NATIONAL STATE OF WATER REPORT 2024

WATER IS LIFE - SANITATION IS DIGNITY

South Africa is a water-scarce country, use water sparingly

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

DOCUMENT CONTROL

Editors:	***Version:***	***Date:***	***Comments:***
SD: Integrated Water Resource Studies	*Ver02*	*31 March 2025*	*Final Report for Publication*

This report should be cited as:

Department of Water and Sanitation (DWS), 2025. National State of Water Report 2024. Integrated Water Resource Studies Report Number WII/IWRS/NSoW-2024. PRETORIA, South Africa.

Editors:
Joshua Rasifudi, Nokulunga Biyase, Hulisani Mafenya, Mirrander Ndhlovu, Thandekile Mbili, and Anna Mamothe Ramothello

Department of Water and Sanitation
Branch: Water Resources Management
Chief Directorate: National Water Resource Information Management

Department of Water and Sanitation
Private Bag X313
0001

Contacts

Mr. Joshua Rasifudi
Scientific Manager: Integrated Water Resource Studies
Tel: 012 336 6856
Email: RasifudiK@dws.gov.za

Mr. Andy Sambo
Director: Water Information Integration
Tel: 012 336 8403
Email: SamboM@dws.gov.za

Dr. Moloko Matlala
Chief Director: National Water Resource Information Management
Tel: 012 336 7860
Email: MatlalaM2@dws.gov.za

APPROVAL

Report Title:	*NATIONAL STATE OF WATER REPORT 2024*
Report No:	*WII/IWRS/NSoW-2024*
Status of Report:	*Final Report*
Final Issue:	*31 March 2025*

PREPARED BY: DEPARTMENT OF WATER AND SANITATION

Chief Directorate: National Water Resource Information Management

Directorate: Water Information Integration

Sub-Directorate: Integrated Water Resource Studies

Recommended for DWS by:

………………………………

Mr. Joshua Rasifudi
Acting Director: Water Information Integration

Approved for DWS by:

………………………………

Mr. Andy Sambo
Acting Chief Director: National Water Resource Information Management

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

Acronym	Description
AOA	Annual Operating Analysis
AMD	Acid Mine Drainage
BOCMA	Breede-Olifants Catchment Management Agency
BRVAS	Berg River Voelvlei Augmentation Scheme
BO&RC	Bulk Operation and Royalty Charge
BWP	Berg Water Project
c/m^3	Cents per Cubic Metre
CMA	Catchment Management Agency
CUC	Capital Unit Charge
CME	Compliance Monitoring and Enforcement
CoGTA	Department of Cooperative Governance and Traditional Affairs
CoH-WHS	Cradle of Humankind World Heritage Site
CS	Citizen Science
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry, Fisheries and the Environment
D&I	Domestic and Industrial
DM	District Municipality
DUCT	Duzi-uMngeni Conservation Trust
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
ECMS	Enforcement Case Management System
EIS	Ecological Importance and Sensitivity
EMI	Environmental Management Inspector
ENSO	El Niño-Southern Oscillation
FRAI	Fish Response Assessment Index
FGD	Flue Gas Desulfurization
FSC	Full Supply Capacity
FSM	Faecal Sludge Management
FY	Financial Year
GwLS	Groundwater Level Status
IMP	Mining and Power generation (IMP)
IRIS	Integrated Regulatory Information System
IRR	Irrigation
IUCMA	Inkomati-Usuthu Catchment Management Agency
IVRS	Integrated Vaal River System
KZN	KwaZulu-Natal
LHWC	Lesotho Highlands Water Commission
LM	Local Municipality

MCM	Million Cubic Meter
MCWAP	Mokolo Crocodile West Water Augmentation Project
mm3/a	Millie metre per annum
M^3	Cubic metre
m^3/a	Million metre cube per annum
MMTS-2	uMkhomazi Water Project-Phase 1
MIRAI	Macroinvertebrate Response Assessment Index
NCIMS	National Compliance Information Management System
NCMP	National Chemical Monitoring Programme
NDP	National Development Plan
NEMA	National Environmental Management Act
NGA	National Groundwater Archives
NMBM	Nelson Mandela Bay Municipality
NIWIS	National Integrated Water Information System
NMMP	National Microbial Monitoring Programme
NPA	National Prosecuting Authority
NRW	Non-Revenue Water
NSF	National Sanitation Framework
NSIP	National Sanitation Integrated Plan
NSoW	National State of Water
NWA	National Water Act
NWRS-2	National Water Resource Strategy 2
NWRS-3	National Water Resource Strategy 3
NWSMP	National Water and Sanitation Master Plan
ONEMP	Optimised National Eutrophication Monitoring Programme
O&M	Operations and Maintenance
ORS	Orange River System
ORWRDP-2	Olifants River Water Resources Development Project Phase 2
PES	Present Ecological State
PNCMP	Priority National Chemical Monitoring Programme
RDM	Resource Directed Measures
REMP	River EcoStatus Monitoring Programme
RBIG	Regional Bulk Infrastructure Grant
RHP	River Health Programme
RQIS	Resource Quality Information Services
RQOs	Resource Quality Objectives
RSA	Republic of South Africa
SANBI	South African National Biodiversity Institute
SAEON	South African Earth Observation Network
SALGA	South African Local Government Association
SAPS	South African Police Service

SANS	South African National Standards
SAR	Sodium Adsorption Ratio
SAWS	South African Weather Services
SAYWP	South African Youth Water Prize
SARB	South African Tunnel Authority
SDG	Sustainable Development Goal
SDCs	Source Directed Controls
SFD	Shit Flow Diagram
SFRA	Stream Flow Reduction Activity
SIP	Strategic Integrated Project
SIV	System Input Volume
SPI	Standardised Precipitation Index
SOF	Stakeholders Operating Forum
SQR	Sub Quaternary Reach
SWSAs	Strategic Water Source Areas
TCTA	Trans-Caledon Tunnel Authority
TDS	Total Dissolved Solids
TP	Total Phosphorous
TPTC	Tripartite Permanent Technical Committee
UNEP GEMS	United Nations Environmental Programme-Global Environmental Monitoring System
VOCMA	Vaal-Orange Catchment Management Agency
VEGRAI	Vegetation Response Assessment Index
VRESAP	Vaal River Eastern Subsystem Augmentation Project
V&V	Verification and Validation
WARMS	Water Use Authorisation and Registration Management System
WC/WDM	Water Conservation and Water Demand Management
WCWSS	Western Cape Water Supply System
WEF	Water Energy Food
WHO	World Health Organisation
WMAs	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WRCs	Water Resource Classes
WRCS	Water Resource Classification System
WSA	Water Services Authority
WSAs	Water Source Areas
WSDP	Water Services Development Plans
WSI	Water Services Institutions
WSP	Water Service Provider
WSS	Water Supply Systems
WWTWs	Wastewater Treatment Works

ACKNOWLEDGEMENTS

The Directorate: Water Information Integration, within the Chief Directorate: National Water Resource Information Management, is the author, editor, and coordinator for providing the National State of Water Report. The reporting on the state of water is a collaborative effort of several components within the Department of Water and Sanitation in partnership with other water sector institutions.

The editors would like to express gratitude and acknowledge the following contributors and authors from various DWS components:

Resource Quality Information Services; National Hydrological Services; Spatial Information; Water Resource Classification; Reserve Determination; Sanitation Services Planning Support; Strategic Water Resource Planning; Water Resource Management Planning; Raw Water Regulation, Compliance & Enforcement; National Register of Water Use; Wastewater Services Regulation; Drinking Water Regulation; Infrastructure Implementation Planning; Shared Watercourse; Water Resource Institution Governance; Water Resource Policy, Strategy and Evaluation.

The following collaborators from other institutions are acknowledged:

- Dr Andries Kruger, Charlotte McBride and Nthabiseng Letsatsi from the South African Weather Services for contributions to the Climatic Environment chapter,
- Dr Mokhele Moeletsi, Dr Johan Malherbe, and Dr Teboho Masupha from the Agricultural Research Council (ARC), the authors and contributors for the Climatic Environment Chapter,
- Dr Luxon Nhamo and Prof Sylvester Mpandeli from the Water Research Commission (WRC) are the authors of the Water-Energy-Food (WEF) Nexus chapter.
- Dr Michele Toucher, Susan Janse van Rensburg, and Mkholo Maseko from the South African Environmental Observation Network (SAEON), the authors of the Sustaining Water Resources in a Changing Climate: Lessons from Quaternary Catchment W70A in Northern KwaZulu-Natal Case Study.
- Esmeralda Ramburran, Ndumiso Dlamini, and Theo Naidoo, from the Department of Forestry, Fisheries and the Environment (DFFE), provided case studies on the current ecological Infrastructure rehabilitation and restoration projects (Chapter 7) in Verloren Vallei (Mpumalanga), and Isimangaliso Wetland Park (KwaZulu-Natal).

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Department of Water and Sanitation (DWS) is a public trustee of the nation's water resources. The DWS is obliged in Chapter 14 of the National Water Act (Act No. 36 of 1998) to establish monitoring networks and information systems and report on the status of water resources in the country. The National State of Water (NSoW) report, which is published annually, aims to convey information about the available water resources to the public through an integrated report that assists water users with information to enable informed decision-making, evaluates the implementation of legislation, highlights identified problem areas, and outlines measures undertaken by the department to eradicate highlighted issues and balance the water demand and supply. The report focuses on analysing identified and monitored water resource indicators for the hydrological year from October 2023 to September 2024.

The El Nino-Southern Oscillation (ENSO) state has prevailed over the past three years, resulting in above-average precipitation, particularly in the summer rainfall regions. This was reflected in the surface water storage, where elevated dam levels were observed from 2021/22 to 2022/2023, particularly during summer. However, the 2023/2024 hydrological year deviated significantly and experienced below-average rainfall within the summer rainfall regions. Critical periods of dryness were observed in November 2023, February 2024, and March 2024, with several areas receiving less than 75% of the long-term average rainfall and some areas facing deficits of less than 50%. These conditions led to the mid-summer drought from January 2024 to March 2024. Conversely, winter rainfall regions experienced above-average precipitation during this period, highlighting the spatial variability of rainfall distribution across the country.

Temperature anomalies were notably high in 2024, with annual mean temperature data from 26 climatic stations reflecting an anomaly of 0.9°C above the reference period (1991–2020). The calendar year 2024 was the warmest year on record since 1951. The extreme heat was predominantly concentrated in the central and northern interior regions, while southern areas experienced temperatures closer to normal. These climatic trends reflect the significant variability and challenges of changing weather patterns.

The dry and warm conditions experienced in the spring of 2024 pronounced impacted surface water storage across South Africa. The Vaal Dam, one of the country's primary reservoirs, experienced a substantial decline in storage levels, decreasing by 39.5%. Similarly, the Gariep Dam saw a reduction of 16.8% in its storage capacity. Nationally, dam storage levels dropped to 79.7% of Full Supply Capacity (FSC), representing a significant decrease when compared to levels exceeding 90% observed during the preceding two hydrological years. These circumstances intensified water scarcity challenges. Nonetheless, the Western Cape demonstrated a remarkable improvement, with its dam storage levels increasing by 49.6% and most dams at 100%

FSC (full or spilling). These disparities underscore the pressing need for targeted interventions in water resource management to address regional challenges and enhance resilience against climate variability.

Although below-average rainfall was experienced during the 2023/24 hydrological year, groundwater levels were significantly replenished across South Africa. Notably, the southwestern regions of the country demonstrate elevated groundwater levels. However, some isolated parts of the Northern Cape indicated very low groundwater levels.

Extreme weather events also occurred during the reporting period. Key incidents included the heatwave of November 2023, severe rainfall events in June 2024, December 2023 and April 2024 and a mid-summer drought event spanning January 2024 to March 2024. Among these, the most notable was the devastating flood event that occurred in KwaZulu-Natal in April 2024, following an orange level 5 warning issued by the South African Weather Services (SAWS) for the province's south coast. Heavy rainfall and thunderstorms struck areas including Margate, Uvongo, Shelly Beach, and Port Edward, with Margate recording 250 mm of rainfall, 225 mm of which fell within six hours on April 14. The uGu District (Margate area) and eThekwini were the two most severely affected District, suffering extensive damage to infrastructure such as homes, roads, schools, clinics, businesses, and electricity supply. The floods affected over 249 people, destroyed more than 110 households, and tragically resulted in five confirmed fatalities. Furthermore, the Western Cape also experienced strong winds and floods on 10 April, which led to one fatality being reported, with 2,779 buildings affected, at least 26 schools damaged, and several highways closed across the Cape Winelands, Overberg, and West Coast regions, as well as several power outages.

The Department seeks to ensure that the water resources across South Africa remain suitable for designated use. Therefore, it implements various monitoring programmes, including the National Microbiological Monitoring Programme (NMMP), National Chemical Monitoring Programme, National Eutrophication Monitoring Programme, etc., to monitor water quality and the health of aquatic environments/ water resources across the country. According to the NMMP, data collected during the reporting period from 75 hotspot sites nationwide revealed significant microbial contamination at all points. Notably, 48% of sites were classified as unsuitable for irrigating crops intended for raw consumption, while 70% were deemed unsafe for recreational activities,

Eutrophication analysis across 69 sites revealed varying nutrient levels and potential impacts. Forty-seven sites exhibited serious to significant potential; another 21 showed moderate potential, while one had negligible potential. Areas characterised by serious eutrophication were predominantly in catchments hosting dense populations, which is associated with stressed sewage systems resulting from rapid urban growth, insufficient infrastructure, and industrial activity. Notably, Rietvlei and Hartbeespoort Dams were classified as hypertrophic, reflecting excessive nutrient enrichment.

Homestead Lake in Benoni was rated eutrophic, while 12 sites, including Koster and Olifantsnek Dams, were identified as mesotrophic, indicative of moderate nutrient levels. Meanwhile, 47 sites were oligotrophic, signifying low nutrient levels and reduced aquatic productivity.

The Macroinvertebrate Response Assessment Index Version 2 (MIRAI v2) was used to assess 503 sites during the hydrological year 2023/24. Most river systems had moderately modified conditions as their dominant state; 272 sites (54%) were found to be moderately modified (Category C). The upper portions of the Crocodile West catchment are in Gauteng's industrial and urban areas, so they are heavily influenced by human activity. The Jukskei River, Modderfonteinspruit River, Crocodile (west) River, Hartbeesspruit, and the Apies and Hennops Rivers were rated very poor (Categories D/E and E). These results highlight the need for targeted riverine conservation measures and effective management strategies to mitigate the adverse impacts of industrial and urban pressures, particularly in highly affected catchments.

The Water Services Act (Act No. 108 of 1997) prescribes the legislative duty of WSAs to provide drinking water to residents of all municipalities. The WSAs must monitor the microbiological and chemical quality of the water provided to the residents at specified intervals to provide suitable drinking water to all South Africans. The chemical and microbiological compliance of water supply systems across South Africa was evaluated between October 2023 and September 2024. For chemical compliance, 144 water services authorities (WSAs) were assessed. However, 36 failed to upload data to the Integrated Regulation Information System (IRIS). While 70% of systems achieved excellent compliance, 4.2% showed poor to critical compliance, reflecting inconsistencies in water quality management. Despite the requirement for 99.9% compliance to mitigate pathogen-related health risks, 75% of WSAs did not meet SANS:241 standards. Only 20% of systems achieved excellent compliance, and seven WSAs did not submit the required data, further impacting the national compliance outlook. The Department is deeply concerned about the overall poor compliance results, as most water supply systems pose a potential health risk to consumers.

South Africa also faces water and sanitation service delivery challenges, such as insufficient water infrastructure maintenance and/or investment. These challenges are further compounded by an increasing number of municipalities not managing their water infrastructure assets strategically; this includes record keeping of water infrastructure assets and their locations and the age and condition of water infrastructure assets. However, South Africa has made notable progress in ensuring universal access to improved sanitation. In May 2024, Stats SA reported that in the last 21 years, there has been substantial progress in access to sanitation in South Africa. In the same period, the percentage of households with improved sanitation facilities, such as flush toilets and pit toilets with ventilation pipes, increased from 61,7% to 83,3% (Stats SA, 2024). At 95%, Western Cape has the highest ratio of flush toilets, followed by Gauteng at 87%. Mpumalanga and Limpopo have the highest combined percentage of pit latrines at 54% and 69%, respectively. There is an urgent need to focus on sustaining the sanitation infrastructure that has been provided since the dawn of our democracy to prolong its lifespan so that the infrastructure remains operational, safe, and hygienic whilst investing in new infrastructure to respond to rapid urbanisation. Moreover, there is also a need to ensure there is adequate investment in the operation and maintenance of wastewater infrastructure.

Lastly, the South African water sector has developed extensive infrastructure to transfer water between catchments to address supply deficits, particularly around the economic hubs. However, the nation's water resources are under significant strain, with over 98% of available water already allocated. According to the 2023 DWS No Drop Benchmarking Report, non-revenue water (NRW) accounts for 47.4%, while avoidable water losses are estimated at 40.8%. The status of NRW, at 47%, is of national concern, indicating that almost half of the potable water transported through the distribution system to customers does not generate revenue, thus resulting in billions of rands in revenue loss for municipalities.

1

INTRODUCTION

1 INTRODUCTION

1.1 Background

The Department of Water and Sanitation is the public trustee of the nation's water resources and has a vital and significant role in managing the country's water resources. The Department runs several monitoring programmes through established monitoring networks to collect data and derive information on surface and groundwater quality and quantity.

River systems (mostly surface water storage) are the common surface water expression of water availability in South Africa, with others being lakes, ponds, and pans. South African river systems and catchments are characterised by a high spatial variation in rainfall and variations in catchment sizes and physical properties. These result in different river flow patterns and dynamics within catchments and across water management areas (WMAs), which affect water resource availability.

Aquifer (groundwater) storage is another expression of water availability that contributes to the countries' water resource mix. Notably, in the past decades, groundwater utilisation has increased in the country's water mix in support of the national groundwater strategy, national water resource strategy 3, and national water and sanitation master plan. Groundwater is essential because of its potential to adapt to climatic-related pressures and the growing need to augment conventional surface water supply systems.

South Africa is naturally inclined to drought conditions because of its semi-arid climate. The other persistent challenges posing a risk to water security are growing water demands, significantly high non-revenue water, water pollution, ageing infrastructure and insufficient investments in water-related infrastructure. South Africa experiences varying weather conditions with different seasons due to its unique geographical location and long coastline spanning 2,800 kilometres. The cold Atlantic Ocean on the west coast and the warmer Indian Ocean on the south and east coasts significantly influence both the climatic and weather conditions. In 2024, South Africa experienced a new record warm year, with very hot conditions predominantly in the central and northern interior, and this had ramifications on the water management environment.

South Africa requires additional water resources to support the growing economy as a developing country. With 98% of the country's available water resources already allocated, opportunities to supplement future water requirements with conventional surface water resources are limited. A mix of water resources or sources will be required to reconcile supply and demand, including sustainable groundwater use, reuse of wastewater, and desalination where feasible.

This National State of Water (NSoW) 2024 Report sets out to communicate the water resources information primarily based on available data from the established monitoring programmes through an integrated report to assist water managers in understanding the state of water resources, influencing decision-making, evaluating the effectiveness of policy, legislation and strategies, and to highlight identified problem areas. Furthermore, the National State of Water Report informs the public on the status of water resources and sanitation and interventions to balance the water demand and supply and ensure water availability for future generations. The report is based on an analysis of identified water resource indicators and available observational data for the hydrological year from October 2023 to September 2024.

1.2 National Water Resource Strategy

The goals of the National Water Resource Strategy-3 (NWRS-3) are to ensure water is protected, used, developed, managed, and controlled sustainably and equitably and that water and sanitation must support development and eliminate poverty and inequality. The NWRS-3 should contribute to the economy and job creation. The NWRS-3 focuses on increasing water supply, reducing water demand, managing effective water and sanitation, regulating the water and sanitation sector, redistributing water for transformation, promoting international cooperation, managing water and sanitation under a changing climate, improving raw water quality, and protecting aquatic ecosystems and maintaining and restoring ecological infrastructure.

The implementation of the NWRS-3 is possible when enabling aspects such as the creation of effective water sector institutions, data collection, analysis and information management for effective monitoring, evaluation and reporting, building capacity for action, ensuring financial sustainability, enhancing and deploying research, development and innovation, and addressing legislative and policy gaps are adequately addressed.

1.3 Water Management Areas

Based on the outcome of the Departmental Institutional Reform and Realignment study, the National Water Resource Strategy second edition (NWRS-2) established six WMAs in South Africa in March 2023 (Figure 1.1). These replaced the nine WMAs identified before this date.

It was recognised that these WMA boundaries needed to be reviewed periodically to accommodate new realisations and issues. WMAs are based mainly on catchment boundaries, except for those catchments that cross international borders. Within these WMAs, catchments are further subdivided into tertiary, secondary, and quaternary catchments. The current state and historical trends of various water resource indicators provided in this report have been analysed and presented based primarily on the six or the nine WMAs and, in some instances, Provinces and District Municipalities.

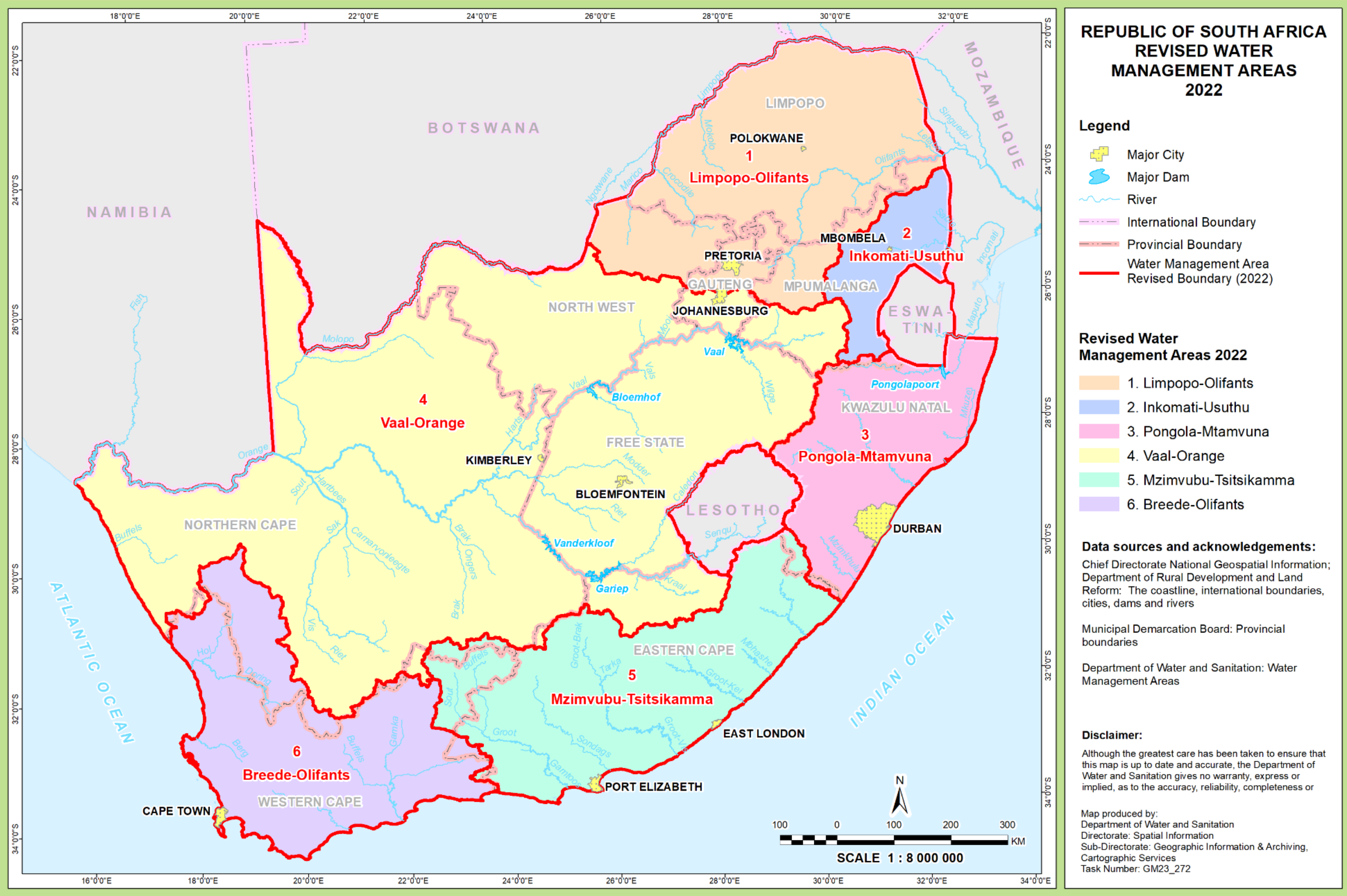


Figure 1.1 South African Six Water Management Areas as of 2023

1.4 Water Sector Institutional Reform

The South African Water Sector Institutional Reform has not been completed, and the outlook is illustrated in Figure 1.2. The National Department of Water and Sanitation is the custodian of water resources and is obliged to perform water resource management functions. The National Department, acting through the Minister, is responsible for water sector policy, support, and regulation.

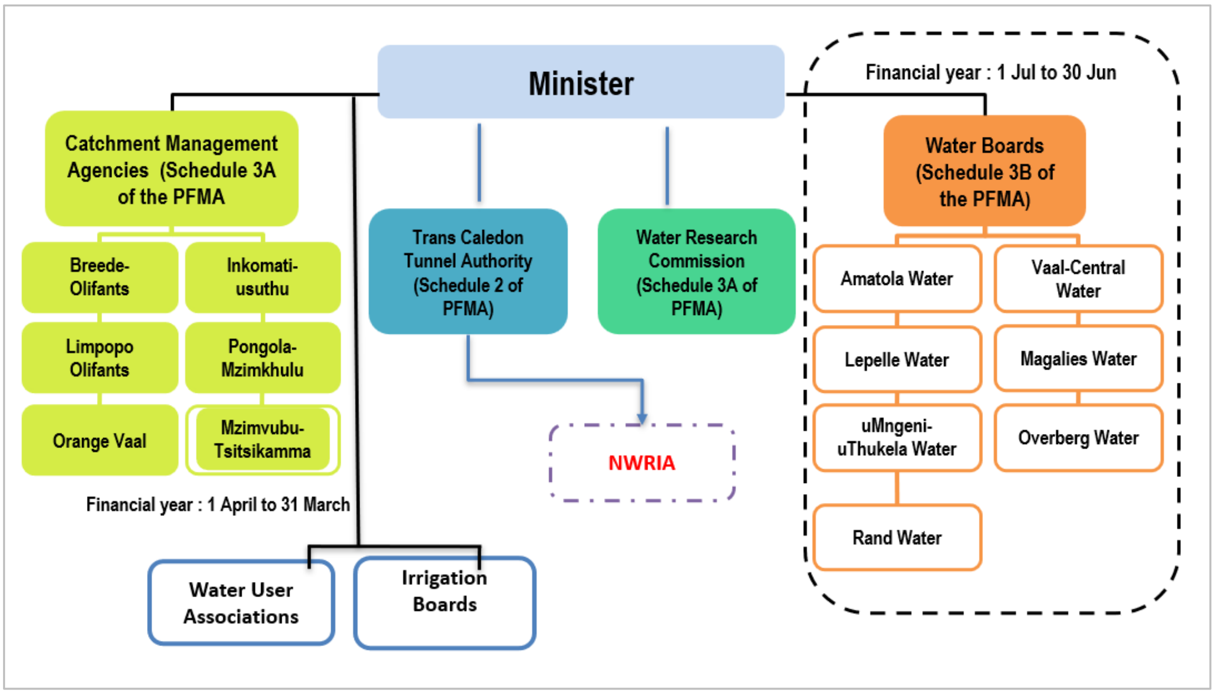


Figure 1.2 An Overview of the Institutional Arrangements

The water resource management functions are to be delegated to the Catchment Management Agencies (CMAs). This supports the principles of good governance, where water is managed locally. In water management areas where a CMA has not been established, DWS National and Provincial Operations remains the responsible authority and continues to act as a CMA to perform all water resource management functions at a catchment level.

At a national level, the reform process involves the consolidation of the DWS's Water Resource Infrastructure Branch and Trans Caledon Tunnel Authority (TCTA) to form a *National Water Resource Infrastructure Agency (NWRIA),* which will be responsible for infrastructure development and management. The Department reviewed the Water Boards in terms of financial sustainability, servicing areas that are not currently serviced and institutional confusion caused by having multiple Water Boards serving the same province. The rationale for the reconfiguration of the Water Boards was to improve and enhance institutional efficiencies and rationalise the number of institutions to ensure economies of scale, improve financial viability and enhance the ability to raise capital from the market for infrastructure projects. The Department completed the reconfiguration of the water boards in 2023. Before the reconfiguration, there were nine water boards, and there are now seven water boards

At a local level, the transformation of Irrigation Boards into Water User Associations (WUAs) has been halted due to policy shifts. Furthermore, we find Water Services Institutions (WSI) at the local level, and these are Water Services Authorities (WSAs) – municipalities that provide water services or outsource water services provisions to the private Water Services Providers (WSPs) – water boards. These WSAs and WSPs provide water and sanitation services and are regulated by the Department of Cooperative Governance and Traditional Affairs (CoGTA).

A water services authority would mean any municipality, including a district or rural council (as defined in the Local Government Transition Act, 1993), responsible for ensuring access to water services. Water Services Providers provide water services to consumers or other institutions. Notably, some WSAs are WSPs; in other cases, the WSA has WSPs that provide water services on their behalf.

1.5 Establishment of CMAs

The Department has embarked on several institutional re-alignment processes to transform the water sector, build stable institutions with clearly defined roles and responsibilities, and promote effective institutional performance.

The National Water and Sanitation Master Plan, launched in November 2019, has prioritised the establishment of CMAs and the progressive delegation or assignment of powers, functions, and duties of CMAs. CMA establishment has demanded attention be given to opportunities to reduce costs and increase efficiencies without compromising on the core objectives of decentralising water resource management.

The main principles in realigning the WMA and CMAs from nine to six are the following:

- ***Operational Integration –*** *connected and integrated water systems, easy coordination, and monitoring of agreements improved capacity-pooled technical skills.*
- ***Integrated water resource planning –*** *the river basins fall within the same system, and improved resource planning and the same conventions manage transboundary systems.*
- ***Economies of scale –*** *enhance revenue and sustainability, cost-effectiveness, and consolidated management structures.*

The CMAs initial function will be to promote community participation in water governance. The CMA will manage and control water resources, develop catchment management strategies and ensure municipal coordination and implementation as per section 80 of the National Water Act, 36 of 1998. The progress of the establishment of CMAs is provided in Table 1-1 below.

Table 1-1 CMA Establishment Progress – March 2025

NAME OF THE CMA	STATUS OF CMA ESTABLISHMENT	Next Steps
Breede-Olifants (BOCMA)	The new board-appointed process is underway and should be finalised by July 2025.	Acting Chief Executive Officer in place
Vaal-Orange (VOCMA)	Cabinet concurred on the appointment of Board Members for the VOCMA in November 2023 and their appointment was on 1 December 2023.	Chief Executive Officer appointed
Pongola-Umzimkulu (PUCMA)	Cabinet concurred on the appointment of Board Members for the VOCMA in November 2023 and their appointment was on 1 December 2023.	Interim Chief Executive Officer appointed for the transitional phase until the board appoints a CEO.
Limpopo-Olifants (LOCMA)	Cabinet concurred on the appointment of Board Members in October 2024, and their appointment was 1 November 2024.	Interim Chief Executive Officer appointed for the transitional phase until the board appoints a CEO.
Mzimvubu-Tsitsikamma (MTCMA)	Cabinet concurred on the appointment of Board Members in December 2024, and their appointment was 11 December 2024.	Interim Chief Executive Officer appointed for the transitional phase until the board appoints a CEO.
Inkomati-Usuthu	No configuration to be done	

1.6 Transboundary Water Resources

South Africa shares four international river basins, namely the Limpopo, Orange/Senqu, Inkomati, and Maputo, with six neighbouring countries, Botswana, Lesotho, Mozambique, Namibia, eSwatini, and Zimbabwe.

The shared watercourse institutions are responsible for international cooperation on water resource management of the basin, including equitable water sharing between countries, basin management, operation of basin infrastructure for droughts and floods, future water resource development options, water resource protection, etc. South Africa has three international rivers, which it shares with its neighbours (Figure 1.3), i.e.:

- Orange – Senqu River: shared with the Kingdom of Lesotho, Botswana & Namibia
- Limpopo River: shared with Botswana, Zimbabwe, and Mozambique
- Inkomati River: shared with the Kingdom of Eswatini and Mozambique
- Maputo River: shared with the Kingdom of Eswatini and Mozambique

The summary of international agreements and their status is given in Table 1-2. The neighbouring states have established these agreements to promote international transboundary cooperation.

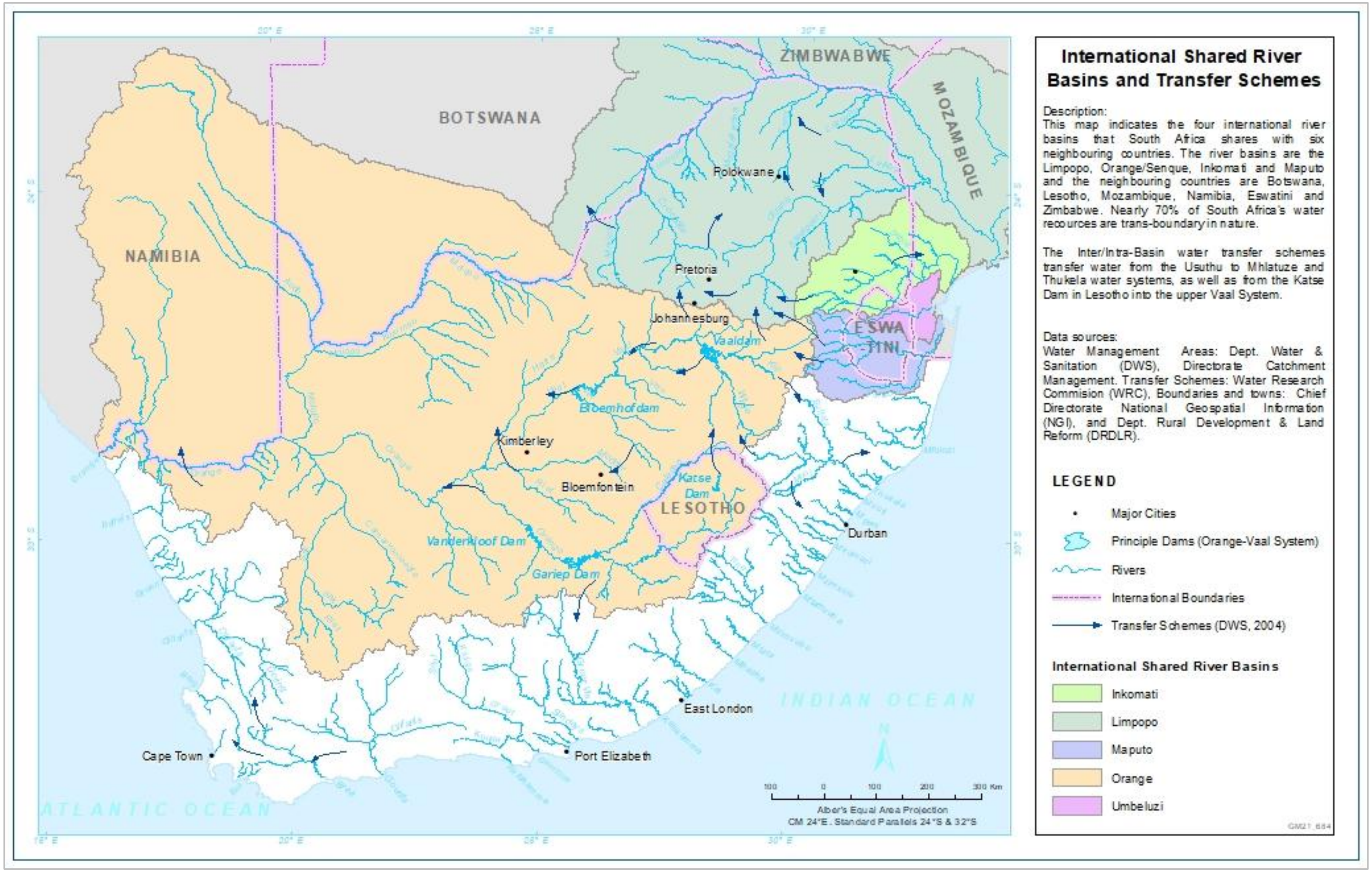


Figure 1.3 International shared basin and transfer schemes

Table 1-2 List of Shared Watercourses Agreements

Country	Title of the Agreement	Date signed	Date entered into force	Status of Agreement	Areas of Cooperation
Republic of Botswana, Republic of Mozambique, Republic of South Africa, and Republic of Zimbabwe	Agreement between the Republic of Botswana, Republic of Mozambique, Republic of South Africa (RSA), and Republic of Zimbabwe on the establishment of the Limpopo watercourse Commission (LIMCOM**)**	2003/11/27	2003/11/27	Active	Joint Integrated Water Resource Management of the Limpopo River Shared Water between RSA, Botswana, Mozambique, and Zimbabwe
Republic of Botswana, Kingdom of Lesotho, Republic of Namibia, and Republic of South Africa	Agreement between Republic of Botswana, Kingdom of Lesotho Republic of Namibia, and Republic of South Africa on the establishment of the Orange Senqu River Commission (ORASECOM)	2000/11/03	2000/11/03	Active	Joint Integrated Water Resource Management of the Limpopo River Shared Water between RSA, Botswana, Namibia, and Lesotho
Republic of Botswana, Kingdom of Lesotho, and Republic of South Africa.	Memorandum of Agreement between the Government of Republic of Botswana, Kingdom of Lesotho and Republic of South Africa on the Lesotho-Botswana Water Transfer Feasibility Study	2017/11/16	2017/11/16	Active	RSA, Botswana, and Lesotho experts (engineers) jointly study the possibility of Botswana extracting water from the Lesotho Highlands Water Project. Implementation of Phase II Procurement process implementation

Country	**Title of the Agreement**	**Date signed**	**Date entered into force**	**Status of Agreement**	**Areas of Cooperation**
					Establishment of Project management
Republic of Mozambique, Kingdom of Swaziland/Eswatini, and Republic of South Africa	**Agreement between the Kingdom of Swaziland, The Republic of Mozambique and Republic of South Africa on the establishment of Inco and Maputo Watercourse Commission.** This is an envisaged Agreement which countries are still consulting with their respective Legal entities in their countries.			Not active	

2

WATER RESOURCES DATA

2 WATER RESOURCES DATA

2. Surface Water Quantity Monitoring

The Department has established and operates a national surface water monitoring network along rivers, dams, estuaries, eyes, canals, and pipelines. The purpose of the national network is to monitor hydrological and hydro-meteorological conditions to enable water resource assessment, planning, water supply management, system operations, and flood forecasting. The summary structure of the surface water monitoring programme in the Department is shown in Figure 2.1. The programmes are divided into two: the first is a hydro-meteorological programme, which monitors evaporation and rainfall, and the second programme is hydrological monitoring, which entails streamflow and dam levels monitoring.

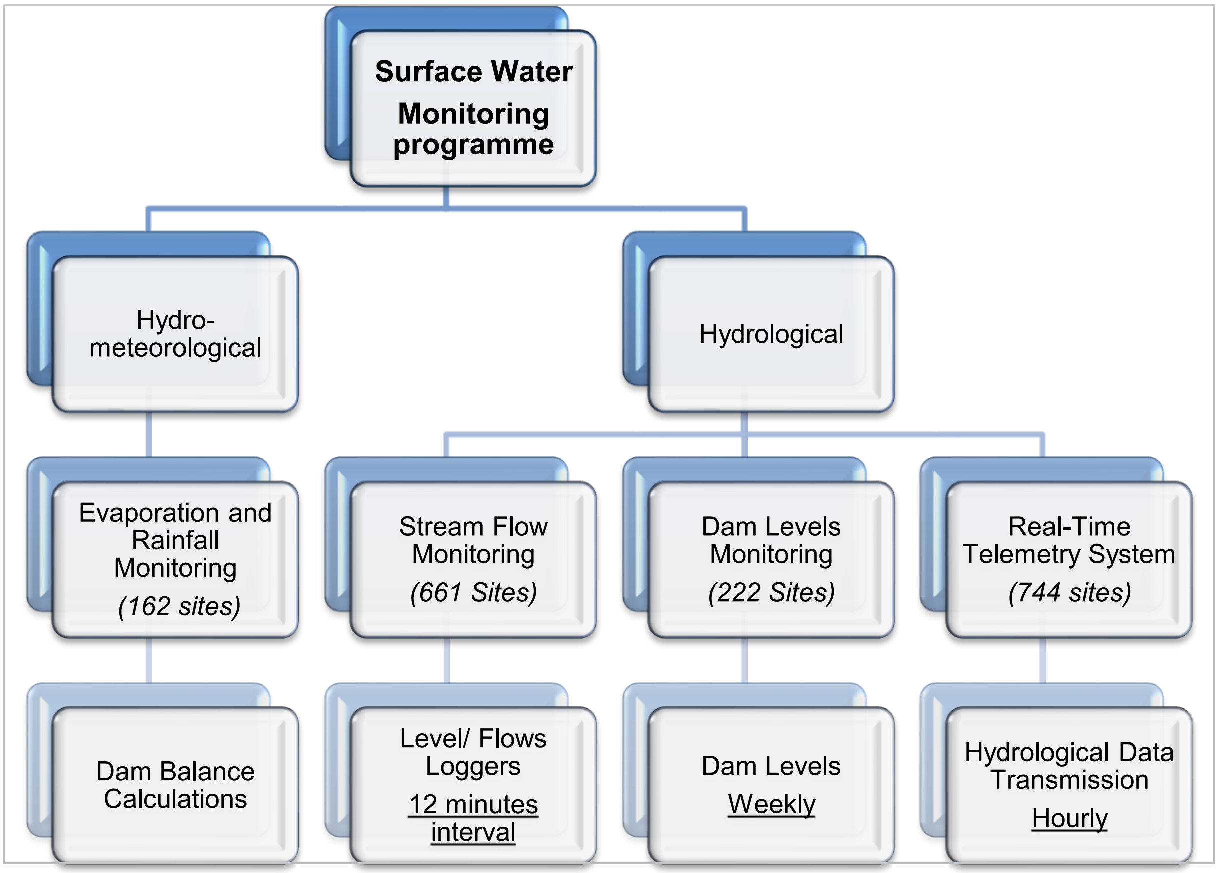


Figure 2.1: Summary structure of the surface water monitoring programmes as of September 2024.

The DWS regional offices have selected several monitoring primary stations equipped with real-time telemetry data transmission systems. These include monitoring stations for dams, evaporation, rainfall, and streamflow. Data is transmitted directly from the monitoring stations to the national office and DWS website in real time. It is made available for all stakeholders as unverified data.

- *Dam Levels Monitoring*

The national dam monitoring is conducted at a regional level, and the DWS regional officials collect dam gauge plate readings every Monday. Upon capturing the collected data, the national office is responsible for processing, verifying, and disseminating data to various stakeholders through a weekly dam levels bulletin and summary synopsis. The locality map of the dam level stations nationally is presented in Figure 2.2

- *Evaporation and Rainfall Monitoring*

Evaporation and rainfall monitoring stations are situated at dam sites. The evaporation and rainfall readings are taken daily, except for rain gauges equipped with automatic tipping buckets. Data collected from these monitoring stations are audited monthly and processed at the national office in three months.

- *Streamflow Monitoring*

The regional offices manage streamflow monitoring stations and are responsible for downloading data from the dataloggers. Several streamflow monitoring stations are equipped with real-time telemetry data transmission systems; data transmitted from these systems can be accessed at www.dws.gov.za/hydrology. The national surface water monitoring network for streamflow gauging stations is presented in Figure 2.3.

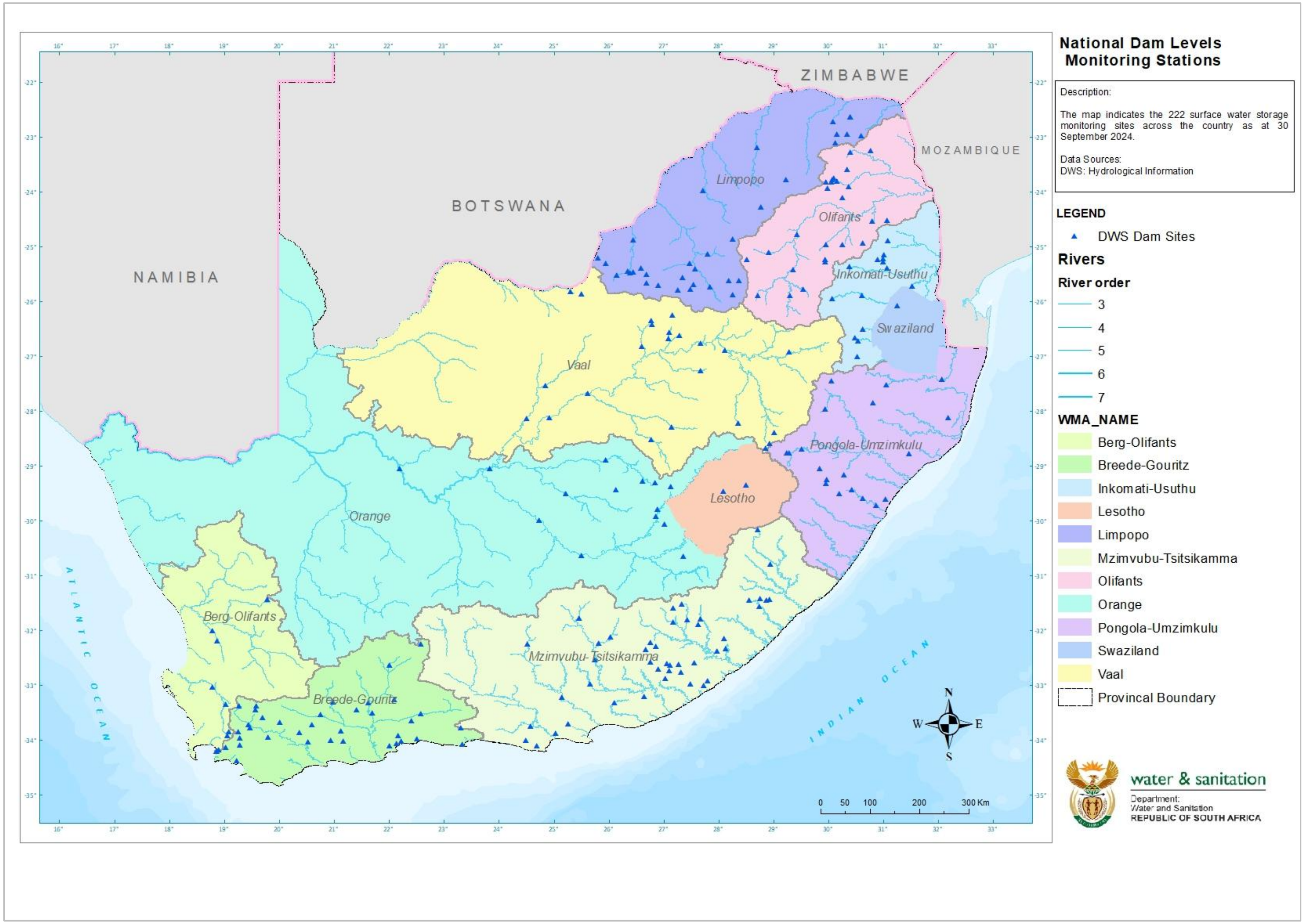


Figure 2.2: Dam levels monitoring stations network- September 2024.

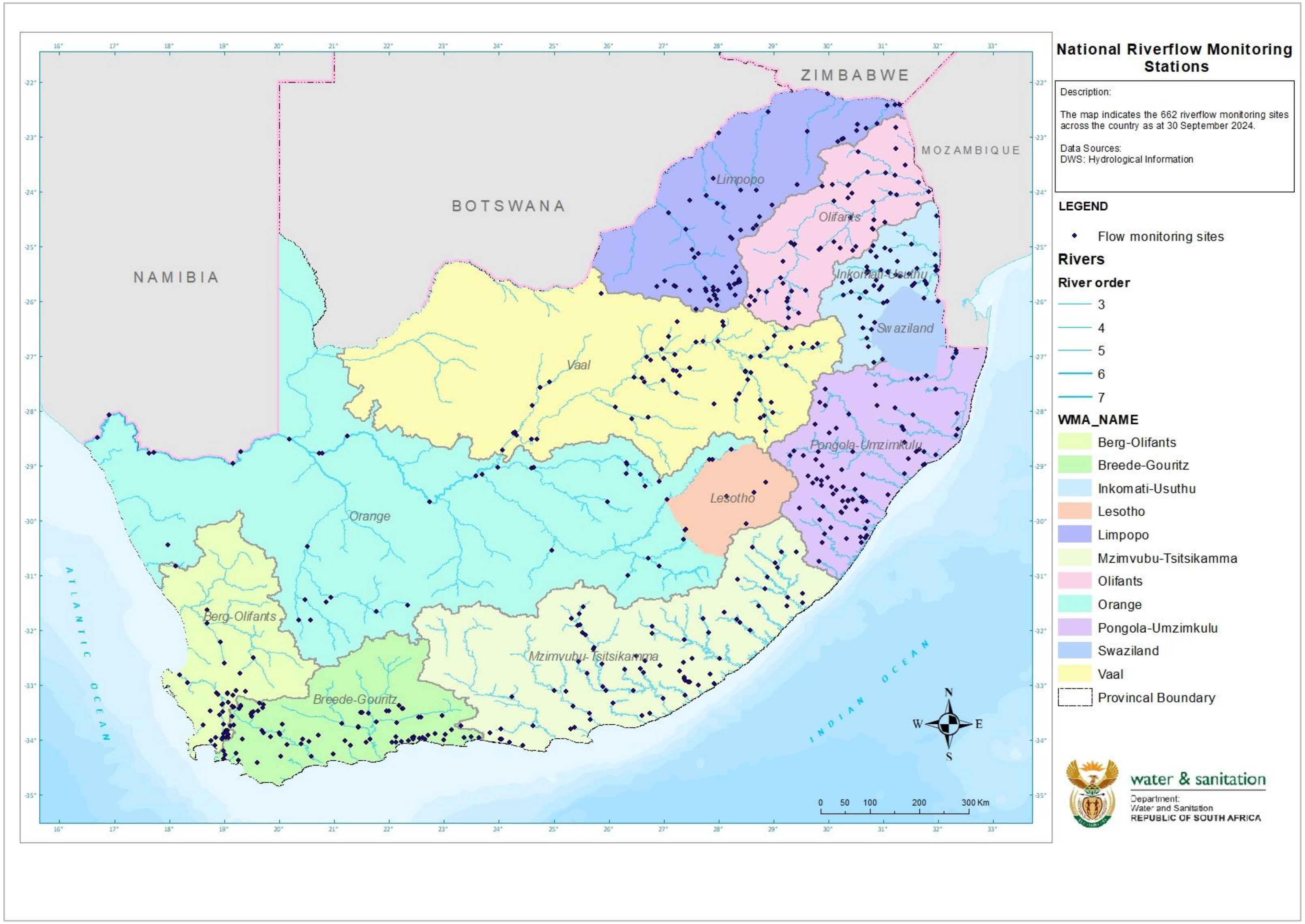


Figure 2.3 National Streamflow Monitoring Network - September 2024

2.1.1. Surface Water Quantity Data Availability

The surface water monitoring network has 1 448 stations across all the provinces, as shown in Figure 2.4. At the end of the current reporting period, 1 126 stations were active with data, a slight improvement from the reported 1 123 active stations with data at the end of the 2022/23 hydrological year. All station types across provinces had remarkable data availability, with the Eastern Cape and Gauteng provinces having more than 90% data availability at the end of the reporting period. The national average data availability across all regions is currently 78%.

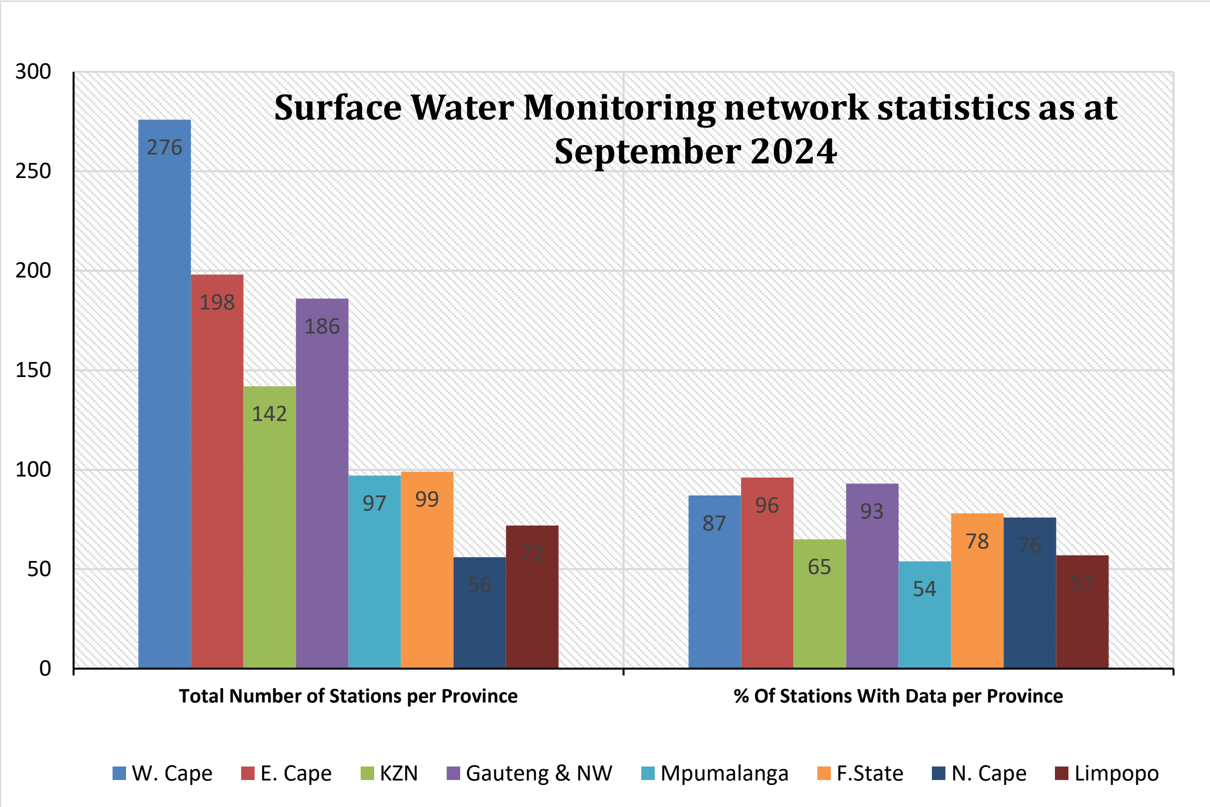
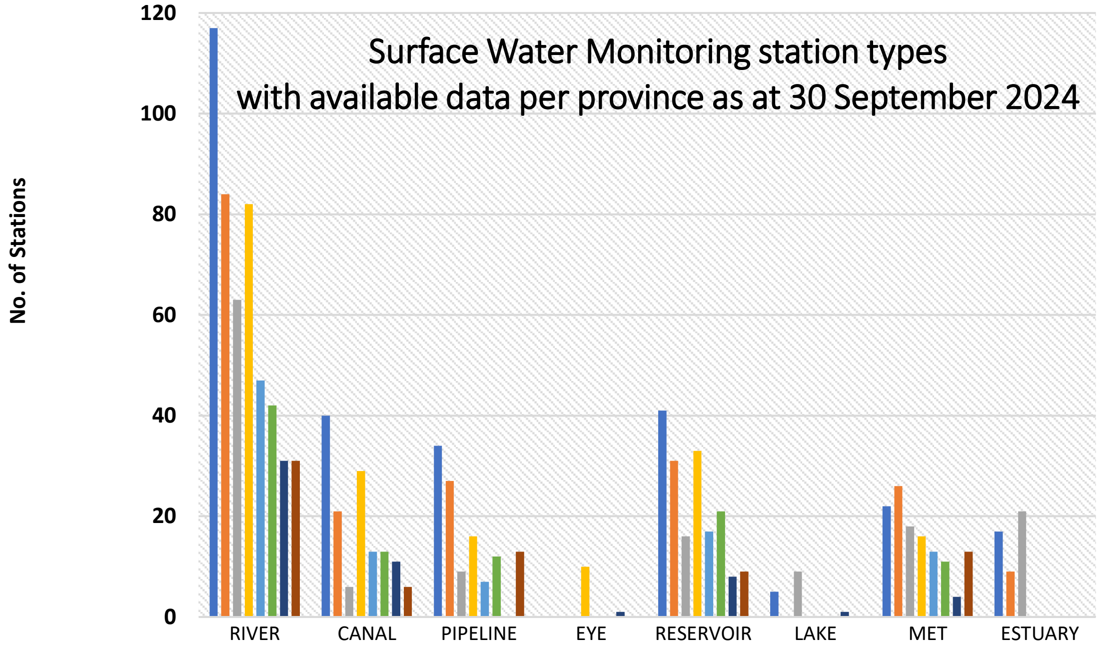


Figure 2.4 Summary of monitoring networks across South Africa as of September 2024

The station types per province in Figure 2.5 show a predominance of stations for river flow monitoring. However, the number of stations with available data for river flow monitoring has declined across all provinces in the current reporting period. Estuaries are monitored in coastal areas, and the country currently has 47 monitoring stations, the majority of which are in KwaZulu-Natal province. All provinces also had a reasonable number of active stations for reservoir monitoring, with the Western Cape, Gauteng, and Eastern Cape provinces leading, respectively.



	RIVER	CANAL	PIPELINE	EYE	RESERVOIR	LAKE	MET	ESTUARY
W. Cape	117	40	34	0	41	5	22	17
E. Cape	84	21	27	0	31	0	26	9
KZN	63	6	9	0	16	9	18	21
Gauteng & N. West	82	29	16	10	33	0	16	0
Mpumalanga	47	13	7	0	17	0	13	0
Free State	42	13	12	0	21	0	11	0
N. Cape	31	11	0	1	8	1	4	0
Limpopo	31	6	13	0	9	0	13	0

Figure 2.5 Station types with available data per province as of September 2024

2.2. Surface Water Quality Monitoring Programmes

The Department of Water and Sanitation seeks to ensure that water resources remain fit for recognised water uses while also maintaining and protecting the viability of aquatic ecosystems. As a result, several water quality monitoring programmes are currently in operation across the country. This section outlines DWS water quality monitoring programmes, their objectives, distribution, and performance during the current reporting period.

2.2.1. National Chemical Monitoring Programme (NCMP)

NCMP provides information on the status and trends of inorganic chemical water quality in South Africa, primarily in rivers, on a national scale. It was established in the 1970s based on the information requirements and national priorities at the time and has been amended over the years to remain relevant to evolving needs. It is the longest-running South African water quality monitoring programme, which has provided data and information for over 50 years on the inorganic chemical quality of surface water resources at various sites across the length and breadth of the country.

Figure 2.6 shows the location of the 339 sites that currently constitute the Priority National Chemical Monitoring Programme (PNCMP). The main objectives of this national scale programme include:

- Having sufficient inorganic water quality data available to determine the status and trends in South African rivers at a national scale;
- Supporting the National River Eco-status Monitoring Programme (REMP); the United Nations Environmental Programme – Global Environmental Monitoring System (UNEP GEMS), and Sustainable Development Goals (especially SDG 6.3) initiatives;
- Contributing to the integrated overarching historical database; and
- The dissemination of data and information.

The NCMP monitoring sites are primarily located at the downstream end of each tertiary drainage region to assess the region's impact on water quality. Sites are also chosen for their strategic importance, such as interactions with neighbouring countries, participation in UNEP GEMS, and Sustainable Development Goals (SDG) initiatives, specifically SDG 6.3.2 on Ambient Water Quality. NCMP site selection seeks to preserve long and consistent data records.

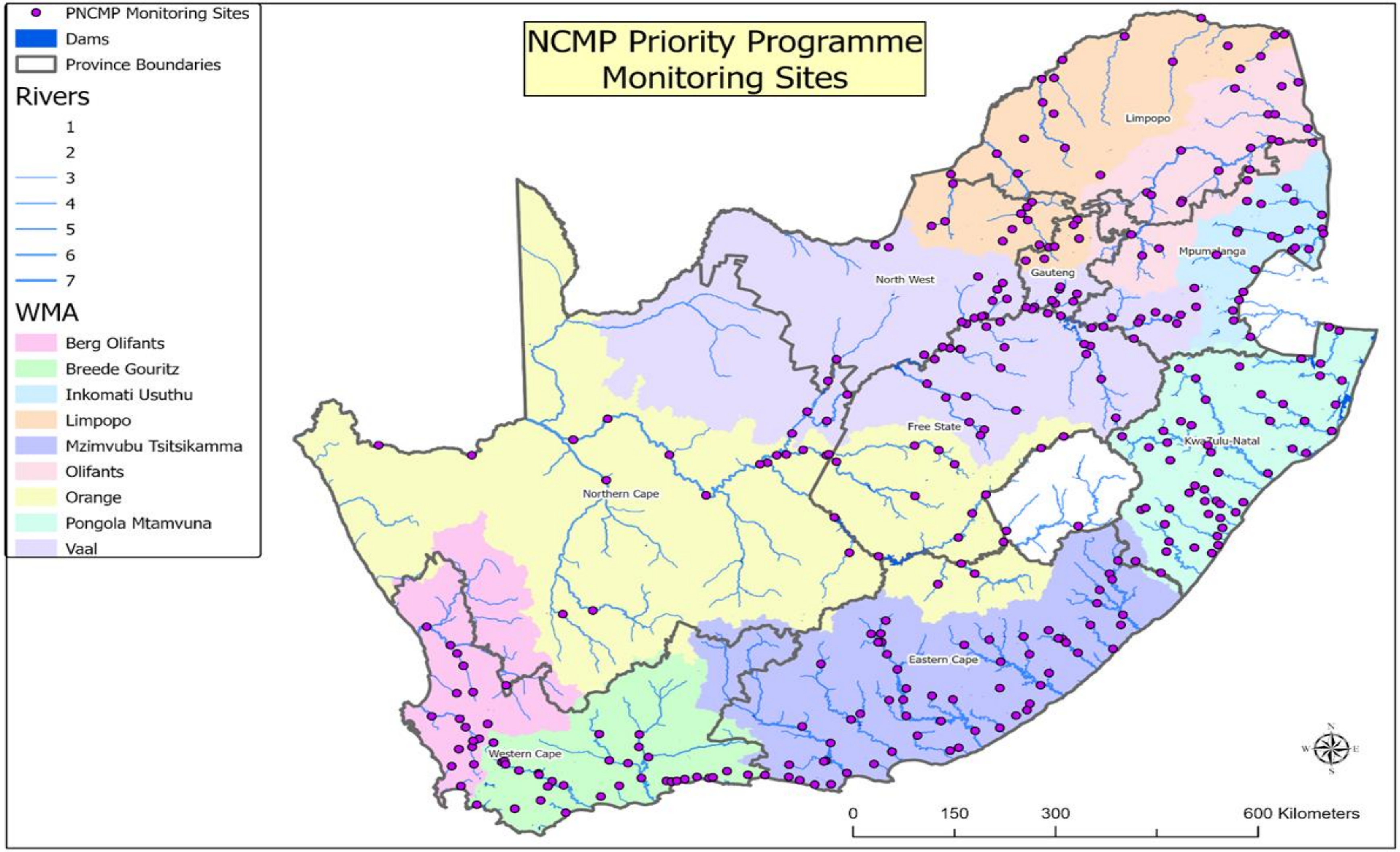


Figure 2.6: Location of the PNCMP sites across South Africa as of September 2024.

The NCMP assesses several parameters, including salinity (measured as Total Dissolved Solids (TDS) or Electrical Conductivity (EC). It also determines the concentrations of several substances, including iron (Fe), sodium (Na), chlorine (Cl), magnesium (Mg), potassium (K), sulphates (SO_4), ammonium (NH_4), and nitrate-nitrite ($NO_3 + NO_2$). The levels of ammonium and nitrate-nitrite provide information about nutrient loading from discharges,, and return flows into water resources. The programme has recently started sampling for trace metal constituents.

Sampling site visit compliance has improved significantly, reaching 72.3% in the current reporting period. This represents a significant increase in compliance rates over the previous three years. For instance, sampling compliance at NCMP sites was only 15.9% during the 2020/21 hydrological year, largely due to COVID-19 travel restrictions. The compliance improved to 42.2% in 2021/22 and slightly decreased to 40.5% in the 2022/23 hydrological year (Figure 2.7).

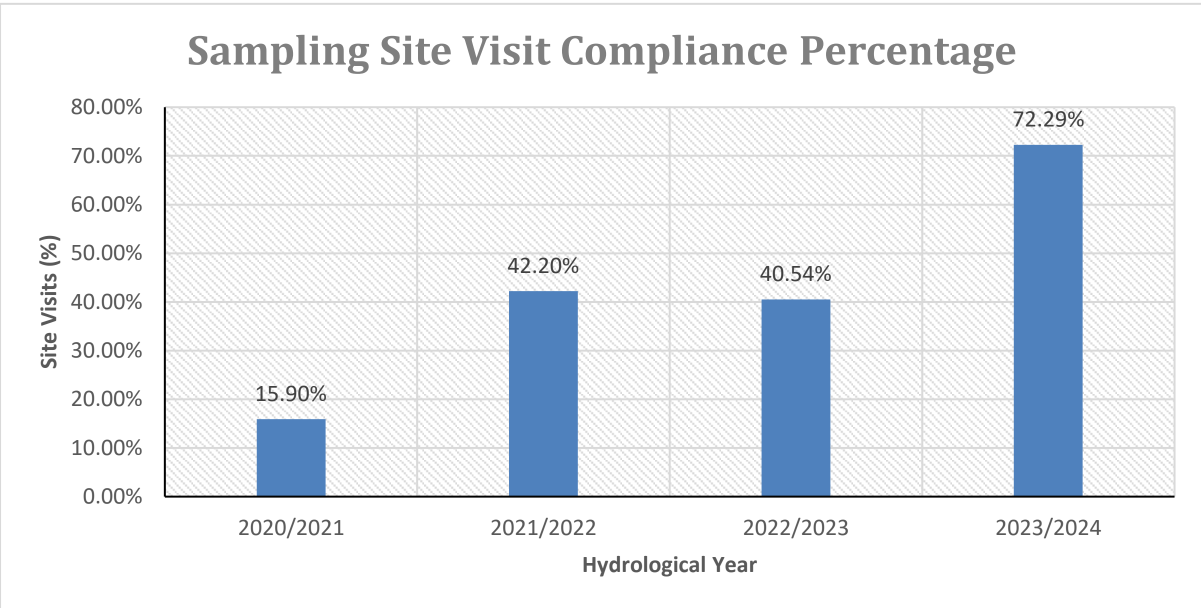


Figure 2.7: Percentage of Priority NCMP sites visited for sampling purposes over the past four hydrological years.

NCMP remains highly dependent on Regional Office officials, as well as staff at Water User Associations and Catchment Management Agencies, for sample collection. The laboratories at the Department of Water and Sanitation's Resource Quality Information Services (RQIS) directorate are essential for sample analysis, quality assurance, and data capture in the Water Management System (WMS) database. Sample Reception, a sub-directorate of RQIS, is essential for sending out the required supplies to samplers and receiving and logging samples sent to RQIS. These data and other resources are available to the public through the link: https://www.dws.gov.za/iwqs/wms/default.aspx.

2.2.2. National Eutrophication Monitoring Programme (NEMP)

The National Eutrophication Monitoring Programme (NEMP) monitors the status and trends in relation to nutrient enrichment of water bodies in South Africa, and it was established and officially implemented in 2002. The objective of the NEMP is to measure, assess and report regularly on the current trophic status and the nature of the current eutrophication problems for South African water resources. It also reports on the potential for future changes in the trophic status of dams/lakes and rivers in a manner to supports strategic decisions in respect of their national management, being mindful of financial and capacity constraints yet being soundly scientific. The NEMP provides frameworks for addressing the following six (6) objectives for impoundments (dams/lakes) and rivers:

- Establishing trophic status in dams/lakes
- Early warning system – water treatment
- Early warning system – blooms
- Early warning system – invasive macrophytes
- Early warning system – long-term impacts
- Nutrient balance

The programme has over 289 registered sites, including dams, lakes, and rivers. The dam sites are selected based on their strategic importance for the region, country, and international commitments. Sampling is conducted at the dam wall or near the abstraction or discharge point. River sites are mostly selected at points that represent the inflow to the dams monitored.

During the 2023/24 hydrological year, 118 sites were sampled for the NEMP (Figure 2.8). The programme has expanded significantly since its inception. The provinces that contributed to sampling compliance were Mpumalanga, Free State, Gauteng, Limpopo, Western Cape, KwaZulu-Natal, and North West. The Northern and Eastern Cape provinces showed improved sampling compliance. Samples were collected by DWS partners and stakeholders, including water boards, Water User Associations

(WUAs)/Irrigation Boards, and National Parks in a variety of water management areas (WMAs)/provinces.

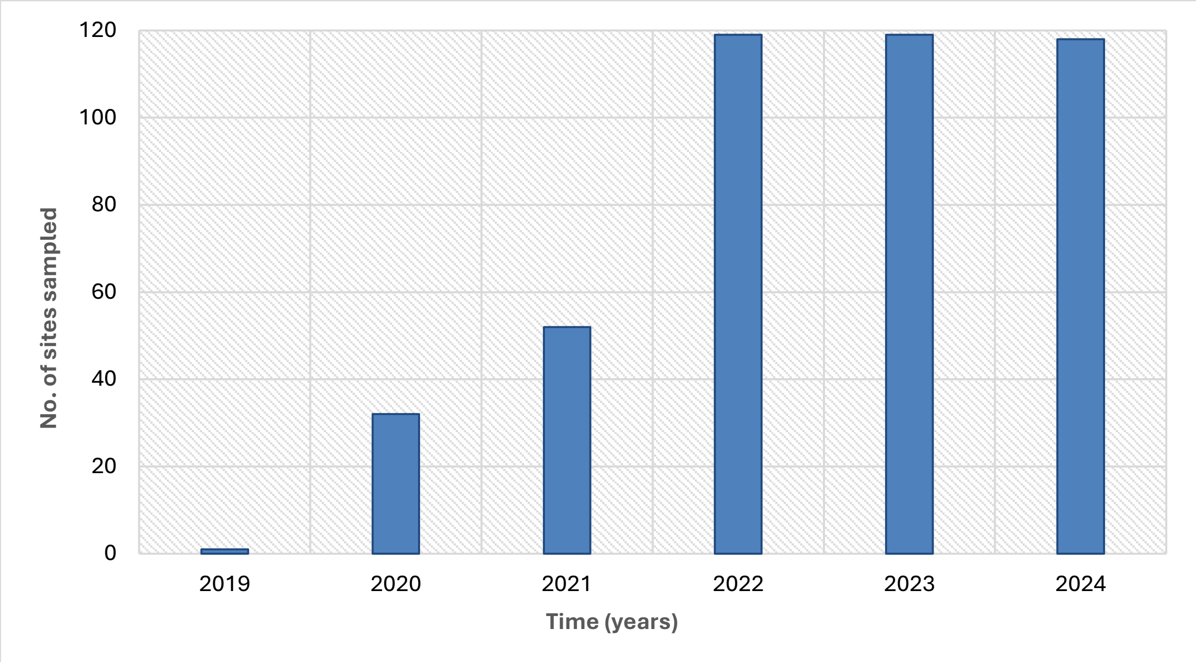


Figure 2.8: NEMP data availability from the year 2019 to 2024.

- *Optimized National Eutrophication Monitoring Programme (ONEMP)*

Figure 2.9 displays the ONEMP sites across the country. The number of sites monitored in the ONEMP increased from 61 in the previous hydrological year to 82 for the current reporting period, with 21 new sites added across five provinces: Limpopo (5), North West (7), Mpumalanga (5), Gauteng (3), and one in KwaZulu-Natal. During the reporting period, 73 of the 82 monitored dams were assessed, yielding an impressive 89% compliance rate with the monitoring programme. This represents a significant improvement in ONEMP sampling, and plans are being implemented to improve sampling compliance even further.

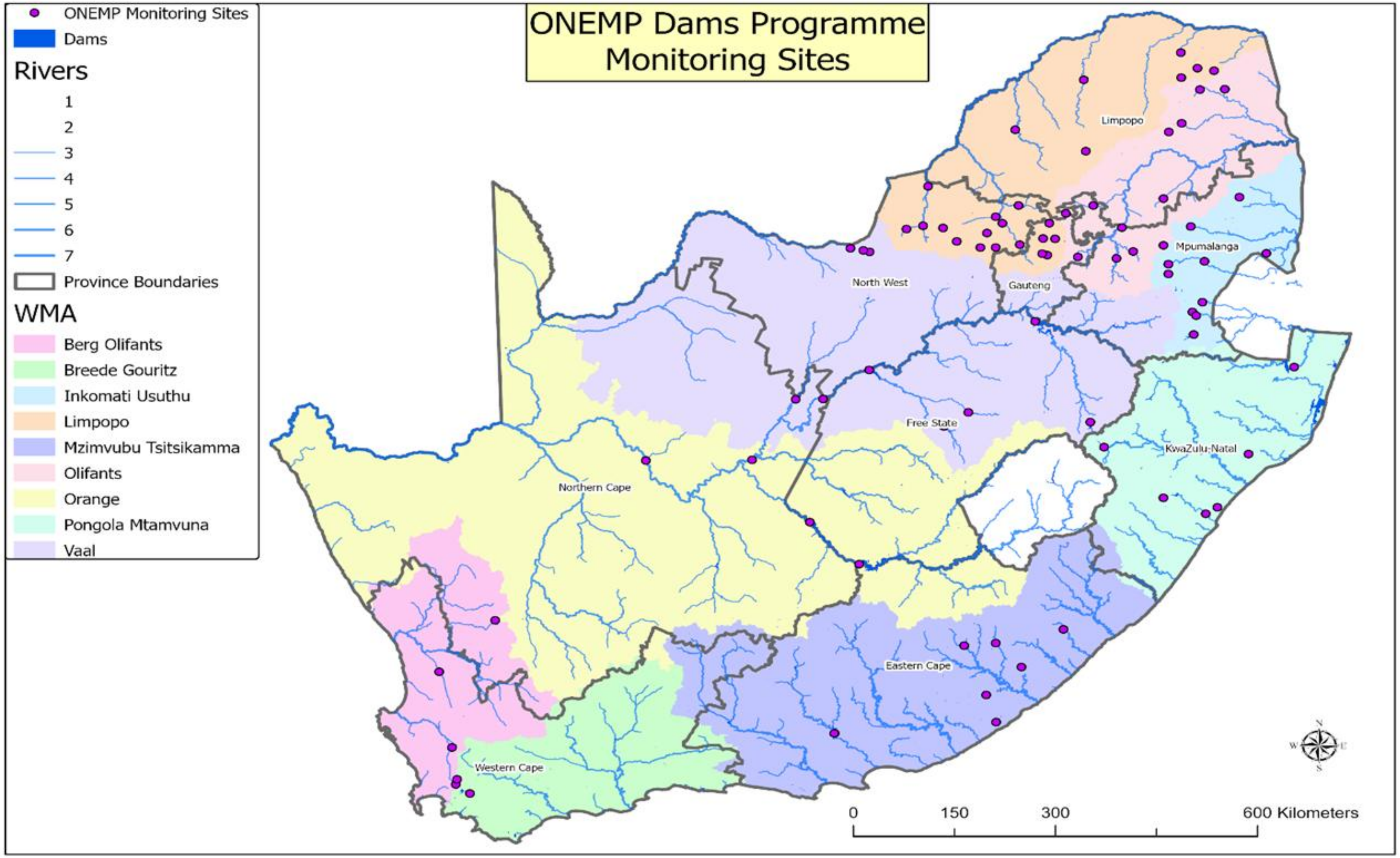


Figure 2.9: Distribution of optimised NEMP sites across the country as of September 2024

2.2.3. National Microbial Monitoring Programme

The National Microbial Monitoring Programme (NMMP) aims to provide information on the status and trends of the extent of faecal pollution in terms of the microbial quality of surface water resources in priority areas in South Africa and to assess the potential health risks to humans associated with the possible use of faecal polluted water resources. The program was implemented nationwide in the year 2000 to report on the potential health risks associated with faecal pollution of surface water resources at nationally identified hotspots. An indicator bacteria (*E. coli* and or Faecal Coliform) is used to indicate the presence of other pathogens in water or as an indicator of faecal-contaminated water. The main objectives of the programme are to:

- Provide information on the status and trends of the extent of faecal pollution in terms of the microbial quality of surface water resources in high-priority areas and
- Provide information to help assess the potential health risk to humans associated with the possible use of faecal-polluted water resources at those sites.

The programme's primary emphasis is on national hotspots, and currently monitors 75 hotspot sites and is expanding. Figure 2.10 indicates that active NMMP sites increased from 52 to 75 between September 2023 and September 2024.

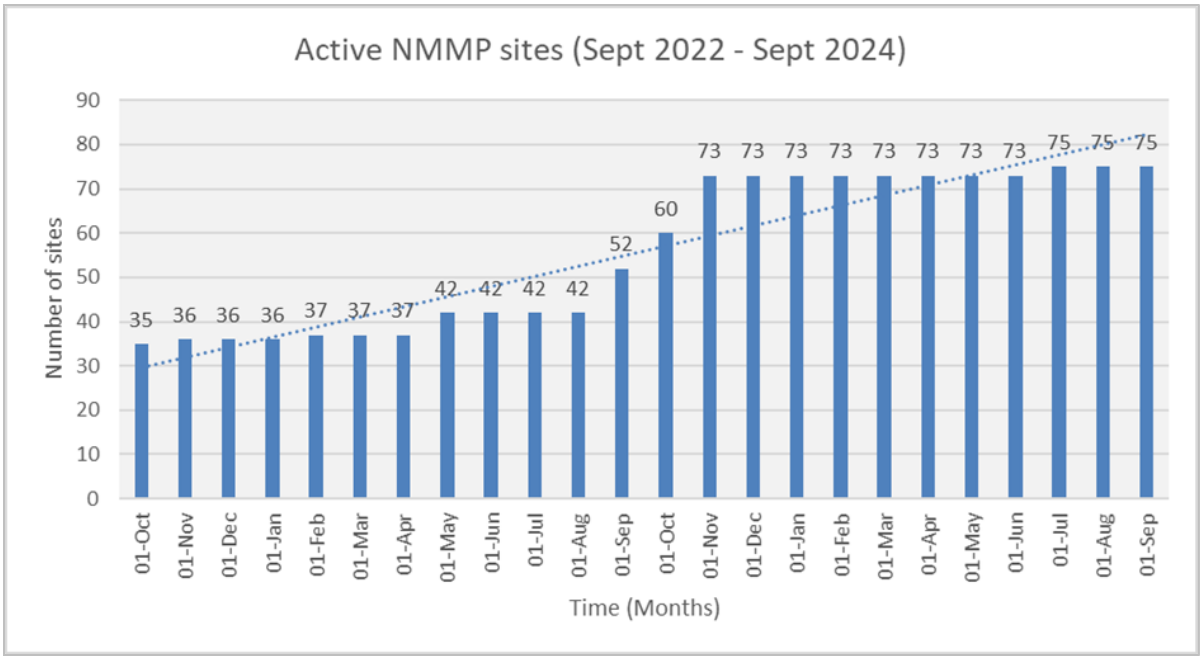


Figure 2.10: Active NMMP sites October 2022 – September 2024

The improvements were made possible by working with internal and external stakeholders such as the DWS Regional offices, eThekwini Municipality, the City of Johannesburg, the City of Cape Town, and the Olifants-Doorn Proto CMA. Figure 2.11

illustrates the spatial distribution of NMMP sites across the country. There are ongoing interactions with stakeholders to identify more sites to expand and improve the programme in other areas.

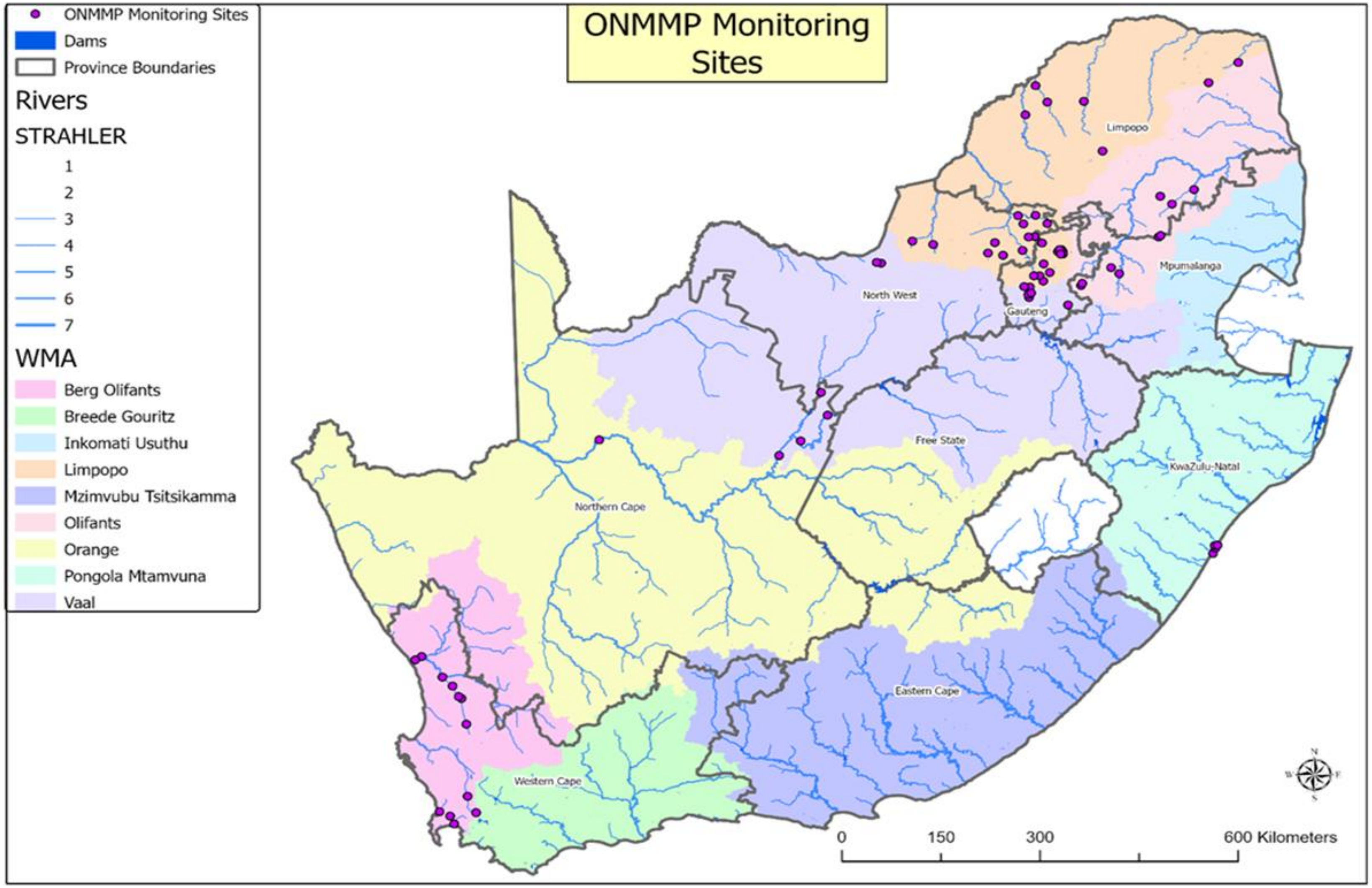


Figure 2.11: Spatial distribution of NMMP sites across the country.

2.2.4. River Eco-Status Monitoring Programme (REMP)

The South African River Health Programme (RHP) was initiated in 1994 in response to the need for more detailed information on the condition of South Africa's River ecosystems. The RHP was instituted before the promulgation of the National Water Act and, as such, did not align completely with the Act, so it was later replaced by the River Eco-status Monitoring Programme (REMP). The REMP enables monitoring of the ecological condition of river ecosystems in South Africa. It provides information regarding the ecological condition of river ecosystems to support the management of rivers and was designed to meet the following objectives:

- Measure, assess, and report the ecological status of river ecosystems;
- Detect and report spatial and temporal trends in the ecological status of river ecosystems;
- Identify and report emerging problems regarding river ecosystems;
- Ensure that all river ecosystem status reports provide scientifically relevant information for the management of these river ecosystems and
- Create public capacity and environmental awareness.

REMP is based on existing approved Eco-Status models such as the Index of Habitat Integrity (IHI), Fish Response Assessment Index (FRAI), Macroinvertebrate Response Assessment Index (MIRAI), Vegetation Response Assessment Index (VEGRAI), and Integrated Ecological Condition (Eco-Status), which are used in the ecological conditions assessment at the sub-quaternary reach or site levels. Monitoring is conducted quarterly, and technical reports are issued annually.

Figure 2.12 presents the spatial distribution of REMP sites across the country. A total of 138 sites have been consistently monitored from the 2016/17 hydrological year to the 2022/23 hydrological year. The annual number of sites monitored increased from 207 in 2016/17 to 503 in 2021/22.

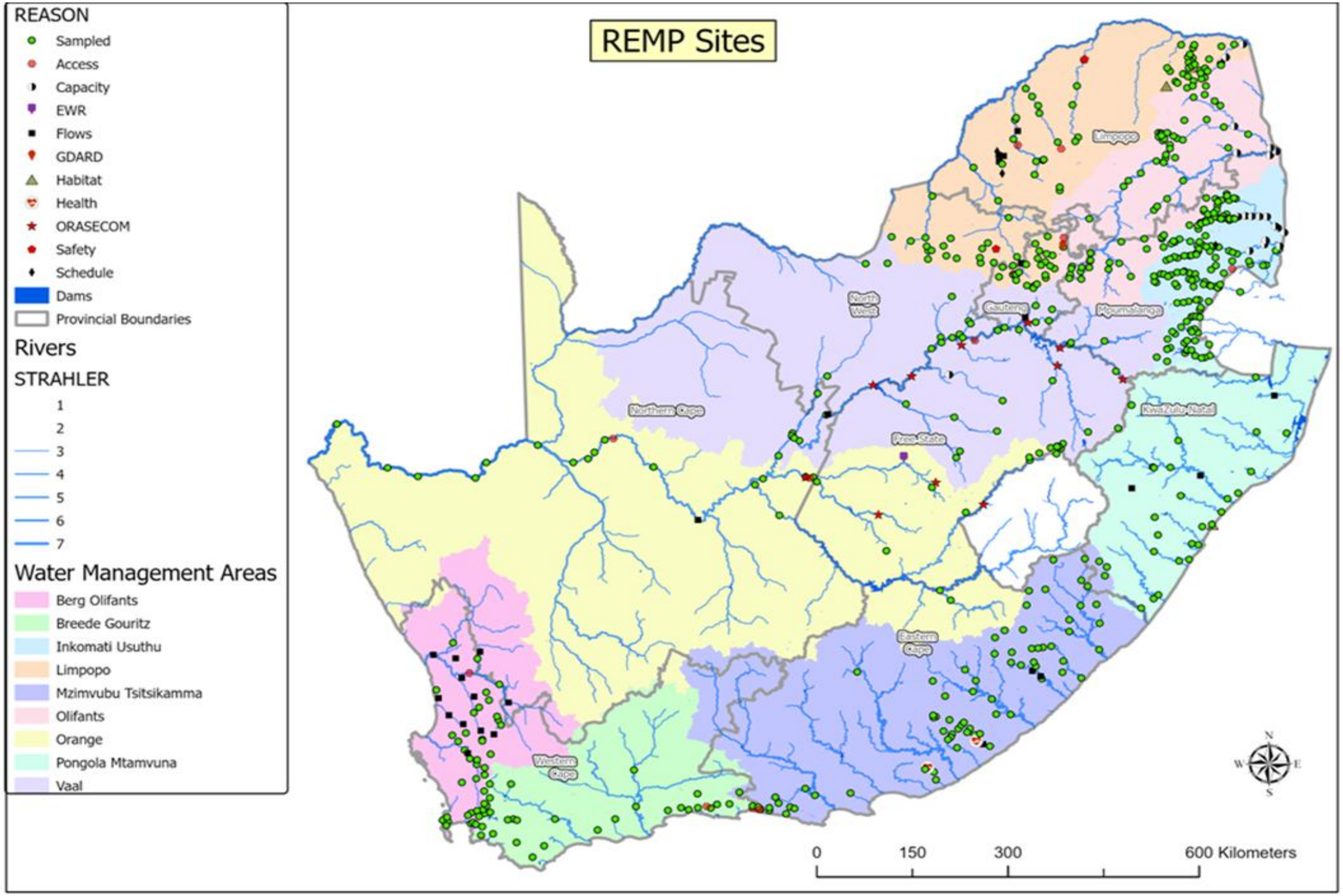


Figure 2.12: Distribution of REMP sites in the 2022/23 hydrological year.

2.2.5. National Wetland Monitoring Programme (NWMP)

The National Wetland Monitoring Programme (NWMP) is a structured initiative designed to assess, monitor, and report on wetlands in South Africa. Its goals include analysing the extent of wetlands, identifying threats to their ecological status, and evaluating the ecosystem services these wetlands provide (Wilkinson *et al*., 2016). The programme also reports on the "state of wetlands," which aims to demonstrate trends in wetland status over time. The NWMP is organized into a three-tiered hierarchical framework (see Figure 2.13), allowing for effective assessment and monitoring of wetlands at various spatial scales (Wilkinson *et al*., 2016).

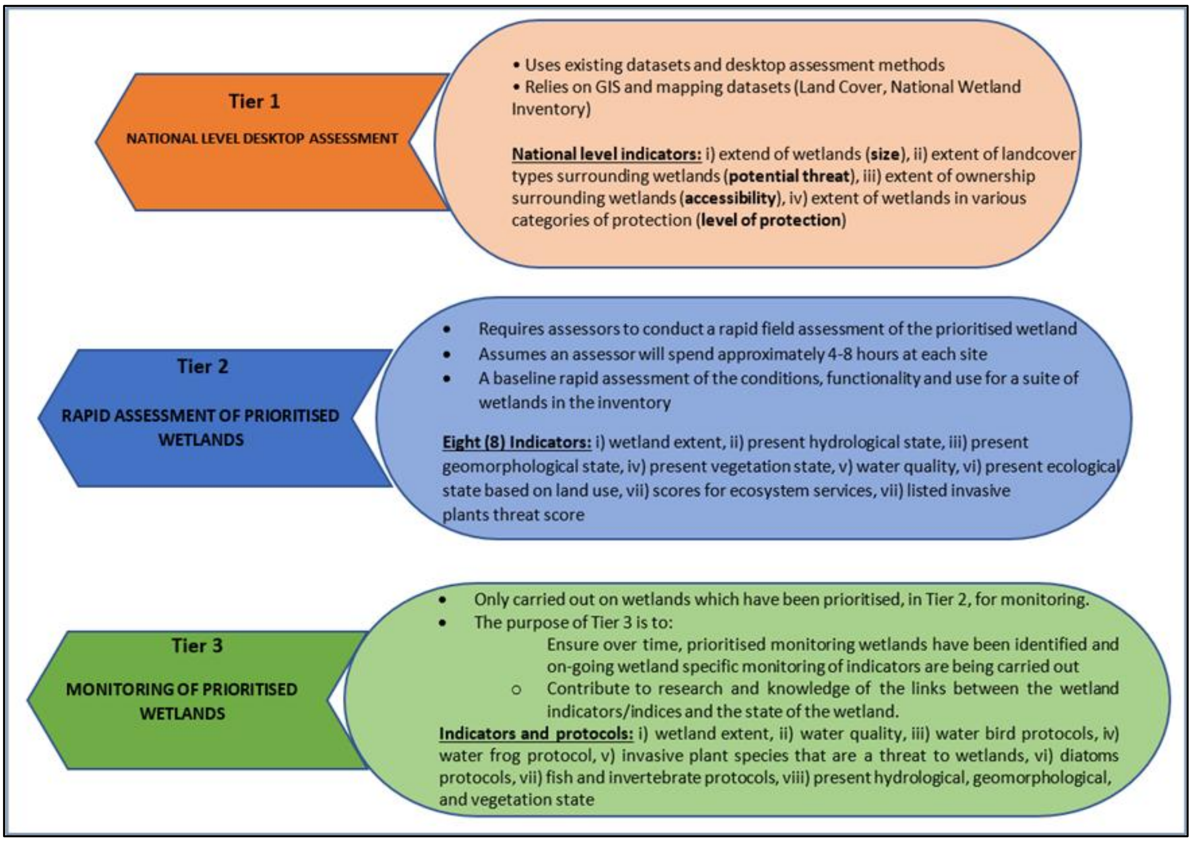


Figure 2.13: NWMP Framework illustrating the three-tiered assessment and monitoring hierarchy

The three tiers are outlined below:

Tier 1: Involves the use of existing datasets and desktop methods. The objective is to focus on four national indicators:

- ✓ The total extent of wetlands in the country – *based on size/mapped wetlands in the country;*
- ✓ the total extent of each land cover type surrounding wetlands – *to provide information based on the potential threats to a wetland;*

- ✓ the total extent of wetlands within protected and conservation areas – *determines the level of protection of a wetland and*
- ✓ the total extent of land ownership surrounding wetlands - *which helps with information on the accessibility of wetlands in an area especially for monitoring*

Tier 2: Involves the rapid field assessment of prioritised wetlands using wetland tools to assist with the prioritization of wetlands for ongoing or continuous monitoring under Tier 3.

Tier 3: Involves monitoring of a subset of wetlands prioritised under Tier 2. It has a combination of indicators from Tier 1 and 2, in addition to new indicators that provide additional information on the health of the wetlands, e.g. biotic indicators such as diatoms, fish, aquatic invertebrates, frog and water birds datasets.

Some Tier 2 and Tier 3 objectives were implemented concurrently, prioritising a subset of Tier 2 wetlands for Tier 3 monitoring. The criteria for prioritising wetlands in Tier 2 rapid assessments include Ramsar sites with threatened ecosystems, critically biodiverse areas, and the presence of biological threats, such as red data species. Additionally, wetlands are prioritised based on Resource Quality Objectives (RQOs), ecological status as determined by Reserve Determination Studies, and their inclusion in the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA). However, Ramsar-listed wetlands will be the primary criterion for long-term monitoring starting from the 2023/24 period. After that, the National Wetland Monitoring Programme (NWMP) will expand to include other priority wetlands.

The water quality protocol under Tier 3 has been implemented at selected Ramsar sites. This includes assessing physical variables on-site and collecting samples for inorganic chemical and microbiological analysis (see Table 2-1 below).

Table 2-1: List of physio-chemical and microbial water quality attributes under NWMP Tier 3

Physical	Chemical	Microbiological
- Temperature (°C), - pH (pH Units), - Dissolved Oxygen (% & mg/L) - Electrical Conductivity (µs/cm)	- Ca Cl, F, Mg, Na, SO4-Diss-Water, Si and K measured in mg/L, - KJELDAHL NITROGEN), NH4-N, NO3+NO2-N (as NITROGEN) in mg/L - Total Phosphorus (TP), PO4-P (Ortho Phosphate, TAL (Total Alkalinity as Calcium Carbonate in mg/L - pH (PH) (pH units)	- Escherichia coli (MPN/100 ml) - Total Coliform (MPN/100 ml)

There are 66 registered active water quality sites across 19 wetlands located in Gauteng, Mpumalanga, KwaZulu-Natal, North West, Eastern Cape, Free State, Limpopo, and Northern Cape provinces (see Figure 2.14). At the beginning of the 2023/24 hydrological year, sampling compliance at NWMP water quality sites was 61.2%. However, this figure improved to 73.1% at the start of the 2024/25 hydrological year. Furthermore, 66 monitoring sites were sampled between July and September 2024, a significant increase from the 41 monitoring sites sampled during the same quarter in 2023. This improvement is largely due to the collaborative efforts of all parties involved, including the DWS regions and DFFE Ramsar Management Units.

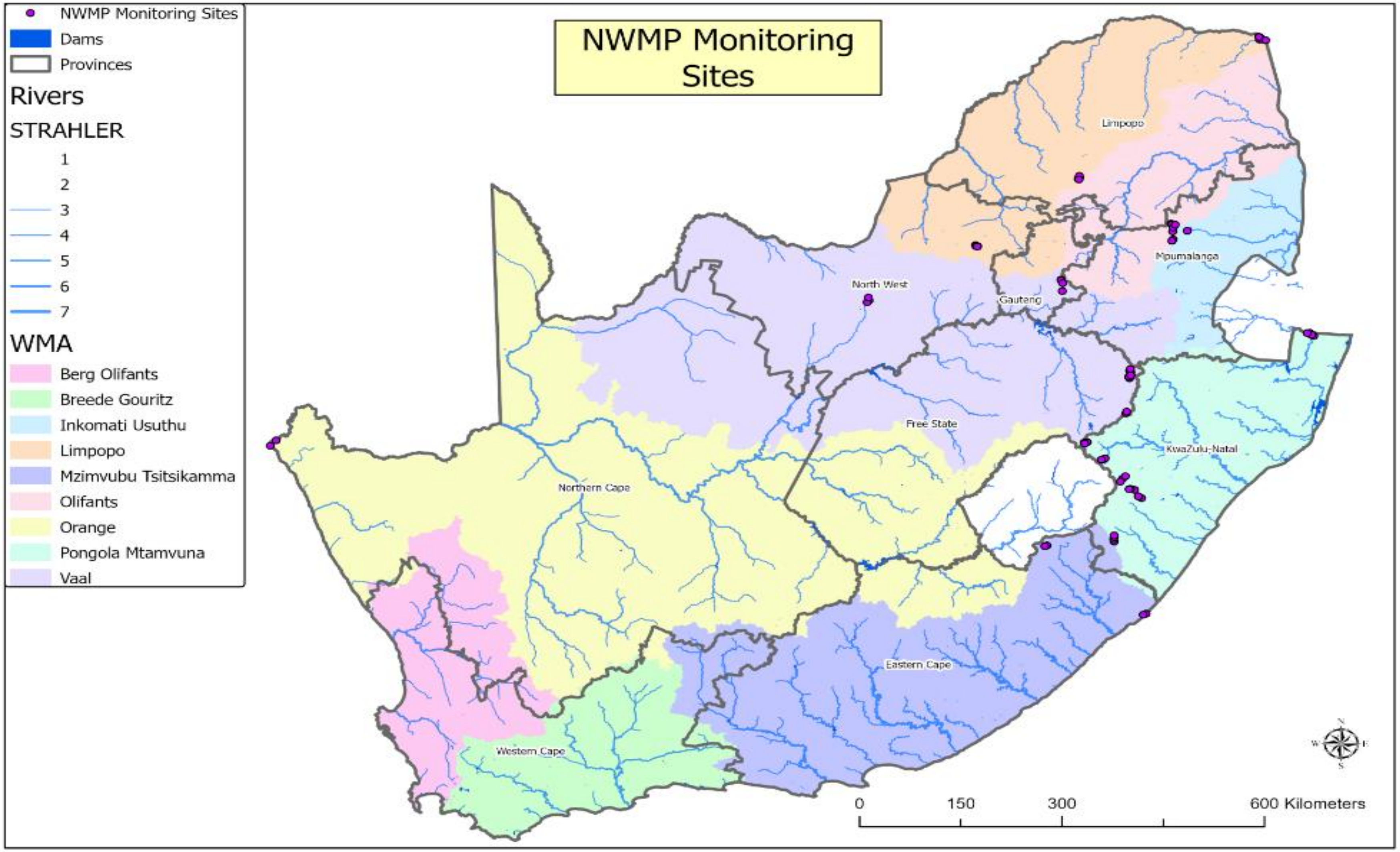


Figure 2.14: Location of the NWMP active water quality sites across South Africa

2.2.6. National Estuarine Monitoring Programme (NEsMP)

The National Estuarine Monitoring Programme (NEsMP) monitors the estuarine systems across the country based on their significance and priority. Established in 2010, the primary objective of the programme is to measure and assess long-term trends and changes in water quality within South African estuaries. The programme adopts a three-tiered approach to achieve these goals (Cilliers and Adams, 2016) (Figure 2.15):

- ✓ Tier 1: Focuses on the collection of basic physico-chemical data to create a long-term database and establish a baseline dataset of the most significant factors affecting estuaries.
- ✓ Tier 2: Involves determining the freshwater requirements of estuaries, which are divided into abiotic and biotic components (Taljaard et al., 2003; DWAF, 2008).
- ✓ Tier 3: Addresses specific management issues that may arise at any given time in a particular estuary. These issues can include pollution incidents, fish kills, and specific developments that could impact the health of an estuary.

