4

STATE OF THE RIVERS

4 STATE OF RIVERS

4.1 Streamflow

The Department of Water and Sanitation (DWS) is mandated by the National Water Act (No. 36 of 1998) Chapter 14, Section 137, to establish and monitor streamflow in the South African rivers. The Department monitors 628 river flow gauging stations across South Africa. Several streamflow monitoring stations are equipped with data loggers that measure the amount of water passing through a point over time in cubic meters per second (m^3/s). The NWRS-2 indicated that streamflow monitoring aims to address our national concerns and is also in response to our obligations within international river basins (DWS, 2013).

Transboundary water systems account for approximately 60% of South African river streamflow. Therefore, it is critical that South Africa implements Integrated Water Resource Management (IWRM) in accordance with international water conventions and treaties, as well as the legislation governing water resource management in South Africa. The international agreements have guidelines and limits on the quantities of water that South Africa may use out of the rivers and the amount of water the country must release to the neighbouring countries.

The South African rivers demonstrate variations in flow regimes or flow patterns, continuously deviating from the historical flows. The flow regime changes are both natural and anthropogenically driven, with high variability in rainfall, population growth, land and water use changes playing significant roles. Some catchments demonstrate increased streamflow while declining trends are also observed in other catchments. The decline in streamflow affects water availability and supply, resulting in competing water requirements between different water use sectors such as agriculture, industrial, and urban water supply.

4.2 Annual Streamflow Anomaly at Strategic Points

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

Figure 4.1 depicts a streamflow anomaly map that shows the deviation of annual streamflow in the 2022/23 hydrological year from the long-term median (median period of 1981-2010), whereas Figure 4.2 depicts the streamflow deviation for the previous hydrological year.

Most strategic points demonstrated a significant increase in the total annual flow volume in the current hydrological year compared to the previous year. This can be attributed to well above-normal rainfall received over extensive parts of central South Africa as a result of ENSO's El Niño event, which is associated with above-normal rainfall in the majority of summer rainfall regions. Only three strategic stations were below normal, compared to five reported last year, with one being extremely below normal.

One of the highlights was a station in the Olifants WMA (B7H007 - Olifants River at Oxford) that has improved from below normal to above normal in the current hydrological year. Water from this station flows into Mozambique, and the streamflow anomaly graph in Figure 4.3 shows a significant increase in total flow volume. The total annual volume recorded at this station in the 2022/23 hydrological year was 2601 MCM, the highest ever recorded.

The flow station D8H014, which is located on the Orange River and flows into Namibia, maintained its extremely above-normal flow status from the previous year. The streamflow anomaly graph for this station indicates that both this station and the one above it (D7H005- Orange River at Upington) had good flows in the last two hydrological years, after 9 years of low flows. Overall, all rivers in the Integrated Vaal River System improved or maintained a significantly higher than long-term median pattern, except for C9H003 (Vaal River at Riverton), which was above normal and regressed to below normal in the current reporting period.

Notably, the streamflow at a station in the Pongola-Mtavuma WMA V5H002 (Tugela River at Mandeni) was again flagged as being below normal, but this was an improvement over the much lower levels reported last year. The historical observed streamflow data, and annual streamflow anomaly graph presented in Figure 4.4 revealed that the flow at this station has been below normal since the 2014/15 hydrological year. Two stations (L7H006- Groot River at Grootrivierspoort and Q9H018– Fish River at Matomela’s Location) in the Mzimvubu-Tsitsikamma WMA improved significantly from below normal to above normal in the current hydrological year, which can be associated with above-normal summer rainfall that caused flooding in some areas of the Eastern Cape.

