulted in increased levels of leakage and non-revenue water, maintenance backlogs and problems with service provision.

Proper operation and maintenance are indispensable to ensure that capital investments on new infrastructure result in sustainable service provision. Without it, a new water distribution system will soon decline to a point where service provision is compromised, leading to greater water losses, financial losses and health risks to consumers.

The aim of this book (TT 600/14) is to assist service delivery by making information on proper operation and maintenance practices available in a practical and accessible way.

The approach adopted in the book is to provide the reader with an understanding of the process leading to system decline, measuring system performance and the best practices in operation and maintenance of water distribution systems. It aims to provide guidance to empower the reader to implement a proper operation and maintenance system in practice, focusing on the most common and important aspects.



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Free online science education resource launched

The United Nations Educational, Scientific, and Cultural Organisation (UNESCO) has launched the World Library of Science (WLoS), a free online science education resource for a global community of users.

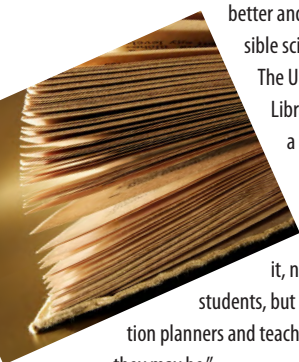
Developed through the joint efforts of UNESCO, Nature Education and Roche, the WLoS was created to give students around the world, especially those in disadvantaged regions, access to the latest science information as well as the opportunity to share their experiences and learning through discussion with their peers in a shared learning environment.

The WLoS is a science resource library stocked with over 300 top-quality articles, 25 eBooks, and over 70 videos from the publishers of *Nature*, the most cited scientific journal in the world. It is also a state-of-the-art digital platform that provides a community hub for learning. Users can join classes, build groups and connect with other learners.

Specifically, the WLoS seeks to make science learning accessible to students everywhere in the world.

"The world needs more science and more scientists to face today's global challenges," said UNESCO DG Irina Bokova. "Achieving this requires better and more accessible science education. The UNESCO World Library of Science is a remarkable and exciting new tool that will help provide it, not only to students, but also to education planners and teachers, wherever they may be."

To access the library, Visit: <http://www.nature.com/wls>



Clean water and sanitation 'missing pieces' in HIV puzzle

Access to clean water and basic toilets is an essential but neglected part of the management and treatment of HIV/Aids, according to a WaterAid and SFAIDS report released ahead of World Aids Day on 1 December.

The new report, *An integrated approach to HIV and water, sanitation and hygiene in southern Africa: A gap and needs assessment*, shows that 70% of all people living with HIV in the world reside in sub-Saharan Africa. This equates to approximately 25 million people.

Clean water is critical to keeping people living with HIV healthy, for taking antiretroviral (ARV) drugs and for the good hygiene required to minimise infections. Yet, 35% of people in sub-Saharan Africa are living without access to clean water and 70% are without basic sanitation. This leaves many people living with HIV suffering from chronic diarrhoea and unable to care for themselves or their families.

Diarrhoea compromises the effectiveness of ARV drugs by reducing the body's ability to absorb nutrients from food and

medicine. Some 90% of people living with HIV in southern Africa suffer from diarrhoea. An overwhelming majority of these cases, 88% are linked to unsafe drinking water, inadequate sanitation and poor hygiene.

"In the last three decades, medical research has made great strides in helping to turn HIV from a death sentence into a more manageable condition. It defies logic that despite so much progress on education and in delivering ARV drugs, there has not also been a focus on making sure people living with HIV/Aids also have clean water, basic toilets and the means to wash themselves and keep their surroundings clean," reported WaterAid CE Barbara Frost.

The assessment focused on people living with HIV in Lesotho, Mozambique, Swaziland and Zambia.

To access the report, Visit: [file:///C:/Users/laniv/Downloads/Integrated-approach-to-HIV-and-water-sanitation-and-hygiene-in-Southern-Africa%20\(1\).pdf](file:///C:/Users/laniv/Downloads/Integrated-approach-to-HIV-and-water-sanitation-and-hygiene-in-Southern-Africa%20(1).pdf)

International funding for Kariba Dam repair

The World Bank International Development Association (IDA) is funding the repair of the Kariba Dam to the tune of US\$25-million.

The Kariba Dam, built between 1956 and 1959, provides more than 50% of Zambia and Zimbabwe's electricity, benefiting an estimated four-and-a-half million people. During these six decades, the dam has been a key driver of regional growth and development and a major source of flood control and river flow management in the Zambezi River basin.

