

THE WATER WHEEL

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WATER AND TECHNOLOGY

*App for hydrocensus and groundwater monitoring
– A citizen science approach*

WATER POLICY

*Water policy is hindering agricultural transformation,
study shows*

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Editorial Committee:

Dr Sylvester Mpandeli (Chair), Ms Khosi Jonas, Ms Manjusha Sunil, Mr Bonani Madikizela, Dr Mamohloding Tlthagale and 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 Twitter:

 @WaterWheelmag

Editor: Lani van Vuuren,

E-mail: laniv@wrc.org.za;

Editorial Secretary: Dikeledi Molutsi,

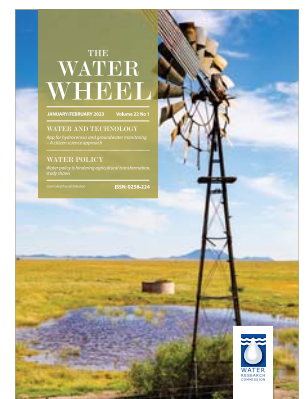
E-mail: dikeledik@wrc.org.za;

Layout: Anja van der Merwe,

E-mail: anjavdm@wrc.org.za

CONTENTS

- 04 UPFRONT**
- 10 WATER AND TECHNOLOGY**
App for hydrocensus and groundwater monitoring – A citizen science approach
- 14 SANITATION**
Bog-standard: survey rates workplace toilets
- 18 STATE OF THE ENVIRONMENT**
Researchers wave red flag: floods pushed some KZN coastal environments to tipping point
- 22 WATER POLICY**
Water policy is hindering agricultural transformation, study shows
- 26 INVASIVE ALIEN PLANTS**
New project aims to map alien invasive trees
- 29 CAPACITY BUILDING**
Water the ultimate winner in inaugural awards
- 32 NEW SANITATION**
New South African guide for the selection of appropriate sanitation systems
- 34 AT A GLANCE**
Wagendrift Dam – first of its kind in the world



A Water Research Commission-funded project has resulted in the development of a new groundwater app. See article on page 10.

NEWS

Cape Town South Africa's first 'wetland' city



The City of Cape Town is South Africa's first city to be accredited as a Ramsar Wetland City.

The announcement was made at the 14th Conference of Parties to the UN Convention on Wetlands, known as the Ramsar Convention, being held in Geneva, Switzerland from 5 to 13 November 2022.

Because of the threats posed by urbanisation and the increased demand for land on wetlands, the Convention in 2015 introduced Wetland City Accreditation for cities that have recognised the importance of protecting urban or peri-urban wetlands. Urbanisation is a globally acknowledged problem that has an impact on the health

and efficiency of wetland ecosystems. The voluntary wetland accreditation system adopted by the Ramsar with the aim of promoting sustainable urbanisation and the conservation of urban and peri-urban wetlands within urban and peri-urban areas.

Cities that have taken exceptional measures to protect their urban wetlands or a wetland of international importance (known as a Ramsar Site) within their city may apply to be accredited as a Ramsar Wetland City. The Wetland City Accreditation programme provides international recognition for cities that uphold a solid and favourable relationship with wetlands through creating public awareness on wetland benefits, incorporating wetland protection into municipal planning and decision-making, and promoting wetland benefits for local people.

The City of Cape Town is home to over 11 000 hectares of wetlands which provide essential services such as disaster risk reduction and contribute to climate change adaptation and mitigation. The city is recognised as a global hotspot of biodiversity and thus has a corresponding number of rare and threatened wetlands supporting many endemic fauna and

flora species. These wetlands include the Rietvlei and Milnerton Lagoon (part of the Table Bay Nature Reserve), the Zandvlei Estuary, Edith Stephens Wetlands, False Bay Nature Reserve (a wetland of international importance), the Noordhoek wetlands and many others. Over the past 20 years, the city has implemented several initiatives, both inside and outside of protected areas, with the aim of rehabilitating wetlands and conserving these natural assets.

Wetlands in and around urban settlements have historically been considered impediments to development. Drainage, filling in and pollution have long been a feature of planned and unplanned urbanisation.

Through the Ramsar Accreditation system those living in urban areas are now being encouraged to regard their wetlands as spaces which contribute to the liveability of cities through improving water quality, regulating the climate and reducing the effects of urban heat islands, providing space for recreation and leisure, and mitigating the effects of extreme events such as floods and resulting infrastructure damage.

SA to play host to earth observation summit in 2023

South Africa is set to host the Group on Earth Observations (GEO) Ministerial Summit in 2023.

According to a statement by the Department of Science and Innovation (DSI), South Africa has been an active executive committee member of GEO since 2005. "Climate change is a cross-cutting challenge and, in this interconnected world, the impact of a single event can have cascading consequences in locations further away

and across borders," said DSI Minister, Blade Nzimande.

According to the minister, global action such as the GEO was needed to respond to societal challenges and improve living conditions for all people, especially the world's poorest citizens.

GEO consists of more than 113 national governments, 31 of which are in Africa. These countries voluntarily contribute towards the common goal of building

the Global Earth Observation System of Systems (GEOSS). GEOSS aims to integrate observing systems and improve data sharing by connecting existing infrastructures using common standards. GEO addresses issues such as climate change, biodiversity, agriculture and health. Its systems encompass technologies from satellites and its comprehensive scope makes it possible to leverage resources and cut across disciplines.

SA university makes a clean sweep at international parasitology congress

Parasites may be viewed by many as pesky organisms, but understanding them and their impact on ecological systems is crucial in nature studies. The researchers and students at the North-West University (NWU) excel as experts in this field.

The NWU made history during the recent International Congress of Parasites of Wildlife by not only winning all the medals for postgraduates but also receiving the most coveted award for a researcher.

The congress was hosted by the Parasitological Society of Southern Africa (PARSA) at the Kruger National Park late last year. "It is the first time in the history of PARSA that a single university received all four the available medals that are presented annually to postgraduates and researchers," says Prof Nico Smit from the School of Biological Sciences, who received the highest honour from PARSA.

He was awarded the Elsdon-Dew Medal for his significant research contributions

to the advancement of parasitology in Africa. Only 24 researchers have received this prestigious medal in the 50-year history of PARSA.

Dr Marliese Truter and Linda van der Spuy received the Senior Neitz Medal for the best PhD thesis and the Junior Neitz Medal for the best MSc dissertation respectively. Dr Anja Erasmus was awarded the Angela Davis Russell Medal for the best publication in parasitology by a postgraduate student.

Phase 2 of 'Blue Deal' kicks off between SA and Dutch governments

The Department of Water and Sanitation alongside the Dutch Water Authorities has officially set wheels in motion for Phase 2 of the Blue Deal Programme which seeks to enhance access to sufficient, clean and safe water for all by 2030 and beyond.

This was done through the signing of a partnership commitment between the two parties during the Blue Deal Conference, held at the end of last year, under the theme 'Leadership deck on successes and learnings to date'. The Conference aimed to support water management worldwide by exchanging knowledge and experiences in the water sector, while expanding its footprint.

Speaking at the Conference, Deputy Minister of Water and Sanitation, David Mahlobo expressed appreciation to the Dutch Water Authorities for the

collaborative efforts with the department being implemented to ensure water security by 2030 and beyond. "South Africa welcomes the exchange of views, identification of mutual interests, ensuring involvement of stakeholders and linking up ideas across institutional boundaries through the Programme."

He further applauded the knowledge exchange between the two parties which is focused on the improvement of water governance, climate resilience and social inclusion. "I am informed that the Blue Deal South Africa Partnership wants to take the next step in the development of water management, I am impressed that the learning component will bridge and interconnect with water colleagues and other domains to catalyse the change that is rapidly needed."

Head of Blue Deal Worldwide, Hein Pieper and Deputy Ambassador of the Netherlands, Janneke Vrijland, shared Deputy Minister Mahlobo's sentiments while expressing the need to ensure effective and collaborative implementation of the programme.

"We need to continue working collaboratively for the programme to yield positive results. The Blue Deal Programme is a big deal, and we need to treat it as such," said Pieper.

The Blue Deal Programme is between the Netherlands Ministries of Foreign Affairs, infrastructure and Water Management and all the Dutch water authorities to support regional and national governments worldwide.

WATER DIARY

Water reuse 15-19 January 2023

The 13th International Water Association Conference on Water Reclamation and Reuse will take place in Chennai, India. The central theme of the conference is 'Water reuse: overcoming challenges of growth and climate change'. *Visit: <https://iwareuse2023.com/>*

Resource recovery 15 – 18 January 2023

The 8th International Water Association

Water Resource Recovery Modelling Seminar will be held in Stellenbosch. Topics will include activated sludge and biofilm processes, advances in sludge treatment and management of solids, resource recovery, separation processes, and aquatic chemistry (including micropollutants of concern), among others. *Visit: www.iwawrrmod2022.co.za*

World Wetlands Day 2 February 2023

World Wetlands Day will be celebrated

around the world on 2 February. *Visit: <https://www.worldwetlandsday.org/en/>*

Hydrogeology 17-22 September 2023

The 50th Congress of the International Association of Hydrogeologists will be hosted at the Cape Town International Convention Centre. *Visit: <https://iah2023.org.za/>*

GLOBAL

Reused water found to be cleaner than conventional potable water



Recycled wastewater is as safe to drink as conventional potable water, and may be less toxic than many sources of water we already drink daily, researchers say.

“We expected that potable reuse waters would be cleaner, in some cases, than conventional drinking water due to the fact that much more extensive treatment is conducted for them,” says William Mitch, senior author of the study in *Nature Sustainability* comparing conventional drinking water samples to wastewater purified as a drinking water, also known as potable reuse water.

“But we were surprised that in some cases the quality of the reuse water, particularly the reverse-osmosis-treated waters, was comparable to groundwater, which is traditionally considered the highest quality water.”

As drinking water sources become scarcer, the discovery is promising news for a thirsty public and utility companies struggling to keep up with demand. Water utilities, particularly those in the drought-stricken western US, are scrambling to find reliable water supplies. Traditional water sources from places such as the Colorado River and Sierra Nevada snowmelt have dried up. Instead, utilities have set their sights on potable reuse as a dependable water supply—one that utilities already conveniently manage and own.

Regulators demand more extensive treatment at potable reuse treatment plants. They specify that treatment systems must remove harmful pathogens, such as viruses and amoebas, and utilities flush out other contaminants using

reverse osmosis, ozonation, biofiltration, and other cleaning techniques.

Reverse osmosis treatment pushes water at high pressure through a filter that’s so small, it squeezes out even sodium and chloride. Mitch and his colleagues discovered the process cleans wastewater as much if not more than groundwater, the gold standard.

Even when reverse osmosis wasn’t applied, reuse waters were less toxic than the samples of conventional drinking waters sourced from rivers across the United States.

To view the original study, visit: <https://www.nature.com/articles/s41893-022-00985-7>

Mangroves – Environmental guardians of our coastline

They are the salt-tolerant shrubs that thrive in the toughest of conditions, but according to new University of South Australia research, mangroves are also avid coastal protectors, capable of surviving in heavy metal contaminated environments.

The researchers found that grey mangroves (*Avicennia marina*) can tolerate high lead, zinc, arsenic, cadmium and copper in contaminated sediment -- without sustaining adverse health impacts themselves.

The study tested the health of grey mangroves living around the Port Pirie smelter. Using leaf chlorophyll content as a proxy to plant health, mangroves were found to be unaffected by metallic

contaminants, despite lead and zinc levels being 60 and 151-fold higher than regulatory guidance values. The findings highlight the vital role of mangroves in stabilising polluted regions, and the importance of protecting these ‘coastal guardians’ around the world.

The study also coincides with a \$3 million federal government initiative to restore mangrove forests in Adelaide’s north.

Dr Farzana Kastury from UniSA’s Future Industries Institute says that ability of mangroves to withstand high metal concentrations make them invaluable in managing polluted environments. “Mangroves are the ideal eco-defender: they protect our coastlines from erosion

and sustain biodiversity, but they also have an incredible ability to trap toxic contaminants in their sediments,” Dr Farzana says. “Grey mangroves are known for their tolerance of potentially toxic elements, but until now, little has been known about the health of these plants in the Upper Spencer Gulf.

“Our research found that grey mangroves were able to adapt and survive exposure to very high levels of lead and zinc – without adverse health effects in their chlorophyll content – demonstrating how valuable they are to coastal ecosystems.”