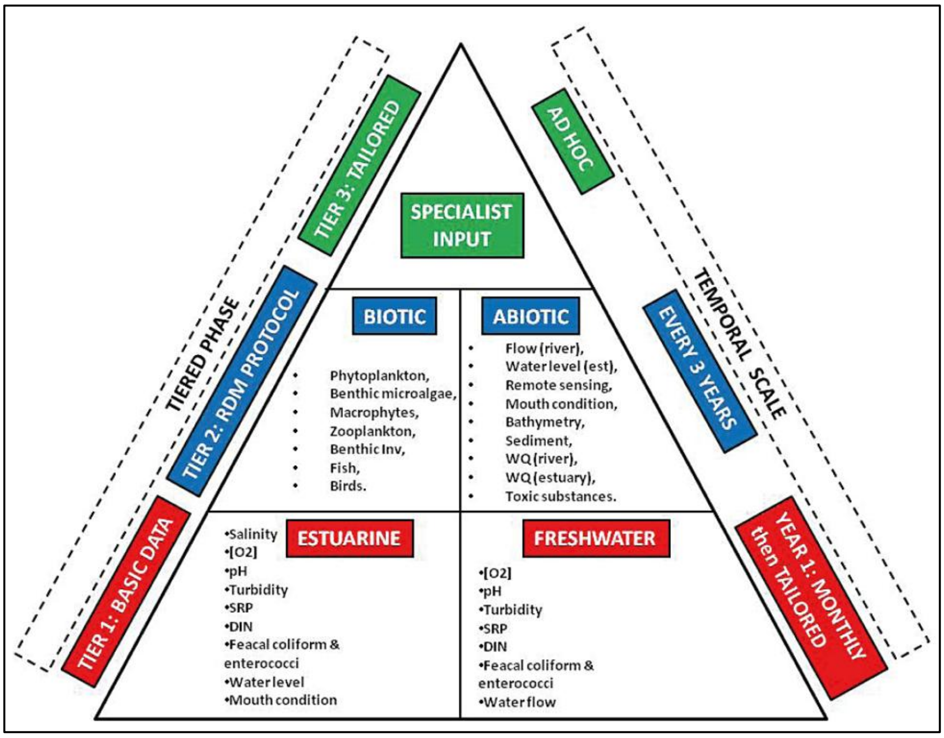


Figure 2.15: Three-tiered approach of NESMP.

NEsMP has 177 registered sites across the country. These sites are evenly distributed along the entire length of each estuary, from the mouth to the upper reaches. The number of sites within each estuary is determined by its Estuary Functional Zone (EFZ), which includes all areas critical to the estuary's functionality, such as open water areas, floodplains, salt marshes, and the near-shore surf zone.

Out of the 177 registered sites, 143 were sampled during the 2023/2024 hydrological cycle, representing an increase of 22 sites compared to the previous cycle (Figure 2.16). The Western Cape made a significant contribution to sampling compliance, while the Eastern Cape and KwaZulu-Natal faced challenges due to budget constraints and a lack of human resources.

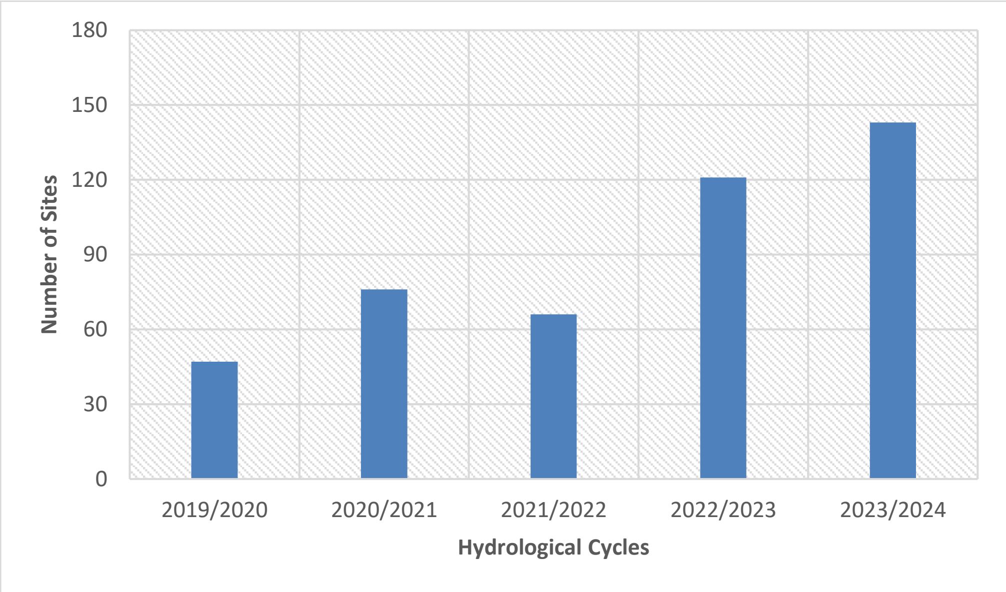


Figure 2.16: The expansion of NEsMP sites over the past hydrological years.

The NEsMP is based on collaborations with a wide range of stakeholders who are affected by or interested in estuaries. These stakeholders include conservation organisations such as Ezemvelo KZN Wildlife, SANParks, Cape Nature, and the Eastern Cape Parks and Tourism Agency. Volunteers from conservation organisations such as the Lower Breede River Conservation Trust, Aquatic CSI, and Adopt-A-River Eco-Solutions also contribute to the programme. This initiative also includes local and district municipalities on the West Coast, Eden, and universities like the University of Zululand.

This collaborative approach ensures that all parties are responsible for programme management, funding, and implementation. Figure 2.17 shows the spatial distribution of these sites across the country.

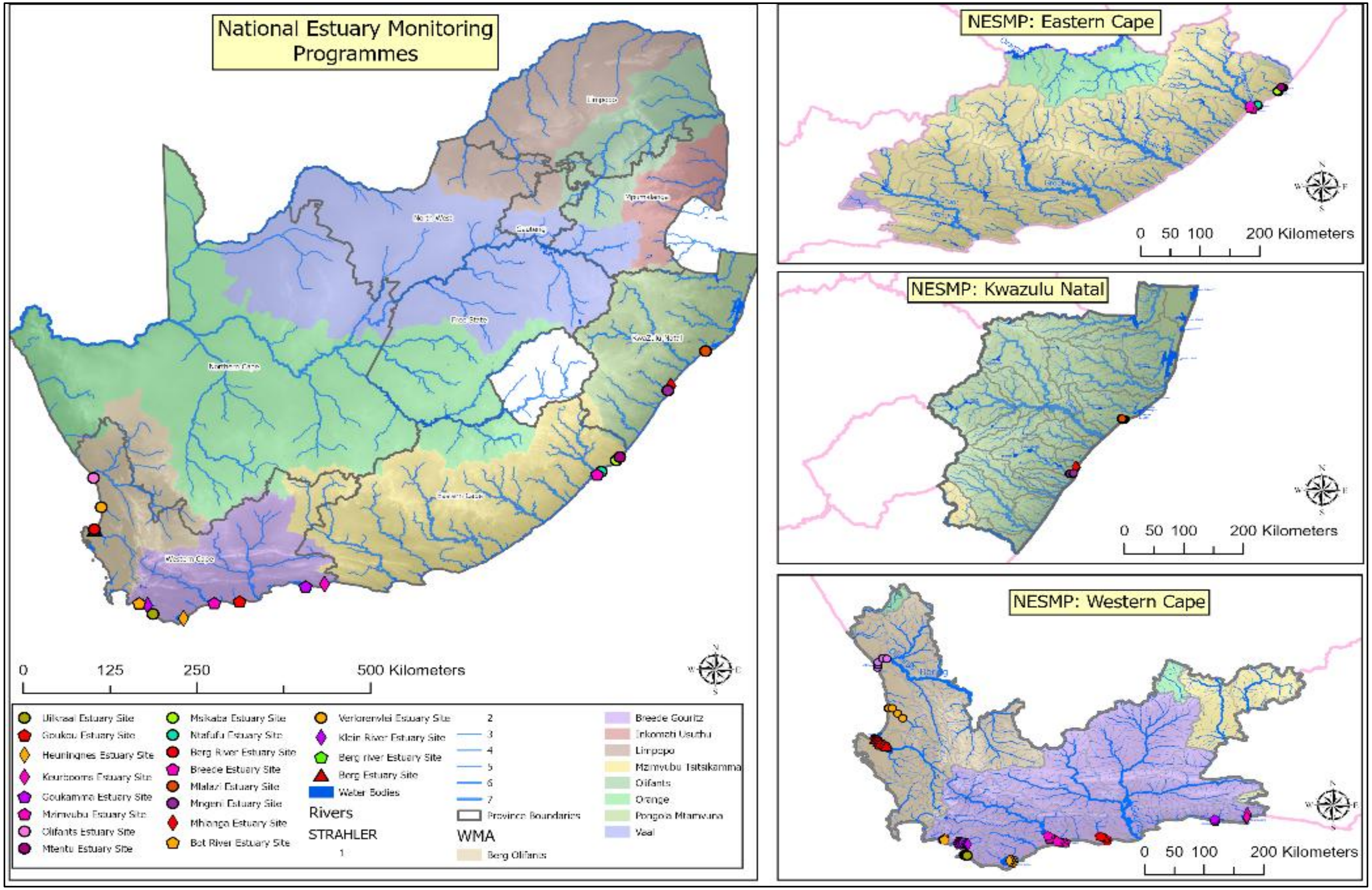


Figure 2.17: Spatial distribution of NEsMP sites during the 2023/2024 hydrological year

2.3. Groundwater Monitoring programmes

The DWS Groundwater Monitoring Programme is divided into two programmes: groundwater quality monitoring and groundwater level monitoring (Figure 2.18). The Groundwater Quality Monitoring Programme comprises two sub-programmes, the National Groundwater Quality Monitoring, also known as the ZQM Programme and the Acid Mine Drainage (AMD) Special Monitoring Programme managed by the National Office at the Cradle of Humankind World Heritage (CoH-WHS) and at Dundee. The Groundwater Level Monitoring programme also comprises two sub-programmes: the combined groundwater level networks managed by the Regional Offices and Catchment Management Agencies (CMA) and the AMD Special Monitoring programme managed by the National Office.

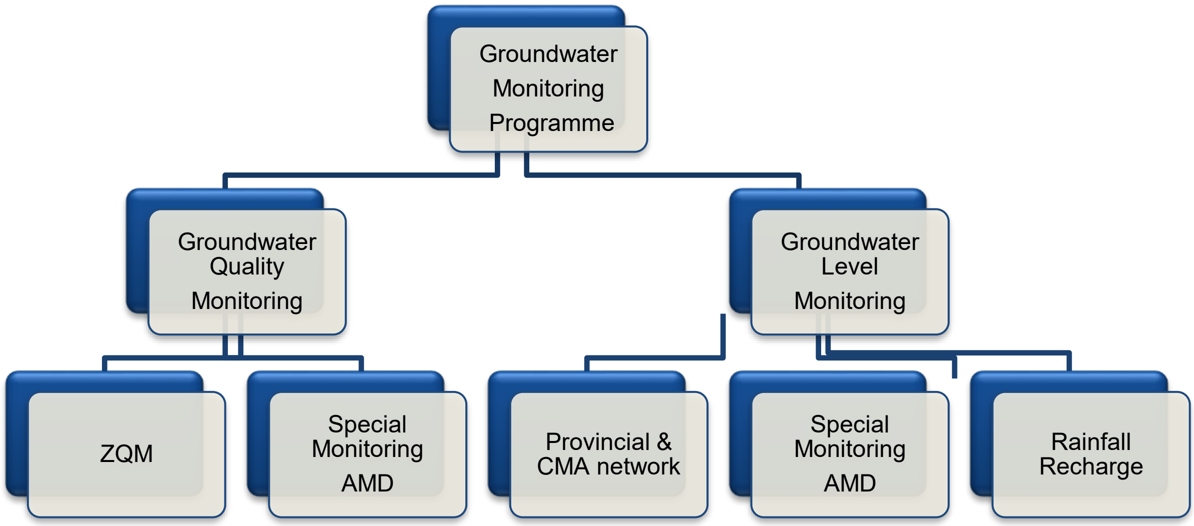


Figure 2.18: Groundwater Monitoring Programmes

2.3.1. Groundwater Quality Monitoring Programmes

The Groundwater Quality Monitoring (ZQM) Programme was established in 1994. The objectives of the ZQM programme are to investigate the influence of rainfall on groundwater quality, to determine the state of groundwater quality nationally, and to observe groundwater quality trends. The ZQM programme has 420 groundwater quality stations, monitoring chemical and physical parameters nationwide. These sites are distributed in strategic locations such as schools, clinics, farms, hospitals, and community supply centres.

The spatial distribution of the ZQM sites based on the 2024 Apr/May monitoring run is presented in Figure 2.19.

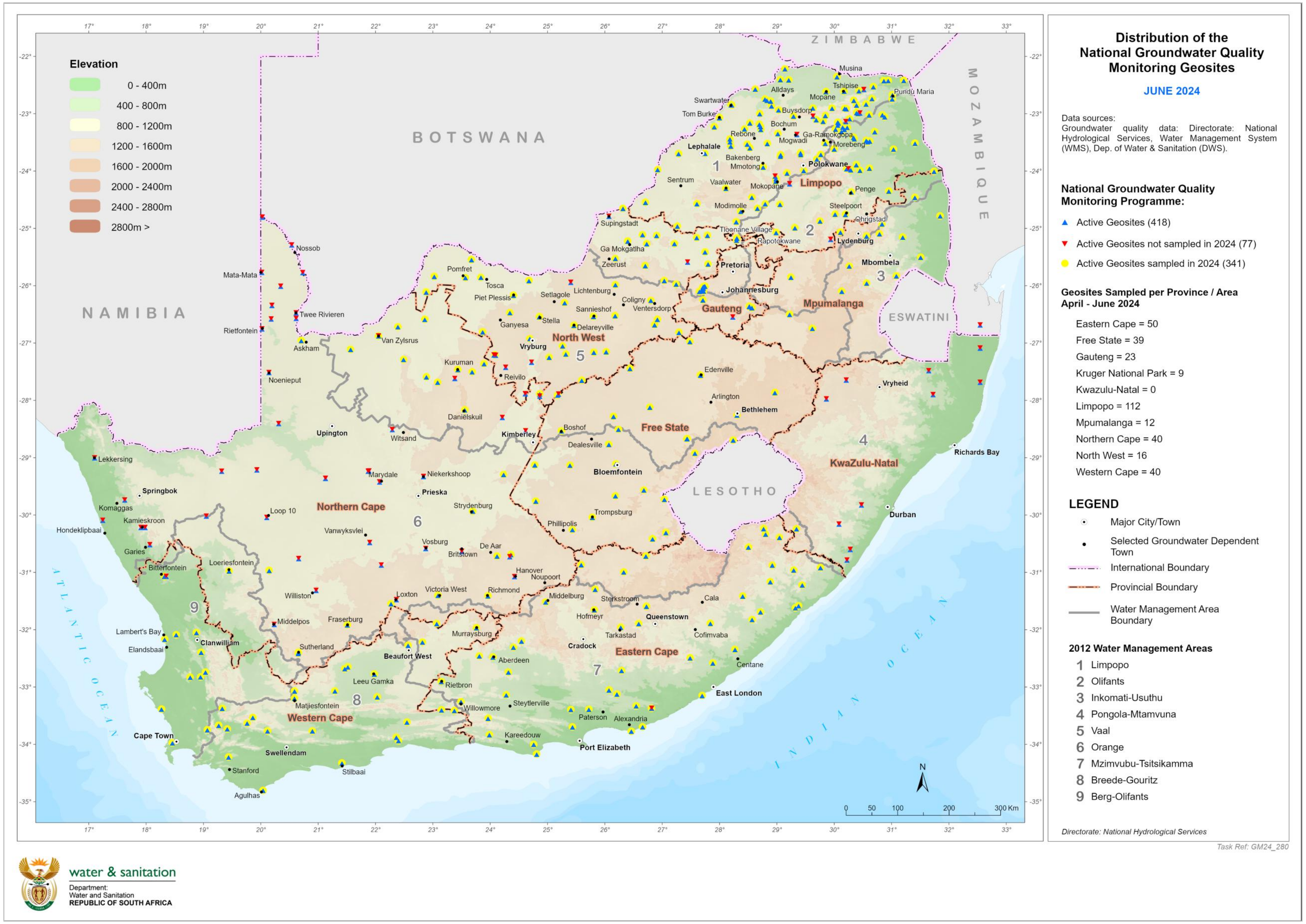


Figure 2.19: The National Groundwater Quality Monitoring network status for the 2024 April-May sampling run.

The AMD special programme at the Cradle of Humankind World Heritage Site (CoH-WHS) was established in 2012. It has 24 monitoring stations, and the frequency is four times a year. The AMD special programme at CoH-WHS aims to evaluate the hydrochemical impact of historical mining activities around CoH-WHS property. Monitoring is a collaboration between the Council for Scientific and Industrial Research (CSIR) and the Gauteng provincial office. The AMD special programme at Dundee was established in 2011. Its objective is to evaluate the impact of defunct coal mines on the local water resources within the Sandspruit catchment.

2.3.2. Groundwater Quality Data Availability

The respective regions monitor the groundwater quality monitoring network except for Gauteng, Mpumalanga, and parts of the North West, where the National office conducts the monitoring. For the hydrological year 2023/24, the groundwater monitoring data coverage starts with the Sep/Oct 2023 monitoring run. This monitoring usually runs from September through to November every year.

During the 2023 Sept/Oct sampling run, were 391 sites available for sampling, of which 305 (78%) were sampled (Table 2-2). KwaZulu-Natal, Western Cape, and Northern Cape were at the lowest performance, at 0%, 33%, and 58%, respectively.

Table 2-2: Sampling Status of the ZQM programme Sept/Oct 2023

Province/ Area	Total number of geosites to be sampled	Total number of geosites not sampled	% geosites not sampled	Total number of geosites sampled	% geosites sampled
Easter Cape	36	2	6%	34	94%
Free State	39	0	0%	39	100%
KwaZulu-Natal	10	10	100%	0	0%
Kruger National Park	9	0	0%	9	100%
Limpopo	121	8	7%	113	93%
North West	13	3	23%	10	77%
Northern Cape	79	33	42%	46	58%
Western Cape	40	27	68%	13	33%
Mpumalanga, Gauteng, parts of North West. Monitoring conducted by National Office	44	3	7%	41	93%
Total	**391**	**86**	**22%**	**305**	**78%**

During the 2024 Apr/May sampling run, there were 418 sites available for sampling, of which 341 (82%) were sampled (Table 2-3). KwaZulu-Natal and Northern Cape at their lowest performance, at 0% and 44%, respectively.

Table 2-3: Sampling Status of the ZQM Programme Apr/May 2024

Province/ Area	Total number of geosites to be sampled	Total number of geosites not sampled	% geosites not sampled	Total number of geosites sampled	% geosites sampled
Easter Cape	51	1	2%	50	98%
Free State	39	0	0%	39	100%
KwaZulu-Natal	12	12	100%	0	0%
Kruger National Park	9	0	0%	9	100%
Limpopo	121	9	7%	112	93%
North West	13	3	23%	10	77%
Northern Cape	90	50	56%	40	44%
Western Cape	40	0	0%	40	100%
Mpumalanga, Gauteng, parts of North West. Monitoring conducted by National Office	43	2	5%	41	95%
Total	**418**	**77**	**18%**	**341**	**82%**

A normalised percentage data availability (2016-2024) based on 420 active monitoring stations from the ZQM programme is presented in Figure 2.20.

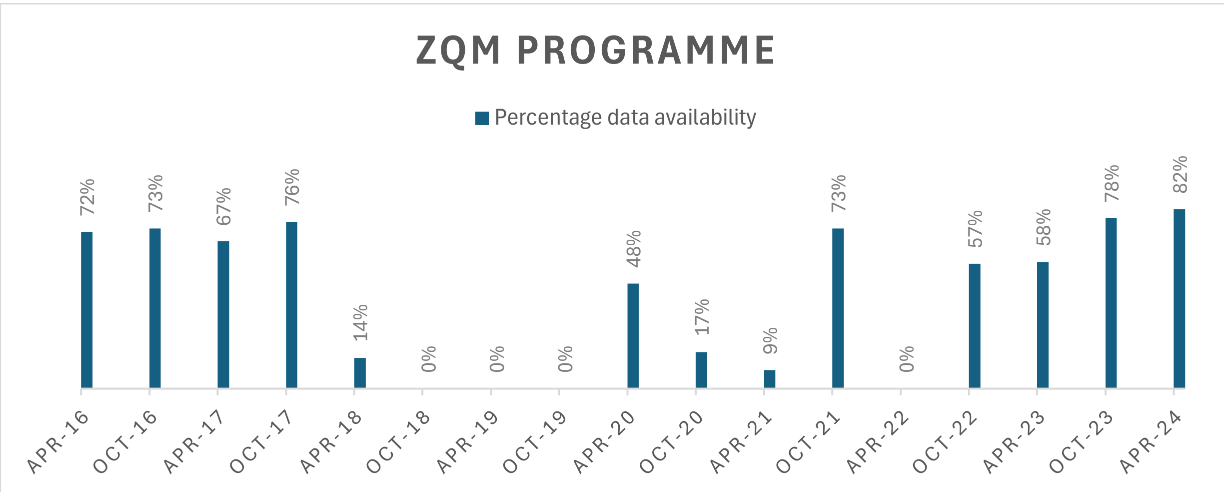


Figure 2.20: ZQM programme data availability on WMS from 2016 to 2024 during the time of reporting.

A significant improvement in the 2023/24 hydrological year's groundwater quality data availability is observed. At 82% (341 samples), groundwater quality data availability has been the highest since 2016. This data is available on the WMS database and is available on request from georequests@dws.gov.za.

2.3.3. Groundwater Level Monitoring

The monitoring frequency for groundwater levels varies significantly from province to province, as summarised previously in Table 2-4. The monitoring frequencies vary from monthly to every 2-monthly to quarterly. The most common frequency is quarterly at 73,8%, followed by monthly at 16,5%, dominated by KwaZulu-Natal, Mpumalanga, and Free State. Gauteng province monitoring frequency is mainly 2-monthly at 98%. The AMD special program is monitored at 90,5% monthly.

Table 2-4: Groundwater level monitoring frequency and equipment status. Out of the 1,726 active monitoring sites, 1,360 sites are monitored manually with a dip meter, while 366 sites are equipped with electronic data loggers. The regions without electronic data loggers are KwaZulu-Natal, Gauteng, Free State, and North West. The groundwater level data is collected and uploaded to the HYDSTRA database system, where it can be extracted for analysis. Groundwater level monitoring data is available to the public through a data request email, which can be sent to georequests@dws.gov.za .

2.3.4. Groundwater Level Data Availability

As of 31 October 2024, there were 1,726 groundwater level sites (geosites) which were active for monitoring, and 1,640 (95%) had groundwater level data available. Figure 2.21 presents a comparison of groundwater data availability for September 2023 and September 2024 as extracted on 14 February 2025.

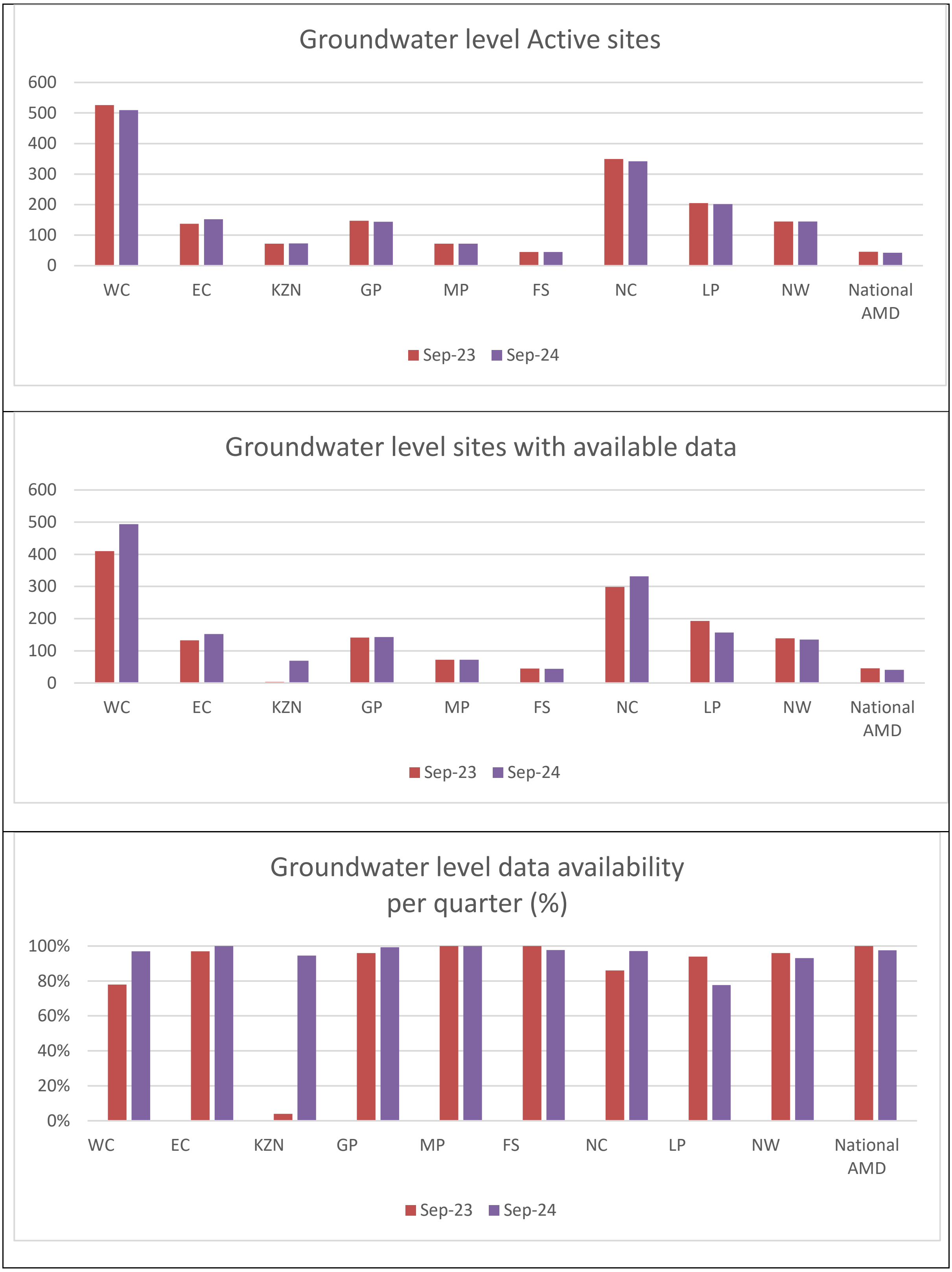


Figure 2.21: Groundwater level data availability status, September 2023 vs September 2024 as of 14 February 2025.

Compared to 2023, the data availability has improved by 10% from 85%. For September 2024, all the regions except North West and Limpopo have data availability greater than 95%. The most significant improvement in 2024 came from KwaZulu-Natal, where data availability was restored from 4% to >95% availability levels. The region with the poorest performance in 2024 is Limpopo, at 78%. However, Limpopo had 202 active sites, which makes it the third-biggest monitoring network nationally, requiring relatively more resources. In Limpopo, groundwater is a strategic water source and accounts for nearly 70% of the rural domestic water supply. Urgent internal interventions are in place to restore data availability in Limpopo.

The spatial distribution of the 1 726 active monitoring sites is presented in Figure 2.22. For Western Cape, most of the 494 active geosites are densely located on the Berg-Olifants WMA. At the same time, the WMA, which has a diversified groundwater level management portfolio, is the Vaal WMA. The geosites in the Vaal WMA are managed by Northern Cape, North West, Free State, and Gauteng.

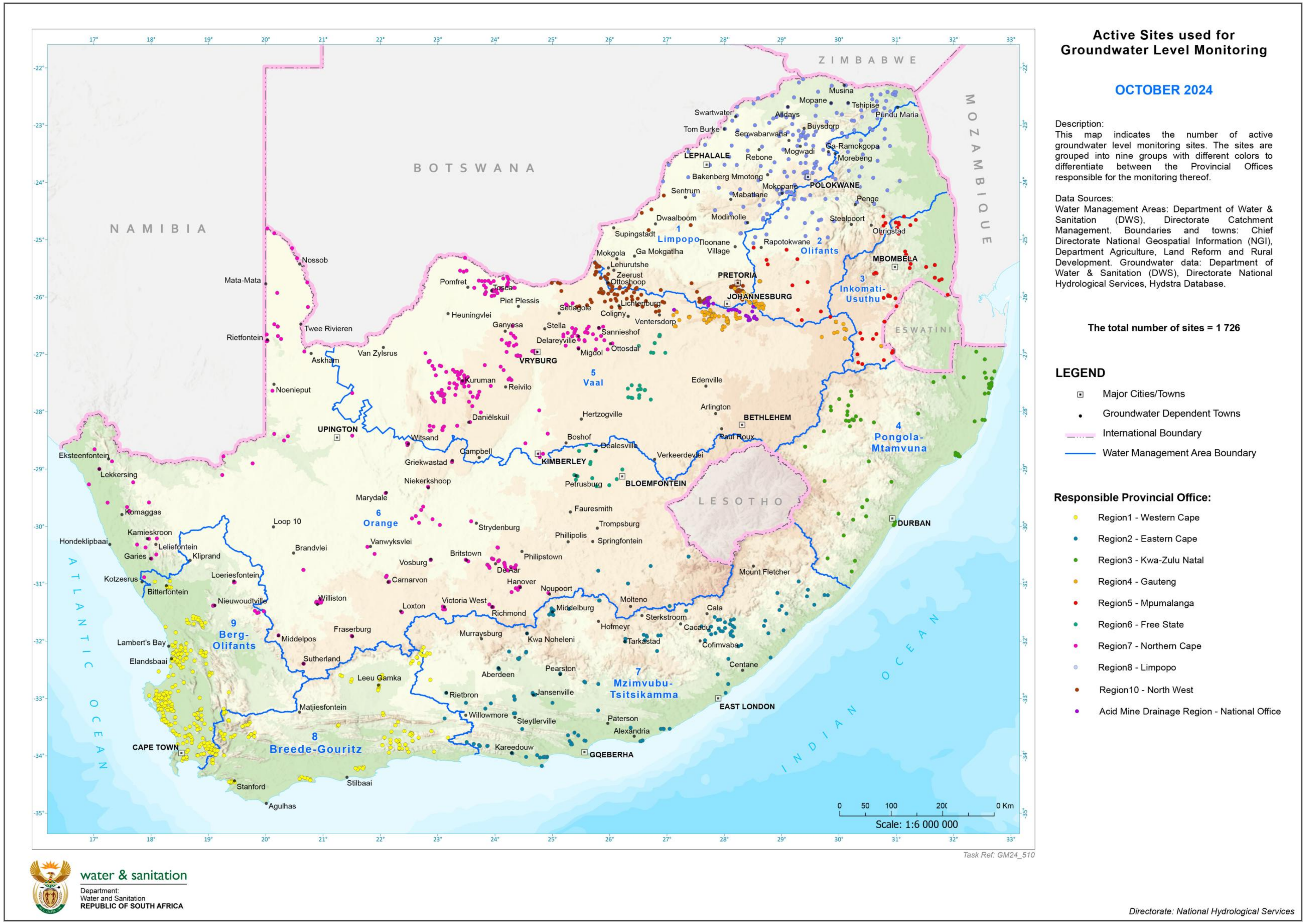


Figure 2.22 Status of active groundwater level monitoring sites – October 2024

2.4. National Integrated Water Information System

The National Integrated Water Information System (NIWIS) was conceptualised to meet the objective of serving as a single extensive, integrated, accessible national water information system to fulfil the mandate of both the National Water Act (No. 36 of 1998; Chapter 14, Sections 137 to 145), as well as the National Water Services Act (No 108 of 1997; Chapter 10, Sections 67, 68 & 69). Effective 01 September 2015, NIWIS went live with 43 dashboards developed and implemented. Ever since NIWIS has been experiencing enormous growth through enhancements responding to ever-growing business information requirements, NIWIS is an information system intended to provide information to researchers, water managers, and the public at large, and this system can be accessed at https://www.dws.gov.za/niwis2.

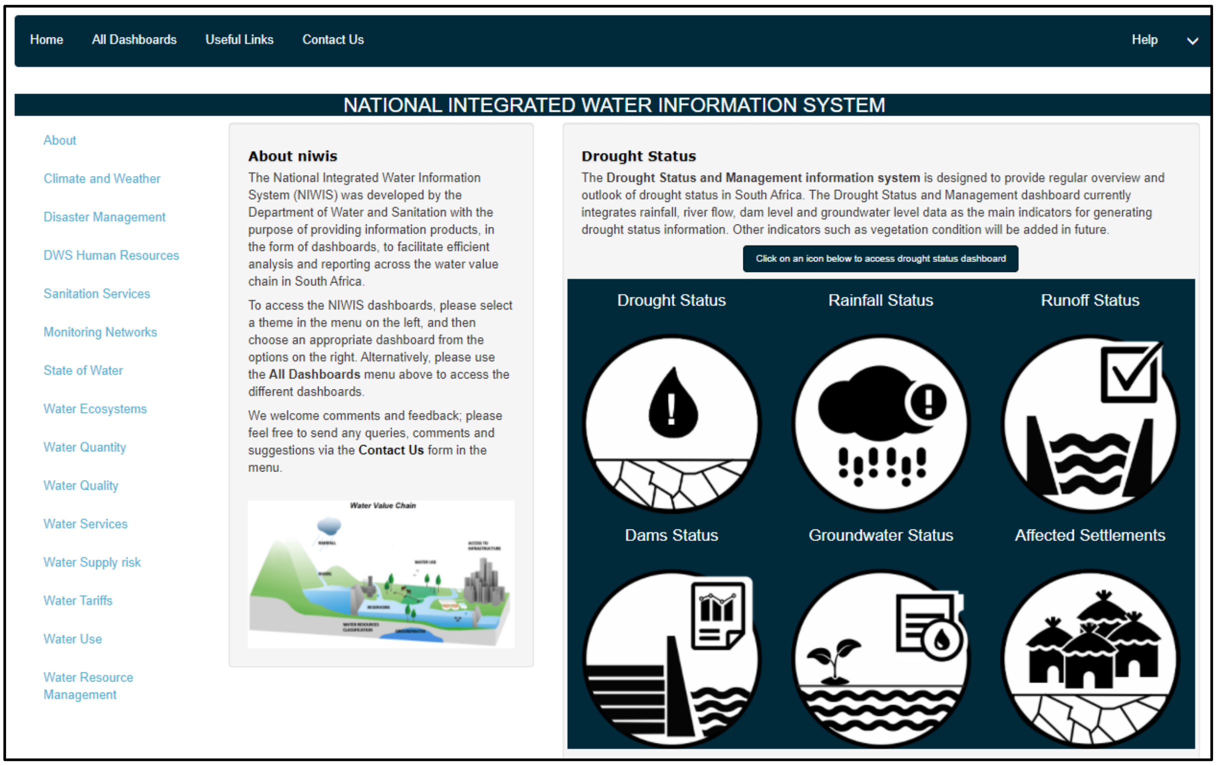


Figure 2.23 NIWIS landing page (https://www.dws.gov.za/niwis2/)

NIWIS allows for user customisation and is convenient. It has since become one of the Department's strategic investment tools, which ensures that information on the sector is readily available and conveniently disseminated. However, the system is currently experiencing challenges, where the automation has been taking place at a business level, not at a Departmental level, which has resulted in many parallel systems that are not complementing one another, albeit sharing the same client or water information in some cases. However, further developments in NIWIS are in progress despite these challenges.

2.5. Citizen Science information

Citizen Science involves the public's participation in generating scientific knowledge. This inclusive and collaborative process enhances scientific expertise and empowers local communities to make informed decisions regarding water management. In 2006, the Department of Water and Sanitation (DWS) acted on a parliamentary question on the health of South African Rivers and initiated an *Adopt-a-River* programme. The programme's objective is to create awareness and foster public participation in protecting and managing rivers in South Africa. The programme was implemented in 2010 after a Strategic Framework was developed, and implementation was tested in selected rivers across South Africa. It was later expanded to areas where interested stakeholders would want to participate in protecting and managing their water resources.

In 2014, DWS reviewed the Adopt a River programme through the Water Research Commission (WRC) and provided recommendations for a way forward. Part of the review included a revision of the institutional and governance framework based on the original framework and challenges encountered during implementation. The new framework is decentralised and provides more opportunities for various stakeholders in society (non-governmental organizations, community lead groups, private sector, etc.) to take part in the programme to ensure long-term sustainability, including the roles and responsibilities of each role player. The revised Adopt-a-River Programme focused on the involvement of schools, training, and capacity building and recognized the role of citizen science in monitoring water resources (Graham et al.*.,* 2016). A Ground model made up of volunteer groups the group is recognised as impactful in providing data and information to local and regional agencies under the guidance of the National DWS Coordinator, with the Catchment Management Forum and Catchment Management Agency being the main channel of communication between DWS and NGOs and other groups.

According to the reviewed programme's Institutional Framework and Governance Structure (Graham *et al.,* 2016). The National Coordinator is also responsible for housing the citizen science database. DWS is currently in the process of setting up a National Citizen science database that will not only house data collected by citizens but also make it available to the public to engage in the data, much like other national monitoring databases.

2.5.1. Evolution of the Programme: Adopt-a-River Citizen Science Programme

In 2015, the Adopt-a-River programme evolved into the Adopt-a-River – Citizen Science Programme. This follows the review of the initial programme with the vision of‘’ Healthy Rivers for all” and appreciating that improving water quality data will require governments and organisations to work collaboratively with locals who collect data, particularly where there are gaps in national monitoring programmes. Citizen science networks can enable large amounts of data to be collected for decision-making, and citizen scientists can act as stewards of their local water systems.

NGOs, private parastatals, local government, community organisations, etc., across the country are the foundation of the programme as implementers on the ground and are required to work closely with the DWS National Coordinator. Although DWS is the National Coordinator, collaboration is voluntary and relies strongly on implementers' cooperation and collaboration. Very few implementors from the private and NGO Fragmented efforts and withholding data from the National coordinator work against open science and achieving ‘’Healthy Rivers for All’’. DWS is establishing a National Citizen Science Database, where citizens can share and engage with data collected by citizen scientists throughout the country to help monitor and track impact.

Various activities other than water river health monitoring take place under the Adopt-a-River Citizen Science Programme, as indicated in Table 2-5 below.

Table 2-5 Adopt-a-River Citizen Science Programme core activities

Component	Tools/Mode of Delivery	Purpose
Safety, Health, and Environment	Training on Health and Safety in the water environment	To empower volunteers with basic health and safety knowledge, as well as an understanding of the water environment
Solid waste removal	General guidance on waste management (sorting and recycling)	Maintain water resources that are free of solid waste
Water resource monitoring (citizen science)	Citizen science tools (Water Research Commission (WRC) Project K5/2350)	To assist communities with understanding the condition of their rivers' health and encourage ownership to improve their water resources
Removal of Alien invasive species	A comprehensive manual for river rehabilitation in South Africa, including identification, removal, and control of alien invasive plants (WRC Project KSA2: K5/2270)	Increase water availability, conserve biodiversity, and empower communities to take care of their water resources.
Awareness, Capacity Building, and advocacy	Pamphlets, Posters, Door to door campaigns, workshops, training and representation at forums, engaging perpetrators, and other communication tools	To create awareness and training on water resource management, encourage advocacy and recourse, and reduce negative impacts on the environment.

2.5.2. Challenges and Opportunities

While the citizen science approach has gained prominence in integrated water resources management, particularly in the Adopt-a-River – Citizen Science Programme, it is not without challenges. Fragmentation of efforts and lack of collaboration by some implementers in integrating collected data and activities with the DWS National coordinator into existing national monitoring networks and decision-making processes means that its full potential in influencing governance and policy is yet to be fully realised. Channels of reporting and coordination of activities by implementers on the ground are done directly with the DWS National Coordinator and through the Catchment Management Forums.

Most of the citizen science miniSASS data is sitting on a database hosted by a private implementer, and the DWS National Coordinator does not have access to this data. The Adopt-a-River Citizen Science Programme presents a tremendous opportunity should the water sector stakeholders come together in collaboration with the DWS National Coordinator. Some of the opportunities include:

- Contribute to Sustainable Development Goal (SDG) Target 6.3.2: Data generated through Citizen Science initiatives or monitoring can also be used to support and provide information on ambient water quality.
- Contribute to UNESCO Intergovernmental Hydrological Programme -IX strategy implementation on priority area 1 (Scientific Research and Innovation): Conducting and sharing research on integrating citizen science into the hydrological discipline to improve understanding of the water cycle, enabling science-based decision-making.
- Practise Open Science
- Strengthening community action
- Improved policy and decision-making
- Public awareness and engagement
- Enhanced data collection

3

CLIMATIC ENVIRONMENT

3 CLIMATIC ENVIRONMENT

Climate, characterised by the long-term patterns and averages of elements such as rainfall, temperature, solar radiation, relative humidity, wind speed, and evaporation, is evident on both temporal and spatial scales. In South Africa, the diverse climatic conditions affecting critical sectors, including agriculture, forestry, and biodiversity, similarly influence the availability and distribution of water throughout the country. Ranging from arid conditions in the western regions to humid subtropical climates in the east, the country's varied rainfall patterns create a dynamic and complex water management landscape.

The climate classification in South Africa is often based on seasonal rainfall patterns such as winter and summer rainfall. The winter rainfall, typically occurring between May and August and concentrated primarily in the southwestern region, contrasts with the summer rainfall region, covering extensive areas of the country. The latter experiences higher rainfall amounts crucial for replenishing rivers, dams, and reservoirs, essential for sustaining numerous sectors. Moreover, the northern and western areas record the highest temperatures, while the elevated regions experience cooler climates. Coastal regions, influenced by the warm Indian Ocean, often maintain higher average temperatures, particularly at night.

The seasonal variability in the country's climate influences water availability and storage dynamics. While summer rainfall regions experience peak flows during wet seasons, winter rainfall areas heavily rely on stored water from dams and reservoirs to meet demands during dry months. Furthermore, climate change exacerbates existing challenges, introducing uncertainties such as changes in rainfall patterns, increased temperatures, and heightened frequency of extreme weather events, which pose challenges for infrastructure development, demand management strategies, and ecosystem sustainability efforts.

The Agricultural Research Council, with its extensive network of weather stations across the country and a comprehensive agroclimatic archive, provides essential data and analysis on these evolving climate trends, which are discussed in the following chapter. The rainfall and temperature data utilised in climate analysis for this study spans from 1950 to 2024, providing a long-term view of the climate's variability and trends. This data is essential for understanding the seasonal and inter-annual dynamics of water availability, particularly as the variability influences the country's water storage systems in rainfall and temperature patterns.

3.1 Temperature

South Africa experienced a new record warm year, with very hot conditions mainly in the central and northern interior. In the south, however, temperatures were closer to normal. The annual mean temperature anomaly for 2024, based on the data of 26 climate stations, was about 0.9 ºC above the average of the reference period (1991-2020), making it approximately the hottest year since 1951 (see Figure 3.1). A warming trend of approximately 0.17 ºC per decade is indicated for the country over 1951-2024, statistically significant at the 5% level.

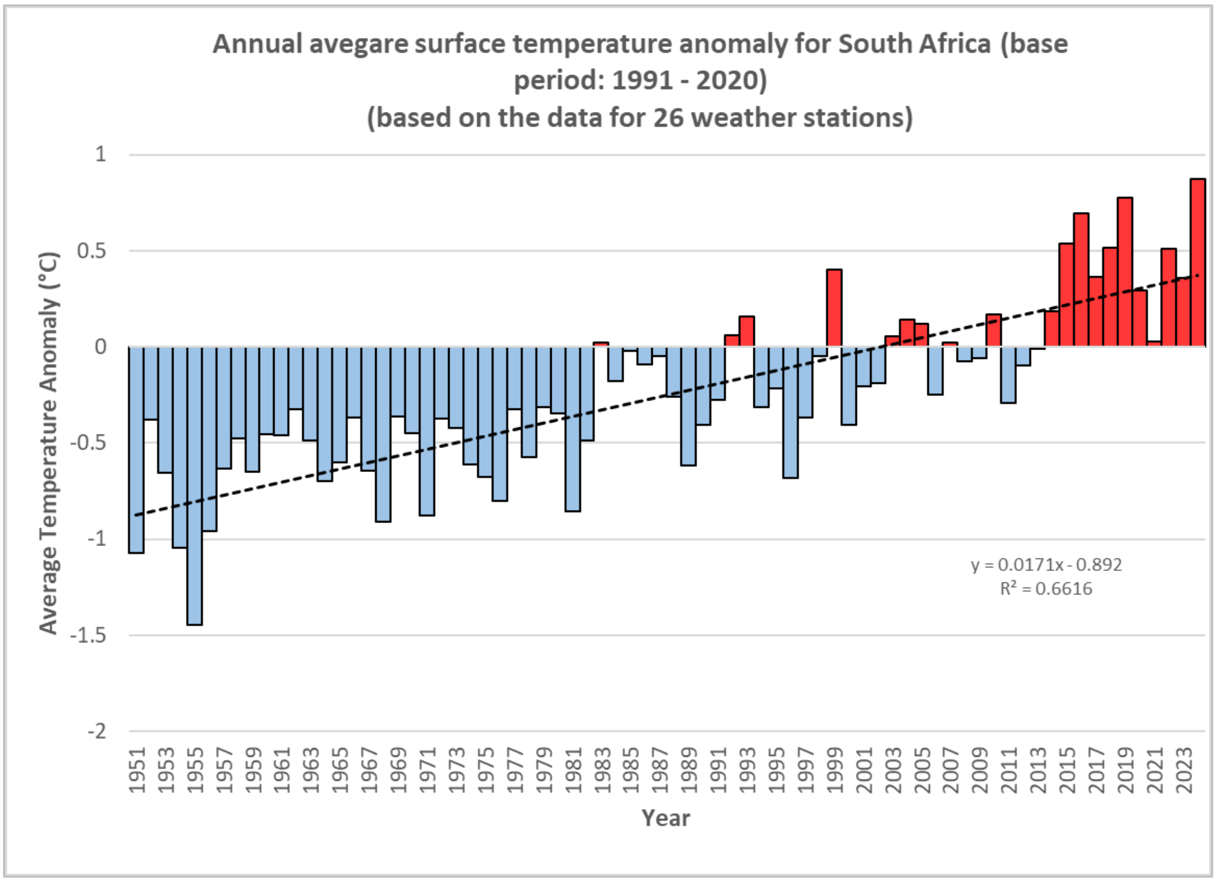


Figure 3.1. Average surface temperature deviation over South Africa based on 26 climate stations: 1951 - 2023 (base period: 1991 - 2020). The linear trend is indicated (Source: South African Weather Service).

Average observed temperatures for the 2023/24 hydrological year are shown in Figure 3.2. Average temperatures for the hydrological year followed a predictable spatial pattern, with temperatures in the lower teens dominating over the cooler southern to eastern escarpment and eastern Highveld. The highest average temperatures occurred over the traditionally warmer parts, including the Limpopo River Valley, Lowveld and north-eastern KZN, with values in the lower to mid-twenties dominating.

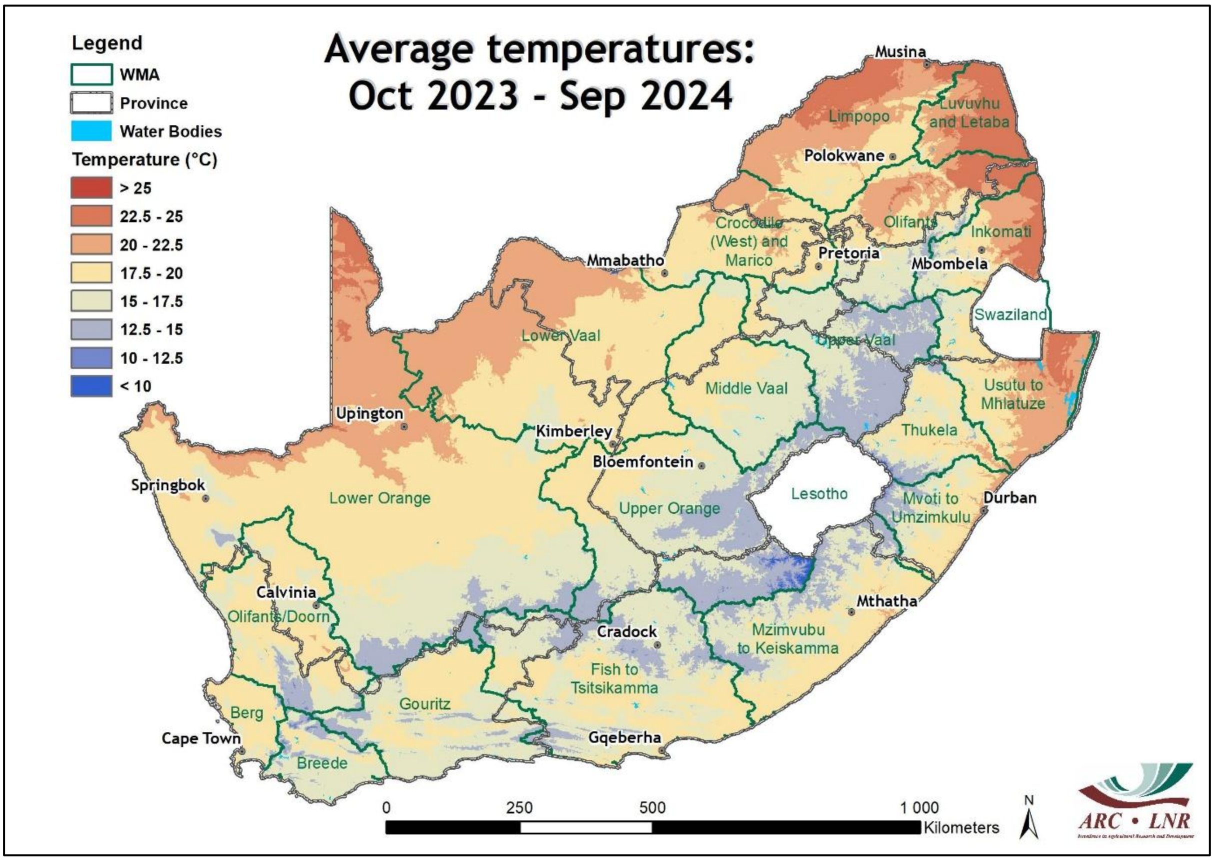


Figure 3.2 Average temperature calculated during the 2023/24 hydrological year.

Compared to the long-term average for the 12-month period covering the 2023/24 hydrological year, temperatures were on average near the long-term average over most of the central to southern parts but tended to be above average over the northern parts of the country (Figure 3.3) Relatively large areas in the north were more than 2°C warmer than the average. Deviations over the rest of the country largely ranged between -0.5 and +1°C from the long-term average during the period as a whole.

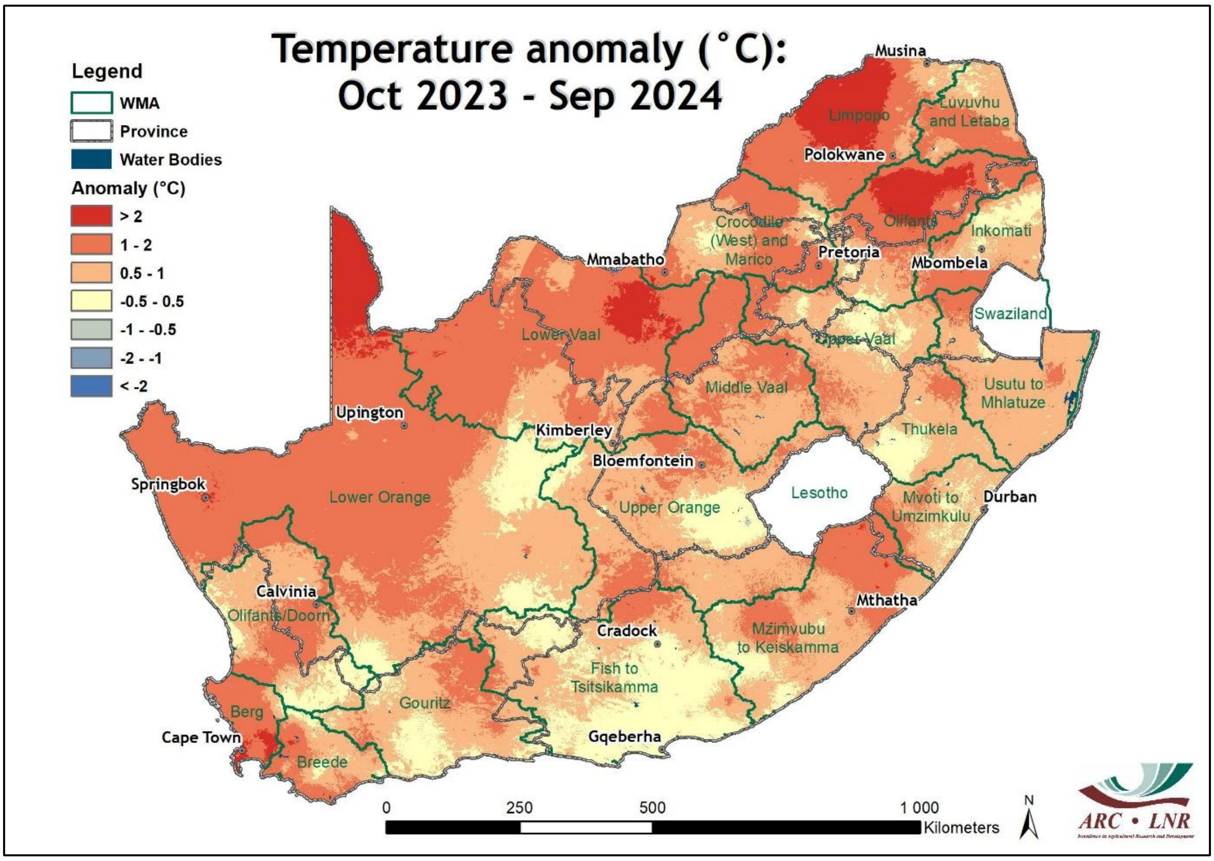


Figure 3.3 Deviation in temperature from the long-term average during the 2022/23 hydrological year.

The monthly breakdown of the average temperature anomalies is shown for the summer and winter halves of the 2023/24 hydrological year in Figure 3.4 and Figure 3.5, respectively. Months that stood out as being warmer than average across the country were November 2023, March and May 2024. February 2024 was also warm over most of the summer rainfall region and constituted part of the very dry period that lasted from mid-January until late March over the summer rainfall region. July, August and September were all anomalously cold over most of the country's southern half.

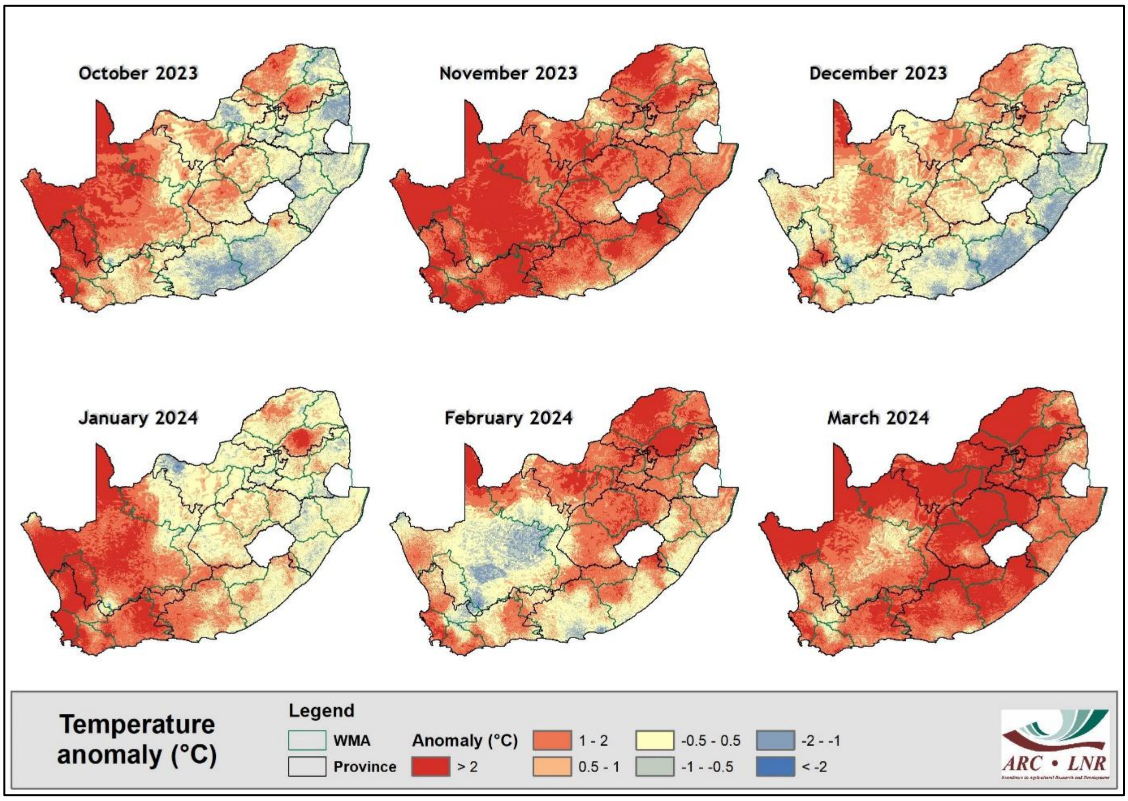


Figure 3.4 Monthly deviation in temperature from the long-term average during the summer half of the 2022/23 hydrological year.

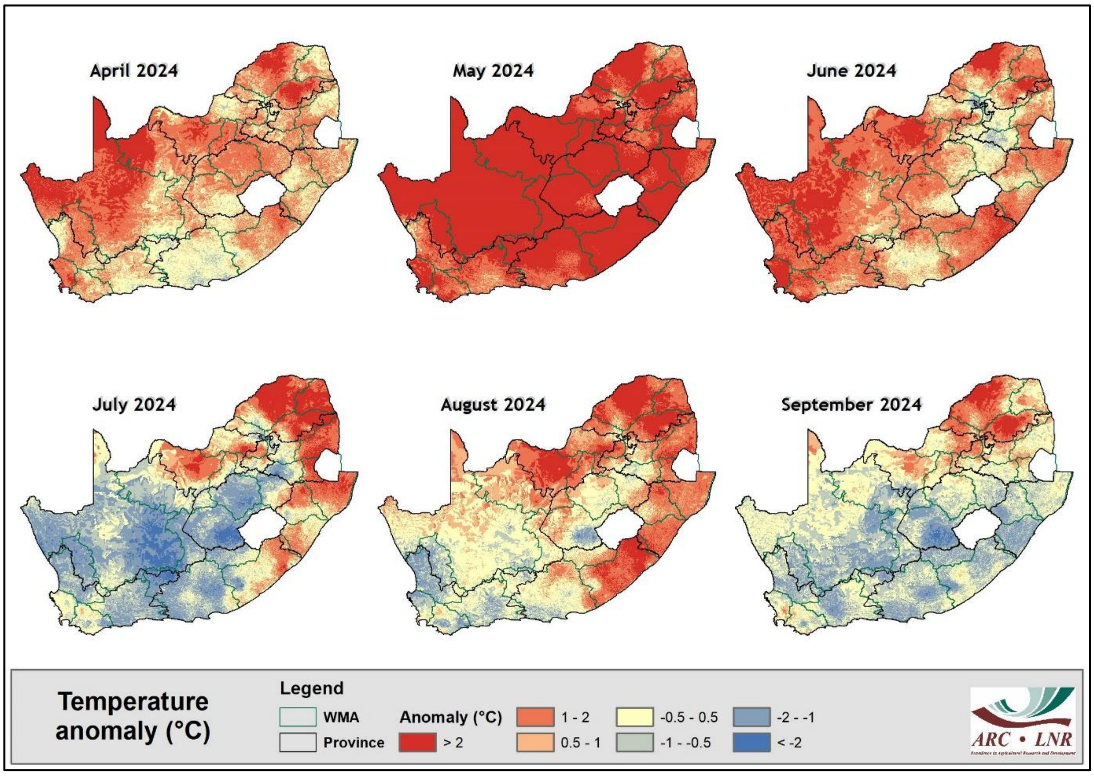


Figure 3.5: Monthly deviation in temperature from the long-term average during the winter half of the 2022/23 hydrological year.

3.2 Rainfall

The hydrological year included the 2023/24 summer, which was influenced by the occurrence of a strong El Niño event. Following three summers falling within the protracted 2020-2023 La Niña event, the 2023/24 summer was characterised by hot and dry periods in contrast to the relatively cool and wet preceding summers. The winter region experienced widespread above-average rainfall during the 2024 winter, a season largely unaffected by El Niño Southern Oscillation. These contrasting patterns resulted in the continuation of a trend that had started during the latter part of the 2022/23 hydrological year and which saw the northern to central interior continue to become drier relative to the southern parts and winter rainfall region where above-normal rainfall occurred. The total rainfall for the 2023/24 hydrological year (October 2023 – September 2024) is shown in Figure 3.6.

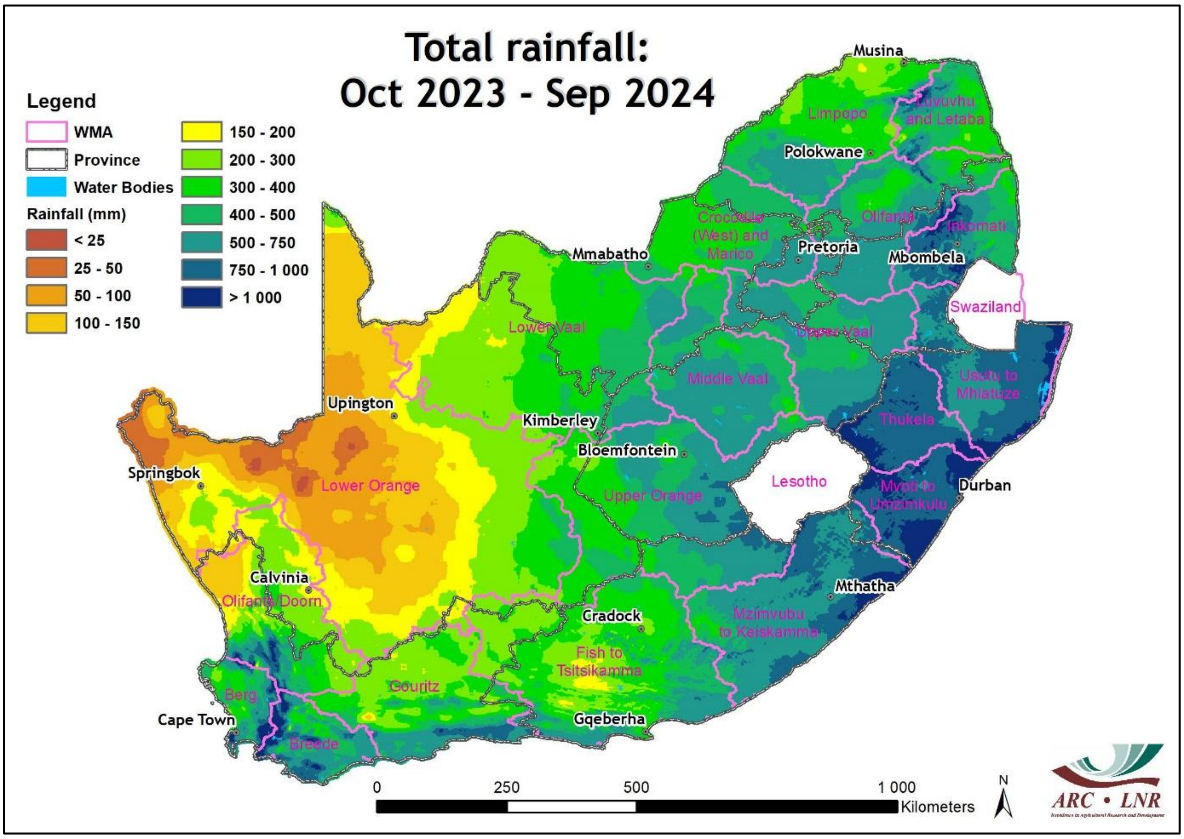


Figure 3.6 Rainfall (mm) for the water year October 2023 to September 2024.

The normal west-east gradient of increasing rainfall is visible over the interior, with the highest totals along the eastern escarpment and another maximum further east along the KwaZulu-Natal and the Eastern Cape coast. Some exceptions included large parts of the northern Free State, where totals were lower than further west, indicative of the drought conditions that dominated the region for significant stretches of the period. Higher rainfall totals were recorded over the southwestern winter rainfall region, especially the mountainous areas and the Garden Route in the south (Figure 3.7).

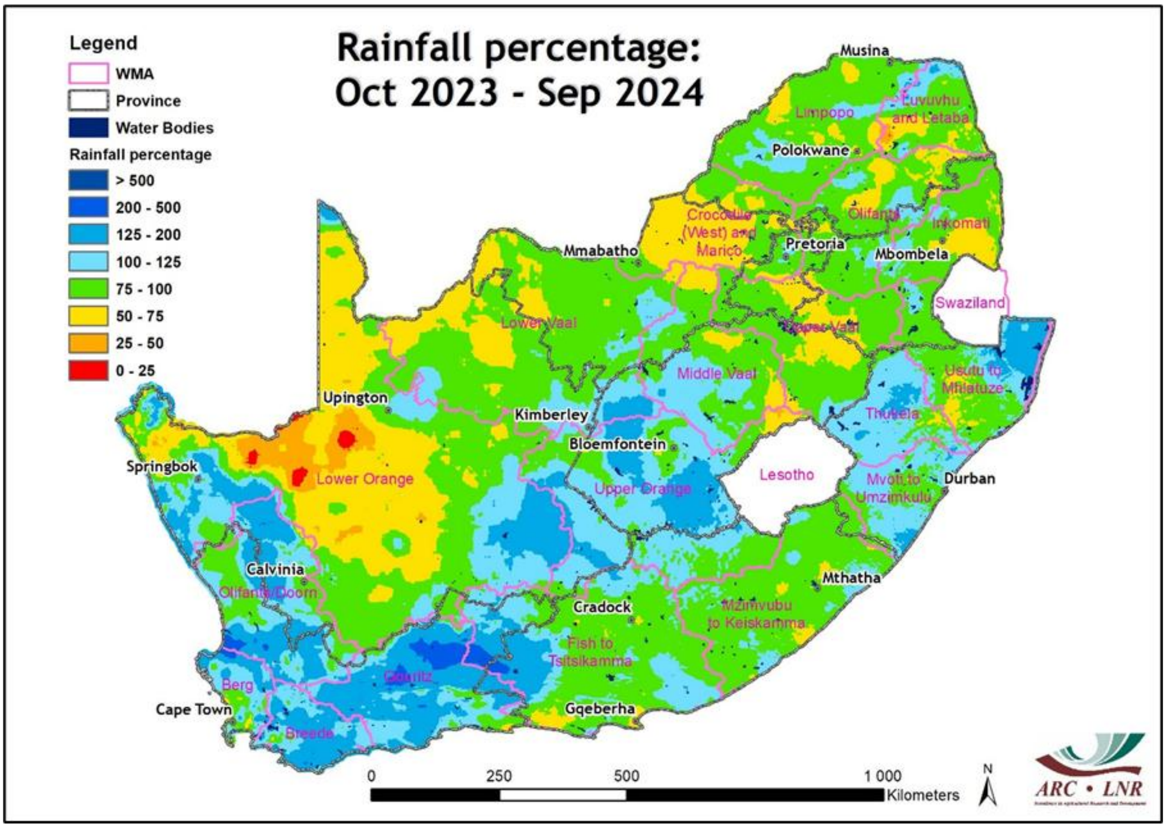


Figure 3.7 Rainfall (percentage of long-term average) for the water year October 2023 to September 2024.

Most of the country received below-average rainfall in total over the period. Notable exceptions are the winter rainfall region, the southeastern parts of the Northern Cape, the southwestern Free State, and large parts of KwaZulu-Natal. The monthly progression of rainfall anomalies is shown in Figure 3.8 and Figure 3.9, which represent the summer and winter halves of the water year.

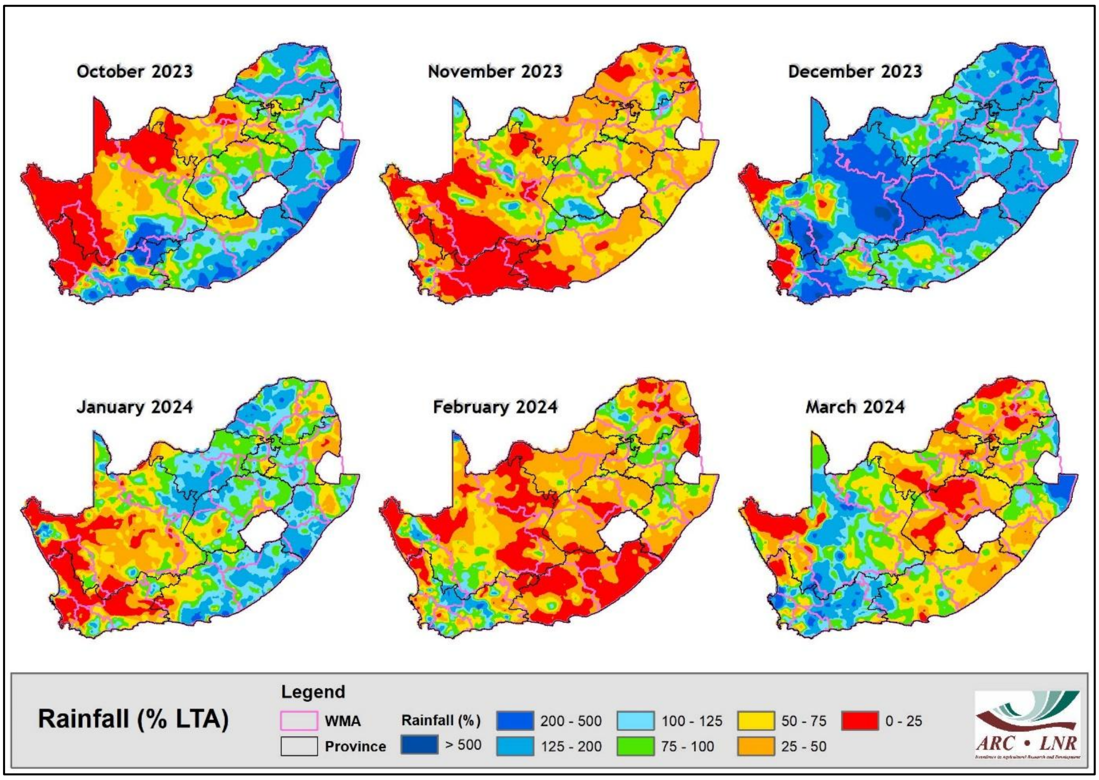


Figure 3.8 Rainfall (percentage of long-term average) per month as indicated for the summer half of the 2023/24 hydrological year (October 2023 to March 2024).

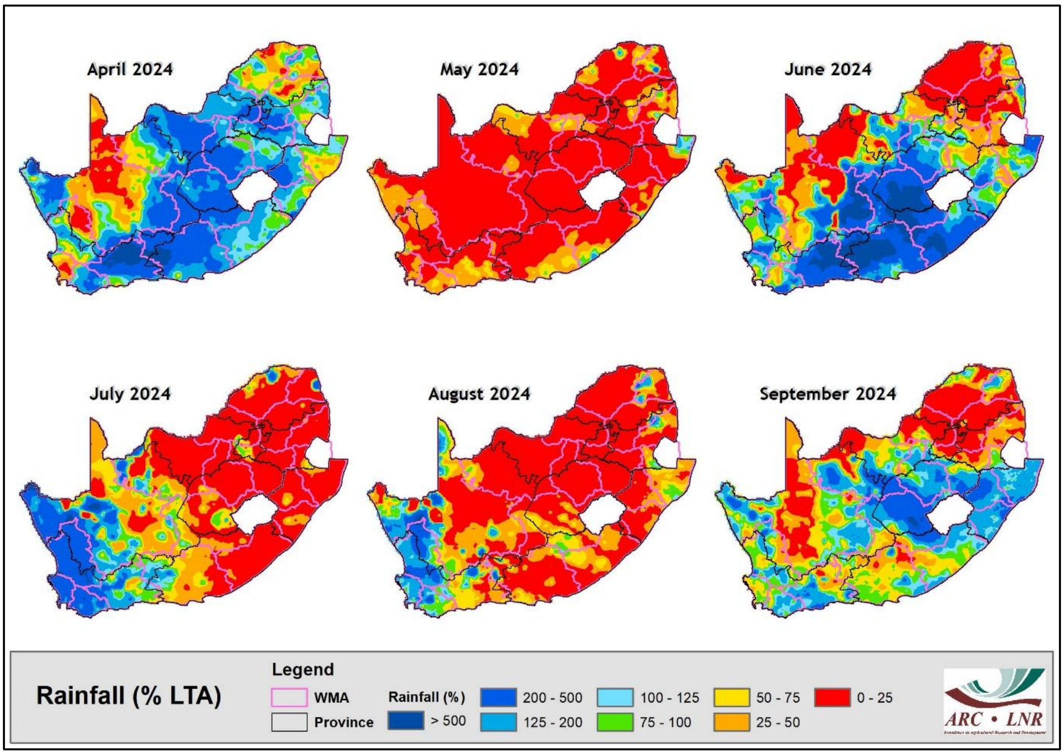


Figure 3.9 Rainfall (percentage of long-term average) per month as indicated for April to September 2024

Considering the monthly rainfall expressed as a percentage of the long-term mean during the 2023/24 hydrological year, a number of months stand out as being largely dry across the country. Over the summer rainfall region, November 2023, February 2024 and March 2024 were dry compared to the long-term average, with most of the interior receiving below 75% of the long-term average and substantial areas receiving less than 50% of the long-term average during these months. There were, however, also periods with above-average rainfall over the interior, with large parts receiving above-average rainfall in total during December, January and April. It was especially during December when extensive areas received above-average rainfall, with large parts of the interior receiving more than 200% of the long-term average. However, the contribution during the relatively wet months was insufficient, and the eventual outcome was below-average rainfall over most of the interior, as indicated earlier.

Over the winter rainfall region, rainfall was above average during most of the months from April to September. Above-average rainfall occurred, especially during July over the larger winter rainfall region and further inland over the western parts of the country. The only month during this period that was relatively dry over the winter rainfall region was May 2024, a month during which almost the entire country was dry and relatively warm.

The long-term total rainfall anomalies from the hydrological year 1922 – 2023 are presented in Figure 3.15 per water management area. The following classes were used: less than 75% is a dry year, 76-125% is a normal year, and greater than 125 % is a wet year. The Berg-Olifants, Breede-Gouritz, Mzimbvubu-Tsitsikamma and Olifants WMA have experienced a wet hydrological year. Other water management areas experienced a normal year, with no WMA, and experienced a dry year across the country.

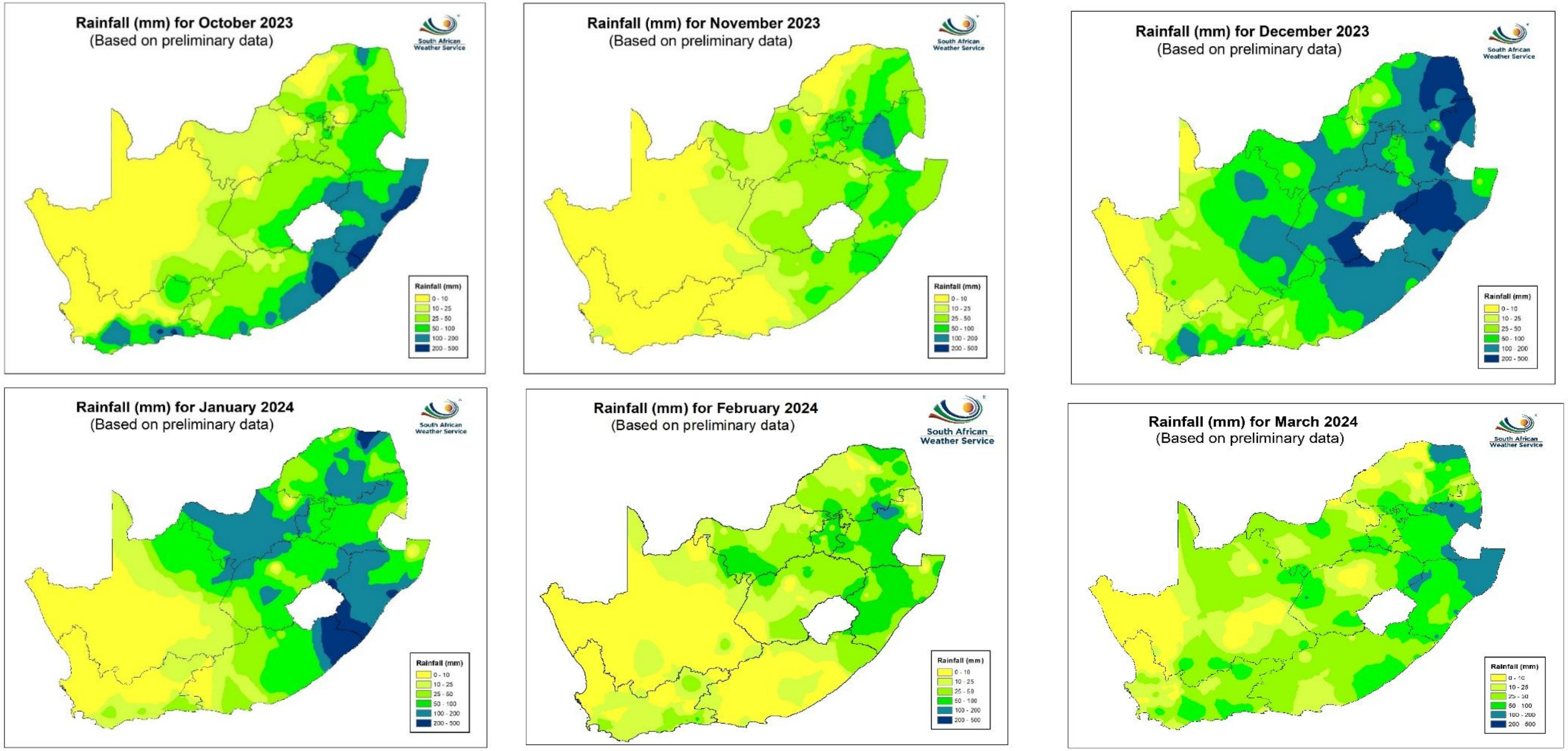


Figure 3.10 Summer season monthly rainfall distribution for October 2023 to March 2024 (Source: SAWS https://www.weathersa.co.za/home/historicalrain)

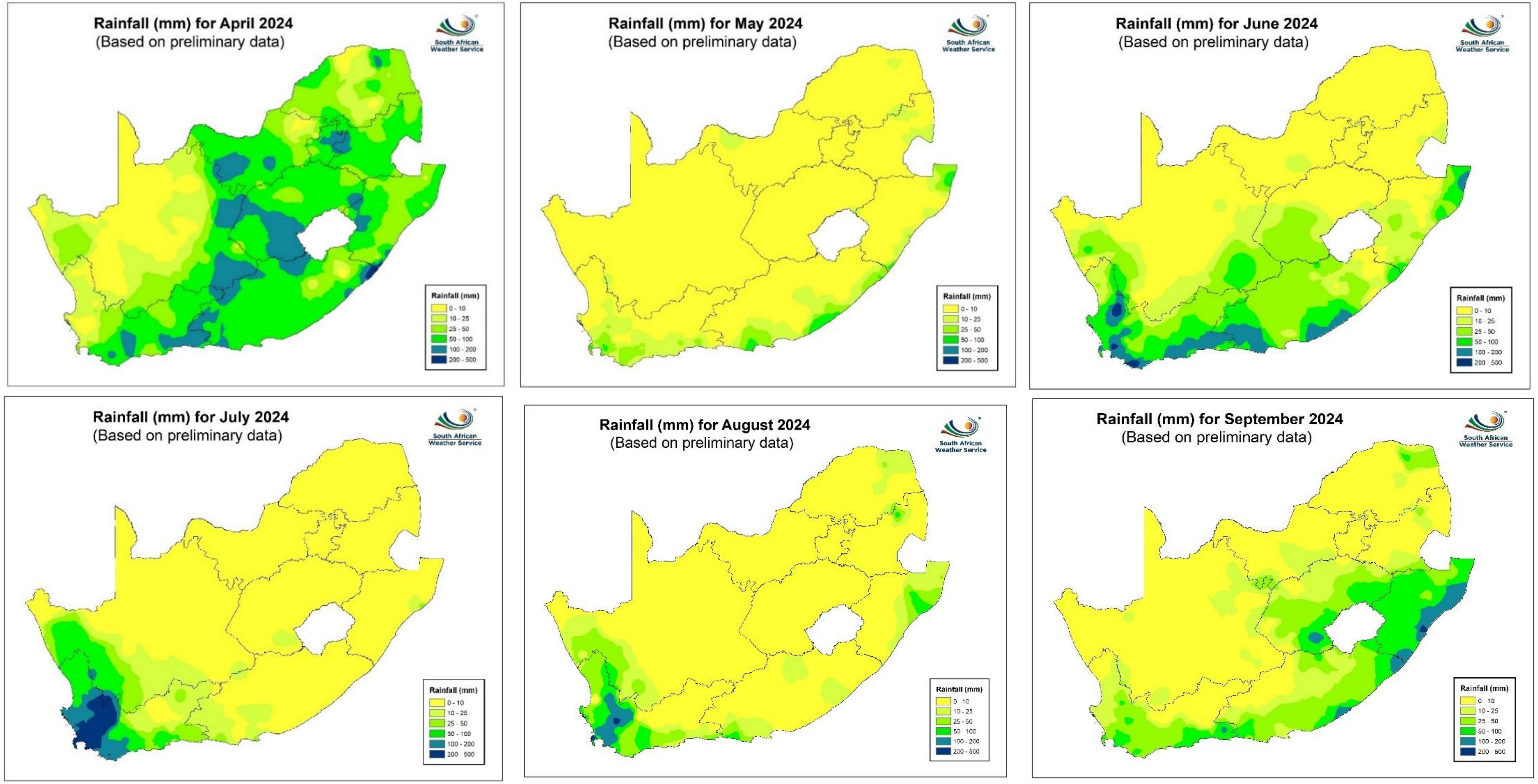


Figure 3.11 Winter season monthly rainfall distribution for April to September 2024 (Source: SAWS https://www.weathersa.co.za/home/historicalrain

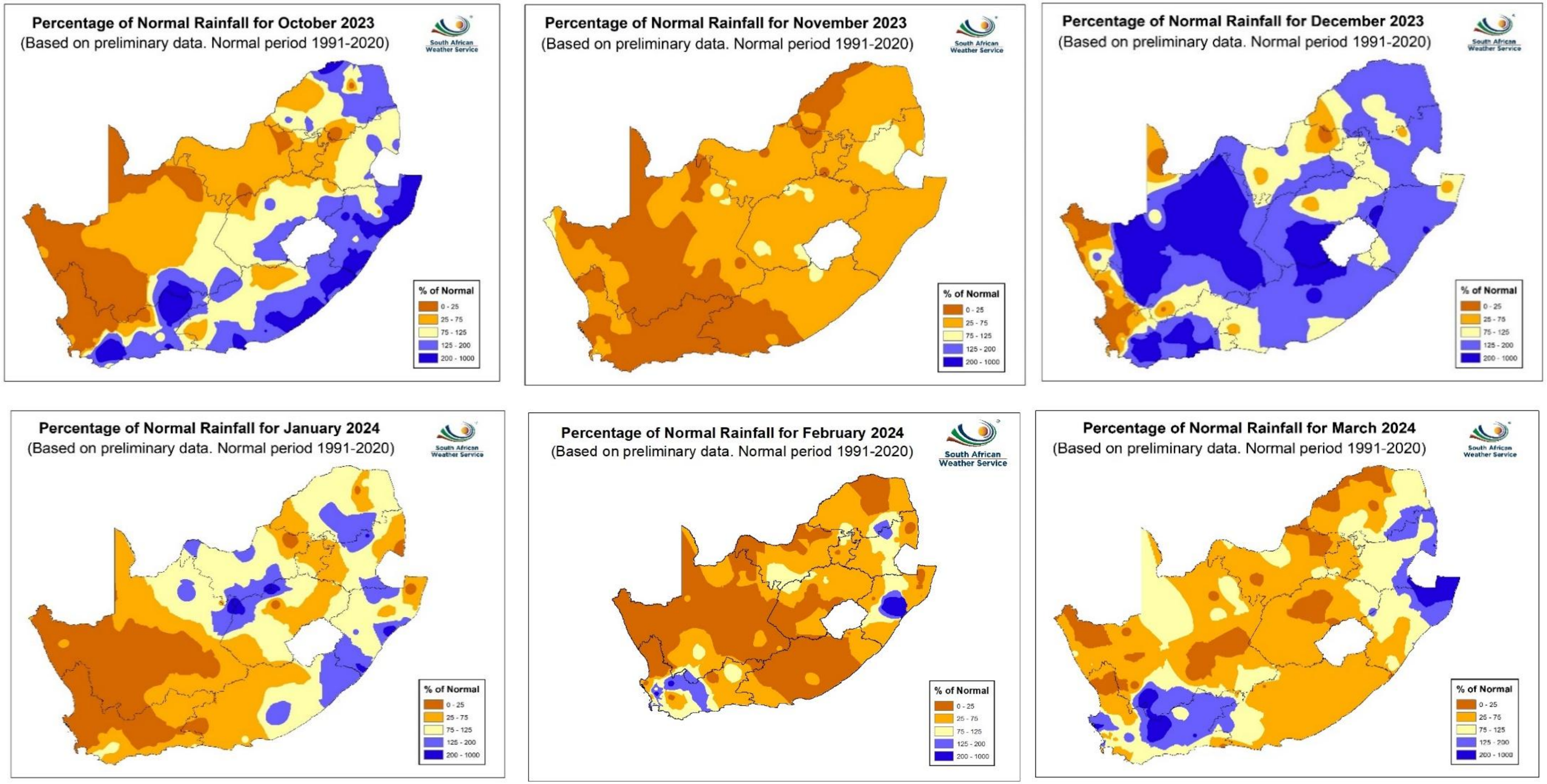


Figure 3.12 Summer season Percentage of normal rainfall for October 2023 to March 2024. Blue shades are indicative of above-normal rain, and the darker yellow shades of below-normal rainfall (Source: SAWS https://www.weathersa.co.za/home/historicalrain)

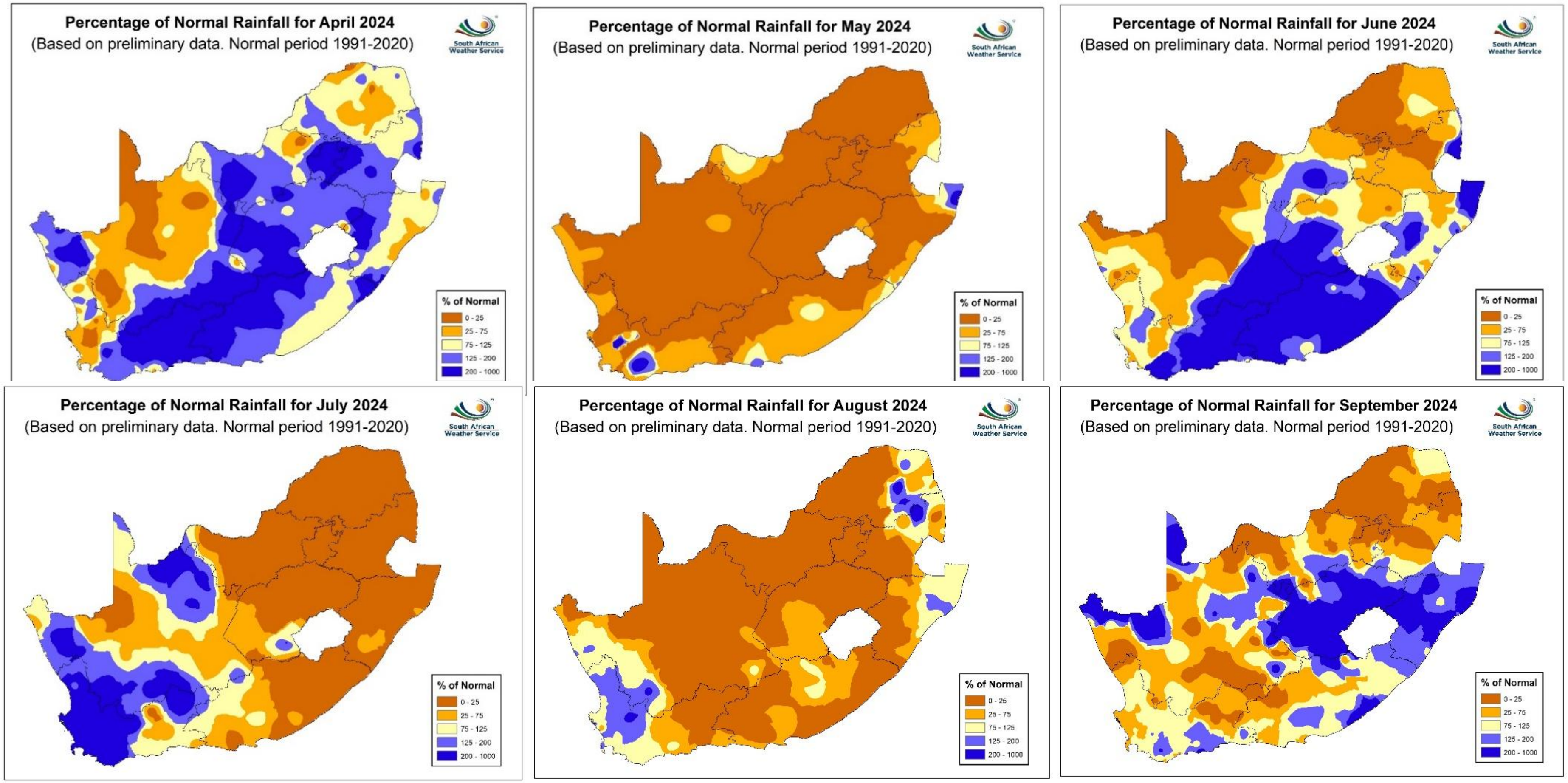


Figure 3.13 Winter season percentage of normal rainfall for April to September 2024. Blue shades are indicative of above-normal rain, and the darker yellow shades of below-normal rainfall (Source: SAWS https://www.weathersa.co.za/home/historicalrain)

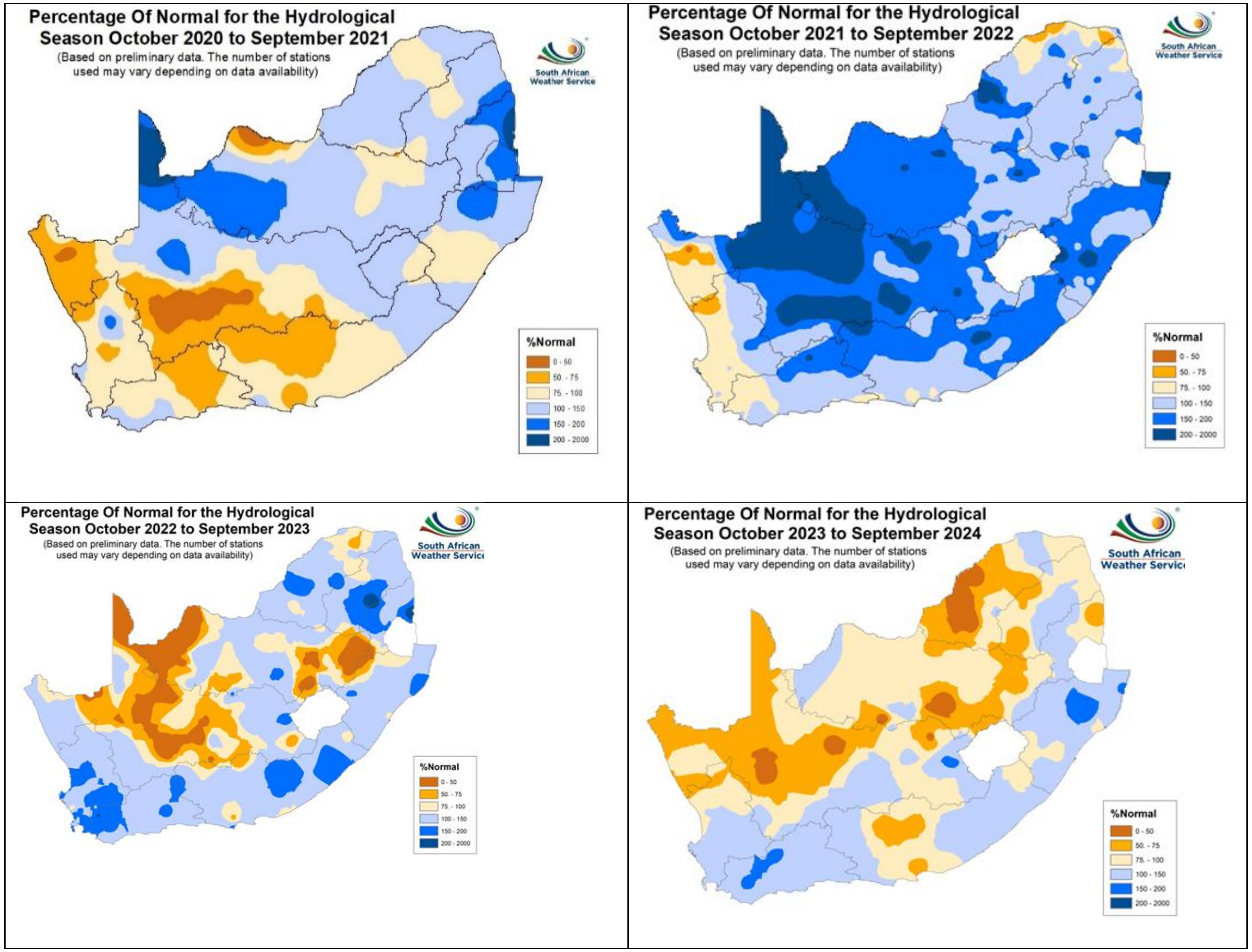


Figure 3.14: Percentage of normal rainfall for 2021/22, 2022/23 and 2023/24 Hydrological period. Blue shades are indicative of above-normal rain, and the darker yellow shades of below-normal rainfall (Source: SAWS https://www.weathersa.co.za/home/historicalrain

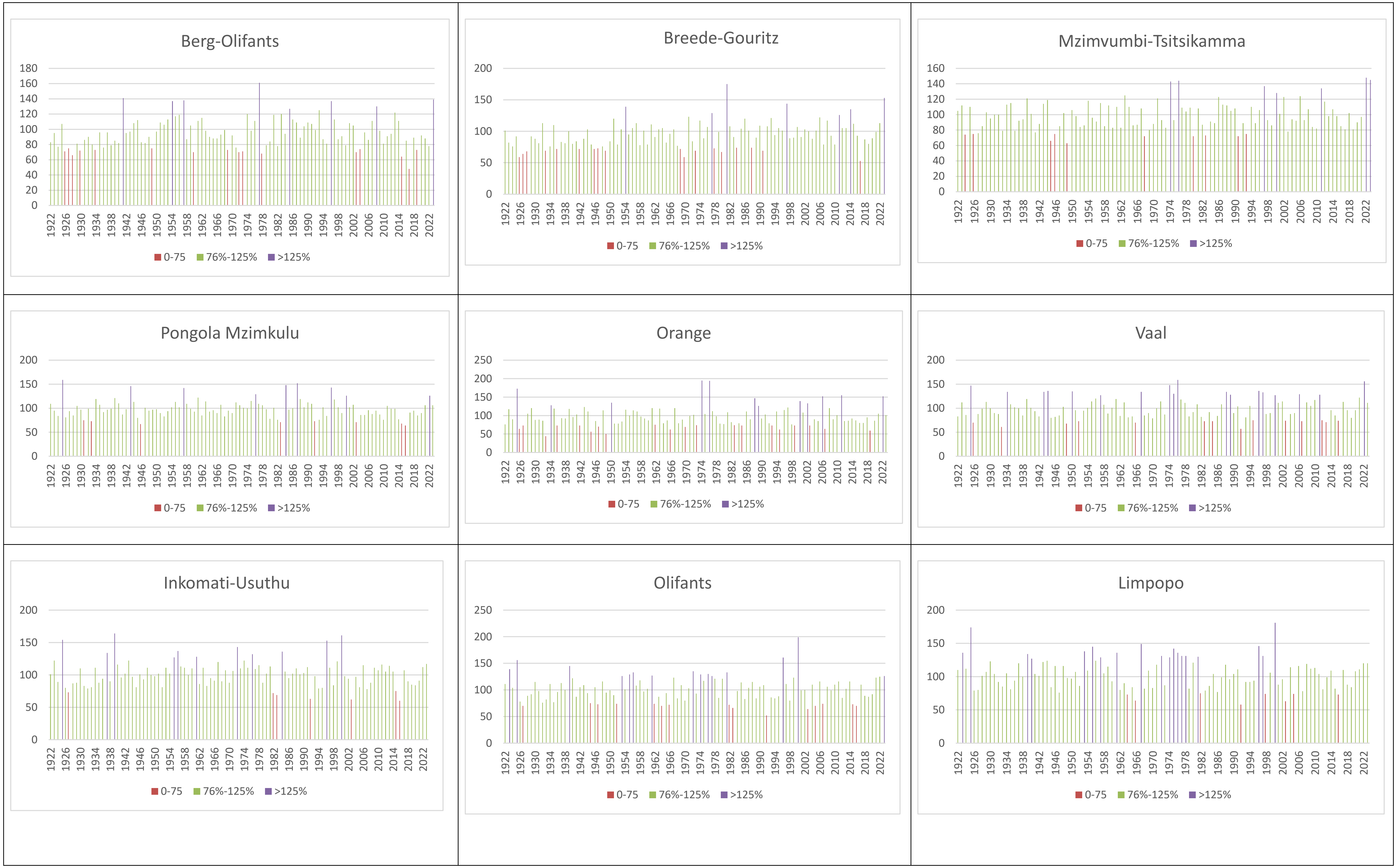


Figure 3.15: Hydrological year long-term trends of Rainfall Anomalies: > 125% (wet) & < 75% (dry) (Data Source: SAWS)

3.3 Potential Evapotranspiration

Figure 3.16 shows the total Potential Evapotranspiration (PET) calculated from observed weather data for the 2023/24 hydrological year. The PET for the hydrological year follows the typical distribution with the highest totals over the warmer, drier northwestern parts of the country, exceeding 1 700 mm and lowest values over the coastal areas in the south and south-east, including the Garden Route, where the total PET for the 12-month period was lower than 1000 mm in general and in isolated areas lower than 900 mm.

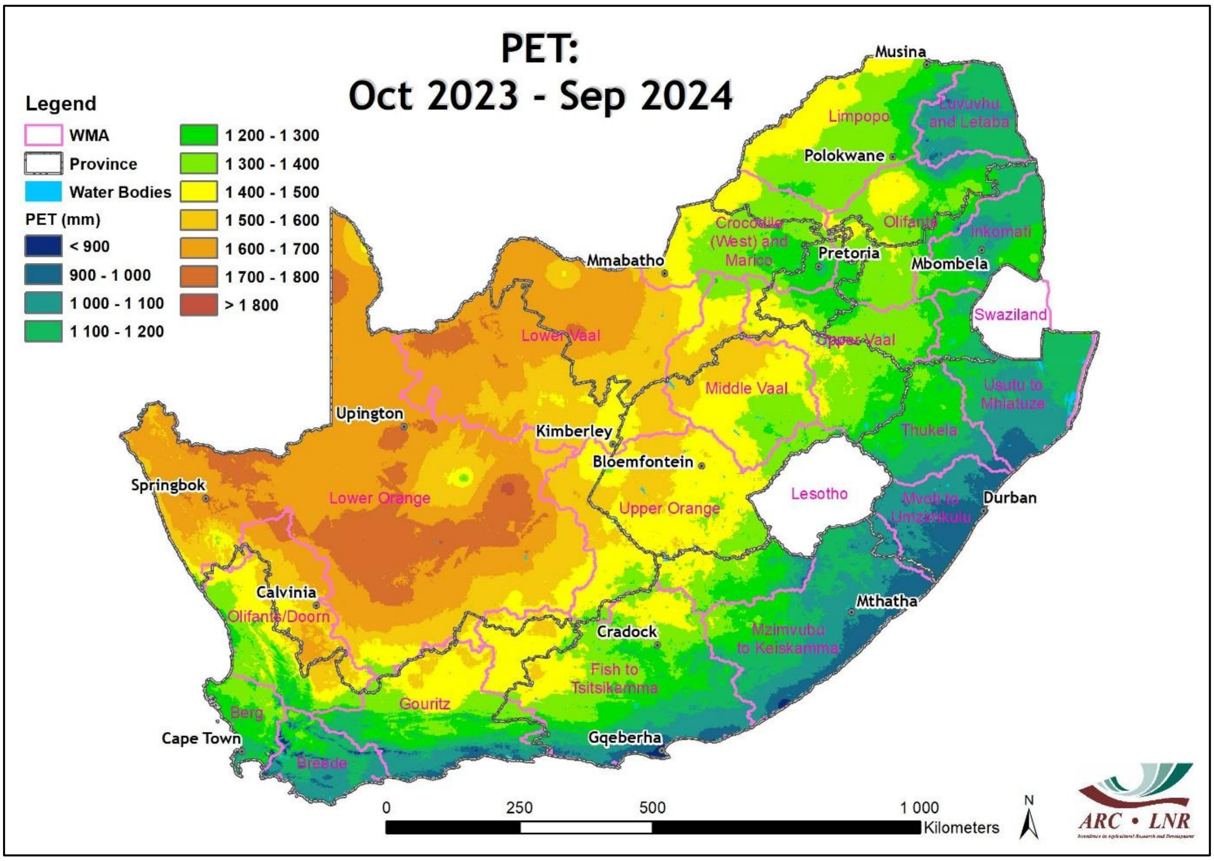


Figure 3.16: Potential Evapotranspiration (PET - mm) for the 2022/23 hydrological year.

In total, PET values were higher than the long-term average only over parts of the Northern Cape as well as along the south-eastern to eastern escarpment and Eastern Highveld (Figure 3.17). PET was lower than the long-term average, especially in the central interior and extreme northeast.

