NATIONAL STATE OF WATER REPORT 2021

WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation

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Water and Sanitation
REPUBLIC OF SOUTH AFRICA

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ACRONYMS

Acronym	Description
AMD	Acid Mine Drainage
AmWSS	Amatole Water Supply System
AmWSS	Amatole Water Supply System
AWSS	Algoa Water Supply System
BMGF	Bill and Melinda Foundation
BRVAS	Berg River Voelvlei Augmentation Scheme
CMA	Catchment Management Agency
CoGTA	Department of Cooperative Governance and Traditional Affairs
CWRWSS	Crocodile West River Water Supply
DTN	Delivery Tunnel North
DWS	National Department of Water and Sanitation
EC	Electrical conductivity
EWR	Ecological Water Requirements
FRAI	Fish Response Assessment Index
FSC	Full supply capacity
FSMS	Faecal Sludge Management Strategy
GBWSS	Greater Bloemfontein Water Supply System
GBWSS	Greater Bloemfontein Water Supply System
GwLS	Groundwater level status
GWSs	Government Water Schemes
GWSs	Government Water Schemes
HDS	High Density Sludge
HSDG	Human Settlements Development Grant
IHI	Habitat Integrity
IUA	Integrated Unit of Analysis
IVRS	Integrated Vaal River System
JV	Joint Venture
KZNCMWSS	KwaZulu-Natal Coastal Metropolitan Water Supply System
LHWP	Lesotho Highlands Water Project
MCWAP	Mokolo Crocoldile (West) Water Augmentation Project
MIRAI	Macroinvertebrate Response Assessment Index
MMM	Mangaung Metro Municipality
MOI	Memorandum of Incorporation
MWP	Mzimvubu Water Project
MWP	Mzimvubu Water Project
NCMP	National Chemical Monitoring Programme

Acronym	Description
NCMP	National Chemical Monitoring Programme
NEMP	National Eutrophication Monitoring Programme
NGA	National Groundwater Archive
NGA	National Groundwater Archive
NGA	National Groundwater Archives
NIWIS	National Integrated Water Information System
NMMP	National Microbial Monitoring Programme
NRW	Non-Revenue Water
NWRS2	National Water Resource strategy 2
OCS	Off-Channel Storage
ORWRDP-2	Olifants River Water Resources Development Project Phase 2
ORWSS	Olifants River Water Supply System
REMP	River EcoStatus Monitoring Programme
RQOs	Resource Quality Objectives
RTTS	Telemetry systems
RUs	Resource Units
SANS	South African National Standards
SASTEP	South African Sanitation Technology Enterprise Programme
SAWS	South African Weather Services
SIV	System Input Volume
SPI	Standardized Precipitation Index
STTCC	Sanitation Technology Technical Coordination Committee
TCTA	Trans-Caledon Tunnel Authority
TCTA	Trans-Caledon Tunnel Authority
TDS	Total dissolved solids
USAID	United States Agency for International Development
USDG	Urban Settlements Development Grant
VEGRAI	Vegetation Response Assessment Index
WCWDM	Water Conservation and Water Demand Management
WCWSS	Western Cape Water Supply System
WMAs	Water management areas
WMS	Water Management System
WSA	Water Service Authority
WSP	Water Service Provider
WWTW	wastewater treatment works
ZQM	National Groundwater Quality Monitoring

EXECUTIVE SUMMARY

The National State of Water (NSoW) report sets out to communicate the available water resources information through an integrated report that will assist water managers and policy makers in decision making. The report highlights: identified problem areas; informs the public on the status of water resources and sanitation; measures taken to improve water supply and demand; status of monitoring programmes, and analysis of its outputs.

Rainfall received during the hydrological year 2020/21 is above normal. This resulted in the national dam storage levels for the 2020/21 hydrological year recording the highest storage levels over the last five years. This was experienced mainly in the eastern parts of the country, which receive summer rainfall. Long-term rainfall trends per water management area for the 2020/2021 hydrological year fell between 76% to125% for most water management areas, which is classified as an average year (neither a dry nor a wet period). This is apart from the Vaal and Olifants WMAs, which experienced a wet year. Cyclone Eloise brought significant rainfall in January 2021 in parts of Limpopo, Mpumalanga, and KwaZulu-Natal regions, recording up to 300 mm of rainfall in a day in parts of the affected areas.

The medium-term observation (12-month) Standardized Precipitation Index (SPI), an index based on the probability of rainfall used to assess the severity of drought, reports dry conditions in the isolated parts of Mpumalanga and Limpopo Province, the southern parts of the Northern Cape Province, and the southern parts of the Eastern Cape. About 36 local municipalities are affected by drought across the country.

Aquifer storage throughout South Africa significantly impacts climate change adaptation with great groundwater resource potential. This is due to the nature of groundwater systems providing a natural buffer against drought impact and have historically provided superb water-supply security and offer cost-effective solutions to improve drought. Conjunctive use of Integrated Water Resources Management, groundwater systems, and surface water resources at the operational level is essential in ensuring water supply security.

Forty-one sites - concentrated in Gauteng, Limpopo, Mpumalanga, and North West provinces - were assigned trophic status as part of the National Eutrophication Monitoring Programme (NEMP). The highest number of sites in a hypertrophic state were in Gauteng and North-West Provinces. These were the Roodeplat Dam, Bon Accord Dam, Leeukraal Dam, Bronkhorstspruit Dam, and Rietvlei Dam, and in the North West were Hartebeespoort Dam, Roodekopjes Dam, Vaalkop Dam, Klipvoor Dam, Klein-Maricopoort Dam, Lotlamoreng Dam, and Modimola Dam. The high levels of nutrients are attributed to sewage (domestic and industrial wastewater effluent) inflows into water bodies, agricultural runoff, and untreated effluent from wastewater treatment plants. The NEMP data acquisition is slowly improving. As more monitoring stations get reactivated, NEMP will provide a countrywide view for nutrient enrichment.

64% of active surface water sites have data as of September 2021. The number of active surface water monitoring stations has declined over the years due to vandalism, theft, wear and tear, and lack of maintenance. There is a significant improvement in the number of groundwater quality sites sampled in 2021 compared to 2019. The National Chemical Monitoring Programme, which depicts the status and trends in South African rivers, was not operational during the reporting period due to the non-functioning of the inorganic laboratory at the RQIS.

The ecological condition of river ecosystems of over 450 sites was sampled via the River EcoStatus Monitoring Programme. The National Microbial Monitoring Programme has not been in full operation since 2014, resulting in massive data gaps. Surface water quality monitoring programmes continue to bear the brunt of budget cuts. Notably, there have been no sites identified to be in an unmodified condition or largely natural (A/B) in the past three hydrological years. Almost all the severely altered sites (D/E and E) occurred in the upper Crocodile West Catchment. Close monitoring and intervention are required for this catchment.

Agriculture, which includes aquaculture, watering livestock, and irrigation, is a significant part of groundwater use at 58%. The average groundwater level status for September 2021 indicates ‘stressed’ geosites in parts of the Limpopo, Northern Cape, and Eastern cape regions. The national average Groundwater Level Status over 2020/2021 indicates a recovery trend within the below-normal risk percentiles compared to the decreasing trend between 2014 and 2019. The nitrate guideline limit of 11 mg/l is exceeded in parts of Limpopo and Free State regions. This could be attributed to the use of unlined pit latrines and nitrogenous fertilizers used in agriculture associated with common land use in these regions. Site-specific investigations must be conducted to validate this and ensure that groundwater resources are protected.

The irrigation and Municipal (urban water supply) remain the largest water use sectors. Efficient water use is necessary for South Africa, a semi-arid country that is forecasted to face drier climatic conditions. The current consumption trends for Integrated Vaal River System are still high compared to the national benchmark of 236 ℓ/c/d, but IVRS includes the highest number of wet industries in the country.

Some parts of the country are still experiencing dry conditions, for example, the southern parts of the Eastern Cape, parts of the Northern Cape, and the Karoo area in the Western Cape Province. The Department implements water use restrictions in these areas that are experiencing dry conditions, which affect dam storage levels in standalone dams or dams within a water supply system. Restrictions were still applicable for all water supply systems in the Eastern Cape, the Polokwane system in Limpopo, and the Bloemfontein system in Free State Province.

Poor performance is reported for compliance to authorization conditions by Municipal Wastewater Treatment Works (WWTW) and average compliance by Municipal landfills, Public Institutions, Afforestation, and Agriculture (irrigation). A total of 52 NWA Directives (23% of total cases) were issued during the reporting period, and most Directives were issued to water users in Gauteng, followed by Mpumalanga. Only four cases ended up at the Water Tribunal, while 14 cases were registered with the SAPS. The enforcement actions taken were dominated by the issuance of the NWA Notices (66% of total cases). Most NWA Directives were issued to the Local Government, followed by Agriculture. While Most SAPS cases registered were for the Mining Sector, followed by Agriculture.

About 60% of South African households that have access to improved sanitation are served with waterborne systems which are connected to Wastewater Treatment Works. With a projected 17% water deficit between demand and supply by 2030. The projected water deficit and climate change impact will have a significant impact on the traditional way of providing waterborne sanitation and requires the country to re-think sanitation provision. The WRC is assessing and validating various alternative sanitation technologies for the entire sanitation value chain through the South African Sanitation Technology Enterprise Programme.

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Mr. Peter Mpoko	Hydrological Information
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1

INTRODUCTION

1 INTRODUCTION

1.1 Background

South Africa is characterized 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. River systems are the common surface water expression of water availability in South Africa, with others being lakes, ponds, and pans.

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. The time has now come when a mix of water resources is required to reconcile supply and demand, including sustainable ground water use, reuse of waste water, and desalination.

The Department of Water and Sanitation as the public trustee or custodian of the nation's water resources 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 the quality and quantity of surface and ground water.

A decrease in water supply threatens South Africa's water security due to negative impacts on yields arising from climate change, degradation of wetlands and water resources, and siltation of dams, whilst water losses and demand are escalating due to population and economic growth, urbanization, inefficient use, and changing lifestyles.

The National State of Water (NSoW) report sets out to communicate the available water resources information through this integrated report to assist water managers in decision making; evaluating the impact of the implementation of legislation; highlight identified problem areas; inform the public on the status of water resources and sanitation; what is being done to balance the water demand and supply; and ensure availability of water to future generations.

Most importantly, this report is part of an effort to disseminate information and knowledge to the public. The main aim is to enhance the quality, accessibility, and relevance of information and data related to Integrated Water Resource Management. This is to improve the public's understanding of the importance of this vital resource and how it can be used more efficiently.

The Directorate: Water Information Integration, under the Chief Directorate: National Water Resource and Information Management, coordinates the provision of the national state of water report. The reporting on the state of water is a collaborative effort of all directorates within different branches of the Department of Water and Sanitation.

1.2 Water Sector Institutional Design

The South African Sector Institutional landscape as of 2020, together with proposed new entities, is illustrated in **Error! Reference source not found.**. The National Department of Water and Sanitation is the custodian of water resources with an obligation of water resource management. The National Department acting through the Minister, is responsible for water sector policy, support, and regulation.

This water resource management obligation or function is to be delegated to an institution at the water management area level, such as a Catchment Management Agency (CMA). This is in support of the principles of integrated water resource management. In water management areas where a CMA has not been established, the responsible authority (DWS national and provincial) continues to act as a CMA to perform all water resource management functions at a catchment level.

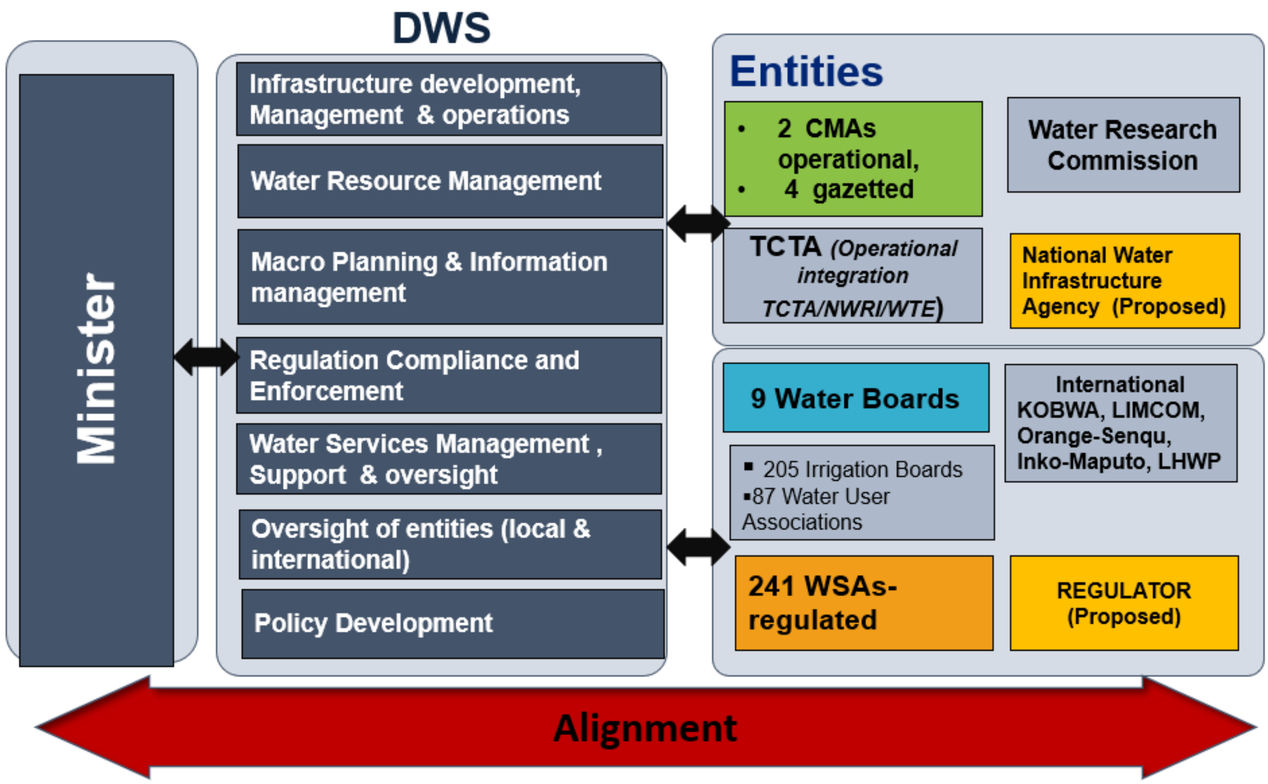


Figure 1.1 Water Sector Institutional Landscape in 2020

At the local level, we find Water Services Institutions, 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 that provide water and sanitation services are regulated by the Department of Cooperative Governance and Traditional Affairs (CoGTA). A water services authority means 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 mean any person who provides water services to consumers or another water services institution. Notably, some WSAs are WSPs; in other cases, the WSA has WSP that provides water services on their behalf.

1.3 Water management areas

Based on the outcome of the Departmental Institutional Reform and Realignment (IRR) study, the NWRS2 established the nine WMAs in South Africa in July 2012. These replaced the 19 WMAs identified before this date. It was recognized 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 status and trends of water resources provided in this report have been analysed and presented based on these nine WMAs.

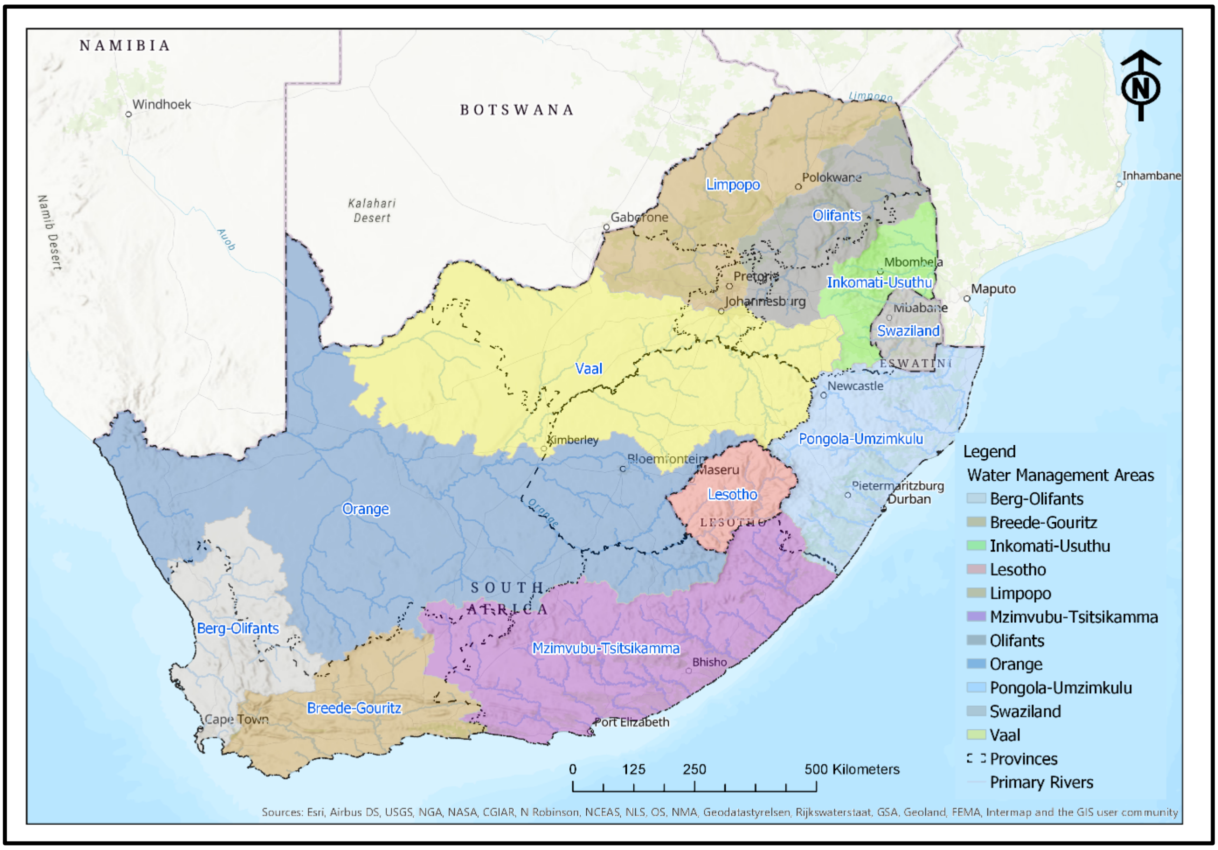


Figure 1.2 South African Nine Water Management Areas as of 2012

The Department has embarked on several institutional re-alignment processes to transform the water sector, build stable institutions with clearly defined roles and responsibilities across the sector, and promote effective institutional performance. It is proposed that as we advance, water resource management will be based on six water management areas for which CMAs will be established, these are: Limpopo-Olifants (1); Inkomati-Pongola (2); Mhlatuze-Mzimkhulu (3); Vaal-Orange (4); Mzimvubu-Tsitsikamma (5); Breede-Olifants (6) – see Figure 1.3.

As part of the Department's turnaround strategy in establishing CMAs, the extension of the boundary of the existing Breede-Gouritz CMA to incorporate the Berg-Olifants water management area has been gazetted for public comments in terms of section 78(1) of the National Water Act, 1998 (Act No. 36 of 1998) to establish the Breede-Olifants CMA in September 2020. While in March 2021, the extension of the Vaal CMA to include the Orange water management area has been gazetted for public consultation in terms of section 78(4) of the National Water Act, 1998 (Act No. 36 of 1998). This incorporation will enhance revenue generation and sustainability of the CMA, as well as enable effective water resources management.

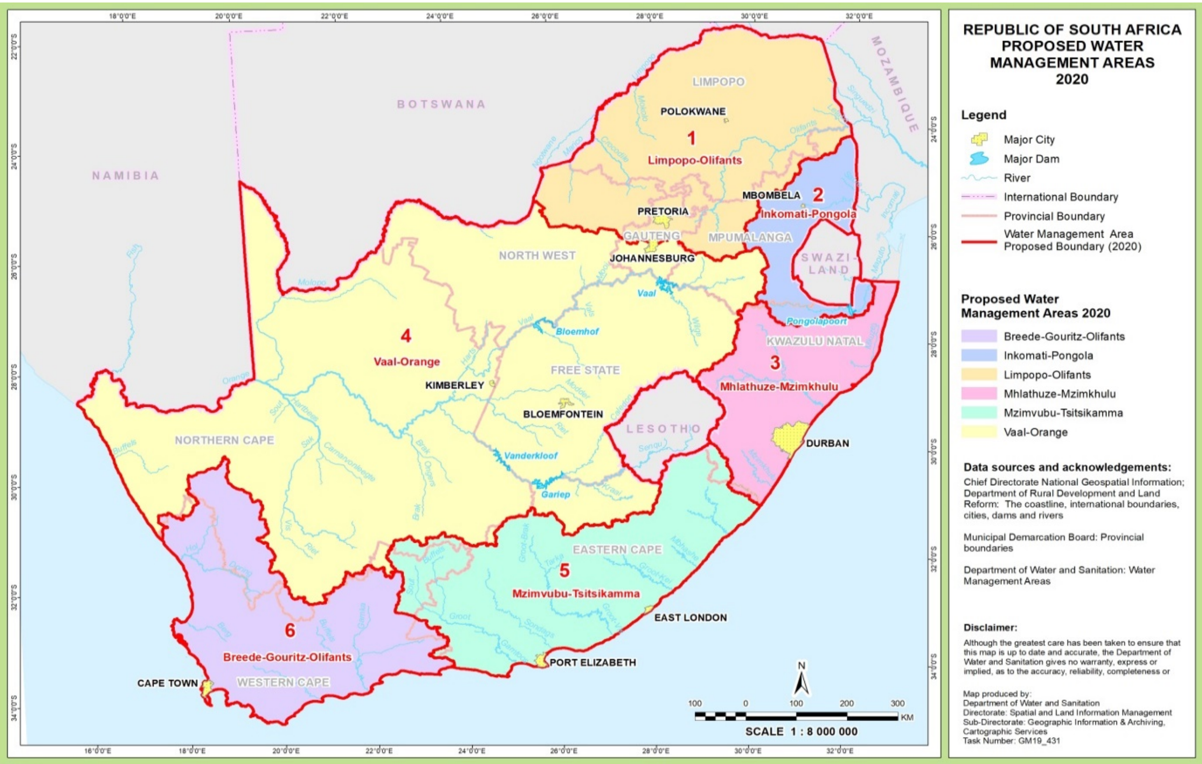


Figure 1.3 Proposed New WMAs and CMA configuration

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 coordination and implementation by municipalities as per section 80 of the National Water Act, 36 of 1998.

1.4 Internationally Shared Basins

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, and future water resource development options, water resource protection, etc. South Africa has three international rivers which it shares with its neighbours (Figure 1.4), i.e.:

- Orange – Senqu River: shared with 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 1-1. These agreements have been established with the neighbouring states to promote international transboundary cooperation.

Figure 1.4 International shared basin and transfer schemes

Table 1-1 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 Republic of Botswana, Republic of Mozambique, Republic of South Africa, 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, Republic of Namibia, and Republic of South Africa	Agreement between SA and ORASECOM for the Hosting of the ORASECOM Secretariat	2008	2008	Active	The South African Department of Water and Sanitation has been responsible for paying office rental for the hosting of the RASECOM secretariat in Centurion every year since 2008
Republic of Botswana, Kingdom of Lesotho, and Republic of South Africa (JSMC Agreement)	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.

Country	Title of the Agreement	Date signed	Date entered into force	Status of Agreement	Areas of Cooperation
					• JSMC monitors the study on a regular basis • Implementation of Phase II • Procurement process implementation • establishment of Project management
Republic of Mozambique, Kingdom of Swaziland/Eswatini, and Republic of South Africa (TPTC)Agreement)	**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

2.1 Surface Water Monitoring

DWS has an established and operational national network of gauging stations along rivers, dams, estuaries, eyes, canals, and pipelines. The purpose of the national network is to measure hydro-meteorological conditions to enable water resource assessment, planning, water supply monitoring, system operations and flood monitoring or flood forecasting. From the mid-1980 DWS had equipped some of the gauging stations with automatic wireless communication data relaying systems.

The summary structure of the surface water monitoring programme in the department is shown in **Error! Reference source not found.**. The programmes can be divided into two. The first is hydro-meteorological, which includes evaporation and rainfall monitoring. The second programme is hydrological monitoring which entails stream flow monitoring and real-time data transmission systems.

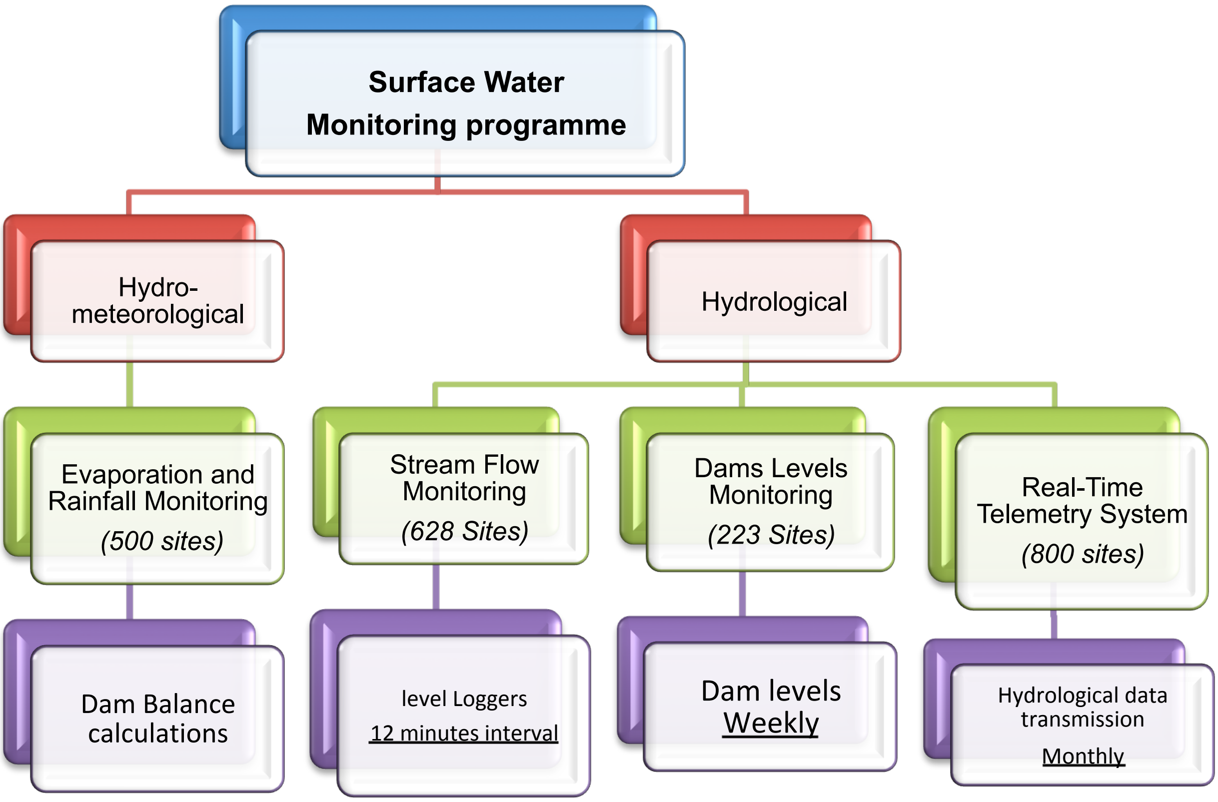
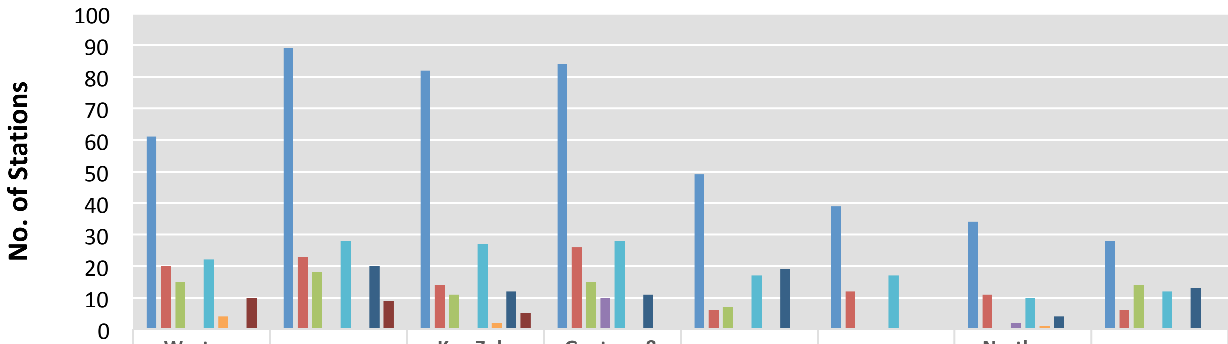


Figure 2.1 Summary structure of the surface water monitoring programmes

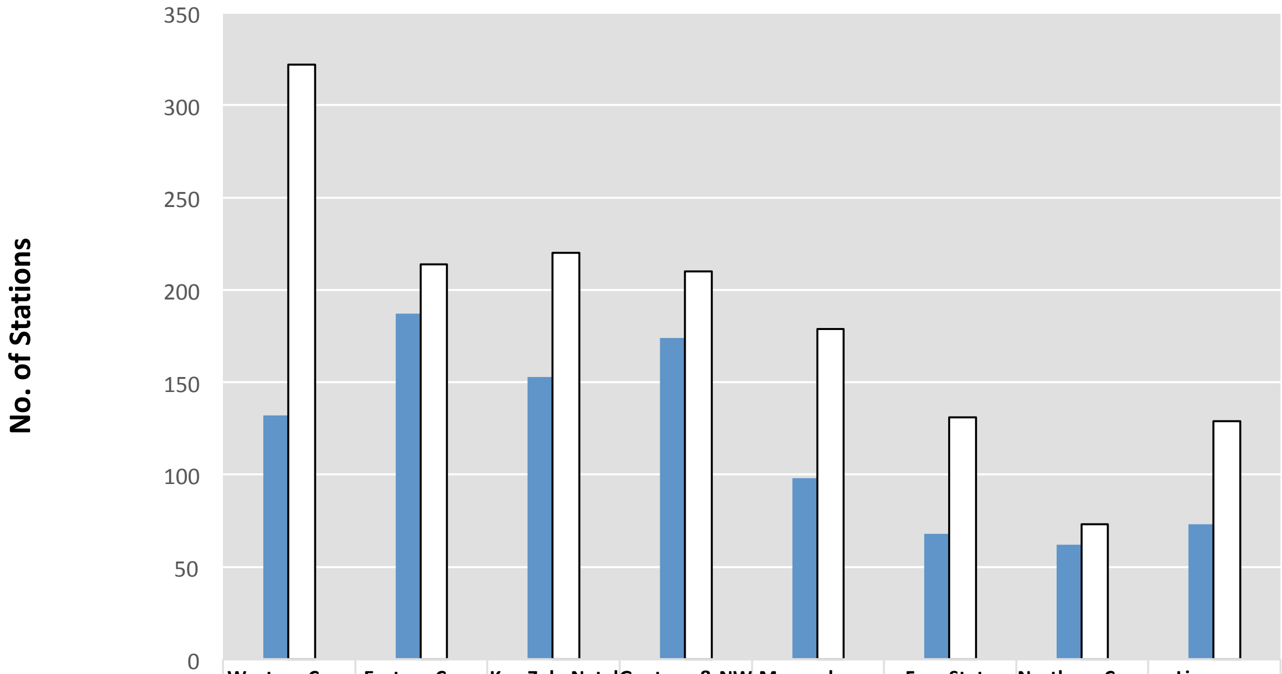
Overtime gauging stations have been equipped with real-time telemetry systems (RTTS) for other essential water resource management resources assessment operations such as water supply infrastructure operation and the monitoring of water abstraction and environmental water requirements status. Currently, 700 hydro-meteorological gauging stations are equipped with RTTS.

The monitoring of surface water levels, data quality control, and its capturing in the HYDSTRA are done by the Provincial Offices. Figure 2.2 presents various surface water monitoring station types across Provinces. Figure 2.3 illustrates the monitoring stations' data available as of September 2021.



	Western Cape	Eastern Cape	KwaZulu Natal	Gauteng & NW	Mpumalanga	Free State	Northern Cape	Limpopo
River	61	89	82	84	49	39	34	28
Canal	20	23	14	26	6	12	11	6
Pipeline	15	18	11	15	7	0	0	14
Eye	0	0	0	10	0	0	2	0
Reservoir	22	28	27	28	17	17	10	12
Lake	4	0	2	0	0	0	1	0
Met	0	20	12	11	19	0	4	13
Estuary	10	9	5	0	0	0	0	0

Figure 2.2 Station types by Province September 2021



	Western Cape	Eastern Cape	KwaZulu Natal	Gauteng & NW	Mpumalanga	Free State	Northern Cape	Limpopo
Stations with data	132	187	153	174	98	68	62	73
Total Stations	322	214	220	210	179	131	73	129
% Station with data	41	87	70	83	55	52	85	57

Figure 2.3 Station's data availability in September 2021

At the end of the reporting period, only 1,478 stations were active or open of the 2,477 total stations that have existed to date. On a national scale, only 64% of the total active stations had data available at the end of September 2021. The spatial distribution of active river flow stations as of December 2020 is presented in Figure 2.4. The surface water monitoring data (dam level, floods, flows) captured internally on the HYDSTRA system is available to the public on https://www.dws.gov.za/Hydrology/Default.aspx .

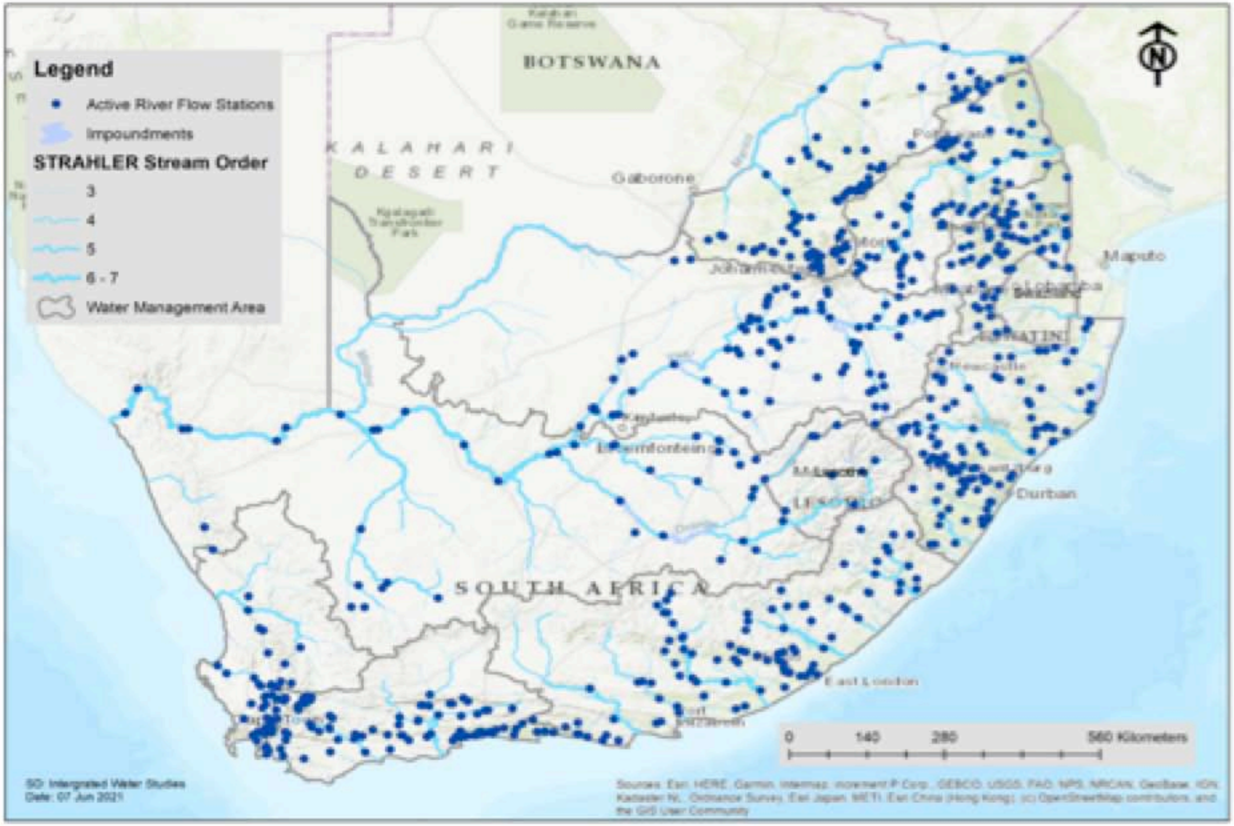


Figure 2.4 River flow stations as of December 2020

2.2 Groundwater Monitoring

Groundwater monitoring within the DWS consists of two programmes which are groundwater quality monitoring and groundwater level monitoring, as presented in Figure 2.5 below.

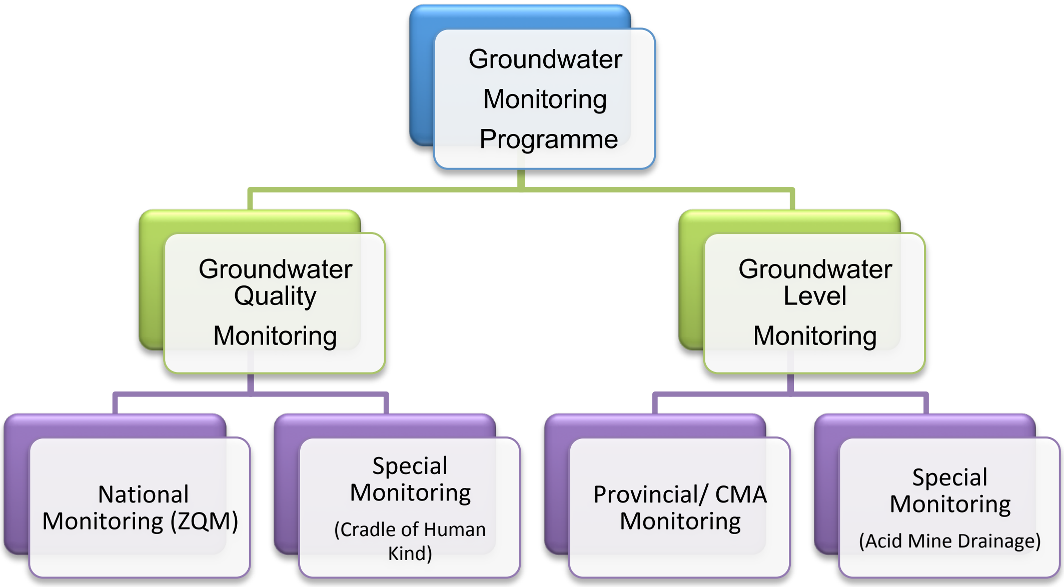


Figure 2.5 Groundwater Monitoring Programmes

2.2.1 Groundwater Level Monitoring

Over 1 800 groundwater level sites (geosites) are monitored throughout the country. Figure 2.6 indicates the locations of these geosites and responsible regional offices. The monitoring data is archived on HYDSTRA whereas additional station data is stored in the National Groundwater Archives (NGA) (https://www.dws.gov.za/groundwater/NGA.aspx). Data requests for groundwater level data monitored by DWS can be sent to geo-request service at georequests@dws.gov.za .

The statistics of available groundwater level data for the reporting period - October 2020 to September 2021, are presented in Table 2-1. The Western Cape, Mpumalanga and National Office had above 80% of their active stations with available groundwater level data throughout the 2020/2021 period. Free State, Northern Cape, Limpopo and The North West regions had the total number of active stations with available data below 49% for the most part of the initial monitoring period. Only Limpopo and the Free State recovered and reported an increase in active stations with available data in September 2021, with above 80% of available data reported for these two regions. About 59% of active stations had available data throughout the 2020/2021 monitoring period.

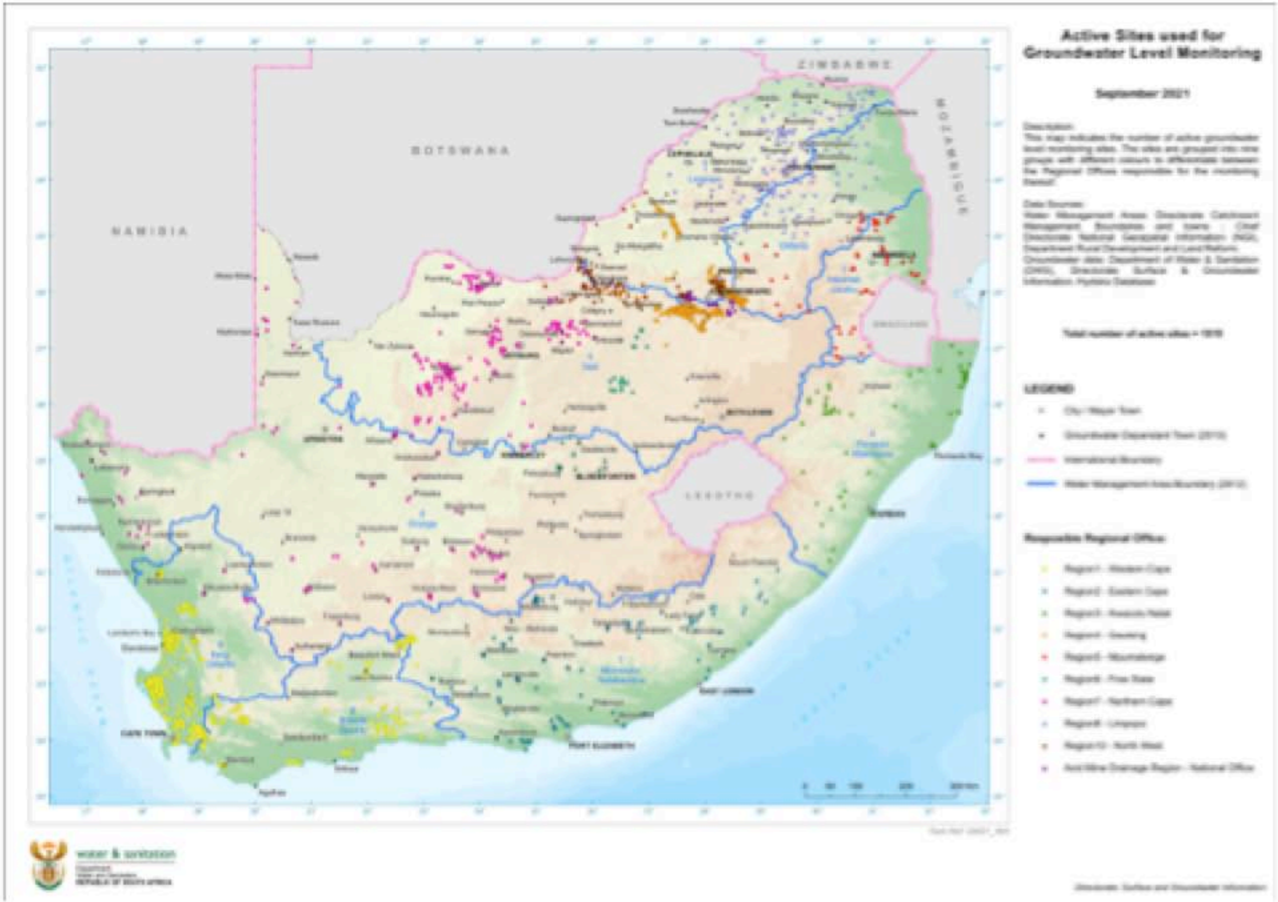


Figure 2.6 Groundwater level monitoring sites

Table 2-1 Availability of Groundwater Level Monitoring Data on HYDSTRA, 2020-2021 Hydrological Year

HYDROLOGICAL YEAR: 2020 - 2021
THE STATUS ON OF THE AVAILABILITY OF GROUNDWATER LEVEL MONITORING DATA ON HYDSTRA
AS ON 10 FEBRUARY 2022

Region	Active Stations with Available data up to Oct'20	Active Stations with Available data up to Nov'20	Active Stations with Available data up to Dec'20	Total Active Stations: Dec'20	Active Stations with Available data up to Jan'21	Active Stations with Available data up to Feb'21	Active Stations with Available data up to Mar'21	Total Active Stations: Mar'21	Active Stations with Available data up to Apr'21	Active Stations with Available data up to May'21	Active Stations with Available data up to Jun'21	Total Active Stations: Jun'21	Active Stations with Available data up to Jul'21	Active Stations with Available data up to Aug'21	Active Stations with Available data up to Sep'21	Total Active Stations: Sep'21	Total Registered WL Monitoring Non-Active Geosites	Total Registered WL Monitoring Geosites
WC	530	541	533	662	533	534	540	622	524	535	531	616	522	503	498	610	1017	1627
EC	91	98	93	127	88	87	86	127	86	87	86	127	82	82	74	123	197	320
KZN	50	61	54	73	59	63	59	73	67	47	64	73	41	44	65	73	61	134
GP	78	96	49	232	1	58	57	232	70	121	27	152	100	126	117	152	730	882
MP	63	58	61	73	53	57	62	73	61	64	63	73	64	64	64	73	46	119
FS	22	39	0	45	31	40	0	45	0	40	40	44	39	40	40	45	121	166
NC	15	251	69	347	23	144	170	367	1	169	137	364	12	149	167	365	1446	1811
LIM	92	80	62	213	20	150	42	206	27	68	117	206	9	7	174	206	387	593
NW	43	3	16	47	0	44	16	47	12	11	73	135	25	118	20	135	289	424
National Office: AMD	37	37	37	37	37	37	38	38	37	37	37	38	37	37	37	37	12	49
Total:	1021	1264	974	1856	845	1214	1070	1830	885	1179	1175	1828	931	1170	1256	1819	4306	6125
Total: (%)	55%	68%	52%		46%	66%	58%		48%	64%	64%		51%	64%	69%			

Hydrological Year: 2020 - 2021

Average (Oct-Dec'20) : **59%**

Average (Jan-Mar'21) : **57%**

Average (Apr-Jun'21) : **59%**

Average (Jul-Sep'21) : **62%**

Total number of active stations with available data between: 80% - 100%

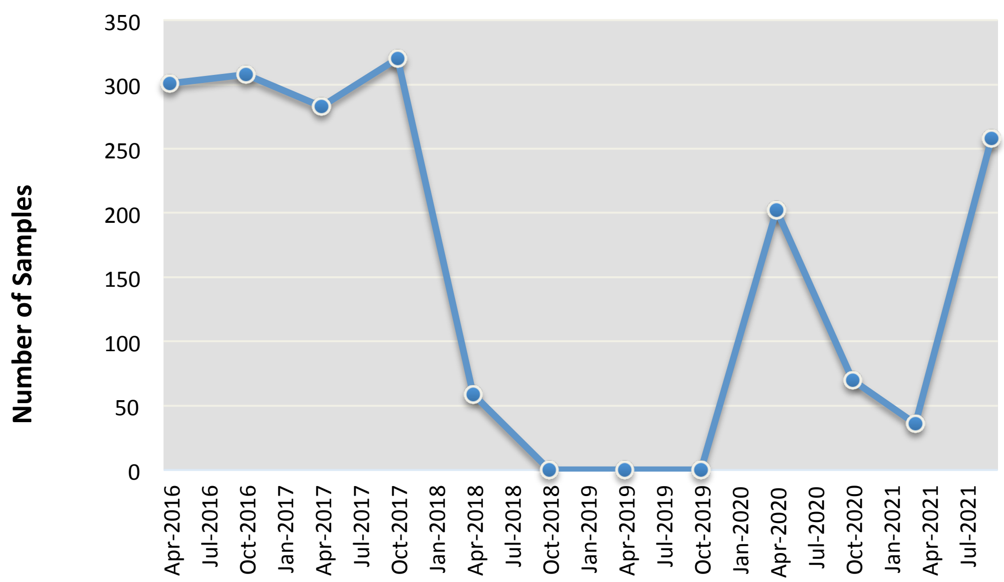
Total number of active stations with available data between: 50% - 79%

Total number of active stations with available data between: 0% - 49%

2.2.2 Groundwater Quality Monitoring

The National Groundwater Quality Monitoring (ZQM) programme was established in 1994. The objective of a national groundwater quality monitoring network is to provide ambient groundwater quality information on a national scale over the long term so that national water managers and planners have available general information pertaining to quality trends and status in both space and time for resource planning and management purposes. About 379 sites are currently being monitored, and the location for these sites is presented in Figure 2.8.

There has been an improvement in the number of groundwater quality sites sampled in 2021 compared to 2020. The previous low groundwater quality numbers were a combination of both Covid-19 pandemic and travel restrictions and budget cuts. The situation has improved with the support of various intervention measures, some of which include national groundwater quality being managed at head office and laboratory contracts issued to analyse samples. Figure 2.7 presents the increase in groundwater quality samples in the 2020/2021 period, from no samples taken to 258 samples by September 2021.



	Apr-16	Oct-16	Apr-17	Oct-17	Apr-18	Oct-18	Apr-19	Oct-19	Apr-20	Oct-20	Mar-21	Sep-21
No. of samples analysed	301	308	283	320	59	0	0	0	202	70	36	258

Figure 2.7 Groundwater Quality Sampling: April 2016- September 2021

Figure 2.8 Sampling Sites for the national groundwater quality monitoring

2.3 Surface Water Quality Monitoring

2.3.1 National Chemical Monitoring

The National Chemical Monitoring Programme (NCMP) was established in 1970s based on the state of knowledge and national priorities at the time. This is the longest-running water quality monitoring programme which has provided data and information for inorganic chemical quality of surface water resources. The programme depends on Provincial officials for data collection and the Resource Quality Information System (RQIS) laboratory for analysis and data capturing on the WMS database. This data is available to the public at https://www.dws.gov.za/iwqs/wms/default.aspx .

The main objectives of this programme include determining at a national scale the inorganic status and trends in South African rivers, supporting the National River Ecostatus Monitoring Programme (REMP); contributing to the integrated overarching database, and dissemination of data and information. The parameters measured include the salinity level of water resources which is measured as total dissolved solids or electrical conductivity, including the concentrations of irons, sodium, chloride, magnesium, potassium, and sulfate. The NCMP also measures the ammonium and nitrate-nitrite levels, which are an indication of nutrient loading from return flows into water resources.

The distribution of monitoring sites across the country is presented in Figure 2.9, with a restricted number of parameters monitored in each province. The sites are mainly at the downstream end of each tertiary drainage region. Until very recently, 346 sites constituted the NCMP, but with the recent closure of site T3H017, the figure now stands at 345. Eighty-one sites are at Level 1 (top priority), and 264 sites, formerly 265 sites, are at Level 2 (also essential sites, but not top priority sites). All the sites (except for those being sampled by the Boskop Regional Office, Limpopo and Eastern Cape Hydrology offices) are currently inactive.