• To view the original study, visit: <https://linkinghub.elsevier.com/retrieve/pii/S0048969722066025>

Magnetic material mops up microplastics in water



Researchers at RMIT University, in Melbourne, Australia, have found an innovative way to rapidly remove hazardous microplastics from water using magnets.

Lead researcher Prof Nicky Eshtiaghi, said existing methods could take days to remove microplastics from water, while their cheap and sustainable invention achieves better results in just one hour. The team says they have developed adsorbents, in the form of a powder, that remove microplastics 1 000 times smaller than those currently detectable by existing wastewater treatment plants.

The researchers have successfully tested the adsorbents in the lab, and they plan to engage with industry to further develop the innovation to remove microplastics from waterways. The research results are

published in the *Chemical Engineering Journal*.

"The nano-pillar structure we've engineered to remove this pollution, which is impossible to see but very harmful to the environment, is recycled from waste and can be used multiple times," said Eshtiaghi from RMIT's School of Environmental and Chemical Engineering. "This is a big win for the environment and the circular economy."

The researchers have developed an adsorbent using nanomaterials that they can mix into water to attract microplastics and dissolved pollutants. Muhammad Haris, the first author and PhD candidate from RMIT's School of Environmental and Chemical Engineering, said the nanomaterials contained iron, which enabled the team to use magnets to easily

separate the microplastics and pollutants from the water. "This whole process takes one hour, compared to other inventions taking days," he said.

Co-lead researcher Dr Nasir Mahmood said the nano-pillar structured material was designed to attract microplastics without creating any secondary pollutants or carbon footprints. "The adsorbent is prepared with special surface properties so that it can effectively and simultaneously remove both microplastics and dissolved pollutants from water," said Mahmood from Applied Chemistry and Environmental Science at RMIT.

• To view the original study, Visit: <https://www.sciencedirect.com/science/article/abs/pii/S1385894722058703?via%3Dihub>

SOUTH AFRICAN AGRICULTURE WELL REPRESENTED AT GLOBAL LEVEL

All photographs supplied



ICID President, Prof Ragab Ragab, congratulates Prof Sylvester Mpandeli after he was endorsed by the International Executive Council as the first Vice President of ICID on 10 October 2022 in Adelaide, Australia.

Water Research Commission (WRC) Executive Manager responsible for the Water Utilisation in Agriculture, Prof Sylvester Mpandeli, attended the 24th International Commission on Irrigation and Drainage (ICID) Congress and the 73rd International Executive Council (IEC) Meeting in Adelaide, Australia from 3 to 10 October 2022. At this event he was appointed Vice President of the ICID.

ICID is a leading international organisation working in the field of irrigation, drainage and flood management to promote sustainable agriculture water management. As a scientific, technical and professional platform, the organisation is dedicated to improving the status of agricultural water management practice around the world. The ICID congress covered several issues, including agricultural water management, climate change, water use efficiencies, food and energy securities, dams and drainage issues.

Prof Mpandeli and his team presented four papers at the congress, namely on 'Adapting crop production to increased water stress in southern Africa', 'Water use of indigenous grain and legume food crops', 'Operationalising the water-energy-food (WEF) nexus through the theory of change', and 'An integrated geospatial and multi-criteria decision approach and factors required in irrigation suitability mapping'. This offered a comprehensive showcase of the stellar agriculture- and irrigation-related research work being undertaken by researchers in South Africa.

Prof Mpandeli was endorsed as Vice President of ICID during the IEC meeting of the organisation. As Vice President, he will be a member of the Permanent Committee on Strategy and Organisation (PCSO), where he will participate in developing strategies, building activities and coordinating all the working



Prof Sylvester Mpandeli with Chair of the African Regional Working Group, Dr Mohammed Wabha from Egypt during the last day of the IEC meeting in Adelaide, Australia.

bodies across the globe. These include, among others, the African Regional Working Group (AFRWG), American Regional Working Group (AMRWG), Asian Regional Working Group (ASRWG), and European Regional Working Group (ERWG). He will also review reports of working groups/committees and the ICID Young Professional's e-Forum (IYPEF) while being an office bearer's committee member and leading one of the strategic theme areas.

The next ICID event is the 4th World Irrigation Forum (WIF), which will take place in China in 2023. The forum aims to bring together all stakeholders involved in irrigation of multi-disciplines and all scales, including the policy-makers, experts, research institutions, non-governmental organisations and farmers. It provides a platform for the world irrigation community and interested development professionals to find solutions to problems plaguing irrigated agriculture, especially in times of depleting freshwater resources and climate change. ICID provides a unique platform for stakeholders in the WIF for sharing and learning by engaging in issues of interest at global level. WIF also gathers a wide range of experts from various fields to discuss important issues highlighted.

The WIF stimulates and promotes multi-disciplinary discussions towards sustainable solution to water management in agriculture through:

- Exchange of latest irrigation and drainage policies, practices, innovations and technologies;
- Exploring and formulating concrete inter-disciplinary proposals;
- Development of liaison/ collaboration among various national / international institutions/ organisations/ private sector working for irrigated agriculture; and
- Advocacy for political commitments.

NEW WRC REPORTS

Nature-based solutions for water management in the peri-urban: Ecological, social and economic nexus

Nature-based solutions (NBS) are defined by the IUCN as “actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.” This research aimed to move beyond the state of the art by taking a systemic perspective on nature-based solutions for water, with an emphasis on complexity, uncertainty, resilience and adaptation for different peri-urban contexts. It focused on the need to ensure the involvement of multiple stakeholders and combine multi- and transdisciplinary knowledge as key elements in the implementation and assessment of nature-based solutions as local responses with replicability potential. This is intended to make progress towards a new management paradigm for peri-urban areas. This WRC-funded project part of an international research project called: ‘Nature-Based Solutions for Water Management in the Peri-Urban (NATWiP): Linking ecological, social and economic dimensions’, which is part of the Water Joint Programming Initiative.

WRC report no. 3036/1/22

Web link: <https://bit.ly/3Fv8ASw>

The use of non-potable water in road construction

Construction of a new bitumenised road typically requires upwards of 1 Mℓ per day of freshwater, enough for 20 000 people at the Cape Town drought ration of 50 litres per person per day. Only freshwater is normally permitted because of certain poor experiences in the past such as damage to the primed base course when even slightly brackish water was used and damage to the bituminous surfacing when salt water was used. The water used cannot be recovered and is lost forever. The causative damage factors have been identified and it is shown that, provided certain design and construction precautions are taken, even seawater can be used in all layers of most roads and other flexible pavements. A short, practical users’ guide is also provided. Although the use of salt water cannot be considered in isolation from the inherent salinity of the pavement layer material itself, the scope of this project does not fully include this aspect and it is assumed that the materials initially comply with those of the conservative national salinity specifications for state roads.

WRC report no. 3035/1/22

Web link: <https://bit.ly/3has3ye>



Including the fate of chemical precipitants and other products of waste resource recovery facilities in their strategic design and operation

The overarching aim of this project was to apply mathematical models for investigating the fate of chemical contaminants and useful byproducts from the waste treatment plant (i.e. biogas, treated water, recovered nutrients, mineral precipitates and stable organics) and to determine whether the

industrial utilisation of these recovered resources could impact tactical decision-making in design and operation optimisation of waste treatment systems. The development of evaluative mathematical models for unit process systems of future water and resource recovery facilities (WRRFs) have a significant role to play in defining operational strategies that shall support resource recovery from waste at minimum cost. Progress to date, towards modelling the entire WWTP system includes the completion of steady state and three-phase dynamic simulation plantwide model for South Africa for nitrification denitrification activated sludge and anoxic-aerobic or anaerobic digestion of primary and waste activated sludge from N removal systems.

WRC report no. TT 879/22

Web link: <https://bit.ly/3F7uoCg>

Understanding of surface water-groundwater interactions from headwaters to lowlands or catchment scale sustainable water resources management

There is generally limited knowledge about the nature and spatiotemporal dynamics of interactions between surface water and groundwater, especially in areas with fractured aquifers. Several studies have been carried out about these interactions at the river reach scale. However, extrapolating site-specific results to different parts of the river from headwaters, midslope, to lowlands often leads to an inaccurate representation of the interactions. Changes in topography, the composition of the hyporheic zone, riparian vegetation, and hydrogeological characteristics along a river affect surface water-groundwater interactions. In regions with distinct wet and dry seasons, these interactions may vary at event-, seasonal- and annual time scales. Knowledge about the nature of the interactions, and factors accounting for their spatiotemporal dynamics at the catchment scale is required to inform integrated water resources management approaches. Without this knowledge, water managers embrace IWRM but are constrained from translating policy into practice. This study aimed to contribute knowledge about the spatiotemporal dynamics of surface water-groundwater interactions at the catchment scale from headwaters to lowlands along the Nuwejaars River in Cape Agulhas.

WRC report no. 2855/1/22

Web link: <https://bit.ly/3P5NcX5>

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or visit: www.wrc.org.za

WATER AND TECHNOLOGY

App for hydrocensus and groundwater monitoring – A citizen science approach

With financial support from the Water Research Commission (WRC), researchers from the North-West University's Centre for Water Sciences and Management have developed a mobile application (app) that will allow ordinary citizens to add borehole locations and other characteristics to the app databases. The simple technology will place the power of groundwater monitoring in the hands of all citizens, over and above professionals and groundwater experts. Article by Petro Kotzé.



“You can’t manage what you don’t measure” is a common saying, but one that is increasingly relevant to South Africa’s groundwater resources. Once known as the country’s Cinderella of water resources, we are increasingly shining the spotlight on groundwater for potential water supply, especially when supplies run low. Cape Town’s close shave with Day Zero is a case in point. An estimated 30 000 boreholes were reportedly drilled in and around the Mother City during the 2016 to 2018 drought, but how much groundwater was abstracted, and the impact thereof, are largely unknown.

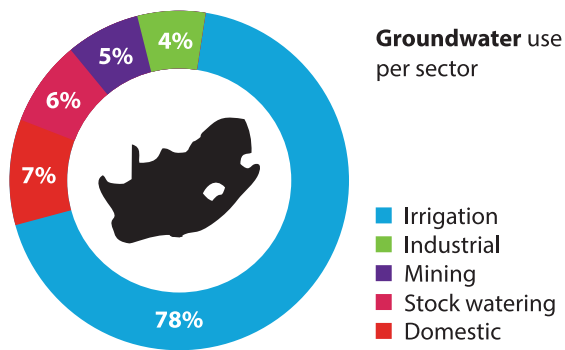
The situation is not unique to the Western Cape. The national database for borehole information has progressively developed a backlog, and contains limited time series data, with serious

consequences for future groundwater resource management.

In a dry country such as South Africa, adequate information on the status and trends of groundwater resources is paramount for strategic development. We need it to help plan how to provide water for the people, to monitor our water resources, provide drought relief and mitigate against the impact of climate change. Without specific and accurate borehole information, we cannot ensure that groundwater is managed well, or protected from over-abstraction and contamination.

It is hoped that the new groundwater app could go a long way towards alleviating the situation.

Storing groundwater information in South Africa



South Africa's predominant fractured rock groundwater system contributes about 15% of the bulk water supply. This plays a major role in domestic water supply, contributing 45% to 60% and in rural areas, possibly as much as 90%.

Groundwater-related data is captured in the National Groundwater Archive (NGA), which is managed and owned by the Department of Water and Sanitation (DWS). The NGA is part of the larger National Groundwater Information System (NGIS).

The NGA dates back to the sixties, and allows registered users to capture, view, modify and extract groundwater-related data. It contains comprehensive information on specific geosites like boreholes, dug wells, seepage ponds and springs. Site names, locations, descriptions and types, drilling details like water strike depth and blow yield, test pumping and abstraction data, groundwater levels and water quality have been logged for thousands of geosites, including at least 270 000 boreholes, spread across 1 225 986 km² of South Africa.

However, the NGA is known as much for the backlog of information that needs to be captured in the database, as the necessity of the data that it must store. Rainier Dennis, project leader and senior lecturer at the NWU says an analysis of the NGA dataset showed a sharp decrease in new information captured over the past two decades.

The NGA's unraveling is likely due to several reasons. For one, the platform is not very user-friendly, says Yazeed van Wyk, WRC research manager in groundwater hydrology. The cumbersome process involves data being emailed to users in spreadsheets, from where coordinates must be plotted on a map or uploaded to a GPS, so the user can find the geosite location in the field.

