

# THE WATER WHEEL

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## NON-REVENUE WATER

*New 'one-stop-shop' to improve non-revenue water management*

## SLUDGE MANAGEMENT

*Avast! Why sewage sludge is bound for the rocks – and how to turn her around*

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**Editorial Committee:**

Prof Sylvester Mpandeli (Chair), Ms Manjusha Sunil, Mr Bonani Madikizela, Dr Mamohloding Tlthagale and Dr Sudhir Pillay.

**Editorial offices:**

Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa.

Tel (012) 761 9300.

**WRC Internet address:**

<http://www.wrc.org.za>

**Follow us on X:**

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**Editor:** Lani van Vuuren,

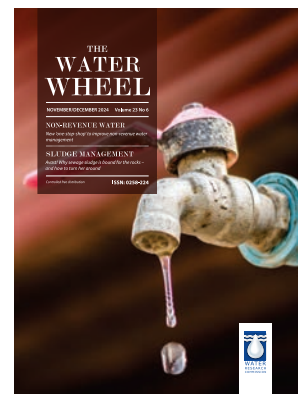
E-mail: [laniv@wrc.org.za](mailto:laniv@wrc.org.za);

**Layout:** Anja van der Merwe,

E-mail: [anjavdm@wrc.org.za](mailto:anjavdm@wrc.org.za)

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*A newly launched initiative has consolidated all of South Africa's non-revenue water knowledge in one place. See article on page 10.*

## NEWS

## Water Security in Africa research programme kicks off



More than 100 researchers and collaborators from southern Africa and Germany convened in Stellenbosch earlier this year for the launch of the Water Security in Africa (WASA) research programme.

The aim of the programme is to contribute to achieving a sustainable increase in water security in Africa. This includes the improvement of water supply and wastewater management as well as the preservation of natural ecosystems.

The programme's guiding principles are to enable joint action by African and German partners from the start of the project, adopt a synergistic and integrated approach involving different ministries and political representatives as well as a focus on applied research and implementation.

WASA includes more than 90 collaborating partner institutions who are uniting under three main thematic fields, namely: sustainable water resource management; water infrastructure and water technology; and hydrological forecasts and management of hydrological extremes.

For more information, visit: <https://www.watersecurityafrica.org/en/frontpage/>

## New research group to advance nature-based climate solutions in Africa

The African Climate & Development Initiative (ACDI), based at the University of Cape Town (UCT), has launched the People in Nature & Climate (PiNC) Lab, a new nature-based, solutions-focused research group. This innovative lab aims to tackle some of the continent's most pressing societal and environmental challenges, by exploring how nature can be used to promote both human and ecosystem health while adapting to and mitigating climate risks across Africa.

Nature-based solutions are strategies that harness the power of nature and natural processes to address environmental and societal challenges. Through the protection, restoration and management of ecosystems, these solutions help

address issues such as climate change, food and water security, and biodiversity loss.

Under the guidance of Lab Lead Dr Petra Holden, the PiNC Lab is dedicated to generating evidence and ideas to support nature-based solutions, with a particular emphasis on sub-Saharan Africa. By collaborating with local and international partners, the lab aims to enable equitable and effective nature-based actions that promote local and planetary health.

The PiNC Lab's mission reflects the growing global recognition that nature can provide solutions to a wide range of climate-related issues, from food and water security to biodiversity loss and

land degradation. Despite the potential of these nature-based solutions, they are often under-funded and under-prioritised.

In response, the PiNC Lab focuses on developing solutions that are effective, financially viable, and inclusive of communities and local knowledge. "As scientists, we need to take risks and make big investments in our research to find solutions for tackling the complex challenges presented by climate change," says Holden. "At the PiNC Lab, we move beyond diagnosing problems to finding, testing and co-creating nature-based solutions that work for people, nature, and the planet – at every scale."

## Norway and South Africa collaborate on groundbreaking climate projects

The National Research Foundation (NRF) of South Africa and Research Council of Norway (RCN) have announced their collaboration on ten climate research projects to be implemented in both countries.

The funded projects include research on sustainable and equitable development in Oslo and Cape Town; ecosystem management in the mountain regions of Norway and South Africa; and sustainable seafood farming practices to ensure economic, environmental and social sustainability in the fjord outside Ålesund and in Saldanha Bay, South Africa.

The projects will receive close to 60

million Norwegian kroner, or R100 million and will encompass common problems within urban development; extinction of species; global value chains in the export of wine; management of marine and fishery resources; planning of renewable energy in various landscapes; and how to prevent and combat increasing rates of forest fires.

Says NRF CEO, Dr Fulufhelo Nelwamondo: "The NRF-RCN collaboration is long and strategic for both sides and the new version is even better in that bigger consortia projects will be supported. [The two organisations] are aiming for the enhanced knowledge to address common challenges within areas under

pressure, particularly sustainability, use and management of land, as well as the utilisation of funded projects results by policy makers, public institutions, private sector and/or civil society."

Norway's Minister of International Development, Anne Beathe Kristiansen Tinnereim says: "We are now continuing a much-requested research collaboration with good results. South Africa and Norway have cooperated well for a long time on nature, oceans and the environment, both politically and within research. I look forward to seeing what skilled researchers in both countries will deliver through this new phase of our collaboration."

## Water minister calls for unity towards sustainable water development

Water and Sanitation Minister, Pemmy Majodina, has called for unity across Africa in sustainable water development and collaboration through public private partnerships and investment. She made this call during the 9<sup>th</sup> Africa Water Week, which took place from 13 – 17 October, in Cairo, Egypt.

"We say water is life and sanitation is

dignity. It requires political will to drive the Sustainable Development Goal 6. Collaboration and cooperation are key to our success," Majodina noted. "Government alone will not be able to achieve this mammoth task. We will continue to forge public-private partnerships because we believe that working together, we can deliver more."

During her visit, Majodina also held bilateral meetings with Egypt, the Orange-Senqu River Commission and the Netherlands, aimed at strengthening relations between countries and to propose other forms of ensuring sustainable water provision through shared water resources.

## UCT sustainability project converts waste to energy and water

The University of Cape Town's (UCT's) Centre for Bioprocess Engineering Research has devised an innovative project that breaks down waste and converts it into an energy source for cooking or to produce water that can later be used to irrigate on-campus vegetable gardens.

The project is part of a campus-wide project to support environmental sustainability goals of UCT's Vision 2030. The five-year-long project includes leading research, feasibility studies and proof-of-concept living laboratories on campus. "The project aims to address certain environmental challenges we

face. These include increasing food waste volumes, the costs associated with disposing of this waste, as well as the significant carbon and water footprints that emanate from landfill disposal," said Kotsiopoulos.

The waste is formed into a multi-product system that incorporates a range of useful stages, including using biogas, a renewable fuel that's produced when organic matter such as food or animal waste is broken down by microorganisms in the absence of oxygen, as an energy source for cooking or alternative applications. The nutrient-rich effluent stream is then channelled through an

aeronic system, also referred to as a vertical farm (the practice of growing plants in an air or mist environment without any substrate), to produce fit-for-purpose water. Solids generated through this process can also be used as fertilizer.

Kotsiopoulos said the constructed arrangements of the vertical farms have the potential to contribute to UCT's interior and exterior landscaping design while also functioning as prospective low-cost climate control arrays that offset building cooling requirements and electricity costs.

# GLOBAL

## River pushing up Mount Everest's peak



Mount Everest is 15 to 50 m taller than it would otherwise be because of uplift caused by a nearby eroding river gorge, and continues to grow because of it, a new study has found.

The study by University College London, which was published in *Nature Geoscience*, found that erosion from a river network about 75 km from Mount Everest is carving away a substantial gorge. The loss of this landmass is causing

the mountain to spring upwards by as much as 2 mm a year, and has already increased its height by between 15 and 50 m over the past 89 000 years.

At 8 849 m high, Mount Everest is the tallest mountain on Earth, and rises about 250 m above the next tallest peak in the Himalayas. Everest is considered anomalously high for the mountain range, as the next three tallest peaks – K2,

Kangchenjunga and Lhotse – all only differ by about 120 m from each other. A significant portion of this anomaly can be explained by an uplifting force caused by pressure from below Earth's crust after a nearby river eroded away a sizeable amount of rocks and soils. It is an effect called 'isostatic rebound', where a section of the Earth's crust that loses mass flexes and 'floats' upwards because the intense pressure of the liquid mantle below is greater than the downward force of gravity after the loss of mass. It is a gradual process, usually only a few millimetres a year, but over geological timeframes can make a significant difference to the Earth's surface.

Today, the Arun River runs to east of Mount Everest and merges downstream with the larger Kosi River system. Over millennia, the Arun has carved out a substantial gorge along its banks, washing away billions of tons of earth and sediment.

- To view the original journal article, visit: <https://www.nature.com/articles/s41561-024-01535-w>

## Research shows legal challenges to climate action on the rise

As the global push towards low-carbon societies accelerates, a new study reveals that justice concerns are increasingly surfacing in legal disputes over climate policies and projects. This phenomenon, described as 'just transition litigation', emphasises the need to balance climate action with social justice considerations, ensuring that vulnerable communities are not disproportionately impacted.

Published in *Nature Sustainability*, the study, led by Prof Annalisa Savaresi at the Centre for Climate Change, Energy

and Environmental Law, University of Eastern Finland, highlights the emerging phenomenon of just transition litigation, which is described as legal disputes challenging the fairness and justice of climate policies and projects, such as wind farms, biomass plants and dams.

Co-authored by experts from 16 institutions, the article argues that while the low carbon transition is essential, it disproportionately impacts vulnerable groups, including indigenous peoples, workers and local residents. For example,

the Sámi Indigenous People in Norway successfully challenged the construction of wind farms on their traditional herding pastures, illustrating the potential of just transition litigation to protect the rights of marginalised communities. According to Prof Savaresi, lawsuits like these exemplify the often overlooked and highly complex social dilemmas and policy conflicts that arise during the transition.

- To view the original journal article, visit: <https://www.nature.com/articles/s41893-024-01439-y>

## New global database of dams and reservoirs



A database developed by the Global Dam Watch (GDW) consortium is set to transform the global understanding of dams and reservoirs.

Coordinated and led by members of a research lab at McGill University, the database integrates existing

global datasets to provide the most comprehensive resource for large-scale analyses to date. The research has been published in the journal, *Scientific Data*.

River barriers, ranging from large dams to weirs or barrages, play an essential role in water supply, flood control, hydroelectric

power production and navigation, but also have ecological consequences, including fragmenting river ecosystems and disrupting sediment flow. With the GDW database, researchers and policymakers can perform large-scale analyses of these trade-offs, leading to more sustainable and better informed water-management practices.

“The scale and depth of the data will facilitate analyses that were previously impossible, helping to strike a balance between harnessing water resources for human use and protecting the ecosystems that rely on these rivers,” said Bernhard Lehner, an Associate Professor in McGill’s Department of Geography, who oversaw the database project in his research lab over the past three years. There are 41 145 dams in the database.

- For more information, Visit: <https://www.globaldamwatch.org/database>

## UN warns world’s water cycle becoming ever more erratic

Increasingly intense floods and droughts are a ‘distress signal’ of what is to come as climate change makes the planet’s water cycle ever more unpredictable, the United Nations has warned.

Last year, the world’s rivers were their driest in more than 30 years, glaciers suffered their largest loss of ice mass in half a century, and there was also a ‘significant’ number of floods, the UN’s World Meteorological Organization (WMO) said in a report. “Water is the canary in the coalmine of climate change,” noted WMO Secretary-General Celeste Saulo in a statement accompanying the *State of Global Water Resources report*. “We receive distress signals in the form of increasingly extreme rainfall, floods and droughts which wreak a heavy toll on lives, ecosystems and economies.” Saulo said the heating up of the Earth’s

atmosphere had made the water cycle “more erratic and unpredictable”. Last year was the hottest on record, with high temperatures and widespread dry conditions producing prolonged droughts. There were also many floods around the world.