The repair project, with total financing of US\$300-million, is being co-financed by the African Development Bank and the European Union. It will help the Zambezi River Authority, which is responsible for the management of the Kariba Dam, to reshape the dam's plunge pool and

refurbish its spillway, as well as improve dam operations in order to bring it up to international safety standards.

"Rehabilitation of the Kariba Dam is an important component of the World Bank's larger programme for boosting the energy security of southern Africa," said Makhtar Diop, Vice President for Africa. "There is much more to be done in reaching that goal, but [this funding] is an important milestone in securing the Kariba Dam for the coming decades."

He added: "The Kariba Dam is woven into the social and economic lives of our two peoples. We remain strongly committed to our continued partnership in ensuring that the benefits of regional cooperation flow directly to the people of our countries."

Source: World Bank

Scientists reveal parchment's hidden agri stories

Millions of documents stored in archives could provide scientists with the key to tracing agricultural development across the centuries, according to new research completed at Trinity College Dublin and the University of York.

Thanks to increasingly progressive genetic sequencing techniques, the all-important historical tales these documents tell are no longer confined to their texts; now, vital information also comes from the DNA of the parchment on which they are written.

Researchers used these modern scientific techniques to extract ancient DNA and protein from tiny samples of parchment from documents from the late 17th and 18th centuries. The resulting information enabled them to establish the type of animals from which the parchment was made, which, when compared to genomes of their modern equivalents, provides key information as to how agricultural expansion shaped the genetic diversity of these animals.

This information therefore gives the scientists an unrivalled resource to analyse the development of livestock husbandry across the centuries. The research has been published in the journal, *Philosophical Transactions of the Royal Society B*.

Noted professor of population genetics at Trinity College Dublin, Daniel Bradley: "This pilot project suggests that parchments are an amazing resource for genetic studies that consider agricultural development over the centuries. There must be millions stored away in libraries, archives, solicitors' offices and even in our own attics. After all, parchment was the writing material of choice for thousands of years, going back to the Dead Sea Scrolls.

"Wool was essentially the oil of times gone by, so knowing how human change affected the genetics of sheep through the ages can tell us a huge amount about how agricultural practices evolved," he added.

Water's role in rise and fall of Roman Empire investigated

Smart agricultural practices and an extensive grain-trade network enabled the Romans to thrive in the water-limited environment of the Mediterranean, a new study shows.

But the stable food supply brought about by these measures promoted population growth and urbanisation, pushing the Empire closer to the limits of its food resources. The research, undertaken by an international team of hydrologists and Roman historians, has been published in the journal, *Hydrology and Earth System Services*.

Stretching over three continents and persisting for many centuries, the Roman Empire was home to an estimated 70 million people. In such a vast area ensuring a stable food supply was no easy task, particularly given the variable and arid climate of the Mediterranean region.

So how did the Romans maintain reliable food supplies to their cities for centuries under such challenging conditions?

To find out, Brian Dermody, an environmental scientist from Utrecht University, teamed up with hydrologists from the Netherlands and classicists at Stanford University in the US. The researchers wanted to know how the way in which Romans managed water for agriculture and traded crops contributed to the longevity of their civilisation. They were also curious to find out if these practices played a role in the eventual fall of the Empire.

"We can learn much from investigating how past societies dealt with changes in their environment," said Dermody. He draws parallels between the Roman civilisation and our own. "For example, the Romans were confronted with managing their water resources in the face of population growth and urbanisation. To ensure the continued growth and stability of their civilisation they had to guarantee a stable food supply to their cities, many located in water-poor regions."

In their peer-reviewed paper, the team focused on determining the water resources required to grow grain, the staple crop of the Roman civilisation, and how these resources were distributed within the Empire. It takes between 1 000 and 2 000 litres of water to grow a kilo of grain. As Romans traded this crop, they also traded the water needed to produce it – they exchanged virtual water.

The researchers created a virtual water network of the Roman world. "We simulated virtual water trade based on virtual-water poor regions demanding grain from the nearest virtual-water rich region in the network," explains Dermody.

The team used a hydrological model to calculate grain yields, which vary depending on factors such as climate and soil type. The authors used reconstructed maps of the Roman landscape and population to estimate where agricultural production and food demand were greatest. They also simulated the trade in grain based on an interactive reconstruction



of the Roman transport network, which takes into account the cost of transport depending on factors such as distance and means of transportation.

Their virtual water network indicates that the Romans' ability to link the different environments of the Mediterranean through trade allowed their civilisation to thrive. "If grain yields were low in a certain region, they could import grain from a different part of the Mediterranean that experienced a surplus. That made them highly resilient to short-term climate variability," says Dermody.

