SHORT COURSE in

MEMBRANE PROCESSES AND ION EXCHANGE

(for desalination and industrial water treatment)

Aimed at engineers, scientists and technologists involved in the planning, management and operation of water and wastewater treatment.

Dates 23 - 25 August 2004

Venue University of Pretoria

Course fee R3 600.00 per person including course notes, lunch, tea/coffee

Presenters

Prof C F Schutte
Head of the Water Utilisation Division,
Department of Chemical Engineering,
University of Pretoria

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

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Letters to the Editor

(E-mail: jand@wrc.org.za)

CLIMATE CHANGE

Dr G Ziervogel from the University of Cape Town writes:

As researchers working on impacts of and adaptation to climate change, we would like to register apprehension over Professor Alexanders article *Climate Change: there is no need for concern*. A number of key sectors in South Africa, including agriculture, water and energy, are projected to experience significant impacts, even with the most conservative estimates of climatic change. Considering that even small regional changes could result in dramatic impacts, our focus needs to be on building adaptive capacity so that future climate variability and change can be managed in a sustainable manner that does not result in any negative effects of climate change. We are excited at governments commitment in this area, and look forward to improving the involvement of the science community in supporting appropriate decision-making and responses through rigorous research.

Gina Ziervogel
Emma Archer
Peter Johnston
Disaster Mitigation for Sustainable Livelihoods Programme (DiMP), University of Cape Town.

CLIMATE CHANGE

Dr Mark Tadross from Cape Town writes:

The following is a letter stating our objections to some of the views expressed in Prof. Alexander's article "Climate change — there is no need for concern", published in the Water Wheel. I have circulated it around the signatories at the end of the letter and all have agreed to its contents. We would be very grateful if it were to be published in the Water Wheel, allowing our views on the subject to be aired. We hope this will contribute to an open and informed debate on the subject.

Prof Alexander's article "*Climate change — there is no need for concern*", ironically, causes us great concern.

We take grave issue with the conclusions presented, and argue that they are premature and overstated. Such a point of view could lead to serious negative consequences if, as the vast majority of the scientific research for the past few decades indicates, it is true that climate change is a serious cause for concern. For a water stressed country like ours, there is no room for complacency or self-delusion, and the threat of global warming and climate change must be seriously considered.

We note that the assertions made are, perhaps, not surprising given the approach used to analyse the data. For example, to analyse mean annual rainfall (MAP) over South Africa is to ignore the fact that the region is subject to strong climate gradients, responding to widely differing atmospheric processes on different sub-annual time scales and compounded by a highly variable landscape. Consequently, any changes are likely to be first seen on these gradients in time (seasonal) and space (climate boundaries). These aspects are obscured in the analysis presented. Also, given that the observed trend in global temperature has been increasing in recent decades, detecting trends over the past 100 years or more may be inappropriate. Prof Alexander's article although interesting, makes broad conclusions regarding rainfall, flooding frequencies, and evaporation rates without looking at regional or local impacts of these changes.

More seriously, a number of the conclusions do not concur with other published results for the South African region and there is an urgent need to reconcile this discrepancy. The material presented by Prof Alexander has yet to appear in the scientific literature, which is the only appropriate place for assessing its true merit. Peer review and discussion would certainly assist in understanding and explaining the contradictions. Prof Alexander has little to say about temperature trends, now already well researched over South Africa, which are not only consistent with findings elsewhere, but are also known to have direct impacts on water resources by altering evapotranspiration. This has major implications for intensive and extensive agriculture and natural ecosystems.

We urge scientists to contribute to this debate in an informative, meaningful and also rigorously scientific way.

Dr. G. Midgely
Chairman, SA Committee for Global Change, and Head: Climate Change Research Group, National Botanical Institute

Dr. M. Tadross, C. Jack, C. Lennard, R. Walawege, A. Steynor, N. MacKeller
Environmental and Geographical Science, UCT

Dr. W. Landman, Dr. W. Tennant
South African Weather Service

Prof R.E. Schulze
School of Bioresources Engineering and Environmental Hydrology, University of KwaZulu/Natal, Pietermaritzburg

GOATS AND WATER

Ms Sally Hall from Muldersdrift writes:

I feel the next major input in "Working for Water" must be the tying up of goats and cattle in rural areas.

These animals, from India to the Comores, are tied up so that they do not destroy the crops of the other inhabitants of the area.

In South Africa they cause three major disadvantages to the upliftment of the rural communities:

- They eat all the new crops, unless the owner of the crops can afford a fence or concrete blocks to protect their fruit trees.
- They feed on trees when they re-sprout. Both free-roaming cattle and goats eat the new sprouts until the tree dies.
- Their hooves break up the soil in the denuded catchment areas and with the next thunderstorm all the soil washes away. This means all our dams are full of sand and nothing can grow and no run-off is retained on the land due to the lack of vegetation.

If these people are rich enough to afford a goat, they can buy some rope or make it out of old plastic bags and tie the goat up to a stay. The cattle can also be tied up and the person who is rich enough to own cattle can pay for grazing or cut it himself. If other third world countries can do this it should not be beyond our government to help the poor to re-establish trees for firewood and erosion protection.

New DWAF Minister Plans to Focus on Sanitation Backlog

The new Minister of Water Affairs and Forestry, Ms Buyelwa Sonjica (left), said in her budget vote speech in the National Assembly on 17 June 2004 that she was going to place special emphasis on the provision of sanitation.

She said that, "While we have made excellent progress with water supply, and will be celebrating the 10 millionth person to receive safe water through the Department's programmes later this year, the same cannot be said for sanitation. Improving sanitation is a major challenge and one on which I am going to concentrate during my term of office."

The Minister said that DWAF's current policy "focuses on firstly achieving the very basic levels of service – usually VIP toilets.

"While these are perfectly adequate in the rural areas, I am not convinced that they are appropriate in urban areas.

"In areas next to existing suburbs and townships where there is already water borne sanitation, it is both socially and politically difficult to give people what they see as a second-best solution. Moreover, in areas close to existing infrastructure, the additional cost may well be less than for an entirely new system."

She said she and Minister Mufamadi (the Minister for Provincial and Local Government) were working on a study to determine alternative strategies for reaching the sanitation targets and providing water borne sanitation in urban and peri-urban areas.

"As a people-centred government, a government with a 70% mandate from the electorate, we are morally and politically bound to give people the level of service that restores their dignity.

"I know that the funding currently available for sanitation is not adequate for us to achieve our targets if we want to provide water borne sanitation in these areas. We will need more investment funds and also to ensure that municipalities can pay for the operating costs, for water to flush toilets, for the staff, chemicals and electricity needed to run the wastewater treatment plants so that we do not pollute our rivers. Free basic water without free basic sanitation will not enable those targeted to enjoy the healthy environment promised by our Constitution."

HIGHLIGHTS

Other highlights from the Minister's speech were the following:

- Water supply and sanitation investment
  Funds for water supply and sanitation investment, previously managed by DWAF will now be allocated to local government.
  The funds will be transferred through the Municipal Infrastructure Grant (MIG) administered by the Department of Provincial and Local Government. The water services budget of the Department is thus reduced from R2 608 million to R1 334 million.
- Water resources
  A National Water Resource Strategy will be published

before the end of this year. The Strategy includes investment in water infrastructure – dams, pipelines and canals – to ensure that South Africa and its neighbours' water needs are met in a sustainable manner. Projects are underway from the Berg River in the Western Cape to the Olifants River in Limpopo province, and DWAF is currently cooperating with South Africa's neighbours through joint projects on the Orange-Senqu and Komati rivers.

- Resource poor farmers

DWAF plans to create opportunities for poor farmers on irrigation schemes, "giving them access to water for high value crops and food production.

"Water is available to irrigate 12 000 ha in the Eastern Cape, Free State and Northern Cape and the Department will be working with Provincial and National Departments of Agriculture to implement schemes to use these allocations.

"Financial assistance is given to emerging farmers for water infrastructure as well as operation and maintenance with 458 farmers receiving financial support from the Department for the first time last year. R28,4 million has been budgeted in 2004/2005 to assist another 4 500 historically disadvantaged households. This will include support for household rainwater harvesting storage tanks, acquisition of water entitlements to promote equity, training in water management and help for viability studies to enhance the sustainability of future schemes.

- Catchment Management Agencies

Four Catchment Management Agencies will be established during this financial year, in the Inkomati, Umvoti/Mzimkhulu, Breede and Crocodile West/Marico water management areas. The Department will devolve administration to the local water users and communities, accompanied by vigorous capacity building so that historically excluded communities can participate in water management. R28 million has been budgeted for this in 2004/2005.

- Human resources

The Department is growing its human resources for the future, developing the next generation of professionals and managers. This year DWAF has placed 35 interns and will shortly appoint another 15 across the country. 20 of their 79 external bursars joined the Department after completing their degrees, while the Water Research Commission helped 428 young professionals, 66% from historically disadvantaged communities, to gain post-graduate qualifications and high level technical experience.

CALL FOR PAPERS: DEADLINE FOR SUBMISSION EXTENDED TO 31DECEMBER 2004

Special Issue of *Water SA* on: Irrigated and Rain-fed Agriculture for Poverty Reduction in Sub-Saharan and North Africa:

Past Performance and Future Challenges

Water SA is a multidisciplinary journal funded and published by the Water Research Commission (WRC) of South Africa. The journal publishes refereed, original work in all branches of water science, technology and engineering. *Water SA* is introducing a series of special editions on various interdisciplinary themes on water resource management in Africa. The first of these editions is planned in collaboration with the Centre for Environmental Economics and Policy Analysis in Africa (CEEPA), to publish original research work on the contribution of irrigated and rain-fed agriculture to poverty reduction in sub-Saharan and North Africa. Contributions are invited for this special issue from all branches of scientific water research and policy on approaches to measurement and evaluation of experiences in technological, institutional and policy innovations for *managing water resources* in support of irrigation and rain-fed agricultural production systems for poverty reduction. Please note that the particular emphasis of this special issue is on the *role of various aspects of water resource management*, and not the contributions of *other forces of agricultural change* to poverty reduction such as breeding and improved crop management innovations in isolation of associated water management problems and challenges. The special issue will be peer-reviewed by a panel of renowned international experts in the relevant disciplines from Africa and the rest of the world. The final date for submission of manuscripts for this special issue, which will be printed in 2005, is December 31, 2004.

Submission of work solely authored by or co-authored with Africans is especially encouraged.

Please send manuscripts to:
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Orange River Blackfly Control

The prevalence of blackflies (*Simulium chutterii*) in the middle and lower Orange River Valley remains a major problem. But, says Dr Steve Mitchell, Director: Water-Linked Ecosystems at the Water Research Commission (WRC), research has brought our understanding of the blackfly to a point where we are able to plan, together with the stakeholders in the Valley, a strategy to manage the pest.

Mitchell, says the fourth project in a series of consultancies has recently been instituted by the WRC. The aim of this project is to develop a programme integrating the available options for controlling the blackfly in the Valley that will be cost effective in the long term and have the lowest possible impact on the economy of the area. The implementation of a successful programme will benefit the whole community in the Valley including the tourist industry.

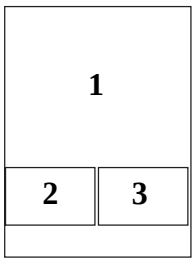
AGRI SA

Agri SA Director: Natural Resources, Nic Opperaman, says the Onderstepoort Veterinary Institute started to investigate the possibility of controlling blackflies through flow manipulation in 1978. A 66 hour closure of Vanderkloof and Boegoeberg Dams reduced blackfly populations for a downstream distance of 370 and 242 km respectively. Despite the initial success of flow manipulation, rainfall in 1987 and 1988 was higher than in previous years and flows could not be reduced sufficiently low for effective blackfly control. This resulted in one of the worse blackfly plagues along the Orange River in memory. Furthermore, flow-regulation was not a practical control option for most of the Orange River because of the increased dependence of riparian agriculture on a steady water supply, the long distance downstream of impoundments and the time required for drying-out of rapids.

