

The changing face of RIETVLEI DAM



One of the six water circulation machines situated in Rietvlei Dam.

Visitors to the Rietvlei Dam, in the past described as one of the most eutrophic dams in South Africa, might be pleasantly surprised by the blue, odour-free water that greets them nowadays. And while the jury is still out as to what exactly is responsible for this incredible turnaround the finger is increasingly pointing to 16 unassuming pieces of machinery scattered around the dam. Article by Lani van Vuuren.

In South Africa, eutrophication has been recognised as a water quality problem for over 30 years. The country has some of the most nutrient enriched water bodies in the world, with around 35% of our dams being either eutrophic (very nutrient enriched) or hypertrophic (extremely nutrient enriched).

Constructed between 1932 and 1934, Rietvlei Dam has been an important source of drinking water

for the City of Tshwane. Today, it still provides around 6% of the city's drinking water requirement while also being the centre of one of the country's few urban nature reserves. The 32 m-high wall holds back around 12-million m³ of water, and the dam covers a surface area of 1,87 km².

Unfortunately, the location of Rietvlei Dam's catchment, which extends as far as OR Tambo International Airport and the resultant urban, industrial and agricultural pollution, has caused the dam to become hypertrophic. Algal blooms were reported as early as 1974, and often comprise mainly of *Microcystis*, a species of cyanobacteria (blue-green algae) which produce harmful toxins that are neurotoxic and hepatotoxic in nature.

More prolific during the warmer, summer months, these blooms are not only harmful to the animals of the nature reserve and recreational

users of Rietvlei Dam, but can also cause bad tastes and odours in drinking water. To cope with the water quality hassles associated with eutrophic blooms the Rietvlei Water Treatment Works has had to repeatedly extend its treatment capabilities through the years. The original processes of flocculation, settling, filtration and chlorination have been augmented with dissolved air flotation in the 1980s, followed by granular activated carbon as a polishing step in 2000. Online turbidity units have also been installed on all filters and on the incoming and final water produced. This has been followed by the recent introduction of ozonation.

Despite the availability of these sophisticated technologies, keeping the drinking water quality up to standard has been challenging. "The inconsistency in incoming water quality has made the water from Rietvlei Dam very difficult to treat," explains Leanne Coetzee of

the City of Tshwane Scientific Services. “Dosage and types of chemicals used have had to change quickly, particularly as a result of the blooms’ influence on turbidity. In addition, we have experienced a significant pH bump with high pH readings during the day as a result of the cyanobacteria’s photosynthesis during the day followed by a drop in pH at night when no photosynthesis occurred.” As a result it has not been unusual for Leanne and her team to get called to the plant in the middle of the night to deal with these sudden changes in water quality. The algae also resulted in filter clogging and increased backwashing, reducing the output of drinking water from the plant while increasing operational costs.

INVESTIGATING THE OPTIONS

The City of Tshwane investigated several possible options to control eutrophication and prevent the outbreak of cyanobacterial blooms at Rietvlei Dam. A challenging aspect was that any solution had to be wary of the conservational and recreational importance of the dam. “The management of the Rietvlei Nature Reserve were very clear that any solution we implemented was not to disturb or be harmful to the fauna and flora of the Reserve. We also had to take cognisance of the importance of Rietvlei for Pretoria’s water sport enthusiasts. This ruled out the use of any chemicals, for example,” says Coetzee.

As a result, the City took a very brave decision by implementing a solution previously untested in South African waters. In 2008, the metro installed the first of a series of SolarBee units – solar-powered water circulation machines developed in the USA. SolarBees are basically upflow pumps with a flexible intake hose that can draw water up from any depth.

The specially-designed distribution dish at the surface allows up to 40 000 ℓ/minute direct and induced

RIETVLEI – A CITY ASSET

Situated about 18 km from the Pretoria CBD, the Rietvlei Nature Reserve covers about 3 800 ha of grassland, extensive vlei areas and the scenic Rietvlei Dam.

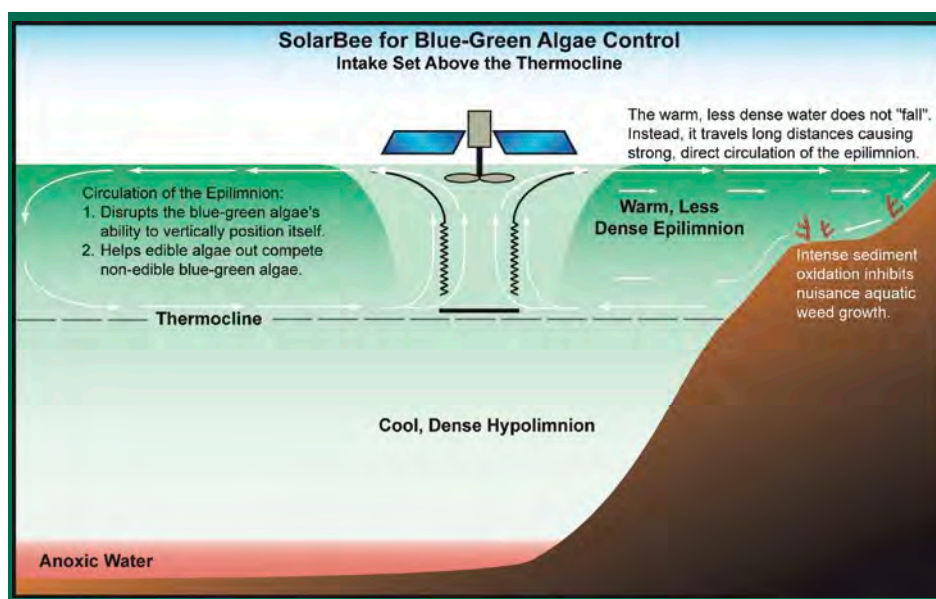
The supply of clean drinking water and the protection of the catchment are the main reasons for the establishment of the reserve. There are three sources of water on Rietvlei, namely the dam with its purification plant below the wall, five fountains and five boreholes. The reserve supplies about 15% of Pretoria’s drinking water (about 40-million ℓ/day).