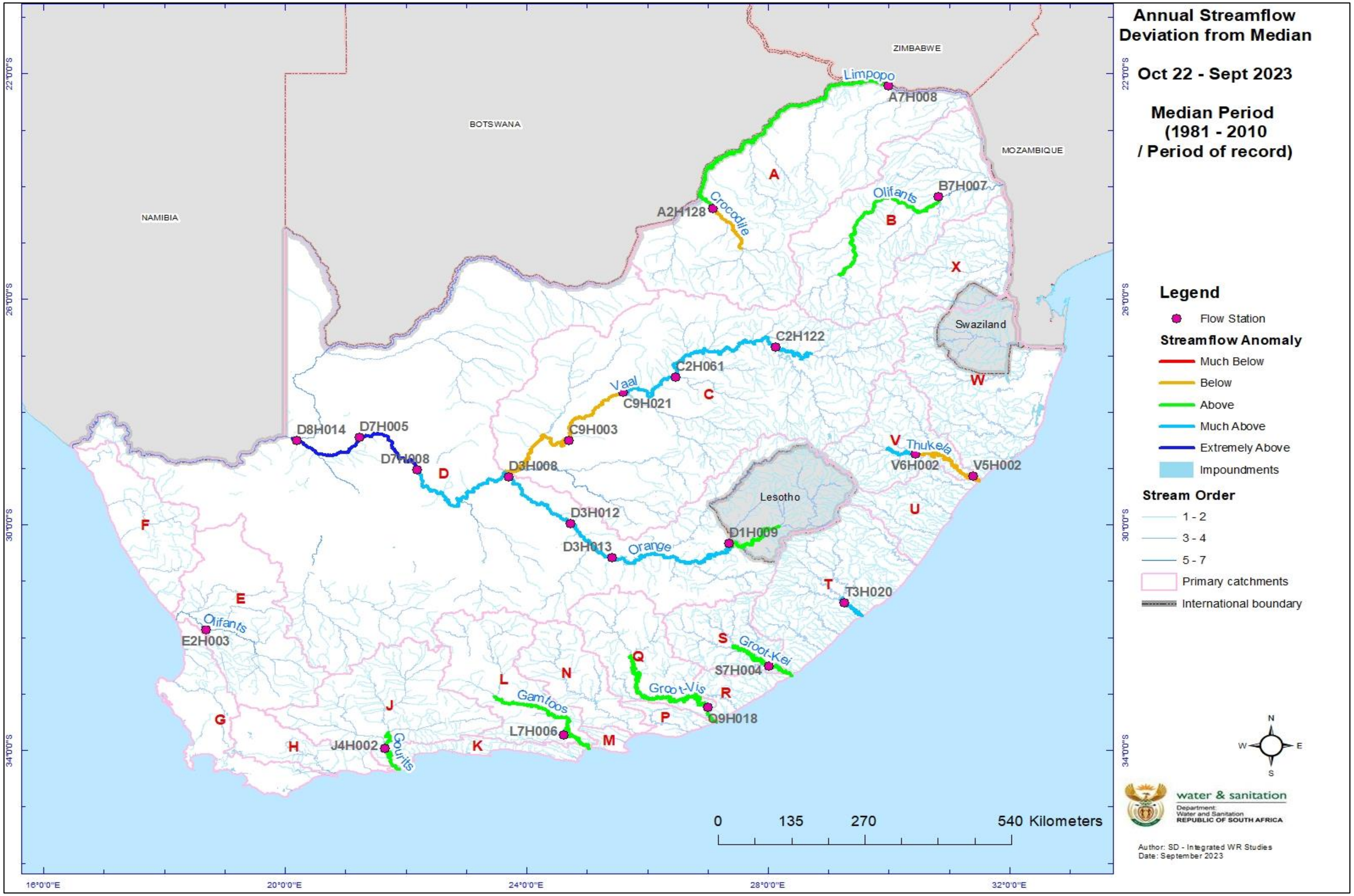


Figure 4.1: Annual Streamflow Anomaly for Strategic River Flow Monitoring Stations as of September 2023.

