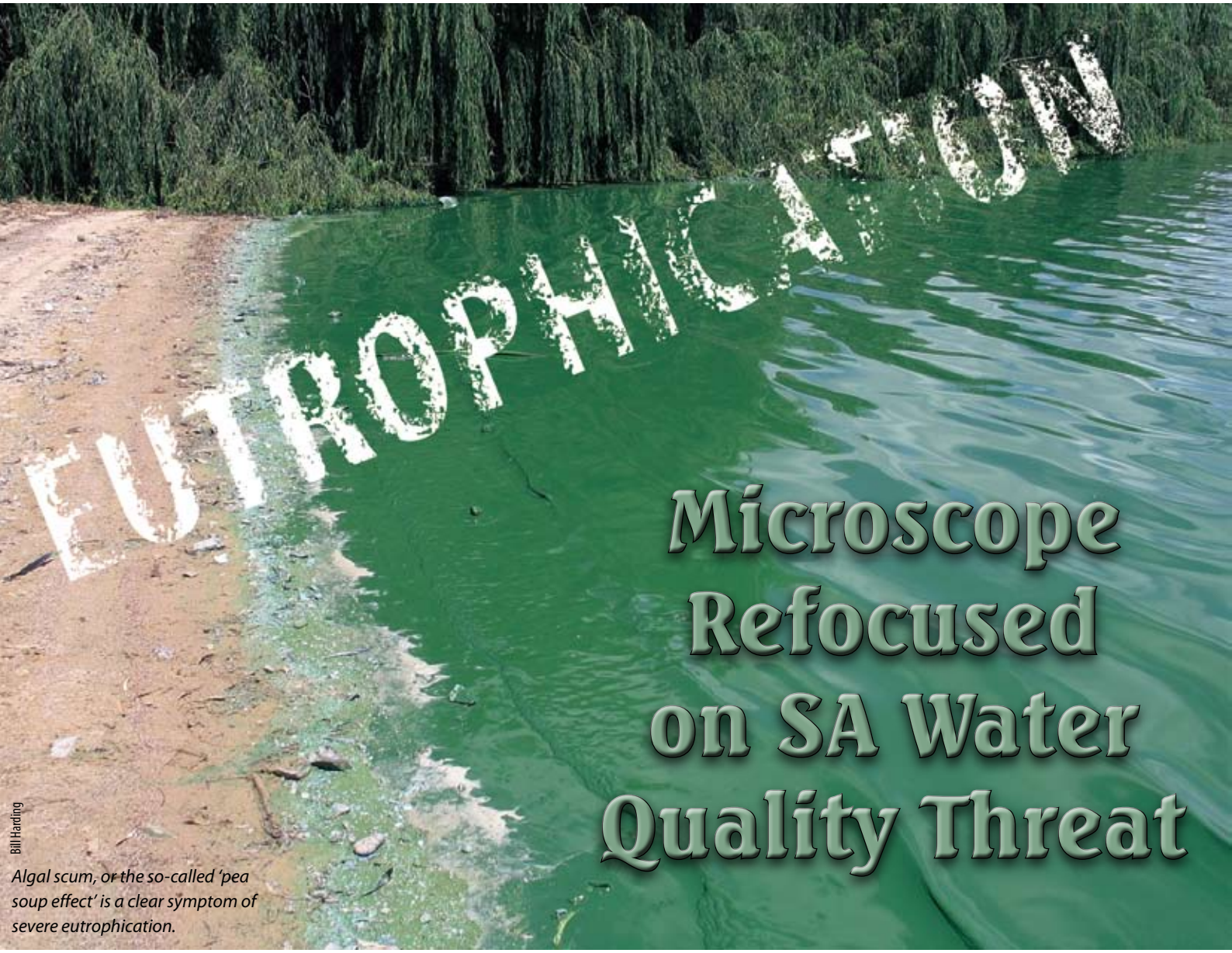

Bill Harding

Algal scum, or the so-called 'pea soup effect' is a clear symptom of severe eutrophication.