Electronic data can be directly uploaded in bulk, but others must be recorded on a detailed, paper-based field form which, back at the office, must be captured electronically and submitted to the DWS, where an official has to capture the information and upload it to the NGA. Due to system failures, hard copies from mines sometimes need to be posted to the DWS.

The data also has to be checked and validated and ideally, monitored, which could involve many kilometres of travelling each month. It becomes an impossible task for an institution such as the DWS, Dennis explains. Most of the monitoring has been delegated to regional offices across the country's

provinces, but many lack the capacity to complete these tasks.

Over and above the backlog of information that needs to be uploaded, a lack of repeat monitoring has resulted in the NGA database containing a very limited time series data, van Wyk says. The location, water level and quality parameters of some boreholes might only have been logged once, decades ago.

Another problem is that users will typically download data from the NGA, but they won't upload data, van Wyk says. Dennis adds that many consultants hold onto their databases instead of uploading them to the national system, as it gives them a competitive advantage for future work. Some borehole users are also just unwilling to share the information for fear of attracting the attention of authorities.

"While we do have a very good understanding of what's happening with our groundwater resources," van Wyk says, citing the many farmers that keep exceptional data sets for their water resources as another example, "the data is sitting in private hands".

An exception is the Limpopo Province, for which "a very thorough and detailed data set" exists, Dennis points out. The Limpopo Groundwater Resources Information Project (GRIP) was regularly updated by consultants, by means of a term contract set up by the DWS. However, though it should ultimately form part of the NGA, it's uncertain if all of it has been merged, reportedly because the persons running GRIP feel their data set is superior and prefers to keep it separate from the NGA.

How to manage what you don't measure?

The impact, especially in terms of monitoring, is massive, van Wyk says. "If we have good quality data we can make more informed decisions. For example, hydrogeologists usually monitor and collect water quality data of aquifers from boreholes. By the time contamination is picked up, it might already be too late as it takes a considerable amount of time for pollution to spread in the aquifer with the next step generally being remediation. Groundwater contamination can be prevented if efficient near real-time monitoring takes place.

"Should we all be prepared to share the data and have an updated national groundwater database, it would put us all in a better place overall for managing groundwater."

Even basic geohydrological work is affected. A common task is to conduct a hydrocensus, which involves the gathering of information on water features, water supply and potential pollution sources in a particular site or area under investigation. Over a large area, with outdated data, finding a borehole is like trying to find a needle in a haystack, Dennis says. Large distances need to be travelled, with no certainty that there is still an actual borehole at the end, adding unnecessary costs and time to the job.



Groundwater is increasingly leaned upon as water resource in South Africa, especially in times of drought. Monitoring is integral to ensure that its use remains sustainable.

“Should we all be prepared to share the data and have an updated national groundwater database, it would put us all in a better place overall for managing groundwater,” Dennis says. Proposed by the local groundwater community, the new app can go a long way to help achieve this.

A solution in the palm of your hand

The app is built around the concept of citizen science, and allows both experts and the general public to upload and access groundwater information. Developed with ArcGIS AppStudio and able to run on both Android and iOS operating systems, the database can accommodate common data between the NGA and GRIP. All data are stored in the cloud making use of an ArcGIS Online server, which the mobile app connects to. Desktop software allows users to perform bulk uploads and downloads.

The app provides easy access to the information in the NGA and GRIP databases. Users can see a map of where boreholes are, and immediately access all the information available to them, on their phones, with the tap of a finger. New information can also be captured and submitted on the spot. This will then be uploaded to a database that can be linked straight to the NGA.

The app takes the onus of groundwater monitoring out of the hands of only experts. In fact, part of its success will lie in the hands of any citizen. Though specialised equipment is necessary for borehole measurements, the public can still easily obtain a GPS location, take a photo, and answer some basic questions about the state of the borehole in the form of selection lists. Even if you only log the position of your borehole or any that you come across, it can give a groundwater professional an idea of where the boreholes are that should be included when studies are done, and they can then submit more specialised information, Dennis explains. This alone will be “a major game changer.”

The app allows for data validation and verification through a star-rating system. Ranging from zero to five, new or novice users will initially be allocated a zero-star rating, while professionals and expert users will be assigned a five-star rating. The rating is also affected by how many times the localities that a user logged were verified by other users.

The developers also incorporated a user credit system that



Though a near 30 000 boreholes were drilled in and around Cape Town during the so-called Day Zero drought, the impact thereof is largely unknown.

allows you to download data if you are also a contributor. The system will allocate a certain number of credits for each type of record uploaded and consume a certain number of credits for each record downloaded.

Van Wyk reports that the app has worked very well for him during a test run out in the field. However, the real impact will only be derived when the app goes “live” and people actually start using it and populating the databases.

“The challenge of this project moving forward is how to keep the general public interested in taking part in the data collection,” van Wyk says. “Boreholes are not very exciting,” Dennis admits. Motivating groundwater professionals to use it is not an issue, he says, but we want those people sitting on isolated farms, those who live in rural areas and small towns to use it too.

This challenge was also picked up in the pilot study conducted as part of the project. Moreso than a general responsibility to help take care of water resources, people wanted to know what was in it for them. “They wanted us to provide incentives,” Dennis explains.

“The irony is if they do it, and log their water levels even just once a month, then, when there’s a problem, and I’ve got that data, we can actually advise him.”

For now, the more immediate challenge is where the app will be housed. “We had a high-level discussion with the key stakeholders on how to best to store and manage the app but these discussions have not yet been finalized,” van Wyk says. However, the app could potentially be managed by the WRC itself “We are in the process of developing a water research observatory that will be a centralised hub for all water-related data,” he says.

If so, the app can play an integral role in South Africa’s future water security. Though there is a popular narrative that groundwater is readily available in sufficient quantities, it still needs to be carefully regulated, van Wyk says. “If not, we might be over-abstracting from deeper groundwater resources, which might not necessarily be renewable.”

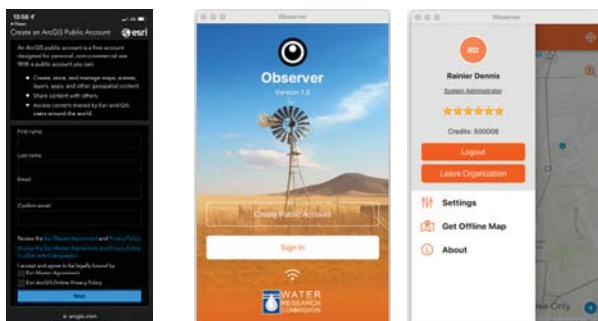
In the long term, it boils down to issues of water security, and



A new app could allow all South African citizens to add information on boreholes to the national database, and so help to safeguard the resource.

the various challenges the state faces to achieve this. We need to assist government, he says. And, this project is a fine example of what the WRC constantly tries to achieve. "Fundamental to whatever we do is how effectively science gets translated to inform policy," van Wyk notes. "That's the only way that we can really help society."

To access the final report of this research project, *Mobile App for Hydrocensus and Groundwater Monitoring (WRC Report No. 2827/1/22)* visit: <https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/2827%20final.pdf>



Screenshots of the new groundwater app

1) You need to register an ArcGIS Account to use the app. 2) Start-up screen where you log-in with your ArcGIS account. 3) System makes use of a star rating to express data confidence and a credit system for fair data use.

Groundwater and the law

Under the country's previous water Act, promulgated in 1956, people that owned the land above where the groundwater was found, owned it. The Water Act of 1998 (the NWA), however, fundamentally reformed any water laws in the country that were discriminatory and not appropriate to South African conditions, specifically the 1956 Act.

Water, and groundwater, are no longer privately owned, but fall under the management of national government. The ultimate aim of water management is, according to the NWA, "to achieve the sustainable use of water for the benefit of all users." Furthermore, the law recognizes that the "protection of the quality of water resources is necessary to ensure sustainability of the nation's water resources in the interests of all water users."

According to the law, water use licenses for boreholes used for low-volume, low-impact activities such as domestic use, livestock, recreation, and emergencies are not legally required. In reference to the mentioned near-30 000 boreholes that were sunk around the Day Zero drought, researchers ask in the report, Mobile App for Hydrocensus and Groundwater Monitoring, if 30 000 boreholes near each other is still considered a low-impact activity.

Since these boreholes were not required to be licensed and registered, most of their positions and water levels at the time, or after, will not be known or likely monitored.

SANITATION

Bog-standard: survey rates workplace toilets

Private sector facilities found to be mostly fine, but government loo's lag and more must be done for women and minorities. Matthew Hattingh reports.



Winston Churchill, so the story goes, went into the House of Commons WC, where he saw Clement Atlee relieving himself at one of the urinals. Churchill strode past him to a urinal at the end of the room. Seeing an opportunity to tease Churchill, Atlee asked "What's the matter, Winston, shy?" "Not at all," replied Churchill, "it's just that every time you see something large, you want to nationalise it."

The exchange is probably apocryphal, but it does give us pause to ponder on the subject of public toilets, particularly those at the workplace, where visits are practically unavoidable and encounters with colleagues occasionally exceed the bounds of friendly banter. So, how do South Africans regard the toilets and change-rooms at the factories or offices where they work? Are

they sufficiently private and safe? Are they sufficiently inclusive? What's wrong with them and how might they be made better?

This, in summary, is the substance of two related reports published by the Water Research Commission (WRC) in September 2022. *Sanitation at the Workplace – Evaluating Existing Sanitation Infrastructure at Public, Commercial, Mining and Industrial Workplaces*, subtitled *Status Quo (WRC Report No. 2870/1/22)* found the condition and cleanliness of workplace toilets and the laws and regulations governing these were, on the whole, up to scratch and on par with international practice. However, toilets at public sector workplaces were letting the side down.

The second report, subtitled *Best Practice Guideline for Workplace Sanitation (WRC Report No. TT 893/22)*, was intended to assist with updating the regulations and to inform policy- and decision-making. It took a considered look at women's toilets and pondered what should be done to make the places where we do our ablutions safer and more private. Increasingly, "access to bathrooms based on gender identity" has become a hot-button topic, and the report mulled over measures to make facilities inclusive for lesbian, gay, bisexual, transgender, queer/questioning, and other people.

The report found religious minorities were neglected and "vast improvements" were needed to aid disabled workers, including installing handrails, lower toilets and secure toilet seats.

The first report noted that the Employment & Labour and Minerals & Energy departments, which are responsible for policing workplace sanitation, have a limited number of inspectors. The Labour Department must keep tabs on 900 000 workplaces, so inevitably toilets don't get much attention. "The inspector's primary goal is enforcement of labour employment conditions and terms of employment with little to no emphasis on the state of sanitation facilities at the workplace," the report said.

Its authors, Dhanashree Naidoo, Temperance Sebele, Ciaran Chidley and Jacqui Davis found lots of literature on public sanitation facilities, but little on the facilities at South Africa's workplaces. They set out to correct this with a review of the regulations and through an online questionnaire. It surveyed the extent to which toilets, showers and change-rooms were within the rules and asked users how things might be improved.

The regulations in question fall under the Occupational Health and Safety Act; the Mine Health and Safety Act; and the National Building Regulations and Building Standards Act. These include a slew of standards and statutes, laying down the law on everything from toilet seats and paper (must-haves); to shower floors (slip-free and sloped); to the number of showers, toilets and urinals required for a given number of workers, men and women.

The various policies and the legislative framework were found to be adequate, appropriate and consistent, with no overlap between the responsibilities of the different departments. "The legislative framework compares well with international legislation," the authors said. However, they felt the legislation's definition of workplace sanitation should be expanded to include change-rooms to better align the needs of the industrial and mining sectors.

Twenty-one respondents in seven provinces and three sectors (more on this shortly) participated in the survey. They answered quantitative questions – giving Yes or No answers, but with the opportunity to make comments. Follow-up telephone interviews helped fill in any blanks respondents left in the SurveyMonkey questionnaires.

The questions were arranged into a number of broad themes, the first of which concerned access.

Ninety-five percent of respondents confirmed they could go to the toilet at any time, but 52% said they had to ask for a key. Public sector facilities were found to be the most restrictive, particularly in Limpopo.

"The literature review has shown that managing the key to the sanitation facility is often a technique used to monitor the productivity of employees. In some instances, women found it to be undignified to request a key to use the toilet," the authors said.

Soap and running water were available, according to all the respondents, and they reported the toilets always flushed. Toilet paper was always at the ready, according to 95% of respondents (the rest got it on request). Towels of some sort or hot air blowers were available for 85% of respondents. The 15% not provided with means to dry their hands mainly worked for the state in the Free State and Limpopo.

