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First Students Graduate as Water MBAs

The first two graduates of the MBA in Water Management in Southern Africa will have their degrees conferred in December 2003.

The School of Business at the University of Natal, Pietermaritzburg, embarked on this unique-to-Africa, Specialist MBA in Water Management degree in 2001. It was recognised that the management of water as a strategic resource in Africa requires the combining and integrating of economic, social, engineering and environmental considerations. Thus this carefully planned MBA programme equips its graduates to meet the challenge of managing Africa's water resources and infrastructure on a sustainable basis. With the expected negative consequences of global warming, general population growth and massive population movement to urban areas, there is also a growing need for better water resources management on an integrated basis. Water managers today must be both knowledgeable about, and able to act, with the authority that comes from knowledge and experience. In many parts of Africa there is a dearth of well-trained managers working in the water sector. There are often specialist engineers, hydrologists, water scientists and technologists within the sector who have had no, or minimal, management training and are ill-equipped to cope with the increasing demands now being made on managers in this sector. Thus there is a need to blend water-engineering skills with management competence.

MARKETPLACE

The School of Business saw this specialist MBA degree as meeting a need in the marketplace and as part of the University's strategic initiative in water which draws on the University's capacity in water related disciplines. The MBA in water management is crucial in supporting the region's long term need to ensure the appropriate use and sustainability of its water resources which is critical to both industry and individual consumers.

Patrick Gombert and Reg Bailey, MBA graduates, being congratulated by Prof Debbie Vigar

SA is not unlike the international scenario where there is intense focus on conserving its water resources, and on ensuring that all the unserved communities in respect of basic water and sanitation services are served within targets generally defined in the Millennium Development Goals as adopted by the United Nations in September 2000. SA's goals in respect of alleviating the basic water services backlogs are more ambitious than the UN's target of 2015, and that presents enormous challenges to the water sector. Durban and its surrounding areas contribute appreciably to SA's Gross Domestic Product, with water resources being critical to the region's large textile and paper industry.

GRADUATES

The MBA in Water management consists of a general management Post Graduate Diploma in Management and then specialised modules in Water Management issues. The two graduates, Messrs Reg Bailey of Ethekweni Municipality, and Patrick Gombert of Umgeni Water, will receive their MBA degrees at the graduation ceremony on 17 December 2003. Both have achieved distinctions in their dissertations as well as several MBA modules.

The dissertation topics are practical in nature and respectively were on designing a welfare maximising water tariff and the other on addressing the backlogs in basic services in KZN. The first dissertation proposes a methodology to develop tariff structures that will ensure that municipal water services are affordable for low income households while simultaneously addressing the financial, political and conservation constraints of the water environment. It has been identified in the latter dissertation that to alleviate the basic services backlogs in KZN will cost in the region of R6 to R7 billion most likely over the next 10 years, provided constraints to delivery and capacity at local level are solved. Should funding at this level be forthcoming, it should bode well for the regions growth and sustainability.

Prof D. Vigar, Director of MBA Programmes on the Pietermaritzburg campus, is proud of the student's achievements, and is sure the expertise and knowledge gained through this programme will benefit them, their organisations and the region immensely.

SANCID Honours Founding Chairman

A certificate of appreciation has been awarded to Mr DS (David) van der Merwe at the 10th anniversary celebration of the South African National Committee on Irrigation and Drainage (SANCID) in Pretoria. Mr Van der Merwe, a former deputy executive director of the Water Research Commission, was the founding chairman of SANCID. Sharing in the festivities at the anniversary lunch were from left: Dr Sizwe Mkhize (who recently joined the Dept of Agriculture), Mr Walter Ntuli, president of the KwaZulu-Natal Agricultural Union (KWANALU), guest speaker, Dr Gerhard Backeberg, Water Research Commission, and current chairman of SANCID, Mr David van der Merwe, Mr Felix Reinders, Institute for Agricultural Engineering, and Dr Hilmy Sally from the International Water Management Institute (IWMI), treasurer of SANCID.

South African National Committee for the International Association of Hydrological Sciences (SANCIAHS)

The National Committee represents the interests of hydrological and water resource scientists with respect to the international community and specifically IAHS. The Committee Members represent South Africa on the International Commissions *(Surface Water, Groundwater, Continental Erosion, Water Quality, Water Resource Systems, Remote Sensing, Atmosphere-Soil-Vegetation Relations and Tracers)*.

Nominations are invited for the National Committee to serve for the next four years.

The present members of the Committee are:
Prof. Denis Hughes, IWR, Rhodes University (Chairman and National Representative)
Prof Roland Schulze, BEEH, University of Natal (Treasurer)
Dr Pete Ashton, CSIR
Mr Jean Boroto, Global Water Partnership, SA
Prof Gerrit Basson, Dept. of Civil Engineering, University of Stellenbosch
Mr Renias Dube, WRC
Prof Andre Görgens, Ninham Shand and Stellenbosch University
Mr Phil Hobbs
Dr Graham Jewitt, BEEH, University of Natal (Treasurer)
Prof Geoff Pegram, Dept. of Civil Engineering, University of Natal

Nominations should be sent to Denis Hughes (denis@iwr.ru.ac.za, Institute for Water Research, Rhodes University, PO Box 94, Grahamstown, 6140).

Nominations can be made by any individual member of IAHS (see the website http://iahs.info for details of how to become a member – it is free) and the nominees should also be individual members.

Nominations can be submitted by E-mail and should be accompanied by a statement to indicate that the nominee is willing to stand.

Nominations will close at the end of January 2004, after which an E-mail election will be held should there be sufficient nominees. Further information will be forwarded to members and published in *Water Wheel* at the end of the nomination process.

The new Committee should reflect the variety of hydrological disciplines that are relevant to South Africa and should be as representative as possible in terms of the regions of South Africa, the sectors of the hydrological community (universities, government, private consulting, etc.), youth and experience, as well as race and gender.

A pile of powder calcium carbonate (limestone), a waste product of the paper industry, which is used to neutralise acid water after it has been slurried.

Creating Cleaner Water, For Less

Developing a low-cost method for managing acid mine drainage remains an elusive goal. But significant improvements have already seen two coal mines in Witbank cut their chemical treatment costs in half.

Traditionally, mining has been the primary source of non-agricultural employment in rural southern and South Africa, and it still lies at the heart of the country's economy. But while the revenue it generates is vast, the resources it uses are not. Water usage, pollution and treatment are a growing concern – and cost – for the local mining industry.

The total annual consumption of water in South Africa is estimated to be in excess of 16 billion cubic metres. Although mines use a relatively small amount (about 4%), they are prolific polluters.

Of all the types of pollution, acid mine drainage (AMD) is the mining industry's greatest and most expensive environmental problem. It is estimated that in Gauteng and Mpumalanga alone, over 300 megalitres of water need to be treated every day. At an average cost of around R5 per cubic metre, this translates into a R1,5 million daily bite out of mining budgets.

"We have now been able to combine two traditional treatment methods into one process, using a product that is less than half the price of normal lime."

Such high costs put the squeeze on marginal mines – they can't afford to treat their wastewater, but stringent water legislation insists that they do.

The development of a low-cost method for the effective management of AMD remains an elusive goal, but steady and significant improvements are being made. The Navigation and Kromdraai coal mines in Witbank have already felt the benefits. Since implementing a new treatment technology developed by the CSIR, the mines have cut their chemical treatment costs from around R8 million per year, to under R4 million.

Dr Jannie Maree, project leader at the CSIR's Sulphate and Neutralisation Group within the Division of

ACID MINE DRAINAGE (AMD)

AMD is the main type of water pollution resulting from mining activities, particularly from gold and coal mines. It forms when previously undisturbed rock is shattered during excavation, exposing the pyrite in ore and other minerals, to accelerated weathering.

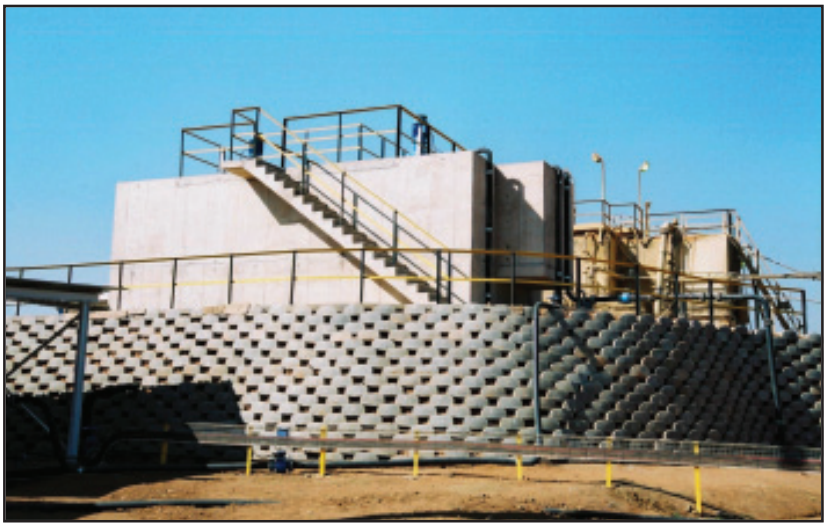
When exposed to air and water, pyrites oxidise to produce sulphuric acid, the main constituent of AMD. This acid then also causes other metals, such as iron, aluminium and manganese, to dissolve into the water.