Following further research, the Department of Agriculture initiated, in 1992, a large-scale control programme using aerial (helicopter) application of larvicides. The programme was highly successful until 2000 and 2002, when serious outbreaks of blackflies were experienced. The outbreaks were attributed to high flows and suspected resistance of blackfly larvae to the organophosphate larvicide *temephos*. The outbreaks had detrimental impacts on the local economy and led to numerous appeals for a long-term solution. This year Agri SA through its affiliates and the Water Research Commission committed funds that aimed "to develop practical management guidelines for integrated blackfly control along the Orange River, based on a combination of chemical and biological control methods, and flow manipulation.

SA SCIENCE LENS 2003
Beauty and excitement of science captured

The front cover of this issue of the *Water Wheel* shows some of the winning entries in the 2003 SA Science Lens photographic competition.



The competition is sponsored and organised by the South African Agency for Science and Technology Advancement (SAASTA), a business unit of the National Research Foundation (NRF).

In 2003 a total of 284 stunning original images from all aspects of science, engineering and technology were received. Three of the winning entries had water as their theme. The winner in the category *Science in Action* was Anton Pauw of Simonstown.

All the winning images and runners-up can be viewed at www.saasta.ac.za/sciencelens/winners/2003.

WINNER: *SCIENCE IN ACTION*
Anton Pauw of Simonstown
The spectre and the spectrum (1)
A rare glimpse of the Brocken Spectre at the top of Kogelberg Peak, haloed by a Glory. The "apparition" is named after the Brocken, the highest peak of Germany's Harz Mountains. This phenomenon can be seen anywhere in the world when the right combination of clouds, light and topography allows bright sunshine to project the shadow of the observer through the clouds. The Brocken Spectre, like all shadows, reaches towards the anti-solar point - the point directly opposite the sun. Under the right conditions, the head of the Brocken Spectre is haloed in glories - rainbow-coloured rings that encircle the anti-solar point. Each observer sees a glory around his own shadow. Glories are formed when water droplets scatter the light of the sun backwards from the anti-solar point. The exact pathway that the light follows is still unknown.

RUNNERS-UP:

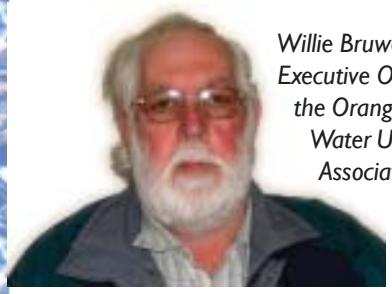
- Alan Bucke of Pretoria
  Volcanic ice (2)
  An ice block melting under blue and white l ights.
- Elizabeth Kee of KwaZulu-Natal
  Ice crystals on grass (3)
  Ice crystals slowly accumulating overnight on blades of grass as a result of a dripping tap.

8 WATER USERS' ASSOCIATIONS (WUAs)

The Orange-Vaal Water Users' Association, based in the Northern Cape town of Douglas, manages water use in one of the driest parts of South Africa.

The Orange-Vaal Canal bringing water from the Orange to the Vaal River.

A group of farmers stood silently on the banks of the Vaal River surveying the few shrinking puddles on the riverbed. The Vaal had never failed them until now. For the first time any one could remember there was no water to irrigate crops or sustain livestock.



Willie Bruwer, Chief Executive Officer of the Orange-Vaal Water Users' Association

They knew that without the river the future of their farms, 180 in all, and the agricultural town of Douglas, built on the banks of the Vaal, were at stake. Without crops what was the point of sustaining this community in the arid Northern Cape. Green fields of lucerne, wheat and mealies, growing on the banks of the steady flowing Vaal, its tributary the Riet and the Orange, further south, was all that softened the harsh Karoo landscape as it reached into the Kalahari. Rainfall, in this dry land, was unpredictable. In a good year one could expect 300 mm of rain.

It was 1981 and Korrels van der Merwe, a farmer and a management committee member of the (former) Orange-Vaal Irrigation Board (now the Orange-Vaal Water Users' Association), knew dramatic action was needed if the more than 9 000 ha of croplands, relying on the Vaal River for water, were to be salvaged.

"There was a feeling that we had to move quickly or else everything we had spent so long building would be lost," he said.

WATER SHORTAGES

In the early days of Douglas water shortages were unheard of but, from the 1950s, as the water needs of the industrialised cities on the Witwatersrand increased, the river

began to show signs of strain. Water supply to Douglas, the last stop on the Vaal before it joins the Orange, became unreliable while the quality of water, polluted by factories and farming upstream, deteriorated. If this small community was to survive its farmers had to find a way of getting fresh water back into the river.

"After much discussion we decided to build a 24km-long canal to lead water from the Orange, south of Douglas, to the Vaal," says Van der Merwe who was part of the team that conceptualised the plan. "It was going to cost a lot of money and we knew we needed state help," he says, "but the problem was there was no time to wait out the process for government to make a decision." What the farmers were able to secure quickly was government approval to go ahead with the project themselves.

ORANGE-VAAL CANAL

The community immediately set about raising the R3 million needed to build the channel and, by 1982, eight months after the decision to build was made, the Orange-Vaal Canal, including pumps and a pump house, was complete. Water flowed steadily, at a rate of between 10 and 12 m^3/s, from the Orange into the Vaal at the Douglas weir basin. The Orange-Vaal canal was the third to serve the community of Douglas. The Bucklands Canal, which channelled water from the Vaal to several small-holdings around town, was built at the end of the 19th century and extended in 1937. It was lined for the first time during 1960 to 1965 and then relined in 1991 and 1992. The unlined Atherton Canal began at the weir on the right bank of the Vaal. Originally all irrigation development around Douglas was below the level of this canal.

The Douglas weir, the holding area where the Orange River water was pumped, was the sixth weir to be built on the site of a Griqua weir that was built in 1870. The first weir built by Europeans was completed in 1890.

The new Orange-Vaal Canal was hailed by farmers as a salvation and they enthusiastically pumped the far cleaner Orange River water onto their lands. However, the project was not without problems. The water flowed through sandy soil and soon sections of the canal walls became unstable and low-lying areas water logged.

"In one instance the Farmer's Co-op had to buy a house in town that was so water logged water was coming up under the floors," said Van der Merwe.

The only way to counter the problem would be to line portions of the canal with cement but that would cost an extra R4 million - beyond the payment ability of the farmers.

STATE TAKE-OVER

Willie Bruwer, Chief Executive Officer of the Orange-Vaal Water Users' Association picks up the story: "It was at that point the state was asked to take over the canal – once this was implemented the canal was cemented from its beginning to a point near the GWK (Griqualand West Co-op) silos." The cost was R18 million. The rest of the canal was temporarily sealed with plastic and a soil/lime mixture. The largest unlined portion was cemented in 1995.

In 1984, Louis Wilken, then Manager of the Irrigation Board discovered that the water meters measuring usage weren't working and that farmers were pumping unknown volumes of water from the river. Wilken persuaded the Board to use the method of crop water requirement as a measuring tool to determine how much water a crop would use in the coming growing season. There was only so much water available and farmers were limited to using 60% of their quota between July and November. (It was a water management plan that worked and today the Orange-Vaal Water Users' Association is one of three WUAs working with the Department of Water Affairs to formulate a water management plan for the whole country.)

Despite these initial hiccups farming in the Douglas area was thrown a lifeline and now, more than twenty years later, 105 major farming operations and 71 small-holdings benefit from the water. The future of town has been guaranteed.

While Douglas is a major farming centre for Griqualand West the story of its beginnings is tied to the history of a fledgling country. In his book, *Discovering South Africa,* T.V. Bulpin described how the town was sited on a strategic ford that, in 1775, had been in bitter contention between the Bushmen and the Hottentots. Forever after the Bushmen knew the area as "Go Koo Lume" which meant "Where we had a hard time," or "where no mercy was shown."

In 1867 European settlers persuaded the Griqua chief, Nicholas Waterboer, to allow them to establish a town at the ford, 12 km above the confluence of the Orange and the Vaal. Waterboer's father Andries, a catechist, had been appointed "captain" of the people by the British in 1813. The Waterboer's had been among the freed slaves that had trekked north with Adam Kok in search of a new life in the hinterland. The area they chose became was a centre of industrious Christian outreach in the early 1800s with characters like the

A measuring flume in the Orange-Vaal Canal.

missionary Dr Robert Moffat settling in the area. The explorers David Livingston (who married Moffat's daughter Mary) and William Burchell were well-known faces in the new communities of Griqualand. A mission station was established near the site of the future town of Douglas in 1848 on the farm Backhouse. When the new village took shape a surge of settlers, eager to try their luck farming between the great rivers, moved into the area. The town was named after Lieutenant-General Sir Percy Douglas and soon grew into a busy agricultural centre.

Douglas historian Willie Bruwer (senior) of the farm Vogelfontein says it was a time in South African history where anything seemed possible.

"Diamonds had been discovered and 107 km east of Douglas, the new town of Kimberly was booming."

In fact Douglas wasn't far from the site where South Africa's first diamond, the Eureka, was discovered in 1866.

It was a time when Cecil John Rhodes was building his fortune and political career and he was instrumental in a decision that allocated funds to Douglas' farmers to build their first weir wall on the Vaal, says Bruwer.

"Douglas was at the forefront of water development in the country," says Bruwer, "it was here that farmers first begin to take advantage of South Africa's great rivers."

In 1882 the new town was also a challenge for land-surveyor John Mintern who surveyed several of the town's original erfs, citing them on the contour – plots that are still in use today and which, says Bruwer, are the only ones never to have been flooded.

FARMING TOWN

Modern day Douglas is typified by the hustle and bustle of a farming town. Depending on the time of year farmers plant lucerne, maize, wheat, potatoes, onions and some even have vineyards.

Van der Spuy Botes, whose farm Kom Nader is 15 km above the Douglas weir, says the challenge now is to be ensure crop production remains economically viable as water and power costs rise and crop prices fall.

"About 80% of my 500 hectares are under spray irrigation," he says. "Water costs are high – we pay for the upkeep of the canals, tariffs for water from the major dams, taxes and power costs." The overheads to keep water flowing and lands producing are high.

"You don't mind any of this if you are guaranteed a reasonable return on your investment but this is not happening and times are hard."

EXTRA PUMPS INSTALLED

During 2002/2003 the Water Users' Association enlarged the original pump station. Three extra pumps and a second pipeline were installed to meet the water requirements of irrigators who had bought extra water rights on the Orange River. It means new work opportunities and greater crop production have given the local economy a new lease on life.

The rivers – the Orange, the Vaal and their tributaries, the Harts, the Riet, the Klein Riet, the Modder – all part of a intricately linked system have, like the farmers on their banks, sometimes bowed under the strain of the demands they face.

"With good management there will always be water," says Willie Bruwer, from the Orange-Vaal WUA, "We have learnt though that it's a resource we cannot take for granted. "Water, like the diamonds discovered on the banks of the rivers near Douglas, is something we must always treasure."

In Memoriam

The *Water Wheel* regrets to announce the sudden death of Mr Willie Bruwer (senior), the Douglas historian, who was interviewed for this article. He died in his sleep on 1 July 2004, aged 77.

Smallholder Systems Innovations in IWRM: An Exciting New Research Programme

The challenge of producing food for a rapidly increasing population in semi-arid Southern Africa is a daunting one. The production of more food translates to more consumptive use of water which in turn is likely to impact on water resources downstream. The intensification of agriculture has often resulted in negative side effects in terms of land and water degradation. Furthermore, water legislation is increasingly concerned with maintaining a "Reserve" to sustain basic human water requirements and instream ecology.