Ninety percent of respondents said the facilities were cleaned during a shift. Service providers, on-site janitors, or employees did the work in roughly equal proportions. Problems with the facilities were generally fixed within a day, said 80% of respondents.

"While unisex facilities may be welcomed by some, others may feel threatened or uncomfortable sharing facilities with other genders, especially in the context of a country struggling with gender-based violence."

Hot water was available to more than 80% of respondents, with the public sector trailing other sectors by some margin. There were no reports of missing toilet seats and in most cases urinals flushed.

Change-rooms were said to have adequate seating, but one-third were used for meals despite not being separated from the toilets. This was against regulations and the "only real non-conformance" issue the survey found.

Eighty-one percent of respondents were happy with the facilities. Those who weren't flagged a lack of warm water, the absence of facilities for disabled people, or wanted shower curtains replaced with doors. Some were unhappy that the women's toilets opened onto the factory floor and others called for better quality hardware and bigger or newer facilities.

Maintenance was an issue for only 5% of respondents, who felt it should be outsourced.

However, the research was done during the Covid-19 pandemic and the authors felt this may have coloured responses. Seventy-seven percent of respondents said the facilities were either very efficiently and effectively operated or moderately so. "This response is viewed with suspicion as many respondents were



All the respondents indicated soap and running water were available in their workplace bathrooms.

concerned about how the responses to the research would affect the ability of the organisation to commence with work during the Covid restrictions.”

Similarly, the authors were sceptical of the entirely positive response to the question, “Are the facilities maintained in a hygienic condition?” “It is possible that respondents were concerned about the impact of their response in light of the Covid-19 virus as well as the concern they may not be allowed back at work if the facilities were unhygienic and could exacerbate the spread of the virus,” they said.

The pandemic proved a headache to the team in other ways too.

“The survey was delayed by four months to allow wider participation, however, both the Eastern Cape and KwaZulu-Natal were dealing with the first wave of the virus when the survey recommenced after the delay of four months,” the report said.

The team initially requested participants do the survey online, with the researchers guiding the survey, but this proved unfeasible because most staff were working from home. “The team requested the assistance of union shop stewards to undertake the survey as it is in their interest to ensure employees are provided with reasonable sanitation facilities. Once again this was not always possible because of the lockdown restrictions.”

Eventually, the team let the participants complete the survey

when they could go to work, where they had access to data. Lockdown prevented the team making site visits so they were unable to independently verify the data.

The other serious difficulty or limitation the researchers faced stemmed from Covid too. At least eight mines agreed to participate in the research but later, fearing staff might be exposed to the virus, denied access. This meant fewer workplaces were surveyed than intended and it forced the team to infer their findings for the mining sector from the literature review. All questions pertaining to the Mine Health and Safety Act were removed from the survey.

The remaining questions sought to gauge whether facilities were gender and culturally sensitive, and to learn how well disabled people were accommodated.

Where separate toilets were available for men and women, an “alarming” 52% of cubicles did not have locks, with a “direct impact on the safety of women”. Nineteen percent of respondents reported their facilities did not separate toilets by gender.

Only one commercial facility catered for cultures or religions aside from the dominant Christian faith by providing Eastern toilets and washing facilities for Muslim prayers. This was “an area for improvement given the diversity of cultures in South Africa”.

Less than a fifth of respondents indicated their dissatisfaction with the following aspects of workplace sanitation:



Thirty-eight percent of respondents said no facilities were provided for disabled people, with the public sector being the worst culprit. This was true of all the provinces surveyed, with 60% of government employees surveyed reporting no disabled facilities.

What should be done?

The second report, by Naidoo and Davis, sought to answer this. It offered guidance for those managing, renovating or building new facilities by detailing the many regulations that apply. It also touched on technologies that may be put to use. These included smart lighting sensors that save energy, hands-free taps and flush valves. But the authors cautioned that as much as South Africans should learn from abroad and keep up to speed with changes, our architects and engineers must pick technology that is durable and appropriate for local and workplace conditions. One size does not fit all; sites and sectors differ. For example,

some workers deal with hazardous materials and must have ablutions to suit; a mine may have more permanent sanitation facilities above ground which may or may not be sewered systems, but temporary non-sewered sanitation below. Similarly, pains must be taken during planning to ensure a design “does not conflict heavily with the cultural preferences” of users.

There were environmental considerations too. The authors quoted former Water and Sanitation Minister Nomvula Mokonyane, who in 2015 urged more regulation and licensing to push developers to build greener facilities that use less water, recycle and rely less on waterborne sewerage.

The authors called for increased regulation and vitally, that the rules be enforced. They said that while developers, planners and employers should as “far as possible” factor inclusive design into new facilities, there was scope to improve things in existing buildings. This would protect people’s dignity, give the disabled a better deal, help women feel safer and generally “reinforce tolerance”.

Getting all this right won’t be easy, though.

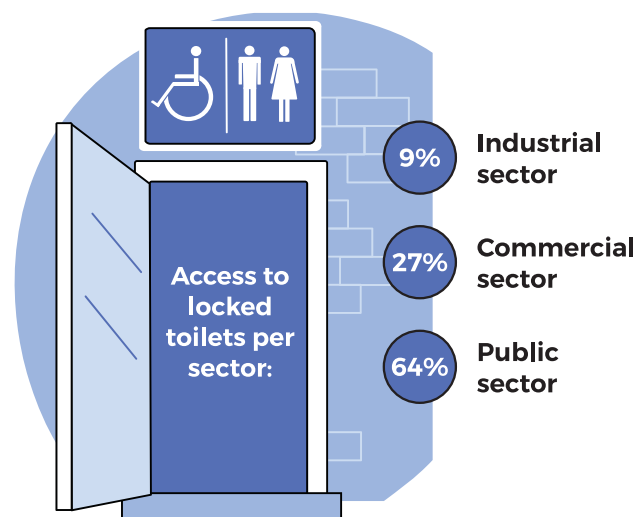
There are broader considerations, including the capacity of the

departments to enforce the regulations and the reality that people’s needs clash. As the authors observed: “While unisex facilities may be welcomed by some, others may feel threatened or uncomfortable sharing facilities with other genders, especially in the context of a country struggling with gender-based violence.”

Then again, it doesn’t necessarily require the wisdom of Solomon to sort out sanitation problems.

“Rather than waiting for issues to arise within the organisation,” the authors recommended employers “design for inclusivity from the beginning.” Where finances allowed, they suggested workplaces provide unisex facilities in addition to male- and female-only facilities.

The report quoted a number of learned works that made relatively simple, concrete suggestions, including “individual direct entry stalls, doors designed to ensure privacy as well as well-lit facilities” to ensure the safety of users. Also mentioned were tiled surfaces to aid cleanliness and the importance of sound budgeting, education and communication to ensure continued maintenance and the convenience of users.



“Thoughtfully placed mirrors can increase security, especially in women’s restrooms, by allowing a line of sight from the entrance to the back of the restroom without compromising privacy,” the authors suggested.

Better sanitation in the workplace is do-able, but here’s plenty to reflect on.

To access the *Best Practice Guideline for Workplace Sanitation (WRC Report No. TT 893/22)*, visit: <https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20893%20final%20web.pdf>

STATE OF THE ENVIRONMENT

Researchers wave red flag: floods pushed some KZN coastal environments to tipping point

Scientists have raised the red flag that multiple KwaZulu-Natal coastal ecosystems are collapsing. The warning comes on the back of the province's first State of the Coast Report (SoCR), released late last year, which brought the "dismal" state of many systems to light. According to authors, recent extreme weather may have pushed many ecosystems to their tipping points and beyond, to new, altered reference states which may not provide the required goods and services anymore. Petro Kotzé reports.



At stake is the roughly 580 km-long coastal strip from the Mozambican border in the north, to the uMthavuna River that borders the Eastern Cape in the south. The area is one of the country's richest environmental treasures, a major contributor to the economy, is scattered with dense urban populations, and a tourism hotspot.

The garden province's unravelling coastal border

The SoCR is a statutory requirement and should provide decision-makers with relevant data and information about the state of the province's coast. Bronwyn Goble, Senior Scientist at Oceanographic Research Institute (ORI) and the KwaZulu-Natal SoCR editor, explains that coastal issues were previously broadly reported on in a subsection of the State of the Environment Report at provincial and national levels.

Now, the Integrated Coastal Management (ICM) Act calls for a report dedicated to the state of South Africa's coastal environment. It sets the baseline of where we are, she says. The documents identify emerging problems and guide management actions such as conservation, development planning, and legislation, in support of sustainable targets for development. The reports are to be published every four years and will, hopefully, address the progress of change, she says.

The KwaZulu-Natal SoCR provides an overview of six main ecosystems: coastal, estuarine, marine, human, economic and governance environments. It also describes the drivers of change, pressures, the current state and potential impacts on each ecosystem. The researchers also suggest key response actions for each ecosystem. "We tried to highlight actions that

government could reasonably put in place," Goble says.

The report builds on the most recent National Biodiversity Assessment which, in 2019, already highlighted several relevant concerns. For one, the assessment found estuaries in KwaZulu-Natal (with those along the Cape west coast) as the country's most threatened and to be prioritised for interventions.

Furthermore, this assessment highlighted the increasing rate of habitat loss linked to new developments along the KwaZulu-Natal coast and adjacent interior. Other mentions relevant to the province included the concentration of threatened amphibians along the east coast; threatened reptiles along the north coast; its critically endangered freshwater lakes, including Lake Sibayi, the country's largest at 8 400 ha; and, the rampant invasive plant diversity along the coastline.

Several impacts related to mining were also mentioned in the 2019 assessment. This included the increase of sand mining as a result of poor compliance, and the enormous demand for building material. This was further facilitated by freshwater draw-down from water abstraction to support agriculture, which exposes riverbeds, making these far easier to mine. Among others, this was causing large-scale sand movement downstream, with new sand deposits smothering the burrows of sandprawns (*Callichirus kraussii*), an important bait species. Other far-reaching effects included sediment supply disruption to beaches and the marine environment, the smothering of species, physiological changes to species and ecological changes to the coastal/marine system, explains Fiona MacKay, Senior Scientist at the ORI and a co-author of the SoCR.

Various social impacts were also reported in the NBA, such as limited accessibility to coastal systems because of mining machinery and infrastructure and accidents in mined pits. Increasing fishing pressure on estuaries was also being exacerbated by the effective open access to resources that

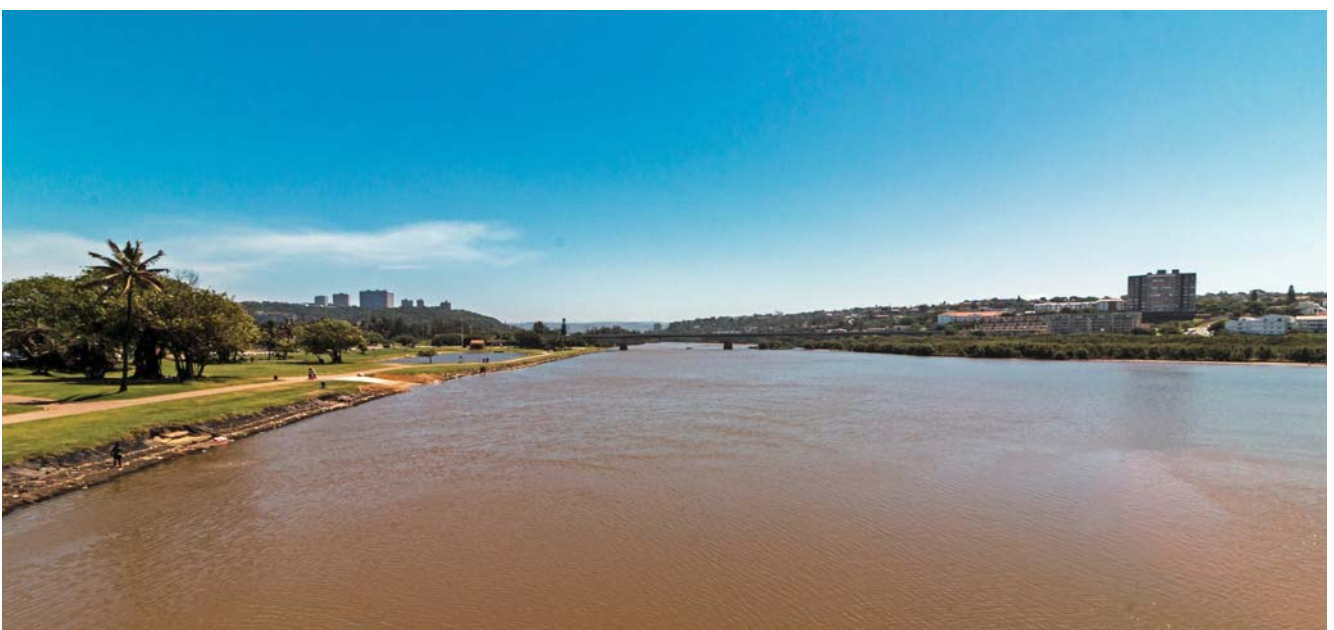
had arisen with the apparent collapse of fisheries compliance in KwaZulu-Natal.