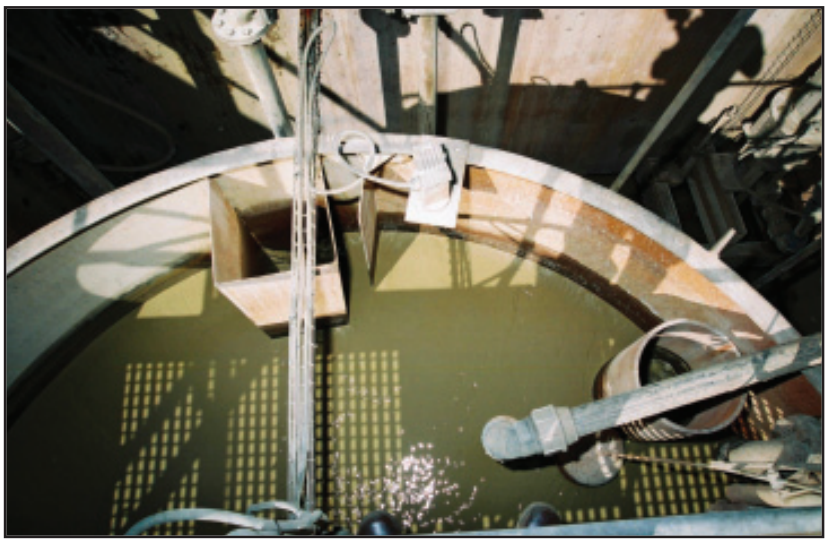
In "water-rich" countries the low pH and metals associated with AMD are the main causes of concern, the reason being that these countries mostly have surplus capacity to dilute the accompanying salinity (sulphur). In "water-poor" South Africa, with our limited dilution capacity, the high salinity associated with AMD is an additional problem.

While CSIR's new technology has relevance for AMD treatment anywhere in the world, its sulphur removal capacity and cost-effectiveness make it particularly appropriate for local conditions.

WATER USE IN SA

Agriculture	**52%**
Nature conservation	**20%**
Domestic/urban use	**12%**
Industry	**8%**
Mining	**4%**
Power generation	**4%**





The slurry tank (top), toe seep neutralisation plant (middle) and toe seep clarifier (bottom) in Witbank, where the Kromdraai and Navigation coal mines have implemented CSIR's new limestone water treatment process.

Water, Environment and Forestry Technology, explains that in the past, sulphate-rich effluent was either treated chemically, with lime, or biologically.

"Our research has shown that it is possible to neutralise acid and remove sulphate from water using limestone – an easily available waste product from the paper-making industry," he says. "We have now been able to combine two traditional treatment methods into one process, using a product that is less than half the price of normal lime."

Maree explains that the integration of limestone neutralisation and biological sulphate removal is a logical combination. "Products generated as a result of one step can be used as raw materials for the other. For example, the carbon dioxide gas produced during limestone neutralisation is needed for sulphide stripping in the biological process. Similarly, iron in the untreated acid water can be used to produce sulphur from the sulphide that is removed in the biological process. Furthermore, the calcium carbonate (the chemical term for limestone) that is produced as a by-product in the biological process, can be used to supplement the limestone that is used for neutralisation."

HOW IT WORKS

Because lime is obtained by heating raw limestone to 1 000°C over burning coal – a process that releases massive amounts of carbon dioxide into the atmosphere – limestone is an eco-friendly alternative in the neutralisation and sulphate removal process. But limestone neutralisation does not reduce sulphate levels enough to safely release effluent water into the environment. This is where the biological process comes in.

Example:

- Water containing 10 g of sulphate per litre is neutralised with limestone.
- The limestone results in partial sulphate removal, leaving the water with just 2 300 mg of sulphate per litre.
- When this is followed by lime treatment, the sulphate content will be reduced to 1 200 mg/ℓ.
- The biological treatment will then reduce the sulphate content to less than 200 mg/ℓ.

Now mines can focus on the production plants, rather than the systems that support them, and plough the savings they make into other areas of improvement.

Most of the sulphate is therefore removed using limestone, at a cost of 10 cents per kilogram of sulphate removed. The lime treatment costs 28 cents per kilogram removed, and the biological treatment, with ethanol as the energy source, costs R1,10 per kilogram removed. **Total cost: R1,48**.

The plants built at Navigation and Kromdraai mines have proved that firstly, acid water with a pH of 2,9 and 130 mg/ℓ iron (II) can be completely neutralised; secondly, that limestone can be dosed at a constant concentration; and thirdly, that the combined system requires little maintenance.

"The beauty of this technology lies in its simplicity," says Maree.

"We have managed to bring together a simple, yet robust design, operating very effectively. And this is what mines need. They no longer have to worry about a chemical dosing system that fails every now and then. They can focus on the production plant, rather than the auxiliary systems that support it, and plough the savings they make into other areas of improvement."

SPIN-OFF BENEFITS

An unexpected advantage of the new technology comes from the carbon dioxide that forms when limestone is used to neutralise acid water, and which the team is now promoting to the cooldrink industry. "In fact, our product is more attractive than the carbon dioxide made from coal gas, as it requires fewer purification stages," says Maree.

To date, the group's efforts have been rewarded with four patents, and one pending:

- Integrated iron oxidation and limestone neutralisation (1997).
- Limestone handling and dosing (2000).
- Integrated chemical/biological process (2000).
- Single stage reactor system for biological sulphate removal (2000).
- Underground mine water neutralisation (provisional).

Apart from creating an increased need for limestone and stimulating the sugar-cane industry (for the production of ethanol), the project has been directly responsible for creating hundreds of jobs at the water treatment plants that have been built at various mines. This includes a limestone neutralisation plant at the BCL copper and nickel mine in Botswana, where iron is also removed during the limestone neutralisation. The capital cost of development to date is estimated at over R20 million.

Dams in the Karoo are often little more than fast drying mud baths - the scarcity of water remains a major crisis for farmers

Tortoises, Midnight Thieves And Keeping Time Has Prince Albert's Irrigation Board On Its Toes

Two farmers eye-balled each other over the water furrow running alongside the main street of the tiny Karoo town of Prince Albert. This was the 1960s and water to irrigate their small-holdings was scarce. It hadn't rained for months and the constant trickle of "lei" water from a spring in the Swartberg Mountains was all they could rely on to feed their crops.

"You are stealing my water," accused one brandishing a spade.

"This is my water," spat the other also raising a spade.

Defiantly the first man tried to close the furrow into his neighbour's dam.

"Touch that water and I will stop you with this spade." The second lunged at his neighbour threatening to knock his knees out from underneath him. A crowd was growing to watch the fight but after a few tense minutes the second farmer closed his furrow and allowed his neighbour to have water.

"Now it's your turn," he said looking at his watch.

The first farmer glared at him. "Your watch is slow," he grumbled.

"No, your watch is fast."

Squinting under the harsh light of the Karoo the two sun-browned old men examined each other's watches. It was true – one was too fast and the other was too slow. Neither knew for sure when his "lei" water turn started or ended. At that moment the church clock struck the hour.

"The church clock is never wrong," said the representative from the

Sas de Kock, chairman of the Kweekvallei Irrigation Board in the Karoo town of Prince Albert checks the "lei" water sluice gate outside his home.

town's Irrigation Board who, relieved that the spades had finally been laid down, spoke up for the first time. "Why don't you both set your watches by the church clock and then maybe next week you won't fight."

Reluctantly the men changed their watches. The following week, when it was once more time for them to take water, they suspiciously studied the church clock as the "lei water" trickled into one small dam and then the other. For the first time in years both agreed on the other's time for water.

From that day onwards the "lei water" turns in Prince Albert have run strictly to the time on the church clock – it's the only way ownership of this scarce resource in the remote semi-desert village hasn't ended in murder.

This story, told by the chairman of Prince Albert's Kweekvallei Irrigation Board, former police major Sas de Kock, highlights the importance of proper management of water in an environment where regular rainfall in unpredictable.

KWEEKVALLEI

The role of the Kweekvallei Irrigation Board is to ensure that furrows are in working order and to oversee repairs, says De Kock who has been involved with supervising water use in the village since 1985. "It's up to the individuals who have water rights to take their turn at the times allocated and to keep their furrows in good repair," he says.

Understanding that the success of his farm depends on water De Kock has made it his business to work with the Irrigation Board.

"One cannot assume the water will come by itself," he says, "before my "lei" water turn on a Saturday night I check all along the furrows to ensure there are no blockages and that my water will come."

When his precious water hours are over it's another man's turn. "There is no turning back the clock – you have your chance to take water and that's it."

TORTOISES

Once or twice De Kock has cleared a mound of clawing desperate tortoises caught in the grids of the furrows and stopping the stream. Recently he removed a dead duiker blocking the flow.

"Everybody who uses water needs to take this responsibility," he says, "it's not only the role of the Irrigation Board."

The Kweekvallei Irrigation Board is an elected committee of volunteers who meet several times a year at a home in town to discuss water issues, deal with problems and enjoy a cup of coffee together. Most members have lived in the Karoo town all their lives and understand the scarcity of the resource they have to share.

"It's important to know the history of water in the town," says secretary Ina Burger, "it gives you a context when dealing with problems.

De Kock points out that, according to the new Water Act of 1998, the

name of the Board is soon to change to the Water User's Association.

"Our function will stay the same," he says.