To address the challenges of increasing food production, improving rural livelihoods, while safeguarding critical ecosystem functions, a research project entitled "Smallholder System: Innovations in Integrated Watershed Management" has recently been launched at the School of Bioresources Engineering and Environmental Hydrology (BEEH), one of six partners in this Swedish (the Swedish International Development Agency - SIDA) and Dutch (Directoraat-Generaal Internationale Samewerking - DGIS) funded initiative. BEEH is a school of learning at the University of KwaZulu-Natal (UKZN). By filling these fundamental research gaps, it will enable researchers to answer currently unanswered questions regarding smallholder land and water management, and ideas on securing human livelihoods in semi-arid tropical savannahs.

PROGRAMME

The programme adopts an integrated approach to agricultural land and water management, analysing the interactions between the adop-

tion and participatory adaptation of water system innovations (such as water harvesting, drip irrigation, conservation tillage, etc.), increased water use in agriculture and water flows in order to sustain ecological functions that deliver critical ecosystem services to humans.

In addition, a core research focus of the University of KwaZulu-Natal over the past decade has been the hydrological impacts of land use change at different spatial and temporal scales.

More commonly known as the Smallholder Systems Innovations (SSI) project, this interdisciplinary programme has field sites in the Thukela Catchment in South Africa and in the Pangani Catchment in Tanzania. These two river basins are representative of typical semi-arid to dry sub-humid rainfed agrarian conditions.

WATERNET

The smallholder systems innovations partners in the SADC region are the School of Bioresources Engineering and Environmental Hydrology, the Pretoria office of the International Water Management Institute and the Sokoine University in Tanzania. They are all members of WaterNet, a regional network of university departments and research and training organisations which aims to enhance regional capacity in integrated water resources management. The other partners are UNESCO-IHE and the Systems Ecology Group at Stockholm University. The programme, lead by Prof Johan Röckstrom of UNESCO-IHE, is funded for four years and provides training opportunities for eight PhD and two Post-Doctoral students divided between the partner institutions and numerous MSc students.

Under the leadership of Professor Graham Jewitt, the University of KwaZulu-Natal component of Smallholder Systems Innovations is developing a field site in the Potsheni community near Emmaus-Bergville in the Thukela Catchment. The site is part on an ongoing Landcare project managed jointly by the Agricultural Research Council - Institute for Soil Climate and Water (ARC-ISCW), the KwaZulu-Natal Department of Agriculture and the local farmers through a monthly farmers forum, in which the SSI team participates. The site was introduced to the team by Dr Terry Everson from the UKZN School of Applied Environmental Sciences. The Landcare project has been running for three years and provides an ideal entry point to the catchment and a mutually beneficial relationship with the ARC. In the Pangani river basin, the northern Makanya-Chome watershed will constitute the focal research location. The interactions between humans and the environment in this landscape are typical of Tanzania. Rapid land use changes under demographic pressure occur in a landscape already subject to severe land degradation and water scarcity. Furthermore, making Makanya-Chome even more interesting in the context of the research programme is that small-holder farmers, in a response to a growing desperation over the difficulty of making their living from low-yielding agriculture, have adopted small-scale water harvesting methodologies on a relatively large scale.

WATER HARVESTING

"Compared to other parts of Africa, South African small scale farmers are not very far advanced when it comes to optimising water use on and around their fields. We were amazed at the extent of water harvesting for crop production that occurs in the Pangani Basin when we visited Tanzania recently", said Prof Jewitt. "We're certainly learning a lot from our colleagues at the Soil and Water Group at Sokoine University in Tanzania. They've been very active in promoting these types of systems in Tanzania and have a wealth of knowledge to share and, of course, at the same time, they're learning a lot about hydrological modelling from us". As such, small systems innovations is part of an emerging group of research initiatives which highlight the importance of linkages between institutions in the Southern African Development Community (SADC) region.

The UKZN component of the programme provides PhD opportunities for three students registered at UKZN, as well as training opportunities for many other students involved in the programme. Khumbu Zuma has joined the project team from the Farmer Support Group (FSG), (who through the input of Monique Saloman, director of the Farmer Support Group, maintain an interest in the project), and will focus her PhD research on investigating the social preconditions for, and monitoring of, the uptake of water system innovations. "Smallholder Systems Innovations is a new exciting project in the School of Bioresources Engineering and Environmental Hydrology. I am enjoying my area of research immensely as it values land and water users' indigenous knowledge and because it is an interdisciplinary research project that integrates the theoretical perspectives of various fields namely, ecology, sociology, and hydrology", said Khumbu.

Victor Kongo has joined the team from Kenya and will focus his research on water resources impacts downstream. "The Smallholder Systems Innovations project provides an excellent platform upon which social and biophysical research scientists are able to address water use and management issues in a holistic

The Smallholder Systems Innovations in Integrated Watershed Management Project Team.

manner. I am happy to be part of the SSI team", said Victor when asked about his involvement in the project.

Third year BEEH PhD student Nick Walker (from the UK) will complement his PhD studies with an investigation of the benefits of water system innovations on water availability in the soil, and ultimately crop yield. "My involvement in the Smallholder Systems Innovations project involves intensive field research to analyse soil, crop, water and atmosphere interactions of innovative production systems, with the aim of improving yields in a sustainable manner while increasing water-use efficiency. It's a privilege to carry out field research in such a stunning part of the world that will hopefully have a positive economic impact on the emerging farmers in that area", said Nick Walker.

GIS DATABASE

Meanwhile Jennifer Kinoti (also Kenyan), despite being registered at UNESCO-IHE, will spend the first six months of her PhD developing a GIS database for use by the rest of the SSI partners. "The Smallholder Systems Innovations project is a multi-disciplinary scientific research project that integrates both social and natural scientists on the issues of sustainable management of water and land resources within the context of adaptation and adoption of system innovations. I am personally proud to be part and parcel of this project and I hope that my individual research outputs will contribute in realising the vision of Smallholder Systems Innovations", said this enthusiastic researcher.

These students and researchers will form part of a wide international research community, and they will be afforded opportunities to expose research findings and share experiences at several international scientific symposia and meetings (e.g. the annual WaterNet symposia, the annual European Geophysical Society General Assemblies, and the annual Stockholm Water Symposia). More importantly, the programme will strengthen the establishment of a regional research group of international repute which will strongly contribute to consolidating a sustainable research environment and knowledge base in the region.

As well as these students, the School of Bioresources Engineering and Environmental Hydrology, will host other members of the SSI team over the next four years. So in addition to IsiZulu and English, you can expect to hear conversations in Swahili, Dutch and Swedish echoing through the UKZN "AgFac" corridors over the next four years.

News Flash

A PhD position in the SSI project has become available. If you have a Masters degree in hydrology, soil science, agronomy or a closely related discipline, or if you have a Masters degree and experience in similar projects and are interested in a full time PhD position within SSI, please contact Prof Graham Jewitt - beeh@ukzn.ac.za (or for more information on the SSI project).

The GWK Limited Irrigation Scheduling Service

The Orange-Vaal Water Users Association's Louis Bosman canal is 24 km long and diverts Orange River water across the divide into the Douglas weir basin in the Vaal River.

It typifies the massive scale and advanced technology of the irrigation area served by GWK Limited (previously Griqualand West Cooperative) with head office in Douglas that now with recent expansions includes some 62 000 highly productive irrigated hectares, two-thirds under centre pivots.

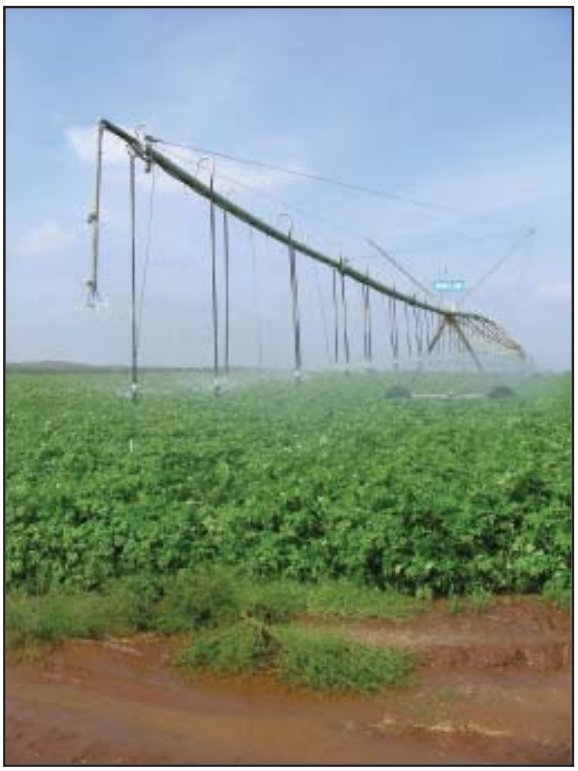
Two of the three Water Affairs and Forestry pilot studies on implementing Water Demand Management that are now approaching successful completion are situated in GWK territory. The studies have been undertaken in conjunction with the Orange-Riet and Orange-Vaal Water User Associations. Possibly a factor that influenced their selection was the well-accepted irrigation-scheduling programme provided by GWK.

There is a perception that all irrigators should "schedule", that is, apply the right amount of irrigation water at the right time based on scientific procedures and that relatively few do! This is not the case where GWK operates and where nearly two-thirds of the area, or about 40 000 ha, is being scheduled. Approximately 55% is being scheduled by the GWK service while consultants cater for a further 12%. Centre pivots predominate in the area and they facilitate scheduling, but this is probably an unequalled record anywhere in the world.

The centre pivots stretch from horizon to horizon and are multi-purpose machines that have revolu-

All concerned with irrigation management are aware of the policy changes brought about by the National Water Act of 1998 and the current emphasis on Demand Management Strategies aimed at making more effective use of existing water sources in preference to creating new ones. Pressure is on for more efficient water use.

tionised irrigation in the region. The spray nozzles are just above the crop reducing wind losses and soil compaction. Fertiliser is applied with the water (fertigation) and there are attachments for applying insecticides and herbicides. They are push-button adjusted or in many cases telemetrically controlled. It is even possible to pre-programme for an extended period.



The significance of the GWK scheduling method lies in its simplicity. To all intents and purposes no additional workload is imposed on the farmer. Once a week he is provided with the level of the soil water in the profile and can then decide if he should step up or reduce the irrigation applications of the pivot during the subsequent week. It is just like pulling up to the garage pump in your car and having the petrol attendant show you the dipstick and ask if you want one or two tins of oil? (It is so similar that if I am sure nobody from GWK is listening I refer to it as the "dipstick scheduling method").

Down the years the Water Research Commission has funded a number of irrigation research projects in the area and there are new projects coming on stream. These projects lead to a number of computer programmes (PUTU, BEWAB, SWB, and SAPWAT) that directly or indirectly could play a role in scheduling. What the Manager Agriservices, Dup Haarhof, achieved, quite apart from his own research contributions, was to weave this data and practical experience into a procedure that was in balance with the climate, crops and soils as well as the irrigation and management practices of the farmers in the area.

What makes the success of the GWK programme all the more remarkable is that while many of the farmers have computers they do not need to use them in the scheduling process unless they prefer to have information e-mailed to them. Irrigation scheduling is so often equated to the farmer use of computer models but here GWK

Andries Wiid, scheduling supervisor Western Region, looks after the computer side of things, organizes and advises. If he sees things going wrong he is quick to warn and recommend. Last winter he had 60 clients with 380 centre pivots and 500 measuring stations.