Africa was the most heavily impacted continent in terms of human casualties. In Libya, two dams collapsed due to a major flood in September last year, claiming more than 11 000 lives and affecting 22% of the population, according to WMO. Floods also hit the Greater Horn of Africa, the Democratic Republic of Congo, Rwanda, Mozambique and Malawi.

In addition to curbing the man-made greenhouse gas emissions that cause global warming, the WMO wants the world’s freshwater resources to be

monitored better, so early warning systems can reduce the damage to people and wildlife. “We cannot manage what we do not measure,” said Saulo.

Stefan Uhlenbrook, director at WMO, warned that returning to a more regular natural water cycle would be difficult. “The only thing we can do is to stabilise the climate, which is a generational challenge. The *State of the Global Water Resources report* is now in its third year and is the most comprehensive to date, with new information on lake and reservoir volumes, soil moisture data, and more details on glaciers and snow water equivalent.

- To access the report, visit: <https://wmo.int/publication-series/state-of-global-water-resources-2023>

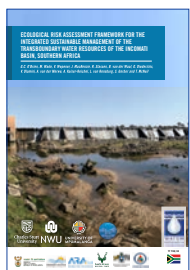
# NEW WRC REPORTS

## Quantities and quality of poop and pee in school sanitation facilities

This report aims to provide scientific support to design engineers, technology developers, regulators, and decision-makers on the development and installation of new sanitation technologies and improve faecal sludge management of rural school communities by quantifying the volumes and/or mass of urine and faeces generated, quality of faecal-origin products produced at schools through characterisation of the physico-chemical, mechanical and thermal properties. The report includes summarised results from the characterisation of faecal matter and effluent from on-site sanitation systems, approximated values of faecal matter and urine generated at each school and design guidelines for the characterisation of faecal sludge from school sanitation facilities – samples were collected in 1 L containers from mobile toilets, septic tank systems and VIP latrines in rural schools of Umbumbulu within the Umlazi district, in KwaZulu-Natal.

### WRC Report No. 3142/1/24

Link: <https://bit.ly/3C96EzK>



## Ecological risk assessment framework for the integrated sustainable management of the transboundary water resources of the Incomati basin, Southern Africa

The University of Mpumalanga with a range of partners, including the Department of Water and Sanitation (DWS), undertook a study to establish a

risk assessment framework to evaluate the effect of multiple stressors and the integrated sustainable management of the transboundary water resources of the Incomati Basin. The aim of the study was to establish a risk assessment framework to evaluate the effect of multiple stressors and contribute to the integrated sustainable management of the transboundary water resources of the catchment. The outcome of the study is a probabilistic risk framework that will dovetail with water resources management in the region, including the Resource Directed Measures activities of the DWS and the Incomati-Usuthu Catchment Management Agency. It is expected that this modelling approach will support policy development and implementation of sustainable water resource management requirements in the region and can be applied to other basins throughout the region.

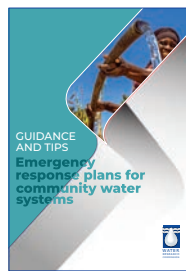
### WRC Report no. TT 938/24

Link: <https://bit.ly/48CUIcV>

## Position paper: A study examining performance-based contracting for non-revenue water and its relevance in the South African context

The non-revenue water (NRW) situation in South Africa is dire. The 2023 No Drop Report found that the national NRW figure is 47%, up from 41% in 2018 and 37% in 2012. Performance-based contracts (PBCs), where the private sector takes risk in implementing NRW interventions in exchange for a portion of the savings, have been implemented successfully internationally and twice in South Africa. PBCs have multiple advantages and appear to be a win-win for both the municipalities and the private sector but have not been applied at scale in South Africa, despite the growing NRW problem. Research funded by the Water Research Commission sought to answer the question: 'Why not?', and to propose a framework for successful implementation of these forms of contract in a South African context.

Link: <https://bit.ly/3YxHbYn>



## Emergency response plans for community water systems – Guidance and tips

All water services systems irrespective of size, location etc. should have emergency response plans (ERP) to guide officials, stakeholders and consumers through emergencies as one way of managing risks in the water-supply system. Emergencies

in the water-supply system may result from natural disasters, equipment failure, human error, and intentional acts (such as vandalism). This booklet provides tips on how to develop a water safety plan and an emergency response plan. While it is not comprehensive, the booklet aims to help communities that do not have formal water provision systems to understand: how to protect their resources and /or water-supply system infrastructure against contamination and how to manage certain water-related challenges that may lead to emergencies.

Link: <https://bit.ly/4fpGIDD>

## Transformative approaches in managing human waste and wastewater by reframing nutrient recovery from innovative sanitation technologies as integral components of farming and food systems

Transformative approaches in agriculture are needed to change the way nutrient recovery from wastewater and human excreta is perceived as an addition to sanitation technologies for sustainable waste management. Reframing human excreta management as integral components of farming and food systems should be integrative and adaptive and allow novel partnerships, cross sectoral and multi-stakeholder relationships when designing, adapting and scaling up innovative sanitation

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technologies that allow nutrient recycling. Among others, this project investigated the local community attitudes, perceptions, and barriers (legal and economic costs) towards the use of waste-based fertiliser products for crop production.

**WRC report no. 3151/1/24**

**Link:** <https://bit.ly/4eeR42O>

#### **Microbiome of VIP latrines**

Ventilated Improved Pit (VIP) latrines are designed to accumulate human excreta and anal cleansing materials and serve as a digestion system for accumulating matter that undergoes stabilisation through natural biological processes. The faecal material added becomes layered over time resulting in discrete zones with different biological, chemical, and physical conditions found within. This report provides an overview of a study undertaken to determine the microbiome of VIP contents by assessing the microbial community composition using genetic sequencing and analysis to gain a deeper understanding of the activities within VIP latrines to enable the development of a microbiome-based model of the pit latrine, based on the concept of semi-batch reactors in series.

**WRC report no. 3146/1/24**

**Link:** <https://bit.ly/4hrTzlk>

#### **Development of an eDNA approach as a novel technique for the early detection of aquatic fungal diseases-causing agents in the environment**

Environmental DNA offers an alternative to labour-intensive and invasive sampling; but still requires optimisation, validation, and standardisation. Environmental DNA monitoring could be applied as a targeted assay; where the presence of a target species is assessed using species-specific primers, or by using a more general approach in which entire communities are characterised through DNA barcoding. Emerging infectious diseases continue to pose a threat to the environment; and with animal trade increasing on a global scale, this issue has become even more concerning. This study aimed to develop an eDNA assay that will serve as the framework of eDNA assays to follow, in both South African and international fresh waters. To achieve the main objective, this study focused on two fungal-like pathogens as model organisms.

**WRC report no. 3075/1/23**

**Link:** <https://bit.ly/4e9wzo7>

**To download any of these reports**  
click on the web link provided, email:  
[hendrickm@wrc.org.za](mailto:hendrickm@wrc.org.za) or visit: [www.wrc.org.za](http://www.wrc.org.za)





# NON-REVENUE WATER

## New 'one-stop-shop' to improve non-revenue water management

*Petro Kotzé reports on a new online knowledge hub aimed at helping water managers with the rising problem of non-revenue water.*



As recently highlighted in provinces such as Gauteng, non-revenue water (NRW) is a critical issue for municipalities. NRW refers to water that is produced and supplied but does not generate revenue because of various losses throughout the distribution system. These losses are generally categorised into physical losses and commercial losses. Physical losses refer to leaks in the distribution systems, theft and unauthorised consumption, while commercial losses are attributed to meter inaccuracies, billing errors and data handling issues.

In South Africa, almost half of the water that is treated to drinking quality standards leaks from the distribution system or, although it costs money to treat and transport, is not paid for. There are many solutions to NRW, and the matter has been

the subject of research and new technology development for years. Technical experts have created guidelines, tools and technologies, but those who need them might be unaware of their existence or not know where to find the scattered information.

Now, the Water Research Commission (WRC), with funding from the Department of Science, Technology and Innovation (DSTI), has created an online knowledge hub where all the existing expert resources that water managers need to deal with NRW have been consolidated. It is called the NRW Management Portal South Africa (<https://managenrw.co.za/>) and it is open for business. It's more important than ever that people involved in potable water management visit the portal and use the

information, as statistics show that the amount of water lost in South Africa has increased and continues to do so every year.

## South Africa's 'lost water'

The [National No Drop Report for 2023](#), an assessment of water losses and NRW in municipalities and Water Services Authorities (WSA), details the scope of the challenge.

The report states that 4.39 billion m<sup>3</sup> of drinking-quality water was supplied to the system from rivers, dams, springs, boreholes, and bulk water service providers (called System Input Value or SIV) for 2022/23. Almost half of this (47.4%) was written off as NRW (totalling 2.08 billion m<sup>3</sup>), caused by leaks and bursts in the piping system, losses through meter inaccuracies, unauthorised consumption, billing mistakes and administrative inefficiencies, and unbilled consumption of clean water.

By far the biggest factor is water losses (40.8% or 1.79 million m<sup>3</sup>). An indication of the condition of the water system, it means that we lose most of our water through things like burst pipes, overflowing reservoirs and leaking connections, as well as poor, or lacking, metering. Over and above the poor state of the water distribution system, NRW is also a telling indicator of the state and health of municipalities that have been mandated to manage and take responsibility for the provision of services. A system in which the percentage of NRW is high cannot be financially viable.

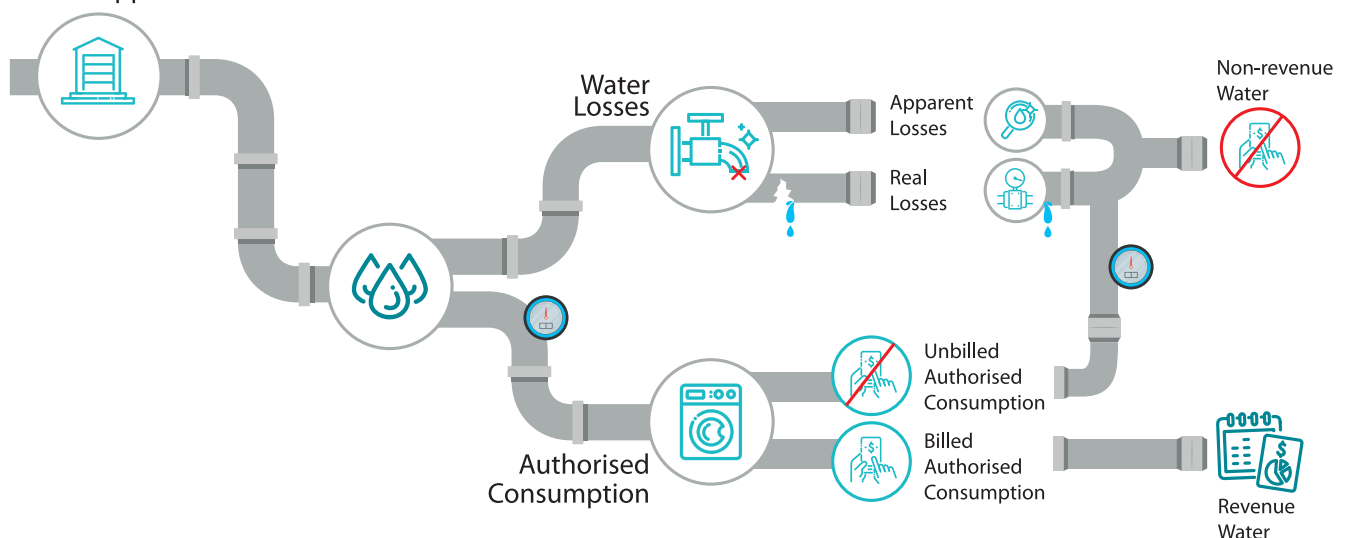
It's clear that many municipalities grapple with issues relating to infrastructure maintenance, effective billing and revenue collection, accessing budgets to undertake effective maintenance, and the skills needed to balance this suite

of dynamics. The results are visible in the statistics. Despite attempts to raise awareness about the issue, NRW and water losses have steadily increased by 5.9% and 4.3%, respectively, since June 2016.