Over the years the lack of water, man's greed and nature's tendency to interfere in the smooth running of the "lei water" has meant the Kweekvallei Irrigation Board has had a lot more on its plate than maintaining furrows.

In the Karoo water is either too scarce or comes in a flood, explains De Kock.

To make his point he tells the story of the late Oom Christian Myburgh of the farm Slagterspoort and the filling of the Gamkapoort Dam in 1970.

One of the farmers asked the chief engineer how long it would take before the new dam was full. The engineer thought about it for a moment then said it would take at least ten years.

Oom Christian shook his head. "What do you think Oom Chris?" asked the others.

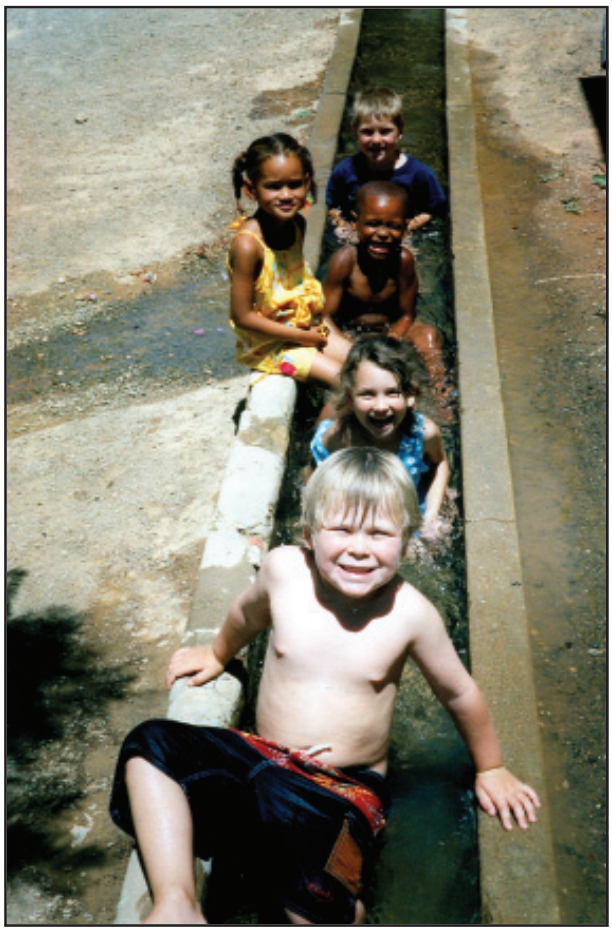
"When the rain comes it will take two days," said the old man.

A little while later the Gamka River came down in flood and, as Oom Christian predicated, the dam filled and overflowed in less than 48 hours.

"There is no half measures in the Karoo," says De Kock, "it's always too much or too little."

SMALL SPRING

A small spring, called the Fonteintjie, that flows from a source high in the Swartberg Mountains, has fed the Karoo town ever since the first



These Prince Albert nursery schoolers can't resist the lure of the "lei" water when it comes rushing past their playground every Monday for the school's water turn.

Dutch settler Zacharias de Beer secured a loan farm from the Cape Colony government in 1762.

De Beer called his farm Kweekvallei (Fertile Valley) an unusual name for a farm in this dry setting. What he had though was a steady trickle of water from the mountains enabling him to grow vegetables, plant fruit trees and keep livestock. Very soon De Beer's children were marrying and raising families on Kweekvallei and so the foundations of a village were laid.

By 1939, when the first Kweekvallei Irrigation Board was established, the existing "lei" water system was already in place and farmers in the town relied on the stone-lined furrows to channel their water onto their lands. Until that time the townsfolk had shared the water without too much infighting but it was becoming more and more apparent that, with the increasing number of settlers in the village, a board was needed to manage this shared resource.

MINUTES KEPT

On July 26, 1940 the town's Irrigation Board was proclaimed. A chairman was chosen and a committee of board members elected. From then on minutes were kept at all meetings and farmers given the opportunity to raise problems relating to their supply of water.

Today, 64 years later, the religiously kept minutes of Irrigation Board

meetings provides a fascinating insight into the intimate history of the town.

On 17 June 1953 for instance the board was in deep discussion as to the future positioning of a dam for Prince Albert while damage to the furrows caused by a flash flood was also cause for concern.

In 1964 there was a surge of requests to close sections of the furrows due to building work in the town. The Irrigation Board debated the issue and decided they could refuse these requests but that if they allowed any closures the property owner was responsible for keeping the furrow in good repair. Seventeen years later unexpected lightning-caused fires in the mountains had the Irrigation Board discussing the viability of controlled burning in future to prevent flooding and erosion.

"These are all issues that played a crucial role in the lives of farmers and their families at the time," says Burger, "they were debates that could raise tempers, make or break a farm and impacted on the way our town developed."

Today De Kock, Burger and many Irrigation Board members are still involved in supervising the steady flow of water into Prince Albert.

"There are ongoing problems with people stealing water," says Burger. Little tricks like a stone under a sluice-gate or taking 15 minutes from the farmer at the bottom of town who takes his turn in the middle of the night are old hat. "By the time the farmer sees his water isn't coming and has driven around trying to find who is taking it, the water is on its way again," says De Kock.

Has anyone ever been prosecuted for stealing water?

"Complaints are laid with the police but unless you catch the thief in the act it's hard to prove," he says. Most often a representative from the Irrigation Board has a friendly chat with the person they believe is causing the problem.

"They always blame the labour," he says, "it's amazing how many times I've heard it was the gardener's fault."

PAYMENT

Payment for water is minimal but the little the Irrigation Board collects from farmers keeps the furrows in good repair and pays an occasional labourer to unblock the grids when litter and plant growth threatens to impede the flow. The municipality also has an allocation of water for household use – 17 hours of full stream "lei" water a week.

An ongoing issue in Prince Albert is the damage caused by the roots of alien blue gum trees to the furrows lining the town's streets. Another problem is the increasing number of property owners not resident in town who don't understand the importance of taking their "lei" water turn. This sometimes leads to flooding and damage to properties further downstream.

The Irrigation Board is also in discussion with the municipality for funds to lay a pipeline from the weir at the entrance to the Swartberg Pass to the Municipal Reservoir – a distance of 6 km.

"This will do a lot to minimise evaporation and save water," says De Kock.

Nevertheless the "lei" water is an age-old system that works for the town and, there is no question, that its quaint appeal is part of what attracts tourists and new residents to Prince Albert.

"We've been through drought and flood but I have never known the 'lei' water to stop," says De Kock, "it's been very low sometimes but that steady trickle has always flowed. I pray I never live to see the day when the water doesn't come."

This article is the first in a series on irrigation boards which have played such a major role in South Africa's irrigation development and therefore also indirectly in the moulding of early water policy as well as in the infrastructural, economic and social development of the country.

The first legislation for the formation of irrigation boards had come into being in 1877. Since then, the economy of South Africa has developed from a rudimentary level through an agricultural phase into that of a sophisticated, rapidly industrialising region. Today, in terms of the new National Water Act (Act 36 of 1998), irrigation boards will be modernised into water user associations.

Water user associations, according to the Department of Water Affairs and Forestry, "are institutions of civil society that are established for the mutual benefit of a group of individual water users. The central feature of water user associations is the common utilisation of water, associated with a collective water supply infrastructure of some kind, the management and operation of which serves the needs of each member of the association."

Musa Will Not Drink Water From That Stream Again

Musa Nzimakwe was 18 years old when he contracted cholera two years ago. He had just finished his electrical engineering exams at a technical college in Durban, and had gone to his rural home between Margate and Post Shepstone in late November. One week later he was seriously ill with cholera. Louise Torr tells the story.

In Durban Musa has access to clean, piped water. At his rural home, domestic water is obtained from a stream, which is supplied by a spring. This stream runs through Musa's homestead, and at places the water is stagnant. Sometimes the water is yellowish green, with frogs, but this is the water that his mother and rest of the community collect for domestic consumption. Until recently people used the bushes when they needed to defecate.

Musa had been helping to build a fence, and used to drink water straight from the stream whenever he felt thirsty, which is what everyone does in that area. In addition, Musa is a soccer player, and whenever he came home after playing, he would drink plenty of water from the stream. His mother, sister and two brothers did not get ill because they did not drink as much as he did – also in Durban he was used to drinking water that was safe. His family was very worried and confused when he became ill, and they gave him plenty of water to drink, but it was water from the same stream.

Soon Musa began to lose his appetite. Three days later he had diarrhoea, but he did not go to the clinic as he thought it would pass. He felt terrible – everything he ate passed through him – he had diarrhoea and vomited, and could not keep anything inside. The makeshift toilet was far from the house, and he needed to get there about 15 times a day. Sometimes he could not get to the toilet in time. His mother brought a bowl to wash him. He felt terrible and began to lose hope. He lost a lot of weight and his mother had to carry him to the clinic.

By the time he got to the clinic, he had no energy. He was given glucose, and a letter of admission to Port Shepstone hospital. He stayed in hospital for a week, and was on an intravenous drip for a few days.

HOW TO TREAT AND PREVENT CHOLERA

When people have diarrhoea and lose a lot of fluids, it is important to give them a sugar/salt solution to drink as often as they can. This home solution stops their bodies from drying out. To one litre of clean water, add 8 teaspoons of sugar and half a teaspoon of salt.