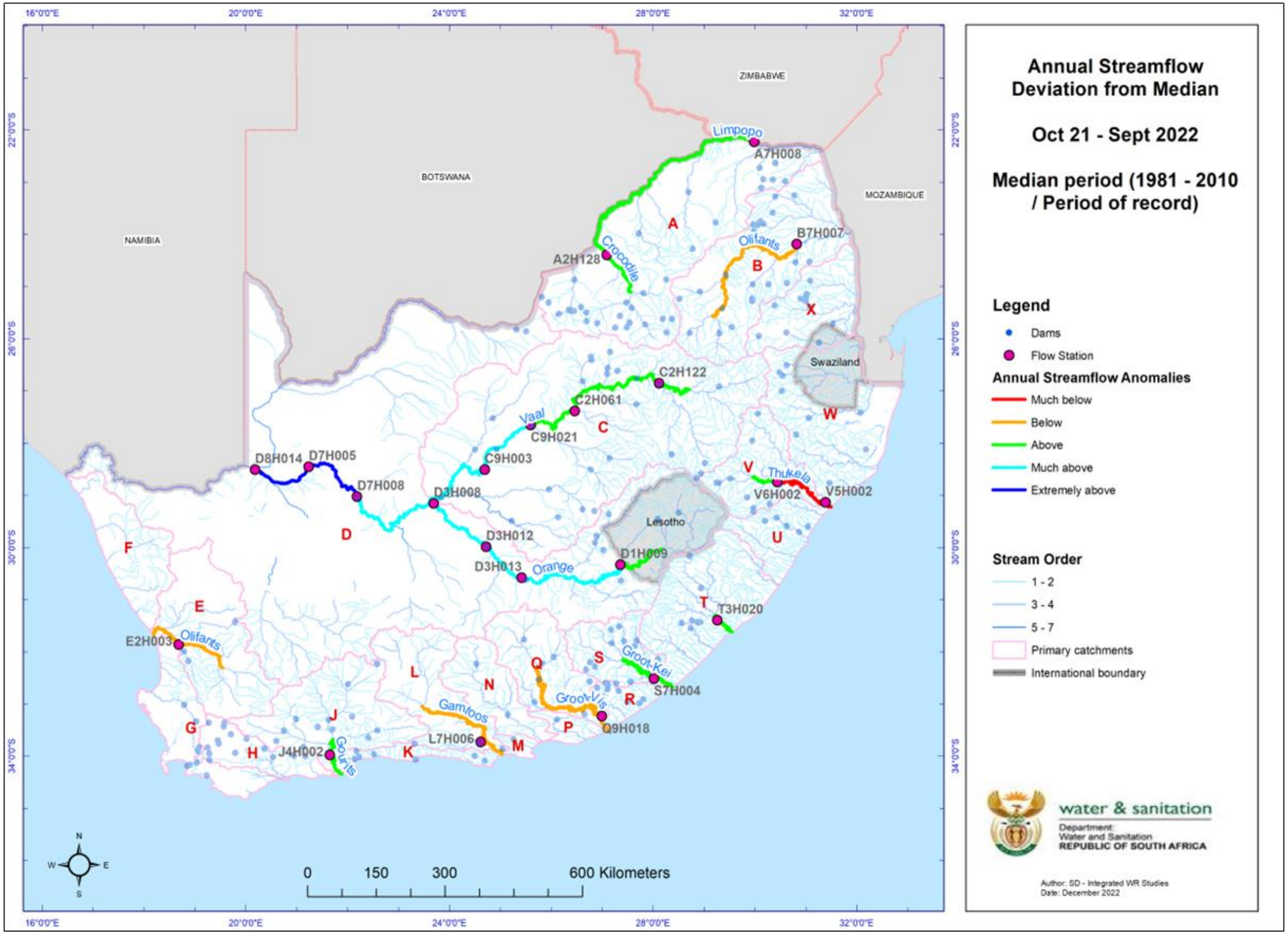


Figure 4.2: Annual Streamflow Anomaly for Strategic River Flow Monitoring Stations for 2021/22 HY.