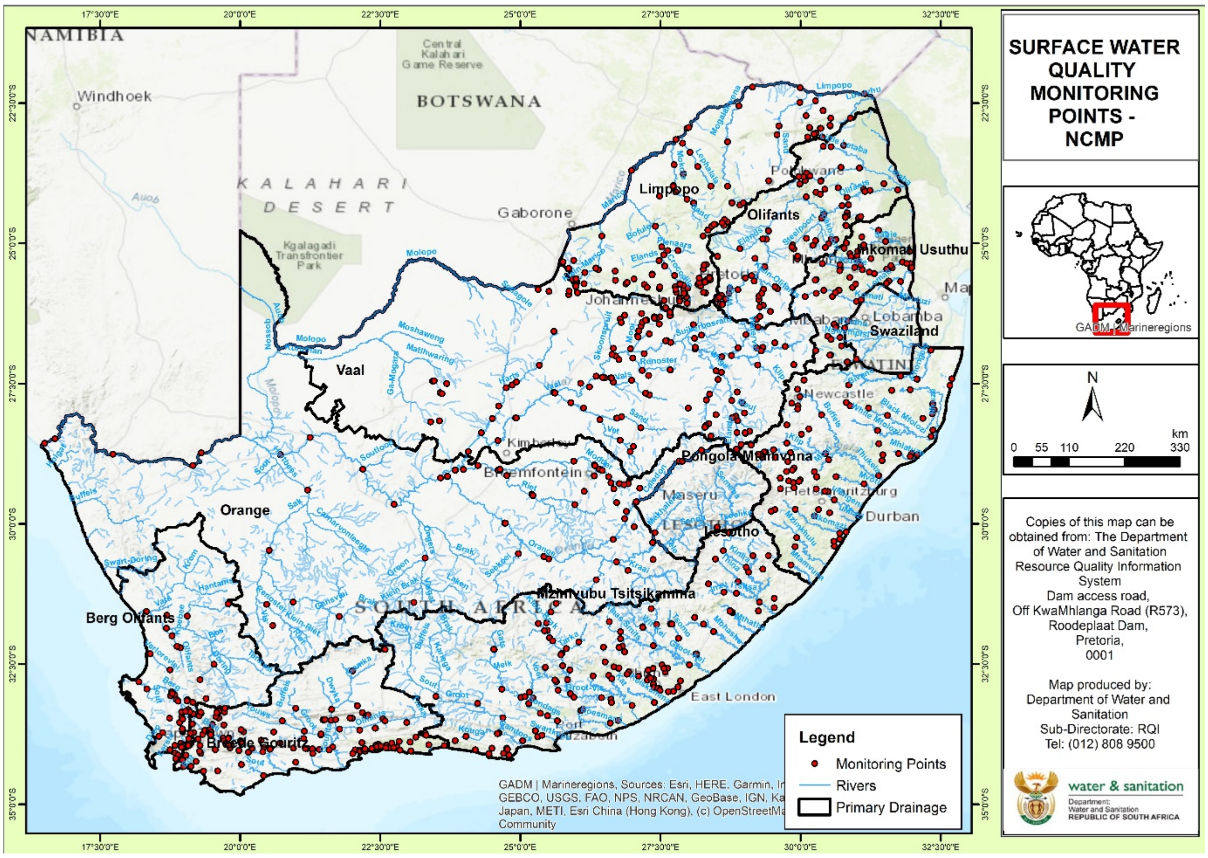


Figure 2.9 The locations of NCMP sites across South Africa

During the reporting period, the NCMP was not operational due to a range of challenges. For example, the inorganic laboratory at the RQIS was not in operation due to shortages of reagents, aging analytical instruments needing replacement, COVID-19 regulations, and budgetary constraints. Because of these challenges, no data had been collected for all the 346 sites nationwide since September 2018. Lack of sufficient data in recent years (2018 to 2021) impacted the status of inorganic chemical water quality reporting. It is important to note that the RQIS laboratory has lost its accreditation, and unless this is addressed, the credibility and reliability of data from the programme may become questionable. Figure 2.9 shows the percentage of active NCMP stations for Rivers and Dams, data collected via the NCMP has been declining since 2016, as depicted as the percentage of active stations.

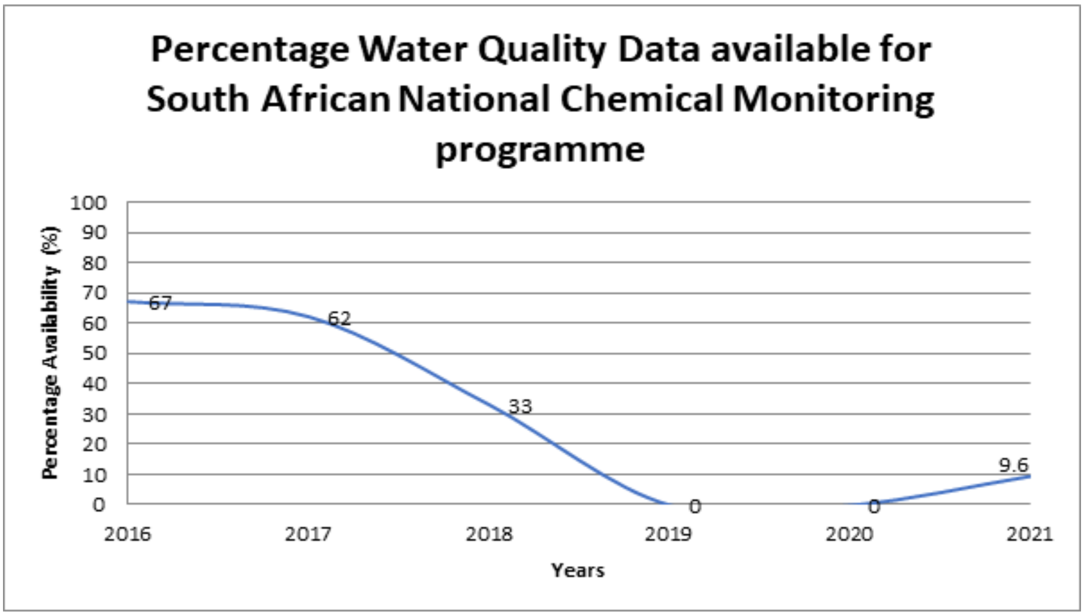


Figure 2.10 Percentage available data for NCMP for Rivers and Dams

The decline of inorganic chemical data in the Water Management System (WMS) database is of great concern and needs urgent attention. Of equal concern is that even when data were being actively collected, not all desire chemical variables were being analysed. In revamping the programme, attention should be given to critical water quality variables of concern for inclusion in the NCMP.

2.3.2 National Eutrophication Monitoring

The National Eutrophication Monitoring Programme (NEMP) was established and officially implemented in 2002. After the implementation of the NEMP, the Department also began regularly releasing data indicating the extent of eutrophication in the country.

The objectives of the NEMP are to measure, assess and report regularly on the trophic status of South African water resources. The NEMP is also aimed at identifying problems associated with eutrophication, determining the potential for future changes in trophic levels of South African impoundments and rivers, as well as serving as an early warning system for specific eutrophication-related problems and nutrient balance.

NEMP sampling (Figure 2.11) coverage remains low because of the 2018 financial constrains, to date NEMP sampling is still not active in Free State, Northern Cape, KwaZulu-Natal, Western Cape, and Eastern Cape provinces.

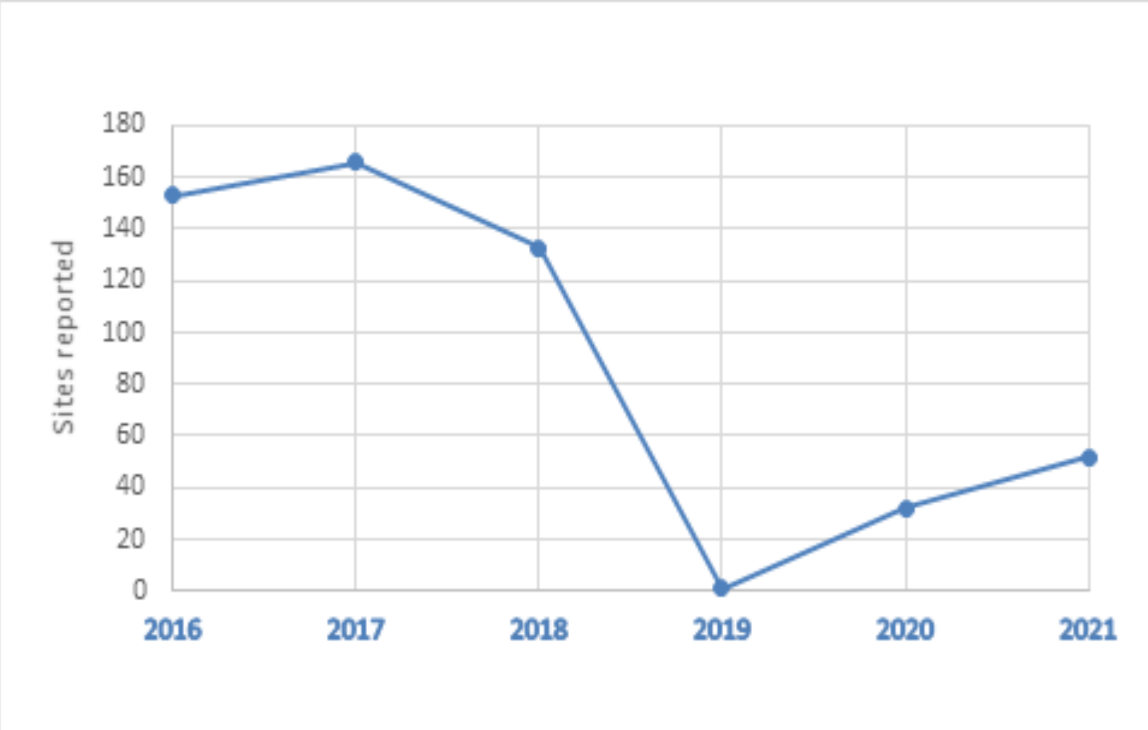


Figure 2.11 NEMP data availability from the year 2016 to 2021

During the reporting period, data collection through sampling was done in Gauteng Limpopo, North West and Mpumalanga regions. Sampling sites in these provinces are closer to RQIS laboratories, and the sampling teams can travel, collect and drop off samples.

2.3.3 River Ecostatus Monitoring

The River EcoStatus Monitoring Programme (REMP) focuses on the monitoring of the ecological condition of river ecosystems as reflected by the system drivers and biological responses. Reference conditions derived from the best available information are determined for the various indicators used in REMP. The present conditions (Ecological Category) for the different indicators are determined as a percentage change from reference. The REMP is built upon the use of models incorporating existing approved EcoStatus models. The assessment can be done on a sub-quaternary reach or site level and includes the use of 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 (Ecostatus). Monitoring is conducted on a quarterly basis, and technical reports are produced annually. Figure 2.12 shows the trends in REMP sites sampled.

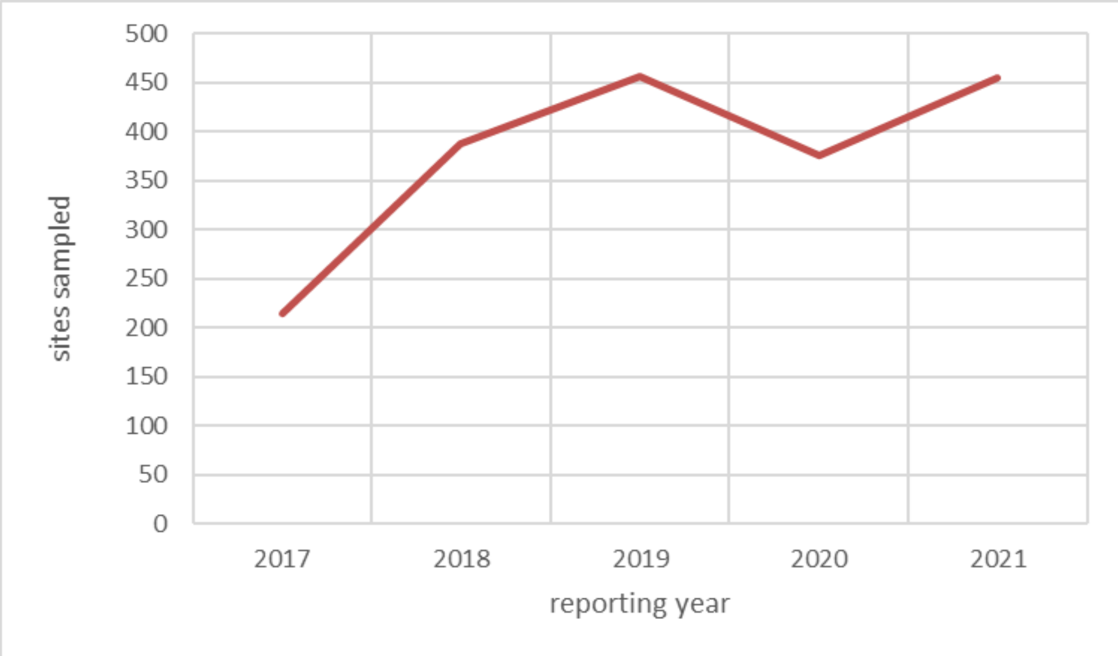


Figure 2.12 REMP Sites Samples

The number of REMP sites sampled since 2016/2017 increased until 2018/2019. The decrease in 2019/2020 can be attributed to the COVID 19 pandemic, where the number of sites sampled was limited due to restrictions. The number of sites sampled in 2020/2021 returned to the 2018/2019 levels, although the frequency of monitoring remained low.

2.3.4 National Microbial Monitoring

The National Microbial Monitoring Programme (NMMP) was implemented in phases nationwide since the year 2000. The programme uses the presence of faecal coliform bacteria in the water to indicate contamination. The main objectives of the NMMP 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 priority areas and to provide information to help assess the potential health risk to humans associated with the possible use of faecal polluted water resources. The main parameters measured include faecal coliform, *E. coli*, pH, turbidity, and temperature.

The monitoring programme has not been in full operation since 2014, resulting in massive data gaps. Of the nine water management areas, only a few sites mostly within Gauteng Province was operational with few data collected for the past two years. For this reporting, the analysis included all regional monitoring sites with microbial data and the NMMP hotspot sites because microbial data for NMMP was scarce. Figure 2.13 illustrates the number of samples for microbial monitoring for the past five years based on available data.

Currently, the challenges include budget limitations. Interventions for the current financial year include resurrecting the programme and getting other regional stakeholders like municipalities who are also doing water quality monitoring to participate and share water quality data.

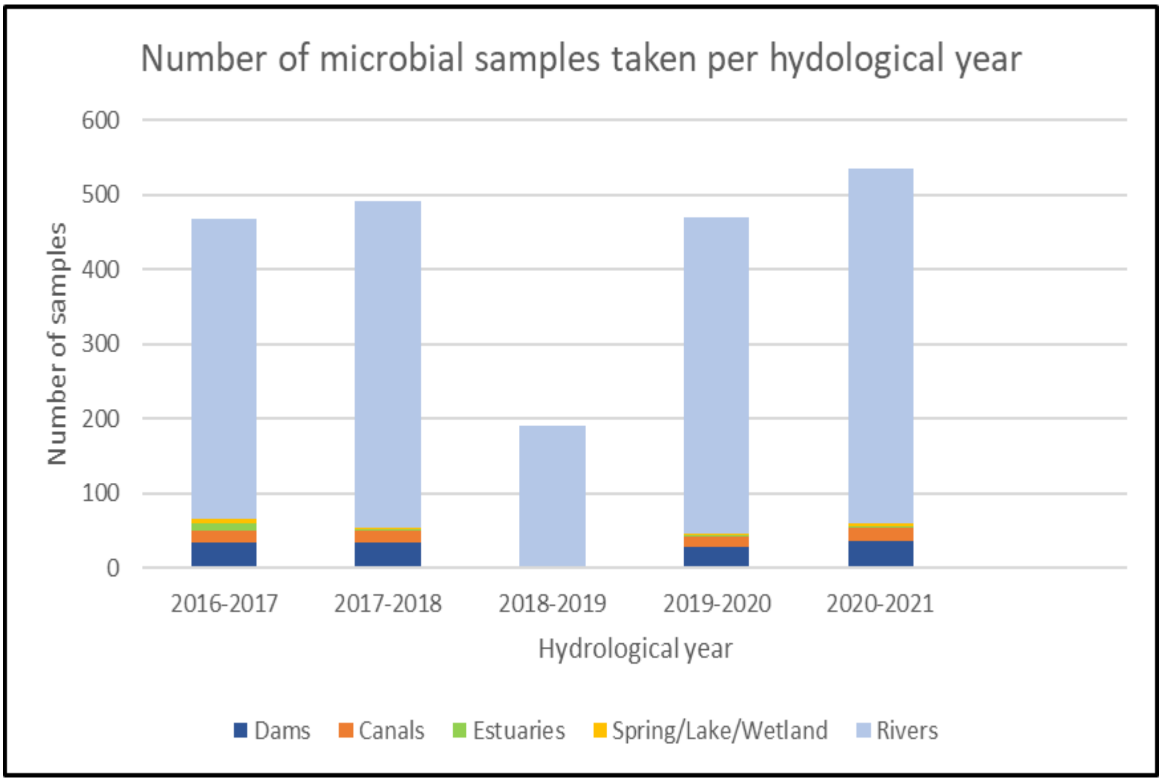


Figure 2.13 Number of microbial samples available per hydrological years

2.4 National Integrated Water Information System

The National Integrated Water Information System (NIWIS) was conceptualized 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 that were 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, this system can be accessed at https://www.dws.gov.za/niwis2.

Currently, NIWIS can provide water-related information in the areas of, Climate and Weather, Disaster Management, Enforcement, Water Infrastructure, Water Monitoring Networks, State of Water, Water Ecosystems, Water Quality, Water Quantity, Water Services, Water Supply Risk, Water Tariffs, Water Use, and other

Water Resource Management areas. The NIWIS dashboards covering various themes are presented in Figure 2.14.

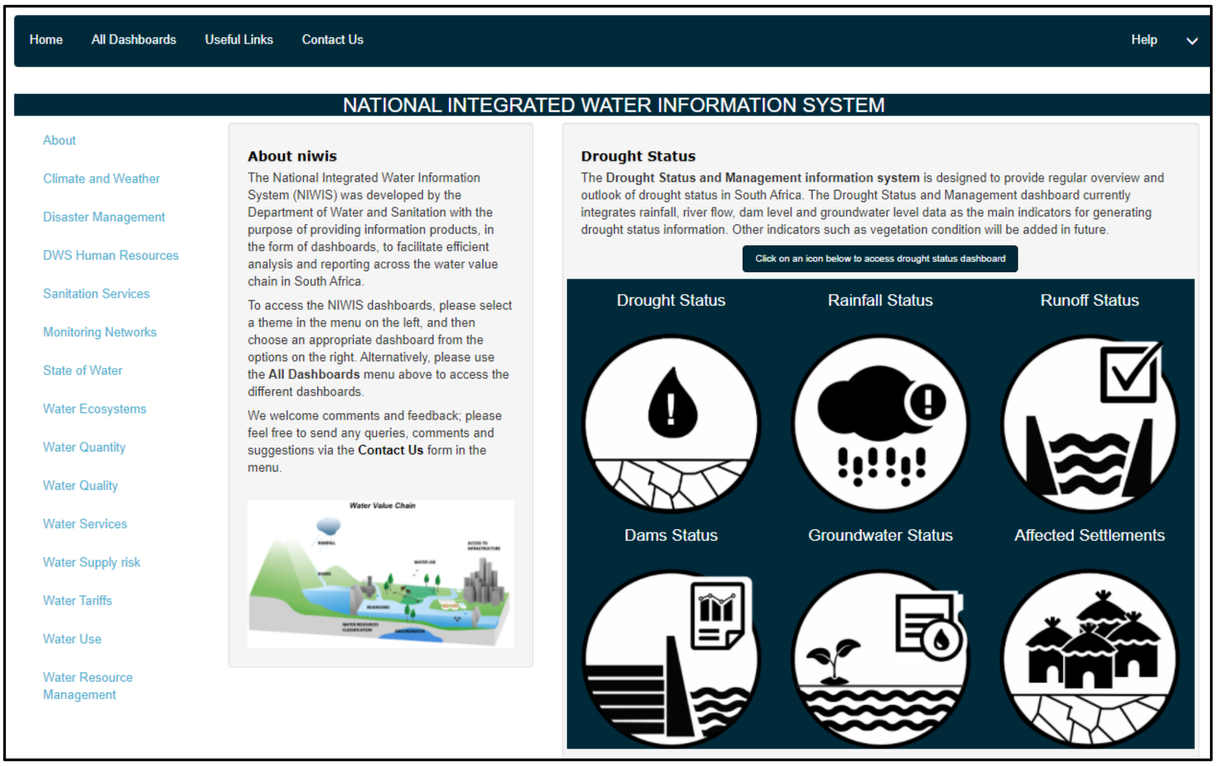


Figure 2.14 NIWIS landing page (https://www.dws.gov.za/niwis2/)

NIWIS allows for user customisation and is convenient. NIWIS has since become one of the Department's strategic investment tools, which ensures that information on the sector is readily available and conveniently disseminated. NIWIS 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 each other, albeit sharing the same client or water information in some cases.

Further development of NIWIS is in progress amidst several challenges such as unavailability of data (not timely, unreliable, unstructured, inaccessible, inaccurate, irrelevant, and poor quality as well as critical data residing outside DWS); a culture of resisting the use of current technology for data processing and information generation; poor business process management and lack of human and financial resources for monitoring.

3

CLIMATIC ENVIRONMENT

3 CLIMATIC ENVIRONMENT

3.1 Climate

Climate is one of the most important drivers of the hydrological response of a catchment. It includes processes such as rainfall, evaporation, and temperature that are variable and can have important implications for water supply for drinking, rain-fed agriculture, groundwater, forestry, biodiversity,

Climate change puts additional pressure on the naturally stressed water resources of South Africa. This puts pressure on water availability, accessibility, quality and demand. Climate changes can have an exaggerated effect on runoff, and the impacts are worsened by the complex response of the hydrological system.

The South African Weather Services (SAWS) is the custodian of meteorological data in South Africa, and the data presented in this chapter is based on data and information provided by the SAWS.

3.1.1 Temperature

South Africa experienced a somewhat warm year, which is mild compared to previous years. This can be ascribed to well-above normal rainfall over most of the country. The annual mean temperature anomalies for 2021, based on the data of 26 climate stations, were, on average higher than the reference period (1981-2010), making it approximately the 13th hottest year on record since 1951 (see Figure 3.1). A warming trend of 0.16 ºC per decade is indicated for the country, statistically significant at the 5% level (Kruger and McBride, 2021)

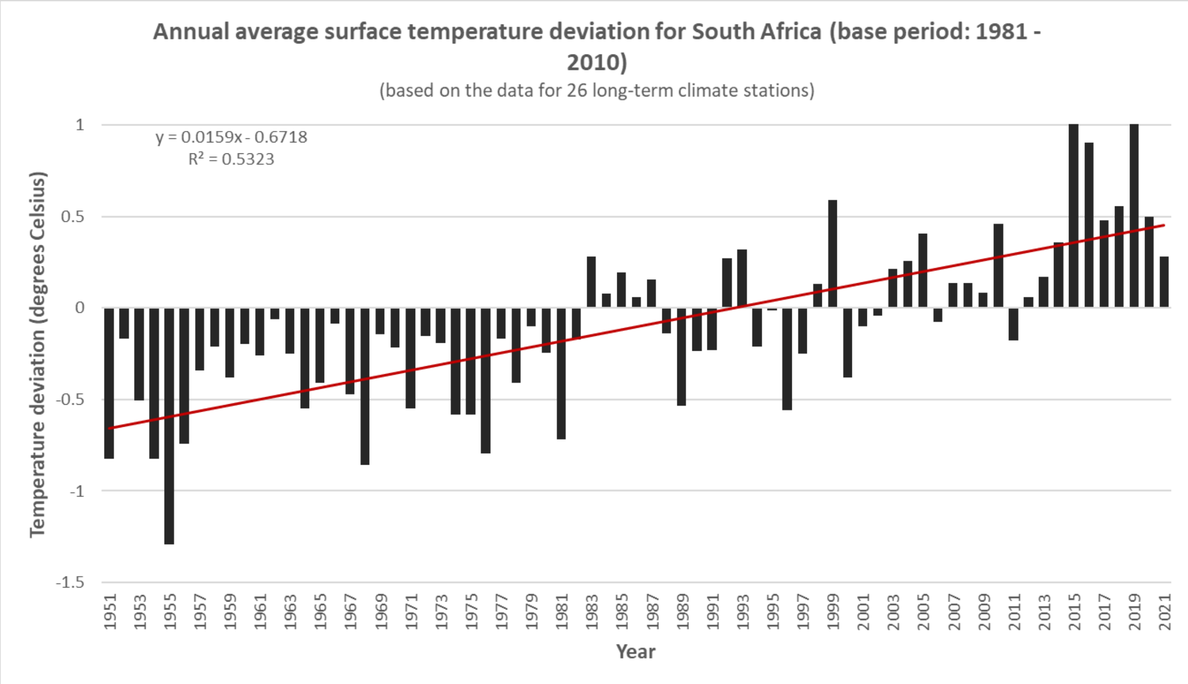


Figure 3.1 Average surface temperature deviation over South Africa based on 26 climate stations: 1951 - 2021 (base period: 1991 - 2020). The linear trend is indicated (Source: South African Weather Service).

3.1.2 Rainfall

A significant feature of the rainfall received during the hydrological year 2020/21, presented in Figure 3.2 is above-normal rainfall received over some parts of South Africa. The above-normal rainfall was experienced mostly in the eastern-half summer rainfall region parts of the country. In contrast, the southern parts of the country received below-normal rainfall.

A comparison of the rainfall anomalies for the hydrological year 2020/21 to the anomalies of the past three hydrological years is presented in Figure 3.2. The section of South Africa experiencing drought has further decreased over the past four hydrological years. This is due to good rains received early in the summer season from November 2020 through to February 2021 (See Figure 3.3).

The southwestern parts of the country typically receive winter rainfall, and during the winter season (Figure 3.4), significant rainfall was received in the southern parts of the Western Cape between May and August 2020. The coastal parts South of KwaZulu-Natal and the northern parts of the Eastern Cape received significant amounts of rainfall during September 2021.

The long-term rainfall trend analysis per water management area is presented in Figure 3.5; Rainfall (% of Normal) for October 1981 - September 2021. The Normal Period used is October 1981 to September 2010. Important from the anomalies plots is that for the 2020/21 hydrological year, most WMAs were classified as having experienced an average year. This is apart from the Vaal and Olifants WMA, which experienced a wet hydrological year, according to the classification. Having experienced a wet year, surface storage Dam levels are expected to have been the highest in the Vaal and Olifants water management area during the reporting period.

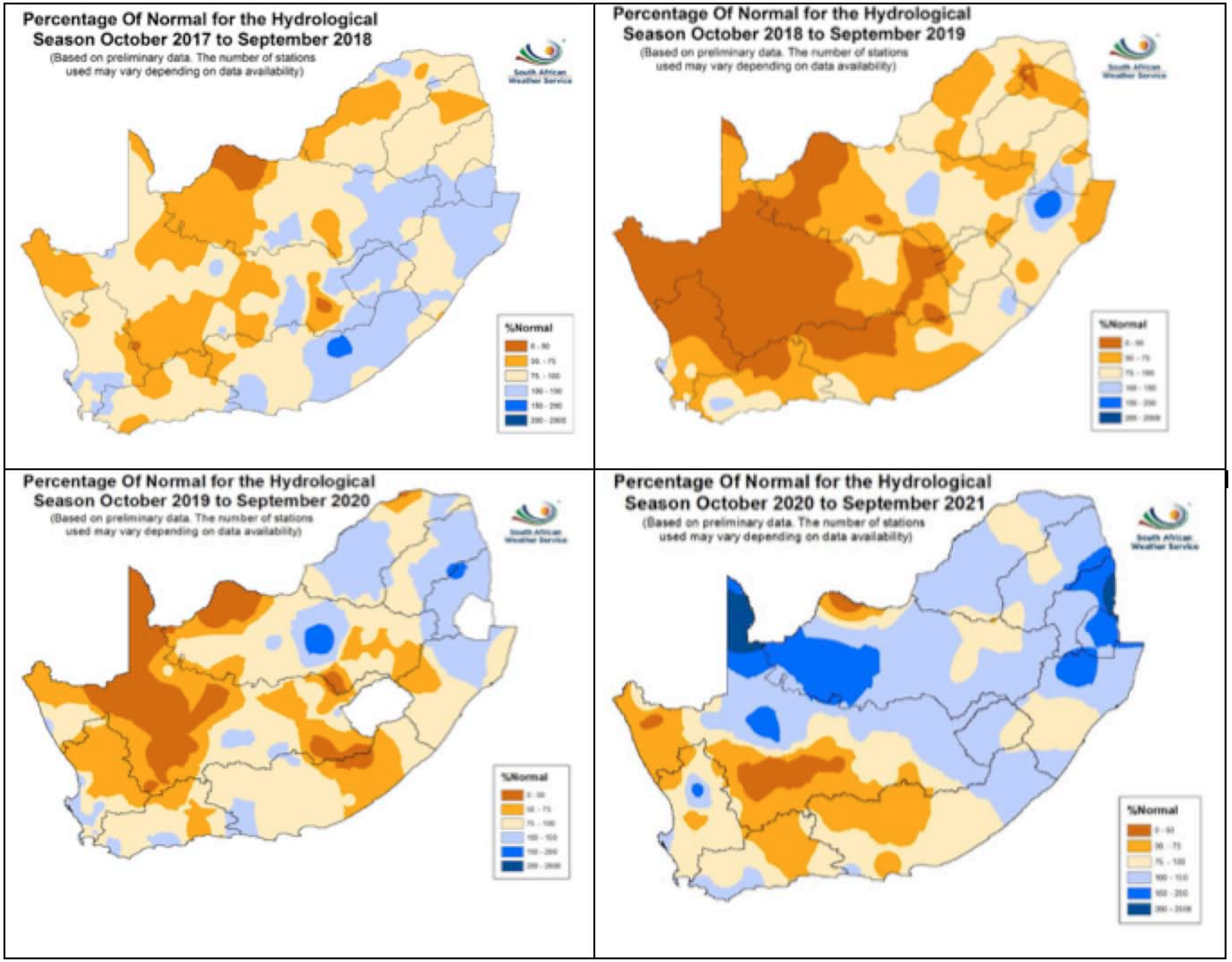


Figure 3.2 Rainfall % anomalies for the past three hydrological years in comparison to 2020-2021. Blue shades are indicative of above-normal rainfall and the darker yellow shades of below-normal rainfall ((Source: SAWS https://www.weathersa.co.za/home/historicalrain)

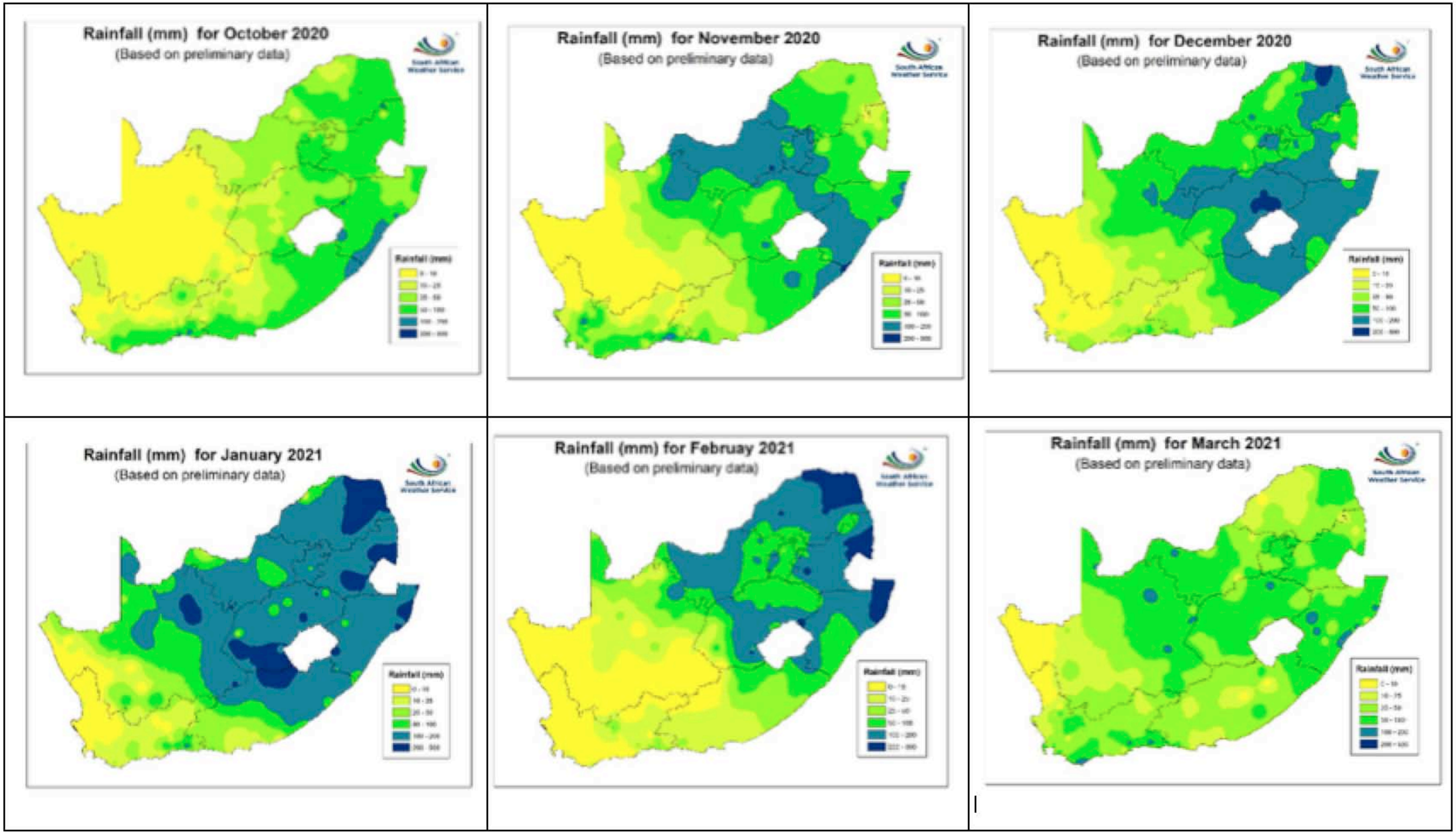


Figure 3.3 Summer season monthly rainfall distribution

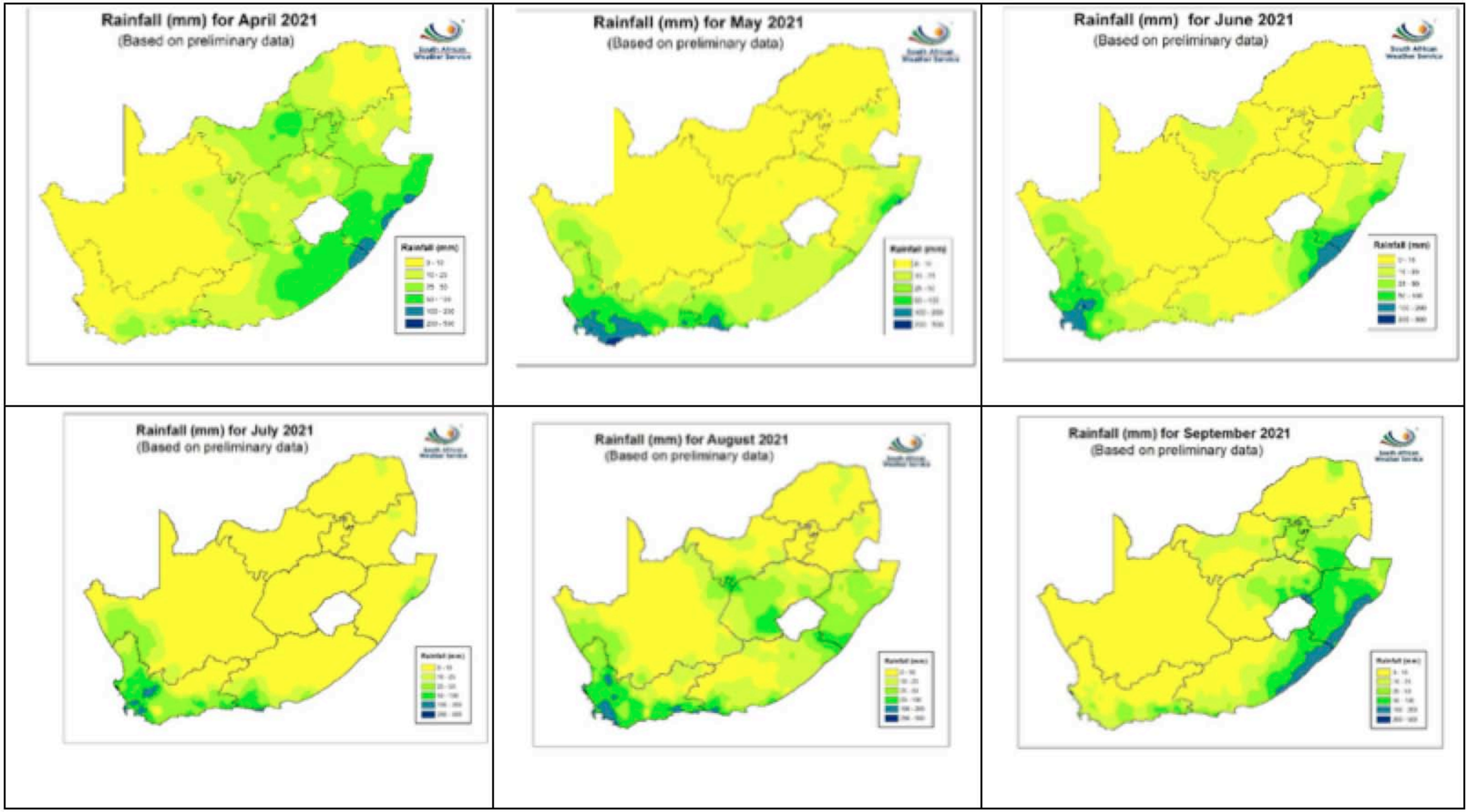


Figure 3.4 Winter season monthly rainfall distribution

Figure 3.5 Hydrological year long-term trends of Rainfall Anomalies: > 125% (wet) & < 75% (dry) (Data Source: SAWS)

3.2 Indicators of Drought

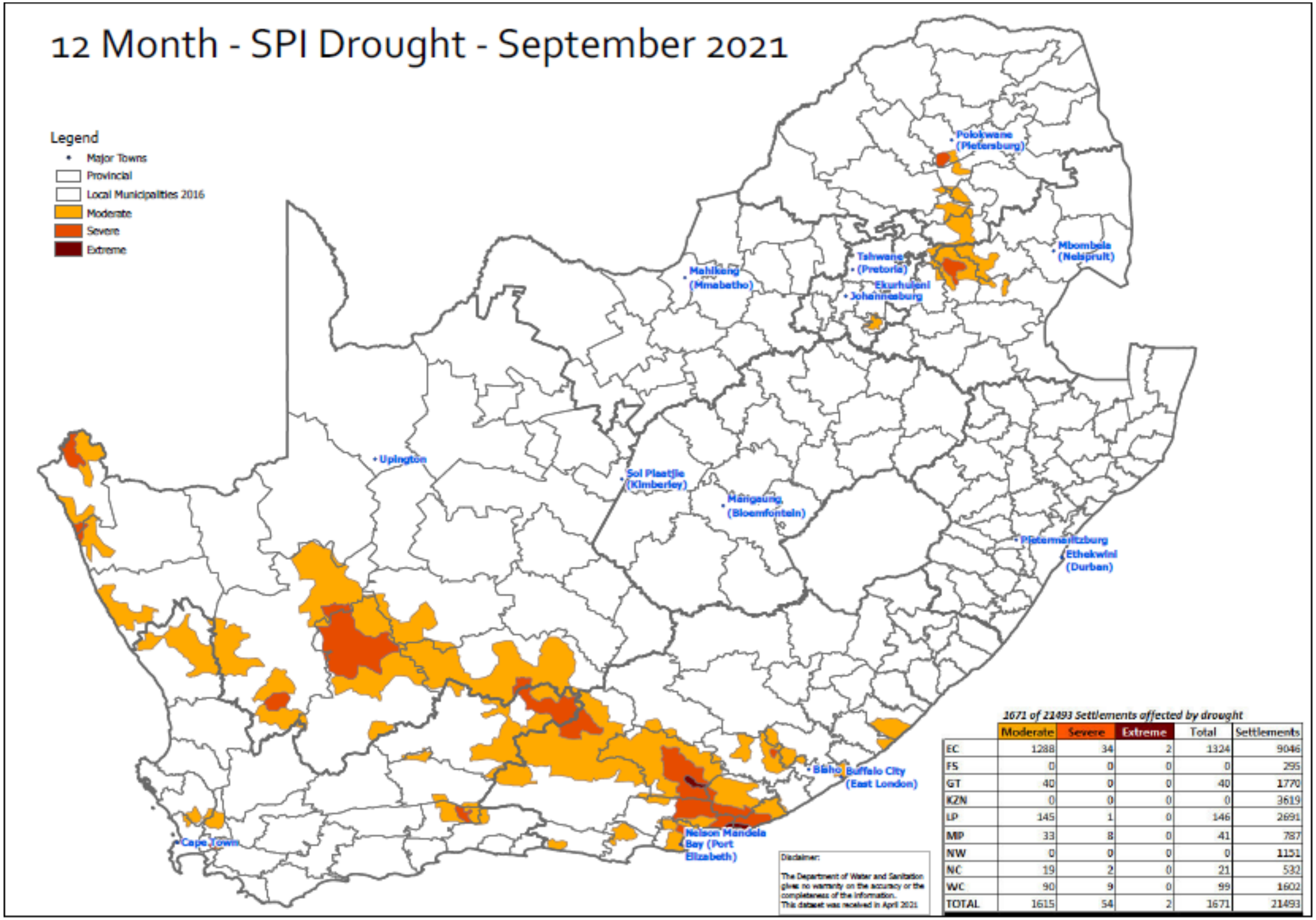
Meteorological drought is defined based on rainfall deficiencies compared to "normal" or average amounts of rainfall for a particular area or place and the duration of the dry period.

The Standardized 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. Long-term drought usually occurs when moisture supply is abnormally below average for periods of up to two years, where-after widespread desiccation occurs. A 12-month SPI is a comparison of the precipitation for 12 consecutive months with the same 12 consecutive months during all the previous years of available data, respectively. SPIs of this medium timescale are useful in identifying areas of drought, as they are subsequently linked to streamflow, reservoir levels, and even groundwater levels in shallow aquifers.

The medium-term observation (12-month) SPI map is presented in Figure 3.6. Even though for the reporting period, above-normal rainfall was received in the eastern half of the country, dry conditions are still noticeable in the isolated parts of Mpumalanga and Limpopo Province, the southern parts of the Northern Cape Province, and the southern parts of the Eastern Cape. Table 3-1 gives the affected District and Local Municipalities during the hydrological year.

Presented in Figure 3.7 is the long-term time series of the SPI per Province. At the beginning of the wet season in October 2015, all Provinces have experienced below normal rainfall, except for the Eastern Cape Province, which received above-normal rainfall up until July 2016. An observation is made that post July 2016, and the Eastern Cape Province has been receiving below normal rainfall to date, while the Western Cape and Northern Cape Provinces have been receiving below normal rainfall from October 2015 to date. It was only in June 2021 where the Western Cape Province received slightly higher than normal rainfall. Technically, only the Eastern Cape is still in a hydro-meteorological drought. Therefore, for the SPI to become positive, a continuous moderate to extremely wet conditions resulting from above-normal rainfall for several months, is required in the province.

The 2020/21 summer rainfall season was relatively wet, with large parts of the country receiving above-normal rainfall since October 2020. The 2021 winter rainfall season was also reasonably wet, with good rainfall totals received since the onset of its rainfall season. The 2020/21 hydrological year has seen the North West, Gauteng, Northern Cape, Free State and Limpopo receiving above-normal rainfalls.



1671 of 21493 Settlements affected by drought

	Moderate	Severe	Extreme	Total	Settlements
EC	1288	34	2	1324	9046
FS	0	0	0	0	295
GT	40	0	0	40	1770
KZN	0	0	0	0	3619
LP	145	1	0	146	2691
MP	33	8	0	41	787
NW	0	0	0	0	1151
NC	19	2	0	21	532
WC	90	9	0	99	1602
TOTAL	1615	54	2	1671	21493

Figure 3.6 12-Month SPI Map for September 2021

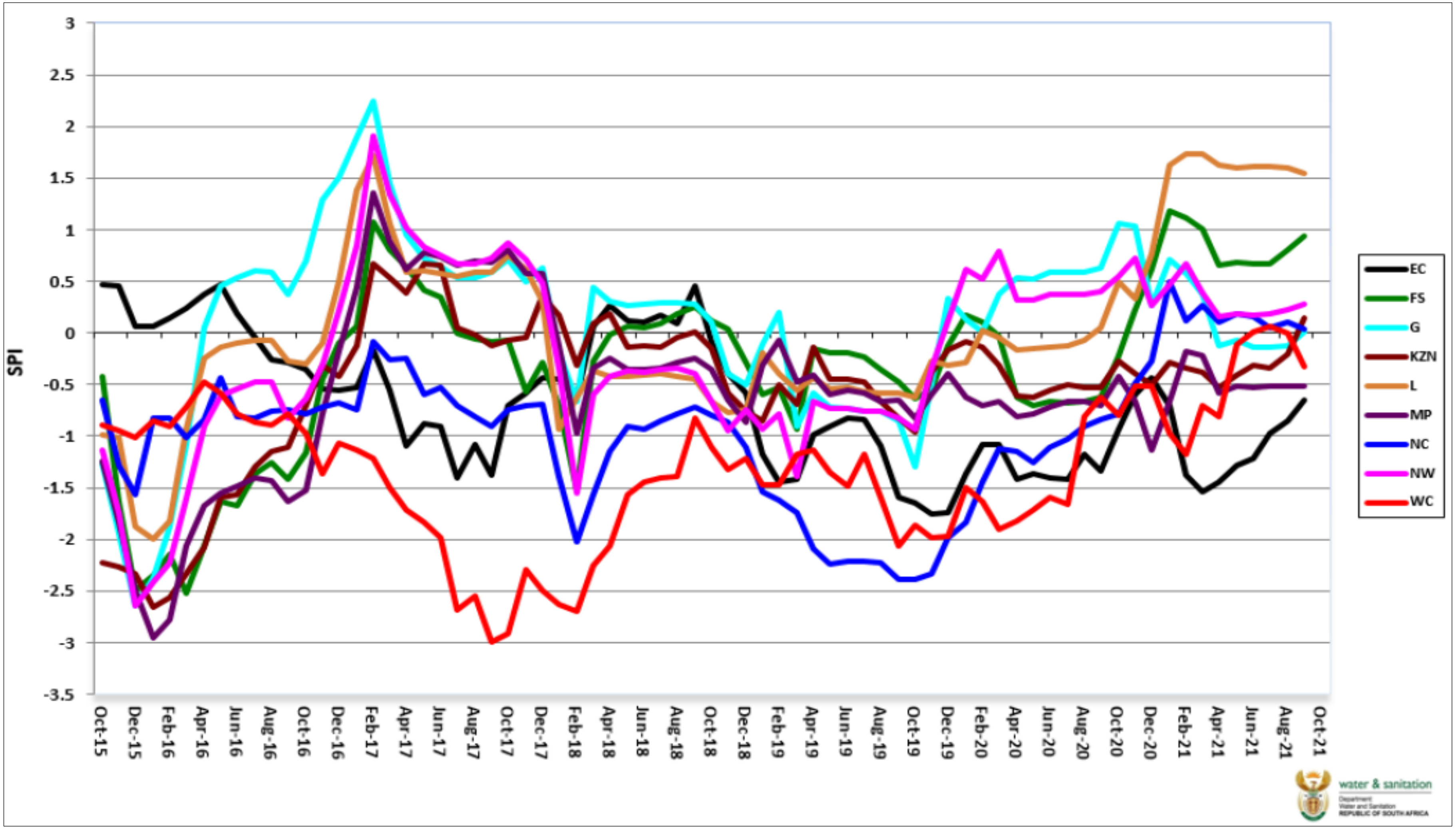


Figure 3.7 Provincial SPI time series from October 2015

Table 3-1 Drought affected Districts and Local Municipalities

Province	Affected District Municipalities	Affected Local Municipalities
Eastern Cape	Amathole	Amahlathi Local Municipality Mbhashe Local Municipality Mnquma Local Municipality Raymond Mhlaba Local Municipality Ngqushwa Local Municipality
	Buffalo City	Buffalo City Local Municipality
	Chris Hani	Enoch Mgijima Local Municipality
	Joe Gqabi	Elundini Local Municipality
	Nelson Mandela Bay	Nelson Mandela Bay Local Municipality
	Sarah Baartman	Sundays River Valley Local Municipality Blue Crane Route Local Municipality Dr Beyers Naudé Local Municipality Kou-Kamma Local Municipality Makana Local Municipality Ndlambe Local Municipality Sundays River Valley Local Municipality
Limpopo	Capricon	Lepelle-Nkumpi Local Municipality Polokwane Local Municipality
	Sekhukhune	Elias Motsoaledi Local Municipality Ephraim Mogale Local Municipality Makhuduthamaga Local Municipality
Mpumalanga	Ehlanzeni	Thaba Chweu Local Municipality
	Nkangala	Emakhazeni Local Municipality Steve Tshwete Local Municipality
Northern Cape	Namakwa	Nama Khoi Local Municipality Richtersveld Local Municipality
Western	Cape Winelands	Drakenstein Local Municipality

Province	Affected District Municipalities	Affected Local Municipalities
Cape	Cape Winelands	Stellenbosch Local Municipality
	Central Karoo	Beaufort West Local Municipality
	Central Karoo	Prince Albert Local Municipality
	City of Cape Town	City of Cape Town Local Municipality
	Eden	Oudtshoorn Local Municipality
	West Coast	Matzikama Local Municipality
	West Coast	Swartland Local Municipality
Gauteng	Ekurhuleni	Ekurhuleni Local Municipality
	Sedibeng	Lesedi Local Municipality

3.3 Extreme Weather Events

In South Africa, dry conditions persisted over large parts of the west of the country and in some parts the dry conditions have continued for approximately seven years (Kruger and Mcbride, 2020).

3.3.1 Tropical cyclone Eloise

Tropical cyclone Eloise was the sixth tropical cyclone to develop in the Southwest Indian Ocean and the third such system to affect southern Africa. “Eloise” made landfall in the early morning hours of 23 January 2021 over the coast of Mozambique around the city of Beira, resulting in significant damage to infrastructure and loss of lives in the city. A few hours after its landfall, “Eloise” lost its strength and was reduced to an overland tropical depression (SAWS, 2021).

Figure 3.8 presents unified model depicting the 24-rainfall occurrence in (A) and (B), indicating areas over the Lowveld region of Limpopo and Mpumalanga that received significant rainfall amounts on the 23rd of January. Stations such as Tshanowa Primary School outside of Thohoyandou recorded 188 mm of rainfall on 23 January 2021 and in the early morning of 24 January 2021, whereas Woodbush recorded 300 mm for the same period. Some parts of Limpopo and eastern parts of Mpumalanga and KwaZulu-Natal received up to 200 mm of rainfall on the 25th of January 2021 –Charters Creek, for example, in KZN had recorded 205mm of rainfall.

It is important to note that from 26 – 28 January, the dominant weather systems were no longer that of a tropical system, but it was rather a surface trough over the western parts of the country and an upper air trough west of the country (SAWS, 2021). The total measured rainfall for the period 23 January to 8 February 2021 is presented in Figure 3.8(C), while the indications of locations with adverse incidence and impacts related to these extreme events are presented in Figure 3.8(D).

The notable rainfall totals measured for this extreme event (23 January to 8 February 2021) are:

- Tshanowa Primary School (Limpopo): 599,6mm
- Kruger Airport (Mpumalanga): 388,3mm
- Charters Creek (KZN): 367,6mm
- Thohoyandou (Limpopo): 343,6mm
- Levubu (Limpopo): 323,6mm.

The observed hydrographs from the flow gauging stations within the vicinity of the rainfall stations where extreme storm events were observed are presented in Figure 3.9 for the following flow stations:

- **A9H003** – Tshinane River at Chibase in Limpopo.
- **A9H012** – Luvuvhu River at Mhinga Village in Limpopo (downstream of the Nandoni Dam).
- **A9H029** – Mutale River at Thengwe Village in Limpopo (Tributary of Luvuvhu River, before the confluence with the Limpopo River); and
- **X2H032** – Crocodile River at Weltevrede in Mpumalanga, by the Kruger National Park.