The reserve is owned and managed by the City of Tshwane, and features some 1 600 head of game, including blesbuck, black wildebeest, red hartebeest, eland, Burchell’s zebra, waterbuck, reedbuck, springbuck, mountain reedbuck, steenbuck and grey duiker. Nocturnal animals such as brown hyena, black-backed jackal, aardwolf and porcupine, to name a few, can also be found here. Over 270 species of birds have been identified and confirmed on the reserve.



“The water quality in the dam has improved tremendously and the occurrence of cyanobacterial blooms has almost disappeared.”

How the solar-powered water circulation machine works.





Lani van Vuuren



Rietvlei Dam before (2007, top) and after (2011, bottom) the installation of the SolarBees.

flow of water to move radially in all directions up to 200 m away from the machine. In this way, the upper waters where the cyanobacteria grow are put into a slow but continuous motion. Three 80 Watt solar panels provide enough energy to run the sealed, magnetic motor and digital control box 24 hours a day. One unit can treat around 12 ha of lake or dam surface area.

STEADY IMPROVEMENT

“Research has shown that when the habitat of cyanobacterial blooms is disturbed it creates a habitat in which cyanobacteria are no longer the dominant species and there is more species diversity,” Coetzee tells *the Water Wheel*. Monitoring and data collection since the installation of the SolarBees has shown slow but steady

improvement in the water quality of Rietvlei Dam.

“The water quality in the dam has improved tremendously and the occurrence of cyanobacterial blooms has almost disappeared,” says Coetzee. “Cyanobacterial growth has decreased allowing the ecosystem to return to a more natural state by enabling the growth of green algae. These green algae are consumed, allowing for the improvement of the entire food chain. “The changes have been gradual but water quality has improved every year since installation,” notes Coetzee.

With the raw water quality now more consistent, the water treatment plant is able to run smoother without needing sudden changes in protocol. In addition, operational costs have decreased as less expensive chemicals and backwashing are required since the water contains only low or no cyanobacteria toxins.

The SolarBee units are a true ‘green’ technology. Virtually maintenance free the only problem experienced so far has been that they tend to move out of position during periods of high rainfall or wind. However, they are easily towed back into position, and the City is now looking into using a different anchoring mechanism to improve their spatial stability.

The inconspicuous machines have proved a significant attraction to the local water bird population. Luckily the SolarBees have been equipped with bird repellent kits to prevent the birds from using the machines as nesting perches. Yachters and canoeists have also expressed their satisfaction with improved conditions at the dam.

In fact, at the time of writing the City of Tshwane was investigating the possible implementation of the units at other reservoirs, such as Leeukraal and Roodeplaat. Security issues and budget constraints are among the factors that will influence whether the machines are deployed there.

The implementation of the SolarBees is not the only factor that could have lead to improved water quality

conditions at Rietvlei Dam, though. Good rainfall over the last couple of years, as well as improvements at upstream wastewater treatment plants, could also have played a role. Working for Wetlands has also done much to restore the reserve's wetland, which aid in clean the incoming water to the dam.

The Water Research Commission has launched a new project that will, among other aims, seek to unlock some of the scientific reasons behind the improvement of the dam's water quality. The study, lead by North West University, will compare present ecological data with historical data to present a clearer picture of the ecological status of the dam and the influence of the SolarBees. Its primary focus, explains WRC Research Manager, Dr Kevin Murray, is to test the validity of a model originally developed to forecast the occurrence of cyanobacterial blooms up to three weeks ahead. The project has just kicked off and will run until 2015.

Whatever the reason it is clear that after four decades of battling eutrophication and cyanobacterial blooms, Rietvlei Dam has turned the corner. It is hoped that its success will be long term, and that it can be replicated to improve the water quality in other eutrophied dams in South Africa on which we so much depend for our daily drinking water. □

"The SolarBee units are a true 'green' technology. Virtually maintenance free the only problem experienced so far is that they tend to move out of position during periods of high rainfall or wind."



Lani van Vuuren

Top right: The clearer water of the Rietvlei Dam has now become a recreational pleasure for Pretoria's yachters and canoeists.

Middle right: Rather than deterring wildlife the water circulation machines have become a huge attraction to Rietvlei Dams' waterbirds.

Below: Every SolarBee treats around 12 ha of dam surface area.



Lani van Vuuren



Lani van Vuuren