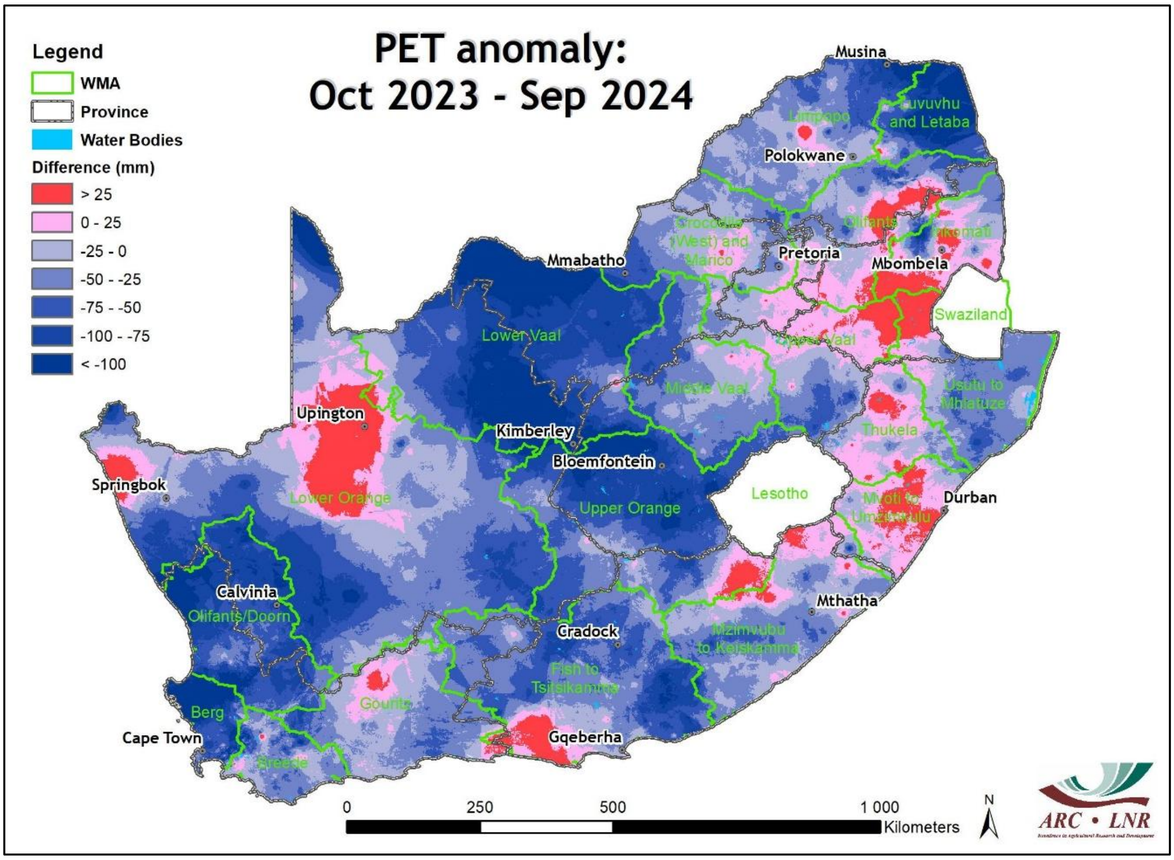


Figure 3.17: Difference (mm) in total Potential Evapotranspiration (PET) for the 2022/23 hydrological year with the long-term average (2022/23 total minus the long-term average value).

3.4 Indicators of Drought

The classification of meteorological drought is based on precipitation's departure from normal (long-term average) over time. Hydrological drought refers to deficiencies in surface and subsurface water supplies due to prolonged meteorological drought. It is measured using indicators derived from streamflow, dam storage levels, and groundwater levels. When precipitation (mostly rainfall in the context of South Africa) is low for a long time, it is reflected in a decline in surface flow and storage and subsurface water levels (soil moisture and groundwater).

3.4.1 Standardised Precipitation Index

The Standardised Precipitation Index (SPI) is an index based on the probability of rainfall for any time scale and can assist in assessing the severity of any drought. The 12- and 24-month SPI maps indicate areas where prolonged droughts exist, in other words, where below-normal rainfall occurred over one year or longer.

The Standardized Precipitation Index (SPI) for the 2-year period ending by September 2024 (Figure 3.18) shows that drought over this longer time scale was virtually absent, with limited areas over the interior experiencing moderate drought. Over the interior, this is linked to the protracted La Niña period, of which the October 2022 – September 2023 period was still a part of and during which widespread above-normal rain still occurred. An area in Lower Orange experienced moderate to severe drought, while moderate drought also occurred in isolated areas over the north-eastern parts of South Africa. Most of the winter rainfall region was moderately to severely wet during this 2-year period, with moderately wet conditions also dominating along the southern escarpment from the winter rainfall region up to Lesotho.

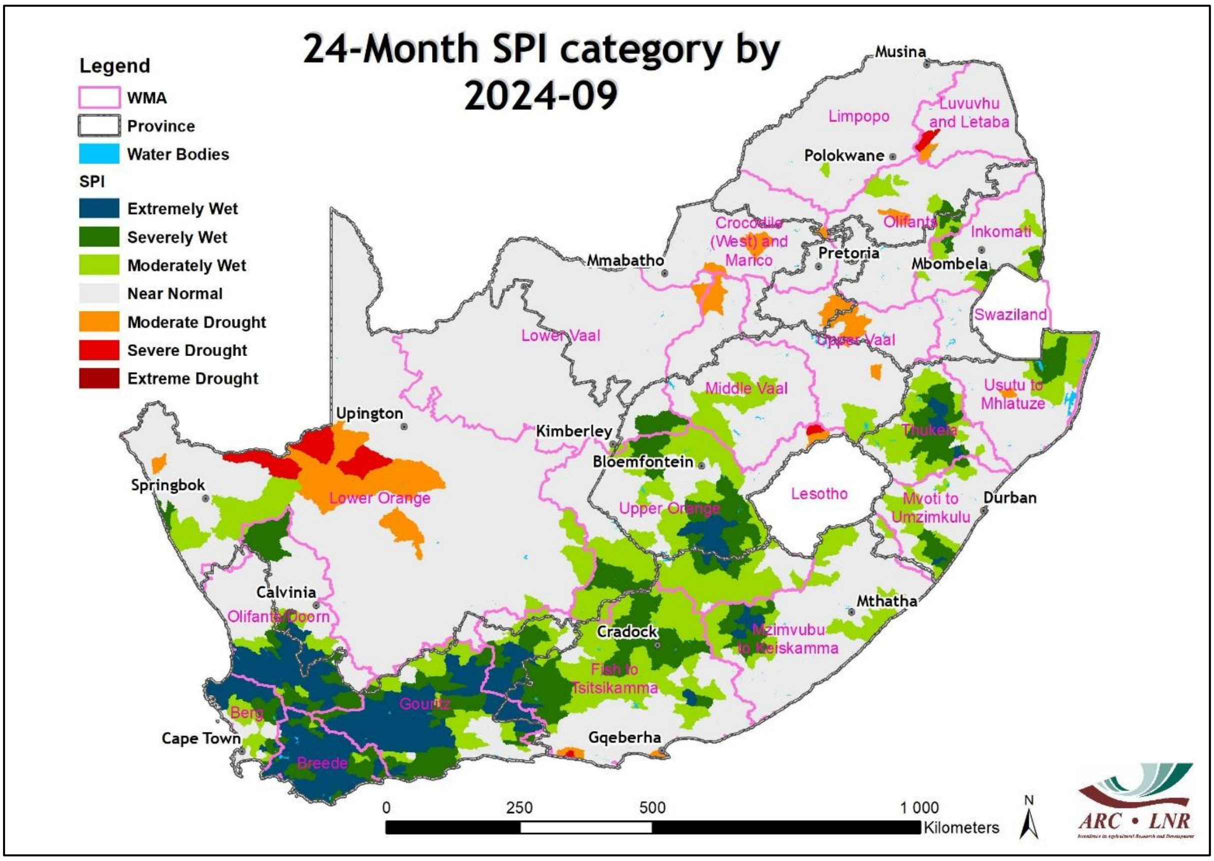


Figure 3.18: 24-Month Standardized Precipitation Index (SPI) by September 2024.

The 12-month SPI (Figure 3.19), which covers the 2023-2024 hydrological year only, shows substantially drier conditions over the interior at this shorter time scale. With the El Niño-associated below-normal rainfall over the interior, large areas in the north-east experienced moderate to severe drought. Water Management Areas where a majority of quaternary catchments experience moderate to severe drought include the Upper Vaal and Crocodile Management Areas.

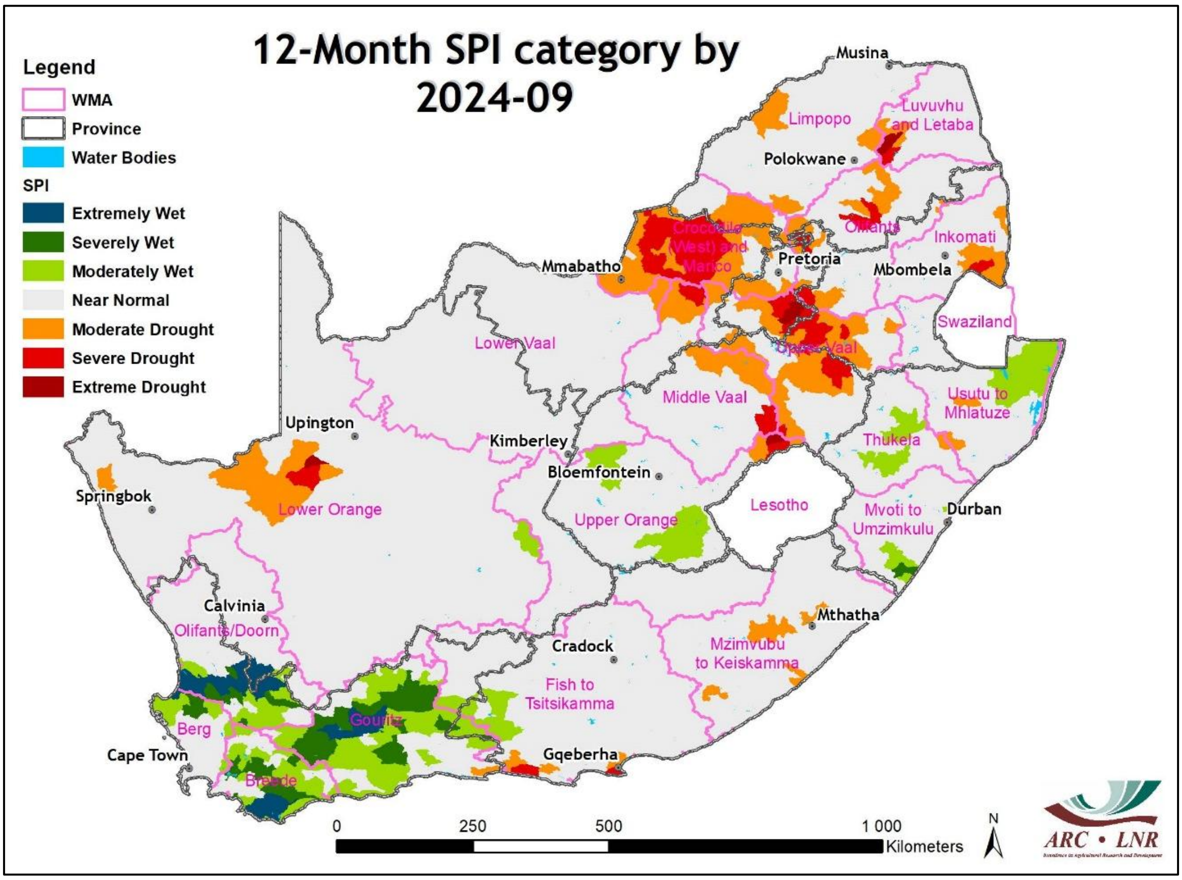


Figure 3.19: 12-Month Standardized Precipitation Index (SPI) by September 2024.

The time series of the 12-month SPI, summarised by WMA, is given in Figure 3.20 for the period 2015–2024. Drier and wetter multi-year periods are shown in the time series. The general trend in all catchments during the 2023/24 hydrological year was downward.

Regional patterns during the last decade include the following:

- Most of the country (north-eastern catchments, central to western and eastern to south-eastern catchments) experienced wetter periods around 2017 and then again during the 2021-2023 period. Drier periods, with widespread drought, occurred during the 2015-2016 period as well as the 2018 – 2020 and, more recently, during the second half of the latest hydrological year (2024).
- The south-eastern, southern and south-western catchments, including the winter rainfall region, experienced regular drought conditions from 2015 to 2020 (Berg WMA, Olifants WMA). Further east, the drought period only started in 2017. This entire region has been relatively wet since 2022.
- The 12-month SPI over the southern catchments has been on a downward trajectory throughout the 2023/24 hydrological year. This followed a peak over the winter rainfall region and in the south by late 2023 and a peak over the south-eastern parts by late 2022/early 2023.

- The El-Niño-related drought over the interior resulted in a downward trend in the 12-month SPI over much of the central to northern interior also following a peak in late 2022/early 2023.

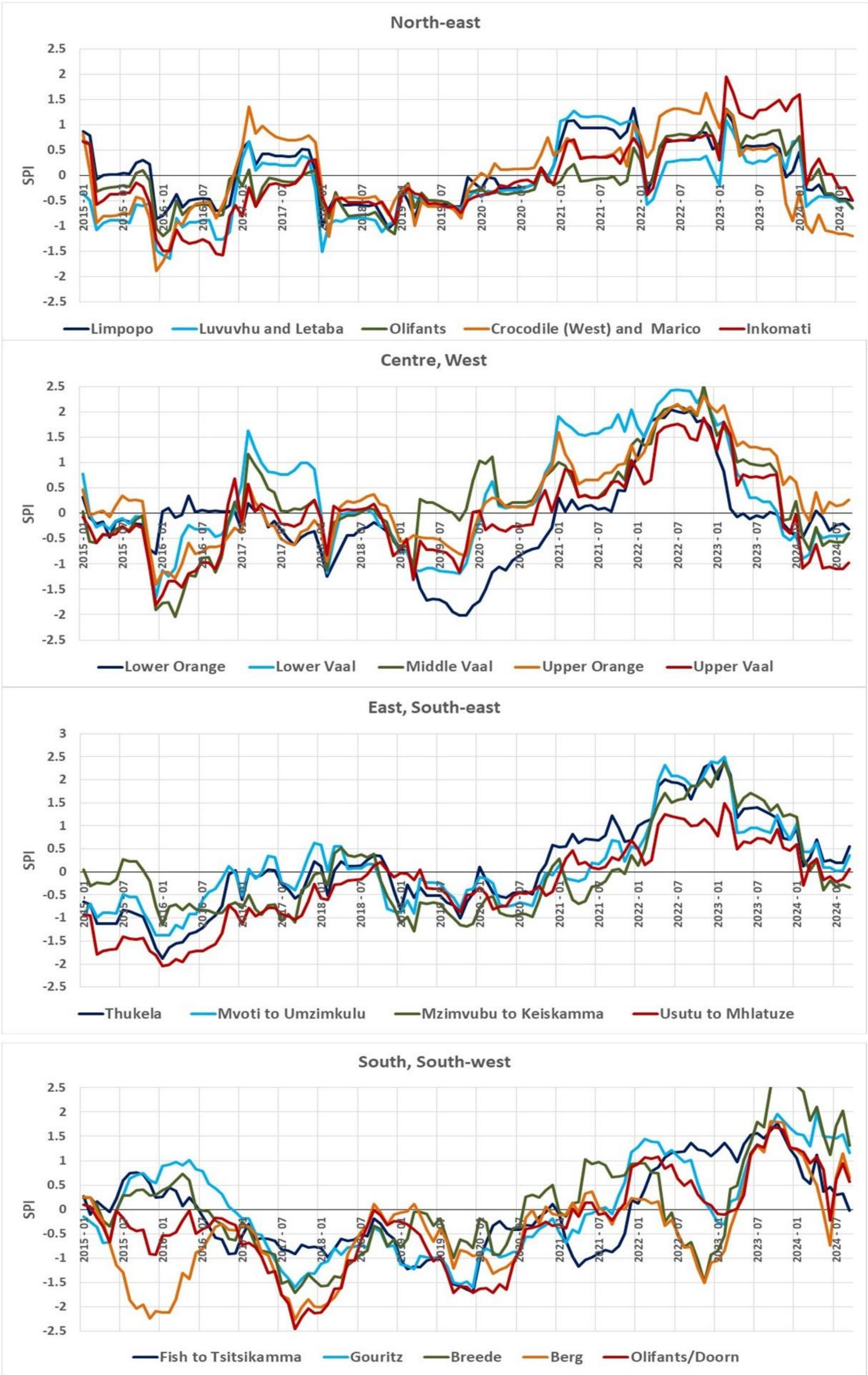


Figure 3.20: 12-Month SPI, per WMA as indicated, for the North-east (top), central to western parts (upper-middle), eastern to south-eastern parts (lower-middle) and

southern to south-western parts (bottom) of South Africa, for the period 2015 – 2024.

3.4.2 Vegetation activity

Figure 3.21 shows the cumulative vegetation activity, as represented by the cumulative Normalized Difference Vegetation Index (NDVI), expressed as a percentage of the long-term average (Percentage of Average Seasonal Greenness – PASG) calculated over the entire 2023/24 hydrological year.

Cumulative vegetation activity, as represented by the PASG, was above average during the 2023/24 hydrological year over the southern to southwestern parts of the country, including the winter rainfall region where above-normal rain occurred during both the 2023 and the 2024 winter. Cumulative vegetation activity was near normal over most of the rest of the country, linked partially to the heterogeneous nature of the summer rainy season that formed part of the 2023/24 hydrological year with alternating wet and dry periods. The northern half of the Lower Orange Water Management Area is an extensive region with below-average cumulative vegetation activity.

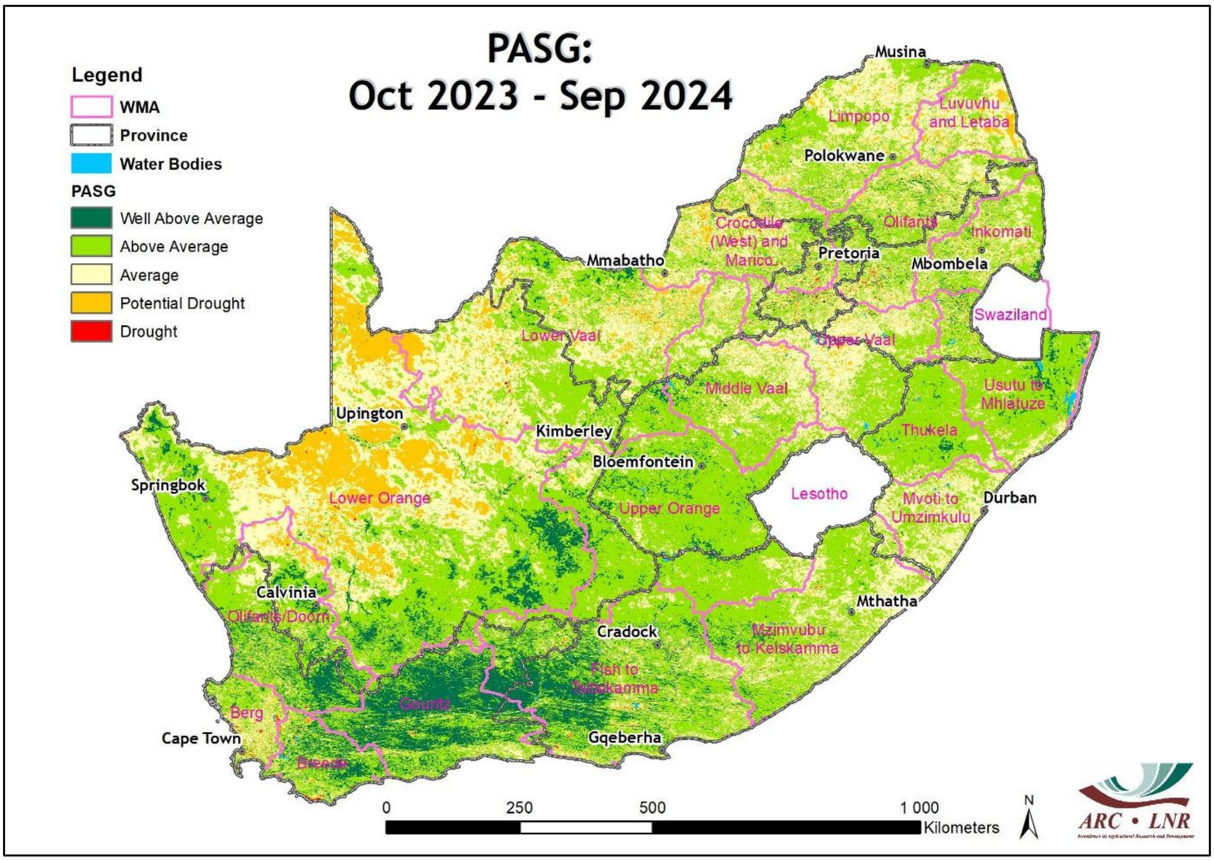


Figure 3.21: Percentage of Average Seasonal Greenness (PASG) for the 2022/23 hydrological year.

3.5 Extreme Weather Events

March also falls within the tropical cyclone season, with the forecast for the season projecting below-normal cyclone activity. However, there was still a chance for a tropical cyclone system to affect the sub-continent. This materialised when severe Tropical Storm Filipo affected South Africa in mid-March 2024. Tropical Storm Filipo made landfall north of Vilanculos, Mozambique, on the evening of 11 March, with average wind speeds of 100 km/h (Figure 3.22). After that, Filipo moved across the southern parts of Mozambique as a post-tropical depression and caused widespread heavy rainfall and flooding. The extreme north-eastern parts of South Africa, particularly the extreme southern Lowveld (Komatipoort) and the extreme north-eastern parts of KwaZulu-Natal, received more than 100 mm of heavy rainfall.

Figure 3.22: Tropical Storm Filipo's position 12 March 2024. Source: Eumetsat, 2024

3.5.1 Extreme Rainfall and Temperature Events from October 2023 to September 2024: Implications for Water Resources

From October 2023 to September 2024, the South African region experienced numerous extreme weather events, with hazardous impacts. Some of these are discussed as examples below, including a heatwave from 19-28 November 2023, a heavy rainfall event from 1-5 June 2024), and a mid-summer drought event from 15 January to 25 March 2024 (Figure 3.23). These events placed significant pressure on water resources, with cascading effects on agriculture, infrastructure and other resources, highlighting the South African region's vulnerability to extreme weather events. Given these challenges, this section draws on ARC weather station observations and reported impacts to examine these events and their effects, particularly for regional water resources, considering water availability, quality, and management.

3.5.2 19-28 November 2023 heatwave event

During the warmest November globally since 1850, a prolonged 10-day heatwave (19–28 November 2023) influenced all regions of South Africa. In the media (Omarjee, 2023), the South African Weather Service (SAWS) reported that this event was associated with record-breaking maximum temperatures, which were observed at roughly 21 weather stations, spread in the Northern Cape, Eastern Cape, Free State, North West, Limpopo and KwaZulu-Natal provinces. On 27 November, which was the hottest day of the heatwave and the day when most temperature records were broken, the SAWS reported that the Northern Cape Augrabies region recorded the highest observed daily maximum temperature during the heatwave, which was the location's highest ever observed daily maximum November temperature Figure 3.23.

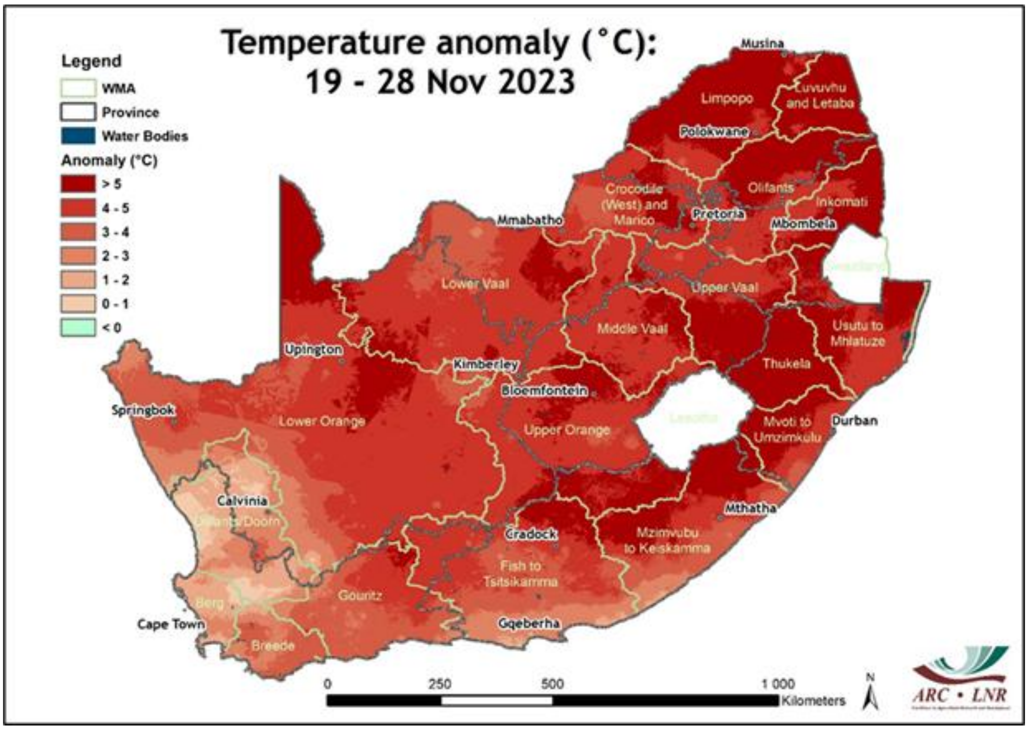


Figure 3.23: Map of average daily maximum temperature anomalies recorded for 19-28 November 2023.

In addition to these very warm temperatures, the long-lasting nature of this event contributed to its severity and extreme nature. This event occurred during a strong El Niño event, which, coupled with ongoing warming, likely contributed to the intense and long-lasting nature of this event, given that heatwaves across South Africa tend to be longer-lasting and more intense during El Niño events.

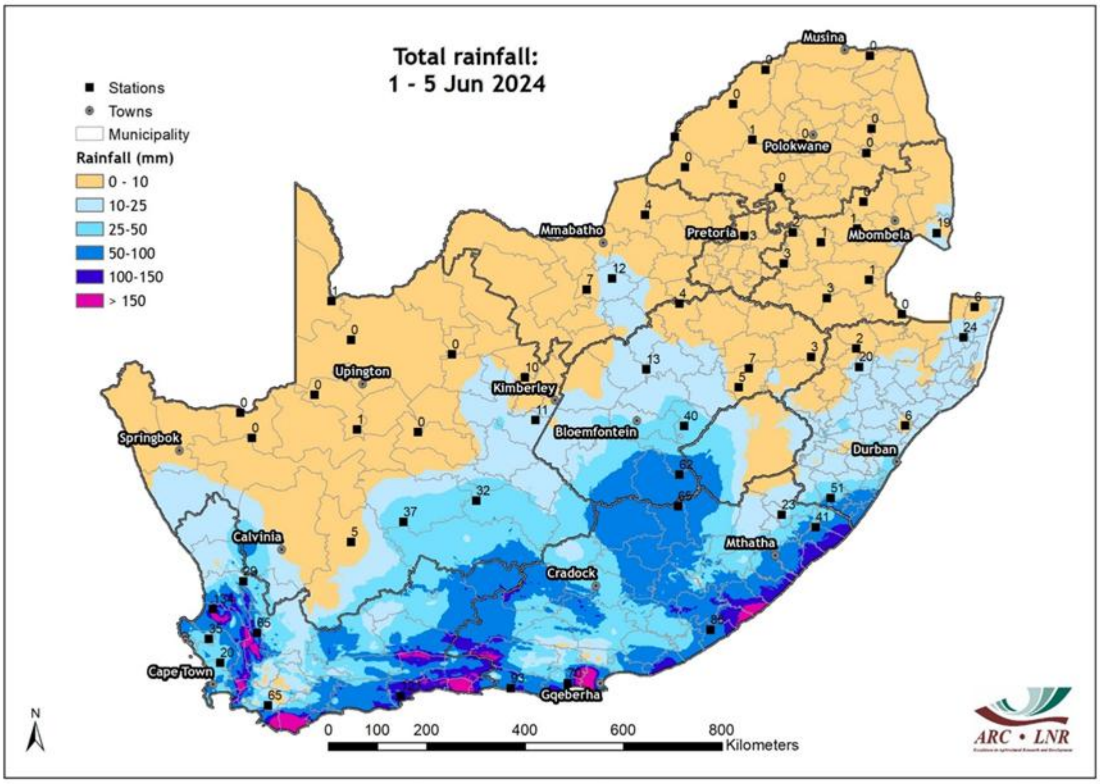
Although this heatwave notably impacted all regions of South Africa, the ARC weather station network observations reflect that anomalous above-normal temperatures were at varying degrees over South Africa. The highest anomalies reached approximately 5°C above normal, occurring over parts of central, northern and eastern South Africa, whereas, over far western regions of the country, above-normal temperature anomalies were below 4°C. These above-normal temperatures were likely driven by a stronger-than-normal mid-level high-pressure system causing air to warm and subside, coupled with a near-normal strength near-surface level trough, which pulled warm air from higher latitudes to South Africa. Such conditions typically cause intense, long-lasting heat waves over South Africa.

According to the December 2023 ARC Umlindi newsletter issue (ARC, 2023), drier-than-normal conditions were observed for November 2023 – this, coupled with the hot temperatures that occurred throughout the heatwave duration, would have notably influenced water resources over SA. Therefore, despite the level of above-normal temperatures, all regions of the country likely experienced water challenges in terms of water availability for drinking, household, industrial and agricultural use. For instance, in the key water management area of the Upper Vaal, temperature anomalies of roughly 4-5°C likely accelerated evaporation and evapotranspiration, reducing water availability in the Vaal dam surface water reservoir, which was 13% lower than during November 2023 (Mafenya et al., 2023) – water availability in many other key reservoirs would have also been notably impacted. This likely also reduced the quantity of available water that could be used for drinking, household, agricultural, and industrial use.

The heatwave also contributed to a surge in water consumption, which placed considerable strain on water supply systems. In an area such as Johannesburg, residents were urged to use water sparingly to prevent system overloads (Sithole, 2023). Even the City of Ekurhuleni, for example, noted a strain on its water supply system due to the high temperatures – officials had urged residents to use water sparingly to reduce pressure on the municipality water system (City of Ekurhuleni, 2023). Moreover, even soil water availability would have been compromised by the prolonged period of above-normal temperatures, negatively impacting water availability for farming activities. Hence, from a reduction in water availability to increases in water demand and stresses on water infrastructure, this November 2023 heatwave had notable impacts on South Africa’s water resources, underscoring the current broader challenges to South Africa’s water security posed partly by increasing temperatures.

3.5.3 1-5 June 2024 Heavy precipitation event

From 1-5 June 2024, many southwestern, southern and southeastern regions of South Africa experienced heavy precipitation, with up to roughly 50-300 mm of rainfall accumulating (Figure 3.24). Above this, conditions were also cold, with an intense cold snap having occurred – this caused widespread frost over interior regions, while snowfall also occurred over some high-lying regions. Over many of the regions influenced by this event, winds were also reportedly quite strong. Having first persisted over southwestern regions, this event was caused by a deep, intense cold-cored cut-off low-pressure system, which extended to the surface as a low-pressure system – on 2 June, a cold front along with this surface low also contributed to some rainfall over southwestern regions. On 3 June, as the cut-off low (and surface low) persisted eastward, a band of thunderstorms developed. Some of these storms became so intense that they produced two tornadoes, which influenced and caused widespread damage to the Newcastle, Tongaat, and Utrecht areas in the KwaZulu-Natal province.



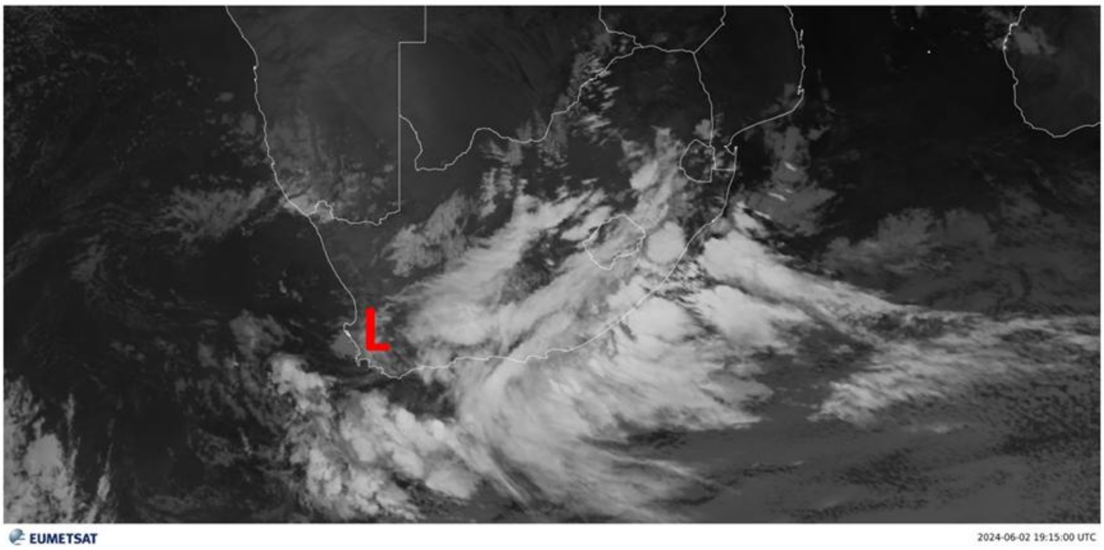


Figure 3.24 Map of the total daily rainfall amount recorded from 1-5 June 2024 (top) along with an EUMETSAT Meteosat black and white satellite image at 15:00 UTC on 2 June 2024 (bottom).

In the context of water resources in South Africa, this event brought both relief and new challenges. In terms of the former, the event contributed to providing relief and replenishment in soil moisture/water and surface water levels following the 2024 mid-summer drought as well as the generally dry conditions that persisted thereafter during April-May (as per the May and June 2024 ARC Umlindi newsletters; ARC, 2024e, f). However, in terms of new challenges and damage, the storm caused widespread infrastructure (housing, roads, bridges and irrigation, among other infrastructure) damage via wind and flood damage, which was mainly concentrated over the Eastern Cape province. The flooding caused at least six deaths, while several thousands of people were displaced and had to evacuate their houses due to the flood damage. This was particularly true in low-lying and informal settlements, where poor drainage systems exacerbated the crisis. In many of the Eastern Cape municipalities, the flooding led to dam level breaches (for dams including the Loerie, Wriggleswade and Nahoon dams), overflowing rivers and saturated soils. The flooding above caused extensive infrastructure damage, leading to a significant risk of potentially contaminated water, causing waterborne diseases, such as cholera. Additionally, the heavy runoff from the flooding also likely resulted in increased sedimentation in dams, reducing storage capacity and affecting water quality. This, in turn, complicated efforts to manage water resources effectively in regions still recovering from prolonged dry conditions.

This event underscored the increasing variability of rainfall patterns, with periods of extreme dryness followed by intense, short-lived downpours, making long-term water resource planning even more complex. As with the November 2023 heatwave and the 2024 mid-summer drought, the impacts of the June 2024 rainfall highlighted the urgent need for adaptive infrastructure, improved early warning systems, and more resilient water management strategies to mitigate both drought and flood risks in a rapidly changing climate.

Case study: Monitoring the January to March 2024 mid-summer drought

Drought is a significant climate-related hazard that poses substantial risks to agricultural productivity, water resources, and livelihoods on a global scale, including in South Africa. The Agricultural Research Council – Natural Resources and Engineering (ARC-NRE) developed the Agricultural Drought Early Warning System (ADEWS) to address these challenges. This web-based platform (https://www.drought.agric.za/) integrates multi-disciplinary datasets and indices specific to agricultural commodities, providing free access to real-time and forecasted drought data (Figure 3-25). The ADEWS enables users to monitor drought conditions, visualise and analyse spatial and temporal trends, and receive daily email updates about drought developments tailored to specific regions.

Figure 3.25 The user-interface of the Agricultural Drought Early Warning System (ADEWS).

The effectiveness of ADEWS was clearly demonstrated in monitoring the mid-summer drought event from 15 January 15 to 25 March 2024 (Figure 3.26). The ADEWS was utilised to track and assess the drought conditions during this period, which followed a heatwave in November 2023 and a period of near-normal to normal rainfall levels in December 2023, as noted in the January 2024 issue of the Umlindi newsletter (ARC, 2024a). The system allowed for detailed tracking of rainfall anomalies, with data showing widespread rainfall deficits across South Africa. Central, northwestern, southern, and northeastern regions, in particular, received less than 75% of the long-term average rainfall, with some areas facing deficits of less than 50% (Figure 3.26). According to the February-April 2024 issues of the Umlindi newsletter (ARC, 2024b, c, d), the February period was especially dry. This resulted in extended dry spells, with many regions experiencing little to no rainfall for consecutive weeks. These conditions led to a substantial reduction in soil moisture, severely impacting agricultural production.

The occurrence of this mid-summer drought was driven by large-scale atmospheric circulation patterns, including higher-than-normal geopotential heights at the 850 hPa level, which contributed to suppressing convection and reducing moisture availability. Moreover, a stronger-than-normal mid-level high-pressure system further inhibited cloud development and rainfall, reinforcing dry conditions. Typically, such patterns are associated with subsidence, warming, and drying, creating an environment unfavourable for rainfall events. These atmospheric anomalies co-occurred with a moderate to strong strength El Niño event, which is typically lined to drier-than-normal mid-summer conditions over much of South Africa – together, these conditions contributed to the occurrence of this drought while also intensifying the severity of the drought. A report by the World Weather Attribution group highlighted that this El Niño event was a particularly strong driver of this mid-summer drought (Kimutai et al., 2024), and it also highlighted that such El Niño induced droughts are becoming increasingly likely as the planet warms. Additionally, the persistence of heatwave conditions during most of February and March 2024 further compounded the drought's severity, exacerbating the soil moisture deficits and extending the dry spell (Evans, 2024).

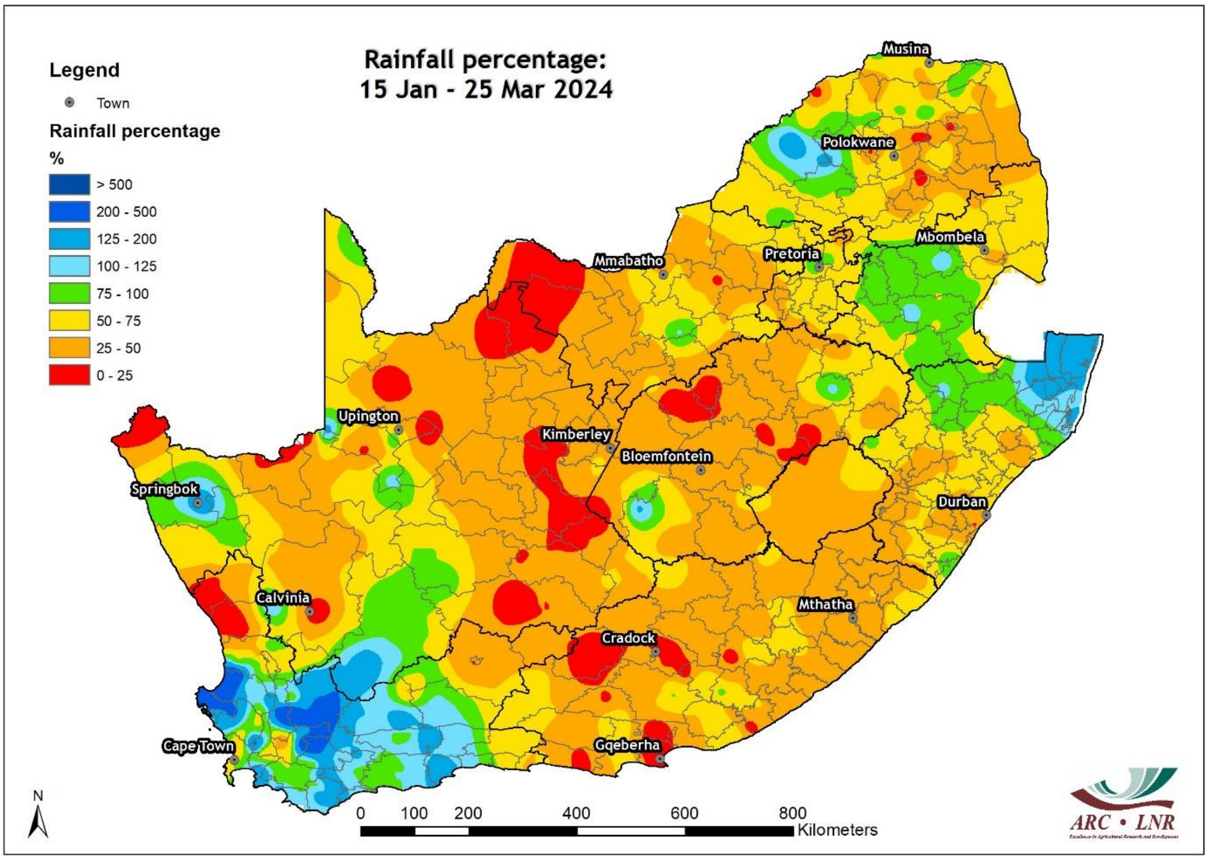


Figure 3.26: Map of the daily rainfall anomalies, represented as a rainfall percentage with respect to the long-term mean rainfall, for 15 January to 25 March 2024.

For dryland farmers, the drought posed significant challenges, especially during critical growth stages for crops. Preliminary reports indicated a 20% decrease in grain and oilseed yields compared to the previous season, underscoring the extent of the losses caused by the drought (Sihlobo, 2024). The lack of rainfall, combined with persistently warm temperatures, exacerbated the moisture deficits, further straining crops already vulnerable to water scarcity. In addition to dryland farming challenges, irrigation-dependent farmers also faced difficulties as surface water resources became increasingly scarce. The reduction in surface water availability due to below-normal rainfall levels and the depletion of reservoirs raised concerns about the availability of water for irrigation and other uses. Considering the DWS monthly state of water bulletin reports for March and April 2024 (Mafenya et al., 2024a, b), surface water reservoir levels in most South African provinces were reported to be up to 7.4% lower than the normal levels observed in March 2023 and previous months. This significant decrease was attributed to higher evaporation rates resulting from above-average temperatures, compounded by the reduced rainfall during the drought period. As a result, many farmers were forced to adapt by seeking alternative water sources, implementing water-saving irrigation techniques, or reducing the areas planted in order to conserve water. However, these adaptations often led to further declines in crop yields, contributing to significant financial strain on farming communities.

Overall, the mid-summer drought of early 2024 underscores the growing vulnerability of South Africa's agricultural and water systems to climate variability. The combination of heatwaves, reduced rainfall, and prolonged dry spells places increasing pressure on water resources, agricultural production, and livelihoods. Addressing these challenges requires enhanced resilience through improved water resource management, climate-informed agricultural practices, and adaptive measures to mitigate the impacts of future droughts and heat waves. The importance of early warning systems and proactive response strategies will only continue to grow as South Africa navigates an increasingly uncertain climate future.

3.6 Floods

In December 2023, most parts of the country received rainfall, which was sufficient to improve surface water storage in some areas. However, the rainfall caused widespread havoc in KwaZulu-Natal, resulting in flooding. On 22 December 2023, the South African Weather Service (SAWS) issued a warning of an upper-air system that was expected to cause scattered to widespread showers and thundershowers in the Free State, North-West, KwaZulu-Natal, Gauteng, Mpumalanga, and Limpopo from Sunday (24 December) onwards, with the possibility of local heavy rainfall and cooler conditions.

According to the report, while isolated severe thunderstorms were expected over the central and south-eastern interior on Sunday (24 December 2023) and possibly into Monday (25 December 2023), the atmosphere was expected to eventually become tropical, allowing for locally heavier and widespread rainfall (SAWS, 2023). SAWS numerical weather models predicted 15-30 mm of rainfall across much of the eastern country from Sunday to Monday (Figure 3.27).

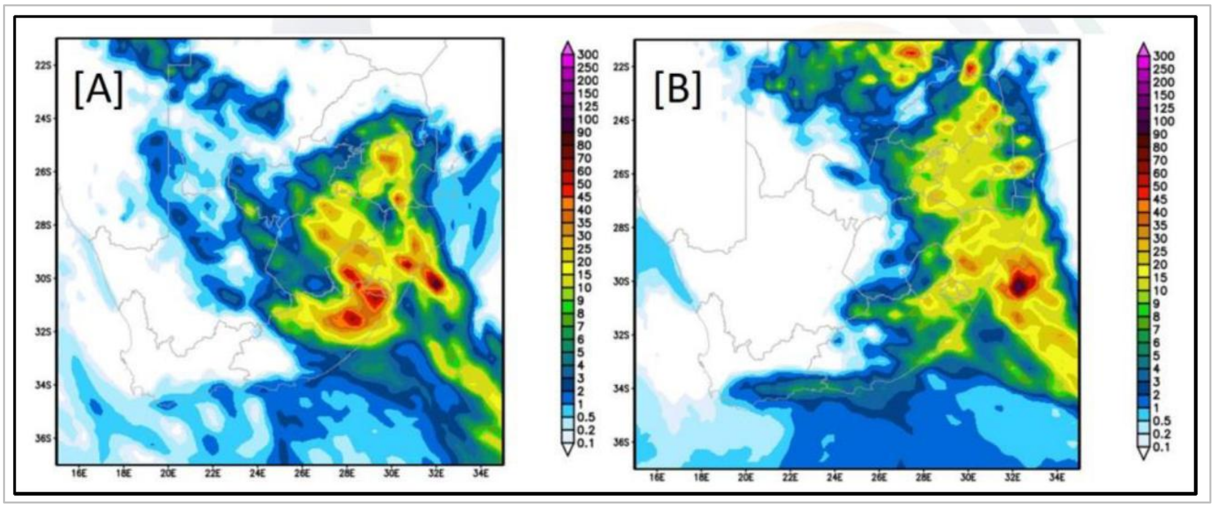


Figure 3.27 24-hour rainfall accumulation (mm) for Sunday, 24 December 2023 (A), Monday, 25 December 2023, as predicted by the Global Forecast System (GFS) (Source, SAWS).

SAWS later issued a yellow level 2 warning for severe thunderstorms and disruptive rain for the province on the 24th and 26th of December 2023, respectively (Figure 3.27). On Christmas Eve (24 December 2023), heavy rains and severe thunderstorms intensified, causing flash floods in the northwestern parts of the province. Figure 3.28 shows that the province received accumulated rainfall ranging from 100 to 200mm in most areas, with the northwestern parts receiving 200 to 500mm in December 2023.

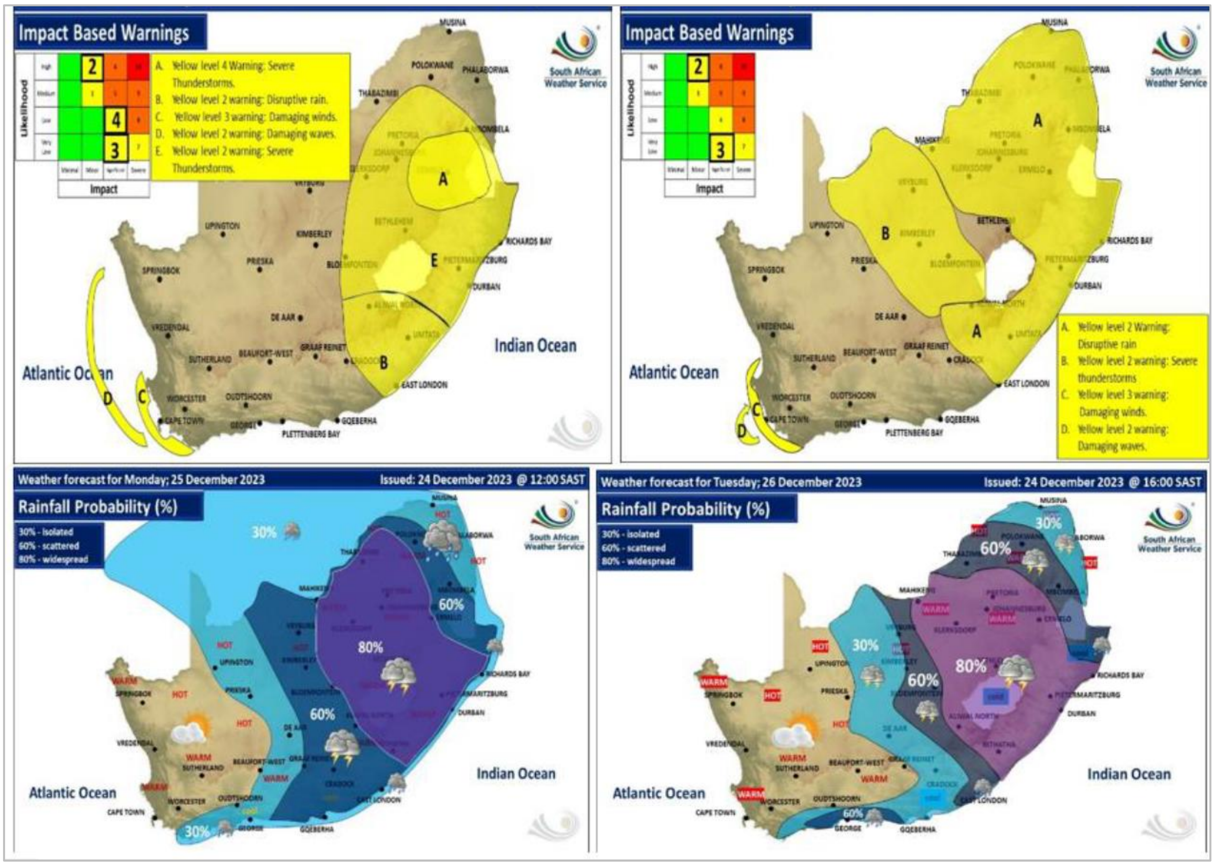


Figure 3.28 Severe weather warnings and rainfall predictions for 25 and 26 December 2023.

These heavy rains caused widespread destruction, affecting households, businesses, and public infrastructure such as schools, roads, and bridges (Figure 3.29). The UThukela District was severely affected, with 23 deaths reported during floods that hit Ladysmith on 24 December 2023 and more than 100 houses damaged.

On 24 December 2023, weather stations in the Ladysmith area reported approximately 60mm of rain within an hour, with approximately 80mm of rain falling over three hours. Strong winds also damaged over 40 homes in King Cetshwayo District, destroying several businesses in the Eshowe industrial area. By 31 December 2023, the number of fatalities from extreme weather conditions in KZN had risen to 31, with three people still missing. COGTA reported that over 600 households and over 140 dwellings were destroyed (COGTA, 2023).

Figure 3.29 Destruction caused by floods in Ladysmith, KZN.

On 7 January 2024, SAWS issued a Yellow Level 2 Warning of an upper-air system that was expected to cause disruptive rain in the province's western and southern areas on 8 January 2024 (Figure 3.30). SAWS numerical weather models had predicted a 24-hour rainfall accumulation of 50mm. The Alfred Duma Local Municipality was severely affected by the heavy rainfall, resulting in flash floods in some of its municipal areas. The floods caused damage to several roads, business properties in the Central Business District (CBD), and homes in its thirteen municipal wards. According to the municipality's assessment, thirty-nine (39) households were affected, with five (5) structures destroyed and eleven (11) partially damaged, affecting one hundred and ninety-nine (199) people. Figure 3.31 depicts a few flooded low-water bridges within the ADLM.

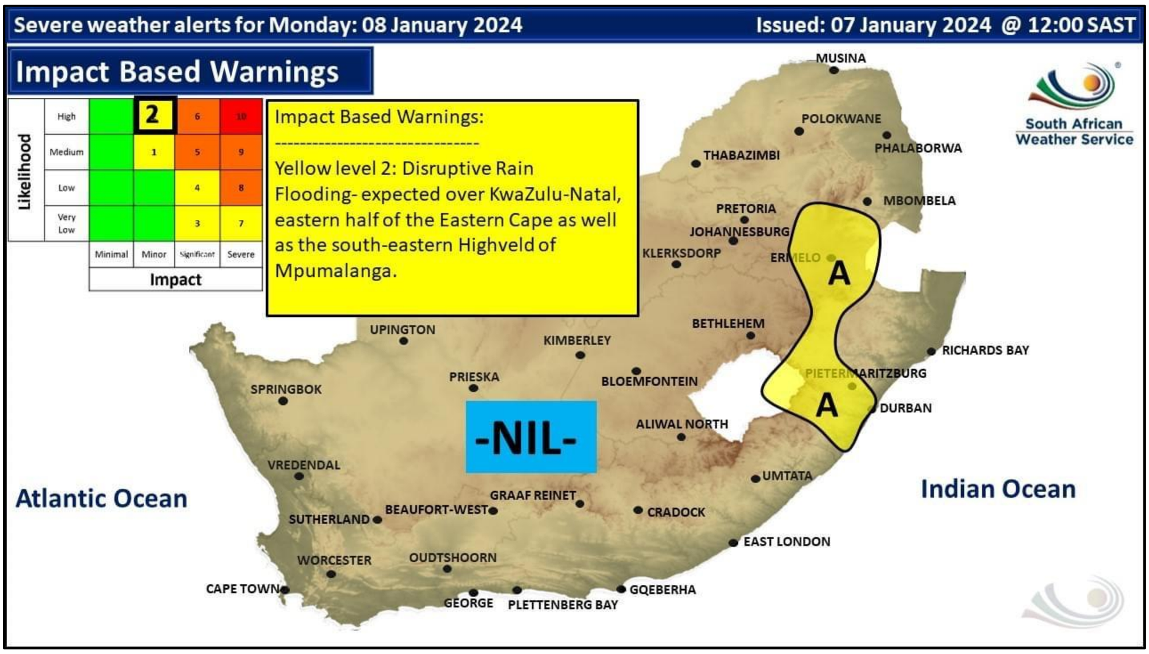


Figure 3.30: Severe weather warning for 08 January 2024 in KZN (Source:SAWS)

Figure 3.31: Damages on road infrastructure in the Alfred Duma Local Municipality (Source: Alfed Duma Local Municipality).

3.6.1 Floods in the eThekwini Metropolitan Municipality

On 12 January 2024, SAWS issued a Yellow Level 2 Warning for Disruptive Rain, which was expected to cause flooding and isolated structural damage in central KwaZulu-Natal (Figure 3.32). On 13 January 2024, heavy rainfall, severe thunderstorms, and strong winds wreaked havoc across KwaZulu-Natal, leaving a trail of destruction. The most severe damage and fatalities were reported in parts of the eThekwini Metropolitan Municipality (EMM) and the north coast of KZN. Hundreds of homes, roads, and bridges were damaged, six people died, and two people were reported missing.

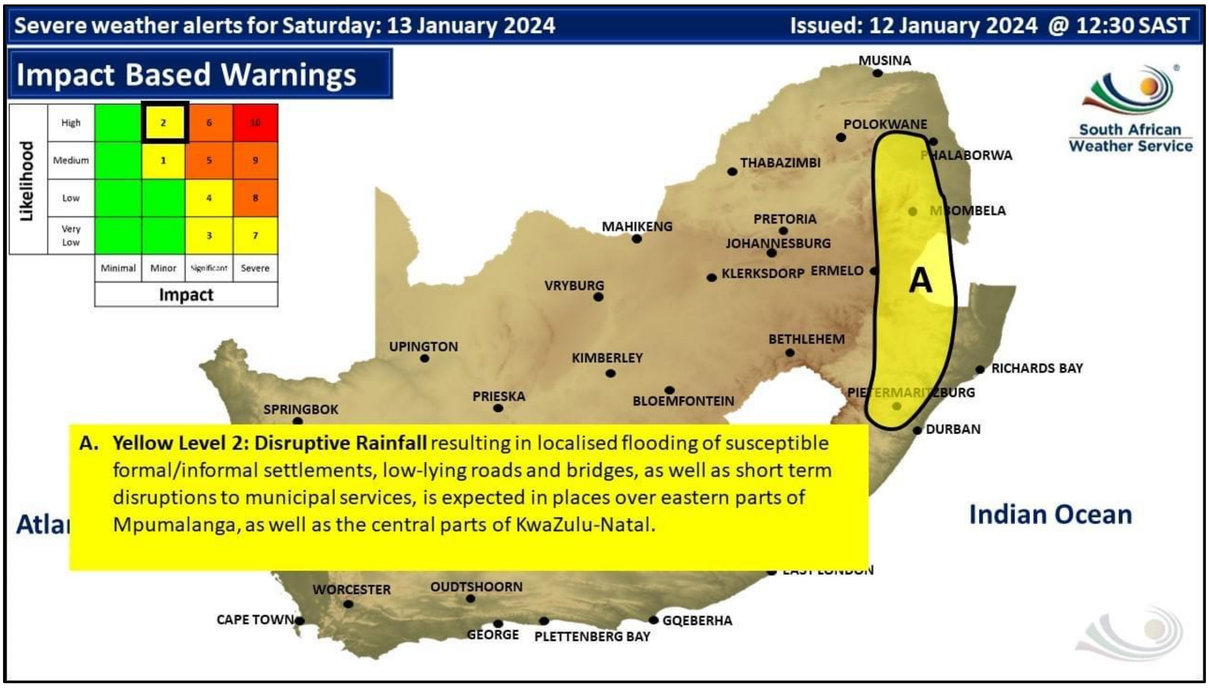


Figure 3.32 Severe weather warning for 13 January 2024 in KZN (Source: SAWS)

Floods also damaged water and electricity infrastructure, leaving some communities in eThekwini and Stanger without access to water and electricity (EMM, 2024a). The Verulam area, located North of Durban, experienced widespread road closures, mudslides, and power outages. According to eThekwini Disaster Management, 250 households and 1,000 people were directly affected in the eThekwini Metro area. Furthermore, on 14 January 2024, the eThekwini Metro issued a statement informing the public of the beach closures due to heavy rains that impacted water quality at some of its beaches (EMM, 2024b).

Most provinces received heavy rainfall in April; in some provinces, the heavy rainfall caused floods, leaving a trail of destruction and fatalities. The rainfall was caused by a cut-off low weather system, which occurs most frequently during this period. Cut-off lows are large weather systems that are known to cause widespread flooding, such as the KwaZulu-Natal flooding in 2022 and the Laingsburg flooding in 1981 (SAWS, 2024*a*). In the first week of April, the cut-off low-pressure system was positioned over the country's western interior. Figure 3.33 shows a widespread showers and thundershowers predicted by the Global Forecast System across most parts of the country, with heavy rainfall and severe thunderstorms predicted in some areas for 7 and 8 April 2024.

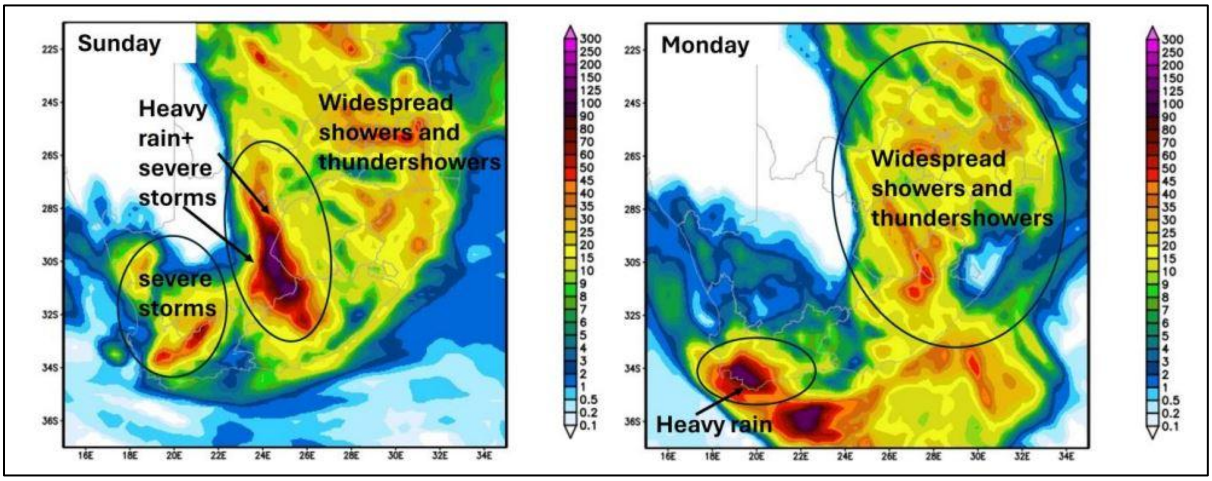


Figure 3.33 24-hour rainfall accumulation for Sunday, 7 April (left) and Monday, 8 April (right) according to the Global Forecast System (GFS) (Source: SAWS

3.6.2 Western Cape: Strong Winds and Floods

On 4 April 2024, SAWS issued an early warning for the Western Cape for disruptive rain and strong winds from 7 April to 9 April (Figure 3.34). The statement described an intense cut-off low that was expected to develop along the country's west coast from 4 April 2024. The statement also predicted heavy rainfall over parts of the Overberg and the south-west coast of the Western Cape on the 8th and 9th as the cut-off low exited along the southern coast of the Western Cape, as well as a strong to gale-force south-easterly wind, which could disrupt coastal marine routines and operations (SAWS, 2024*a*).

On 9 April, the Western Cape Government reported that George had accumulated more than 100mm of rain within 24 hours. Furthermore, dam levels in the Karoo and Garden Route districts rose rapidly, with some dams reportedly overflowing, particularly those along coastal areas.

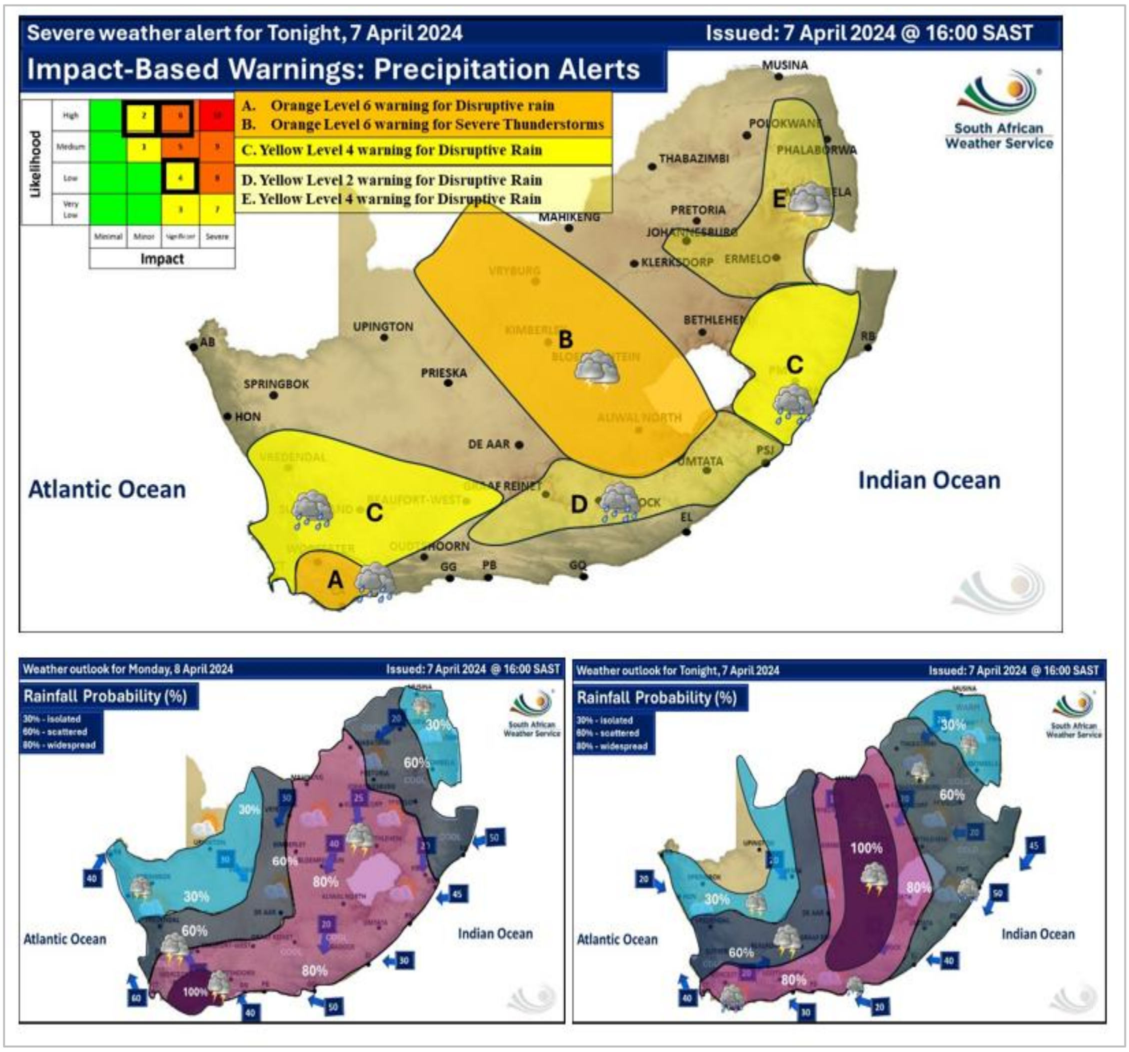


Figure 3.34 Extreme weather warning indicating heavy rainfall for the Western Cape Province

By 10 April, one fatality had been reported, with 2,779 buildings affected, at least 26 schools damaged, and several highways closed across the Cape Winelands, Overberg, and West Coast regions, as well as several power outages.

3.6.3 Kwa-Zulu Natal: Floods

On 14 April, SAWS issued an orange level 5 warning for KwaZulu-Natal's South Coast, predicting heavy rainfall and thunderstorms (Figure 3.35). A severe storm hit the Margate- Uvongo -Shelly Beach - Port Edward areas from the 14 to 15 April, as per rainfall probability, and a warning was issued, as displayed in Figure 3.35. A total rainfall of 250mm was recorded in Margate, with 225 mm recorded between 16h00 and 22h00 on 14 April (SAWS, 2024*b*).

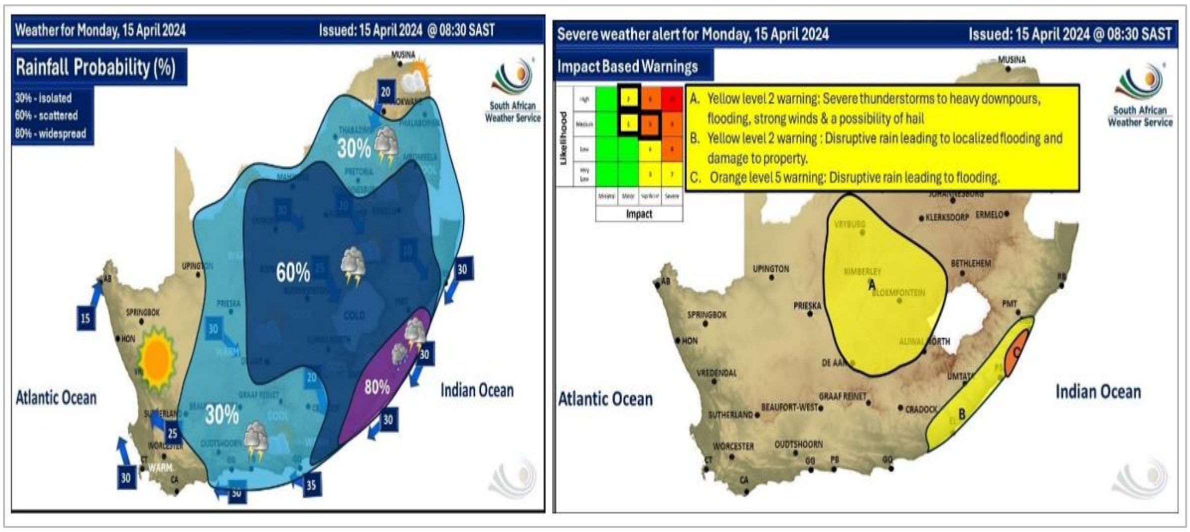


Figure 3.35 Rainfall probability and severe weather warning for 15 April 2024, affecting KZN's south coast.

The two most severely affected districts were uGu District (Margate area) and eThekwini District. Floods caused damage to infrastructure such as shelters, roads, schools, clinics, water, businesses, and electricity supply. Over 249 people were estimated to have been affected, more than 110 households were destroyed, and five fatalities were confirmed. Figure 3.36 depicts the trail of destruction left by floods in Margate.

Figure 3.36 Images showing the destruction caused by floods in KZN's South Coast (Margate 15 April 2024). (Source: Social media).

The range of extreme events which occurred from October 2023 to September 2024 underscores the growing vulnerability of South Africa's water resources to climate variability and change. Such events' increasing frequency and intensity highlight the urgent need for improved forecasting, early warning systems, and adaptive water management strategies. Strengthening resilience requires a deeper understanding of how these events affect water supply, quality, and distribution, ensuring better preparedness for future climate challenges.

3.7 State of El Niño-Southern Oscillation (ENSO)

The El Niño-Southern Oscillation (ENSO) has recently crossed the La Niña threshold and is predicted to remain on the boundary of this threshold for the next few months (March, April and May). Current predictions are still uncertain, with multiple global models predicting different directions (either strengthening the La Niña state or moving back to a Neutral state). For South Africa, caution is still advised when using the ENSO in any important planning decisions as it seems to be currently very volatile and unpredictable. For South Africa, time is running out as well for a potential La Niña to affect us as summer is coming to an end.

Current predictions indicate above-normal rainfall for most of the north-eastern parts of the country during autumn; however, this is expected to change to only above-normal rainfall for the interior and eastern coastal areas during late autumn and eventually mostly below-normal during early winter (Figure 3.37). However, due to a significant reduction in rainfall over the central and northeastern parts of the country during late autumn and early winter climatologically, the most important forecast is for the southwestern parts of the country, where below-normal rainfall is expected during these seasons.

Minimum (Figure 3.38) and maximum (Figure 3.39) temperatures are expected to be mostly above normal countrywide for the forecast period. However, the southern coastal areas indicate that below-normal temperatures are more likely throughout the summer period.

The SAWS will continue to monitor the weather and climate conditions and provide updates on any future assessments that may provide more clarity on the current expectations for the coming season.

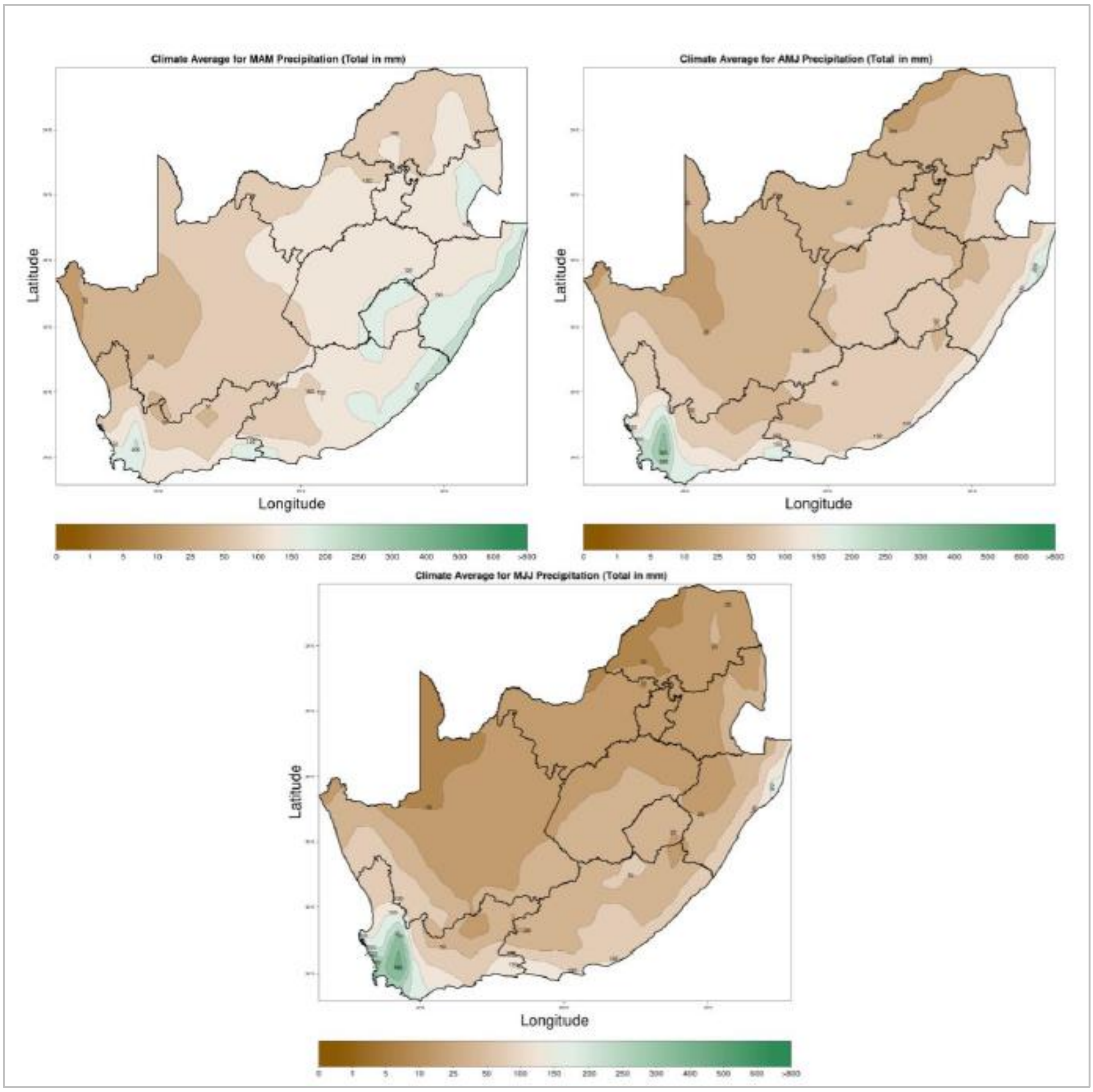


Figure 3.37 Climatological seasonal totals for precipitation during March-April-May (MAM; left), April-May-June (AMJ; right) and May-June-July (MJJ; bottom).

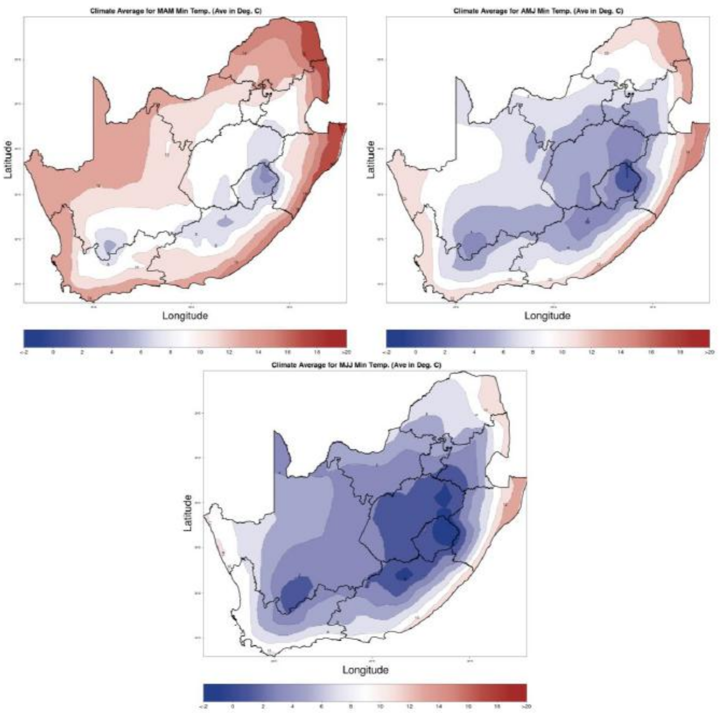


Figure 3.38 Climatological seasonal averages for minimum temperature during March-April-May (MAM; left), April-May-June (AMJ; right) and May-June-July (MJJ; bottom).

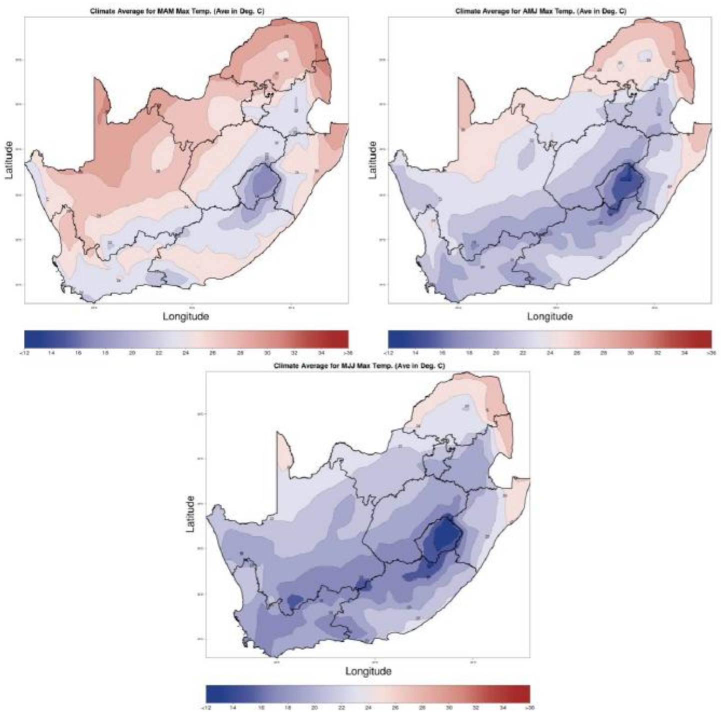


Figure 3.39 Climatological seasonal averages for maximum temperature during March-April-May (MAM; left), April-May-June (AMJ; right) and May-June-July (MJJ; bottom).

3.8 Climate Change

The phenomenon known as climate change refers to an ongoing trend of changes in the earth's general weather conditions due to an average rise in the earth's surface temperature, often referred to as global warming. This rise in the average global temperature is primarily due to the increased atmospheric concentration of greenhouse gases (GHGs). These gases intensify a natural phenomenon called the greenhouse effect by forming an insulating layer in the atmosphere that reduces the amount of the sun's heat that radiates back into space, making the earth warmer.

In South Africa, future climate scenarios suggest significant temperature increases and variability in rainfall. Overall, the western half of the country is expected to see significant drying, while the eastern half could see increased wetting, on average, but with greater variability contributing to an increased frequency of both floods and droughts. In the long term (i.e. up to 2100), South Africa will likely experience drying. This, combined with increasing demands for water, requires immediate response so as not to negatively impact individual livelihoods, communities, companies, and the economy. In addition to the direct impact on water availability, higher temperatures and reduced streamflow might also contribute to increasing water quality risks, which is already a national crisis. Increased rainfall intensity will also contribute to more flooding and threaten critical water-related infrastructure.

The National Climate Change Response White Paper (2011) and, more recently, the National Climate Change Act (2024) indicate that all sectors are required to develop climate change response strategies (CCRS) and plans. In response to this, the Department went through a process of reviewing its National Climate Change Response Strategy for the Water and Sanitation Sector, developed in 2014, that involved a review of the state-of-the-art science on climate change and water resources and sanitation, which culminated in the updating of the 2013 Climate Change Status Quo for the Water and Sanitation Sector. The outcomes of this assessment then informed the review and update of the 2014 National Climate Change Response Strategy for Water and Sanitation.

The CCRS includes an updated vision, key strategic objectives (KSOs), and priority response actions (RAs). These KSOs and RAs are unpacked as part of the Strategy and include proposed next steps for implementation. The Strategy also includes a summary of the updated status quo assessment and proposed adaptation and mitigation actions that can inform the next steps in moving towards achieving the vision of a low-carbon, climate-resilient, equitable and sustainable water and sanitation sector by 2050.

Priority actions, potential partners, proposed timeframes, and indicators for each of the five Key Strategic Objectives (KSO) of the updated strategy are identified in Figure 3.40.

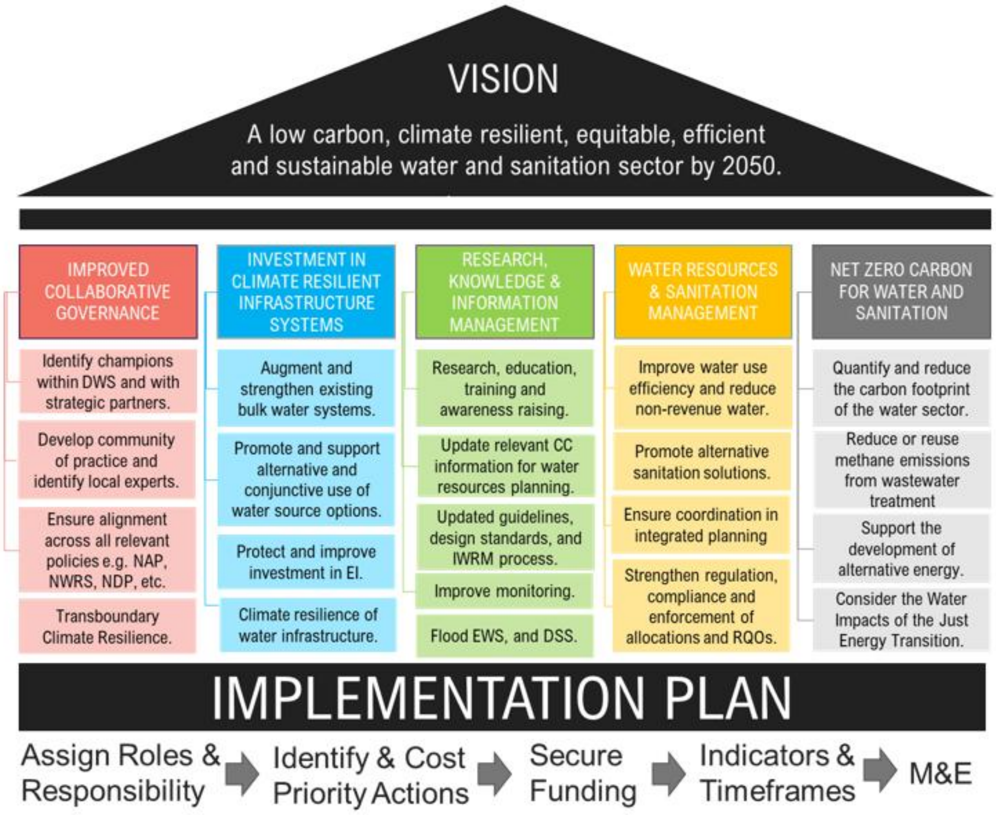


Figure 3.40 Strategic framework for achieving the vision of low carbon, climate resilient water and sanitation sector

To achieve the vision of a low-carbon, climate-resilient, equitable, efficient, and sustainable water and sanitation sector by 2050, one of the most critical priorities for South Africa is to implement critical water and sanitation infrastructure that has already been identified through the various planning processes at both national and local level. Several of these critical infrastructure projects have been delayed and are contributing to the current level of water and sanitation security risks impacting the economy and individual livelihoods. As a result, the priority of KSO is to implement KSO2, which includes the implementation of critical (and, in many cases, delayed) infrastructure as well as increased investments in protecting and rehabilitating natural systems and ecological infrastructure (EI).

Improving operations and maintenance of existing water and sanitation infrastructure is even more critical than investing in new climate-resilient infrastructure (i.e. KSO 3). This will not only have a direct impact on achieving the overall vision but is also necessary to support the investment in climate-resilient infrastructure systems (KSO 2) and also to achieve the objective of reducing the overall carbon footprint of the water and sanitation systems (i.e. KSO 5).

Underlying improved operations and maintenance (KSO 3), investing in climate-resilient infrastructure systems (KSO 2) and reducing the carbon footprint of the water and sanitation sector (KSO 5) is improved collaboration and cooperative governance, which includes training and capacity building for key stakeholders and decision-makers.

Finally, the provision of knowledge and information through training, research, and capacity building is critical in supporting all aspects of improved climate resilience for water and sanitation in South Africa and science-based decision-making for water security.

It is clear that climate change is already starting to have a major impact on water security and infrastructure in South Africa, and any delays in responding to these increasing risks will make it increasingly difficult to adapt in future and result in further damage and economic impacts.

In terms of the Way Forward, the immediate priority actions for DWS (i.e. the **FIVE BOLD STEPS**) that need to be taken to advance the updated climate change strategy are as follows:

- Implement critical (and delayed) water supply and sanitation infrastructure.
- Integrated climate change response actions into a revised NWRS and WSMP
- Raise awareness of climate change risks within DWS and alignment with the JET.
- Identify critical areas of research and updating of IWRM guidelines and practices.
- Help develop guidance on securing climate finance for water security and sanitation.

The development of the updated CCRS for water and sanitation has undergone extensive stakeholder engagement to try to accommodate all voices. It has also been developed in the specific context of promoting Gender, Equity and Social Inclusion (GESI). In addition to updating the CCRS, the DWS is also currently revising the latest version of the National Water Resources Strategy (NWRS) and the Water and Sanitation Master Plan (WSMP). These documents together form a comprehensive approach to improved water security in the

DWS also developed the water and sanitation sector policy (2017) to set out the policy position for the water and sanitation sector. This Water and Sanitation Policy on Climate Change will provide a framework for the implementation of the Climate Change Response Strategy for the water and sanitation sector, not forgetting that the policy will also strengthen the development.

3.8.1 Climate Change Act of 2024

The South African Climate Change Act (Act No. 22 of 2024), signed into law on July 18, 2024, establishes a legal framework for the nation's response to anthropogenic climate change. The Act recognises the urgency of addressing greenhouse gas (GHG) emissions and adapting to the impacts of climate change, with the goal of transitioning to a low-carbon and climate-resilient economy. Of particular relevance to the Water and Sanitation sector are several key aspects:

National Adaptation Strategy and Plan & Sector Adaptation Strategy and Plan (Sections 21 & 22): The Act mandates the development of a National Adaptation Strategy and Plan, which will outline a coordinated approach to reducing vulnerability to climate change impacts across various sectors. Critically, each sector (including water and sanitation) must develop its own sector adaptation strategy and plan. This necessitates a comprehensive scientific assessment of climate change risks to water resources, water infrastructure, and sanitation services.

It will require detailed modelling of potential changes in precipitation patterns (including increased drought and flood frequencies), temperature increases, and their impacts on water availability, water quality, and the functioning of wastewater treatment systems. Adaptation measures must be evidence-based, incorporating the best available climate science and hydrological data. These strategies need to consider factors such as rainfall intensity and seasonality changes. Increased evaporation rates due to higher temperatures, Sea-level rise and its impact on coastal water infrastructure, The effects of altered water temperatures on aquatic ecosystems and water quality, The potential for increased frequency and intensity of extreme weather events (floods, droughts) to damage water and sanitation infrastructure.

Greenhouse Gas Emissions: While the Water and Sanitation sector may not be a primary GHG emitter compared to energy or industry, the Act's provisions related to GHG emissions are still relevant. Wastewater treatment plants, for instance, can be sources of methane (CH_4) and nitrous oxide (N_2O), both potent GHGs. The Act’s emphasis on developing sectoral emissions targets (Section 25) and potentially carbon budgets (Section 27) will likely require the sector to quantify its GHG emissions, identify mitigation opportunities (e.g., improved energy efficiency in treatment processes, biogas capture from anaerobic digestion), and implement strategies to reduce its carbon footprint. The Act also establishes a National Greenhouse Gas Inventory (Section 29), which will require the sector to contribute data on its emissions.

Intergovernmental Coordination: The Act acknowledges that climate change transcends traditional sectoral governance and necessitates a coordinated, cooperative response across national, provincial, and municipal levels. This is particularly important for the Water and Sanitation sector, where responsibilities are often shared between different levels of government. The Act calls for a collaborative approach, requiring effective communication and data sharing to ensure that climate change considerations are integrated into water resource management, infrastructure planning, and service delivery.

3.8.2 Climate Change Response Strategy

The Department of Water and Sanitation (DWS) has developed a Climate Change Response Strategy for the Water and Sanitation Sector, recognising that "Water Security is Climate Security." The strategy acknowledges South Africa's vulnerability to climate change impacts, which exacerbate existing water security challenges, including increased risks of floods and droughts and declining water quality. The strategy aims for a "low-carbon, climate-resilient, equitable, efficient, and sustainable water and sanitation sector by 2050."

The strategy emphasises improved collaborative governance across sectors and spheres of government, partnerships between state, civil society, the private sector, and multilateral nations (Figure 3.40). The strategy focuses on reducing vulnerability and improving resilience through adaptation and mitigation actions. Adaptation measures aim to provide multiple benefits, including increased agricultural productivity, food security, and biodiversity conservation.

The Climate Change Response Strategy operates within the existing framework of integrated water resources management in South Africa, recognising that climate change impacts are superimposed upon existing climate variability and water security challenges. Key stakeholders and strategic partners such as municipalities are identified as playing a crucial role in climate change mitigation, adaptation, and resilience, as they are responsible for providing water services.

Implementation of the strategy requires significant investment from both the public and private sectors, aligned with South Africa’s Just Energy Transition (JET). Cross-sectoral partnerships and collaboration are essential. The strategy emphasises the use of knowledge and information generated from partnerships to inform actions and steps taken by municipalities to ensure resilience. Improved monitoring of climatic variables and citizen science are crucial for data availability and knowledge generation.

The strategy strongly encourages transdisciplinary collaboration and knowledge exchange among government agencies, research institutions, municipalities, and local communities to address climate change impacts on rivers. Data sharing, collaborative monitoring programs, and the integration of local ecological knowledge are crucial. Finally, the report can inform evidence-based policy and investment decisions that promote climate-resilient water resources management and safeguard the ecological integrity of South Africa's rivers. This should include recommendations for optimised water allocation strategies, investments in green infrastructure, and the implementation of policies that reduce pollution and protect riparian habitats.

3.8.3 Climate Change Scenarios for Water and Sanitation

- *<u>Increasing Climate Change Risk and Vulnerability in Africa</u>*

Much of Africa, including Southern Africa, will be impacted by climate change (Figure 3.41) and is vulnerable to the impacts of climate change largely due to limited financial capacity to adapt to the impacts of climate change, according to the Notre Dame Global Adaption Initiative (ND-GAIN) index. South Africa is currently ranked 96 out of 182 countries in terms of their vulnerability to climate change, preparedness for adaptation, and enhanced resilience. The worst-performing indicators for South Africa are the projected change in cereal yields, agriculture capacity, and dam capacity in terms of the low average storage capacity per capita, despite South Africa having several large dams.

This vulnerability is reflective of South Africa having one of the lowest rates of per capita runoff and without the large rivers that can provide significant storage, including in countries such as Zimbabwe and Zambia, which have fewer dams but a few very large dams on the Zambezi.

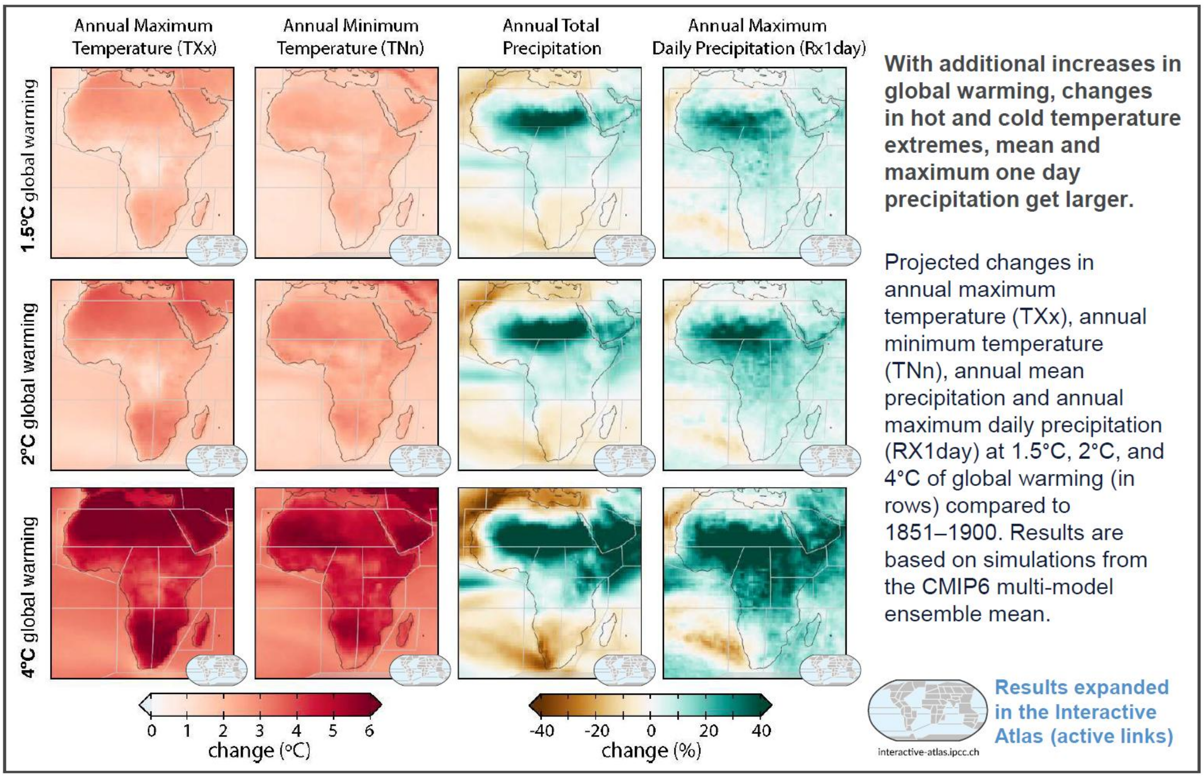


Figure 3.41 Increasing Climate Change Risks for Africa (IPCC, 2022)

- *Latest Global Climate Change Scenarios for South Africa*

The latest climate change scenarios from the IPCC 6th Assessment Report (Figure 3.42) indicate an increase in average temperature from around 18.54 °C to a median value of between 18.89 °C and 23.37 °C for South Africa by 2100, depending on the resulting global emission scenarios, but with much hotter temperatures expected in the north and inland areas and cooler by the coast. There is a similar significant increase in the number of very hot days.

Overall, there is an expected small decrease in precipitation nationally, but with significant spatial variability, as shown in Figure 3.43. The country's eastern half is expected to see an overall increase in mean annual precipitation, while the western half, and in particularly the southwest, is expected to experience drying. It is also expected that the number of very hot days and the maximum daily rainfall will increase across almost all of the country, which suggests an increased risk of flooding, and there will be increased variability in precipitation, contributing to more droughts. In contrast, there is an expected significant increase in the maximum daily rainfall over most of the country, particularly over the eastern half.

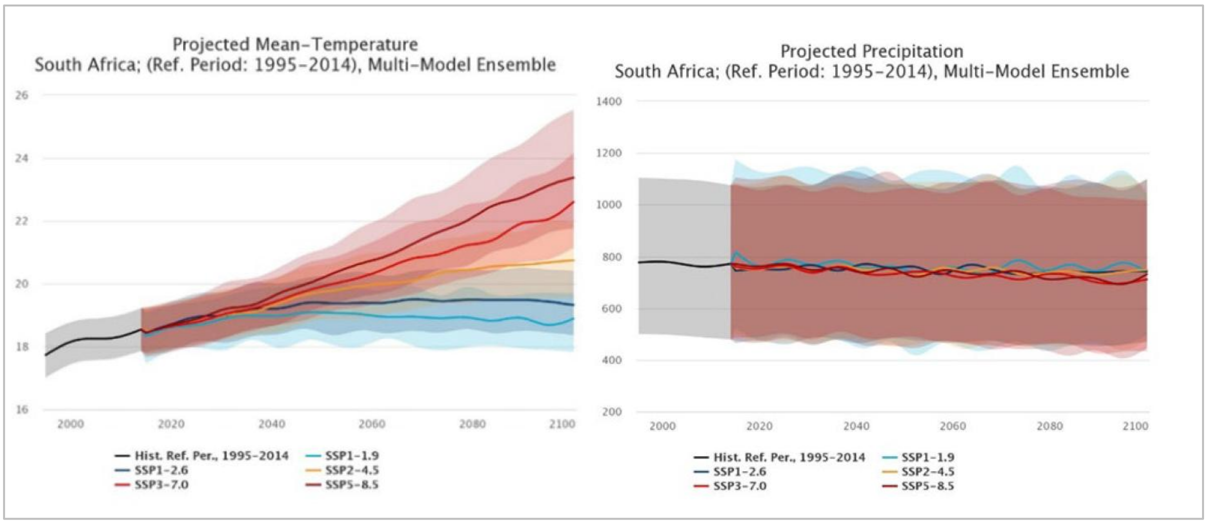


Figure 3.42 CIMP6 projected changes in mean temperature and mean annual precipitation for South Africa.

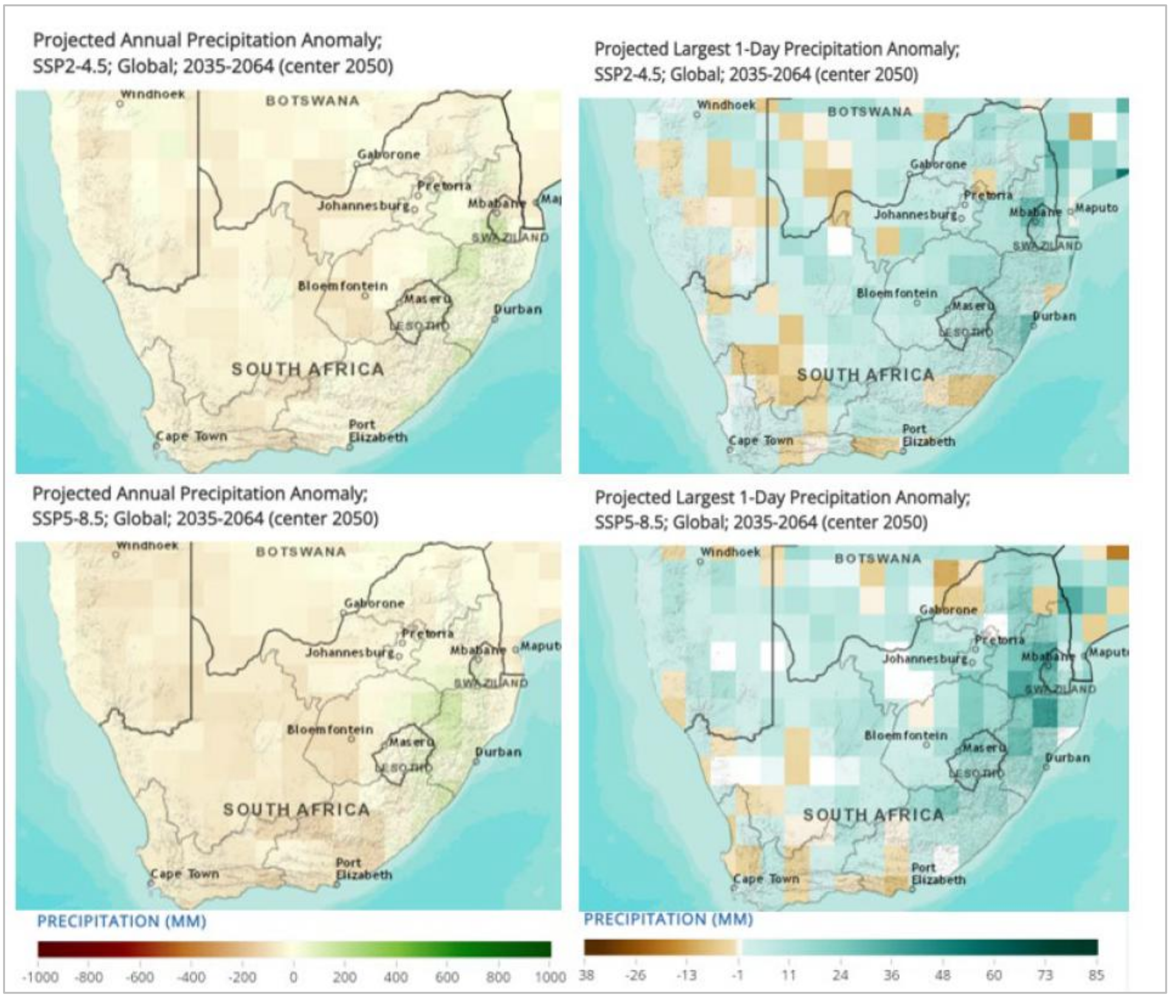


Figure 3.43 Projected change in average annual precipitation (left) and largest 1-day rainfall (right) under two different global emission scenarios for the period 2035-2064 across South Africa (Source: CCKP).

- *Downscaled Climate Change Scenarios for South Africa*

To date, there has been no work on downscaling the latest CIMP 6 data, and the currently available downscaled climate scenarios, such as those used in the CSIR Greenbook and described below, are based here to see how these compared to the available downscaled climate scenarios and analysis relevant for each of the different hydro-climatic zones. High-resolution (8km x 8km) downscaled climate scenarios have been produced for South Africa and are presented in the CSIR Greenbook (**www.greenbook.co.za**) for the CMIP5 RCP4.5 and RCP8.5 climate scenarios (Figure 3.44).