"What was highlighted in the NBA for our province was dire," says MacKay "but since 2019 we've just further degenerated – as shown in the [latest] SoCR." The warnings do not seem to have been heeded and have continued on a downward trajectory, some systems reporting the worst health conditions ever reported, she notes. The SoCR authors highlight challenges in the way of improvement including a lack of collaboration across government departments, a lack of political buy-in, a lack of support for environmental concerns, a general aversion to the message emanating from scientific data and a hesitance to take responsibility or admit the scale of the disaster.

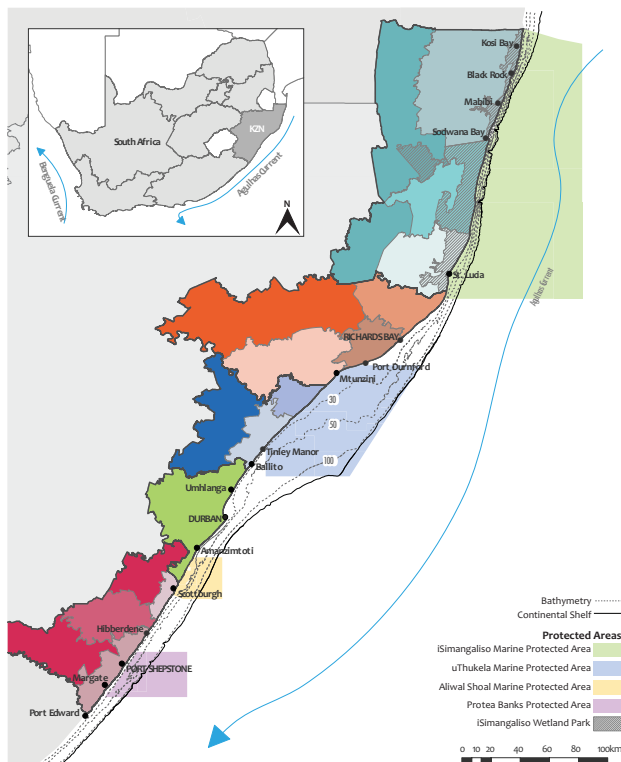
Already, the fragile state of the KwaZulu-Natal coast has been emphasised by a series of social upheavals. These include the COVID-19 pandemic and associated major lockdowns that swept over South Africa and the rest of the world over the last few years. The province was also rocked by violent riots in 2021 that resulted in severe damage to infrastructure and the interruption of basic services for months, adding pressure on wastewater treatment works, many already teetering on the brink.

Over and above these pressures, chronic sewage and various pollution spills, freshwater flow manipulation, invasive alien animals and plants, sand mining leading to general habitat degradation and poor water quality have all left devastating marks on the environment.

The culmination of these pressures are highlighted in the SoCR. Overall, the state of the KwaZulu-Natal coast is considered concerning, with 23 of the 35 sub-systems identified as being in a moderate state and 11 in a poor state. The overall trend shows a "dismal trajectory", with 18 sub-systems in a declining trend, 12 considered stable and only one, Marine Protected Areas, showing improvement. One of the main crosscutting environmental



KwaZulu-Natal estuaries such as uMngeni have been impacted increasingly by anthropogenic pressures.



Map of the KwaZulu-Natal coast.

threats identified was pollution and sewage treatment, and one that morphed over the last 30 years from a relatively minor pressure on the KwaZulu-Natal coast to a grave concern.

More threats include climate change, coastal sand mining, oil and gas exploration and changes in human settlements. In addition, water quality concerns, new diseases largely through aquaculture, and mining in the Estuarine Functional Zone (EFZ) have been identified as emerging concerns.

Of the coastal environments reported on, sandy and rocky shores were found to be in a moderate state, but declining. Swamp forests, coastal lakes, wetlands and vegetation were all found to be in a poor state, and declining. All estuarine environments, which included estuaries, mangroves and submerged macrophytes were also found to be in a poor state and declining. The report states that estuaries along the entire coast are under extreme threat and are being affected by bacteriological contamination. Sewerage infrastructure failures have resulted in repeated and prolonged raw sewage overflows into many systems over years, including the iKongeni Estuary (Margate), Durban Bay and uMngeni Estuary with the consequent closure of swimming beaches. The authors reported that direct consequences for human health, livelihoods and economies were already clearly emerging.

Of the marine environments assessed, coral reefs were found to be in a moderate state, but in decline, while rocky reefs and the pelagic environment were in a stable, moderate state. Soft sediments were in a moderate state but declining.

In April, a cut-off low system that swept over the province resulted in exceptionally heavy rainfall and the worst floods in living memory. More than 400 people died in

floods and landslides that displaced over 40 000 people, destroyed thousands of houses, and severely damaged other infrastructures like roads, health centres, schools, and ports. Only a month later, in May, more devastating rainfall, flooding and mudslides left thousands more homeless in the northeastern parts of the province.

“It was the last straw,” Mackay says. “We were already on a trajectory of collapse but now we are looking at collapsed.” We’ve probably pushed some systems beyond the tipping point, she says. One example of systems particularly at stake are estuaries, which are highly vulnerable to change and multiple human-induced pressures. However, a tipping point does not only refer to coastal ecosystems, but also to the greater socio-ecological system. Coastal communities are feeling the loss of basic resources like continuous water supply, loss of infrastructure and facilities. Due to the contamination of many beaches in eThekweni serially and continuously for months at a time, the use of the coast for recreation and cultural activities is also being lost.

Forward, beyond the brink

Already before the floods, the KwaZulu-Natal SoCR stresses that the findings must lead to action. Over and above, the recommended actions in the report are very simple, Goble explains. “We’ve distilled it down to simple, achievable things,” she says.

Key actions to curb pollution, for example, include improving the development and maintenance of sewage. The Green Drop programme must be reinstated to ensure systems are in place to monitor wastewater works. Regular, systematic monitoring of receiving waters must be conducted. Marine laboratory capability must be improved. There must be a paradigm shift regarding the ways in which solid waste is generated and disposed of.

For estuaries, compliance and enforcement of legislation must be improved. Estuarine flow requirements must be prioritised. Discharges to estuaries should comply with the provisions of the ICM and the National Water Acts. Authorities need to ensure that those 70% of the province’s estuaries without formal management plans, must get them. Existing protocols, legislation and policies must be enforced – including the Protocol for Requests to Breach Estuary Mouths in KwaZulu-Natal: Mouth Maintenance Management Plans, the EFZs and Coastal Management Lines (CMLs) and water quality monitoring under the National Estuarine Monitoring Programme.

In general, the areas to focus on are, first, governance. “Human and financial resources are critically needed to improve coastal management and the management of critical ecosystems within KwaZulu-Natal.” Second, awareness, education and knowledge sharing are critically important to improving the overall understanding of the value of the coastal environment, its ecosystems and resources. Last, the researchers write that planning for future risk through the determination and enforcement of CMLs for the coast and estuaries is imperative in reducing risk to infrastructure and properties.

However, mere months after the above was published, they now heed that though some of the damage can be reversed,

some systems will not recover for possibly decades. "We need to evolve and refocus our science into restoration and promote ecosystem-based adaptation very quickly." They need absolute urgent action, MacKay says, and the action is no longer saving the systems, but rather, that some of those systems must be restored because they are no longer fulfilling critical ecosystem functions.

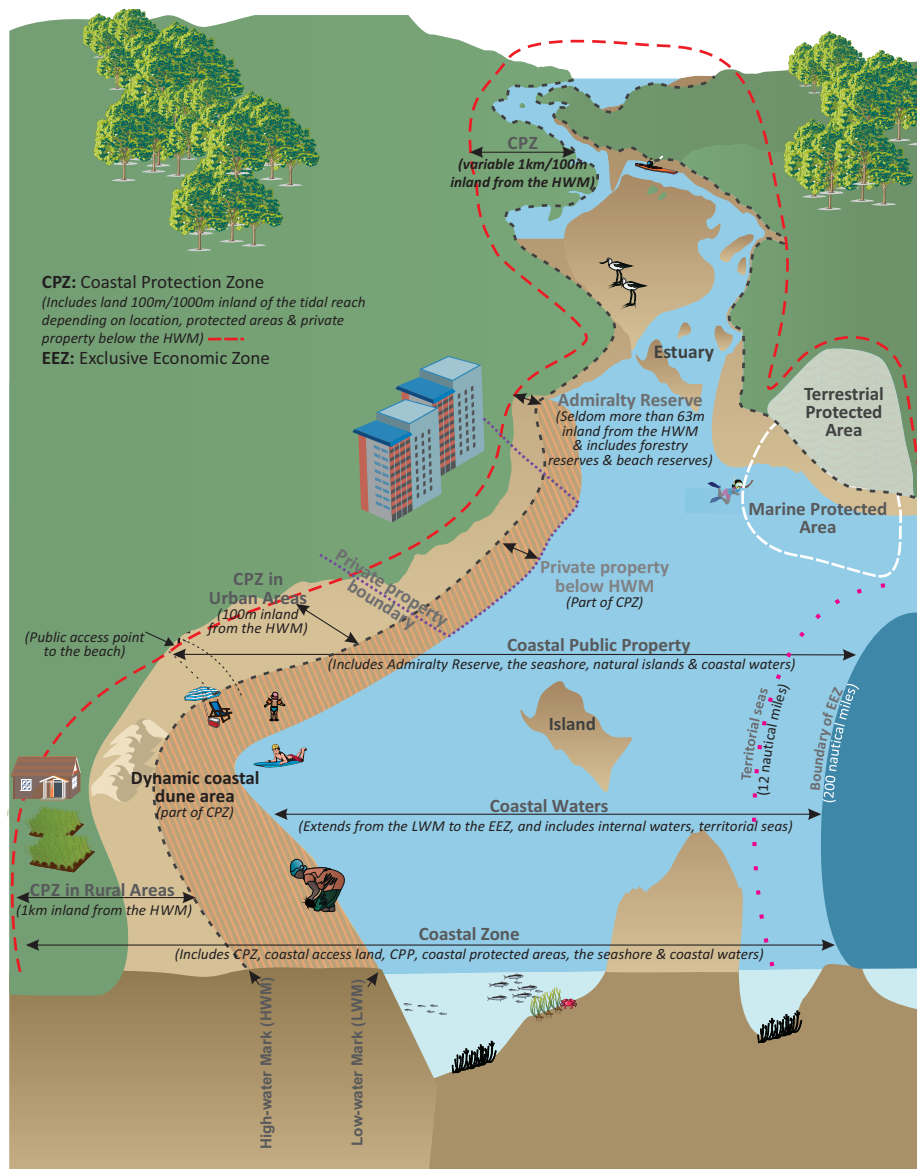
Ignorance at our own peril

Although it seems dismal, MacKay says there is a positive spin-off in that we should be learning from this. What is happening in KwaZulu-Natal should be a red flag globally, she says. For example, in 2005, the Millennium Ecosystem Assessment stated that coastal ecosystems are among the most productive in the world, but the most threatened by human settlement. According to estimates published in the report, about one third of coastal mangrove forests and one fifth of coral reefs had already been lost, while many fish populations have declined and estuaries and wetlands are under increased pressure from domestic and industrial waste.

Heed, and act on the red flags early on, MacKay says, because once they are compounded, you cannot easily stop and manage for the myriad of consequences.

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Summary of the Coastal Zone.

KZN EDTFA 2019

WATER POLICY

Water policy is hindering agricultural transformation, study shows

Lauded as one of the most progressive Constitutions in the world, South Africa's supreme law has not fully achieved its mandate to advance human rights and freedoms. The enormously unequal distribution of water for agriculture, almost 25 years since the onset of democracy, is one of the clearest examples of how the imbalances created by apartheid persist, reports Petro Kotzé.