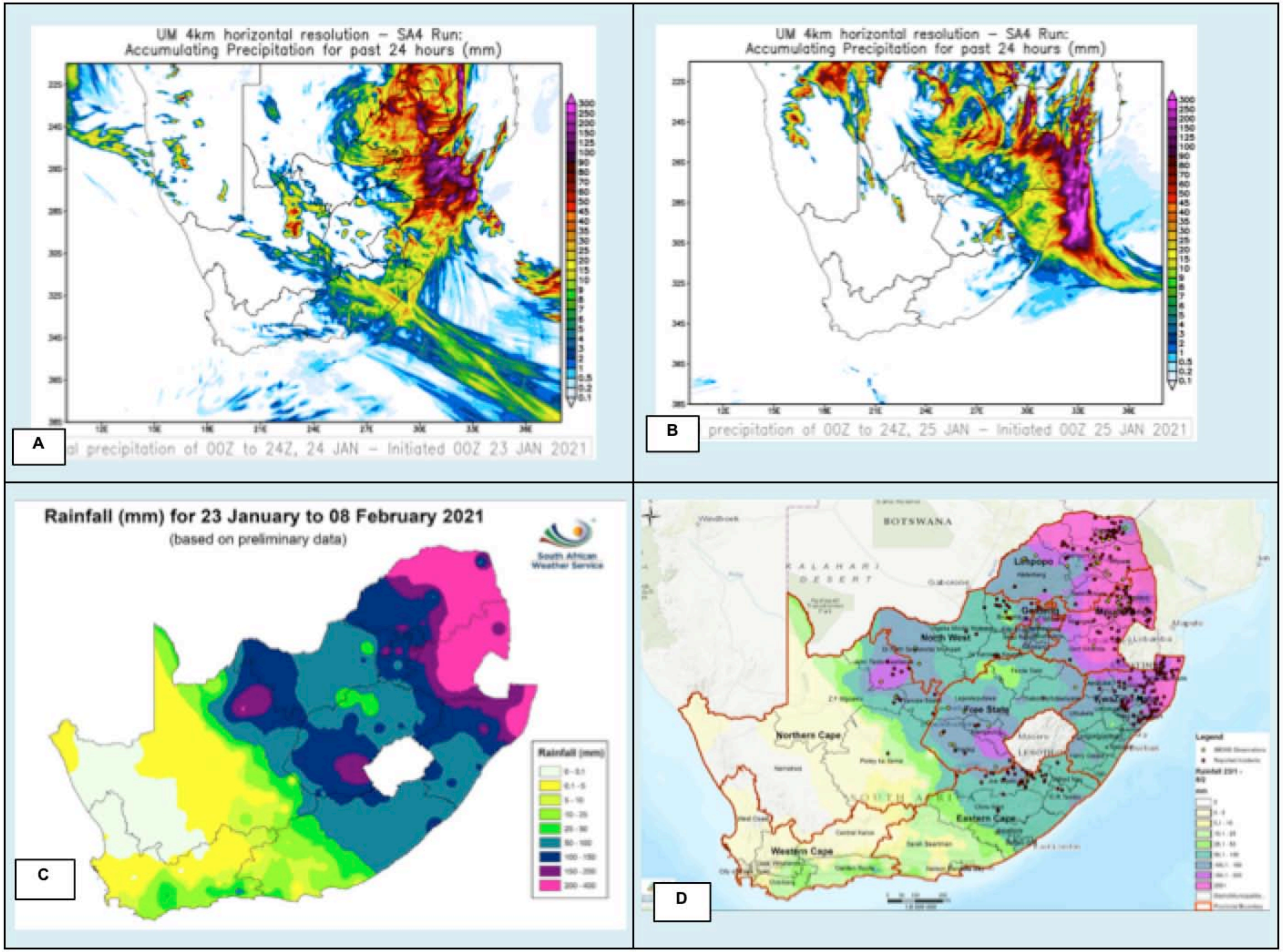


Figure 3.8 Unified model depicting 24-hour rainfall accumulation for 24 January 2021 (A) & 25 January 2021 (B) (Source: SAWS), (C): Total measured rainfall (mm) for the period 23 January to 08 February 2021 (Source: SAWS), (D): Composite map of total rainfall (provided by SAWS), overlaid with mapped locations of adverse incidents and impacts in relation to this event (Source: NDMC)

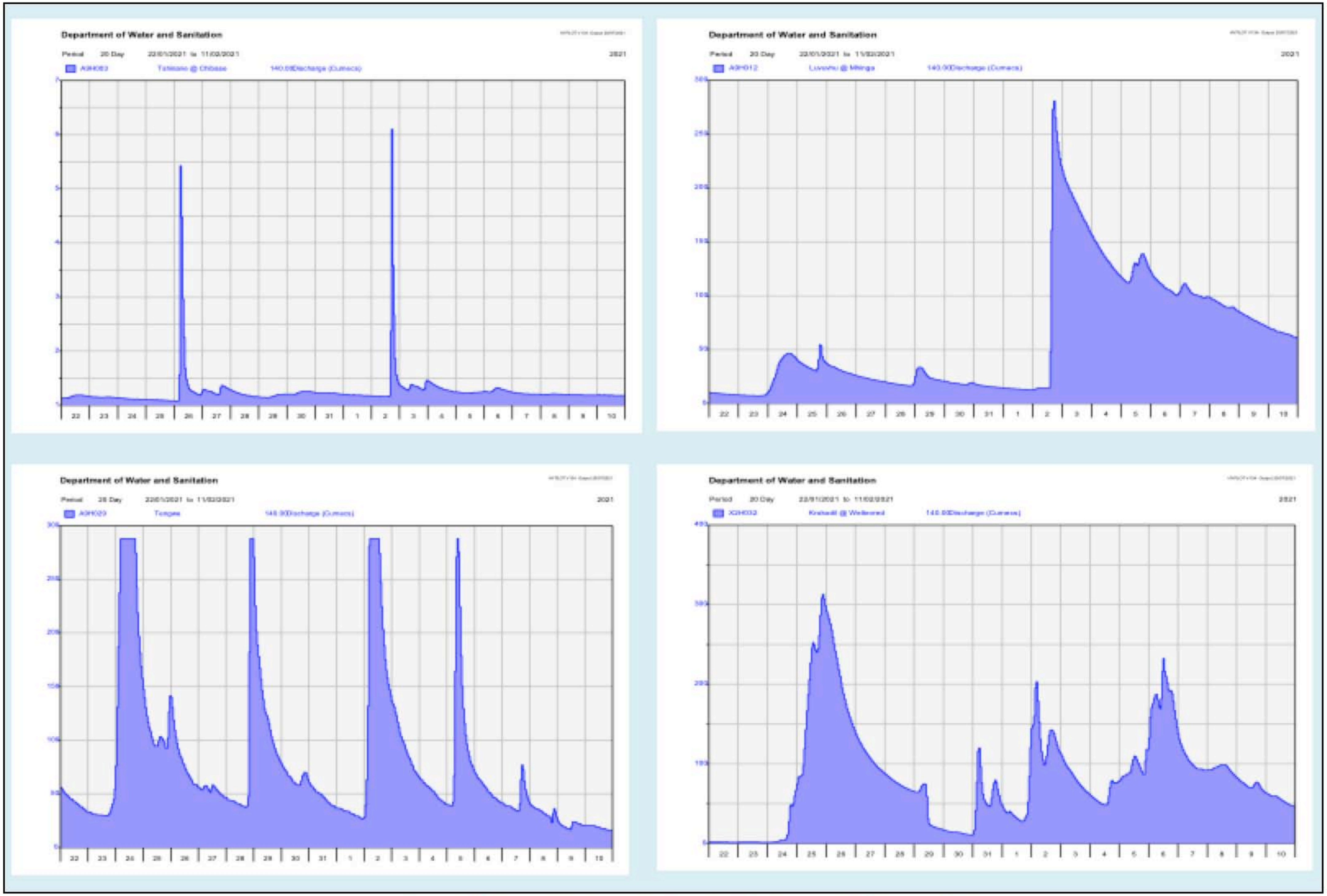


Figure 3.9 Observed hydrographs for period 22 January - 10 February 2021

3.4 Climate Change

According to the Department of Environmental Affairs (2017), Climate change is already a measurable reality posing significant social, economic, and environmental risks and challenges globally. South Africa is especially vulnerable to the impacts of climate change. South Africa has a tremendous task of balancing the acceleration of economic growth and transformation with the sustainable use of environmental resources and responding to climate change.

Water is the primary medium through which the impacts of climate change are being felt in South Africa, according to the National Water Resource Strategy (Department of Water Affairs, 2013). Increases in climate variability and climatic extremes are impacting both water quality and availability through changes in rainfall patterns, with more-intense storms, floods and droughts; changes in soil moisture and runoff; and the effects of increasing evaporation and changing temperatures on aquatic systems. Forecasted and current droughts in parts of the country have an impact on crop losses, water restrictions, and impacts on food and water security.

Climate change risk and vulnerability assessments have been completed for the various water management areas and for various systems. Climate Change Risk and Vulnerability assessments are conducted to address certain objectives, such as identifying what could be “hot spots” in terms of climate change-related impacts and assisting in prioritizing adaptation actions. These assessments also provide a better understanding of the socio-ecological system's weaknesses that led to climate change vulnerability, such that the system cannot withstand climate impacts or such that a system may fail due to climate change impacts. System failure in terms of climate change means that the systems can no longer meet the water requirements, and as such, it has failed and is no longer sustainable. It may also mean that a system may never bounce back because its physical characteristic has also changed. Vulnerability assessments are therefore used to inform strategic decisions by identifying which sectors or regions are at risk and are most vulnerable to such changes and what needs to be done as part of adaptation before climate change impacts are dire.

Due to the expected increases in temperature, the systems are likely to be stressed as evaporation rates are likely to increase. Some notable impacts that are of concern:

- Increasing temperatures will lead to high evaporation rates and deteriorating water quality. All Water Management Areas (WMAs) are affected.
- Decreasing rainfall trends from East to West may lead to reduced system yields/ water quantity and less dilution capacity. e.g., the Lower Orange and the Lower Vaal.

- Increase in severity and frequency of extreme events such as droughts and floods that are caused by severe tropical cyclones from the Indian Ocean (The Limpopo, The Olifants, The Inkomati-Usuthu and the Pongola-Umzimkulu).

To meet its responsibility to the South African citizens in response to the impacts of climate change, and to contribute to the international effort to mitigate climate change, the Government of South Africa, in consultation with business, labour and civil society, has endorsed a ***National Climate Change Response White Paper***. The water and sanitation sector has, in response to the White Paper's call, developed a Climate Change Response Strategy for the sector, which is a step towards broadening the focus from climatic prediction and mitigation to response and adaptation options.

Aquifer storage throughout South Africa play a significant role in climate change adaptation with great groundwater resource potential. This is due to the nature of groundwater systems providing a natural buffer against drought impact and have historically provided superb water-supply security and offer cost-effective solutions to improve drought, as evident in some cases in the Eastern Cape Province to augment surface water supplies. Groundwater resources have unique management requirements, requiring integrated land and water management to ensure an equitable and sustainable future.

Conjunctive use of Integrated Water Resources Management, groundwater systems, and surface water resources at the operational level are essential in ensuring water supply security.

4

STATE OF RIVERS

4 STATE OF RIVERS

4.1 Streamflow

It would not be an easy task to derive the difference between the natural streamflow and present-day streamflow, which is passing a specific point within a river system without configuring a rainfall-runoff model such as the WRSM2000. Total natural runoff of water flowing and present-day streamflow has been predicted up to September 2010 primarily based on the WRSM2000 / Pitman Model from the Water Resource Study of 2012.

In the absence of the most current model simulations, the surface water monitoring points that are of strategic importance (outlet of catchments, international obligations importance) and contain long-term continuous data were selected to assess the deviation of streamflow during the reporting period from the normal. A normal mean period was chosen to be from October 1981 to September 2010. A streamflow anomaly was then derived based on the total annual volumes of streamflow at each selected site, and this is presented in Figure 4.1 below.

Below normal streamflow is observed downstream the Vaal-Orange River confluence through to the Augrabies Falls. The flow is lower than normal by between 332- 346 million cubic metres per annum. This below-normal streamflow is likely due to the large dams in the Orange and the Vaal Rivers to facilitate water abstractions and transfers in and out and the highly controlled systems that exist upstream. Higher than normal streamflow has been experienced during the reporting period on the Olifants River at Witbank (eMalahleni), Renoster River at Arriesrus, Great Fish River at Rietfontyn, and Bree River at Wolvendrift.

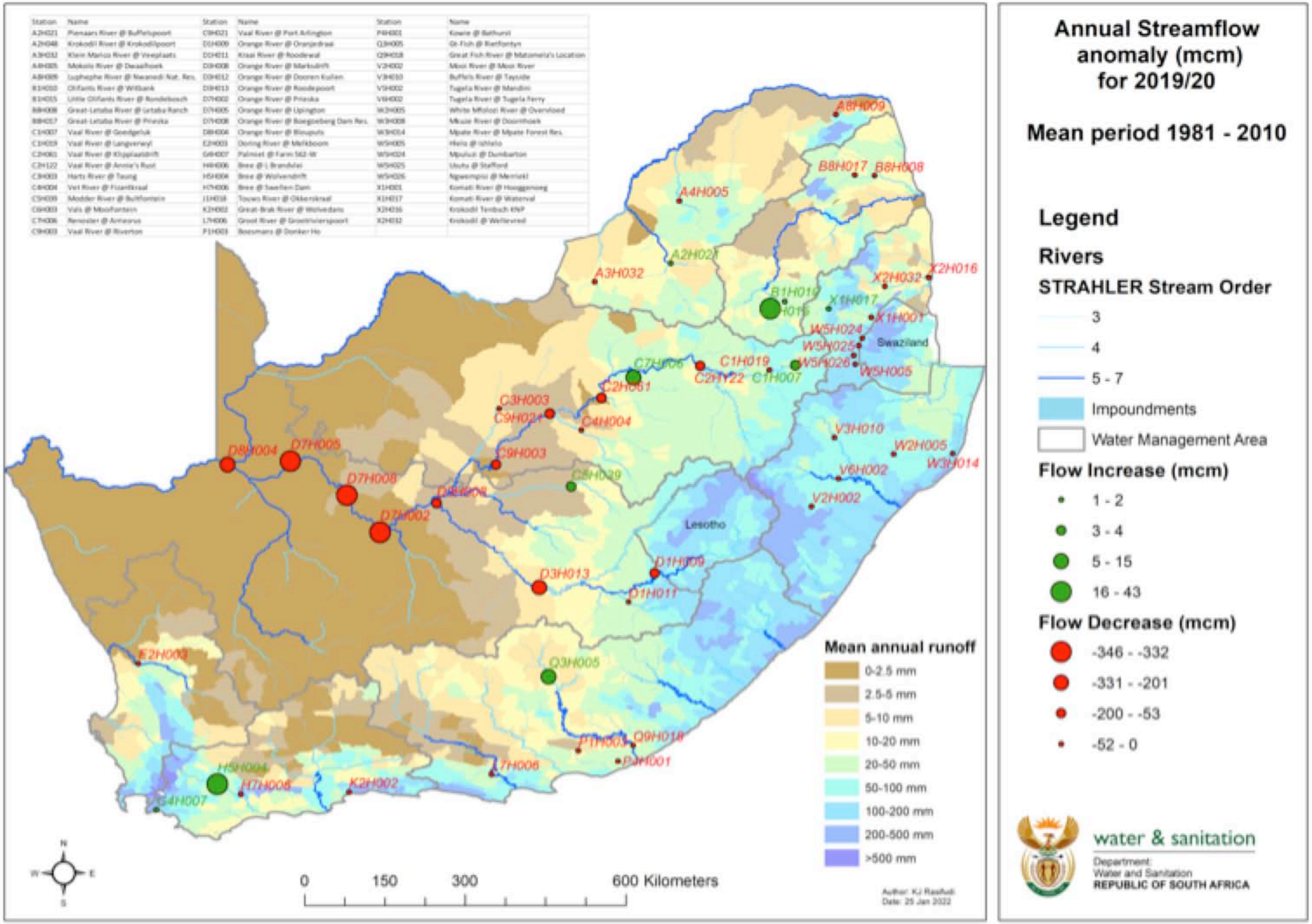


Figure 4.1 Annual Streamflow Anomaly for Strategic River Flow Monitoring Stations

4.2 Surface Water Resource Quality

4.2.1 Eutrophication

Eutrophication is the process of enrichment of water bodies with plant nutrients, particularly phosphorous and nitrogen compounds. It is a natural occurrence during the life of an impoundment (Dam) that can take thousands of years to reach environmentally harmful levels. Intensive human activities and associated water pollution impacts lead to accelerated eutrophication (cultural eutrophication) which results in water quality deterioration in water bodies. This leads to the emergence of eutrophication symptoms such as explosive growth of animal and plant life (algae and macrophytes), leading to negative impacts such as health risks to people and animals, ecosystem degradation, and nuisance during recreational activities, and increased water treatment costs.

This section assesses the trophic status and the potential for eutrophication symptoms for dams and rivers during the reporting period of 01 October 2020 – 30 September 2021. The list of trophic status classes and criterion used to assign the trophic status are given in Table 4-1 and Table 4-2 below, while Table 4-3 provides a summary of the trophic status classes within the monitored provinces.

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

1. **Oligotrophic**	low in nutrients and not productive in terms of aquatic and animal plant life;
2. **Mesotrophic**	intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems;
3. **Eutrophic**	rich in nutrients, very productive in terms of aquatic animal and plant life and showing increasing signs of water quality problems; and
4.**Hypertrophic**	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

The current trophic status for sites monitored during the reporting period is shown in Figure 4.2. Forty-one sites were assigned trophic levels status as part of the National Eutrophication Monitoring Programme (NEMP) for 01 October 2020 to 30 September 2021 period. These lakes, dams, and rivers in Gauteng, Limpopo, Mpumalanga, and North-West Provinces were monitored for nutrient enrichment. Of the 41 dam/lake sites were assigned trophic status of which: *12 were hypertrophic*, *3 eutrophic*, *6 mesotrophic* and *20 oligotrophic.*

In Gauteng, five sites were hypertrophic, two eutrophic, one mesotrophic, and five sites had an oligotrophic status. The hypertrophic sites were Roodeplat Dam, Bon Accord Dam, Leeukraal Dam, Bronkhorstspruit Dam and Rietvlei Dam. The eutrophic sites were Centurion Lake and Florida Lake; the mesotrophic site was Homestead Lake, and the oligotrophic sites were Blaaupan Lake, Civic Lake, Kleinfontein Lake, Victoria Lake, and Vaal Dam. The Homestead Lake was the only mesotrophic.

The North-West region had seven sites with a hypertrophic status, one eutrophic, three with a mesotrophic status, and four had an oligotrophic status. The hypertrophic sites were Hartebeespoort Dam, Roodekopjes Dam, Vaalkop Dam, Klipvoor Dam, Klein-Maricopoort Dam, Lotlamoreng Dam and Modimola Dam. The eutrophic status was noted for Bospoort Dam, and mesotrophic sites were Buffelspoort Dam, Koster Dam, and Olifantsnek Dam, and oligotrophic sites included Lindleyspoort Dam, Marico-Bosveld Dam, and Disaneng Dam.

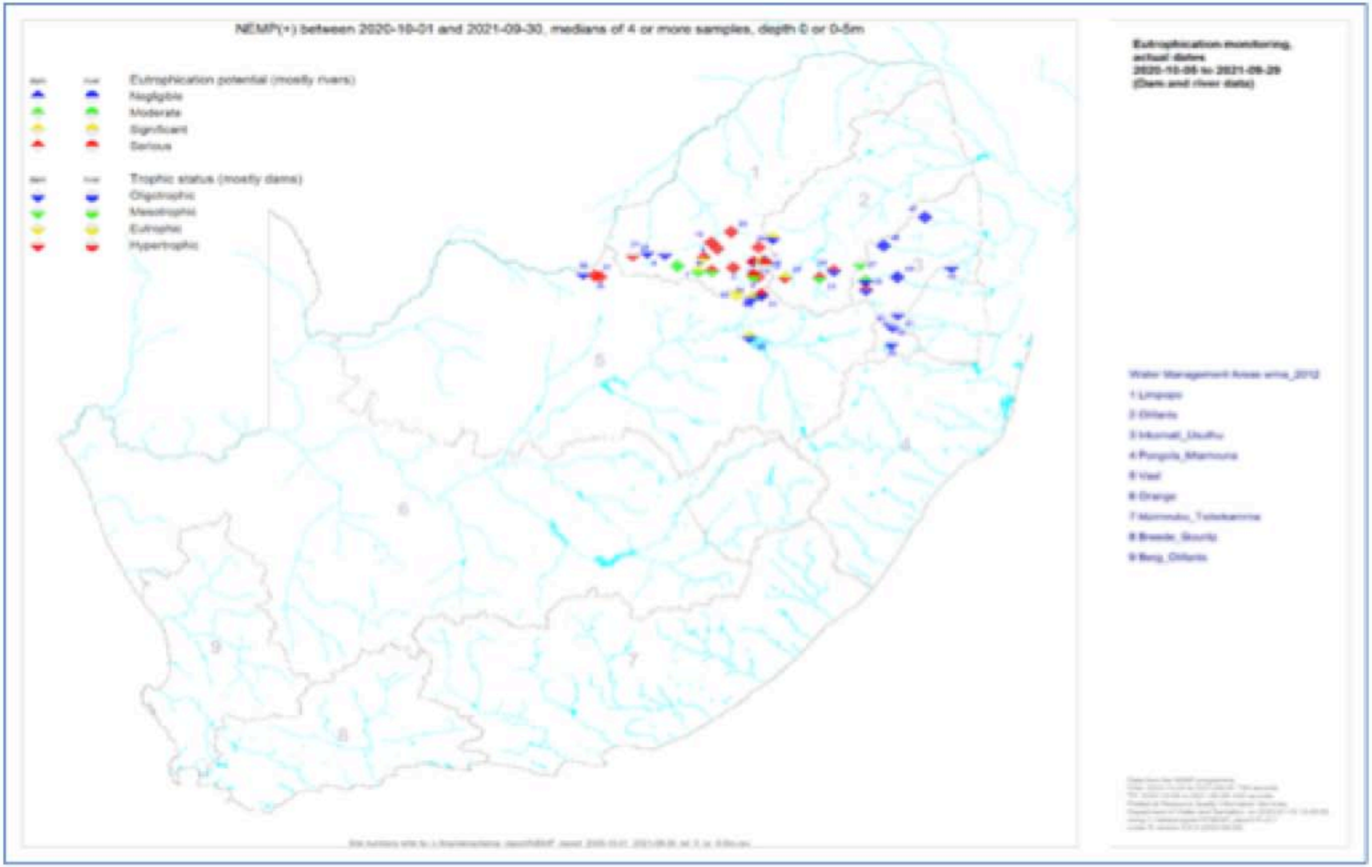


Figure 4.2 Eutrophication monitoring results based on the data collected during the 2020 to 2021 hydrological year

Table 4-3 Summary of NEMP monitoring in South African provinces for 01 October 2020 to 30 September 2021 period

Province	Hypertrophic	Eutrophic	Mesotrophic	Oligotrophic
Gauteng	5	2	1	5
North West	7	1	3	3
Mpumalanga	0	0	2	11
Limpopo	0	0	0	1
Total	12	3	6	20

In Mpumalanga, eleven sites had an oligotrophic status, and two had a mesotrophic status. The oligotrophic sites included Middleburg Dam, Heyshope Dam, Jericho Dam, Morgenstond Dam, Westoe Dam, Boesmanspruit Dam, Nooitgedacht Dam, Vygeboom Dam, Driekoppies Dam, Kwena Dam and Inyaka Dam. Mesotrophic sites were Witbank and Belfast Dam. Limpopo had one mesotrophic status at the Rust De Winter Dam.

This eutrophication report shows incidences of nutrient enrichment for some of the sampled water resources. The high levels of nutrients can be attributed to sewage (domestic and industrial wastewater effluent) inflows into water bodies, agricultural runoff, and untreated effluent from wastewater treatment plants. The symptoms of eutrophication, such as algal blooms and outbreaks of alien aquatic weeds (water hyacinth), have been prevalent in most water resources. Although water hyacinth can absorb nitrogen and phosphorus, the secondary pollution caused by water hyacinth decay increases the level of eutrophication in water bodies (Zheng *et al.,* 2009). The NEMP data acquisition is improving as more monitoring stations get reactivated. This will provide a countrywide view of nutrient enrichment.

4.2.2 Microbial Pollution

Water pollution can have harmful effects on drinking water, recreation and agriculture. Significant sources of pollution of surface waters include agricultural and urban run-off, municipal and industrial effluent, and run-off from rural and informal settlements with insufficient sanitation. Surface water can carry these pollutants into nearby streams, rivers, and coastal waters.

According to the World Health Organisation, 159 million people depend on surface water globally, and at least 1.8 billion people use drinking water sources that are contaminated with faeces. Microbial water quality measures the microbiological conditions of water in relation to human health. The overall purpose of the microbial monitoring programme is to assess and manage the health risks to water users due to faecal pollution of water resources.

Bacterial analyses provide an indication of any contamination from sewage or animal faecal matter. Faecal coliforms and *E. coli* are the best indicators for the assessment of recent faecal pollution, and they also indicate the potential presence of pathogenic bacteria, viruses, and parasites. Faecal coliform and *E. coli* are measured, and results compared to the South African Water Quality Guidelines.

The microbiological data represented on the map (Figure 4.3) shows that surface water resources are not suitable for drinking without any treatment processes. 91% of the collected samples indicate that there was a high risk to human health if the water was consumed directly from the source. This risk is significantly reduced to a low risk if the water is treated before consumption. Limited treatment includes treating water at household level, such as boiling. 9% of the monitored sites still indicate a potential high risk even after limited treatment, which means that those water resources are highly polluted. 71 % of the sampled sites showed a low health risk if water from the source was used for irrigating crops that were eaten raw. Only 49% of the 536 sampled sites were associated with a low Health risk when used for recreational activities. This includes such activities as swimming, washing laundry in the rivers etc., and these activities should be discouraged in some of these monitoring sites that are highly polluted and pose potential health risks to the users. Some of the monitoring sites are highly polluted sporadically located in the Western Cape, Eastern Cape, and Gauteng, and the use of these water resources for domestic and recreational use should be discouraged.

National Microbial Monitoring Programme guidelines in Table 4-4, were used, and there was a high potential health risk if the water was used for drinking purposes with no treatment..

Table 4-4 Guidelines for assessing the potential health risk for the four water uses

	Potential health risk		
	Low	**Medium**	**High**
Water use	***E. coli*** **counts/ 100ml**		
1. Drinking untreated water	0	1 - 10	> 10
2. Drinking partial treated water	< 2 000	2000 – 20 000	> 20 000
3. Full contact recreational	< 130	130 – 400	> 400
4. Irrigation of crops to be eaten raw	< 1 000	1 000 – 4 000	> 4 000

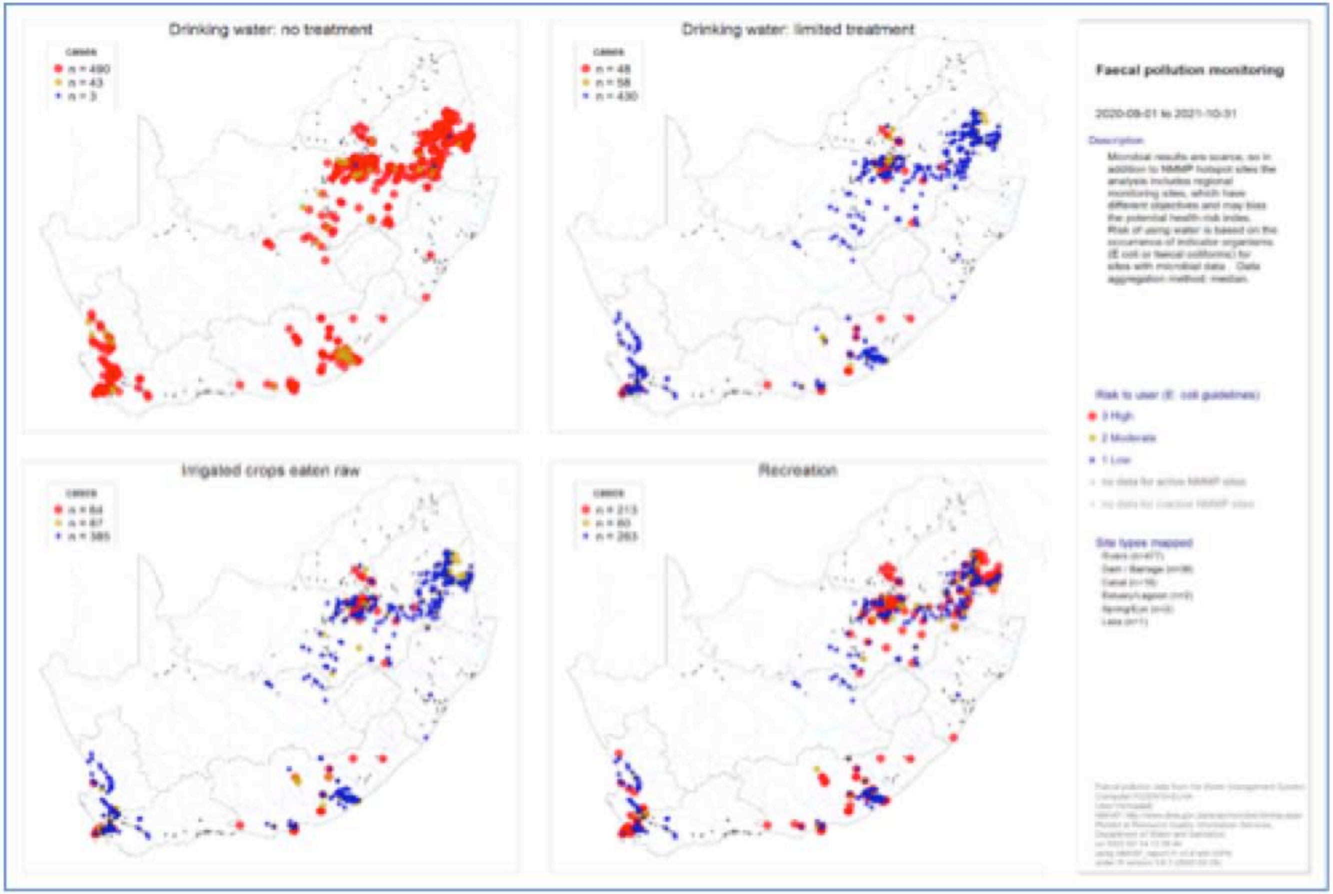


Figure 4.3 Spread of human health risks associated with microbiological pollution in priority hotspots

4.2.3 Chemical

The main inorganic water quality issues of concern on a country-wide basis include the problem of elevated salinity, the perception of failing wastewater treatment works in some municipalities, and acid mine drainage. However, high salinity may also be the result of natural processes due to the geological formations in the catchment and the dissolution of rocks and is also influenced by surface water and groundwater that also contains salts. The levels of these can also be elevated due to urban and agricultural run-off, domestic wastewater effluents, mining or industrial effluent discharges, and others.

The National Chemical Monitoring Programme (NCMP) provides data for interpretation into information on the inorganic chemical quality of the country's surface water. Since the NCMP is a national scale programme, issues that are known and experienced at a local (fine-scale) level may not be reflected at the sites selected to show the overall situation in South Africa. This finer scale is beyond the scope of a national programme and needs to be reported on in catchment and situation-specific assessments, that is, at regional and site-specific water quality management levels.

Due to various ongoing significant constraints, the water quality picture able to be represented is currently lacking or incomplete in many areas of the country. Pre-existing problems at a Department of Water and Sanitation laboratory level to perform maintenance on equipment, purchase new equipment, and obtain the required reagents and other supplies had already contributed to a significant backlog in samples to be discarded when they exceeded their preservative lifespan.

Figure 4.4 represents the water quality situation in **2017-2018** as the most recent period for which there was at least adequate data to provide a water quality depiction of the situation across South Africa. In order to show any water quality fitness-for-use on the presented map, a less stringent requirement of data points per site for the entire year had to be implemented in the above-mentioned assessment. This is clearly not scientifically defensible but needed to be done to represent inorganic chemical water quality on a map.

The information depicted on the map should have been even sparser if scientifically defensible criteria were used (Figure 4.4). Refer to Figure 4.5 for the representation of the 2019-2020 hydrological year. The data are very sparse and do not cover the country well at a spatial level. There is no map available for the 2020-2021 hydrological year.

However, since several inorganic chemical water quality attributes are of a conservative nature, the broad trends evident in previous years are likely to continue unless a major change in land use or management practice takes place.

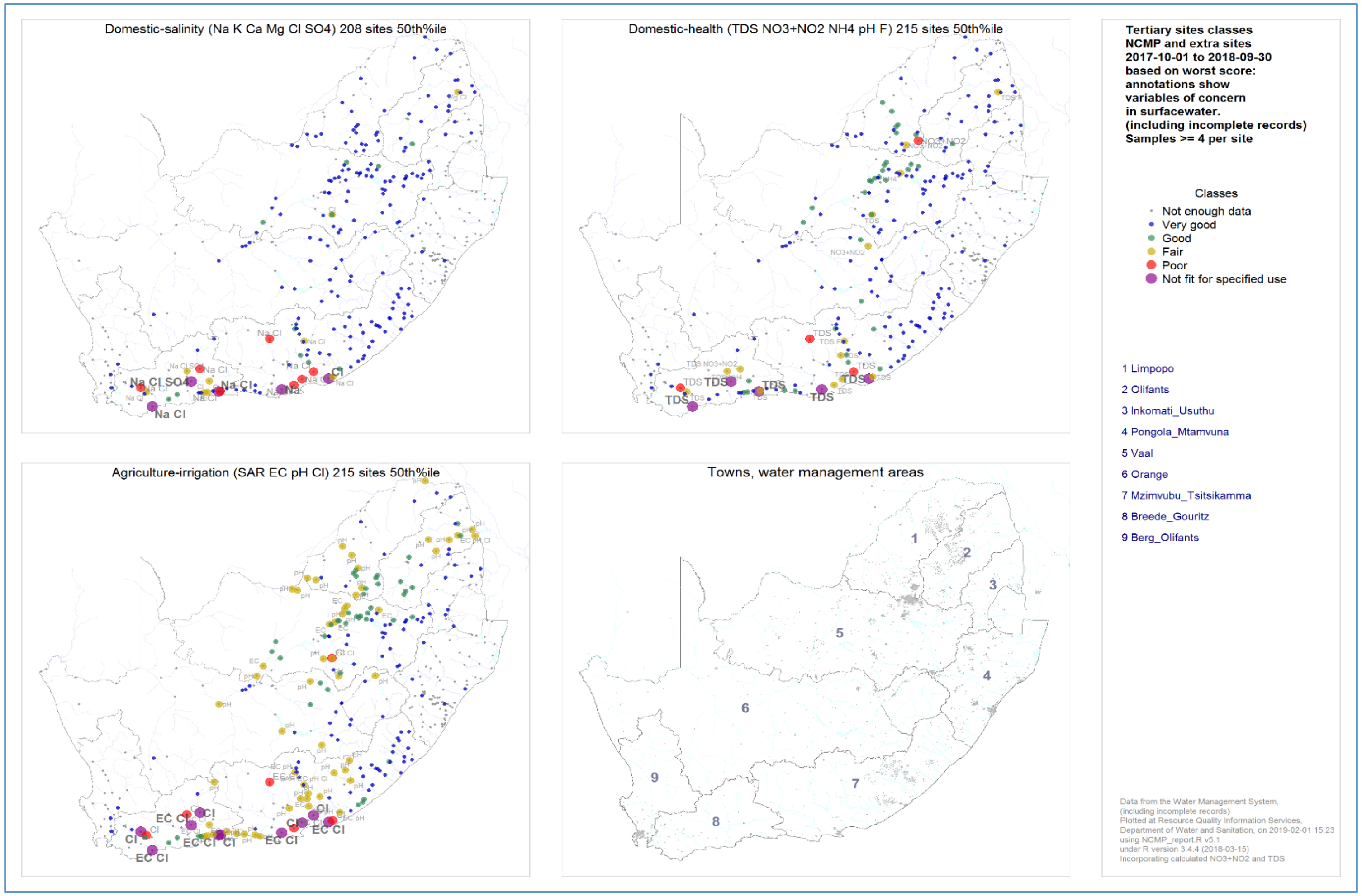


Figure 4.4 The inorganic chemical water quality situation in South Africa during the 2017/2018 period as an example that is still likely to be broadly true of the 2019/2020 situation that has even less data to assess and report on.

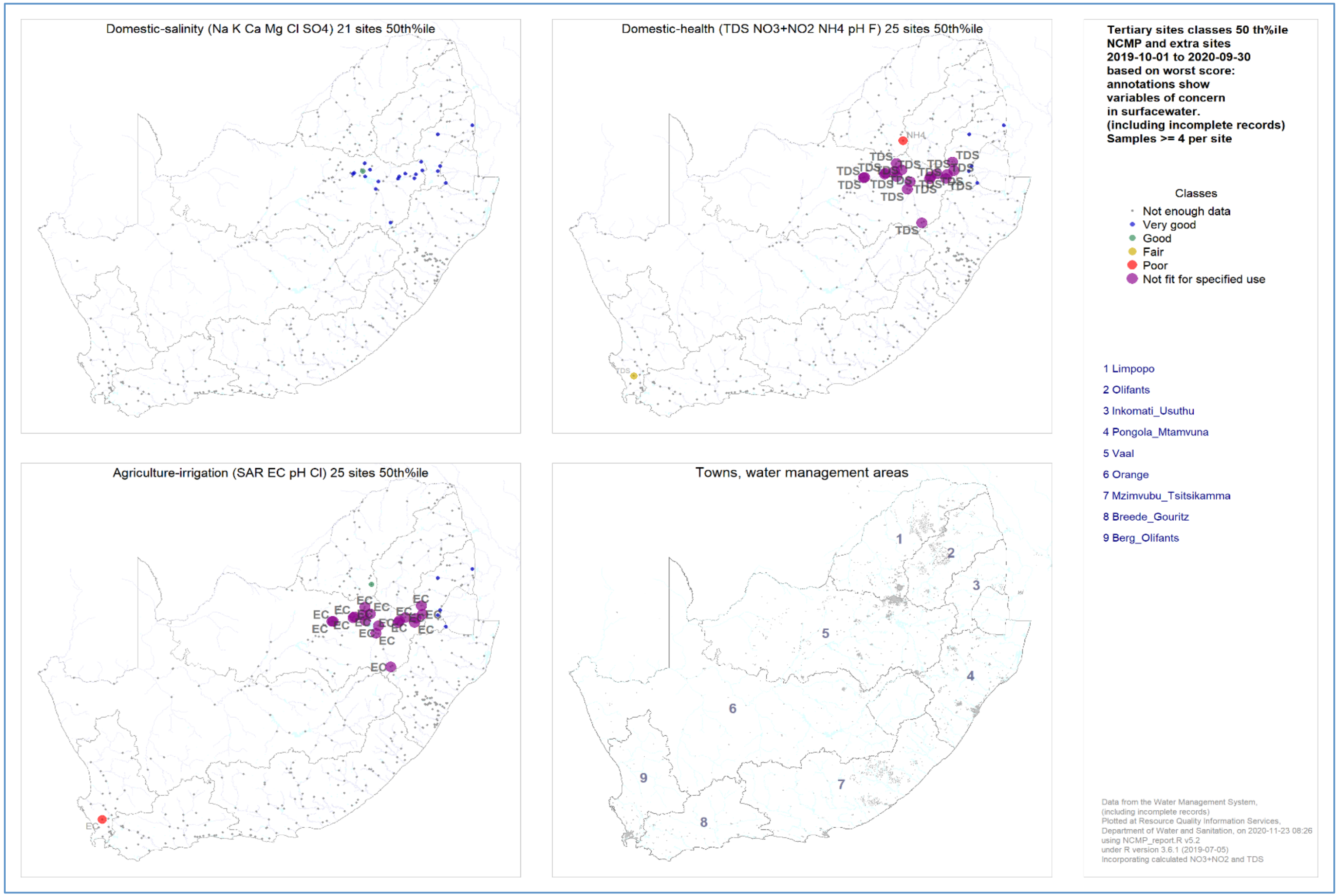


Figure 4.5 The very limited inorganic chemical water quality situation in South Africa during the 2019/2020 hydrological period.

- ***Salinity***

The salinity level of water resources is calculated as total dissolved solids (TDS) or measured as electrical conductivity (EC) and is also gauged from the concentrations of individual ions such as sodium, chloride, magnesium, potassium, and sulphate, amongst others.

Increased salinity affects the taste and perceived freshness of water. When salt levels are high, and the water is used for domestic purposes such as drinking, it can lead to serious health risks in infants under the age of one year; individuals with heart or kidney disease who have been put on a salt-restricted diet; and those with chronic diarrhea. Excessively high levels of salts in water can also affect water infrastructure by corroding water distribution pipes, leading to increased maintenance and replacement costs.

According to Figure 4.4, which reflects the situation evident in 2017-2018, high salinity levels are concentrated around the Southern and Western Cape regions of the country due most likely to marine geology, with a limited occurrence of elevated chloride in the Vaal WMA. There was an isolated pocket of elevated magnesium, chloride, and fluoride in the Olifants Water Management Area (WMA) in the Ga-Selati River at Loole-Foskor (at a Fair level for Domestic Use), and elevated sulfate levels at selected sites within the Breede-Gouritz WMA.

For irrigated agricultural use, high levels of salts (chloride, EC, and the irrigation suitability indicator, the Sodium Adsorption Ratio –SAR) in water can have an impact on sensitive crops resulting in reduced crop yields and hence negatively affecting profitability. The result clearly showed poor to non-acceptable levels of variables impacting irrigated agricultural use in the Southern and Western Cape. There were many instances of elevated EC throughout the Vaal River WMA and Lower Olifants River WMA, where EC and chloride were seen to be within the Fair range. Throughout the rest of the country, there were also incidences of pH levels that are not ideal for irrigated agriculture.

In practical terms, though, the real-life situation may not be as severe as the water quality guidelines would suggest, and this is due to the abruptness of the transition between the Very Good and the Not Very Good water quality ranges that is not realistic. There should be a more gradual transition for it to be meaningful and practical. This is something that needs to be addressed in water quality assessment terms to accurately be able to represent the water's true fitness-for-use.

- ***Potential Problems with Wastewater Works***

Elevated ammonium ($NH4+$) and nitrate-nitrite ($NO3+NO2$) levels could be indicative of the poor performance of wastewater treatment works (WWTW) to meet discharge limits or direct discharge of untreated or minimally treated human or animal waste or agricultural return flows entering the water resource. Two sites within the upper

Crocodile-Marico WMA had elevated nitrate-nitrite levels, a site in the Upper reaches of the Orange River WMA and a site in the Breede-Gouritz WMA. A site in the Upper reaches of the Vaal River WMA had ammonium (NH4+) elevated into the Fair range for Domestic use purposes. Instances of poorly functioning or non-functional WWTW have been reported in the media, including the contamination of the Vaal River in the vicinity of Parys. This affects all classes of water use and has significant negative impacts. Ammonium was also elevated in a site in the Breede-Gouritz WMA.

- ***Acid Mine Drainage***

Acid Mine Drainage (AMD) is a consequence of mining activities and is not unique to South Africa. In the past, it was common practice to abandon mine sites without implementing adequate pollution control measures after mineral extraction was no longer financially viable. There was little concern for the environment since mine closures before the promulgation of the Water Act of 1956 were not subjected to legislative closure requirements. The possible risks of AMD include contamination of shallow groundwater and surface water if mines decant contaminated water. This can affect the suitability of the water resources required for domestic and agricultural uses. Sulfate in combination with low pH (acidic) conditions, can be an indicator of Acid Mine Drainage (AMD).

In 2002 the South African government realized the extent of the negative impact that mine effluent has on the environment and the threat that it poses to our natural resources such as water, especially with concerns about mines in the Western, Central, and Eastern Basins primarily within the Vaal River catchment. There are also initiatives in the KwaZulu-Natal Province to rehabilitate numerous coal mine discard dumps and defunct or ownerless opencast coal mine sites in the Klip River coalfields. The aim is to mitigate the impacts of post-coal mining activities and improve water quality in the catchment.

AMD occurs when abandoned mines are exposed to water, mainly due to inundation by groundwater that then fills up the voids left by mining operations and liberates sulphate and metals from the exposed rock into the water. If the water levels rise and reach the surface, then the polluted water can decant into the surface water resources, reducing the pH levels of the receiving water and contaminating it with high levels of sulphate and metals. This can represent a risk to downstream users and can impact very negatively upon the environment.

On a national scale, reduced pH levels are not necessarily seen to coincide with those areas (the Breede-Gouritz WMA) indicated in Figure 4.4 that have elevated sulphate (SO4) levels. Finer scale and more rigorous sampling will, however, most probably reveal a different picture. The isolated elevated salinity (chloride) levels within the Vaal River may be partially due to AMD. Irrigation return flows and the effects of discharge from urban areas. It must be borne in mind that due to a limited number of samples in many cases across the country, there are indeed water quality problems that are just not being revealed because there are no, or very limited, data. In this case a lack of findings does not necessarily indicate a good situation!

4.2.4 River Ecology

The River Eco-Status Monitoring Programme (REMP) monitors the ecological condition of river ecosystems as reflected by system drivers and biological responses. For the various indicators used in REMP, reference conditions derived from the best available information are determined. The current conditions (Ecological Category) for each indicator are calculated as a percentage change from the reference. The REMP is based on models that incorporate existing approved Eco-Status models. The assessment can be performed at the sub-quaternary reach or site level, and it includes the use of 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). Monitoring is conducted on a quarterly basis and technical reports produced once a year.

Due to COVID-19 challenges, such as a lack of sufficient Personal Protective Equipment (PPE), social distancing, and difficulties in finding accommodation for distant sites, the program has been reduced to only monitoring macro-invertebrates during the 2020-21 hydrological year. This was because macro-invertebrate monitoring is rapid, which meant that less time would be spent at a site, and smaller teams would suffice.

Most of the presented results reflect the condition of the Macroinvertebrates, using the Macroinvertebrate Response Assessment Index (MIRAI), developed by RQIS as a tool to be used during Ecological Reserve Determinations, monitoring for water use license conditions, monitoring of Resource Quality Objectives (RQOs), and the River Ecostatus Monitoring Programme. (Thirion 2008, 2016). The macroinvertebrates were sampled quarterly according to the South African Scoring System version 5 (SASS5) protocol (Dickens and Graham 2002). The MIRAI v2 model (Thirion 2016) for each site was populated with the SASS5 results for the 2018- 2019 Hydrological year. These results were then used to run the model per site, and the condition of the river was expressed as an ecological category, reflecting a percentage change from reference. The Guidelines for interpreting River Ecostatus results are provided in Table 4-5.

Table 4-5 Generic guidelines for interpreting change in ecological categories for REMP (modified from Kleynhans 1996 & Kleynhans 1999). Each category has been colour-coded and correlates to the national and regional maps

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 to pre-development conditions. The resilience of the system has not been compromised.	>92 - 100
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 have 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 change in the natural habitat template, biota and basic ecosystem functions are extensive. Only resilient biota may survive and it is highly likely that invasive and problem (pest) species may 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
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

During this reporting period, the number of sites where macroinvertebrate monitoring could be conducted increased to 401, from 369 in the 2019-20 hydrological year. This increase in the number of sites monitored was mostly due to increased monitoring by the IUCMA. During the 2019-20 hydrological year the IUCMA could not monitor the Sabie catchment at all. It is worth noting, however, that the program appears to be stabilizing, as 321 of these sites were the same as those monitored during the 2019-20 hydrological year; the 80 percent repetition rate aids in the development of trends and a better understanding of our river systems. These trends are depicted in Figure 4.6 below. Approximately 60.5% of sites remained in the same category as the previous reporting period; most of these were sites in the C category (see Table 4-5) for an explanation of ecological categories). Sites in this moderately modified condition (C category) seem to be resilient and not easily respond to changes. They could maintain basic ecosystem functions, provided the catchments around them do not get subjected to severe disturbances. There was an improvement at 22% of the sites and a decline in ecological condition at 17.5%.

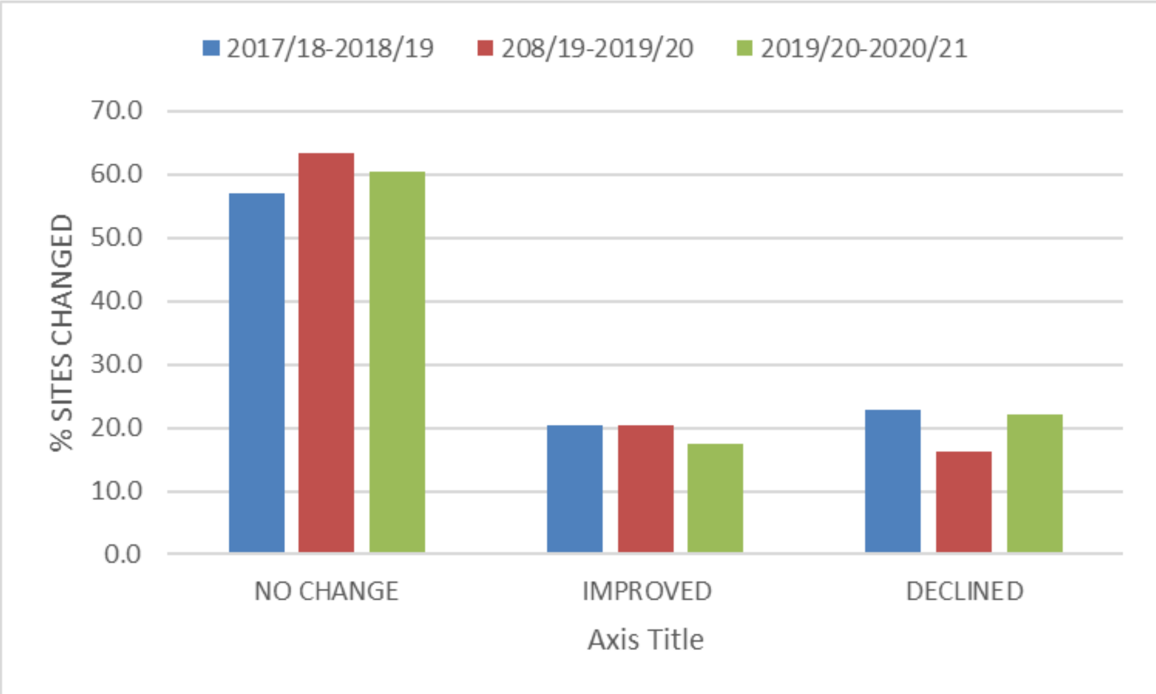


Figure 4.6 Rate of change in the macroinvertebrate ecological condition at sites monitored from 2017-18 to the 2020-21 hydrological years

Figure 4.7 indicates the distribution of the monitored sites and their condition. Almost 60% of the sites were moderately in a moderately modified (C) category C. Approximately 2% of the sites were in an unsustainable seriously modified (E category) or close to seriously modified (D/E) condition. As can be seen from Figure 4.7 these sites were mostly located in the urban areas of Gauteng. Approximately 15% of the sites were in a Largely Natural (B) and close to Largely Natural (B/C) condition. These sites were mostly located near the source or in rural areas. The Lotterings river, which was in the BC category in the 2019-20 hydrological year, deteriorated to a moderately modified (C) category, while most of the sites in the Apies, Hennops, Crocodile, Jukskei, and Pienaars rivers were in a largely modified condition (D – D/E). Because these rivers are mostly located in densely populated areas or run through cities and towns, they deteriorate because of impacts. The Kromme River flows through a drought-affected area of the Eastern Cape, and the Vaal River has ongoing water quality issues.