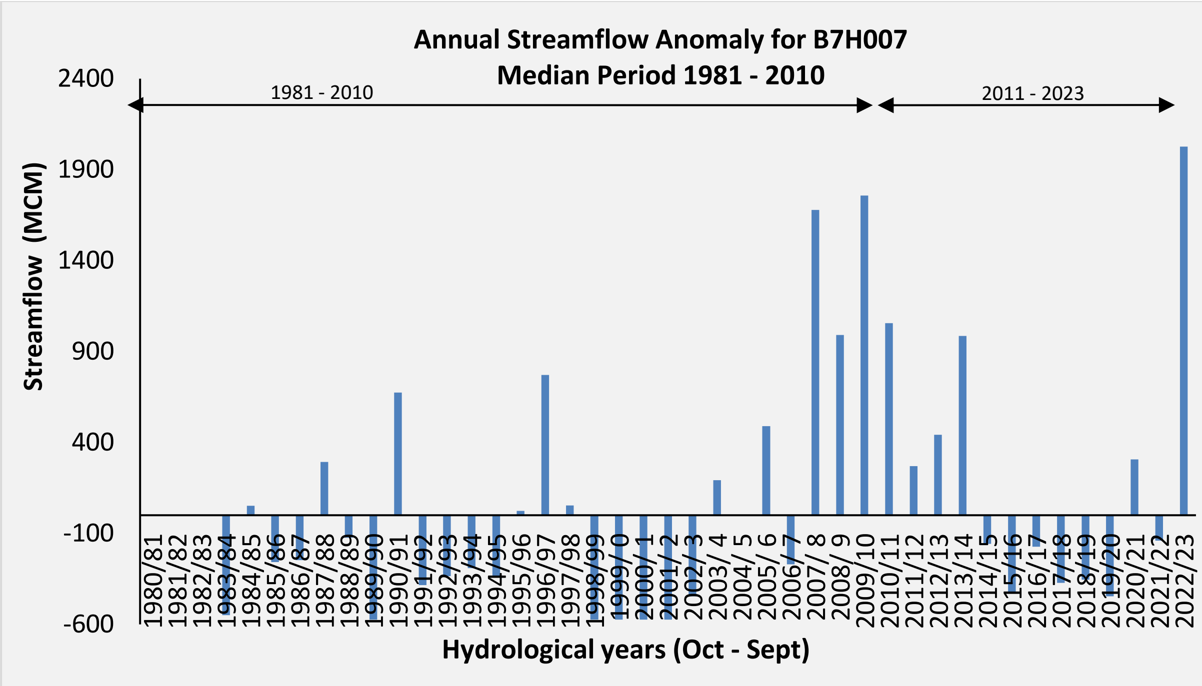


Figure 4.3: Annual streamflow deviation from the long-term median at station B7H007.