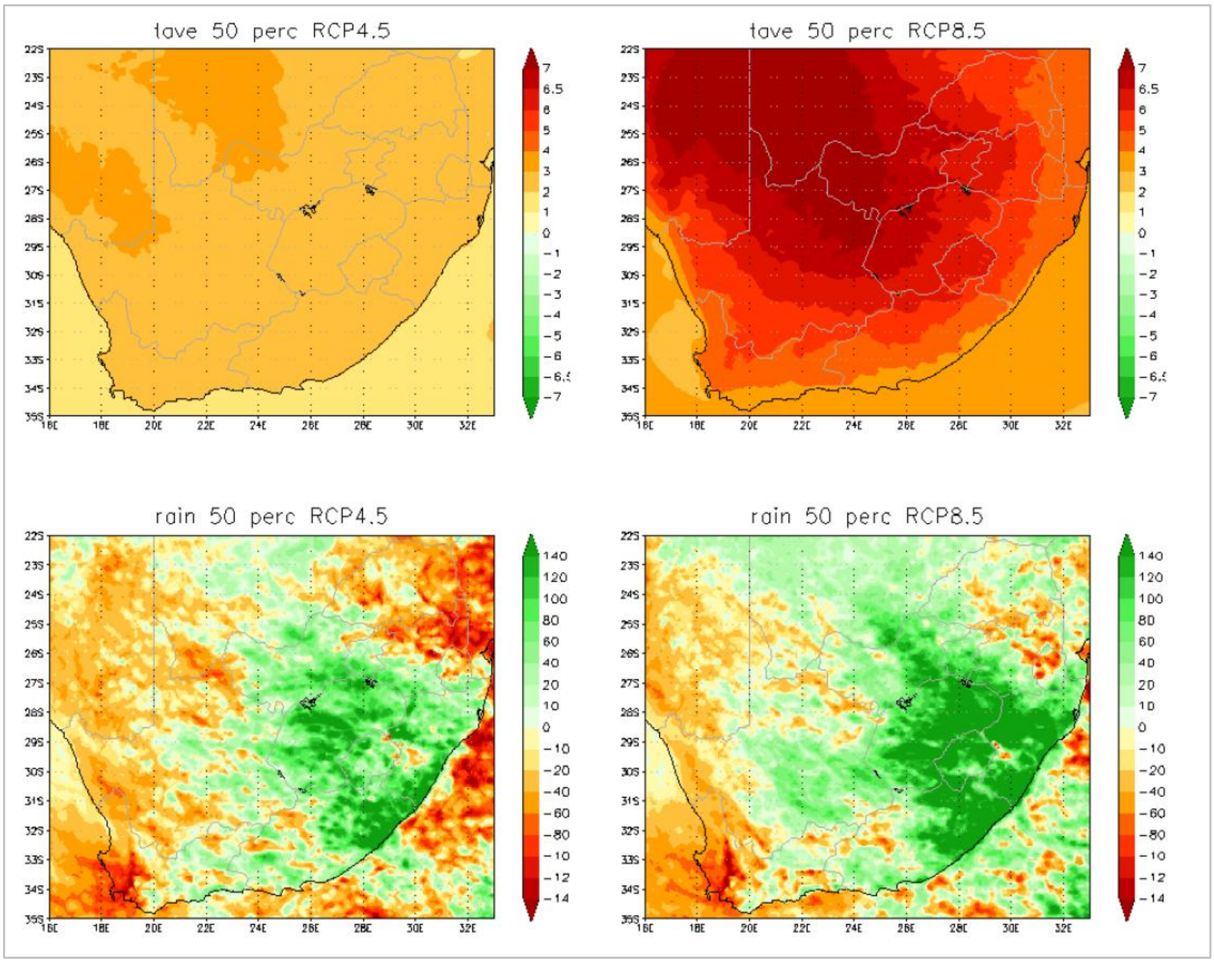


Figure 3.44: Summary of downscaled climate change scenarios for South Africa (Source: CSIR Greenbook)

- Hybrid Frequency Distribution Climate Scenarios and Impacts

As an alternative to producing selected individual global climate models to be downscaled, a study undertaken in support of determining the economic impacts of climate change in South Africa (Cullis *et al.,* 2015) and the Long Term Adaptation Scenarios (DEA, 2015) consider a hybrid frequency distribution (HFD) approach to evaluating climate change risk across a wide range of possible climate scenarios that was also then modelled in terms of the potential impact on surface water runoff as well as reliability of water supply taking into account the ability to manage and move water across the country with the integrated bulk water supply system (Cullis *et al.,* 2015). The results of this study were used to assess the overall economic impacts of climate change and highlighted the critical importance of the integrated bulk water system.

The HFD approach considers global emission scenarios, namely an unconstrained emission scenario (UCE), which is equivalent to a low mitigation scenario such as SSP5-RCP8.5 and a Level 1 stabilisation (L1S) scenario, which is representative of a lower emission scenario equivalent to SSP2-RCP2.5.

Figure 3.45 shows the range of possible impact (i.e., relative change) on MAP across each secondary catchment under the UCE scenario.

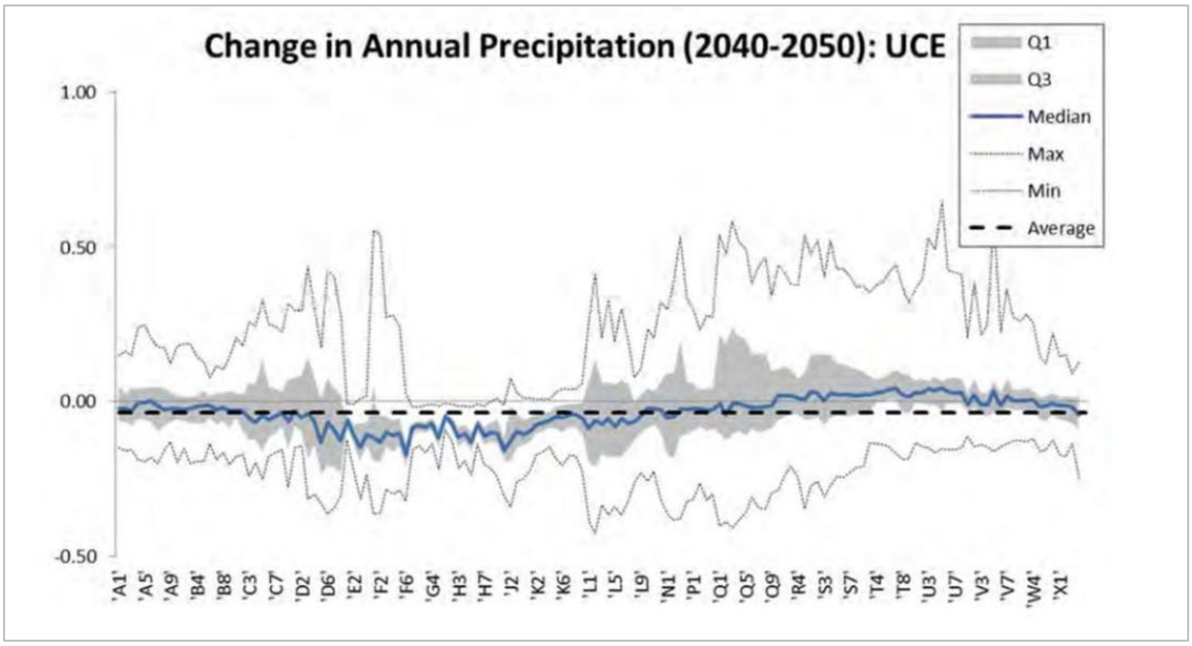


Figure 3.45 Range of possible impact of climate change on mean annual precipitation across all secondary catchments in South Africa under the UCE scenario for the period 2040-2050 relative to the base period. The solid blue line indicates the median value in each section.

The impact of the different climate change scenarios on surface water runoff was determined using the Pitman model (Pitman, 1973) at quaternary catchment scale across South Africa using existing calibrated Pitman parameters contained in Water Resources 2012 (WR2012) and used to generate monthly streamflow impacts at quaternary catchment scale for the two global emission scenarios (UCE and LS1). The Pitman model is a monthly rainfall-runoff model that is the standard for water resources simulations to enable planning in South Africa (Pitman, 2006; DWA, 2012) and is widely used for hydrological modelling across Southern Africa (Hughes *et al.,* 2006).

The variation in the impact on the mean annual rainfall (MAR) across the country is shown in Figure 3.46 for the UCE scenario. These results show a reduction in streamflow for the western half of the country (D to K), particularly the Western Cape (F, G and H), where all the climate models show a reduction in streamflow. In contrast, some very large potential increases in runoff for the east coast (Q to W) could result in increased flooding risks.

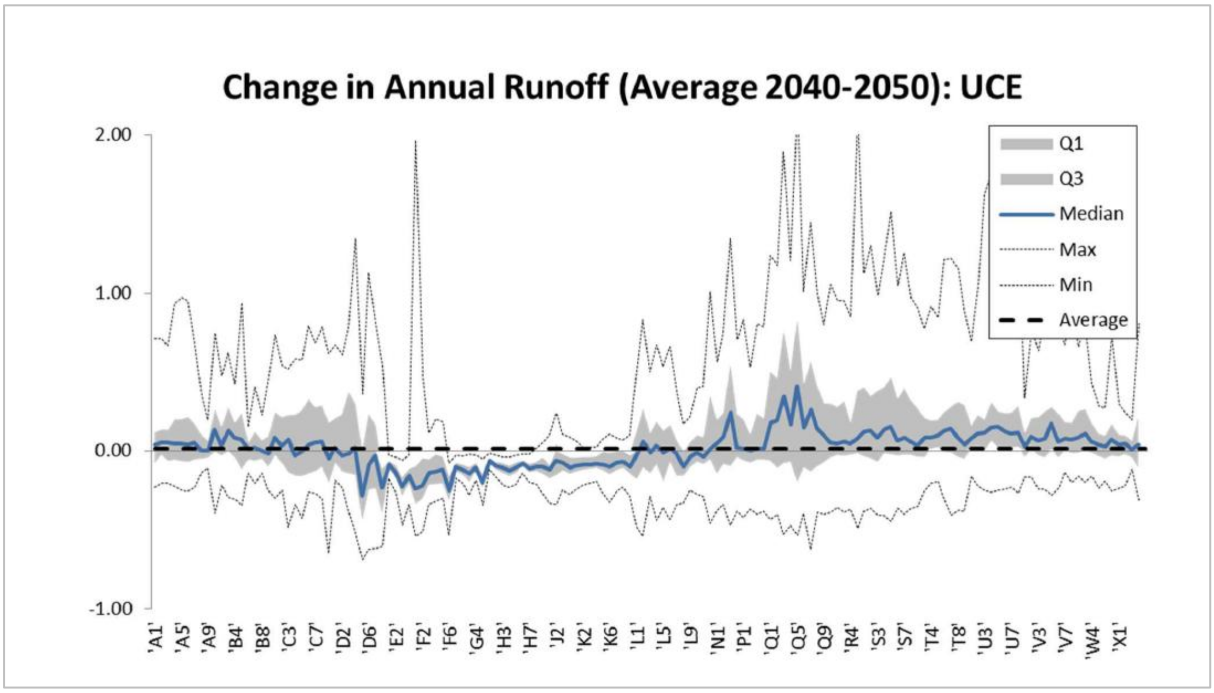


Figure 3.46 Range (i.e., mean, Q1, Q3, max and min) of potential impacts of climate change on the mean annual catchment runoff for all secondary catchments from 2040 to 2050 under the UCE scenario.

The impact of the L1S scenario in terms of reducing the potential risk for both large increases in catchment runoff and large reductions in catchment runoff becomes more obvious at the secondary catchment scale (Figure 3.47). While some models were showing the potential doubling in annual MAR in selected secondary catchments in the eastern half of the country, under the L1S scenario, the additional risk is only half but still shows possible increases up to 100% of the base scenario under some of the more extreme (but less likely) model results. The spatial variations are projected to change in the median, 5th and 95th percentile of MAR by 2050 relative to the base period at the secondary catchment scale. Results show that drying is still likely to occur in the Western Cape, even under a very wet scenario.

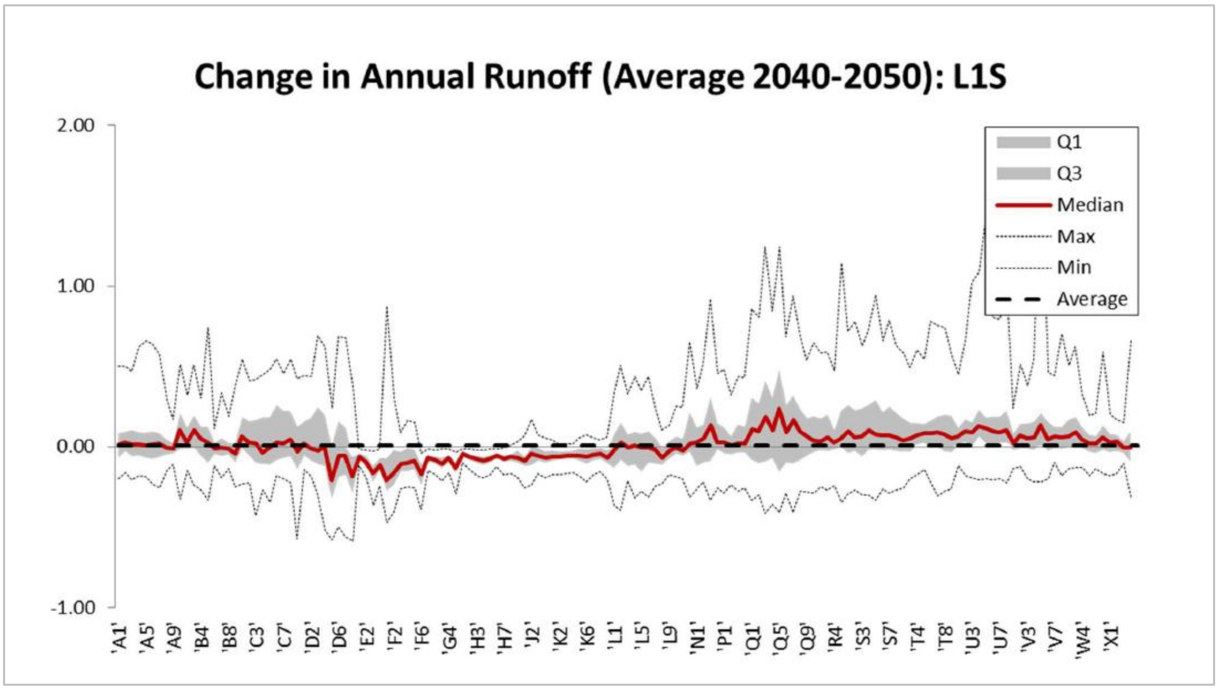


Figure 3.47 Range of potential impacts of climate change on the average annual catchment runoff for all secondary catchments for the period 2040 to 2050 due to the L1S scenario relative to the base scenario

A comparison of HFD results for the change in the national average annual catchment runoff for the whole of South Africa resulting from the UCE and L1S scenarios relative to the base scenario for 2040 to 2050 is present in Figure 3.48. The results show that the median impact of the UCE scenario is an annual catchment runoff over the whole country of around 4.4% over the baseline, while the median impact of the L1S scenario is an increase in the total catchment runoff of only 2.6%. For both scenarios, there is a wide range of potential impacts. The risk of extreme impacts at both ends of the spectrum (wet and dry) is significantly reduced under the L1S climate scenario. For the UCE scenarios, the potential impacts on total catchment runoff range from a 13% reduction to a 48% increase, while under the L1S scenario, the range is markedly smaller, from a 10% reduction to a 30% increase.

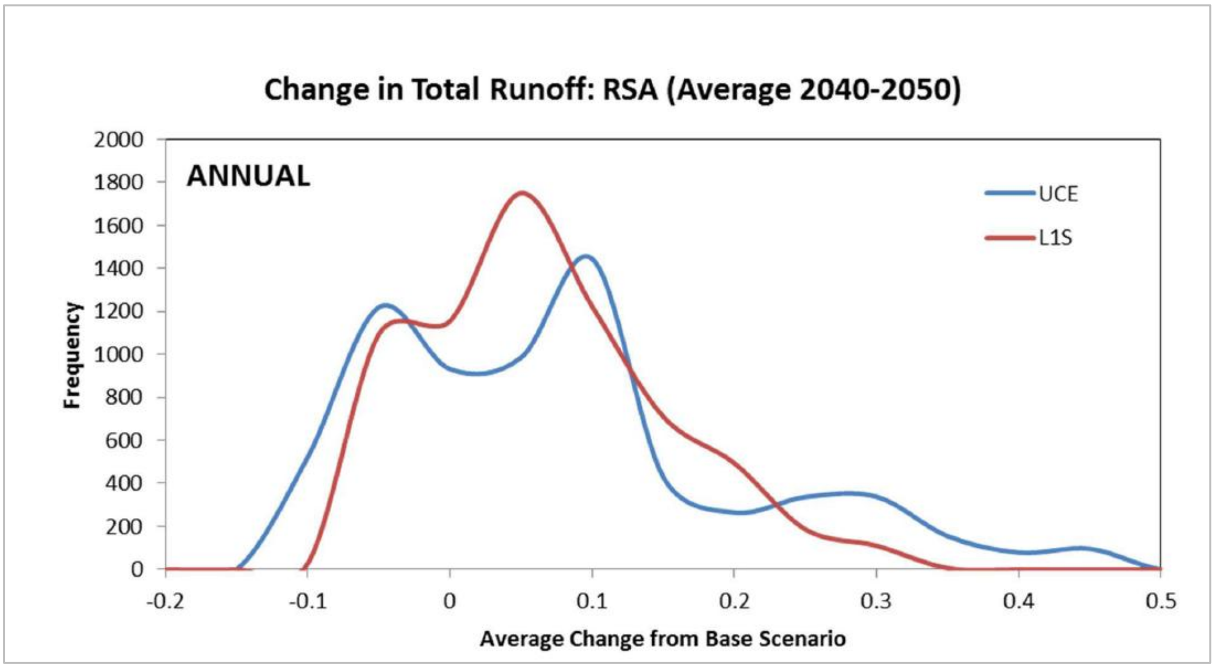


Figure 3.48 Hybrid frequency distributions (HFDs) of the impacts of the UCE and L1S climate scenarios on the national average annual catchment runoff for the period 2040-2050 relative to the base scenario

The following general observations can be made based on these results for different catchments across South Africa that represent the different hydro-climatic zones:

Mokholo River: Even a chance of increases and decreases in annual precipitation, with the impact being most significant in the early part of the wet season (December and January).

Modder River: A general drying with only a few scenarios showing the potential for increases in annual runoff with the potential impacts relatively evenly spread during the year.

Berg River: All models show drying. The likely impacts are relatively consistent for each month, but the magnitude of the impact is greatest during the winter rainy season.

Koega River: A roughly equal chance of either wetting or drying with the median close to zero change in the MAR. The wettest scenarios show the greatest impact in April.

Mfolozi River: A greater possibility of wetting than drying, but still some dry scenarios are possible. The greatest impact is likely to occur in January showing a potential shift in the early period of the high flow season. There is a significant risk of increased flooding.

Sabi River: Possibility for increased runoff outside of current variability with the greatest impact being during the wetter months (December and January). As a result, there is an expected increase in the risk of flooding and greater variability in mean annual runoff (MAR).

3.8.4 Climate Change Adaptation and Mitigation Options

Climate Change adaptation options for water and sanitation should be implemented through reducing vulnerability and improving resilience. In addition, adaptation can result in various benefits, including increased agricultural productivity, innovation, health and well-being, food security, livelihood security, biodiversity conservation, and risk and damage reduction (IPCC, 2022). A provisional list of adaptation possibilities based on an examination of observed climate adaptation responses in the literature and in applied practice include:

- Integrated Water Resources Management and Planning
- Implementing critical water and sanitation infrastructure
- Improved monitoring and decision support systems
- Diversification of water supply options
- Climate-resilient water and sanitation systems
- Reducing Unaccounted and Non-Revenue Water
- Improved Water Use Efficiency in All Sectors
- Climate Smart Agriculture
- Innovative Sanitation Technologies and Solutions
- Ecosystem-based Adaptation
- Water-Sensitive Cities and Urban Water Resilience

In addition to the list of general adaptation response options described below, individuals or institutions can implement several individual adaptation response actions to reduce water security risks in the context of climate change. These are presented in various documents, including the CSIR Greenbook and a recent WRC Report (Schulze et al., 2023).

All adaptation response actions for water and sanitation in South Africa need to be considered in the context of the existing approaches to integrated water resources management practised in South Africa, recognising that any impacts of climate change are “superimposed” upon existing climate variability and water security challenges (Schultze *et al.,* 2023). Identifying and implementing adaptation responses for water and sanitation must also be developed and operate within the overarching guiding principles of South Africa’s National Climate Change Adaptation Strategy (NCCAS).

4

STATE OF RIVERS

4 STATE OF RIVERS

4.1 Streamflow

The Department of Water and Sanitation (DWS) is mandated by the National Water Act (No. 36 of 1998) Chapter 14, Section 137, to establish and monitor streamflow in the South African rivers. The Department monitors 628 river flow gauging stations across South Africa. Several streamflow monitoring stations are equipped with data loggers that measure the amount of water passing through a point over time in cubic meters per second (m^3 /s). The NWRS-2 indicated that streamflow monitoring aims to address our national concerns and is also in response to our obligations within international river basins (DWS, 2013). Transboundary water systems account for approximately 60% of South African river streamflow. Therefore, it is critical that South Africa implements Integrated Water Resource Management (IWRM) in accordance with international water conventions and treaties and the legislation governing water resource management in South Africa.

The international agreements have guidelines and limits on the quantities of water that South Africa may use out of the rivers and the amount of water the country must release to the neighbouring countries. The South African rivers demonstrate variations in flow regimes or flow patterns, continuously deviating from the historical flows. The flow regime changes are both natural and anthropogenically driven, with high variability in rainfall, population growth, and land and water use changes playing significant roles. Some catchments demonstrate increased streamflow, while other catchments also observe declining trends. The decline in streamflow affects water availability and supply, resulting in competing water requirements between different water use sectors such as agriculture, industrial, and urban water supply.

4.1.1 Annual Streamflow Anomaly at Strategic Points

The Department has several strategically important surface water monitoring points (outlet of catchments, importance of international obligations, and SDGs reporting). These stations provide long-term data used to assess how the total annual streamflow volume during the current reporting period deviates from the long-term median (1980-2010).

Some strategic points demonstrated a significant decrease in total annual flow volume in the current hydrological year compared to the previous year. South Africa experienced mostly below-average rainfall during the 2023/24 summer season, except for December 2023. In a recent report, the World Meteorological Organization (WMO) also confirmed that 2024 was the warmest year on record, with a global average surface temperature of 1.55 °C (with a margin of uncertainty of ± 0.13 °C)

(WMO,2024). These conditions (low rainfall and high surface temperatures) promote high evaporation rates in river systems and water bodies, resulting in significantly lower water levels and decreased river flow, while in some catchments, this decrease may be attributed to increased water abstractions. Figure 4.1 illustrates the streamflow anomaly maps, which show the deviation of annual streamflow during the 2023/24 hydrological year from the long-term median (1981-2010), as well as streamflow anomalies from the previous year (2022/23 HY), while Figure 4.2 and Figure 4.3 present streamflow anomalies at two strategic stations.

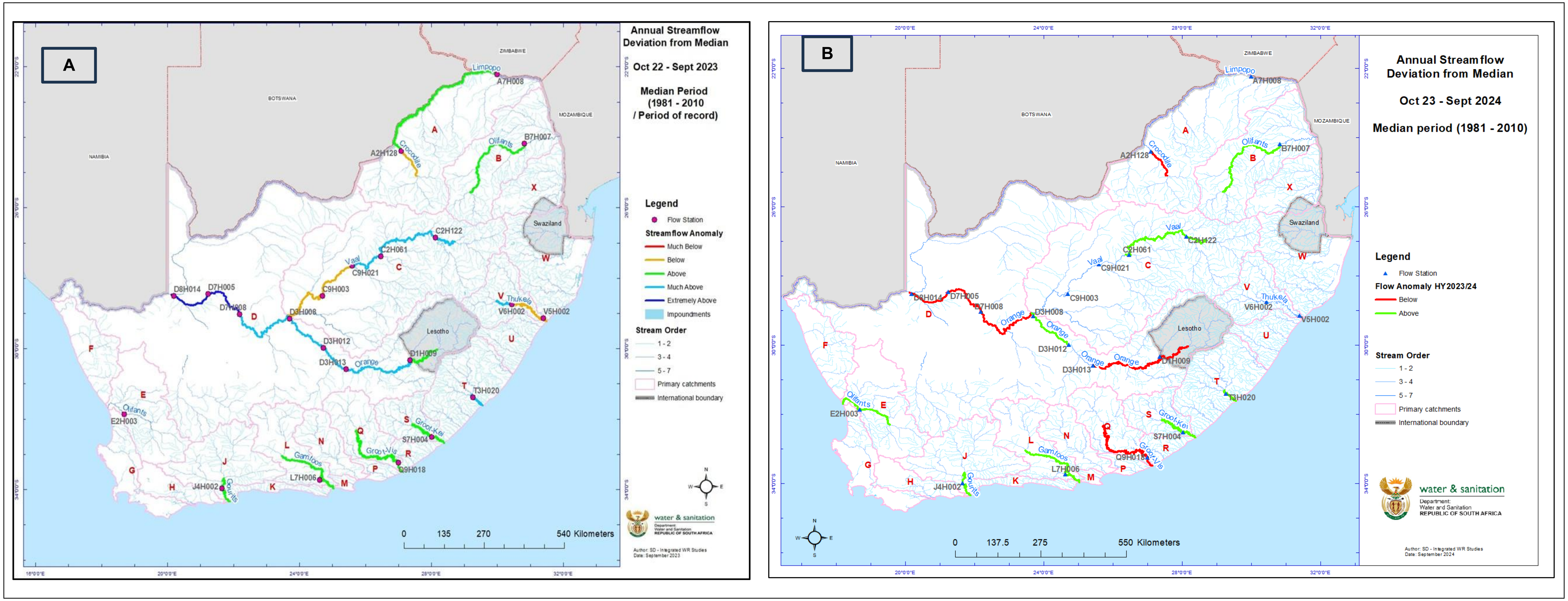


Figure 4.1: Annual Streamflow Anomaly for Strategic River Flow Monitoring Stations for the (A) 2022/23 hydrological year and (B) 2023/24 hydrological year.

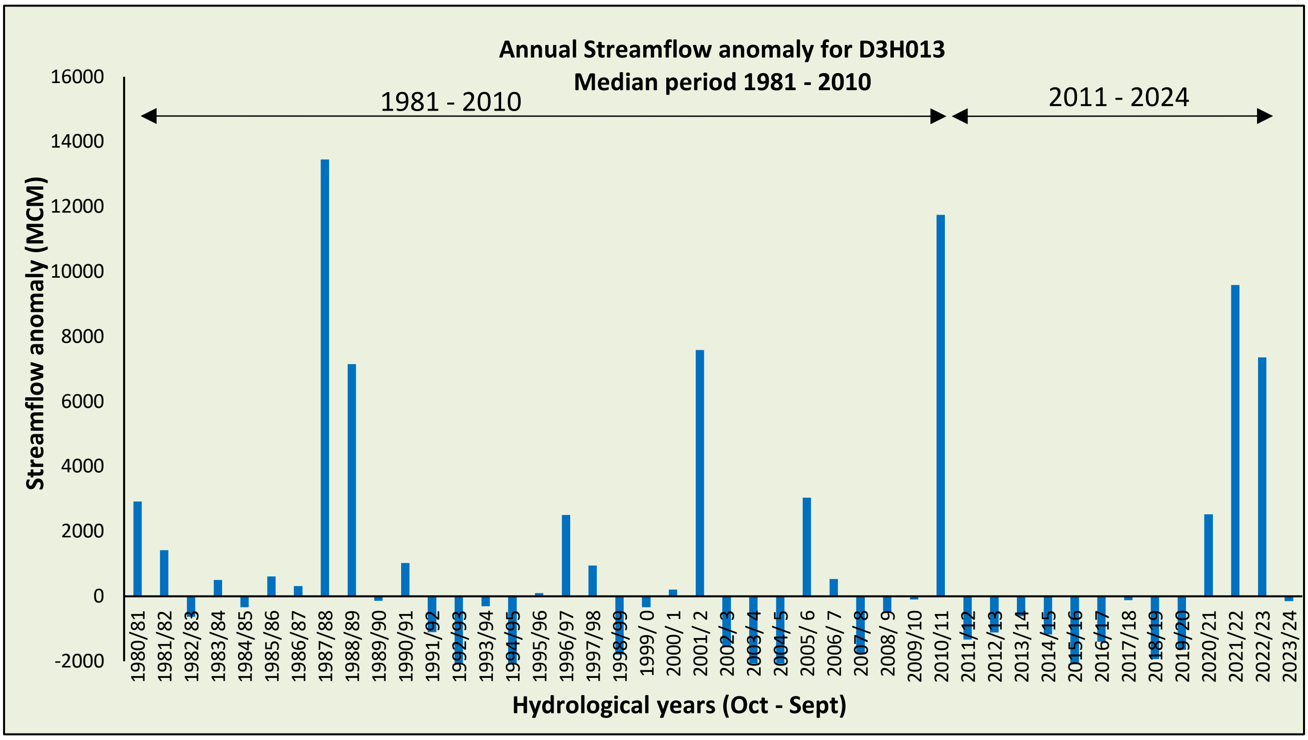


Figure 4.2: Annual streamflow deviation from the long-term median at station D3H013.

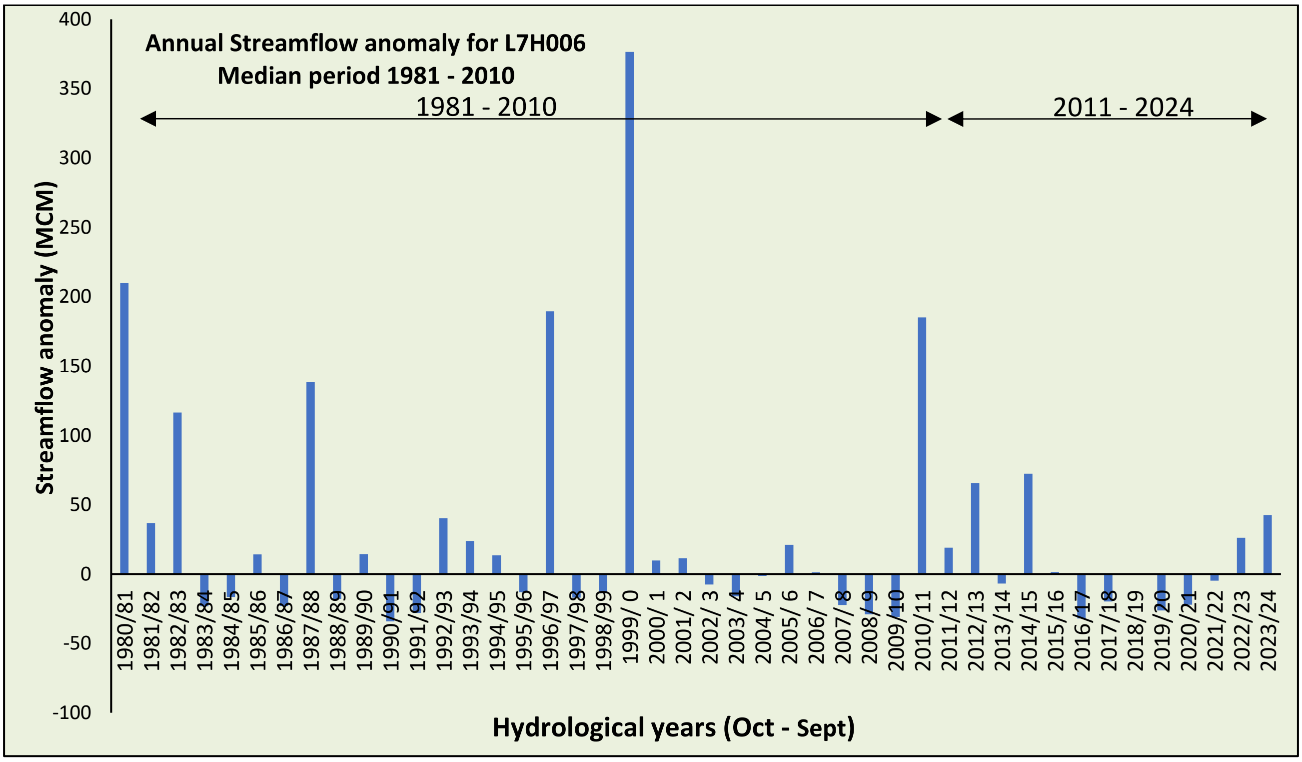


Figure 4.3: Annual streamflow deviation from the long-term median at station L7H006.

The maps presented indicate that in the previous hydrological year (2022/23), the flow volume in most strategic points exceeded the long-term median, with certain stations, such as D8H014 and D7H005 (Orange River at Upington), classified extremely above the long-term median. However, for the current hydrological year, it is noteworthy that the map key only shows the flow volume that is "above" and "below" the median. The rationale for this is that all stations above the median demonstrated only a slight positive deviation, with no deviations that could be classified as "much above" or "extremely above" the median.

A flow gauging station located along the Eastern Cape province's coastal area, within the Fish to Tsitsikama WMA (Q9H018- Great Fish River @ Matomela's Location) demonstrated a negative deviation in the 2023/24 HY compared to the 2022/23 HY when it reported a 550.4 MCM in total flow volume. The total streamflow volume recorded in the HY 2023/24 at Q9H018 was 275 MCM lower than the previous year.

Moreover, the three stations with higher negative deviations from the long-term median are all located in the Upper Orange Water Management area (D3H013- Outflow from Gariep Dam; D3H008- Orange at Marksdrift) and the Lower Orange Water Management area (D7H008- Outflow from Boegoeberg Dam). These stations had consistently deviated positively from the median over the last four hydrological years; however, in the 2023/24 HY they all experienced a decline in total flow volume and consequently negatively deviated from the median. In particular, the D3H013 (Figure 4.2) station had an annual flow volume of 4583 MCM in the current reporting period compared to 12090 MCM in the previous HY. It demonstrated a deviation of -151 MCM from the long-term median.

The streamflow anomaly for L7H006 (Groot River @ Grootrivierspoort) in the Fish to Tsitsikama WMA, shown in Figure 4.3 has also improved significantly over the last two HYs. In 2023/24, the total flow volume at this station was 78.9 MCM, which was 16.5 MCM higher than the previous year. The Olifants WMA station (B7H007 - Olifants River at Oxford) had the least improvement in annual flow volume, deviating by only (+4.4 MCM) from the median. The station is of international significance as it flows into Mozambique. The total annual volume recorded at this station in the 2022/23 hydrological year was 2601 MCM, the highest ever recorded; however, the total flow volume at this station dropped significantly to 579.1 MCM in the 2023/24 HY.

Sustaining Water Resources in a Changing Climate: Lessons from Quaternary Catchment W70A in Northern KwaZulu-Natal

Water scarcity limits economic activity and reduces community resilience, especially in impoverished areas facing global change. One such area is Quaternary Catchment W70A, located in the uMhlabuyalingana Local Municipality (ULM) in the northern Maputaland Coastal Plain (MCP), KwaZulu-Natal (KZN). This region faces high unemployment, poverty, and environmental challenges such as invasive species, habitat degradation, and declining water resources. Quaternary Catchment W70A is a rainfall-dependent, groundwater-driven system with no surface water rivers supplying it. South Africa's largest freshwater lake, Lake Sibaya, falls within this catchment and relies on groundwater for both its water levels and the health of its diverse ecosystem (Figure 1).

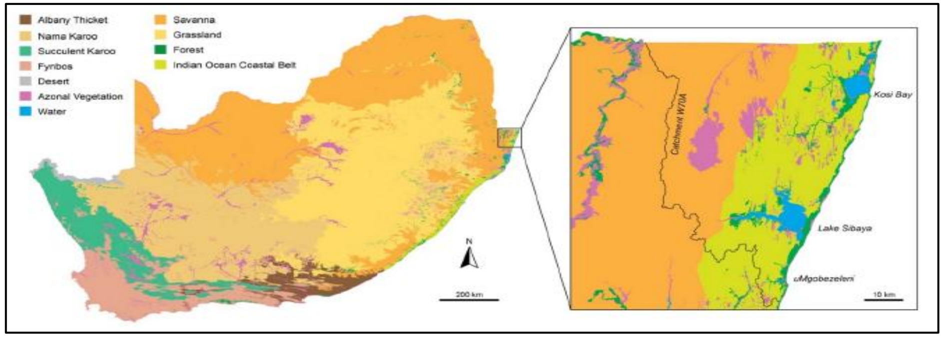


Figure 1: *The location of the study area relative to South Africa, as shown on the National Vegetation Map 2012 Biomes.*

Since 2001, Lake Sibaya's water level has continuously declined, reflecting a decrease in groundwater availability. The lake reached a record low in HY 2014/15, and this decline has persisted through 2021. For the past 14 years, Lake Sibaya has remained below its ecological drought reserve level of 16.5 m AMSL. The primary causes of this decline have been suggested to be below-average rainfall and commercial forestry, which impact groundwater recharge. Currently, there is no available water available to support population growth in the area.

To address water and economic security challenges, the Grassland node of the South African Environmental Observation Network, in collaboration with researchers from UKZN, ASSET, and UCT, conducted a Water Research Commission funded project (C2020/2021-00430). This project used an integrated, multi-scale approach to evaluate how different land-use scenarios, identified by local communities, might impact water resources under various climate change scenarios. The project integrated hydrological, climatological and economic modelling to provide a decision support tool for land custodians. A surface water hydrological model was loosely coupled with a groundwater model to simulate historical, current, and future water resource conditions under different land-use and climate scenarios. These included projections of a hotter climate with either increased or decreased rainfall.

The key findings from the research in terms of water resources for the area were:

- ❖ Rainfall is the primary driver of the system. For groundwater recharge to occur, a minimum of 30 mm of rainfall has to fall in a single event. Since 2001, rainfall events exceeding 20 mm have declined, reducing recharge rates. Hydrological modelling confirmed that reduced rainfall is the main driver of groundwater depletion, both historically and in future projections.
- ❖ Land use has a significant impact on water availability. Scenarios involving different land uses—such as reduced commercial forestry, bush encroachment, irrigated and dryland cropping, and macadamia/marula cultivation—were assessed. A "No Forestry" scenario showed that without commercial forestry, current lake levels would be approximately 1.5 meters higher, even with two decades of low rainfall. Furthermore, the 14-year current breach in drought reserve would not have occurred. This suggests that afforestation has significantly contributed to groundwater depletion.
- ❖ Alternative land uses need to be water-wise. Irrigation is not a feasible option due to insufficient water availability. Dryland crops, such as cassava and marula, were identified as water-wise alternatives that warrant further exploration.
- ❖ Grasslands play a critical role in groundwater recharge and should be prioritised for conservation and protection.

Thus, from a water perspective, to minimize water scarcity, a least-regret strategy should as a priority be adopted. The remaining grassland areas within the region must be protected and managed to support groundwater recharge. Further options which need to be explored include a conversion of commercial plantation forestry to water-wise, climate-smart alternatives, e.g. cassava and Marula, combined with improving animal husbandry, commercial processing of high value products from these, as well as optimising benefits from tourism.

Case Study Prepared by: Michele Toucher, Susan Janse van Rensburg, Mkholo Maseko

Affiliated institution: South African Environmental Observation Network Foundation

4.2 Surface Water Resource Quality

The Department of Water and Sanitation seeks to ensure that surface water is suitable for designated uses ("fitness-for-use") while protecting and preserving aquatic ecosystems. The department implements various programmes to monitor water quality and the health of aquatic environments across the country. These efforts aim to provide essential data, information, and expertise nationally, serving as crucial inputs for national and international water resource management and planning.

This section will present an overview of the country's surface water quality and ecological conditions based on selected national monitoring programs during the current reporting period.

4.2.1 Inorganic Surface Water Chemical Pollution

Salinity: Salinity is measured using various water quality indicators, such as Total Dissolved Solids (TDS), Electrical Conductivity (EC), and concentrations of ions like sodium, chloride, magnesium, potassium, and sulphate. High concentrations of salt have an adverse effect on the taste and freshness of water. Furthermore, excessive salt can cause corrosion in water distribution pipes, increasing maintenance costs.

Figure 4.4 presents the "Irrigated Agriculture Fitness-for-Use" which includes a limited number of relevant variables for the current and previous reporting period. The observations regarding Electrical Conductivity (EC) were made as follows:

- In the lower Olifants Water Management Area (WMA), a site on the Ga-Selati River was observed to have elevated EC levels, categorising it within the fair range. However, it is important to clarify that this is not the same site reported last year (Figure 4.4A) with elevated EC levels, as it has since improved and is now classified within a "good" range.
- Nine sites within the Vaal WMA displayed elevated EC levels that were categorised in the fair range, indicating an improvement from the previous year when some sites were noted as being in the poor range. The remaining sites in the Vaal fell within the "good" category.
- One site each in the Berg-Olifants WMA and the Inkomati-Usuthu WMA were recorded to be within the same range. These sites have demonstrated persistent elevation, as illustrated in Figure 4.4a, which indicates a similar case to the one reported in the previous year.
- Several sites in the Orange, Breede-Gouritz, and Mzimvubu-Tsitsikamma WMAs are categorised as fair, while others are classified as poor or not suitable for irrigation. The Breede-Gouritz, and Mzimvubu-Tsitsikamma WMAs are showing a decline in terms of EC, as illustrated in Figure 4.4B, indicating that during the current reporting period, a greater number of sites were classified as either poor or Not Fit for irrigation compared to the previous reporting period.

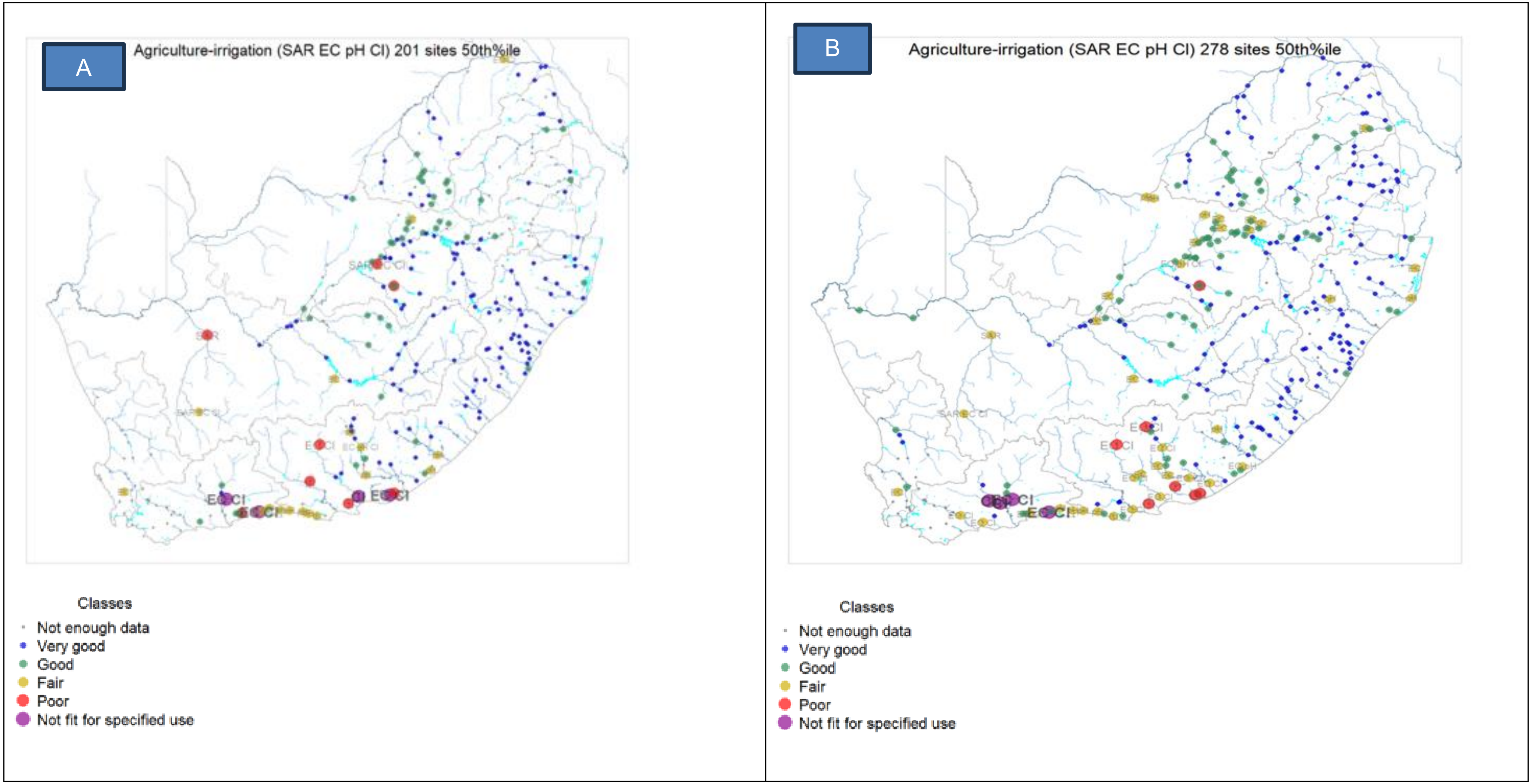


Figure 4.4: The salinity concentrations and suitability "for agricultural use" for (a) 2022/23 HY, and (b) 2023/24 HY.

NOTE: In the fair range, a low-frequency irrigation system can maintain a 90% relative yield of moderately salt-tolerant crops, while in the poor range, low-frequency irrigation can still achieve an 80% relative yield. Beyond this range, specific crops may be irrigated with sound management practices and acceptable yield reductions.

The Sodium Adsorption Ratio (SAR) indicates the likelihood of irrigation water creating sodic soil conditions, which can negatively affect crop yield and quality by increasing sodium uptake in sensitive plants and reducing soil permeability. Chloride (Cl) is a crucial micronutrient for plants but can cause injury, such as leaf burn, when levels are too high. In the Vaal WMA, two sites had elevated chloride levels, which were categorized as Fair and Poor. The lower Orange WMA had one site in the Fair range, and twelve sites in Mzimvubu-Tsitsikamma were classified as Fair or Poor. The Breede-Gouritz WMA had four sites rated Fair and four others that were not fit for irrigation.

Extreme pH levels can adversely affect crops by solubilizing toxic heavy metals. While pH does not directly affect crops, caution is advised for values outside the Ideal range. Notable high pH levels were found at two sites in the Vaal WMA, while significantly low levels were recorded at three sites in the Breede-Gouritz WMA.

These low pH levels may be naturally occurring and not indicative of water quality problems.

Case Study: Contribution of the Vaal Dam, Klip, Rietspruit and Suikerbosrand Rivers to Increased Nutrient Levels at the Vaal Barrage: A Historical Overview

The section of the Vaal River between the Vaal Dam and the Vaal Barrage is known for high nutrient levels, which have resulted in excessive growth of algae and aquatic plants. *Figure 4.5* indicate that both phosphate and nitrate concentrations are significantly higher at the Vaal Barrage compared to the Vaal Dam. This disparity between the two locations has become even more pronounced since the early 2000s.

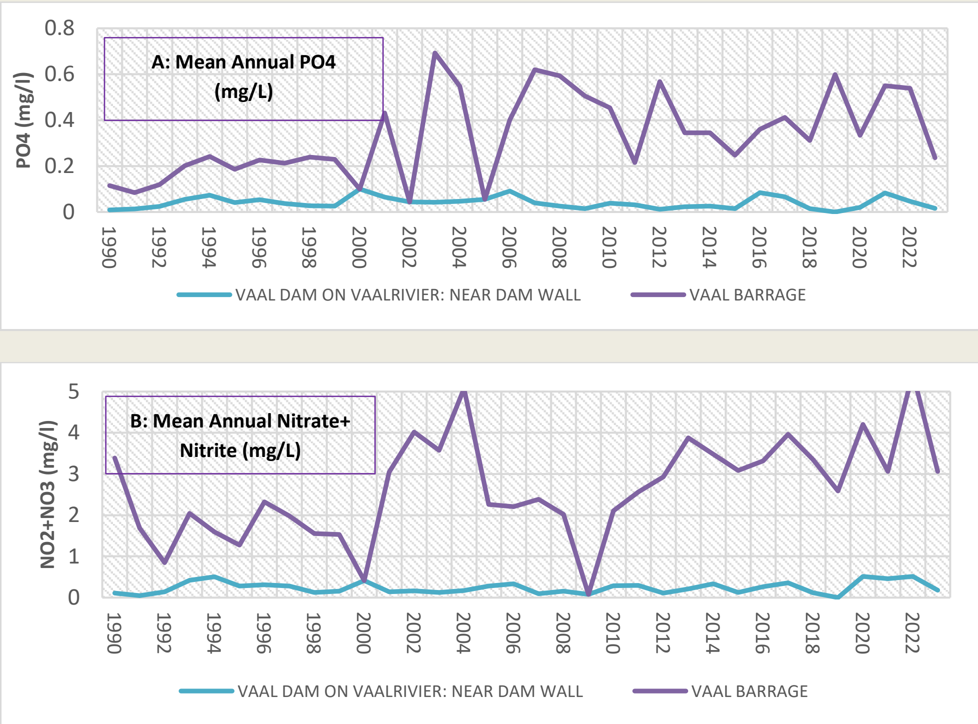


Figure 4.5: Ortho Phosphate and B) Nitrate Levels in the Vaal Dam and Vaal Barrage from 1990 to 2023.

The Vaal Barrage is primarily supplied by flows from the Vaal Dam, along with the Klip, Suikerbosrand, and Rietspruit rivers. These three rivers drain large urban areas, both formal and informal, as well as mining and industrial zones located to the east and southwest of Johannesburg. Consequently, there is an increased pollution load in the waters upstream of the Vaal Barrage. The long-term nutrient levels in these three tributaries, measured before they converge with the Vaal River, are illustrated in Figure 4.6. For reference, the nutrient levels in the Vaal Dam and the Vaal Barrage are also shown. Although the nutrient levels shown in the graphs indicate high pollution levels in these tributaries, it's essential to consider that differences in catchment size and characteristics affect the flow rates and volumes entering the Vaal River. The amount of nutrients (nutrient load) flowing into the Vaal from these tributaries depends on both the concentration of nutrients and the volume of water.

Comparing the general flow rates, the Klip River averages between 15-35 m³/s, while the Rietspruit and Suikerbosrand range from 2-4 m³/s and 2-15 m³/s, respectively. This suggests that, with similar nutrient levels, the nutrient loads from the Klip River could be significantly higher than those from the Rietspruit and Suikerbosrand. From Figure 4.6, ***it's evident that the Klip and Rietspruit rivers are the main contributors to nutrient loads*.**

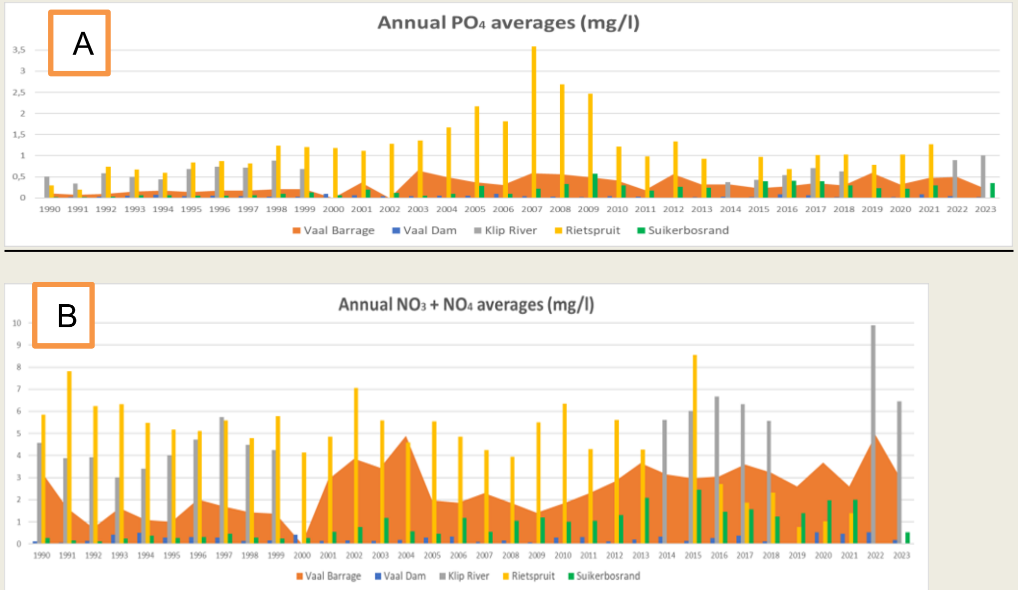


Figure 4.6: *Ortho Phosphate, B) Nitrate annual average levels in the Klip, Rietspruit and Suikerbosrand rivers from 1990 to 2023.*

4.2.2 Trophic Status

Eutrophication is the excessive enrichment of water with nutrients, particularly phosphorus and nitrogen, leading to water quality deterioration due to the overgrowth of macrophytes, algae, or cyanobacteria. In South Africa, the primary sources of these nutrients include sewage treatment plant discharges, agricultural and urban runoff, and industrial wastewater.

Eutrophication causes biodiversity loss, animal deaths, increased water treatment costs, chronic health issues from toxins in drinking water, and unpleasant taste and odour that affects recreational use. Table 4-1 below summarizes the various trophic status classes of water bodies, while Table 4-2 outlines the criteria for assigning trophic status based on median Chlorophyll-*a* concentration values and the percentage of time concentrations exceeding 30 µg/L. The annual median total phosphorus values also indicate the potential for algal and plant productivity across trophic classes. The comparison of trophic status and trophic potential in the current and previous Hydrological Years (HYs) for all ONEMP sites is presented in Figure 4.7 and Figure 4.8, respectively.

Table 4-1: Trophic status classes used for assessment of dams in South Africa.

Oligotrophic	Mesotrophic	Eutrophic	Hypertrophic
Low in nutrients and not productive in terms of aquatic animals and plant life.	Intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life, and showing emerging signs of water quality problems.	Rich in nutrients, very productive in terms of aquatic animal and plant life, and showing increasing signs of water quality problems.	Very high nutrient concentrations where plant growth is determined by physical factors. Water quality problems are serious and can be continuous.

Table 4-2: Criterion used to assign trophic status for the dams in South Africa.

Statistic	Unit	Current trophic status			
Median annual Chl *a*	µg/l	0<x<10	10<x<20	20<x<30	>30
		Oligotrophic (low)	Mesotrophic (Moderate)	Eutrophic (significant)	Hypertrophic (Serious)
% of time Chl a> 30µg/l	%	0	0<x<8	8<x<50	>50
		Negligible	Moderate	Significant	Serious
Potential for algal and plant productivity					
Median annual Total Phosphorus (TP)	mg/l	x<0.015	0.015<x<0.047	0.047<x<0.130	>0.130
		Negligible	Moderate	Significant	Serious

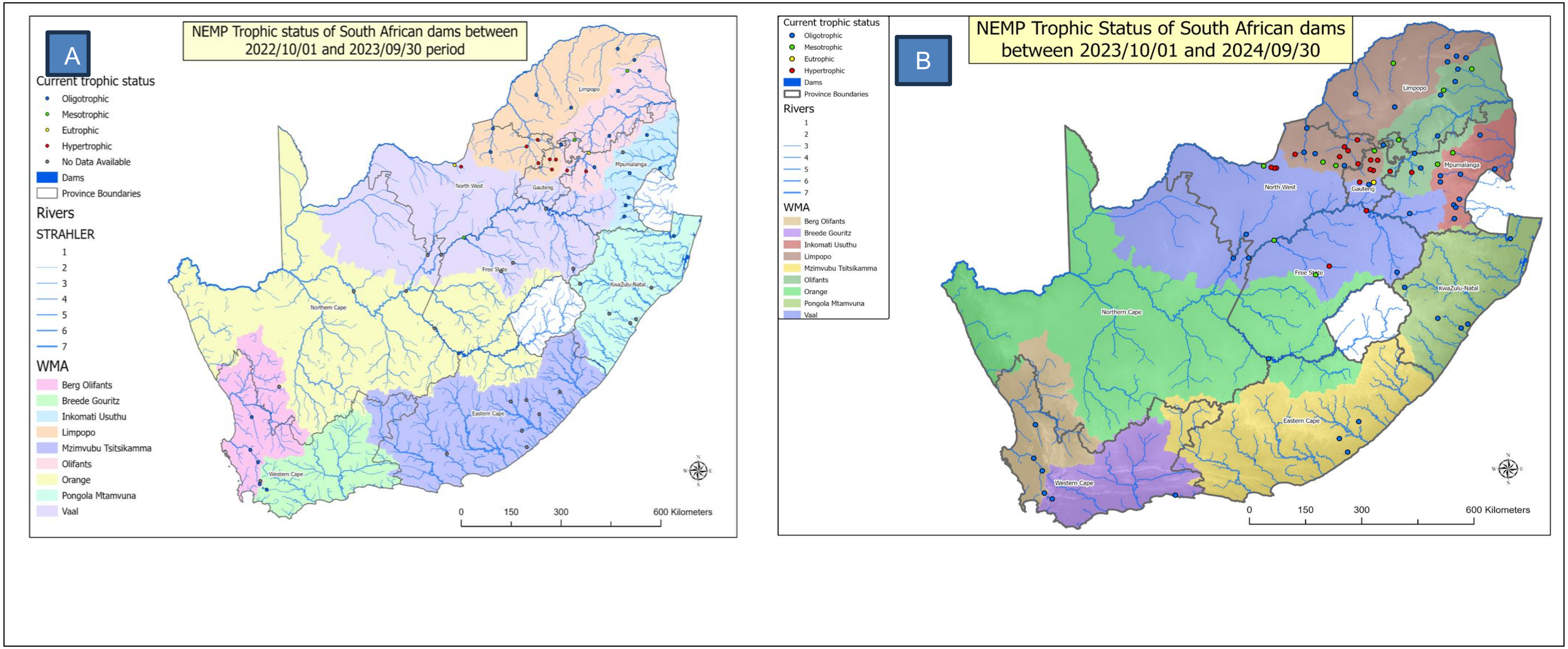


Figure 4.7: NEMP Trophic status analysis for the sites monitored between October 2023 and September 2024.

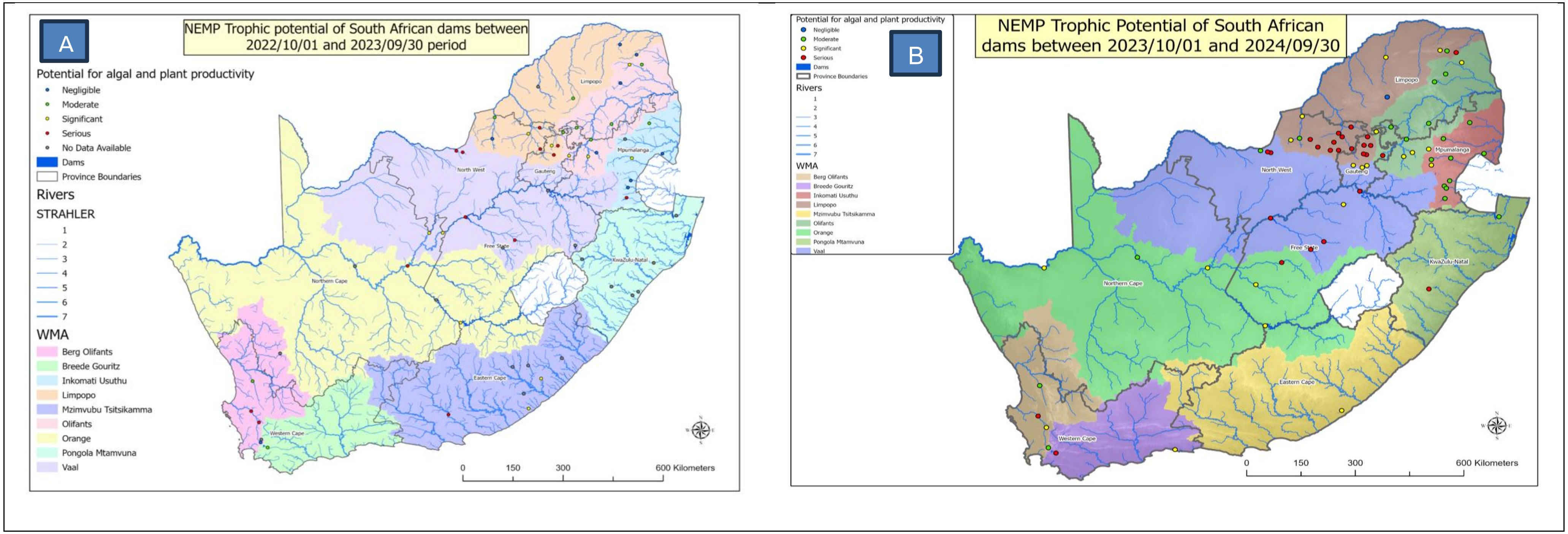


Figure 4.8: Trophic potential of the ONEMP sites for the (a) 2022/23 HY and (b) 2023/24 HY.

Trophic status and eutrophication potential were assessed at 78 of the 82 ONEMP sites. The chlorophyll-a concentration was used to determine trophic status, while the total phosphorus (TP) concentration determined trophic potential from October 2023 to September 2024. Eighteen sites were deemed hypertrophic, one eutrophic (Homestead Lake in Benoni), twelve mesotrophic, and 47 oligotrophic. It is worth noting that the hypertrophic status of the Rietvlei Dam and Hartbeespoort Dam has not changed since the previous hydrological year, whereas mesotrophic sites included the Koster Dam and Olifantsnek Dam. Oligotrophic sites showed low nutrient levels and reduced aquatic productivity.

Twenty-six of the sixty-nine sites analysed had a high potential for eutrophication, an improvement over the previous year when 49 sites across the country had high nutrient levels with significant to serious algae and potential plant productivity. Moreover, twenty-one (21) sites had significant potential, twenty-one had moderate potential, and one had negligible potential. The majority of sites with serious eutrophication issues are located in densely populated areas with overburdened sewage systems as a result of rapid population growth, inadequate infrastructure, and industrial activity.

High nutrient levels in hypertrophic and eutrophic sites increase the risk of algae and plant growth.

4.2.3 Microbial Pollution

Microbial pollution of surface waters is a major public health concern, particularly in areas with inadequate wastewater management and sanitation facilities. The National Microbiological Monitoring Programme (NMMP) seeks to assess the extent of faecal pollution in surface waters and the potential health risks associated with its use. The program employs E. *coli* as an indicator organism due to its strong association with faecal contamination and associated health risks. The E. *coli* testing results are compared to the South African Water Quality Guidelines (Table 4-3) to analyse potential microbial health risks.

Figure 4.9 compares microbiological data collected in hotspots across the country for the analysis of suitability for recreational activities and irrigating crops that are eaten raw, for the 2022/23 and 2023/24 HYs.

Table 4-3: Guidelines for assessing the potential health risk of using raw water for four water uses

	Potential health risk		
	Low	**Medium**	**High**
Water use	***E. coli* counts/ 100ml**		
Full-contact recreational	< 130	130 – 400	> 400
Irrigation of crops to be eaten raw	< 1 000	1 000 – 4 000	> 4 000

A total of 75 hotspot sites across the country were monitored to assess the microbial quality of the water during the current reporting period. Microbiological data collected from October 2023 to September 2024 indicate that 70% of the sampled sites were deemed unsafe for recreational activities, an increase of 3% compared to the previous HY (Figure 4.9 A and Figure 4.9 B).

Similarly, in the current reporting period, the number of sites deemed unsuitable for irrigating crops intended for raw consumption increased from 41% reported in the previous year (Figure 4.9C and Figure 4.9D) to 48% in the 2023/24 HY. This poses a high risk of infection for individuals engaging in such activities, which include full-contact events like swimming, washing laundry, and traditional practices such as baptisms that are common in NMMP hotspot sites. The increase in sites deemed unsuitable for irrigation and recreational activities, indicated by E. *coli* in water, points to recent faecal contamination. This situation raises concerns regarding the effectiveness of wastewater treatment, potentially highlighting inadequate removal of pathogens or insufficient disinfection processes in the treated water discharged into the river system near these sites.

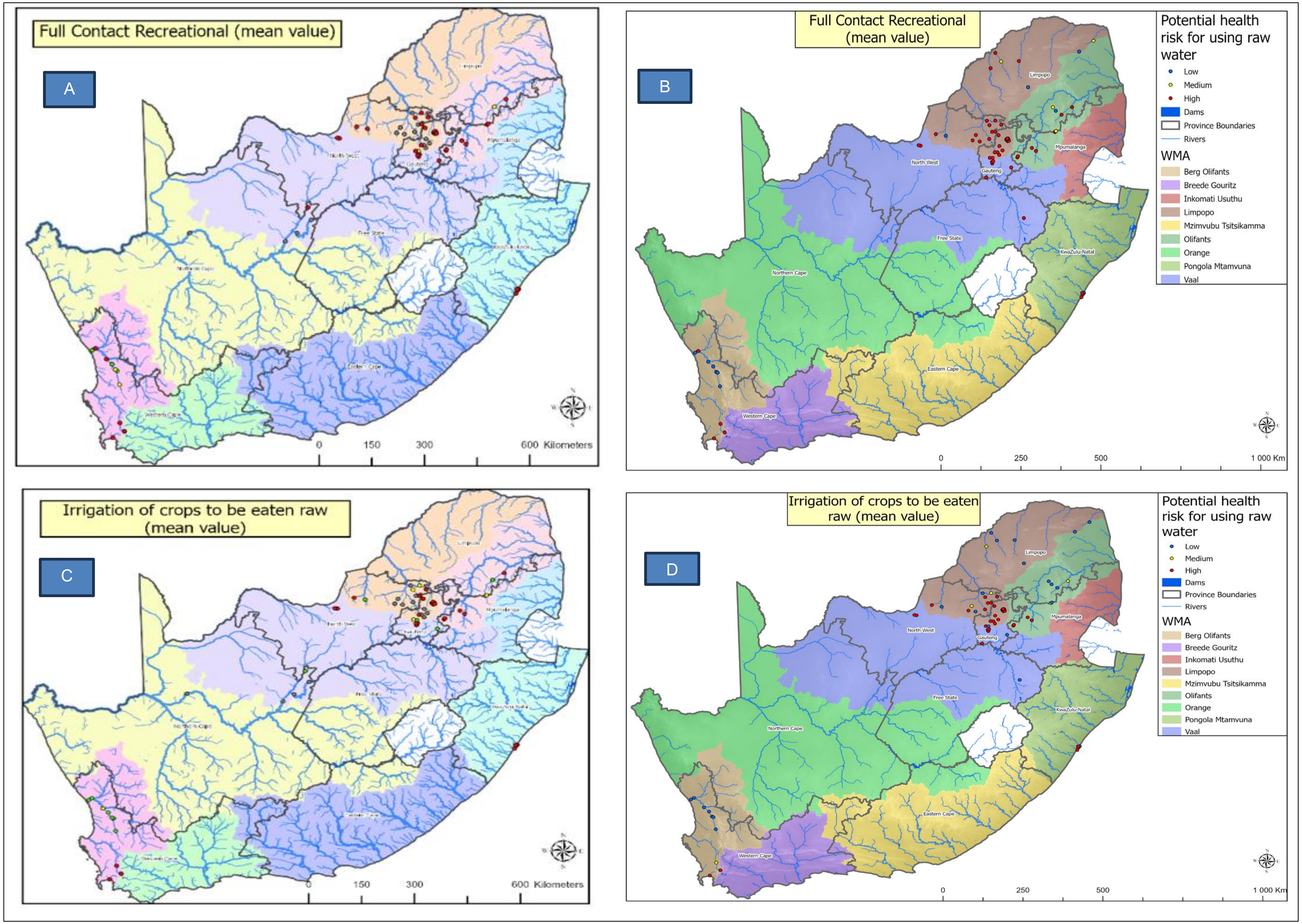


Figure 4.9: Faecal pollution data for (A&C) HY 2022/23 and (B&D) HY 2023/24.

4.3 Estuaries Water Quality

The data for the National Estuarine Monitoring Programme (NESMP) was interpreted using a variety of information sources, including the South African Water Quality Guidelines for Coastal Marine Waters (DWAF, 1996), guidelines for establishing environmental quality objectives and targets in the coastal zone of the Western Indian Ocean Region (UNEP/Nairobi Convention Secretariat and CSIR, 2009), recreational use guidelines (DEA, 2012), and the significance of the River-Estuary Interface (REI) Zone (Bate *et al*., 2002). The results are shown in Figure 4.10, the values on the map represent the data range for medium to high concentrations of the variables listed.

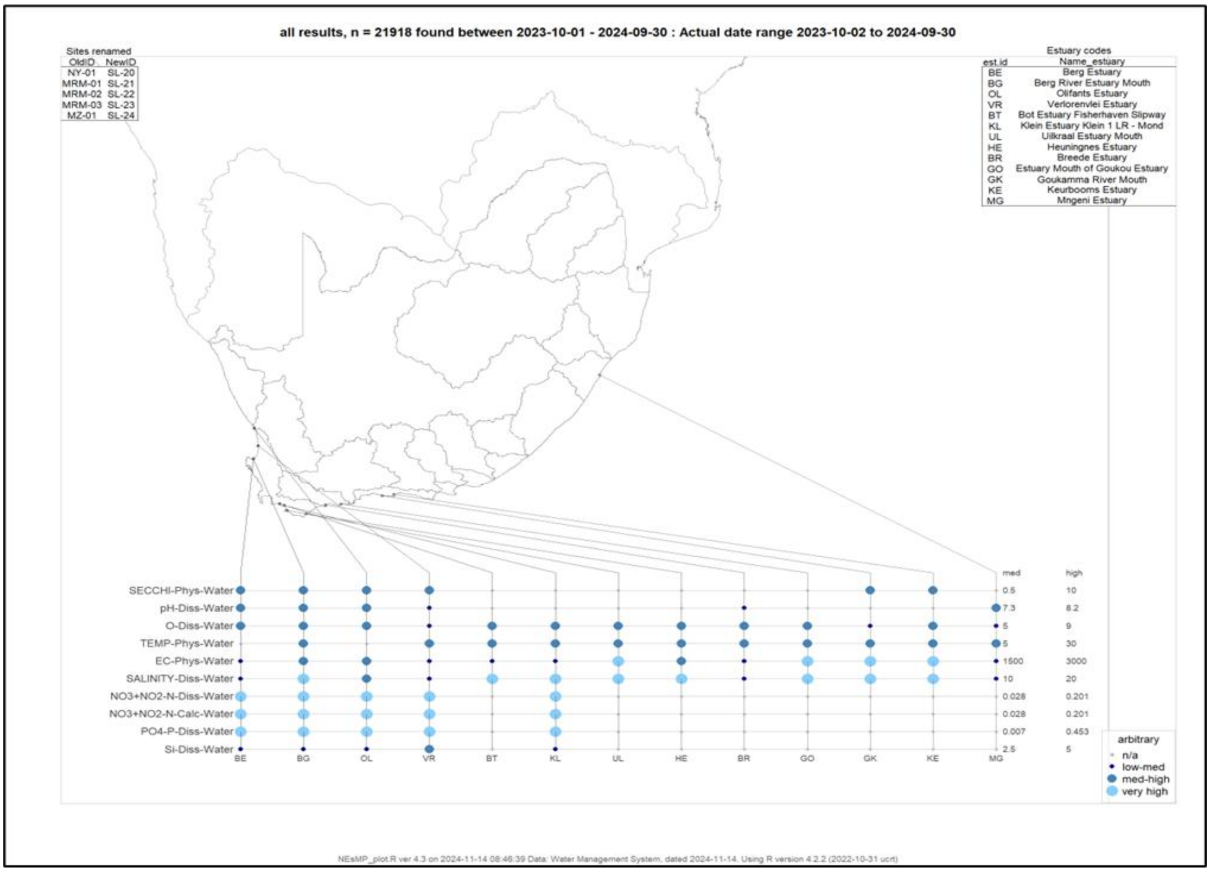


Figure 4.10: Summary of findings from 12 estuaries monitored during the 2023/2024 hydrological cycle.

The Berg, Bot, Uilkraal, Heuningnes, Goukou, Goukamma, and Keurbooms estuaries have high salinity concentrations, reflecting seawater penetration and creating a salinity gradient that influences the biodiversity of these estuarine systems. In contrast, the Olifants, Verlorenvlei, Breede, and uMngeni estuaries have low salinity levels, indicating a high flow of freshwater from upstream areas into the estuary.

The pH levels in the Berg, Olifants, and uMngeni estuaries varied between 7.3 and 8.2. However, low pH levels were detected in the Verlorenvlei and uMngeni estuaries. The Verlorenvlei Estuary has been experiencing drought since 2017, with no freshwater flowing into it until June 2023. This prolonged drought resulted in acidic conditions in the estuary. Currently, water is flowing into Verlorenvlei, but the system is still recovering.Low pH levels in the uMngeni Estuary are the result of industrial effluent discharges.

Temperatures in the estuaries varied from 5 to 29 °C over the hydrological year, reflecting seasonal variations. Verlorenvlei, Goukamma, and uMngeni estuaries had relatively low dissolved oxygen levels (less than 4 mg/L). These low oxygen levels are caused by insufficient system flushing, particularly in the estuary's deeper pockets, which increases stress on the biota and causes fish kills. In contrast, the remaining estuarine systems are well-oxygenated, with oxygen concentrations exceeding 5 mg/L.

The Berg, Olifants, Verlorenvlei, and Klein estuaries had relatively high nutrient levels for nitrate + nitrite and orthophosphate (above 0.201 mg/L for nitrogen and 0.453 mg/L for phosphorus). The elevated nutrient concentrations could be due to agricultural runoff from activities higher up in the catchment areas. It is worth noting that no nutrient samples were collected from the Bot, Uilkraal, Heuningnes, Breede, Goukou, Goukamma, Keurbooms, or uMngeni estuaries.

4.4 River Ecological Status

In the 2023/24 hydrological year, riverine macroinvertebrates were evaluated at 480 sites using the Macroinvertebrate Response Assessment Index Version 2 (MIRAI v2). Alongside MIRAI, various other indices were utilized to assess certain sites. The Riparian Vegetation Response Assessment Index (VEGRAI) was implemented at 267 locations, fish indices were employed at 194 locations, the Index of Habitat Integrity (IHI) was evaluated at 198 locations, and the Geomorphology Driver Assessment Index (GAI) was applied at 53 locations. The guidelines for interpreting River Eco-status results are provided in Table 4-4, and the results for 2023/24 are shown in Figure 4.11.

Table 4-4: Generic guidelines for interpreting change in ecological categories (modified from Kleynhans 1996 & Kleynhans 1999).

ECOLOGICAL CATEGORY	GENERIC DESCRIPTION OF ECOLOGICAL CONDITIONS	GUIDELINE SCORE (% OF MAXIMUM THEORETICAL TOTAL)
A	**Unmodified/natural.** Close to natural or close to predevelopment conditions within the natural variability of the system drivers: hydrology, physico-chemical and geomorphology. The habitat template and biological components can be considered close to natural or pre-development conditions. The resilience of the system has not been compromised.	>92 - 100

ECOLOGICAL CATEGORY	GENERIC DESCRIPTION OF ECOLOGICAL CONDITIONS	GUIDELINE SCORE (% OF MAXIMUM THEORETICAL TOTAL)
A/B	The system and its components are in a close to natural condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a B category.	>88 - ≤92
B	**Largely natural with few modifications**. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged.	>82 - ≤88
B/C	Close to largely natural most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a C category.	>78 - ≤82
C	**Moderately modified.** Loss and change of natural habitat and biota have occurred in terms of frequencies of occurrence and abundance. Basic ecosystem functions are still predominantly unchanged. The resilience of the system to recover from human impacts has not been lost and it is ability to recover to a moderately modified condition following disturbance has been maintained.	>62 - ≤78
C/D	**The system is in a close to moderately modified condition most of the time.** Conditions may rarely and temporarily decrease below the upper boundary of a D category.	>58 - ≤62
D	**Largely modified.** A large change or loss of natural habitat, biota and basic ecosystem functions has occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.	>42 -≤58
D/E	**The system is in a close to largely modified condition most of the time.** Conditions may rarely and temporarily decrease below the upper boundary of an E category. The resilience of the system is often under severe stress and may be lost permanently if adverse impacts continue.	>38 - ≤42
E	**Seriously modified.** The changes in the natural habitat template, biota and basic ecosystem functions are extensive. Only resilient biota may survive and invasive and problem (pest) species may likely dominate. The resilience of the system is severely compromised as is the capacity to provide Ecosystem Services. However, geomorphological conditions are largely intact but extensive restoration may be required to improve the system's hydrology and physico-chemical conditions.	20 - ≤38

ECOLOGICAL CATEGORY	GENERIC DESCRIPTION OF ECOLOGICAL CONDITIONS	GUIDELINE SCORE (% OF MAXIMUM THEORETICAL TOTAL)
F	**Critically / Extremely modified.** Modifications have reached a critical level and the system has been modified completely with an almost complete change of the natural habitat template, biota and basic ecosystem functions. Ecosystem Services have largely been lost This is likely to include severe catchment changes as well as hydrological, physico-chemical and geomorphological changes. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible. Restoration of the system to a synthetic but sustainable condition acceptable for human purposes and to limit downstream impacts is the only option.	<20

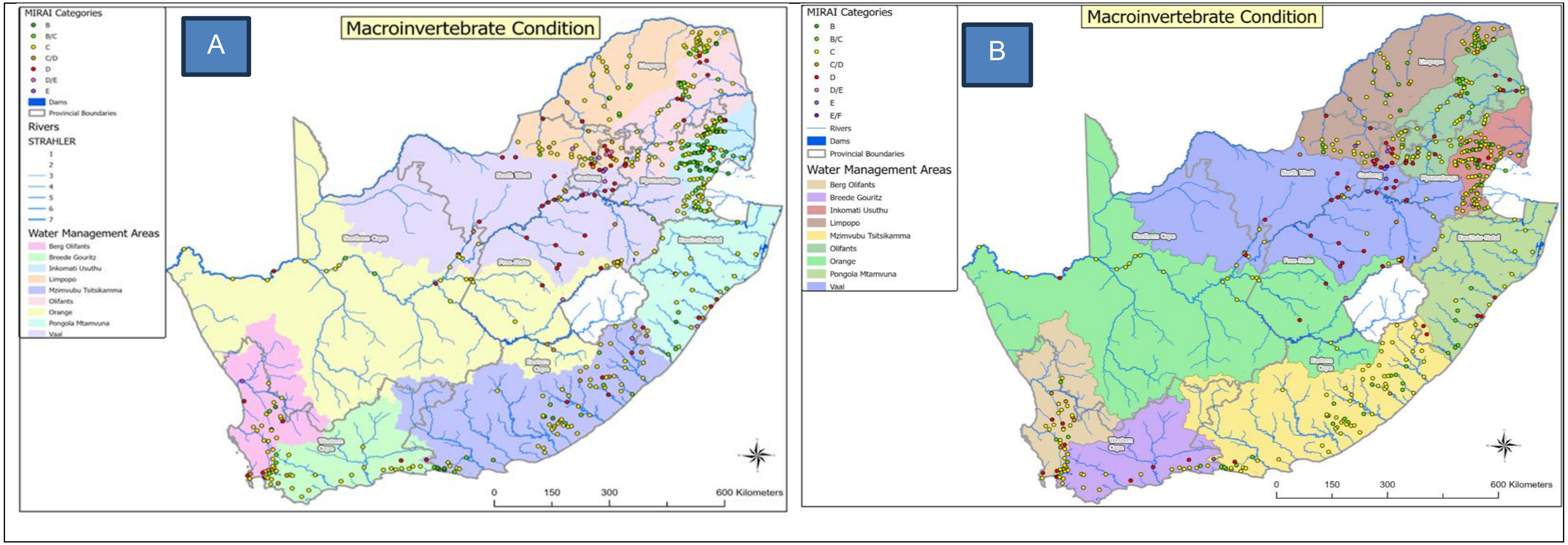


Figure 4.11: Summary of Ecological Categories illustrating the macroinvertebrate conditions for sites monitored during the (a)2022/23 HY, and (b) 2023/24 HY.

The moderately modified conditions have consistently been dominant in most river systems. In the previous hydrological year, 54% were identified as moderately modified (Category C), whereas in the current reporting period, this figure has risen to 59%. Furthermore, this report highlights a concern regarding the upper sections of the Crocodile West catchment, situated in Gauteng's industrial and urban zones. This includes the Jukskei River, Modderfonteinspruit River, and Crocodile River upstream of Hartbeespoort Dam, along with Hartebeesspruit just upstream of Roodeplaat Dam, as well as the Apies and Hennops Rivers, which have been assessed as being in very poor condition (Categories D/E and E) since the last HY.

Similarly, in alignment with the 2022/23 report, 20 sites in the Sabie catchment, 14 sites in the Komati catchment, and 13 sites in the Usuthu catchment demonstrated a significant number of sites categorized as being in largely or nearly largely natural conditions (B and B/C categories) in the current HY. The largely natural sites in the country are primarily located in the upper reaches near their sources, such as the Magalies, Debengeni, Berg, and Breede-Gouritz sites. Additionally, some sites were found in protected areas, including Eerste, Klerkspruit, Perskeboomspruit, Glen Reenenspruit, and Ribbokspruit, as well as in rural regions like the former Transkei, Mkomazi, Mhlatuze, and Pongola catchments.

Additionally, the riparian health data (Figure 4.12) collected from sites mainly in Gauteng province between August 2023 and March 2025 through the Citizen Science (CS) program aligns with the REMP data. The recent CS data reveal that only 2 of the 68 sites indicated good riparian health, while the remainder predominantly reported poor to very poor conditions. Similarly, data from 72 CS observations measuring water clarity from June 2023 to March 2025 indicated that 24% of the sites had very good water clarity, with the Apies at Groen Kloof site demonstrating exceptionally good water clarity. 75% of the monitored sites indicated water clarity ranging from poor to extremely poor.

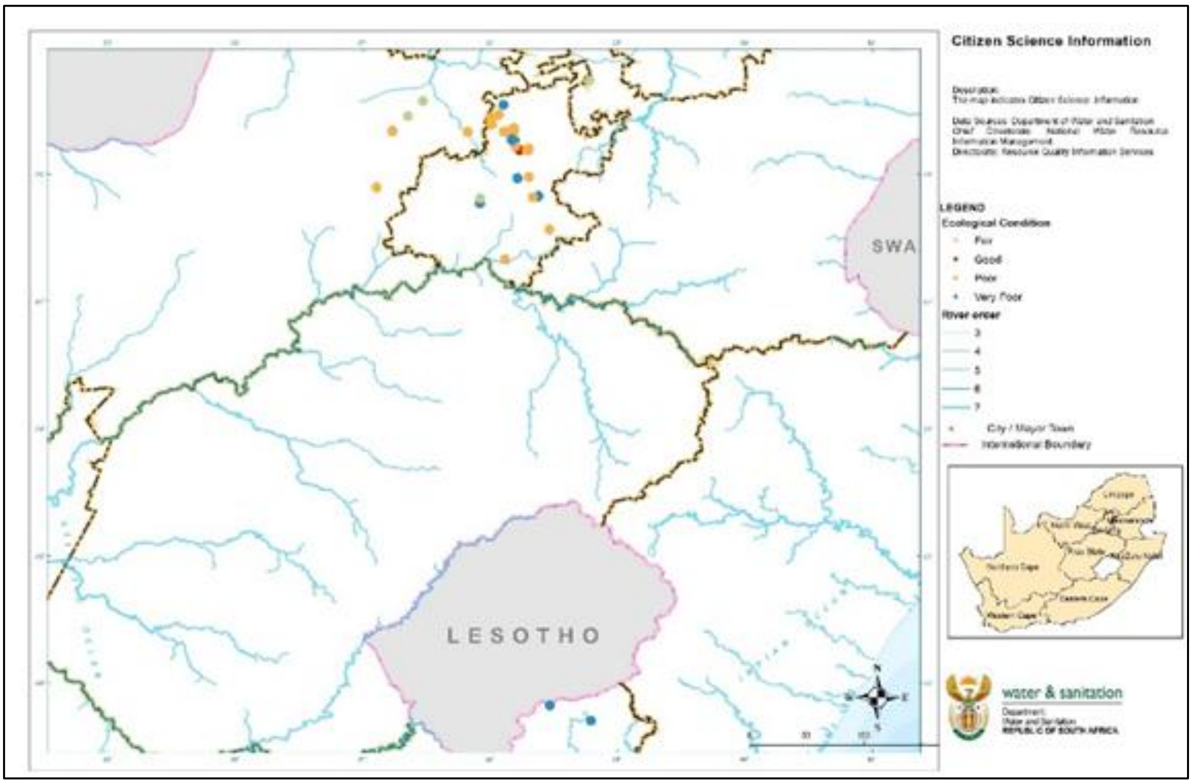


Figure 4.12: River ecological condition data collected from the Citizen Science programme.

The river condition trends illustrated in Figure 4.13 indicate there was an observed improvement in ecological conditions at 18% of the sites, while 23% experienced a decline. It is good to notice that although the proportion of sites remaining in the same condition has been relatively stable over the last four years, there has been an increase in the proportion of sites showing improvement over the last two hydrological years.

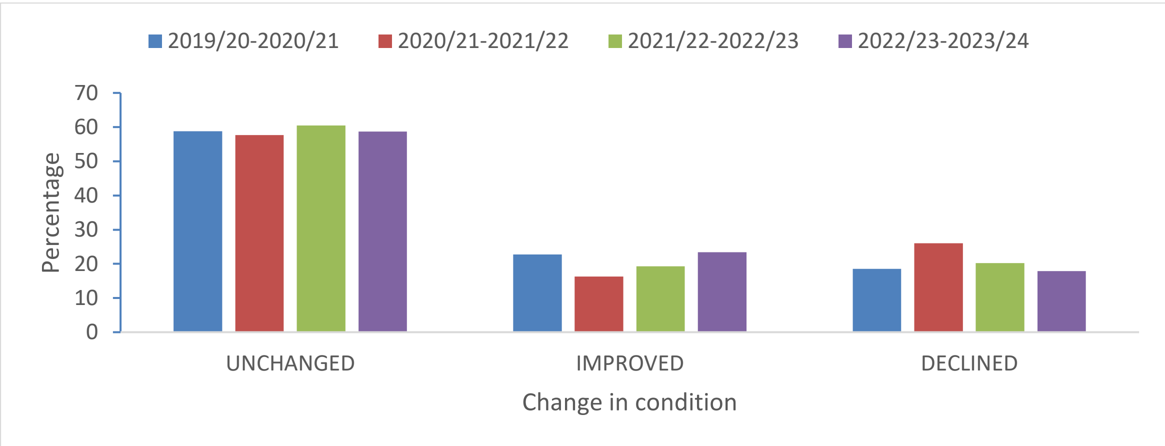


Figure 4.13: Trends in the Ecological Condition of macroinvertebrates at monitored sites

Case Study: Crocodile-West Marico Catchment: A Historical Ecological Conditions Overview

Fluctuations in the diversity of the macroinvertebrate community in the Crocodile-West River Catchment of North West Province have long indicated the impact of human activities. In most of the upper sub-catchments of the Crocodile-West River, macroinvertebrate conditions are primarily categorized between ***a largely modified (D) and a critically modified (F) state,*** particularly as they flow through cities and highly developed areas.

A study conducted by Gao *et al*. (2023) revealed an increase in pollution-resistant macroinvertebrates, such as *Chironomidae*, as urban water bodies continue to degrade. This trend signals declining water quality and a reduction in sensitive taxa. Contributing factors include discharges from wastewater treatment facilities, overflowing manholes, and return flows from various sources.

Agricultural activities and industrial effluents contribute to the deterioration of the ecological quality of water resources. This includes rivers such as the Jukskei, Pienaars, Apies, and Hennops, which all drain into the Crocodile River. Figure 4.14 below illustrates the trends and fluctuations in the ecological condition of macroinvertebrate populations from 2017/2018 to 2022/2023 HYs.

Most sites appear to be in stable condition, a success largely attributed to improved catchment management strategies and enforcement practices. These strategies include the implementation of citizen science activities, particularly in the upper parts of the catchment. This program encourages community involvement in river cleanups and the rehabilitation of riparian areas.

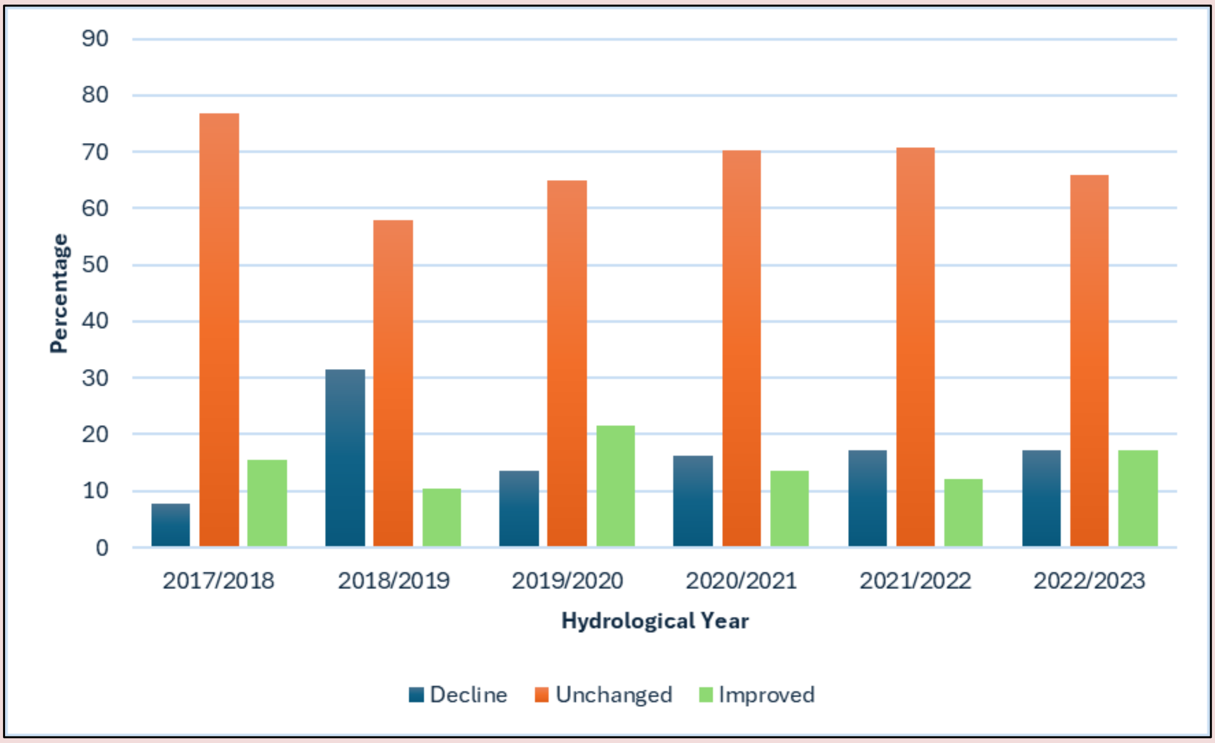


Figure 4.14: Crocodile-West Marico Catchment Macroinvertebrates Trends from 2017-2023

The sites located in the upper reaches of the catchment area, including the Magalies, Pienaars, Elands, Skeerpoort, and Sterkstroom rivers, generally maintain a better ecological condition. They range from close to natural (B/C) to moderately modified (C) due to limited human interference. A study conducted by Orozco-González and Ocasio-Torres in 2023 found that river sections located in the upper reaches, within nature reserves or protected areas with minimal human interference, typically have better ecological conditions compared to river stretches that are urbanized, developed, or outside of nature reserve.

4.5 National Wetland Desktop Assessment Indicators

Due to limited data availability on the national ownership dataset surrounding wetlands, this section will focus on three of the Tier 1 indicators. Additionally, while data is available for nine Water Management Areas (WMAs), this report will use the Limpopo WMA to demonstrate the methodology used to determine the overall national picture concerning the extent of landcover in and surrounding the country's wetlands and the level of protection. The National Wetland Map 6 (Figure 4.15) will be used as a baseline dataset for each national assessment indicator.

Tier 1 indicators provide a comprehensive overview of the wetlands across the country. For instance, the wetlands in the Limpopo Water Management Area (WMA) cover only a small portion of the country's total water management areas (2.13%) but enjoy a moderate to high level of legislative protection. It is noteworthy that 92% of these wetlands are located in areas officially designated as protected under several laws, including the National Environmental Management: Protected Areas Act, the World Heritage Convention Act (Act 49 of 1999), and the Mountain Catchment Areas Act (Act 63 of 1970).

4.5.1 National extent of wetlands in South Africa

The map presented in Figure 4.15 displays the most recent coordination of wetland mapping conducted by the South African National Biodiversity Institute (SANBI) on behalf of the country's water sector. The total wetlands in South Africa is estimated to be 3,856,000 hectares (approximately 38,560 km²), representing 3.15% of the country's total land area. Table 4-5 below breaks down the extent (size) of wetlands by water management areas across the country.

Table 4-5: The National Wetlands Map 6 areas of the different WMAs and their percentage coverage

WMA	NWM 6 (km^2)	WMA Area (km^2)	% of WMA
Limpopo	2342	109978	2.129858758
Olifants	2051	73713	2.782368717
Inkomati Usuthu	1383	36639	3.775994376
Orange	14938	355588	4.200890041
Vaal	7539	246622	3.056919736
Pongola Mtamvuna	5004	93764	5.336294088
Berg Olifants	1466	70543	2.078408134
Mzimvubu Tsitsikamma	1528	163590	0.933789639
Breede Gouritz	2309	72612	3.179842145

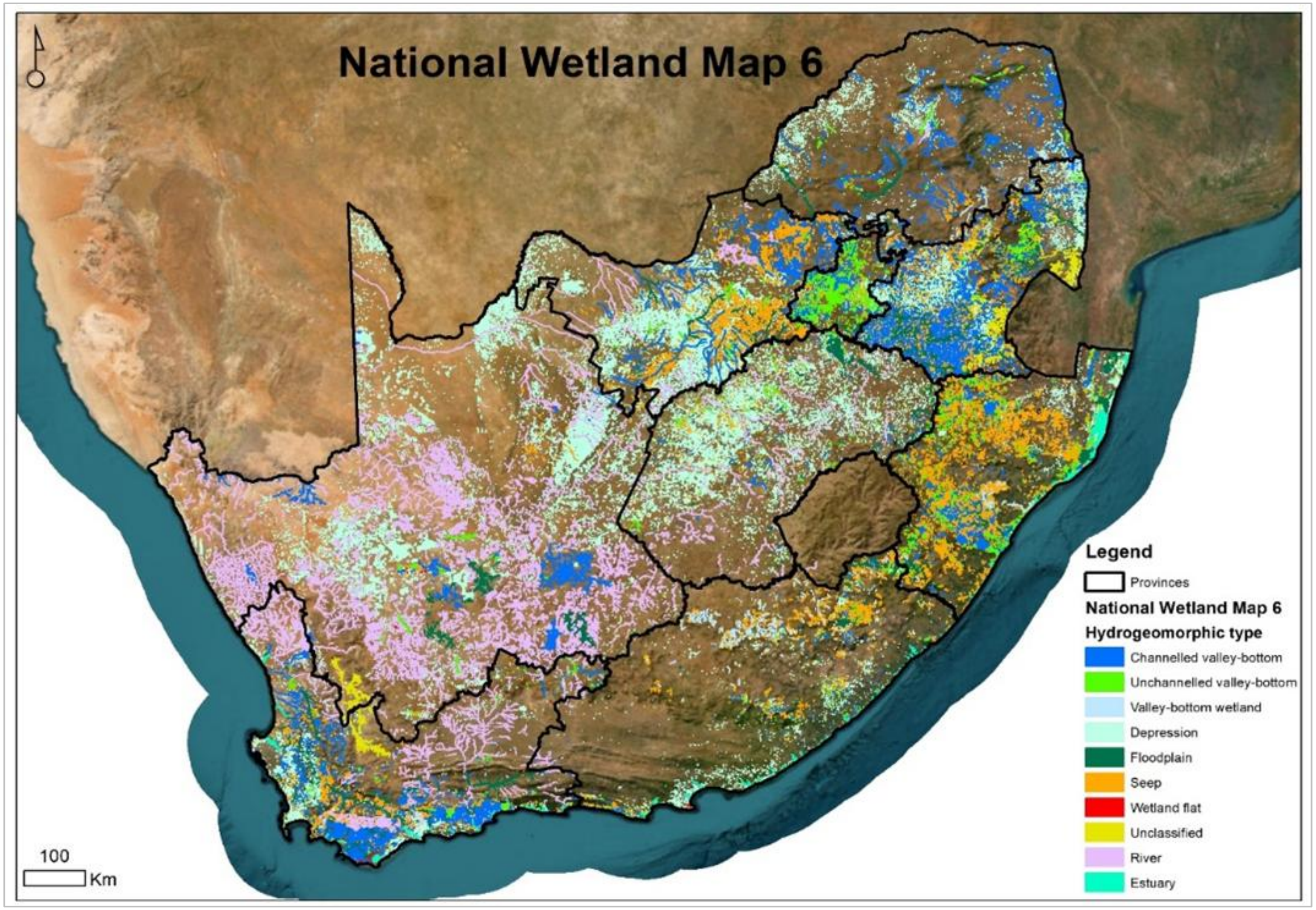


Figure 4.15 National Wetland Map (NWM) Version 06 showing the extent of wetlands (based on Hydrogeomorphic type, HGM) in South Africa

- *National extent of land cover types in and around wetlands in South Africa*

A total area of 259,102 hectares was reported for various land cover types including wetlands, in the Limpopo Water Management Area (WMA) (Table 4-6). Within a 100-meter radius around the wetlands in this WMA, the most common land cover type was forest land, comprising 48.23% of the area, while shrubland was the least common, accounting for only 0.01%. Figure 4.16, provides a national picture when all the information from different water management areas is aggregated.

Table 4-6: Area and percentage of land cover types within 100 meters of wetlands in the Limpopo WMA

Landcover Type (level1)	Area km^2	Area (%)
Grassland	461.006192	17.8
Waterbodies	14.979192	0.58
Barren Land	15.735411	0.61
Wetlands	94.723753	3.66
Built-up	283.338062	10.94
Cultivated	466.131572	18.0
Mines & Quarries	5.162245	0.20
Shrubland	0.253578	0.01
Forested Land	1249.692618	48.23

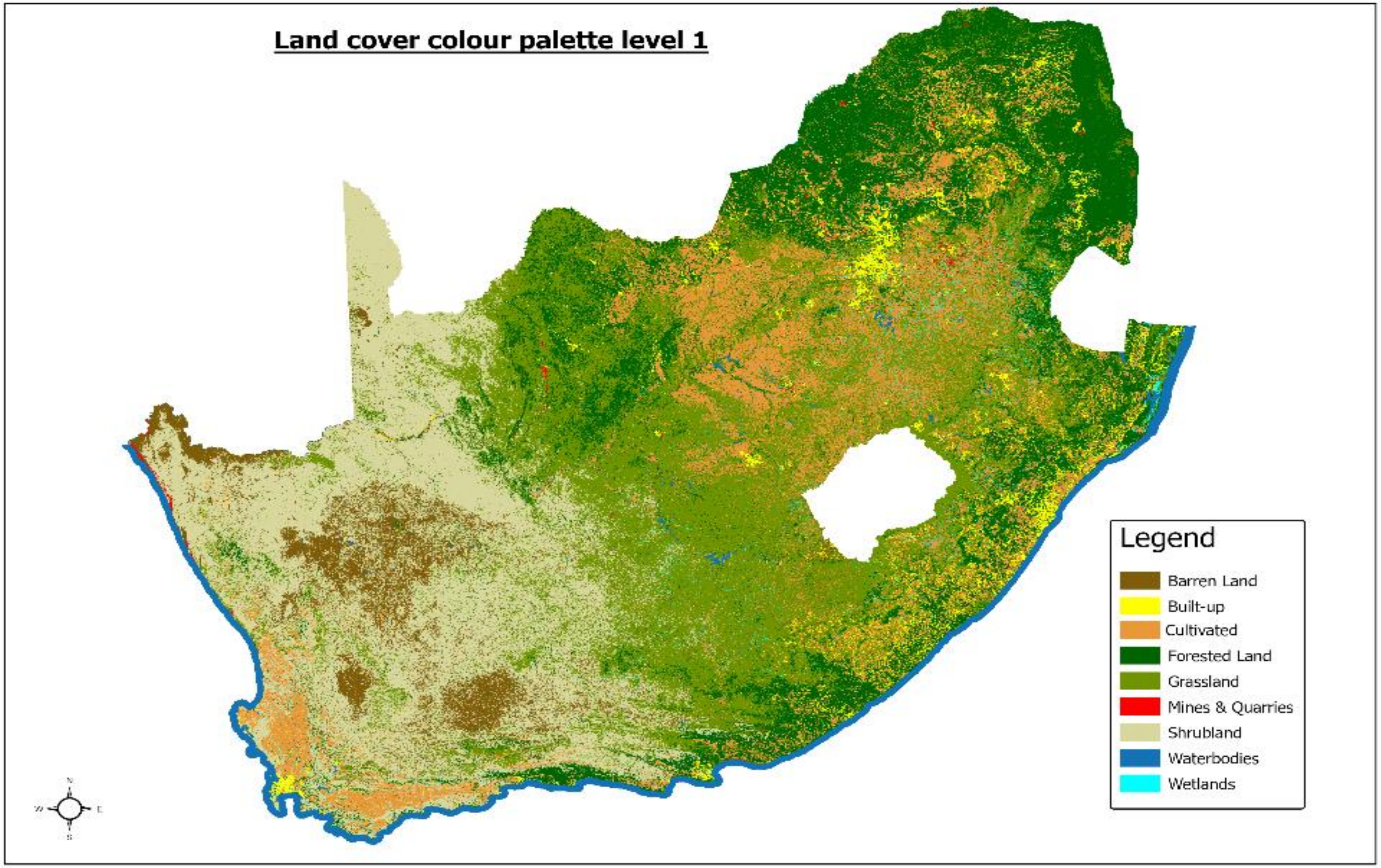


Figure 4.16: Final landcover palette level 1 (Ngcofe et al., 2020)

- *National extent of wetlands in various categories of protection in South Africa*

The layers of protection (SAPAD) and conservation (SACAD) were obtained to differentiate between various sub-types of protection and conservation areas, as shown in Table 4-7.

Table 4-7: Different types of protected and conservation areas

PROTECTED AREA TYPES	CONSERVATION AREA TYPES
National Parks	Biosphere Reserves
Nature Reserves	Conservancies
Special Nature Reserves	Botanical Gardens
Mountain Catchment Areas	
World Heritage Sites	
Protected Environments	
Forest Nature Reserves	
Forest Wilderness Areas	
Marine Protected Areas	

The total area of wetlands within conservation areas in the Limpopo Water Management Area (WMA) was reported to be 74740.80 hectares, while protected areas accounted for 116206.98 hectares (Table 4-8). Most of the wetlands in the Limpopo WMA are located in conservation areas designated as Biosphere Reserves, covering 46812.2 hectares, as well as in protected areas identified as Nature Reserves, totalling 107096.9 hectares (Table 4-9).