Most (72%) of the largely modified (D category) to seriously modified (E) sites were in the upper Crocodile and upper Vaal sub-catchments, which are subjected to intensive urban and industrial development Figure 4.8. As can be seen in Figure 4.9, almost 50% of the sites in near-natural conditions (B and B/C categories) occurred in the Inkomati (X) drainage region. The other largely natural sites were either in the upper of rivers and in smaller tributaries.

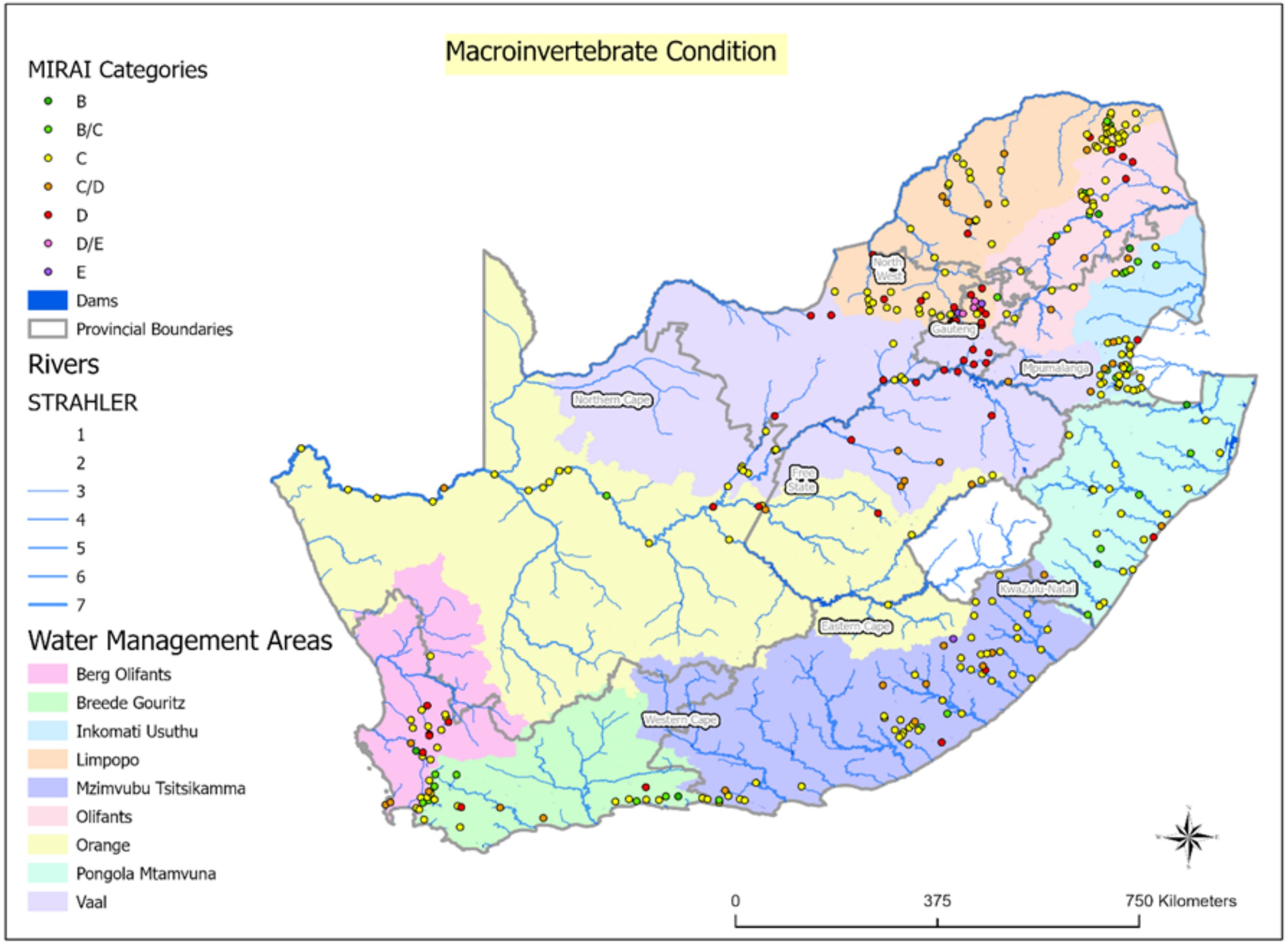


Figure 4.7 Summary Ecological Categories reflecting the macroinvertebrate condition for 401 sites in selected rivers monitored during the 2020/2021 hydrological year

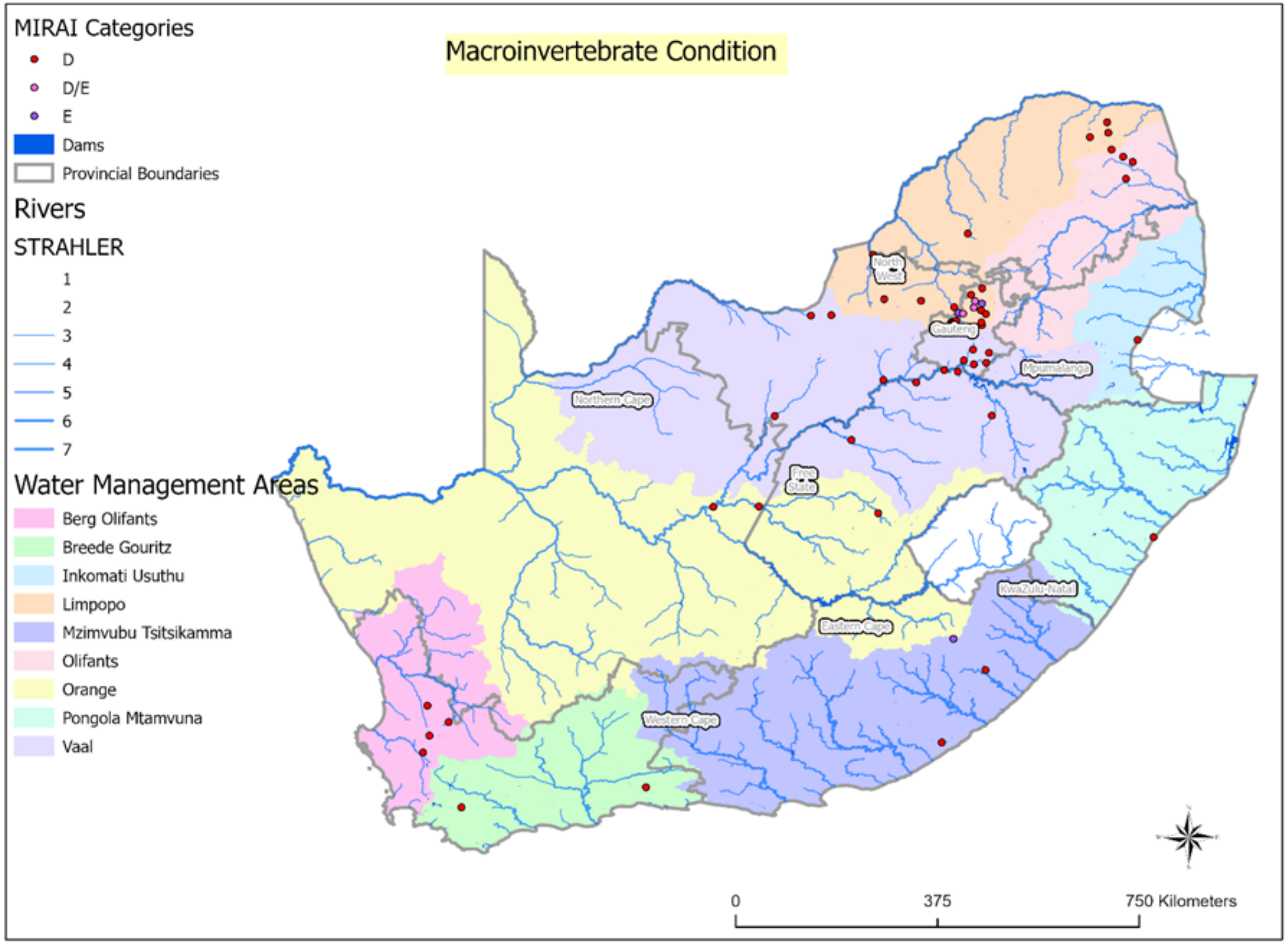


Figure 4.8 Ecological Categories reflecting the macroinvertebrate condition for sites in poor condition in selected rivers monitored during the 2019/2020 hydrological year

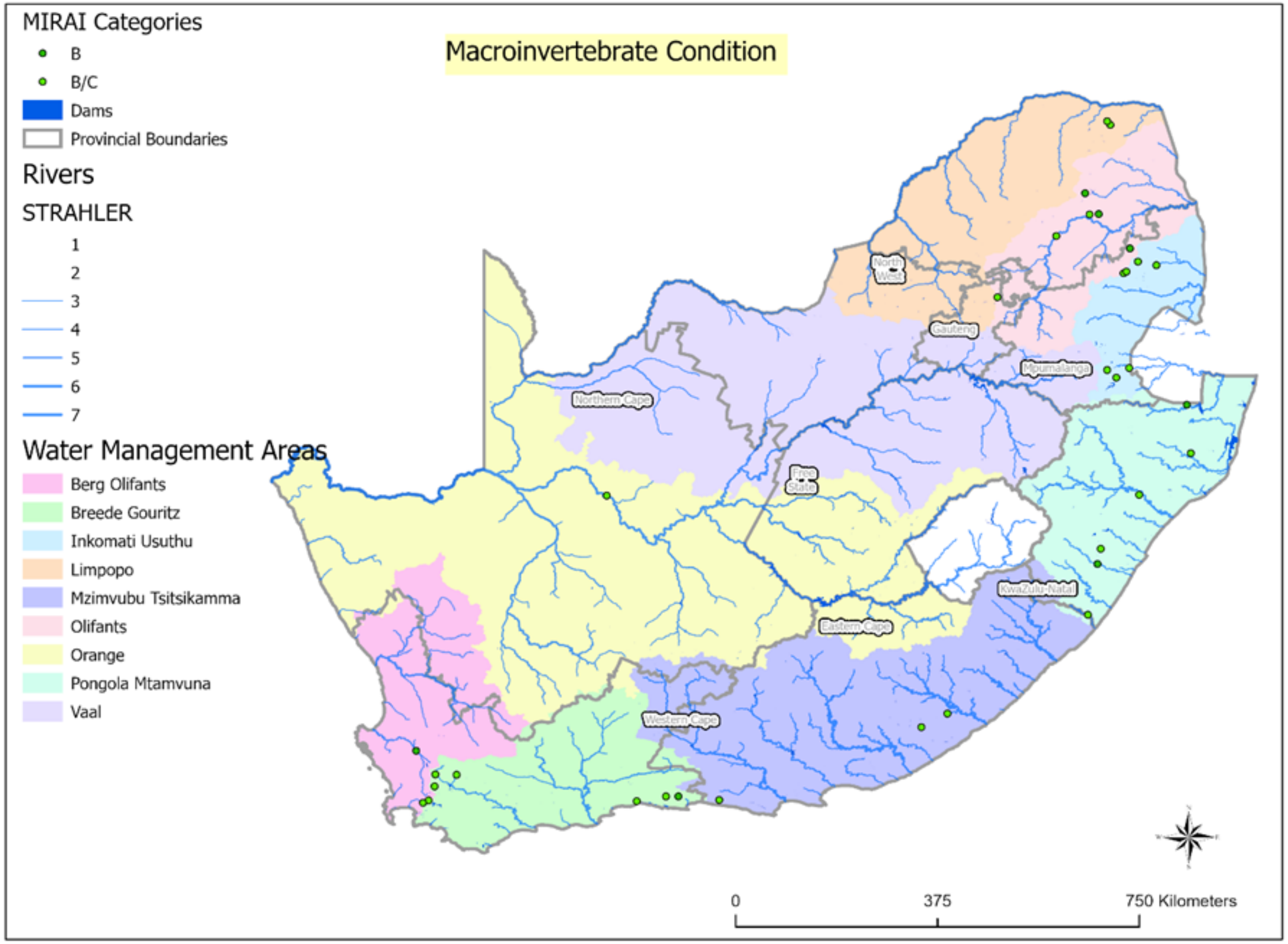


Figure 4.9 Ecological Categories reflecting the macroinvertebrate condition for sites in good condition in selected rivers monitored during the 2019/2020 hydrological year

Compared to the previous hydrological year, the proportion of sites in a seriously (E) modified and close to largely natural (D/E) condition remained at about 2% of the sites. Unfortunately, the number of sites in a largely natural (B) or close to largely natural (B/C) decreased compared to the previous year. There was a slight increase in the number of sites in a moderately modified (C) and close to moderately modified (C/D) condition while the sites in a largely modified (D) condition decreased from about 17.5% to 13 % (Figure 4.10).

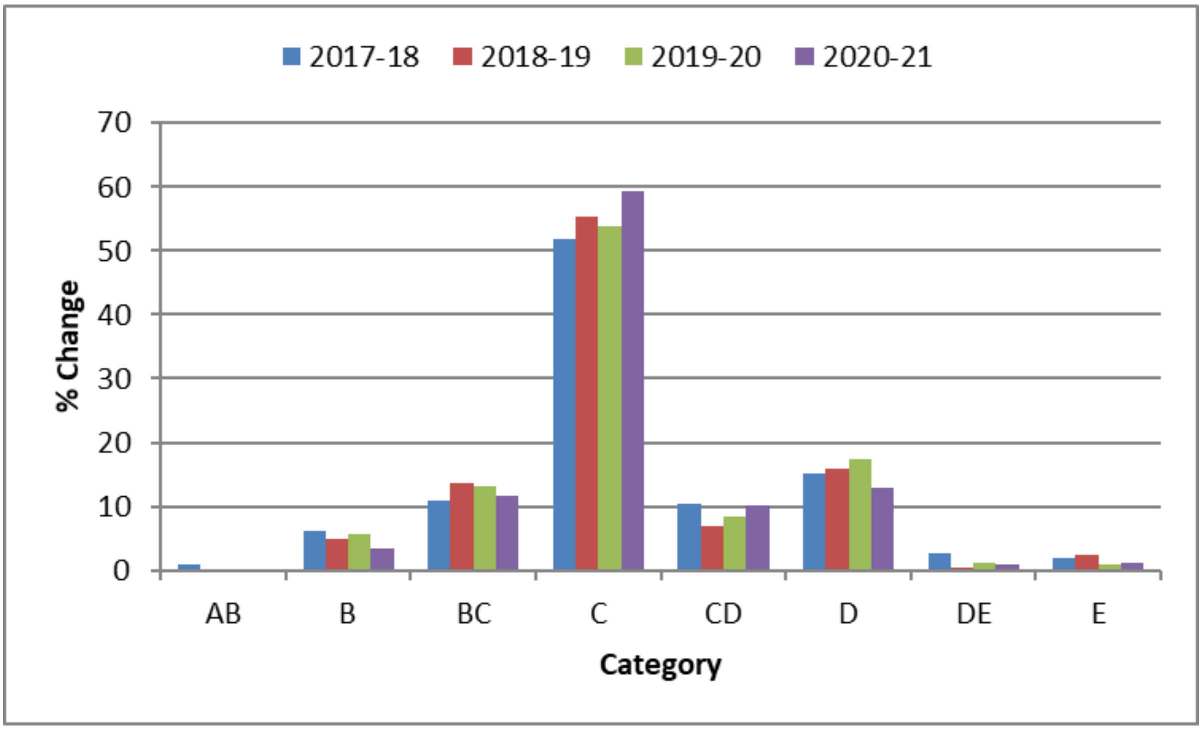


Figure 4.10 Comparison of changes in the ecological categories reflecting the macroinvertebrate condition from the 2017-2018 to the 2019-2020 hydrological year

In conclusion, the Crocodile West River Catchment, particularly in its upper reaches, requires close monitoring and intervention. Almost all the severely altered sites (D/E and E) occurred in the upper Crocodile West catchment. The sites along the Jukskei River were in disrepair. Due to ongoing sewage contamination, the main stem Hennops River is no longer sampled. The Apies River, downstream of the Daspoort Wastewater Treatment Plant, is also severely altered. Malfunctioning Wastewater Treatment Works in Gauteng pose a significant threat to environmental integrity, and enforcement is required.

4.2.5 Estuaries.

The South African coastline is subdivided into four bio-geographical zones according to the National Biodiversity Assessment (Van Niekerk, 2019) as presented in Figure 4.11 below.

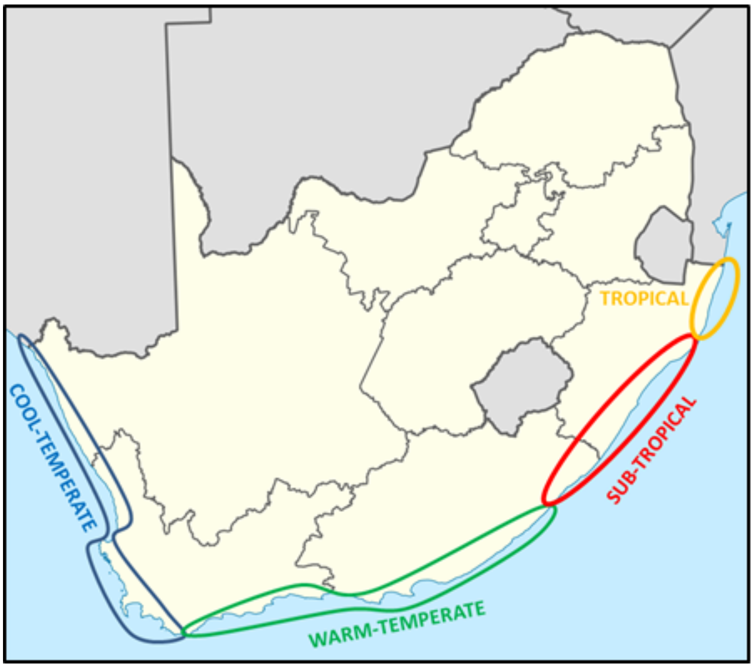
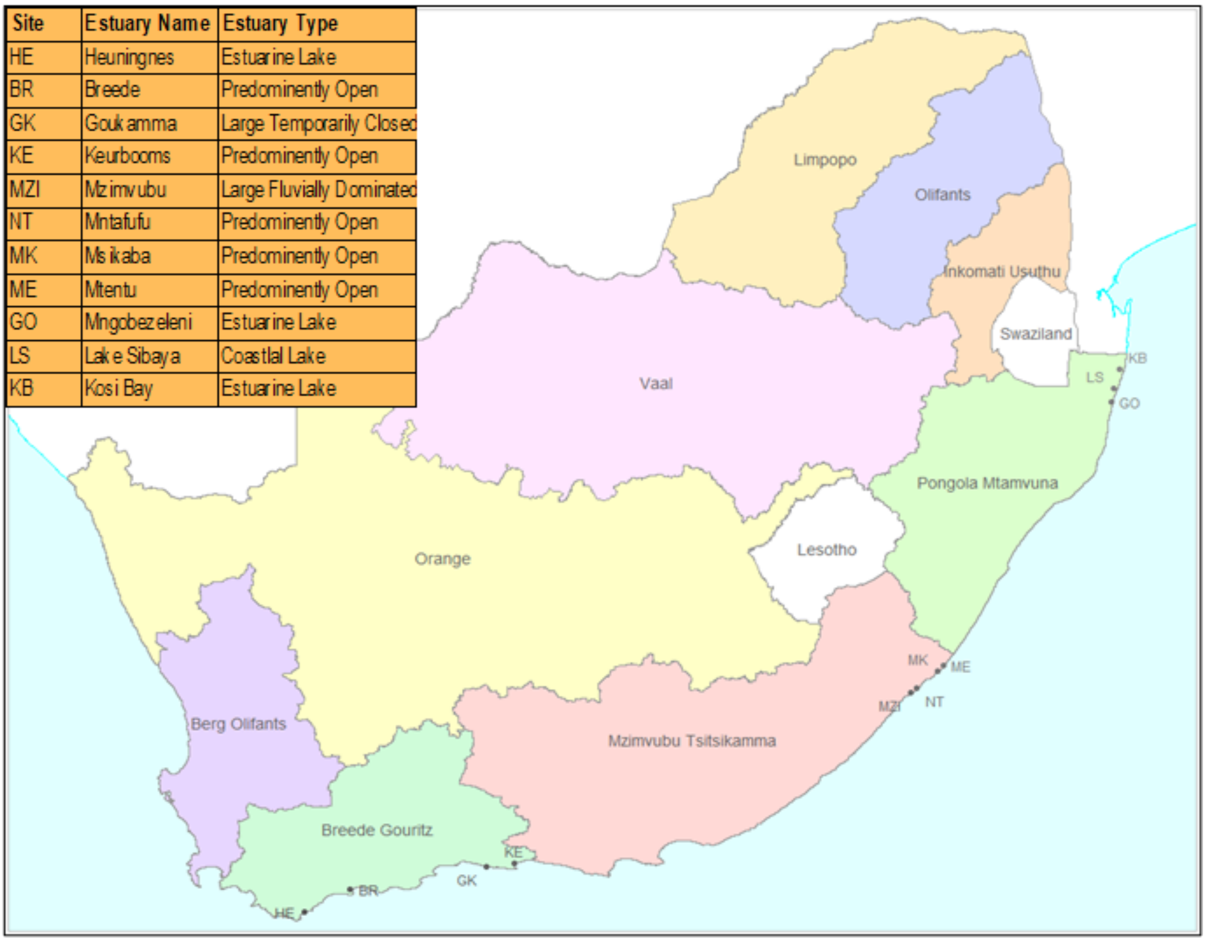


Figure 4.11 The four biogeographical regions (Van Niekerk et al. (2019).

The Tropical sub-region extends from Kosi Bay Estuary to uMgobezeleni Estuary, the Subtropical from St Lucia Estuary to Mbashe Estuary, the Warm Temperate zone is from the Mendwana Estuary to Heuningnes Estuary near Cape Agulhas, and the Cool Temperate zone from Ratel Estuary and ends at the Orange River mouth in the Northern Cape.

South African estuaries were classified into five categories (Whitfield, 1992) and have been refined into nine categories (Van Niekerk, 2019), i.e., estuarine lakes, estuarine bay, estuarine lagoon, predominantly open estuaries, large temporary closed estuaries, small temporary closed estuaries, large fluvial dominated river mouth, small fluvial dominated river mouth, arid predominantly closed. The individual systems may change from one type to another under the influence of natural events or anthropogenic influences.

In the current reporting period, eleven estuaries were monitored as part of tier one (Figure 4.12). Tier 1 involves the collection of basic physico-chemical data to develop a long-term database and establish baseline dataset of the most important drivers within estuaries.



Site	Estuary Name	Estuary Type
HE	Heuningnes	Estuarine Lake
BR	Breede	Predominently Open
GK	Goukamma	Large Temporarily Closed
KE	Keurbooms	Predominently Open
MZI	Mzimvubu	Large Fluvially Dominated
NT	Mntafufu	Predominently Open
MK	Msikaba	Predominently Open
ME	Mtentu	Predominently Open
GO	Mngobezeleni	Estuarine Lake
LS	Lake Sibaya	Coastlal Lake
KB	Kosi Bay	Estuarine Lake

Figure 4.12 Estuaries monitored during 2020/21 hydrological year

The Breede estuary experienced moderately low pH levels during the year 2020/2021 while Mzimvubu, Mntafufu, and Msikaba estuaries experienced high pH levels (Figure 4.13). High pH levels are an attribute of runoff from palm tree plantations higher up in the catchment. Temperatures remained between medium to high throughout the hydrological cycle. All estuaries were well-oxygenated with an oxygen concentration of greater than 5 mg/L, apart from Goukamma, which had less than 4 mg/L of oxygen. Low oxygen concentrations impact heavily on the biota and may cause a fish kill.

High salinity and electrical conductivity values are due to seawater intrusion into these estuarine systems. Heuningnes, Keurbooms, Mntafufu, Msikaba, and Mtentu estuaries experienced high salinity concentrations; indicative of seawater penetration, thus creating a salinity gradient that drives the biodiversity of estuarine systems. Breede and Mzimvubu estuaries experienced low salinity concentrations, indicative of high freshwater flow from higher up the catchment into the estuary.

Chlorophyll-a concentrations in the water column (proportional to phytoplankton biomass) remain moderately low to medium throughout the cycle, indicative of low nutrient uptake for phytoplankton growth. Nutrient results remained fairly high in all systems. High ammonium concentrations were detected in all estuaries. Extremely high values were recorded for nitrates + nitrites in all recorded systems. All recorded estuaries exhibited medium concentrations of orthophosphates. These medium nutrient concentrates can be attributed to runoff from agricultural activities from higher up the catchments. Mntafufu, Msikaba, and Mtentu estuaries form part of Pondoland Marine Protected Area, with a high diversity priority rating. High nutrient load in these systems can be attributed to agricultural runoff from higher up the catchments.

Monitoring of estuaries has shown that the southern coastline estuaries of South Africa are exposed to similar pressures as estuaries on the east coast, although on a smaller scale due to catchment size and the nature of the estuarine systems. Southern coastline catchments and estuaries are also exposed to intensive farming and rapid developments with resulting environmental perturbation, thus requiring immediate management intervention.

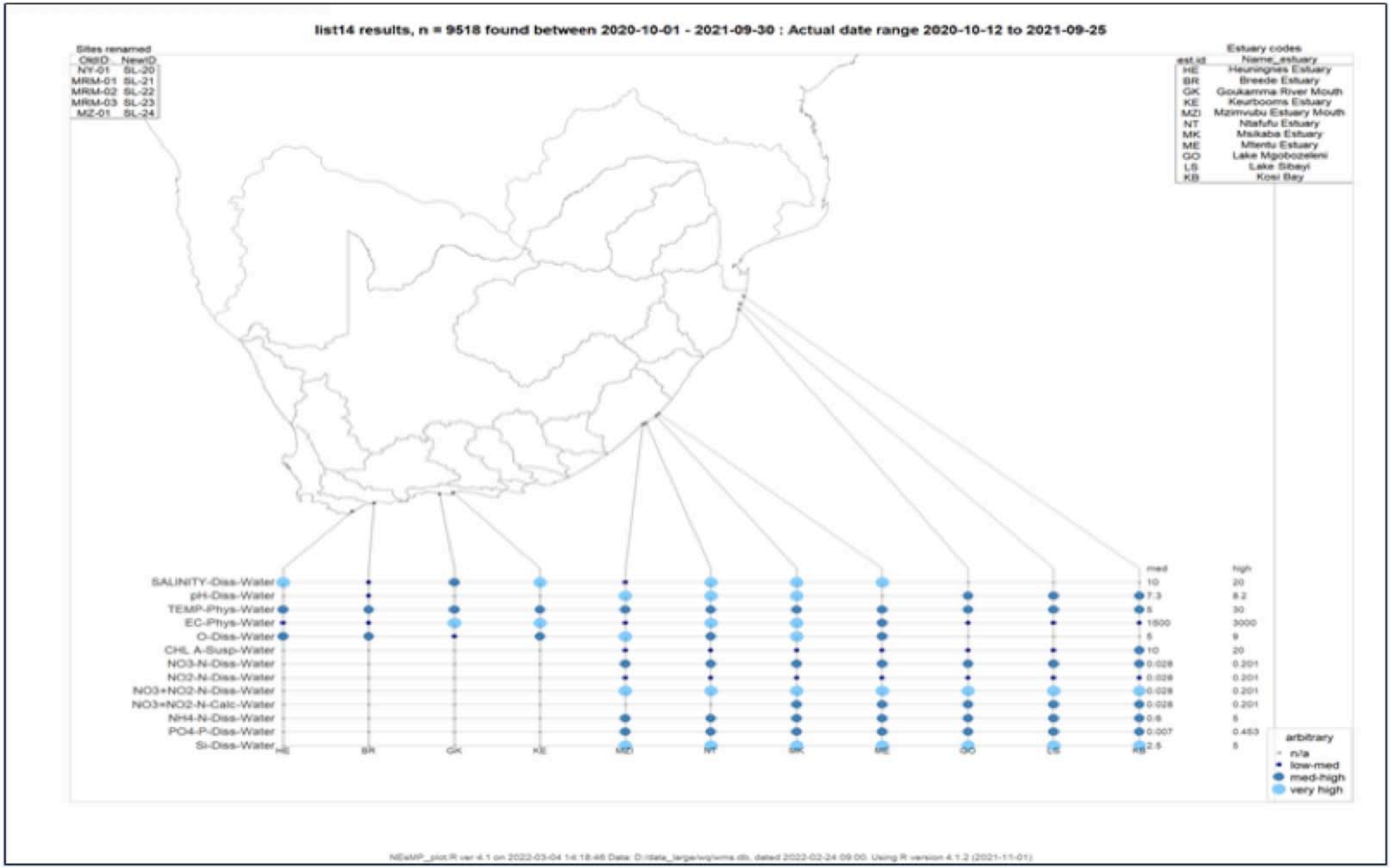


Figure 4.13 Summary findings from 11 estuaries monitored during 2020/2021 hydrological cycle. Right hand side values indicate data range for what would be medium to high concentrations/levels of the variables on the left-hand side

5

SURFACE WATER STORAGE

5 SURFACE WATER STORAGE

5.1 National Storage

The national dam storage levels for 2020/21 hydrological year were the highest in the past five years between December 2020 to September 2021, as presented in Figure 5.1 below. This is due to the good summer rainfalls that have been received in the eastern half of the country during the summer months.

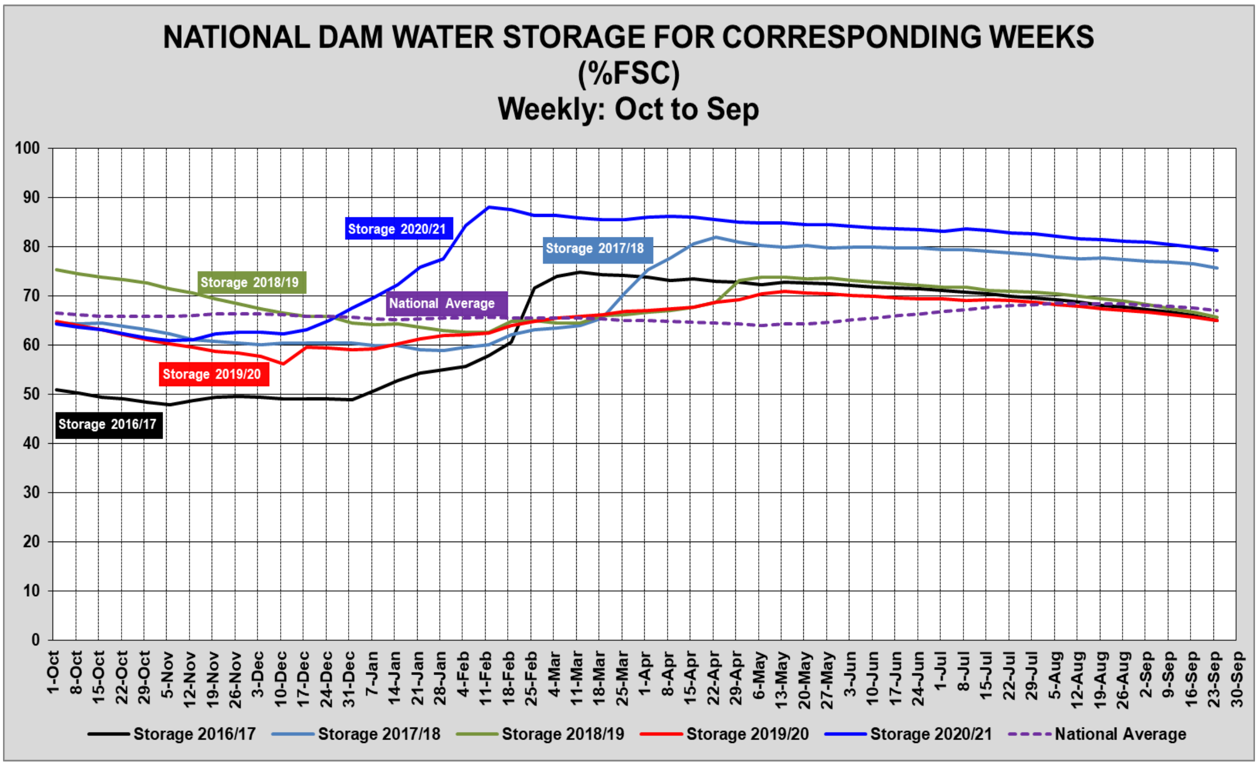


Figure 5.1 National Dam storage levels for the past five years compared to a national average

In the past five hydrological years, the national storage has been below the national average for the period of October to mid-December, apart from the 2018/19 hydrological year. Peak rainfall is received from late December to March, the typical summer rainfall season, resulting in storage levels above the national average for this period.

Given in Table 5-1 is the classification of surface storage levels for Provinces ranging from critical storage levels, closer to dead storage of the dams (<10% of FSC); at risk of non-supply (>10% - <50% of FSC); optimal water levels for supply operations (>50% -<100%); and >100% of FSC (Full or spilling dams). At the end of the hydrological year (September 2021), approximately 9% of the dams were at critical storage levels, 17% at risk, while over 70% of the dams were either spilling or at optimal storage levels.

Table 5-1 Surface storage at the end of September 2021

PROVINCE / INTERNATIONAL AREA	FSC MILLION M³	TOTAL	NUMBER OF DAMS PER PROVINCE			
			<10%	>=10% <50%	>=50% <100%	>=100
Eastern Cape	1824	48	11	15	20	2
Free State	15657	21	0	0	18	3
Gauteng	128	5	0	0	2	3
Kwazulu-Natal	4784	19	0	2	16	1
Kingdom of Lesotho	2363	2	0	1	1	0
Limpopo	1480	28	1	3	19	5
Mpumalanga	2539	22	1	1	20	0
Northern Cape	146	5	0	1	2	2
North West	867	28	0	7	18	3
Kingdom of Eswatini	334	1	0	0	1	0
Western Cape – Other Rainfall	269	22	7	5	3	7
Western Cape – Winter Rainfall	1597	22	1	2	9	10
Western Cape – Total	1866	44	8	7	12	17
NATIONAL – GRAND TOTAL	**31986**	**223**	**21**	**37**	**129**	**36**
Percentage (%)		**100%**	**9%**	**17%**	**58%**	**16%**

Most of the dams that were at critical storage conditions were in the Eastern Cape and Western Cape – all-year rainfall region/winter rainfall region., The dams that were still full or spilling in the Western Cape Province during September 2021 period were due to winter rainfall received between May and August 2021 (See Figure 5.2).

The Storage comparison for 2019/20 & 2020/21 of the ten largest dams, as of the end of September 2021, versus their full supply capacities, is presented in Figure 5.3. The top ten large dams had storage levels in 2020/21 that were higher than the previous year (2019/20). Notably, the Theewaterskloof Dam has been full to capacity at this time for the past two years.

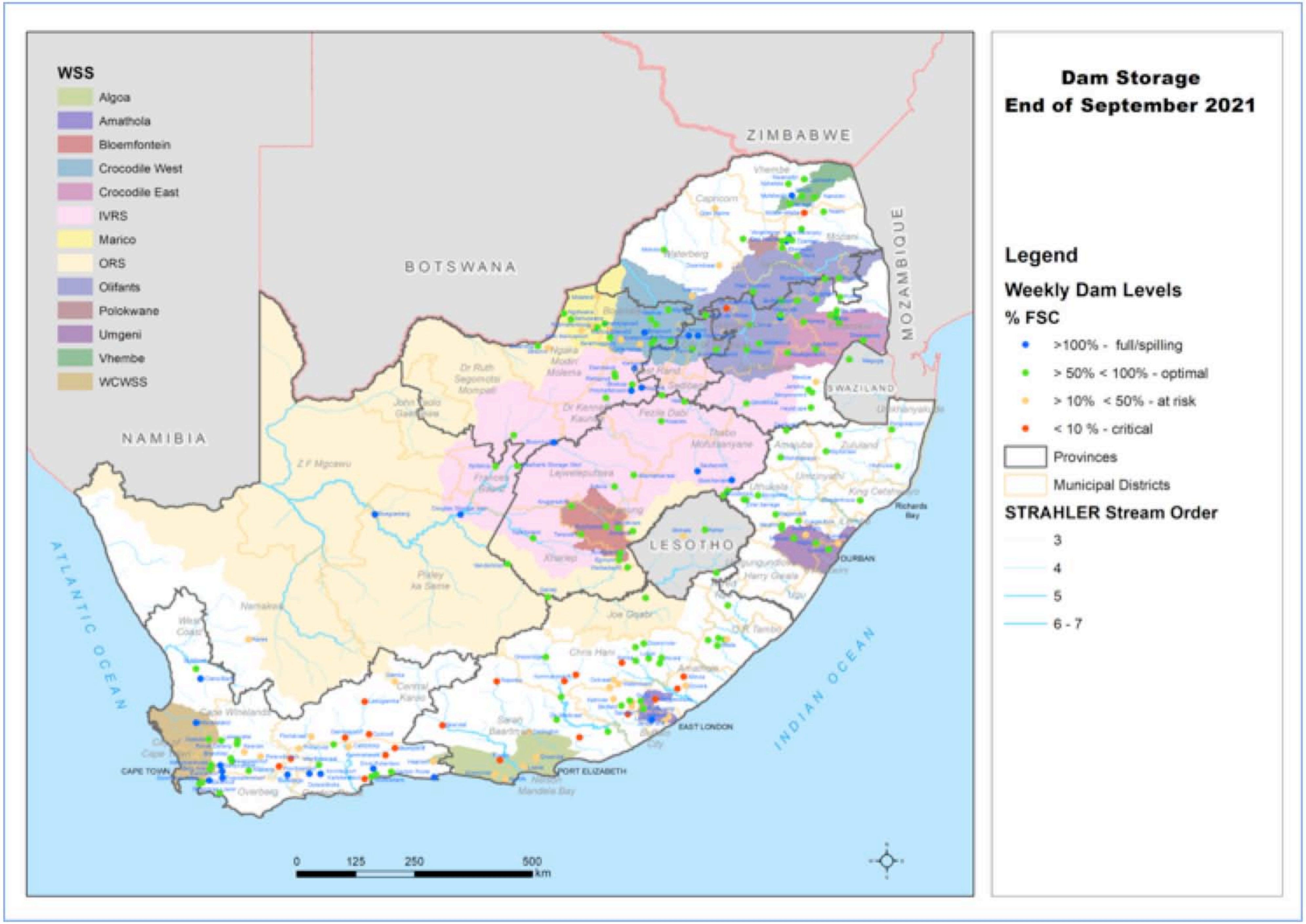


Figure 5.2 Dam Storage Levels at the end of September 2021

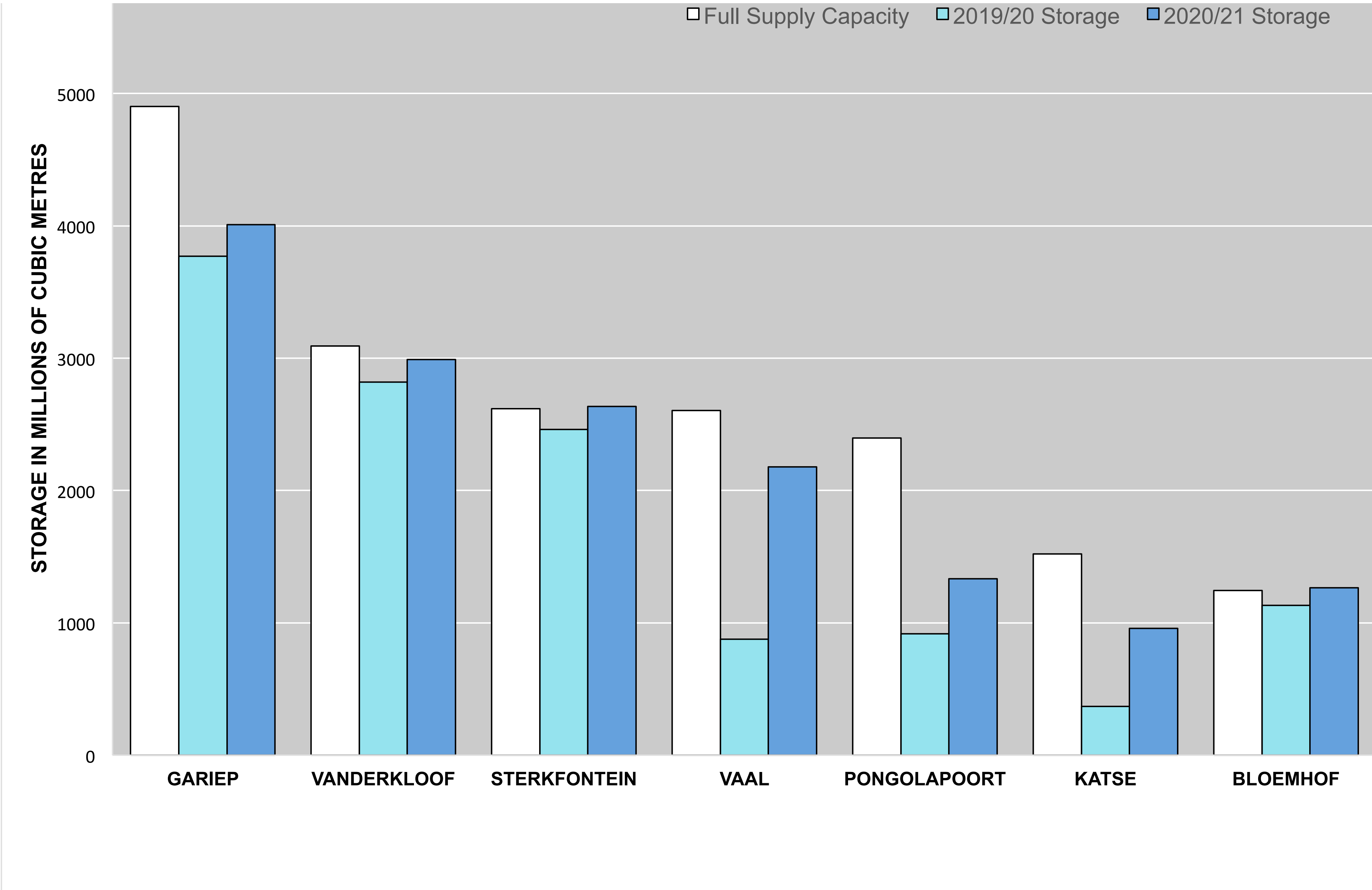


Figure 5.3 Storage comparison 2019/20 & 2020/21 of the ten largest dams, as at the end of September versus the full su

5.2 Provincial Storage

The long-term median storage for each Province during 2020-2021, compared with the previous hydrological year, is presented in Figure 5.4. For the 2019/20 hydrological year, Gauteng and Northern Cape Province have experienced storage levels above the long-term historical median., while all other Provinces' storages were below. For the 2020/21 hydrological year, median storage for Free State, Gauteng, Limpopo, Mpumalanga, Northern Cape, North West, and Western Cape were above the historical median, apart from the Eastern Cape and KwaZulu-Natal Provinces. Notably, the Eastern Cape median storage has not changed in the past hydrological years, and it remains way lower than the historical median storage level of the province.

5.3 Water Management area storage

The comparison of the long-term historical median storage levels of water management areas and the past two hydrological years' median storage is presented in Figure 5.5. The 2020/21 median storages have been above the historical median and 2019/20 median storages in all water management areas. The median storage of combined dams in the Kingdom of Lesotho (an international area) was below historical median storage during the 2019/20 reporting period.

5.4 Water Supply Systems Storage

The storage levels in water supply systems during the beginning of the hydrological year (October 2020), the decision date for most WSS (31 May 2021), and the end of the hydrological year (September 2021) are presented in Figure 5.6. Five of the 14 water supply systems being reported on having for this hydrological year started high in October but declined towards the end of the hydrological year. These are the Algoa, Amathole, Crocodile East, Cape Town, and Luvuvhu water supply systems. The Bloemfonten, Crocodile West, IVRS, Kliplaat, Orange, and Umgeni were at high storage levels at the end compared to the beginning of the hydrological year.

The most notable decline observed in Luvuvhu system started at 97% FSC and declined to 21% FSC at the end of the reporting period. IVRS was the most improved system at the end of September.

5.5 Water Use restrictions

There are still parts of the country that are still experiencing dry conditions, for example, the southern parts of the Eastern Cape, parts of the Northern Cape, and the Karoo area in the Western Cape Province. The Department implements water use restrictions in these areas that are experiencing dry conditions which affect dam storage levels in standalone dams or dams within a water supply system or cluster to avoid the risk of failure of water supply or non-supply to the various water use sectors, including users with a high assurance of water supply such as strategic users in the power generation industries.

The list of major water supply systems and applicable restrictions at the end of the 2020/21 hydrological year are given in Table 5-2. Restrictions were still applicable for all water supply systems in the Eastern Cape, the Polokwane system in Limpopo, and the Bloemfontein system in Free State Province.