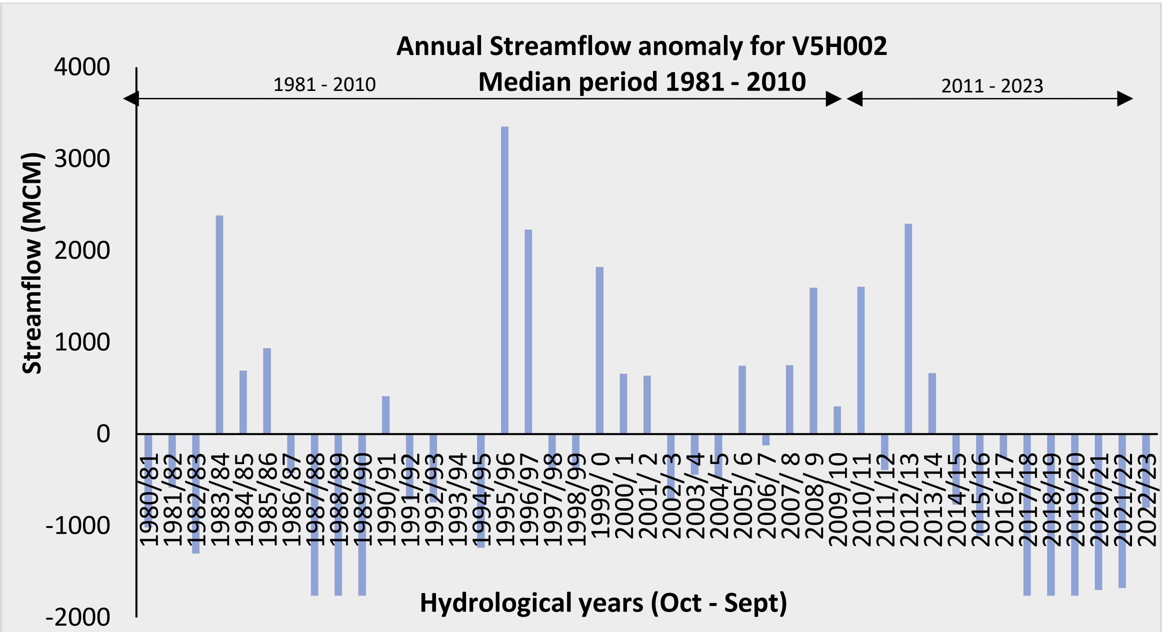


Figure 4.4: Annual streamflow deviation from the long-term median at station V5H002.

4.3 Surface Water Resource Quality

The Department of Water and Sanitation, as custodian of South Africa's water resources, seeks to ensure that water resources remain fit for recognised water uses while also maintaining and protecting the viability of aquatic ecosystems. As a result, several water quality monitoring programmes are currently in operation across the country. This section will present the country's water quality data as collected through the DWS water quality monitoring programmes in the current reporting period.

4.3.1 Inorganic Chemical Pollution

The inorganic water quality is described in terms of attributes for which the values exceeded the Ideal and Good classes specified in the guidelines for domestic and irrigated agricultural use. These water user classes were chosen where users could withdraw water directly from surface water and use it without pre-treatment. This is assumed not to be the case where domestic users have access to reticulated water that has been adequately treated to make it safe for consumption.

Figure 4.5 depicts the inorganic chemical water quality for the 2022/23 hydrological year across the country. The assessment used the available data for the hydrological year to extract information from what were, in some cases, limited sampling events during the period. Figure 4.5 shows that there was little evidence of elevated nutrient levels during the current reporting period. Therefore, this report will focus on water quality attributes related to salinity.

- ***Salinity***

Salinity is reflected by a number of water quality attributes, including: Total Dissolved Solids (TDS) or its equivalent Dissolved Major Solids (DMS); Electrical Conductivity (EC); and concentrations of individual ions such as sodium, chloride, and magnesium, potassium and sulphate, amongst others. *Increased salinity affects the taste and perceived freshness of water. When salt levels are high in water and it is used for domestic purposes, such as drinking, it can cause serious health problems in infants under the age of one year (Blue Baby Syndrome), people with heart or kidney disease who are on a salt-restricted diet, and people with chronic diarrhoea. Excessive salt levels in water can also damage water infrastructure by corroding distribution pipes, resulting in higher maintenance and replacement expenses.*

Figure 4.5 (A and B) shows the inorganic water quality attributes deemed to be especially significant for the **Domestic Fitness-for-Use**. The attributes are split into two subsets for the maps to be more legible. The **Irrigated Agriculture Fitness-for-Use** (Figure 4.5C) has fewer attributes, and Figure 4.5D displays Electrical Conductivity (EC) assessed according to Domestic use guidelines.