Table 4-8: Area and percentage of wetlands within various conservation areas in the Limpopo WMA

Site Type	Area km^2	Area ha	Area (%)
Biosphere Reserve	468.121588	46812.15875	62.65
Ramsar Site	278.742644	27874.26436	37.22
Botanical Garden	0.54377	54.376968	0.072
	747.408002	**74740.80008**	

Table 4-9: Area and percentage of wetlands within various protected areas in the Limpopo WMA

Site Type	Area km2	Area ha	Area (%)
Nature Reserve	1070.969171	107096.9171	92.08
Protected Environment	19.575767	1957.576731	1.69
World Heritage Site	21.852103	2185.210336	1.88
National Park	49.672743	4967.27427	4.27

Are wetlands in protected areas less vulnerable to land-based activities? A case study of the Kgaswane and Blesbokspruit Nature Reserve wetlands.

Kgaswane and Blesbokspruit Wetlands are Ramsar wetlands (Ramsar, 2019). Both wetlands are located within Nature Reserves, which are primarily governed by the National Environmental Management: Protected Areas Act of 2003 (Act 57 of 2003) and the Nature Conservation Ordinance No. 19 of 1974. As Ramsar sites, they have international conservation status under the Ramsar Convention of 1971 (Ambani, 2013), which aims to protect endangered species and threatened ecosystems in order to preserve biological diversity. However, a water quality assessment of the Kgaswane and Blesbokspruit wetlands suggests otherwise.

The physical, chemical, and microbiological properties of both wetlands were assessed. The electrical conductivity of the Kgaswane wetland was measured at ≤ 40 mS/m, which indicates very good water quality according to the Target Water Quality Ranges (TWQR) for aquatic ecosystems, agricultural, and domestic use (Figure 4.17A and B). In contrast, Blesbokspruit wetland showed TWQRs ranging from 40 to 90 mS/m, indicating good water quality, and from 90 to 270 mS/m, indicating fair water quality (Figure 4.17A).

The electrical conductivity of the Kgaswane wetland was measured at ≤ 40 mS/m, which indicates very good water quality according to the Target Water Quality Ranges (TWQR) for aquatic ecosystems, agricultural, and domestic use (Figure 4.17B).

A similar trend was observed for nitrogen where the Kgaswane wetland had nitrogen levels below 1.0 mg/l for NO3 + NO2 across all sites, reflecting very good water quality. In comparison, the Blesbokspruit wetland exhibited a range of nitrogen levels that included both good water quality (6 - 10 mg/l) and very good water quality (Figure 4.17C).

E. *coli* counts, which are typically indicative of faecal contamination, were found to be alarmingly high in March and April 2024 at Blesbokspruit wetland (Figure 4.17E), indicating extremely poor water quality. The elevated E. *Coli* levels were most noticeable at the wetland's two inlet sites, but decreased at the outlet site, indicating that the wetland's natural filtration properties are still in effect, despite the poor water quality.

In April 2024, Kgaswane wetland reported E. *Coli* counts of 400 to 800 MPN/100mL, indicating poor water quality. The evaluation of these two wetlands shows that the water quality varies despite existing legislation designed to protect them. Several factors can have an impact on water quality, including mining and industrial effluents, changes in land use that harm the environment, and sewage treatment plants that contribute to water pollution (Ambani and Annegarn, 2015). Finally, data on water quality indicate that, despite protective legislation for nature reserves, wetlands within these areas may remain vulnerable to land use practices occurring upstream and within the catchment area.

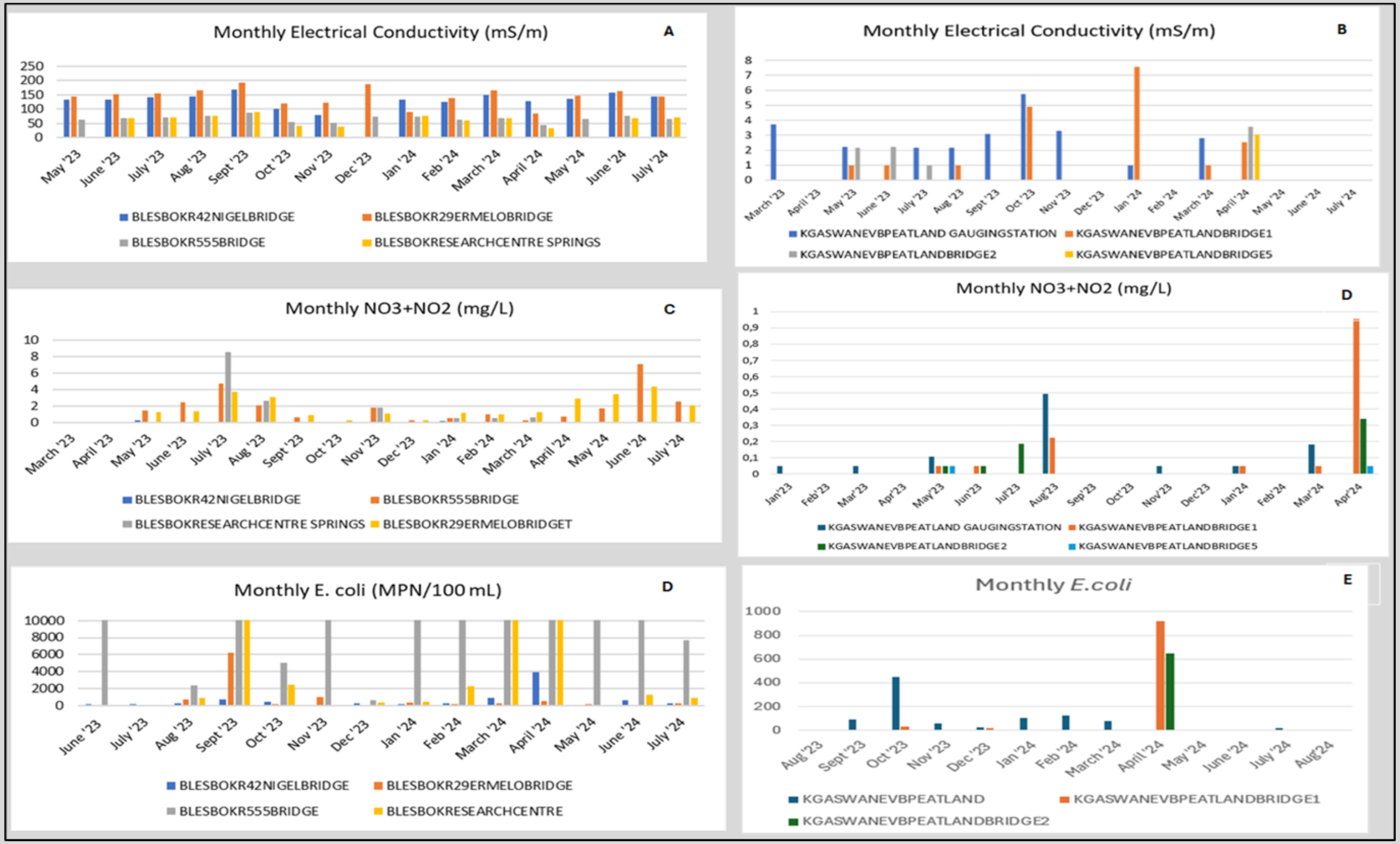


Figure 4.17: Comparison of the physical (electrical conductivity), chemical (Nitrate (NO3) and Nitrite (NO2)) and microbiological properties (E. coli) of Blesbokspruit and Kgaswane Wetlands.

5

SURFACE WATER STORAGE

5 SURFACE WATER STORAGE

5.1 National Storage

The national dam's water storage trends for the previous four hydrological years and the trend for the current hydrological year (2023/24) are presented in Figure 5.1. At the end of September 2024, the national dam levels were at **79.7%** of Full Supply Capacity (FSC). This level is lower than the last two hydrological years, at the same time of reporting when national storage levels were greater than 90% of FSC. **16%** of the national dams were **above 100% of FSC** (either full or spilling), **70%** were between 50 and 100% of FSC, **11.72%** were between 10 and 50% of FSC, and at least **1.4%** were below 10% of FSC (critically low).

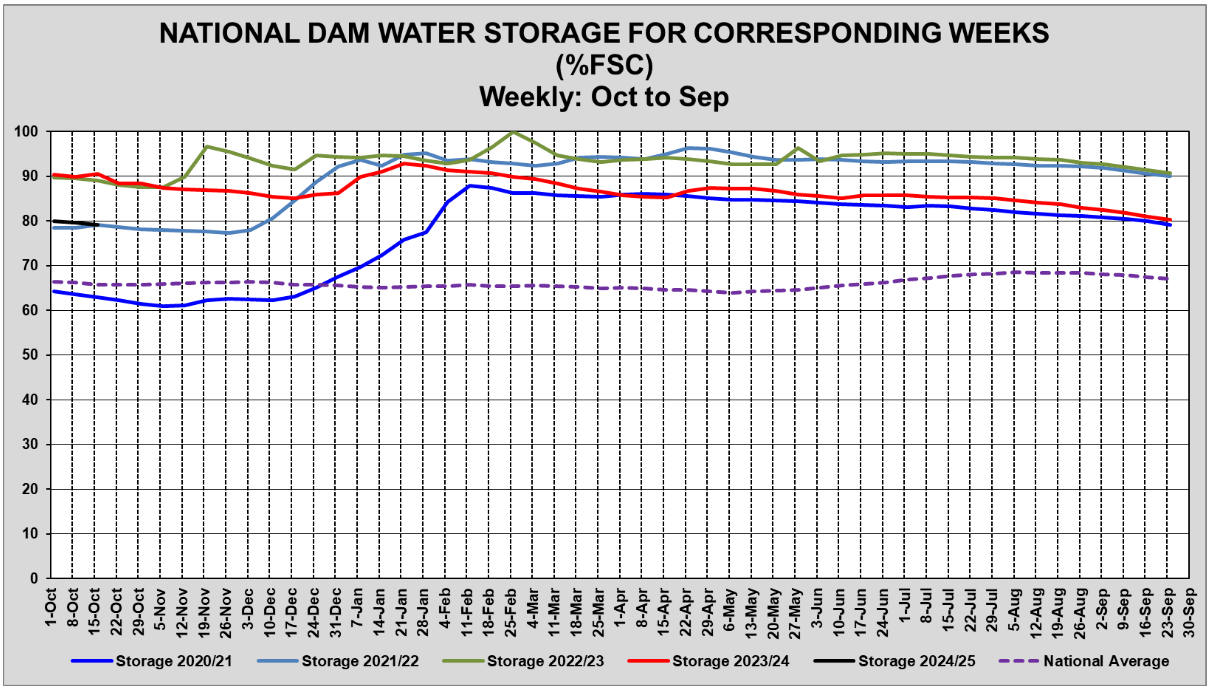


Figure 5.1: National Dam Storage end September 2024

The comparison between September 2023 and September 2024 of the country's five largest dam storage (% of FSC) is presented in Table 5-2. Due to the drier and warmer conditions experienced this spring compared to 2023, the Vaal Dam and Gariep Dam storage levels have declined by -39.5% and -16.8%, respectively.

The dams in critical storage conditions at the end of the reporting period were each from Eastern Cape and Limpopo. The list of dams at critical low storage levels (<10% of FSC) is given in Table 5-3.

Table 5-1 Surface storage at the end of September 2024

Provinces/Countries sharing Water Resources with RSA	Full Supply Capacity (FSC) million m^3	Total No. of Dams	Number of Dams per Province/Country				% of Full capacity		
			<10 (% of FSC)	10 - <50 (% of FSC)	50 - <100 (% of FSC)	>=100 (% of FSC)	Last Year 30/09/2023	Last Week 23/09/2024	This Week 30/09/2024
Kingdom of Eswatini	333.75	1			1		96.3	84.2	81.7 ↓
Eastern Cape	1730.13	46		6	39	1	83.8	77	77.3 ↑
Free State	15656.73	21		2	17	2	91.7	77.6	77.5 ↓
Gauteng	128.08	5			3	2	96	89.7	89.3 ↓
KwaZulu-Natal	4909.66	19			18	1	85.8	84.9	84.6 ↓
Kingdom of Lesotho	2362.63	2			1	1	89	77.4	77.7 ↑
Limpopo	1484.64	29	2	4	20	3	84	74.4	73.7 ↓
Mpumalanga	2538.57	22		3	19		93.2	85.1	84.0 ↓
Northern Cape	149.28	5		1	2	2	86.7	79	76.6 ↓
North West	867.29	28	1	9	14	4	83	65.7	65.7 =
Western Cape - Other Rainfall	269.55	22		1	12	9	86	92	92.2 ↑
Western Cape - Winter Rainfall	1596.8	22			11	11	97.1	94.6	95.0 ↑
Western Cape - Total	1866.35	44	0	1	23	20	95.5	94.2	94.6 ↑
Grand Total:	**32027.11**	**222**	**3**	**26**	**157**	**36**	**90**	**79.9**	**79.7 ↓**

Table 5-2: Storage Levels comparison for the Five Largest storage dams (by volume) to last year

Reservoir	River	Province/ Country	WMA/Country	FSC	30 September 2024	30 September 2024	Diff. between %Full
Gariep Dam	Orange River	Free State	Orange	4903.45	87.8	71	-16.8
Vanderkloof Dam	Orange River	Free State	Orange	3136.93	97.8	97.5	-0.3
Sterkfontein Dam	Nuwejaarspruit River	Free State	Vaal Major	2616.9	99.7	98	-1.7
Vaal Dam	Vaal River	Free State	Vaal Major	2560.97	80.5	41	-39.5
Pongolapoort Dam	Phongolo River	Kwazulu-Natal	Pongola-Mtamvuna	2395.24	83.1	82.6	-0.5

Table 5-3: Dams below 10% of Full Supply Capacity compared to last year

Reservoir	River	Province	30 September 2023 (%FSC)	30 September 2024 (%FSC)	% Change (-/+)
Middle-Letaba Dam	Middel-Letaba River	Limpopo	4.3	0.7	-3.6
Glen Alpine Dam	Mogalakwena River	Limpopo	62	28	-34

The spatial distribution of the dams with a classified range of their storage levels on 30 September 2024 is presented in Figure 5.2. An observation can be made that most of the dams in the Western Cape province were above 100% of FSC (either full or spilling), while the majority of national dams across the country were at storage levels of between 50-100% of FSC.

Figure 5.3 presents the 24-month Standardised Precipitation Index (SPI) for August 2024, indicating that the Namakwa District in the Northern Cape, is the only district that had areas experiencing extreme drought with some of its areas having severe to moderate drought in the last 24 months. Several District Municipalities (DM) also had some areas experiencing severe drought in the last 24 Months including the Thabo

Mafutsanyane DM in the Free State, the Sarah Baartman DM in the Eastern Cape, the Capricorn, and the Mopani DM in Limpopo. Moreover, district municipalities such as the Zululand DM in KwaZulu-Natal, Gert Sibande DM in Mpumalanga, Bojanala and Ngaka Modiri DM Molema in North-West, Sekhukhune DM in Limpopo, Ekurhuleni and Sedibeng DM in Gauteng only experienced moderate drought. These areas are experiencing drought as a result of below-normal rainfall received during the previous summer rainfall season.

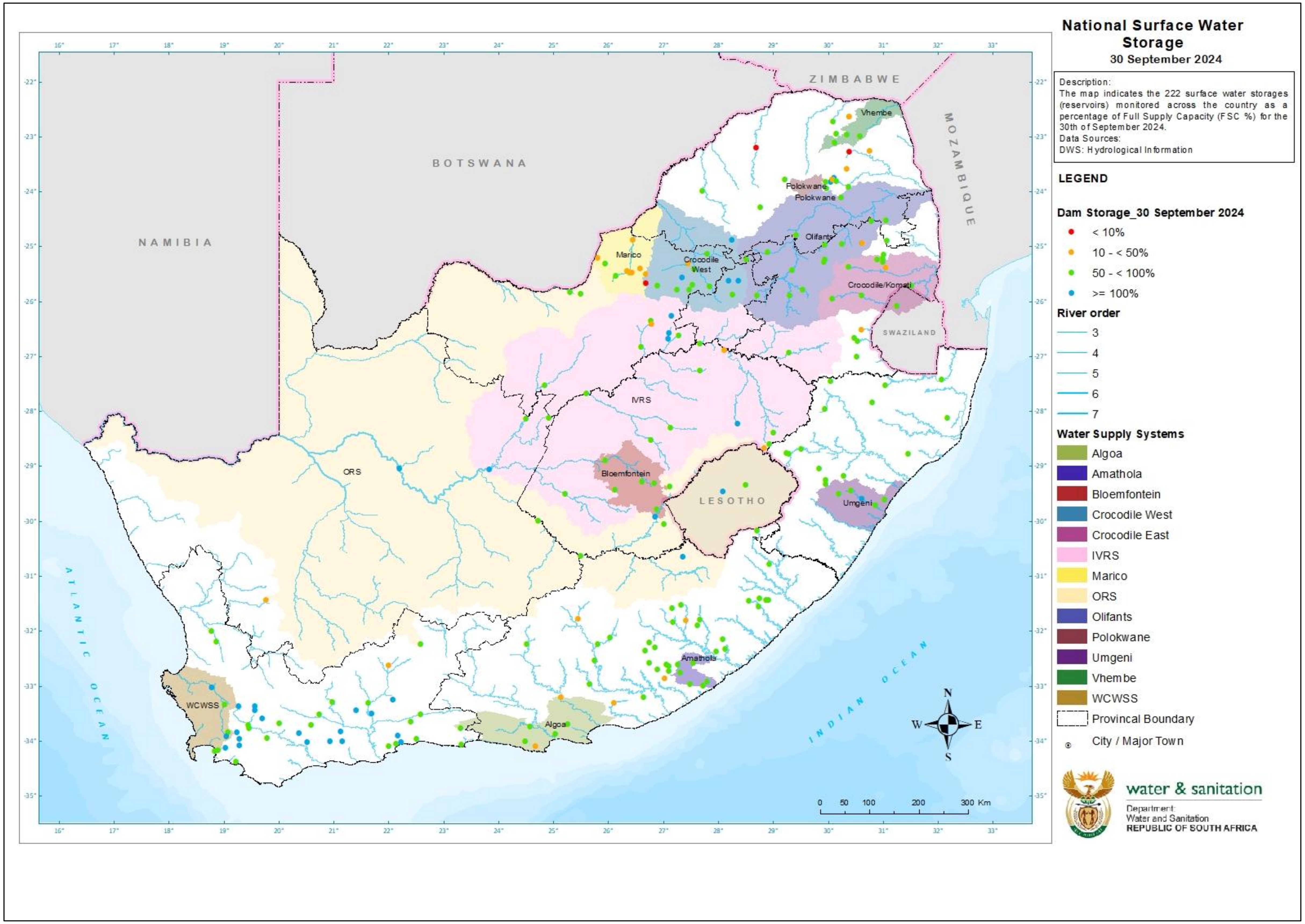


Figure 5.2: Surface Water Storage Levels - September 2024

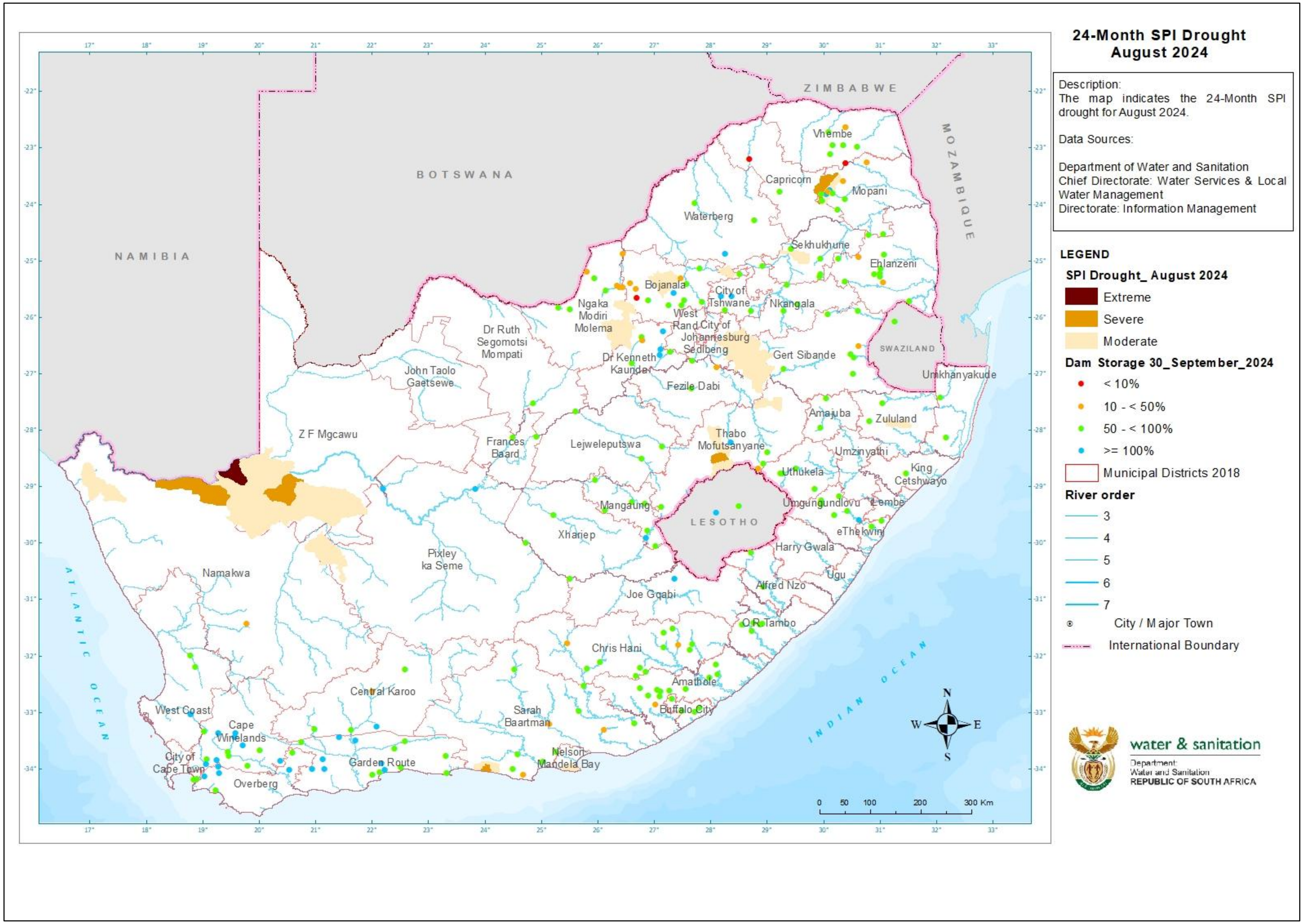
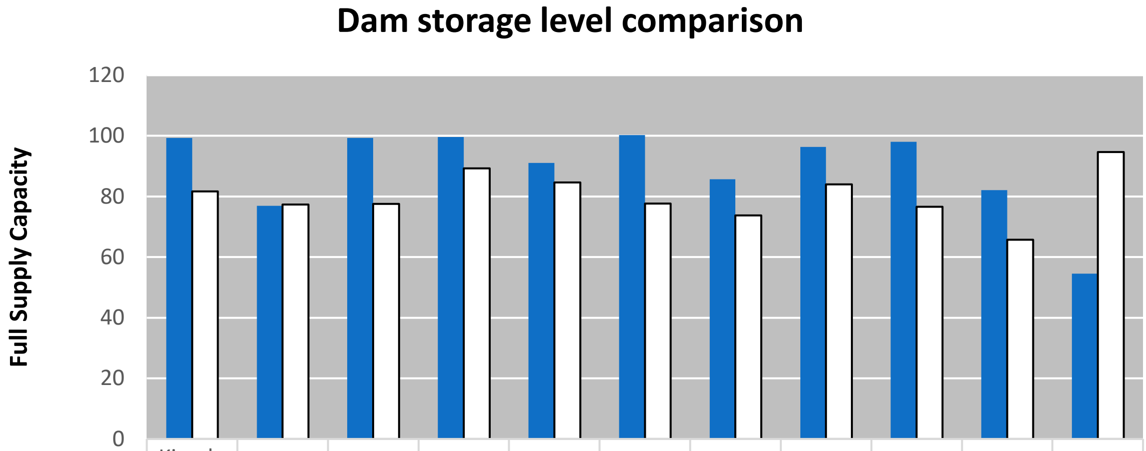


Figure 5.3: 24-month Standardised Precipitation Index (SPI) and dam levels

The comparison of the storage levels per province and international areas for September 2024 to the same time last year is presented in Figure 5.4. Free State (-14.2%), North West (-17.5%), Limpopo (-10.3%), and Northern Cape (-10.1%) showed significant declines in dam storage levels compared to the previous year. Meanwhile, Western Cape (+49.6%) showed substantial increases year-on-year.



	Kingdom of Eswatini	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Kingdom of Lesotho	Limpopo	Mpumalanga	Northern Cape	North West	Western Cape
30-Sep-23	99.3	76.9	99.3	99.6	91.1	100.3	85.7	96.3	98	82.1	54.5
30-Sep-24	81.7	77.3	77.5	89.3	84.6	77.7	73.7	84	76.6	65.7	94.6

Figure 5.4: Water Storage Levels September 2023 vs. September 2024

The comparison of the long-term median storage for each province during the 2022/23 hydrological year, compared with the previous hydrological year, is presented in Figure 5.5.

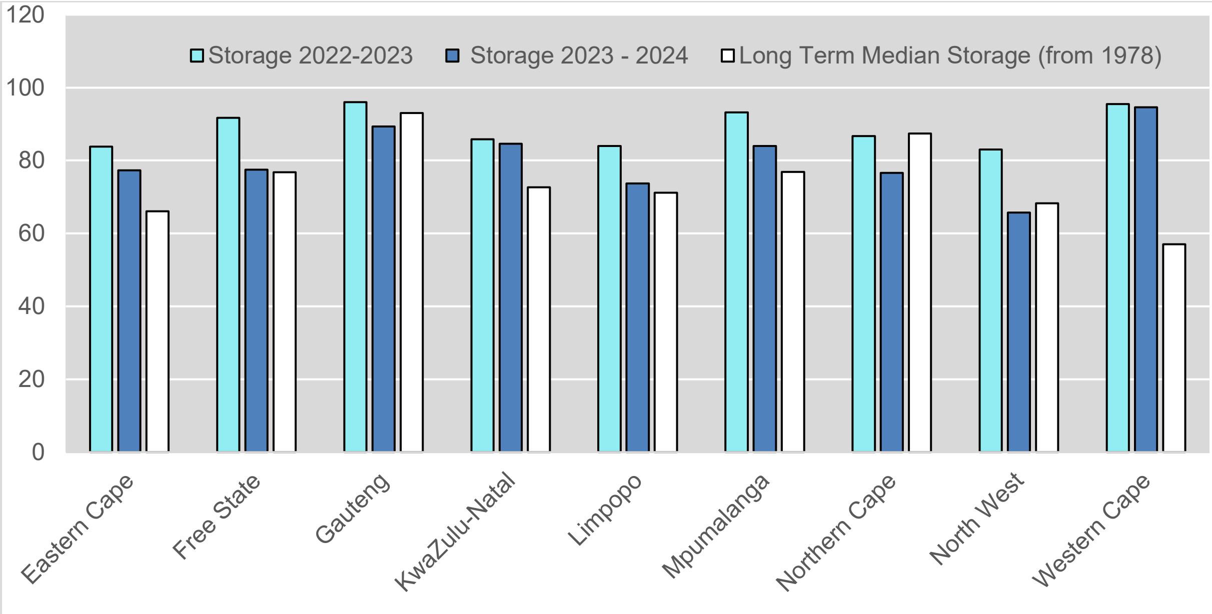


Figure 5.5 The storage situation in each Province during 2023/2024, compared with the previous hydrological year and the median.

For the hydrological year 2023/24, the dam levels for most of the provinces were above the long-term median storage levels. Notably, all median storages for the 2023/24 hydrological year were lower than the previous hydrological year.

5.2 Water Management Area storage

The comparison of the long-term historical median storage levels (2016-2022) of WMAs and the past two hydrological years' median storage is presented in Figure 5.6

The 2023/24 storages have been above the historical median for all water management areas, indicative of a hydrological year characterised by above-normal rainfall for almost all parts of the country with major dams. A similar pattern was observed for the previous hydrological year (2022/23) for all WMAs.

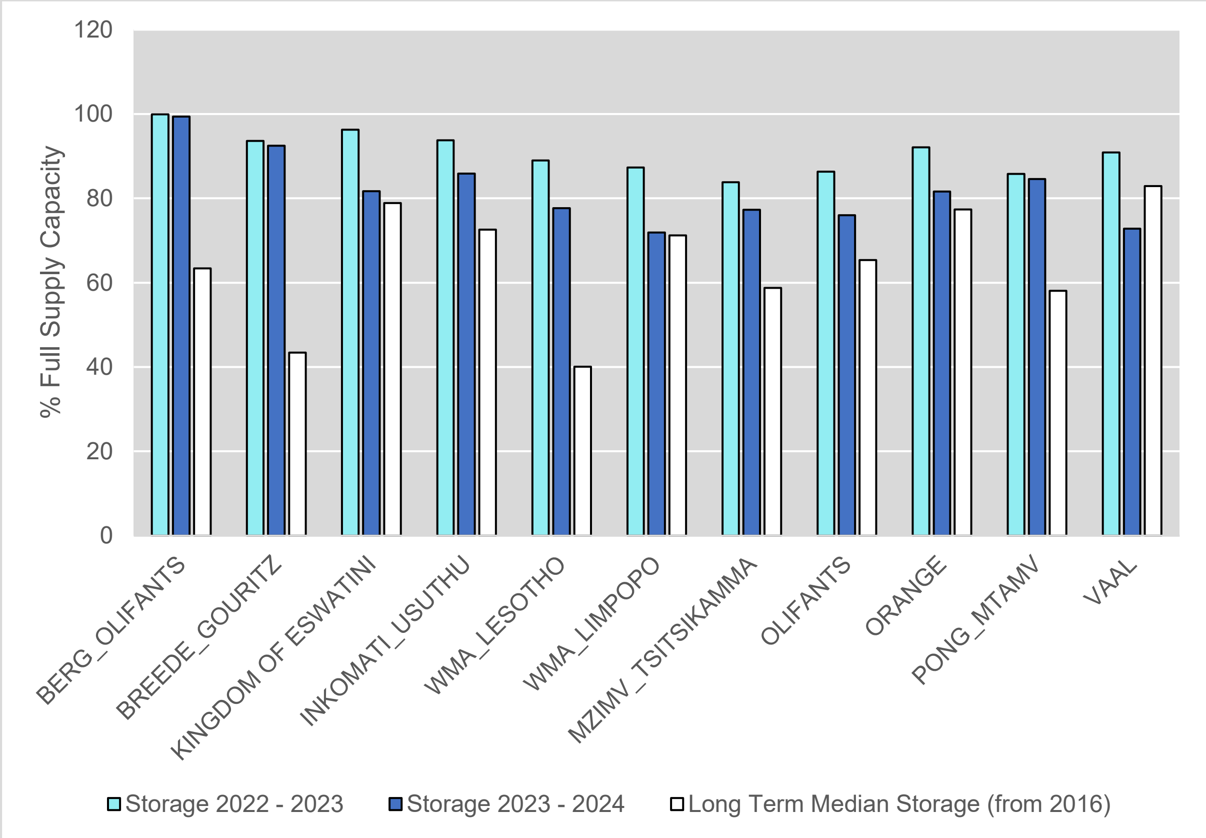


Figure 5.6 The storage situation in each WMA during 2023/24, compared with the previous hydrological year and the median.

Notably, all median storages for the 2023/24 hydrological year are lower than the previous year for all WMAs, apart from the Inkomati-Usuthu, Orange and Vaal WMAs. However, the dam storage levels in these three WMAs remained higher than the long-term median dam levels.

5.3 District Municipalities

The year-on-year comparison of water storage levels per District Municipality (DM) is presented in Figure 5.7. Garden Route DM experienced significant increases (>+20%) in dam storage levels compared to last year. But, Capricorn DM and Namakwa DM experienced significant declines (>-40%) in dam levels compared to last year.

The dam storage levels in water supply systems (WSSs) and applicable restrictions are presented in Table 5-4. The Algoa WSS decision date was changed from 1 June to 1 November, and a new annual operating analysis for the decision date was performed, resulting in an update of water restrictions which were in effect from 1 November 2023 to 31 October 2024. However, these restrictions are yet to be gazetted. ***Due to infrastructure limitations, permanent restrictions are applicable for the Polokwane and Bloemfontein WSSs.***

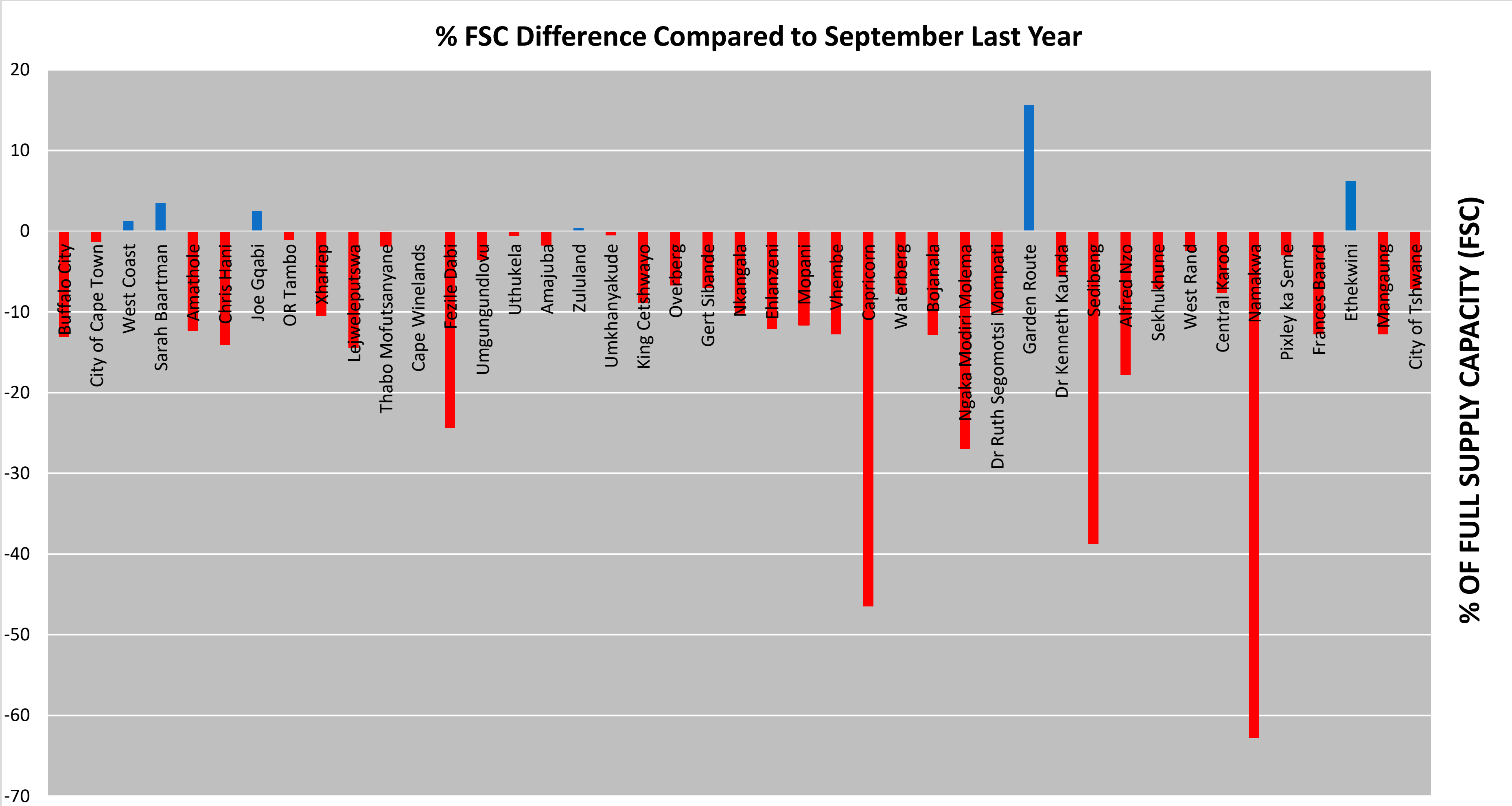


Figure 5.7 Comparison of water storage levels per District Municipality September 2023 vs September 2024

Table 5-4: Water Supply Systems storage levels

Water Supply Systems/clusters	Capacity in $10^6 m^3$	30 September 2023 (% FSC)	30 September 2024 (% FSC)	System Description
Algoa WSS	282	71.5	75.9	The following 5 dams serve the Nelson Mandela Bay Metro, Sarah Baartman (SB) DM, Kouga LM and Gamtoos Irrigation: Kromrivier Dam, Impofu Dam, Kouga Dam, Loerie Dam, Groendal Dam
Amathole WSS	241	100.6	91.4	The following 6 dams serve Bisho & Buffalo City, East London: Laing Dam, Rooikrans Dam, Bridle Drift Dam, Nahoon Dam, Gubu Dam, Wriggleswade Dam
Klipplaat WSS	57	100.8	94.6	The following 3 dams serve Queenstown (Chris Hani DM, Enoch Ngijima LM): Boesmanskrantz Dam, Waterdown Dam, Oxkraal Dam
Luvuvhu WSS	225	98.3	92.4	The following 3 dams serve Thohoyandou etc: Albasini Dam, Vondo Dam, Nandoni Dam
Bloemfontein WSS	219	94.3	81.2	The following 4 dams serve Bloemfontein, Botshabelo and Thaba Nchu: Rustfontein Dam, Groothoek Dam, Welbedacht Dam, Knellpoort Dam
Butterworth WSS	14	100.2	77.6	Xilinxa Dam and Gcuwa weirs serve Butterworth
Integrated Vaal River WSS	10 546	90.9	75.9	The following 14 dams serve Gauteng, Sasol, and Eskom: Vaal Dam, Grootdraai Dam, Sterkfontein Dam, Bloemhof Dam, Katse Dam, Mohale Dam, Woodstock Dam, Zaaihoek Dam, Jericho Dam, Westoe Dam, Morgenstond Dam, Heyshope Dam, Nooitgedacht Dam, Vygeboom Dam

Water Supply Systems/clusters	Capacity in $10^6 m^3$	30 September 2023 (% FSC)	30 September 2024 (% FSC)	System Description
Polokwane WSS	254.27	96.5	85.1	The following 2 dams serve Polokwane: Flag Boshielo Dam, Ebenezer Dam
Crocodile West WSS	444	94.5	86.3	The following 7 dams serve Tshwane up to Rustenburg: Hartbeespoort Dam, Rietvlei Dam, Bospoort Dam, Roodeplaat Dam, Klipvoor Dam, Vaalkop Dam, and Roodekopjes Dam
uMgeni WSS	923	87.1	85.2	The following 5 dams serve Ethekwini, iLembe & Msunduzi: Midmar Dam, Nagle Dam, Albert Falls Dam, Inanda Dam, and Spring Grove Dam
Cape Town WSS	889	104.6	100.2	The following 6 dams serve the City of Cape Town: Voelvlei Dam, Wemmershoek Dam, Berg River Dam, Steenbras-Lower Dam, Steenbras-Upper Dam, and Theewaterskloof Dam
Crocodile East WSS	159	92.5	77.4	Kwena Dam supplies Nelspruit, KaNyamazane, Matsulu, Malelane, and Komatipoort areas and surroundings
Orange WSS	7 996	91.7	81.3	The following two dams service parts of the Free State, Northern, and Eastern Cape provinces: Gariep Dam, and Vanderkloof Dam
uMhlathuze WSS	301	98.4	89.5	Goedertrouw Dam supplies Richards Bay, Empangeni small towns surrounding rural areas, industries, and irrigators, supported by lakes and transfer from Thukela River

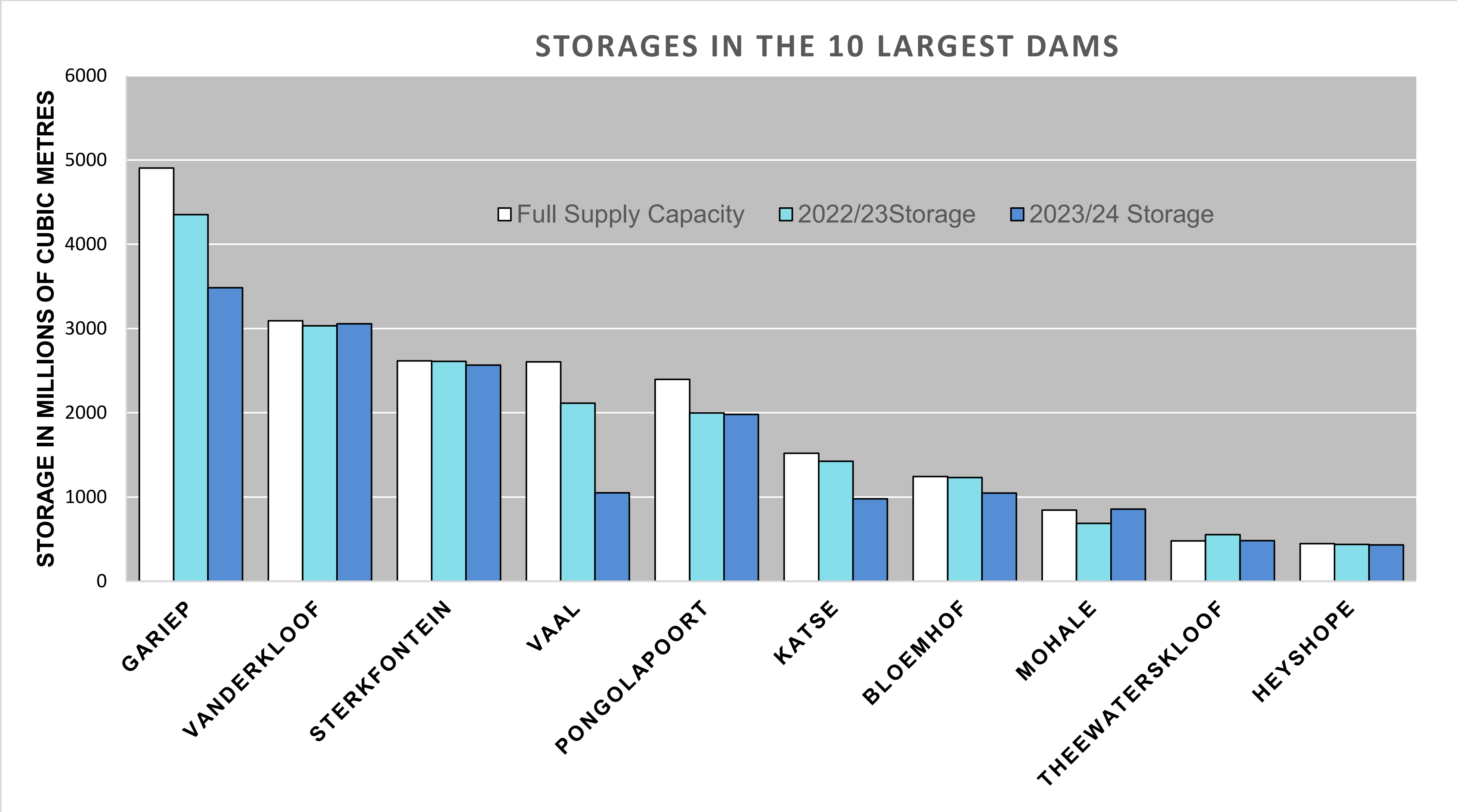


Figure 5.8: Storage volume comparison 2022/23 & 2023/24 of the ten largest dams at the end of September 2024.

5.4 Performance of Water Resources Systems Operation

The Department of Water and Sanitation developed guidelines for managing water supply systems during normal, drought, and flood conditions. These guidelines help ensure that the country's water resources are protected and used sustainably. As per the guidelines, formal operating rules have also been developed for the main water supply systems (WSS) in the country - such as the Algoa, Amathole, Greater Bloemfontein, Crocodile West, Integrated Vaal River (IVRS), Orange River System (ORS), Olifants, Polokwane, Umgeni, Umhlathuze and Western Cape.

An operating rule is a procedural guide for governing the regulation of water resources for a particular system/dam to reconcile expected water requirements with availability. The purpose of operating rules is to manage abstractions, transfers, releases, and restrictions to enhance sustainable and equitable water supply and mitigate the risk of failure to supply water during drought periods. The department conducts system and dam performance monitoring against the operating rules to serve as an early warning against failure to supply water from the systems.

Results of the monitoring of the water supply systems' performance during 2024-2025 can be summarised as follows:

Algoa System: Comprises of five (5) dams namely Kouga, Churchill, Impofu, Groendal and the Orange-Fish- Sundays Transfer, serving the Nelson Mandela Bay Metro and surrounding areas. There was significant improvement in the system total storage in the year 2024 which saw all 4 out of 5 dams in the system full and spilling, the exception being Impofu Dam in the Kromme subsystem. The Algoa water supply system is not fully integrated and as a result, some restrictions remained in place in the Kromme subsystem. Restrictions of 23% for domestic and industrial use and 43% on irrigation use were recommended for the 2024/2025 water operating year within the Kromme system. No water restrictions are imposed on the Groendal, Old Dams, Kouga, Orange Fish- Sundays and Groundwater systems.

Amathole System: comprises of six (6) dams serving the Buffalo City; and some parts of Amathole Districts Municipality. On the decision date of 1 May 2024 all dams were at almost full capacity. No water restrictions were required for the system from a water resources point of view in the 2024/2025 period due to sufficiently high storage at the decision date. The system remained in a good state in 2024.

Crocodile West System: Major dams in the Crocodile West system are Hartbeespoort, Roodeplaat, Vaalkop, Roodekopjes and Klipvoor. This system supplies water to Tshwane, Madibeng and Rustenburg areas. The system storage volume on the 1st of May 2024 decision date was on an average storage level of 91.56%. No restrictions were imposed on major dams in the system

Greater Bloemfontein System: Comprises of four (4 dams) namely Rustfontein, Knellpoort, Welbedacht and Mockes dams. The Annual Operating Analyses (AOA) was clear that the Greater Bloemfontein Water Supply System (GBWSS) is in deficit. As the water requirements continue to exceed the yield of the system water restrictions are required when the total system storage at the start of the operating year is below 95%.

The system storage was below 91% on 1 May 2024 decision date indicating restrictions needed to be imposed. 25% restrictions are required as recommended by the Annual Operating Analysis adopted at the Stakeholders Operating Forum (SOF) Preparations for the lifting of the restrictions for the operating year can start when the total system storage starts to exceed 95% and the Rustfontein dams starts to spill. The combined system storage was recorded at 96.08% as of January 2025. Hence, restrictions of 25% will continue until the system recovers to above 95%.

Integrated Vaal River System: The system comprises of fourteen (14) dams that serve mainly Gauteng Rand Water, Sasol and Eskom. The system storage was at a good state on the decision date of 1 May 2024. There were no restriction recommended for the system during 2024/2025 period form the water resources perspective. An analysis was undertaken in May 2024 to assess the risk to the IVRS performance because of the Lesotho Highlands Water Project tunnel outage and to determine the impact of the shutdown on water availability to users in South Africa.

The analysis indicated the impact of the outage on the overall IVRS will be insignificant considering that dams in the IVRS such as Sterkfontein Dam and others were relatively full. This meant that the closure of the tunnel for maintenance would not result in any disruption of water to supply Rand Water, and to the municipalities in Gauteng and other provinces which are customers of Rand Water

The Standard operating rule is that Sterkfontein Dam releases water to the Vaal Dam when the Vaal Dam reaches its minimum operating level of 18%. The analysis indicated a 5% risk of this to occur in the 2024-2025 operating year (1 May 2024 - 30 April 2025). Hence releases from Sterkfontein Dam to support the Vaal Dam were not envisaged during the 2024-2025 operating year and Sterkfontein Dam remains full to date. The Vaal Dam has also experienced a recovery, reaching 50% as a result of the recent rainfall in January.

Olifants system: The system consists of ten (10 dams supplying water to Sekhukhune District Municipality (DM) in Limpopo and Nkangala DM. The major dams Bronkhorstspruit, Middelburg, Witbank, Flag Boshielo, Loskop, Mkhombo and Blyderivierspoort. These dams are operated as 5 subsystems instead of one system because the model is not fully integrated yet. The combined storage volume for the dams in the May 2024 decision date was 93.7%. Based on the annual operating analysis conducted, no water restrictions were required during the 2024/2025 period.

Orange River System: The system consists of Katse and Mohale Dams of the Lesotho Highlands Water Project as well as Gariep and Vanderkloof Dams of the Orange River Project supplying water for irrigation and Eskom Hydropower generation.

The Orange River System storage was at 90.6% at the decision date of 1 May 2024. Restrictions were thus not required for the 2024-25 period as confirmed through the Annual Operating Analysis (AOA) and adopted at the Stakeholders Operating Forum (SOF).

Polokwane System: The system comprises of nine (9) dams supplying Polokwane and surrounding areas. The combined storage of the dams was above 83.4% with the major dams namely, Flag Boshielo and Ebenezer at 100% of their full supply capacity at the decision date of 1 May 2024. Allocable resources based on the AOA 2024/2025 were 44.32 million m^3/a compared to the target requirement of 61.34 million m^3/a. Due to the deficit in supply versus demand, an overall water restriction of 17.02 million m^3/a (~ 30%) was recommended on the system to bring the system into balance.

Umgeni system: The Umgeni system consist of six (6 Dams) namely Spring Grove Dam, Mearns Weir, Midmar Dam, Albert Falls, Nagle Damand Inanda Dam. The Umgeni WS system is augmented from the Mooi River System using the Mooi-Mgeni Transfer Scheme (MMTS). The annual Operating analysis for the system for the 2024/2025 period was conducted in May 2024. The analysis showed no restrictions for the 2024/2025 operating year. However, the risks associated with the current over-abstraction of the resource above the licensed water allocation to supply the ever growing demand is a concern to sustainable water supply from the system un the short to medium term. The analysis recommended a gradual reduction in water usage through water conservation strategies and water demand management measures, to mitigate risks and prevent exceeding the licensed water allocation.

Umhlathuze System: The UMhlathuze system comprises of Goedertrouw Dam and several lakes within the KwaZulu-Natal (KZN) northern coastline. The Umhlathuze system supplies water for irrigation, domestic, and industrial use within the King Cetshwayo District Municipality. Goedertrouw Dam storage was at 97% at the decision date on 1 May 2024. All lakes were full, and farm dams were assumed to be full as well. It was agreed through the Annual Operating Analysis (AOA) and adopted at the Stakeholders Operating Forum (SOF) that there would be no water restrictions for the 2024/24 operating year, considering the good storage level in the system

Western Cape Water Supply system (WCWSS): Comprises of the six 6 dams namely Wemmershoek, Upper and Lower Steenbras, Theewaterskloof, Berg river and Voelvlei dams serving mainly the City of Cape Town and some irrigation users/ Water Users Associations.

The system was at a combined storage level of 100% at the decision date of 1 November 2024. There are no restrictions imposed on the system for the current water operating year 2024/2025.

In summary, the main water supply systems have been gradually recovering due to favourable rainfall in December 2024 and January 2025. It is anticipated that these water supply systems will be full restored by the end of the rainy season in time for the annual operating analysis, typically conducted in May for most water supply systems. The annual operating analysis for the period of 2024-2025 was conducted for all the main water supply systems, with no restrictions necessary for the majority. The following systems in Table 5-5, however, have restrictions.

Table 5-5:Water supply system and restrictions imposed

Water supply system	Restrictions Imposed
Greater Bloemfontein Water Supply System	Restrictions of 25% for domestic and industrial water use
Algoa Water Supply System (Kromme Sub-system)	Restrictions of 23% for domestic and industrial water use and 43% for irrigation.
Polokwane Water Supply System	Restrictions of 30% for domestic and industrial use.

6

GROUNDWATER

6 GROUNDWATER

6.1 Background

Groundwater is water in saturated layers or zones below the land surface. While South Africa mainly relies on surface water with over 33 billion m^3 total gross dam storage capacity, the total groundwater recharge for South Africa is estimated to be over 34 billion m^3/a. The maximum national potential for accessible groundwater is approximately 4.5 billion m^3/a, of which only 3.2 billion m^3/a is being utilised. Although groundwater is underutilised, it is a strategic resource in many parts of South Africa, especially in rural areas. It plays an important role in the supply of water to small towns and villages in the drier parts of the country. Groundwater services between 52% and 82% of community water-supply schemes in the Eastern Cape, Limpopo, Northern Cape, North West and KwaZulu-Natal.

Discharges or outflows of groundwater sustain springs and river flows during dry seasons. Sustained river flows are important as they support people and communities who depend directly on rivers for their water, particularly during the dry seasons and droughts. There is considerable potential for additional development of groundwater resources to augment existing resources. The need for improved groundwater management to ensure sustainable and efficient use of the resource was first recognised in the National Water Resource Strategy-1 and led to the formulation of a National Groundwater Strategy through which strategic actions were undertaken.

South Africa is experiencing increasing water scarcity mainly due to its semi-arid climatic conditions, growing population, urbanisation, and climate change. Surface water, the traditional bulk supply source, is becoming unreliable and unavailable in some parts of the country. The costs of piping water from dams to supply the water needs of 59 million people are becoming increasingly challenging to meet. Hence, groundwater is vital in sustaining water security and contributing to the water mix to augment conventional resources.

6.2 Groundwater Strategic Water Source Areas

South Africa’s water supply is dependent on Strategic Water Source Areas (SWSAs). SWSAs are natural water source areas that supply disproportionately large volumes of water per unit area. These areas are strategically significant for water security from a national planning perspective, either for surface water,groundwater, or both. Groundwater SWSAs are areas of land of national importance that have high groundwater recharge and high dependence.

All surface water SWSAs are located in high rainfall areas where baseflow is at least 1 125 mm/a, which is evidence of a strong link between groundwater and surface water in the SWSAs. These groundwater SWSAs supply about 46% of the groundwater used by agriculture and 47% for industrial purposes in South Africa.

There are 37 national groundwater SWSA, which cover around 9% of the land surface of South Africa. National groundwater SWSAs contribute around 42% to baseflow and have a key role in sustaining surface water flows during the dry season. The total groundwater recharge for South Africa is estimated to be 34 912 million m^3/a, with 15% (5,397 million m^3/a) contributed by groundwater SWSAs. About 24% of the settlements reliant on groundwater are located within groundwater SWSAs, which is equivalent to 10% of all settlements in South Africa.

The inputs to the groundwater sections below came from the Directorate: National Hydrological Services.

6.3 Groundwater Level Status

Groundwater level fluctuations are influenced by recharge, discharge, and water abstractions. Recharge naturally comes from rain and can also be artificial. Depth to the water table is dynamic and usually fluctuates short and long-term in response to seasonal precipitation patterns. The rate of depletion is a combination of natural and manmade factors. Groundwater resources are significantly stressed when abstractions exceed recharge, usually during drought. Water-level measurements provide insight into the physical properties that control aquifer recharge, storage, and discharge. The Department has over 1,800 active groundwater level monitoring sites nationwide. The frequency of the data collection varies; some are monthly, while others are bi-monthly, quarterly, or bi-annual.

The impact of groundwater over-abstraction during drought can be presented by its severity on the groundwater resource (average groundwater level status). There are seven percentile ranges used to classify GwLS (Figure 6.1). The average GwLS is presented against the percentiles of the historical groundwater levels. The graph was created by D: Water Resource Management Planning. It paints a visual picture used to raise a drought condition warning. Restrictions on groundwater abstraction can be implemented promptly before any negative impacts occur. Each grouping of boreholes has a different severity range. The average groundwater level status as of September 2024 shows normal percentile groundwater levels (green), which is lower compared to the same time in 2023, when the levels were above normal (light blue). However, it must be noted that the number of stations used for September 2024 levels is 1099 (61%).

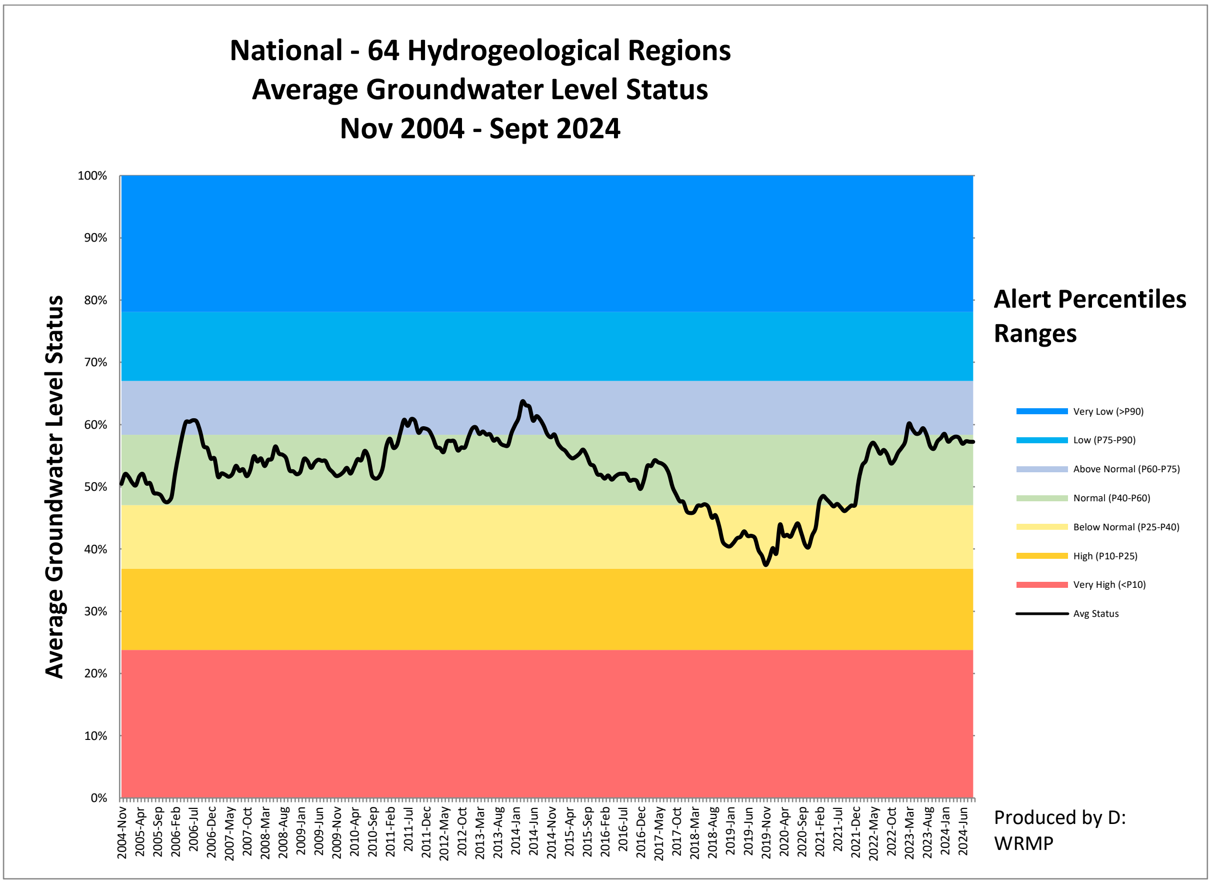


Figure 6.1: National Average Long-Term Groundwater Level Status (data extracted January 2025).

The groundwater level is presented as a percentage of the groundwater level status (GwLS). The historical groundwater level monitoring record is per borehole to ensure a constant point of reference. The GwLS of the geosites is averaged within the topo-cadastral 1:50 000 map sheet grid. The groundwater level status is not linked to groundwater availability and storage levels within an aquifer but only gives an indication of the relative water level over time.

The GwLS approach allows for the comparison of groundwater level data of any geosite on the same scale. Figure 6.2 shows GwLS for September 2023. GwLS average greater than 60% dominates over levels below 25%. Spatially, the southwest parts of the country, which received winter rainfall, have better levels dominated by the blues and green. Meanwhile, the rest of the country is dominated by the orange-yellows-red levels. Overall, the colours indicate another year of adequate recharge from above-normal rainfall received for almost all parts of South Africa, apart from some isolated parts in the Northern Cape as reported in Chapter 3. Compared to the previous three hydrological years, the end of the 2023/24HY water level spatial data shows groundwater levels are replenished by the annual rainfall received in 2024 (Figure 6.3).

There is a need for groundwater data collaborations whereby DWS can include all locally collected data from key water sector institutions like local municipalities and the South African Environmental Observation Network (SAEON).

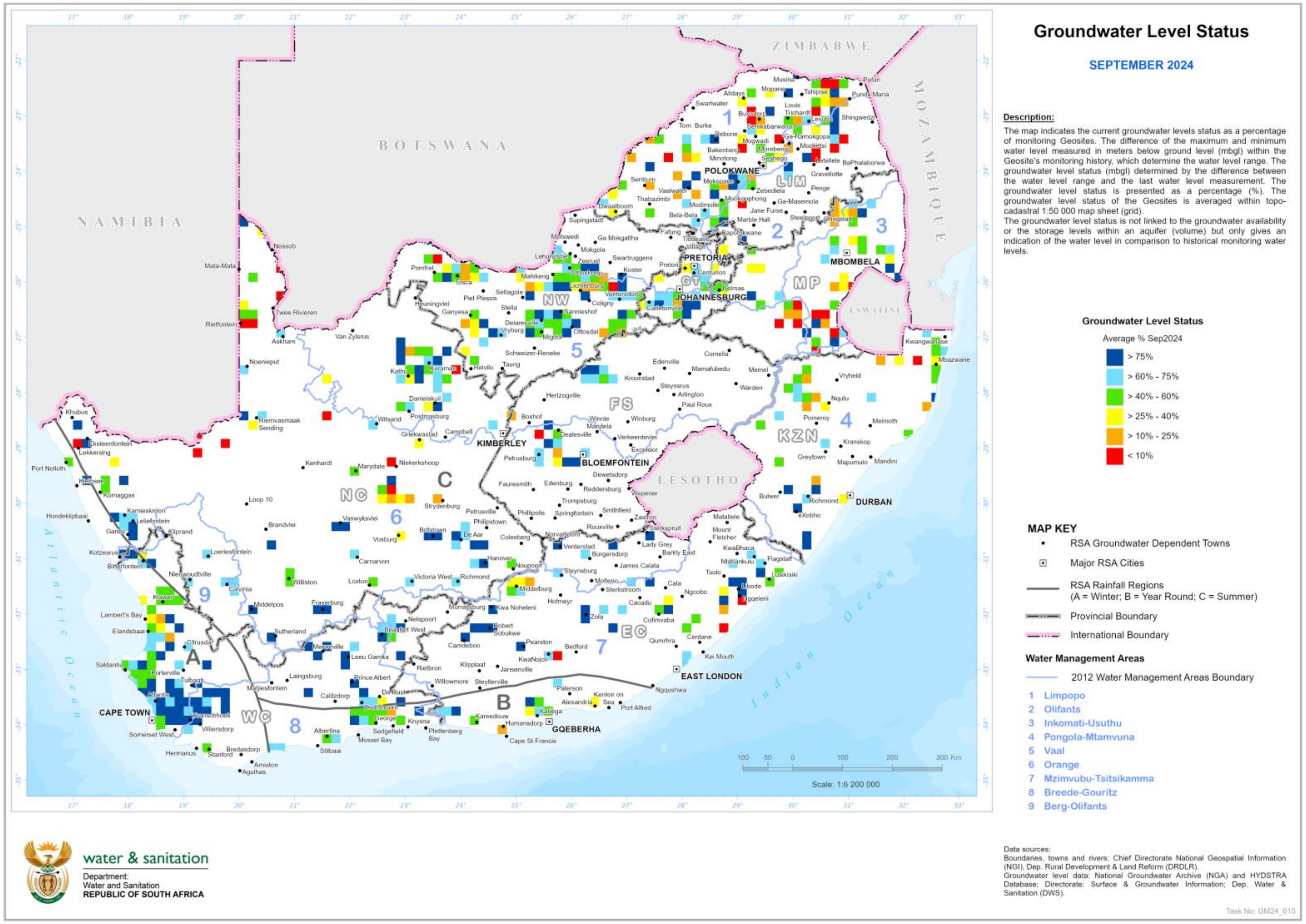


Figure 6.2: Groundwater Level Status Map – September 2024.

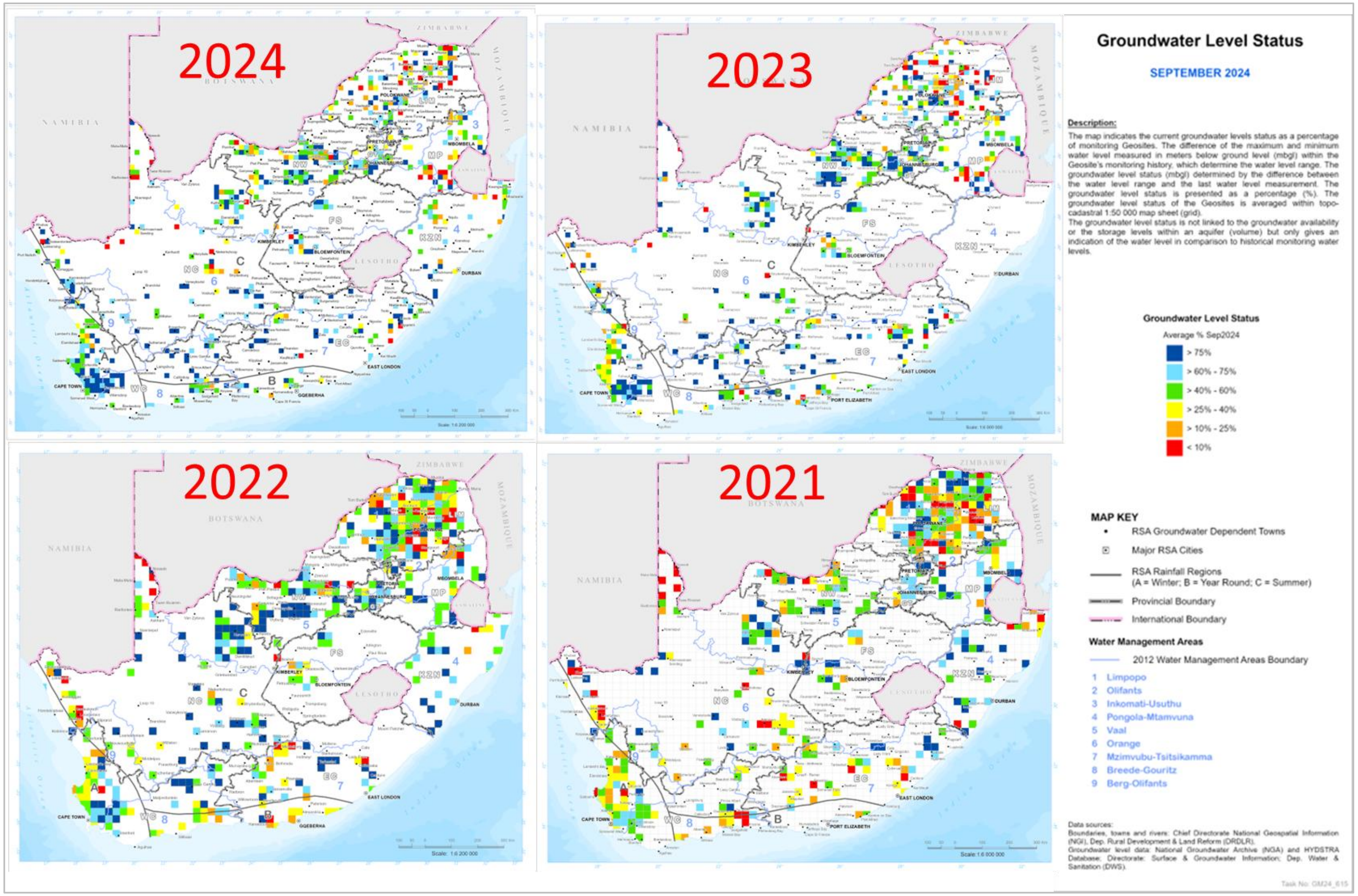


Figure 6.3: Groundwater Level status comparison - past four hydrological years

6.4 Groundwater Quality Status

For the groundwater quality monitoring programme, the frequency of the data collection is bi-annual, before rainfall (September/October) and after rainfall (April/May). In addition to these national stations, there are Acid Mine Drainage (ADM) special monitoring programmes, managed by the National Office. The AMD sites are located at the CoH-WHS and Dundee, and the monitoring frequency is four times a year. The collected data is archived on WMS and the National Groundwater Archive (NGA).

The most noticeable element of concern for groundwater quality in South Africa is nitrate, with some exceedances observed for fluoride. Nitrate is a known persisting problem and has been flagged as the single most common reason for groundwater sources to be declared unsuitable for drinking in South Africa. High nitrate concentration in drinking water is a major health risk for bottle-fed infants, and it causes methaemoglobinaemia, also known as “blue-baby syndrome”.

During the last hydrological year, ten-year-mean analyses were performed on a variety of chemical water quality parameters, and maps were generated to show high-resolution spatial distribution. The samples came from the DWS groundwater quality monitoring programme and from non-monitoring once-off samples. The analyses were averaged to determine a representative concentration level of the chemical per geosite. Each hexagon on the map represents 25 km^2. The maps only illustrate the groundwater quality, not its fitness for any use.

The ten-year-mean nitrate spatial distribution shows high (>20 mg/L) geosites are found mainly in the northern parts of South Africa, particularly the Limpopo-Olifants and Vaal-Orange WMAs (Figure 6.4).

The Limpopo-Oliphant high nitrate situation is the most severe of the two WMA (Figure 6.5). The map also shows us two areas with >50 mg/L nitrate, one far and another at the provincial border of Limpopo and North West. Limpopo has the highest combined ratio of pit latrines at 69% (StatsSA, 2024). The high nitrate levels in groundwater in Limpopo are well understood to be associated with pit latrines. Lalumbe and Kanyerere (2022) found that high nitrate concentration levels in the Soutpansberg groundwater region area were associated with pit latrines and the agricultural use of nitrate compound fertilisers.

In a recent study by Ndhlovu (2024), 319 groundwater samples, from 17 monitoring sites located within Limpopo granulite-gneiss region collected between 2000 and 2017, were analysed to evaluate groundwater suitability for drinking and irrigation purposes. Over 71% of the water samples have concentrations of nitrate higher than the WHO and SANS241 recommended guideline value of ≤11 mg/L, making 15 out of 17 monitoring sites unsuitable for drinking. However, the remaining two sites failed drinking water suitability in other chemical categories. To mitigate methemoglobinemia, it was recommended that authorities should adequately flag nitrate-polluted groundwater and educate the community particularly mothers about this deadly non-microbial contaminant. The author also suggested that at the clinics, during prenatal and postnatal consultations, mothers should be made aware that while boiling water works to kill microbial contaminants, extended boiling with excessive nitrate, can further increase the levels of nitrate during evaporation. Alternative safe water should be made available to mothers regularly, and the blending of surface water and groundwater should be promoted. The author also recommended that sustainable and affordable groundwater remediation options be considered and implemented urgently to prevent bottle-fed babies from drinking formula made from nitrate-contaminated water. Magnesium nitrate should be flagged as unsuitable for use as a fertiliser in the affected areas, to prevent further groundwater contamination.

Vaal-Orange WMA's high nitrate situation is less intense than that of Limpopo-Olifants WMA (Figure 6.6**Error! Reference source not found.**). Stampriet Transboundary Aquifer System (STAS) is shared between Botswana, Namibia, and South Africa and is utilised massively, especially in Namibia. The STAS' nitrate problem is also well understood. The aquifer supplies water to Ramotswa, a community on the Botswana side of the border. Groundwater supply in Ramotswa was abandoned in the 1990s when the nitrate concentrations were found to be higher than the 50 mg/L global drinking standards and because Ramotswa lacked the capacity and resources to treat the water. The source of nitrate pollution is understood to be pit latrines. Surface water was, therefore, piped in from Gaborone to Ramotswa. A severe drought from 2013 to 2016 severely lowered the Gaborone reservoir level to <5% capacity from late 2014 to early 2016. If the reservoir has a capacity below 5%, it fails to release water. In 2014, the Ramotswa groundwater supply was reopened as an emergency source of water until Tropical Cyclone Dineo struck Botswana in Feb 2017 and filled the Gaborone reservoir. The drinking water supplied in Ramotswa is a blend of high nitrate (>50 mg/L) groundwater from the Ramotswa wellfield and surface water supplied by pipes from the Gaborone Dam. However, the volumes of dilution water from Gaborone were not always unavailable. This led to water restrictions for hours and sometimes days. The community then turned to groundwater-contaminating pit latrines for waterless sanitation.

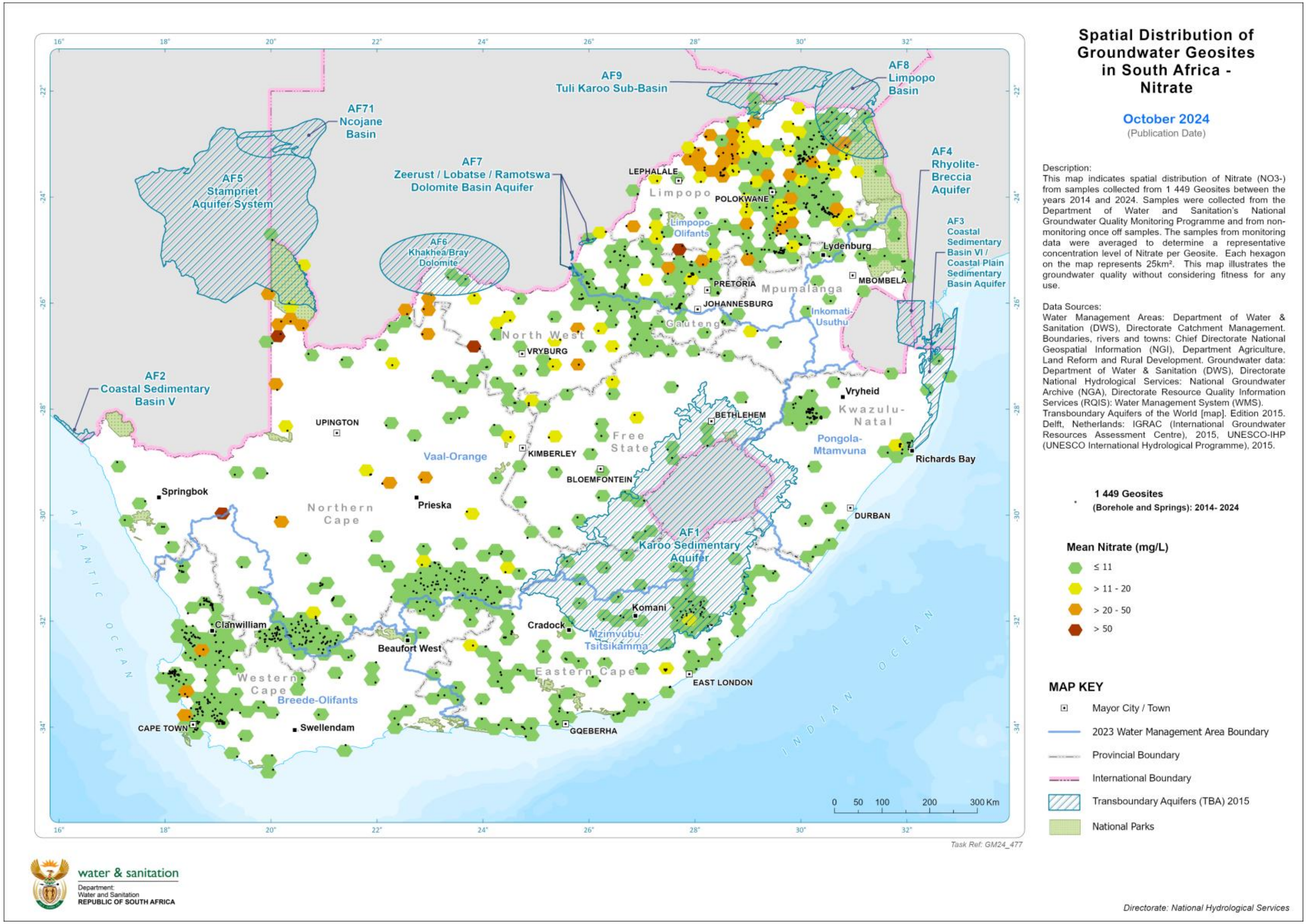


Figure 6.4: Spatial distribution of mean nitrate in groundwater 2014-2024

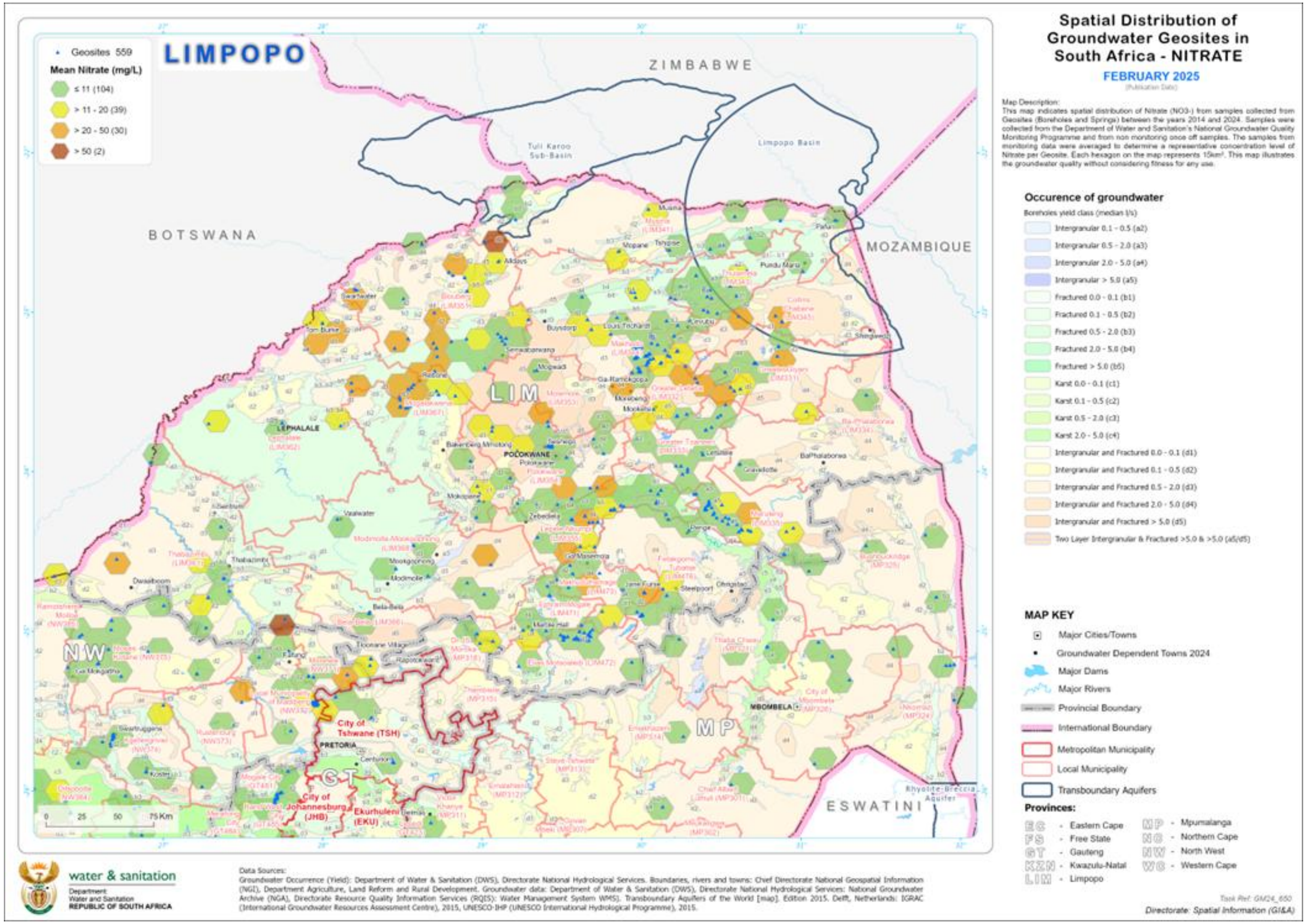


Figure 6.5 Limpopo spatial distribution of mean nitrate, each hexagon on this map represents a 15 km2 radius.

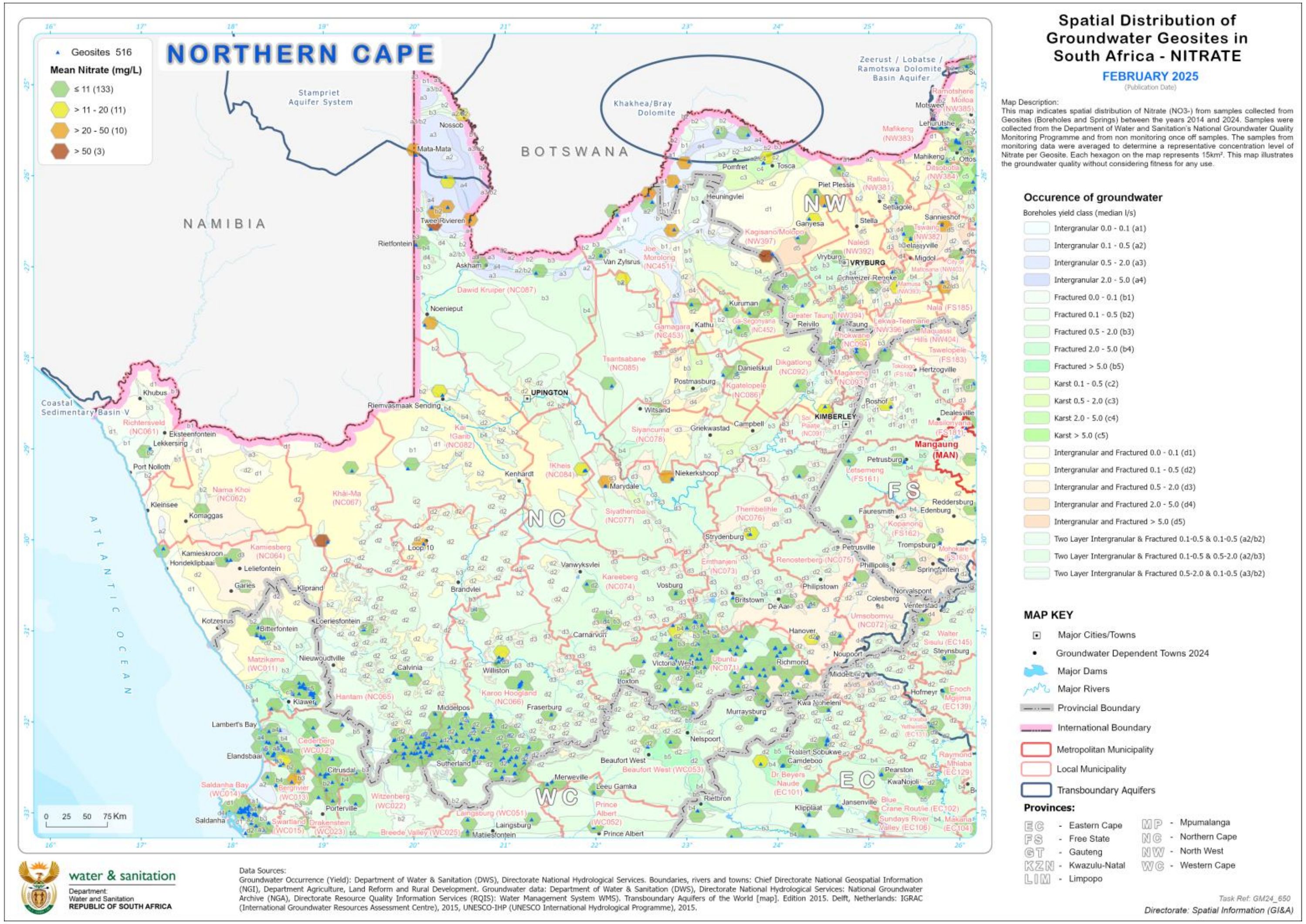


Figure 6.6 Northern Cape spatial distribution of mean nitrate, each hexagon on this map represents a 15 km2 radius

The ten-year-mean fluoride spatial distribution shows high fluoride concentrations (>1.5 mg/L) found in groundwater, mainly in the Limpopo-Olifants WMA (Figure 6.7). There are isolated areas with >5 mg/L fluoride in Mpumalanga, Free State, Eastern Cape, and around the Limpopo North West provincial border. These concentrations are natural and are known to be associated with geothermal springs. South Africa is relatively well endowed with thermal springs, with Limpopo hosting relatively more than any other province. Some of these thermal springs have been developed for recreational and tourism purposes, with facilities including swimming pools, jacuzzis, and spas fed by water from the springs. Limpopo reportedly also has the most developed thermal spring resorts. In South Africa, a handful of the thermal spring water is bottled and sold for therapeutic purposes; in some cases, the thermal spring is the only water source for the entire resort.

The ten-year-mean Electrical Conductivity spatial distribution shows higher salinity (>370 mS/m) in the Northern Cape and some isolated coastal areas around Clanwilliams, Western Cape and Gqeberha, Eastern Cape (Figure 6.8). The proximity of coastal aquifers to the sea and geological, geomorphological, and hydrological factors promote salinity intrusion into the aquifers.

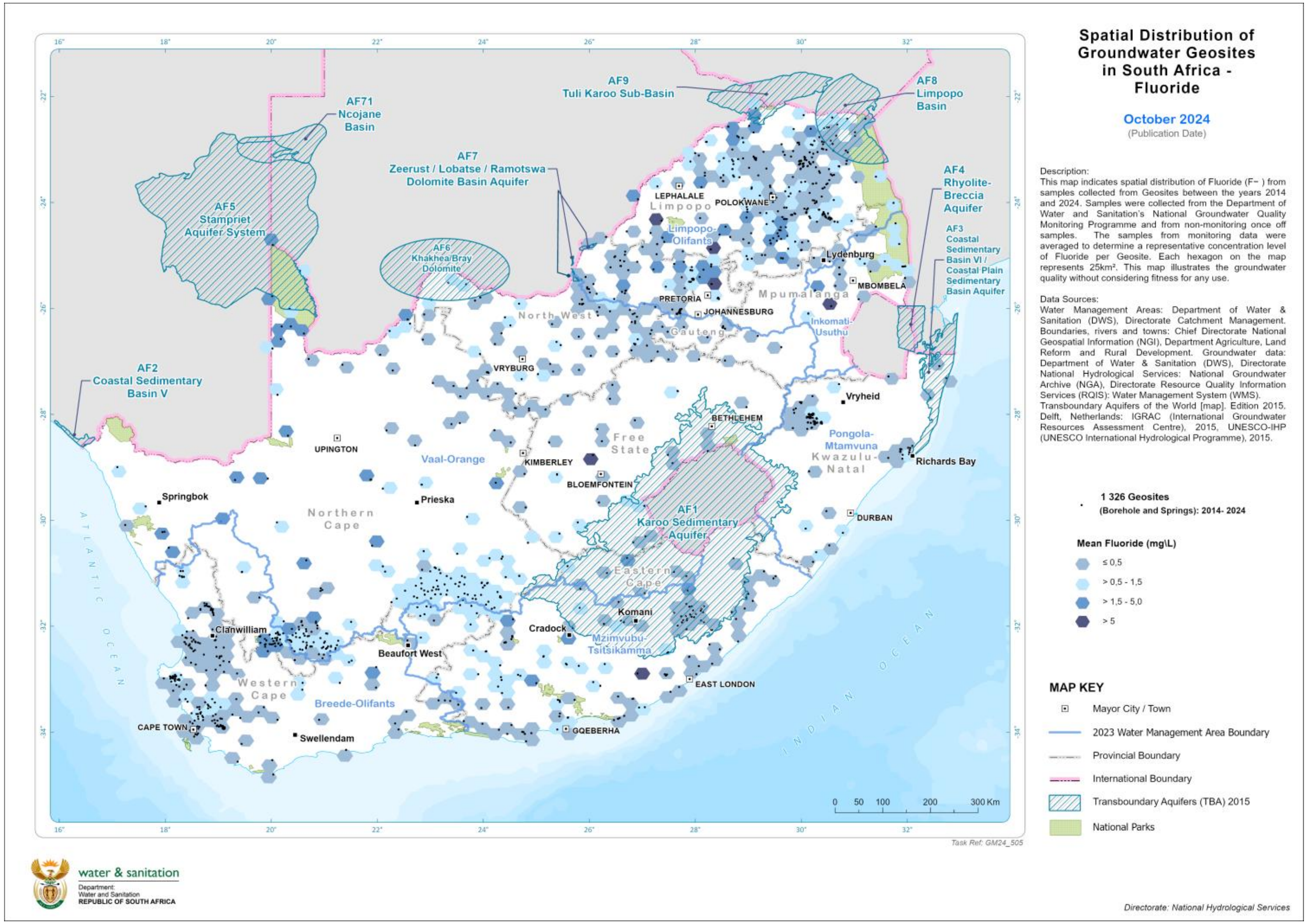


Figure 6.7 Spatial distribution of mean fluoride in groundwater 2014-2024

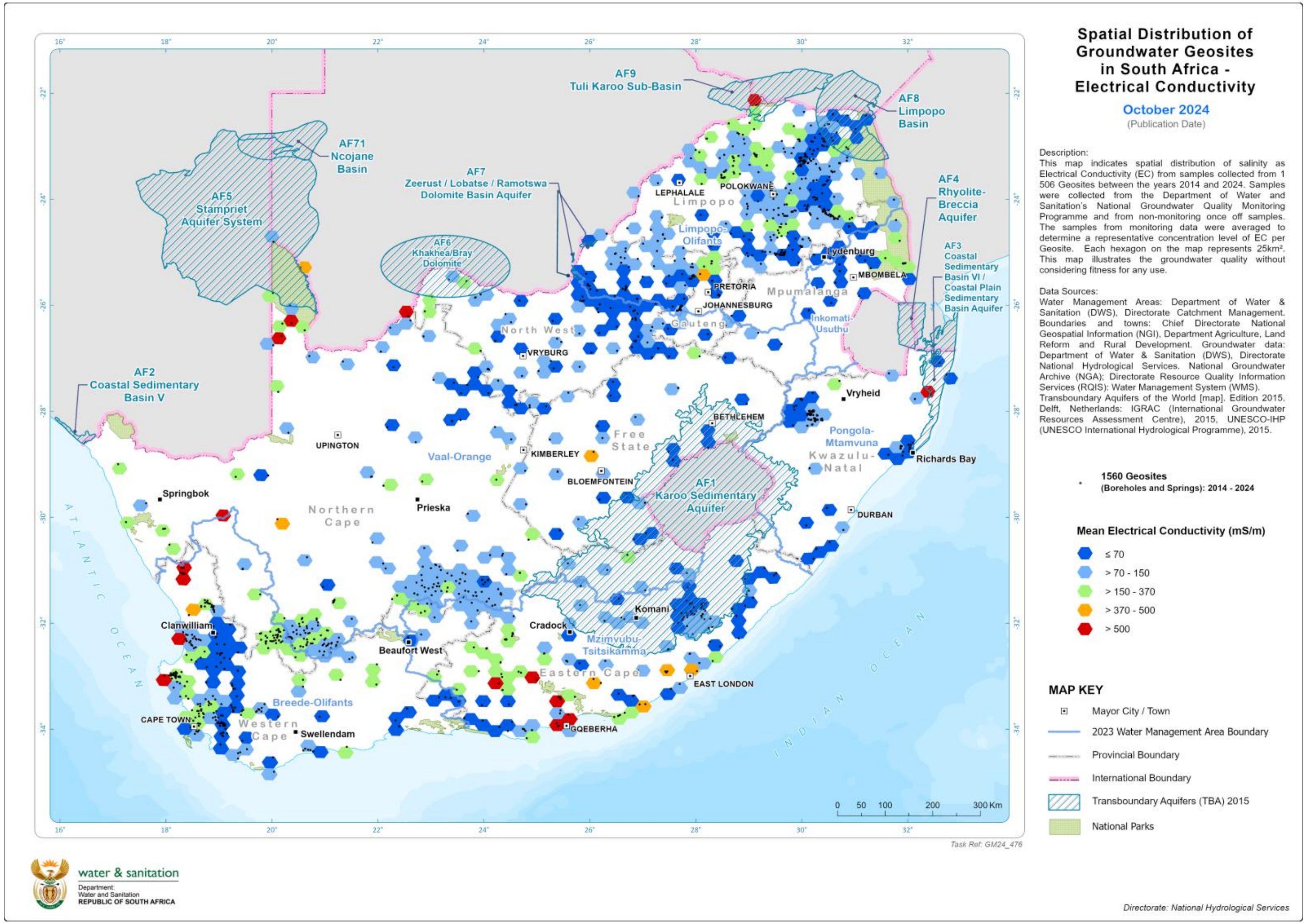


Figure 6.8: Spatial distribution of mean EC in groundwater 2014-2024

7

WATER SECURITY

7 WATER SECURITY

7.1 Introduction and Background

South Africa is a water-scarce country with an average rainfall of 450 mm, which is half the world average. Also compounding the water scarcity is the country's high evaporation rate, from 2000 to >2600 mm/a. Water scarcity is the ratio of human water consumption to available water supply in a given area. It is a tangible reality that can be measured regularly across regions and over time. The two fundamental drivers of water scarcity are physical and/or economic. Physical water scarcity occurs when there are inadequate natural water resources to meet demand. The demand is usually population-driven, where rapid population growth places high pressure on the amount of water available, leading to per capita water shortages. Climate-driven water scarcity occurs when insufficient precipitation and high evaporation create low available stream run-off, reducing water availability. In South Africa, climate-driven water scarcity is intensified by global climate change, climate variability and recurrent droughts. South Africa is the 30th driest country in the world.

South Africa has areas like Gauteng and Western Cape, which are more prone to severe physical water scarcity, where high population densities converge with low freshwater availability. Gauteng, with nearly 16 million residents, is the leading centre for both international migrants and domestic migrants. Gauteng is projected to reach 20 million residents by 2050, a growth not matched by an adequate increase in dam storage capacity. Western Cape, with 7.6 million residents, is the second major immigration attraction centre in South Africa. Western Cape is projected to reach 8.5 million residents by 2050, a growth not matched by an adequate increase in dam storage capacity.

The South African water sector has established extensive infrastructure to transfer water between catchments to address supply deficits, particularly around the economic hubs. However, over 98% of South Africa's available water resources are already allocated. There are also limited opportunities to increase future water requirements with conventional surface water resources; hence, more intervention is required on the demand side to address the projected supply deficit of 17% by 2030. South Africa is also known for water wastefulness. South Africans consume about 218 litres of water per capita per day (l/c/d), 26% above the world average of 173 l/c/d. Gauteng leads with water consumption at 266 l/c/d, followed by Northern Cape at 247 l/c/d.

The water scarcity situation in South Africa is not limited to physical drivers. It is also a consequence of economic factors. Economic water scarcity is caused by inadequate investment in water distribution infrastructure, technology, and human resources. It is induced by political power, policies, and/or socioeconomic relations. According to the

2023 DWS No Drop Benchmarking Report, non-revenue water accounts for 47.4%, while avoidable water losses are estimated at 40.8%. Geospatial disparities, inherited from apartheid history, are evident. Rural communities, small towns, and rural provinces remain inadequately serviced.

7.2 Water Use Efficiency

In the water sector, the term 'water use efficiency' is generally understood as a dimensionless ratio between water use and water withdrawal. Water Use Efficiency is about using water without waste. In the DWS, Water Use Efficiency goes hand in hand with Water Conservation and Water Demand Management (WC/WDM). **Water Conservation** is the minimisation of water loss or waste, the care and protection of water resources, plus the efficient and effective use of water. **Water Demand Management** is the adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage to meet key objectives such as economic growth & development, social development & equity, environmental protection, sustainable water supply and services, etc. WC/WDM is thus concerned with reducing water usage & wastage and safeguarding the quality & quantity of water resources. WC/WDM is a fundamental step in promoting water use efficiency across all sectors in the country. The potential benefits of WC/WDM include the following:

- Improved water security is where there is a reliable water supply that meets reasonable demand.
- Financially sustainable water utilities emanating from efficient billing and cost recovery.
- Improved water infrastructure operation and maintenance, drastically preventing excessive leakages and improving service delivery.
- Reduced synthetic wetlands which breed mosquitoes and other health hazards to communities.
- Reduced timeframes and cost-effective approaches which allow for delayed construction of augmentation schemes such as large dams.
- Improved water production technology.
- Improved relations between government and citizens

The Agricultural sector, particularly irrigated agriculture, is the country's largest consumer of water, accounting for over 61% of the country's annual water usage. Agriculture plays a critical role in ensuring national food security and supporting a rural economy where there is considerable poverty. However, despite the sector's importance for food security and economic stability, its reliance on water-intensive irrigation systems, outdated irrigation practices and general water use inefficiencies place immense pressure on the country's limited water resources. The levels of WUE vary considerably across the country, and some of the inefficiencies can be linked largely to conveyance losses (in canals and pipelines) and poor in-field practices. The

NWRS3 indicates that the average water loss across irrigation schemes is around 30%. The agriculture sector must adopt more conservative water management strategies to ensure productivity and sustainability.

The municipal water use sector is estimated at around 27% nationally, providing water to households, businesses, and public services. The role of this sector in economic development is significant, driven by the country's large metropolitan centres, which are supported by the large water supply systems. However, the challenges facing this sector are the increasing levels of water losses and Non-Revenue Water (NRW). The current status of NRW, at 47%, is of national concern, indicating that almost half of the potable water transported through the distribution system to customers does not generate revenue, thus causing billions of rands in revenue loss for municipalities. Furthermore, the water that does make it is mostly wasted. At 218 l/c/d, the national water consumption is 26% higher than the international benchmark usage of 173 l/c/d. Factors such as inadequate metering and billing inefficiencies, unauthorised water use, ageing infrastructure, insufficient maintenance, and poor water management practices are key contributors to the growing NRW issue. This is an urgent national matter that needs to be addressed to improve water supply efficiency, ensuring that more potable water reaches consumers and is conserved upon arrival.

Water use within the industry, mining, and power generation (IMP) sector is highly variable, with this sector collectively using around 7% of all water in the country. Despite their smaller water use share, these sectors typically provide between 10-15% of the Gross Domestic Product (GDP). The IMP sector is extremely diverse and equally unique in that businesses in these sectors can supply their own water through abstractions from the resource. Water is typically used within production processes for scrubbing, washing, cleaning, dust suppression, and cooling. Some IMP companies have implemented innovative technologies such as water recycling, desalination, and closed-looped systems to reduce freshwater consumption and enhance water use efficiency. The IMP sector has implemented various initiatives to enhance WUE. Similarly, power plants, more especially those relying on coal, are adopting more efficient cooling technologies to reduce water use intensity. WUE is essential in balancing economic development with sustainable water management of the country's limited water resources.

7.2.1 Legislation and Policy

Water is at the core of human survival, peace, and prosperity. The highest legislative mandate for efficient and effective distribution of water resources comes from the Constitution of the Republic of South Africa Act (No. 108 of 1996), Section 27 (1)(b), which states that everyone has a right to access sufficient food and water. The National Water Act, 36 of 1998 (NWA) provides the legal framework for the promotion of efficient, equitable, and sustainable management of the country's water resources. The NWA recognises that water is a scarce and precious resource that belongs to all the people of South Africa, and that the goal of water resource management is to achieve the sustainable use of water for the benefit of all South Africans. The guiding principles are to develop, protect, use, conserve, manage, and control water resources, ultimately promoting the integrated management of water resources sustainably and efficiently.

The Water Services Act 108 of 1997 provides the additional legal framework for the provision of water supply and sanitation services to end users such as households, businesses, and industries, within municipalities, promoting water conservation in the provision of water services. It compels water service authorities (WSAs) to outline measures to conserve water resources and places the duty to conserve water on water service institutions. The Water Services Act and its Regulations enable the implementation of WC/WDM specifically for the municipal sector by encouraging the sector to develop By-Laws, WC/WDM plans, Water Services Development Plans, etc. The key provisions and aspects of ensuring WC/WDM are Section 11 (1): the duty to provide sustainable access to water services; Section 11 (2) (e): the duty to conserve water resources; and Sections 12 and 13: the duty to prepare a WSDP which contains, amongst others, details of existing and proposed water conservation, recycling, and environmental protection measures. The Regulations relating to Compulsory National Standards and Measures to Conserve Water (GNR.509 of 8 June 2001) under the Water Services Act protect consumers and Water Service Authorities and ensure the application of sound water management principles.

The National Water and Sanitation Master Plan (NWSMP) 2018 acknowledges that South Africa is facing a water crisis caused by insufficient water infrastructure maintenance and investment, recurrent droughts driven by climatic variation, inequalities in access to water and sanitation, environmental degradation and resource pollution, and a lack of skilled water engineers. This crisis has already impacted economic growth and some South Africans' well-being. The NWSMP also recognises that building a water-secure future will require proactive infrastructure management, effective water infrastructure operations and maintenance, and ultimately reduced water demand. Management of NRW is central to the achievement of these objectives.

The NWRS-3's purpose is to ensure that national water resources are protected, used, developed, conserved, managed, and controlled efficiently and sustainably. The NWRS-3 acknowledges that South Africa is a water-stressed country, facing several water challenges and concerns, including water security, environmental degradation, water pollution, and inefficient water use. It outlines the importance of WC/WDM and NRW management. The WC/WDM and NRW management are priority programmes for reaching the 15 % water demand reduction target.

Considering the urgency to protect our water resources and the adverse effects of climate change, the NWRS-2 (2013) concurs that WC/WDM should be a priority, and measures should be taken to reconcile demand and supply to provide for the national goals of a better life for all through economic growth and job creation. The new NWRS-

3 provides core principles as set out in the National WC/WDM strategy essential to the realisation of WC/WDM.