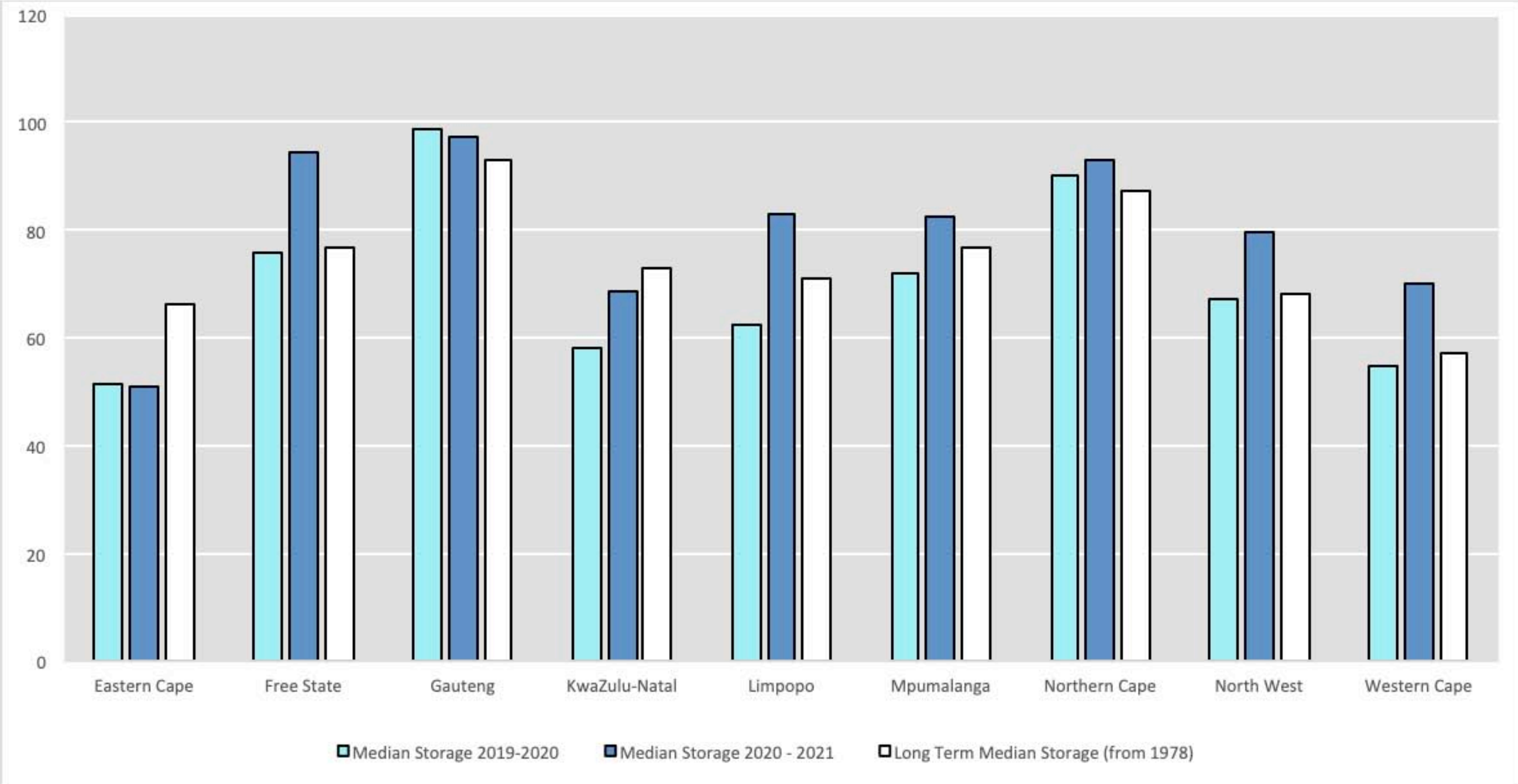


Figure 5.4 The storage situation in each Province during 2020-2021, compared with the previous hydrological year and the median

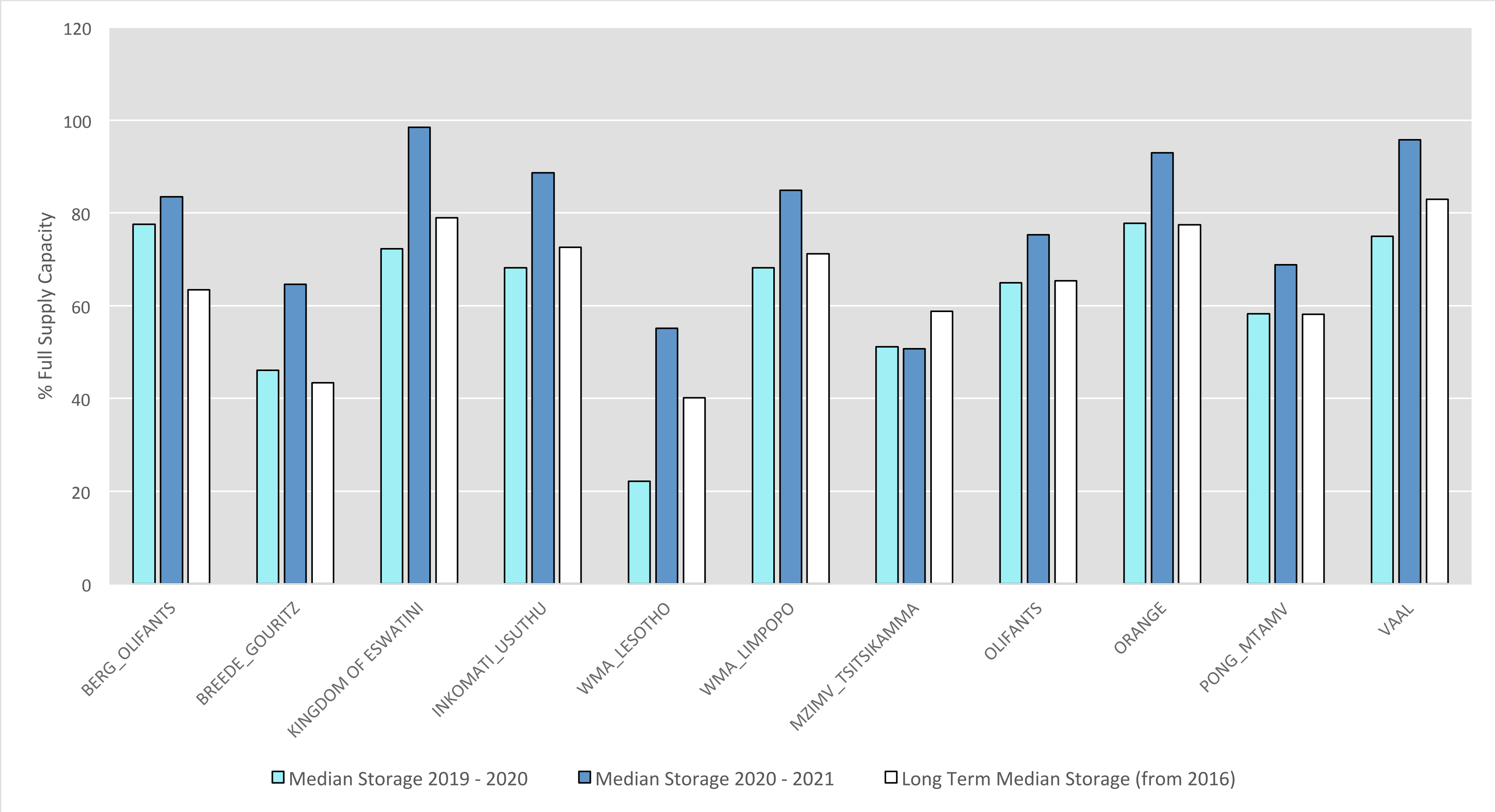
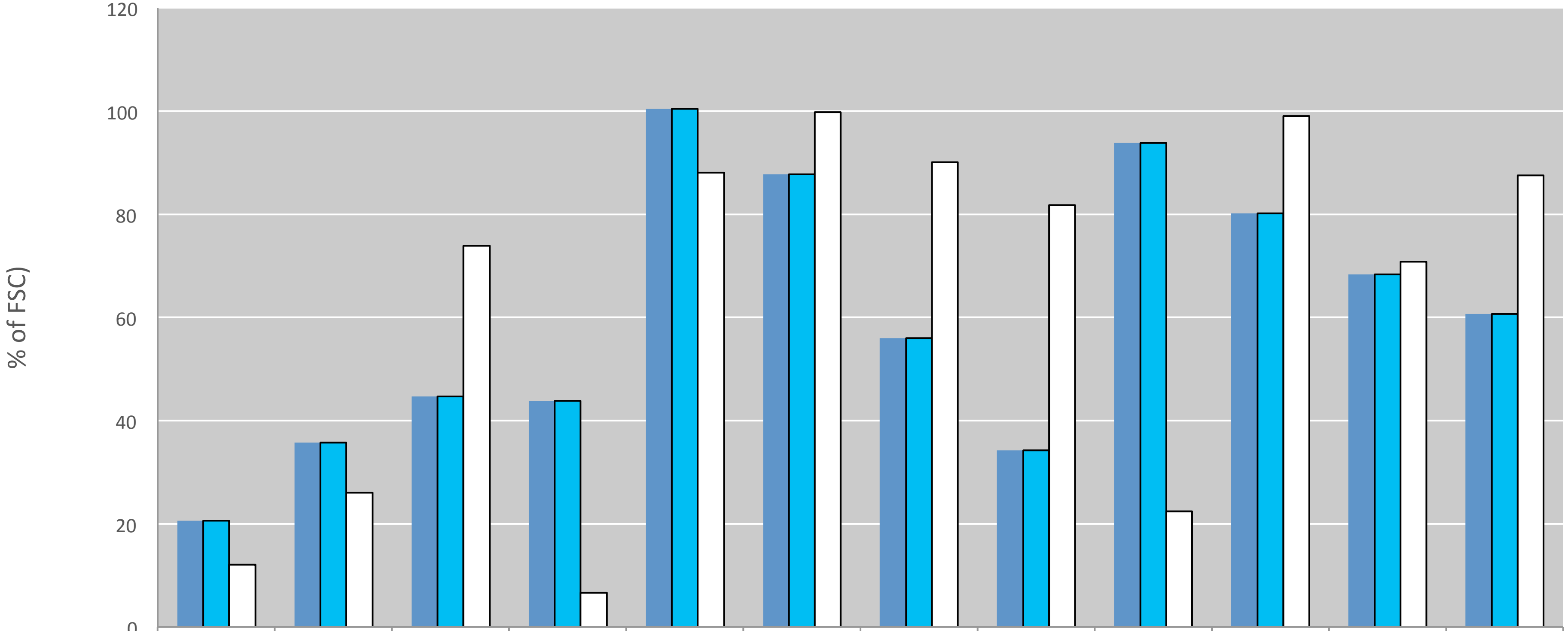


Figure 5.5 The storage situation in each WMA during 2020-2021, compared with the previous hydrological year and the median



	Algoa	Amathole	Bloemfontein	Crocodile East	Cape Town	Crocodile West	IVRS	Klipplaat	Luvuvhu	Orange	Polokwane	Umgeni
12/01/2020	20,6	35,7	44,7	43,8	100,4	87,7	56	34,2	93,8	80,2	68,3	60,7
31/05/2021	20,6	35,7	44,7	43,8	100,4	87,7	56	34,2	93,8	80,2	68,3	60,7
29/09/2021	12,1	26	73,9	6,6	88	99,8	90,1	81,8	22,4	99	70,8	87,5

Figure 5.6 Comparison of Water supply storage levels through the hydrological year 2020/21

Table 5-2 Water restrictions applicable at end of September 2021

Water Supply Systems/clusters	Cap in $10^6 m^3$ (% FSC)	System Description	Status of Restrictions
Algoa System	282	System of 5 dams for Nelson Mandela Bay Metro, Sarah Baartman (SB) DM, Kouga LM and Gamtoos Irrigation:	Compliance with overall 30% domestic & industrial restrictions, 80% irrigation restrictions; Varying levels of restrictions were also recommended for groundwater abstractions – restrictions are generally accepted by water users but were not yet gazetted.
Amatole System	241	System of 6 dams for Bisho & Buffalo City, East London:	Domestic restrictions of 10%. Irrigation at 30%. Buffalo City Metro implemented level 2 restrictions.
Klipplaat System	57	System of 3 dams for Queenstown (Chris Hani DM, Enoch Ngijima LM):	30% of Irrigation restrictions are still in place. Chris Hani District is maximizing its use from Xonxa Dam.
Butterworth System	14	Xilinxa Dam and Gcuwa weirs for Butterworth:	Domestic restrictions of 20% still in place (Covid and community frustration occurring, further interventions like augmenting river flows from upstream Dams)
Integrated Vaal River System	10 546	System of 14 dams serving Gauteng, Sasol, and ESKOM:	No restrictions. The system recovered reasonably well since the February/March flooding event
Polokwane	254	System of 7 dams serving Polokwane and surroundings:	20% restrictions on Domestic and Industries

Crocodile West	444	6 dams for Tshwane up to Rustenburg:	No restrictions
Luvuvhu	225	System of 3 dams for Thohoyandou etc:	No restrictions
Umgeni System	923	System of 5 dams serving Ethekwini, iLembe & Msunduzi:	No restrictions
Cape Town System	889	System of 6 dams for the City of Cape Town:	No restrictions
Bloemfontein	219	System of 3 dams serving Bloemfontein, Botshabelo and Thaba Nchu:.	A 16% restriction has been recommended on Domestic water; the gazette is being prepared
Crocodile East	159	Kwena Dam supplies Nelspruit, Kanyamazane, Matsulu, Malelane and Komatipoort areas & Surroundings:	No Restrictions
Orange	7 996	Two dams serving parts of the Freestate, Northern and Eastern Cape Provinces:	No restrictions
uMhlathuze	301	Goedertrouw Dam supplies Richards Bay, Empangeni Towns, small towns, surrounding rural areas, industries and irrigators, supported by lakes and transfer from Thukela River:	No restrictions

6

STATUS OF GROUNDWATER

6 STATUS OF GROUNDWATER

6.1 Groundwater Level Status

The Department of Water and Sanitation monitors over 1 800 groundwater levels on a monthly, bi-monthly, quarterly, and at some geosites bi-annual basis throughout the country. Groundwater fluctuations can be a result of human-induced recharge, groundwater abstractions, or the reflection of climate variation and indicate the stress placed on the resource (Fourie, 2022).

The groundwater level value is presented as a percentage of the groundwater level status (GwLS). The entire historical groundwater level monitoring record is assessed per borehole to ensure significant results and understanding. The groundwater level status of the geosites is averaged with 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 water level.

The Groundwater Level Status approach allows the comparison of groundwater level data of any geosite/borehole on the same scale. The Averages of the Groundwater Level Status for September 2021 are mapped in Figure 6.1. According to Fourie (2022), the averages of the Groundwater Level Status can be plotted on a map and classed into ranges, and severity profiles developed for decision-makers.

Figure 6.1 average groundwater level status for September 2021 indicates ‘stressed’ geosites in parts of the Limpopo, Northern Cape, and Eastern cape regions. Some of the aquifers in these regions are investigated on a case-by-case basis to determine the management actions required. Figure 6.2 presents a snapshot of the average groundwater level status for the September months of the last four years. There appears to be a slight improvement in groundwater levels during the same reporting period in 2021 compared to 2020 in the Limpopo region. This may be attributed to recharge by the above-normal summer rainfall reported in 2021/2022. Further aquifer-specific investigations and analysis can confirm the true nature of the observed high-level improvement mapped in the Groundwater Level Status maps.

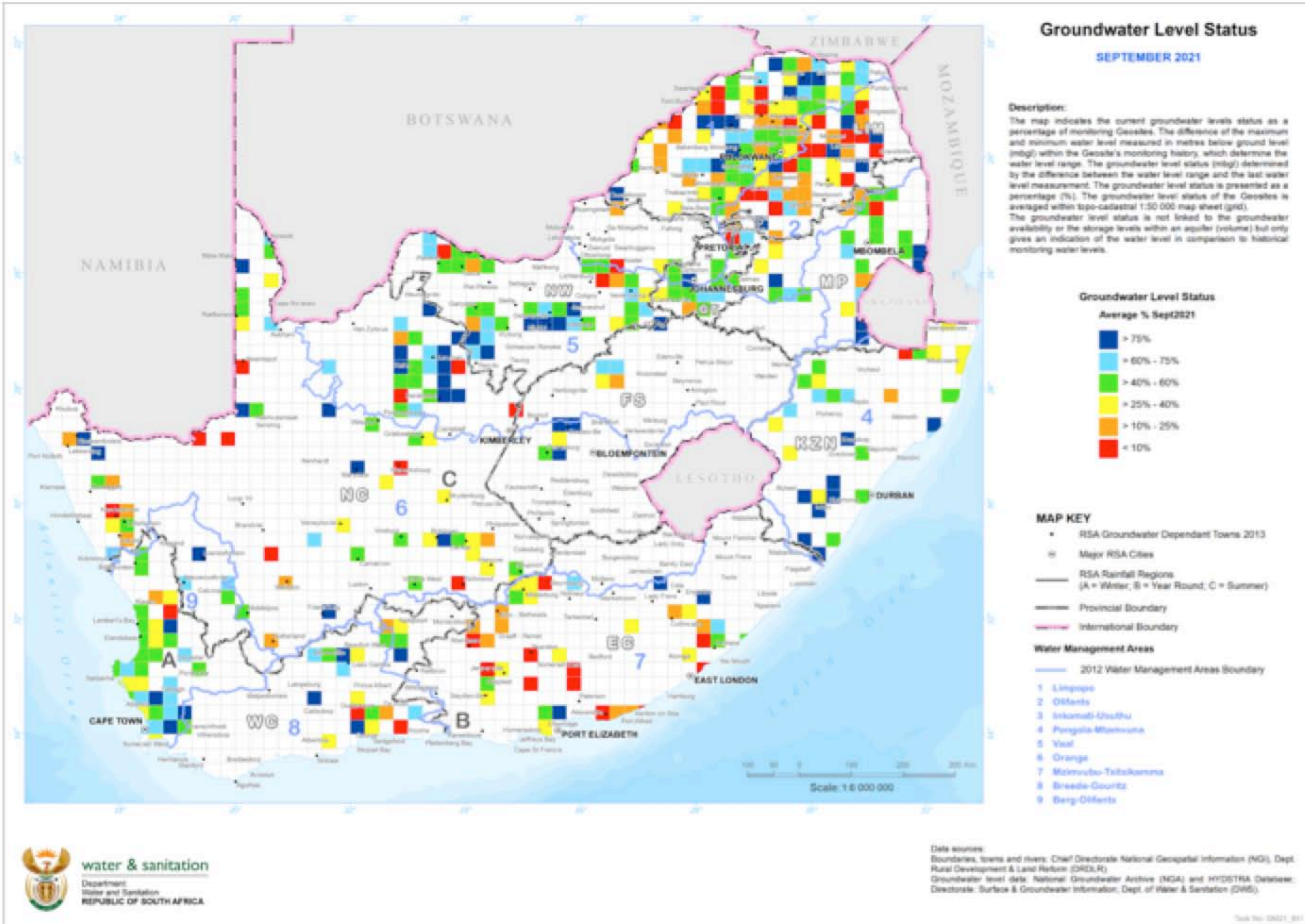


Figure 6.1 Groundwater Level Status September 2021

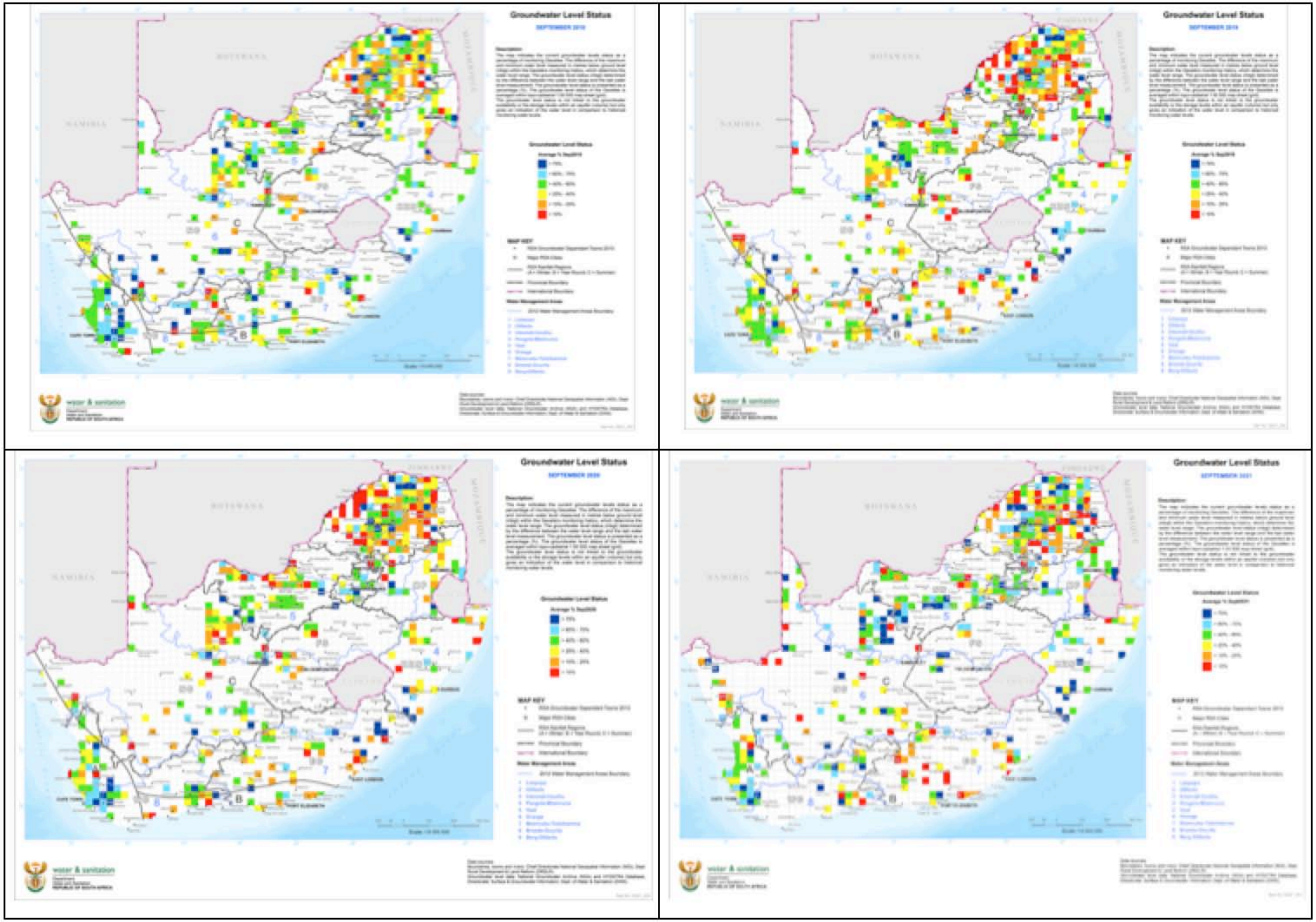


Figure 6.2 Groundwater Level Status Comparisons September 2018 to 2021

6.2 Groundwater Risk Map

The impact of drought or over-abstraction on groundwater levels can be presented by its severity on the groundwater resource (average groundwater level status). The exact reasons for the primary stress driver can only be determined if the assessment is done on individual boreholes and grouping the boreholes according to hydrogeological characteristics.

The term "Risk" is used to describe the GwLS if presented against the percentiles of the historical groundwater levels (Figure 6.3). The risk graph provides a visual presentation to indicate drought conditions. Restrictions on groundwater abstraction can be implemented timeously before any negative impacts occur. Each grouping of boreholes will have different severity ranges (7 percentile ranges).

The national average GwLS over 2020/2021 indicates a recovery trend within the below-normal risk percentiles compared to the decreasing trend between 2014 and 2019. A case-by-case grouping of boreholes according to hydrogeological characteristics would need to be done to determine the management actions required. Geosites used to derive the average GwLS in December 2021 had been significantly low due to the lag in groundwater level data availability and or uploading this data onto the data-sharing platform (HYDSTRA). As more data becomes available, this may improve the input data results for the December 2021 period.

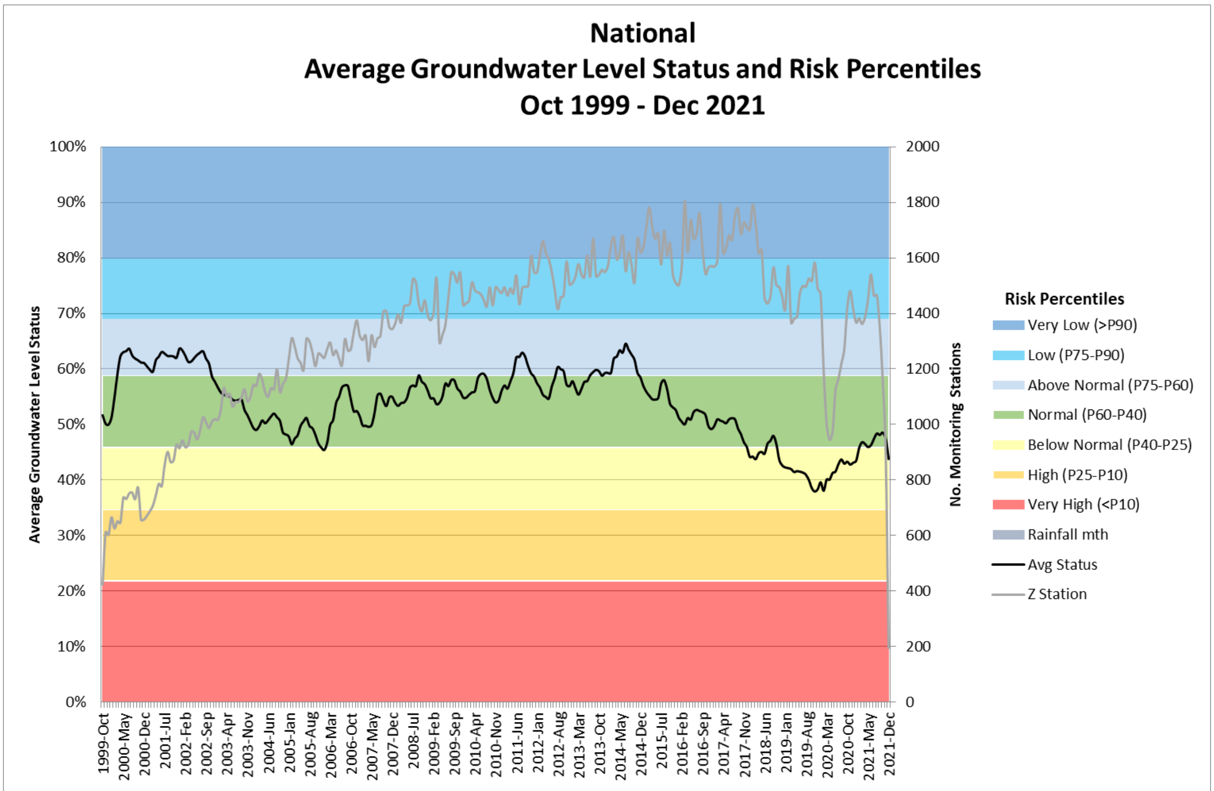


Figure 6.3 National average groundwater level status and risk percentiles.

6.3 Groundwater Quality

Groundwater resources are set to play a significant role in climate change adaptation and will need to be protected against pollution. Three care parameters are reported for the 2021 sampling period. These are electrical conductivity in milliSiems/meter (mS/m); pH in pH units, and Nitrate or nitrite in mg/l. Nitrate or nitrite was combined in laboratory analysis and was reported as separate the nitrate values were used for the geosite. The three quality parameters were compared to the SANS 241 (2015) Drinking water quality guideline limits.

Electrical conductivity is an important indicator for water quality assessment. The composition of mineral salts affects the electrical conductivity of groundwater. Figure 6.4 presents the groundwater quality electrical conductivity (EC) values. EC exceeded the SANS 241 limit of 170 mS/m in areas where the geosite is colored red in parts of the Limpopo, Eastern Cape, Western Cape, Northern Cape, and Free State regions.

pH is a measure of the balance between the concentration of hydrogen ions and hydroxyl ions in water. According to SANS 241 of 2015, the limit of pH for drinking water is specified as ≥5 to ≤9. Figure 6.5 presents the groundwater pH across the country, with only one monitored geosite located in the Mpumalanga region falling outside the range limit.

To ensure that the drinking groundwater quality meets the health standard, SANS 241 limits for nitrate are monitored because nitrate plays a significant role in the occurrence of *methemoglobinemia* - a blood disorder in which an abnormal amount of methemoglobin is produced due to drinking water with high nitrate concentrations. There are several ways nitrate/nitrite can make its way into groundwater. These are improper disposal of waste, waste from animal farms, use of nitrogenous fertilizers, and use of unlined pit latrines (Yu *et al*., 2020). It is concerning to note the geosites that exceed the nitrate guideline limit of 11 mg/l in the Limpopo and Free State regions. At the desktop level, these could be attributed to the use of unlined pit latrines and nitrogenous fertilizers used in agriculture associated with common land use in these regions. Site-specific investigations would need to be conducted to validate this and ensure that groundwater resources are protected, which provides a special buffer against climate change.

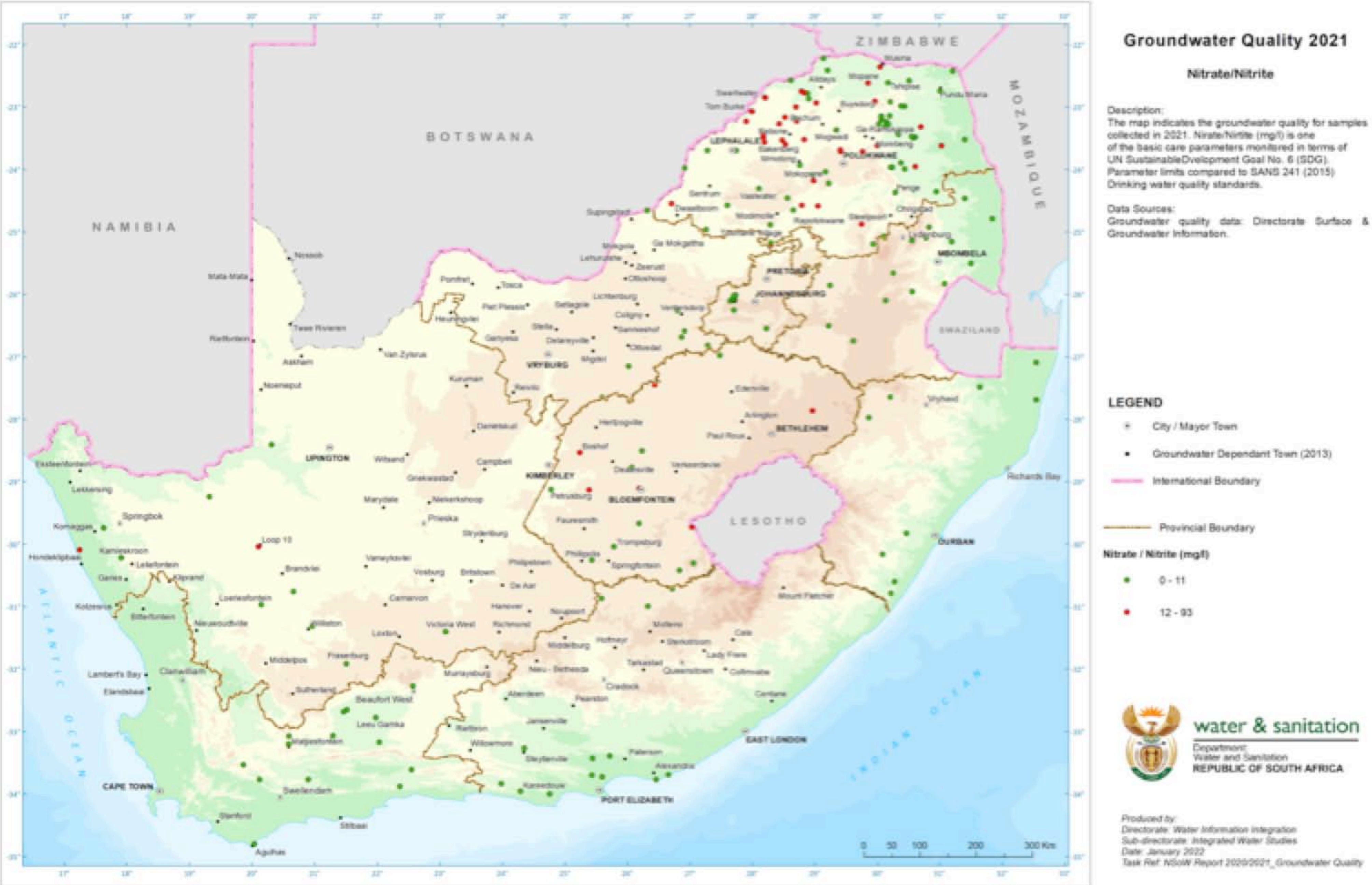


Figure 6.6 Groundwater Quality 2021- Nitrate/Nitrite

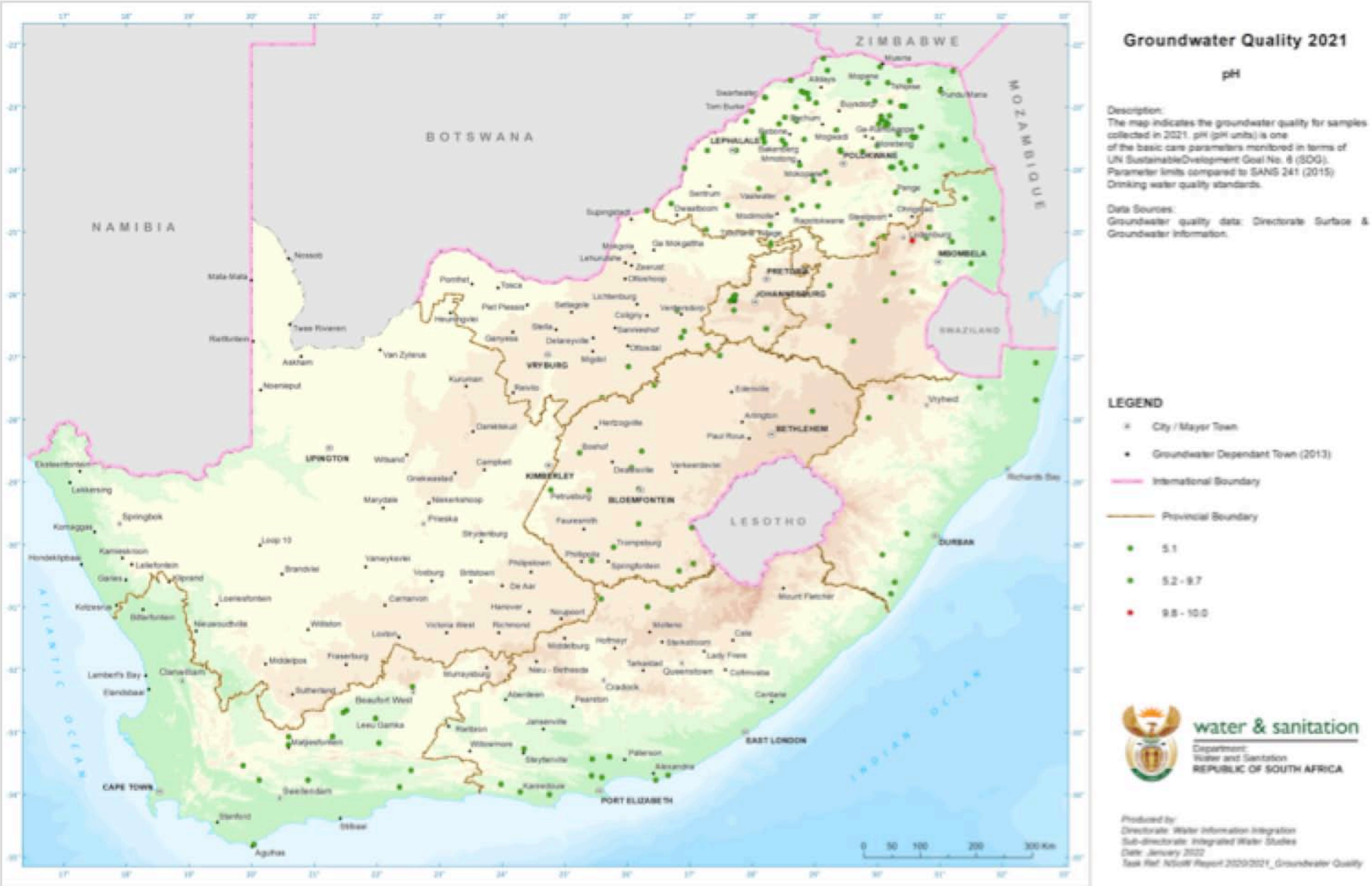


Figure 6.5 Groundwater Quality 2021 - pH

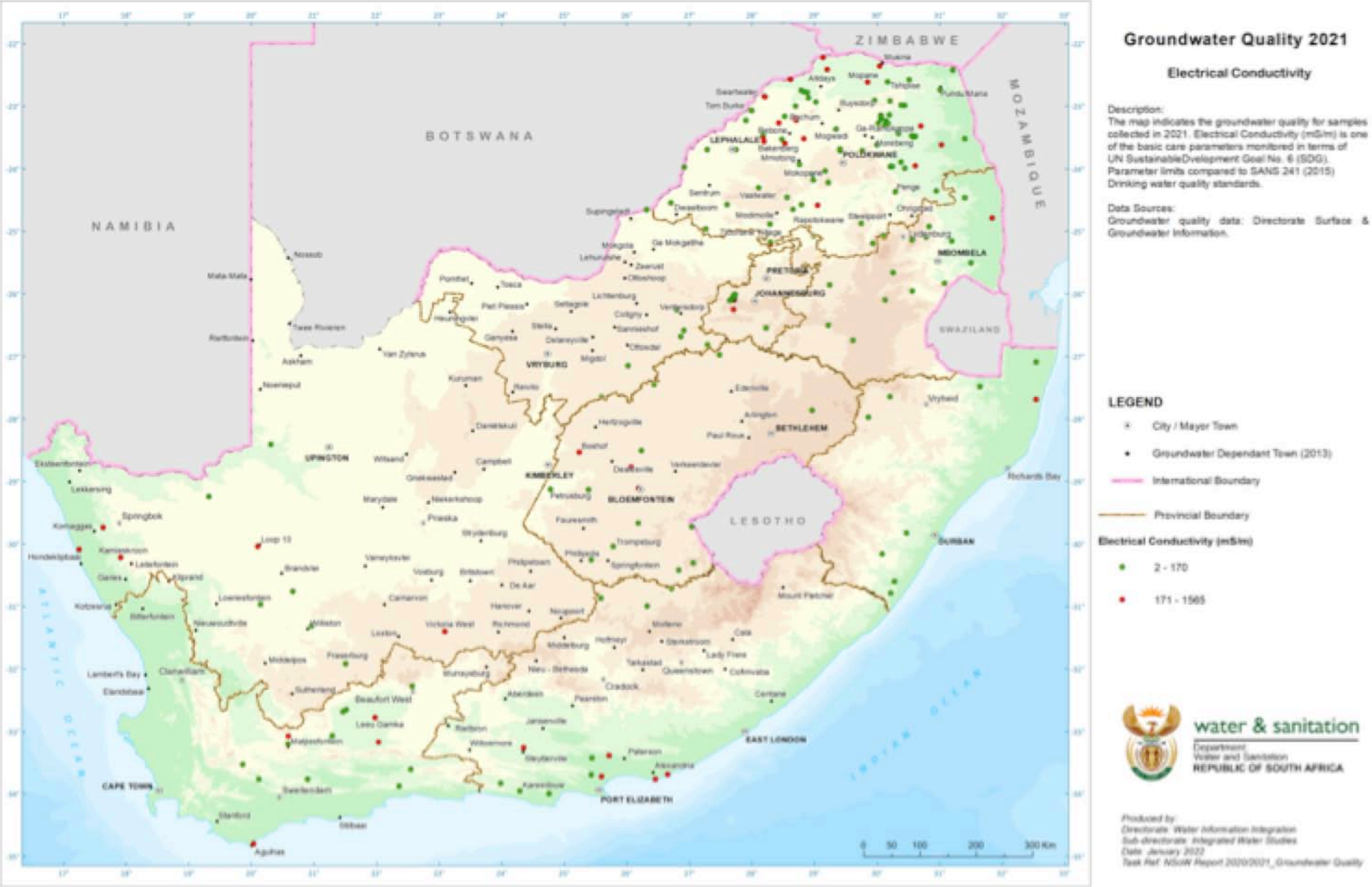


Figure 6.4 Groundwater Quality 2021- Electrical Conductivity.

6.4 Groundwater Utilised

Groundwater utilization continues to grow in the wake of climate change and to augment conventional surface water supplies. Groundwater utilization was assessed for the period September 2020 to October 2021 from data captured from the WARMS database. Figure 6.7 illustrates the groundwater use by the water management area. The Vaal utilizes the most reported groundwater use by water management area with 24%. The Berg-Olifants, Brede-Gourits, and Inkomati-Usuthu report the least groundwater utilized, with all reporting 3%.

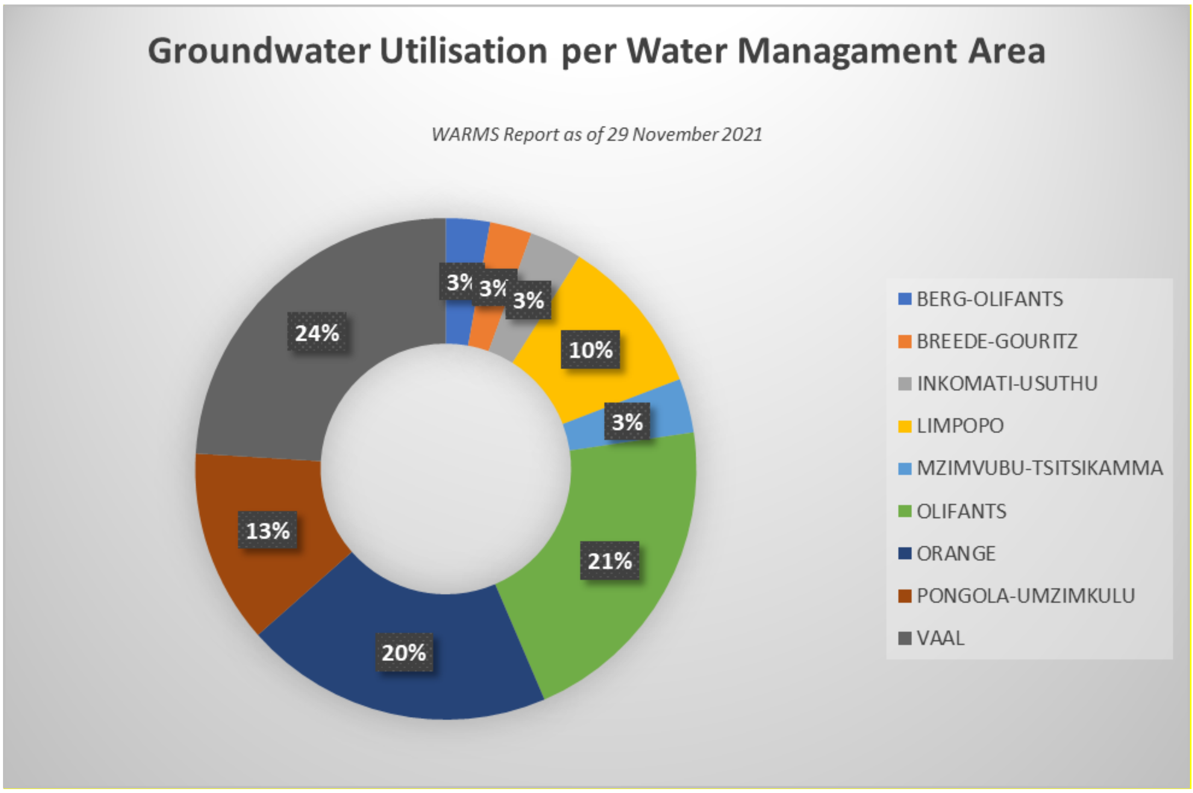


Figure 6.7 Groundwater utilization per water management area

Figure 6.8 is a pie chart of groundwater utilization in the country per sector. Agriculture, which includes aquaculture, watering livestock, and irrigation, make up a significant part of groundwater use at 58%. This trend mirrors the global trends of groundwater use, where access to groundwater allows farmers to intensify their cropping systems, improve household food security and incomes, and shield against droughts CGIAR, 2017). However, unstainable use of groundwater can have severe and long-lasting consequences for both ecosystems and society. Innovative management of groundwater resources and policy solutions can support sustainable groundwater use.

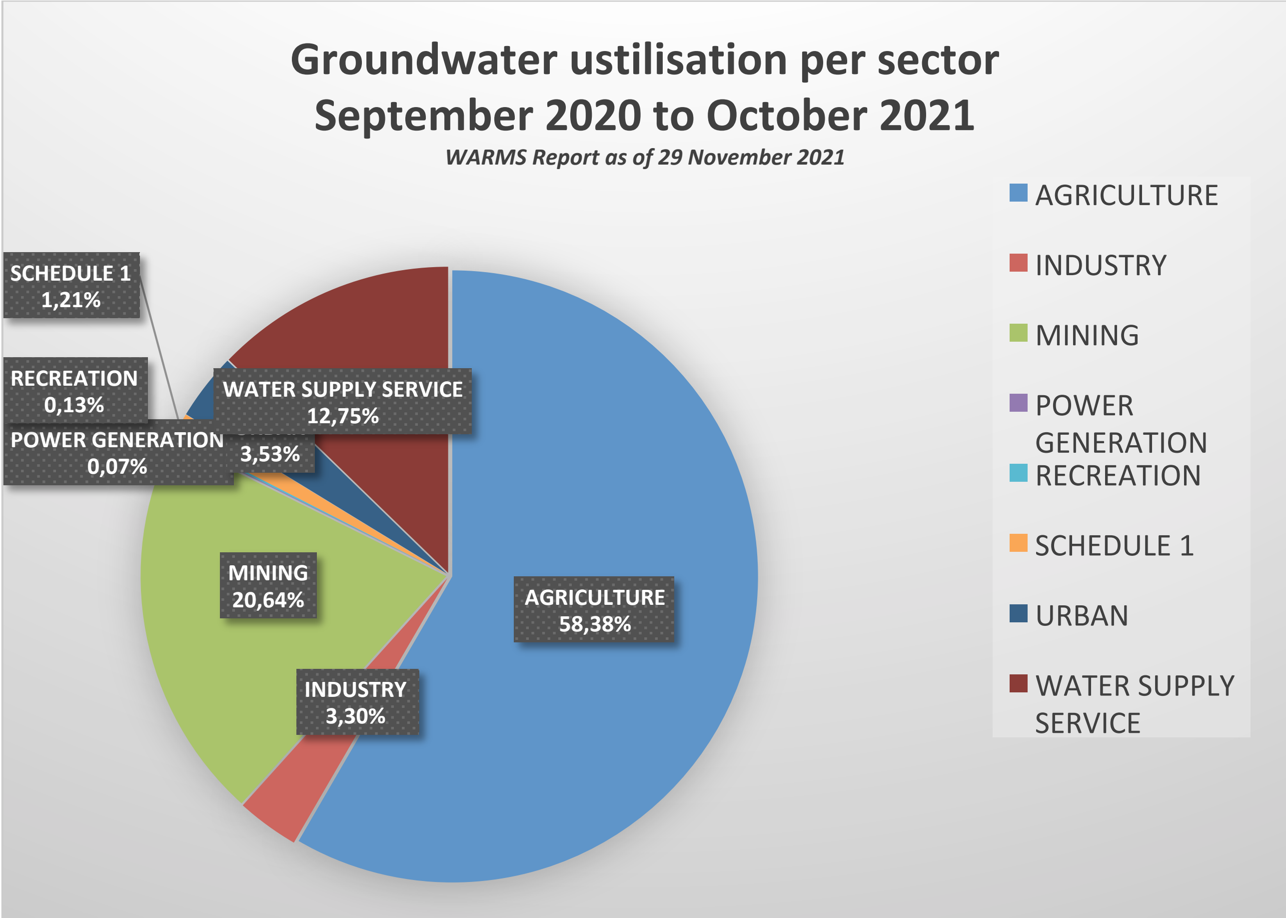


Figure 6.8 Groundwater utilization per sector

Today the impacts of climate change are being felt with the increase in private borehole drilling activities to augment traditional surface water resources in various parts of the country. The public and consultants alike are urged to register and capture new boreholes drilled and related data on the National Groundwater Archive (NGA). This database is accessible 24 hours a day, seven days a week, and is user-friendly with minimum clicks and easy navigation. The groundwater data and information captured on the NGA assists in the planning and management of groundwater resources to provide water, monitor groundwater, and provide a buffer in the wake of climate change. To register, visit https://www.dws.gov.za/NGANet/ .

7

WATER SECURITY

7 WATER SECURITY

7.1 Water availability and demand

Water supply in South Africa is mostly through water supply systems, consisting of a system of dams or standalone (surface water storage). Therefore, Water availability has been estimated at a water supply system (WSS) scale.

Ideally, the water balance is to be made available for each WMA. However, there is no latest available data on the water balances of WMAs. From a strategic planning and/or operation perspective, water balance data is made available for WSS. Key water resource systems are presented in Figure 7.1 below.

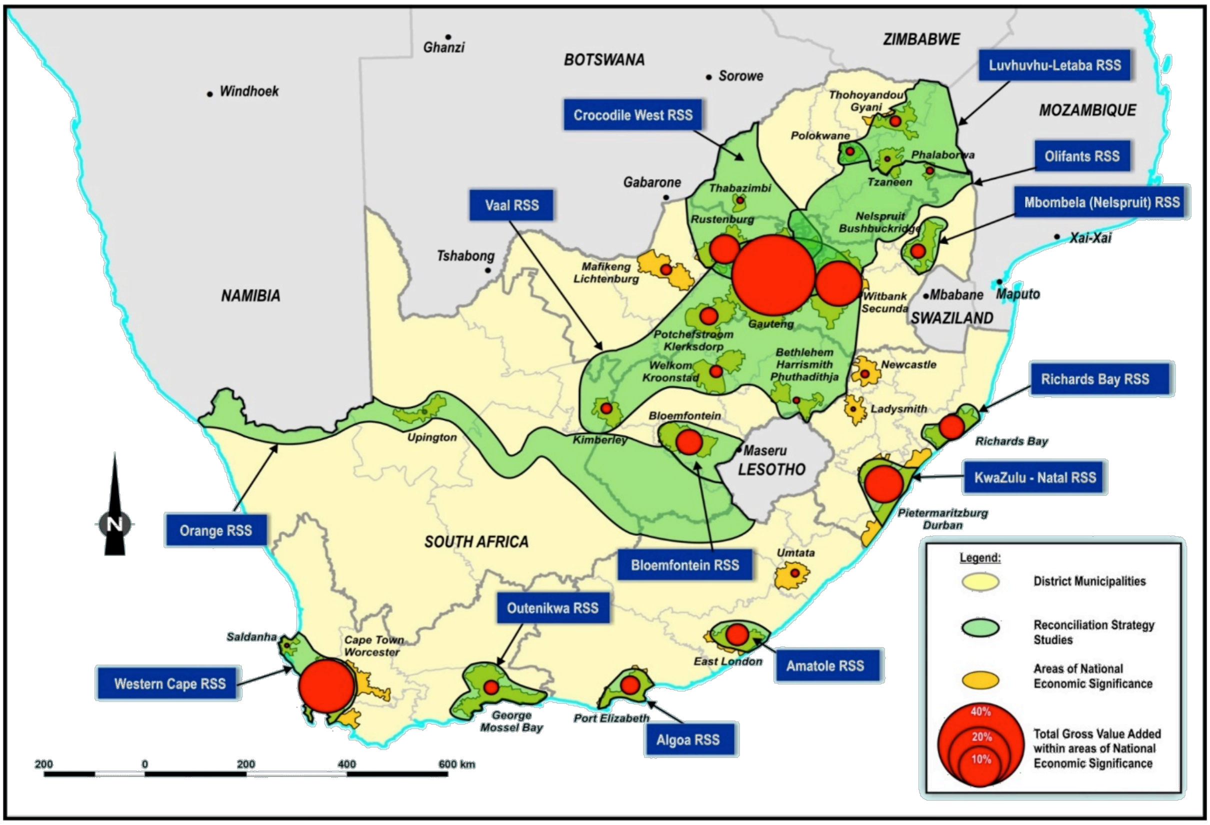
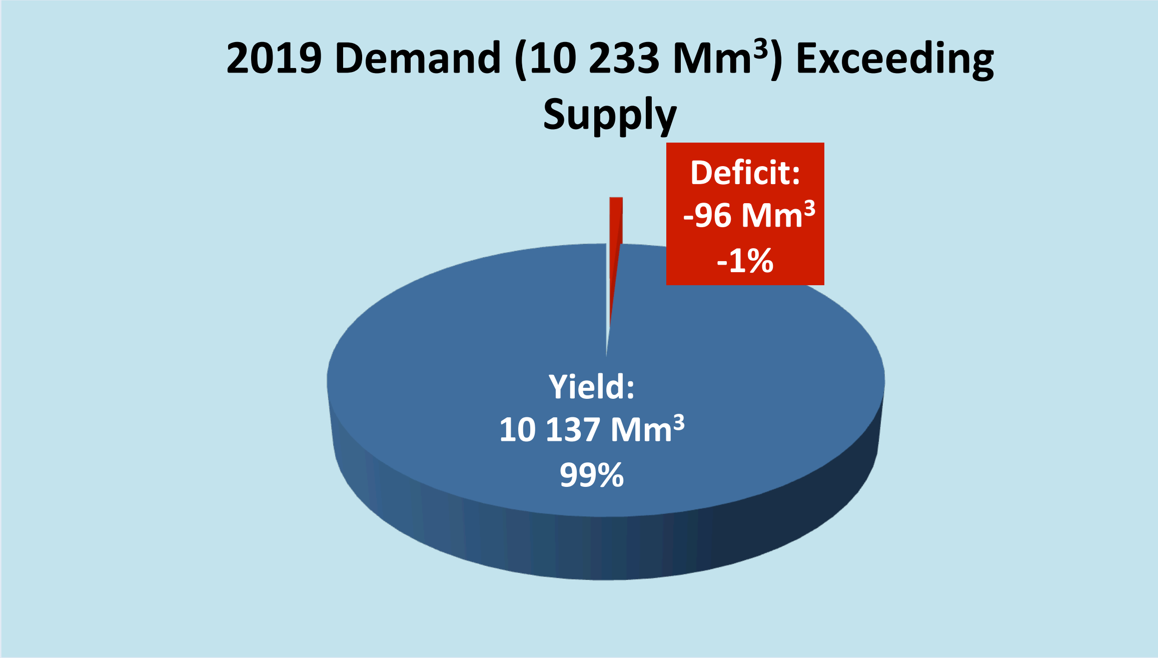


Figure 7.1 Key water resource systems

Based on data from 2019, as given in Table 7-1, large systems where water requirements exceed water available are:

- Quteniqua in WC (-6 M m³/year)
- Amathole in EC (-11 M m³/year)
- Olifants in Limpopo (-33 M m³/year)
- Orange in NC, FS, EC(- 147 M m³/year)
- Mgeni – KZN (- 62 M m³/year)

Nationally the water supply systems are at a deficit of 96 M m³/year (1%), predicted to be 3.4 % by 2040 (see Figure 7.2).



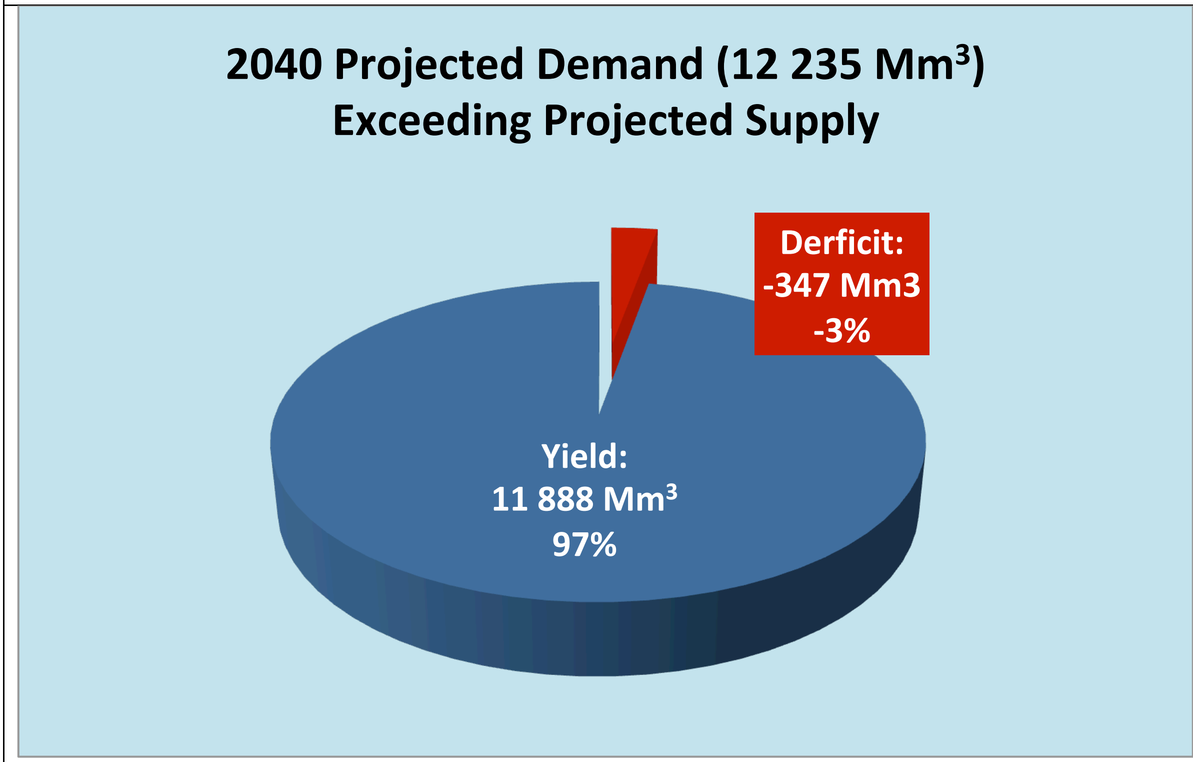


Figure 7.2 Projected demand in comparison to the yield in large water supply systems

Table 7-1 Water availability and requirement in large systems

System	Province	Systems in Mm^3	Current in Mm^3/Year, the base year 2019			Future in Mm^3/Year, projected for 2040		
		Total Storage capacity	Availability (integrated system yield)/ scheme yield	Demands (estimated requirements)	Deficit (-) / Surplus (+)	Availability (integrated system yield)/ scheme yield	Demands (estimated requirements)	Deficit (-) / Surplus (+)
Western Cape	WC	895	590	590	0	1 160	1 125	35
Outeniqua	WC	49	62	68	-6	62	90	-28
Algoa	EC	281	195	182	13	225	258	-33
Amathole	EC	241	104	115	-11	124	125	-1
Other Dams in EC	EC	989	36	5	31	36	7	29
Crocodile West	L, NW	495	1 200	1 170	30	1 460	1 365	95
Polokwane	L	254	268	261	7	433	408	25
Luvuvhu/Letaba	L	472	243	215	28	276	277	-1
Olifants	L	1 859	425	458	-33	442	566	-124
Crocodile East	Mp	340	67	62	5	76	76	0
IVRS	Mp, NW, GP, FS	10 566	3 154	3 120	34	3 640	3 600	40
Orange	NC, FS, EC	7 996	2 950	3 097	-147	2 766	3 150	-384
Mgeni and Coasts	KZN	978	499	561	-62	736	705	31

System	Province	Systems in Mm^3	Current in Mm^3 /Year, the base year 2019			Future in Mm^3 /Year, projected for 2040		
		Total Storage capacity	Availability (integrated system yield)/ scheme yield	Demands (estimated requirements)	Deficit (-) / Surplus (+)	Availability (integrated system yield)/ scheme yield	Demands (estimated requirements)	Deficit (-) / Surplus (+)
Richards Bay	KZN	413	239	225	14	290	292	-2
Bloemfontein	FS	84	105	104	1	162	191	-29
TOTAL		**25 912**	**10 137**	**10 233**	**-96**	**11 888**	**12 235**	**-347**

The water use per sector projections is given in Table 7-2 below. The irrigation and Municipal (urban water supply) remain the largest water use sectors. It is expected that relative to other use sectors, by 2040, the municipal and afforestation sectors will see an increase to 36% and 3%, respectively (see Figure 7.3).