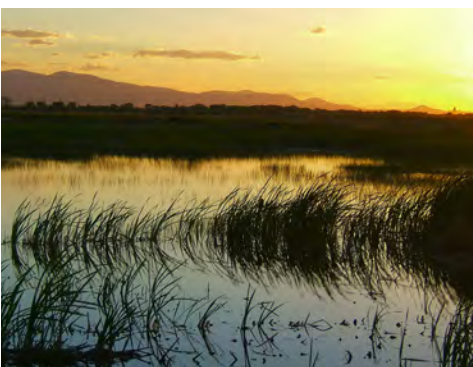
But the Romans' innovative water-management practices may also have contributed to their downfall. With trade and irrigation ensuring a stable food supply to cities, populations grew and urbanisation intensified. With more mouths to feed in urban centres, the

Romans became even more dependent on trade whilst at the same time the Empire was pushed closer to the limits of their easily accessible food resources. In the long term, these factors eroded their resilience to poor grain yields arising from climate variability.

"We're confronted with a very similar scenario today. Virtual water trade has enabled rapid population growth and urbanisation since the beginning of the industrial revolution. However, as we move closer to the limits of the planet's resources, our vulnerability to poor yields arising from climate change increases," concludes Dermody.

- To access the original article, Visit: <http://www.hydrol-earth-syst-sci.net/18/5025/2014/hess-18-5025-2014.pdf>

Wetlands more vulnerable to invasives as climate changes



In the battle between indigenous and invasive wetland plants, a new Duke University study finds climate change may tip the scales in favour of the invaders – but it is going to be more a war of attrition than a frontal assault.

"Changing surface-water temperatures, rainfall patterns and river flows will likely give invasive alien plants such as Japanese knotweed, hydrilla, honeysuckle, privet and other noxious species an edge over less adaptable native

species," noted Neal Flanagan, visiting assistant professor at the Duke Wetland Centre, who led the research.

Increased human disturbance to watersheds and nutrient and sediment runoff into riparian wetlands over the coming century will further boost the invasive species' advantage, the study found.

"It's death by a thousand small cuts. Each change on its own may yield only a slight advantage for invasive species, but cumulatively they add up," reported

co-author Curtis Richardson, Director of the Duke Wetland Centre and professor of resource ecology at Duke's Nicholas School of the Environment.

If left unchecked, over time these changes will reduce the diversity of plants found in many wetlands, and could affect the wetlands' ability to mitigate flooding, store carbon, filter out water pollution and provide habitat for local wildlife, the authors warned. The findings have been published in the journal, *Ecological Applications*.

Citizen science network

– Communities working towards South Africa's water security

To measure is to know. If we want to conserve our increasingly scarce water resources we need to first measure its health.

The members of the Triwaters Tour – adventurers Brett Merchant, Franz Fuls, and Troy Glover, who are traversing the Vaal and Orange rivers from source to sea, took time out last year to attend a three-day SADC Citizen Science workshop in Howick, KwaZulu-Natal, to learn more about the discipline of citizen science, miniSASS and the power behind the citizen science movement.

For three days delegates from South Africa, Botswana, Zimbabwe, Zambia, Swaziland and Lesotho came together to share their experiences on mobilising communities to leverage the power of citizen science towards a goal of a sustainable future. The event was hosted by the Wildlife and Environment Society of South Africa (WESSA), with support from the British High Commission, Department of Water and Sanitation and GroundTruth.

“High-profile decision-makers from civil society and government addressed the delegation in what was clearly not just another green-washing exercise, but a deliberate and focused commitment in response to the world's dwindling resources and climate change,” said the Triwaters team.

The highlight of the event was the miniSASS exercise the team conducted under the supervision of experienced scientists in the Ingobongo stream below Shelter Falls. Delegates received first hand advice on how to best conduct miniSASS sampling, empowering them to transfer the skill to others in their own regions.

It was refreshing to have the opportunity to sample in a pristine stream. One group member even found a pollution sensitive stone fly – with an observation score of 8.2 this stream was classified as Unmodified (i.e. in natural condition).

Through intensive workshops delegates were exposed to other citizen science tools, such as the Turbidity meter that measures

water clarity in a stream, which will empower citizen scientists who are interested in the health of rivers, streams, wetlands, estuaries and measuring rainfall.

Anisa Khan from Ecoschools enlightened the team on taking citizen science to schools through action and enquiry-based projects that achieve improved water use efficiency, water quality, access to water, sanitation, and sustainability through a seven-step framework on whole school development.

Mark Graham of GroundTruth explained the logic behind miniSASS while Bongani Madikizela, Research Manager at the Water Research Commission, took the team on a journey starting at the birth of this river monitoring tool. Together, they explained how miniSASS – a condensed version of a larger scientific tool, SASS – evolved into a simple yet accurate citizen science tool.