In response, the research and innovation sector has developed and refined a portfolio of tools, guidelines, and technologies to support municipalities. Investigative studies that put in place baselines and analyse policy, skills and other dynamics also continue. Still, finding ways to help municipalities address NRW challenges remains a high priority to many partners, including the Department of Water and Sanitation (DWS), DSTI, the WRC, the South African Local Government Association (SALGA) and the Municipal Infrastructure Support Agent (MISA).

In support of positioning these research and innovation resources to be used by those who need them, WRC RDI Roadmap Manager Shanna Nienaber says partners reported that an important next step would be to fund a project to consolidate the existing knowledge base on the topic in a user-friendly way. This would also allow experts to identify gaps in the available knowledge, which can then be addressed with appropriate funding. The resulting project was undertaken by the WRC in partnership with the DSTI. Engineering consultancy WRP, which specialises in water resources engineering, water conservation, demand management, and NRW reduction, was commissioned to build the portal. The project objective was to consolidate and package the existing advisory packages, solutions, guidelines, reports, innovations and technologies in the proven and emerging pipeline related to NRW so it could be easily accessed and used by partners like the DWS, municipalities, SALGA and MISA.

## Water Supplied



*Non-revenue water is the difference between the amount of water injected into the water-supply system and the actual amount of water billed to customers as a result of real losses due to leakage, apparent losses due to metering inaccuracies or unauthorised consumption (e.g. illegal connections), and unbilled authorised consumption.*

The resulting 'one-stop-shop' for NRW management was launched at the 11<sup>th</sup> South African Water Loss Summit, held online on 20 and 21 August. It heralds the completion of the first phase of the knowledge portal. Though it caters specifically for the water services sector, water users across all sectors will find it valuable.

## **An overview of the NRW management portal**

Nienaber explains that the portal will be useful to three core user groups (as a starting point). The first group is municipalities mandated to manage and bill for water and maintain the infrastructure. The second user group is the cohort of consultants supporting municipalities in doing the work, like replacing and refurbishing pipes, water load planning, leak management, etc. The third audience is the researchers, innovators, advisors, and national departments providing an exploratory and advisory function for NRW.

The bulk of the resources available on the portal were published by the WRC and the DWS. The information is categorised into topics of advisory packages, guidelines, and tools (which form the bulk of the available resources); applied research and baseline reports; equipment and technologies; funding; policies, legislation, and regulations; practical case studies; software solutions; technical briefs, templates; and training materials. The information is available in various formats, including documents, presentations, images, spreadsheets, data, and videos.

The information, Nienaber says, is categorised to link to the stages of NRW management. "Essentially, the portal is premised on the different lifecycle management steps of dealing with non-revenue water."

These are planning, design, funding, implementation, operation, and maintenance. Together, the stages form a cohesive framework for addressing NRW and achieving sustainable water resources management, water services, and financial viability.

The portal offers the tools that will help users conduct each stage of NRW management:

- Planning stage: Strategies to identify and mitigate factors contributing to NRW, laying the groundwork for efficient water management.
- Designing: Creating infrastructure and optimising systems to minimise water loss and maximise revenue generation.
- Implementation: Translating plans into action and deploying technologies and methodologies to monitor and control water flow.
- Operation: The daily management of water distribution systems, utilising best practices to minimise losses and enhance efficiency.
- Maintenance: Activities crucial for preserving infrastructure integrity, addressing leaks, and optimising long-term performance.

## **A wealth of information, but easy to navigate**

The portal also offers different ways to search for the needed information, Nienaber says. The first route is via a custom search function. This is most suitable for people who know exactly what tools they are looking for, like experienced municipal engineers and consultants. This route allows users to search for keywords, categories or authors. For example, the keywords

'pressure management' can be tagged with 'bulk water supply'. The tools available are presented in summary and can then be downloaded.

A second route, the toolkit search, is suitable for people who are less experienced with the support tools available to support NRW implementation., Nienaber says. Here, users will find pre-packaged toolkits that list materials for the various stages of NRW management mentioned above, and they can be easily selected and downloaded.

A third option, an overview search, provides a sense of the body of knowledge available to support NRW, such as advisory packages, baseline reports, equipment and tech, case studies, and software. It offers a summary of all information available per category, an option more suitable for academics. A database of all available material on the NRW portal can also be downloaded. (From this option, users can also deduct who the experts and authorities on specific topics are.)

Based on feedback from the first phase of the project, further development and opportunities are being explored. "It's a work in progress," she says, but the existing format is already an invaluable resource. "If you visit," she says, "you're likely to find what you're looking for." The WRC is inviting all parties involved in NRW management to do exactly that. To access the information, users need to register first and then build a profile to access full functionality.

The portal is available here: <https://managenrw.co.za/>

## **Non-revenue water threatening SA's water security**

The latest No Drop Report, released in 2023, paints a bleak picture of non-revenue water in South Africa. The report assessed the degree to which drinking water distribution systems of municipalities supplied water efficiently, without wasting water. Only four municipalities scored more than 90% thus qualifying for No Drop Certification. They were Overstrand, Midvaal and Swartland local municipalities along with the City of Cape Town.

In the last ten years non-revenue water has increased 10% to 47%. This far surpasses the international average of 30%. The high percentage of NRW in South Africa is caused by physical losses, poorly functioning or non-existent water meters, illegal connections and poor billing and revenue collection. The Department of Water and Sanitation has called on municipalities to improve operation and maintenance of their infrastructure, repair leaks, improve metering, billing, revenue collection and debtor management, improve pressure management and engage in community education and awareness.

# WATER HERITAGE

## Global recognition bestowed on South African irrigation infrastructure

*Petro Kotzé reports on South Africa's first World Heritage Irrigation Structures award given to the Douglas Weir.*



Lari van Vuuren

*The Douglas Weir, as it looks today.*

Heritage is not for the sake of heritage, wrote Prof Ragab Ragab. "It has important sustainability lessons for our future survival." President of the International Commission on Irrigation and Drainage (ICID), Ragab commented on the value of the World Heritage Irrigation Structures (WHIS) Awards, established in 2012 as part of a programme that documents historical structures worldwide that have contributed to the evolution of irrigation and drainage in agriculture through history.

This past September, WHIS recognition was given to a South African structure, namely the Douglas Weir, situated on the Vaal River. Prof Sylvester Mpandeli, Chair of the South African National Committee on Irrigation and Drainage (SANCID), ICID Vice-President and WRC Senior Manager, received the award on behalf of South Africa. Mpandeli led the submission of the South African nomination. South Africa now becomes part

of an exclusive club of only three African countries (the other two being Egypt and Morocco) who have had their heritage irrigation structures recognised by ICID. Japan and China are the countries with the most awarded heritage irrigation structures.

ICID is a leading scientific, technical, and professional not-for-profit international organisation working in the field of irrigation, drainage, and flood management to the promote and achieve sustainable agriculture water management. Country membership is spread over 110 countries, covering over 95% of the irrigated area of the world.

Describing himself as a 'hardcore' scientist, Mpandeli says he became fascinated with the rich history of South Africa's water and irrigation infrastructure once he started learning more about it. One reason for this fascination is the drive for transdisciplinary



*One of the canals fed by the Douglas Weir.*

research, which includes socioeconomics, history and culture, over and above biophysical aspects in research. Another, he adds, is the need to understand where we come from and how we came to where we are now. The journey, he adds, has presented him with a unique opportunity to learn.

### **Heritage from a water perspective**

The main objectives of recognition as a WHIS are to understand the evolution of irrigation in civilisations across the world, to gather knowledge about the unique features that have sustained the project for such a long period, to learn the philosophy and wisdom on sustainable irrigation from these structures; and to protect and preserve them.

To be considered for recognition as WHIS, structures or facilities must adhere to a list of criteria. First, they must be older than 100 years. Dams (mainly for irrigation purposes), water storage structures such as tanks for irrigation, barrages, and other water diversion structures, canal systems, old waterwheels, old shadouf (hand operated devices for lifting water), agriculture drainage structures, and sites functionally related to present or past agricultural water management activity are considered.

The structures must represent a milestone or turning point in the development of irrigated agriculture and bear exceptional testimony to the development of agriculture and increase in food production along with the improvement of the economic condition of farmers. The structure must have been considered ahead of its time in terms of project formulation, engineering design, construction techniques, system dimensions, quantum

of water diverted, and size of the command.

The structures must have made an outstanding contribution to enhancing food production, livelihood opportunities, rural prosperity, and poverty alleviation in a region. They must be considered innovative at their time. They must also have contributed to the evolution of efficient and contemporary engineering theories and practices and set an example of attention to environmental aspects in its design and construction.

Lastly, the structure must have been an example of engineering marvel or excellence at the time of its construction and unique in some positive and constructive way. Last, the structure must bear the stamp of a cultural tradition or a civilisation of the past.

From the start of the awards in 2012 until 2023, the WHIS register has grown to include 159 structures from 18 countries. They include China's Chongyi Shangbao Terraces, which, according to the Classic of Mountains and Seas and other historical documents, dates to the pre-Qin period before 221 BC.

Another example is the Qazvin Qanat FazlAli Khan, an ancient Iranian irrigation structure called Qanat, which is still in use today and drives groundwater to the surface using gravitational force. The Persian qanat has a unique niche in the country's cultural, social, economic, political, and physical landscapes.

The list also includes Egypt's Aswan Dam, built across the Nile in 1898 (and completed in 1902). Described as an excellent piece

of engineering work that showcases durability, resilience, high-end engineering skills, and strategic planning, it transformed Egypt's place in history to the extent that it has been described as surpassing the Great Pyramid in service. The country's second entry is the Delta Barrage, constructed from 1833 to 1861 to improve irrigation and navigation downstream along the main Rosetta and Damietta Nile branches. It realised the development of the valuable cotton crop in the vast tracts of the Nile Delta.

The Khettaras in Morocco are also recognised. The Khettaras is a sort of water mine, an underground gallery that intercepts the water of a water table located upstream of the area to be irrigated. It ensured a limited but continued water supply to inhabitants without risking drying up the water table and limiting evaporation to a minimum. In the process, it eliminated the exhausting tasks of water supply chores.

It was these last three awarded structures that made Mpandeli sit up and take notice. While South African irrigation structures are not quite as ancient as those of Egypt, they certainly speak of the country's rich engineering ingenuity, and he was adamant that South Africa also make the list. "Bagging an award would demonstrate South Africa's diverse and rich irrigation infrastructure history," he notes. The Douglas Weir proved to be a winner.

#### **The history and significance of the Douglas Weir**

The Douglas Weir is the country's oldest and the first ever built over the Vaal. At the time of its construction it was considered to be at the forefront of water development in the country and serves as an excellent example of how erstwhile farmers started altering South Africa's water courses to overcome the volatility of the country's natural watercourses.

The purpose of the weir was to provide water to irrigate agricultural lots at the lower end of Douglas, but the farmers needed the weir to help solve water quality and shortage problems. The weir was first constructed in 1890. Shortly after completion, the weir was damaged and, in February 1894, completely washed away by floods. A new site was selected, and work on a masonry weir started again in August 1894. It is located on the south (left) bank of the Vaal River just above its junction with the Orange River.

Except for floods, the weir construction was also affected by drought and budget constraints, Mpandeli says, but the farmers persevered, and construction was finally completed in 1896 (the weir was raised in 1977).

The original Douglas Weir was a diversion scheme comprising a masonry wall some 399 m in length, with a maximum height 3.6 m in thickness built on a solid rock foundation. The weir connected to farms Atherton on the north bank and St Clair on the south bank about eight km above the town of Douglas. Water is transferred via the 24-km, concrete-lined Douglas Canal, which runs alongside the left bank of the Vaal. In 1977, the original weir was replaced with a concrete weir of saw-tooth design with two steel gates on the right flank.

The weir is located in the Lower Vaal Water Management Area and forms part of the Orange–Vaal Transfer Scheme (also known as the Orange–Douglas Government Water Scheme). Owned

by the Department of Water and Sanitation it is central to the Orange–Vaal water user association. The scheme is still in active use today and supplies an area of 8 113 ha of irrigation. Several farming activities occur around the Douglas Weir, including livestock farming and crop production.