We can all work hard to prevent cholera if we:

- Make sure that human faeces do not get into the water that we drink.
- Make drinking water safe. Add one teaspoon of Jik (or other bleach) to 25 litres of water. Let it stand overnight, or for two hours at least, to clean the water properly and to kill the cholera germs. Water can also be boiled to make it clean.
- Wash hands with soap after going to the toilet, and after changing a baby's nappy.
- Wash hands with soap and water before preparing or eating food.

Illustrations supplied by SANTAG (KwaZulu-Natal Sanitation Task Group). Artwork by Hildegarde van Zyl.

Make drinking water safe:

- **Add one teaspoon of Jik (or other bleach) to 25 litres of water.**
- **Let it stand overnight, or for two hours at least, to clean the water properly and to kill the cholera germs.**

Make a home solution for people who have diarrhoea:

- **To one litre of clean water, add 8 teaspoons of sugar and half a teaspoon of salt.**

Give this sugar/salt solution to people with diarrhoea to drink as often as they can.

Thereafter he was given healthy food, plenty of liquid and fruit. On the seventh day, he was much better and discharged.

CHOLERA

People know that cholera is bad, but Musa thinks that they are not aware that cholera is caused by bad sanitation habits. Since last year the uGu District Municipality has supplied toilets to this area, badly affected by cholera, but this has not been accompanied by an education campaign. No workshops have been held to educate people about the connection between bad sanitation, contaminated drinking water and cholera. People are still drinking unsafe water from the stream. They do not realise that it has to be purified – they generally do not boil their drinking water, nor do they cleanse it with Jik. Earlier this year, handpumps were installed in the vicinity, but people still use the water from the stream because they have to walk too far to collect water from the handpump.

It seems that people in the area seem to know more about the ways that HIV/AIDS is spread than they know about how cholera is contracted. But they show the same indifference, and do not take precautions.

Musa, however, learnt the hard way. He will not drink water from that stream again.

CHOLERA CAN SPREAD DURING SUMMER HOLIDAYS

Over the past few years KwaZulu-Natal has been hit by outbreaks of cholera during the December holidays. The disease can spread easily with the movement of people during the summer holidays, because people spread the disease.

Not everyone will get cholera. People with clean piped water will not get cholera, but those who do not have clean, safe drinking water can get cholera if the water is infected with cholera germs. These germs are found in human faeces. Communities can easily get cholera in areas where the toilets are badly constructed, and the human waste can contaminate their drinking water. If they defecate in the bushes, their faeces can wash into the river when it rains. If the water is made dirty by human faeces, the cholera germs will grow and spread.

When heavy rains fall and the weather is hot, cholera germs can grow and spread very quickly. When the weather gets cool and dry, these germs can stay sleeping in water for many years. They will grow again when it gets hot and spread when the rivers flow after rain.

People who drink infected water and get cholera, suffer from diarrhoea and vomiting. If the body fluids that they lose are not replaced quickly enough, they can die. During last year's cholera epidemic the Health Department helped to stop people from dying of cholera. People in cholera areas were given Jik to clean their water, and clean water was brought to cholera areas. Emergency clinics or rehydration centres were set up, where people with cholera were given extra fluids to replace those lost from diarrhoea and vomiting.

Using Creativity In Catchment Education

by Robert Berold and Marita Kritzinger

A degraded section of the Kat River near the village of Ntilini. The workshops and dramas discuss the causes of environmental problems such as this, encouraging stakeholders to come up with solutions.

The Catchment Creative Group have been working with communities in the Eastern Cape's Kat River Valley for four years now, using drama to inform people about the catchment and how it should be managed. Although none of these seven young people is a scientist or even a social scientist, they are experienced in communicating concepts like the ecological Reserve, streamflow variability, and the role of catchment forums. They work with and complement the catchment research and facilitation done under the leadership of Professor Kate Rowntree at the Department of Geography at Rhodes University.

The origins of the group date from 1996, when Rhodes researcher Nicky Motteux was working in the Kat River Valley, finding ways to motivate and educate people in villages. Initially she worked with Jerry Ntsebeza, who lived in the valley, and with Bulelwa Nqweniso a young Grahamstown woman who is a talented actress. Together they learned how to present environmental problems through Forum Theatre, acting out prolems such as pollution in a way that the audience is encouraged to participate.

To get across a concept like the ecological Reserve, learners from one school acted as plants, invertebrates, animals, trees – all the components of the river ecosystem.

In 1999 Nicky brought in environmental education practitioner Jane Burt to help her organise a children's drama festival in the catchment. The festival, called the Umlambo Festival, was a big project, involving four schools and a youth group, and they recruited some Grahamstown actors Apollo Phillip, Vuyani Hoboshe and Matthews Nontyi. To get across a concept like the ecological Reserve, learners from one school acted as plants, invertebrates, animals, trees – all the

Prof Kate Rowntree

A community stakeholder taking part in a workshop about the ecological Reserve.

Prof Kate Rowntree

Matthews Nontyi demonstrates the concept of flow variability using the building block method. Workshop participants actively take part.

components of the river ecosystem. "We wanted to pass the message that each resource depends on each other. So that if we treat the river ecosystem in a good manner, it will treat us well." Another school put on a play about how painful it was that their ancestral graves were not moved when the dam was built. The Umlambo Festival was a resounding success, with 800 people attending.

Monde Ntshudu, a Xhosa teacher, and currently leader of the group, became involved through a different route. Nicky had asked him to translate a brochure about Catchment Forums into Xhosa. According to Monde "The brochure was about the definition of a catchment, what it involves, how people benefit from it." They went on to publish a Kat River Valley newsletter, which Monde describes as "people giving their stories, from their social life to environmental changes, and discussing what they could do". Then, responding to the illiteracy in the catchment, Nicky and Monde expanded from newsletter to drama. An environmental education group was formed with the actors from

Prof Kate Rowntree

Jerry Ntsebeza, Monde Ntshudu and Matthews Nontyi act out a scene about scientific researchers approaching an old man in a village who will only allow his voice to be heard, excluding the rest of the community.

the drama workshops, and it has remained active since as the Catchment Research Creative Group, with seven members.

WORKING METHODS

Apollo says much of the group's success comes from their working methods: "We spent a lot of time sitting with people in their villages, experiencing their lifestyle, hearing about the indigenous knowledge of the river, because we wanted to combine scientific knowledge and indigenous knowledge. We never stayed in hotels, we just stayed with people in their houses. They were

taking us as their children, so it was easy to get whatever information from them. After we collected data, we went back and showed them the information in a play."

Monde adds: "We started with Fairburn and Hertzog in 1999, but then other villages joined in. Remember there are no taxis or telephones in this area. There were no lines of communication between the villages. The people from Gonzana, for example, did not know Amherst village and their environmental problems. The downstream villages were just blaming the upstream villages for their problems."

Under the old water law, riparian rights lay with the irrigation farmers. "It was the irrigation farmers who decided when the dam was to be opened, the domestic users and the black farmers had no say." That all changed with the 1998 National Water Act, when the distribution of water in the catchment area became a community issue and everybody became stakeholders. "The starting point was the common need of everybody, and that was water," said Monde Ntshudu. "We wanted to pass on the message that people have to work together." A Water User Association had to be set up, involving all stakeholders and users in the catchment. It was decided that the Irrigation Board would be transformed into Water User Association. Says Monde, "At the very first meeting we presented a drama, showing the different roles of all the stakeholders, and the needs of the ecosystem itself." This went down well, and within a few weeks the constitution of the Water User Association was drafted.

The Creative Group then started moving into the communities in the catchment, running environmental awareness workshops in all the villages, with the aim of forming a Catchment Forum. Matthews explains: "We decided to involve the schoolchildren, and so we started running drama classes in the schools. We involved the teachers, in a separate project which we ran with Ilitha Arts Project. We wanted the teachers to be trained so they could take over the process".

Prof Kate Rowntree

Actors from the Catchment Research Creative Group, Apollo Phillip and Matthews Nontyi (foreground) demonstrate a trust-building exercise in a workshop (Monde Ntshudu, the group's leader looks on in the background).

BUS TRIPS

Led by Nicky Motteux, the group became involved in introducing Catchment Forum stakeholders to each other by taking them on a bus trip so that they could get a sense of the whole catchment. As Monde puts it: "All the rivers are to be classified according to a management class, and communities need to be involved in this. They must have the capacity to participate in determining the Reserve. Our drama showed that if we don't participate, someone else will take the decision for us."

".....Our drama showed that if we don't participate, someone else will take the decision for us."

"One of the reasons why we communicated very well is because they felt comfortable with us. Take the Reserve determination for example. If you talk with them in scientific terms, you've lost them. But actually people do know about these things in their own way, they are just scared of the researchers. Then we also had to deal with the gap between generations, the older generation was not listening to the younger ones. We brought them together so that they could each give something to the other. The older generation knew how the river was originally, but the younger generation only knows about the present state of the river. We illustrate the role that people have to play in the environment and how to treat it with respect."

"We show people how to integrate their indigenous knowledge with scientific knowledge," explains Apollo. "It is a two way process, we do not only teach the people. They share their knowledge, by becoming actors." Monde gives some examples of indigenous knowledge "The old people knew how to repair dongas, they used aloes. They also used to prune trees. Like the Umnquma tree, children were told you never cut the bottom of this tree, you cut the top. We take this information back to Rhodes, to tell the scientists what the people know." The traditional Xhosa respect for

Dr Nicky Motteux

Dr Nicky Motteux and stakeholders during a transect walk along the Kat River.

the river spirits can also be seen as an indigenous version of respect for the ecological Reserve. "That belief that the ancestors are staying in the river makes people respect the river more than many of the commercial farmers."