Sindy de Jager is the scheduling administrator for the GWK Western Region and handled 500 measuring points through last winter and a further 325 this summer. One of the three field units visits each site once a week and Sindy enters the neutron probe readings into the computer that is programmed to do the calculations and produce the output tables and graphs. The results are transmitted, with a minimum of delay, to the farmer by e-mail, fax or SMS.

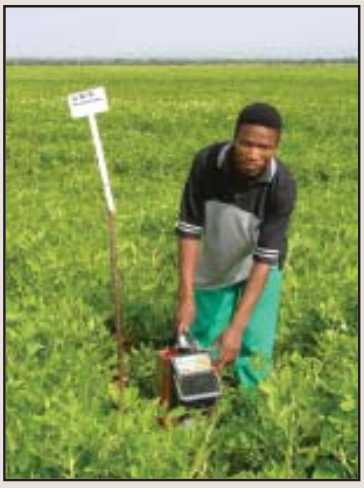
Top right: *This energy and control centre illustrates simplicity in modern technology. No unnecessary buildings or fuss. Just Eskom power, pump house, instrument room and tanks for storing fertiliser and chemicals.*

Bottom right: *Field measurements of profile water content are taken by neutron probe at measurement points where an aluminium pipe is tightly fitted into an augured hole 1.20 m deep. Water content readings are taken at 0.3 m depths over the full 1.20 m depth.*

The first and vital step in the process is to make a small circular dam about 3 m in diameter around the neutron probe pipe and to keep filling the dam up with water until the profile is saturated. The surface is covered with a plastic sheet to prevent evaporation losses and the excess water allowed to drain away. The time this takes, depends on the water holding capacity of the soil but at the end of the process the so-called upper limit or field capacity of each soil layer is known.

The other important point is the refill water content that is the stage when the crop would start to be exposed to stress and the trick of scheduling is to irrigate in such a way that the water content in the root zone remains between the two limits - thus we are back to the dipstick!

Adam Mosebets, scheduling assistant, takes soil water content readings with the neutron probe on his regular weekly visit to the measuring point. On his return to the office Sindy de Jager will download the readings on to the computer and the farmer will soon have the results. Note the extensive area under the pivot. What does this cost? This depends on the the number of measuring stations on a farm and the number of weekly visits during the season. A typical example is 200 ha wheat, 13 weekly visits to 6 measuring points that came to R5 705 or R28.53/ha. On another farm 600 ha of wheat with 17 measuring points and 17 visits this came down to R17.66/ha. According to the GWK Costs Guide *inputs totalled R6 060/ha so that scheduling represented from a quarter to half a per cent.*



specialists handle the computer work in the background.

A crop of maize running at over 13 t/ha under a 50 ha centre pivot represents an expenditure on production inputs of R320 000 and at current prices a gross income of R715 000. This is in the same order as the capital investment in the centre pivot.

Should the maize be double-cropped with wheat the totals for the year would add up to R623 000 and R1 202 500. This is high risk intensive management farming and nothing can be allowed that could have an adverse impact on yield or quality. The position is even more critical in the case of a crop such as onions that is subject to volatile market forces where the corresponding figures are R2 300 000 and R5 500 000.

The GWK scheduling service, in all its simplicity, has been developed to meet the needs of these farmers and has stood the test of time.

Johannes Haas (left), scheduling assistant, is one of two working out of Douglas. Here he sorts out a minor problem with a neutron probe cable under the watchful eye of Andries Wiid and a farm foreman. Absolute reliability is essential and requires discipline, organised training and support at all times.

SCHEDULING WEEKLY DATA

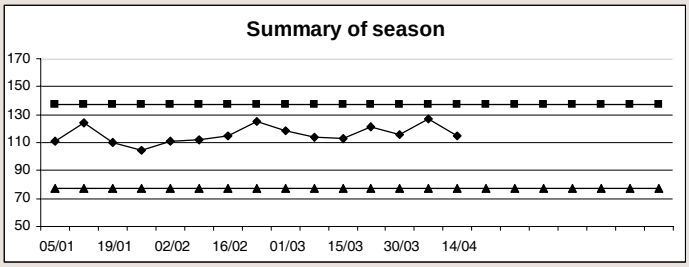
This is the condensed output that the farmer receives weekly for each measuring point.

Pivot # 3			Previous	Current
mm	Upper/ Lim	Low/ Lim	06/04	14/04
0-30	38	23	36	33
31-60	31	16	31	27
61-90	32	17	30	28
91-120	36	21	31	28
0-120	**137**	**77**	**127**	**115**

The water content of the soil in mm is determined for each 30 mm layer plus the total for the root zone as a whole by subtracting the Lower Limit from the Upper Limit in each case. The water holding capacity of the profile is 137-77 = 60 mm. The last two columns give the actual water content at the end of the previous week and of the current week. In this example the profile had dried slightly but at 115 mm was still comfortably in the "safe range". This implies that the water added by irrigation and possibly rain had been adequate.

Surplus/ deficit	Weather station	Rain meter	Recommendation
-22	26	10	25

This table indicates the current state of the profile. The water content has a deficit of 22 mm implying that 22 mm is required to bring it up to the level of the Upper Limit. "Weather station" is the calculated water requirement of the crop based on weather data using a Putu or Sapwat routine based on crop factors or possibly Bewab programme. Rain meter is self-explanatory while the "recommendation" is based on a calculated water balance and provides perspective.



The "summary of season graph" is in practice the crux of the matter from the point of view of the farmer. He knows that if he keeps wobbling along between the limits he will not be going far wrong. It is seldom possible to give the quantity of water planned each week to each pivot. In practice other operations upset the rhythm or things go wrong. Despite this it is quite surprising how effectively farmers keep on track, compensating from week to week.

Olivia's Rise from Street Sweeper to Manager

Lebo Moncho reports

Olivia Radebe's brief career reads like a fairy tale. Recently promoted to Manager: Environmental Projects at Pikitup, Olivia's story is an inspiration to many young people struggling to get their careers off the ground.

Like many other youngsters, Olivia finished high school with great ambitions. She wanted to become a medical doctor, but due to circumstance was unable to register for the degree. Instead she enrolled at Pretoria Technikon where she began a Diploma in Environmental Engineering. By her own admission this was an unusual choice for a girl from Dobsonville, but as she says that is what was available at the time and she was determined to go to tertiary school.

As testament to her commitment to better herself, Olivia also interned in an Experiential Training programme at Sasol.

In 1999 she was forced to drop out of school and the Sasol programme. No one in her family was working and she could no longer afford her school fees. She went looking for employment.

Again circumstance played a hand. She was told Pikitup was looking for street sweepers at the Selby depot. Selection was a simple process. All applicants put their ID documents in a bucket and those that were drawn out got the job.

Olivia remembers her feelings about getting the job as a night street sweeper. "I was relieved to get a job. But I never thought that I would end up as a street sweeper. In life you set standards for yourself and this is not what I wanted for myself. But my mother said when money comes it doesn't say where it comes from. On the other hand I made good friends with the various people I met on my route which made the experience bearable."

With very clear ideas about where she wanted to end up in life, Olivia was determined to turn her life around – circumstance or no. A year after starting at Pikitup her appointment was upgraded to full time which allowed her to re-register at Pretoria Technikon to complete her Diploma.

"I traveled to Pretoria by train every day," says Olivia. "In the day I went to school and at night I swept the streets of Johannesburg. It was a tough time. I would study and sleep on the train but it was worth it."

As a result of her sacrifices she graduated in 2001. She was also promoted to a position at Pikitup head office as a Community Education Facilitator. In 2002 she completed her B.Tech in Environmental Management and the following year enrolled for her master's degree which she is currently busy with.

OPPORTUNITY AND WILL

When asked what she credits her success to Olivia is quick to respond, "Opportunity and will. You are the captain of your own ship. Your attitude determines your altitude. So grab what is available and make use of it."

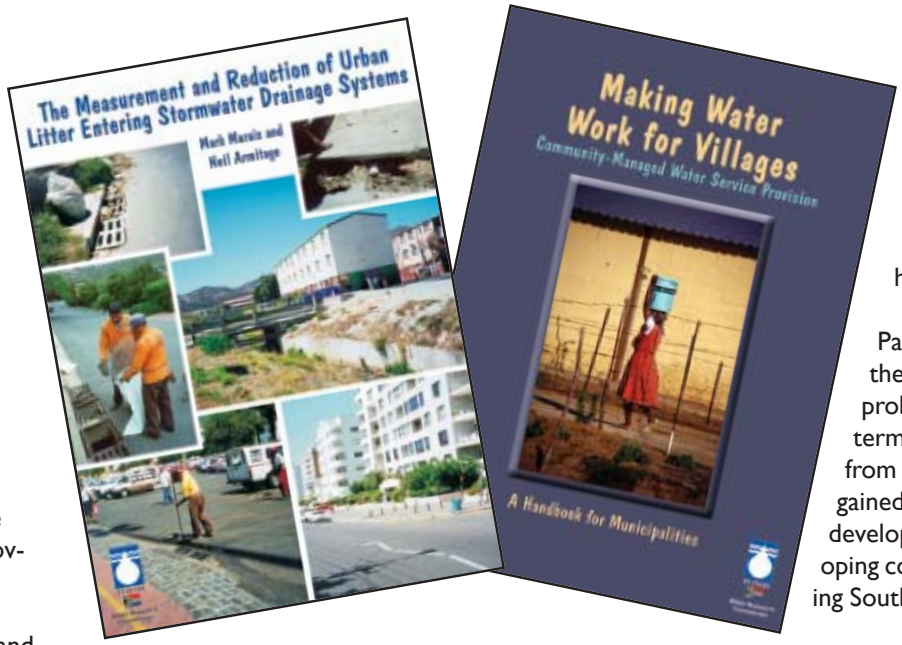
She even sees value of having been a street sweeper in her current job. "My job now is very community-based. So being able to talk to anyone and having first hand understanding of what happens at street level is very helpful."

Olivia is also grateful for the assistance that Pikitup has given her along the way. The company helped finance her B.Tech degree. She also values the exposure she received at International Association of Impact Assessors (IAAIA) conferences which she attended through Pikitup.

Her family has also been a source of strength. Her younger brother is her biggest fan. He is always bragging about her and her accomplishments.

With so much under her belt at 27 years old where does she want to end up? "Ke batla ho ba MD!" she says with a laugh. Somehow, one can see it happening.

Two New WRC Reports for Municipalities



MAKING WATER WORK FOR VILLAGES

Since 1994, water provision to all households in rural and urban areas has been one of the main developmental strategies of the South African government.

This important and increasingly urgent task of quality water provision is now the mandate of municipalities. In rural communities where the villages in a single local authority are often spread out over a large geographic area, local governments face the significant challenge of carrying out this mandate efficiently and effectively.

This workbook is designed to assist municipalities to explore ways of managing these challenges. The one option is through developing community-level systems that will operate and maintain water schemes. The facets of community managed schemes are explored in this guide, which is divided into two sections:

Part 1 Introducing community-managed water schemes which examines the contribution that community-based water service providers can make to improve the functioning of water service provision; and

Part 2 How to establish and support community-managed water schemes which focuses on the practicalities of establishing community-based operations and maintenance of water provision in villages.

THE MEASUREMENT AND REDUCTION OF URBAN LITTER ENTERING STORMWATER DRAINAGE SYSTEMS

The impact of litter pollution in urban stormwater runoff may appear to be mainly of visual and aesthetic importance, but the fact is litter pollution seriously interferes with aquatic life in the receiving streams, rivers, lakes and oceans.

A more sinister effect of the presence of litter is that it is one of several environmental cues associated with neighbourhood decline. Litter is a physical "symbol of disorder" or "incivility" along with vandalism , dilapidated or abandoned housing and dirty vacant lots.

This publication describes the results of a two year monitoring programme and sets out guidelines for litter management in South African urban catchments.