Looking at the motivation behind citizen science, Mike Ward of WESSA explained to delegates the various methodologies of scientific observation, while elaborating on the great value that citizen science has for formal scientists. It became clear that communities have a very important role to play in the collection of scientific data that is used by scientists in complex models, which then become tools for national and international strategy and policy-making.

Serving traditional science is only a part of the power of

citizen science. Through many of its methods, citizen science can directly empower communities and the individuals who conduct the sampling. Basic analysis of the findings can indicate sources of pollution, and to some extent even severity. This can provide a platform that communities can use themselves to improve their immediate environment to their own direct benefit.

By the end of the workshop delegates were empowered to formulate their own workshops to start citizen science projects around river health: who to network with, conducting field work, reporting strategies, action taking and other concepts to create a solid foundation for new projects.

“With many other expert speakers also addressing the delegation, it was clear that citizen science, and miniSASS, is bound to become the next big thing in southern Africa's conservation drive,” noted the Triwaters members.

Triwaters Tour is part of this drive, and plans to empower riverside communities along the Vaal and Orange Rivers early in 2015, providing communities with tools and techniques that they can use themselves to influence the sustainability of the areas where they live.

- To learn more about the Triwaters Tour, Visit: <http://www.triwaters tour.com/>
- To learn more about miniSASS, Visit: <http://www.minisass.org/>



The Triwaters team posing with delegates attending the workshop.

Regional partnership spearheads aquaculture capacity development

In response to a general decline in capture fisheries in sub-Saharan Africa, the governments in this region have encouraged investments into the aquaculture sector, both at smallholder and commercial levels, as an alternative. The aquaculture sector, however, needs technologically skilled human resources to guide it, but the region lacks a vibrant regional 'fit-for-purpose' training programme that holistically contributes to a lasting solution to this enduring food security challenge.

Strengthening the links between the higher education institutions (HEI) in the region and a sharing of teaching and research capacity, modern technologies and research into the demands of the fisheries and aquaculture sector are integral to increasing fish production and the sustainable management of resources.

Growing regional capacity through training at PhD level in aquaculture and fisheries science is imperative to this cause. This is the incentive behind the 'concerted fit-for-purpose PhD training in aquaculture and fisheries to improve food security and livelihoods in sub-Saharan Africa' project. Besides Rhodes University, partnering universities are Lilongwe University of Agriculture and Natural Resources (LUANAR), in Malawi, the University of Eldoret, in Kenya and Makerere University, in Uganda.

This project is one of a number of projects that form part of the Edulink II programme

that is funded by the African, Caribbean and Pacific Group of States – European Union (ACP-UP) Cooperation Programme in Higher Education.

The objectives of the project are to review the capacity and teaching facilities at the partner institutions, visit a lead aquaculture/fisheries science teaching institution in Africa and in Europe, develop PhD curricula in aquaculture and fisheries science, constitute an academic advisory board and to start implementing the curricula.

With a well-established and internationally recognised PhD programme, Rhodes already has experiences that it can share with its partners in addition to a model for the joint supervision of students that would allow the department and South African Institute for Aquatic Biodiversity (SAIAB) staff to partner in capacity building and staff exchange programmes.

Rhodes is also expected to benefit from the development of strong partnerships with these other African universities, which may in turn attract additional international students. The programme will also allow Rhodes to ensure that these international students have a good foundation from which to work. A working knowledge of the programme will also allow them to design their own PhD and MSc curricula to cater for students from more diverse academic backgrounds.

"Our role at Rhodes is to initially assist and advise in developing the curricula with

opportunities to possibly get involved in drafting them to possibly form collaborative student supervisory teams with staff from the partner universities in time to come," reported Dr Cliff Jones, senior lecturer in the Department of Ichthyology and Fisheries Science. "Ultimately, our own aquaculture and fisheries curricula is likely to benefit from this project too – there is always room to improve and grow."

Last year, Dr Jones along with Drs Daniel Sikawa (LUANAR), Phillip Raburu (Eldoret) and

Robinson Odong (Makerere) attended the RUFORUM (Regional Universities Forum for Capacity Building in Agriculture) Biennial Conference in Maputo, Mozambique, where they facilitated a conference side-event interaction among fisheries and aquaculture actors in Africa and beyond.

The project partners met again at Rhodes later in the year to identify what the university has to offer the project going forward and to develop a work plan for 2015.



Members of the fit-for-purpose PhD training at the inception meeting held in 2013.



Dr Cliff Jones of Rhodes University's Department of Ichthyology and Fisheries Science and student Elethu Duna setting a gill net on an Honours fieldtrip.