Microscope Refocused on SA Water Quality Threat

A new guide and associated tools developed with funds from the Water Research Commission (WRC) hopes to improve the management of one of the greatest threats to South Africa's water resources. Lani van Vuuren reports.

Eutrophication is a persistent water quality problem, plaguing water resource managers around the globe. In South Africa, eutrophication has been recognised as a priority water quality problem for over 30 years. The country has some of the most nutrient enriched water bodies in the world, highly problematic considering that, as a water scarce country, South Africa is hugely dependent on water stored in dams.

At present, 35% of the total storage available in our dams is either eutrophic (very nutrient enriched) or hypertrophic (extremely nutrient enriched). "If we add this to the number of dams in which the conditions are approaching eutrophic, then a total of 60% of our stored water is impaired," reports Dr Bill Harding of DH Environmental Consulting and co-author of ***A Guide to Catchment-Scale Eutrophication Assessments for Rivers, Reservoirs and Lacustrine Wetlands***, which has just been published by the WRC.

A PROLIFIC PROBLEM

Why is eutrophication so prolific in South Africa? Eutrophication assessment guide co-author Nico Rossouw of Ninham Shand explains that over the years, the management of the country's water has evolved to maximise the use

of this scarce resource. This includes the treatment and disposal of wastewater effluent back into rivers for further use by downstream users.

"However, domestic wastewater is rich in nutrients and not all wastewater treatment works are equipped or operated to efficiently remove phosphates. The result is high nutrient loads entering our rivers and reservoirs resulting in eutrophication of those water bodies," Rossouw tells ***the Water Wheel***. "In some cases, treated wastewater is the main or only inflow into a river or reservoir during the low rainfall months."

"In some cases, treated wastewater is the main or only inflow into a river or reservoir during the low rainfall months."

For this reason, eutrophication generally tends to be associated with areas where South Africa's population is concentrated and large volumes of wastewater are generated. (Hartbeespoort Dam, which suffers from extremely hypertrophic conditions, receives around 175 t/year of phosphates from more than a dozen wastewater treatment plants in the catchment). Rossouw adds that South Africa's abundant sunshine and warm water temperatures also create ideal conditions for algae to flourish.

SHRINKING EXPERTISE

Until the mid-1980s, South Africa was a world leader in research in the field of eutrophication. Unfortunately, this advantage has since been lost due to eutrophication being afforded low priority status by government, which led to the termination of funding for research in this field. Many of the researchers involved in early eutrophication research have since moved into better research fields, into consultation or have emigrated. As a result, appropriate management strategies directed against eutrophication have been seriously constrained by a widespread lack of understanding of the problem, particularly at the decision-making level.

The new millennium has seen renewed interest in eutrophication management and research, thanks largely to a WRC report on eutrophication-related policy and research needs in South Africa, authored by Dr Danny Walmsley, and published in 2000. Dr Walmsley found that the lack of input to policy development, monitoring, research, reporting and capacity development had diminished South Africa's ability to deal with the problem.

"The situation is now being reversed, with investment in eutrophication research improving and processes being put in place to close the gap between setting policies for eutrophication management and implementing management actions to deal with the problem," reports Rossouw. Unfortunately, according to Dr Harding, the scope remains somewhat fragmented, with the development of human capacity with understanding of the problem still lacking. "Critically, public awareness and understanding are not being developed to the same level as has been achieved in Europe, Australia and the US, where we are now seeing court action related to eutrophication of water bodies," he notes.

TURNING THE TIDE

The latest WRC eutrophication assessment guide is aligned with present water resource management policies and procedures endorsed by the Department of Water Affairs & Forestry (DWAF). The document sets out the key components of an investigation required to assess the eutrophication status of a catchment or sub-catchment, with a view to developing management options that take into account the needs and aspirations of stakeholders and also the constraints imposed on a particular catchment.