Like the rest of the structures honoured, the Douglas Weir has withstood the tests of time and still demonstrates important lessons for water security, food security, and sustainable agricultural water management.

The Douglas Weir was constructed with the exclusive purpose to kickstart irrigation activities in the area so that the agricultural community could produce good quality products over generations. Its original creators wanted to use the weir to create employment opportunities, relieve poverty and stimulate the local economy, notes Mpandeli. "They had a long-term vision and they did not give up until they realised the dream."

Heritage, Ragab said, can also be seen as an intangible force that guides us in future. Mpandeli agrees. He already has a long list of heritage irrigation structures to submit to ICID over the next few years for consideration for inclusion on the official WHIS list. The selection is rich, he says, and it indicates what has been achieved in the country regardless of South Africa's complex and difficult history. "Our heritage can show coming generations that anything is possible and that we can achieve coming goals, together," he concludes.

At the time of writing, the WRC, together with partners, the Department of Agriculture Land Reform and Rural Development (DALRRD), the Department of Water and Sanitation, and the Agriculture Research Council (ARC), were finalising plans to hand over the Douglas Weir WHIS award to the Orange–Vaal WUA.

Prof Sylvester Mpandeli expressed his thanks to the team who aided in the preparation and submission of the Douglas Weir application to ICID, especially colleagues Gerhard Backeberg, Palo Kgasago and Michael van der Laan.



*WRC Senior Research Manager, Prof Sylvester Mpandeli, receiving the award from ICID.*

# ECOLOGICAL MONITORING

## Local government contributions to improved river ecological monitoring

*Chantel Petersen, Swastika Surujlal-Naicker and Shadley Mackenzie report on the City of Cape Town's river ecological monitoring programme.*



Sustaining water-related ecosystems in urban rivers is critical to improved living conditions in cities. The world has already lost 70% of its water-related ecosystems, which is crucial for sustainable development (Xu et al., 2019). Effective monitoring programmes are essential to understand urban river quality and the impacts of pollution on its ecosystems.

In South Africa, a progressive decline in the extent and integrity of national monitoring programmes was noted as one of the main conclusions in the Water Research Commission (WRC) funded study in 2012, 'The freshwater science landscape in South Africa, 1900-2010' (Ashton et al. 2012). Ashton et al. (2012) further stated that due to the lack of appropriate skills in the aquatic sciences, the number of water quality sites monitored had declined, with a decrease in parameters being analysed and

a decrease in sampling frequency, hampering the management of water resources. The reducing trend in water monitoring has been occurring at the same time as a general decrease in water quality. The study called for expanding monitoring efforts and a focused effort in training strong, decisive scientific leaders in aquatic science.

Four years later, Impson (2016) suggested that the minimum ideal capacity of aquatic scientists required within provincial government departments managing inland waters as a mandate in coastal provinces should be eight and six for inland provinces. These should include fish, wetland, river, and estuarine scientists with qualifications ranging from a Master's to a Doctorate. However, at the time of the assessment, only one province in South Africa had the minimum complement of

eight aquatic scientists (Impson, 2016). Van Deventer et al. (2019) showed that the water quality monitoring network (surface and groundwater) of the National Department of Water and Sanitation (DWS) was severely underfunded during 2018/19, with the consequent result that less than 40% of the surface and groundwater monitoring sites sampled nationally were analysed (van Deventer et al. 2019) illustrating that the downward trend reported by Ashton et al. (2012) continues. Similar challenges are also experienced in local municipalities.

The City of Cape Town has recognised the shortcomings and the need to understand freshwater ecosystems as part of a multidisciplinary system holistically. The metropolitan municipality has a role in achieving the 2030 Agenda for Sustainable Development Goals (SDGs) targets as outlined in the Integrated Development Plan (IDP) July 2022 to June 2027. Among the SDGs relating to water and sanitation are SDG 11, where target 11.6 aims to reduce cities' environmental impact, especially related to air quality, municipal and other waste management. SDG 6, target 6.3 aims to improve water quality by reducing pollution, eliminating dumping, minimising the release of hazardous chemicals and materials, minimising the proportion of untreated wastewater, and increasing recycling and safe reuse (UN, 2020). The IDP outlines how the municipality will contribute to the SDGs with various programmes and initiatives (IDP, 2022-2027). Monitoring the water sector is essential to achieve the objectives of these initiatives, as it is impossible to manage a resource without measuring it (Ashton et al. 2012).

In the Water and Sanitation Directorate, the Scientific Services Branch has subsequently expanded its capacity in

the aquatic sciences with disciplines in freshwater ecology, fluvial geomorphology and groundwater. The City employs Infrastructure and Skills Development Grant (ISDG) graduates funded by the National Department of Treasury on three-year contracts. The most recent intake included graduates with Honours and Master's degrees in geohydrology and fluvial geomorphology, with the possibility of acquiring these skills in permanent positions. Some graduates are pursuing Master's and PhD degrees within the ISDG programme.

**Water quality monitoring in the City of Cape Town**

The City of Cape Town, through the Scientific Services Branch, monitors a vast array of water quality types, including natural freshwater such as rivers and vlei areas, groundwater, stormwater, potable water, wastewater, treated effluent, industrial effluent, and coastal water quality throughout the city boundaries. The freshwater ecosystem sample sites are located in 20 major river catchments (Figure 1), which amounts to more than 150 inland river points, five recreational vleis, and other minor wetlands sampled for water quality monthly.

In addition to physicochemical, microbiological and hydrobiological (algae and toxicity) analyses of the rivers, vleis and wetlands, the ecological condition of river sites is also assessed using the South African Scoring System version 5 (SASS5) rapid biomonitoring method. The method was introduced to the metro's water quality monitoring programme in 2000, following the broad-scale introduction of the assessment with the DWS National River Health Programme (now known as the River Ecosystem Monitoring Programme – REMP).

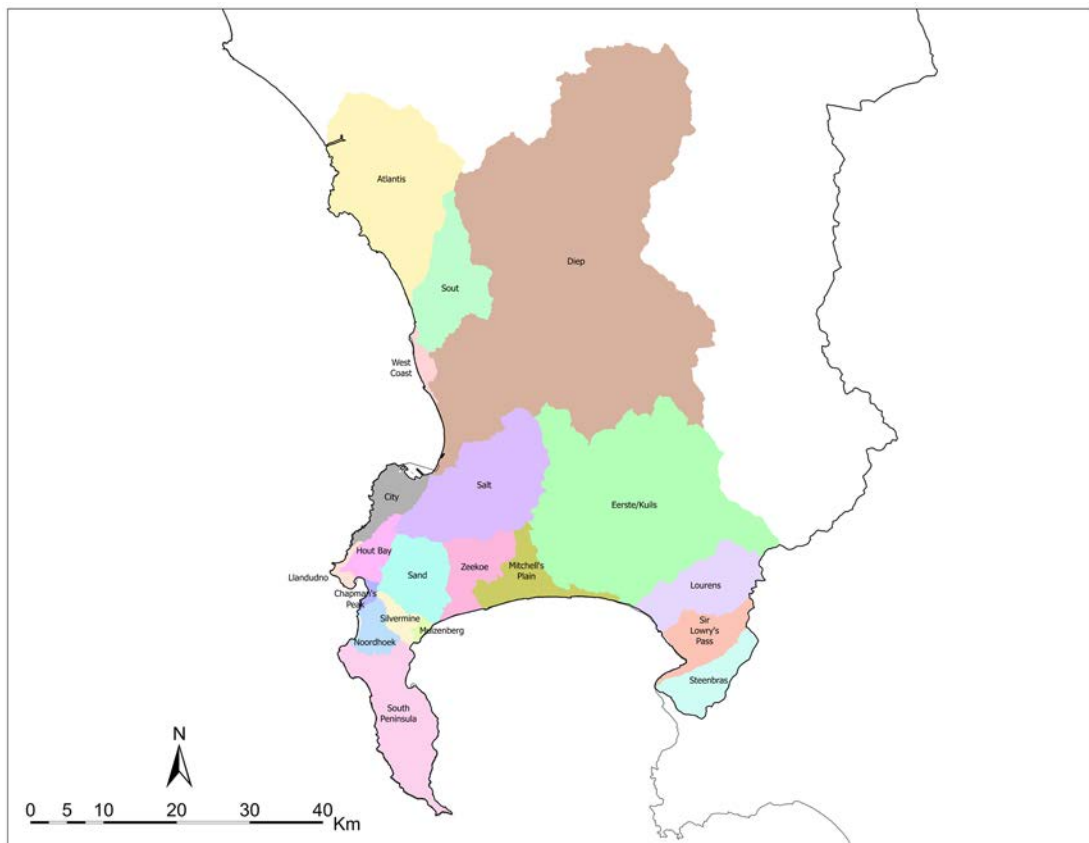


Figure 1. Major river catchments in the City of Cape Town.





*Figure 2. City of Cape Town biomonitoring team training and sampling using the SASS5 method.*

The biomonitoring programme has faced challenges, with more than 80 biomonitoring river sites across the City of Cape Town requiring quarterly (seasonal) sampling. To improve on the seasonal biomonitoring programme, capacity building in the SASS5 method occurred within the Scientific Services Branch. Staff attended the short course offered by the Freshwater Consulting Group in Cape Town in February 2023 to achieve accreditation in the method. Following course attendance, intensive SASS5 training continued with previously accredited SASS5 practitioners within the City training staff new to the technique (Figure 2) in preparation for the accreditation testing offered by DWS. Subsequently, all ten staff successfully obtained accreditation in the SASS5 method. With this many practitioners in the organisation, seasonal sampling of all 80+ biomonitoring sites will be possible since more sites can be sampled by more than one team.

### **The value of biomonitoring data**

Biomonitoring sites are located at point sources of pollution and at reference sites and sites throughout the river length to indicate the ambient water quality throughout the city rivers. Relating biomonitoring data with traditional physicochemical water quality analysis will improve the correlation between water quality and ecological river conditions. The programme also provides baseline macroinvertebrate and habitat data before the commencement of the City's river and wetland rehabilitation

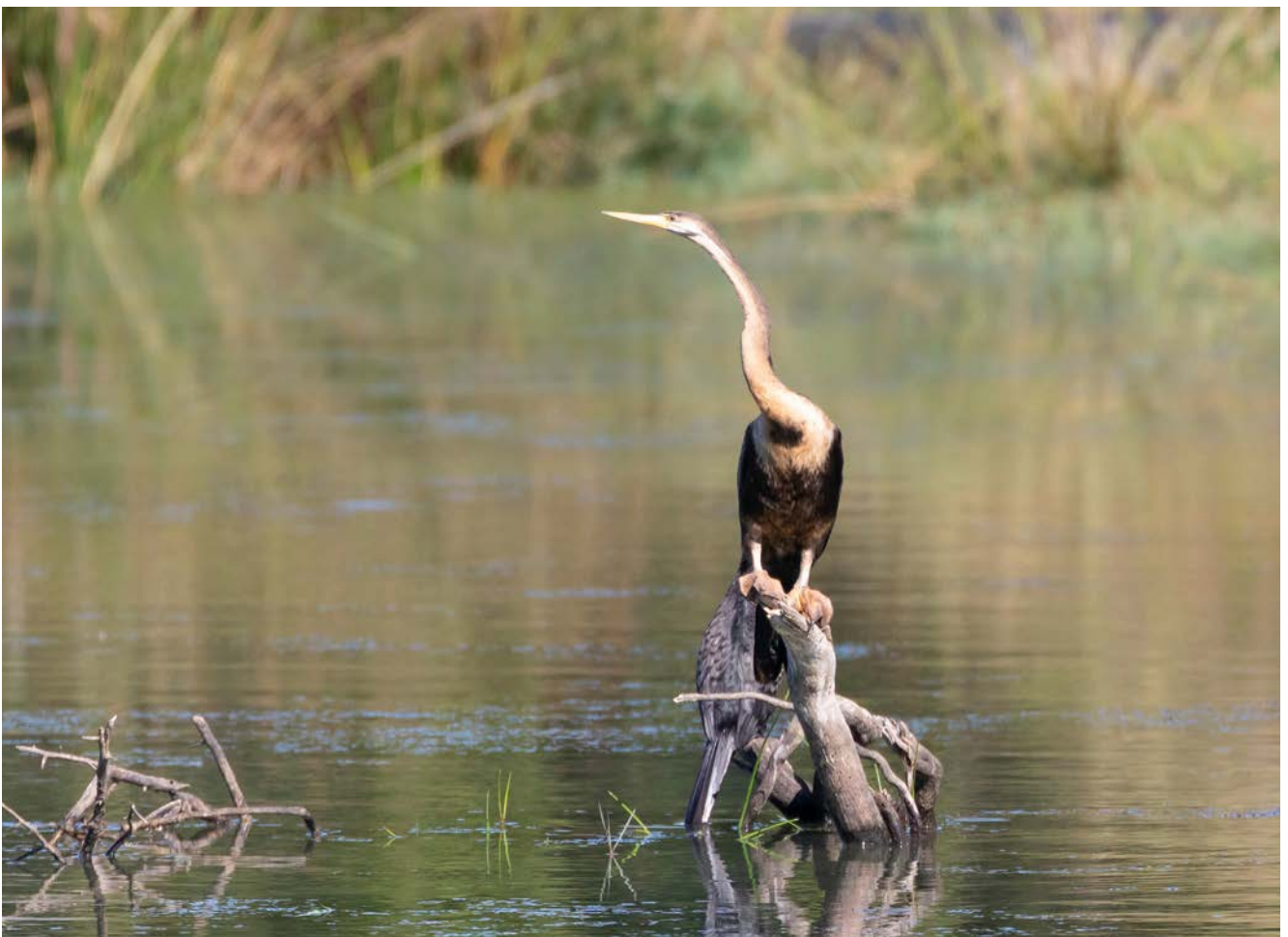
plans, such as the Liveable Urban Waterway (LUW) project in some of the City river catchments.