The NDP presents a vision for South Africa in 2030 to eliminate poverty and reduce inequality while recognising that access to water and sanitation services is fundamental to this vision. In terms of water, the NDP envisages that by 2030:

- All main urban and industrial centres will have reliable water supply to meet their needs while ensuring efficient agricultural water use for rural communities.
- Natural water sources will be protected to prevent excessive extraction and pollution.
- Water will be recognised as a foundation for activities such as tourism and recreation, reinforcing the importance of its protection.
- Where rivers are shared with other countries, South Africa will honor its obligations.
- All South Africans will have affordable, reliable access to safe water and dignified sanitation.
- Water demand will be reduced by 15% below baseline levels in urban areas.

The National Water and Sanitation Master Plan (NWSMP) (2018) recognises that building a water-secure future requires proactive water infrastructure management, effective water infrastructure operations, and maintenance, coupled with reduced water demand.

7.2.2 Water Conservation and Water Demand Management Strategy for The Water Services Sector (2023)

This WC/WDM Strategy for Water Services Sector 2023 is an updated version of the 2004 version of the WC/WDM Strategy for Water Services Sector. National WC/WDM Strategy, which provides the overarching framework for the various sub-sector WC/WDM Strategies for Agriculture, Industry, Mining and Power Generation, and Water Services. Even though there are new technologies and innovations; the strategies, techniques, and approaches recommended in the 2023 WC/WDM strategy to achieve more effective and efficient use of water are well known and have been known for decades. Despite this, research work undertaken in recent years provides evidence that in South Africa non-revenue water (NRW), for example, has not improved, but deteriorated. As for many of the other challenges in South Africa, the solutions are known, but implementation is the obstacle.

The National WC/WDM strategy presents the overarching framework for the strategies. Four goals have been identified to effectively implement WC/WDM across the various sector value chains (Figure 7.1). The are ten objectives supporting these goals, which link the key pillars of WC/WDM (legislative, social, technical and financial), as they cut across multiple goals.

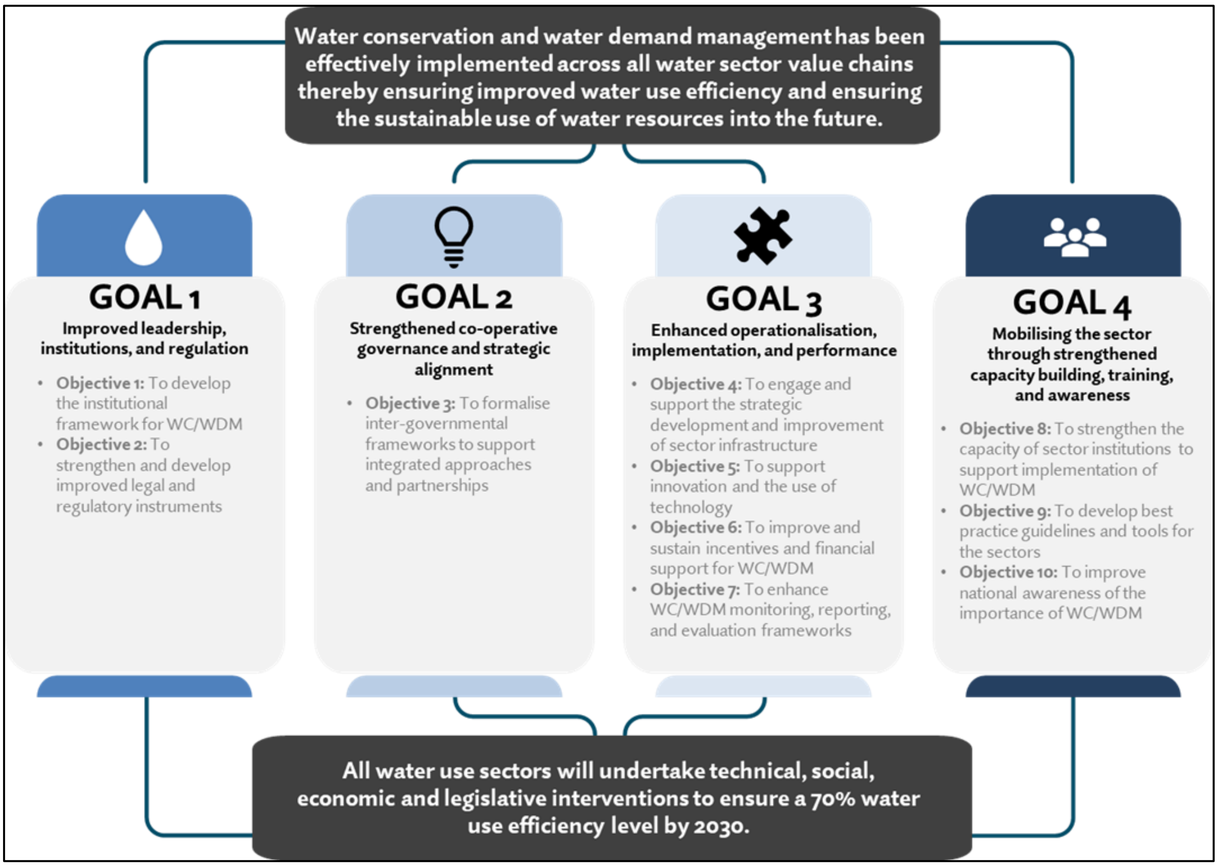


Figure 7.1: WC/WDM Strategy Framework

Implementation plans have been developed for each subsector to guide the implementation of the subsector strategies. The plans provide for interventions that will compel the active participation of national and provincial government departments, municipalities, the private sector, and civil society.

7.2.3 WC/WDM in the Water Services Sector

The status of WC/WDM at the large municipal water supply systems is a concern and a threat to national water security. The DWS monitors and analyses the progress made with the implementation of WC/WDM and targets for the large water supply systems by collecting International Water Association (IWA) water balances from the municipalities.

- *The National Water Balance*

NRW management is central to achieving these objectives, based on the principle that measurement and monitoring of water resources is the foundation of sound decision-making, allocation of resources, and effective WC/WDM implementation. South Africa has a 20-year benchmarking history, starting with the adaptation of the International

Water Association's methodology for calculating and understanding NRW and water losses in 2002, in the development of a pragmatic approach to benchmark water losses in potable water distribution systems in South Africa. The first comprehensive national benchmark study was published in 2012 in The State of Non-Revenue Water in South Africa (2012). Since 2012, several detailed assessments and updates have been undertaken, including the No Drop Assessment in 2015. The last national water loss benchmarking study was published in the No Drop Watch Report 2023.

Based on the 2023 No Drop Watch Report, the National Water Balance indicates a System Inputs Volume (SIV) of 4.39 billion m³/a, 40.8% water loss, and 47.4% Non-Revenue Water (NRW) (Figure 7.2: 2023 National Water Balance (Figure 7.2). NRW and water losses have increased by a notable 5.9% and 4.3%, respectively, since June 2016. Between 2016 and 2019, these fluctuations were less than 1%. The highest increase was in 2020/2021, attributed to the increased water demands and the impact of the COVID-19 pandemic.

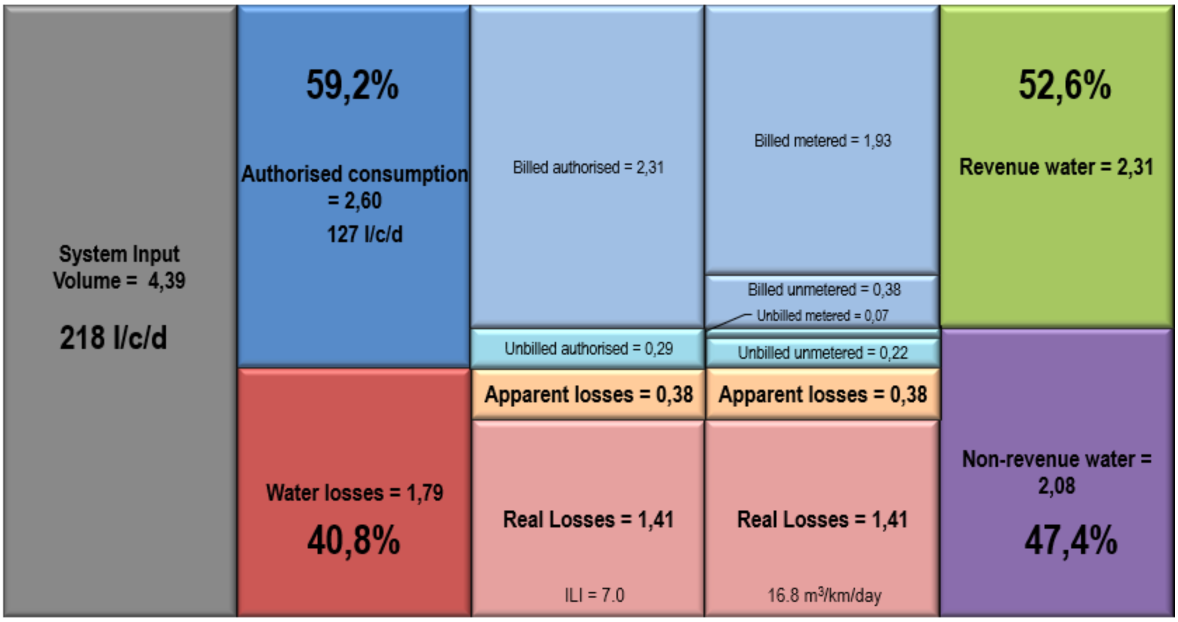


Figure 7.2: 2023 National Water Balance

The DWS will be conducting the No Drop Progress Assessment Tool (PAT) in the 2025/26 financial year, which is a concise and focused benchmarking exercise that extracts some of the key risk areas that would, individually and collectively, give a snapshot view of the status of the WSI's WC/WDM business. The No Drop PAT report is expected in December 2025.

7.2.4 WC/WDM in the Agriculture Sector

DWS requested the WRC to help develop a new framework for reporting water use efficiency in agriculture. This framework, now known as the Irri-Drop Report, aims to generate more information on the extent of agricultural water losses at irrigation schemes across the country. The framework borrows cues from similar reports such as the Green-Drop, Blue-Drop, and, more recently, the No-Drop reports. The Irri-Drop framework aims to provide a tool for assessing irrigation schemes in terms of water conveyance efficiency and the readiness of this sector to deal with water losses transparently. Extending the Irri-Drop Report concept to cover on-farm water delivery networks was recommended.

The state of irrigation water losses and measures to improve water use efficiency on selected irrigation schemes (WRC report no. 2970/1/23), was based on academic data analysis from the Vaalharts and Loskop irrigation schemes, the two biggest irrigation schemes in South Africa. The Vaalharts scheme, on the boundary of North West and Northern Cape provinces, is reported to have over 1 176 km network of canals and storm drains over 29,000 hectares. Most of the water is fed to crops using centre-pivot irrigation systems. The scheme is gradually transitioning from traditional methods, such as overhead sprinklers and flooding, to micro-sprayer and drip systems.

The second biggest public irrigation scheme, Loskop, is fed by the Loskop Dam at the boundary of Limpopo and Mpumalanga provinces. The reservoir irrigates nearly 19,000 hectares using a 495 km long network of concrete-lined canals. Furthermore, Dr Macdex Mutema, a senior researcher at the Agricultural Research Council and lead author of the study, acknowledges that upgrading irrigation infrastructure can be very costly, and hence, a need to redirect funding to projects that can yield the best water-saving benefits. Dr Macdex Mutema amplified the urgent need to address the data gaps for better accounting of water deliveries to farmers. Equally important is the establishment of more gauging stations at strategic positions of the canal networks because the most cost-effective way to minimise water losses from canal networks is to isolate and remediate the problem areas. Hence, identifying appropriate gauging stations on the main canal, secondary, tertiary, and community canals and equipping these gauging stations with accurate measurement devices were highly recommended. A good working data collection system and competent personnel are also required to handle the data collected. Other measures for improving the efficiency of canals are improvements in operations and infrastructure maintenance. This should include proper maintenance plans and sealing the gaps between the concrete slabs that make up the canal walls and beds to reduce leakage.

Major irrigation schemes submit water use efficiency accounting reports monthly. The average water loss of the applicable schemes is about 30% (see Table 7-1).

Table 7-1: Water Losses in Major Irrigation Schemes, 2024

Irrigation Scheme	Water Released $(x10^3m^3)/a$	Volume used $(x10^3m^3)/a$	Volume Losses $(x10^3m^3)/a$	Water losses (%)
Vaalharts WUA	413 440	325 487	87 953	23%
Vanderkloof WUA	635 433	581 554	53 878	16%
Kakamas WUA	475 772	393 783	81 990	17%
Boegoeberg WUA	42 449	18 995	23 454	39%
Orange Vaal WUA	4 150 507	3 558 228	592 279	14%
Sandvet WUA	116 149	88 357	27 792	22%
Orange Riet WUA	369 884	234 159	99 096	26%
LORWUA	112 048	84 688	27 360	24%
Gamtoos IB	70 583	60 230	10 353	15%
Impala WUA	232 207	150 372	81 835	35%
Loskop IB	303 041	265 904	37 136	12%
Hartbeespoort IB	126 266	233 456	100 746	43%
Crocodile West IB	532 236	452 401	79 835	15%
Marico Bosveld GWS	14 631	10 049	4 581	31%
Nzhelele GWS	21 024	18 669	2 355	11%

7.2.5 WC/WDM in the Industry, Mining, and Power Generation Sector

The efficiency of water usage by different IMP sub-sectors has not yet been systematically determined. However, data from a study commissioned by DWS in partnership with the Minerals Council of South Africa in 2012 does provide some indicative water use efficiency benchmarks for common minerals mined in South Africa. Through this partnership, a suite of supporting tools to guide the mining sector's implementation of WC/WDM has been developed. These include the commodity-based national water use efficiency benchmarks that have been developed for coal, gold, platinum, and "other" commodities.

In terms of power generation, Eskom power plants have diverse technical parameters and use a combination of cooling technologies bound to provide different water usage profiles. Eskom employs three types of cooling systems at its power plants. The most common and older type is wet cooling, but there are also direct and indirect dry cooling systems.

DWS has developed a methodology to guide the implementation of WC/WDM within the mining sector, and processes are underway to develop supporting tools for the industrial sector. All these, along with a range of technical interventions developed in association with sector partners like WRC, NCPC-SA, and CSIR, aimed at improving water usage, water treatment, and re-use options in the industrial sector, further illustrate room for improvement. Industries are encouraged to recycle and reuse water.

However, compliance varies, with some sectors (e.g. mining) showing better adherence to water conservation regulations than others. Water Use Licences (WUL) and regulations remain the key instruments for enforcing the implementation of WC/WDM. Specific WC/WDM conditions requiring the development of WC/WDM plans have been incorporated into the WUL.

7.2.6 Education and Awareness Campaigns

Appropriate social awareness and education programmes are imperative for WC/WDM's success and sustainability. Raising awareness about WC/WDM issues to the relevant stakeholders improves general knowledge and helps facilitate changes in behaviour through the education of stakeholders; knowledge about the subject increases.

7.3 Demographics

The Department of Water and Sanitation started a verification process for service delivery for all settlements in South Africa in 2011. Twenty-seven thousand nine hundred six communities were identified as part of the process. Spatial Polygons delineating the spatial extent of every settlement as well as demography data and service levels for every settlement, were verified and populated in a DWS reference geodatabase.

The dataset was aligned with Census 2011 results. The alignment was done at the local municipal level, the lowest level common area where data could be compared. Population figures per settlement were used as a ratio of the summed local municipality population. This ratio was applied to the Census 2011 data to disaggregate data from the municipal level into the identified settlement areas. Using the census-aligned community dataset as a baseline, annual adjustments are made to population, households, and service levels per settlement.

Annual population and household growth are calculated based on annual growth figures sourced from StatsSA as well as interprovincial migration figures in annual StatsSA midyear documents.

A realignment was again done at the local municipality level when the Census 2022 results were released. Financial delegations on Municipal Infrastructure Grant (MIG), Regional Bulk Infrastructure Grant (RBIG), and Water Service Infrastructure Grant (WSIG) projects are published annually. A specific percentage of these allocations are earmarked for the Water Services delivery project. Using these allocations in conjunction with unit cost figures calculated at the local municipality level by the Civil Engineering Sector as part of a cost model developed for Water Services, a figure is calculated for households potentially being served, e.g. [MIG Allocation] *0.2/ [Unit Cost per household] = [Households Served].

The served figure is subtracted from the existing water backlog in the specific local municipality, and the newly calculated backlog figure is then split into the settlements for that local municipality based on the ratio derived from the population per settlement. Figures are annually calculated per settlement per service level. Only settlements with existing water backlogs can be served per Local Municipality. Using the difference between the backlog figures for the year (n) vs year (n+1) a served figure is derived. These potential services people are split between the settlements in the area.

The analysis of the demographics for South Africa as per the last update for the year 2024 is given in Table 7-2. The Eastern Cape, one of South Africa's nine provinces that presents a diverse demographic profile characterised by a mix of urban and rural households, is home to approximately 1.87 million households, supporting a total population of over 7.35 million people. This results in a household density of 3.93, indicating the average number of individuals per household.

Table 7-2: District Municipality Provincial Household Density (DWS, 2024).

Region	Time Frame	Total Households	Total Population	Household Density	Urban Households	Rural Households
Eastern Cape	April 2024	1871169	7352691	3.93	849909	1021260
Free State	April 2024	849197	2999613	353	771617	77580
Gauteng	April 2024	5599783	15627688	2,79	5051024	548759
KwaZulu-Natal	April 2024	2912226	12818479	4,4	1599987	1312239
Limpopo	April 2024	1897352	6822375	3,6	377004	1520348
Mpumalanga	April 2024	1491045	5361261	3,6	742190	748855
North West	April 2024	1154367	3852976	3,34	527790	626577
Northern Cape	April 2024	339528	1398650	4,12	253561	85967
Western Cape	April 2024	2397488	7743151	3,23	2215896	181592
Provincial	April 2024	18512155	63976884	3,46	12388978	6123177

The demographic distribution reveals a significant rural presence, with 1.1 million households (about 54.6%) situated in rural areas, compared to (45.4%) households in urban settings. This rural-urban split highlights the province's unique blend of urban development and rural landscapes, each contributing to the overall socio-economic composition of the region.

The Free State province, located in the heart of South Africa, presents a unique demographic profile. The province is home to approximately 849 thousand households, supporting a total population of nearly 3 million people. This results in a household density of 3.53, indicating the average number of individuals per household.

The demographic distribution in Free State shows a significant urban presence, with 772 thousand households (about 90.9%) situated in urban areas, compared to (9.1%) households in rural settings. This urban-rural split highlights the province's predominantly urban character, with a smaller proportion of its population residing in rural areas.

Gauteng, the economic powerhouse of South Africa, showcases a dynamic and densely populated demographic profile. The province is home to approximately 5.6 million households, supporting a total population of over 15.6 million people. This results in a household density of 2.79, indicating the average number of individuals per household. The demographic distribution in Gauteng is predominantly urban, with 5.1 million households (about 90.2%) situated in urban areas, compared to (9.8%) households in rural settings. This urban dominance reflects Gauteng's status as a major urban centre, encompassing key cities such as Johannesburg and Pretoria, which are hubs of economic activity, cultural diversity, and infrastructural development.

KwaZulu-Natal, a province known for its rich cultural heritage and diverse landscapes, presents a complex demographic profile. The province is home to approximately 2,9 million households, supporting a total population of over 12.8 million people. This results in a household density of 4.40, indicating the average number of individuals per household. The demographic distribution in KwaZulu-Natal shows a balanced mix of urban and rural households, with (about 55%) of households situated in urban areas, compared to (45%) households in rural settings. This urban-rural split highlights the province's unique blend of bustling urban centres and extensive rural areas, each contributing to the overall socio-economic fabric of the region.

Limpopo, a province in the northern part of South Africa, presents a distinctive demographic profile. The province is home to approximately 1.9 million households, supporting a total population of over 6.8 million people. This results in a household density of 3.60, indicating the average number of individuals per household. The demographic distribution in Limpopo shows a significant rural presence, with 1.5 million households (about 80.1%) situated in rural areas, compared to (19.9%) households in urban settings. This rural dominance highlights the province's extensive agricultural landscapes and rural communities, which play a crucial role in its socio-economic structure.

Mpumalanga, a province known for its scenic landscapes and rich natural resources, presents a diverse demographic profile. The province is home to approximately 1.5 million households, supporting a total population of over 5.36 million people. This results in a household density of 3.60, indicating the average number of individuals per household. The demographic distribution in Mpumalanga shows a balanced mix of urban and rural households, with (about 49.8%) of households situated in urban areas, compared to (50.2%) households in rural settings. This near-equal urban-rural split highlights the province's unique blend of urban development and rural communities, each contributing to the overall socio-economic of the region.

North West, a province in the north-central part of South Africa, presents a distinctive demographic profile. The province is home to approximately 1.2 million households, supporting a total population of over 3.85 million people. This results in a household density of 3.34, indicating the average number of individuals per household. The demographic distribution in the North West shows a significant rural presence, with (about 54.3%) households situated in rural areas, compared to (45.7%) households in urban settings. This rural dominance highlights the province's extensive agricultural landscapes and rural communities, which are crucial to its socio-economic structure.

Northern Cape, the largest and most sparsely populated province in South Africa, presents a unique demographic profile. The province is home to approximately 340 thousand households, supporting a total population of nearly 1.4 million people. This results in a household density of 4.12, indicating the average number of individuals per household. The demographic distribution in the Northern Cape shows a significant urban presence, with 254 thousand households (about 74.7%) situated in urban areas, compared to (25.3%) households in rural settings. This urban dominance reflects the province's concentration of population in key urban centres despite its vast geographical area.

Western Cape, a province renowned for its scenic beauty and vibrant cities, presents a diverse demographic profile. The province is home to approximately 2.4 million households, supporting a total population of over 7.74 million people. This results in a household density of 3.23, indicating the average number of individuals per household.

The demographic distribution in the Western Cape shows a significant urban presence, with 2.2 million households (about 92.4%) situated in urban areas, compared to 181,592 households (7.6%) in rural settings. This urban dominance reflects the province's concentration of population in key urban centres such as Cape Town, which are hubs of economic activity, cultural diversity, and infrastructural development.

Overall, in April 2024, the total population reached 64 million, as depicted in Figure 7.3 below.

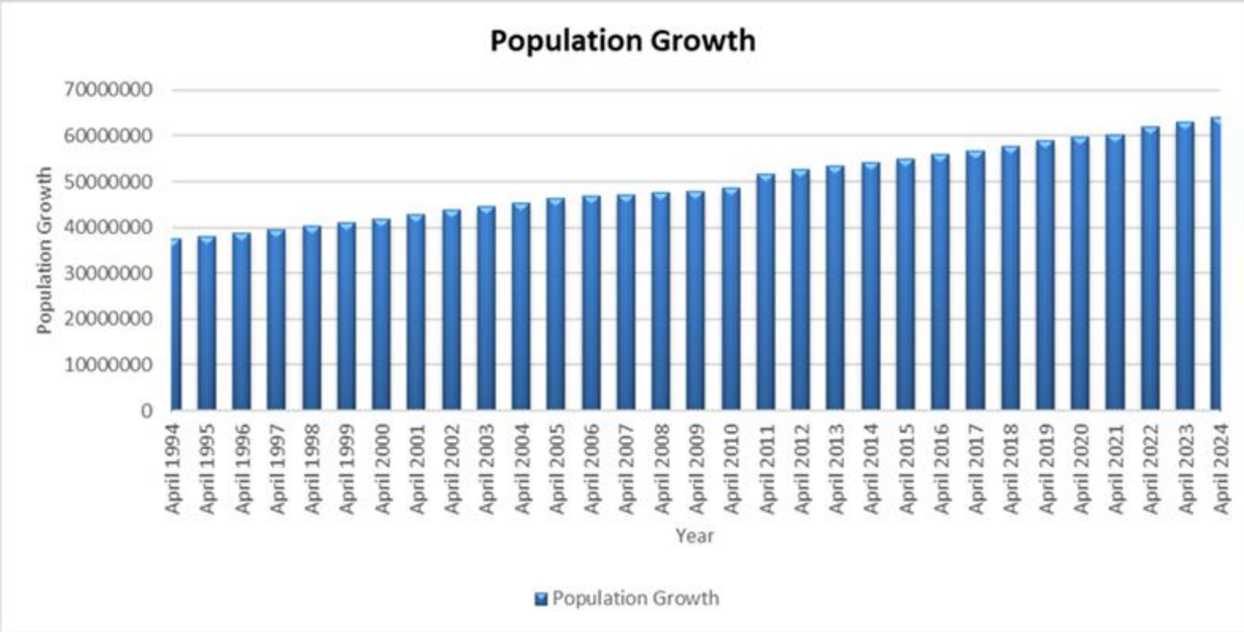


Figure 7.3: Population Growth Projections

The population growth rate is 1.5%, while the household growth rate is slightly higher at 1.9%. There is a total population of 64 million. Of this population, 62% are urban residents, approximately 39 million. In contrast, 38% of the population, or about 25 million people, lived in rural areas, as shown in Figure 7.4.

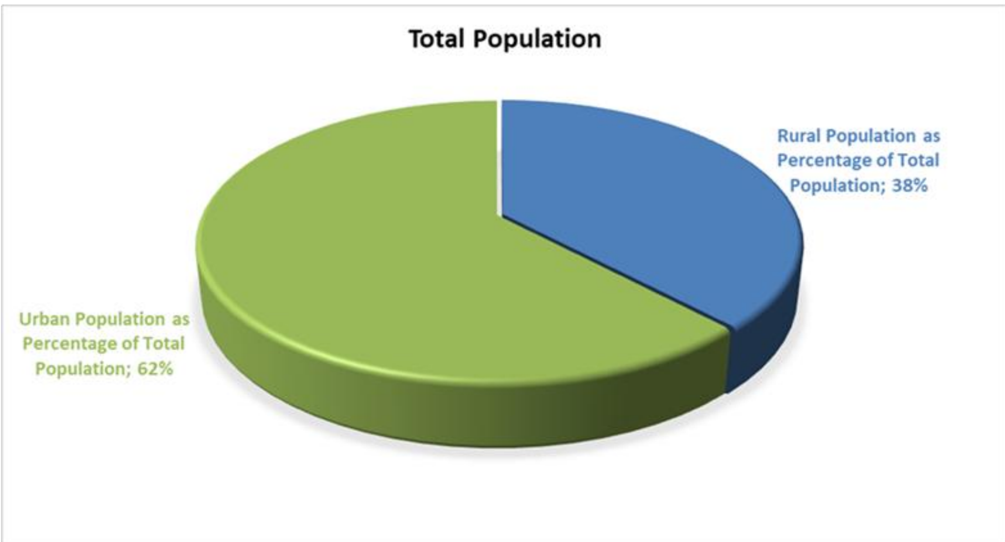


Figure 7.4: Rural and Urban Population as a Percentage of Total Population

The Provincial region had a total population of 28 thousand; of this population, 19% were urban residents, amounting to approximately 5 thousand people. In contrast, 81% of the population, or about 23 thousand people (Figure 7.5), lived in rural areas.

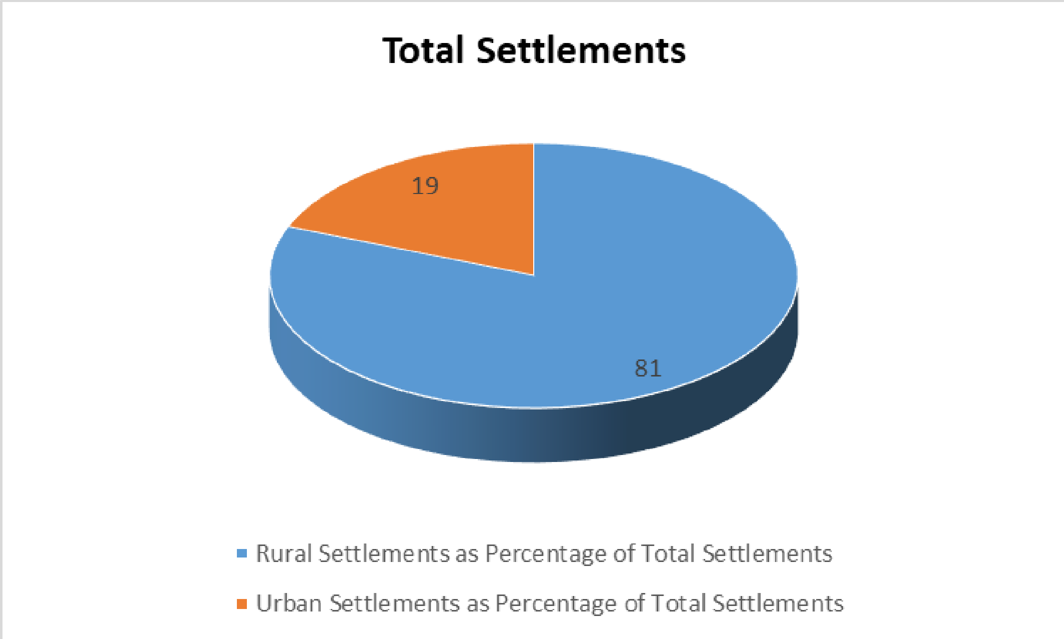


Figure 7.5: Rural and Urban Settlement as a Percentage of Settlements

In the Provincial region, the distribution of households shows a significant urban majority. As of April 2024, 67% of the households are urban, amounting to approximately 12.39 million households. In contrast, 33% of the households are rural, which translates to around 6.12 million households (Figure 7.6Figure 7.6). This distribution shows the concentration of the population in urban areas, reflecting urbanisation trends and the development of infrastructure and services.

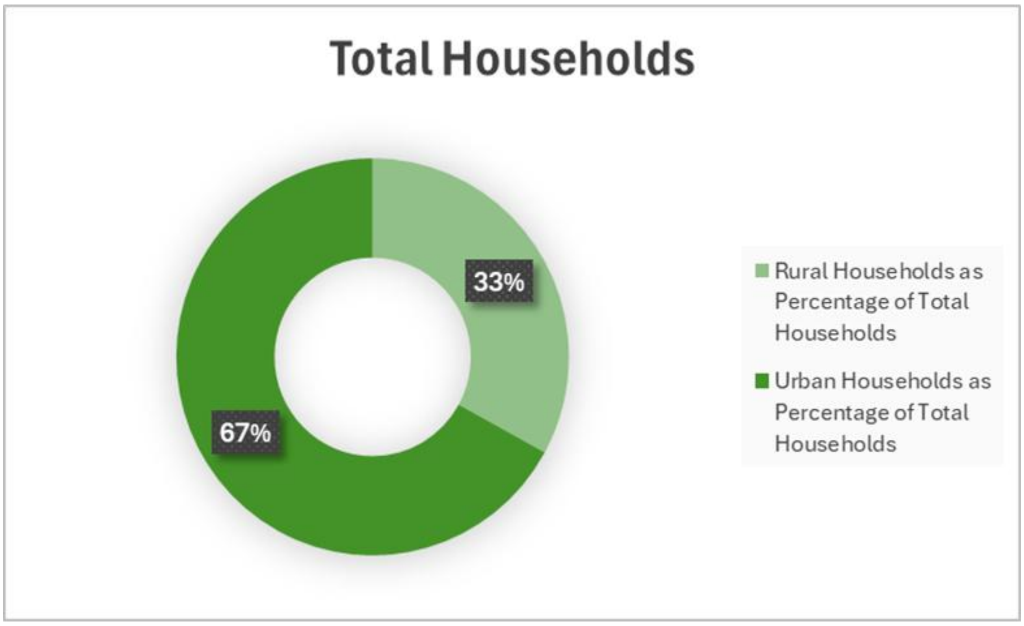


Figure 7.6: Rural and Urban Households as a percentage of Total Household

7.4 Access to Water and Sanitation

Table 7-3 gives District Municipal Provincial Water and Above Reconstruction and Development Program (RDP) Households. In the Eastern Cape, there are a total of 1.9 million households. Among these, a notable 81.02% of households have access to water infrastructure. Furthermore, a substantial (78.68%) of households meet or exceed the Rural Development Program (RDP) standards for water infrastructure. However, the situation with reliable water supply is less favourable, with only 58.18% of households enjoying consistent and dependable access to water. This disparity suggests that while access to basic water services is widespread, many households still struggle with the reliability of their water supply.

Gauteng boasts a total of 5,56 million households, demonstrating impressive statistics regarding water access. An overwhelming (99.08%) of households benefit from water infrastructure, showcasing the province's commitment to meeting the needs of its residents. Moreover, an impressive (97.38%) of households have access to water infrastructure that meets or exceeds RDP standards. In terms of reliability, (78.02%) of households have a consistent water supply, reflecting both high access levels and a relatively dependable water provision system.

With 850 thousand households, the Free State presents a favourable depiction for water access, as nearly all 98.78% of households have access to water infrastructure. Additionally, (94.7%) of households meet or exceed RDP standards for water services. However, the reliability of this water supply leaves room for improvement; only (56.2%) of households have a constant and reliable source of water. This highlights a gap between access to water services and the reliability of those services.

In KwaZulu-Natal, there are 2,9 million households, of which (90.7%) have access to water infrastructure. Furthermore, the majority (85.6%) of households meet or exceed the RDP standards for water service provision. However, while these figures are encouraging, only (60.4%) of households experience a reliable water supply. This suggests that despite good access to water infrastructure, many residents still face challenges regarding the consistency of their water services.

Limpopo is home to 1,9 million households. Among these, (85.2%) of households have access to water infrastructure, while (69.54%) meet or exceed RDP standards. The reliability of these water resources, however, the information suggests a different narrative, with only (58.81%) of households enjoying a dependable water supply. This indicates a notable discrepancy between basic access and reliable water provision in the province.

In Mpumalanga, there are 1.5 million households. A commendable (90.36%) of households have access to water infrastructure, with (83.56%) complying with RDP standards. Despite these promising figures, the reliability of the water supply remains a concern, with (54.53%) of households experiencing consistent access to water. This highlights an ongoing challenge to ensure that a significant number of households with access also benefit from reliable water services.

The North West province consists of 1.2 million households, with (95.45%) households having access to water infrastructure. Additionally, (83.58%) of households meet or exceed the RDP standards for water services. However, only (57.03%) households benefit from a reliable water supply. The data stresses the need to bridge the gap between having basic access to water and ensuring its reliability for the residents of the North-West.

The Western Cape has a total of 340 thousand households. Within this province, (96.96%) of households have access to water infrastructure, and (90.13%) meet or surpass RDP standards. However, only (54.62%) of households have a reliable water supply, indicating that while infrastructure access is strong, many residents still face challenges in securing consistent water service.

On a broader scale, across all provinces, there are a total of 18,5 million households. Remarkably, (93.55%) of households have access to water infrastructure, and (88.58%) households meet or exceed RDP. Nevertheless, regarding reliable water supply, only (68.09%) of households can depend on a consistent water service, refer to Figure 7.7.

This reveals a significant trend: while a large majority of households across various provinces have access to essential water infrastructure, there are pronounced gaps in the reliability of this resource (Table 7-3). Provinces like Gauteng and the Western Cape exhibit both high access and reliability rates. In contrast, provinces such as Mpumalanga and Limpopo face greater challenges in ensuring that all households have access to water infrastructure and benefit from reliable water supply systems. This underlines the pressing need for improvements in water infrastructure to secure consistent and dependable water services for all households across the provinces.

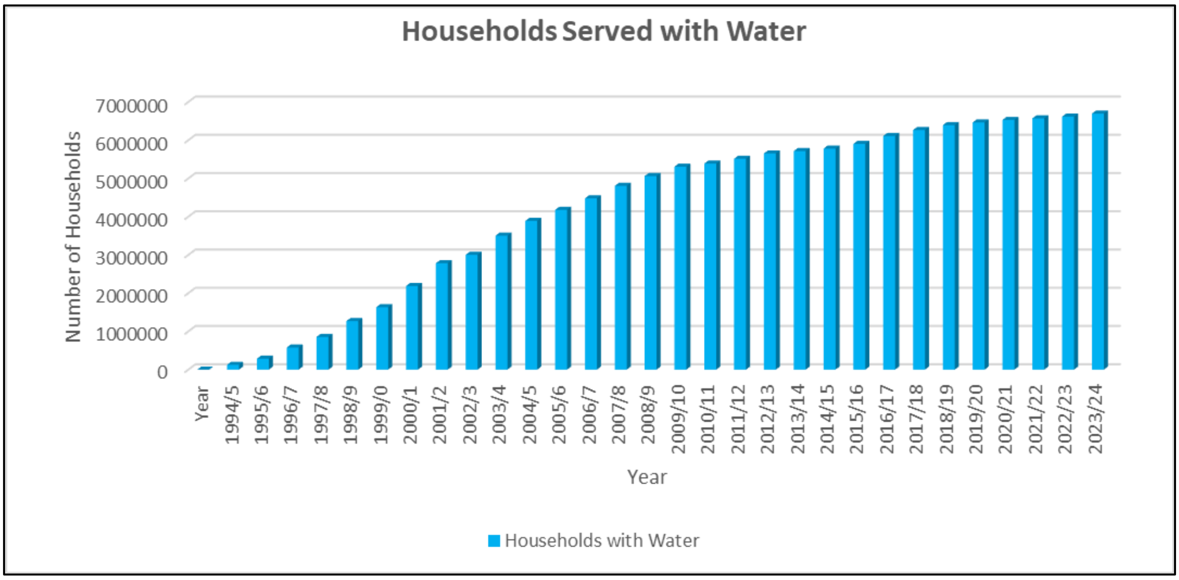


Figure 7.7: Households Served with Water

Table 7-3: District Municipal Provincial Water at and above RDP Households (DWS,2024)

Region	Time Frame	Total Households	Access to Water Infrastructure Households	Access to Water Infrastructure Households %	Total At and Above RDP Water Infrastructure Households	Total At and Above RDP Water Infrastructure Households %	Reliable Water Households	Reliable Water Households %
Eastern Cape	April 2024	1871169	1516033	81,02	1472321	78,68	1088670	58,18
Free State	April 2024	849197	838807	98,78	804230	94,7	477233	56,2
Gauteng	April 2024	5599783	5548485	99,08	5453309	97,38	4369073	78,02
KwaZulu-Natal	April 2024	2912226	2641461	90,7	2492924	85,6	1758844	60,4
Limpopo	April 2024	1897352	1616479	85,2	1319445	69,54	1115896	58,81
Mpumalanga	April 2024	1491045	1347376	90,36	1245946	83,56	813047	54,53
North West	April 2024	1154367	1101809	95,45	964876	83,58	658349	57,03
Northern Cape	April 2024	339528	329208	96,96	306007	90,13	185464	54,62
Western Cape	April 2024	2397488	2378608	99,21	2338180	97,53	2137636	89,16
Provincial	April 2024	18512155	17318266	93,55	16397238	88,58	12604212	68,09

7.5 Raw water use charges for the 2024/2025 financial year

Water tariffs are fees that public utilities charge for supplying and treating water and wastewater services. These fees cover water treatment, storage, transportation, and wastewater management costs. The amount and structure of water tariffs can differ between water management areas and types of users, such as residential, commercial, and industrial customers. The main goals of water tariffs are to ensure financial sustainability, improve efficiency, provide fair access to services, and support water conservation and environmental health.

Raw water tariffs are fees for using untreated water from natural sources like rivers, lakes, and aquifers. Government agencies or water management authorities usually set these tariffs to cover the costs of managing water resources, maintaining infrastructure, and protecting the environment. Raw water tariffs help manage how water is charged for use (Figure 7.8). They usually include a fixed charge and a charge based on the amount of water abstracted.

These tariffs encourage people to use water wisely, protect water resources, and keep water management systems financially stable. Several key factors are important when setting raw water tariffs. First is cost recovery, which ensures that expenses for managing water resources and maintaining infrastructure are covered. Economic efficiency encourages responsible water use. Tariffs also reflect the environmental impact of taking water to encourage conservation. Social equity ensures that tariffs are fair and include protections for vulnerable groups, while Transparency and accountability are also necessary for clear processes and consulting with stakeholders to ensure all parties understand how tariffs are set and used.

Figure 7.9 shows that the involvement of various stakeholders in establishing and managing water tariffs is essential for effective water resource management and sustainability. The Department of Water and Sanitation (DWS) is responsible for regulating water tariffs by establishing comprehensive norms and standards that aim to promote sustainable water usage and equitable access. This regulatory framework is designed to ensure that water resources are utilized efficiently while safeguarding the interests of all users. The Trans-Caledon Tunnel Authority (TCTA) is key in this process, as it not only finances but also oversees the implementation of bulk water infrastructure projects across the country by ensuring that cost recovery mechanisms are integrated into the tariff structure.

In addition to governmental bodies, banks and investors are crucial for providing the necessary funding for water infrastructure projects. They help bridge the significant investment gap often faced in the water sector, enabling the development and maintenance of essential water services and infrastructure. The impact of water tariffs extends directly to the water sector and end users. These tariffs must be carefully calibrated to balance several competing priorities: ensuring sufficient cost recovery to fund infrastructure and maintenance, maintaining affordability for consumers—especially vulnerable populations—and promoting water conservation practices.

Monitoring bodies such as the South African Reserve Bank (SARB) play an important role by overseeing administered prices, including water tariffs, to mitigate economic inflationary pressures. This monitoring helps ensure that any tariff increases do not disproportionately affect consumers, while ensuring that the water services remain sustainable.

The National Treasury is responsible for overseeing the broader financial framework in which these tariffs operate. It ensures that the tariffs are established efficiently and transparently, allowing for public scrutiny and fostering trust among stakeholders. Furthermore, the South African Local Government Association (SALGA) is actively involved in advocating for fair tariff adjustments. It represents the interests of municipalities during tariff discussions, ensuring that local governments have a voice in the process and that the tariffs set are fair and reflective of local needs.

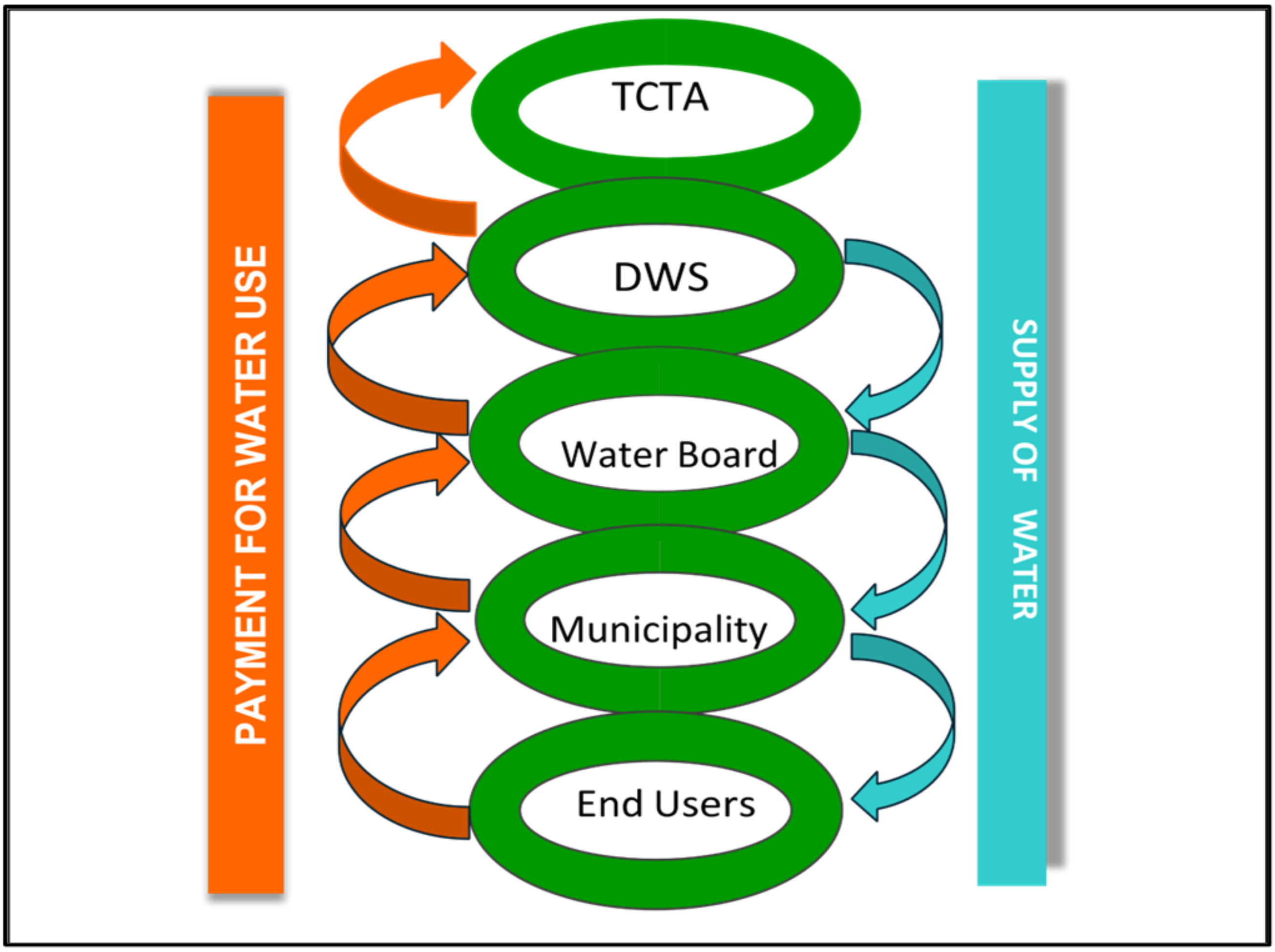


Figure 7.8: Water Supply Chain

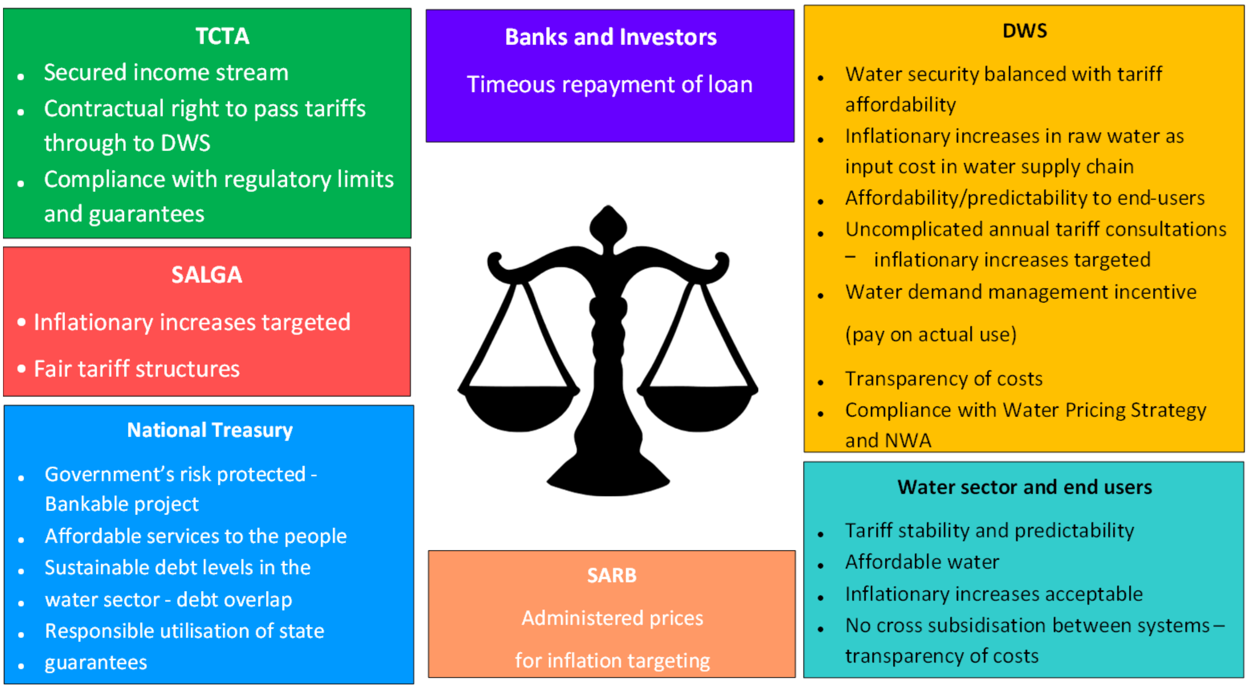


Figure 7.9: Balanced Tarrif Objective Source (TCTA, 2024)

7.5.1 Water Resource Management Charges

Considering the issue of affordability and financial stability of the institution, the increased range for the Water Resource Management Charges was approved as given in Table 7-4. The analysis of water tariffs for the Limpopo-North West Water Management Area (WMA) between the fiscal years 2023/24 and 2024/25 reveals a positive trend of consistent increases across all categories. The domestic and industrial (D&I) tariff has risen from 4.80 c/m³ in 2023/24 to 5.21 c/m³ in 2024/25, reflecting an 8.6% increase. Likewise, irrigation (IRR) tariffs have grown from 3.37 c/m³ to 3.65 c/m³, and forestry tariffs have advanced from 2.65 c/m³ to 2.87 c/m³, both also demonstrating an 8.6% rise.

Table 7-4: 2024/2-25 Approved Water Resource Management Charges

	APPROVED TARIFFS 2024/25 FY		
WMA	**Domestic and Industry c/m³**	**Irrigation c/m³**	**Forestry c/m³**
Limpopo North West	5.21	3.65	2.87
Pongola Mzimkhulu	3.39	2.50	2.19
Olifants	4.78	3.54	2.68
Inkomati Usuthu	5.07	2.57	1.99
Berg Olifants	6.36	3.06	2.99
Breede Gouritz	5.85	3.26	1.67
Mzimvubu Tsitsikamma	4.38	3.33	2.94
Orange	1.89	1.15	0.00
Vaal	3.11	2.64	2.64

In the Pongola-Mzimkhulu Water Management Area (WMA), the assessment of water tariffs between the fiscal years 2023/24 and 2024/25 highlights some significant observations. The tariff for domestic and industrial (D&I) use has remained stable at 3.39 c/m³, indicating a solid pricing strategy that supports consistency for consumers. In contrast, the irrigation (IRR) tariffs have increased from 2.30 c/m³ in 2023/24 to 2.50 c/m³ in 2024/25, reflecting an 8.6% rise. Forestry tariffs have also risen from 2.01 c/m³ to 2.19 c/m³, maintaining the same 8.6% increase.

For the Olifants Water Management Area (WMA), the review of water tariffs shows a consistent and constructive increase across all categories. The domestic and industrial (D&I) tariff has risen from 4.41 c/m³ in 2023/24 to 4.78 c/m³ in 2024/25, indicating an 8.6% increase that aligns with overall growth objectives. Furthermore, irrigation (IRR) tariffs have progressed from 3.26 c/m³ to 3.54 c/m³, while forestry tariffs have increased from 2.47 c/m³ to 2.68 c/m³, both showing an 8.6% rise. The analysis of water tariffs for the Inkomati-Usuthu Water Management Area (WMA) reveals a positive trend, with consistent increases across all categories. For domestic and industrial (D&I) use, the tariff rose from 4.67 c/m³ in 2023/24 to 5.07 c/m³ in 2024/25, representing an 8.6% increase. Likewise, irrigation (IRR) tariffs have moved from 2.37 c/m³ to 2.57 c/m³, and forestry tariffs have increased from 1.83 c/m³ to 1.99 c/m³, both reflecting an 8.6% rise.

Similarly, in the Berg-Olifants Water Management Area (WMA), the comparison of tariffs demonstrates a constructive increase across all categories. The domestic and industrial (D&I) tariff increased from 5.86 c/m³ in 2023/24 to 6.36 c/m³ in 2024/25, highlighting an 8.6% growth. In addition, irrigation (IRR) tariffs have grown from 2.82 c/m³ to 3.06 c/m³, and forestry tariffs have risen from 2.76 c/m³ to 3.00 c/m³, again showing an 8.6% increase.

The upward trend in water tariffs is also noteworthy in the Breede-Gouritz Water Management Area (WMA). The tariff for domestic and industrial (D&I) use has grown from 5.51 c/m³ in 2023/24 to 5.85 c/m³ in 2024/25, indicating a 6.2% increase. Additionally, irrigation (IRR) tariffs have increased from 3.00 c/m³ to 3.26 c/m³, and forestry tariffs from 1.54 c/m³ to 1.67 c/m³, with both categories demonstrating an 8.6% increase.

The tariffs for the Mzimvubu to Tsitsikama Water Management Area (WMA) between the fiscal years 2023/24 and 2024/25 show a consistent increase across all categories. For domestic and industrial (D&I) use, the tariff increased from 4.04 c/m³ in 2023/24 to 4.38 c/m³ in 2024/25, reflecting an 8.6% rise. Similarly, irrigation (IRR) tariffs rose from 3.07 c/m³ to 3.33 c/m³, and forestry tariffs increased from 2.71 c/m³ to 2.94 c/m³, both also showing an 8.6% increase.

The analysis of water tariffs for the Orange Water Management Area (WMA) reveals positive developments across all categories. For domestic and industrial (D&I) use, the tariff increased from 1.74 c/m³ in 2023/24 to 1.89 c/m³ in 2024/25, reflecting a constructive 8.6% rise. Similarly, irrigation (IRR) tariffs increased from 1.06 c/m³ to 1.15 c/m³, demonstrating an 8.6% growth. No forestry tariffs were recorded for this WMA.

The evaluation of water tariffs for the Vaal Water Management Area (WMA) during the same fiscal year highlights consistent improvements across all categories. For domestic and industrial (D&I) usage, the tariff rose from 2.87 c/m³ in 2023/24 to 3.11 c/m³ in 2024/25, marking an encouraging 8.6% increase. Furthermore, irrigation (IRR) tariffs increased from 2.43 c/m³ to 2.64 c/m³, while forestry tariffs remained steady at 2.43 c/m³.

The WRMC for waste-related activities was determined according to the principle of apportionment, wherein the total cost of the CMA was allocated to the waste activities based on the registered waste volumes refer to Table 7-5.

Table 7-5: 2024/25 Approved WRMC for Waste Related Activities

WASTE DISCHARGE TARIFFS	
APPROVED 2024/25 FY	
Domestic and Industry Sector	
WMA	**Approved 2024/2025 Tariffs C/M³**
Berg Olifants	4.36
Breede Gouritz	5.67
Inkomati Usuthu	5.07
Limpopo North West	3.91
Mzimvubu Tsitsikamma	3.04
Olifants	3.55
Orange	2.20
Pongola Mzimkhulu	3.46
Vaal	2.93

7.5.2 Water Resource Infrastructure Charges

Water Resource Infrastructure charges play a role in ensuring the effective management of water supply systems. These charges are designed to cover the essential cost involved in planning, designing, constructing, operating, maintaining, refurbishing, and enhancing government water schemes. The infrastructure charges are categorized into four key elements 1) Depreciation 2) Return of Assets; 3) Operations and Maintenance (O&M) and 4) Capital Unit Charge (CUC).

The water resources infrastructure charges for all other systems/ schemes and water user categories are represented in Table 7-6 are approved as follows:

Vaal River System: The total weighted average capital tariff for augmentation schemes has seen an increase, rising from R3.45/m³ to R3.725/m³, while the marginal tariff moved up from R5.55/m³ to R5.997/m.

The Berg Water Capital Charge has remained stable, indicating effective management of this component, while the Third-Party Capital Charge has increased significantly from R7.10/m³ to R7.627/m³.

Table 7-6: The water resources infrastructure charges

PROJECTS	2024/25 FY Approved tariffs R/m3	
Vaal River System (VRS)	Capital Unit charge (CUC)	**2.805**
	Bulk Operation and Royalty Charge (BO&RC)	**0.920**
	Total Weighted Average Augmentation Schemes Capital Tariff	**3.725**
	Marginal Tariff	**5.997**
Berg Water Project (BWP)	Berg Water Capital Charge	**0.191**
	Third Party Capital Charge	**7.627**
Vaal River Eastern Sub System Augmentation Project (VRESAP)	Eskom VRESAP- User Tariff	**1.861**
	Sasol VRESAP User Tariff	**3.701**
	VRESAP marginal tariff	**5.542**
Komati Water Scheme Augmentation Project (KWSAP)		
	KWSAP user tariff	**3.184**
	KWSAP marginal tariff	**7.260**
Mokolo and Crocodile River (West) Water Augmentation Project Phase 1 (MCWAP)		
	MCWAP- 1 User Tariff	**4.53**
	MCWAP-Marginal Tariff	**6.95**
Mooi- Mgeni Transfer Scheme 2 (MMTS-2)		
	MMTS -2 Capital Tariff (zero rated and not discontinued)	**0.000**
	MMTS -2 Incremental Tariff	**4.879**
uMkhomazi Water Project-Phase 1 (uMWP-1)	uMWP-1 Capital Tariff	**2.139**

The Vaal River Eastern Subsystem Augmentation Project (VRESAP): Eskom's user tariff increased from R1.75/m³ to R1.861/m³, and Sasol's user tariff rose from R3.50/m³ to R3.701/m³. Furthermore, the marginal tariff rose from R5.25/m³ to R5.542/m³, ensuring that these critical services remain sustainable as costs evolve.

Komati Water Scheme Augmentation Project (KWSAP) -The user tariff has risen from R3.00/m³ to R3.184/m³, reflecting the need for continuous investment in water supply systems. The marginal tariff also saw an increase from R7.00/m³ to R7.260/m³.Mokolo and Crocodile River (West) Water Augmentation Project Phase 1 (MCWAP): The user tariff increased from R4.25/m³ to R4.53/m³, and the marginal tariff rose from R6.75/m³ to R6.95/m³. Mooi-Mgeni Transfer Scheme 2 (MMTS-2): The incremental tariff increased from R4.50/m³ to R4.879/m³.

uMkhomazi Water Project-Phase 1 (uMWP-1): The capital tariff rose from R2.00/m³ to R2.139/m³.

7.6 Water Infrastructure

Infrastructure development is critical for driving socio-economic progress in South Africa, and the Department of Water and Sanitation (DWS) is essential in this important initiative. The DWS is tasked with the sustainable management of the nation's water resources, including ensuring the availability of clean and safe water for all citizens and providing efficient and reliable sanitation services. This mandate is crucial for safeguarding public health, promoting environmental sustainability, enabling economic activities that contribute to the nation's growth, and improving every South African's overall quality of life.

The Department has developed strategic initiatives to address the water sector's multifaceted challenges, notably the National Water and Sanitation Master Plan. This comprehensive plan outlines actionable strategies to tackle issues such as water scarcity, inadequate sanitation facilities, and infrastructure upgrades. It strongly emphasises enhancing water security by diversifying water supply sources, optimizing water use, and protecting vital ecosystems.

Additionally, the initiatives focus on expanding access to clean water and improving sanitation infrastructure, particularly in underserved urban areas and rural communities where access to these essential services is often limited. By prioritizing investments in modern infrastructure, such as water treatment plants and sanitation facilities, along with the adoption of innovative technologies, the DWS aims to create a more resilient water sector. This sector will meet the current needs of a growing population and adapt to the dynamic economic landscape and climate challenges. Through these efforts, the DWS is committed to fostering a sustainable, equitable, and efficient water and sanitation system that supports community development, enhances public health, and drives economic growth across South Africa (DWS, 2024). The augmentation projects that were taken as part of the initiatives are depicted in Figure 7.10.

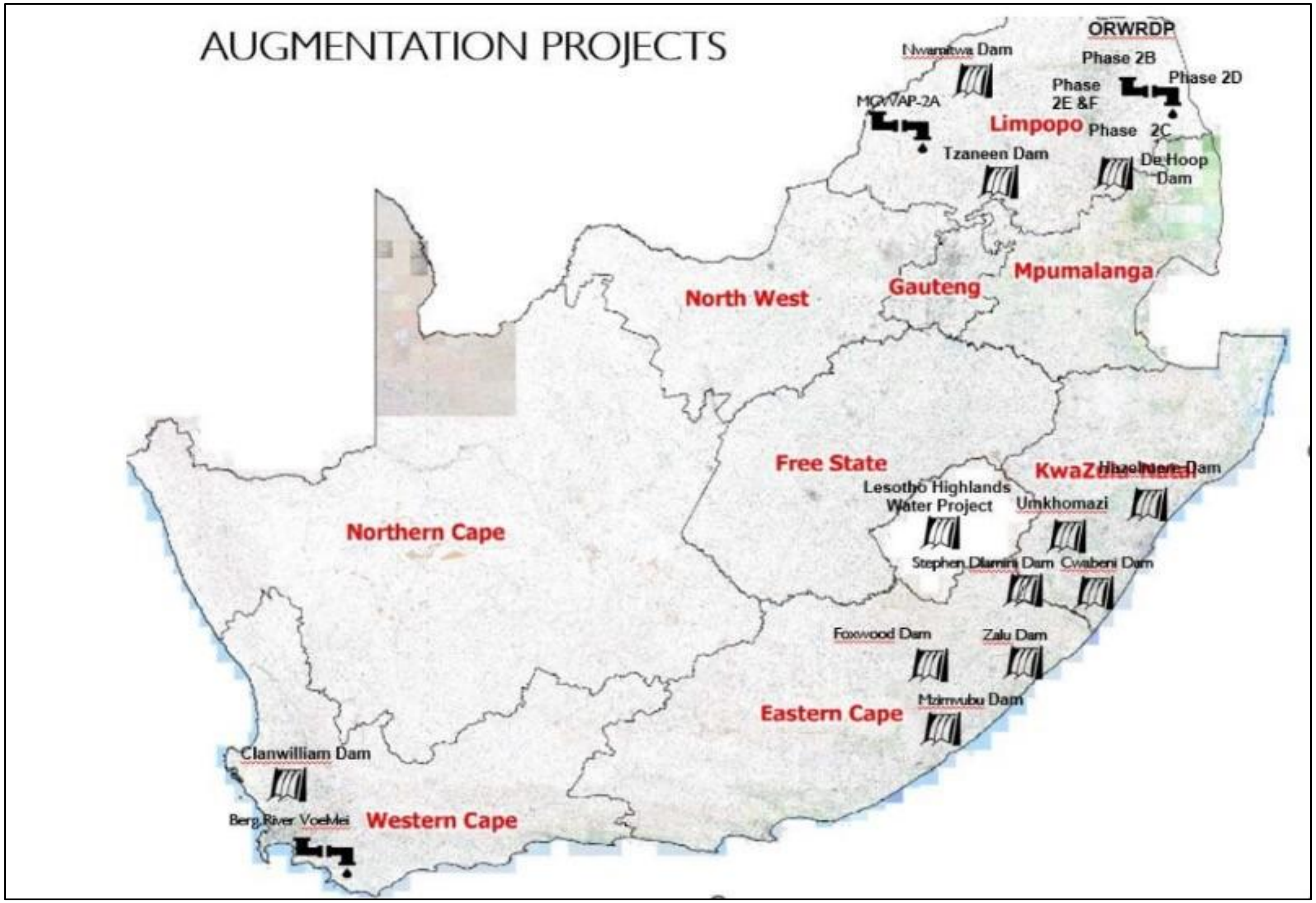


Figure 7.10: Water Resource Development Projects Underway

7.7 Projects At Close Out Phase

7.7.1 Hazlemere Dam

The project to raise Hazelmere Dam aims to enhance the water supply to the KZN North Coast by increasing the dam wall height by 7 meters. This will improve the dam's yield for medium-term water supply. The scope of work includes constructing a piano key weir on the spillway, installing rock anchors, performing foundation grouting, and undertaking other minor works.

7.7.2 De Hoop Dam

Phase 2 of the ORWRDP (ORWRDP-2) focuses on the development of additional water resource infrastructure, particularly the De Hoop Dam on the Steelpoort River. Phase 2A encompasses the construction of the De Hoop Dam and its associated works.

7.1. Projects at construction Phase

7.7.3 Raising of Tzaneen Dam

This project focuses on constructing a large storage dam with a gross capacity of approximately 187 million cubic meters on the Great Letaba River, downstream from the confluence with the Nwanedzi River. The aim is to accommodate the ecological water reserve as well as domestic and irrigation water requirements. The Raising of Tzaneen Dam project is designed to enhance the region's water supply by increasing the height of the dam wall by 3 meters to improve the dam's yield and address water shortages. The work includes demolishing the top of the existing spillway, constructing a labyrinth spillway, and performing other minor related works, along with the realignment of affected national and provincial roads.

7.7.4 Raising of Clanwilliam Dam

The Raising of Clanwilliam Dam project aims to increase the reliability of water supply for agricultural purposes. It also intends to allocate water to resource-poor farmers and address safety concerns associated with the dam. The project involves raising the existing dam wall by 13 meters, relocating a section of the N7 highway that is directly affected by the elevated dam wall, and raising secondary provincial roads impacted by the Full Supply Level (FSL) within the dam basin. Currently, the project is 19% complete and is expected to be finished by 2028.

7.7.5 Mzimvubu Water Project (MWP) Stages 1 & 2

The Ntabelanga and Lalini dams and their associated infrastructure represent an exciting opportunity for development on the Tsitsa River, a vital tributary of the Mzimvubu River. This multi-purpose project is designed to enhance potable water supply, promote irrigation, generate hydropower, and foster tourism. Recognized as a Strategic Integrated Project under SIP-19, it underscores the government's commitment to sustainable development.

The project is positioned to significantly impact the regional economy by effectively utilizing the water resources in the Mzimvubu River catchment. Its focus areas, including domestic water supply, irrigation, hydropower generation, and job creation, aim to uplift local communities and stimulate growth.

The implementation of this project is planned in four strategic stages, starting in 2018/19:

Stage 1: includes the development of Advanced Infrastructure, with a key emphasis on building access roads (Figure 7.11)

Stage 2: Implementation of the Ntabelanga Dam, which will serve as a foundation for the project.

Stage 3: Establishment of the bulk distribution system to ensure efficient water delivery.

Stage 4: Integration of irrigation and hydropower components, which will also include the construction of roads and staff housing

Figure 7.11: Mzimvubu Site. Source (DWS, 2024)

7.8 Projects in the Design Phase

7.8.1 Groot Letaba River Development Project (GLeWAP): Raising of Tzaneen Dam

The project involves the construction of a large storage dam with a gross storage capacity of approximately 187 million m^3 on the Great Letaba River downstream of the confluence of the

Nwanedzi River to provide for the ecological water reserve and domestic and irrigation water requirements. The scope of the work includes the construction of the Nwamitwa Dam and the realignment of affected National and provincial roads

7.8.2 Olifants Management Model

The Olifants Management Model (OMM) involves the further developments of the bulk water distribution system from the De Hoop Dam consisting of a pipeline from Flag Boshielo dam to Sekuruwe WTW in Mogalakwena (ORWRDP 2B & 2B+), a pipeline from Clapham pump station to the Olifantspoort weir (ORWRDP 2F) and the refurbishment of existing LWUA Infrastructure (ORWRDP 2H).

Additional work includes the southern extension of the existing LWUA pipeline, and the potable water supply system to communities adjacent to the bulk supply system

7.8.3 Lusikisiki Regional Water Supply Scheme: Zalu Dam

The Zalu Dam project involves constructing a storage dam with a yield of 6.85 million cubic meters per year (m^3/a) on the Xura River at the Zalu site, located approximately 10 km northwest of the town of Lusikisiki. Additionally, it includes the development of water distribution infrastructure to supply water for domestic use and irrigation to the town of Lusikisiki and surrounding villages

7.8.4 Algoa Water Supply System: Coerney Dam

The project entails the construction of a new earth-fill embankment dam, with a capacity of 4.69 million cubic meters, located to the east of the existing Scheepersvlakte Dam. This new dam will provide additional balancing storage for water transfers to the Nooitgedagt Water Treatment Works, serving the Nelson Mandela Bay Municipality. The project is currently 11% complete.

7.8.5 Foxwood Dam

The project entails the construction of a new composite concrete gravity and earth embankment dam on the Koonap River, located upstream of Adelaide. This dam will enhance the water supply for Adelaide and ensure a reliable bulk water source for new irrigation development aimed at resource-poor farmers. The proposed dam will have a gross capacity of approximately 55 million cubic meters and will feature a dam wall with a maximum height of 48 meters above the foundation level. Currently, the project is at 0% completion.

7.8.6 Raising of Gcuwa Weir

The Raising of Gcuwa Weir project aims to augment the water supply in the Butterworth area by raising the Full Supply Level of the Gcuwa Weir by 1.5 meters, which will increase its storage capacity by 0.7 million cubic meters to address water shortages. The scope of work includes raising the existing spillway to 549.5 meters above sea level (masl), strengthening the existing earth-fill embankment, raising the NOC by 1.2 meters, and making other modifications to existing works. The project is scheduled to start in 2021 and end in May 2030, with a completion percentage currently at 0%.

7.8.7 Olifants River Water Resources Development Project (Phase 2A)

De Hoop Dam: This operational project, De Hoop Dam, involves repairs to 38 houses and the water reticulation and sewage network at the Buffelskloof

7.9 Projects at the Implementation Phase by TCTA

7.9.1 Berg River Voelvlei Augmentation Scheme (BRVAS)

The Water Reconciliation Strategy for the Western Cape Water Supply System (WCWSS) highlighted a concerning projection indicating that the system was facing an impending water deficit. It required substantial augmentation efforts by the year 2019/20 to prevent a significant shortfall in water supply. This urgency became particularly apparent during the severe drought conditions experienced in 2018-2019 when the WCWSS demonstrated an inability to meet the region's water demands.

To address this critical situation, the proposed project aims to abstract and transfer excess winter flows from the Berg River (see Figure 7.12). This initiative will involve pumping the water to the existing Voëlvlei Dam, increasing the dam’s yield by an estimated 23 million cubic meters per annum.

The project comprises several key components, including the construction of a diversion weir in the Berg River to manage water flow and a pump station that will facilitate the extraction of water from the river. A significant feature of the project is the installation of a 6.3 km long rising main pipeline designed to transport the abstracted water efficiently to the Voëlvlei Dam. This pipeline will ensure a reliable water flow, particularly during winter when excess flows are available.

In addition to the main components, ancillary works will also be undertaken. These include the construction of access roads to facilitate transportation and maintenance, a canoe-chute fishway to ensure safe passage for aquatic life, temporary river diversion works to minimize environmental impact during construction, and an electrical supply system aimed at powering the pumps necessary for the water transfer operation.

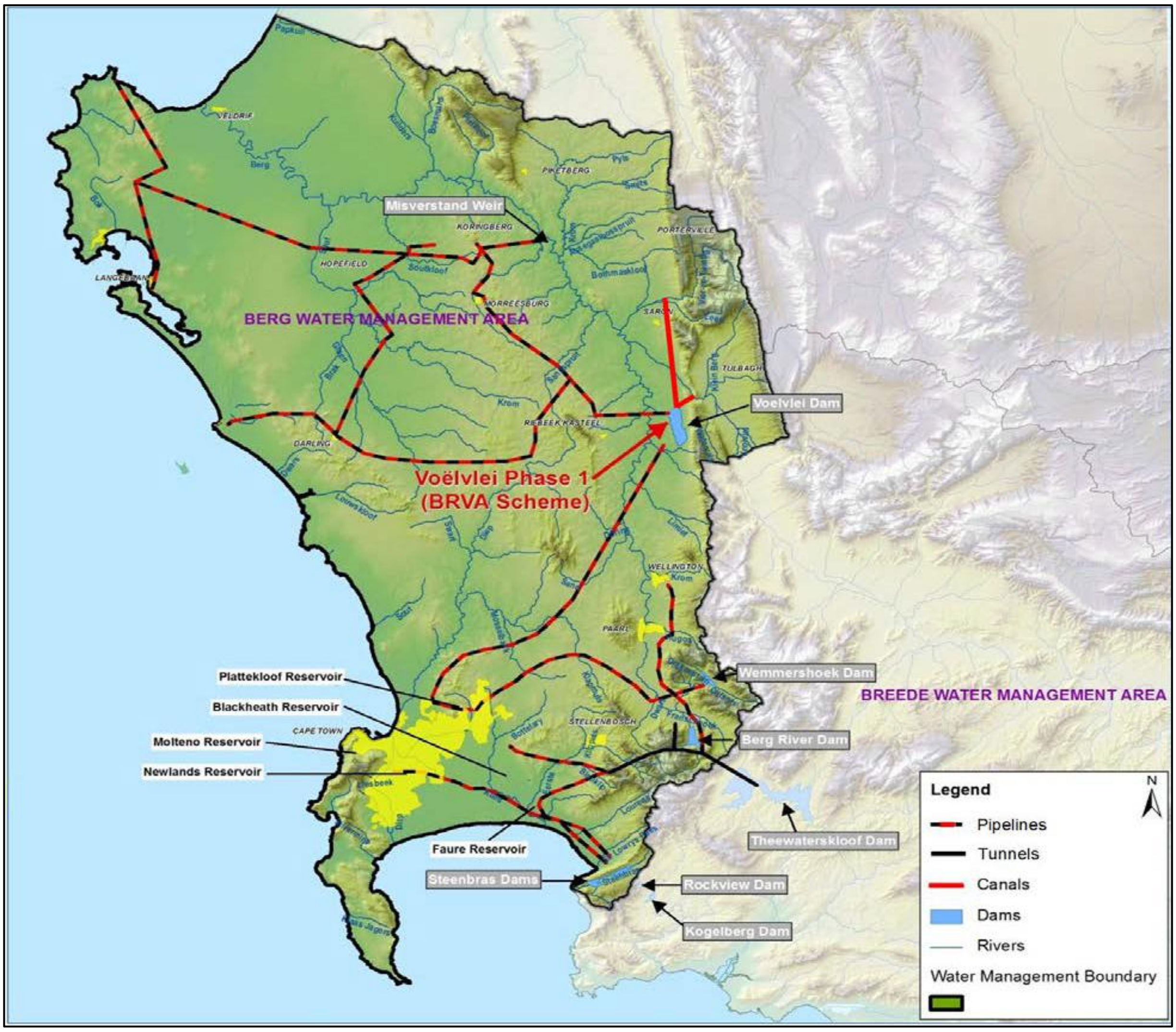


Figure 7.12: Location of the Berg River Vloevlei Project

7.9.2 Mokolo and Crocodile River Water Augmentation Project -2A (MCWAP)

The development of the Waterberg area is a pivotal component of the PICC SIP-01 program, aimed at strengthening the region's industrial growth and sustainability. This project is designed to address the escalating water demands faced by the Lephalale Municipality, which is experiencing significant population growth. This initiative will support local communities and enhance Exxaro's operational efficiency by ensuring a reliable water supply and providing them with the necessary resources for their mining activities.

In addition, the MCWAP-2A project (Figure 7.13) is integral to supplying Eskom with a secondary water source essential for the functioning of its two primary power stations in the Waterberg region—Medupi and Matimba. This additional source will facilitate an adequate water supply for Medupi Power Station, enabling it to operate three extra Flue Gas Desulfurization (FGD) units that are crucial for reducing emissions. For the Matimba Power

Station, the additional water will ensure the smooth operation of its 6 FGD units, which cannot currently receive water from the existing MCWAP-1 pipeline due to capacity constraints.

The MCWAP-2A project consists of several key infrastructure components designed to support its operational objectives:

- Abstraction Weir
- River Management System
- Water Transfer Infrastructure
- Pump Station
- Operational Control Centre

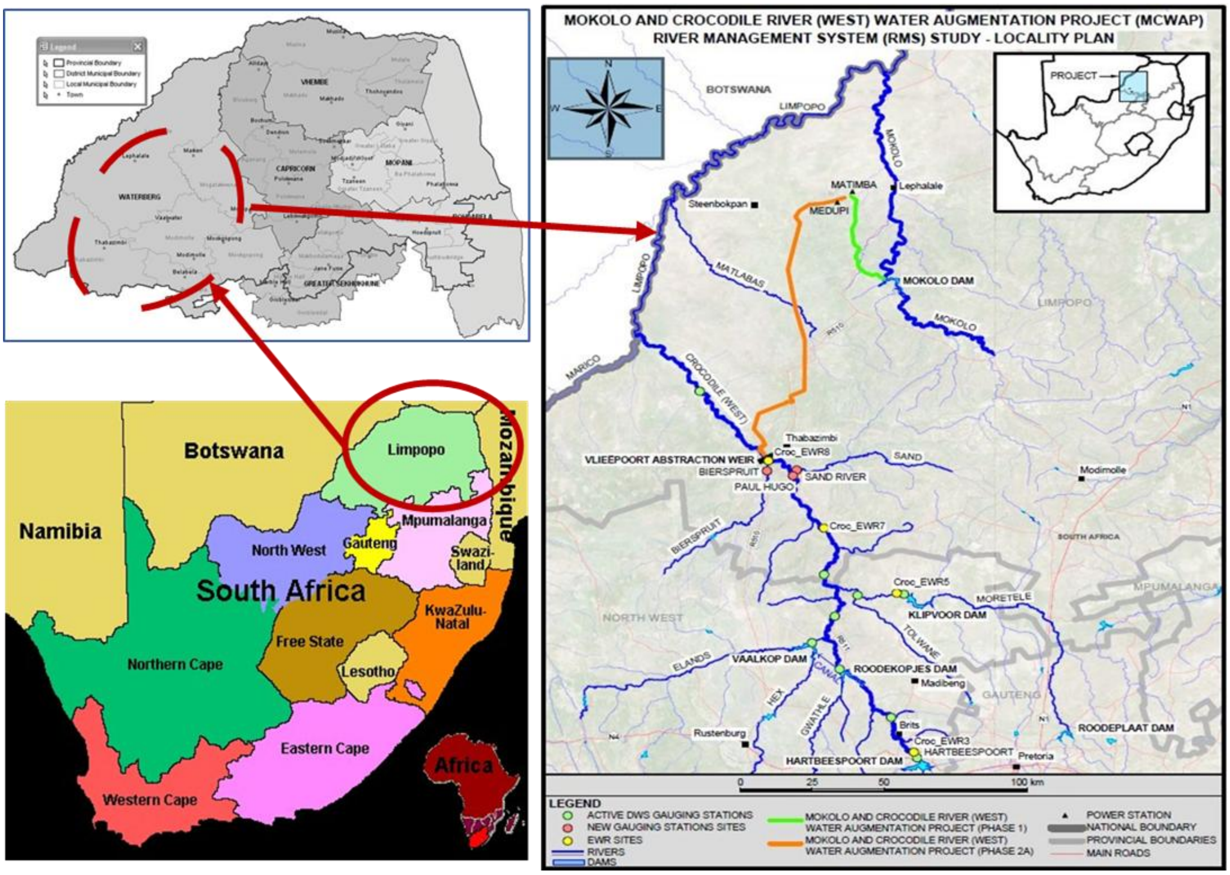


Figure 7.13: Mokolo and Crocodile River Augmentation Project- Phase 2A (MCWAP -2A)

7.9.3 uMkhomazi Water Project (uMWP-1)

The projections for water requirements indicate that the Mgeni System has been facing a deficit since 2016. To address this challenge, the Umgeni Water Project 1 (uMWP-1) (refer to (Figure 7.14) has been proposed to enhance the water resources.

The project will incorporate both bulk raw water infrastructure, managed by the Trans Caledon Tunnel Authority (TCTA), and bulk potable water infrastructure, guided by Umgeni-uThukela Water (UUW).

The primary objective of this project is to significantly increase the yield of the Mgeni System from 394 million cubic meters per annum (m^3/a) to 608 million m^3/a by December 2032.

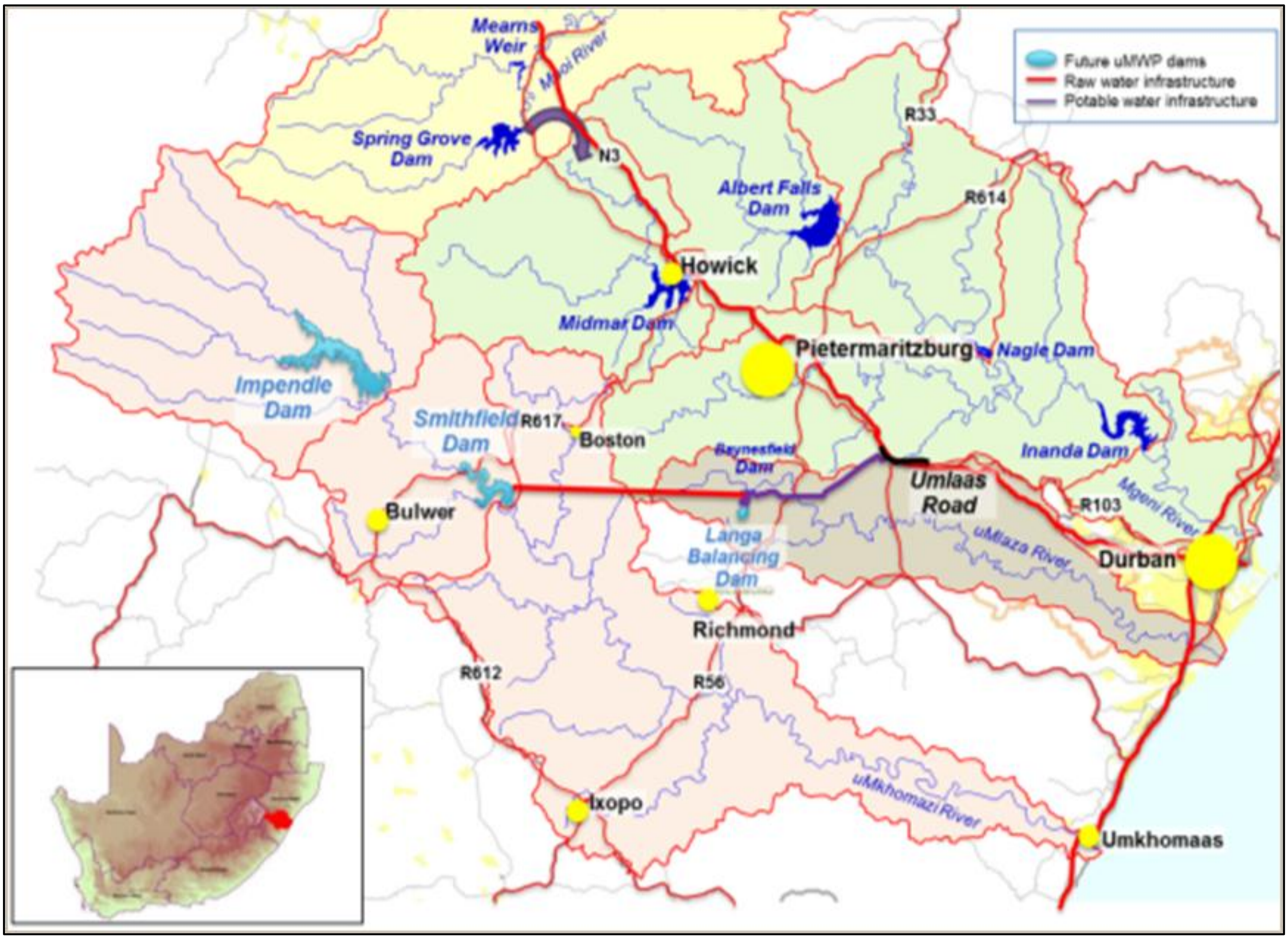


Figure 7.14: Schematic layout of uMWP-1. Source (DWS, 2024)

7.9.4 Nwamitwa Dam Project

To enhance the management of water resources in the region, it was proposed that the Tzaneen Dam be raised. This initiative aims to improve the water storage capacity and ensure a more consistent supply for various applications, including agricultural use, domestic consumption, and industrial processes.

In conjunction with this effort, the development of the Nwamitwa Dam on the Groot Letaba River is recommended. This project will encompass essential supporting infrastructure to facilitate effective integration with existing systems. The following components will be included:

- Nwamitwa Dam

- Sanral Bridge
- Rail Bridges
- Roads
- Relocation of Eskom Substation and Power Lines

7.9.5 Lesotho Highlands Water Project Phase 2 Update

Target: LHWC delivery schedule compliance, November 2024 plan was 0 MCM (Figure 7.15). Actual delivery for October to March 2024 was 0 MCM as per Planned 2024 Shutdown. Planned maintenance consists of five yearly inspections and tests as per the O&M Manual, not annual routine inspections.

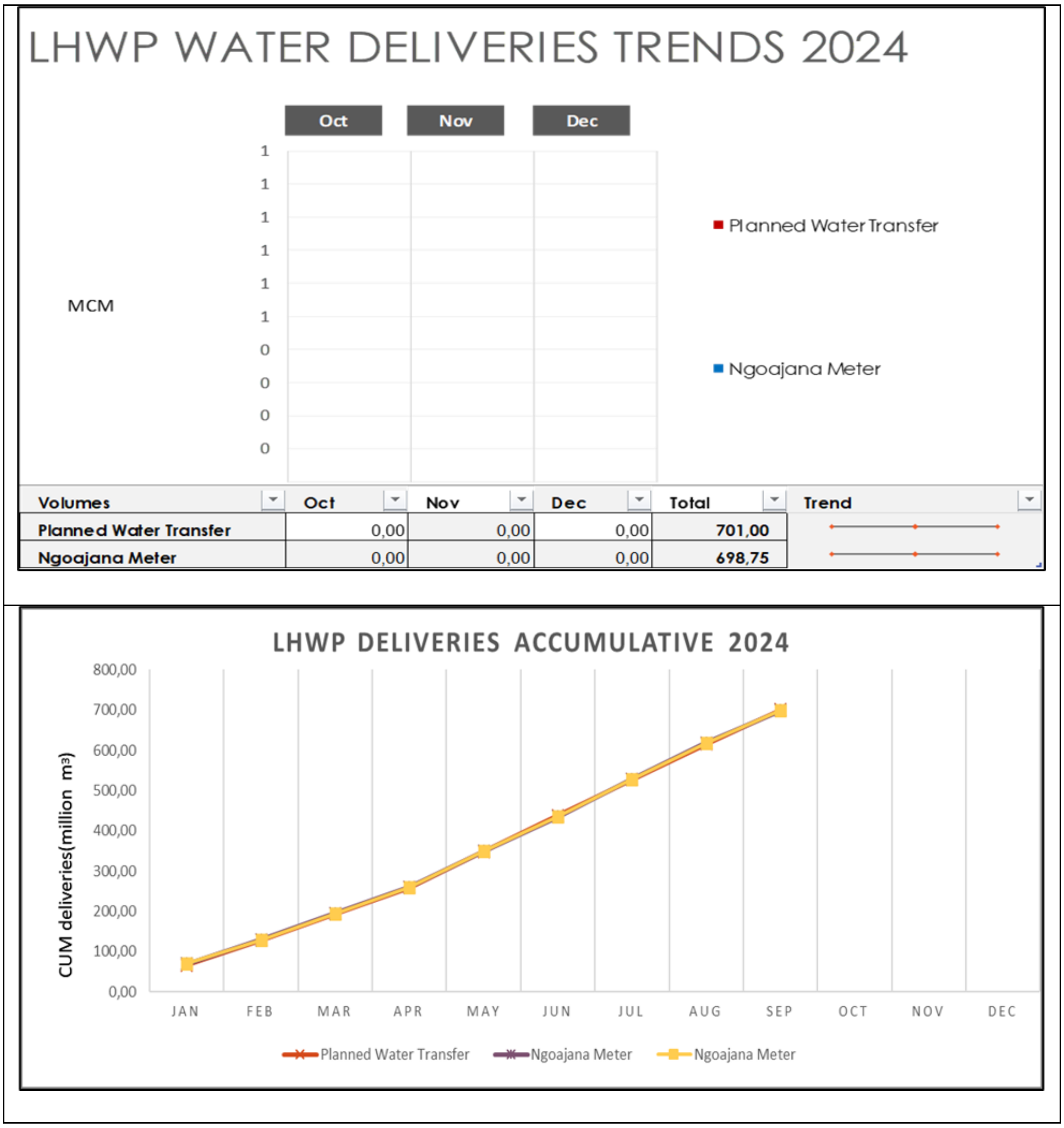


Figure 7.15: Lesotho Highlands Water Project water deliveries trends for 2024. Source DWS, 2024

7.10 Umgeni-uThukela Water Project

7.10.1 Stephen Dlamini Dam

The Stephen Dlamini Dam project aims to provide sustainable water supplies to Bulwer and surrounding peri-urban and rural communities. This project involves constructing a large storage dam on the Luhane River, which will serve as the main water source for the Harry Gwala District Municipality's Regional Bulk Water Supply Scheme.

7.10.2 Cwabeni Dam

The project involves the construction of a new concrete-faced zoned rockfill dam on the Ncwabeni River. It will include a multi-level intake tower, an abstraction weir on the uMzimkhulu River, and a pump station with a pipeline to transfer water into the off-channel storage dam. The project began in June 2017 and is currently 80% complete, with an anticipated completion date in 2030.

7.11 Reconciliation Strategies

The purpose of the Reconciliation Strategy studies is to determine the current water balance situation and to develop various possible future water balance scenarios for at least a 25-year planning horizon. It further aims to describe the proposed strategy, and the associated actions, responsibilities and timing of such actions that are needed to reconcile available resources and requirements, to enable additional interventions to be timeously implemented, to prevent the risk of a water shortage becoming unacceptable. The Strategies offers a system for the continuous monitoring and updating of existing Reconciliation Strategies.

7.11.1 Algoa System

Nelson Mandela Bay Municipality (NMBM) is regarded as the economic hub of the Eastern Cape Province, contributing 36,8% of the gross geographic product of the Province. The proximity of extensive commercial agriculture contributes to growth in the NMBM, providing permanent and seasonal jobs, as well as value-added activities for communities, both within and on the fringe of the NMBM. The opportunities within the NMBM have led to a rapidly increasing population through in-migration and growth in peri-urban settlements, which has exacerbated the backlog in services.

The Algoa WSS extends from the Kouga River system in the west to the Sundays River system in the east. The Algoa WSS provides water to the Gamtoos Water Users Association (WUA), NMBM and several smaller towns within the Kouga Municipality.

The system currently comprises three major dams in the west, several smaller dams, and a spring situated near NMBM, as well as an inter-basin transfer scheme from the Orange River via the Fish and Sundays rivers to the east. Towns located within Kouga LM are supplied from boreholes and springs, in addition to the supply from the Algoa Water Supply System (WSS).

System Yield and Water Balance

The updated 2024 1:50-year long-term stochastic system yield is 163.2 million m^{3}/a (447.1 Mℓ/d). The WSS is therefore in severe deficit because of over-allocation and reduced water availability, and the slow implementation of interventions. Considering the updated 2024 system yield, the WSS is currently in severe deficit of 58.76 million m3/a (161.0 Mℓ/day).

For the ***Medium Linear Per Capita Growth with Moderate Climate Change Water Balance Scenario***, as shown in Figure 7.16, and regarded as the preferred scenario to plan for, water requirements increase from the current (2022/23) 125.2 million m^{3}/a to 214.7 million m^{3}/a in 2055, i.e., an increase in water requirements of 89.5 million m^{3}/a.

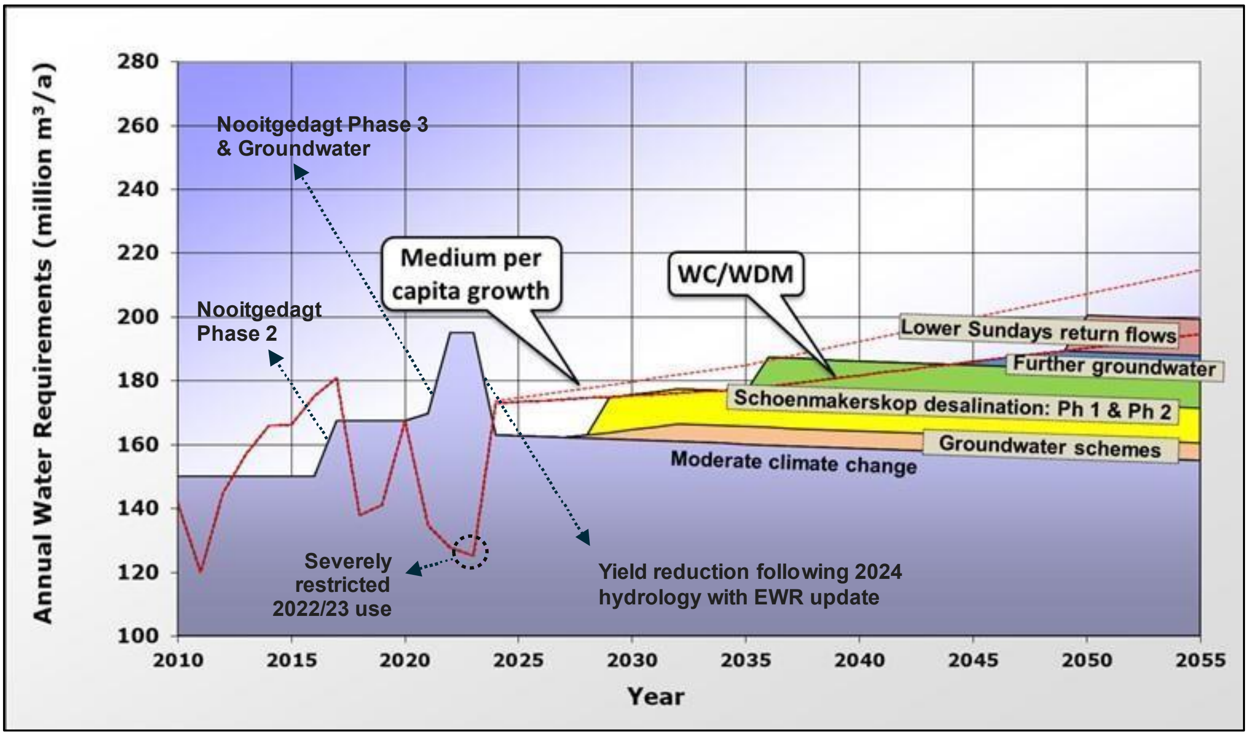


Figure 7.16: Medium Per Capita Growth with Moderate Climate Change Scenario

Intervention Options

A summary of the evaluated interventions to be considered for the water balance scenario evaluation are presented in Table 7-7.

Table 7-7: Intervention options for the Algoa WSS

WSS	Intervention	Progress
ALGOA	**Nooitgedagt-Coega Low Level Scheme Phase 3:**	NMBM completed the Phase 3 project, following earlier implementation by Amatole Water. Phase 3 is operational since 2022 and ensures a supply of 76.55 million m^3/a) (210 Mℓ/day).
	Municipal Groundwater Evaluations and Implementation of Groundwater Schemes	NMBM has constructed six new wellfields, all of which are in operation, however, some are not yet operating to full capacity. The estimated combined capacity is 27.1 Mℓ/day with an emergency supply potential of 36.3 Mℓ/day. NMBM recently completed an assessment of future groundwater target areas in and around the Metro. The CDC has been tasked by the NMBM to investigate these potential new groundwater sources. Kouga Municipality sought to reduce their reliance on surface water, from the Churchill and Kouga dams. In 2018/9 and 2022/3 numerous boreholes were drilled in Jeffreys Bay, Humansdorp, Hankey, Patensie, St Francis Bay and Oyster Bay - many of which have been equipped. The combined supplied yield is estimated to be ~11 Mℓ/day with the potential to increase it by an additional ~7 Mℓ/day.
	New Dam in the Kouga River	The comparative costs and potential impacts of the Guernakop Dam and the alternative ‘raised’ Kouga Dam were updated during this support cycle of the Algoa Reconciliation Strategy, during 2023.
	Nooitgedagt Scheme Phase 4	An evaluation of Phase 4 needs to be done, considering the required municipal treatment and distribution infrastructure, as well as implications of water efficiency measures needed for the Orange-Fish-Sundays transfer scheme from Gariep Dam, to ensure water availability. DWS indicated that any further allocations of Orange River water to NMBM would need to be coupled to proven associated savings in transferred Orange River water.
	NMBM 60 Mℓ/d phased Schoenmakerskop Desalination Scheme	The Nelson Mandela Bay Business Chamber (funded by Ezethu Trust) in cooperation with NMBM, has undertaken an Implementation Readiness Study to develop a preliminary design (Design Basis Report that will form part of an Environmental Impact Assessment submission) and advise on implementation readiness to guide the procurement process for construction of a phased 60 Mℓ/day seawater desalination plant at Schoenmakerskop south of the Metro.
	Coega SEZ 15 Mℓ/day Desalination Scheme	It was previously planned that the proposed phased desalination scheme in Coega be part of the augmentation for the SEZ, to be connected to the Olifantskop reservoir when built. An application for funding of the scheme was however not approved. In view of the various interventions being explored by NMBM to address the ongoing potable water supply shortages in the municipality, this

WSS	Intervention	Progress
		may negate the need for CDC to find additional water supply sources, particularly desalination plants.
	Lower Sundays River Return Flows Scheme	Flow monitoring in the Sundays River in support of this intervention is ongoing. Flow and water quality sampling to support the planning of the scheme have been done in the lower Sundays River by DWS. The reconnaissance-level evaluation of the scheme was revisited as part of this study, in 2023.
	Re-Use of Treated Effluent from WWTWs throughout NMBM	Treated effluent at small-scale are made available for irrigation or construction purposes.
	Direct Reuse of Treated Effluent from WWTWs	NMBM has identified a pilot project for the direct re-use of treated effluent from the Cape Recife WWTW. The feasibility study for the implementation of this pilot project has been completed. The Driftsands WWTW, with a treatment capacity of 22 Mℓ/day, together with the Driftsands Reservoir (with a storage capacity of 24 Mℓ), has been identified as a good prospect for the direct use of treated effluent at a large scale in the longer-term. The expected yield from this scheme is estimated at 3.65 million m3/a (10 Mℓ//day), based on an Average Dry Weather Flow (ADWF) of between 15 to 20 Mℓ//day. Further investigation is needed to explore the potential of installing a direct water reuse plant at the Driftsands WWTW.

7.11.2 Amathole System

The Amathole WSS is in the Eastern Cape Province, Amathole District Municipality (ADM). The WSS includes the catchments of the Buffalo River system, the Nahoon catchment, the Upper Kubusi catchment, which transfers water to the Buffalo River catchment, and the Gqunube River system.

In the original (2016) water reconciliation strategy of the Amathole WSS, it was determined that there may be potential to supply the system from the dams in the upper Keiskamma River catchment, given that Sandile Dam supplies Dimbaza in the Buffalo City Metropolitan Municipality (BCMM). Dimbaza was not in the original Amathole WSS footprint. Secondly, with boreholes drying to the east of the Gqunube River, BCMM had started providing water to areas in their jurisdiction that had previously not been included in the Amathole WSS. Based on the above, the study area was extended to include the whole of the BCMM area east of the Amathole WSS, including and up to the Kwelera River catchment and Cinsta Bay, as well as the upper Keiskamma catchment (quaternary catchments. R10A, B and C).

The extended Amathole WSS covers a total area of 4 293.94 km^2 with an estimated population of 896 726 as of 2022. The average population density of the WSS is 208 inhabitants per km^2. This is much higher than the average population of South Africa, which is 48.3 inhabitants per km$^{2.}$

System Yield and Water Balance

The water balance analyses indicate that the existing yield available at 1 in 50 years recurrence interval is insufficient to meet the Amathole WSS's water requirements. However, the additional water's quantum and timing differ depending on whether the yield is reduced by implementing preliminary Ecological Water Requirements (EWR) and the successful implementation of the Water Conservation/ Water Demand Management (WC/WDM) intervention measures. The additional water required for the median growth scenario without successfully implementing WC/WDM increases from 46.26 million m^3 /a, for the base scenario to 58.21 million m3 /a with the phased implementation of the preliminary EWR. This is an increase of 38.5% in additional water required with the phased implementation of the EWR. There is an urgency to undertake the classification of the water resources of the Amathole WSS to balance at least the ecologically sustainable base configuration (ESBC) with the need to ensure that the water resources of the Amathole WSS can sustain the economic utilisation of the water resources while maintaining the ecological status at the desired level based on the classification of the water resources of the Amathole WSS.

The determination of the water resource classes of the significant water resources in the Amathole WSS will ensure that the desired condition of the water resources, and conversely, the degree to which they can be utilised is maintained and adequately managed within the economic, social and ecological goals of the water users. With or without the phased implementation of the EWR, the future water requirements of the Amathole WSS will require either managing the consumer demands through implementing WC/WDM intervention measures and/or the development of conventional and non-conventional sources of supply.

The first initiative is to make up for the reduction in yield that is available for economic growth and development in the system due to the implementation of the preliminary EWR. The economic value of the additional water is critical for the sustainable economic growth and development of the Amathole WSS.

Table 7-8Figure 7.17 summarises the water reconciliation options required to meet the current and future water requirements with the phased implementation of the preliminary EWRs and implementing WC/WDM interventions to achieve a 50% rate in the water saving target.

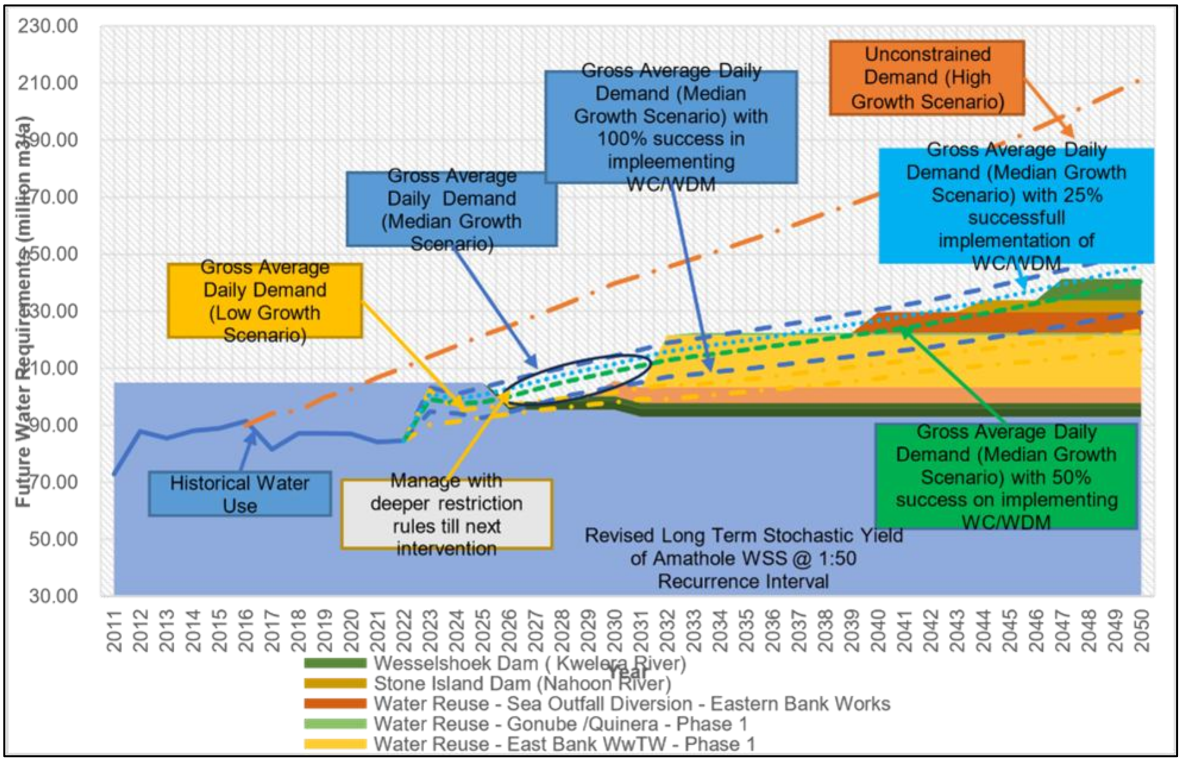


Figure 7.17: Water Balance Perspective to meet current and future water requirements- Median growth scenario with phase implementation of EWR & 50% successful Implementation

Interventions Options

A summary of the evaluated interventions to be considered for the water balance scenario evaluation are presented in Table 7-8.