Table 7-2 Water use per sector projections

User sector*	**Water requirements (million m³/annum)**				
	2015	**2020**	**2025**	**2030**	**2040**
Municipal (industries, commerce, urban and rural domestic)	4 447	4 900	5 400	5 800	6 600
Agriculture (irrigation and livestock watering)	9 000	9 500	9 600	9 700	9 800
Strategic/Power generation	362	390	410	430	450
Mining and bulk industrial	876	921	968	1 017	1 124
International obligations	178	178	178	178	178
Afforestation	431	432	433	434	434
Total	**15 294**	**16 321**	**16 989**	**17 559**	**18 586**

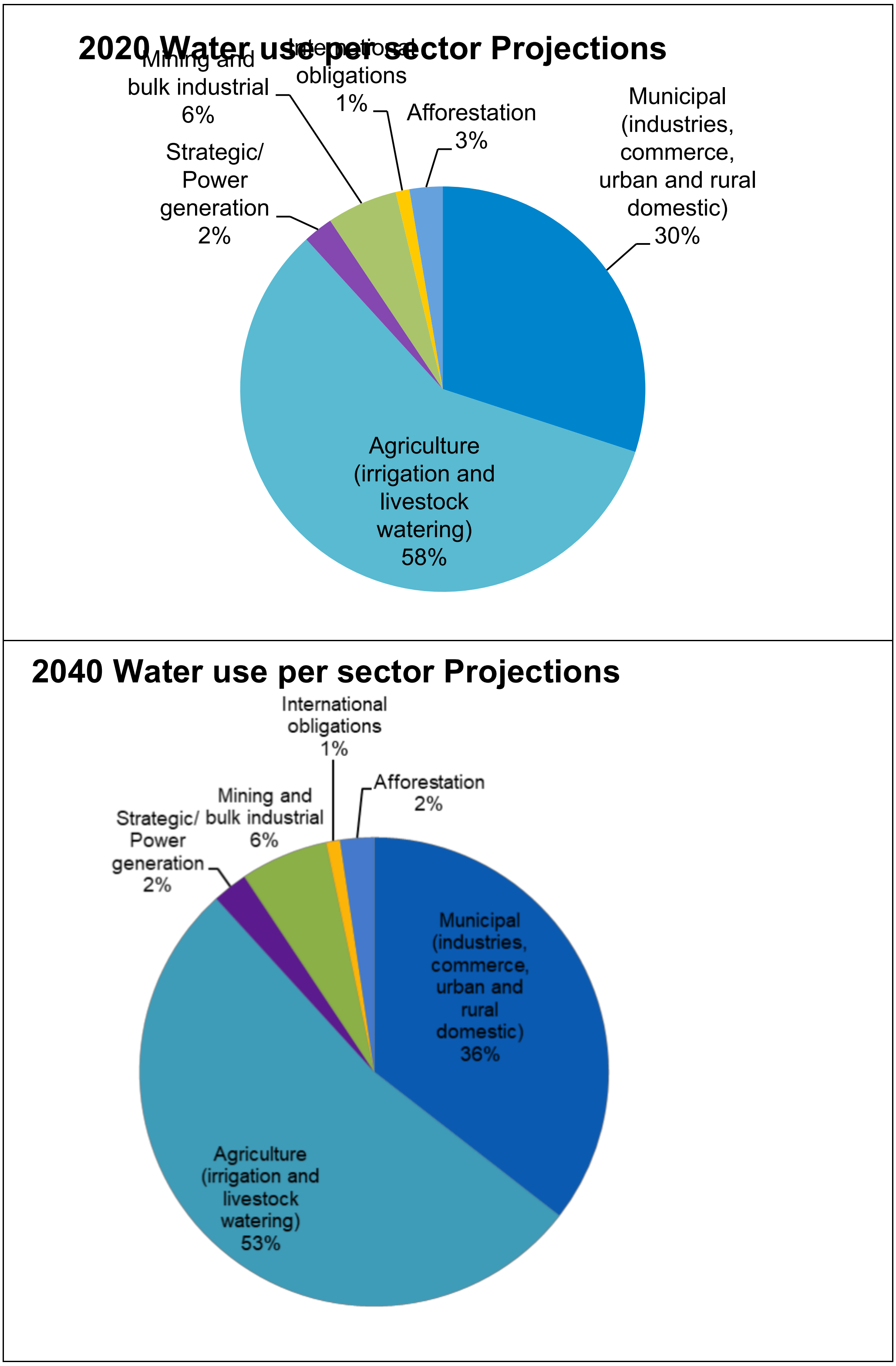


Figure 7.3 Water Use per sector 2020 and 2040 Projections

7.2 Water Reconciliation Strategies

The objective of the reconciliation strategy within a water supply system is to reconcile or find a balance between the current and future water requirements by implementing appropriate intervention measures to increase the available water, conserve water through water conservation and demand management measures, as well as improve the water quality in the river systems.

The Department has recently completed the reconciliation strategies for the Integrated Vaal River System, Mbombela water supply system, Algoa water supply system, and the Richards Bay water supply system. The interventions in these areas have been based on the recommended reconciliation options.

i. The Integrated Vaal River System Reconciliation Strategy

The Vaal Catchment consists of the Upper, Middle, and Lower Vaal River WMAs. Due to numerous inter-basin transfers that link the major Vaal WMA with other WMAs, the reconciliation planning is done in the context of the integrated Vaal River System, which also includes portions of the Komati, Usuthu, Thukela, and Senqu River (located in Lesotho) catchments. Significant water transfers also occur to water users in Olifants and Crocodile (West) River Catchments, of which most are totally dependent on water resources of the Integrated Vaal River System.

The main users of the IVRS water resources are bulk industrial users (Eskom and Sasol), urban users (Rand Water and Sedibeng water), and irrigators (predominantly the Vaalharts Scheme).

The following options are recommended:

- **Water Conservation and Demand Management** - Water loss reduction to reduce water requirement growth.
- **Removal of unlawful irrigation** - Finalize Verification and Validation of lawful water use.
- **Reuse** - Carry out a Regional Reuse investigation. Implement reuse where feasible
- **Lesotho Highlands Water Project Phase 2** - Implement project, finalize completion of Polihali Dam and other associated infrastructure construction.
- **Yield Replacement: Orange River** - Finalise feasibility to determine suitable option (Noordoewer/Vioolsdrift, Verbeeldingskraal). Implement a project to construct the scheme

The status of the implementation of some of the interventions is summarized in Table 7-3.

Table 7-3 Status of implementation of the intervention plans

Intervention	Summary of implementation progress
WCWDM	Limited progress made, some successes of Rand Water Project 1600, Impacts not yet seen on water balance, greater attention required, Municipalities to improve commitment of financial resources
Removal of unlawful Irrigation	Initially some progress made. Successful removal of 80 million m3 of unlawful irrigation. Recent years have seen slowdown of progress. Validation and Verification completion delaying further implementation. Northern Cape continuing with efforts, Free State and Gauteng committed to restarting process. Target to remove additional 75 million m3.
Reuse of treated effluent and other discharges	Short Term AMD solution implemented. Long Term AMD solution requires further investigation. CoT reuse plans slowed down due to budget constraints. Overall Regional reuse feasibility investigation required. Ongoing links to Crocodile (West) Reconciliation Strategy implementation plans.
New Infrastructure construction	Implementation of LHWP Phase 2 delayed till earliest date of April 2027 for delivery. Yield replacement Dam in Orange River Feasibility Study started, still to be completed before best option determined. Earliest data for yield replacement set at 2028.Improved maintenance of existing transfer infrastructure required.

ii. Mbombela Reconciliation Strategy

The major water requirements within the Mbombela Water Supply System are for irrigation, making up 54% of the total Crocodile and Sabie catchment requirements. Sugarcane is the predominant crop in these two catchments. Cross-border flows for the Crocodile and Sabie Rivers have a minimum requirement of 37 million m^3/annum according to the InoMaputo Water Use Agreement to cross the border from South Africa into Mozambique.

The Crocodile system provides water to several users along the stretch of the river and downstream of the main dam for the system - Kwena Dam. The yield of the Crocodile River System is influenced directly by the abstraction volumes and location of the water users within the system. The main water resource infrastructure in the Sabie River is the Inyaka Dam which supplies the Sabie and Sand catchments via the Bushbuckridge Transfer Pipeline.

Options for reconciliation and or intervention measures for the Crocodile System include:

- WCWDM
- Removal of Invasive Alien Plants
- Surrender Irrigation allocations
- Strict restriction rules on low-priority users
- Releases from the Ngodwana Dam

Reconciliation options and or intervention measures for the Sabie System include:

- WCWDM
- Removal of Invasive Alien Plants
- Development of groundwater
- Additional return flows from treated effluent

iii. Algoa Reconciliation Strategy

The Algoa WSS currently comprises three major dams in the west, several smaller dams, a spring situated near NMBM, and an inter-basin transfer scheme from the Orange River via the Fish and Sunday Rivers to the east. Five water user categories included domestic/industrial, Gamtoos irrigation, other irrigation, environmental, and losses.

Urban water use from the Algoa Water Supply System is more than 60% of total use from the system and is expected to increase. Water use within the Kouga Municipality is 10.0 million m3/a (27.3 Mℓ/d), with an estimated bulk water requirement of 13.0 million m3/a (35.5 Mℓ/d). Of this, 5.85 million m3/a was supplied from the Algoa WSS in 2016/17. The Municipality plans to develop a long-term Water Provision Master Plan with reference to the upgrading and rehabilitation of bulk infrastructure. In the future, Groundwater from the Humansdorp area will be used by Kouga LM. There is a possibility of the supply of additional Orange River water to the NMBM, in lieu of more water supplied from the Kromme River sub-system to the Kouga LM and the proposed power plant.

The following interventions are recommended:

- **Further allocation of Orange River water to NMBM**

The concept of the further phasing of the NCLLS (post Phase 4) of transferred Orange River water has been added, termed Phase 5. The assumed yield of the Nooitgedagt Phase 5 Scheme has been assumed to be 18.25 million m3/a (50 Mℓ/d). Conveyance to NMBM could be by either of the two-bulk supply (high-level and low-level) pipelines. Should the capacity of these pipelines be exceeded (assuming that supply cannot be boosted), a further bulk supply pipeline would be required.

- **Groundwater supply**

The yields of the Coega Fault, Moregrove Fault, and Jeffreys Arch aquifers have been revised, while in some areas, the original yield estimates have not been changed. The total long-term yield of the eight potential groundwater interventions has been updated from 29.5 million m3/a to 36.0 million m3/a.

- **Large seawater desalination scheme**

A potential large seawater desalination scheme, with a capacity of 87.6 million m3/a (240 Mℓ/d) has been added as a potential intervention to consider for implementation should the allocation of transferred Orange River water be revoked.

iv. Richards Bay Reconciliation Strategy

Intervention options in the Richards Bay system comprise the implementation of combinations of various reconciliation options over time and can be divided into two main categories, namely:

- Reconciliation options are used to reduce the water requirements; and
- Reconciliation options that will increase the yield available from the existing water resources.

The following interventions are recommended:

- **Reducing water demand by introducing WCWDM** - KCDM have recently (May 2020) started a WCWDM project aiming to reduce water losses in their water supply schemes.
- **Remove alien vegetation** - removing alien vegetation is a standard intervention measure for saving water in all Reconciliation Strategies and is very important in severely water-stressed catchments.
- **Water Reuse** - Indirect effluent reuse, whereby treated effluent could be discharged to Lake Mzingazi for indirect potable and industrial reuse. Also, consider the blending of treated effluent at the Mzingazi WTW or artificial recharge to create a barrier to prevent seawater intrusion. Potential uptake of treated effluent by bulk industrial water users close to the Arboretum macerator. Potential users would need to be identified.
- **Transfers from Neighboring Catchments -** an increase in the Thukela transfer from Middeldrift be compared with other transfer options (Lower Thukela Coastal pipeline and Umfolozi off-channel storage Dam) at a pre-feasibility level, after which a decision can be made as to the preferred option. However, drought hit the catchment shortly after the completion of the Strategy (2015), and the upgraded Thukela transfer was then selected as an emergency scheme. Construction of the upgrade began, which would increase the size of the existing transfer from 1.2 m^3/s to 2.4 m^3/sd.

- **New Dam Construction -** a new dam on the Nseleni River. The proposed dam will be located on the Nseleni River, a tributary of the Mhlathuze River just upstream of the Bhejane township, from where water can be released downstream to Lake Nsezi for abstraction.
- **The raising of Goedertrouw Dam** - the dam can be raised by 2.8 meters which will result in an increase in storage capacity from the existing volume of 301 million m^3 to 336 million m^3. The corresponding increase in yield to the system would be 5.8 million m^3/annum.

7.3 Water Resources Development

Water resource development mainly addresses issues such as socio-economic uplifting and development, ensuring the availability of safe water supplies to communities, and meeting the water requirements for industries and other sectors critical for economic growth. The Department has been involved in the development of water resources infrastructure development to augment water supply and safeguard future water security. Estimated funding of **at least R126 Billion** is required to finance key water resource development projects **in the next ten years.** A schematic illustration of the phases for various projects is presented below.

Furthermore, the list of prioritized water resources development per water supply system is given in Table 7-4.

Resource Development Flow Chart

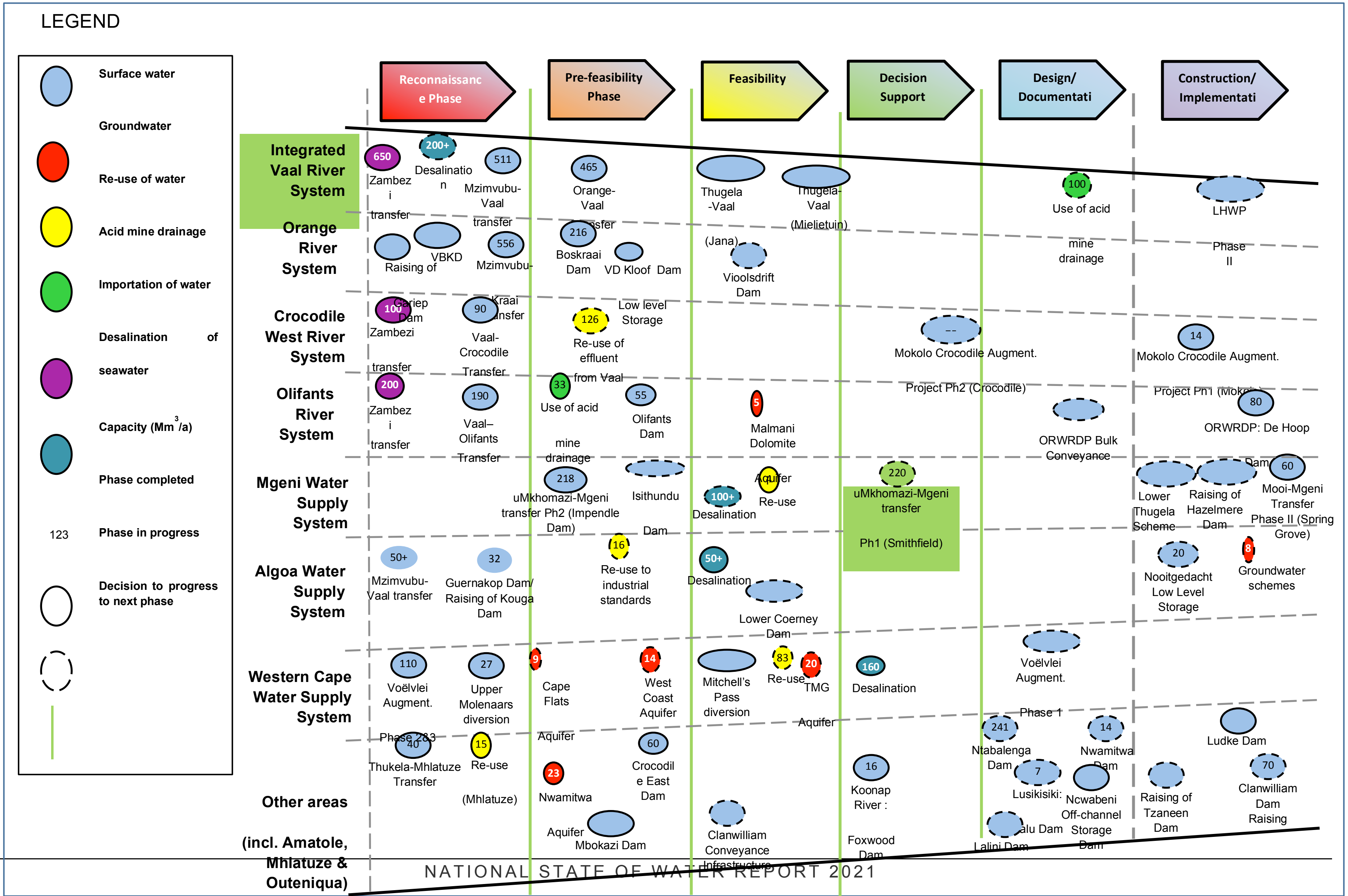


Table 7-4 Current Prioritized Water Resource Development

Water Resource (WR) System	**Current Prioritized Water Resource Development Option and Estimated Date of Water Delivery**		
	2020 - 2030	2031 - 2040	2041 – 2050
Integrated Vaal River System	Phase 2 of Lesotho Highlands Water Project by 2025 (R32.6 Billion)	Use of Acid Mine Drainage	Thukela Water Project (Jana & Millietuin Dam s)
Orange River System	Gariep Pipeline by 2024 (R8 Billion), Vioolsdrift Dam in the Lower Orange (R6 Billion)	Dam at Verbeeldingskraal in the Upper Orange River	
Crocodile West River System	Mokolo Crocoldile (West) Water Augmentation Project (MCWAP) by 2024 (R15 Billion)	Re-Use of Effluent	Re-Use of Effluent
Olifants River System	Olifants Water Resource Development Project (ORWRDP) Phases 2B (R6.6 Billion) , 2D (R1.8 Billion) , 2E (R0.5 Billion) & 2F (R2.3 Billion) Exploitation of the Malmani Dolomitic Groundwater Aquifer	Re-Use of Effluent	Olifants Dam (Possibly Rooipoort Dam)
Mgeni Water Supply System	Phase 1 of uMkhomazi Water Project by 2026 (Dam at Smithfield , transfer tunnel and Associated Works) (R18.5 Billion)	Re-Use of Effluent	Phase 2 of uMkhomazi Dam (Dam at Impendle and Associated Works)
Algoa Water Supply System	Lower Coerny Balancing Dam Ground Water Development Scheme	Re-Use of Effluent	Kouga Dam Augmentation Scheme
Western Cape Water Supply System	Berg River – Voelvlei Augmentation Scheme (BRVAS) by 2021 (R0.9 Billion) Table Mountain Group Aquifer Scheme	Breede-Berg River Augmentation Scheme (Mitchell’s Pass Diversion & Raising of Voelvlei Dam)	Raising of Lower Steenbras Dam Desalination of Sea Water

Eastern Cape Water Schemes	Mzimvubu Water Project (R17.9 Billion), Koonap River Development Project (Foxwood Dam) (R3 Billion), Lusikisiki Water Project (Zalu Dam) (R2 Billion)	Groundwater Development	Phase 2 of Mzimvubu Water Project
Letaba Water Supply System	Groot Letaba Water Augmentation Project (GLeWAP) (Nwamitwa Dam (R1.7 Billion) & Raising of Tzaneen)	Groundwater Development	Water Re-Use
Olifants-Doorn Water Scheme	Clanwilliam Dam Raising (R 3.3 Billion) Phase of Conveyance System from the Raised Clanwilliam Dam (R6 Billion)	Phase of Conveyance System from the Raised Clanwilliam Dam	Groundwater Development

7.3.1 Augmentation Projects

Water infrastructure is aging and becoming dysfunctional. Aged infrastructure results in huge water losses and water supply backlogs. Infrastructure renewal lies in the responsibility of the Infrastructure Management Branch within the Department, which is also responsible for the management of Government Water Schemes (GWSs). Table 7-5 reports the progress made on augmentation projects that are being implemented by the Chief Directorate: Infrastructure Development for the period up to the end of September 2021.

7.3.2 Trans-Caledon Tunnel Authority

Trans-Caledon Tunnel Authority (TCTA) is an institution directed to raise funds and implement a portfolio of projects which are at various phases namely, project preparation phase, project implementation phase and close-out phase. Table 7-6 reports on a portfolio of projects including a status update on those projects that are on hold due to funding and other constraints. In addition, TCTA oversees the Operation and Maintenance of several other projects.

Table 7-5 Progress of augmentation projects across the provinces

Province	Project Description	Projects status	Other
Limpopo	Nandoni Dam	Giyani water services project including pipeline from Nandoni Dam on progress	Nandoni water purification upgrade including possible waste-water treatment plant
	Phase 2 of the Olifants River Water Resources Development Project (ORWRDP – 2) involves the development of additional water resource infrastructure consisting of the De Hoop Dam on the Steelpoort River	A BOQ for repairs to the Buffelskloof houses, water supply and sewage network and Tsehla Trust furrow has been compiled and is being finalised	
Western Cape	The project for the Raising of Clanwilliam Dam is aimed to provide additional water to improve the assurance of supply for agriculture, provide for water	The civil design is complete. Most of the construction drawings are complete and have been formally issued to the Contractor. Construction progress is at 21%	

	allocations to resource-poor farmers and to address dam safety aspects. The scope of the work includes the raising of the existing dam wall by 13 metres, the relocation of a section of the N7 directly affected by the raised dam wall and the raising of the secondary provincial roads affected by the Full Supply Level	completion	Upgrade of Greater Brandvlei Dam Scheme
Gauteng	Lesotho Highlands Phase 2	Lesotho Highlands Phase 2 in progress	
KZN	uMkomazi Water Project	Raising of Hazelmere Dam. The project for the Raising of Hazelmere Dam is aimed to augment the water supply to the KZN North Coast by raising the dam wall by 7 metres to increase the yield of the dam for medium term supply. The scope of the work includes the construction of a piano key weir on the spillway, the installation of rock anchors, foundation grouting and other minor works	
Eastern Cape	Cwabeni off-channel storage dam The project involves the construction of a new concrete faced zoned rockfill dam on the Ncwabeni River, with a multi-level intake tower, an abstraction weir on the Umzimkhulu River and a pump station and pipeline to pump water into the off-channel storage dam	Civil and mechanical designs that are independent of the geotechnical investigations and surveys are continuing. Preliminary design is 85% complete, detailed design is 22% complete and tender documentation is 8% complete. The procurement of environmental engineering, geotechnical engineering and surveying services required to advance the design work is being hindered by the lack of funding for the project	

Table 7-6 TCTA Projects Progress end of September 2021

No.	Project Name	Start Date	End Date	Project description	Status
PROJECTS AT PREPARATION PHASE					
1.1	uMkhomazi Water Projects – Phase 1	February 2019	2028	Water requirement projection indicates that the Mgeni System is experiencing a deficit since 2016 and therefore there is a need for new water resources, hence uMWP-1. uMWP-1 consists of Bulk raw water implementation by TCTA and Bulk Potable Water Implementation by Umgeni Water. The Bulk Raw Water portion consists of: • 81m high dam and appurtenant works at Smithfield on the uMkhomazi River near Bulwer. • Conveyance infrastructure (32km 3.5m diameter tunnel and 5km 2.6m diameter raw water pipeline) to the proposed Umgeni Water's Water Treatment Works (WTW) in the uMlaza River valley. Cost at Completion: R 23.243 billion	Design Complete: N/A
PROJECTS AT OPERATIONAL PHASE					
2.1	Berg River Voelvlei Augmentation Scheme (BRVAS)	May 2017	June 2025	The Water Reconciliation Strategy for the Western Cape Water Supply System (WCWSS) indicates that the system is projected to be in deficit soon and should have been augmented by at least 2019/20 to avert a serious shortfall. The urgent need for augmenting the	Design Complete: 0%

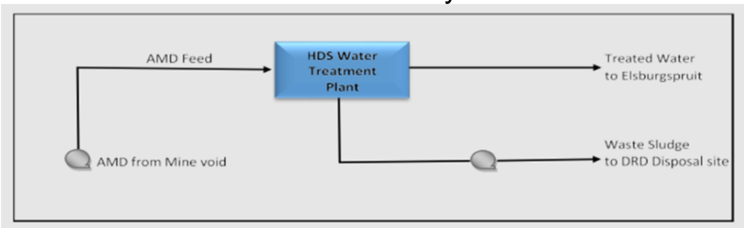
No.	Project Name	Start Date	End Date	Project description	Status
				WCWSS has become evident by the system's inability to cope with the current drought situation. BRVAS is conceptualised to abstract winter flows from the Berg River and pump it to the existing Voëlvlei Dam, increasing the yield by 23 million m^3 per annum and consists of: • abstraction works in the Berg River - diversion weir, sediment traps, 5MW pump station; • canoe chute-fish way; and • a 6.3 km long pipeline to deliver the water to the Voëlvlei Dam Cost at Completion: R 728 million	
2.2	Mzimvubu Water Project (MWP)	2019	2022	Two multi-purpose dams and associated infrastructure, Ntabelanga and Lalini dams, on the Tsitsa river, which is a tributary of the Mzimvubu river, will be developed to provide for potable water supply, irrigation, hydropower, and tourism. Government has classified the project as a Strategic Integrated Project under SIP-3. The project aims to develop the water resources in the Mzimvubu river catchment to provide a stimulus for the regional economy, in terms of domestic water supply, irrigation, hydropower generation and job creation. The project was envisaged to be implemented in 4 stages (2018/19). Stage 1 is Advanced Infrastructure, mainly access road. Stage 2 is the Implementation of Ntabelanga	Design Complete: 0%

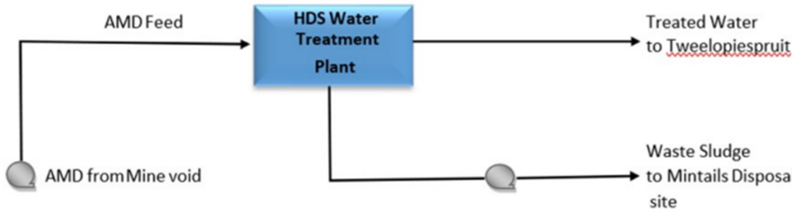
No.	Project Name	Start Date	End Date	Project description	Status
				Dam and Water Treatment Works. Stage 3 involves the bulk distribution system. Stage 4 is the Irrigation and Hydropower components – roads, staff housing. TCTA is only providing Project Management advisory services for implementation of Stage 1. Cost at Completion: R 15 billion construction cost	
2.3	Mokolo and Crocodile River Water Augmentation Project-Phase 2A	April 2019	April 2028	Additional water from MCWAP-2A is required to provide Eskom with a second water source to run their two Waterberg power stations, Medupi and Matimba. This water is to further provide Medupi Power Station with enough water to operate the additional three Flue Gas Desulphurization (FGD) units and Matimba Power station to operate their 6 FGD units, which could not be supplied from the MCWAP-1 pipeline. It will also provide the Lephalale Municipality with water and provide Exxaro with required additional water to increase their mining capacity. The Industrial Development of the Waterberg area is one of the objects of the PICC SIP-01 programme, and the project will also aim to provide water to aid that industrialisation. MCWAP-2A consists of an abstraction weir, a River Management System and implementation of a 160 km water transfer infrastructure with a capacity of 75 million m3/annum with associated ancillary infrastructure. Design Complete: 99% Cost at Completion: R12.36 million	Design Complete: 99%

No.	Project Name	Start Date	End Date	Project description	Status
PROJECTS AT CLOSE OUT PHASE					
3.1	Olifants River Water Resources Development project –Phase 2C	March 2012	2022	The ORWRDP-2 bulk distribution system (BDS) transfers water from the De Hoop and Flag Boshielo dams for municipal and mining needs in the middle Olifants river catchment area, unlocking significant social and economic development. Phase 2C will improve water supply to Jane Furse / Nebo Plateau and for mining activities in the Steelpoort - Burgersfort area. Phase 2C has been implemented by TCTA as per revised Ministerial Directive Construction Complete: 100% Cost at Completion: R2 544 million	Construction Complete: 100%
PROJECTS ON HOLD					

Project		Directive	Strategic Impact	Status
4.1	Olifants River Water Resources Development Project – Phase 2B (ORWRDP-2B)	To source funding and implement commercial portion of Phase 2B. Augment water supply to Mogalakwena	To source funding and implement commercial portion of Phase 2B. Augment water supply to Mogalakwena Municipality	To source funding and implement commercial portion of Phase 2B. Augment water supply to Mogalakwena Municipality by 50 million m^3 per year. DWS signed MOI with Mines for the implementation of the outstanding phases on

No.	Project Name	Start Date	End Date	Project description	Status
		Municipality by 50 million m^3 per year. DWS signed MOI with Mines for the implementation of the outstanding phases on a JV basis with shared responsibility. TCTA awaits DWS guidance on what role TCTA will play within the new institutional framework. TCTA also placed this on agenda with new Minister		by 50 million m^3 per year. DWS signed MOI with Mines for the implementation of the outstanding phases on a JV basis with shared responsibility. TCTA awaits DWS guidance on what role TCTA will play within the new institutional framework. TCTA also placed this on agenda with new Minister	a JV basis with shared responsibility. TCTA awaits DWS guidance on what role TCTA will play within the new institutional framework. TCTA also placed this on agenda with new Minister
4.2	Acid Mine Drainage – Long Term Solution (AMD-LTS)	To fund and implement the AMD Long-term solution.		Desalination of partially treated acid mine drainage water from the Short-term Intervention to a potable or industrial standard.	TCTA Board raised the way forward on the implementation of the Long-Term solution during the meeting with the new Minister, feedback from DWS is awaited.
POTENTIAL PROJECTS					
	Project	**Directive**		**Strategic Impact**	**Status**
5.1	Olifants River Water Resources Development Project (ORWRDP - 2D, 2E	Possible directive for TCTA to implement social phases related to Phases		Development of additional water resource infrastructure.	See ORWRDP-2B above

No.	Project Name	Start Date	End Date	Project description	Status
	and 2F) – Phase 2B	2D, 2E and 2F withdrawn.			
5.2	Nwamiwta Dam	Possible directive to TCTA to implement the project.		Implement the project. Increase in water supply for commercial and social use in the Tzaneen area.	Proposal made to DWS awaiting response.
	OPERATIONS AND MAINTENECE				
6.1	Acid Mine Drainage Treatment Plants in the Western , Central and Eastern Basins	**Objectives:** To draw down the AMD Central Basin water level to be at or below the level recorded on 31 March2021. To operate and maintain the Central Basin – High Density Sludge (HDS) Water Treatment Plant in a cost effective and environmentally sustainable manner.  Winze 18 Shaft. During the year 1 April 2021 - 31 March 2022 the water level not to exceed 1m below shaft collar to operate and maintain the Western Basin - High Density Sludge (HDS) Water Treatment Plant in a cost effective and environmentally sustainable manner.			

No.	Project Name	Start Date	End Date	Project description	Status
					
6.2	Delivery Tunnel North (DTN) of the Lesotho Highlands Water Project (LHWP)	**Objectives:** • To transfer water as per LHWP Treaty, protocol VI. • To operate and maintain the Delivery Tunnel North transfer scheme in a cost effective and environmentally sustainable manner. Operator: TCTA in house Operation and Maintenance as per Treaty requirements. Target: Annual LHWC delivery schedule compliance, September 2021 plan was 80.0 MCM. Delivery for September 2021 was 80 00 MCM as per Ngoajane meter reading by LHDA on 1st October 2021. TCTA is performing the Operations and Maintenance of the Delivery Tunnel North transfer scheme in-house and form part of the TCTA staff costs.			

7.4 Water use efficiency

Efficient use of water is necessary for South Africa, a semi-arid country that is forecasted to face drier climatic conditions in the future, which will see the demand for water resources exceeding the conventional supply. Systemic water management improvements through technology can aid the monitoring of water use efficiencies, such as ensuring supply systems efficiency, which informs planning, maintenance, and refurbishment.

Water Losses in the Major water supply systems are reported. This is because about 60% of water is allocated to these major supply systems. This section aims to give the status and trends in the improvement within the eight large water supply systems, to potentially reduce system input volume, water losses, and non-revenue water (NRW) and subsequently improve water use efficiency.

South Africa is a semi-arid country that experiences high variability and uncertainty in available surface water resources. Water Conservation / Water Demand Management (WCWDM) is a key strategic intervention to reconcile water requirements with water availability.

7.4.1 Water Losses in Major Water Supply Systems

i. Integrated Vaal River System

The NRW trends are shown in Figure 7.4. NRW deteriorated in the past six months from 38.5% to 40.1% in December 2020. It is concerning to note that the System Input Volume (SIV) and NRW are steadily increasing and are at their highest level in 10 years. Municipalities in the IVRS exceeded their 2020 targets by 106 million m3 /annum and need to reduce their current consumption by 66 million m3 /annum to achieve their 2022 DWS target. The Rand Water consumption needs to be reduced by 140 million m3 /annum or 10% to achieve the Project 1600 target.

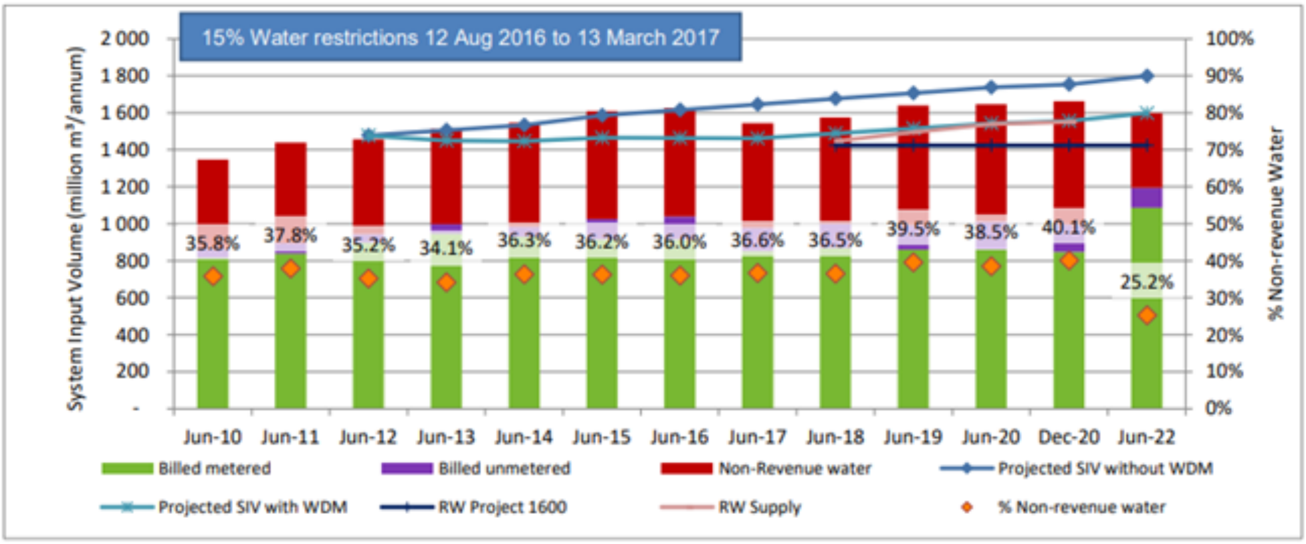


Figure 7.4 IVRS Water Balance Trend for Non-Revenue Water

ii. Crocodile West River Water Supply (CWRWSS)

No accurate assessment could be made of the NRW trend as presented in Figure 7.5, but indications are that municipalities are achieving the 2019 target. NRW is steadily increasing and reaching levels that could jeopardize the sustainability of the municipalities.

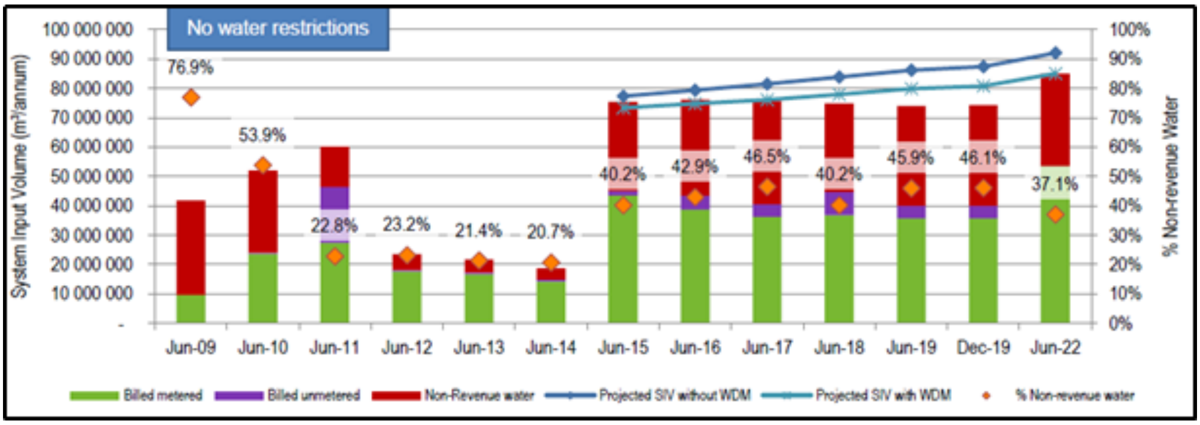


Figure 7.5 CWRWSS Water Balance Trends for Non-Revenue Water

iii. KwaZulu-Natal Coastal Metropolitan Water Supply System (KZNCMWSS)

The NRW and SIV trends for KZNCMWSS are presented in Figure 7.6. The results indicate that NRW is increasing, and municipalities are following the high population with WCWDM projected demand mainly because of water restrictions.

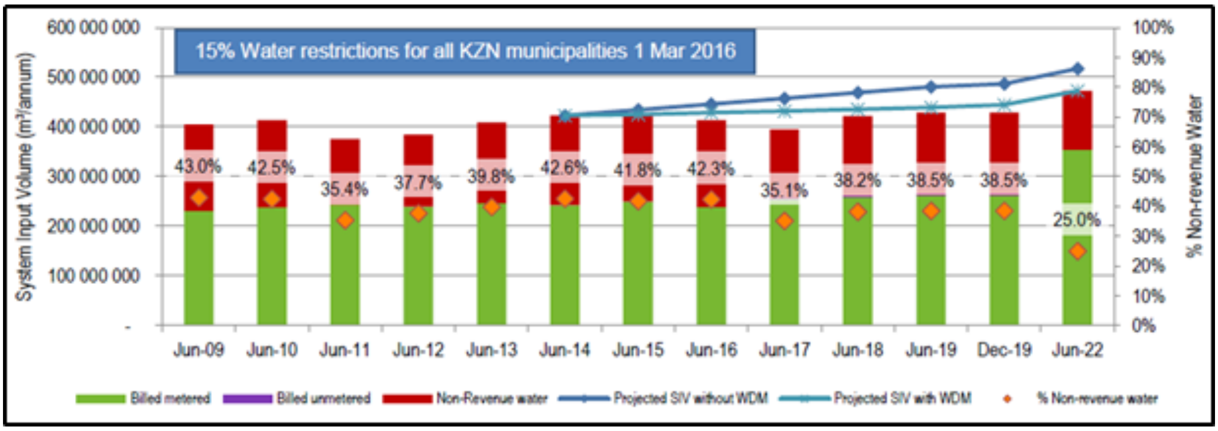


Figure 7.6 KZN Coastal Metropolitan WSS Water Balance Trend for Non-Revenue Water

iv. Western Cape Water Supply System (WCWSS)

The NRW and SIV trends are shown in Figure 7.7. Severe droughts have been experienced in this system since the end of 2014, which is a reason for the lower SIV.

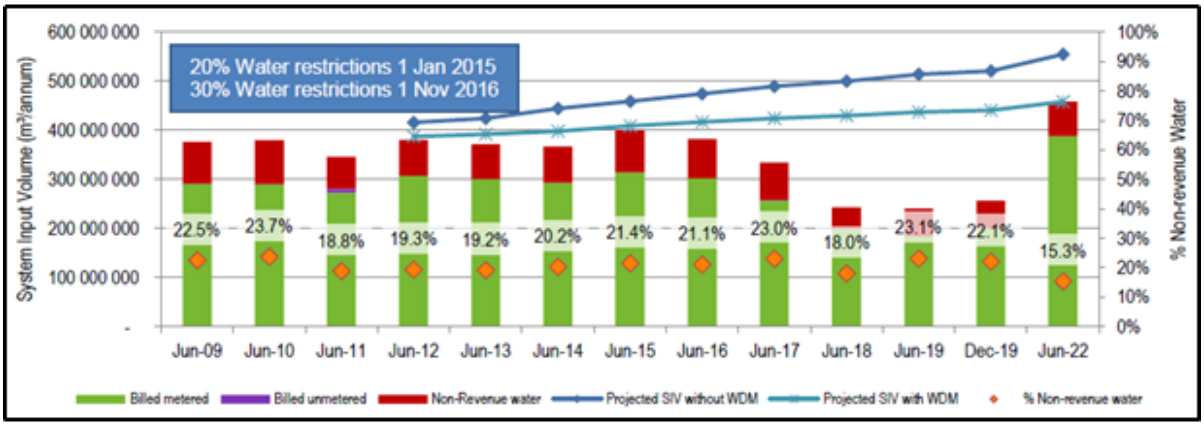


Figure 7.7 Western Cape WSS Water Balance Trend for Non-Revenue Water.

v. Algoa Water Supply System

The Algoa Water Supply System (AWSS) data includes Nelson Mandela Bay, Koukama, Kouga, and Sundays River Valley municipalities and have a medium confidence level. The average NRW is in line with poorly managed systems. The NRW and SIV trends for AWSS are presented in Figure 7.8.

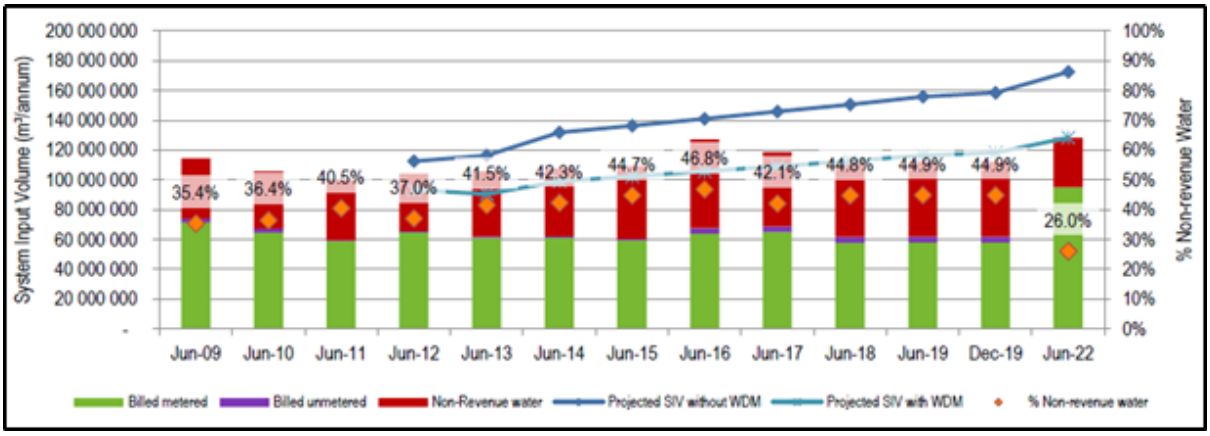


Figure 7.8 Algoa WSS Water Balance Trend for Non-Revenue Water

vi. Amatole Water Supply System

The NRW and SIV trends for Amatole Water Supply System (AmWSS) are shown in Figure 7.9. The data has a medium confidence level.

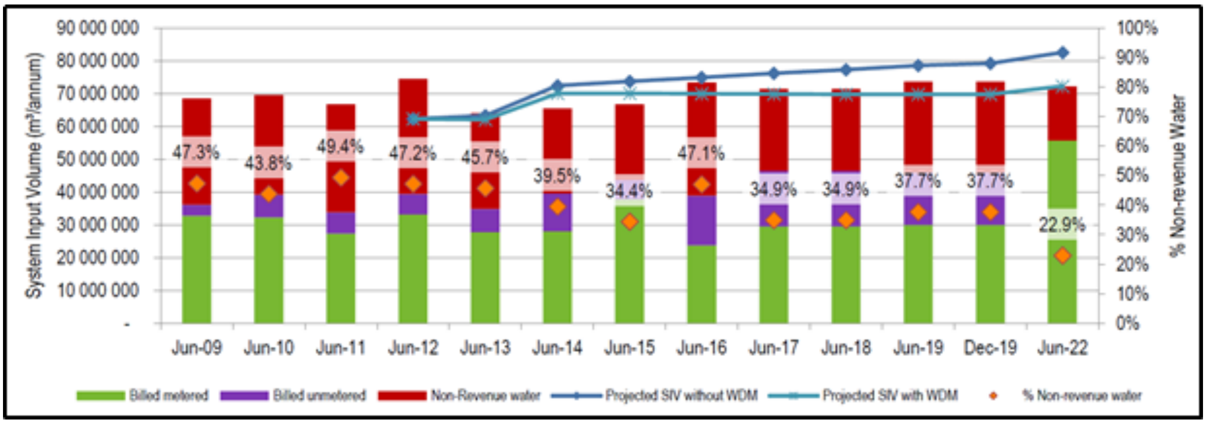


Figure 7.9 AmWSS Water Balance Trends for Non-Revenue Water

vii. Greater Bloemfontein Water Supply System

The Greater Bloemfontein Water Supply System (GBWSS) supplies water to the Mangaung Metro Municipality (MMM) and smaller towns in Naledi, Kopanong, and Mantsopa municipalities.

Figure 7.10 shows the NRW and SIV trends for MMM. The NRW of MMM reduced by almost 20% in the past year and needs further investigation. The MMM should strive to improve its water balance data. MMM has managed to achieve its water restrictions target.

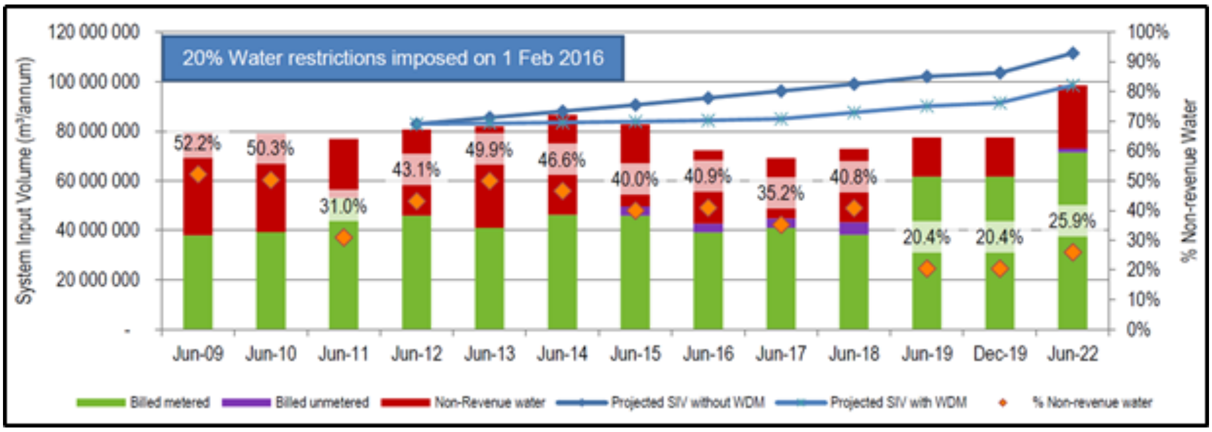


Figure 7.10 MMM Water Balance Trends for Non-Revenue Water

viii. Olifants River Water Supply System

Information regarding the total consumptive water use and losses in the towns within the Olifants River Water Supply System (ORWSS) was based on the limited WCWDM investigation carried out as part of the Olifants WCWDM Study. NRW is stable between 40% and 45%, as presented in Figure 7.11

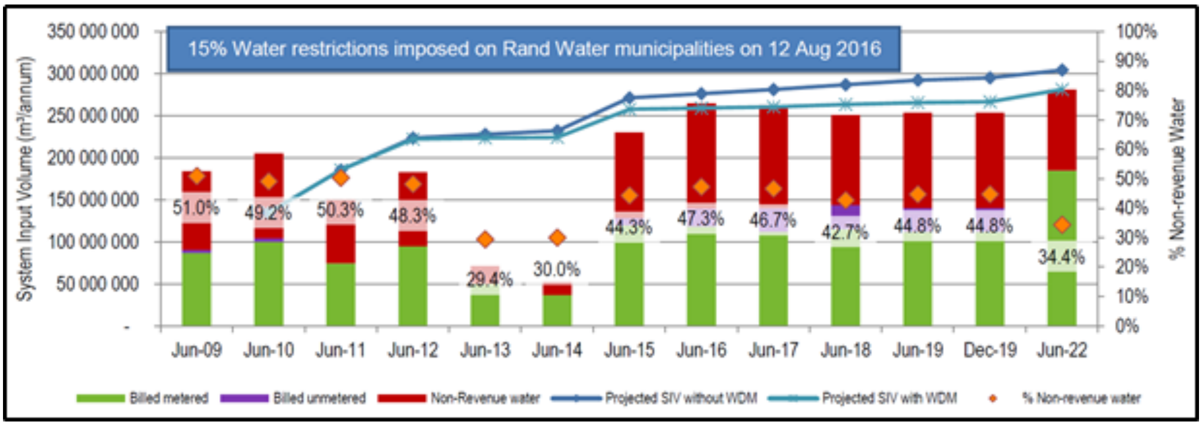


Figure 7.11 ORWSS Water Balance Trends for Non-Revenue Water

7.4.2 Consumption Trends

i. Integrated Vaal River System

The per capita consumption is shown in Figure 7.12 and has been reducing from 2015 because of some WCWDM interventions and imposed water restrictions. The current consumption is still high compared to the national benchmark of 236 ℓ/c/d, but the study area includes the highest number of wet industries in the country. The ℓ/c/d is expected to reduce to 251 ℓ/c/d if the 2022 target is achieved, and further improved efficiencies and water loss reduction could reduce this figure to an expected international benchmark of 180 ℓ/c/d.