The LUW project will focus on collaboration and water-sensitive design management in line with commitments made in the City's Water Strategy in 2019 (City of Cape Town, 2019; City of Cape Town, 2021; Mathews, 2023). The improvement in ecological monitoring by the City can also benefit national-scale projects and objectives where long-term monitoring data is essential, such as reporting on river ecological conditions to the National Biodiversity Assessments, which are led by the South African National Biodiversity Institute (SANBI). The reference sites where biomonitoring occurs are also in strategic water source areas. Long-term macroinvertebrate data in these areas can assist in identifying trends linked to a changing climate that will negatively affect these important water provision areas, which can trigger mitigation planning.

With many government departments lacking capacity, the way forward is collaboration and partnerships for knowledge co-production. The Scientific Services Branch has embarked on establishing several collaborations and Memorandums of Agreements with government departments, water utilities, academic institutions, parastatals, and the like with the aim of cooperation and scientific information sharing.

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# CITIZEN SCIENCE

## State of rivers: A citizen science perspective

*As part of pursuing an understanding of the water resources of southern Africa, there has been a massive increase in attempts to understand the ecological state of rivers among researchers, hydrologists, and environmentalists. Rivers continue to be the lifeblood of our environment, meaning they have a huge biological importance in our everyday lives. However, like any other natural resources rivers are subject to deterioration; hence it's important to look after them.*

*Article by Dr Simphiwe Ngcobo, and Tanisha Curtis.*



The limitations of mandated institutions to monitor the condition of river systems across South Africa has hindered the ability of annual reporting on the national state of rivers (DWS, 2021) and global commitments to reporting on Sustainable Development Goal (SDG) 6.3.2 (Stats SA, 2019). Against the backdrop of limited river health monitoring, and the importance of staying abreast of the challenges which rivers systems are facing, a current Water Research Commission (WRC)-funded project is evaluating the potential for citizen science to inform broader water resources management through the generation

of a **Citizen Science State of Rivers Report** for 2024. Citizen practices for generating environmental data have seen a global growth in application as noted by Carlson and Cohen (2018) mentioning South Africa as one of the countries where this trend has been noted. The accessibility of citizen science tools means that individuals with limited technical training can contribute effectively to accurate data collection. Efforts are underway to enhance citizen science capabilities through dedicated research and capacity-building initiatives.

**What is citizen science?**

Citizen science includes the collaboration between scientific and civil societies in collecting, analysing and sharing scientific data pertaining to a particular concern or area of interest (Graham & Taylor, 2018). Citizen science has the potential to overcome challenges with data collection for a particular issue through mobilising the volunteers, who are not necessarily trained professionals in the field of concern, to collect data pertaining to an issue. Depending on the nature of the project, these volunteers may be more or less involved in the design, planning, interpretation and decision-making aspects of the study or project. Within the context of this project, citizen science approaches are being used to gather collaborators from various backgrounds to participate, engage and contribute to determining the state of rivers across South Africa, with potential participation from the community of practice in neighbouring countries.

This project aims to play a key role in promoting the use of citizen science to inform monitoring and reporting on SDG 6.3.2 which is set out to monitor the proportion of water bodies which possess good ambient water quality, based on national water quality standards (UNEP, 2018).

By engaging a variety of collaborators in the monitoring and reporting of river ecological conditions, it fosters a greater understanding of water quality issues and promotes sustainable water management practices among communities. This participatory approach will not only empower citizens but also provides an opportunity for policymakers with essential information to implement effective water quality management strategies, ultimately supporting the achievement of SDG 6.3.2 goals. "Our water resources are all threatened, way above 65% (NBA, 2018), due to excessive pollution, including plastics and other forms of solid waste".

"Only the transformed behaviour of citizens can change the status quo for better as they take full advantage of empowerment and then action" said Bonani Madikizela, Research Manager at the WRC.

**Collaboration is key**

This project, a joint collaboration between the University of KwaZulu-Natal (UKZN) and GroundTruth, is being supported by United Nations Children's Fund (UNICEF). The potential for collaboration towards generating the *Citizen Science State of Rivers Report 2024* has sparked significant interest from stakeholders across South Africa and a few neighbouring countries, reflecting its compelling objectives and potential impact.

Through a strategic engagement approach, the project team has garnered the attention and involvement of a diverse array of stakeholders from various backgrounds and geographical locations. The project uses online forums as integral components for data consolidation. Online forums offer a flexible and accessible platform to create conversation around the project, such as ideas exchange which aims for a community driven approach to monitoring and improving river health. The connections made through this project are also hoped to continue into the future, encouraging the growth of a co-ordinated and connected citizen science community of practice.

Among these collaborators are academic researchers, independent citizens, South African Scoring System version 5 (SASS5) practitioners, government departments, non-profit organizations, community groups, and other relevant stakeholders, all bringing unique perspectives, expertise, and resources to this project. This diverse network of collaborators spans not only South Africa but also reaching neighbouring countries such as Namibia, Zambia and Lesotho, enriching the project with a broad range of insights and experiences. In fact, a



*A clarity tube, used to measure water turbidity and suspended solids.*

WRC archives



*Assessing the aquatic health of a river systems by evaluating aquatic macroinvertebrates found in a water sample.*

number of NPOs/NGOs, academic institutions, are taking up and using the citizen science tools in training students, from primary schools to post-doctoral, business and all interested community organizations and individuals. The WRC and partners are leading in the establishment of the citizen science society for southern Africa as an ultimately owner of the citizen science efforts into the future.

Through a bursary provided by the uMngeni-uThukela Water Chair of Water Resources Research and Innovation at UKZN, this project will also conceptually support a UKZN MSc Hydrology student in *An Evaluation of the Use of Citizen Science for Water Quality Monitoring*. The student is the lead researcher on this project, thus aspects of this project will be included and drawn upon for inclusion in the MSc thesis.

### Monitoring tools used

Previous *State of Rivers* reports have given insight that part of the contributions that add to the poor monitoring commitment of our rivers is the lack of individual capacity and personnel for sampling as well as funds to access training courses such as SASS5, which has proven to be an effective tool for sampling in various parts of the country. Online training material on citizen science for river health monitoring have been developed (see, for example, **WRC Report No. TT 933/23**) and the project has made provision for the collaborators to freely access these materials. The suite of tools and techniques utilised under the project are as follows:

- The mini Stream Assessment Scoring System (miniSASS): a simplified version of SASS5 and accessible citizen

science biomonitoring tool for assessing the water quality and health of streams and rivers. The miniSASS method involves collecting and identifying certain species of aquatic macroinvertebrates found in a water sample. These macroinvertebrates are sensitive to changes in water quality and habitat conditions, so their presence or absence can provide valuable information about the health of the stream.

- The clarity tube: used to measure water turbidity and suspended solids. It helps to determine suspended solid loads within a river and monitor these loads over time.
- The riparian health audit (RHA): serves as a citizen science instrument designed to evaluate the ecological health of rivers by assigning a score reflecting the integrity of habitat within a specified river segment, determined by assessments of factors like bank erosion, alterations in flow, and presence of alien invasive vegetation.
- Chemical testing kits: Chemical testing kits for water are commonly used to analyse the quality and safety of drinking water, as well as monitoring water quality. An example of a citizen science-based chemical testing kit is the iLab Water Testing kits available from WaterCAN, which test for chemical parameters, *E. coli*, and coliforms. The chemical parameters tested here include nitrates, nitrite, phosphates, metals, pH, alkalinity, hardness and chlorine
- *E. coli* testing kits: *E. coli* detection kits detect the presence of *Escherichia coli* bacteria in water. Prae-cautio *E. coli* sampling kits indicate the quantitative results of *E. coli* or coliforms present in a body of water based on the colour (green for *E. coli* and yellow for coliforms) which an incubated sample turns over a 24-hour period.

In addition to the citizen science tools previously mentioned, there exists a variety of other tools and methods that can be used. These additional resources contribute to the diverse range of approaches within the realm of citizen science, offering further opportunities for data collection. For example:

- Dragonfly biodiversity index: The Dragonfly Biodiversity Index is a tool used to gauge ecosystem health by assessing the diversity and abundance of dragonfly species. Dragonflies are sensitive to environmental changes, making them useful indicators. By monitoring their populations, scientists can determine the condition of freshwater habitats and guide conservation efforts.
- The Transparency Velocity Head Rod (also referred to as the velocity plank): This tool is used to measure parameters, such as the depth and width of a river, which can be used to determine the velocity and the discharge of a river.
- Mini-WET Health: This technique evaluates wetland health by utilising indicators derived from geomorphology, hydrology, and vegetation characteristics.

All these tools have been identified as effective tools for citizens to monitor their environment and can supplement the data observed concerning the condition of local water resources.

#### Long-term monitoring

Questions have been raised about the long-term sustainability plan to keep the interest in water quality monitoring alive; there is already an ambition to continue monitoring beyond this project's timeframe. Financial constraints have contributed to a lack of widespread and continuous monitoring (DWS, 2021). Citizen science responds to overcome this obstacle through exploring low-cost river health monitoring options. This includes the creation of a low-cost miniSASS kit; for example, using ice cream containers to collect macroinvertebrates and also budget-friendly nets to promote the accessibility of citizen science practices.

South Africa has been declared a water-scarce country (Crookes *et al.*, 2018), which should be alarming for every citizen, including its neighbouring countries, since water is a shared resource. This project called for all citizens to take action for their rivers by monitoring the health of that system. This has been strongly encouraged to assist in capacitating citizens to better understand the state of river systems, and prompt all to reflect on their impact on these systems. This monitoring will also contribute to telling the story of the ecological conditions of rivers from a citizen science perspective. However, citizens are encouraged to keep using these techniques beyond the duration of this project to inform themselves and their communities, and to stay abreast, adapt and be resilient to the condition of their local river systems. Be sure to keep an eye out for the **2024 Citizen Science State of Rivers** report!

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*Dragonflies are sensitive to environmental changes, making them useful indicators.*

# WATER TECHNOLOGIES PROCUREMENT

## Study explores ways to increase uptake of innovations in municipal space

*A Water Research Commission-funded study explored the challenges and opportunities presented by South Africa's public procurement legislation in increasing the uptake of water and sanitation innovations. Article by Sue Matthews.*



"The sheer number of the Acts and the Regulations which address procurement issues makes it very difficult for conscientious officials to get a clear understanding of what is required from them," noted the Zondo Commission in Part 1 of the State Capture report.