Table 7-8: Summary of Water Reconciliation Options in the Amathole WSS

INTERVENTION	Water Reconciliation Options	Earliest First Water
Groundwater	Gasela Rooikrans Gubu Valley Sttuterheim Rabula-Keiskammahoek	2026
Water Conservation and Demand Management	Buffalo City Metropolitan Municipality Amatole Water- Rooikrants Pipeline Amatola Water- Laing Dam WTWs Amatola Water – Nahoon Dam WTWs Amathole DM- Stutt	2028 2026 2027 2027 2027
Water Re-Use and Desalination	Water Reuse - Reeston / Central Regional WWTW Phase 2 Water Reuse - East Bank WwTW - Phase 1 Water Reuse - Gonubie / Quinera WwTW- Phase 1 Water Reuse - Sea Outfall Diversion - Western Bank Works	2030 2032 2032 2030 2033
Desalination of Seawater and Brackish Water	Desalination Plant near East Bank WWTW	2030
Surface Water Resources	Stone Island Dam (Nahoon River) Mhalla's Kop Dam (Gqunube) Wesselshoek Dam (Kwelera River) North Slope (Toise River) Ravenswood Dam (Keiskamma River) Thornwood Dam (Keiskamma River)	2035 2038 2037 2029 >2050

7.11.3 Western Cape Water Supply System

The Western Cape Water Supply System (WCWSS) supplies water to the City of Cape Town, to towns in the Boland, West Coast and the Riviersonderend catchment, and to irrigators along the Berg, Riviersonderend, and the Eerste Rivers.

The current City of Cape Town (CoCT) population is estimated to be 4.98 million people. The future (medium growth population scenario) projections indicate that the total population of the WCWSS strategy area will grow from 5.98 million to 7.14 million by 2035 and to 9.19 million by 2055.

System Yield and Water Balance

As a result of the reduction in system yield, the WCWSS is currently over-allocated. It is mainly the Theewaterskloof and Voëlvlei dams that are over-allocated. The Western Cape economy is water-constrained, and this constraint applies even when the region's dams are full. The 2023/24 water use from the WCWSS was 506 million m^3/a, in comparison with the 98% assured system yield of 553 million m^3/a. The system water use in 2023/24 was 84 million m3/a less than the system allocation, mainly described to irrigation water use. New augmentation options and ways of managing them are required to avoid climate-water constraints and to sustain the resilient economic development of the CoCT and surrounding areas.

The Medium Growth scenario is regarded as the probable scenario to plan for, in combination with moderate climate change, as depicted in Figure 7.18 , whilst keeping in mind the potential implications of more severe climate change or higher future growth in water requirements.

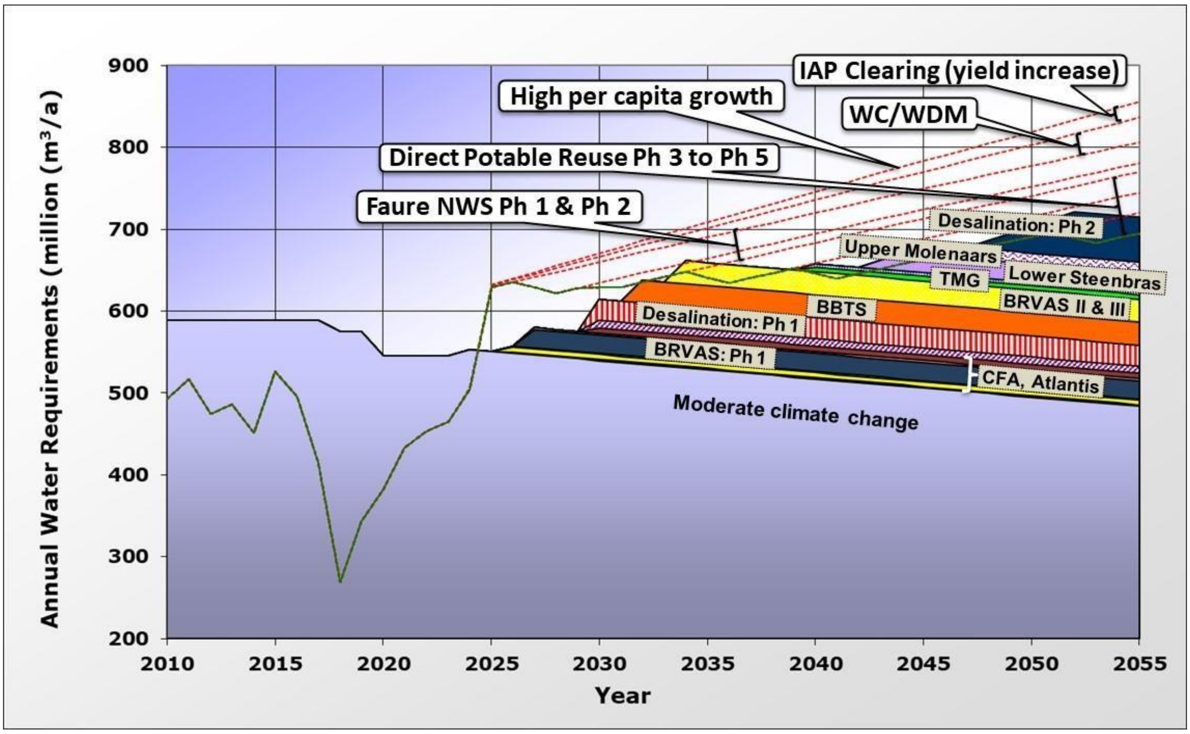


Figure 7.18: Total Medium Growth Scenario with Moderate Climate Change

Intervention options

A significant issue to address in the evaluation of potable water use scenarios is the current extent of reliance on surface water. While this is, to an extent being addressed through the implementation of groundwater schemes, this does not make the system adequately climate-resistant, and further diversification of sources is needed.

A summary of the features and costs of the evaluated interventions to be considered for the water balance scenario evaluation is given in Table 7-9.

Table 7-9: Summary of potential interventions

WSS	INTERVENTION	PROGRESS /COMMENTS
WESTERN CAPE WATER SUPPLY SYSTEM	COCT WC/WDM Programme	
SURFACE WATER		
	Alien Vegetation clearing Breed Berg River Transfer Scheme (BBTS)	IAPs clearing programmes Diversion of winter flows from a diversion weir on the Dewars River tributary of the upper Breede River to Voelvlei Dam, including raising of Voelvlei Dam.
	Raising Lower Steenbras Dam BRVAS Phases II / III	Raising of the Lower Steenbras Dam by 20m Simultaneous implementation of Phase II, increasing diversion capacity from 4 m³/s to 6 m³/s, and Phase III that entails raising of Voëlvlei Dam by 2m.
	BBTS + BRVAS Phases II / III, with 2m Raising of Voëlvlei Dam	Simultaneous implementation of the BRVAS Phases II / III and BBTS schemes.
	Upper Molenaars Diversion	Diversion of winter flows from the upper Molenaars River tributary of the Breede River, from where water would be pumped to flow through the existing Huguenot Tunnel. From there, water would be conveyed under gravity to various points.
	Raising Wemmershoek Dam	Raising of Wemmershoek Dam Wall.
GROUNDWATER AUGMENTATION SCHEME		
	Table Mountain Group (TMG) Aquifer Cape Flats Aquifer CFA	Nuweberg Phase 2 Wellfield, with a planned commission date of 2035 Groenlandberg Phase 3 Wellfield with a planned commission date of 2025 Hanover Park, with a planned commission date of 2025 Strandfontein North and East, with a planned commission date of 2026

WSS	INTERVENTION	PROGRESS /COMMENTS
		Philipi, with a planned commission date of 2026 Mitchells Plain WTW, with a planned commission date of 2027
	Atlantis Aquifer further phases	Scheme refurbishment because of significant losses in production capacity, plus increased abstraction from the aquifer.
	Langebaan Road (and Hopefield) Aquifer (LRA) wellfield expansion	Continuation of Phase 2, to implement a MARs Scheme (artificially recharged by Berg River from Withoogte WTW to reduce the impact of abstraction
DESALINATION		
	CoCT Seawater Desalination: Phase 1 Paarden Island CoCT Seawater Desalination further phases (3 phases)	Establishment of a CoCT 50 - 70 Mℓ/day permanent desalination plant (Paarden Eiland) located adjacent to Paarden Island in Cape Town. Preliminary site selection investigations were conducted for seven sites. A site has not been determined for this scheme; however, potential sites are being investigated along the west coast of the Western Cape province between Kleinbaai and Buffelsbaai.
EFFLUENT REUSE		
	Faure New Water Scheme Phase 1 Faure New Water Scheme Phase 2 Further potable use of treated effluent Treated Effluent Reuse (Dual infrastructure reticulation)	Phase 1 of the Faure New Water Scheme is currently being implemented. Phase 2 of the Faure New Water Scheme of which Phase 1 is currently being implemented. The CoCT Strategic Water Reuse Study considered the potential for the further development of direct water reuse schemes, following the implementation of the Faure New Water Scheme. Non-potable treated water supplied to end-users as an alternative use, from 11 existing WWTWs.

7.11.4 KZN Coastal Metro Area Reconciliation Strategy

The KZN Coastal Metro Area Reconciliation Strategy comprises three distinct, but interlinked water supply systems (WSS) with associated supply areas. Due to interlinkages in water supply and across administrative boundaries, they are covered in a single over-arching strategy. The water balances, however, cannot be lumped as there are realities such as certain users being supplied by certain sources, which need to be factored into the water balance projections.

Three WSS are described below and displayed conceptually:

1. The uMngeni WSS, which includes the bulk of the eThekwini, Msunduzi, and portions of uMgungundlovu Municipalities. This WSS is supplied by the major dams on the uMngeni River, supported by transfers from the Mooi River catchment.
2. The Upper and Middle South Coast WSS, that includes southern coastal portions of eThekwini, and northern coastal portion of Ugu municipalities. This WSS is supplied by local resources (3 water treatment plants (WTP), from local rivers and dams), augmented by a potable supply pipeline from a WTP linked to the uMngeni WSS.
3. The North Coast WSS, which includes the northern coastal portion of eThekwini, and the Coastal portion of iLembe municipalities. This WSS is supplied by The Hazelmere Dam on the uMdloti and an abstraction from the Lower Thukela River.

System Yield and Water Balance

uMngeni WSS

The water balance and status quo for the South Coast WSS is shown in Figure 7.19**.**

The uMngeni WSS is currently in deficit and has been for a few years. The wet years have masked this reality. The current water abstractions from the system are in the order of 515 million m^3/a (1 410 ML/d). This is approximately 20% higher than the “safe” yield of the water resources which are calculated to be 420 million m^3/a (1 150 ML/d), at a multi-user assurance level (approximately and average of 1:100-year recurrence of failure).

The current abstraction is also higher than the water use licence which has been aligned with the sustainable water resources potential. The throughput of water also exceeds the optimal operation capacities of the water treatment plant (WTP) facilities and is already equal to the maximum WTP capacities.

Thus, the system is stretched, and not only over-abstracted and at risk of drought impacts but has already reached its infrastructure supply potential. Further growth in effective supply will need to be achieved by making more water resources available and reducing water losses and the inefficient use of current resources.

Based on the level of over-abstraction, water requirements need to be managed, and the system brought back into balance as a matter of urgency to reduce risks to an acceptable level looking forward. The past few wet years have provided some gracious relief, but projections (coupled with the official progression into an El Niño cycle), means the system could already be at risk of needing some level of water restrictions in 2025 (from a resource perspective).

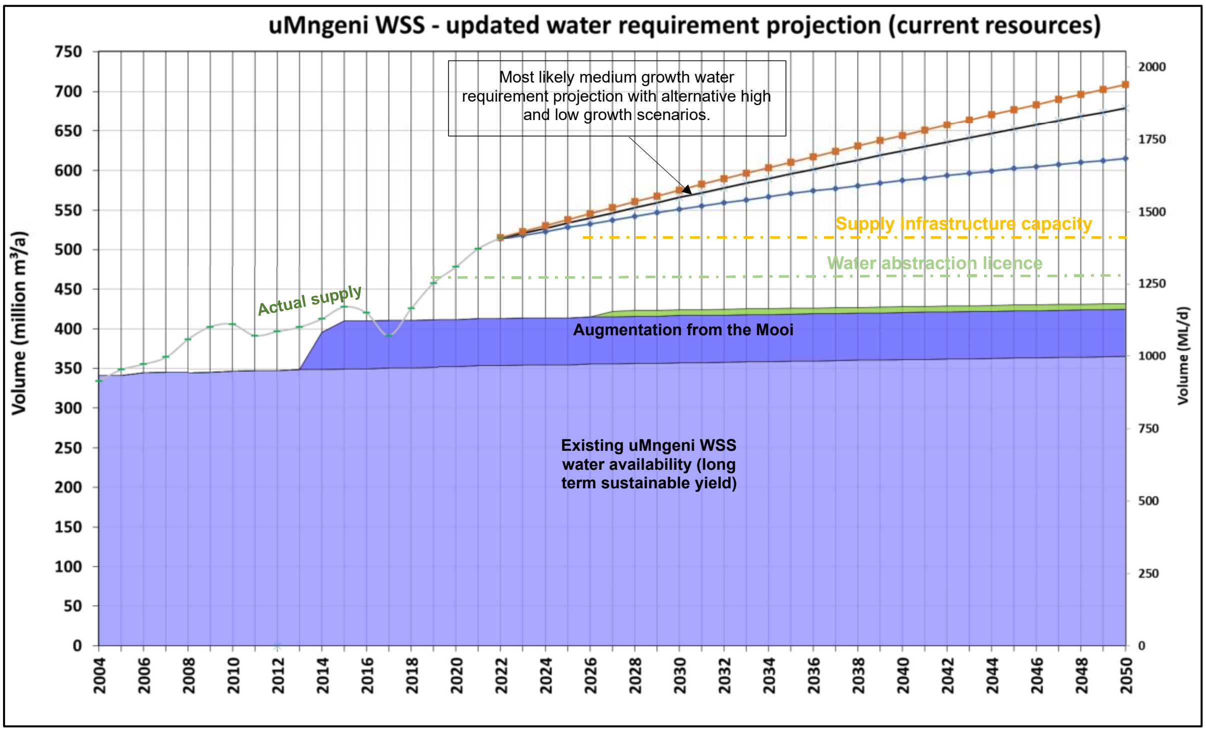


Figure 7.19: Water Balance with updated water requirement projections for the uMngeni WSS status quo

South Coast WSS

The Water balance and status quo for the uMngeni WSS is shown in Figure 7.20.

The South Coast WSS has reached a capped water supply situation, with water requirements exceeding the water resources available. As such, there is a suppressed water requirement situation. However, the Lower uMkhomazi Bulk Water Supply Scheme (BWSS) is under construction and should be completed by 2026 to augment the current shortage and meet growing water requirements over the projection period. While not a current resource, it is a committed project and in implementation. A smaller scheme named the Lovu River abstraction has recently been completed that improves the volume at which a suitable assurance of supply can be achieved from the local resources.

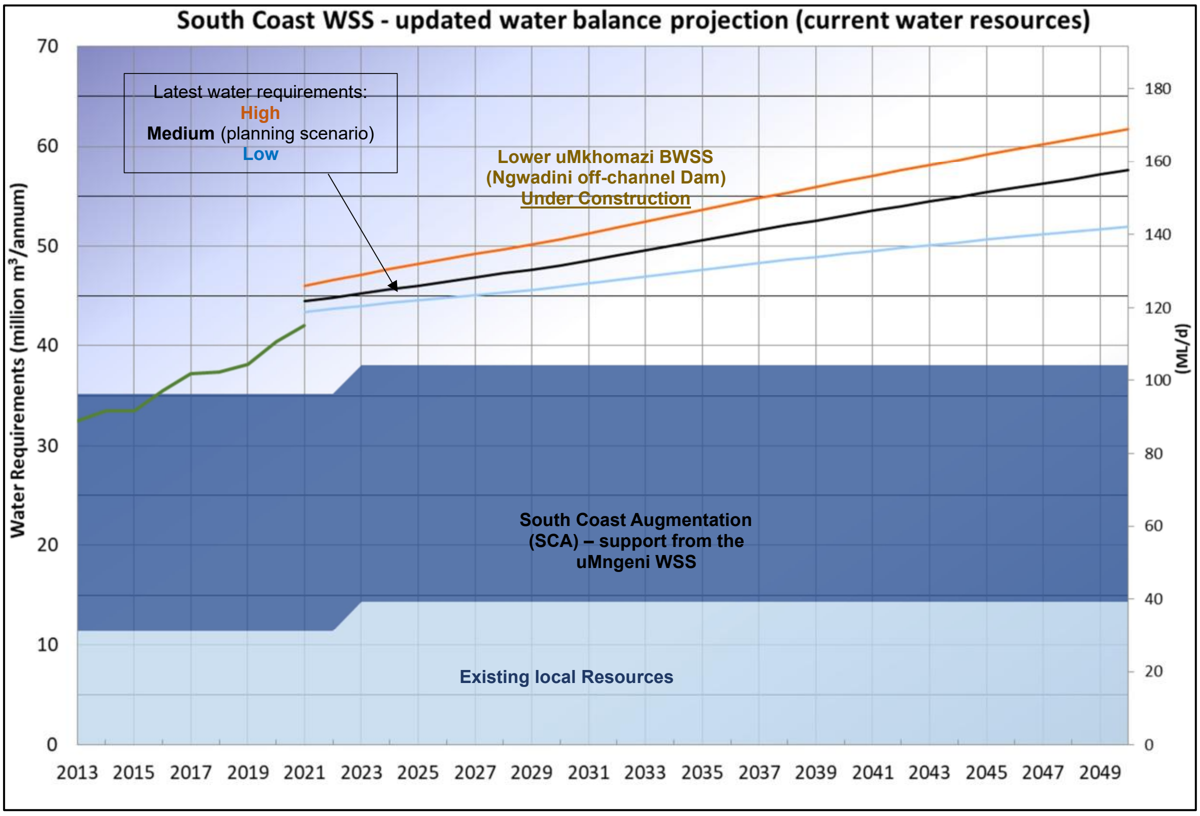


Figure 7.20: Water balance with updated water requirement projection for the South Coast WSS status quo

North Coast WSS

The water balance and status quo for the North Coast WSS is shown in Figure 7.21.

The North Coast WSS is also approximately in balance with current water requirements. Higher growth is projected for this area, with the requirements projected to exceed resources by 2024. This includes the increased water that will become available due to the raising of the Hazelmere Dam. The physical dam raising has been completed. However, there are some social issues related to households residing within the flood line of the raised dam level.

The abstractions of water associated with the raised dam is a risk while the dam is operated at a lower level. This issue is reported to be resolved in 2024, but it is important to be achieved prior to the ending of the wet season otherwise the increased storage will be of little benefit until the next year.

To augment supply to the growing water requirements an additional phase of the Lower Thukela BWSS is currently being pursued, as an extension to the existing Phase 1 that was completed and operational in 2018. Once Phase 2 is completed, it will add a volume of up to 20 million m^3/a (55 ML/d). Phase 2 of the scheme is currently in detailed design and is anticipated to proceed into construction with a projected completion date of around 2026/27.

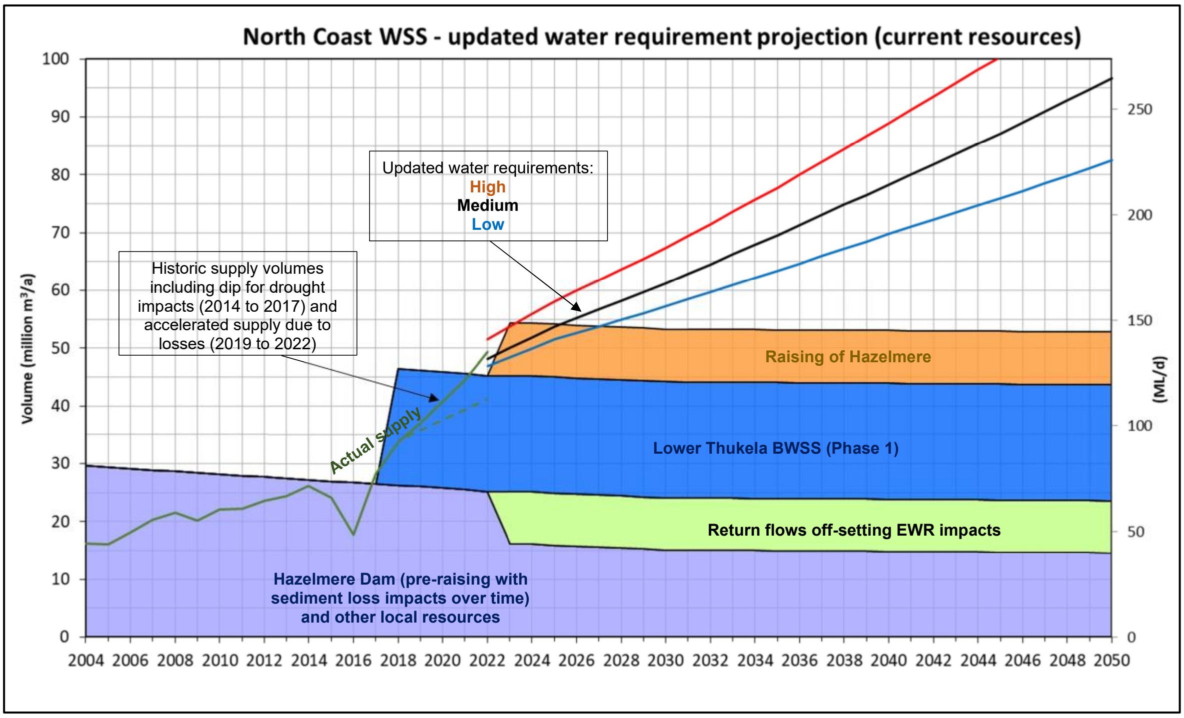


Figure 7.21: Water balance with updated water requirement projection for the North Coast WSS status quo

Intervention Options

Based on the status quo of the three WSS, there is a need for both short-term and long-term actions in all areas to address current and projected water security and supply constraint risks. Intervention options are summarised in Table 7-10: Intervention options for reconciling water requirements with water resources, together with the possible alternative options.

Table 7-10: Intervention options for reconciling water requirements with water resources

DESCRIPTION	INTERVENTION	PROGRESS/COMMENTS
Sustainable Supply Interventions	Mooi-Mgeni Transfer Scheme Phase 2A & B (DWS/TCTA)	Completed
	North Coast Pipeline and Hazelmere Supply Infrastructure (Umgeni Water)	Completed
	Hazelmere Dam Raising (DWS)	Raising of a dam by 7 m with piano key weir. Estimated completion date – Dec 2022
	Lower Thukela Bulk Water Supply Scheme Phase 1 (Umgeni Water)	Commissioning commenced Jan 2017

DESCRIPTION	INTERVENTION	PROGRESS/COMMENTS
Emergency Drought interventions		
	Mpambanyoni Emergency Abstraction Scheme (Umgeni Water)	Augment the Umzinto System (Umzinto and EJ Smith dams)
	uThongati Emergency Transfer	Augment supply of raw water to Hazelmere Dam
	Sembcorp Siza Water – Frasers WwTW	Treated effluent used for potable water supply in iLembe DM
Priority Management Interventions		
	Water Conservation and Water Demand Management	To bring use back in line with Water use licence. WSA WC/WDM Master Plans
	System Operations and Drought Management Forums	Protection of priority water use; avoiding system failure; managing short-term deficit
Priority Infrastructure interventions		
	Lower Thukela Bulk Water Supply Scheme Phase 2 (Umgeni Water)	Complete design and implement with urgency
	Indirect re-use of treated effluent (to off-set EWR releases from Hazelmere Dam)	Review growth of effluent return flows below the dam, reduce EWR release requirements accordingly.
	Re-use of treated effluent (possibly via Hazelmere Dam)	Update the initiative potential once regional WWTWs plans and dates are confirmed.
	Desalination of Seawater North Coast (Tongaat site)	Compare with alterative options. Consider phasing if selected.
	Mvoti River development (Isithundu Dam?)	Update hydrology and yields and compare with Desal and assess potential for All-towns areas supply.
uMgeni WSS		
	Remix project (Combination of desalination and re-use of wastewater)	Pilot is on hold. May be recommissioned if needed.
	Re-use in eThekwini (southern works)	Re-instate industrial supply contract.
	Re-use in eThekwini (Northern and Kwamashu works)	Linkages beyond 2030 when uMWP1 is implemented to be

DESCRIPTION	INTERVENTION	PROGRESS/COMMENTS
		resolved. Pilot phase at KwaMashu (20 to 25 Mℓ/d)?
	uMkhomazi Water Project Phase 1 (DWS)	Scheme to be implemented. Progress to be tracked.
South Coast WSS		
	Lower uMkhomazi Bulk Water Supply Scheme (Umgeni Water)	Scheme to be completed with urgency. Ability to reduce SCA to be reviewed and optimised.
	Lovu Desalination Plant	Desalination of sea water at Lovu. long standing option for beyond planning horizon
	iLovu River Scheme	Scheme to augment Toti WTP and reduce over-abstraction of Nungwane Dam
Support Interventions		
	Catchment Care and Ecological Infrastructure	Critical for maintaining water quantity and quality
	Rainwater Harvesting	Encourage the sustainable use of RWH in both formal and informal housing areas, and commercial buildings / office parks
Long-term Interventions		
	uMkhomazi Water Project Phase 2 (DWS)	Impendle Dam – long term option beyond 2050
	Thukela Water Project (Jana and Mielietuin dams)	Supply parts KZN (via lower Thukela) from surplus yield of Jana and Mielietuin dams.

7.11.5 Umhlathuze WSS

The focus of the Reconciliation Strategy Study was the Richards Bay Water Supply System (RBWSS). The RBWSS supplies water to the City of Umhlathuze Local Municipality (CoMLM), which comprises the towns of Richards Bay, Empangeni, Ngwelezane and Esikhawini, as well as a number of rural villages. Furthermore, the RBWSS also supplies large well-developed industries, commercial areas and business centres within the Study Area.

The RBWSS's supply area is within the Umhlathuze River Catchment, which is the major water resource. Water is, however, also sourced from various natural lakes within the Catchment such as Lake Nhlabane, Lake Mzingazi and Lake Cubhu. The

Catchment also serves as the resource for agriculture, both irrigated and dryland, afforestation, and ecological requirements.

The Study Area includes the Umhlathuze River Catchment. Umhlathuze River Catchment receives inter-catchment transfers from the Umfolozi River and Thukela (Tugela) River Catchments, and, as a result, these catchments are also part of the Water Supply System/Study Area. Additional smaller towns not incorporated in the Strategy (2015), namely Eshowe, Mtunzini, Melmoth, Gingindlovu and Amatikulu, were included in the Reconciliation Strategy Study. As a result of this, the catchments south of the Umhlathuze, namely the Mlalazi and Amatikulu, were also considered part of the study.

System Yield and Water Balance

The Umhlathuze system water balance is produced for users along the Umhlathuze River who have access to releases from the Goedertrouw Dam and abstractions from the Umhlathuze weir. In addition, the additional resources of Lakes Nsezi, Mzingazi and Cubhu as well as the existing transfer from the Umfolozi, are also included in the water balance representing the uMhlathuze System.

These users also make use of river runoff from tributaries entering the Umhlathuze River. It is assumed that the Thukela transfer from Middeldrift (Phase 1) is operational at its maximum installed capacity of 1.2 m^3 /s. The current resources are shown separately, including the available system yield and additional yield that can be obtained if the system is operated efficiently. The full benefit of runoff from tributaries is abstracted at the uMhlathuze weir. This efficient operation is reliant on real-time monitoring and controlled releases from Goedertrouw Dam. As of FY 2024, the catchment experienced a surplus in resources during the duration of this study due to the rainfall received above average. The growth in water use has been significant over recent years.

Figure 7.22 shows the high growth projection scenario and includes the full projection for Tronox (Exxaro) based on their contracted volume with uMngeni- uThukela Water of 17.83 million m^3/a. The scenario shows the steep jump, assuming that Tronox and RBM will take up their full water requirements in the upcoming year.

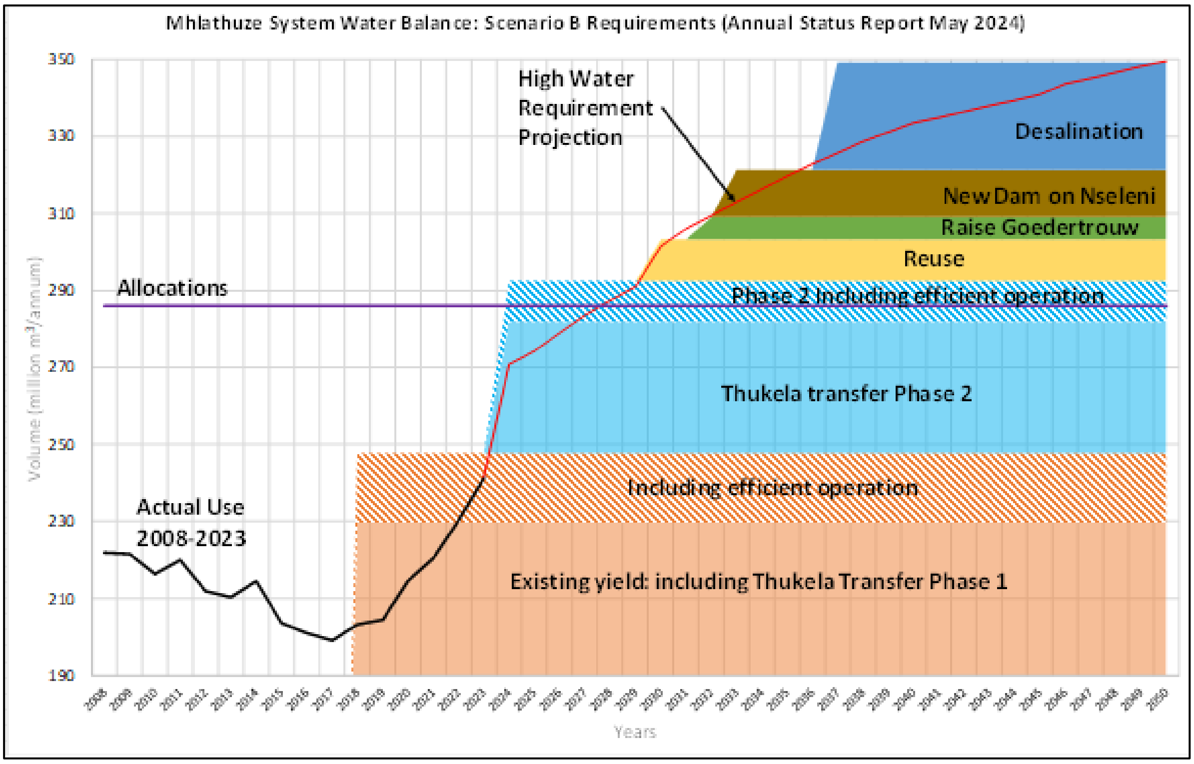


Figure 7.22: uMhlathuze System Water Balance Scenario B

Intervention options

Table 7-11 presents an updated Action plan to take forward for further interventions and monitoring.

Table 7-11: Action Plan of Interventions from 2024 update

WSS	Intervention	PROGRES/ COMMENTS
uMhlathuze WSS	Water Conservation / Water Demand Management	Implementation of the proposed WCWDM plan: Institutional: Improved political backing, capacity building Financial: Enhance revenue collection, improved tariff structure Social: Raise public awareness Technical: reduce water wastage, pressure management, bulk metering
	Maintain existing Thukela Transfer scheme	Ongoing maintenance of existing transfer scheme to ensure transfer can take place as and when required

WSS	Intervention	PROGRES/ COMMENTS
uMhlathuze WSS	Complete Thukela Transfer upgrade from Middeldrift	Minister to sign directive for uMngeni-uThukela Water to complete the work U-U W to finalise the construction and implement the scheme
	Water Reuse	Continue with existing PPP efforts to implement intervention, including establishing takers
	Interim Restriction Rule to Benefit Priority (Primary) Users	Carry out annual operating analyses to determine level of restrictions to be imposed on users on an annual basis, water requirement dependent Implement restrictions on lower priority users according to priority classification table Continuously monitor water use of large users to confirm actual growth is in line with projections
	Efficient system operation	Continuous maintenance of real time flow monitoring system, both data capture (measurement) and data sharing (cloud based) Enhancement of real time system based on pre-determined strategic monitoring points
	Existing Dam Raising	Feasibility Study and detailed design of raising Goedertrouw Dam
	New Dam Construction	Feasibility Study on new dam on the Nseleni River
	Remove alien vegetation	Implement programme to systematically clear alien vegetation and continuously maintain cleared areas Rehabilitate land and re-establish indigenous vegetation
	Desalination	Feasibility Study to determine viability and costing of large-scale desalination of seawater
	Groundwater use	Promote development of Groundwater resources on a local level

7.12 Ecological Infrastructure Rehabilitation

The conservation and restoration of wetlands are essential for ensuring water security in the country. Wetlands are natural resources and infrastructure that offer a range of functions and services. Despite their ecological significance, Wetlands constitute only 2.4% of the country's area (DFFE, 2021). Ecological assessment studies indicate that wetlands are among the most endangered ecosystems in South Africa and are presently in a deteriorated ecological state. The 2011 National Biodiversity Assessment indicated that 65% of wetland types were threatened, comprising 48% critically endangered, 12% endangered, and 5% vulnerable (SANBI, 2011).

Approximately 11% of wetland ecosystem types were identified as adequately protected, while the remaining 71% remained unprotected (SANBI, 2011). During the 1970s, governments globally, including South Africa, provided incentives to farmers to transform their wetlands into agricultural land. Over the years, these activities have profoundly influenced and transformed the landscapes of South Africa. SANBI (2011) and DFFE (2021) reported that 35% to 60% of South Africa's wetlands have been lost or significantly degraded. Figure 7.23 illustrates the national wetlands.

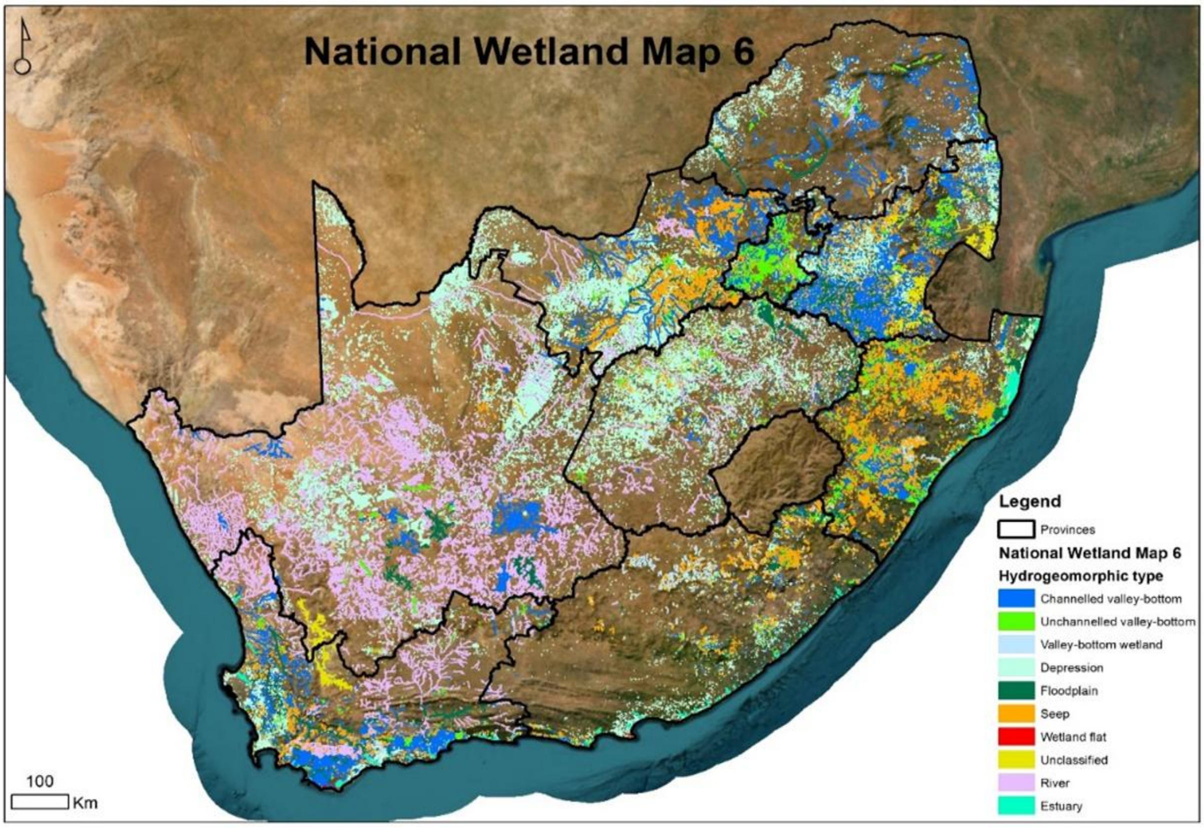


Figure 7.23: National Wetland Map (NWM) Version 06 showing the extent of wetlands (based on Hydrogeomorphic type, HGM) in South Africa.

7.12.1 Legislative Framework on Wetlands Protection

The South African government policy acknowledges that effective wetland conservation strategies must encompass both proactive measures for sustaining healthy wetlands and initiatives to remediate previous degradation. This aspect is fundamental to a government-initiated wetlands program. The following legislation advocates the safeguarding of wetlands in South Africa:

- ✓ **Section 24 of the South African Constitution** states that "everyone has the right to an environment that is not harmful to their health or well-being; and the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic growth."
- ✓ **The 1984 Conservation of Agricultural Resources Act** became the first substantial legal instrument for protecting wetlands and remains in force to this day.
- ✓ The **National Environmental Management Act (NEMA, Act No. 107 of 1998)** and the **National Water Act (Act No. 36 of 1998)** and the environmental provisions of the **Mineral and Petroleum Resources Development (Act No. 28 of 2002)** (MPRDA) ensure that urban and commercial developments do not affect or alter the natural state of wetlands.
- ✓ Principles such as the 'duty of care', enshrined in **Section 28 of the NEMA**, require that landowners take reasonable measures to prevent, minimise and rectify environmental degradation on their properties.

7.12.2 Ecological Infrastructure Rehabilitation and Restoration Projects

According to the 2018 National Biodiversity Assessment, rivers, wetlands, and catchment areas are critical ecological infrastructure for water security, often supplementing built infrastructure; however, the benefits of some of these ecosystems are currently jeopardised due to their poor ecological condition (SANBI, 2018). Water security can be enhanced through integrated natural resource management in Strategic Water Source Areas (SWSAs) and other critical catchments. SWSAs account for only 10% of South Africa's land area but supply 50% of all surface water, supporting half of the country's population and nearly two-thirds of its economy. Moreover, with climate change expected to alter rainfall patterns, wetlands will play a greater role in mitigating the effects of floods and droughts. All rehabilitation interventions aim to improve the condition and functioning of wetland ecosystems, addressing both causes and effects of degradation.

There are currently ongoing wetlands rehabilitation projects in the country; however, this report will focus on a few projects, including those implemented by DFFE in the provinces of KwaZulu-Natal and Mpumalanga. The wetland rehabilitation project in KwaZulu-Natal is currently in the process of restoring wetlands in the Isimangaliso Wetland Park. This park contains extensive areas of the system that have been historically degraded as a result of anthropogenic activities, including commercial forestry and human settlement development. The Park Authority, in collaboration with DFFE, has implemented the Working for Wetlands Programme to make substantial investments in financial and human resources to rehabilitate degraded areas and preserve the ecological integrity of the system. This has been achieved through the development of rehabilitation plans and associated implementation activities.

The DFFE also conducts a variety of rehabilitation interventions at the Verloren Vallei wetland site in Mpumalanga. These interventions aim to enhance water retention and habitat, with a particular emphasis on the White-Winged Flufftail, which necessitates a specific depth for breeding and hatching security. The White-winged Flufftail (Sarothrura ayresi) is a bird species of particular importance at the Verloren Vallei Ramsar Site and is critically endangered. One of the primary reasons the site has been designated as a Ramsar Wetland of International Importance is the elusive nature and preference for wetland habitats of this bird. Detailed information regarding the two DFFE projects is available in the case studies below.

In addition to these projects, DWS is rehabilitating a wetland along the Blesbokspruit River in collaboration with the City of Ekurhuleni and the Gauteng Department of Agriculture, Rural Development, and Environment (GDARDE). Upon its completion, this project will contribute to better managing and cleaning the Vaal Water Management Area (VWMA). This project's most recent progress report indicated that the wetland has experienced an increase in the number of new bird species, and water quality monitoring is ongoing.

The Rehabilitation of iSimangaliso Wetland Park, KwaZulu-Natal

The iSimangaliso Wetland Park, formerly known as the Greater St. Lucia Wetland Park, is a UNESCO World Heritage Site located in the KwaZulu-Natal province of South Africa. It is one of the country's most ecologically diverse and significant conservation areas, covering approximately 3,280 km² along the northeastern coast of KwaZulu-Natal. The Park plays a crucial role in environmental conservation, as it harbours several threatened and endangered species including three major lake systems, eight interlinking ecosystems, 700-year-old fishing traditions, most of South Africa's remaining swamp forests, Africa's largest estuarine system, 526 bird species and 25 000-year-old coastal dunes – among the highest in the world.

iSimangaliso also contains four wetlands of international importance under the Ramsar Convention. This dynamic ecological system comprises multiple interconnected wetlands of varying sizes and characteristics (i.e., Hydrogeomorphic units).

Large areas of the system were historically degraded due to anthropogenic activities such as commercial forestry and human settlement development. The Park Authority in conjunction with the Department of Forestry, Fisheries and the Environment (DFFE) through the Working for Wetlands Programme has made substantial investments to rehabilitate degraded areas and maintain the system's ecological integrity through the development of rehabilitation plans and associated implementation activities. These areas have since been cleared of forestry plantations, and earthworks in the form of 'historical forestry road removal' were the predominant rehabilitation intervention during the 2024/2025 financial year as guided by the Park's wetland rehabilitation plan. Figure 7.24 and Figure 7.25 show the progress of the historical road removal.

Figure 7.24: Historical road project site before revegetation.

Figure 7.25: Historical road project site after revegetation.

The Working for Wetlands Programme has adopted a multipronged approach towards wetland rehabilitation as it aims to address various socio-ecological challenges such as:

- **Invasive Species Control**: Non-native plant species threaten the natural wetland ecosystem. Rehabilitation often involves the removal of these invasive species to make room for native vegetation, which in turn supports native wildlife.
- **Water Quality Improvement**: Wetlands are critical in filtering and improving water quality. Efforts to rehabilitate these systems may focus on reducing pollution, such as nutrient overload from agricultural runoff, and restoring the natural hydrological flow.
- **Restoration of Natural Hydrology**: Many wetlands in the park have been altered by human activities such as drainage for forestry or development. Restoration includes re-establishing the natural water flow and flood regimes that are vital for wetland species and plant growth.
- **Biodiversity Conservation**: Wetland rehabilitation is also crucial for preserving the park's diverse range of wildlife, including migratory birds, amphibians, and fish. By restoring wetland habitats, the park supports these species' survival and increases their population numbers.
- **Community Involvement**: Local communities are involved in rehabilitation efforts through the Expanded Public Works Programme (EPWP) model, both as stakeholders in preserving the park's natural resources and as participants.

During the 2024/2025 financial year, a total of eight wetlands were rehabilitated within the park through the removal of historical forestry roads and revegetation of these areas with native wetland species. Rehabilitation of these wetlands ensures the continued ecological health of the area, benefiting biodiversity and supporting sustainable livelihoods for

Working for Wetlands Programme – A Case Study of the Verloren Vallei Wetland, Mpumalanga

The Verloren Vallei Ramsar Site is a wetland area located in the Mpumalanga province of South Africa. It covers approximately 6,300 hectares and is recognized for its ecological importance. The site is primarily known for its diverse range of wetland habitats, including marshes, grasslands, and peat bogs. Verloren Vallei is home to a variety of rare and endangered species, particularly birdlife, such as the Blue Crane, White-winged Flufftail (Sarothrura ayresi) and the Yellow-breasted Pipit. The site was designated as a Ramsar Wetland of International Importance due to its unique biodiversity and its value as a key habitat for migratory birds.

Conservation efforts are focused on preserving the area's ecological integrity while maintaining its importance for biodiversity. The Department of Forestry, Fisheries and the Environment (DFFE) is currently working on various rehabilitation interventions at the Verloren Vallei wetland site to improve water retention and habitat in particular for the White-Winged Flufftail which requires a specific depth for breeding and hactchling safety.

Project Progress

The progress at Verloren Vallei includes the following rehabilitation interventions:

- Raising the water level within the wetlands with the aid of Donga locks
- Construction of cattle grids on gates for access roads to minimise scouring and sedimentation of wetlands
- Upgrading of access roads (visitor) paths/roads to minimise disturbance of wetland soils and vegetation
- Alien invasive plant species removal to improve biodiversity, water retention and protection the soils.

Project Partners

Organisations involved in the work at Verloren Vallei include the DFFE, as the project implementer, MTPA, Bird Life SA, and Friends of Verloren Vallei.

Other rehabilitation projects currently in implementation in Mpumalanga include:

- Manyaleti Nature Reserve
- Loskop Dam Nature Reserve
- Wakkerstroom – KwaMandlangampisi Protected Environment
- Kruger National Park

The rehabilitation work involves various tasks and infrastructure development with a wide range of applications ranging from safe access for rangers, addressing head-cut erosion and removal of alien invasive plant species

Figure 7.26: Safe crossing over a wetland/watercourse in the Kruger National Park – This structure aids game rangers with safe and quick access to sites over watercourses to fight against poachers. The structure ensures that the vehicles do not disturb the wetland soils, protects the wetland from erosion and allows for free flow of the watercourse over the structure (Source: DFFE)

8

WATER-ENERGY-FOOD NEXUS

8 WATER-ENERGY-FOOD NEXUS

8.1 Background

The security of water, energy, and food is a critical concern for South Africa, as the recurrence of extreme weather events, depletion, degradation, and the increasing demand from a growing population exacerbates the country's risk and vulnerability. The three sectors—energy, water, and food—are intricately interconnected (Figure 8.1). This is due to the fact that energy generation necessitates a significant amount of water for the purposes of fuel production, mining, hydropower, and power plant cooling. Conversely, energy is required for the collection, treatment, and discharge of wastewater and for water pumping, treatment, and distribution. Concurrently, the production of food necessitates both water and energy, while crops such as maize, soybean, and sugarcane have been identified as potential biofuel sources (Gerbens-Leenes et al., 2009). The water-energy-food (WEF) nexus is the term used to describe these mutual interconnections (Leck *et al.,* 2015).

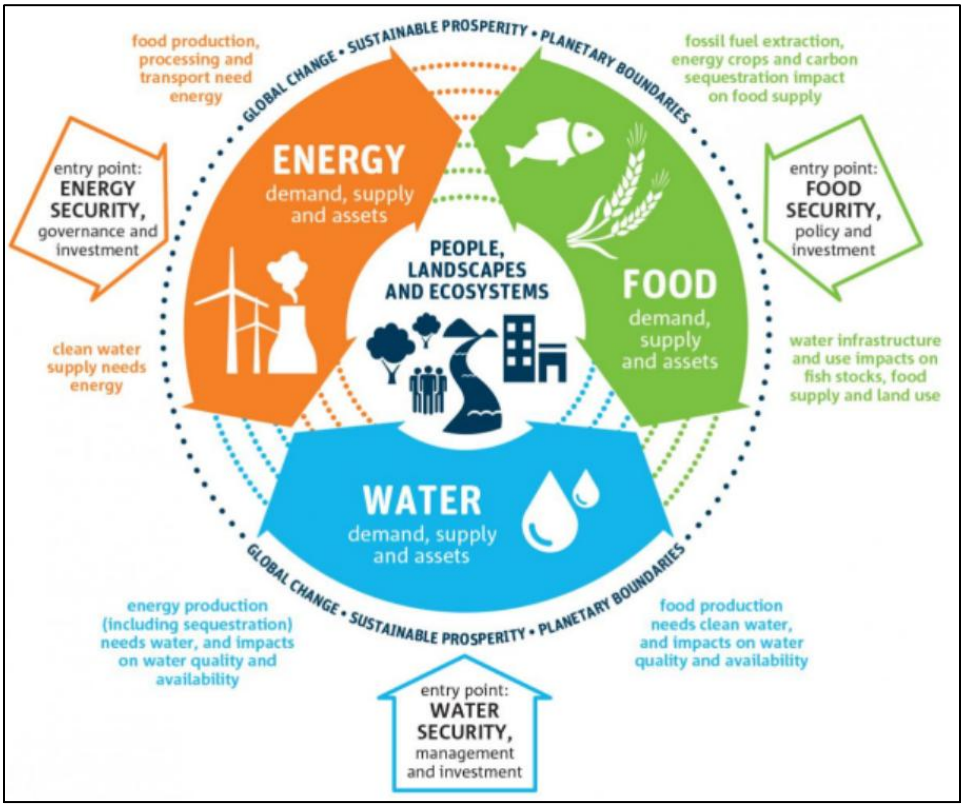


Figure 8.1: The interconnectedness of water, energy and food sectors (Source: IWA, 2018).

The WEF nexus, a three-way mutual interaction among WEF sectors, has become a critical subject for facilitating the transition from a linear to a circular economy since

2008. It has experienced significant growth in popularity since the Sustainable Development Goals (SDGs) were implemented in 2015, as it is closely associated with sustainable development. However, the absence of a unified governance framework has impeded the adoption of the WEF nexus and the realization of the SDGs. The transition from the linear to the circular economy and integrated resource management has been impeded by the sectoral nature and lack of coherence of South Africa's well-written policy documents, which include strategies, acts, plans, and white papers. The country is confronted with the triple challenge of poverty, inequality, and unemployment, with over 50% of households experiencing food insecurity, 98% of water resources already allocated, and severe energy insecurity challenges. The absence of a comprehensive and integrated governance framework to facilitate the concurrent development of the three sectors has resulted in the slow adoption and implementation of the WEF nexus.

A WEF nexus integrative decision support tool was created in South Africa to facilitate the management of the country's three WEF resources and to pinpoint areas that require immediate attention. Resource insecurity is further exacerbated by climate change, extreme weather events, and the growing population. The WEF nexus is transformative and integrated, providing strategic guidance for holistic resource management decisions. It has the potential to incorporate strategies to address the challenges posed by population growth, rural-urban migration, urbanization, increased consumption demands, and climate change. This method generates numerous efficiencies by removing inefficiencies and duplication in resource allocation and utilization. However, a transformation in governance structures is required to facilitate the transition to a circular economy and sustainable development.

8.2 Climate change impacts on WEF sectors

Climate change projections for South Africa show that temperature will increase by between 1 to 2°C for coastal regions and between 3 to 4°C for interior regions by 2050 (Davis and Vincent, 2017). The changing rainfall patterns are expected to shift, resulting in the western parts of the country experiencing significant stream flow reduction (Xulu *et al*., 2023). This will have some implications for agriculture as yields will decline, impacting food security. The WEF nexus significantly balances resource allocation and enhances climate change resilience and adaptation, benefiting mostly smallholder farmers who are the most vulnerable (Nhamo *et al*., 2020a). Climate change is also impacting water resources in South Africa, with high spatial variability (Davis and Vincent, 2017). Recently, most areas have been affected by climate change-induced flash floods (Figure 9.3), resulting in property destruction and loss of lives.

Figure 8.2 Climate change-induced flash floods in Durban in October

The adverse impact of climate change will continue to worsen the existing systemic water insecurity challenges. As previously stated, South Africa's agricultural sector accounts for more than 60% of water use, but it is projected that irrigation water demand will have to increase by between 4% and 6% by 2030 to meet the food demands of a growing population (Ngarava, 2021). The increased demand for irrigation water should also be viewed within the context of increased demand for water for energy generation and domestic use due to a growing population. The increased frequency in the recurrence of droughts and floods is threatening rainfed agriculture as the risk of crop failure increases (Davis and Vincent, 2017; Nhamo *et al*., 2019). This highlights the need to adopt and implement the WEF nexus for holistic and sustainable resilience and adaptation. Although the country has clear policy documents on climate change, it tends to be silent on policy integration and cross-sectoral interventions (Nhamo *et al*., 2025; Ntombi, 2017).

8.3 Selected WEF sectors related institutions and policies

The Constitution of South Africa is the overarching policy document that guides all legal and policy instruments in the country. The right to water is enshrined in the Constitution and implemented through different statutes framed around the Constitution. The Constitution is clear on sufficient access to sufficient water, food, and energy by all. The legal framework governing WEF sectors in SA is presented in (Table 8-1).

Table 8-1: Main policy and legal frameworks governing WEF sectors in South Africa

Water sector	Energy sector	Agriculture (food) sector
▪ National Water Act 36 of 1998, with the Amendment Bill (2023) ▪ National Environmental Management Act 107 of 1998 ▪ National Water Resource Strategy 3 (2013) ▪ White Paper on a National Water Policy for South Africa ▪ Water for Growth and Development Framework	▪ The National Energy Act (2008) ▪ White paper on energy policy (1998) ▪ White paper on renewable energy (2003) ▪ Integrated Energy Plan (IEP, 2003 and 2005) ▪ Integrated resource plan (IRP, 2019)	▪ Agricultural Policy in South Africa (1998) ▪ White paper on energy policy (1998) ▪ Agriculture and Agro-processing Master Plan (AAMP) (2022) ▪ White paper on agriculture (1995) ▪ Integrated resource plan (IRP, 2011) ▪ Strategic Agriculture Sector Plan

8.4 Current WEF Resource Management in South Africa

An overview of the current status of WEF resources governance and management in South Africa in 2015 and 2020 is given in Table 8-2 (WorldBank, 2024). The data were used in an integrative analytical WEF nexus model (Nhamo *et al.,* 2020a), which applies the Analytic Hierarchy Process (AHP), a multi-criteria decision method (MCDM) (Saaty, 1977). The AHP was used to establish the pairwise comparison matrix (PCM), normalise the indices, and provide the numerical relationships between the distinct indicators (Nhamo et al., 2020a). The model, which is applicable at any spatial scale, assessed resource management in 2015 and 2020, and the results are key to assessing progress in achieving the SDGs over time. The approach simplifies the human understanding of the interconnectedness of interlinked sectors, facilitates easy interpretation of the complex relationships between the WEF sectors and guides policy decisions on holistic priority interventions (Naidoo et al., 2021; Nhamo et al., 2020a).

Table 8-2. State of the WEF resources indicators for South Africa in 2015 and 2020 (Source: World Bank, 2024)

Indicator and short name	Indicator status		
	2015	**2020**	**Units**
Proportion of available freshwater resources per capita (availability)	821.3	821.4	m^3
Proportion of crops/energy produced per unit of water used (water productivity)	26.2	26.2	$/m^3$
Proportion of population with access to electricity (accessibility)	85.5	84.4	%
Energy intensity measured in terms of primary energy and GDP (productivity)	8.7	8.7	MJ/GDP
Prevalence of moderate/severe food insecurity in the population (self-sufficiency)	5.7	6.2	%
Proportion of sustainable agricultural production per unit area (cereal productivity)	3.5	5.6	kg/ha

The PCM and the normalisation of the indices generated the composite indices for the two reference years (Table 8-3). A five-year interval was selected in this case as it is a reasonable period where resource management and governance changes can be appreciated. The composite indices represent the quantitative relationships between the WEF sectors; however, the relationship is difficult to interpret and understand when shown in a table format. The quantitative relationships are then represented through a spider graph (Figure 8.3*Figure* 9.3*Figure* 9.4), vividly illustrating how resources are related and managed. The WEF nexus integrated index is a weighted average of the composite indices that indicate the level of the country's resource management.

Table 8-3. WEF resources security composite indices for South Africa in 2015 and 2020

Indicator	Composite indices	
	2015	**2020**
Water availability	0.126	0.099
Water productivity	0.128	0.221
Energy accessibility	0.141	0.079
Energy productivity	0.111	0.199
Food self-sufficiency	0.314	0.292
Cereal productivity	0.180	0.111
WEF integrated index	0.203	0.155

The composite indices (Table 8-3 and Figure 8.3) are dimensionless relations between 0 and 1. The spider graph, therefore, quantitatively relates WEF nexus indicators in terms of management (Nhamo *et al*., 2020a). For example, the water availability indicator is related to other indicators by 0.126 in 2015, which decreased to 0.099 in 2020. However, an indicator of 1 represents the best possible resource management, and 0 represents poor management.

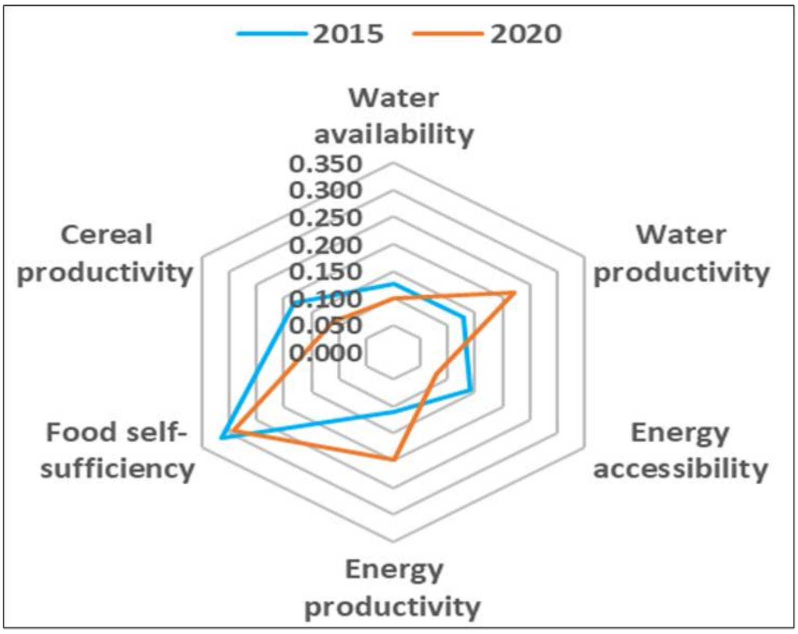


Figure 8.3 Spatio-temporal changes in South Africa WEF resources management in 2015 and 2020.

The centrepieces are irregular in shape, an indicator of linear and sector-based governance systems still being pursued. The centrepieces should be circular to indicate balanced resource management indicating a clear path towards sustainability. Therefore, the shape of the centrepieces gives a synopsis of the state of resource management and governance and the economic model being pursued. Sector-based and linear models in resource management only compound current cross-cutting challenges. The shape of the centrepieces is key to indicating priority areas for priority intervention from a cross-sectoral and holistic perspective. Therefore, the key to the spider diagram is to identify trade-offs and synergies for timely intervention. The shape of the centrepieces shows areas needing either to mitigate trade-offs or maximise synergies. The changes indicated in the spider graph show that the approach can be used to assess progress towards achieving the SDGs (Mabhaudhi et al., 2021).

Therefore, the integrative analytical WEF nexus model is a decision-support tool for assessing the state of resource management and governance at any given time and at any spatial scale. The model has been used at the local scale (Nhamo et al., 2020b), national scale (Nhamo et al., 2020a) and regional scale (Mabhaudhi et al., 2019). The approach provides pathways to (a) enhance holistic, sustainable, and resource use efficiency of the WEF resources, (b) promote equitable and balanced resource management and distribution, (c) ensure human and environmental health, and (d) support the provision of ecosystem services. These attributes make the WEF nexus an essential systems approach to assess resource management. However, besides the current evidence of the importance of the WEF nexus, its implementation has been hindered by the lack of an integrated, harmonised, holistic governance framework.

8.5 Conclusions and Recommendations

Considering the interlinkages between WEF sectors and the impact of climate change on resources, there is a need for coherence in governance frameworks of interlinked sectors to facilitate policy harmonisation, coordination and management of resources. The current linear approach in managing resources in South Africa is resulting in optimal efficiency attributes in some sectors at the expense of equally important resources. The presence of a harmonised WEF nexus governance framework guides integrated resource development and management and identifies cross-sectoral synergies and trade-offs for timely intervention.

The South African case study has highlighted that the WEF nexus approach offers opportunities for policymakers to sustainably meet set targets, including achieving SDGs and the NDP goals (Nhamo *et al*., 2025). Advancing integrated planning, policy coherence and management is critical for raising inter-sectoral awareness about the WEF nexus. Efforts should focus on eliminating barriers, including lack of collaboration, fragmented and sector-based policies, uncertainty and anxiety among key stakeholders, and inequality (Naidoo *et al*., 2021). These are the major challenges hindering the implementation of the WEF nexus. The following recommendations are proposed for the successful operationalisation of the WEF nexus:

- Evidence from the case study has shown that at the level of governance, it is necessary to ensure that horizontal linkages exist during the design and implementation phases of the WEF nexus model. It is also important to harmonise and coordinate policies on water, energy, food and climate to guide a sustainable transition from the current linear approaches to the circular model. The WEF nexus, therefore, provides opportunities to stabilise competing demands in an environment of scarce resources by ensuring that development in one sector has minimal impacts on the other sectors.
- Despite the SDGs being intended to be accomplished by 2030, there has been minimal progress in achieving the established objectives within the designated timeframe (UN, 2023). The SDGs are intended to be driven and catalyzed by the WEF nexus; however, the concept has been adopted at a glacial pace.
- Energy insecurity in South Africa has contributed to the country’s credit status being downgraded. The ‘crises’ in the energy sector have also led to the ‘explosion’ of new coal mines. This has raised renewed fears of acid mine drainage and conflicts with the water and agriculture sectors, as mining pollutes

water and competes for land with agriculture. While energy might receive more attention as an important economic driver, it must be noted that many of the pressures that drive energy demand also apply to water and agriculture. Therefore, water, energy and food are all central to South Africa's vision of delivering a better quality of life to its citizens. This highlights the urgent need for better convergence of policy amongst the three sectors.

- As an initiative to start the WEF nexus discussions, there is a need for an inter-sectoral dialogue that also includes all stakeholders to establish a Community of Practice at the national level. The platform should be used to promote WEF nexus research and harmonisation of policies.

9

WATER RESOURCE PROTECTION

9 WATER RESOURCE PROTECTION

Chapter 3 of the National Water Act, 1998 (Act No. 36 of 1998) prescribes measures that aim to balance protecting and utilising water resources for social and economic development. The Act makes use of two different mechanisms to find the right level of protection, i.e., Resource Directed Measures (RDM) and Source Directed Controls (SDC). RDM provides descriptive and quantitative goals to ensure water resource protection, while SDC specifies the criteria for controlling source impacts such as waste discharge and abstraction of water.

The demands on water resources are growing as the economy expands and the population increases; therefore, for the country to continue to develop economically whilst meeting the wide-ranging needs for water, critical steps must be taken to ensure the protection of the water resources. In recent years, South Africa's water resources have been under increasing threat due to pollution, which has resulted in rapid demographics and increased socio-economic development. The degradation of the ecosystem may lead to a reduction in ecosystem services, such as reduced capacity to generate water and loss of food production. The protection of water-related ecosystems is mainly to ensure that ecosystem services continue to be available to society.

The Department's goal is to enhance protection and ensure the sustainable use of water resources. Several measures aimed at protecting water resources, preventing pollution, mitigating its effects, and balancing the need to use water as a factor of production to enable socioeconomic growth and development have been implemented by the Department. These measures are Resource Directed Measures (RDM) as prescribed by the NWA to ensure comprehensive protection of water and Source Directed Controls (SDC) that form a link between the protection of water resources and regulation of water use.

9.1. Resource Directed Measures

Chapter 3 of the Act prescribes three Resource Directed Measures, which aim to achieve a balance between protecting the water resources and utilising the water resources for social and economic development. The Resource Directed Measures are:

- The classification of significant water resources
- The determination of the Reserve
- The setting of Resource Quality Objectives

The linkages between the above three resource-directed measures are presented in Figure 9.1.

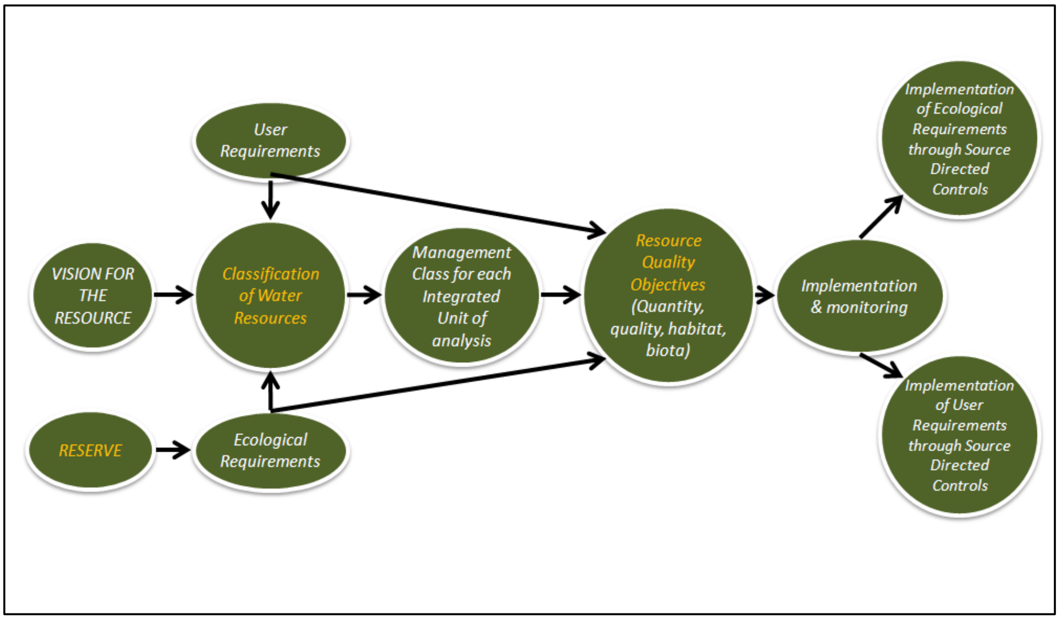


Figure 9.1: Linkages between the Resource-Directed Measures

9.1.1. Classification of significant water resources

Water Resource Classification System (WRCS) was formally prescribed through Regulation 810, published in the Government Gazette (GG 33541 of 17 September 2010). This system prescribes processes to be followed to determine RDM. This system categorises water resources according to specific water resource classes that represent a management vision for a particular catchment. The water Resource Classification process considers a catchment's social, economic, ecological and environmental landscape to assess the costs and benefits associated with utilization versus protection of a water resource. Water Resource Classification defines three water resource classes based on the extent of use and the alteration of the ecological condition of water resources from the pre-development condition, as given in Table 9-1 below.

Table 9-1 Water Resource Classes

Classes	Description of use	Ecological Category	Description of water resource
Class I	Minimally used	A-B	Minimally altered
Class II	Moderately used	C	Moderately altered
Class III	Heavily used	D	Heavily altered

**Ecological Category (EC) - the assigned ecological condition of a water resource in terms of the deviation of its biophysical components from a pre-development condition*

The classification of water resources represents the first stage in the protection of water resources and determines the quantity and quality of water required for ecosystem functioning as well as maintaining economic activity that relies on a particular water resource.

9.1.2. Resource Quality Objectives

The Act states that the purpose of Resource Quality Objectives (RQOs) is to establish clear goals relating to the quality of the relevant water resources, and it stipulates that in determining RQOs, a balance must be sought between the need to protect and sustain water resources and the need to use them.

RQOs are numerical and/or narrative descriptors of conditions that must be met to achieve the required management scenario provided during the water resource classification. Such descriptors relate to the:

(a) Water quantity, pattern, timing, water level and assurance of instream flow;
(b) Water quality, including the physical, chemical, and biological characteristics of the water;
(c) Character and condition of the instream and riparian habitat; and
(d) Characteristics, condition and distribution of the aquatic biota.

Once determined, the RQOs will give effect to the water resource classes set.

DWS has progressively conducted studies to determine water resource classes and the associated RQOs in several catchments. Table 9-2 indicates the status of water resource classification and RQO studies in South Africa as of September 2024.

Table 9-2: Status of water resource classification and RQO studies as of September 2024

Study Area	Status	Government Gazette No.
Olifants-Doorn	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 39943 of 22 April 2016
Olifants		
Upper Vaal		
Middle Vaal		
Lower Vaal		
Letaba	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 40531 of 30 December 2016
Inkomati		

Study Area	Status	Government Gazette No.
Mvoti to Mzimkhulu	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 41306 of 08 December 2017
Crocodile (West) Marico, Mokolo, and Matlabas	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 42775 of 18 October 2019
Breede-Gouritz	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 43726 of 18 September 2020
Mzimvubu	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 43015 of 14 February 2020.
Berg	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 43872 of 06 November 2020
Thukela	The Department finalised and gazetted the water resource classes together with the associated Resource Quality Objectives.	GG 48187 of 10 March 2023
Usuthu to uMhlathuze	The Department published the notice containing the proposed water resource classes together with the associated proposed Resource Quality Objectives for public comments on 21 June 2024. The closing date for receiving comments was 16 September 2024. Preparations for publishing the final gazette is currently underway and the final gazette is scheduled to be published by April 2025.	GG 50840 of 21 June 2024
Keiskamma and Fish to Tsitsikamma Catchments	The technical process for the determination of water resource classes and the associated Resource Quality Objectives in the study area commenced in September 2021 and is scheduled to complete in November 2025.	Not applicable yet, study still in progress
Luvuvhu	The technical process for the determination of water resource classes and the associated Resource Quality Objectives in the study area commenced in September 2021 and is scheduled to complete in September 2025.	Not applicable yet, study still in progress

Study Area	Status	Government Gazette No.
Upper Orange	The technical process for the determination of water resource classes and the associated Resource Quality Objectives in the study area commenced in October 2023 and is scheduled to complete in October 2026.	Not applicable yet, study still in progress
Lower Orange	The technical process for the determination of water resource classes and the associated Resource Quality Objectives in the study area commenced in September 2023 and is scheduled to complete in September 2026.	Not applicable yet, study still in progress

Figure 9.2 below depicts the status of water resource classification and Resource Quality Objectives studies in South Africa as of September 2024. It should be noted that after the completion of the technical processes for the determination of water resource classes and the associated RQOs in a particular river system, a legal notice for the proposed water resource classes and the associated proposed RQOs is published in the Government Gazette for 60 days public commenting period. The public comments received are considered in order to finalise the water resource classes and the associated RQOs. Once the Minister of Water and Sanitation approves the final water resource classes and the associated RQOs for the respective river systems, these are published in the Government Gazette and become binding on all institutions and authorities.

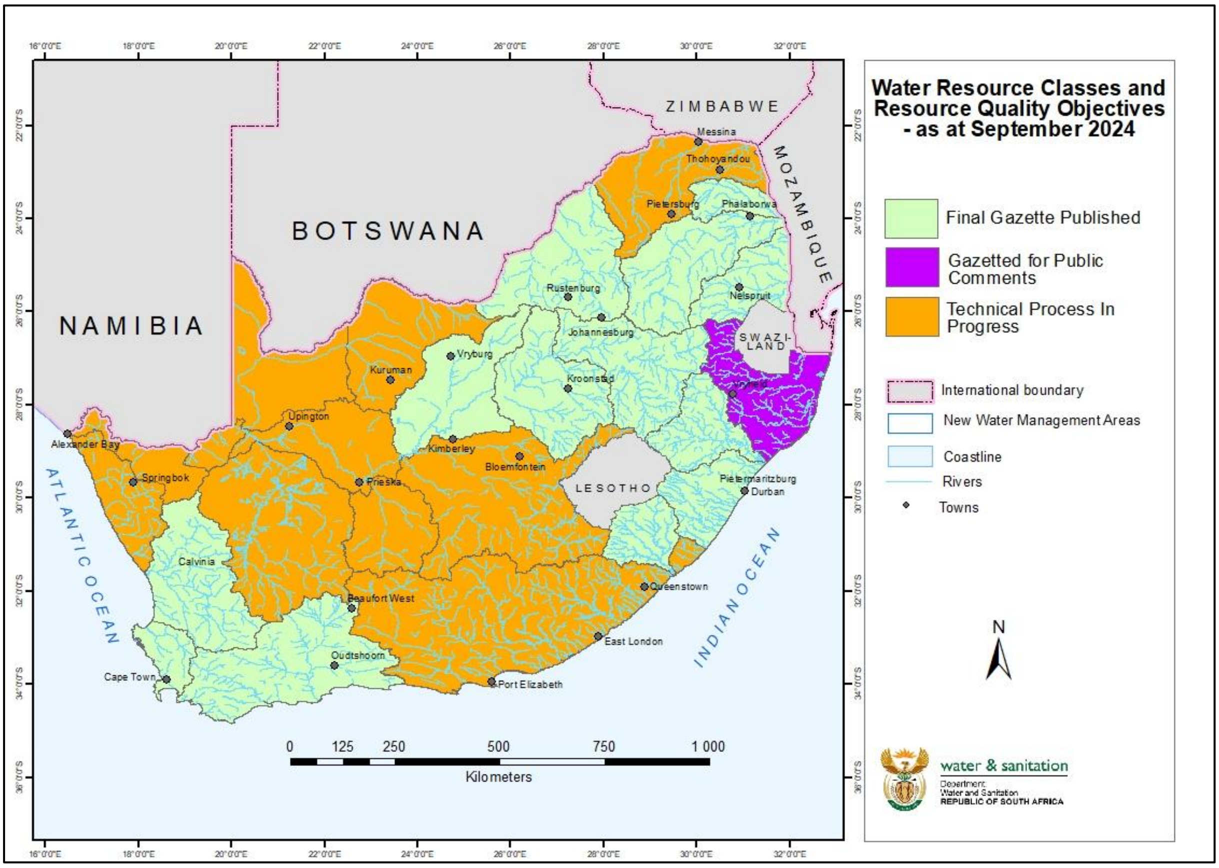


Figure 9.2: Status of Water Resource Classification and RQO studies as of September 2024

9.1.3. Reserve determinations

The Department is systematically determining the Reserve for significant water resources at various levels of confidence ranging from desktop to comprehensive. The level of Reserve determination depends on the type of impact and the magnitude of water resources to be impacted on, as well as the importance/status of the water resource, the credibility and the availability of the quantity and quality of data available to run the models.

The Reserve for surface water resources (i.e. rivers, wetlands and estuaries) has been determined at desktop, rapid, intermediate and comprehensive levels. Similarly, the Reserve for groundwater resources (aquifers) has also been determined at desktop, rapid, intermediate and comprehensive levels. The Reserve studies for both surface and groundwater conducted thus far have been plotted spatially, and Reserve maps have been developed for South Africa, as presented in Figure 9.3 and Figure 9.4. These maps have been made available to the Provincial offices to assist in the decision-making process for processing Water Use Authorisation applications.

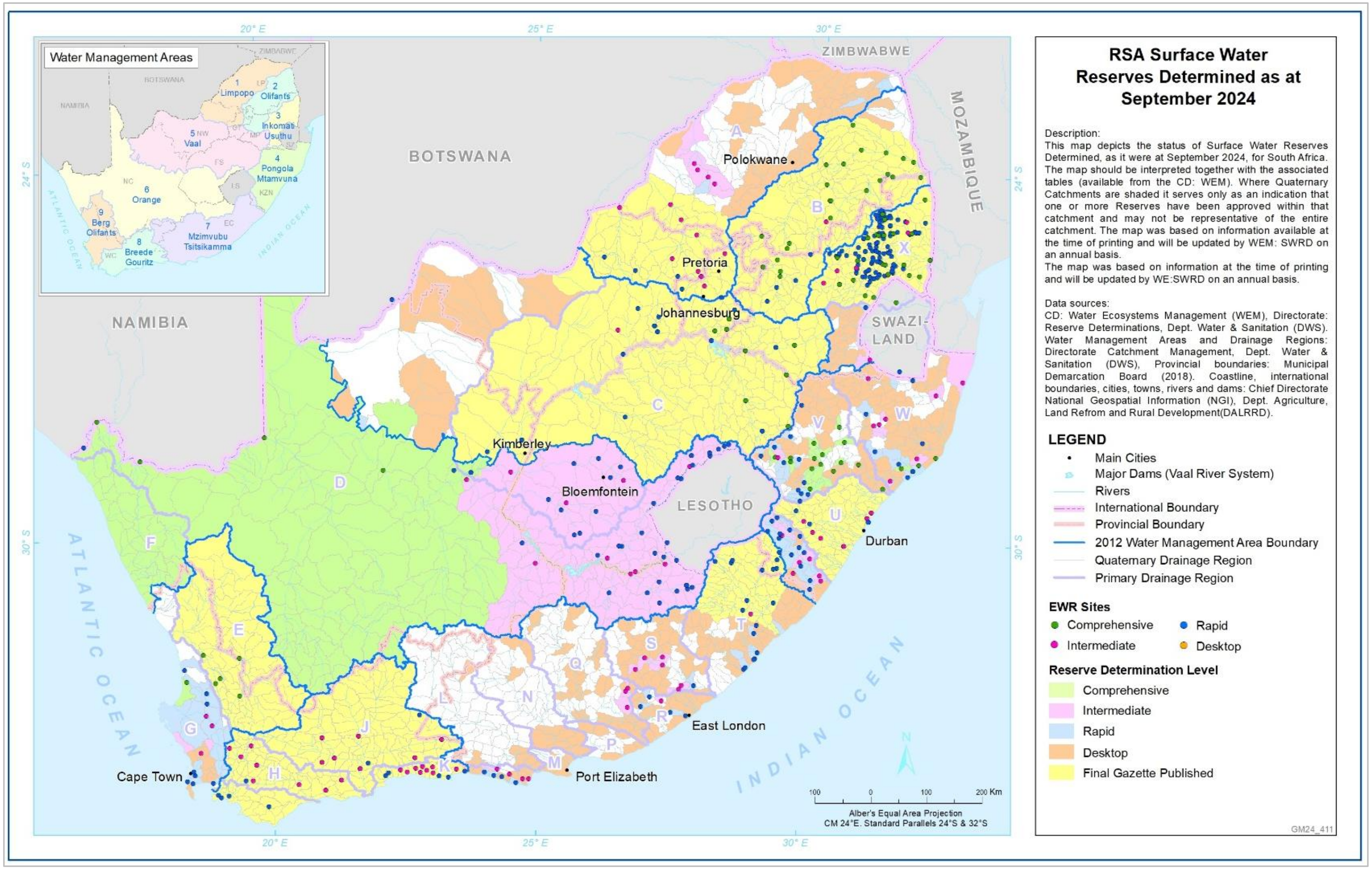


Figure 9.3 : Surface Water Reserves determined as of September 2024

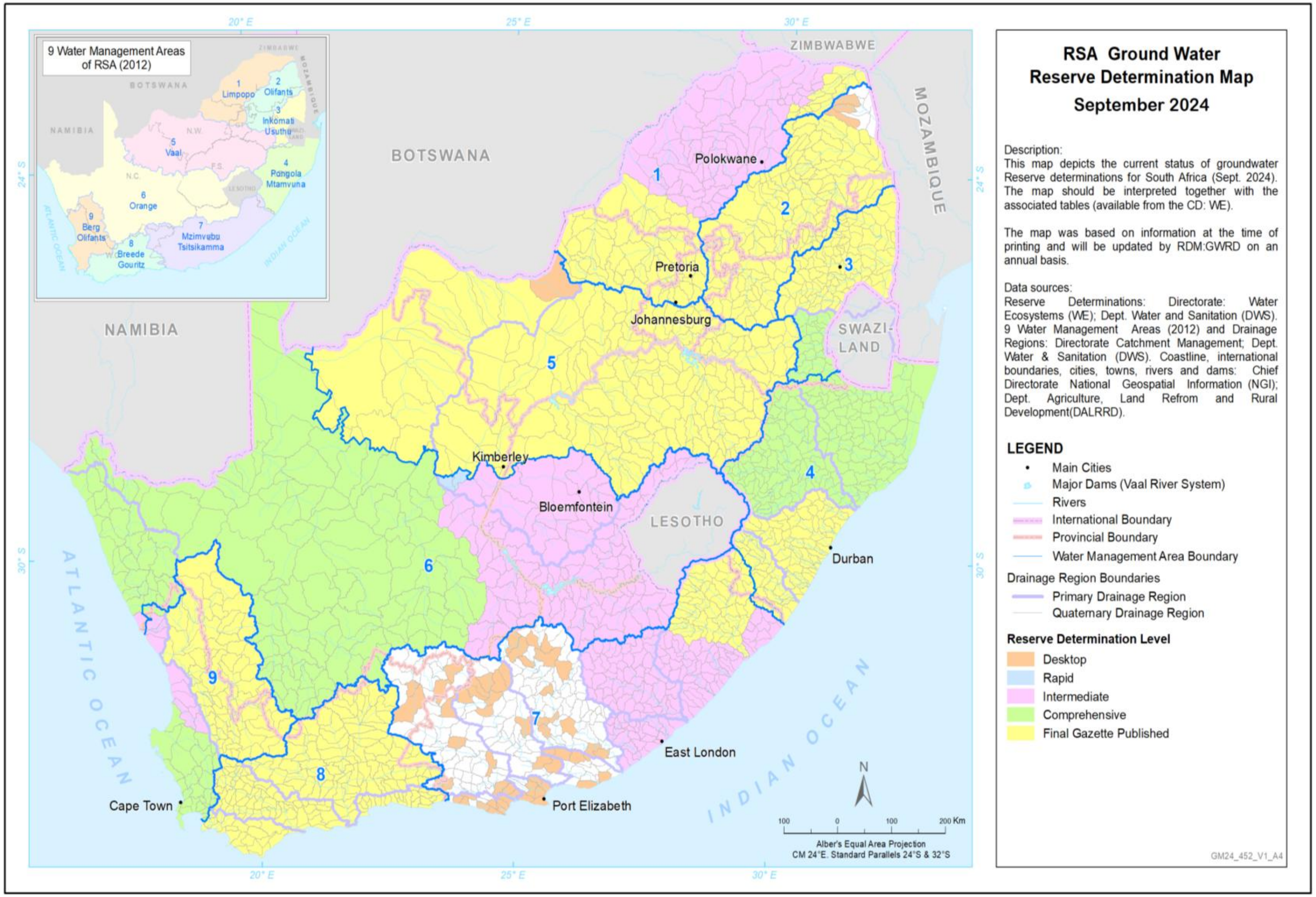


Figure 9.4: Groundwater Reserves determined as of September 2024

- *Present Ecological State, Ecological Importance & Sensitivity Database, 2013*

The Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) have initially been determined for all main stem rivers in the 1 946 Quaternary catchments in South Africa (Kleynhans, 1999). The 2011 PES/EIS update included the PES and EIS for main stem rivers and their tributaries, as well as important wetlands. Both the 1999, 2007 and 2014 PES/EIS databases are based on, amongst others the high confidence Reserve information that has been extrapolated to areas where there was no sufficient data.

The D: Reserve Determination (D: RD) has initiated a study to review the 2014 PES/EIS database. The main objectives will include updating the current PES/EIS 2014 database as reported in the previous State of Water Report (National State of Water Report 2023). The new study will follow the same principles, procedures, concepts, and assessment methods as implemented previously to allow for compatibility and comparison of data and sites. The study will assess the instream and riparian components of rivers and instream wetlands, such as floodplains and instream valley bottom wetlands, per sub quaternary reach (SQR). It will also address the estuaries that form part of the bottom of a river reach in a sub-quaternary reach.

The Present Ecological State (PES) and its Ecological Importance (EI) and Ecological Sensitivity (ES) for the identified water resource reaches within the 147 Secondary Catchments in South Africa will be assessed at a desktop level, using all data that has become available since 2011. For updating the 2014 PES/EIS, the water resources have been divided into 5 groups covering the entire country (sub divided, as per the 2014 study) to allow for trend analysis, i.e., assessing the change in the PES values from then to now. An additional team that is responsible for the technical support and the overall management of the 5 teams, named Group 0 was established as follows:

- Group 0: Technical Support (Spreadsheet Development, Database Management)
- Group 1: Limpopo, Olifants, Inkomati/Usuthu
- Group 2: Inkomati/Usuthu, Pongola/Mtamvuna
- Group 3: Vaal, Orange
- Group 4: Mzimvubu/Tsitsikama
- Group 5: Breede/Gouritz; Berg/Olifants

Each group is led by a team of specialists specialising in water resource management. In addition, the Department of Water and Sanitation (DWS) has identified several individuals who should be part of the study from start to finish and be capacitated on all aspects of this study.

Between October 2023 and September 2024, the teams have been working on updating the 2014 spreadsheets for the different catchments and ensuring that the capacity-building component is also implemented. To update the spreadsheet, the teams relied on their expert and local knowledge of the different catchments, and field surveys were conducted where there was insufficient data. To date the spreadsheets for the following secondary catchments have been produced and the population of the spreadsheets were rolled out to be updated: A, B, C, D, E, F, G, H, J, L, M, N, P, R, S, U, V, W and X. The specialists' teams, together with the DWS officials are working on updating these spreadsheets (some have been completed, and some are still in progress), while Group 0 is providing technical support to the teams. Additional information has been provided that will aid the DWS scientists and managers with making decisions related to protecting and managing water ecosystems where potential new and existing impacts could cause a threat.

- *Status of the Reserve Determination*

53 Surface Water Reserves were determined and completed between October 2023 and September 2024. Table 9-3 indicates the number and level of Surface Reserves determined/approved per Water Management Area (WMA).

Table 9-3: Summary of Surface Water Reserves completed between October 2022 and September 2023 per WMA

Water Management Area	Desktop	Rapid	Intermediate	Comprehensive	Total
Limpopo	0	0	0	0	0
Olifants	0	0	0	0	0
Inkomati-Usuthu	0	0	0	0	0
Pongola-Mzimkhulu	0	0	0	0	0
Vaal	0	0	0	0	0
Orange	5	30	10	0	45
Mzimvubu-Tsitsikama	8	0	0	0	8
Breede-Gouritz	0	0	0	0	0
Berg-Olifants	0	0	0	0	0
TOTAL	**13**	**30**	**10**	**0**	**53**

Four desktops, two intermediate and one comprehensive groundwater Reserves were completed between October 2023 and September 2024. Table 9-4 indicates the number and level of Groundwater Reserves determined per Water Management Area (WMA).

Table 9-4: Summary of Groundwater Reserves completed between October 2023 and September 2024 per WMA

Water Management Area	Desktop	Rapid	Intermediate	Comprehensive	Total
Limpopo	0	0	0	0	0
Olifants	0	0	0	0	0
Inkomati – Usutu	0	0	0	0	0
Pongola – Mtamvuna	0	0	0	0	0
Vaal	0	0	0	0	0
Orange	0	0	1	0	1
Mzimvubu – Tsitsikamma	4	0	0	0	4
Breede – Gouritz	0	0	0	0	0
Berg – Olifants	0	0	1	1	2
TOTAL	**4**	**0**	**2**	**1**	**7**

- *Gazetting of the Reserve*

Section 16(1) of the National Water Act, 1998 (Act No. 36 of 1998) states that "As soon as reasonably practicable after the class of all or part of a water resource has been determined, the Minister must, by notice in the Gazette, determine the Reserve for all or part of that water resource. The Chief Directorate: Water Ecosystems Management has completed the gazetting of the Reserve in the following Catchments/WMAs (Table 9-5 and Table 9-6).

Table 9-5: List of WMAs/Catchments where the Reserve has been gazetted.

Water Management Area/Catchments	Government Gazette Number
Olifants/Doring (excluding F60 and G30 tertiary catchments)	41473
Vaal	43734
Mvoti-Mzimkulu	41970
Inkomati	42584
Olifants/Letaba (excluding B9 Shingwedzi secondary drainage region)	41887
Breede-Gouritz	46798
Croc-West and Marico	45568
Mzimvubu catchment (tertiary drainage T1 – T36)	47526

Table 9-6: List of WMAs/Catchments where the Reserve has been gazetted for public comments.

Water Management Area/Catchments	Government Gazette Number
uThukela Catchment	50071

10

WATER RESOURCE REGULATION

10 WATER RESOURCE REGULATION

10.1 Compliance Monitoring and Enforcement

The Compliance Monitoring function promotes and monitors the status of compliance of water users to standards, with water use authorisation conditions and regulations across the full water value chain of all sectors in a way that triggers appropriate enforcement or other regulatory-enhancing action if needed.

The Enforcement function ensures that a set of actions (administrative, criminal, and civil) are taken against non-compliance with the provisions of the National Water Act as a Specific Environmental Management Act (SEMA) under the National Environmental Management Act (NEMA) (Act no. 107 of 1998).

The Department of Water and Sanitation (DWS) constantly strives to enhance the compliance monitoring and enforcement (CME) procedures, protocols and instruments for effective functioning within the Environmental Management Network. The development of the DWS CME / Environmental Management Inspector (EMI) Standard Operating Procedure (SOP) Manual has been finalised to harmonise and standardise operating procedures within the water sector that will allow the CME officials and EMIs to perform their duties in an administrative just and legal defensive manner and conform to the chain of custody process and actions at national, regional and Catchment Management Agency (CMA) levels to result in successful court cases.

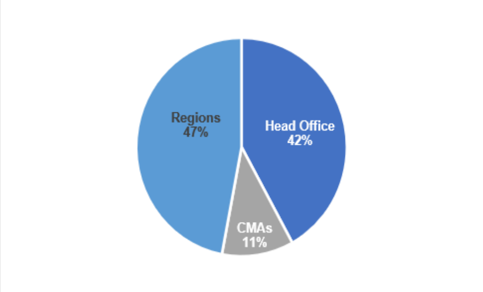
In support of an enhanced compliance and enforcement capacity, there is ongoing training and designation of officials as Environmental Management Inspectors (EMIs). The current total of EMIs designated by the Minister of Water and Sanitation is one hundred and twenty-four (124). The DWS is part of the blue sector (freshwater) and brown sector (waste), and its performance data is also reported by the Environmental Secretariat and EMI network. Presently, there are 65 EMIs in provincial offices, 15 in CMAs, and 44 at the National Office, which is distributed throughout the DWS. In terms of their designation, one (1) is a Grade 3, one hundred and fourteen (114) are Grade 2 and nine (9) are Grade 1 (Figure 10.1). There are 21 CME officials who were trained during the reporting period that awaited their EMI designation and have been since designated as EMIs, increasing the EMIs designated to 145 to date. It needs to be noted that during this financial year, only 141 DWS and CMA CME officials are performing the CME functions, and about 93 officials are within the regions and CMAs to regulate all the water sectors registered on the Water use Authorisation & Registration Management System (WARMS) of about 134 524 water users as well as identified unlawful activities.

A significant part of the DWS Compliance Monitoring and Enforcement (CME) Strategy is the commitment to training and capacity building as well as access to information relating to CME. The National Compliance Information Management System (NCIMS) and the Enforcement Case Management System (ECMS) are operational, with future integration planned into one Integrated Regulatory Information System (IRIS) together with Wastewater and Drinking Water (Green Drop and Blue Drop Programmes).

The two established CMAs, namely Breede-Olifants CMA (BOCMA) and Inkomati-Usuthu CMA (IUCMA), are conducting CME functions in their respective WMAs, and these CME functions were also incorporated into the national Annual CME Report 2023/24 with respect to their CME Annual Performance Plan (APP) targets to give a holistic overview of the water sector performance and status of compliance in South Africa.

The Department is in the process of implementing the approved organizational structure and NWA delegations, 2023. The relocation of the Compliance Monitoring & Enforcement function from the Regional Head (offices) to the CMAs necessitates a concerted effort to bolster the CME capacity as well as the criminal enforcement capacity of new officials that will be integrating into the CMAs / National Office from various units encompassed within the Department.

Executive overview of the Environmental Management Inspectorate (EMI) designations

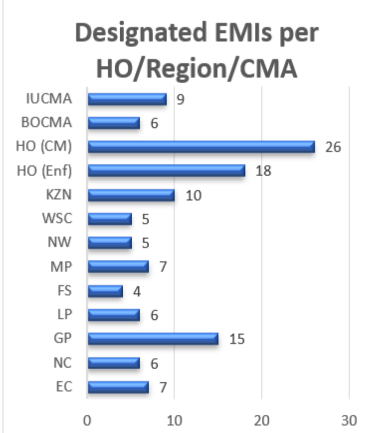


Total number of active designated EMIs is 124

124 = Active
9 = Inactive (Left department/moved out of Compliance Monitoring)
21 = Waiting for designation

National and provincial EMIs trained per financial year

2016/2017	13
2017/2018	**12**
2018/2019	**15**
2019/2020	**36**
2020/2021	**20**
2021/2022	**16**
2022/2023	**21**
2023/2024	**21**



Designated grades		
Grade 1 = 9	**Grade 2 = 114**	**Grade 3 = 1**

Training dates	Number of DWS and CMA / proto-CMA CME officials	Total officials enrolled
Training undertaken in May and October 2023 and February 2024	Twenty One (21) officials trained; one (1) in BOCMA; two (2) in IUCMA; four (4) in Mzimvubu-Tsitsikamma (MTCMA) Proto CMA; one (1) in Head Office: Compliance Monitoring; three (3) in Northern Cape Region; one (1) in Free State Region, one (1) in KZN Region; one (1) in Mpumalanga Region; one (1) in North West Region, one (1) in Gauteng Region; one (1) in Northern Cape Region, two (2) in Limpopo Region, one (1) in Western Cape Region, one (1) in Eastern Cape Region.	Total = 21

Figure 10.1: The Environmental Management Inspectorate – DWS and its entities' component

10.1.1 Compliance Monitoring

The Compliance Monitoring team set a target to monitor 406 authorised water users across the various sectors for the 2023/2024 financial year (including Dam Safety). The Compliance Monitoring team achieved 433 (including Dam Safety) and exceeded the target by 34 due to additional inspections done by the Provincial Offices as well as the Western Cape joint operation Blitz.

Figure 10.2 reflects the trend analysis for compliance inspections. The number of water users monitored has increased for the past three (3) financial years since taking a sharp decline in 2019 due to the COVID-19 pandemic that forced regions to conduct desktop compliance inspections.

The average number of water users monitored in the past 3 years is 401 water users (including Dam Safety). Although there has been an improvement, this is still a far cry considering the large number of water users that must be monitored. The number of water users registered with the DWS is close to 134524. This implies that DWS monitors only 0.30 % (401/134524) of water users per year. Unfortunately, the compliance monitoring officials in the provincial offices are not distributed evenly according to the number of inspections to be conducted for all the water sectors per year.

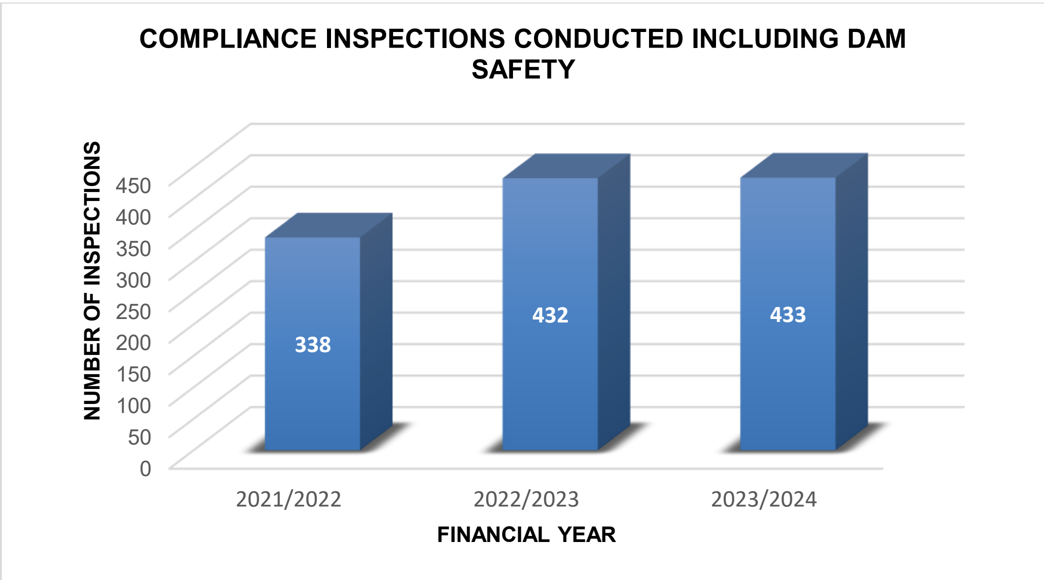


Figure 10.2: Overview of Compliance Inspections from 2021/2022 -2023/2024

The mining sector received more attention from the compliance inspections conducted during the financial year 2023/24, followed by the Irrigation and Industry sectors, as reflected in Figure 10.3.

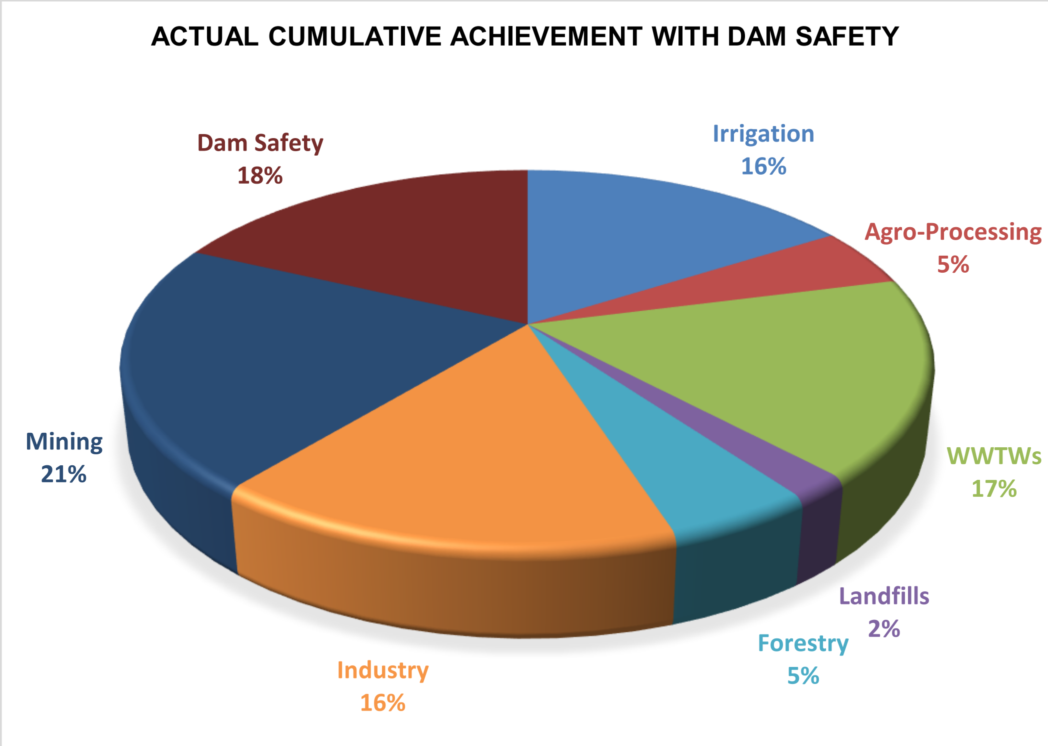


Figure 10.3: Compliance inspections conducted per water sector for the 2023/2024 financial year

In the Medium-Term Strategic Framework (MTSF) and Outcome 10 performance agreement, an impact indicator is used to determine the level of performance of the water users and sectors. The purpose of the impact indicator is to add value to the statistics of users monitored by indicating the status of compliance against the conditions of the authorisation. A scorecard has been developed and used to accurately and consistently measure/score performance and forms part of the portfolio of evidence together with the inspection report.

The target set for % compliance with water user authorisations obligations per sector is 65%. The DWS Compliance Monitoring (without Dam Safety inspections) planned to monitor 329 facilities and achieved 357 water users inspected. The 357 water users monitored achieved a combined average performance level of 56% during 2023/24. The combined average performance percentage level of all water users per sector monitored for compliance from 2022/2023 (58%) to 2023/2024 (56%) shows a decline of 2%.

The compliance inspections conducted for the financial year for the different water sectors were as follows: Mining (91); Industry (73); Agro-Processing (20); Agricultural/ Irrigation (69); Afforestation - SFRA (20); Government: Municipal Wastewater Treatment Works (75); and Waste disposal facilities (landfills) (9) shown in Figure 10.4.

The SFRA (Plantations) at (73%), Industry at 67% and Agro-Processing at 67% achieved a compliance percentage score above 65%. The compliance percentage score for Mining was 60%, and Irrigation was 60%, below the 65% target. The Government (WWTWs) (36%) and Waste Disposal Facilities (Landfills) (32%) are sectors that scored a compliance level of less than 50%.

The results indicate a lower-than-desired performance level. To improve this, follow-up inspections must be emphasised to ensure findings are implemented and that enforcement actions and consequences are followed where required.