It is structured around six management questions, each of which is designed to

LEVELS OF EUTROPHICATION:

Oligotrophic: Indicates the presence of low levels of nutrients and no water quality problems.
Mesotrophic: Indicates intermediate levels of nutrient levels, with emerging signs of water quality problems.
Eutrophic: Indicates high levels of nutrients and an increasing frequency of water quality problems
Hypertrophic: Indicates excessive levels where plant production is governed by physical factors. Water quality problems are almost continuous.

Lani van Vuuren

Rietvlei Dam, located in the Crocodile West-Marico water management area (WMA), is also considered hypetrophic. Most of the dams with eutrophication problems are situated in this WMA.

Bill Harding

Fish deaths due to extreme hypertrophic conditions is common, mostly as a result of toxic cyanobacteria (blue-green algae).

EUTROPHICATION IN SOUTH AFRICA – A SHORT HISTORY

1950s-1960s: The first impacts of eutrophication became apparent in the 1950s, reaching problematic levels in the 1960s.

1970s: Eutrophication, as a serious water problem is brought to the attention of water resource managers. Research by the National Institute for Water Research resulted in the publication of the first review of eutrophication and initial guidelines for its control. This is followed by an investigation into eutrophication problems in several South African reservoirs. This research results in a second report, providing guidelines for the control of eutrophication in South Africa.

1980s: The Department of Water Affairs & Forestry (DWAF) issues a special phosphorus standard (1 mg P/ℓ) on effluent discharged into sensitive catchments. The knowledge base is extended through various research studies, for example, the Hartbeespoort Dam research project, nuisance algae at Vaal Dam and Barrage; eutrophication studies at Roodeplaat, Bloemhof and Hartbeespoort dams, and nuisance algae and treatment studies at Balkfontein.

1990s: Funding for large multidisciplinary research on eutrophication declines and research and training initiatives at universities become eroded. Eutrophication-related technical and scientific publications are almost non-existent during this period. As a result, decision-makers are not exposed to information on the subject. Capacity to manage eutrophication is reduced due to staff transformation and high staff turnover.

2000-present: A Water Research Commission (WRC) funded assessment by Dr Danny Walmsley into South Africa's policy towards eutrophication (WRC Report No: **KV129/00**) found that the country's policy and approach to eutrophication control has been inadequate over the last 20 years. A lack of input into policy development, monitoring, research, reporting and capacity development has greatly diminished the country's ability to deal with the problem. As a result, eutrophication management starts receiving considerably more attention by DWAF, supported by initiatives from the WRC. The National Eutrophication Monitoring Programme (www.dwaf.gov.za/iwqs/eutrophication/NEMP/default.htm) is designed in a joint initiative between DWAF and the WRC. This programme is still yielding data and information on eutrophication status of a large number of water bodies in South Africa.

be answered through the execution of a corresponding eutrophication assessment task:

- Characterisation of current eutrophication status and historical trends;
- Engagement with water-related institutions and stakeholders;
- Formulation and recording of eutrophication-related water quality issues, concerns, problems and opportunities;
- Projection of eutrophication-related water quality impacts of future water-related development scenarios;
- Formulation and prioritisation of eutrophication management options; and
- Monitoring and auditing of the implementation of eutrophication management strategies.

ON-LINE ASSISTANCE

Along with the guide, an Internet-based eutrophication assessment guide has been developed (www.dhec.co.za/neap/). The so-called nutrient enrichment assessment protocol (NEAP) has been designed as a simple-to-use, phosphorus-based, eutrophication screening tool for open water environments (lakes and dams). As such it provides a non-data intensive means of determining the trophic status (degree of nutrient enrichment) of water bodies. As a screening tool it can be used to inform options for management by providing a rapid approximation of the level of eutrophication in a particular reservoir. Despite the simplicity of the tool, it is extremely important that NEAP users understand that eutrophication is not simply a function of phosphorus loads and concentrations, but that a wide variety of biophysical and chemical factors can enhance or constrain the observed level of eutrophication in a particular water body.