Government heeded those words and introduced the Public Procurement Bill in the National Assembly on 30 June 2023. Just over a year later, on 23 July 2024, the Public Procurement Act was published in the Government Gazette, having been approved by President Cyril Ramaphosa. Subsequently, National Treasury issued a media statement on 13 August, clarifying that the provisions of the Act are not yet in force and will be phased in through gazetted proclamations. For many of the provisions, regulations first need to be developed through a

consultative process, so in the meantime it's business as usual according to the existing Public Finance Management Act (PFMA), Municipal Finance Management Act (MFMA), Preferential Policy Procurement Framework Act (PPPFA) and their applicable regulations.

It remains to be seen whether the new Act and associated regulations will make procurement and supply chain management (SCM) processes – often perceived as cumbersome and onerous – easier to navigate. Indeed, the WRC had so many of its municipal and utility partners comment on the perceived challenges of scaling up new innovations to full scale in the context of public procurement processes, that it commissioned a study in November 2022 to explore the issue.

A project team led by Bosch Capital conducted an initial desktop review and then identified 86 stakeholders to complete an online survey. Although there was a response rate of only 30%, most categories of stakeholders – national government, end users, innovators, funders, consultants and other – were adequately represented. In-depth interviews were also conducted with 15 key stakeholders, and several workshops were held to discuss procurement issues and the research findings. Three informative engagements were also held with representatives of National Treasury's Office of the Chief Procurement Officer, to sense check interpretation and findings.

The team's research report, *Supporting the enabling environment for public sector uptake of water and sanitation innovations – final evaluation and recommendations (WRC report no. TT 941/24)*, was published earlier this year, accompanied by a practical guideline booklet titled *A water practitioners guide to supply chain management (WRC report no. SP 174/24)*.

The study revealed that challenges in procuring water and sanitation innovations were not so much the rules within the public procurement framework as the application of those rules. In the guideline document, the team highlight several misconceptions that often result in incorrect application of the rules.

One of these is the erroneous belief that value-for-money only equates to the lowest capital cost and the cheapest quote received. Value-for-money is the first of the Five Pillars of Procurement outlined in the General Procurement Guidelines, the others being open and effective competition, ethics and fair dealing, accountability and reporting, and equity. The pillars reflect the principles enshrined in the Constitution that public sector procurement must be fair, equitable, transparent,

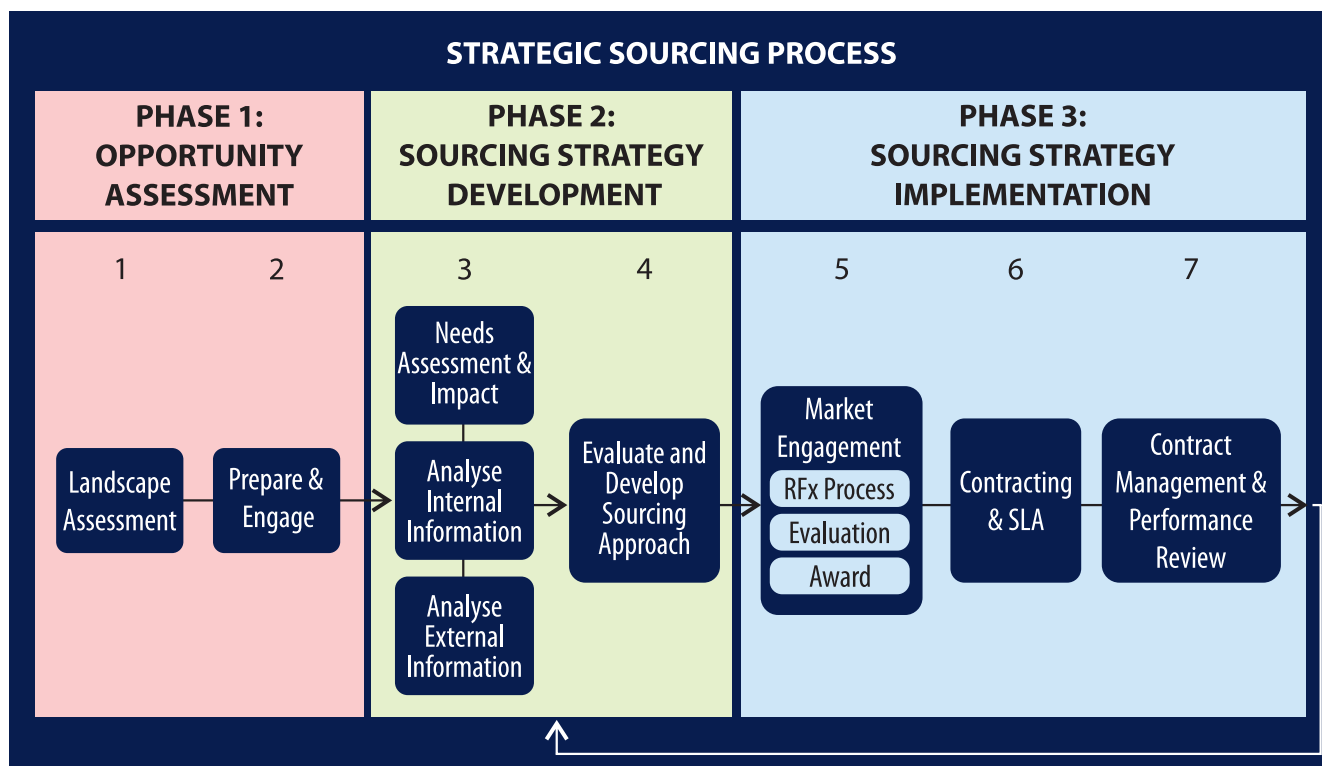
competitive and cost-effective.

"In considering value-for-money, you can't just select the lowest capital cost – you need to take into account the full lifecycle cost as well as the strategic benefits such as eradication of backlogs," says Bosch Capital's Rajiv Paladh. "Many people we engaged said 'No, we don't agree, it doesn't work that way in our organisation', but Treasury confirmed this."

Certainly, the concept is clearly explained in the General Procurement Guidelines as well as the February 2016 issue of *Civilition*, "Focus on: National Treasury Standard for Infrastructure Procurement and Delivery Management", published by the South African Institution of Civil Engineering (SAICE) in collaboration with National Treasury.

Another misconception was that the MFMA does not allow for contracts longer than three years, but Section 33 of the MFMA outlines the process to be used for contracts imposing financial obligations on the municipality beyond three years. This largely involves inviting comment from the local community and other interested persons, National Treasury and the relevant provincial treasury, the national department responsible for local government, as well as the Department of Water and Sanitation (DWS), in the case of contracts involving provision of water or sanitation services. The municipal council must take into account these comments and the impact of the financial obligations on future municipal tariffs and revenue.

"The procurement framework is structured in a manner that is flexible but does require planning processes to be very thorough and detailed prior to committing large budgets for an extended period," says Paladh. "It's important to provide evidence to develop a business case indicating that the expenditure is in the



The strategic sourcing process.



best interests of an institution and the community it serves.”

He points out that Public-Private Partnerships (PPPs) can result in budgetary commitments that extend for up to 30 years. In February, National Treasury called for comments on proposed amendments to the two regulations that govern PPPs – National Treasury Regulation 16 and the Municipal Regulation 309. An accompanying explanatory note states that Government recognises that PPPs can be an important lever to deliver much-needed infrastructure, and the amendments are expected to reduce procedural complexity.

The research also revealed some confusion as to whether single- and sole-source quotations are permitted in municipalities. Single-source quotations involve a transparent and equitable pre-selection process to request only one amongst a few prospective bidders to make a proposal, while sole-source quotations apply where there is no competition and only one bidder exists. The two guideline documents published by National Treasury, *Supply Chain Management: A guide for accounting officers of municipalities and municipal entities* (October 2005) and *Supply Chain Management: A guide for accounting officers/authorities* (February 2004) – the latter applicable to PFMA-regulated institutions, including water boards – suggest that they are allowed under specified circumstances.

*“A key recommendation emanating from the research project was that institutions should develop innovation policies that signal their intent to innovate and that are aligned to SCM, budgeting and governance structures.”*

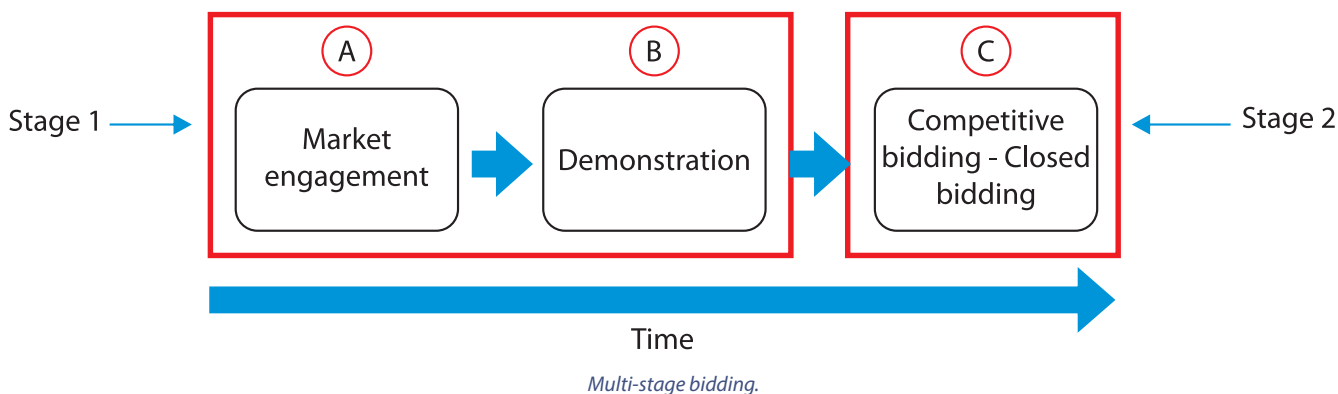
More recently, PFMA SCM Instruction No. 3 of 2021/22 reiterated that single- and sole-source quotations form part of limited bidding, but no similar confirmation could be found amongst the MFMA SCM circulars. The MFMA Municipal SCM Regulations do, however, state in Section 36 that an SCM policy may allow the accounting officer to dispense with the official procurement processes if required goods or services are only available from a single provider. Furthermore, the Standard for Infrastructure Procurement and Delivery Management, published as a Treasury

Instruction in 2015, applies to any municipality or municipal entity that adopts it, and it states that tenders may be solicited from a confined market where goods or services are only available from a sole contractor or a very limited number of contractors.

It is noteworthy, however, that the final sentence of Part 1 of the Zondo Commission’s State Capture report is a recommendation that consideration be given to enacting legislation to discontinue any procurement process deviation based on the concept of a sole-source service provider.

The project team propose an alternative model for procuring innovations in the water and sanitation domain, starting with the adoption of National Treasury’s Strategic Procurement Framework, first issued in May 2016 with a revised version issued in February 2024. It outlines the strategic sourcing process – a step-by-step, collaborative approach to get the best possible service and value from selected suppliers. Critically, the SCM unit is involved early in the process. The importance of this cannot be overstated, as it is only in a partnership between technical practitioners and SCM staff that an optimal outcome can be achieved. In the guideline document, it is recommended that SCM should transition towards an enabler for the implementation of innovations, assisting the organisation to meet business objectives rather than focusing only on compliance with procurement rules.