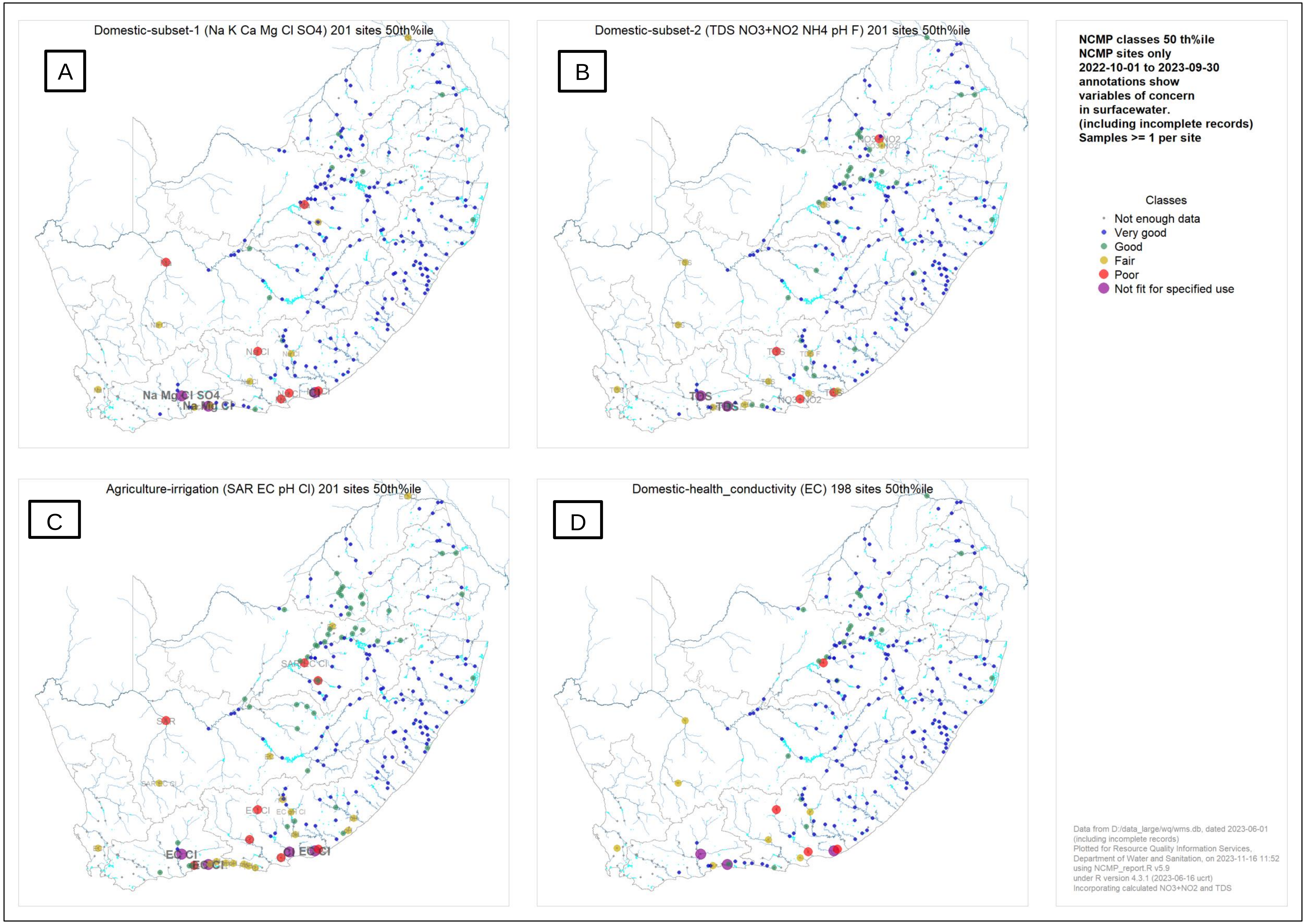


Figure 4.5: The inorganic chemical water quality situation in South Africa during the 2022/2023 hydrological year.

i. Domestic Use: Salinity (Na; K; Ca; Mg; Cl and SO_4)

Figure 4.5A shows that in the Berg-Olifants Water Management Area (WMA) and the Breede-Gouritz WMA in the Western Cape and Southern Cape, monitored sites demonstrated varying levels of Sodium (Na) and Chloride (Cl), ranging from fair to not suitable for specified uses. Additionally, there were a few instances in the Olifants River in the Breede-Gouritz WMA where Magnesium (Mg), Sulphate (SO_4), and Potassium (K) levels were higher than normal.