According to the National Water Sanitation Master Plan (NWSMP) published in 2019 by the Department of Water and Sanitation (DWS) after extensive consultation with all stakeholders in the water sector, it is estimated that a mere 5% of agricultural water is estimated to be used by emerging. A major hurdle to reversing this disparity is the failure of Irrigation Boards (IBs) to transform into Water User Associations (WUAs), the vehicles for the historically disadvantaged to participate in the water allocation process.

A recent Water Research Commission (WRC) funded study investigated the challenges obstructing this transformation, and found a host of other complex issues at play, including

acknowledgment of existing lawful use, ironically provided for in the renowned National Water Act (NWA) of 1998 which is supposed to achieve equitable allocation of water to all. "To understand how we got here, we need to understand where we come from," says Bongani Msimang, MD of Boloka Development, the consultancy that conducted the study.

Inequitable water allocation in South Africa stems back to the 17th century, he points out, when European settlers came into the country. "That political dispensation ushered in a way in which water was managed according to the aspirations of those who came at the time."

Water, land and the law

Writers such as Guelke & Shell (1992) have traced the South African history of water giving narratives of dispossession that have lasted for centuries. When the Dutch East India Company arrived at the Cape of Good Hope in 1652, they developed water laws to serve the interests of the white settlers, based on Roman-Dutch Law, a legal system developed in the Netherlands. Land and water resources were taken from Khoikhoi pastoralists and it became difficult for them to sustain themselves in a land in which access to limited water resources was necessary for survival.

The settlers did not attempt to create a uniform policy for water use between the new arrivals, and native communities. Water use entitlements started to be officially allocated by the colonial government around the 1760s.

When the British government took over in 1805, new laws were introduced. A key change, that still heavily impacts water management in South Africa today was the dissolution of state control of water for the riparian principle. Landowners who had perennial streams passing through their land now had the first right to use the water for productive purposes. "These water rights were inextricably aligned to land ownership," Msimang points out and, very few black people could then own land. "Ultimately, this entrenched a huge era of inequity inequality in terms of water management and the usage of water," he notes.

Irrigation districts and, within them, irrigation boards to manage irrigation water along river courses were officially established within the Cape Colony with the promulgation of Act 8 of 1897. Water courts to preside over disputes were established soon after, with Act 40 of 1899 of the Cape Colony. The promulgation of the Cape Irrigation Act of 1906 further cemented the riparian principle.

Soon after, the new Union of South Africa's Irrigation and Conservation of Waters Act in 1912 preluded the beginning of a new era in water management within South Africa. Later, a change of government in 1948 kickstarted serious water resource development projects for economic development, followed by several new Acts written by the newly elected Nationalist Party. The most relevant of these was the Water Act of 1956. This law entrenched riparian rights and cemented inequalities in water access across races. It ingrained the legal right of a large portion of South Africa's water resources to be used by a minority of water users. The law did not afford black communities the same level of access to potable water and sanitation. It was based on total disregard and discrimination, Msimang says. Irrigation boards were again established under Section 79 of the Water Act No. 4 of 1956.

The era saw substantial resources pumped into commercial agriculture and the development of large government irrigation schemes. Concurrently, the handful of South Africans privy to the necessary land and water benefited hugely from the government's unwavering support.

Water policy was next reviewed for a new, democratic South Africa, and to reflect the new Constitution of 1997. The White Paper for National Water Policy for South Africa was published in

the same year, with the objectives to promote equity and access to water; to ensure benefit for all South Africans; and, to address the needs and challenges of water management. The riparian principle was abolished. Instead, water was to be allocated based on the promotion of equitable social and economic development. The national government became the custodian of water as a national resource.

The NWA of 1998 was a fundamental reform of the law relating to South Africa's water resources. At the time, it was hailed by the international water community as one of the most progressive pieces of water legislation in the world, and a major step forward in the translation of the concept of integrated water resources management (IWRM) into legislation.

Based on the principles of IWRM, the Act calls for the establishment of Catchment Management Agencies (CMAs) through which water resource management is delegated to the catchment level, with the involvement of local communities. IBs were to be (mostly) replaced with WUAs, which are defined as cooperative associations of local individual water users who wish to undertake water-related activities for their mutual benefit.

Yet, almost 25 years later, little of the Act's ambition for transformation in the irrigation sector has been fully achieved. Only about 50% of the roughly 279 irrigation boards in existence in 1998 have transformed into WUAs, Msimang says. Furthermore, none of the targets for water allocation to historically disadvantaged individuals (HDIs) set in the Water Allocation Reform Strategy of 2008 have been remotely reached. The figure of 5% in 2022 falls woefully short of the projected 30% by 2014, 45% by 2019, and 60% by 2024. Furthermore, the commercial farmers that use 95% of the allocated agricultural water, own 70% of commercial farms.

Hurdles to transformation

The study found multiple probable causes of Water Allocation Reform (WAR) not being achieved as planned. For one, there is a lack of institutional capacity to plan and implement the programme. "There was an inability within the department to manage the processes related to transformation," Msimang says. For example, the department did not have adequate capacity in terms of staff to evaluate or respond to the many proposals and business plans necessary to establish WUAs submitted to them.

In turn, only two catchment management agencies (CMAs) have been formed and are operational in the country and they also have not been delegated full operational powers in crucial activities such as water use licensing, which is still centralised.

Furthermore, the legal framework involved is complex. There were insufficient guidelines in terms of what the transformation of irrigation boards meant, for example, the implications for property ownership, assets and liabilities. More reasons include weak cooperation between the different government departments and the administrative burden of water use applications.

Msimang adds that, even among those IBs that transformed in terms of principle and practice, many still operate as IBs. "They



A mere 5% of agricultural water is estimated to be used by emerging farmers in South Africa.

have not necessarily assumed or embraced the principles that are important for transformation,” he says. Most management committees, for example, are still dominated by white males and they still operate along the same lines. “In most, the only thing that has changed is the name.”

However, a large part of the challenge lies in the NWA of 1998 itself, in which a number of loopholes opened up the way to blocking transformation. One is the NWA’s recognition of Existing Lawful Use (ELU), intended as a transitional arrangement at the time. ELU meant that a water user did not need to apply for a new water license (except in water-stressed catchments) if they could prove existing water rights were in place during the two years before the new Act commenced (thus, from 1996 to 1998). In other words, farmers with water quotas and pumping permits granted to them under the 1956 Act, could continue under the same conditions.

Though these users did not need to reapply, they had to register ELU. However, historically disadvantaged individuals who were denied any formal water right before 1998 were supposed to obtain licenses for pre- and post-1998 water uses. Over and above that, Msimang explains, “many black people did not even understand all these processes and were not aware that they needed to register, even though they had land and they used water.” Most commercial farmers, however, many with easy access to information, networks and the necessary exposure and access to these processes, registered their ELU.

Today, ELUs still authorise huge volumes of water used in the country. The NWA actually entrenched the status quo in terms of water rights, Msimang says, with far-reaching impact in terms of the water available for re-allocation that he thinks what not

appreciated by legislators at the time. “How then,” he asks, “will you achieve equity, if all the water is already allocated lawfully to commercial irrigation farmers who mostly happen to be white, through existing lawful use?” You’ve enacted in your law that water belongs to them, unless of course you can conduct the Verification and Validation process so that all water not allocated can be determined and re-allocated to achieve better equity, he says.

A second loophole is that, according to the NWA of 1998, an IB will continue to exist until it has been declared a WUA or until it has been “disestablished in terms of the law by or under which it was established.” In this case, it is the Water Act of 1956, which recognises riparian rights. “There’s a disparity today in terms of motif and intention,” Msimang explains, “because the 1956 Act established irrigation boards for a particular purpose, and to favour a particular race but the new law says you can only disestablish them in accordance with the 1956 law under which they were established.”

The challenges are exacerbated by the slow restitution of agricultural land. Membership of WUAs generally reflects land ownership and water use but, according to The Institute for Poverty, Land and Agrarian Studies, more than 70% of commercial farms in the country are estimated to be owned by white farmers with about 39 000 white commercial farmers and 5 300 black farmers (according to the African Farmers Association of South Africa). Most of the black commercial farmers have relatively smaller farms. Logically, WUA governance is thus often focused on white commercial farmers’ interests. On top of this, some landowners traded away their existing lawful water use rights, so that the water allocation was not transferred to land reform beneficiaries.

The impact of the delay has been “huge”, Msimang says. “There has been little transformation since 1994.” In many areas that he’s visited, emerging farmers are not included in the water management structures. In some places, meetings and statements are in Afrikaans, which the emerging farmers cannot understand. Many emerging farmers do not understand how the water charges work and are developed, and thus have built up debt. As a result many of them lose their farms or lease them back to commercial farmers because of accumulated debt and inability to farm due to high input costs, including electricity for their water pumps. Even those that do have land, do not necessarily have access to water.”

A realistic look at the future

The study has identified a number of recommendations and solutions.

The most important message is that a legislative review process is critical, Msimang says. “Without it, we will not be able to circumvent some of the provisions that are entrenching the disparity in terms of water use and allocation.

Then, for holistic transformation, there must be closer collaboration between government departments. Also, water reform goes hand in hand with land reform. Education and awareness of the challenges that the water sector is facing in relation to transformation are just as important, Msimang says. “A lot of support is required to ensure that emerging farmers are at the same level, or that they are brought to the same level as those that have already existed for that long in that space.” Furthermore, the establishment of water management institutions like CMAs must be fast-tracked. And, when institutions are developed, it is important to understand that the institutions are developed to serve the interest of all South Africans for whom these institutions are developed.

According to the final report, *Strengthening the knowledge base and capacity to support the transformation of Irrigation Boards to Water User Associations*, “the institutional arrangements

for water management within agriculture have for long been centred on irrigation infrastructure and not water as a resource. Transformation of IBs to WUAs accords us an opportunity to work the institutional arrangements around managing water as a shared resource.”

The researchers concluded that IWRM must be revisited. According to the report, “important decisions on water re-allocation should consider the implications of relationships between water users in a catchment, especially where historical water use differences exist in order to achieve equity and redress within the water sector.

Last, the focus must change from managing the water supply to managing the increasing water demands. It’s imperative that all water users conserve the water they use.

The study results will inform the development of a Transformation Charter to address inequality within the water sector. Lessons from the work will also contribute to guidelines for the transformation of Irrigation Boards into WUAs, to be used by the Department of Water and Sanitation (DWS) and its partners.

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The institutional arrangements for water management within agriculture have for long been centred on irrigation infrastructure and not water as a resource.

INVASIVE ALIEN PLANTS



New project aims to map alien invasive trees

A project supported by the Water Research Commission (WRC) aims to map invasive alien trees and their impacts in key strategic water source areas. Article by Alanna Rebelo, Karen Esler and David le Maitre.



The WRC is funding a project which aims to map woody invasive alien plants and their impacts in four key strategic water source areas. Strategic water source areas are those which supply a disproportionately large amount of water relative to their area. Called MAPWAPS for short, this project was launched on 1 April 2022 and will run for three years until March 2025.

The project aims to use freely available satellite imagery and cloud computing to map alien trees in some of the strategic water source areas that do not have recent information on biological invasions and their impact.

The project team is led by Dr Alanna Rebelo of the Water Science Unit at the Agricultural Research Council – Natural Resources and Engineering, along with collaborators Profs Karen Esler and David Le Maitre of the Conservation Ecology and Entomology

Department, Stellenbosch University, and an MSc and PhD student that will be trained on the project. They will study which techniques work best in particular biomes for detecting alien trees and quantifying their impacts on water resources.

Why do we need to map invasive alien trees?

Alien tree invasions are known to be highly problematic in South Africa, causing damages estimated to amount to billions of Rands annually. According to Van Wilgen and Wilson (2018), Government alone spends millions of Rands (close to a billion) annually on managing alien tree invasions.

The main reasons that alien tree invasions have such negative impacts on society are related to water, fire, soil, carbon and biodiversity.

Alien trees are known to use more water than our indigenous South African vegetation, resulting in a reduction of our already scarce water resources. These results are well understood in South Africa, first being measured for plantations in paired-catchment experiments that began in the 1980s, and since then confirmed by various other empirical and modelling studies, such as those of Le Maitre et al. (2016).

Alien trees, because of their large sizes, also result in higher fire intensities and increased fire risk due to softening boundaries between fire-prone wildlands and urban spaces (e.g. invasive alien trees which have been allowed to grow in nature areas particularly on the urban interface and around houses, creating fire bridges from natural spaces into urban areas), and in ecotones (e.g., there is usually a harder boundary between grasslands and forest, but when aliens invade both, fire can bridge from fire-prone grasslands into old forests which don't often burn).