The strategic procurement process then helps to inform public institutions of the type of bidding process to follow to allow for an optimal service delivery outcome. The project recommends, however, that a multi-stage bidding process has emerged as a possible method for procuring water and sanitation innovations that have the potential to be upscaled from demonstration to full scale implementation. Multi-stage bidding would be particularly useful for innovations that need to be demonstrated at a larger scale before wider implementation, such as non-sewered sanitation systems (NSSS). In such a bidding process, innovators would be invited through an Expression of Interest (EoI) process to demonstrate their NSSS at selected sites, with performance criteria used to evaluate the innovations – such as effluent quality, water savings and maximum operating costs – clearly specified. Following the demonstration period, innovators whose NSSS met the performance criteria would be invited to respond to a Request for Proposal (RFP) process to provide a price for implementing their NSSS at a larger scale. Currently, the WRC is partnering with the City of Cape



Town to demonstrate three NSSS innovations – the EnviroLoo Clear Recirculation toilet system, the NEWgenerator recycling sanitation system and Aquonic treatment system for septic tanks – in five informal settlements. The intention is to pilot and then scale up the implementation of these technologies in the city's underserved communities. Rather than using municipal funds, however, the pilot project was made possible through a US\$4.5 million grant from the Bill & Melinda Gates Foundation (BMGF), paid over multiple financial years through the South African Sanitation Technology Enterprise Programme (SASTEP). SASTEP is an innovation platform established by the WRC in partnership with BMGF and the Department of Science and Innovation (DSI), and with the support of DWS, to accelerate the adoption of innovative and emerging sanitation technologies.

Even when tested and piloted at limited scale, though, large-scale implementation may not be practical for some innovations. The project team note that it is critical to document the entire process and lessons learnt for the benefit of both the institution – for example, to build a robust business case for adoption of an innovation or to respond to concerns about wasteful expenditure if it proves ineffective at scale – and other sector institutions. In September, the WRC launched the Next Generation Sanitation (NGS) Knowledge Hub on the SASTEP website to share case studies and other resources, such as policy briefs and access to funding opportunities. Similar initiatives that could offer useful insight and assistance include the DSI-WRC Water Technologies Demonstration Programme (WADER), the DSI Technology Innovation Agency (TIA), the CSIR Water Centre, and the recently established Water Partnership Office (WPO), which is a DWS programme with the Development Bank of South Africa (DBSA) and South African Local Government Association (SALGA) as partners. Its aims include supporting municipalities and water boards to prepare bankable projects and facilitating blended financing, where appropriate.

A key recommendation emanating from the research project was that institutions should develop innovation policies that signal their intent to innovate and that are aligned to SCM, budgeting and governance structures, allowing innovation to be integrated into regular operations.

“Innovation policy is sometimes developed in isolation, with a very siloed approach,” says Dr Chantal Kotze, Managing Director of Isle Utilities: South Africa, which was also part of the project team. “Our water boards do much better than most municipalities in implementing innovations, partly because they have more capacity in terms of scientific and technical staff but mainly because they have been structured in a way that allows them to undertake this sort of work. At Rand Water, for example, there is robust engagement across departments and divisions, and proper engagement at executive levels on policies, processes and how they feed into each other. There has to be organisation-wide agreement and consensus that we do want to invest in innovation, and we do need to look at solutions where traditional technologies and infrastructure are just not going to be suitable, or where value can be added by complementary innovations.”

The project team suggest that SALGA and the Water Institute of South Africa (WISA) could play a valuable capacity-building role

in empowering municipal officials to develop and implement innovation policies, respectively. They also recommend that DWS considers including criteria in the Blue Drop and Green Drop programmes that would incentivise implementation of innovation policies and adoption of innovations aimed at improving service delivery or quality compliance.

To access the research report, *Supporting the enabling environment for public sector uptake of water and sanitation innovations - final evaluation and recommendations* (WRC report no. TT 941/24), visit: <https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20941%20final%20web.pdf>

Or check out the practitioner's guide, [https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/SP%20174\\_final.pdf](https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/SP%20174_final.pdf)



# SLUDGE MANAGEMENT

## Avast! Why sewage sludge is bound for the rocks – and how to turn her around

*Contradictory laws for handling wastewater residues have us all at sea. Lashing these into line must top the rescue plan. Matthew Hattingh reports on a recent workshop hosted by the Water Research Commission (WRC).*



Across crystal waters, in the distance, shimmers an emerald green city – where the words “sustainability” and “circular economy” echo on the wind. When it comes to wastewater management, and more particularly, the mountains of sludge we produce, South Africa has a vast raft of legislation, regulations and guidelines. (The WRC guidelines, for example, for the utilisation and disposal of wastewater sludge, run to five volumes.)

We hope the many policies and rules will transport us to the

promised shore of environmental and community health. Trouble is, it’s an ungainly craft, with the different laws acting against each other like sails set by a fractious crew. And as we flounder, new technologies are devised to get us there. Sometimes the laws prevent their launch, over others, doubts linger. If a technology or process worked well abroad, would it work here and could we afford it?

South Africa urgently needs to get shipshape on sludge. An estimated 31% of the country’s households aren’t sewered –

with the 63 000 or so dry tons produced daily mostly ending in pit latrines and seldom collected for processing. Recent WRC research and a Green Drop report, found 877 wastewater treatment plants producing 1 750 dry tons of sludge daily, with 1 100 tons being untreated primary sludge and the rest secondary, partially treated sludge. Many plants struggle to handle this waste.

To help the sector navigate better, the WRC recently co-hosted a workshop on sludge management. The August online meeting briefed guests on three interrelated WRC sludge management research projects, which focused on updating the guidelines, trends and advances in the sector, and strategies to recover resources from sanitation waste. Workshop guests heard why some rules required straightening out so they might work together better, and why others should be “thrown into the dustbin”.

They learnt how sludge, a costly environmental headache, might be refashioned as resources, including methane, solid biofuel and hydrogen for energy, as well as other high-value materials, such as proteins and plastics. But guests were reminded that sanitation waste has a yuck factor that puts the public off – a whiffy headwind to progress.

Dr Sudhir Pillay, the WRC’s research manager for sanitation, sketched the extent of the sludge problem and noted that many municipalities were finding it difficult to deal with. And

because they couldn’t meet standards for downstream use, they were increasingly stockpiling sludge. Pillay said the WRC was reviewing its research strategy to understand why this was happening and what could be done to improve matters.

The workshop viewed a sanitation flow diagram developed by consultants Zutari, showing sludge at its different stages in South Africa, from containment through to emptying, transport, treatment and disposal. Worrying findings included that 58% of municipalities and other utilities were failing to reuse or dispose of sludge appropriately. Some 70% of wastewater systems have a high-risk rating and 39% are in a critical state, with consequences for human health and the environment.

Pillay added that the Department of Water and Sanitation launched a faecal sludge management strategy last year, but “a big gap” persisted, with neither the know-how in the country to develop plants to treat it, nor the capacity to manage these.

Dr Heidi Snyman, instrumental in drafting the WRC’s sludge guidelines in the noughties during her tenure there, agreed the training needs of municipalities were “very high, even at metro level”, although there were “pockets of excellence, which we need to capitalise on”. Now a consultant and co-chief executive of bioremediation company iWater, Snyman acknowledged calls for the adoption of a circular economy and the need for innovation, but stressed that constraints must first be addressed.



SUSANA/Flickr

*If managed correctly, sludge can be reused as, for example, fertiliser in agriculture fields. In South Africa, only 15% of sewage sludge is being recycled or reused.*



*Sludge pellets, used typically in agriculture applications.*

"The legislation is not on our side for innovation, for smart thinking," she said, recommending "dialogue with our regulators". Quoting Pillay, she reminded the webinar that removing organic materials from wastewater creates residues or sludges which must be disposed of or used. These needed classification – to know what was in it. In practice, however, 62% of utilities were not classifying their sludge. So, their sludge didn't meet guidelines for particular end-products, like fertiliser.

Even when municipal and other wastewater officials have the capacity to do their jobs, contradictory laws make it difficult. Officials must bear in mind the Water Act and regulations governing authorisations and licensing for different forms of water use and waste discharge. They also must be mindful of the Environmental Management Waste Act and adhere to its requirements for different categories of waste, consultative processes and authorisations.

All this could be "quite cumbersome", said Snyman, "It's almost that if we follow the rules, if we follow the legislation in place, we actually are not going to be protecting the environment, and we're also not going to be using it [the sludge] beneficially." She noted that nearly 20 years after WRC-funded research first uncovered confusion in the sector over sludge disposal in landfills, it persisted. "And sadly, the practice of stockpiling sludges is again common practice." Many municipal landfill sites were refusing to accept sludge from their sister wastewater treatment departments, "based absolutely on inaccurate information".

Snyman agreed there were better options to dumping sludge

in landfills, but felt it had its merits. Provided the sludge was sufficiently dry, it could be added to day cover – the soil used to dress landfills, isolating it from the weather, and limiting the spread of disease and odours. Sludge could also help kickstart the processes that break down landfill waste and produce methane, which could be used for energy generation. She said the WRC's 2009 guidelines were no longer relevant and an update was needed to rescue the sector from its muddle and to ensure guidelines reflected changing economic realities. She noted that in the early 2000s electricity was cheaper than now, making landfill methane gas projects more compelling today.

Sludge management guidelines needed to be revised to take on circular economy principles, SABS standards for non-sewered systems, and concerns over environmental health and emerging contaminants. These included per- and polyfluoroalkyl (PFAS) substances – or "forever chemicals" for their persistence in the environment – which might be toxic even in tiny quantities. Snyman said problems were not in individual pieces of legislation, but that these pieces of legislation were not aligned: "Revision and the update of the guidelines will provide improved long-term sustainability planning and management."

Volumes 3 and 5 of the guidelines should be "thrown in the dustbin", said Snyman, although she stressed the science underpinning them remained relevant. Officials faced a "lot of resistance from the public" over recycling and putting sludges to good use. Because "people don't understand", there is a "huge need for educational awareness".

Francois Gouws of water innovation consultancy Isle Utilities,

told the workshop that only 15% of sewage sludge was being recycled or reused. "This indicates massive opportunities for circular economy expansion, such as the adoption of sludge beneficiation and reuse," he said. Gouws welcomed the 2022 inclusion of sludge management categories in the Green Drop wastewater evaluation scorecard. This created incentives to utilities to improve compliance.

He shared a few findings from a literary research report Isle was helping prepare for the WRC, stressing that whatever tools or technology were used, environmental considerations and energy efficiency needed to be considered. The business case for any solution and how it fitted into the circular economy was important too. "Is there a market for the beneficiated product? Who would value this product enough to buy it? Is the beneficiated product part of a circular loop, once it is used," said Gouws. "We're needing municipalities to... partner with these private sector companies, and they don't always have the capacity or the resources to... contribute a certain amount towards, say... every ton of sludge."

Answering a question from the floor, Gouws said South Africa could innovate – "we have fantastic ideas" – and localise international technology, but cautioned that "markets are not being created to make it economically viable". Like Snyman, Gouws referenced legislative hurdles to innovation and its funding, urging continued investigations into and support for innovative procurement and business models. He said the project's draft research strategy for the country identified short-, medium- and long-term priorities.

Short-term, included developing sanitation flow diagrams for individual wastewater works to aid decision-making; interim strategies for dealing with stockpiled sludge; and investigation of and support for the markets that develop technologies. Medium-term focus would be on improving the capacity of staff to operate and manage new technologies. "A lack of skilled operators has consistently emerged... as a reason for failed or inefficient implementation of advanced sludge management," said Gouws.

Up to and beyond 2035, the focus remained on advanced treatment and recovery technologies, with PFAs, endocrine disruptors, and microplastics all areas of concern. Dr Eustina Musvoto, of consultants TruSense, shared findings from a WRC research project on opportunities to recover resources from sanitation waste.

The project sought to understand the quality and quantity of sanitation waste available. Its objective was to develop plans and a national policy to assist municipalities in recovering resources, by adopting circular economy principles. Musvoto spoke of the hundreds of tons of sludge nutrients and other high-value contents going to waste daily, stressing that about half of the country's activated sludge wastewater treatment plants were "energy guzzlers". She noted that the biggest potential market for sludge lay in the energy it contained. "The priority would be for plants to try... to become as energy efficient as possible, and probably move towards energy neutrality. If the energy is generated and used on-site, then you don't even have to deal with regulations concerning energy generation and feeding that

into the grid."