Municipalities in the IVRS exceeded their December 2020 target by 106 million m3. Ekurhuleni, Mogale City, Govan Mbeki and Midvaal surpassed their 2019 water demand targets. The city of Johannesburg, City of Tshwane, Emfuleni and Rustenburg, the major contributors to water losses in the IVRS, have not achieved their targets and seem unlikely to do so within the next two years unless significant effort and funds are dedicated to water loss reduction.

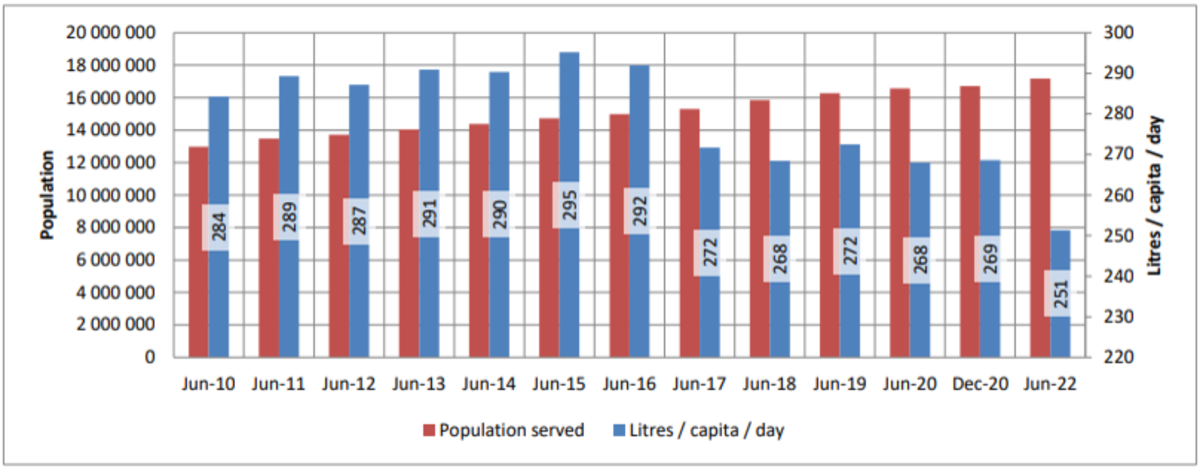


Figure 7.12 IVRS per capita consumption trend

ii. Crocodile West River Water Supply (CWRWSS)

The per capita consumption is presented in Figure 7.13. In December 2019, the consumption was estimated at 170 ℓ/c/d, which is in line with the level of service. The results indicate that progress has been made with the reduction of water losses within these municipalities, although the data had a very low confidence level.

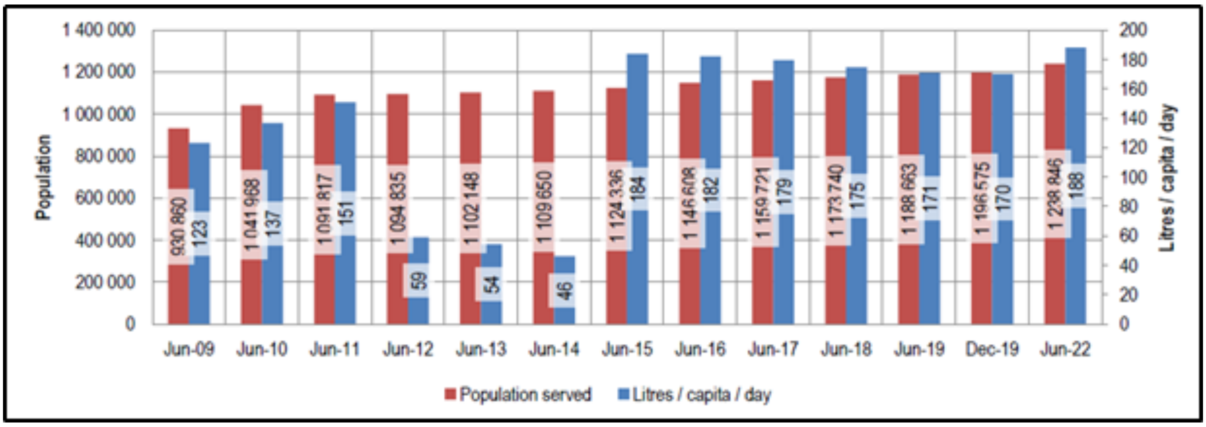


Figure 7.13 CWRWSS per capita consumption trend

iii. KwaZulu-Natal Coastal Metropolitan Water Supply System (KZNCMWSS)

The per capita consumption is presented in Figure 7.14, which has been consistently increasing since 2017, when water restrictions were lifted.

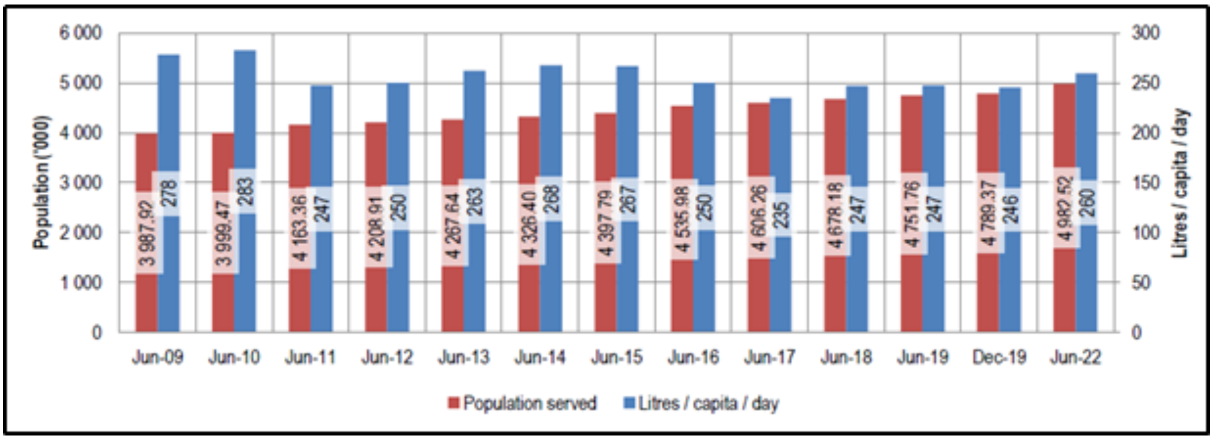


Figure 7.14 KZN Coastal Metro WSS per capita consumption trend

iv. Western Cape Water Supply System (WCWSS)

The per capita consumption is presented in Figure 7.15, which has been consistently decreasing over the past ten years. The average consumption of 127 ℓ/c/d is well below the national benchmark of 236 ℓ/c/d.

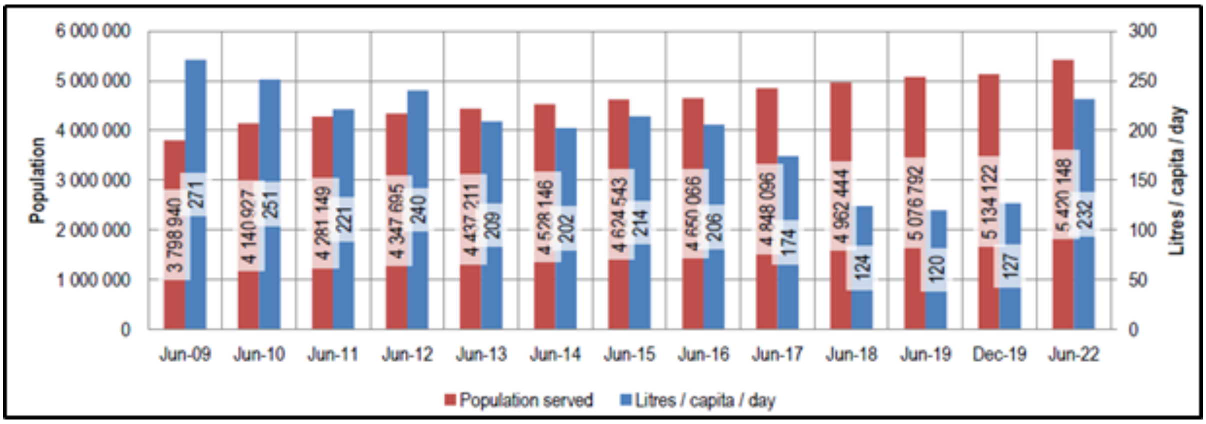


Figure 7.15 Western cape WSS per capita consumption trend

v. Algoa Water Supply System

The results indicate that NRW has been relatively constant over the last six years, at approximately 45%. The AWSS per capita consumption is shown in Figure 7.16, which has been between 199 and 277 ℓ/c/d over the past ten years. The average consumption is expected to reach 226 ℓ/c/d if the 2022 target could be achieved.

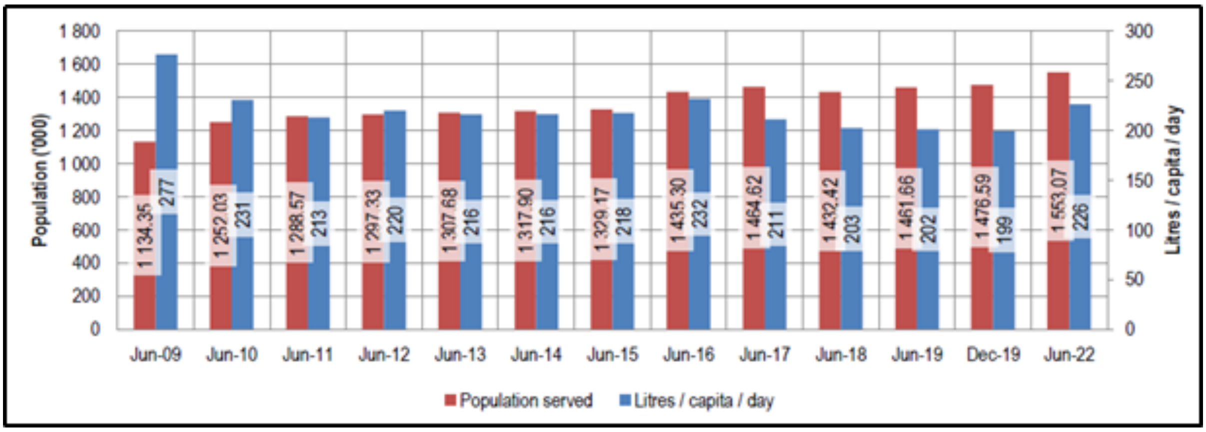


Figure 7.16 Algoa WSS per capita consumption trend

vi. Amatole Water Supply System

The per capita consumption for AmWSS is presented in Figure 7.17. The average per capita consumption has been stable over the past few years.

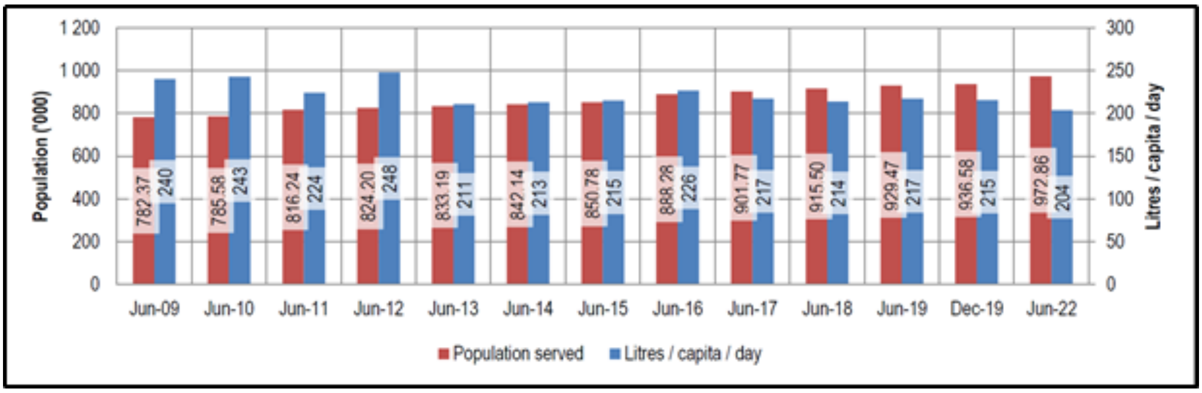


Figure 7.17 AmWSS per capita consumption trend

vii. Greater Bloemfontein Water Supply System

The per capita consumption for MMM is shown in Figure 7.18. The average per capita consumption has been improving over the past few years. However, it can improve considering the level of service. Restrictions of 15% were implemented in MMM during July 2015, which was increased to 20% in July 2016 due to resources being under stress.

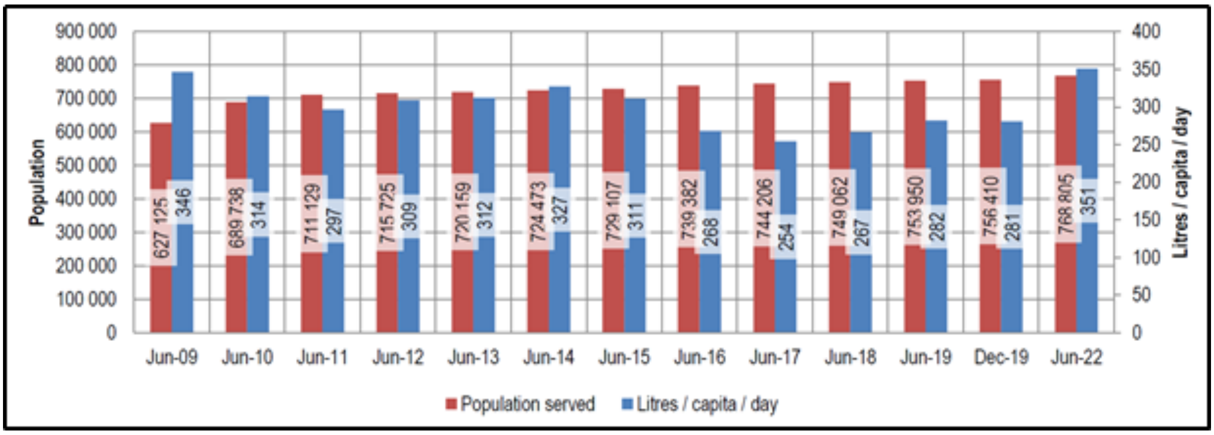


Figure 7.18 MMM per capita consumption trend

viii. Olifants River Water Supply System

The per capita consumption is shown in Figure 7.19. There is a very low confidence level in the unit consumption decrease over the past five years, however. The current estimated average consumption is 184 ℓ/c/d.

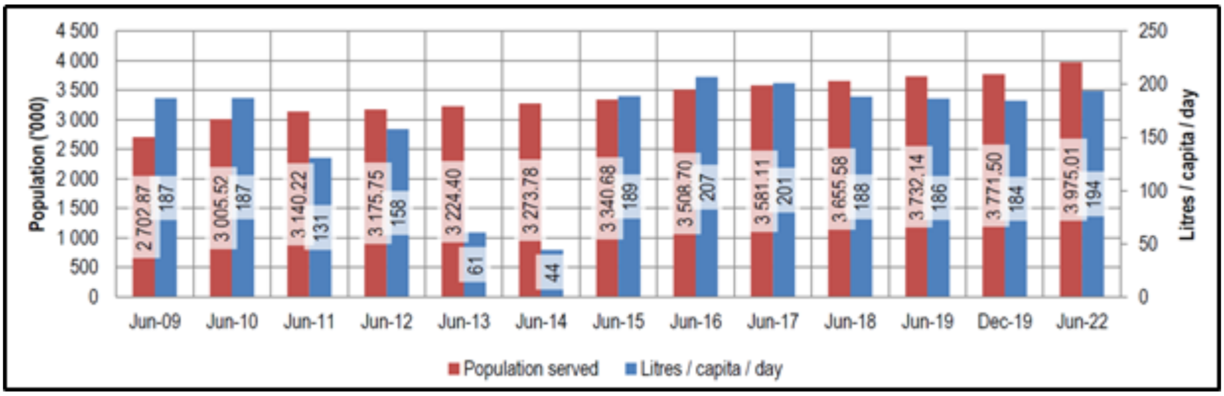


Figure 7.19 ORWSS per capita consumption trend

8

REGULATION, COMPLIANCE & ENFORCEMENT

8 REGULATION, COMPLIANCE & ENFORCEMENT

8.1 Water Allocation

The water use registration data from the Water use Authorisation and Registration Management System (WARMS) is presented in Figure 8.1.

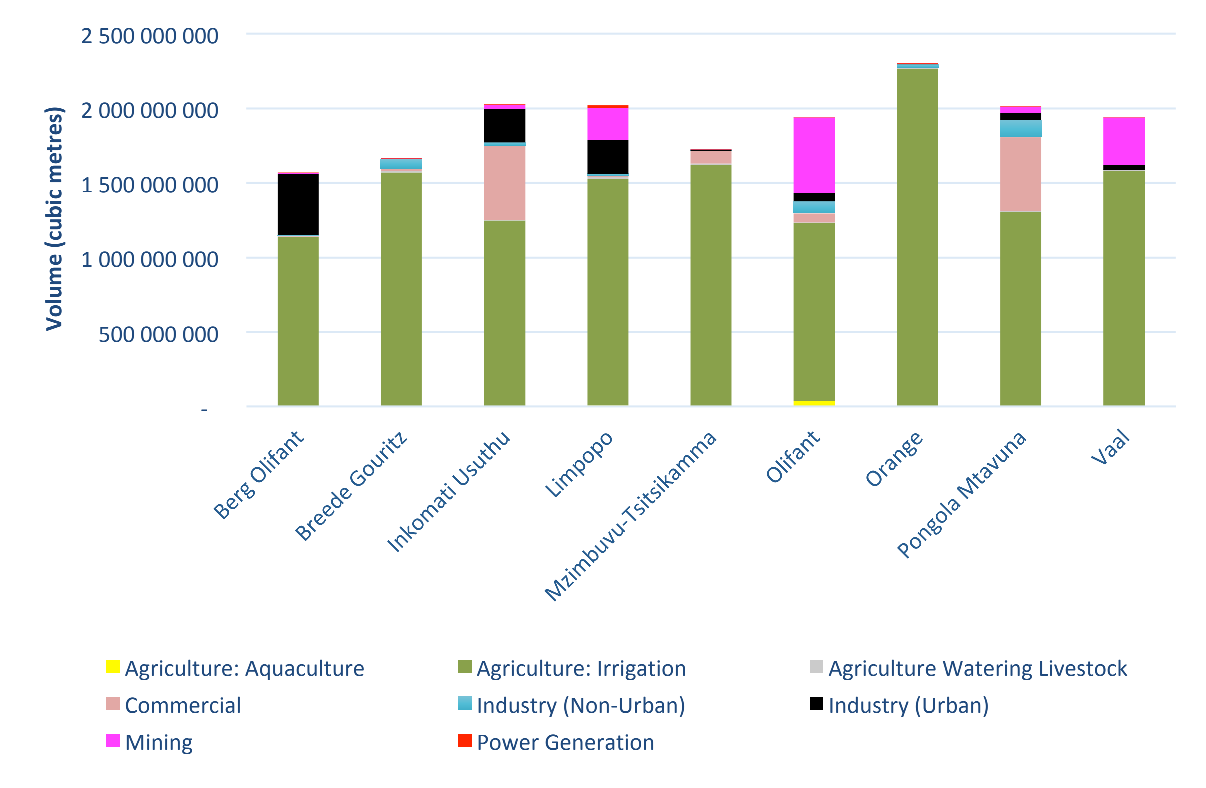


Figure 8.1 Water Allocation Volumes (m^3) per water use sector (WARMS, 2021)

The agricultural sector, mainly irrigation, remains the sector with the largest portion of water use allocation in all Water Management Areas (WMA), with Orange WMA allocated the most. This is due to the role that agriculture plays in the economy and food security in the country. Mining-related water allocations were the most in the Olifants, Vaal, and Limpopo WMA.

8.2 Water Pricing Strategy

The pricing strategy provides the framework for the pricing of the use of water from South Africa’s water resources, i.e., the use of raw (untreated) water from the water resource and/or supplied from government waterworks and the discharge of water into a water resource or onto land. It is developed in terms of the National Water Act, which empowers the Minister of Water & Sanitation (the Minister), with the concurrency of the Minister of Finance, to establish a pricing strategy for charges of any water use within the framework of existing relevant government policy. The **third revision** of the strategy is currently being finalized to incorporate social-economic, environmental, and other changes.

The primary objectives of the pricing strategy are to:

- Ensure that the costs of achieving and maintaining the Resource Quality Objectives are sufficiently recovered through the water use charges.
- Ensure that there is adequate funding for the effective operation, maintenance, and development of waterworks by the Department and other water management institutions.
- Provide an enabling framework for the provision of financial assistance and the use of water pricing to support the redress of racial and gender imbalances in access to water and to support the redistribution of water for transformation and equity purposes.
- Facilitate financial sustainability of water management
- Promote/facilitate water use efficiency.

The pricing strategy recognizes the developmental context of the South African water sector and acknowledges that where, for social equity, environmental or affordability reasons, water management cannot be sustainably financed from specific water users, then that shortfall must be recovered transparently. The following principles underpin the revised pricing strategy:

- ***Hybrid tariff approach*** – The pricing strategy provides for a combination of national charges and water management-specific charges to facilitate the development of affordable tariffs for all users; some elements of the water charge will be levied based on a national charge for a particular sector(s), and some on the basis of the scheme based or catchment level charge in terms of sections 56(3) and 56(4) of the NWA

- ***User pays and recovery of costs*** – The intent of the pricing strategy is to provide for the full recovery of costs associated with the management, use, conservation, and development of water resources and the associated administrative and institutional costs. Users must pay for the costs of their water use in this regard, taking into account the need for targeted subsidies where, due to socio-economic conditions, users are not able to afford the costs resulting from the full application of these principles. In line with section 61 of the NWA (56)(2)(a)and (b).

- ***Polluter pays*** – Alined to the principle above, this principle sets out that polluters must pay for the costs of their water discharge or pollution,

- ***Differential charges and capping of water use charges*** – The pricing strategy allows for differential charges and the capping of water use charges to designated water use sectors to support the achievement of key national objectives, such as food security, racial and gender equity, job creation, economic development

- ***Fiscal support*** – The Department will provide fiscal support for core national and public interest functions. The source of funding will come from National Treasury, undertaken by water management institutions, which cannot be recovered fully through water use charges

- ***Ecological sustainability*** – The pricing strategy will facilitate funding to ensure the provision of water for the ecological reserve and the water sector's contribution to maintaining water ecosystems.

- ***Accountability*** – Funding will be allocated to specific water management institutions so that there is transparency and accountability for the funds that are generated through the pricing strategy of Section (57)(3)(b). • Efficiency – The pricing strategy makes provision for the independent economic regulator charge to ensure that the water management charges are maintained at affordable levels. • Multi-year tariffs – The pricing strategy provides for multi-year tariff determination to facilitate longer-term planning and greater levels of certainty for water institutions and users.

8.2.1 Water User Categories

In terms of Section 56 (3) of the NWA, the pricing strategy may differentiate on an equitable basis, on the basis of geographic areas, and between different categories of water use; and different water users. This pricing strategy provides for six water user categories from the previous four to better represent the water user groups and to allow for more clearly targeted charges. These six categories are presented in Figure 8.2.

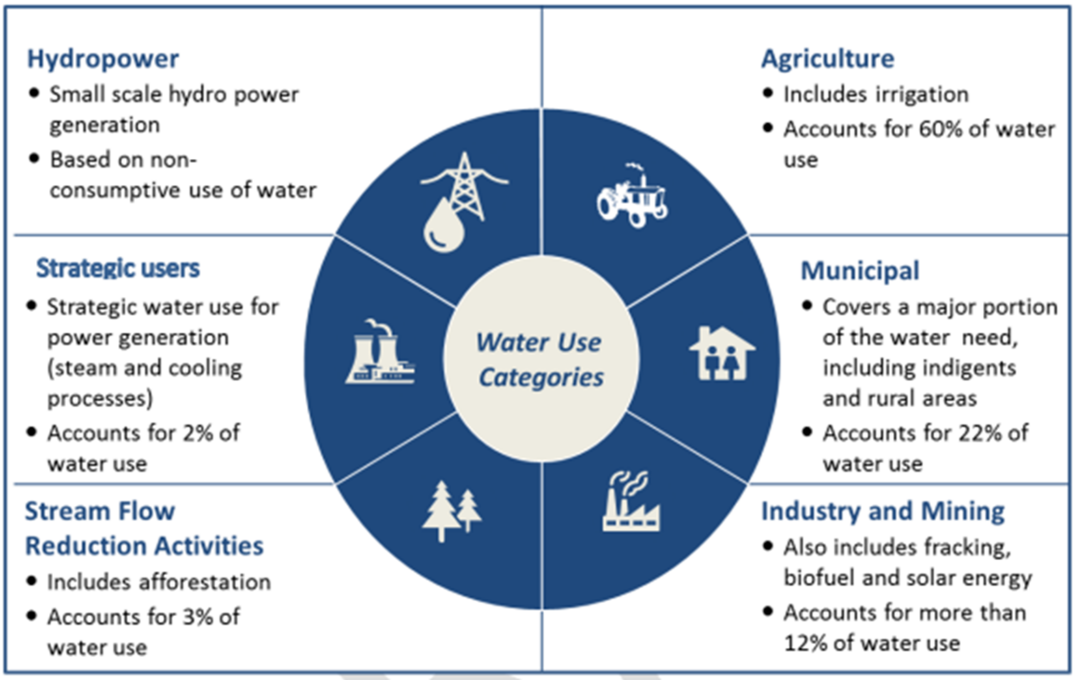


Figure 8.2 Proposed water user categories for charging purposes

8.2.2 Categories of Charges

In terms of Section 56(1) and (2) of the National Water Act, the pricing strategy may determine the methodology of setting water use charges. These charges are presented in Figure 8.3.

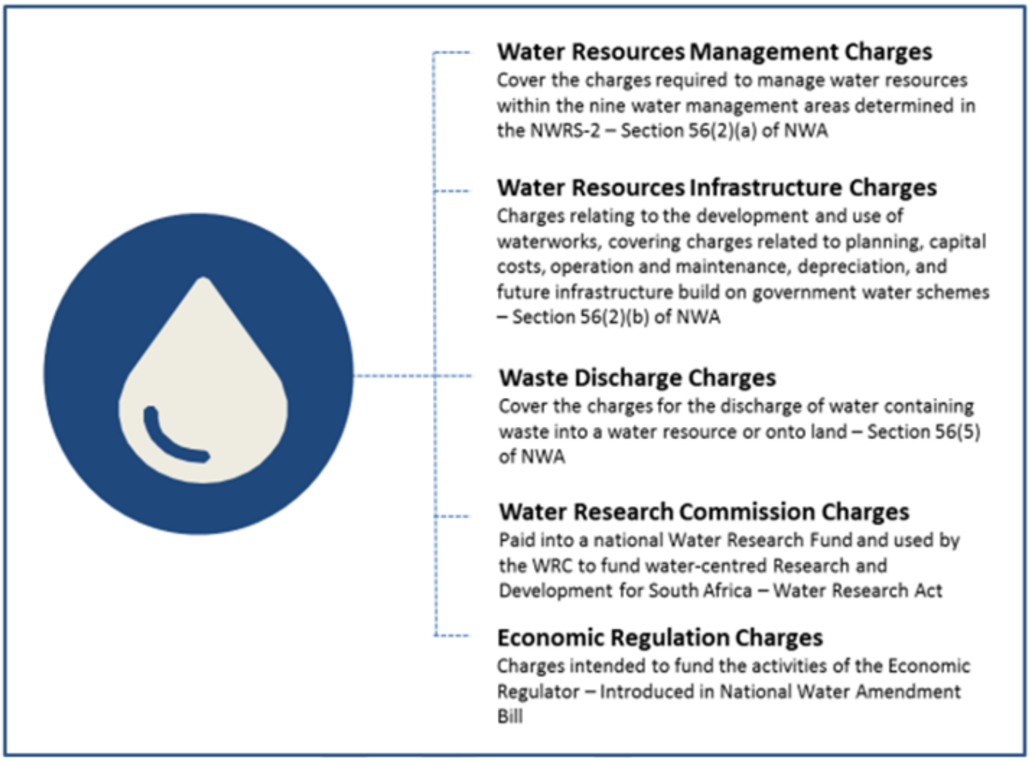


Figure 8.3 Water Use Charges Categories

Table 8-1*Table 8-1* presents a summary of the water use charges per water use category, and Table 8-2 water management areas approved tariffs for the 2020/2021 financial year.

Table 8-1 Summary of water use charges per water use category.

Sectors	Water Resources Management Charge	Water Resources Infrastructure Charge	Waste Discharge Mitigation Charge	WRC Charge	Economic Regulation Charge *(Future)*
Municipal	YES	YES	YES	YES	YES
Industry and Mining	YES	YES	YES	YES	YES
Strategic Users	YES	YES	YES	YES	YES
Agriculture	YES	YES *(Capped)*	YES	YES	YES
Stream Flow Reduction Activities	YES	✕	✕	✕	YES
Hydropower	✕	YES	✕	✕	YES

Table 8-2 Approved Tariffs for 2020/2021 Financial year - Water Management Areas

Water Management Areas -Approved Tariffs for 2020/2021 Financial Year			
Nine Catchment Management Agencies (CMA) / PROTO CMA's	**Domestic & Industrial c/m^3**	**Irrigation c/m^3**	**Forestry** c/m^3
Limpopo-North West	4,80	3,12	2,65
Olifants	4,41	2,84	2,21
Inkomati-Usuthu	3,7	1,93	1,44
Pongola-Mzimkulu	2,98	1,89	1,61
Vaal	2,87	1,99	2,21
Orange	1,71	0,96	-
Mzimvubu-Tsitsikama	3,63	2,51	2,04
Breede-Gouritz	5,44	2,46	1,15
Berg-Olifants	5,78	2,31	2,35

8.3 Water Use Authorizations

During the period April 2020 – March 2021, approximately 970 water use license applications were processed and approved. Figure 8.4 shows the spatial distribution of approved licenses per province which contributed to 49% of Single use and 51% of Integrated water-use licenses, respectively.

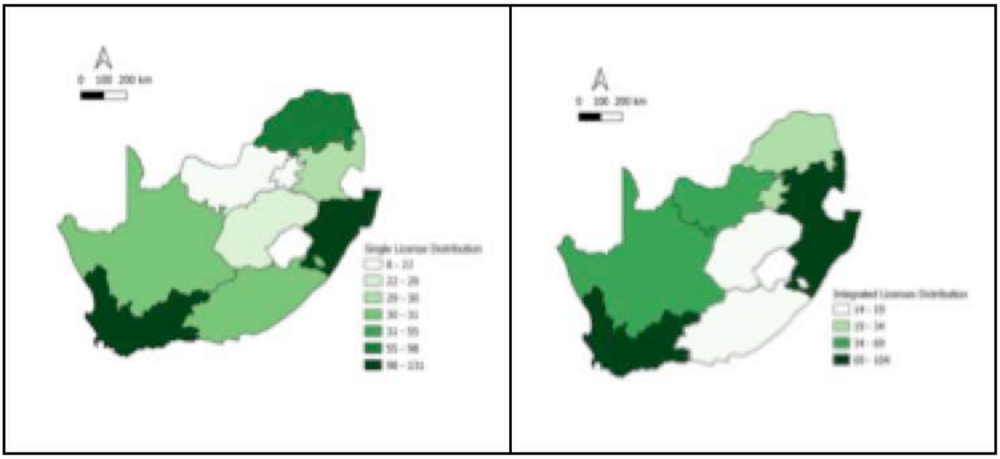


Figure 8.4 Distribution of water use licenses approved per Province

These approved licenses were for the areas where licenses had not existed previously. Amongst the approved licenses were those for individual groups: historically advantaged (HAI) and historically disadvantaged (HDI), as given in Table 8-3 below.

Table 8-3 Approved Licences April 2020 – March 2021

Gender	Historically advantaged Individuals	Historically Disadvantaged Individuals	Percentages Gender
Male	22	79	77%
Female	1	30	23%
Total (HAI / HDI)	17%	83%	

8.4 Compliance Monitoring

Compliance monitoring involves the monitoring of compliance to standards, conditions of authorizations, and regulations across the full water value chain in a way that triggers appropriate enforcement or other regulatory enhancing action if needed.

The national overview of the compliance monitoring inspections conducted from the financial year (Apr-Mar) 2014/15 to 2020/21 is presented in Figure 8.5 below.

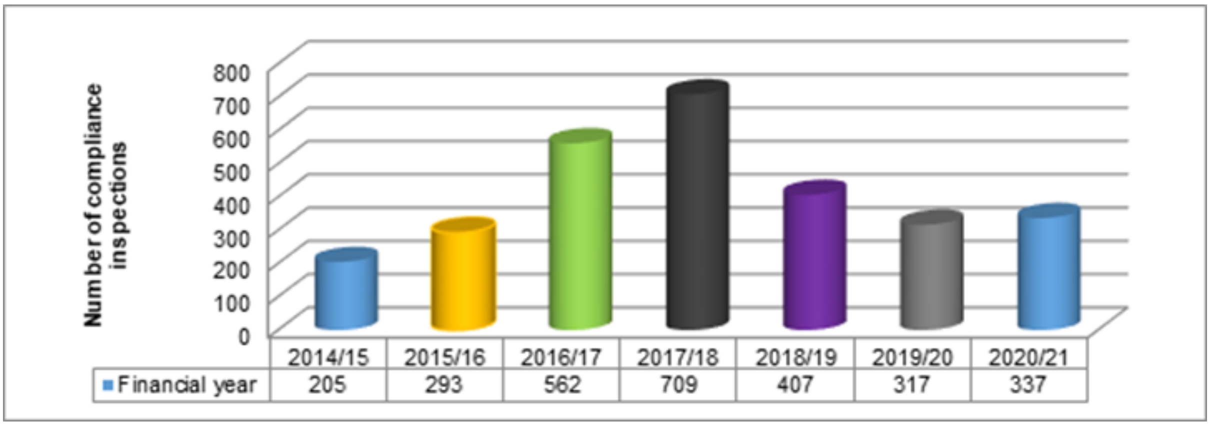


Figure 8.5 Compliance Inspections from 2014/15 to 2020/2021

Many inspections were conducted during the two financial years of 2016/17 and 2017/2018. This was due to the Blitz operations inspections conducted in addition to the targets (these include the Blitz operations done in KwaZulu-Natal, Limpopo, Free State, and Western Cape during the drought period which was being experienced across many Provinces in the Country). Also to note is that a low number of inspections conducted is depicted for 2014/15 and 2015/16 due to the exclusion of Dam Safety inspections in the reporting for these two years.

The average compliance performance per authorization for each water-use sector for the financial year 2020/21 is illustrated in Figure 8.6.

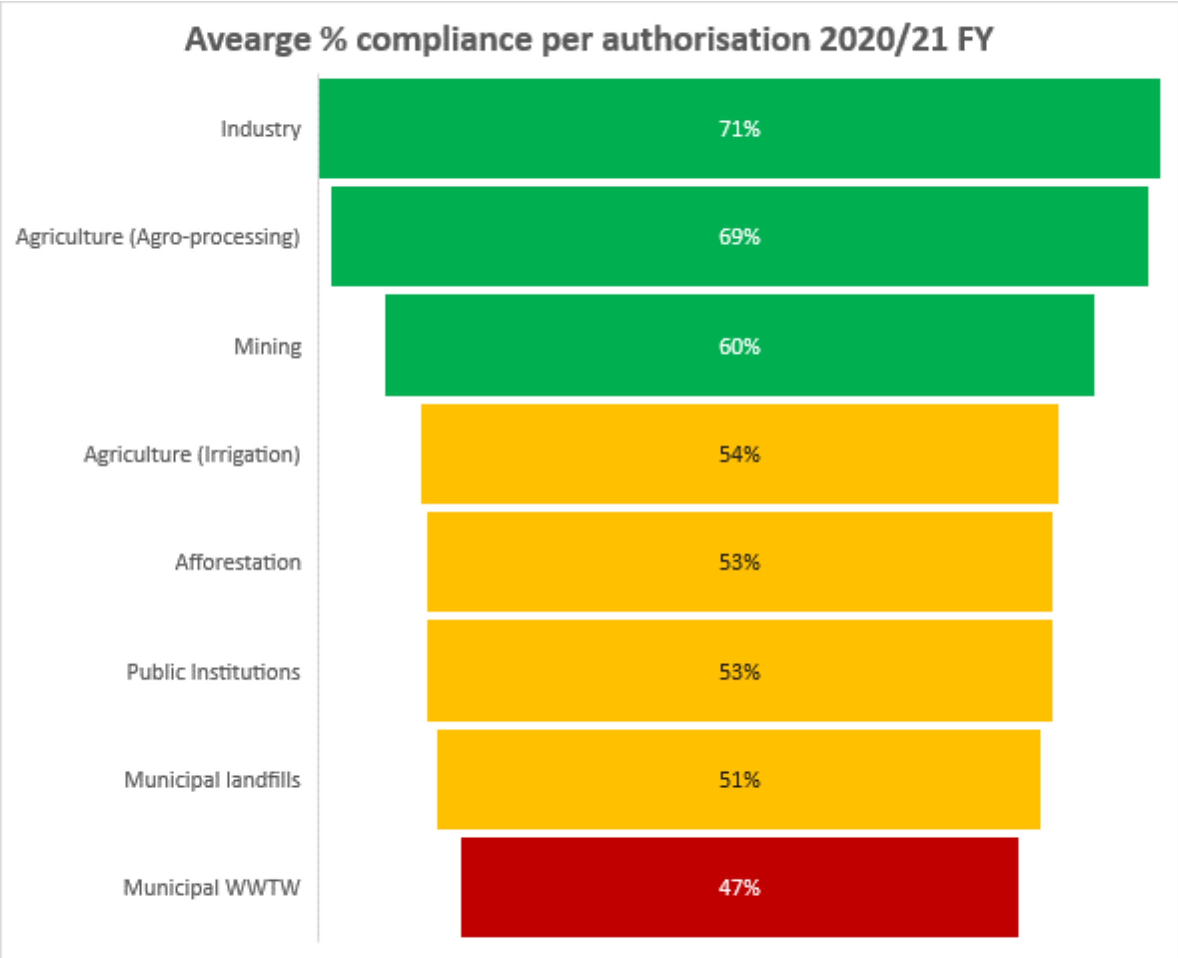


Figure 8.6 Average % compliance per authorization from a total number of audits or inspections conducted.

If for purposes of analysis and derivation of information and/or establishing a performance level, for the average % of compliance per authorization audited, if the shade of red is used for poor compliance performance, orange for average performance / at risk, and green good compliance performance.

Therefore, poor performance is reported for compliance to authorization conditions by Municipal Wastewater Treatment Works (WWTW), and average compliance by Municipal landfills, Public Institutions, Afforestation, and Agriculture (irrigation), while some good performance in compliance can is reported for Industry, Agriculture (Agro-Processing) and the mining sector for the 2020/21 financial year.

The breakdown of the number of audits or inspections conducted per Province during the financial year 2020/2021 is presented in Figure 8.7 below.

Figure 8.7 Sectoral Breakdown of the audits or inspections conducted per Province (2020/21 FY)

8.5 Enforcement

Enforcement promotes and enforces compliance to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and other relevant legislation; enables successful prosecution through effective investigations and joint operations; identifies, develops, and implements appropriate enforcement tools (administrative, criminal and civil) based on current experience and best practices locally and internationally to assist in attaining compliance; document and share lessons learned as well as case law on water issues to enable the Department to take effective enforcement action against transgressors and building capacity and skills base of enforcement personnel within the Department and its institutions as well as its stakeholders.

The national overview of enforcement cases investigated from the financial years 2014/15 – 2020/21 is presented in Figure 8.8 below.

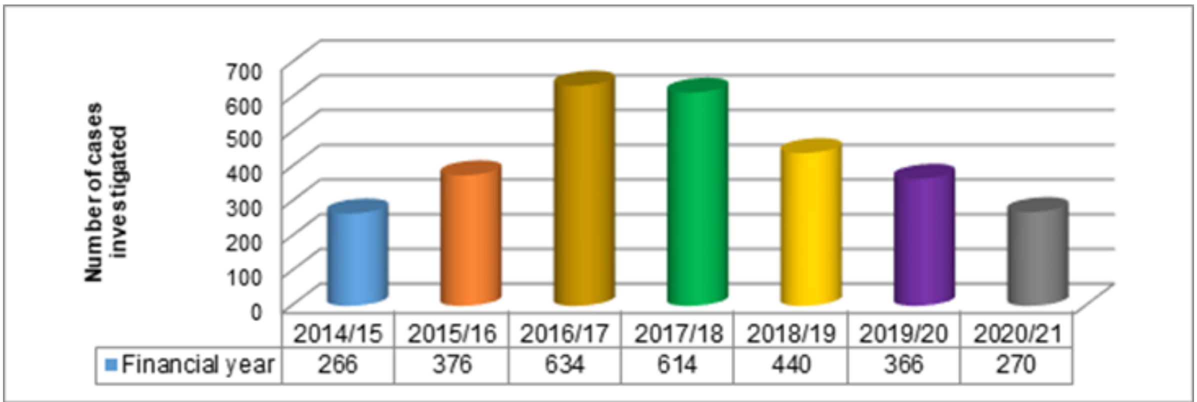


Figure 8.8 Enforcement cases investigated from 2014/15 -2020/21

The description and summary of enforcement actions taken on reported non-compliance cases per DWS Regional Offices are given in Table 8-4. A total of 52 NWA **Directives** (23% of total cases) were issued during the reporting period. Most Directives were issued to water users in Gauteng, followed Mpumalanga. Only 4 cases ended up at the Water Tribunal, while 14 cases were registered with the SAPS. The enforcement actions taken were dominated by the issuance of the NWA **Notices** (66% of total cases).

Table 8-4 Enforcement Action Taken on reported non-compliant cases from October 2020 - September 2021

Regional Office/Water Management Area	Non-Compliance Letters	NWA Notices Issued	NWA Directives Issued	Water Tribunal	Cases Registered with SAPS
Eastern Cape	1	11	5	0	0
Free State	2	5	4	0	1
Gauteng	0	34	16	0	1
KwaZulu Natal	3	31	6	2	9

Regional Office/Water Management Area	Non-Compliance Letters	NWA Notices Issued	NWA Directives Issued	Water Tribunal	Cases Registered with SAPS
Limpopo	0	22	3	0	1
Mpumalanga	0	16	13	1	2
North West	1	7	4	0	0
Northern Cape	0	14	1	1	0
Western Cape	1	12			
Total	**8**	**152**	**52**	**4**	**14**

Furthermore, the investigated cases are broken down based on the sector and actions taken in Figure 8.5. Most NWA **Directives** were issued to the Local Government, followed by Agriculture. A similar trend is observed for NWA Notices Issued. While Most SAPS cases registered were for the Mining Sector, followed by Agriculture. These sectoral trends are also a reflection of the sectorial performance in terms of compliance, where there is poor performance in compliance with license conditions in the local government (Municipal WWTW).

Table 8-5 Sectoral Enforcement Action Taken on reported non-compliant cases from October 2020 - September 2021

Sector	Non-Compliance Letters	NWA Notices Issued	NWA Directives Issued	Water Tribunal	Cases Registered with SAPS
Agriculture	1	51	13	3	3
Commercial	0	2	0	0	0
Government [National/Prov]	0	6	2	0	0
Industry	0	12	7	0	0
Local Government [WSA/WSP]	6	55	21	0	2
Mining	1	16	6	1	9
Domestic/Private Use	0	6	0	0	0
Tourism	0	4	3	0	0
All Sectors	**8**	**152**	**52**	**4**	**14**

9

WATER RESOURCE PROTECTION

9 WATER RESOURCE PROTECTION

9.1 Resource Directed Measures

Chapter 3 of the National Water Act, 1998 (No. 36 of 1998) prescribes Resource Directed Measures that aim to achieve a balance between protecting the water resources and utilizing the water resources for social and economic development. The Act makes use of two Integrated Water Resource Management (IWRM) approaches or tools, i.e., Resource Directed Measures (RDM) and Source Directed Controls (SDC).

The RDMs determine the required level of protection of the water resource through a Water Resource Classification (WRC) process. This WRC process states the kind of impacts that are acceptable to achieve the desired class based on stakeholder consultations. RDMs also allows for water to be set aside as Reserve for basic human need and the ecosystem (Ecological Reserve), and lastly, they allow for the setting of the Resource Quality Objectives (RQOs). RQOs are clear numerical goals and /or descriptive goals for the resource, and these are required for both water quality and quantity as well as the assurance of supply (Odume *et al.*, 2018).

9.1.1 Classification of significant water resources

Water Resource Classification System (WRCS) was formally prescribed through Regulation 810, which was published in the Government Gazette (GG 33541 of 17 September 2010). This system prescribes processes to be followed for determining RDM. Through this system, water resources are categorized according to specific water resource classes that represent a management vision of a particular catchment.

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.

Table 9-1 Water Resource Classification 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

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

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

In 2011 the Department developed a procedure for the determination of RQOs. The RQO determination procedure involves, amongst other things, the delineation and prioritization of Resource Units (RUs) for the different water resource components (e.g., rivers, dams, wetlands, and groundwater). RQOs are determined at RU level.

A Resource Unit (RU) is a stretch of river that is sufficiently ecologically distinct to warrant its own specification of Ecological Water Requirements (EWR). Resource Units are nested within IUAs and, in the RQO process, are aligned to IUA boundaries. There are normally several RUs within a single IUA. Once determined, the RQOs will give effect to water resource classes set for each Integrated Unit of Analysis (IUA) during the classification process.

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 a 60-day public commenting period. The public comments received are considered to finalize the water resource classes and the associated resource quality objectives. Once the Minister of Water and Sanitation approves the final water resource classes and the associated RQOs for the respective river systems, then these are published in the Government Gazette, and they become legally binding on all institutions and authorities.

The integrated framework of the Gazetted steps for classification, reserve, and RQO determination are presented in Figure 9.1. Figure 9.2 shows the status of WRCs and the finalization of RQOs in South Africa as of September 2021.

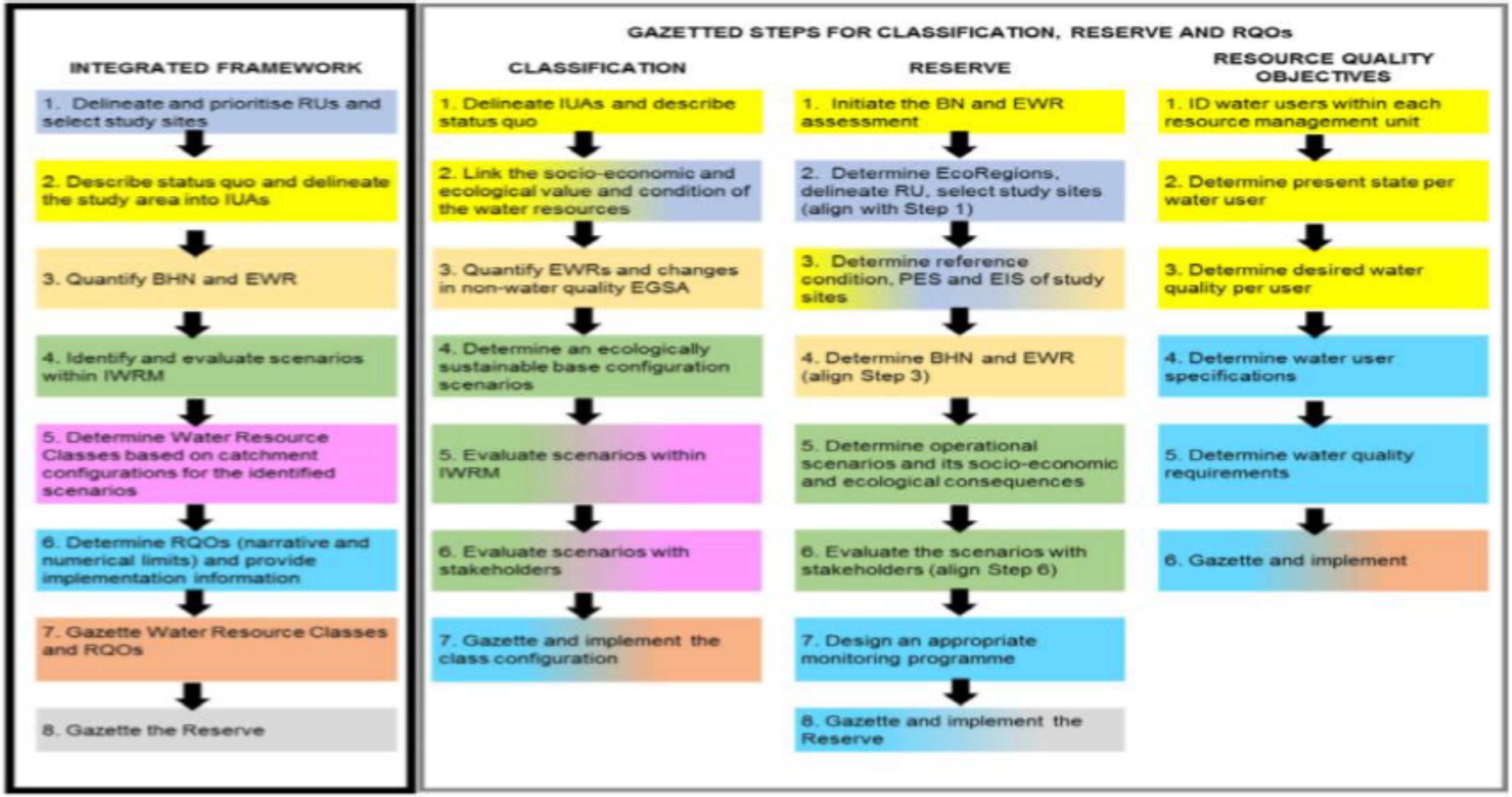


Figure 9.1 integrated framework for Gazetted steps for classification, Reserve, and RQO determination

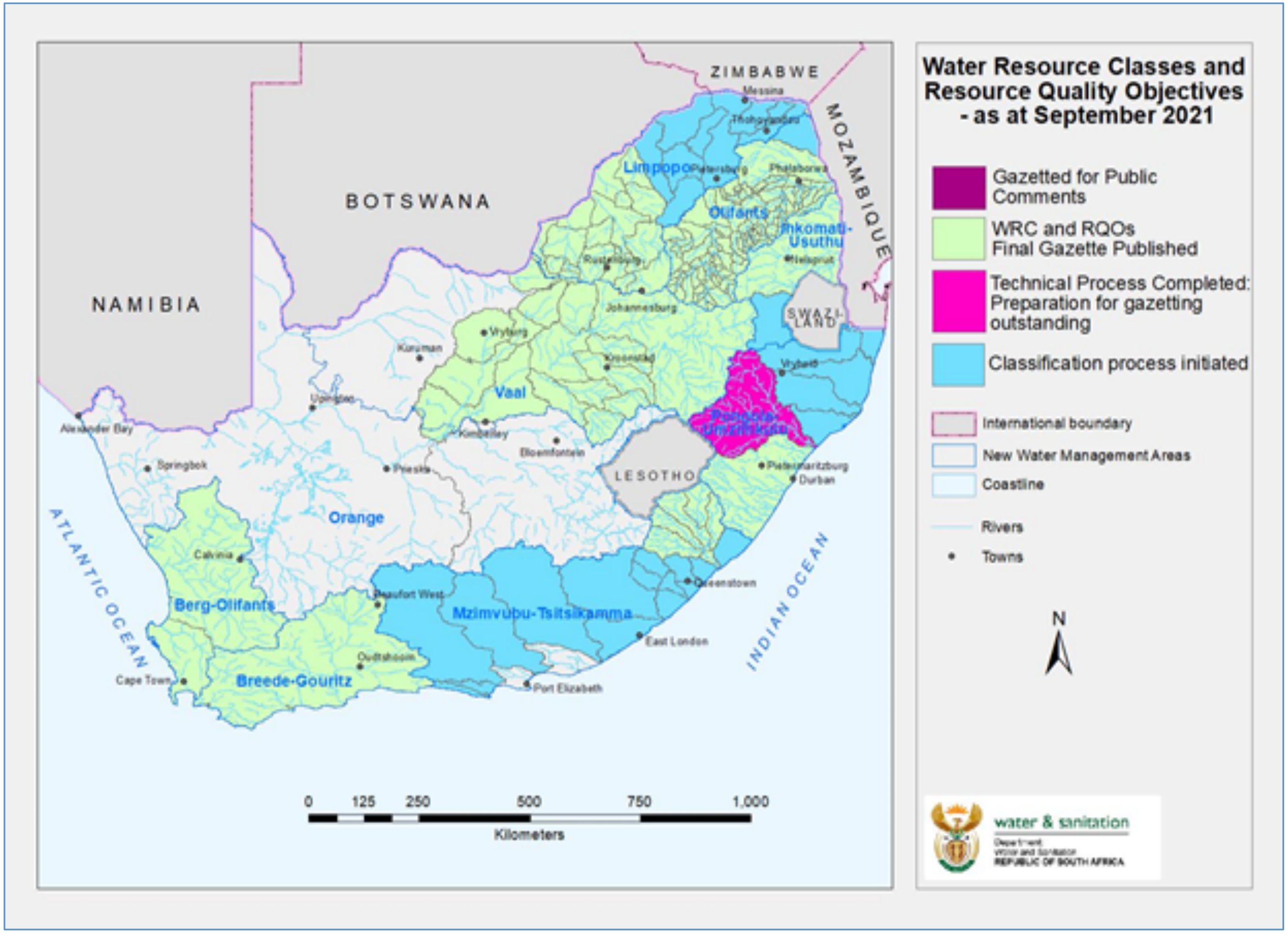


Figure 9.2 Status of WRC and RQOs determination Post 2010 to by September 2020

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 a 60-day public commenting period. The public comments received are considered to finalize the water resource classes and the associated resource quality objectives. Once the Minister of Water and Sanitation approves the final water resource classes and the associated RQOs for the respective river systems, then these are published in the Government Gazette, and they become binding on all institutions and authorities.