The publication has four parts:

Part 1 introduces the urban litter problem in general terms borrowing from the experience gained in various developed and developing countries, including South Africa.

Part 2 focuses on the information about the source, type and amount of urban litter obtained from the monitoring programme carried out in the nine pilot catchments in the Cape Metropolitan Area. Social attitudes amongst members of the community living in two of these catchments are examined.

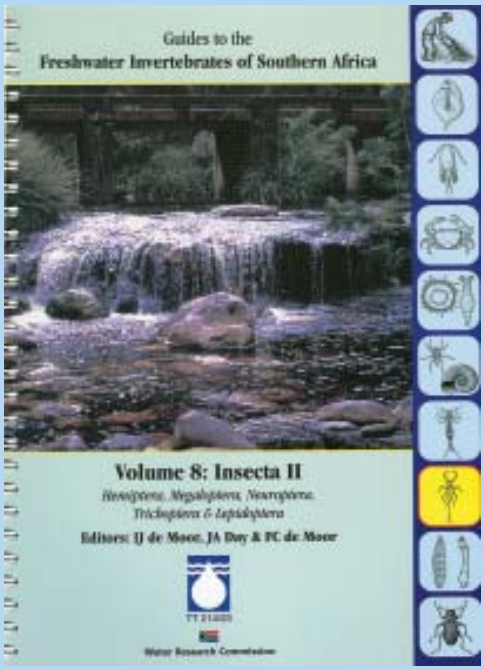
Part 3 reviews litter management options generally and then focuses on current South African initiatives.

Part 4 presents a set of generic guidelines for litter management, proposes a method for selecting appropriate litter reduction options and summarises the outcome of the research.

Copies of both these publications are available free of charge from the Water Research Commission,
Private Bag X03,
Gezina 0031.
Tel: 012 330 0340
Fax: 012 331 2565
E-mail: publications@wrc.org.za
(Attention Rina Winter or Judas Sindana)

Guides to the Freshwater Invertebrates of Southern Africa – Volume 8: Insecta II

This identification guide is one of a series of ten books that include keys to most of the fresh and brackish water invertebrates of Southern Africa. The lack of identification guides for non-specialists has become "a yawning gap in the tools available to scientists, managers and scholars concerned with the assessment and management of water resources.



The principle aim of this series is to synthesize much of the existing knowledge on the identification of freshwater invertebrates into a standard format that is accessible to users who wish to identify taxa beyond their field of expertise.

It is true that identification guides are perpetually out of date, particularly in terms of nomenclature, due to advances in systematics. To keep abreast of some of the changes in nomenclature, readers are referred to the *Checklist of Aquatic Insects and Mites* (http://www.ru.ac.za/aquatalogue).

Identification of taxa to species level is the ideal to which we would like to strive, but for a number of reasons this is not always possible: the present knowledge of taxa does not often permit such detailed identification, and in instances where taxa are well-known, identification to such a fine resolution is usually constrained by space considerations and cost effectiveness. In some instances, particularly for small, relatively well-researched groups such as the freshwater molluscs, taxa have been identified to species level. Since new species are constantly being discovered, users of these guides are cautioned against attempting to "make" unusual specimens "fit" existing keys to species level. Users are encouraged to inform experts of such specimens, to take note of new distribution records, and to lodge all collections with well-known museums, particularly those that are depositories for collections of freshwater invertebrates (e.g. the Albany Museum in Grahamstown, the South African Museum in Cape Town and the Transvaal Museum in Pretoria).

It is hoped that this series of guides will stimulate a greater collection effort, which will in turn lead to the upgrading of geographical information on the diversity of freshwater invertebrates in Southern Africa.

To order a copy of this Guide – Volume 8: Insecta II, which describes *Hemiptera, Megaloptera, Neuroptera, Trichoptera* and *Lepidoptera* contact Rina Winter or Judas Sindana at the Water Research Commission in Pretoria.
Tel: +2712 330-0340.
Fax: +2712 331-2565.
E-mail: publications@wrc.org.za

CALL FOR PAPERS

BIENNIAL GROUNDWATER CONFERENCE

THEME : GROUNDWATER – STRETCHING OUR VISION

7 - 9 MARCH 2005 : CSIR CONFERENCE CENTRE, GAUTENG

Organised by the **Groundwater Division (GWD)** of the **Geological Society of South Africa (GSSA)**

OBJECTIVE

The conference aims to consolidate knowledge of ground water in view of the dynamic changes to water resources management the last five years. The time will be opportune, to look back, stretch out and then push forward in the field of ground water.

PAPERS AND POSTERS

High calibre papers and posters that are relevant to the conference theme are invited. Prospective authors are requested to e-mail the following information to the Secretariat.

* Title of paper/poster
* The main author's title, initials and surname
* The main author's postal address, telephone, fax and e-mail details
* Name(s) of co-author(s)
* A 200-word abstract
* Indication whether the abstract is submitted as an oral or a poster paper (poster authors are also required to submit a written

Papers will be accepted on the understanding that the main author, or a co-author will personally attend the conference as a fee-paying delegate and present the paper; and that the deadlines indicated below will be strictly adhered to. Please note that full papers will not be edited or reviewed and will be required in a camera-ready format according to guidelines sent to authors with the official letter of acceptance.

31 August 2004:	Provisional acceptance of papers – authors advised to start preparation of their full papers.
1 November 2004:	Submission of full paper (8 – 10 pages) in camera-ready format.
10 November 2004:	Distribution of final (printed) conference announcement which will include the draft programme.
7 – 9 March 2005:	CONFERENCE

TOPICS

* Methods to quantify ground water resources, with special emphasis on basin wide studies through the adoption of system analysis approaches.
* Techniques for improved evaluation and prediction of ground water interactions with the surface water environment (including the ecological role and function of ground water - aquatic and terrestrial)
* Provision of water services to communities from resources that are located in traditionally low yielding hydrogeological domains.
* Translation of the principles of sustainable development and integrated water resource management (IWRM) to reality in order to ensure sustainable ground water management.
* Development and application of ground water resource decision support systems and monitoring systems.
* Support of policy development (resource directed measures and source directed controls) and institutional arrangements (including stakeholder participation) for water resource management
* Improved characterisation of ground water recharge, flow and storage in relation to assessing the role of aquifers in conjunctive use or integrated management schemes and for drought preparedness
* Improved understanding of subsurface biochemical/biological processes determining the natural contaminant attenuation capacity of aquifers in the vadose and saturated zones
* Approaches to control subsurface contaminant loads from existing land-use practices (e.g. mining) and future land-use planning.

CORRESPONDENCE AND ENQUIRIES

The Secretariat (Conference Planners)
PO Box 82
IRENE
0062 South Africa

Tel: +27 (0)12 667-3681
Fax: +27 (0)12 667-3680
E-mail: confplan@iafrica.com
Website: www.gwd.org.za

GSSA
Geological Society of South Africa

The Water Wheel publishes the following articles, written by three well-known and prominent researchers in the South African water field, to conclude the fascinating debate on climate change - Ed.

Climate Change – A Cause For Concern

by Professor Bruce Hewitson, Climate System Analysis Group, University of Cape Town

Mention climate change in any group of people and one is bound to stir up some derisive comments. It would seem that many people hold strong opinions – and the facts are often, apparently, of secondary importance. The reality is that, on one level, climate change is a complex subject requiring careful consideration, and this article can only begin to touch the surface of the subject.

On the global scale there is much that can be stated with confidence about climate change; for example, that human activity has undeniably changed the global atmosphere (as evident in, for example, atmospheric CO_2 concentrations). However, when it comes to statements about regional scale change and impacts, the purported threat rouses strong reactions. Yet, if climate change is real, and if we ignore the issue, at a minimum we do a disservice to society and the future generations who are the inheritors of our inaction. At worst, our irresponsibility results in very real suffering and hardship when the consequences of climate change exceed the limitations of the societal infrastructure and activities.

ATTITUDES

Perhaps the most dangerous attitude we could adopt is to over simplify matters. Far too often one encounters generalized, sweeping assertions that are justified with the briefest of evidence. Such assertions can never be responded to in a few simple statements and this demonstrates the power of rhetoric to confound and mislead, where a closer examination would perhaps indicate a contrary conclusion. Rather, assertions about what will, or will not be, require careful consideration. For example, a statement might be made that the climate of a region is not changing, and in support the evidence offered is perhaps that the mean annual precipitation (MAP) for a recording station shows no trend. However, this completely ignores pertinent questions such as: is the period analyzed appropriate, is MAP actually what is relevant, is the station representative of the region, or whether the data is appropriately quality controlled for any number of spurious artifacts[1], etc. For example, dry spell duration and rainfall intensity could both increase significantly, yet MAP could remain unaffected. Such

Pictures of the contrast over the Western Cape between 2002 and 2003, showing the effect of drought.

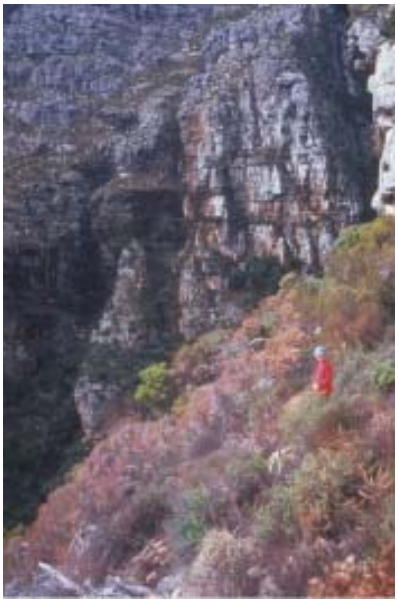
changes would obviously have a significant impact on society and remain completely unidentified in the MAP. Similarly, if calculating the trend of a time series over the last 100 years in order to assess possible change, one needs to be cautious of simple linear trends considering, for example, that a) the human induced signal is only detectable against natural variability in the latter half of the 20th century, b) the change signal is likely exponential and would be under-estimated by a linear trend, or c) simple linear trends are highly sensitive to outliers in the data.

Thus, because of the tremendous importance of the question of climate change to all aspects of society, it is imperative that we examine the issue carefully. Of special importance are the relevant aspects of climate change for any given sector; what are the interdependencies of the coupled human-environment system? For example, for an agricultural crop such as maize, changes in dry spell duration and water availability, coupled with increases in temperature, would together affect soil moisture, crop stress, and vulnerability to crop diseases with significant impacts on productivity. Such combinatory impacts could potentially make a given activity in one region non-viable with further consequences for the economy, employment, and quality of life for many. This example serves to emphasize the extreme importance of careful assessment. Crucially, it must be recognized that as society builds an infrastructure and undertakes activities designed for a given climate, any change in the climate makes the infrastructure sub-optimal, potentially to the point of failure.

CLIMATE CHANGE FOUNDATIONS

To understand climate change one must begin with the recognition that the climate is a response to the energy balance of the coupled global system. Change the distribution or level of energy and the climate system responds. One of the key determinants of this global energy balance is the chemistry of the atmosphere, commonly referred to by the misnomer of "*greenhouse effect*". This is the process by which a number of gasses (not just CO_2) affect the global radiative energy balance. In this respect it is absolutely clear that human activity has changed the atmospheric chemistry; accordingly the climate system is responding. The key question is whether the magnitude of the climate system response is, or will be, of any relevant consequence to society.

What is a "relevant consequence"? This is a question often ignored by many sectors and requires thinking beyond the simple attributes of averages in space and time. In many cases the sensitivity of a sector is not understood. For example, the spatial extent of malaria is highly sensitive to minimum temperature. As shown later, this attribute of the climate is changing significantly over southern Africa – imagine the cascade of consequences of malaria becoming prevalent in Gauteng! Thus, a starting point in considering the relevance of climate change to a given sector of interest (e.g. water) is to first understand the sensitivity of that sector to climate, and especially what the existing infrastructure can accommodate (e.g. peak storm water flows in an urban setting).