The devastating impacts of the 2017 Knysna fire, the 2021 Cape Town (University of Cape Town) fire and the Somerset West fire in 2022 on infrastructure, homes and livelihoods were made worse by alien plant invasions.

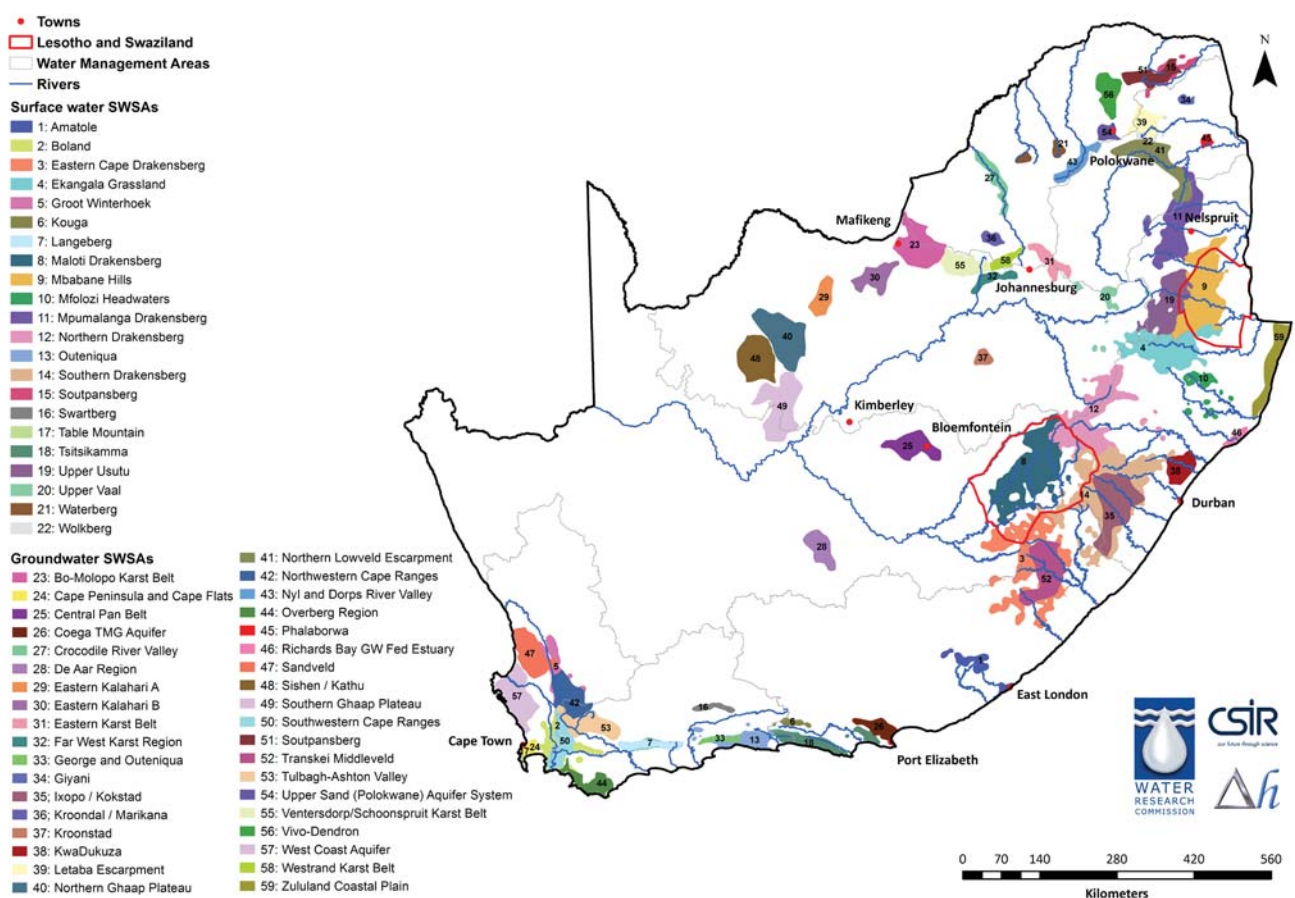
The increased fire intensity can scorch the soil, consuming the organic matter and making them water repellent and very prone to erosion. Some types of these alien trees also release chemicals into the soil to out-compete other native vegetation (called

allelopathy), thereby changing the soil composition, leading to reduced soil organic carbon, soil denudation, and exacerbating erosion.

This soil loss, and the loss of soil organic carbon, as well as the loss of native vegetation that stores a large part of its biomass underground in bulbs, tubers, corms etc. (safe from fires) results in a net loss of carbon from these ecosystems. This may seem counter-intuitive because trees are often thought of as a means to trap carbon. However, in fire-prone and adapted ecosystems, where all above-ground biomass is burned regularly, trees do not equate to more carbon being trapped from the atmosphere, but rather the opposite.

Last but not least, alien trees negatively impact biodiversity, threatening critical plant and animal species, as well as entire vegetation types (e.g. critically endangered Peninsula Granite Fynbos is highly threatened by alien gums and wattles in the Cape).

We need to restore ecosystems for climate change adaptation, by clearing invasive alien trees. Recognising the urgency of these efforts, the United Nations has declared this current decade the *Decade on Ecosystem Restoration* (2021-2030). However, to be able to do alien tree clearing systematically and effectively, accurate and up-to-date maps are required to guide prioritisation and costing. This is where the MAPWAPS project aims to fill the gap.



The strategic water source areas of South Africa. The four proposed project study sites are in the Luvuvhu River, Sabie-Crocodile, Tukhela and Mzimvubu catchments.



Felling of invasive alien pine trees in the fynbos, Western Cape

Bonani Madikizela, Research Manager at the Water Research Commission (WRC) observes that: "It is therefore worth noting that the WRC is investing in water security and ecosystem services through funding projects such as this one and others in order to generate a nature-based solution toolbox on how best to rehabilitate the extensively degraded ecological infrastructure in the country. Some of the projects are focusing on siltation management."

"These results would be useful input data for hydrological models, or to inform hydrological modelling for water resource management, thereby enhancing their accuracy."

What does the project involve?

The project has two key components: (1) to map invasive alien trees using freely available satellite imagery and field data in key strategic water sources areas (sites) in South Africa, and (2) to estimate their water use relative to native vegetation also using freely available satellite-derived products.

The first component will involve not only mapping alien tree occurrence and distribution, but also to estimate density and age for the target taxa. The free Google Earth Engine platform and robust machine learning algorithms will be harnessed to cloud-process Sentinel-2 imagery along with training data to produce the maps.

Using satellite imagery is what makes this work different from other projects that have gone before, which typically used modelling approaches, or relied solely on field data collection or systematic sampling alone.

The field campaigns will involve a few weeks of intensive field sampling at each site to collect training data (which will be collated on the citizen science platform iNaturalist.org), using photographic evidence.

Within each site, short workshops will be held with relevant

stakeholders (scientists, managers, NGOs, volunteers, etc.). The resultant maps will be shared with these stakeholders during the process for sense checking and validation.

The second component of the project aims to estimate the water-use of the alien trees mapped relative to native vegetation. This will be undertaken by upscaling ground-measured water-use to freely available satellite-derived products (e.g. MOD16).

This will provide a better understanding of the impact of the alien tree invasions on water resources by deriving the incremental water use by the invasions over and above that used by the indigenous vegetation. These results would be useful input data for hydrological models, or to inform hydrological modelling for water resource management, thereby enhancing their accuracy.

Where will the project take place?

Four sites have been selected by the study team: the Luvuvhu River catchment in Limpopo, the Sabie and Crocodile River catchments in Mpumalanga, the Tukhela River catchment in KwaZulu-Natal and the uMzimvubu River catchment in the Eastern Cape.

These sites were selected based on four key criteria: (1) water security – they needed to be important strategic water source areas within their region, (2) alien trees – strategic water source areas that experience the greatest estimated reductions in runoff due to invading trees, (3) spatial variation – to capture a spread of biomes, climate etc., and (4) data scarcity – sites for which data are lacking and needed.

The final selected sites span four provinces, different biomes (forest, grassland and savanna), and a range of different climates (bimodal to summer-rainfall), soils, socio-economic context's and land-uses.

We will be working closely with local initiatives within these catchments where possible, for example the Environmental and Rural Solutions in the uMzimvubu catchment, Eastern Cape. If you would like to get involved by joining a stakeholder workshop in your region, please contact Dr Alanna Rebelo at RebeloA@arc.agric.za.

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CAPACITY BUILDING

Water the ultimate winner in inaugural awards

The inaugural #cocreate Blue-Green Cities Design Awards celebrated projects with a strong design element and with water as the principal focus. Article by Sue Matthews.



Supported by The Umvoto Foundation (TUF), volunteers from Indawo, Abantu, Injongo eKhayelitsha conduct regular clean-ups in the Griffiths Mxenge community of Khayelitsha in Cape Town

The water community was shocked and saddened to learn in July 2021 that COVID-related complications had claimed the lives of Rowena Hay and her husband, Dr Chris Hartnady. As founder and MD of the earth science and groundwater consultancy Umvoto Africa, Rowena led a number of research projects funded by the Water Research Commission (WRC), and was a past member of the WRC Board. Among her many accolades was the WRC Knowledge Tree Award in the category 'Empowerment of Communities' in 2015.

Since then, Rowena had taken her altruistic endeavours a step further by establishing a non-profit company, The Umvoto Foundation. More commonly referred to as TUF, its aim is to support the development of community capacity in achieving clean and healthy ecosystems through advocacy and outreach work, and by fostering an understanding of social responsibility.

In fact, TUF's vision says it well: "A clean and healthy water system supports vibrant, safe and resilient communities. Our water sources and ecosystems are restored, respected and actively cared for by present and future generations."

So, it seems a fitting tribute to Rowena's legacy that an initiative supported by TUF was not only the overall winner in the 'Best Community-based Project' category of the inaugural #cocreate Blue-Green Cities Design Awards, but also won awards for the most valued water-sensitive innovation and the most valued water champion project.

Indawo, Abantu, Injongo eKhayelitsha, which means 'Place, People, Purpose in Khayelitsha' was started by Busiswa Nomyayi and four other women in November 2019, shortly after Busiswa attended a stewardship training course hosted by TUF and

learned how waste impacts water systems. The group began doing weekly clean-ups on their street in the Griffiths Mxenge community of Khayelitsha in Cape Town, and with TUF's support were able to secure equipment such as wheelbarrows, rakes, brooms, gloves and safety boots.

In 2021, TUF facilitated partnerships between the group and local artists to beautify the street. One painted a colourful wall mural while another covered concrete benches made from recycled building rubble with a mosaic design incorporating nature-related elements and traditional patterns. The group planted flowers and vegetables alongside the benches, with the intention of encouraging residents to respect their environment and avoid littering. More recently, a vegetable patch was started by TUF and the group at the adjacent primary school. The gardens provide an opportunity to engage community members on environmental issues such as biodiversity, stormwater runoff, water pollution and aquifer recharge.

The group needed to buy additional equipment for their expanding team, so they started a stall across the street from the mural in December 2021, and TUF organised a collection drive for second-hand clothing that they could sell. Recognising that recycling could provide another income stream, TUF asked the City of Cape Town's Solid Waste Management Department to assist the group. The City not only provided recycling bags but also hosted a waste minimisation and recycling training workshop in April 2022 for clean-up groups from Khayelitsha and Macassar.

In September 2022, TUF submitted an entry for the #cocreate Blue-Green Cities Design Awards, which were part of the #cocreate DESIGN FESTIVAL. The festival is an initiative of the Mission Network of the Kingdom of the Netherlands in South Africa, and the Consul General of the Netherlands in Cape Town, H el ene Rekkers, was pleased with the outcome. "The depth of knowledge-sharing that has come out of this festival has been inspiring, and we hope that it will ignite a flame that motivates us to do more as civil society, as government organisations and as the private sector to ensure that we are sensitised to the importance of water," she said.

The Craft and Design Institute in Cape Town helped organise the festival, which was curated in partnership with the University of Cape Town's Future Water Institute, the City of Cape Town and the Institute for Landscape Architecture in South Africa (ILASA). Held over two days in October, it was the culmination of four Creative Exchanges held from April to September under the theme 'Designing African blue-green cities for all'.