Another feature of the workshops was the use of the building block model to illustrate natural flow variability. Although most water users would like a steady flow of water all year round, it is essential for river health that natural flow variability is not tampered with too much.

CREATIVE SOLUTIONS

Of course there have been difficulties. Communicating through drama is also not easy and the team had to come up with creative solutions to bridge language barriers. "There are differences in languages, like between Afrikaans and Xhosa, or even between different dialects of Xhosa. In such cases we use mime – acting without dialogue – introducing the dialogue only later".

How do they get the attention of the community? Apollo says "Well once we just stood in the village and start to play our drums and shakers, but only a few people arrived to see the performance. These days we approach the chief or the community committee. We explain what we are doing – although even this explanation we present as a performance. And then we set a date to come back. We never write a script. We just stay with the community and hear about their problems, and present this back to them in a play. In the play we deliberately provoke the audience, we provoke them to participate, and they do. By staying with them in their homes, we build a level of trust with the communities. This means they are more receptive to the drama." Says Matthews: "We don't have a formal script, although we do have a structure based on our local research."

The group feels they have helped to establish a good working relationship with all the stakeholders in the Kat River Valley. "The white farmers are working with the black farmers. Local government is involved. The Catchment Forum is now able to take decisions without relying on Rhodes University researchers. In fact they are now forming a junior forum."

Matthews says: "I can say we have achieved what we came for. We've seen the fruits of our work in the Kat River Valley. We have seen the maturity of the Catchment Forum, because now they can now apply for their own projects. There is a culture of learning here." Jane Burt, one of the original facilitators, agrees: "The project wouldn't have happened without their commitment".

Nicky Motteux, who has since completed her PhD in participatory catchment management, writes from Australia where she now lives, "The Kat River Creative Group are inspirational, innovative and passionate about their work. Through the years they have learnt to work as a team with a common vision and good understanding of the principles of participation, always willing to learn and reflect on their work to ensure that the community is the client. I greatly value the opportunity I had to work with them."

The Catchment Research Creative Group is available to travel to other catchments in South Africa and train others in their communication skills. Their range of skills includes:

- Using drama to establish Catchment Forums.
- Using drama to explain concepts like the ecological Reserve, relationships between upstream and downstream, and streamflow variation, and the effect of agricultural practices on river water.
- Different forms of theatre for development, how to train teachers and schoolchildren, and how to run catchment drama festivals.

To contact the group, phone Monde Ntshudu at 073 3566 739 or e-mail him at m.nstshudu@ru.ac.za.

Wetland Plants - Dr Jekyll or Mr Hyde?

Wetland plants are often considered problematic but research now proves otherwise. **Edith Webster** reports.

Wetland plants are not entirely villainous vegetation – ongoing research into the biology of these plants, as well as conservation efforts, prove we couldn't survive without them.

So says René Glen of the National Botanical Institute in Pretoria.

"Wetland plants are often considered to be problem plants, growing in wet, smelly places that are ideal breeding places for mosquitoes," she explains.

"They are also often referred to as aquatic weeds, which depicts infestations of unwanted plants, causing severe economic losses."

But, continues Glen, "aquatic weeds" are not all bad – these plants (including *Potamogeton* species *pectinatus*, *crispus* and *schweinfurthii*) point out the most prolific bass fishing areas in South Africa, for example.

"Juvenile bass crowd under the thick weed beds to hide from predators while adult bass hide among the weeds to ambush prey.

"The weeds provide homes for insects, which in turn attract small bait fish attractive to feeding bass."

SUPERMARKET

In the USA, the common "cat tail" (*Typha latifolia*) is considered "the supermarket of the swamp" as the pollen can be used as a flour substitute, the flowers for stuffing pillows, the leaves for weaving baskets and mats, and the rhizomes, which contain as much protein as rice and more carbohydrate than potato, can also be ground into flour, and eaten whole, raw, boiled or roasted.

The South African equivalent "bulrush" (*Typha capensis*) is also benefi-

cial in that it prevents soil erosion, acts as a filter system or breaks the force of water, especially during floods.

"No doubt the most important property of *Typha capensis* is that it is a food source and/or shelter for several wetland animals thereby enhancing the biodiversity of any wetland," says Glen.

"Sadly, these positive 'Dr Jekyll' characteristics are overshadowed by the negative 'Mr Hyde' characteristics, such as vigorous growth, that block waterways."

Nevertheless Glen proposes: "Should we not be concentrating on how to use this potential food source to alleviate some of the starvation in this country instead of trying to find ways of eradicating this plant from wetlands?"

WATERBLOMMETJIE

Take the "waterblommetjie" (many South Africans may be familiar with this plant, scientifically known as *Aponogeton distachyos*). It is often cooked in a "bredie" or stew. This plant is valuable as a food source, it keeps water clean, it is home to (and protects) various creatures, and it can be grown commercially. Unfortunately, in Australia, waterblommetjies have been introduced as an attractive pond plant – where it has lost all its "Dr Jekyll" attributes and changed into "Mr Hyde", Glen points out.

"All these wetland plants only become a problem when they grow in polluted water or are introduced into foreign habitats," she says.

"In the novel *Dr Jekyll and Mr Hyde*, during the day Dr Jekyll was an extremely helpful and kind medical practitioner but at night he drank 'potions' that changed him into a barbaric, unkind person," Glen explains.

"Likewise, wetland plants react to the 'potions' people put into the wetlands and then become uncontrollable, as did Mr Hyde."

Glen wonders: "Is it not time we stopped blaming the plants and enforced better management programmes instead?"

Waterblommetjies are often cooked in a "bredie" or stew.

Examples of aquatic weeds

Potamogeton pectinatus

Potamogeton schweinfurthii

Potamogeton crispus

Potamogeton schweinfurthii

A Better Understanding of Irrigation Principles

This series of articles, Talking Irrigation, have their origin in a Water Research Commission initiative to document the performance of irrigation systems and their applications, particularly if these are not well known or are controversial. It is the belief that articles in the popular press based on SAPWAT case studies will propagate a better understanding of irrigation principles.

Field investigations have shown that running real life scenarios on SAPWAT in the company of a farmer, official or designer creates a relaxed "computer game" atmosphere that is not only congenial but also effective. These are the experiences we want to share with you.

SAPWAT is not a crop growth model or a scheduling tool, but it can facilitate "what iffing" as well as promoting understanding of what is happening down there in the root zone. It helps answer such questions as:

- Should we increase or decrease cycle times?
- What will be the effect of making a change to pivots?
- How should we irrigate these heavy, shallow soils?
- Can we manage to cut back to only one shift a day?
- How can we plan to exploit Ruraflex, and so on?

Irrigation is a necessary chore and at times the source of real anxiety and frustration. To confound the agony, the consequences of irrigation management decisions are buried way down in the soil profile and invisible, "out of sight, out of mind"?

To establish if the SAPWAT irrigation planning and on-farm management model was accurately reflecting the realities of farm practice a number of irrigation farms were visited. It was disappointing to discover that in this era of high-tech farming irrigation there was a dearth of accurate data on water use, rooting depths etc so that only too often it was not possible to fully assess the accuracy of SAPWAT predictions. What has come out is that greater attention to irrigation management, approaching the standards achieved in other aspects of the production cycle, could be highly beneficial and that SAPWAT certainly can contribute to upgrading and simplifying irrigation and water management practices.

We will be chatting about a varied range of interesting irrigation subjects and in this article are previewing some of the subjects that are in the pipeline.

DWAF ACTIVITIES - REGISTRATION AND VERIFICATION OF AGRICULTURAL WATER USE

The first article in this series (*Water Wheel* Volume 2 no 5) was based on an interview with Mr Hennie Schoeman, consulting engineer, and dealt with the process that had been followed during the official registration of agricultural water use. Schoeman and Partners in conjunction with Thompson & Thompson and Copad are developing an official DWAF manual spelling out both the legal and technical details of the next step in the registration process, namely, the verification procedure that will be contracted out to consultants across the country. Mr Hennie Schoeman explained that the registration process had required that all water uses, without consideration of legal status, had to be registered. The only requirement was that it must be an existing use, whether lawful or not.

Pora Mears of Schoeman and Associates preparing the Upper Vaal pilot registration verification study.

Greater attention to irrigation management, approaching the standards achieved in other aspects of the production cycle, could be highly beneficial and SAPWAT certainly can contribute to upgrading and simplifying irrigation and water management practices.

The **verification of the legality of registered water use** is critical, however, since lack of proper verification of legality may lead to a situation where the injustices of the past, where a water user is using more than a fair share, are perpetuated unnoticed. The process of verification consists of the capture of data on GIS involving the acquisition and validation of information on existing entitlements, title deeds, cadastral updates and all the data created by the registration process quite apart from the detailed evaluation of the crop irrigation requirements. The approach to arriving at crop irrigation requirements is an extension and refinement of the process followed when doing the registrations. Here it is even more important to standardise water volumes to avoid a scenario where the same crop differs materially as a consequence of the variations in irrigation method and management. We will be following the fascinating ins and outs of this process that will require some modifications to SAPWAT to accommodate the many thousands of calculations that will be necessary.