Courtesy: Prof Peter Linder

A picture of dead vegetation from a drought year on Table Mountain. It shows the death of many individual shrubs in this normally moist vegetation. These shrubs normally survive until fire arrives to burn them and trigger seed release and germination, so drought death is highly unusual ecologically, as it can rapidly lead to extinction. Such events are being noticed on broader and broader scales by naturalists.

Every sector of society needs to address this question. In Africa the water resource management sector particularly needs to understand sensitivity and response to change in the climate. However, prior to investing in such activities it is appropriate to separate and briefly consider the different elements that underlie the climate change debate.

COMMON ISSUES

- The first issue is that of detection. According to basic physics it is undeniable that humans are changing the climate – but can

[1] Data quality is the subject of data homogenisation; a difficult task where subtle errors in the data may have notable effects on the analysis, and may often go unidentified in cursory data quality control.

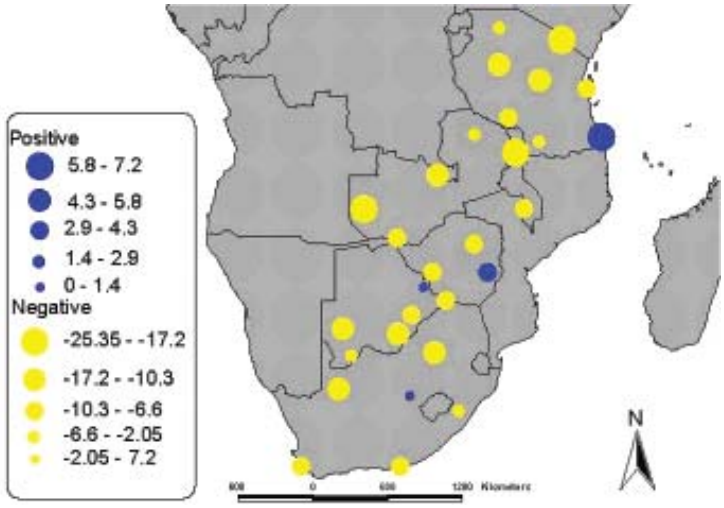


Figure 1

50-year change in the number of days where daily minimum temperature dropped below the 10th percentile. Yellow indicates a decrease, and the pattern is remarkably spatially cohesive. These trends are from the early results of the ETCCDMI[4] workshop held in June, 2004, Cape Town.

one detect historical change on time scales of relevance? This requires separating change from natural variability, which in turn requires consideration of appropriate time scales. For example, the atmospheric composition and climate system dynamics 400 000 years ago may be of scientific interest, but is of little value to managing societal infrastructure and natural resources. Of concern here is the period since the industrial revolution.

Again, on basic physical principles, it is apparent that change[2] as a consequence of human activities will likely be an accelerating attribute. The human contribution to altering the climate system has been one of ever increasing magnitude and can be measured by a broad range of attributes, such as atmospheric CO_2 concentrations. Consequently, in addition to the fundamental questions of data quality as mentioned earlier, detection studies need to consider non-linear change, or at the least understand that linear techniques[3] are likely to underestimate the change. Undertaking detection is a complicated task; one good example is the range of activities of the ETCCDMI[4] which, using sophisticated techniques and careful data preparation, have assessed changes over a number of global regions. Figure 1 shows one example of the significant change in daily minimum temperatures across the sub-continent. In another more national example (Figure 2), it is clear that at sub-annual scales there have been strong changes over the last 50 years.

- Following detection is the question of attribution – can detected change be attributed to human activities? Beginning in the IPCC[5] Third Assessment Report[6], and subsequently replicated by a number of researchers, it has been convincingly demonstrated that the climate record of the 20th century cannot be explained without including the effect of human activities. Moreover it has been recognized that most of the increase in global temperature in the last 50 years is attributable to human activities. Regional attribution is still difficult due to the complex mix of the regional response to the global energy balance and other local forcings. However, this does not negate the clear detection of change at the regional scale that has been found in most regions of the world, and that the detected change is consistent with our understanding of the physics and dynamics of the climate system.

- Given the detection of change, and the attribution of human contributions (at least at the global scale), the subsequent very real questions raised are: a) can one prevent change, and b) what response is appropriate? To the former the answer is clear; we are 100% committed to a continuation and acceleration of climate change for at least the next 50-100 years. One may quibble over the magnitude of the change, but the commitment is clear – society is wedded to energy use from fossil fuels, population and energy demand are growing, and significantly, the residency times

[2] It is important to distinguish global change from global warming – the latter is not automatic for any given region.
[3] For example, a linear regression fit to a time series that has an exponential growth will under-estimate the rate of change.
[4] The Expert Team on Climate Change Detection, Monitoring and Indices – an international team of scientists facilitating detection studies. See http://www.clivar.org/organization/etccd.
[5] Intergovernmental Panel on Climate Change
[6] Available from http://www.ipcc.ch. See especially the summary for policy makers from Working Group 1.

in the atmosphere of the relevant gasses contributing to the change are of the order of decades. Furthermore, the climate system's response to greenhouse gas forcing is a delayed response, and change will thus continue even if the atmospheric chemistry were stabilized.

The second question of 'what response is appropriate?' brings us full circle in our discussion. The appropriate response is to be responsible. If climate change is real (and the basic physics says it is), recognizing the accelerating nature of such change, and acknowledging that societal structures are not often designed for change, we need to urgently assess the vulnerability of South Africa. This cannot be answered with simple generalizations, but requires care – with potentially dire consequences if ignored.

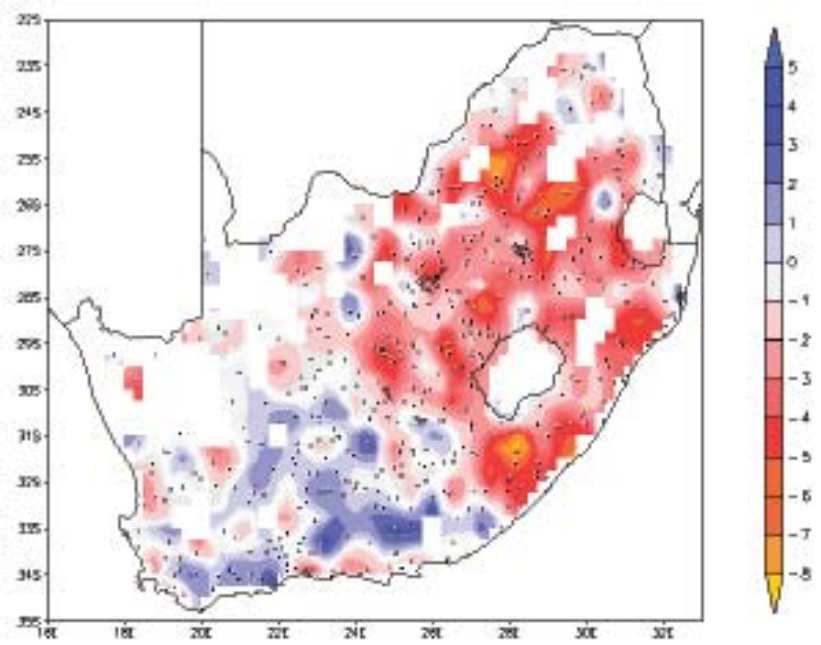


Figure 2

50-year change in the average number of April raindays (blue = increase), indicating that marked, spatially cohesive changes have and are occurring on sub-annual time frames. Trends are calculated with a robust regression technique for 482 stations (indicated by black dots) from the Lynch (2002) data set. The trend values on each station have been spatially interpolated with Cressman interpolation. All stations have been quality controlled and have fewer than 1% missing days.

REALISTIC ACTION

While there is much more that may be said on the previous topic, what may be suggested for the water sector? Limited by the constraints of this article, some suggestions may be proposed as being of value regardless of one's opinion on climate change:

- Assess the *characteristics of relevance* in the climate system for the water sector: which climate characteristics are important? For example, is it rainfall totals, interannual variability, seasonal timing, dry spell duration, extreme events, the histogram of daily rainfall magnitudes, return periods of rare events, etc?

- What *multiplicative attributes* may be important? For example: is temperature a complicating factor, is interannual variability important, does changing societal demand for a resource exacerbate potential climate change? Are there thresholds, which if exceeded by the climate system, will have an amplified consequence?

- Undertake scenario based *sensitivity assessments*. For those variables identified above, explore what the consequences to the water sector would be for a perturbation of, say, a 20% decrease in summer rain with a 10% increase in dry spell duration and a 2°C increase in minimum temperature.

- Examine the past record for evidence of changes in these attributes – *change detection*. This requires careful quality controlled data, assessing the spatial representivity of the data, and understanding the limitations and possible misleading characteristics of the chosen analysis method.

- Consider the *projections of future change*. There are a number of approaches to this, from the simple (e.g. Hewitson, 2003), to more sophisticated downscaling and probabilistic approaches. We must realize that these are accompanied by some measure of uncertainty, but nonetheless are probable developments of the climate system based on the best understanding of the climate system physics and dynamics.

- Consider *adaptation possibilities*. Are there strategies that can be adopted that would minimize the impact of climate change?

Are there "no-regrets" policies that could be implemented that are beneficial regardless of the climate change?

- *Keep up to date* with developments, explore the literature, listen to both sides of the debate, and understand the strengths and limitations of the science. Many readily accessible publications facilitate this[7].

In conclusion, what may be said with confidence? Humans are affecting the global climate system, regional changes can be detected and are manifest on widely different scales of time and space, and these changes are consistent with the physics of greenhouse gas forcing. Climate change will continue, and very probably accelerate. Society is structured for a given climate and all change places stress on these structures.

As noted by the recent report "Poverty and Climate Change" (African Development Bank, et al., 2003), prepared by 10 development and environmental agencies; "climate change poses a serious risk to poverty reduction and threatens to undo decades of development efforts." This is an issue that is possibly the single largest long-term threat to development in Africa. There is much more to be said on the subject, convincing evidence to be presented, and issues to be explored that are not covered here. This article seeks to raise awareness of the reality of climate change, and that there is very real cause for concern.

REFERENCES

African Development Bank; Asian Development Bank; Department for International Development, United Kingdom; Directorate-General for Development, European Commission; Federal Ministry for Economic Cooperation and Development, Germany; Ministry of Foreign Affairs Development Cooperation, The Netherlands; Organization for Economic Cooperation and Development, United Nations Development Programme; United Nations Environment Programme; and The World Bank (2003) *Poverty and Climate Change, Reducing the Vulnerability of the Poor through Adaptation*. The World Bank, Washington, DC, USA.

Hewitson BC and Crane RG (2004) Gridded area average precipitation via conditional interpolation. In press in *Journal of Climate*.

Hewitson BC (2003) Developing perturbations for Climate Change Impact Assessments. *EOS* **84** (35) 337-348.

Lynch SD (2002) The development of an improved gridded database of annual, monthly, and daily rainfall. WRC Project K5/1156/0/1, Water Research Commission, Pretoria.

[7] For example, Tiempo (http://www.cru.uea.ac.uk/tiempo/) offers up-to-date and accessible articles on new developments and understanding about climate change and the developing nations.

Is Climate Change Really of no Concern?