The awards aimed to celebrate inspirational initiatives that represent best practice in terms of water sensitive design and the transition to water sensitive cities in South Africa. All finalists had to submit a poster of their project that was displayed at the festival, and also present an 'elevator pitch' of three to five minutes. While the festival attendees voted on the best posters, the pitches were judged by a panel consisting of Prof Neil Armitage from UCT's Department of Civil Engineering, Accelerate Cape Town CEO Ryan Ravens, and ICLEI Africa Regional Director, Kobie Brand. The event was live-streamed to water-aware design practitioners and other stakeholders from around the world.



Busiswa Nomyayi and Fahad Aziz receiving the Best Community-based Project award from H el ene Rekkers, Consul General of the Netherlands Consulate in Cape Town, and Ian Neilson, the City of Cape Town's Water and Sanitation Portfolio Committee Workshop Chairperson.

When the awards were announced at the end of the festival, Busiswa Nomyayi and TUF's Fahad Aziz were delighted to accept the winner's trophies, which were hand-crafted from wire and beads. The runner-up for best community-based project was the Papenboom Meadow project in Newlands, Cape Town, with landscape architect Clare Burgess accepting the award on behalf of the Newlands Residents Association (NRA).

The meadow is a strip of public open space that originally formed part of the much larger Papenboom Estate, granted to Rutger Mensing in 1695 to set up the Cape Colony's first brewery. Mensing selected the site partly because it had a spring of clean water for his beer-making. The so-called Kommetjie Spring is still used by a brewery today, as some of its water is piped just over a kilometre downslope to the South African Breweries facility in Newlands, although it is apparently only used for cleaning purposes nowadays. Most of the spring's water is used to irrigate the SACS school sports fields, just over the road.

For the past few decades, the spring has been hidden within a collection chamber under a concrete cover, and a small overflow had been blocked off until the NRA community project kicked off in 2011. At the group's request, this flow was channelled underground to bubble up into a pond dug near the head of the original watercourse. The pond not only emulates a natural spring outlet, but also provides a waterbody deep enough to fill buckets for irrigating indigenous arum lilies, shrubs and trees, which were planted as part of the meadow's transformation from an overgrown site frequented by vagrants to a safe space that can be enjoyed by all. Invasive canna lilies, morning glory and bugweed were cleared, and paths and boardwalks constructed, allowing visitors to wander along the restored stream course and through a shady grove of poplars. A fynbos circle has recently been established at the front of the site alongside the famous Foresters Arms pub, affectionately known as Forries.

Awards were also given in the category **Best use of water as a design informant**. The winner was the water point upgrade project at the Europe informal settlement, which is built on an uncapped landfill site wedged between the N2 and Klipfontein

Road, about 5 km from Cape Town International Airport. The settlement has limited access to potable water from communal taps, no waterborne sewage reticulation, a lack of safe space for recreation, and is prone to flooding and ponding in winter due to poor infiltration and the absence of a drainage system.

The Rotary Club of Noon Gun therefore initiated a project that drew upon the skills of three of its members – landscape architect Amy Thompson and architects Jackie James and Claire du Trevou. Along the main pedestrian access route to Klipfontein Road, two new paved plazas were created, equipped with seven ergonomically designed water points and providing space for socialising and recreation, and a drainage channel was installed beneath a permeable walkway. Since domestic greywater was habitually discarded by residents onto walkways, which contaminated pooled stormwater and created a health hazard, a greywater separation system was constructed as well. Two to four households now share a gully, which conveys greywater to an underground pipe and through a silt trap before entering the municipal stormwater system along Klipfontein Road. Engineering services for the project were provided by JG Afrika, with funding obtained through Rotary International.

The runner-up in this category was a project to upgrade High Street in Hermanus from a tarred, car-dominant road that was prone to seasonal flooding into a paved, shared street where pedestrians can stroll, cafés can have sidewalk seating and retail businesses can thrive. This was made possible using a dual (hard and soft) stormwater system incorporating principles of sustainable urban drainage systems (SUDS), with trees and planted infiltration areas. The design by GAPP Architects and Urban Designers was implemented by Element Consulting Engineers for Overstrand Municipality.

In the category **Best student/research project**, the winner was Tahir Rakiép, who is currently a Master of Architecture student at UCT but submitted his honours project, titled 'Knowing Water: Facilitating knowledge transfer through social practice and the natural environment'. The project was motivated by flooding problems in the Cape Flats area of Cape Town, and proposes converting a stormwater detention basin in Delft into a bioretention pond that would provide natural habitat around a permanent water body. The pond would partially remove pollutants from stormwater, while beautifying the area and creating a space for rest and reflection. The site design included an early childhood development centre (ECD), a fynbos research satellite office and a vegetable garden. The envisaged garden could be tended by community members and irrigated using water from the pond, with the vegetables either sold or used as a food supply for the ECD.

The runner-up was Oliver Brown, a candidate architect for the Department of Public Works, based in Durban. His award was for his Master of Architecture project 'Islamic Tirthas: a river pilgrimage in the cradle of Islam in the Cape in Sandvlei and Macassar, Cape Town'. The dissertation re-imagines a new heritage route that starts just upstream of the Eerste-Kuil River confluence, continues through the farmlands of Sandvlei towards the kramat of Sheikh Yusuf Al-Makassari, and ends at Macassar Beach on the False Bay coastline. Sheikh Yusuf, who arrived at the Cape as an exile in 1694, is widely regarded as

the founder of Islam at the Cape. The conceptual route includes a series of water infrastructures – such as weirs, bridges, water storage and flood detention facilities – that are inspired by traditional Islamic design.

Other finalists shortlisted for the awards included the Paterson Park stormwater renaturalisation project by Chris Brooker and associates for the City of Johannesburg, a project on retrofitted infiltration basins by Craig Tinashe Tanyanyiwa and Rachelle Schneuwly from UCT's Future Water Institute, the Table Mountain Water Source Partnership project represented by WWF-SA's Klaudia Schachtschnieder, and Youth Visions for a Changing Climate – a collaborative project in Cape Town involving street artists, academics, facilitators and conservationists.

Following the award ceremony, Kirsty Carden, the interim Director of the Future Water Institute, remarked: "The #cocreate Blue-Green Cities Design Awards have provided a wonderful opportunity to reflect on best practice in creating water-sensitive, liveable and resilient spaces in South Africa – and give us hope for better things to come."



As part of the community project, the group planted gardens alongside benches constructed from building rubble and then decorated by a mosaic artist.



Water from the Kommetjie Spring fills a pond constructed near the head of the old watercourse and then flows along the edge of the meadow in the restored stream.

NEW SANITATION

New South African guide for the selection of appropriate sanitation systems

A new guide has been developed to assist municipalities with the selection of appropriate sanitation systems. Article by Jeanette Neethling.



While South African municipalities struggle to address sanitation service backlogs for low density rural areas, peri-urban and informal settlements, technology developers across the globe are innovating new solutions in sanitation. In South Africa, dry on-site sanitation is utilised in most rural and peri-urban areas while waterborne sanitation is the norm in urban areas (the binary sanitation paradigm).

While the drive to extend waterborne sanitation to rural areas is motivated largely by political pressure and user aspirations, widespread implementation of conventional approaches is unsustainable and near impossible in a country with water scarcity, constrained infrastructure, and limited budgets due to the high costs involved. Alternative solutions have been

developed in recent years with the aim of improving sanitation services without the high capital investment and water usage required for large reticulation services.

The growing suite of options available has the potential to bridge the gap between basic and improved sanitation and allow municipalities to achieve dignified hygiene and sanitation for all. Sanitation alternatives will contribute directly to the target of the National Water and Sanitation Master Plan to “develop, demonstrate and validate appropriate alternative, waterless, and off-grid sanitation solutions.” With more options comes more difficult decision-making, which is why South Africa’s 2016 National Sanitation Policy states a position to “develop criteria to evaluate appropriate sanitation technologies”.

The South African Sanitation Technology Enterprise Programme (SASTEP) is a national system of innovation platform that seeks to fast-track the adoption of innovative and emerging sanitation technologies in South Africa through fostering local manufacturing and commercialisation. In 2021/22, SASTEP commissioned a project to investigate the barriers to uptake of alternative sanitation systems and create a suite of tools to help municipalities overcome these barriers.

The work included consultation with municipal representatives and technology developers to first understand how and why implementation of innovative technologies is hampered. In general, obstacles to the introduction of innovative technology are related to technology selection and technology procurement. In terms of technology selection, this may include limitations such as: limited understanding of sanitation systems and how they are meant to function; lack of knowledge on available systems; resistance to change; and lack of certification and limited testing of new technologies.

In terms of technology procurement, limitations include, inter alia: struggles to procure specific piloted technologies while ensuring fair procurement processes; tender specifications that are either too specific or too broad; evaluation protocols focused solely on capital cost rather than considering lifecycle costs; and limited options for receiving alternative offers or pursuing design-build contracts.

Following the barriers analysis, a suite of tools was produced to improve understanding of sanitation systems in general and support decision makers who have limited capacity and time. The tools aim to empower municipalities, water services authorities, and water services providers to deploy sanitation solutions that are contextually appropriate, including alternative and traditional approaches. While a tool can never replace critical thinking and technical expertise, decision-making tools can open the possibilities for implementation of alternative sanitation solutions. This will introduce a wider range of technology solutions that can be used in addressing sanitation service delivery challenges, ideally leading to increased access to improved sanitation for more South Africans.

This project led to the creation of the following tools:

- **Selecting sanitation systems:** A document setting a framework for understanding what is included in a sanitation system, based on the *Compendium of Sanitation Systems and Technologies* by EAWAG (2014). The aim of this document is to establish a common language among South African decision makers. The document also establishes key criteria to consider when selecting a sanitation system, based both on project goals and constraints.
- **Sani Select decision-support tool:** An MS excel tool that assists with decision-making along the sanitation value chain while considering many different factors
- **Writing a sanitation policy:** A document providing simple guidance for municipalities on writing their own sanitation policy

- **Procurement processes for alternative sanitation systems:** A document providing guidance on procuring alternative sanitation technologies, with some proposed alternatives to traditional approaches. This also includes some example specifications to assist decision makers.
- **Advocating for alternative sanitation systems:** A document providing high-level tips to technology suppliers and advocates to improve their promotion of alternative sanitation systems, based on feedback from those interviewed during this study.

The above tools are a starting point for supporting municipalities and other decision makers in taking the step towards more sustainable and appropriate sanitation. Since the completion of the Guide, SASTEP and Partners in Development have hosted several workshops aimed at municipal engineers and decision – makers. While there is considerable interest in the tools created through this work, the tools must be mainstreamed to ensure uptake. This may include incorporation of the tools and guidance into Department of Water and Sanitation policy and processes and inclusion of the materials in a non-sewered sanitation masterclass for South African professionals. All tools are available freely to the public through the Water Research Commission.



There is a growing suite of sanitation options available to municipalities.

WAGENDRIFT DAM – FIRST OF ITS KIND IN THE WORLD

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KwaZulu-Natal holidaymakers are used to seeing the Wagendrift Dam as they drive down the N3, but few people know its history. The dam was constructed in the early 1960s and completed in 1963 for irrigation purposes. The final dam is a 40 m-high multiple double-curvature arch dam – believed to be the first of its kind in the world. The design retained the economics of an arch structure while fitting a wide-bottomed site at the same time. Wagendrift had an initial storage capacity of some 58,4 million m³. Like many other South African dams, this dam was also designed in such a way to allow for future raising.

During the final design stage the initial arches were modified to domes – the latter being more economical than arches and also offering the added possibility of simplification of the outlet and scouring arrangements. The final structure has four domes supported by five buttresses spanning the major section of the river. The flanks have been closed off by means of half-domes with the crown thrust from the half-domes carried to the foundation and flanks by means of prestressed cantilever thrust blocks. One of the greatest challenges of the project was the

shuttering – while the type of shuttering used at Kariba Dam was applied it took a considerable time before proficiency in application of a flat plane to a warped or curved surface was achieved.

DWA designers had to design a dam that would be able to withstand extremely variable flow, from as little as about 0,1 m³/s to in excess of 28 m³/s. High flood discharge is carried over the two central domes which provide a spillway length of 107 m, but low floods and service requirements are accommodated by the outlet works contained in the central buttress. The whole structure is symmetrical about the central buttress which has been split on its centre line to provide for the outlet works. The buttress is virtually a mass gravity structure but has been reinforced near the upstream face by means of post-tensioned stressing cables.

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