GRASS IS A HIGH VALUE CROP

We were recently privileged to spend a few days is in the Umzimkulu valley talking to dairy farmers who are applying New Zealand's principles of pasture management based on perennial pastures. The main purpose of the visit, on the invitation of Mr Mike Arnold in the Creighton district, was to evaluate if the SAPWAT irrigation planning and on-farm management model could make a contribution to

Astrid Hattingh (soil scientist) and Dalyn Ludick (pasture technician) measuring soil water content on the calibration plot

Irrigated vegetables

managing the irrigation of the pastures in the valley. The visit was an eye-opener. The level of technology and management being applied in milk production is impressive and the results achieved reflect this. There does not appear to be anything that is not monitored, measured and recorded on a weekly or even daily basis on the farm except irrigation! Possibly what was most striking is that the returns being achieved make both perennial and annual pastures one of the highest value crops being produced under irrigation in South Africa.

There does not appear to be anything that is not monitored, measured and recorded on a weekly or even daily basis on the farm except irrigation!

The problem in managing the irrigation of these extensive pastures is a lack of simple practical ways and means of keeping pace with what is taking place in the shallow root zone and the heavy soils that predominate. A similar situation applies not far from Johannesburg and a soil scientist, Ms Astrid Hattingh, and the farmer, Mr Simon Lavery, are organising trials evaluating equipment and practices against SAPWAT predictions. In addition to conventional methods of tracking soil water, the use of low cost augers, penatrometers and probes is under investigation. It appears that sports fields and golf clubs will also benefit from these activities and Ms Gail Andrews, a specialist researcher attached to Rand Water, has shown keen interest.

HOUSEHOLD PRODUCTION OF VEGETABLES IN VILLAGES

Household production of vegetables does not play the role it could in helping to eliminate poverty and promote food security and better nutrition. There are several valid reasons for this including the shortage of water and soils that are the least suitable for agricultural purposes. The returns on gardening, that involves hard work and considerable risk, are not considered worthwhile.

The work that has been undertaken on a plot north of Pretoria by Ms Tshepo Kabane has led to the Water for Food movement and the realisation that there is water for the taking provided gathering and managing is effective. Most of the areas where villages are concentrated have an annual rainfall in the order of 500 mm and this represents no less than 50 m^2 of water from an area of 100 m^3 of roof.

Contributions may also come from paved areas, hardened lapas and even from roads and fields. There can be no control over when it rains or how much it rains in any one storm so that if water harvesting is to be effective, storage is essential. Storing relatively small quantities of water at an affordable cost is a challenge that is receiving urgent attention. Deep fertile soils are a must and the most viable way of achieving this is to adopt trench farming with beds excavated and filled with organic and other materials in order to create fertile soils with a good water holding retention for vegetable production.

It is possible by harvesting and storing available rain and creating fertile soils to produce vegetables successfully where previously it was considered impossible. Villagers have in the past had to revert to hand watering using buckets and watering cans. The introduction into the vegetable production system of manual pumps is the last link in the process. It is possible to pump water into storage and out of storage and to deliver at some considerable distance by hosepipe to the vegetable beds. For all gardening purposes the relatively inexpensive hand pump is all that is required.

SAPWAT has been extensively applied to estimate the irrigation requirements of the vegetables, the water that will be available for harvesting, storage volumes and the required pump capacity and hours of pumping required.

PIVOT IRRIGATION STRATEGY

There are several distinct but inter-related phases in arriving at an effective irrigation strategy.

The designer must estimate the peak requirement for irrigation so that his client, the farmer, can provide for all those hot dry periods when the rain seems to have disappeared forever and it is necessary to apply maximum amounts of irrigation water in the short term. In the lower rainfall areas and in consultation with the client the designer may decide to ignore rain altogether when calculating peak application amounts for specific months.

On the other hand, there will also be concern for the total annual and seasonal volumes of water that must be provided to cater for the crops total water requirements. Here it is not feasible to cater for extreme drought conditions and estimates are normally based on average water requirements. Rain must be taken into account when calculating storage requirements and economic returns on investment. This is particularly important when rain makes a significant contribution to crop water requirements.

The modern centre pivot creates a microclimate and manageable infiltration rates

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There was a time with flood and hand move sprinkler irrigation that large applications (60 mm) were made at extended intervals (14 days) and the assumption was that the determining factor was the depth of soil and its water holding capacity. These remain important but modern short cycle systems such as pivots and drip have made the previously impossible practical. The cost of pumping large quantities of water has become increasingly important and developing strategies, that favour pumping during off-peak hours can have a significant impact on profits.

Scheduling, providing the crop with the required volume of water at the right time, is widely recognised as being a must if irrigation is to be more efficient. Unfortunately, it appears that only a minority of farmers "schedule" according to this fairly strict definition.

There is undoubtedly a need for more communication on irrigation strategies between designers, water supply managers, economists, crop production specialists, and farmers. SAPWAT has proved to be a valuable aid in facilitating the discussion of alternative strategies. We have discussed this with a number of prominent stakeholders in the irrigation sector, and we will be giving you insights into some of the innovative approaches that we have encountered.

WRC Initiative to Disseminate Available Knowledge of Irrigation in Agriculture

The Water Research Commission (WRC) has embarked on an initiative to bring the practical applications of its research results more directly to the attention of farmers and their support organisations, including co-operatives and water user consultants. The timeliness of the initiative is underscored by the currently falling levels of dams throughout South Africa, and warnings by weather forecasters that the country is entering a cyclical downturn in rainfall over the next number of years.

The WRC initiative kicked off with an information day in Douglas, Northern Cape on 7 October, between top researchers and engineers in various disciplines of water utilisation, and members of the Griqualand West Co-operative. The Co-operative serves farmers around the confluence of the Orange, Vaal and Riet Rivers. The area is characterised by extensive livestock farming and intensive grain and wine production under irrigation.

The Managing Director of the Co-operative, Mr Johan van Dyk, said in opening the proceedings that the effective use of water was of cardinal importance. "Our area has some of the top irrigation farmers in South Africa, who are here to extend their knowledge of irrigation technology," he said. "Let it be our challenge to ensure that the available research is effectively applied by producers."

An impressive record of the research-based knowledge on irrigation that is available for practical application by producers, was provided by the speakers on the programme.

SAPWAT

Mr Pieter van Heerden, a Bloemfontein-based agricultural consultant specialising in agricultural extension and irrigation practice with the emphasis on water needs planning, spoke on the user-friendly SAPWAT computer program. This program, developed for the WRC by Mr Charles Crosby, uses data from a countrywide network of weather stations. It serves as a training aid and planning tool for crop water needs, production systems and the use of river systems, for comparing irrigation strategies and for irrigation scheduling, taking into account such aspects as evaporation at different stages of plant development. Correctly applied, it can help a producer to achieve optimal production in relation to his outlay on irrigation. He said SAPWAT had proved reliable in diverse areas and for numerous crops with different harvesting dates.

WEATHER STATION INFORMATION

Prof Jimmy de Jager, now retired but formerly with the Department of Soil, Crop and Climate Sciences at the University of the Free State, spoke on the role of the automatic weather stations around the country on which SAPWAT is based. "If you are engaged in agriculture, the weather is the deciding factor ('die groot meneer'). It exerts enormous forces in respect of crop yields, water usage, frost damage and plant diseases – and all that we can do is try to adapt to these forces," he said.

To be effective, therefore, agriculture had to be aware of the weather from year to year. In this respect, the automatic weather stations, each of which covered a fairly wide area, had proved reliable. The weather data that they gathered could be sent electronically to processing centres, by telephone or radio. The results, which were used for preparing scheduling models, could then guide farmers in their irrigation needs and strategies.

Prof De Jager demonstrated how the system combined data on energy from the sun with aerodynamic factors (the wind), humidity and evaporation concepts. It then brought all the data together and presented farmers with information on which to make their own decisions on which crops to plant on specific lands, and how to apply their irrigation strategies.

Prof De Jager termed it "weather-driven irrigation management".

SCHEDULING MODELS

Dr Martin Steyn of the Department of Plant Production and Soil Science at the University of Pretoria spoke on the SWB (Soil Water Balance) model, developed and implemented jointly with his colleague, Prof John Annandale. He described it as a computer-simulated irrigation scheduling model based on plant,

soil and atmospheric measurements, the producer's irrigation system and the management thereof. The model included factors such as rainfall, evaporation, drainage, runoff and plant transpiration. All the facts at its disposal were integrated to determine optimal water usage and ensure sustainable production.

Dr Steyn said various options were available for using the program. A consultant could provide a full service and make recommendations to the producer; or the consultant could assist the producer by setting up his computer and program, which the producer then operated himself; or the producer could operate the whole SWB computer program himself, asking the consultant for advice if and when necessary. Alternatively, producers without computer skills could be provided with a production calendar for the season, which would be adapted from time to time in accordance with changing weather conditions.

Training courses are provided countrywide for consultants, advisers and producers on the comprehensive SWB irrigation model.

DEFICIT IRRIGATION

Prof Alan Bennie, of the Department of Soil, Crop and Climate Sciences at the University of the Free State, spoke on Deficit Irrigation and the BEWAB computer program developed for its application. Deficit irrigation is the strategy that is applied where irrigation water is in short supply. The producer aims for lower target yields, applies irrigation water more sparingly than when biologically maximum production is the target, and thereby leaves the soil more receptive to rain in the rooting zone where the plants can use it. The available irrigation water is thereby used with maximum effectiveness and the crop adapts to the conditions, avoiding excessive loss of water through transpiration (by means of shorter plants with smaller leaves).