Dr Harding reports that the use of NEAP has been promising. Interestingly there has been interest not only from South Africa, but also from overseas. In fact, more international users are registered to use the product than South Africans at present. "The value of a product such as NEAP is that it support the development of an understanding of how lakes and reservoirs behave – on multiple levels from hydromorphology to nutrient assimilation."

SHORT COURSE

The need to rebuild capacity for the assessment and management of eutrophication provided the motivation behind the third tool developed as part of this project, namely the design of an eutrophication short course based on the eutrophication assessment guide. Course material has been prepared mainly for water resource managers and practitioners as well as for freshwater scientists and, secondly, for students at tertiary training institutions.

Level of eutrophication in reservoirs and lakes in developed vs developing countries

Area	Percentage of lakes/ reservoirs impaired by eutrophication
Asia	54%
Europe	53%
North America	48%
South America	41%
Africa	28%
South Africa	35%

The course provides participants with a broad overview of eutrophication and nutrient enrichment, especially in South African rivers, dams and lacustrine wetlands. Furthermore, it imparts knowledge on approaches to deal with the problem through legislation and the basic approach and steps needed to undertake a catchment-scale eutrophication assessment study.

The research team believes that the outcomes of this project can contribute greatly to rebuilding the necessary capacity in South Africa to deal with eutrophication effectively. "Eutrophication problems occur in all parts of the country, and from discussions with DWAF officials it is clear that the regional offices who deal with these problems experience serious capacity constraints due to a high turnover in junior water quality managers and an exodus of experienced water quality managers from the department in recent years," reports Rossouw. "The eutrophication assessment guide and its supporting tools will certainly help less experienced staff, not only in DWAF but also in local authorities, to take a first stab at assessing an eutrophication problem, identifying some of the root causes and drawing up a short list of possible management interventions. It also provides guidance on when it is appropriate to involve eutrophication experts to investigate or advise on specific problem areas."

Besides being of immediate value, it is hoped that the outcomes of this project will serve as a platform for further development of eutrophication assessment and capacity building tools.

To order the eutrophication assessment guide, **Report No: TT 352/08** or related report, ***The Determination of Annual Phosphorus Loading Limits for South African Dams*** (**Report No: 1687/1/08**) contact Publications at Tel: (012) 330-0340, Fax: (012) 331-2565 or E-mail: www.wrc.org.za

WHY THE CONCERN OVER EUTROPHICATION?

Eutrophication refers to the enrichment of water bodies (such as dams and lakes) with plant nutrients, particularly phosphorus and nitrogen compounds. It is a natural phenomenon that normally occurs during the life of an impoundment or a lake and can take thousands of years to occur. However, agricultural and urban runoff, municipal and industrial wastewater effluents, and septic tank leach fields all contribute plant nutrients, as well as other pollutants, to catchment areas, which accelerate the eutrophication of lakes and dams.

Water bodies that are eutrophic (nutrient enriched) experience an increase in algae (especially cyanobacterial or blue-green algae which can be toxic) and weedy aquatic plants, such as water hyacinth, which choke waterways. Extreme and prolonged eutrophication leads to the deterioration of water quality, taste and odour problems, oxygen depletion, and decline of more desirable fish species. The resultant prolific growth in algae also disrupts water treatment, which means the water is more expensive and difficult to treat for drinking water purposes. Nutrient enrichment, therefore, remains one of the leading causes of water quality impairment in the world.

Source: DWAF

Heidi Snyman

Hartbeespoort Dam is arguably one of the most notorious hypertrophic dams in South Africa. In March 2003, the dam experienced one of the worst algae blooms in its history.

Lani van Vuuren

Even during winter water hyacinth plagues Pretoria's Roodeplaat Dam.