A Call for a More Holistic Vision

by Professor Rob Hart*, Programme Director – Ecology and Conservation Biology, School of Botany and Zoology, University of KwaZulu-Natal; and Peter Ashton, Principal Scientist & Divisional Fellow, CSIR-Environmentek, Pretoria**

Will Alexander's View point article in the January/February 2004 *Water Wheel* suggests that climate change is of no environmental concern. Flying in the face of contemporary opinion it is a brave call. But we believe it is erroneous. It simplifies, even trivializes, an issue that affects humanity at large, and demands debate. We are in no position to challenge the validity of his analysis showing that rainfall has increased roughly 10% in the past 70 years. But we vigorously contest his subsequent conclusion that climate change therefore poses no environmental threat. Accepting that rainfall is indeed higher, the punch line of Will's article – that higher temperature (the necessary driver or corollary of this higher rainfall) poses no threat to the environment is at variance with an awesome amount of scientifically accredited evidence. His conclusion (unsubstantiated inference, in fact) is fundamentally flawed in two respects. First, it totally disregards the indubitable effects that temperature plays on the environment as a whole, and on the ecology and physiology of its constituent biota. Second, 'water quantity' is equated to the 'environment' as a whole. We elaborate some our concerns in these regards below.

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TEMPERATURE

Temperature plays a ubiquitous role in ecology. It is a prime determinant of habitat suitability for living organisms, and serves as the singularly most important abiotic dimension of ecological niche for virtually all ectothermal biota (i.e. virtually all living organisms – biodiversity at large). While their warm-bloodedness may 'spare' birds and mammals from such effects, their food supplies are generally not spared. Beyond its extraordinarily far-reaching consequences to aquatic ecosystems and, in turn, to human life, temperature also has an enormous array of consequences outside the aquatic environment that ultimately will impact also on the aquatic environment. Changes in land use patterns, cropping patterns, crop types, water use patterns, fertilizer application patterns, etc. will all, gradually or abruptly, bring about changes in water quantity and/or water quality. Temperature's effects are direct and/or indirect, subtle and obvious. Whole volumes are dedicated to the comprehensive elaboration of the impacts of environmental warming at both global and regional levels, and document its multiplicity of effects. Agricultural crops, agricultural pests and human disease vectors may be foremost in the public mind. Maize, wheat, sugar and cotton lands will shift and change; our famous southern Cape vineyards are likely to shrink; fungal rusts, weevils and worms, along with parasite-vectoring mosquitoes are likely to expand or otherwise change their distribution ranges – either in space and/or time. But these are only the visible tips of the proverbial iceberg. Temperature affects the density of water, the solubility of solids and gases, and the rates of biochemical processes, all factors that are major determinants particularly of aquatic ecosystem function and structure.

A rise in water temperature of one or two degrees Celsius (°C) may seem unimportant in ensuring a reliable and sufficient supply of wholesome water. But this seemingly small rise has profound implications for all manner of biological and ecological processes. There is a veritable arsenal of information documenting these effects.

As a prominent water resource engineer, Will Alexander cannot be unaware of thermal stratification events in standing waters, and the eutrophication threats to our national water resource base. Yet his conclusion disregards any consideration of the impact of warming on these crucial issues. That increases in air temperature will unquestionably impact on the heat content of surface waters, intensify stratification, and thereby *inter alia* increase the competitive ability of blue-green 'algae' to endure the now stronger and longer summer stagnation period. That longer (and quite probably denser) summer blooms of the least favourable autotrophs, those nasty blue-green 'algae' that are in reality photosynthetic prokaryote bacteria, and not eukaryote protists – are an almost inevitable outcome, along with a host of indirect effects cascading through the lacustrine ecosystem. Prominent examples include reduced zooplankton grazing, depressed rates of secondary productivity, greater sediment sequestration of phosphorus, increased internal phosphorus loading, and yet greater competitive advantage for nitrogen fixing 'nasty' cyanophytes in particular. And so on.

MICROBES

For credible practical reasons, ecologists have tended to focus on macroscopic organisms, whereas the "real" ecosystem web-masters, particularly in aquatic systems, are microbes. Temperature impacts on the rates at which almost every bacterial (and other biochemical) transformation process proceeds. With Q_{10} values mostly between 3 and 7 over the temperature range of 15-35°C, bacteria will at least triple their reaction rate for every 10°C rise in temperature. A mere 2°C rise in temperature translates into an increase in biochemical transformation rate of somewhere between 30 and 70%. Meanwhile, the rate-temperature functions are such that rate acceleration increases disproportionately with rising temperature. So, with climate warming, decomposition processes, in particular, will literally "take off". (That we may not have already documented such effects in South Africa is most probably because of the very limited funding levels allocated to date to basic, and long-term ecological research in the country). Similar effects would be seen in terms of nitrification and denitrification, sulphur reduction, carbon dioxide and methane production. Higher water temperatures favour cyanobacteria and bacteria over diatoms, green, brown and red algae. The consequences for eutrophication processes and symptoms in general would be profound.

SOLIDS AND GASES

Increased water temperatures would have significant implications for the solubility of solids and gases, and probably result in altered gas-water equilibria of certain key gases like oxygen, nitrogen, carbon dioxide, methane and hydrogen sulphide. Life cycles of aquatic invertebrates (and vertebrates) are closely linked to the timing, extent and duration of water temperature cycles. A one to two degree rise in water temperature would effectively raise the 'thermal latitudinal position' of numerous habitats, drawing them closer to the "thermal equator". Organisms that require colder

temperatures would have some aspect(s) of their life cycle threatened or even curtailed. Emergence patterns of 'pest species' would alter, extending the duration of the 'pestilential potential' of Blackfly for example, and possibly also reducing their vulnerability to aquatic predators. Yet other species would hatch in greater numbers than usual and exhaust their normal food supplies earlier than anticipated.

AQUATIC PARASITES

At present, several areas of southern Africa effectively lack important aquatic parasites such as Bilharzia in man and Fascioliasis in stock. (And malaria can be added as a water-linked disease). Their absence is attributable to various factors that are directly or indirectly linked to temperature; climatic bio-regions that are simply too cold to sustain effective vector and/or parasite populations throughout the year; water that contains insufficient dissolved calcium or lies in a pH range that is unsuitable for shell formation in the snails, or inhibits the growth of suitable "snail fodder" plants. A rise in water temperature could (and likely would) change the spatial (and tem-poral) patterns of snail (and parasite) distribution and endemism.

Oxygen saturation (in milligrammes per litre) declines at higher water temperatures. Oxygen uptake and use by biochemical processes (e.g. nitrification and respiration) would increase the rate at which dissolved oxygen is consumed. Depending on the gas-water equilibria, and the (relatively slow) rate at which oxygen can diffuse into water, increased incidences and durations of 'oxygen deficits' can be expected to occur. The problems would be compounded where the water bodies concerned are also used as repositories for organic wastes such as treated domestic effluent.

WATER QUANTITY

Second: water quantity is neither synonymous with, nor equivalent to, "the environment" (aquatic or otherwise). By conducting a statistical analysis of rainfall and resulting river flows (water quantity), and then 'proving' that no significant change has occurred over time (or that any slight change that has occurred is, or may be, "beneficial" in terms of the same or more water being available), is to provide only part (a very small part) of the argument. Changes in the patterns of rainfall events (e.g. the same rainfall volume distributed between five rather than twenty storm events) generate quite dramatic differences in the rainfall intensity and the shape (height and duration) of rain-all-runoff hydrographs. Quite apart from the potential impacts on streamside-dwelling human populations, this would also have some 'interesting' effects on groundwater recharge patterns, as well as on evaporation/evapotranspiration patterns and the subsequent (surface water) stream flows. Simple annual or seasonal averages of total rainfall and total stream flow do not (and will not) reflect the "real picture" (or the importance of 'water quantity') from an aquatic ecology perspective, though they might be sufficient for individuals tasked with procuring adequate quantities of water for various off-channel uses. For example, whilst the quantity of water needed may be available, its *quality* would likely be questionable at best.

To conclude that global warming poses no threat to the environment is to disregard the overwhelming weight of scientifically accredited evidence that can only be interpreted to the contrary.

We hope that we have persuaded *Water Wheel* readers to accept that even small increases in temperature have manifold repercussions on ecosystems and the wider environment in general. Indeed, so seriously is this threat viewed globally that luminary ecologists are now spearheading a return to nuclear energy to prevent further greenhouse gas emissions. As horrifying as they were, former nuclear disasters like Chernobyl and Three Mile Island were at least spatially localized, and experiential knowledge now exists to avoid (but not preclude) future recurrences. Greenhouse gas emissions, on the other hand, exert truly global impacts. The failure of certain major nations (like the USA and Japan) to sign the Kyoto Protocol is now being viewed almost complacently by the rising "Green" nuclear champions, as it would have been too little, too late. To conclude that global warming poses no threat to the environment is to disregard the overwhelming weight of scientifically accredited evidence that can only be interpreted to the contrary. Scientific perspectives and understanding today require a much broader, more holistic, and commensurately realistic view of the World, fortunately embraced by many contemporary hydrologists and water engineers. Will Alexander's rainfall analysis provides important evidence consistent with regional climate warming, and we urge him to use his detailed information to join, rather than contest, this global challenge.

SOUTHERN AFRICA & AFRICA 2004

WATER & SANITATION
SEPTEMBER 23 – 25

The WASH (Water, Sanitation and Health) Africa Fair will be held in Harare, Zimbabwe.
Enquiries: Institute of Water and Sanitation Development, 7 Maasdorp Avenue, Alexandra Park or Box MP 422, Mt Pleasant, Harare, Zimbabwe.
Tel: +263-4-735017/26/35.
Fax: +263-4-738120.
E-mail: warsh@iwsd.co.zw
Web: http://www.iwsd.co.zw

ENVIRONMENTAL MANAGEMENT
OCTOBER 5 – 7

A short course on environmental management will be held at the Post-Graduate Centre of the University of Pretoria.
Enquiries: Ms Anneke Kruger.
Tel: (012) 420 5026. Fax: (012) 362 5285.
E-mail: anneke.ce@up.ac.za

GROUNDWATER
OCTOBER 11 – 14

A short course on model sensitivity analysis, data assessment, calibration and uncertainty evaluation will be presented at the University of the Western Cape.
Enquiries: Dr Shafick Adams, Groundwater Group, Department of Earth Sciences, University of the Western Cape.
Tel: 021-959 2637. Fax: 021-959 2438.
E-mail: groundwater@uwc.ac.za

WASTECON 2004
OCTOBER 11 – 15

The WasteCon 2004 Congress with the theme: Integrated Waste Management, will take place at the Sun City resort in North West Province.
Enquiries: Stan Jewaskiewitz, PO Box 79, Allen's Nek 1737, Gauteng.
Tel: 011 675 3462. Fax: 011 675 3465.
E-mail: iwmsa@iafrica.com
Website: www.iwmsa.co.za

FOG
OCTOBER 11 – 15

The 3rd international conference on fog, fog collection and dew will be held at the Commodore Hotel, Victoria and Alfred Waterfront, in Cape Town.
Enquiries: Prof Hannes Rautenbach, University of Pretoria. Tel: 012 420 4111.
E-mail: hannes.rautenbach@up.ac.za

LARGE DAMS
OCTOBER 13 – 14

The 4th South African multi-stakeholder initiative on the World Commission on Dams (WCD) report will be held at the Rand Water Conference Centre in Johannesburg. The purpose of this forum is to discuss the draft report, make proposals for its finalisation and recommend its publication.
Enquiries: Cathy Sepeng, c/o Development Bank of Southern Africa, PO Box 1234, Halfway House 1685.
Tel: 011 313 3615. Fax: 011 313 3086.
E-mail: catherines@dbsa.org

SOLIDS-LIQUIDS
NOVEMBER 8 – 9

The 2nd international symposium on Solid-Liquid Separation (SLS '04), organised by Minerals Engineering International, will be held at the Mount Nelson Hotel in Cape Town.
Enquiries: Dr Barry Wills.
E-mail: bwills@min-eng.com