Irrigation options based on the crop, the soil and weather conditions determine irrigation intervals. With high target yields, weekly irrigations give the best yield, but where deficit irrigation is necessary, irrigations at two to three weekly intervals give the best (most economical) results at low target yields.

Prof Bennie said more scientific systems for determining irrigation strategies would be adopted by producers or their consultants if they are affordable, comparatively easy to use, and result in greater production efficiency.

Deficit irrigation practices will be at a premium in the expected dry cycle.

CENTRE PIVOT MANAGEMENT – TECHNICAL FACTORS

Mr Felix Reinders, of the Agricultural Research Council's Institute for Agricultural Engineering, spoke on the technical factors involved in centre pivot management. The centre pivot system is now 50 years old, and the 30 models which once were sold in South Africa are now dominated by six models. About 15 000 pivots are in use in South Africa, including the biggest one in the world.

Major benefits of the system are the automation that it makes possible, the low labour requirement, the uniformity of water application, and the long life of an installation, of 15 to 20 years. However, he said, the capital cost was high and the system was thus better suited to large farms.

Mr Reinders discussed the advantages of the various sprinkler heads available – the smaller the drops the greater the loss through evaporation, which could reach 40% of the water input. He listed the technical factors that producers had to consider before specifying and installing a centre pivot system. Factors included the amount of water available, its quality, clarity and reliability; the soil type, its moisture holding capacity and depth; the slope (which increases runoff); the climbing capacity of the pivot; the management requirement; and the availability of backup service – "factors that are essential to know".

He advised strongly against planting more than one crop at a time under a pivot, because different crops required different irrigation management practices.

CENTRE PIVOT MANAGEMENT – COST FACTORS

Prof André Meiring, of the Department of Agricultural Economics at the University of the Free State, demonstrated how a centre pivot user could evaluate the overall financial risk before purchasing and installing a new system, re-evaluate an existing system, and evaluate his management strategy. Prof Meiring's demonstration, based on a wheat production unit in a semi-arid area, employed various computer programs, namely IrriCost, RiskMan and FARMS.

The basic input factors included in his computer evaluation were the physical elements present – such as the height of the land, which would affect water pressure, the capacity of the pivot, the soil type and the

crop – from which the producer could determine gross margins per ton (of the crop) and per millimetre of water applied. Then he included variable irrigation costs such as electricity, water, labour and maintenance and repair costs, from which the producer could further project his gross margins. The various cost factors were inserted into purpose-designed forms and processed by computer programs developed for this specific purpose. Finally, the results were shown in graphic form, demonstrating clearly where a given pivot system could be expected to reach economic break-even point.

WATER QUALITY – IMPACT ON SOIL

Prof Chris du Preez, of the Department of Soil, Crop and Climate Sciences of the University of the Free State, said soil degradation was not attributable solely to poor quality of the irrigation water used. Other factors also played a role, such as sub-optimal irrigation conditions, restricted leaching and the accumulation of drainage salts, the soil type (texture, depth, internal drainage and internal salt content), the irrigation system used (e.g. flood or sprinkler), and poor management practices including incorrect irrigation scheduling. Different crops also had varying salt tolerances.

Prof du Preez said effluent from industry in Gauteng was not the real cause of the problems encountered by irrigation farmers in the confluence area of the Vaal, Harts, Orange and Riet Rivers. He pointed for example to poor water quality flowing downstream from the Harts River, due to some farmers allowing poor quality water to flow into the system from their lands.

He said the solution lay in amended irrigation practices, and he foresaw higher water costs as unavoidable.

WATER QUALITY – IMPACT ON THE ECONOMY

Prof Giel Viljoen, of the Department of Agricultural Economics at the University of the Free State, spoke on the financial effects of poor and fluctuating salinity in the irrigation water of the lower Vaal and Riet Rivers. His computer-aided simulation model covered gross profit margins, irrigation water requirements and irrigation water inefficiencies for all combinations of 6 crops, 4 soil types, 4 soil drainage statuses, 3 irrigation methods and 6 leaching fractions – a total of 1 728 combinations for use in identifying solutions.

He said short term management options that could be considered, included changing to salt-tolerant and high-value crops, yield targets vs leaching decisions and pollution charges. Long term options that could be considered included the installation of artificial drainage, a change in irrigation systems, and on-farm water storage.

The results of the study revealed that artificial drainage was not financially viable, and that river return flows and on-farm storage would need to be subsidized. Important decision-making would be required on the price to charge farmers for irrigation water, the determination of water transfer costs, and whether to supply water on a volume basis or by means of per-hectare rights.

At national level, consideration would have to be given to the dilution value of Orange River water (to dilute the water emanating from the Vaal, Harts, and Riet Rivers); to the need for subsidization of artificial drainage; to the need for management options and controls for river return flows; and to the right incentives to promote leaching as a salinity management tool.

In his conclusion, Prof Viljoen said salinity had been identified as the worst water quality problem in the Orange Vaal Water Users Association (OVWUA) area; that the process of irrigation caused salinity; that in the case of the OVWUA area there was a case for a closed system; that leaching was essential for sustainable irrigation; that optimal farm level management was necessary; and that drainage and on-farm storage should be con-sidered to reduce the impact on soil.

INTEGRATED INFORMATION SYSTEM

Dr Nico Benade, a civil engineer engaged in the development of integrated computer information systems, described the integrated technologies available to producers – direct or through consultants and irrigation schemes – for administering their irrigation practices. The technologies that he touched on were the SWB (Soil Water Balance) model to help producers with their irrigation scheduling, the RiskMan model to assist producers on irrigation schemes with their planning at whole-farm level, the WAS (Water Administration System) model for use by irrigation schemes as a management tool, and the GIS (Geographic Information System) which integrates the three models for practical implementation.

He described in greater detail the functions of the WAS model, where-

by irrigation schemes manage water requests from farmers, release the water via canals and rivers, calculate water losses through seepage and other causes, and administer accounts.

In his conclusion, Dr Benade reverted to the theme of the information day, namely that there is no point in developing fancy models for the enhancement of irrigation practice if farmers did not know of them and effectively applied them.

THE START OF A PROCESS

Dr Gerhard Backeberg, the Water Research Commission's Director: Water Utilisation in Agriculture, summed up the WRC's approach to the information initiative as follows: "What is the practical application of our research? How can it contribute to practical solutions? We have the knowledge to address the problems you are experiencing. For us, this meeting is a matter of information exchange, the start of a process. We invite you to inform us what research work you consider as important. You can do so direct, or through your agricultural advisors and consultants, your co-operative or agri-businesses. We must talk to each other more, and work towards follow-up actions. We must look at water utilisation in agriculture together, assess progress more critically, and form partnerships between organisations representing farmers, scientists and research managers. From our side, the Water Research Commission will support this."

He added: "We would like to extend this initiative to hold information days for other co-operatives in the country."

WRC Key Strategic Area: Water Utilisation In Agriculture Research Output of Practical Relevance in Irrigation Areas of the Orange-Vaal River Convergence Systems

Project No	Title	Authors
423/1/97	Reaksie van gewasse op voorafgeprogrammeerde tekortbesproeiing	Bennie ATP, Van Rensburg LD, Strydom MG, Du Preez CC
513/1/97	The development of a computerised management system for irrigation schemes	Benadé N, Annandale J, Van Zijl H
290/1/98	Die ontwikkeling en rekenarisering van 'n geskikte vloedbesproeiingontwerp prosedure. Vol 1: Samevattende verslag	Kruger GHJ
624/1/99	A computer program for establishing irrigation requirements and scheduling strategies in South Africa: Executive summary	Crosby CT, Crosby CP
753/1/99	Facilitating irrigation scheduling by means of the soil water balance model	Annandale JG, Benadè N, Jovanovic NZ, Steyn JM, Du Sautoy N
740/1/00	Effect of water quality on irrigation farming along the Lower Vaal River: The influence on soils and crops	Du Preez CC, Strydom MG, Le Roux PAL, Pretorius JP, Van Rensburg LD, Bennie ATP
893/1/00	Factors which influence the Acceptability of Irrigation Scheduling with Specific Reference to Scheduling Models	Botha CAJ, Steyn GJ, Stevens JB
TT163/01	Using SAPWAT to estimate water requirements of crops in selected irrigation areas managed by the Orange-Vaal and Orange-Riet Water Users Association	Van Heerden PS, Crosby CT, Crosby CP
581/1/01	Research on a computerized weather-based irrigation water management system	De Jager JM, Motram R, Kennedy JA
946/1/02	The development of an integrated information system for irrigation water managementusing the WAS, SWB and Risk Management computer models	Benadè N, Annandale JG, Jovanovic NZ, Meiring JA, Crous CI
947/1/02	The economic impact of changing water quality on irrigated agriculture in the Lower Vaal and Riet Rivers	Viljoen MF, Armour RJ
894/1/02	Implementation of the Firm-Level Agricultural Management Simulator (FARMS) system for management decision-making in irrigated farming	Oosthuizen LK, Meiring JA

SOUTHERN AFRICA & AFRICA 2004

WATER SUPPLIERS
FEBRUARY 19-24

The Union of African Water Suppliers (UAWS) will be holding its 12th bi-annual African congress in Accra, Ghana.
Enquiries: Mr Dennis D Mwanza, Water Utility Partnership (WUP), 05 BP 2642, Abidjan, Cote d'Ivoire. Tel: +225 21 2408 28. Tel (direct line): +225 21 2408 13. Cell: +225 07 0199 01. Fax: +225 21 75 8656/7.