Extracting energy from sludge rather than making products from it was also easier for the public to swallow. The study included analysis of a number of feasible technologies for recovering energy and other resources from faecal and wastewater sludge. Musvoto went into detail here, mentioning several processes. Like Snyman and Gouws, she flagged legislative and other hurdles to waste recovery, and the feasibility of resource recovery technologies. Although recovering resources from waste, particularly energy, was "known to be very feasible", the joined-up thinking for this to happen was missing.

"Legacy technologies such as activated sludge processes as well as anaerobic digesters," were not up to standard to recover biogas, nor could they be easily retooled. And, because of the cost and long life cycles of these assets, they couldn't be made redundant either. The absence of "supportive policies and incentives to attract private sector investment" further frustrated efforts to produce products from waste.

Responding to a question from Dr Ashton Mpofu, a senior consultant at Isle Utilities, who wanted to know what low-hanging fruit the sector ought to pluck, Musvoto felt there was a strong case for upgrading anaerobic digesters at large, 20 megalitres-a-day plants to collect biogas. Procurement systems preventing municipalities from readily procuring innovative technologies were another obstacle, with the Public Finance Management Act prescribing partnerships between public entities and private companies.

Despite numerous well-meaning reforms over the years to become fair, equitable, transparent, competitive and cost-effective, "the legislation is still rigid", Musvoto said, which often puts the kibosh on innovation. Municipal budgets tied officials to rigid planning timelines which could "make it impossible to introduce new projects or programmes". In addition, the question of price remained a key determining factor in procurement and "a huge hindrance" to innovation.

In response, workshop guest Rajiv Paladh, a public sector funding and procurement expert, with Bosch Capital, pointed out that municipalities now have greater discretion on pricing: "If you plan appropriately and identify a strategic need for a particular innovation, you can justify procuring (innovations) even though it's not the lowest capital cost. Value for money includes other sorts of financial and non-financial benefits," he said.

Musvoto called for changes: for public procurement to adopt more innovative and sustainable systems. This must be part of a multi-pronged approach that would include "adequate regulatory mechanisms, financial instruments and incentives to support public and private engagement in circular economy pathways".

Pull for the shore, sailor!

# WORLD TOILET DAY

## SASTEP – Leading the rollout of sanitation transformation in SA schools

*Every year, the world celebrates World Toilet Day on 19 November. Akin Akinsete and Ednah Mamakoa take this opportunity to reflect on a programme to bring dignified sanitation to South Africa's schools through the implementation of next generation sanitation technologies.*

All photographs supplied



On August 14, 2018, President Cyril Ramaphosa launched the Sanitation Appropriate for Education (SAFE) Initiative in response to a spate of school learner fatalities in unsafe and dilapidated school toilet facilities. The SAFE Initiative's mandate is to "spare generations of young South Africans the indignity, discomfort and danger of using pit latrines and other unsafe facilities in schools". It is timeous and needs to be sustained with multi-stakeholder support and attention until every school learner in South Africa has access to a school toilet facility that allows them to perform basic bodily functions in privacy and dignity without fear or danger to their health, safety, and overall well-being, regardless of whether it is a school situated in an urban, peri-urban or rural setting. However, focus and emphasis of the SAFE initiative is mainly on capital expenditure, on replacing old unimproved pit latrines, and very little budget is given to much-needed operations and maintenance. As such, the improvements brought on by the SAFE Initiative could evaporate in the not-too-distant future if a concerted school

sanitation operation and maintenance strategy is not adopted soonest.

The provision of school sanitation facilities seems to suffer from a one-size-fits-all approach. The current approach is in lockstep with the current sanitation service paradigm across the country and mirrors the economic inequality that pervades our society. Solutions deployed seem to be motivated by expediency rather than what is good for the learners. It should be recognised that solutions are constrained by available sanitation infrastructure and availability of water, which are easily overcome by emerging innovations in sanitation technologies. There is also a reluctance from school sanitation decision-makers to embrace innovation and, in many cases, they stick with incumbent technologies that is within their comfort zone.

While this approach works for school in areas with good infrastructure e.g. in cities, upmarket suburbs and metropolitan

areas, schools in peri-urban or rural areas, where there are no bulk sanitation infrastructure, have to make do with pit latrines or other variants of dry sanitation technologies. These dry sanitation technologies are sustainable if well maintained. However, this is not often the case, and the reason for selecting these technologies is because of the perception that pit latrines do not require maintenance. Learner fatalities in schools have shown that this approach and lack of attention to pit latrines that become dilapidated is a risk and a good reason why expediency should not be the key factor in selecting school sanitation technologies.

Next Generation Sanitation (NGS) technologies can assist in addressing current sanitation challenges in schools and achieve the vision of the presidency's SAFE Initiative. NGS solutions can address sanitation challenges in areas where there is no existing sewer reticulation system. Non-sewered sanitation systems that recover flush water, treat it, and recycle it for flushing, making waterborne solutions possible in water stress areas. Even areas with a reliable water supply and existing sewer reticulation systems can benefit from innovative water-efficient pedestals that minimize the flush volume and reduce water bills in schools. It is, therefore, imperative to support and fast-track the adoption of these technologies in schools. It is also important that this is backed by a coherent operation and maintenance strategy to ensure the realisation of the promised benefits of NGS.

The Water Research Commission (WRC) has been at the forefront of advancing the adoption of relevant innovation in school sanitation, and several WRC studies have shown that an ill-equipped sanitation technology toolbox and lack of investment in operation and maintenance (O&M) are responsible for the deplorable state of some of the sanitation facilities found in schools. The inclusion of the innovative next generation in the sanitation technology mix and the introduction of a sustainable O&M model would alleviate the current issue and deliver the vision of President Ramaphosa's SAFE Initiative.

Through the WRC's sanitation programme, the South African Sanitation Technologies Enterprise Programme (SASTEP), next-generation sanitation technologies are being demonstrated in schools to address the issues highlighted above and to ensure the uptake of innovative sanitation technologies and solutions that are capable of transforming school sanitation, and reduce the current high cost per toilet seat, increase safety and provide

the next generation of learners with hygienic and dignified sanitation solutions.

Since 2020, demonstration projects have been launched in schools in Gauteng, the North-West, KwaZulu-Natal and Eastern Cape provinces. A total of thirteen schools will receive innovative sanitation technologies. The aim of these projects is to showcase these technologies in schools and demonstrate their robustness, appropriateness, and value proposition. The data from these demonstration projects are expected to strengthen the argument for the inclusion of innovative technologies in school sanitation and provide an understanding of the capital expenditure, operational expenditure, O&M and the social aspects (user acceptance, behavioural change etc.). The WRC plans to filter the data collected, lesson learnt and knowledge into a school sanitation toolbox that can inform and direct school sanitation stakeholder and decision makers on available technologies, cost, operational models and behavioural changes needed to improve sanitation in school within their spheres and control. This will also contribute to recommendation to enhance and improve school sanitation norms and standards.

These projects have not only improved the sanitation and hygiene conditions of the schools, but have also improved the socio-economic impact of local communities by providing employment and business opportunities.

**Table 1: Number of job opportunities per school project**

Name of school	Number of job opportunities
Celikungu Primary School	14 labourers, A janitor and an assessor
Tsholetsega Primary school	A local contractor, 2 janitors and 5 plumbers
Olivenhoutbosch and Esikhisini Primary Schools	10 SMMEs, 4 interns and 2 janitors
Tirelo Farm School	A local contractor, 15 personnel and a janitor
Bakerville Primary School	Local contractor, 3 personnel and a janitor



*A clear recirculating toilet was handed over to Tsholetsega Primary School in Krugersdorp on in 2020. The toilets serve 1 200 learners and, to date, no issues have been reported. The principal has reported that school attendance has improved, and that the school is saving money.*



These projects have shown, over a short period of time, the capacity for next-generation sanitation solutions to provide and foster safer sanitation facilities that protect learners from unsafe and unhygienic facilities and prevent child mortality. In addition, feedback from parents and teachers at the schools have been overwhelmingly positive and common feedback is that parent and teachers no longer worry about unsafe and unhygienic toilets in these schools. It is hoped that upon conclusion of the SASTEP SAFE Schools Project, an innovative school sanitation toolbox would have emerged that not only address current sanitation challenges, regardless of the geographical, location but one that has the South African child at its centre, fulfils the aspirational needs of communities and narrows the inequality gap in service delivery across all schools in the country.



*Celinkungu Primary School is situated in at Mount Ayliff, in rural Eastern Cape. Roads to the school are often flooded if there are heavy rains. This school is home to 158 learners and 6 teachers, who all had to use pit latrines which were full and chemical toilets that were not well maintained. In 2022, the Eazy-Split solution was handed over to the school. This pedestal separates urine and faecal matter and requires only 2 litres of water to flush.*



*Bakerville Primary School is located in Ngxabaxa Mount Frere, in the Eastern Cape. The school has 172 learners, and had only 3 pit latrines that had deteriorated significantly. The Arumloo low-flush toilet and associated DEWdrop ecological wastewater treatment system presented an opportunity to address the challenge of effective robust sanitation delivery to provide hygienic and dignified school sanitation facilities.*

## Benefits of installing new generation sanitation (NGS) technologies in schools

1. Aspirational waterborne sanitation technologies provide learners with improved and dignified sanitation facilities.
2. Improved safety of school sanitation facilities. NGS technologies remove the need for the storage of faecal matter in vaults underneath pit latrines that are susceptible to failure over time, and have been main cause of learner fatality in schools.
3. Hygienic and clean facility.
4. Toilet facility can be situated closer to classrooms. Pit latrines are situated far from classroom due to the odour from pits.
5. Situating NGS toilet facilities in close proximity to classrooms and school administrative block allows for better teacher supervision and learner safety.
6. NGS toilet facilities offer more effective treatment of faecal waste and help prevent faecal-mouth disease transmission prevalent with pit latrines.
7. Full recirculating water NGS technologies recovers the water streams from sanitation waste and reused for flushing. This minimises water use, promotes water conservancy and resilience.

# THE WATER WHEEL

## SUBSCRIPTION

### Contact Details

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Designation: \_\_\_\_\_

Tel: \_\_\_\_\_

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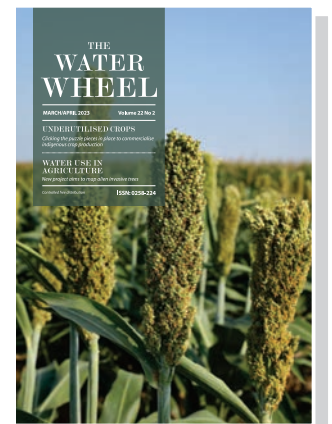
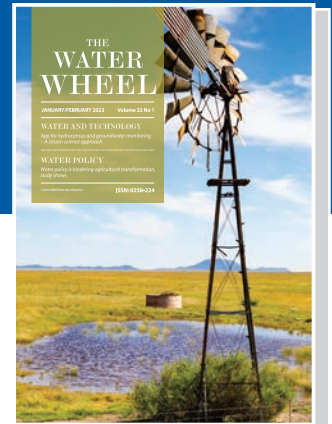
What would you like to read more about in the Water Wheel?

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### The Water Wheel

Tel: +27 (0) 12 761-9300

E-mail: [laniv@wrc.org.za](mailto:laniv@wrc.org.za) / [www.wrc.org.za](http://www.wrc.org.za)

Physical address: Lynnwood Bridge Office Park, Bloukrans Building, 4 Daventry Street, Lynnwood Manor

Postal address: Private Bag X03, Gezina, 0031

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The Water Research Commission not only endeavours to ensure that its commissioned research remains real and relevant to the country's water scene, but that the knowledge generated from this research contributes positively to uplifting South African communities, reducing inequality and growing our economy while safeguarding our natural resources. The WRC supports sustainable development through research funding, knowledge creation and dissemination.

The knowledge generated by the WRC generates new products and services for economic development, it informs policy and decision making, it provides sustainable development solutions, it contributes to transformation and redress, it empowers communities and it leads various dialogues in the water and science sectors.

The WRC Vision is to have highly informed water decision-making through science and technology at all levels, in all stakeholder groups, in innovative water solutions through research and development for South Africa, Africa and the world.

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