GROUNDWATER
NOVEMBER 22 – 24

A short course on fractured rock aquifer assessment will be held at the University of the Western Cape.
Enquiries: Dr Shafick Adams, Groundwater Group, Department of Earth Sciences, University of the Western Cape.
Tel: 021-959 2637. Fax: 021-959 2438.
E-mail: groundwater@uwc.ac.za

2005

GROUND WATER
MARCH 7 – 9

The 2005 biennial ground water conference – "Ground Water: Stretching your Vision" will be held at the CSIR Conference Centre in Pretoria. Call for Papers. (See p 20)
Enquiries: The Secretariat (Conference Planners), PO Box 82, Irene 0062.
Tel: 012 667 3681. Fax: 012 667 3680.
E-mail: confplan@iafrica.com
Web: www.gwd.org.za

WASTEWATER TREATMENT
AUGUSTUS 9 – 12

A conference on the "Sustainable management of residues emanating from water and wastewater treatment" will be held at the Sandton Convention Centre in Johannesburg.
Enquiries: Dr Heidi Snyman at
e-mail: hsnyman@golder.co.za

OVERSEAS 2004

BIOTECHNOLOGY
SEPTEMBER 6 – 8

The first international meeting on environmental biotechnology and engineering will be held in Mexico City in Mexico. Delegates will be provided with up-to-date information on advances the remediation of soils and aquifers, microbial ecology and the application of molecular biology to solve environmental problems.
Enquiries: Dr Hector M Poggi-Varaldo, CINVESTAV-IPN, Department of Biotechnology and Bioengineering, PO Box 14-740, Mexico DF 07000 Mexico.
Tel: 52(55) 5061 3800 (ext 4324 or 4336).
Fax: 52(55) 5061-7002

ECOHYDRAULICS
SEPTEMBER 12 – 17

The 5th international symposium on ecohydraulics will be held in Madrid, Spain. Theme -"Aquatic habitats: analysis and restoration".
Enquiries: The Secretariat – Londres, 17 – 28028 Madrid, Spain.
Tel: +3491 361 2600. Fax: +3491 355 9208.
E-mail: ecohydraulics@tilesa.es
Web: http://www.tilesa.es/ecohydraulics

WATER MANAGEMENT
SEPTEMBER 13 – 15

The Chartered Institution of Water and Environmental Management (CIWEM) will hold their Second National Conference at Bretton Hall, Wakefield, United Kingdom.
Main themes: Wastewater management, Odour – regulation, monitoring and control, Infrastructure asset management, Water resources and water quality, Flooding and drainage, Risk assessement and risk management, Industrial wastewater treatment.
Enquiries: AE Technology Transfer, Richmond House, 16 Blenheim Terrace, Leeds LS2 9HN.
Tel: 0113 2424200.
Fax: 0113 2442166.
E-mail: ciwem@aquaenviro.co.uk

WORLD WATER
SEPTEMBER 19 – 24

The International Water Association (IWA) will hold its 4th world water congress in Marrakech, Morocco.
Enquiries: AMEPA –
Tel: +212 3763 2093. Fax: +212 3763 7682.
E-mail: sehi@elan.net.ma
Web: http://www.iwahq.org.uk/

DAM SAFETY
SEPTEMBER 26 – 29

The 21st annual dam safety conference and exhibition will be held in Phoenix, Arizona, USA.
Enquiries: Susan Sorrell. Tel: 859 257 5140.
E-mail: info@damsafety.org
Web: http://www.damsafety.org

WETLANDS
SEPTEMBER 27 – 30

The 9th international conference on Wetland Systems for Pollution Control will be held in Avignon, France.
Enquiries: The Secretariat. CEMAGREF – 3, bis quai Chauveau, 69336 Lyon Cedex 09, France. Fax: +33 4 7847 7875.
E-mail: wetlands@lyon.cemagref.fr

HYDRAULICS
DECEMBER 15 – 18

The 4th international symposium on environmental hydraulics and the 14th congress of the Asian-Pacific division of the international association of hydraulic engineering and research will be held simultaneously in Hong Kong, China.
Enquiries: Conference Secretariat: Dept of Civil Engineering, the University of Hong Kong, Pokfulam Road, Hong Kong, China.
Tel: (852) 2859 2667. Fax: (852) 2559 5337.
E-mail: iseh4@hkucc.hku.hk

2005

URBAN WATER
MARCH 14 – 18

A conference on the efficient use and management of urban water supply will be held in Santiago, Chille.
Enquiries: Francisco Cubillo – Scientific Committee Chairman.
E-mail: scientific@efficient2005.com
Web: www.efficient2005.com or in South Africa – Mr Johannes Buckle (Rand Water).
Tel: 011 682 0814.

WATER RESOURCES
APRIL 11 – 13

The third international conference on water resources management will be held in Algarve, Portugal. The conference will present the most recent technological and scientific developments associated with the management of surface and sub-surface water.
Enquiries: Conference Secretariat: Amy D'Arcy-Burt. Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA.
Tel: 44 (0) 238 029 3223.
Fax: 44 (0) 238 029 2853.
E-mail: adarcy-burt@wessex.ac.uk

SALINITY
APRIL 25 – 28

A meeting of the International Salinity Forum will take place in Riverside, California, USA.
Enquiries: Dennis Neffendorf, 501 West Felix Street, PO Box 6567, Fort Worth, TX 76115.
Tel: +1 8175093225. Fax: +1 817 509 3271.
E-mail: dennis.neffendorf@ftw.nrcs.usda.gov
Web: http://www.waterresources.ucr.edu

WASTEWATER TREATMENT
MAY 29 – JUNE 2

The 2nd IWA conference on instrumentation, control and automation for water and wastewater treatment will be held in Busan, South Korea.
Enquiries: ICA 2005 Secretariat. Ms Elle Kwak. 1213 Ocean Tower, 760-3 Woo1-dong, Haeundae-gu, Busan, South Korea 612-726. Fax: +82(0)51 7405160.
E-mail: ica2005@pusan.ac.kr

ACTIVATED SLUDGE
JUNE/JULY 2005

A conference on microorganisms in activated sludge and biofilm processes will take place at the Gold Coast, Queensland, Australia.
Enquiries: Linda Blackall, Department of Microbiology, The University of Queensland, St Lucia, 4072, Queensland, Australia.
Tel: +61 7 336 54645. Fax: +61 7 33654620.
E-mail: blackall@biosci.uq.edu.au

WATER ECONOMICS
JULY 8 – 10

An international conference on Water Economics, Statistics, Benchmarking and Finance will be held in Rethymno, Crete, Greece.
Enquiries: Konstantinos P Tsagarikis. Department of Economics, University of Crete, Rethymno 74100, Greece.
Tel: +30 28310 77433/ +306 945 706431.
Fax: +30 28310 77406.
E-mail: iwa@econ.soc.uoc.gr
Web: www.soc.uoc.gr/iwa

WASTEWATER TREATMENT
JULY 17 – 20

The 4th activated sludge population dynamics specialist conference – Microbial population dynamics in biological wastewater treatment will be held at the Hotel Watermark, Surfers Paradise, Queensland, Australia.
Enquiries: Professor Linda Blackall, Advanced Wastewater Management Centre, The University of Queensland, St Lucia 4072, Australia.
E-mail: aspd4@uq.edu.au
Web: http://www.awmc.uq.edu.au/aspd4

URBAN DRAINAGE
AUGUST 21 – 26

The 10th international conference on urban drainage will take place in Copenhagen, Denmark.
Enquiries: Peter Steen Mikkelsen.
E-mail: 10icud@er.dtu.dk
Web: http://10icud.er.dtu.dk

ANAEROBIC DIGESTION
AUGUST 31 – SEPTEMBER 2

The 4th international symposium on anaerobic digestion of solid waste will take place in Copenhagen, Denmark.
Enquiries: Conference Secretariat, BioCentrum-DTU, Building 227, Technical University of Denmark, DK-2800 Lyngby, Denmark.
Tel: +45 45256175. Fax: +45 45883276.
E-mail: info@adsw2005copenhagen.dk

WASTEWATER TREATMENT
SEPTEMBER 18 – 21

A conference on nutrient management in wastewater treatment processes and recovery will be held in Krakow, Poland. International experts will deliver state-of-the-art lectures followed by a set of paper and poster presentations selected from the call for papers.
Enquiries: Adam Kalucki, Lemtech Consulting, Szpitalna 40, 31-024 Krakow, Poland.
Tel: +48 124294031. Fax: +49 12 4294065.
E-mail: adamk@lemtech.krakow.pl

OFF-FLAVOURS
OCTOBER 2 – 6

The 7th symposium on off-flavours in the aquatic environment will be held in Ontario, Canada.
Enquiries: Christina Collard, c/o St Lawrence River Institute of Environmental Sciences, 2 Belmont Street, Cornwall, Ontario, Canada K6H 4Z1.
Tel: 613 936 6620 ext 222. Fax: 613 936 1803.
E-mail: info@riverinstitute.com
Web: http://www.riverinstitute.com/conferences/off-flavours

Institute for Water and Environmental Engineering, Department of Civil Engineering

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6 to 10 September 2004

List of invited speakers, institutions and topics

SPEAKER	INSTITUTION	TOPIC
	Monday 6 September 2004 (course commences at 8:00)	
Mr Eddie Bosman	University of Stellenbosch	Welcome and Introduction
Dr Henriëtte van Niekerk	Maritime Education Research and Information Technology	Future SA Port Expansion Needs Based on Economical Evaluation of SA Ports
Mr Marius Rossouw	CSIR (ENVIRONMENTEK)	Southern African Meteorology and Wave Climate
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Introduction to Port Planning
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Master Planning Process
	Tuesday 7 September 2004	
Mr Stephen Luger	CSIR (ENVIRONMENTEK)	Numerical modelling of waves, currents, sediment transport and water quality
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Planning of Channels and Basins
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Planning of Terminals
Dr Koos Schoonees	CSIR (ENVIRONMENTEK)	Southern African Coastal Sediment Regime
	Wednesday 8 September 2004	
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Container terminals
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Queuing Theory and Simulations
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Port Planning Exercise
Prof Han Ligteringen	Technical University (TU) of Delft, The Netherlands	Port Planning Exercise
	Thursday 9 September 2004	
Dr Allan Wijnberg	Prestedge Retief Dresner Wijnberg	Port Breakwater Layout and Access Channel Design with reference to Coega Port [Wave penetration and ship tracking]
Dr John Zietsman	Zietsman Lloyd & Hemsted Inc	Numerical model Analysis of Vertical Ship Movement in Access Channel with reference to Coega Port
Dr John Zietsman	Zietsman Lloyd & Hemsted Inc	Case Study of Numerical model Analysis as aid to Design of Single Buoy Mooring System
Dr André van Tonder	ENTECH	Wave Recording in field, Physical Modelling and Model Wave Generation
Mr Hans Moes	CSIR (ENVIRONMENTEK)	Physical Modelling of Motions of Ships at Mooring with reference to Coega Port
	Friday 10 September 2004	
Mr Anton Holtzhausen	Prestedge Retief Dresner Wijnberg	Rubble Mound and Vertical Breakwater Design with reference to Coega Port
Mr Martin Beeby & Mr Daryll Bevis	National Port Authority (NPA)	Maintenance Dredging of SA Ports by Conventional Dredging
Mr Gordon Prestedge/ Mr Andy McClarty	Prestedge Retief Dresner Wijnberg	Fixed Sand bypassing System with reference to Coega Port
Mr Henry de Wet	(Protekon)	Quay Wall Design [Cases of Piled and Gravity Types e.g. Richards Bay and Coega]
Mr Dave Phelp	CSIR (ENVIRONMENTEK)	Monitoring of Stability of Rubble Mound Breakwaters - Technique and Case Studies

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