It is desirable to report on the status of achieving the set resource quality objectives for areas where they have been set, but to date, the monitoring of the RQOS at a regional or local scale has not been fully implemented.

The Department of Water and Sanitation has finalized and gazetted the water resource classes (WRC) together with the associated resource quality objectives (RQOs) for several catchment areas this hydrological year. The overview status of WRC and RQOs from post-2010 to September 2021 is given in Table 9-2, while Table 9-3 gives the study area where water resource classes and RQOs are still outstanding.

Table 9-2 Overview status of WRC and RQO determination post-2010 to September 2021

Study Area	Status	Government Gazette No.
Olifants-Doorn	The Department finalized 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 finalized and gazetted the water resource classes together with the associated resource quality objectives.	GG 40531 of 30 December 2016
Inkomati		
Mvoti to Mzimkhulu	The Department finalized and gazetted the water resource classes together with the associated resource quality objectives.	GG 41306 of 08 December 2017
Crocodile (West)	The Department finalized and	GG 42775 of 18 October

Study Area	Status	Government Gazette No.
Marico, Mokolo, and Matlabas	gazetted the water resource classes together with the associated resource quality objectives.	2019
Breede-Gouritz	The Department finalized and gazetted the water resource classes together with the associated resource quality objectives.	GG 43726 of 18 September 2020
Mzimvubu	The Department finalized and gazetted the water resource classes together with the associated resource quality objectives.	GG 43015 of 14 February 2020.
Berg	The Department finalized and gazetted the water resource classes together with the associated resource quality objectives.	GG 43872 of 06 November 2020
Thukela	The draft notice containing the proposed water resource classes and resource quality objectives to be published for public comments has been submitted to the Chief State Law Advisor for a legal opinion.	Not yet gazetted
Fish to Tsitsikamma	The technical process for the determination of water resource classes and the associated resource quality objectives in the study area will commence in the third quarter of the 2021/22 financial year and is scheduled to complete in the 2024/25 financial year.	Not yet gazetted
Luvuvhu	The technical process for the determination of water resource classes and the associated resource quality objectives in the study area will commence in the third quarter of the 2021/22 financial year and is scheduled to complete in the 2024/25 financial year	Not yet gazetted

Study Area	Status	Government Gazette No.
Usuthu to Mhlathuze	The technical process for the determination of water resource classes and the associated resource quality objectives in the study area will commence in the last quarter of the 2021/22 financial year and is scheduled to complete in the 2024/25 financial year	Not yet gazetted

Table 9-3 Outstanding Water Resource Classification and RQOs studies as of September 2021

Study Area	Status	Government Gazette No.
Upper Orange	The Department is progressively determining water resource classes and resource quality objectives in the country. It is anticipated that the Classification process in the Upper Orange will commence in the 2023/24 financial year.	Not yet gazetted
Lower Orange	The Department is progressively determining water resource classes and resource quality objectives in the country. It is anticipated that the Classification process in the Lower Orange will commence in the 2023/24 financial year.	Not yet gazetted

9.1.3 Determination of the Reserve

The Department has been making progress in the determination of the Reserve for significant water resources at various levels of confidence ranging from desktop to comprehensive, depending on the type of impact, the magnitude of the impact on water resources, and the quantity and quality of data available to run the models.

Reserves for surface water resources (i.e., rivers, wetlands, and estuaries) have been determined at a desktop, rapid, intermediate, and comprehensive level. Similarly, the Reserve for groundwater resources (aquifers) has also been determined at a desktop, rapid, intermediate, and comprehensive level.

A total of eleven desktop Surface Water Reserves have been determined and completed during the period October 2020 to September 2021. This includes three in Pongola-Mzimkhulu, five in Mzimvubu-Tsitsikama, and three in Orange WMA, as given in Table 9-4 below.

Table 9-4 Summary of Surface Water Reserves completed between October 2020 and September 2021 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	3	0	0	0	3
Vaal	0	0	0	0	0
Orange	3	0	0	0	3
Mzimvubu-Tsitsikama	5	0	0	0	5
Breede-Gouritz	0	0	0	0	0
Berg-Olifants	0	0	0	0	0
TOTAL	**11**	**0**	**0**	**0**	**11**

A total of 17 desktop groundwater reserves were determined and completed between October 2020 to September 2021, two in Limpopo, three in Mzimvubu-Tstsikamma, three in Pongola-Mzimkhulu, four in Orange, two in Breede-Gouritz and three in Berg-Olifants WMA as given in Table 9-5 below.

Table 9-5 Summary of Groundwater Reserves completed between October 2020 and September 2021 per WMA

Water Management Area	Desktop	Rapid	Intermediate	Comprehensive	Total
Limpopo	2	0	0	0	2
Olifants	0	0	0	0	0
Inkomati-Usuthu	0	0	0	0	0
Pongola-Mzimkhulu	3	0	0	0	3
Vaal	0	0	0	0	0
Orange	4	0	0	0	4
Mzimvubu-Tsitsikama	3	0	0	0	3
Breede-Gouritz	2	0	0	0	2
Berg-Olifants	3	0	0	0	3
TOTAL	**17**	**0**	**0**	**0**	**17**

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 given in Table 9-6.

Table 9-6 List of WMAs/Catchments where the Reserve has been gazetted

Water Management Area/Catchments	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

The spatial distribution of the surface water Reserves and groundwater Reserves determined to date by September 2021 are presented in Figure 9.3 and, Figure 9.4, respectively.

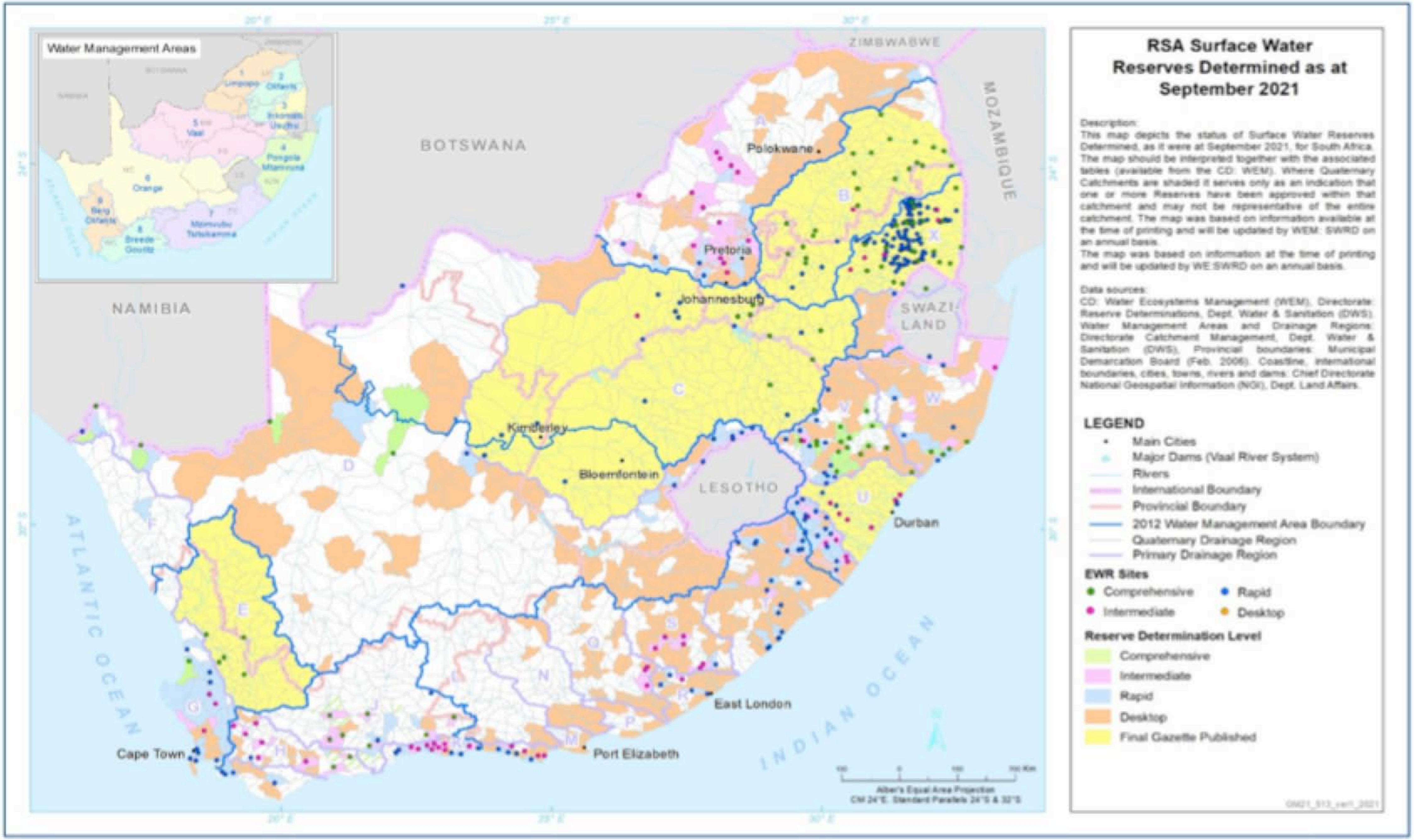


Figure 9.3 Surface Water Reserves determined as of September 2021

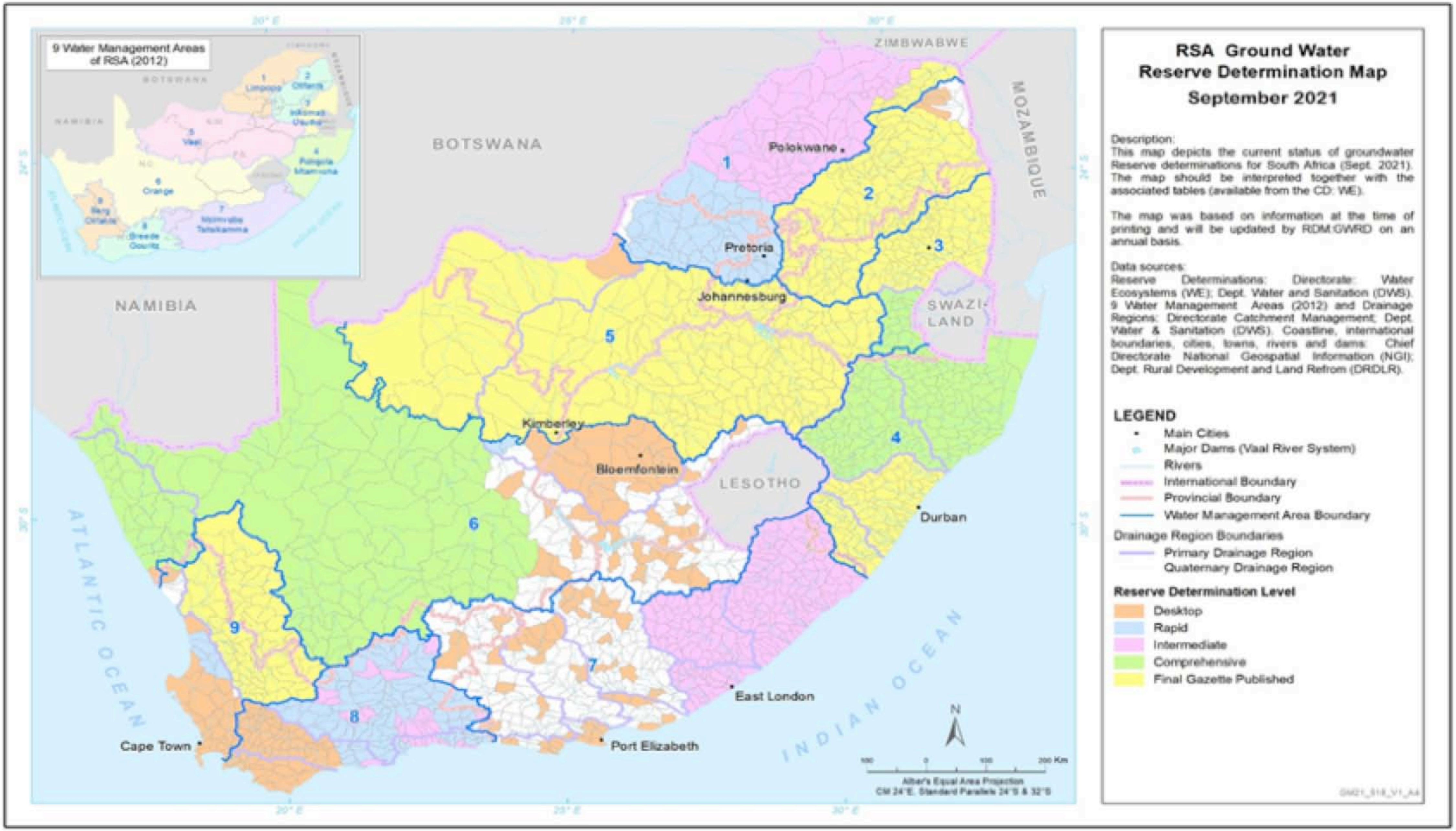


Figure 9.4 Groundwater reserve determined as of September 2021

10

SANITATION SERVICES

10 SANITATION SERVICES

The Africa Water Vision 2025: is for *"an Africa where there is an equitable and sustainable use and management of water resources for poverty alleviation, socio-economic development, regional cooperation, and the environment."* This shared vision calls for a new way of thinking around water resources management and its use even in sanitation delivery programmes.

The first pillar of the shared Africa Water vision 2025 focuses on "sustainable access to safe and adequate water supply and sanitation to meet the basic needs of all." This Pillar is in line with the aspirations of the National Development Plan,2030 vision, the national targets for water supply and sanitation of achieving universal, sustainable, and reliable water supply and sanitation provision for all.

Despite the Constitutional provisions that give direction to the water and sanitation sector, South Africa realizes that in achieving its national sanitation goals, the country is facing significant challenges such as recurrent droughts driven by climatic variations, poor operation and maintenance of infrastructure, inequalities in access to water and sanitation, rapid urbanization, etc. It is therefore imperative that the country takes steps to address these challenges and find a solution that is equitable and sustainable in meeting the basic needs of all.

It is against this background that the Department of Water and Sanitation (DWS) is leading the sector in the development of the ***National Sanitation Integrated Plan (NSIP),*** which will create enabling environment and provide guidance to ensure that the set targets are achieved as it provides a roadmap to pursue strategic direction and contribute to set performance goals.

The vision of the NSIP is to develop a coordinated plan that considers South Africa's scarcity of resources (water, energy, financial and technical) and promotes the delivery of equitable, efficient, and sustainable sanitation services to all, and contributes to the public health and clean environment.

Moreover, The DWS, in collaboration with United States Agency for International Development (USAID): Resilient Waters Program, is at an advanced stage in the development of the ***Faecal Sludge Management Strategy (FSMS)*** for non-sewered sanitation systems. The strategy will guide the sector on the safe management of faecal sludge to prevent contamination of water resources, safeguard public health, and protects the environment from pollution throughout the sanitation service value chain.

Furthermore, the National Development Plan has a target of ensuring the use of technologies that minimizes the use of water resources and encourages recycling and reuse. This target is aligned with the National Water and Sanitation Master Plan target to develop, demonstrate, and validate appropriate alternative waterless and off-grid sanitation solutions by 2025. In this regard, the DWS, in collaboration with the Department of Science and Innovation (DSI) is in the process of establishing the Sanitation Technology Technical Coordination Committee (STTCC) that will advise the sector on appropriate alternative sanitation technologies suitable for all settlement types that are using minimal resources and taking into consideration the effects of climate change.

10.1 Policy and Legislative Framework

The Constitution of the Republic of South Africa (Act 108 of 1996) provides the right of all people in South Africa to dignity and access to an environment that is not harmful to health and well-being and is sustainable and protected from pollution and degradation through legislative measures. Access to adequate sanitation services is important to achieve goals of improved health, safety, environmental standards, and dignity for all South Africans. The Water Services Act (Act 108 of 1997) section 3 (1) provides for a basic right of access to basic water supply and basic sanitation for everyone.

The Department of Water and Sanitation (DWS), as a sector leader, has been at the forefront of reviewing the White Paper on Basic Household Sanitation, 2001, which resulted in the National Sanitation Policy, 2016. The National Sanitation Policy, 2016 provides a suite of procedures, rules, and allocation mechanisms for sanitation in the country, which are implemented through the policy instruments of laws and regulations, economic measures, information and educational programmes, and assignment of rights and responsibilities for providing services. Below are other legislative and policy documents contributing to the implementation of sanitation provisions in South Africa.

- the White Paper on Water Supply and Sanitation (1994)
- the White Paper on a National Water Policy of South Africa (1997)
- the White Paper on Basic Household Sanitation (2001)
- the National Sanitation Policy (2016)
- Water and Sanitation Master Plan (2019)

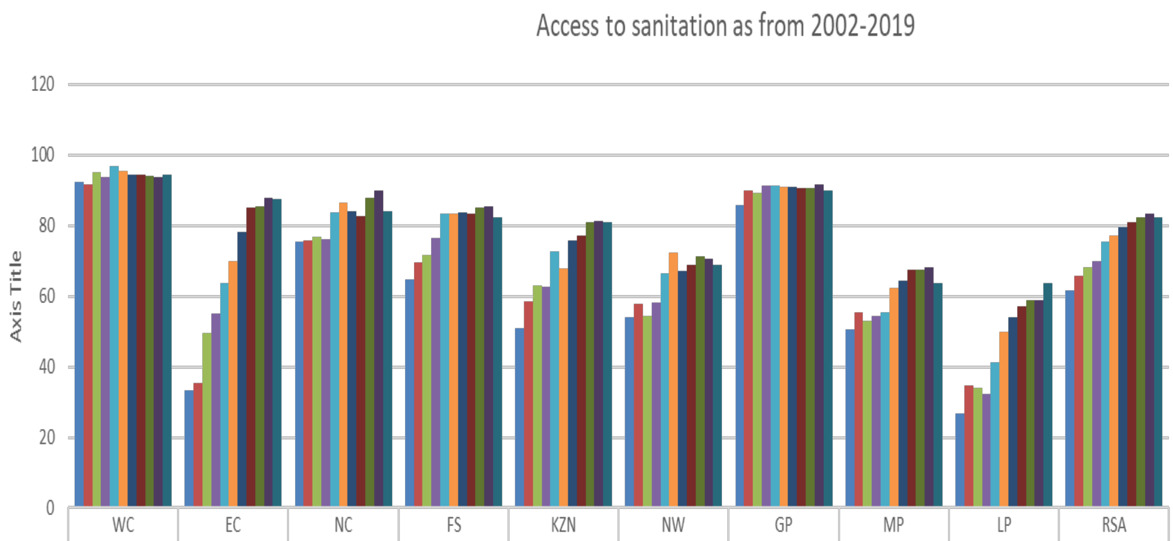
The White paper on Water supply and Sanitation (1994) was legitimized by the Water Services Act (No 108 of 1997) as a legislative instrument for the water supply and sanitation sector with the aim to ensure, amongst others, the right of access to basic water and sanitation, setting the national norms and standards, providing financial assistance to water services institutions, and monitoring of interventions by relevant Provinces, etc.

10.2 Access to Sanitation Services

Statistics South Africa conducts the General Household Survey annually to determine the progress of the development in the country. It measures on a regular basis the performance of programmes and the quality-of-service delivery in a number of key service sectors in the country. Sanitation is one of the services which is measured and progress reported.

10.2.1 Progress on Sanitation Provision

The Key findings from the General Household Survey of 2019 suggest that, through the provision and the efforts of government, support agencies, and existing stakeholders, the percentage of households with access to improved sanitation increased by 20,4 percentage points between 2002 and 2019, growing from 61,7% to 82,1%, as demonstrated in Figure 10.1 below on sanitation delivery trends per province.



	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
2002	92,2	33,4	75,5	64,7	50,9	54,1	85,9	50,7	26,9	61,7
2004	91,8	35,5	75,9	69,7	58,5	57,8	89,8	55,3	34,6	65,9
2006	95,2	49,4	76,9	71,8	63	54,4	89,1	53,1	33,9	68,3
2008	93,7	54,9	76,2	76,4	62,8	58,1	91,3	54,4	32,1	70
2010	96,7	63,6	83,7	83,4	72,7	66,5	91,2	55,4	41,1	75,4
2012	95,5	70	86,6	83,5	68	72,2	91,1	62,4	49,8	77
2014	94,5	78,2	83,9	83,8	75,9	67	90,9	64,4	54	79,5
2016	94,3	85,1	82,6	83,2	77,2	69	90,5	67,5	57,1	81
2017	94,1	85,3	87,7	85,1	80,8	71,3	90,5	67,6	58,9	82,2
2018	93,8	88	90	85,5	81,4	70,6	91,8	68,1	58,9	83,4
2019	94,5	87,6	83,9	82,3	80,9	68,8	90	63,7	63,7	82,2

Figure 10.1 Sanitation delivery trends per Province

The most improvement was noted in the Eastern Cape, where the percentage of households with access to improved sanitation increased by 54,1 percentage points to 87,6%, and in Limpopo, in which access increased by 36,5 percentage points to 63,7%. The installation of pit toilets with ventilation pipes played an important part in achieving the improvements.

Eastern Cape Province has illustrated a constantly accelerated delivery rate over the past 17 years. There are lessons to be learned in Eastern Cape province that could be applied in other provinces. Western Cape and Gauteng provinces demonstrated a high coverage delivery of sanitation services amongst all provinces. However, the delivery rate between 2018 and 2019 illustrates a regression in seven provinces except for Limpopo and Western Cape, which have increased by 4.8% and 0.7%, respectively.

A range of reasons, including rapid household growth and urbanization, as well as a preference for flush toilets, have all contributed to the slow progress over the reference period. The relative scarcity of water and regular water interruptions experienced in many parts of the country will increasingly lead to the use of alternative sources of sanitation (STATS SA, 2020).

With only nine years left until 2030, the rate of sanitation service delivery will need to be accelerated if South Africa is to achieve the NDP and SDG sanitation targets, as there are still approximately 2.8 million households in South Africa without access to improved sanitation services. Moreover, the eradication of open defecation requires immediate attention. In 2019, approximately 1.3% of households practiced open defecation (STATS SA 2020).

10.2.2 Sanitation Technology Options used in South Africa

In terms of technical options (Figure 10.2) used in the country, 59.9% out of 82.1 % of all households with access to improved sanitation are served with waterborne toilets which are connected to Wastewater Treatment Works (WWTW). This technology is mainly used in urban and high-density settlements. Waterborne or full flush toilets depend on the availability of water to flush human excreta and transport it to a WWTW where it is treated and discharged or disposed of into the environment.

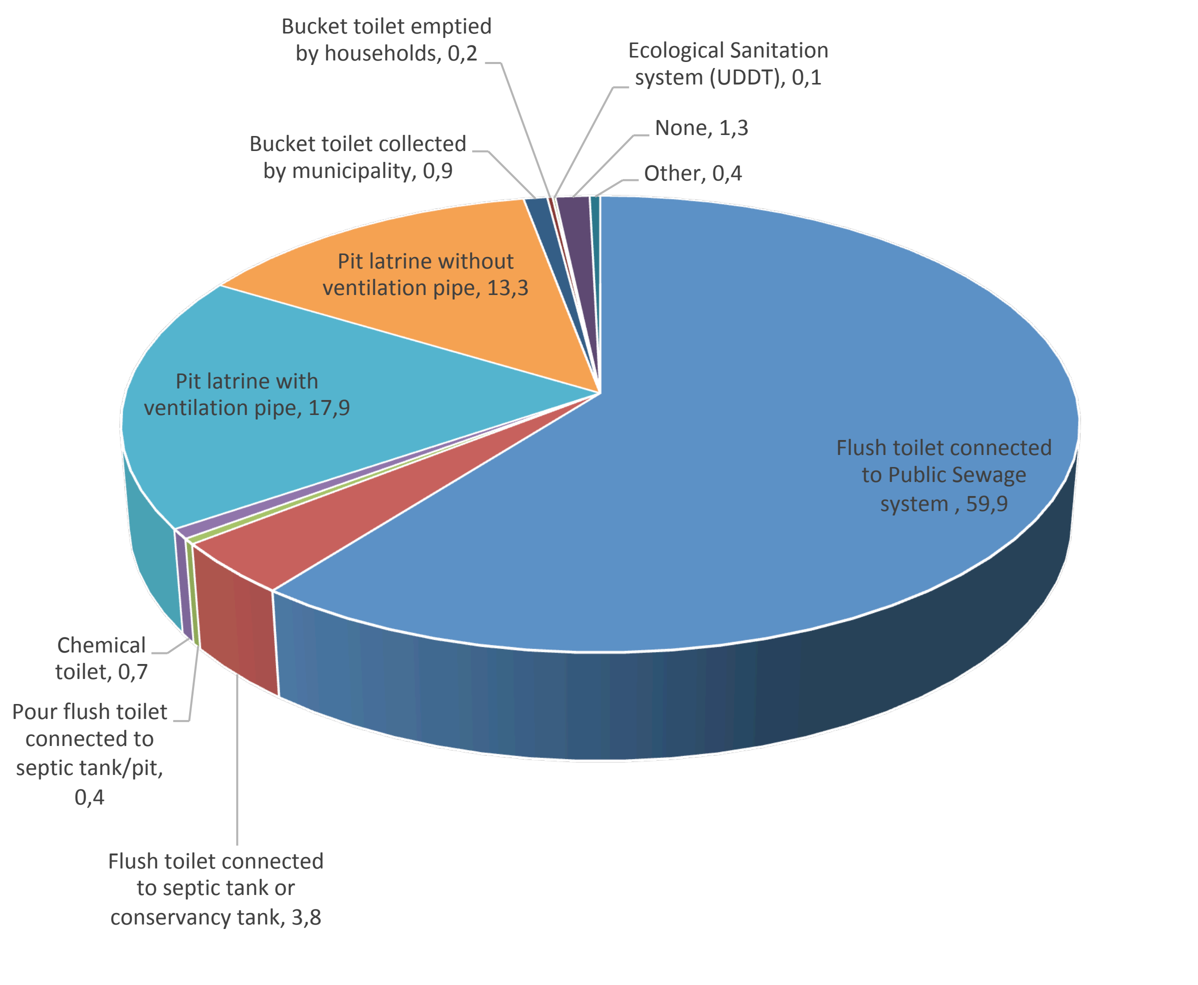


Figure 10.2 South African households using various sanitation technical options. (STATS SA 2020)

When considering technology choices for service provision, the choice has generally been full flush or latrine-based technologies. The technology choice is based on interlinked determinants such as availability of water, proximity in relation to the existing sewer network, and cost.

South Africa is a semi-arid country, with a projected 17% water deficit between demand and supply by 2030. The projected water deficit and climate change impact will have a significant impact on the traditional way of providing waterborne sanitation and requires the country to re-think sanitation provision, with more investment in non-sewered, low water, and waterless sanitation solutions.

Large-scale infrastructure programmes were implemented to build VIPs, with around 30% of the entire South African population relying on this technology and its derivatives (STATS SA, 2018). Latrines were built on the premise that sludge would not accumulate and, therefore, not require emptying. The opposite was proving true; latrines were filling, and many thousands of these systems were reaching their capacity faster than anticipated. The consequence of the rapid latrine building programmes – while delivering essential services within the technical constraints had brought upon another set of challenges related to the servicing, operation, and maintenance of the implemented solution.

From a user perspective, dry sanitation technologies are not considered the “best” option. Dry sanitation is considered the “poor person’s toilet.” Studies within South Africa have shown a strong user preference for a flush toilet over dry sanitation technologies (Duncker & Matsebe, 2008). These findings highlight the complexity of sanitation provision in which the service provider must match user needs and preferences to limited technical, natural, and financial resources. Further, it points to the lack of suitable technology alternatives that can encompass these design requirements. (STATS SA, 2020)

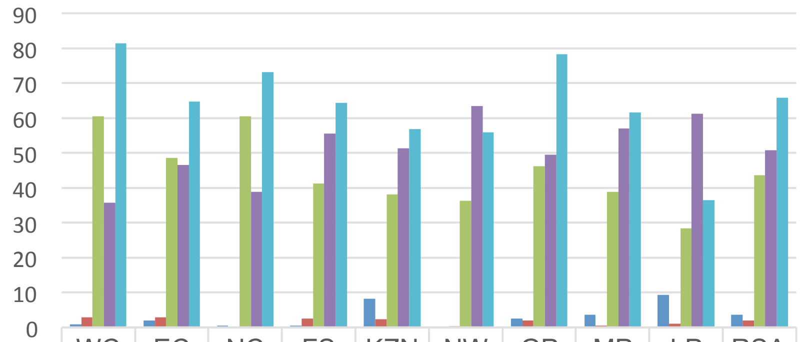
Table 10-1 Type of sanitation systems per province (STATS SA 2020)

	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA	Total (Thousands)
	Percentage										
Flush toilet connected to a public sewerage system	92,2	42,4	60,5	70,3	44,7	39,6	84,8	37,2	18,6	59,9	**10 289**
Flush toilet connected to a septic or conservancy tank	2,1	2,7	10,5	2,8	5,3	9,7	1,2	5,4	5,9	3,8	**658**
Pour flush toilet connected to septic tank or pit	0,1	0,5	0,3	1,7	0,4	0,1	0,3	0,2	0,5	0,4	**62**
Chemical toilet	1,6	0,2	0,0	0,1	0,4	0,1	1,2	0,1	0,1	0,7	**112**
Pit latrine/toilet with ventilation pipe	0,1	42,0	12,4	7,4	30,5	19,5	3,7	21,0	38,5	17,9	**3 069**
Pit latrine/toilet without ventilation pipe	0,3	6,9	8,1	13,6	16,2	28,7	6,5	34,0	34,4	14,3	**2 457**
Bucket toilet, collected by municipality	2,2	0,5	0,9	1,3	0,1	0,0	1,6	0,1	0,1	0,9	**149**
Bucket toilet, emptied by household	0,7	0,0	0,2	1,0	0,1	0,0	0,3	0,0	0,0	0,2	**37**
Ecological Sanitation Systems (urine diversion / separation)	0,1	0,0	0,0	0,0	0,0	0,1	0,2	0,0	0,0	0,1	**14**
None	0,4	4,2	5,1	1,0	1,3	2,2	0,1	1,9	1,7	1,3	**230**
Other	0,3	0,7	1,9	0,7	0,9	0,2	0,2	0,3	0,4	0,4	**76**
Total Percentage	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**17 163**
Total (Thousands)	**1 875**	**1 702**	**350**	**921**	**2 985**	**1 247**	**5 072**	**1 331**	**1 621**	**17 163**	

Table 10-1 above shows that flush toilets that were connected to public sewerage systems were most common in the most urbanized provinces, namely Western Cape (89,1%) and Gauteng (88,6%). Only 26,5% of households in Limpopo had access to any type of flush toilet, the lowest of any province. In the absence of flush toilets, 70,2% of households in Limpopo used pit latrines, most (37,6%) without ventilation pipes. In Eastern Cape, 40,3% of households used pit toilets with ventilation pipes. Only 0,3% or 48 000 households primarily used ecological toilets, also known as urine diversion/separation or composting toilets. Given the scarcity of water in South Africa, non-sewered sanitation systems are expected to become much more common in the future.

10.2.3 Status of Hygiene and User Education

The provision of sanitation services includes the provision of a sanitation facility, as well as hygiene and user education. Figure 10.3 below on hygiene status per province demonstrates that six out of nine provinces have less than 70% of households that do not have access to hand washing facilities, whereas seven provinces have less than 50% of households that wash hands with water and soap after using a toilet. (STATS SA 2020).



	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
Do not clean hands	0,9	2	0,6	0,6	8,2	0,1	2,5	3,6	9,3	3,7
Clean Hands with sanitiser or wet wipes	2,9	2,9	0,1	2,6	2,3	0,4	1,9	0,6	1,1	1,9
Washing hands with soap after using the toilet	60,5	48,5	60,5	41,3	38,1	36,2	46,1	38,8	28,4	43,6
Rinse hands with water	35,7	46,6	38,8	55,6	51,4	63,4	49,5	57,1	61,2	50,8
Access to hand washing facility	81,5	64,7	73,1	64,3	56,8	55,9	78,3	61,6	36,4	65,9

Figure 10.3 Hygiene status per province

It is concerning that 3.7% of households do not clean their hands. Limpopo (36.4%) and North West (55.9%) are the provinces with the lowest number of households with access to hand washing facilities. This situation in which much of the population does not wash hands with water and soap after using a toilet calls for strengthening hygiene promotion, and user education.

Hand washing with soap and water is widely recognized as a top priority for reducing disease transmission, and South Africa has started tracking the level of hygiene as of 2018. The SDG6 subgoal 6.2 also highlights the importance of hygiene and calls for special attention to the needs of women and girls. Indicator 6.2.1 measures the percentage of the population using safely managed sanitation services, including a hand-washing facility with soap and water.

The DWS has identified a need to empower water and sanitation community forums with key sanitation and hygiene related concepts and policy positions to be able to participate meaningfully and effectively in overseeing the delivery of sanitation services in their municipalities on sanitation and hygiene. Moreover, to strengthen their knowledge, negotiation skills, and advocacy in sanitation related issues as well as rights awareness. The facilitation of capacity building, hygiene promotion and education workshops to empower the Water and Sanitation Community Forums is done in collaboration with WaterAid South Africa (an NGO).

As part of an effort to support the fight against the Covid-19 pandemic and provide people with information that they can use to change their behavioral patterns to improve their health, WaterAid, has installed approximately 20 handwashing stations in various public places, schools, and clinics in Gauteng and Limpopo Provinces. The aim is to increase easy access where people can wash their hands with water and soap. In addition, WaterAid has significantly contributed to Hygiene awareness and education campaigns and promotional material, including the provision of menstrual hygiene products to the vulnerable and needy women and girls in these two provinces.

10.2.4 Schools Sanitation

The primary objective of the SAFE initiative is to replace basic pit toilets with appropriate sanitation in accordance with the Norms and Standards for school infrastructure. The number of toilet seats to be provided is determined by the learner enrolment. Such a number of seats must include age-appropriate facilities in primary schools, as well as facilities for the disabled in all schools. The scope of work includes the following:

- Assessment of existing sanitation infrastructure,
- De-sludging of the existing pit toilets,
- Demolition of the existing pit toilets,
- Construction of appropriate toilets,
- Provision of rainwater harvesting tanks, and
- Construction of walkways.

Table 10-2 Number of schools' sanitation per stage of progress-Department of Basic Education

Province	Number of schools per stage of progress							
	Total schools allocated	Planning & design	Tender	Construction <25%	Construction 25-50%	Construction 51-75%	Construction 76-99%	Practical Completion
Summary	2825	213	203	795	179	94	123	1218
EC	1088	132	88	425	109	52	29	253
FS	106							106
GP								
KZN	1066	74	105	313	40	15	43	476
LP	393	7	10	57	30	27	51	211
MP	99							99
NW	73							73
NC								
WC								

Table 10-2 depicts the number of schools' sanitation per stage of the progress implemented in different provinces. Gauteng, Mpumalanga, and Northern Cape are not allocated with schools during this financial year. Out of 2 825 schools allocated per province for this financial year, 1 218 schools are on practical completion. There is a need in the country to eradicate school sanitation backlogs, especially in rural areas (DBE, 2018).

10.2.5 Sanitation Delivery through Human Settlements

Table 10-3 below shows the service sites and houses delivered by the Department of Human Settlements (DHS) through the Breaking New Ground (BNG) programme during the period under review.

Table 10-3 Breaking New Ground Delivery (Service sites and houses delivered): Source: Department of Human Settlements

PROVINCE	SITES	UNITS
EC	14 842	17 870
FS	14 377	5 051
GP	24 529	23 632
KZN	10 973	31 650
LIMP	8 524	14 680
MPU	8 069	12 722
NC	5 153	1256
NW	12 060	11 224
WC	11 797	16 903
TOTAL	110 324	134 988

The number of service sites and houses delivered by the Department of Human Settlements The department has served 110 234 service sites and 134 988 households with sanitation through the BNG programme.

Progress on the Human Settlements for the period (2019-24) planned programmes for the provision of basic sanitation services are funded through the Human Settlements Development Grant (HSDG) and Urban Settlements Development Grant (USDG)

The HSDG: is a schedule 5 grant of which the objective is the creation of sustainable and integrated human settlements that enable improved quality of household life and access to basic services. The HSDG supplements provincial equitable share allocations. One of the outputs of the HSDG is the number of housing opportunities created, that is, the number of residential units delivered in all housing programmes and the number of serviced sites delivered in all housing programmes. During the period under review, the Department of Human Settlements serviced their sites and households using this grant.

The USDG: supplement the capital revenues of the metropolitan municipalities to implement infrastructure projects (including water and sanitation infrastructure) that promote equitable, integrated, productive, inclusive, and urban development. The grant also provides funding to facilitate a pragmatic, inclusive, and municipality-wide approach to upgrading informal settlements.

10.2.6 Sanitation Delivery Through Municipal Infrastructure Grant

The Municipal Infrastructure Grant (MIG) Programme entered its seventeen years of implementation in 2020/21 and is aimed at providing grant funding to municipalities to implement infrastructure that would allow municipalities to provide at least a basic level of service to poor households.

The MIG is the largest infrastructure transfer to local government administered by the Department of Cooperative Governance (DCoG) and is allocated through a formula in which its vertical division allocates resources between sectors, and the horizontal division takes account of poverty, backlogs, and municipal powers and functions in allocating funds to 218 municipalities. DCoG administers the grant and is a schedule 5B grant in terms of the Division of Revenue Act, which implies that funding is transferred directly to municipalities. The MIG is 1 of 13 conditional grants to local government (10 direct and five indirect) and represents 37% (R47,3 billion) of the total conditional infrastructure grants allocated to local government over the 2020 MTEF

Table 10-4 MIG allocation and expenditure as of 30 June 2021

Province	Allocated (R'000)	Transferred to date (R'000)	Transfers as % allocation	Expenditure to date (R'000)	Cumulative Exp incl. Rollover	Expenditure as % allocation (exc roll-overs)	Expenditure as % transferred (exc roll-overs)	Unspent Balance as (R'000)
Eastern Cape	2 866 318	2 866 318	100,00%	2 616 478	2 655 551	91,28%	91,28%	249 840
Free State	797 376	797 376	100,00%	695 847	751 036	87,27%	87,27%	101 529
Gauteng	349 140	349 140	100,00%	243 684	257 445	69,80%	69,80%	105 456
KwaZulu Natal	3 158 316	3 158 316	100,00%	3 061 794	3 248 538	96,94%	96,94%	96 522
Limpopo	2 977 399	2 977 399	100,00%	2 654 691	2 749 889	89,16%	89,16%	322 708
Mpumalanga	1 698 153	1 698 153	100,00%	1 666 397	1 699 897	98,13%	98,13%	31 756
Northern Cape	452 552	452 552	100,00%	301 189	313 580	66,55%	66,55%	151 363
North West	1 754 813	1 754 813	100,00%	1 574 113	1 554 117	89,70%	89,70%	180 700
Western Cape	436 998	436 998	100,00%	412 530	412 530	94,40%	94,40%	24 468
TOTAL	**14 491 065**	**14 491 065**	**100,00%**	**13 226 723**	**13 642 583**	**91,28%**	**91,28%**	**1 264 342**

Source: MIG DoRA – June 2021

Table 10-4 above gives the MIG allocation and expenditure as of 30 June 2021. All nine provinces were allocated R14,4mil, and the expenditure as of 30 June 2021 was R13,6mil. All nine provinces managed to spend R91,28%, excluding rollovers. The 2020/21 MIG framework states in response to COVID-19, the municipalities can utilize up to 10% of their allocations for the water and sanitation repairs and refurbishment projects, whilst non-water services authorities may request approval from the transferring officer to spend on water and sanitation projects, on presentation of the signed service level agreements with the relevant water services authorities.

10.3 Development of the Faecal Sludge Management Strategy

There are operations and maintenance needs that should be met which necessitate faecal sludge management from the collection, transportation, treatment, safe disposal, or reuse. In the past, the operation and maintenance of onsite sanitation technologies have not been given attention when compared to offsite sanitation systems, which include sewerage networks and Wastewater Treatment Works (WWTW).

In total, 36% (6 159 000) of households have access to onsite sanitation technologies (improved and unimproved sanitation facilities). During special public events and social gatherings, people use mobile toilets, which accumulate faecal sludge onsite, and need toilets tanks to need to be emptied. In most cases, the faecal sludge is not safely managed due to a lack of options which results in illegal dumping. Under these conditions, onsite sanitation poses a risk of contaminating water resources.

In the country, 10% (507 732) of households served with onsite sanitation technologies have full pits (STATS SA, 2019). When pits are full, there is a high possibility of reverting back to open defecation. This is a challenge that needs to be addressed urgently as full pits pose a public health risk to communities

The Strategy will guide the sector on the safe management of faecal sludge to prevent contamination of water resources, safeguard public health, and protects the environment from pollution throughout the sanitation service value chain. Sustainable Development Goal 6.2 target is one of the international initiates that accelerated actions toward faecal sludge management to ensure safely managed sanitation. As a result of research completed in developing the preliminary Draft National Faecal Sludge Management Strategy for Non sewered sanitation and stakeholder engagement to date, specific issues have emerged as challenges in the sanitation sector:

Sector coordination: In terms of institutional frameworks, while the roles of DWS and local government are clear – DWS regulates and supports FSM service delivery and local government plans and implements FSM services – however other stakeholders' roles require clarity and coordination.

Regulation: While the current draft norms and standards do specifically address on-site sanitation (section 7.3.2), they do not regulate standards and rather specifically provide that "The type of sanitation infrastructure or facility adopted and installed shall be an improved facility and depends on the preferences and cultural habits of the intended users, the capacity of the services provider (financial and skills), the existing infrastructure, the availability of water (for flushing and water seals), the soil formation (for groundwater and surface water protection) and the capacity of the applicable wastewater treatment methods").

DWS is in the process of finalizing the development of a Compulsory National standard relating to the provision of water services in accordance with section 9 of the Water Services Act (Act 108 of 1997). Therefore, water services authorities must regulate locally through Council determined and approved policies and by-laws. Local municipalities require guidance and support from the national sector regarding norms and standards for the whole FSM service chain. Norms and standards for construction and operation of on-site facilities, as well as for FSM transport and treatment, are still under development.

Faecal sludge emptying and transport: Faecal sludge is generated by onsite sanitation systems, which are increasingly being rolled out in municipalities. However, the services to manage the faecal sludge generated by those new facilities are not in place, and emptying services are uncoordinated. Therefore, faecal sludge will continue to build up. Mobile toilets used during public events and social gatherings struggle with the safe disposal of faecal sludge as there are very limited alternatives for safe disposal; as a result, there is noted illegal dumping of faecal sludge.

Faecal sludge management data: There is no reliable data for unsewered urban areas – served in affluent areas by septic tanks and informal areas, nor for informal settlements where services range from city to city and encompass the full range from chemical toilets to portable toilets, to pit latrines (formal and informal, shared and private) to sewered communal ablution blocks. There is no clear data for emptying, transport, and treatment services in peri-urban areas, where people use pit latrines or septic tanks according to what they are able to afford. There is no reliable or consistent data on emptying, transport, and treatment services in rural areas – mainly served by government-provided full VIPs.

Faecal sludge management technologies: South Africa has access to a variety of uncertified technologies for toilets/containment technologies, emptying, and on-site treatment. Perceptions of these technologies are that they are interim solution and that they are inferior technology. In addition, there is no transparent standardization process in place. In addition, planning and budgeting for FSM technologies at the Municipal level needs strengthening. Finally, the services required to use those technologies safely are not in place and need to be regulated.

Faecal sludge management financing: Key issues for current FSM financing mechanisms in South Africa are as follows:

- Equitable Share is inadequate to meet all infrastructure maintenance requirements.
- The Municipal Infrastructure Grant is a well-established mechanism to support on-site sanitation however, more funds are allocated to water supply than sanitation.
- The Water Services Infrastructure Grant tends to focus on water infrastructure in rural areas. The contribution to on-site sanitation and FSM is minimal
- Capital grants for networked / sewered sanitation services dominate overall sanitation expenditure.
- Tariff revenue tends to be well short of cost-recovery levels, leaving no room for cross-subsidy.
- Capital and operational subsidy go primarily to capital expenditure in most municipalities. Support to operations is inadequate.

The strategy sets out the processes and actions to address the six pillars set out in the Conceptual Framework: and interventions to be undertaken in the next 10 years by the sector, against each aspect of the sanitation service chain, as set out in Table 10-5.

Table 10-5 Scope of the strategy in a sanitation service chain

FSM service chain step	Scope of the strategy
Containment	Strategies to guide safe, appropriate and affordable on-site sanitation systems that can be safely emptied; and recommended actions to give effect to them.
Emptying and transport	Strategies to guide effective and safe emptying and transport services to separate pathogens from humans and the environment; and recommended actions to give effect to them.
Treatment and re-use / disposal	Strategies to guide the installation of appropriate and effective treatment of faecal sludge and the beneficial use or safe disposal (at site or following treatment) of treated sludge; and recommended actions to give effect to them.

Progress made in the development of the national faecal sludge management strategy for the period October 2020 to September 2021 is as follows. The following key documents have been developed:

- A Conceptual Framework that outlines the vision, scope, and areas of inquiry for the National Faecal Sludge Management Strategy for non-sewered sanitation.
- Faecal Sludge Management Status Quo Report in SA
- Preliminary Draft Faecal Sludge Management Strategy, which outlines propositions and interventions that are relevant to addressing the challenges identified.
- Framework for Stakeholders' consultations on the Preliminary Draft National Faecal Sludge Management Strategy for non-sewered sanitation

10.4 Alternative Sanitation Technologies Assessment

In terms of the National Sanitation Policy (2016), the Minister may establish the National Water and Sanitation Advisory Committee to provide, amongst others, the development of a formal process for certification and accreditation of appropriate sanitation technologies and decentralized sanitation system. Policy Position 24 requires the following actions:

- Development of criteria to evaluate appropriate sanitation technologies.
- Development a formal process for certification and accreditation of appropriate sanitation technologies.

- Development of funding models to provide incentives that encourage the utilization of resource efficient sanitation infrastructure; and
- Research and innovation of appropriate sanitation service technology to be strengthened.

The successful implementation of these policy positions and targets requires coordinated efforts to ensure that the sector is well placed to respond to these policy positions and ever-developing environment. The department reviewed the Sanitation Technology Assessment and Evaluation Protocol that was developed by the Department of Science and Innovation (DSI) in collaboration with the Water Research Commission (WRC) and handed over to DWS. It is envisaged that these assessment criteria will be digitized and adopted by the sector as the formal criteria to assess sanitation technologies.

The WRC is currently assessing and validating various alternative sanitation technologies for the entire sanitation value chain through the South African Sanitation Technology Enterprise Programme (SASTEP), which is a national system of innovation platform that seeks to fast-track the adoption of innovative and emerging sanitation technologies through fostering local manufacturing and commercialization.

The SASTEP programme was established by the WRC in partnership with the DSI, and the Bill and Melinda Foundation (BMGF) and with the support of the DWS. Furthermore, DWS, in collaboration with DSI is in the process of establishing the Sanitation Technology Technical Coordination Committee (STTCC) under the Memorandum of Understanding between DWS and DSI.

The STTCC will constitute a technical structure that will consist of sector stakeholders such as government departments, state-owned enterprises, and private sector partners involved directly or indirectly in the planning, development, assessment, validation, certification, accreditation, implementation, and monitoring of sanitation technologies. The major role of the STTCC is to coordinate sanitation assessment processes and ensure a standardized process for sanitation technology uptake, which is fair, transparent, and able to remove obstacles that delay uptake, adoption, and implementation of new innovative sanitation systems.

In addressing the Sanitation and hygiene challenges South Africa faces, the following actions need to be considered:

- Exploring an approach to expanding sanitation economic opportunities for the entire sanitation service value chain and paving a clear plan for building a sanitation economy.
- Strengthening of hygiene and user education
- Prioritization of operation and maintenance (O&M) budget for sanitation services.
- Review of infrastructure grants to have a specific allocation for O&M.

- Budget prioritization at WSA level and commitments to address the sanitation backlog.
- Establish systems that include the use of alternative and appropriate technologies that minimizes the use of water resources.
- Development of technical capacity for safe management of each stage of the sanitation value chain.

It is crucial to understand the status of sanitation per WSA and also analyze the reasons for certain performances in order to turn around poor performance. Hence the development of the NSIP is for South Africa to achieve national and international sanitation targets by 2030, ensuring sustainable sanitation services and leaving no one behind.

The National Sanitation Integrated Plan will explore an approach to expanding sanitation economic opportunities for the entire sanitation service value chain. There will be a consideration of renewable resource flows, data availability, and information that could transform future settlements, communities, and businesses. The sanitation sector is positioning itself for transformation to consider smart sanitation solutions. This approach requires the government to scale up sanitation efforts and work in collaboration with both public and private sectors paving a clear plan for building a sanitation economy.

The process of the development of the NSIP will have an intense stakeholder consultation to ensure ownership and commitments by all role players, including integrated planning and source of budget allocation toward the planned provincial action plans

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