WATER AFRICA 04
MARCH 17-19

The Water Africa 2004 sub-Sahara international exhibition and seminars will be held in Maputo, Mozambique.
Enquiries: Jacqui Hepworth, ACE Event Management, Johannesburg. Tel/Fax: 011 705 1648. Cell: 083 626 5882. E-mail: jacqui-acesa@mweb.co.za

WISA
MAY 2-6

The biennial conference and exhibition of the Water Institute of Southern Africa (WISA) will be held at the International Convention Centre in Cape Town.
Enquiries: The Secretariat. WISA, PO Box 6011, Halfway House 1685. Tel: (011) 805 3537. Fax: (011) 315 1258. E-mail: conference@wisa.co.za

DESALINATION
MAY 3-5

An international exhibition of water, wastewater and desalination equipment and services (running alongside the EUROMED 2004 Conference) will be held in Marrakech, Morocco.
Enquiries: Jacqui Hepworth, ACE Event Management. Tel/Fax: (011) 705 1648. Cell: 083 626 5882. E-mail: jhepworth@mweb.co.za.
Web: www.ace-events.com/www.desline.com

WASTEWATER
JUNE 27-30

An IWA specialist conference on water and wastewater management for developing countries will be held at Victoria Falls in Zimbabwe.
Enquiries: Innocent Nhapi, Department of Civil Engineering, University of Zimbabwe, Box MP167, Mount Pleasant, Harare, Zimbabwe. Tel: 263 (0) 4 303288.
E-mail: wamdec2004@eng.uz.ac.zw
Web: www.uz.ac.zw/engineering/civil/wamdec2004

WATER RESOURCES
AUGUST 3-6

An international conference on Water Resources of arid and semi-arid regions of Africa (WRASRA) – Issues and Challenges will be held in Gaborone, Botswana.
Enquiries: EM Shemang, c/o Department of Geology, Faculty of Science, University of Botswana. Private Bag UB 00704, Gaborone, Botswana.
Tel: (+267) 355 2537.
Fax: (+267) 3185 097.
E-mail: waterconference@mopipi.ub.bw or shemae@mopipi.ub.bw

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

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

OVERSEAS 2004

DRAINAGE
MARCH 21-24

The 8th international drainage symposium together with the 10th national symposium on individual and small community sewage systems, will be held in Sacramento, California, USA.
Enquiries: American Society of Agricultural Engineers, 2950 Niles Road, St Joseph, MI 49085. Tel: 269 429 0300. Fax: 269 429 3852. E-mail: AS31@umail.umd.edu
Web: http://www.asae.org/meetings/sew04/index.html

AUTOMONET
APRIL 19-20

An international conference on automation in water quality monitoring - networks for surveillance, early warning and process control strategies and techniques of real time water quality assessment - will be held in Vienna, Austria.
Enquiries: Bernadette Ebner, KUONI Incoming Service GmbH, Wahringer Str 2-4/40, A-1090, Vienna, Austria. Tel: +43(0)1 319 7690-26. Fax: +43(0)1 3191180.
E-mail: bernadette.ebner@kuoni.at

FILTRATION
APRIL 19 -23

The 9th world filtration congress, sponsored by the American Filtration and Separations Society, will be held in New Orleans, Louisiana, United States.
Enquiries: Ms Kathy Hemming – Tel: 1 703 538 1000. Fax: 1 703 538 6305.
E-mail: Kathleen.hemming@verizon.net
Web: www.afssociety.org

PIPES
APRIL 19-22

A conference called Plastic Pipes XII will be held in Milan, Italy.
Enquiries: Michael Ball, PPI – Tel: (202)462 9607. E-mail: mball@plasticpipe.org
Web: www.plasticpipe.org

DAMS
APRIL 26-28

An international conference on hydraulics of dams and river structures will be held in Teheran, Iran.
Enquiries: Conference Secretariat, Water Research Institute, PO Box 16765-313, Teheran, Iran. Tel: +9821 7310577. Fax: +9821 7311959. E-mail: hdrs@pwit.ac.ir
Website: http://hdrs.pwit.ac.ir

SERVICE RESERVOIRS
MAY 12-14

The 1st international conference on service reservoirs in drinking water distribution systems will take place in Geneva, Switzerland.
Enquiries: Storage 2004, Geneva Water, SIG, PO Box 2777, CH-1211 Geneva 2, Switzerland. Tel: +41 22 4207381. Fax: +41 22 4209457. E-mail: info@storage2004.org

HYDROSCIENCE
MAY 30 - JUNE 3

The 6th international conference on hydroscience and engineering (ICHE-2004) will be held in Brisbane, Australia, with the central theme: "Enhancing the sustainable water resources and environmental quality of the world through the advancement of hydroscience and engineering".
Enquiries: Dr Mustafa Altinakar, NCCHE, School of Engineering, the University of Mississippi, Carrier Hall, Room 102, University MS 38677 USA.
E-mail: iche@ncche.olemiss.edu

WASTEWATER TREATMENT
JUNE 1-4

The 2nd IWA leading-edge conference on water and waste-water treatment technologies will be held in Prague, Czech Republic.
Enquiries: International Water Association, Alliance House, 12 Caxton Street, London SW1H0Qs, United Kingdom. Tel: +44 (0)20 7654 5500. Tel: +44 (0)20 7654 5555.
E-mail: LET2004@iwahq.org.uk

ECWATECH
JUNE 1-4

The 6th international trade fair and conference about water, ecology and technology will be held in Moscow, Russia.
Enquiries: Mr Sergey Malygin. SIBICO International Ltd, PO Box 173, Moscow 107078, Russia. Tel: +7 (095) 975 5104. Fax: +7 (095) 975 3423.
E-mail: ecwatech@sibico.com
Web: www.ecwatech.com

WATERSHED 2004
JULY 11-14

The Water Environment Federation (WEF) will sponsor an international speciality conference in Dearborn, Michigan, USA, on integrated resource management and environmental protection using watershed approaches.
Enquiries: WEF, 601 Wythe Street, Alexandria, VA 22314-1994, USA. Tel: 703 684 2400 x 7010.
E-mail: watershed04@wef.org

HYDROLOGY
JULY 12-16

This conference – Hydrology: Science and Practice for the 21st Century – will be held in London, United Kingdom, and is designed to bring together hydrologists involved in scientific research and operational practice to address key issues affecting hydrology in the new century.
Enquiries: For more information, please visit the website: www.hydrology.org.uk/bhs2004/welcome.htm

WATER GOVERNANCE
AUGUST 29 - SEPTEMBER 1

An international speciality conference on "Good water governance for people and nature: What roles for law, institutions, science and finance?" will be held in Dundee, Scotland.
Enquiries: American Water Resources Association – 4 West Federal Street/PO Box 1626, Middleburg VA 20118-1626. Tel: (540) 687 8390. Fax: (540) 687 8395.
E-mail: info@awra.org

ANAEROBIC DIGESTION
AUGUST 29 - SEPTEMBER 2

The 10th World Congress – Anaerobic Digestion 2004 - with the theme: Anaerobic Bioconversion for Sustainability will be held in Montreal, Canada.
Enquiries: Mrs Marie Lanouette, National Research Council Canada, 1200 Montreal Road, Building M-19, Ottawa, ON, Canada K1A0R6. Tel: (613) 993-0414. Fax: (613) 993 7250.
E-mail: ad10.2004@nrc-cnrc.gc.ca
Website: http://www.ad2004montreal.org

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.

TROUT FARMERS
SEPTEMBER 16-18

The 50th conference and trade show of the US Trout Farmers Association will be held in Twin Falls, Idaho, United States.
Enquiries: Mary Lee. Tel: 304 728-2167. Fax: 304 728 2196.
E-mail: ustfa@intrepid.net

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/

AQUACULTURE
SEPTEMBER 26-29

The Australasian Aquaculture 2004 conference will be held in the Sydney Convention and Exhibition Centre in Darling Harbour, Australia.
Enquiries: Dr Tom Lewis. 73 Lansdowne Crescent, West Hobart 7000. Tel/Fax: (03) 6231 9230. Cell: 0417 537 806.

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

AQUACULTURE
OCTOBER 20-23

The conference "Aquaculture Europe 2004: Biotechnologies for Quality" will be held in Barcelona, Spain.
Enquiries: The Secretariat. Tel: +32 59 323859. Fax: +32 59321005.
E-mail: ae2004@aquaculture.cc
Web: http://www.easonline.org

FISHERIES
NOVEMBER 30 - DECEMBER 4

The 7th Asian Fisheries Forum and conference will take place at the Hotel Equatorial in Penang Malaysia. The theme will be "New dimensions and challenges in Asian Fisheries in the 21st century". Special symposia will include: Advances in shrimp biotechnology; Technology needs and prospects for Asian aquaculture – participation of the poor; and Biotechnology for growth and reproduction in fish.
Enquiries: The Secretariat, 7th Asian Fisheries Forum, School of Biological Sciences, University Sains Malaysia, 11800 Minden, Penang, Malaysia. Tel: 60 4 6533 888 ext 3961. Fax: 60 4 6565125.
E-mail: 7aff2004@usm.my