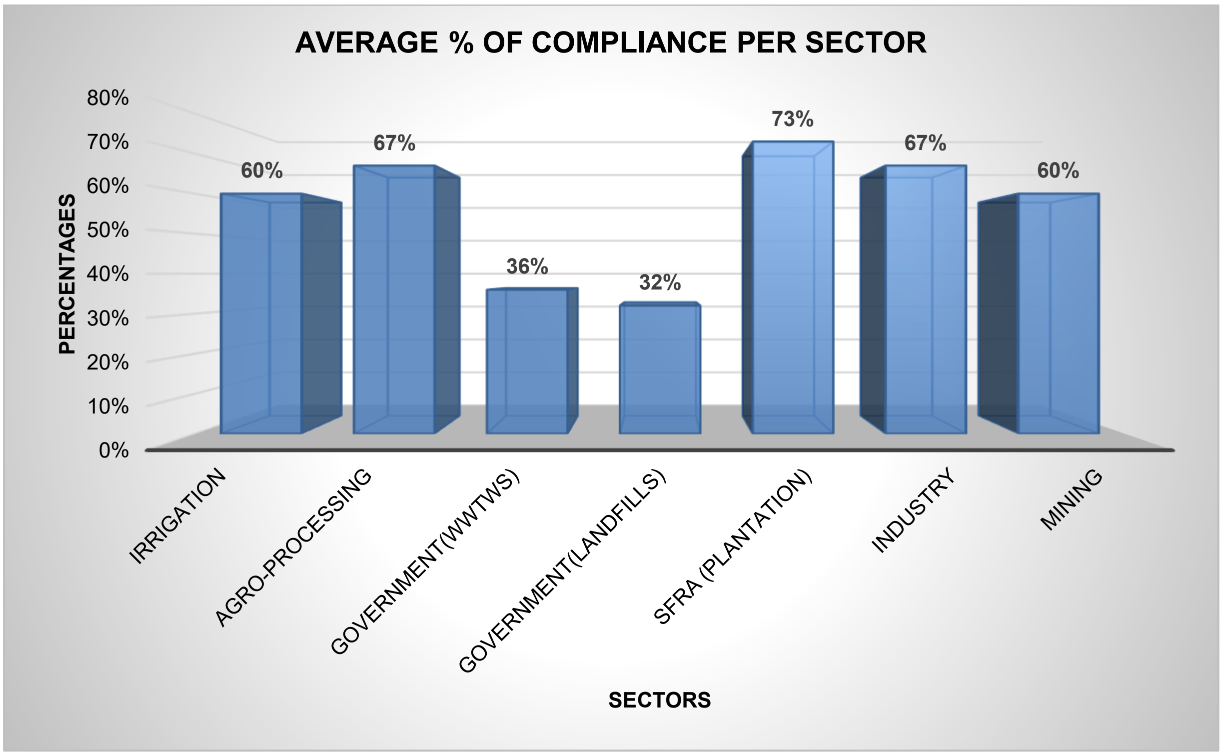


Figure 10.4: Overview of compliance performance of the water sectors for 2023/2024

DWS conducted 357 compliance inspections, and BOCMA conducted 72 compliance inspections. It amounts to 429 compliance inspections conducted in combination between DWS and BOCMA. Joint compliance monitoring of thirteen (13) for compliance with WARMS unit was performed under Irrigation Sector for Water Management Institutions (WMIs), and two (2) joint compliance monitoring inspections for Waste Disposal Facilities (WDF) were conducted with DFFE as well as two (2) self-regulation desktop audits for WDF were conducted. Additionally, IUCMA conducted 92 desktop audits and BOCMA 9 desktop audits. It must be noted that the SOPs and use of the NCIMS were not applied with the latter IUCMA and BOCMA desktop audits, the status of compliance for water users was not calculated, and no PoE was provided in this financial year for audits conducted.

10.1.2 Enforcement for DWS

During the 2023/2024 financial year, a total of 583 cases of non-compliance were reported. Of these, 467 were duly investigated, meeting the target with an 80% achievement rate Figure 10.5. It must be noted that these results for cases and enforcement actions taken include BOCMA and IUCMA for those enforcement cases registered on the Enforcement Case Management System (ECMS).

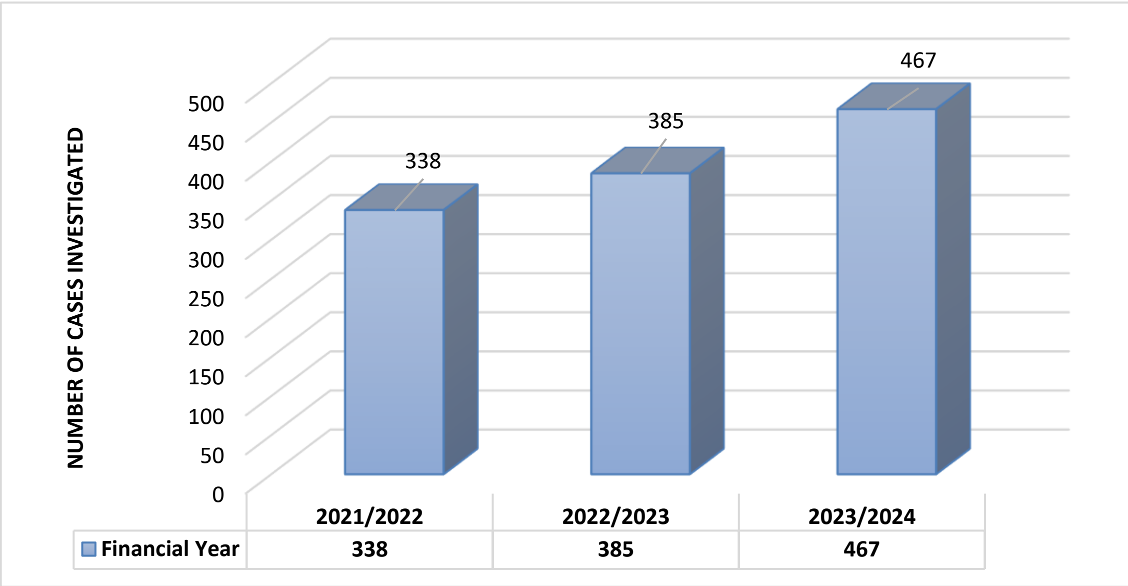


Figure 10.5: Overview of Enforcement cases investigated from 202/21 -2022/23

Findings arising from the cases investigated revealed non-compliance with the aforementioned water-related regulations. In response to these contraventions, the Department invoked its authority to initiate administrative enforcement actions aimed at rectifying the identified contraventions. Furthermore, it was necessary for the DWS to initiate criminal charges or pursue civil actions in instances where such enforcement measures were deemed appropriate and necessary to address cases of significant non-compliance.

The Department undertook both administrative and criminal actions against water users who were found to be non-compliant. A total of two hundred and seven (207) notices of intention to issue directives were duly issued. Subsequently, fifty-nine (59) directives were issued.

During the reporting period, the Department successfully closed 126 cases, as the transgressors complied by rectifying the contraventions and implementing the requirements outlined in the Notices and Directives issued. Some of the administrative actions resolved originated from or dated back to periods outside the financial year under review.

Furthermore, the Department laid sixty-three (63) criminal charges against non-compliant water users and polluters, and twelve (12) case dockets were finalised and referred to the National Prosecuting Authority for a decision. For comprehensive specifics pertaining to the aforementioned information, please refer to Table 10-1 below.

Table 10-1: Enforcement actions taken against non-compliant water users and water polluters in the various provincial offices.

Region	Percentage of reported non-compliant cases investigated	*Notices Issued	*Directives Issued	*Cases Registered with SAPS	*Cases referred to NPA
Breede-Olifants CMA	16	31	6	4	3
Eastern Cape	84	26	1	2	2
Free State	23	26	8	3	0
Gauteng	66	4	1	11	1
IUCMA	19	11	9	1	**0**
KwaZulu Natal	55	14	2	3	0
Limpopo	19	15	8	2	1
Mpumalanga	67	34	11	9	6
North-West	80	26	9	9	1
Northern Cape	28	10	4	18	1
Western Cape	10	10	0	1	0
Total	**467**	**207**	**59**	**63**	**12**

Numerous complaints have been lodged concerning illegal water usage and pollution, indicating widespread non-compliance across various sectors. The agriculture sector is the primary offender, responsible for 28% of the complaints, and local government municipalities, particularly those managing wastewater treatment, represent 28% of the issue. Commercial activities and domestic/private water usage each account for 5% of the complaints. Government sectors, including national and provincial entities, are involved in 1% of the cases. The industrial sector shows non-compliance in 9% of the complaints. The mining sector is another major concern, with 17% of the complaints. Tourism and other sectors also contribute to 5% and 2% of the reported cases, respectively (Figure 10.6).

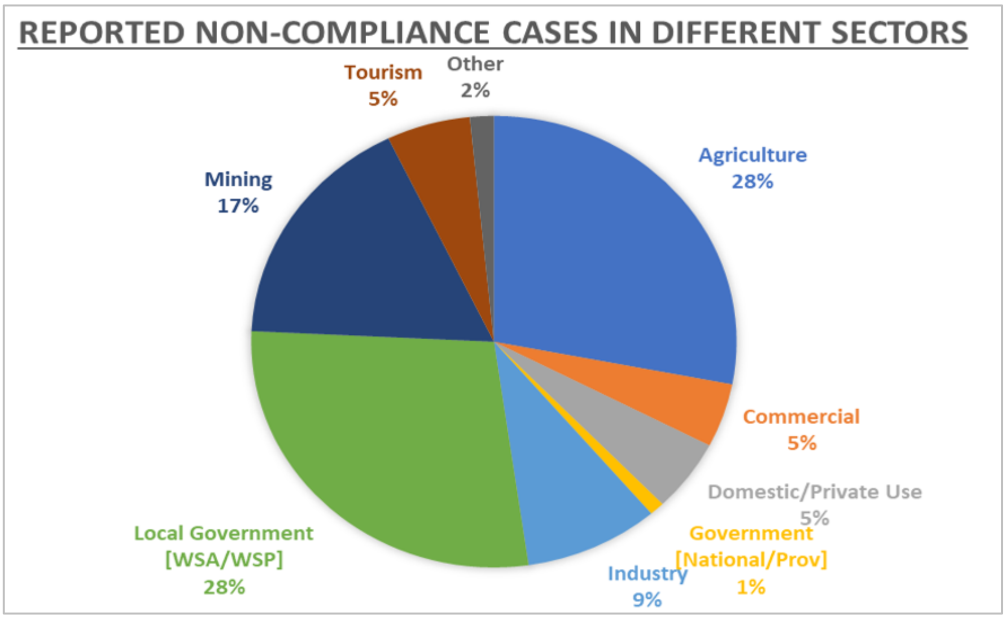


Figure 10.6 Enforcement cases per water sector for the 2023/24 financial year

During the 2023/2024 financial year, there were twenty-two (22) cases where compliance was achieved through administrative actions, demonstrating a positive response by water users to regulatory requirements. In eighty (80) instances, investigations concluded with no contraventions detected. No cases were marked as nolle prosequi or declined for prosecution, highlighting the decisive actions taken without needing to forgo charges. One case was resolved through a plea sentence agreement, indicating an admission of guilt. Additionally, remedial actions were taken in 22 cases during the investigation phase, emphasizing a commitment to early mitigation. These outcomes reflect the effectiveness of the regulatory framework and the diligence of enforcement efforts across various sectors (Table 10-2).

Throughout the 2023/2024 period, the Department referred a total of twelve (12) cases to the National Prosecuting Authority (NPA) for decision to prosecute. Comparatively, seven cases were referred to the NPA in the previous financial year 2022/2023.

During this period, legal proceedings led to the successful issuance of 1 court order and the conclusion of 1 plea sentencing agreement. These outcomes were achieved following the court's careful review and finalisation of both cases in accordance with the applicable legal procedures and standards.

The Department has opened sixty-three (63) criminal cases against non-compliant water users, with the majority of these charges targeting local government entities, particularly municipalities, for polluting water resources. This represents a significant increase compared to the previous financial year of 2022/2023, during which only seventeen (17) criminal charges were filed against offenders. The rise in criminal charges demonstrates stricter enforcement of legislation aimed at protecting water resources from pollution. This stance is essential in addressing and mitigating impacts on water resources caused by non-compliance, ensuring that water resources are protected for future use.

The Department has implemented its recently approved organisational structure. As part of this process, the Enforcement Unit introduced and added a new official responsible for the Criminal Investigation Unit. This role has been established to ensure the thorough investigation and finalisation of criminal cases for prosecution.

Furthermore, officials were seconded to the Criminal Investigation Unit, where they assisted in opening criminal cases, having been trained to manage case dockets for investigation. This has significantly strengthened the capacity of the Criminal Investigation Unit at DWS Head Office.

Table 10-2 Summary of resolved enforcement cases in financial year 2023/24.

Summary of Resolved Cases	**No**
Complied with Administrative Action	22
No Contravention Detected	80
Court (order) Interdict	1
Plea Sentence Agreement (Admission of guilt)	1
Remedial action taken in Investigation Phase	22
Total	126

Overall, this analysis provides insights into the various resolutions achieved following enforcement interventions, emphasizing the significance of enforcing compliance and taking appropriate measures to rectify non-compliance instances.

10.1.3 Joint Compliance And Enforcement Operations

Over the past three financial years, the joint operations by DWS Enforcement Units have shown fluctuating trends in the number of reported non-compliance cases. In 2021/2022, a total of 30 joint operations were conducted to address reported non-compliances. This number increased significantly in 2022/2023, with 25 joint operations conducted. In the current 2023/2024, there has been an increase to 46 joint operations (Figure 10.7). **IUCMA** did not deal with any joint operations in 2023/2024. During 2023/2024, **BOCMA** conducted two blitz operations in the third quarter and fourth quarter with DWS and DEADP EMI's.

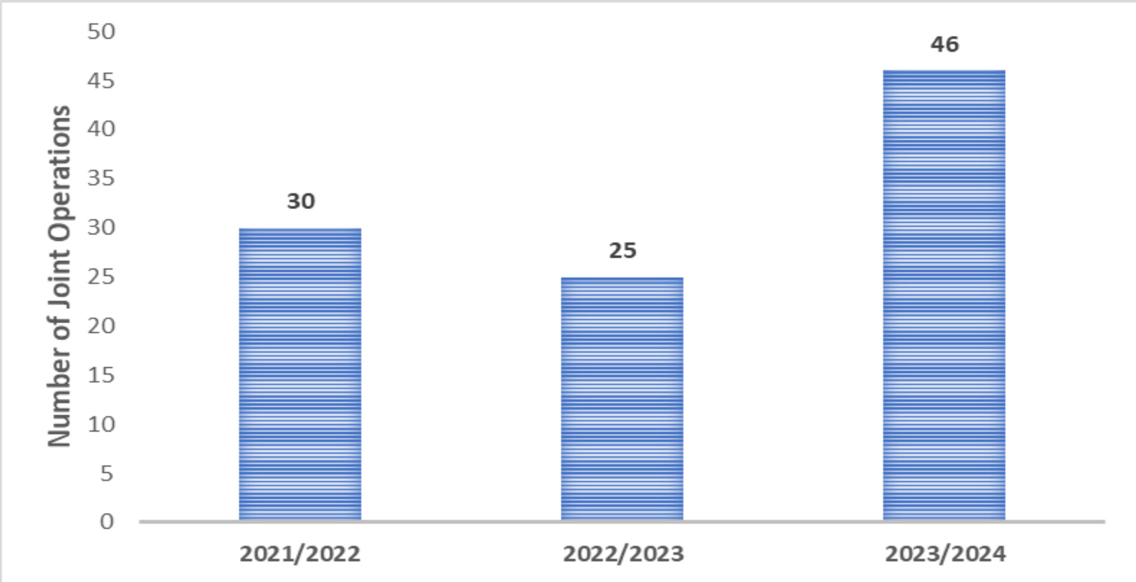


Figure 10.7 Number of DWS joint enforcement operations over the last three financial years 2021/2022-2023/24.

10.1.4 Pollution Incident Enforcement

During the 2023/2024 review period, a total of five hundred and eighty-three (583) cases of non-compliance were reported. Among these cases, one hundred and forty-one (141) were related to the control of incidents resulting in water resource pollution, which includes emergency incidents. In response to these incidents, the Department conducted thorough investigations and, when necessary, initiated administrative enforcement actions or filed criminal charges against those responsible. These actions were aimed at compelling individuals or entities involved to undertake corrective measures to mitigate pollution.

The Department issued one hundred and nineteen (119) notices, and forty-six (46) directives were issued, while (56) criminal cases were opened against the facility operator who, either intentionally or negligently, engaged in activities that resulted in the pollution or potential pollution of a water resource. Collaboratively, the Department is actively engaged with SAPS to facilitate the completion of the case docket, which will then be forwarded to the NPA for a decision. Furthermore, eight (8) cases have been closed as facility operators have undertaken corrective measures to clean and rehabilitate the affected areas, effectively mitigating the pollution risk to our water resources.

During the period under review, the CME division under Inkomati-Usuthu Catchment Management Agency (IUCMA) received twenty-seven (27) reported pollution incidents-related cases for investigation. All reported matters were attended to within 24 hours of the reported period as per the IUCMA SOP. Verbal directives were issued on-site as provided for in terms of S 20 of NWA. Most of these issues were related to sewage overflow due to municipal infrastructure failure. Eighteen (18) of the reported matters were resolved with a verbal directive. Only nine (09) directives were confirmed in writing within 14 days of issuing a verbal directive. Follow-up inspections were conducted, and all users issued directives fully complied with the IUCMA's requirements. For the quarter under review, all directive matters were resolved.

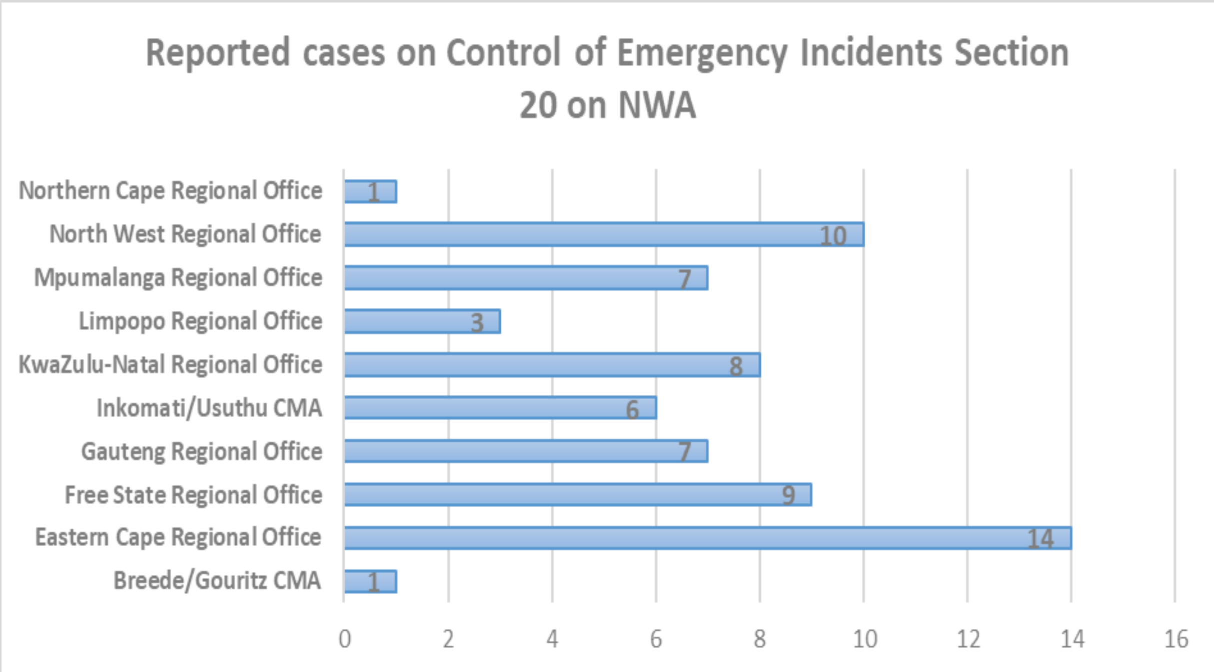


Figure 10.8 Number of emergency pollution incidents of non-compliance reported per DWS/CMA offices.

During the 2023/2024 financial year, the BOCMA CME unit dealt with one (1) emergency pollution incident (section 20) related cases for investigation and obtained from the ECMS. Other pollution incidents are not captured on the ECMS and provided by BOCMA at the time of publication of this report.

10.1.5 CME Capacity Building

The DWS CME Strategy approved in March 2018 is progressively being implemented with the further training of DWS and CMA CME/EMI personnel and external stakeholders. In respect of EMI Basic Training undertaken during 2023/2024, 21 of the DWS and CMAs officials received training by DFFE. The 21 CME officials are awaiting designation as EMIs by the end of March 2024 but have been designated since April 2024.

Internal DWS / CMA training courses for officials to perform their duties more effectively and efficiently and to enable them to be designated as EMIs. A WUCME database register is updated on a quarterly basis for official receiving training and which training sessions attended for 2023/24. It gives a good indication of who still needs to be trained and for which advanced courses to take.

Phase 1 (3-days) & Phase 2 (2-days) CME training was developed, and training was provided to Proto-CMAs that already appointed staff and will be conducting CME functions and existing CME Regional Office officials that will be moving over to the CMAs on:

- **Phase 1:** Generic concepts, processes, procedures and IT Application tools (NCIMS and ECMS) and how to compile a Compliance Inspection Report to CMAs/Proto-CMAs

- **Phase 2**: CME training on compliance monitoring SOPs and requirements for specific water sectors, as well as enforcement SOPs and actions to be taken.

IUCMA already received training on Phase 1 in the previous financial year 2022/2023 (8-10 February 2023) and requested to be trained on Phase 2 at a later stage due to internal organizational structure issues. When VO Proto-CMAs North West and Gauteng; PM Proto-CMA (KZN) and LO Proto-CMA (Mpumalanga & Bronkhorstspruit offices) appoint CME officials, the CME Phase 1 & Phase 2 training will also be rolled out to them in 2024/25.

The development of an advanced EMI Waste and Pollution Sampling training course in collaboration with DFFE is completed and training will be provided in the 2024/25 financial year.

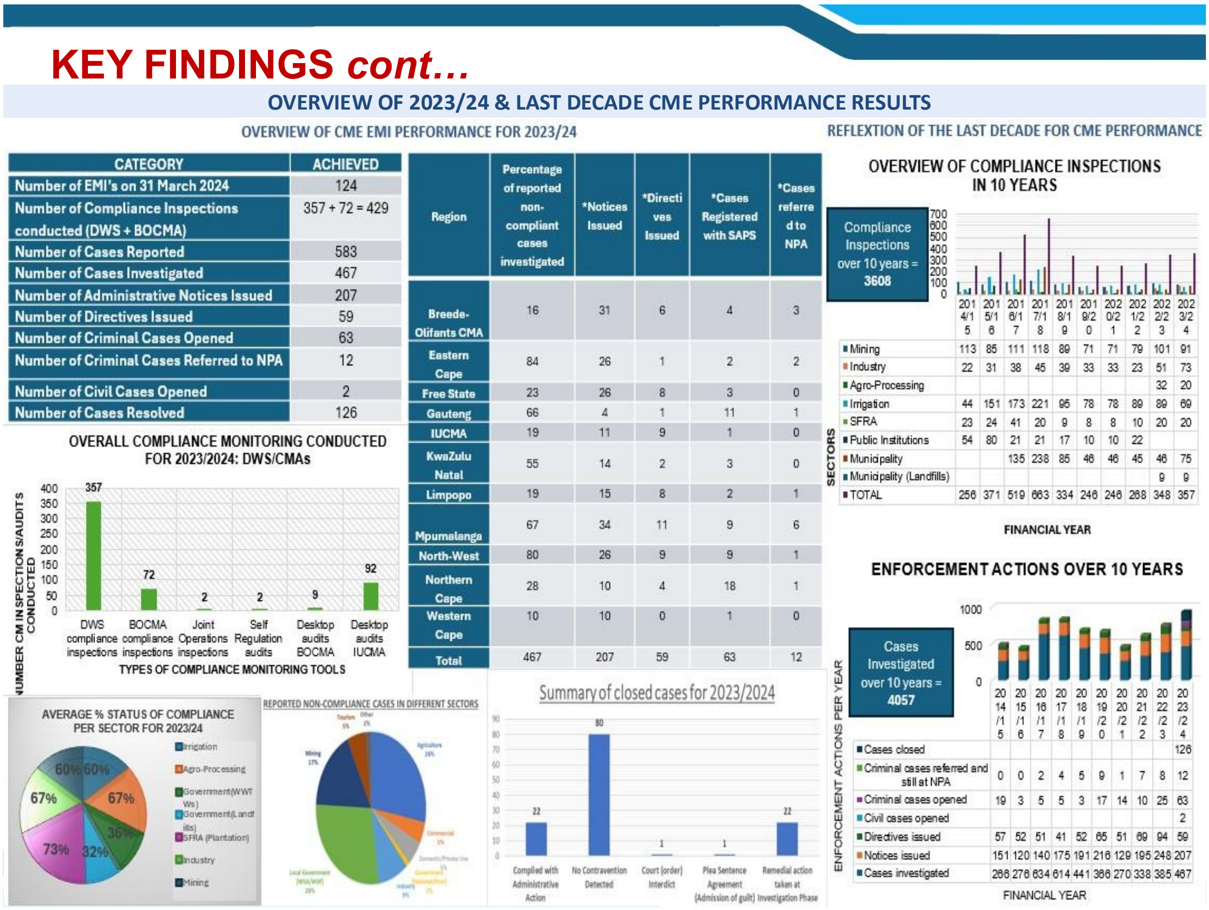
Additionally, during the 2023/2024 financial year the sub-directorate Enforcement Support conducted legally oriented capacity-building training sessions with its external stakeholders such as SAPS, NPA and Traditional leaders. The external stakeholders have a direct involvement in the investigation and prosecution of criminal matters and thereby enforce compliance with the National Water Act. Therefore, these engagements are important to build the capacity and skills base of the personnel within these institutions to successfully investigate and deal with water-related criminal cases. The external stakeholder training sessions were held for 16 SAPS, 5 NPA and 2 Traditional communities for capacity-building initiatives.

During the last 10 years DWS has conducted a total of 3608 compliance inspections for various water users (excluding dam safety infrastructure inspections). Therefore, an average of 361 compliance inspections have been conducted each year. With 134524 water users registered on WARMS on 1 April 2024 only 2.7 % water users have been inspected. This gives a reality check on the enormous task at hand for about 70 Compliance Monitoring officials in DWS and CMAs to conduct these compliance monitoring inspections and audits.

10.1.6 Reflection of the last decade for CME performance

During the last 10 years DWS has conducted a total of 3608 compliance inspections for various water users (excluding dam safety infrastructure inspections). Therefore, an average of 361 compliance inspections have been conducted each year (Figure 10.9). With 134524 water users registered on WARMS on 1 April 2024 only 2.7 % water users have been inspected. This gives a reality check on the enormous task at hand for about 70 Compliance Monitoring officials in DWS and CMAs to conduct these compliance monitoring inspections and audits.

The average of the compliance performance percentage (%) for the water sector are 55% over the last 10 years for DWS. Compliance inspections in these graphs do not include CMA data as BOCMA and IUCMA only commence with compliance inspections in 2023/24.



CATEGORY	ACHIEVED
Number of EMI's on 31 March 2024	124
Number of Compliance Inspections conducted (DWS + BOCMA)	357 + 72 = 429
Number of Cases Reported	583
Number of Cases Investigated	467
Number of Administrative Notices Issued	207
Number of Directives Issued	59
Number of Criminal Cases Opened	63
Number of Criminal Cases Referred to NPA	12
Number of Civil Cases Opened	2
Number of Cases Resolved	126

Region	Percentage of reported non-compliant cases investigated	*Notices Issued	*Directives Issued	*Cases Registered with SAPS	*Cases referred to NPA
Breede-Olifants CMA	16	31	6	4	3
Eastern Cape	84	26	1	2	2
Free State	23	26	8	3	0
Gauteng	66	4	1	11	1
IUCMA	19	11	9	1	0
KwaZulu Natal	55	14	2	3	0
Limpopo	19	15	8	2	1
Mpumalanga	67	34	11	9	6
North-West	80	26	9	9	1
Northern Cape	28	10	4	18	1
Western Cape	10	10	0	1	0
Total	467	207	59	63	12

SECTORS	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Mining	113	85	111	118	89	71	71	79	101	91
Industry	22	31	38	45	39	33	33	23	51	73
Agro-Processing									32	20
Irrigation	44	151	173	221	95	78	78	89	89	69
SFRA	23	24	41	20	9	8	8	10	20	20
Public Institutions	54	80	21	21	17	10	10	22		
Municipality			135	238	85	46	46	45	46	75
Municipality (Landfills)									9	9
TOTAL	256	371	519	663	334	246	246	268	348	357

ENFORCEMENT ACTIONS	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Cases closed										126
Criminal cases referred and still at NPA	0	0	2	4	5	9	1	7	8	12
Criminal cases opened	19	3	5	5	3	17	14	10	25	63
Civil cases opened										2
Directives issued	57	52	51	41	52	65	51	69	94	59
Notices issued	151	120	140	175	191	216	129	195	248	207
Cases investigated	266	276	634	614	441	366	270	338	385	467

Figure 10.9 Reflection of the last 10 years of compliance inspections conducted per water sector and enforcement actions.

During the last 10 years 4057 cases were investigated. Enforcement cases investigated, notices and directives issued, criminal cases opened and referred to NPA for the last decade as per the ECMS data are tabled above in Figure 10. Cases closed were only recorded during the 2023/24 annual reporting period. CMAs BOCMA & IUCMA included.

10.2 Drinking Water Regulation

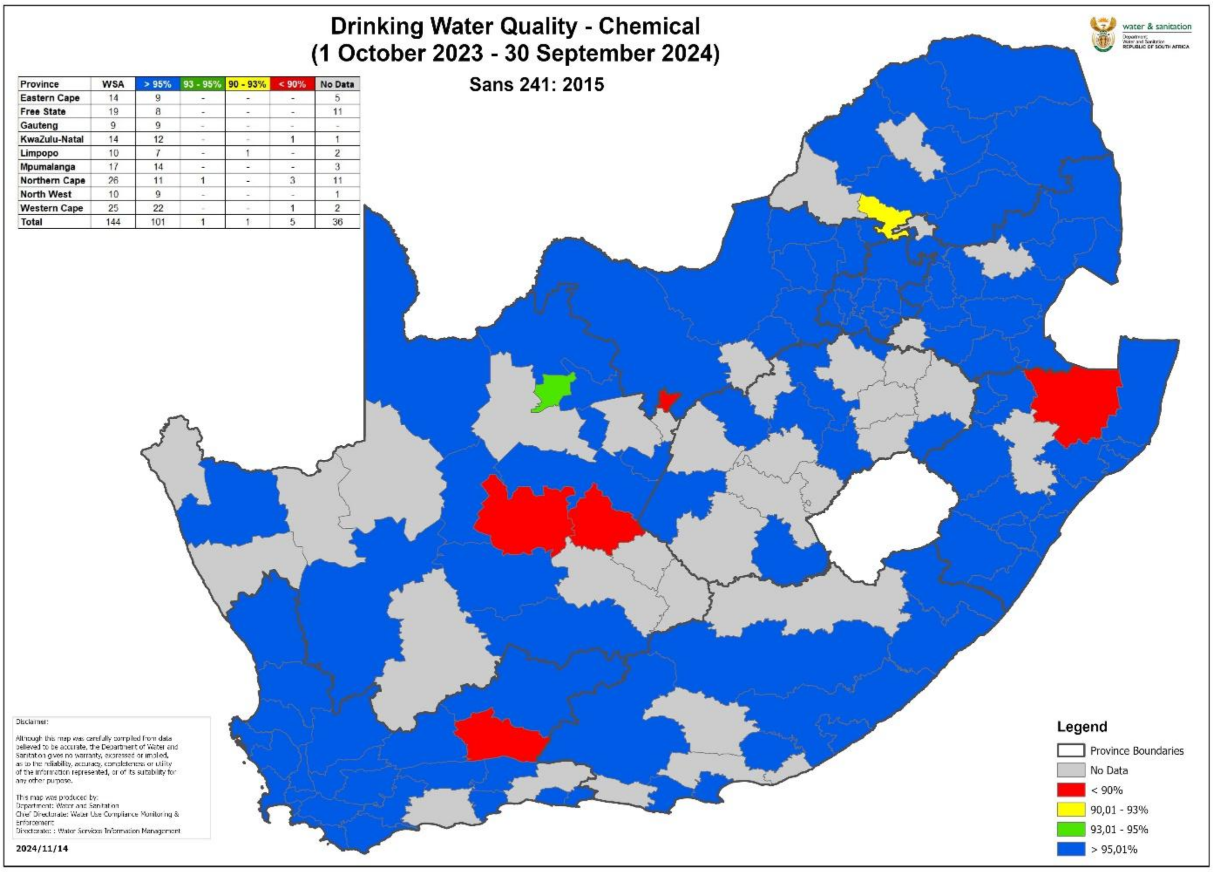
In South Africa, the South African National Standard for Drinking Water (SANS:241) is the definitive reference on acceptable limits for drinking water quality determinants. SANS:241 prescribes the minimum numerical limits that must be met for drinking water quality to be deemed safe for human consumption. There are approximately 1300 drinking water treatment works (WTWs) in South Africa, mostly owned by municipalities and water boards, and they are privately owned. There are several determinants that are analysed in the laboratory to determine compliance, and they are mainly grouped into microbiological, chemical (acute), and chemical (chronic). In addition, operational and aesthetic determinants are also monitored.

In terms of SANS 241, Water services authorities (WSAs) are required to monitor the microbiological and chemical quality of the water provided to the residents at specified intervals, including hourly, daily, weekly, fortnightly and monthly tests of various types. The Water Services Act (Act No. 108 of 1997) prescribes the legislative duty of WSAs to provide drinking water to residents of all municipalities. The Act requires the Minister to establish and maintain a National information system and monitor the performance of all water services institutions. Based on this, the Department has established the Integrated Regulatory Information System (IRIS) to monitor drinking water quality. The IRIS is accessible to the public at http://ws.dwa.gov.za/IRIS/documents.aspx.

10.2.1 Chemical Drinking Water Compliance

Chemical quality is determined by determinants prescribed by SANS:241 or the World Health Organization (WHO), which may be acute or chronic in nature, with each determinant carrying specific health risks. Acute health risks can result in death if the limit is exceeded, whereas chronic limits provide maximum limits that can be consumed over time before health effects become apparent.

Chemical determinants could be monitored at least once a year, assuming no prior risk to consumers has been identified. In compliance monitoring, all WSAs must perform a full SANS:241 as specified by the standard. To be considered safe, drinking water must meet at least 95% chemical compliance. A total of 144 water services authorities were monitored in the current reporting period, however, 36 of the 144 water services authorities did not upload data on the IRIS. The results of the water supply systems compliance in terms of chemical drinking water quality from October 2023 to September 2024 are presented in Figure 10.10 below.



Province	WSA	> 95%	93 - 95%	90 - 93%	< 90%	No Data
Eastern Cape	14	9	-	-	-	5
Free State	19	8	-	-	-	11
Gauteng	9	9	-	-	-	-
KwaZulu-Natal	14	12	-	-	1	1
Limpopo	10	7	-	1	-	2
Mpumalanga	17	14	-	-	-	3
Northern Cape	26	11	1	-	3	11
North West	10	9	-	-	-	1
Western Cape	25	22	-	-	1	2
Total	144	101	1	1	5	36

Figure 10.10: Status of drinking water chemical quality compliance.

The (Oct 2023-Sept 2024) results presented in Figure 10.10 show that 70% of water supply systems demonstrated excellent chemical quality compliance, while 4.2% demonstrated poor to critical chemical quality compliance. IRIS reports non-compliance (<90%) to the Municipality monthly. The Department will continue to monitor and support non-reporting and non-compliant Water Service Authorities at their regional offices.

10.2.2 Microbiological Drinking Water Compliance

Microbiological compliance reflects the actual compliance of the final water and distribution systems between October 2023 and September 2024 against microbiological determinants. The presence of these determinants in water is a strong indication of recent sewage or animal waste contamination. There is potential for contracting diseases from pathogens; thus, the Water Services Institutions are expected to be 99.9% compliant with ***all microbial indicators*** analysed. The results for the drinking water microbiological compliance for the reporting period are presented in Figure 10.11.

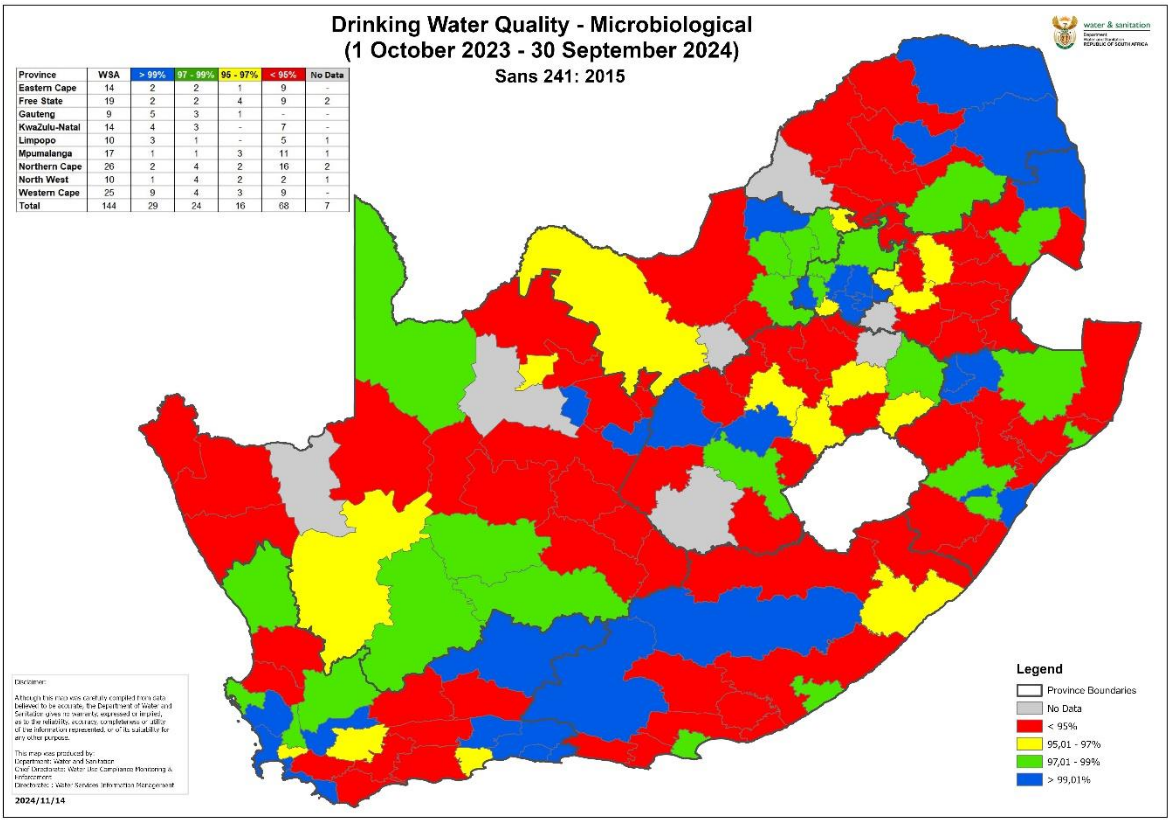


Figure 10.11: Status of drinking water microbiological quality compliance.

The results show that ***75% of the water services authorities in the country did not meet SANS:241 actual compliance requirements for the reporting period (1 October 2023- 30 September 2024),*** and only 20% of the water supply systems achieved an excellent status (>99.9%). It was also noted that 7 WSAs did not submit their drinking water quality data as prescribed by the norms and standards, thus affecting the national outlook as these WSAs could not be assessed in the absence of drinking water quality data submission to the Department.

The Department is deeply concerned about the overall poor compliance results, as most water supply systems pose a potential health risk to consumers. Through its provincial offices, the Department is constantly monitoring and engaging with relevant WSAs that have achieved microbiological compliance levels below 99.9%, including those that do not provide water quality data to the Department.

11

SANITATION SERVICES

11 SANITATION SERVICES

11.1 Background

Section 24 of the Constitution of the Republic of South Africa states that “everyone has the right to an environment that is not harmful to their health or well-being”. This makes access to safe and hygienic sanitation a human right. Access to safe and hygienic sanitation improves public health, dignity, and a clean environment. The Department of Water and Sanitation is committed to achieving the vision and objectives of the National Development Plan (NDP), which targets all South Africans to have access to affordable, reliable, and hygienic sanitation by 2030. The NDP coincides with the Sustainable Development Goal Target 6.2 (SDG 6.2), which aims to "achieve access to adequate and equitable sanitation and hygiene for all and end open defecation" by 2030.

In 2015, South Africa adopted a revolutionary approach under the theme – “It is not all about flushing”, recognising that South Africa is a water-scarce country, with a projected 17% deficit in the availability of water by 2030 if the same rate of water consumption is maintained. The projected water deficit will significantly impact the historical way of providing waterborne sanitation and requires the sector to reconsider sanitation approaches, with more investment in non-sewered, low water and waterless sanitation solutions to increase the rate of sanitation service delivery within the five years left until 2030.

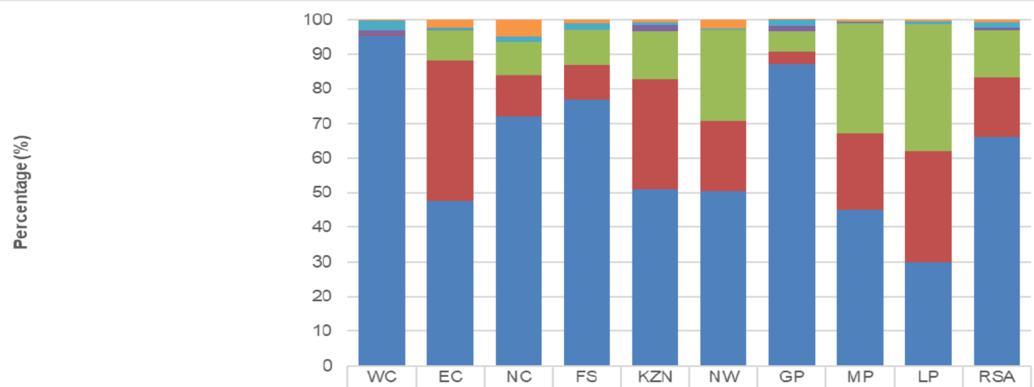
The DWS has recognised that due to a) the impact of climate change, b) water resources constraints, and c) energy supply challenges, the historic approach of providing waterborne sanitation is no longer sustainable and realistic to achieve universal access to safely managed sanitation. The envisaged 17% deficit in the availability of water and projected demand by 2030 requires the water sector leader to embrace the use of a range of sanitation solutions, including innovative technologies, which require little or no water or recycled water to lower water requirements.

In response to the National Sanitation Policy (2016), DWS developed the National Sanitation Framework (NSF). It is an implementation framework that assists the government in providing equitable and safe sanitation for all settlement types. It guides towards ensuring appropriate support to Water Services Authorities (WSAs) in cases of service delivery lapses and non-compliance with regulator prescripts, leading to a deterioration in the provision of sanitation services. The NSF provides for the revision of the national minimum norms and standards as it relates to sanitation services, thus ensuring more equitable provision of sanitation underpinned by the strengthened monitoring and compliance to these standards. The NSF reinforces the importance of prohibiting the provision of bucket toilets by municipalities as a sanitation solution, ending open defecation, and eradicating sanitation backlogs by rolling out a range of support measures to poor-performing municipalities, thus ensuring a turnaround of sanitation services. In doing so, the future choice of sanitation technology options for the provision of sanitation services must be based on technical considerations and include population density, groundwater pollution risks, and economies of scale. In line with the National Water and Sanitation Master Plan (NWSMP) actions, all new settlements and developments should use water-efficient sanitation solutions.

There is an urgent need to focus on sustaining the sanitation infrastructure that has been provided since the dawn of our democracy to prolong its lifespan so that the infrastructure remains operational, safe, and hygienic whilst investing in new infrastructure to respond to rapid urbanisation. Moreover, there is also a need to ensure there is adequate investment in the operation and maintenance of wastewater infrastructure.

11.2 State of Sanitation Services in South Africa

South Africa has made significant progress in ensuring universal access to improved sanitation. In May 2024, StatsSA reported that in the last 21 years, there has been substantial progress in access to sanitation in South Africa. In the same period, the percentage of households with improved sanitation facilities, such as flush toilets and pit toilets with ventilation pipes, increased from 61,7% to 83,3% (StatsSA, 2024). Nationally, access to flush toilets is at 66%, while access to pit toilets with ventilation pipes is at 17%, and access to pit toilets without ventilation pipes is at 14% (Figure 11.1).

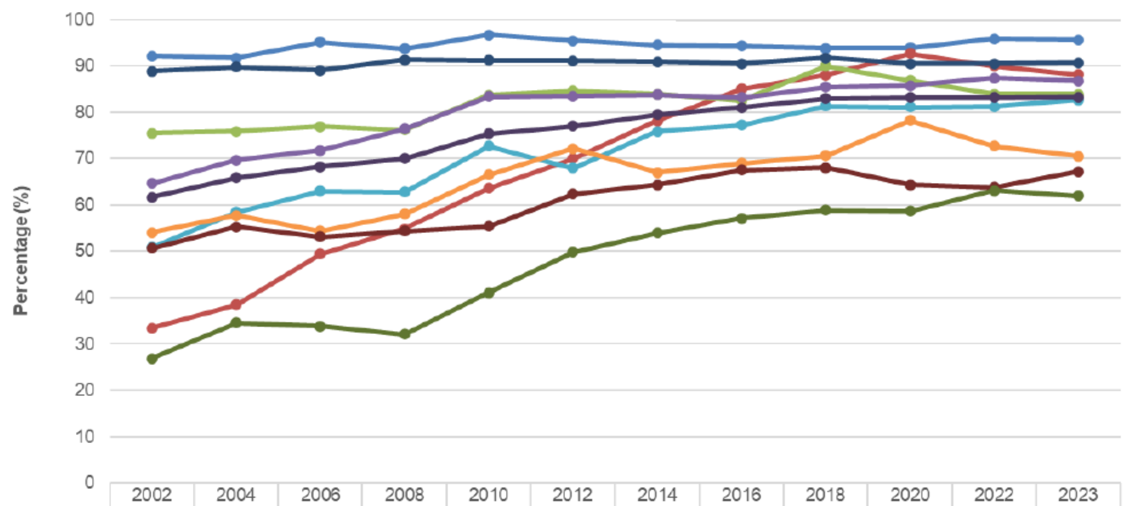


	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
None	0,4	2,2	4,9	1,1	0,8	2,5	0,1	0,6	0,6	0,9
Other	2,9	0,9	1,5	1,9	0,8	0,4	1,8	0,3	0,7	1,3
Chemical toilet	1,0	0,1	0,1	0,0	1,9	0,0	1,5	0,1	0,1	0,9
Pit latrine/toilet without ventilation pipe	0,0	8,6	9,6	10,2	13,8	26,6	5,8	31,8	36,6	13,6
Pit latrine/toilet with ventilation pipe	0,2	40,5	11,8	9,8	31,7	20,0	3,7	22,2	31,9	17,3
Flush toilets	95,4	47,6	72,2	77,0	51,0	50,6	87,1	45,0	30,0	66,0

Figure 11.1: Access to sanitation in South Africa 2023 (StatsSA, 2024).

At 95%, Western Cape has the highest ratio of flush toilets, followed by Gauteng at 87%. Mpumalanga and Limpopo have the highest combined percentage of pit latrines at 54% and 69%, respectively. The largest percentage of pit toilets with ventilation pipes were observed in Eastern Cape (40.5%), Limpopo (31.9%) and KwaZulu-Natal (31.7%).

Percentage distribution of households that have access to improved sanitation by province for 2002–2023 is presented in (Figure 11.2).



	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022	2023
WC	92,2	91,8	95,2	93,7	96,7	95,5	94,5	94,3	93,8	93,9	95,9	95,6
EC	33,4	38,5	49,4	54,9	63,6	70,0	78,2	85,1	88,0	92,7	90,0	88,1
NC	75,5	75,9	76,9	76,2	83,7	84,6	83,9	82,6	90,0	86,9	83,9	83,9
FS	64,7	69,7	71,8	76,4	83,4	83,5	83,8	83,2	85,5	85,8	87,4	86,8
KZN	50,9	58,5	63,0	62,8	72,7	68,0	75,9	77,2	81,4	81,2	81,2	82,7
NW	54,1	57,8	54,4	58,1	66,5	72,2	67,0	69,0	70,6	78,3	72,7	70,5
GP	88,9	89,8	89,1	91,3	91,2	91,1	90,9	90,5	91,8	90,5	90,5	90,7
MP	50,7	55,3	53,1	54,4	55,4	62,4	64,4	67,5	68,1	64,4	63,8	67,2
LP	26,9	34,6	33,9	32,1	41,1	49,8	54,0	57,1	58,9	58,7	63,1	61,9
RSA	61,7	65,9	68,3	70,0	75,4	77,0	79,5	81,0	83,0	83,2	83,2	83,3

Figure 11.2: Percentage (%) distribution of households that have access to improved sanitation by province, 2002–2023 (StatsSA, 2024).

A noteworthy increase in improved sanitation of 55% was observed in the Eastern Cape. The significant increase in the Eastern Cape is due to the installation of Ventilated Pit (VIP) toilets which took place in 2022 and 2023. Also noteworthy are the figures below 70% observed in North West, Limpopo, and Mpumalanga.

The SDG 6.2 target has significantly changed the approach to sanitation services, from access to a household sanitation facility, as previously prioritised under the Millennium Development Goals, to ensuring “safely managed sanitation”. This calls for a paradigm shift as it is no longer about simply constructing a toilet but a holistic approach to sanitation management across the entire sanitation service chain. The sanitation service chain refers to capture and containment, emptying, transportation, treatment, and disposal or reuse. Hence, there is a need to embrace a combination of on-site, off-grid, sewered or non-sewered sanitation systems, including centralised or decentralised wastewater treatment solutions. In addition, South Africa must accept the reality that the country no longer has the luxury of flushing 9 to 12 litres of potable water while some parts of the country do not have access to drinking water.

Although the flush toilet system is everybody's aspiration, it comes at a high cost, which at times is not viable as it does not justify economies of scale and population density. The adoption of alternative sanitation systems can be a significant driver of water security in the country.

The inputs to the sections below came from the Chief Directorate: Sanitation Services Support.

11.2.1 Development of the National Sanitation Integrated Plan (NSIP)

The NSIP provides a 10-year roadmap for ensuring access to adequate sanitation services, eradicating open defecation and sanitation backlogs per province, creating a pathway to generate new sanitation opportunities, and providing innovative solutions to address challenges in the sanitation sector. The NSIP is a countrywide, long-term turnaround plan for Sanitation with inputs and data provided by all 144 WSAs (including Metros) to enable long-term sustainable management of sanitation services in South Africa. The NSIP sets targets for the short, medium, and long term, and the implementation of these actions will grow competency and capability within municipalities, thus enabling improved performance.

The NSIP will help prioritise sanitation provisions aligned to the National Development Plan (NDP) 2030 commitments, NWSMP, and SDGs. The vision of the NSIP is a coordinated plan that considers South Africa's water resource scarcity promotes equitable, efficient, and sustainable sanitation services to all, and contributes to public health and a clean environment. The NSIP strategic drivers are:

1) To achieve universal access to sanitation and hygiene that are managed safely

2) To turn around the current decline in performance in the delivery of sanitation services.

3) To strengthen the regulatory framework for on-site and non-sewered sanitation.

4) To Responding to climate change and improve the climate resilience of sanitation infrastructure.

5) To create economic opportunities along the sanitation service chain.

6) To finding innovative ways to deliver sanitation services and use alternative sanitation technologies in addressing sector challenges such as:

- use of bucket toilets and unsafe pit latrines
- the rise in the use of chemical toilets
- practising of open defecation

To strengthen governance, support, and implementation of the NSIP, Provincial Sanitation Task Teams are set up to work as a vehicle to drive integrated planning, monitoring, reporting, and implementation of sanitation programmes and projects in a coordinated manner.

11.2.2 The National Faecal Sludge Management Strategy 2023

The National Faecal Sludge Management (FSM) Strategy was ratified in October 2023. The strategy aims to implement parts of the National Sanitation Policy, the National Development Plan (NDP), and the SDGs (DWS, 2023). The National FSM Strategy will establish sustainable management and regulatory frameworks for faecal sludge management in South Africa. It guides the sanitation sector on the safe management of faecal sludge to enhance the operation and maintenance of on-site sanitation systems, prevent groundwater contamination, safeguard public health, and protect the environment from pollution throughout the sanitation service chain. The strategy acknowledges the economic value of sanitation by promoting the beneficial use of faecal sludge as a resource.

Faecal sludge management will be mainstreamed as an integral part of sustainable sanitation services that will ensure that people live in an environment that is not harmful to their health and well-being. Of importance is the need to recover, re-use, and recycle resources from faecal sludge and wastewater sludge for beneficial use. The strategy indicates the actions required by various stakeholders, guided by six pillars (Figure 11.3).

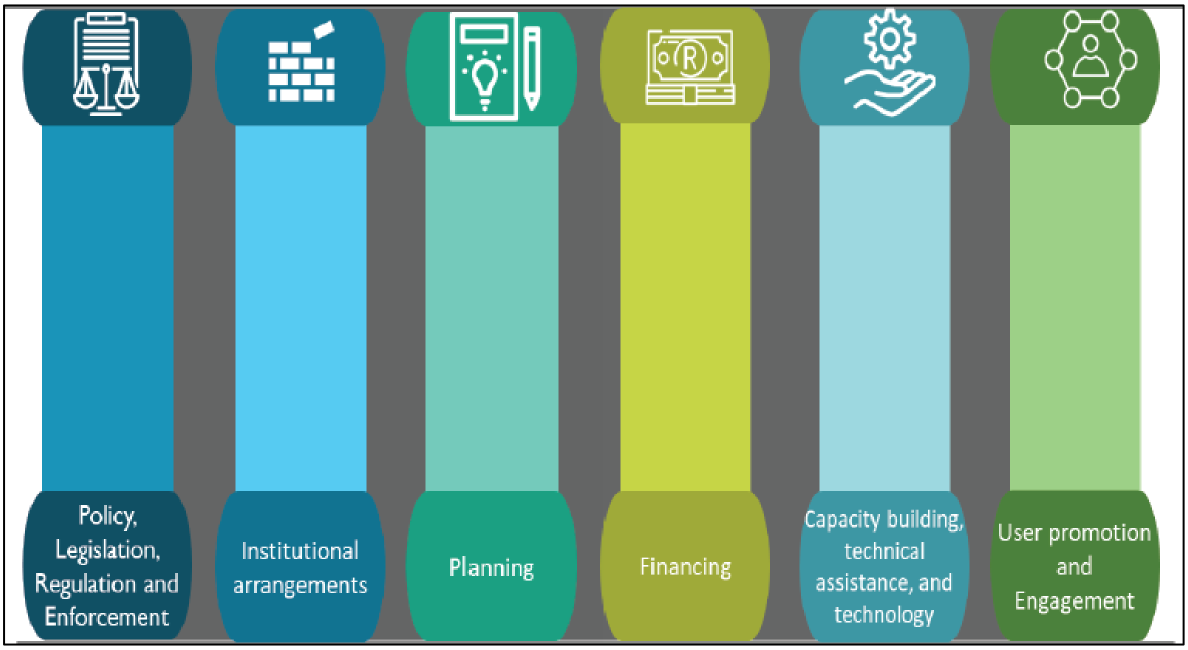


Figure 11.3: Pillars of the National FSM Strategy

The Department is working with the Water Research Commission and various Universities to fast-track resource recovery initiatives from sludge. The private sector is also encouraged to take advantage of the sludge beneficial use and resource recovery business opportunities. As part of the Promotion and User Engagement Pillar, DWS developed FSM educational and awareness materials using innovative approaches to communicate relevant messages to specific stakeholders.

11.2.3 Developing Shit/ Excreta Flow Diagram Capacity Building Programmes

A shit flow diagram, also known as SFD or excreta flow diagram, is a tool used to visually illustrate the management of human waste within urban sanitation systems. It is one of the tools that were developed globally to assist countries in meeting the SDG 6.2 target on Sanitation and Hygiene. Figure 11.4 demonstrates the sanitation service chain and options for managing faecal sludge.

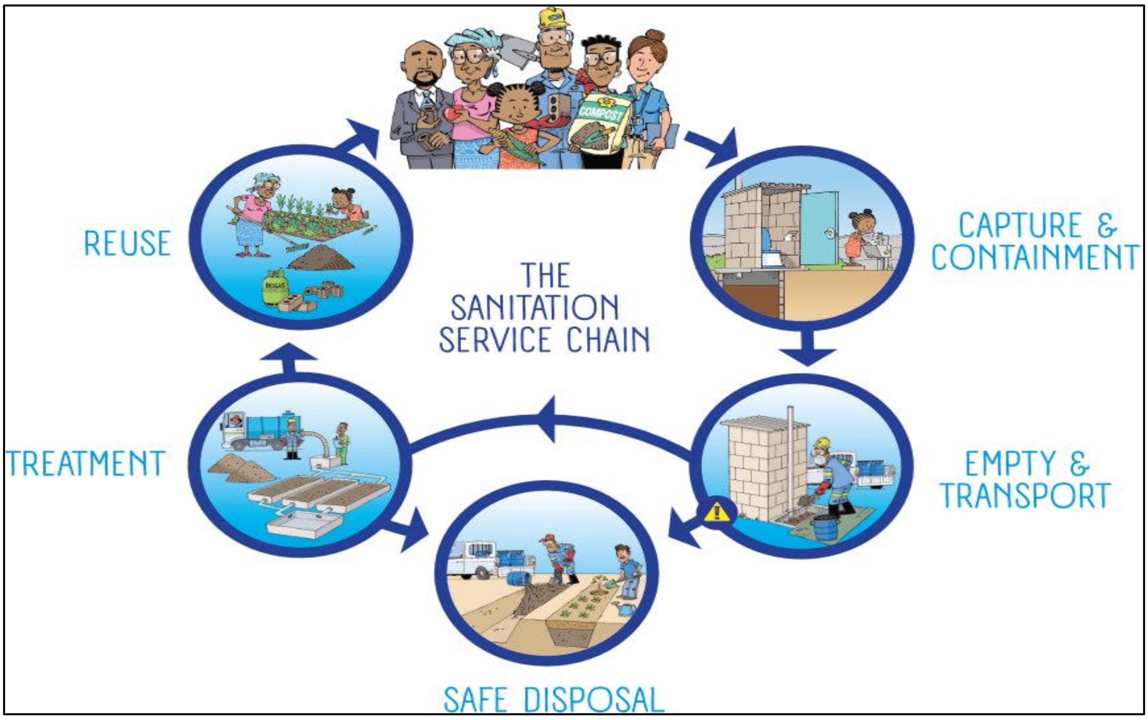


Figure 11.4: Sanitation Service Chain in South Africa (DWS, 2024).

It clearly shows how human excreta generated in a municipal area is contained (safely or unsafely) as it moves from defecation to disposal or end-use. It functions as a tool to identify where sanitation improvements are needed. The SFD aims to estimate a proportion of the population using safely or unsafely managed sanitation. It consists of a diagram, a narrative report, and a record of data sources. SFD has been identified as a useful tool for better understanding the sanitation situation within South Africa. SFDs have been developed for only a few WSAs in South Africa. Therefore, It is not currently possible to develop a provincial or national view of sanitation status using SFD outputs.

DWS has modified the global SFD manual to fit the South African context while still maintaining the global standard. The South African SFD manual focuses mainly on information that is relevant to South Africa. DWS is rolling out SFD “Train the Trainer” programme in a phased approach, starting with 36 WSAs across the country. Lessons learnt from phase 1 will be used to modify the South African SFD manual. The next phase will focus on the remaining 108 WSAs.

11.2.4 Development of financial mechanisms and economic models to facilitate faecal sludge management circular economy

The water and sanitation sector has embraced the reality that sanitation has economic value. Therefore, there is a need to explore approaches to creating economic and job opportunities along the sanitation service chain. This can be realised by transitioning from linear to circular economy by converting faecal and wastewater sludge into various by-products such as biogas, composting, and biochar.

DWS is working with the University of KwaZulu-Natal to develop guidelines on financial mechanisms and economic models to facilitate faecal sludge management. These guidelines will assist the sector in transforming faecal sludge into a commercially viable resource.

11.2.5 Development of Regulatory Mechanisms for non-sewered sanitation services

Sanitation services in South Africa vary from sewered (decentralised) wastewater systems to non-severed (centralised) sanitation systems depending on settlement conditions. The management of faecal sludge from non-sewered sanitation systems is not a Green Drop focus, even though sludge from these systems is disposed of at wastewater treatment works. Furthermore, research has proven that faecal sludge and wastewater should be treated differently, focusing on the impact of faecal sludge on the WWTWs. The other challenges around non-sewered sanitation are full toilet pits or containments, health and safety handling of faecal sludge, and appropriate treatment and disposal methods of faecal sludge. Faecal sludge management is now included in the Compulsory National Norms and Standards for Water Supply and Sanitation Services.

Regulation mechanisms are available for offsite systems through the Green Drop Certification Programme. In contrast, existing regulatory mechanisms for onsite sanitation systems are limited to package plants, decentralised systems, and vacuum tank discharges through Bylaws and enforcement. To address this gap, a new set of criteria has been developed and will be incorporated into the Green Drop Certification process to ensure safely managed sanitation regardless of the sanitation system used. These new criteria will be communicated to WSAs and rolled out accordingly. The inclusion of the non-sewered sanitation criteria into the Green Drop Certification Audit will be implemented in a phased approach, firstly stakeholder advocacy and awareness engagements, secondly water services institutions training and capacity building, and finally a trial at selected WSAs.

The aim of the approach is to provide sufficient time for:

- Sector stakeholders to grasp and understand the complexities of including assessment of non-sewered sanitation systems.
- WSAs to improve current monitoring and evaluation systems.
- DWS to further refine the criteria through practical testing of the draft criteria (through pilot trial at selected WSAs).

11.3 Bucket Eradication Programme

The bucket sanitation system is a toilet with a bucket or other receptacles placed directly under the toilet seat to collect urine and faeces. It is widely regarded as one of the worst sanitation systems because it violates the human dignity of the users and those responsible for collecting and disposing of the waste. The current Bucket Eradication Programme (BEP), initiated in 2012, seeks to replace bucket toilets with waterborne sanitation in the Eastern Cape, Free State, Northern Cape, and North West. The project has had significant delays, mainly because the Sanitation function went through several transfers between departments and Implementing Agents appointed by the different departments. The programmes also experienced technical challenges such as engineering planning and design of the sanitation infrastructure upgrades. All the original BEP elements have been completed except for one Northern Cape project and eight Free State projects. These projects are expected to be completed during the 2024/25 financial year (Table 11-1).

Table 11-1: Progress summary as of the end of August 2024

MUNICIPALITY	PROJECT	NO OF BUCKETS PER PROJECT	COMPLETED TOILETS	COMPLETION %		ESTIMATED COMPLETION DATE
				March 2023	August 2024	
Setsotso	Clocolan	3379	0	21%	74%	December 2024
	Ficksburg	218	0	46%	71%	December 2024
	Senekal	2435	0	39%	74%	December 2024
Nketoana	Arlington	1192	0	24%	76%	March 2025
	Reitz	739	0	43%	90%	December 2024
	Petrus Steyn	960	0	40%	63%	March 2025
Tokologo	Dealesville	1279	0	31%	91%	December 2024
Siyancuma	Campbell (Ph 2 – Bulk Water) (Ph 3 – Reticulation)	596	596	0%	Ph 1 – 5,5% Ph 2 – 0%	July 2025 March 2026
	Siyancuma	387	387	100%	-	-
Tsantsabane	Postdene	134	134	100%	-	-
	Maranteng	149	149	100%	-	-
Sol Plaatjie	Motswedimosa	656	656	100%	-	-
	Fraser Moleketi	97	97	100%	-	-
Total		**12 221**	**1 423**			

11.4 Sanitation Challenges

- Even when all the BEP projects are complete, South Africa will not have eradicated bucket toilets because the scope of the current BEP only included bucket toilets identified in the initial audit in formal settlements. There are other bucket toilet systems in informal settlements, and new bucket toilet systems may be introduced on an ongoing basis.
- More than 10% of pits are full, while more pits are being constructed with limited emptying services in place.

- Onsite sanitation solutions such as VIPs are generally not being emptied, and this has resulted in some households reverting to unimproved sanitation solutions.

- Additional wastewater due to rapid urbanisation is overloading wastewater treatment works.

- Groundwater contamination risks due to poorly constructed sanitation facilities boreholes drilled close to sanitation facilities.

- There are limited regulatory mechanisms to ensure on-site sanitation systems are well-constructed and well-managed.

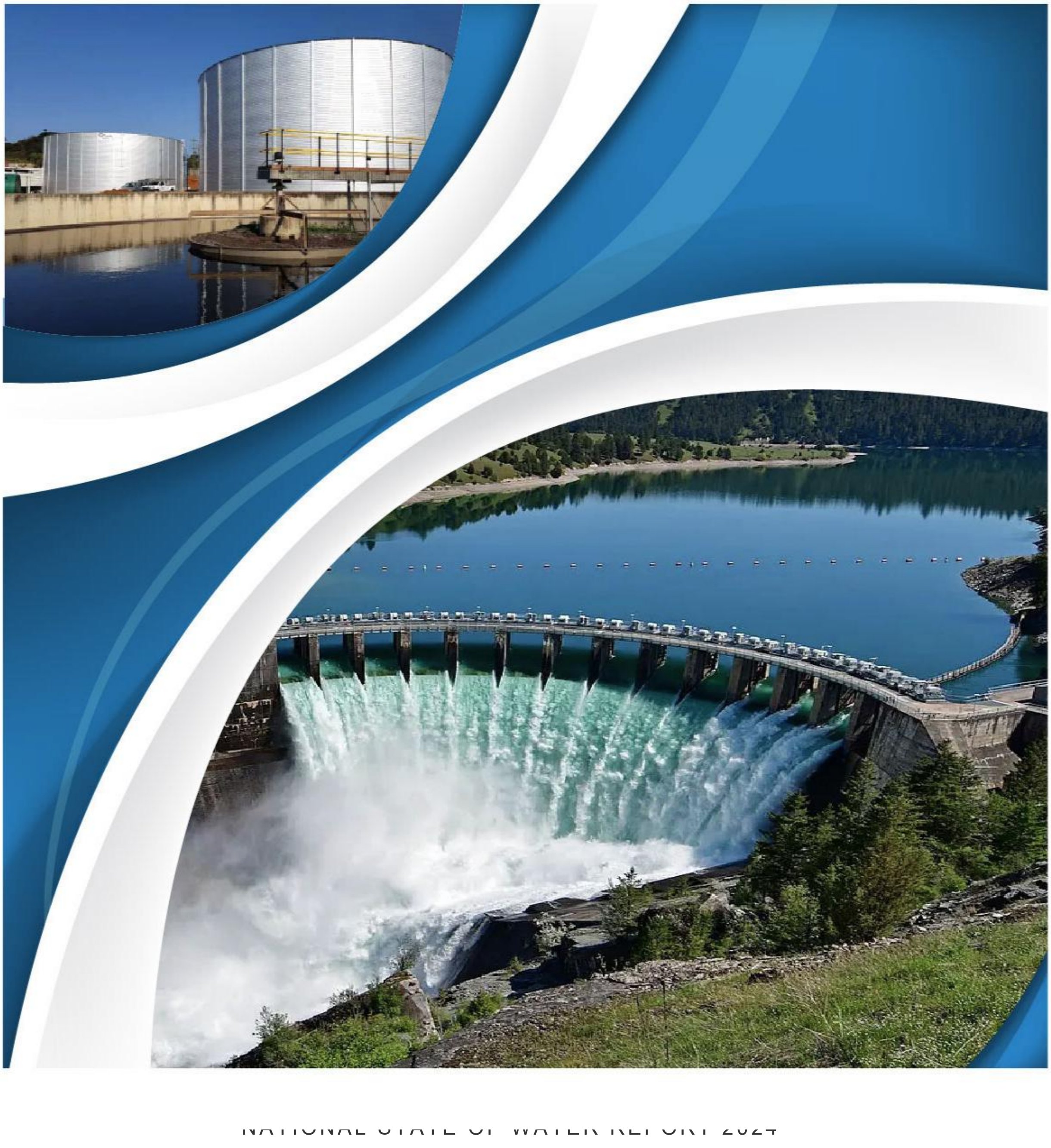
- Approximately 30% of WWTWs exceed their current design capacity, resulting in malfunctioning wastewater treatment works.

- Inadequate investment in the operation and maintenance of wastewater infrastructure.

- Incomplete and/or unrealistic Water Services Development Plans (WSDPs) are affecting the ability to plan and implement projects.

Achieving the Sustainable Development Goal 6.2 will require multi-sectoral partnerships and collaborations between government, private sector, academic and research institutions, civil society organisations, communities, and others. With only five years left until 2030 and approximately 2.8 million households without appropriate sanitation, the WSAs in collaboration with all stakeholders, need to accelerate the transition to safely managed sanitation in South Africa and ensure that ‘no one is left behind’.

12 CONCLUSIONS



12 CONCLUSIONS

Key features that characterise water resources availability in South Africa are the following:

- South Africa is characterised by spatial variability in rainfall, with the east of the country lying in the summer rainfall zone with high rainfalls. In contrast, the country's west lies in an all-year-round or winter rainfall region that is semi-arid to arid.
- The seasonal variability in the country's climate influences water availability and storage dynamics.
- River systems (mostly through the surface water storage in large dams) are the common surface water expression of water availability in South Africa, with others being lakes, ponds, and pans.
- Aquifer (groundwater) storage is another expression of water availability in the country where an increased groundwater utilisation in the country's water mix has been observed due to the significant potential of the groundwater resources in adaptation to climatic-related stresses and augmenting conventional surface water supply systems.
- South Africa's water supply is dependent on Strategic Water Source Areas (SWSAs). SWSAs are defined as areas of land of national importance that either (a) supply relatively large quantities of mean annual surface water runoff compared to their size (b) have high groundwater recharge and high dependence, or (c) areas that meet both criteria (a) and (b). They include transboundary Water Source Areas that extend into Lesotho and Swaziland.
- South Africa is a water-scarce country. Water insecurity has become severe as almost 98% of the available freshwater resources are already allocated, and over 60% is used for crop production. Water availability is highly variable, determined by rainfall variability in the national territory.

The following features characterise water resource management in South Africa:

- The water sector institutional reform is ongoing; for the current outlook, the National Department of Water and Sanitation is the custodian of water resources with an obligation to perform water resource management functions. The water resource management functions are to be delegated to the six Catchment Management Agencies (CMAs), where two exist, and four are being established; this supports the principles of good governance, where water will be managed locally.
- At a local level, there are Water Services Institutions (WSI), which comprise Water Services Authorities (WSAs) that provide water services or outsource water services provisions to the private Water Services Providers (WSPs).

- The four new CMAs, namely Breede-Olifants CMA, Vaal-Orange CMA, Pongola-Mzimkulu CMA, Mzimvubu-Tsitsikamma CMA have been established, with three of the four CMAs already having interim CEO appointed.
- South Africa shares four international river basins, namely the Limpopo, Orange/Senqu, Inkomati, and Maputo, with six neighbouring countries, Botswana, Lesotho, Mozambique, Namibia, eSwatini, and Zimbabwe. These water resources are managed through shared watercourse institutions, commissions, and international agreements to promote international transboundary cooperation.
- The Department of Water and Sanitation has established monitoring networks (along rivers, dams, estuaries, eyes, canals, pipelines, groundwater aquifers, wetlands, and abandoned mines), monitoring programs, and information systems to ensure that water resource data is freely available and accessible.
- South Africa faces water, energy, and food insecurity; while the country is food secure at a national level, over 50% of households still face food insecurity, 98% of the country's water resources are already allocated, and the country currently faces instability in the energy sector (StatsSA, 2019).

Rainfall and Temperatures

South Africa experienced its hottest year since 1951 in 2024, with an annual mean temperature anomaly of 0.9 ºC above the reference period. Average temperatures were consistent across the country, with temperatures in the lower teens dominating over the cooler southern to eastern escarpment and eastern Highveld. The highest average temperatures occurred over the traditionally warmer parts, including the Limpopo River Valley, Lowveld and north-eastern KZN, with values in the lower to mid-twenties dominating. Most parts of the country received below-average rainfall in total over the reporting period. Notable exceptions are the winter rainfall region, the southeastern parts of the Northern Cape, the southwestern Free State, and large parts of KwaZulu-Natal.

Drought

The Standardized Precipitation Index (SPI) for the two-year period ending in September 2024 reveals that drought was negligible, with only a few areas, including the Lower Orange and northeastern areas of the country, experiencing moderate drought conditions. The majority of the winter rainfall region experienced moderate to severe wet conditions during this two-year period, with moderately wet conditions prevailing along the southern escarpment extending to Lesotho.

Surface Dam Storage

As of the end of September 2024, the national dam levels were at 79.7% of Full Supply Capacity (FSC). This level is lower than that of the previous two hydrological years during the same reporting period when national storage levels exceeded 90% of FSC. As a result of the drier and warmer conditions observed this spring relative to 2023, the storage levels of the Vaal Dam and Gariep Dam also decreased by 39.5% and 16.8%, respectively. The dams that reached critical storage levels by the end of the reporting period were located in the Eastern Cape and Limpopo.

Trophic status

The ONEMP site assessment identified 78 sites of varying trophic status and eutrophication potential. The Rietvlei Dam and Hartbeespoort Dam were hypertrophic, whereas the Koster Dam and Olifantsnek Dam were mesotrophic, with low nutrient levels and reduced aquatic productivity. Twenty-six of the sixty-nine sites assessed for eutrophication potential demonstrated a high risk of eutrophication, which was an improvement over the previous year. Most eutrophication-related sites are in densely populated areas with overburdened sewage systems due to rapid population growth, inadequate infrastructure, and industrial activities.

Microbial Pollution

An assessment of 75 hotspot sites in the country revealed that 70% were deemed unsafe for recreational activities, reflecting a 3% increase from the prior year. Furthermore, 48% of sites were classified as unsuitable for irrigating crops intended for direct consumption, presenting a significant risk of infection for those engaged in these practices. The detection of E. *coli* in water indicates recent faecal contamination, highlighting concerns regarding the efficacy of wastewater treatment and the potential inadequacy of pathogen removal or disinfection processes in treated water released into the river system.

River Ecological Status

The report indicates that moderately modified conditions have prevailed in the majority of the country's river systems, with 59% of sites classified accordingly in the current hydrological year. 18% of sites have shown an improvement in ecological conditions, whereas 23% experienced a decline in the current reporting period. Several sites within the Sabie, Komati, and Usuthu catchments have been classified as predominantly or almost entirely in a natural state.

Groundwater

As of September 2024, South Africa's average groundwater levels are normal but lower than those of 2023. Elevated concentrations of nitrate and fluoride are observed in the northern regions, specifically within the Limpopo-Olifants and Vaal-Orange Water Management Areas. Elevated salinity is noted in the Northern Cape and select coastal regions, influenced by geological, geomorphological, and hydrological processes.

National Water Balance

The national water balance indicates a System Inputs Volume of 4.39 billion m³/a, with a water loss of 40.8% and a Non-Revenue Water (NRW) of 47.4%, as per the 2023 No Drop Watch Report. The COVID-19 pandemic and increased water demands resulted in the most significant increase in NWR and water losses in 2020/2021. DWS will implement the No Drop Progress Assessment Tool (PAT) during the 2025/26 financial year to provide a snapshot of the current state of WSI's WC/WDM business.

Ecological Infrastructure Rehabilitation

The ecological infrastructure rehabilitation initiatives aim to improve the condition and functionality of wetland ecosystems. DFFE has achieved notable advancements in wetland rehabilitation efforts in KwaZulu-Natal and Mpumalanga, restoring wetlands that human activities have historically degraded. DWS is also engaged in the restoration of a wetland along the Blesbokspruit River in collaboration with the City of Ekurhuleni and the Gauteng Department of Agriculture, Rural Development, and Environment (GDARDE).

Resource Protection

The Department has finalized and published the Water Resources Classes (WRCs) and the corresponding Resource Quality Objectives (RQOs) in various Water Management Areas (WMAs), with the Usuthu to uMhlathuze WMA study concluded in June 2024. The Department is currently left with the Orange River System (Upper and Lower Orange), Luvuvhu, Keiskamma, and Fish to Tsitsikama Catchments, where technical processes are ongoing.

Water-Energy-Food NEXUS

The connectedness of current challenges (climate change, environmental degradation, population growth, migration, and the emergence of novel infectious diseases) requires circular and transformative approaches that holistically address these cross-cutting challenges. Managing the intricate relationships between distinct but interconnected sectors through nexus planning has provided decision-support tools to formulate coherent strategies that drive resilience and sustainability. As a result, the Water-Energy-Food (WEF) nexus has gained increasing attention in the research and decision-making communities in recent years as a prominent integrated resource management approach.

Compliance Monitoring and Enforcement

In the last three years, DWS Enforcement Units have documented 583 cases of non-compliance, of which 141 pertain to water resource pollution control. The Department issued 119 notices and 46 directives, and it initiated 56 criminal cases against facility operators. Eight cases have been resolved, with facility operators implementing corrective actions. Complaints predominantly originate from the agricultural sector (28%), local government municipalities (28%), commercial activities (5%), government sectors (1%), industrial sectors (9%), mining sectors (17%), and tourism sectors (5% and 2%).

Drinking water compliance

The drinking water quality assessment indicates that 70% of water supply systems have excellent compliance with chemical quality standards, whereas 4.2% demonstrate poor to critical compliance. 75% of water services authorities failed to meet SANS:241 microbial water quality compliance standards, while 20% attained excellent status. Seven (7) Water Service Authorities (WSAs) failed to submit drinking water quality data, impacting the national perspective. The Department will oversee and assist Water Service Authorities that fail to report or comply.

Sanitation Services

Over the past 21 years, South Africa has achieved significant improvements in sanitation access, with 83.3% of households having improved facilities, including 66% with flush toilets. Access to pit toilets with ventilation pipes is at 17%, and access to pit toilets without ventilation pipes is at 14%. To achieve Sustainable Development Goal 6.2, South Africa needs multi-sectoral partnerships and collaborations from the government, private sector, academic institutions, civil society, and communities. With only five years until 2030, WSAs must accelerate the transition to safely managed sanitation.

13

REFERENCES

13 REFERENCES

Agricultural Research Council (ARC), 2023a. Umlindi, issue 2023-12. Available from: https://www.arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20December%202023.pdf (Available online from 20 December 2023).

Ambani, A. E. (2013). Long-term assessment of the surface water quality in the Blesbokspruit Ramsar Wetland, M.Sc. University of Johannesburg: South Africa.

Ambani, A. E. and Annegarn, H. (2015). A reduction in mining and industrial effluents in the Blesbokspruit Ramsar wetland, South Africa: Has the quality of the surface water in the wetland improved? Water SA. 41(5): 648.

ARC, 2024a. Umlindi, issue 2024-01. Available from: https://www.arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20Issue%202024-01,%20January%202024.pdf (Available online from 25 January 2024).

ARC, 2024b. Umlindi, issue 2024-02. Available from: https://arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20Issue%202024-02,%20February%202024.pdf (Available online from 20 February 2024).

ARC, 2024c. Umlindi, issue 2024-03. Available from: https://arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20Issue%202024-03,%20April%202024.pdf (Available online from 2 April 2024).

ARC, 2024d. Umlindi, issue 2024-04. Available from: https://www.arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20Issue%202024-04,%2019%20April%202024.pdf (Available online from 19 April 2024).

ARC, 2024e. Umlindi, issue 2024-05. Available from: https://www.arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20Issue%202024-05,%2021%20May%202024.pdf (Available online from 21 May 2024).

ARC, 2024f. Umlindi, issue 2024-06. Available from: https://www.arc.agric.za/arc-iscw/Newsletter%20Library/UMLINDI%20Issue%202024-06,%2021%20June%202024.pdf (Available online from 21 June 2024).

Bakharia U, 2024. Six people dead and hundreds evacuated in Eastern Cape floods https://mg.co.za/news/2024-06-03-six-people-dead-and-hundreds-evacuated-in-eastern-cape-floods/ (Available online from 3 June 2024).

Bohdziewicz, J., Bodzek, M., Wqsik, E., (1999). The application of reverse osmosis and nanofiltration to the removal of nitrates from groundwater. Desalination 121, 139-147.

Cassidy E, 2024. Scorched Earth: Severe Drought Devastates Southern Africa. https://scitechdaily.com/scorched-earth-severe-drought-devastates-southern-africa/ (Available online from 25 April 2024).

Chakona, G., Shackleton, C.M. (2019) Food insecurity in South Africa: To what extent can social grants and consumption of wild foods eradicate hunger? World Development Perspectives 13, 87-94.

City of Ekurhuleni, 2023. Customers urged to use water sparingly amidst high demand due to heatwave. Available from: https://www.ekurhuleni.gov.za/press-releases/service-delivery/water-sanitation/customers-urged-to-use-water-sparingly-amidst-high-demand-due-to-heatwave/ (Available online from 29 November 2023).

Davis, C.L., Vincent, K., (2017) Climate risk and vulnerability: A handbook for Southern Africa, 2nd ed. Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa, p. 202.

Donnenfeld, Z., Crookes, C., Hedden, S., (2018) A delicate balance: Water scarcity in South Africa. Institute for Security Studies (ISS), Pretoria, South Africa, pp. 1-24.

du Plessis, J. (1995b) Water fluoridation in South Africa: What should the optimum concentration of fluoride in the drinking water be? A review of the literature. South African Dental Journal. 50(12): 605-607.

DWAF (1996). South African Water Quality Guidelines for domestic use. 1st Edition.

DWAF (1996a). South African Water Quality Guidelines, Volume 1: Domestic Water Use. Second Edition 1996. Department of Water Affairs and Forestry, South Africa.

DWS, (2023). National Faecal Sludge Management Strategy 2023. Department of water and sanitation. Pretoria, South Africa.

Evans J, 2024. 'Heatwaves are going to get worse, like nothing we've ever seen before' — SA climatologist. https://www.dailymaverick.co.za/article/2024-03-20-heatwaves-are-going-to-get-worse-like-nothing-weve-ever-seen-before-sa-climatologist/ (Available online from 20 March 2024).

FAO, (2014) The water-energy-food nexus: A new approach in support of food security and sustainable agriculture, in: Dubois, O., Faurès, J.-M., Felix, E., Flammini, A., Hoogeveen, J., Pluschke, L., Puri, M., Ünver, O. (Eds.). Food and Agriculture Organization (FAO), Rome, Italy.

GreenCape, (2017) Water 2017 Market Intelligence Report. GreenCape, Cape Town, South Africa, p. 52.

Hohls, B.C., Silberbauer, M.J., Kühn, A.L., Kempster, P.L., and Ncube, E. (2001). National Water Status Report: Surface Inorganic Chemical Water Quality – The Big Picture. Report No. N/0000/REQ0801. Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria, South Africa.

https://www.csir.co.za/strategic-water-source-areas-south-africa#:~:text=Strategic%20Water%20Source%20Areas%20(SWSAs,recharge%20and%20where%20the%20groundwater

https://www.gcis.gov.za/sites/default/files/docs/gcis/21.%20Water%20and%20Sanitation.pdf

https://www.gcis.gov.za/sites/default/files/docs/gcis/21.%20Water%20and%20Sanitation.pdf

International Programme on Chemical Safety, United Nations Environment Programme, International Labour Organization, World Health Organization & IPCS Task Group on Environmental Health Criteria for Fluorine and Fluorides. (1984). Fluorine and fluorides. World Health Organization. https://iris.who.int/handle/10665/37288

Kimutai J, Zachariah M, Nhantumbo B, Nkemelang T, Jain S, Pinto I, Clarke B, Wolski P, Vahlberg M, de Boer T, Stewart S, Mutombwa M, Wina W, Singh R, Arrighi J, Otto FEL (2024). El Niño key driver of drought in highly vulnerable Southern African countries. https://spiral.imperial.ac.uk/server/api/core/bitstreams/e5e06d3b-5c9f-4660-81c7-e2cb1e724f05/content (Available online from 18 April 2024).

Kumwenda, I., van Koppen, B., Mampiti, M., Nhamo, L., (2015) Trends and Outlook: Agricultural Water Management in Southern Africa: Country Report, Malawi. International Water Management Institute (IWMI), Pretoria, South Africa, p. 45.

Lalumbe, L., and Kanyerere, T., (2022). Assessment of Concentration Levels of Contaminants in Groundwater of the Soutpansberg Region, Limpopo Province, South Africa. Water, 14, 1354; 1-16.

Liphadzi, S., Mpandeli, S., Mabhaudhi, T., Naidoo, D., Nhamo, L., (2021) The Evolution of the Water–Energy–Food Nexus as a Transformative Approach for Sustainable Development in South Africa, in: Muthu, S. (Ed.), The Water–Energy–Food Nexus: Concept and Assessments. Springer, Kowloon, Hong Kong, pp. 35-67.

Mabhaudhi, T., Nhamo, L., Chibarabada, T.P., Mabaya, G., Mpandeli, S., Liphadzi, S., Senzanje, A., Naidoo, D., Modi, A.T., Chivenge, P.P. (2021) Assessing Progress towards Sustainable Development Goals through Nexus Planning. Water 13, 1321.

Mafenya H, Biyase N, Reddy J, Ndhlovu M, Rasifudi J, 2024a. Department of Water and Sanitation Monthly state of water bulletin: March 2024. Available from: https://www.dws.gov.za/Projects/National%20State%20of%20Water%20Report/Documents/Monthly%20State%20of%20Water%20Bulletin%20-%20March%202024.pdf (Available online from March 2024).

Mafenya H, Biyase N, Reddy J, Ndhlovu M, Rasifudi J, 2024b. Department of Water and Sanitation Monthly state of water bulletin: April 2024. Available from: https://www.dws.gov.za/Projects/National%20State%20of%20Water%20Report/Documents/Monthly%20State%20of%20Water%20Bulletin%20-%20April%202024.pdf (Available online from April 2024).

Mafenya H, Biyase N, Reddy J, Rasifudi J, 2023. Department of Water and Sanitation Monthly state of water bulletin: November 2023. Available from: https://www.dws.gov.za/Projects/National%20State%20of%20Water%20Report/Documents/Monthly%20State%20of%20Water%20Bulletin%20-%20November%202023.pdf (Available online from November 2023).

Marais, S., (1999). Dependency of communities on groundwater for water supply and associated nitrate and fluoride problems. Paper presented at Water Research Commission Workshop on Fluorides and Nitrates in Rural Water Supplies, Mafikeng, South Africa, 9–10 March 1999.

Matchaya, G., Nhamo, L., Nhlengethwa, S., Nhemachena, C. (2019) An Overview of Water Markets in Southern Africa: An Option for Water Management in Times of Scarcity. Water 11, 1006.

Mpandeli, S., Nhamo, L., Moeletsi, M., Masupha, T., Magidi, J., Tshikolomo, K., Liphadzi, S., Naidoo, D., Mabhaudhi, T. (2019) Assessing climate change and adaptive capacity at local scale using observed and remotely sensed data. Weather and Climate Extremes 26, 100240.

Ndhlovu, N. M., (2024). Assessment of groundwater quality for irrigation and drinking purposes in the Limpopo Granulite-Gneiss region, Limpopo Province, South Africa. MSc Water Resource Management. University of Pretoria.

NDP, (2013) National development plan: Vision 2030. National Planning Commission (NDP), Pretoria, South Africa, p. 489.

Nhamo, L., Mabhaudhi, T., Modi, A. (2019) Preparedness or repeated short-term relief aid? Building drought resilience through early warning in southern Africa. Water SA 45, 75-85.

Nhamo, L., Mabhaudhi, T., Mpandeli, S., Dickens, C., Nhemachena, C., Senzanje, A., Naidoo, D., Liphadzi, S., Modi, A.T. (2020) An integrative analytical model for the water-energy-food nexus: South Africa case study. Environmental Science and Policy 109, 15-24.

Nhamo, L., Ndlela, B. (2021) Nexus planning as a pathway towards sustainable environmental and human health post-Covid-19. Environment Research 110376, 7.

Nhemachena, C., Nhamo, L., Matchaya, G., Nhemachena, C.R., Muchara, B., Karuaihe, S.T., Mpandeli, S. (2020) Climate Change Impacts on Water and Agriculture Sectors in Southern Africa: Threats and Opportunities for Sustainable Development. Water 12, 2673.

Omarjee L, 2023. This has been the hottest November on record - and more heat is on the way. Available from: https://www.news24.com/fin24/climate_future/news/this-has-been-the-hottest-november-on-record-and-more-heat-is-on-the-way-20231130 (online from 30 November 2023).

Pitman, W. (2011) Overview of water resource assessment in South Africa: Current state and future challenges. Water SA 37, 659-664.

Ramsar, (2019) South Africa designates three new Ramsar Sites. Available from: https://www.ramsar.org/news/south-africa-designates-three-new-ramsar-sites [10 November 2024]

RSA, (1996) Constitution of the Republic of South Africa (Act 108 of 1996), Government Gazette No. 25799. Republic of South Africa (RSA), Pretoria, South Africa, p. 182.

Ruiters C. and Amadi-Echendu J. (2022) Economic costs and investment challenges of water infrastructure in South Africa. Infrastructure Asset Management 9(4): 194–206

SABS (2001). Fluoride standard for drinking water. *SABS 241.* 5th Edition.

Siddiqui, S., Cai, X., Chandrasekharan, K., (2016) Irrigated Area Map Asia and Africa (International Water Management Institute. International Water Management Institute (IWMI), Colombo, Sri Lanka.

Sihlobo, W 2024. Agricultural outlook: What to expect for South Africa's maize and oilseed market. Available from: https://mg.co.za/business/2024-07-10-agricultural-outlook-what-to-expect-for-south-africas-maize-and-oilseed-market/ (Available online from 10 July 2024).

Sithole, H, 2023. Joburg residents urged to use water sparingly as heatwave continues. https://www.sabcnews.com/sabcnews/joburg-residents-urged-to-use-water-sparingly-as-heatwave-continues-2/ (online from 23 November 2023).

StatsSA, (2010) National Accounts: Environmental Economic Accounts. Water Management Areas in South Africa. Statistics South Africa (StatsSA), Pretoria, South Africa, p. 165.

StatsSA, (2017) Census of Commercial Agriculture 2017. Statistics South Africa (StatsSA), Pretoria, South Africa.

StatsSA, (2019) Towards measuring food security in South Africa: An examination of hunger and food inadequacy. Statistics South Africa (StatsSA), Pretoria, South Africa, p. 36.

StatsSA, (2021) Statistical Release: Quarterly Labour Force Survey. Quarter 1: 2021 Statistics South Africa (StatsSA), Pretoria, South Africa, p. 138.

StatsSA, (2024). General Household Survey 2023 Statistical Release P0318. Statistics South Africa (StatsSA), Pretoria, South Africa.

StatsSA, 2017. Sustainable Development Goals: Indicator Baseline Report 2017, South Africa. Statistics South Africa (StatsSA), Pretoria, South Africa, p 217.

Van Veelen, M and Dhemba, N. (2011). Development of a reconciliation strategy for the Olifants River water supply system. Water Quality Report. P WMA 04/B50/00/8310/7.

Von Bormann, T., Gulati, M., (2014) The Food Energy Water Nexus: Understanding South Africa's most urgent sustainability challenge. World Wide Fund for Nature (WWF-SA), Cape Town, South Africa, p. 40.

WRC (1998). Quality of Domestic Water Supplies. 1 Assessment Guide, Second Edition. *WRC Report no. ITIOI/98.*

WRC, (2018) Assessing the State of the Water-Energy-Food (WEF) Nexus in South Africa, in: Mabhaudhi, T., Simpson, G., Badenhorst, J., Mohammed, M., Motongera, T., Senzanje, A., Jewitt, A. (Eds.). Water Research Commission (WRC), Pretoria, South Africa, p. 76.

Adom, R.K., Simatele, M.D., Reid, M. (2022) Addressing the challenges of water-energy-food nexus programme in the context of sustainable development and climate change in South Africa. Journal of Water and Climate Change 13, 2761-2779.

Botai, J.O., Botai, C.M., Ncongwane, K.P., Mpandeli, S., Nhamo, L., Masinde, M., Adeola, A.M., Mengistu, M.G., Tazvinga, H., Murambadoro, M.D. (2021) A review of the water–energy–food nexus research in Africa. Sustainability 13, 1762.

Correa-Cano, M., Salmoral, G., Rey, D., Knox, J.W., Graves, A., Melo, O., Foster, W., Naranjo, L., Zegarra, E., Johnson, C. (2022) A novel modelling toolkit for unpacking the Water-Energy-Food-Environment (WEFE) nexus of agricultural development. Renewable and sustainable energy reviews 159, 112182.

Davis, C.L., Vincent, K., (2017) Climate risk and vulnerability: A handbook for Southern Africa, 2nd ed. Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa, p. 202.

DEA, (2011) White paper on a National Climate Change Response Policy for South Africa. Department of Environmental Affairs (DEA), Pretoria, South Africa, p. 56.

DWS, (2022) Green Drop 2022 Report - Water Services. Department of Water and Sanitation (DWS), Pretoria, South Africa, p. 558.

FAO, (2014) The water-energy-food nexus: A new approach in support of food security and sustainable agriculture, in: Dubois, O., Faurès, J.-M., Felix, E., Flammini, A., Hoogeveen, J., Pluschke, L., Puri, M., Ünver, O. (Eds.). Food and Agriculture Organization (FAO), Rome, Italy.

Gerbens-Leenes, W., Hoekstra, A.Y., van der Meer, T.H. (2009) The water footprint of bioenergy. Proceedings of the National Academy of Sciences 106, 10219-10223.

Hellegers, P., Zilberman, D., Steduto, P., McCornick, P. (2008) Interactions between water, energy, food and environment: evolving perspectives and policy issues. Water Policy 10, 1-10.

Hoff, H., (2011) Understanding the nexus: Background paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. Stockholm Environment Institute (SEI), Stockholm, Sweden, p. 52.

IPCC, (2022) Climate Change 2022: Impacts, Adaptation and Vulnerability: Summary for Policymakers. A report of Working Group II of the IPCC, in: Pörtner, H.-O., Roberts, D.C., Poloczanska, E.S., Mintenbeck, K., Tignor, M., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V. (Eds.), Part of the Working Group II Contribution to the Sixth Assessment Report of the IPCC. Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge, UK and New York, NY, USA.

Kibret, S., Wilson, G.G., Tekie, H., Petros, B. (2014) Increased malaria transmission around irrigation schemes in Ethiopia and the potential of canal water management for malaria vector control. Malaria Journal 13, 1-12.

Leck, H., Conway, D., Bradshaw, M., Rees, J. (2015) Tracing the water–energy–food nexus: Description, theory and practice. Geography Compass 9, 445-460.

Lues, L. (2016) South African Public Service Human Resource Management. Administratio Publica 24, 11-30.

Mabhaudhi, T., Mpandeli, S., Nhamo, L., Chimonyo, V.G., Nhemachena, C., Senzanje, A., Naidoo, D., Modi, A.T. (2018) Prospects for improving irrigated agriculture in southern Africa: Linking water, energy and food. Water 10, 1881.

Mabhaudhi, T., Nhamo, L., Chibarabada, T.P., Mabaya, G., Mpandeli, S., Liphadzi, S., Senzanje, A., Naidoo, D., Modi, A.T., Chivenge, P.P. (2021) Assessing Progress towards Sustainable Development Goals through Nexus Planning. Water 13, 1321.

Mabhaudhi, T., Nhamo, L., Mpandeli, S., Nhemachena, C., Senzanje, A., Sobratee, N., Chivenge, P.P., Slotow, R., Naidoo, D., Liphadzi, S. (2019) The Water–Energy–Food Nexus as a Tool to Transform Rural Livelihoods and Well-Being in Southern Africa. International journal of environmental research and public health 16, 2970.

McCollum, D., Gomez Echeverri, L., Riahi, K., Parkinson, S., (2017) SDG7: Ensure access to affordable, reliable, sustainable and modern energy for all. International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, p. 47.

Mpandeli, S., Naidoo, D., Mabhaudhi, T., Nhemachena, C., Nhamo, L., Liphadzi, S., Hlahla, S., Modi, A. (2018) Climate change adaptation through the water-energy-food nexus in southern Africa. International journal of environmental research and public health 15, 2306.

Mpandeli, S., Nhamo, L., Senzanje, A., Jewitt, G., Modi, A., Massawe, F., Mabhaudhi, T., (2022) The water–energy–food nexus: its transition into a transformative approach, Water-Energy-Food Nexus Narratives and Resource Securities. Elsevier, Amsterdam, Netherlands, pp. 1-13.

Naidoo, D., Nhamo, L., Mpandeli, S., Sobratee, N., Senzanje, A., Liphadzi, S., Slotow, R., Jacobson, M., Modi, A., Mabhaudhi, T. (2021) Operationalising the water-energy-food nexus through the theory of change. Renewable and sustainable energy reviews 149, 10.

NDP, (2013) National development plan: Vision 2030. National Planning Commission (NDP), Pretoria, South Africa, p. 489.

Ngarava, S., (2021) Long-term relationship between food, energy and water inflation in South Africa. Water-Energy Nexus, 4, 123–133.

Nhamo, L., Mabhaudhi, T., Modi, A. (2019) Preparedness or repeated short-term relief aid? Building drought resilience through early warning in southern Africa. Water SA 45, 75-85.

Nhamo, L., Mabhaudhi, T., Mpandeli, S., Dickens, C., Nhemachena, C., Senzanje, A., Naidoo, D., Liphadzi, S., Modi, A.T. (2020a) An integrative analytical model for the water-energy-food nexus: South Africa case study. Environmental Science and Policy 109, 15-24.

Nhamo, L., Mpandeli, S., Liphadzi, S., Mabhaudhi, T., (2024) Understanding circularity and transformative approaches and their role in achieving sustainability, Circular and Transformative Economy. CRC Press, Boca Raton, Florida, USA, pp. 1-8.

Nhamo, L., Mpandeli, S., Liphadzi, S., Mabhaudhi, T. (2025) Catalysing Sustainable Development Goals through the water-energy-food nexus. iScience, 30.

Nhamo, L., Ndlela, B. (2021) Nexus planning as a pathway towards sustainable environmental and human health post-Covid-19. Environment Research 110376, 7.

Nhamo, L., Ndlela, B., Mpandeli, S., Mabhaudhi, T. (2020b) The Water-Energy-Food Nexus as an Adaptation Strategy for Achieving Sustainable Livelihoods at a Local Level. Sustainability 12, 8582.

Nhamo, L., Ndlela, B., Nhemachena, C., Mabhaudhi, T., Mpandeli, S., Matchaya, G. (2018) The water-energy-food nexus: Climate risks and opportunities in southern Africa. Water 10, 567.

Ntombi, R.-T., (2017) Fragmented sectoral approach on water, energy and food in South Africa, Trade & Industrial Policy Strategies (TIPS) Forum 2017. TIPS, Johannesburg, South Africa, p. 14.

Prasad, P., Duker, A., de Fraiture, C., van der Zaag, P. (2023) Irrigation development under uncertainty: A call for adaptive investment pathways. Environmental Science & Policy 140, 104-110.

Rai, P.K. (2023) Role of water-energy-food nexus in environmental management and climate action. Energy Nexus, 100230.

Rogge, K.S., Reichardt, K. (2016) Policy mixes for sustainability transitions: An extended concept and framework for analysis. Research Policy 45, 1620-1635.

Saaty, T.L. (1977) A scaling method for priorities in hierarchical structures. Journal of Mathematical Psychology 15, 234-281.

Schlemm, A., Mulligan, M., Tang, T., Agramont, A., Namugize, J., Malambala, E., van Griensven, A. (2024) Developing meaningful water-energy-food-environment (WEFE) nexus indicators with stakeholders: An Upper White Nile case study. Science of the total environment 931, 172839.

Simpson, G.B., Jewitt, G.P., Becker, W., Badenhorst, J., Masia, S., Neves, A.R., Rovira, P., Pascual, V. (2022) The water-energy-food nexus index: a tool to support integrated resource planning, management and security. Frontiers in Water 4, 825854.

StatsSA, (2019) Towards measuring food security in South Africa: An examination of hunger and food inadequacy. Statistics South Africa (StatsSA), Pretoria, South Africa, p. 36.

Taguta, C., Nhamo, L., Kiala, Z., Bangira, T., Dirwai, T.L., Senzanje, A., Makurira, H., Jewitt, G.P., Mpandeli, S., Mabhaudhi, T. (2023) A geospatial web-based integrative analytical tool for the water-energy-food nexus: the iWEF 1.0. Frontiers in Water 5, 1305373.

UN, (2023) The Sustainable Development Goals Report 2023: Special Edition, Towards a Rescue Plan for People and Planet. United Nations (UN), New York, USA, p. 80.

UNGA, (2015) Transforming our world: The 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly (UNGA). United Nations General Assembly, New York, USA, p. 35.

WorldBank, (2024) World Bank Indicators. World Bank Group (WB), Washington DC.

Wu, L., Elshorbagy, A., Pande, S., Zhuo, L. (2021) Trade-offs and synergies in the water-energy-food nexus: The case of Saskatchewan, Canada. Resources, conservation and recycling 164, 105192.

Xulu, N.G., Chikoore, H., Bopape, M.-J.M., Ndarana, T., Muofhe, T.P., Mbokodo, I.L., Munyai, R.B., Singo, M.V., Mohomi, T., Mbatha, S.M. (2023) Cut-Off Lows over South Africa: A Review. Climate 11, 59.

Layout & design by:
DEPARTMENT OF WATER & SANITATION
Communication Services
www.dws.gov.za