In a coastal vlei, it is expected that one of the sites would have high salinity levels due to the influence of the ocean. In the Vaal WMA, there were two sites with elevated Cl levels and one site with elevated Na levels. The Orange WMA also had two sites where both Na and Cl levels were elevated. Within the Limpopo WMA, a site located at the Beit-Bridge border showed slightly higher concentrations of Cl. In the Mzimvubu-Tsitsikamma WMA in the Eastern Cape, there were several instances where Na and Cl levels exceeded the acceptable range, and two of those sites also had slightly elevated Mg levels (Mackies Puts Eye at Graaff-Reinet and in the Kariega River).

ii. Domestic Use: Salinity (TDS; NO_3-NO_2; NH_4, pH and F)

Figure 4.5B shows a monitoring site in the Berg-Olifants WMA along the Diep River with slightly increased levels of TDS. In the same Breede-Gouritz WMA, two locations had elevated TDS, and one of these is situated within the Swart Vlei, which is strongly influenced by marine conditions. Additionally, the pH is low in this WMA, which may not necessarily be due to human influences. In the Mzimvubu-Tsitsikamma WMA, several locations displayed elevated TDS, with one showing increased levels of Nitrate-Nitrite (NO_3-NO_2) and Ammonium (NH_4) on the Swartkops River near Uitenhage, and slight elevations of Fluoride (F) at a site on the Tarka River (Figure B).

In the Vaal WMA, one site on the Sandspruit River exhibited slightly elevated TDS, while slightly elevated TDS levels were observed at two sites: the Sak River and the Rooiberg Dam on the Hartbees River within the Orange WMA (Figure 4.5B).

iii. Irrigated Agriculture Use (Indicator SAR; EC; pH; and Cl)

In the Berg-Olifants WMA, there is a site where the EC concentration is slightly higher than normal (Figure 4.5 C). In the Breede-Gouritz WMA, several sites demonstrated elevated SAR (Sodium Adsorption Ratio) levels. The SAR levels varied between fair and poor at three sites. Additionally, EC and Cl concentrations were often higher than usual at various sites within the Breede-Gouritz WMA.

In the Mzimvubu-Tsitsikamma WMA, SAR levels are elevated at five sites, which could negatively impact agricultural crop yield if the water is used for irrigation. Low pH levels were also observed in several sites within the Mzimvubu-Tsitsikamma WMA. Furthermore, elevated EC and Cl concentrations were found at multiple sites.

In the Vaal WMA, three sites exhibited elevated levels of factors that adversely affect the suitability of water for irrigated agriculture. This includes a poor SAR at a location on the Sandspruit, as well as varying degrees of elevated salinity indicated by EC and chloride levels across the sites. Additionally, the pH was high at the Sandspruit site. Furthermore, within the Limpopo WMA, the site at the Biet Bridge border post showed elevated levels of EC and chloride.

iv. Domestic Use Electrical Conductivity

Figure 4.5D shows one site with high EC in the Berg-Olifants WMA, while the Breede-Gouritz WMA had three sites with elevated EC, one of which was only slightly increased, while the other two were significantly elevated. The Mzimvubu-Tsitsikamma WMA had seven sites with elevated EC, ranging from acceptable to unsuitable for direct human consumption, and the Orange WMA had two sites with slightly elevated EC (Figure 4.5D).

Figure 4.6 depicts the average EC levels over the last five years in the country. It deviates from specific water quality guideline values for various water user groups and instead provides a more detailed scale for lower EC levels and broader categories as the levels rise. The inclusion of the figure/map is intended to cover a longer period of EC data and to include more sites that may have had limited or no sampling during the current hydrological year.

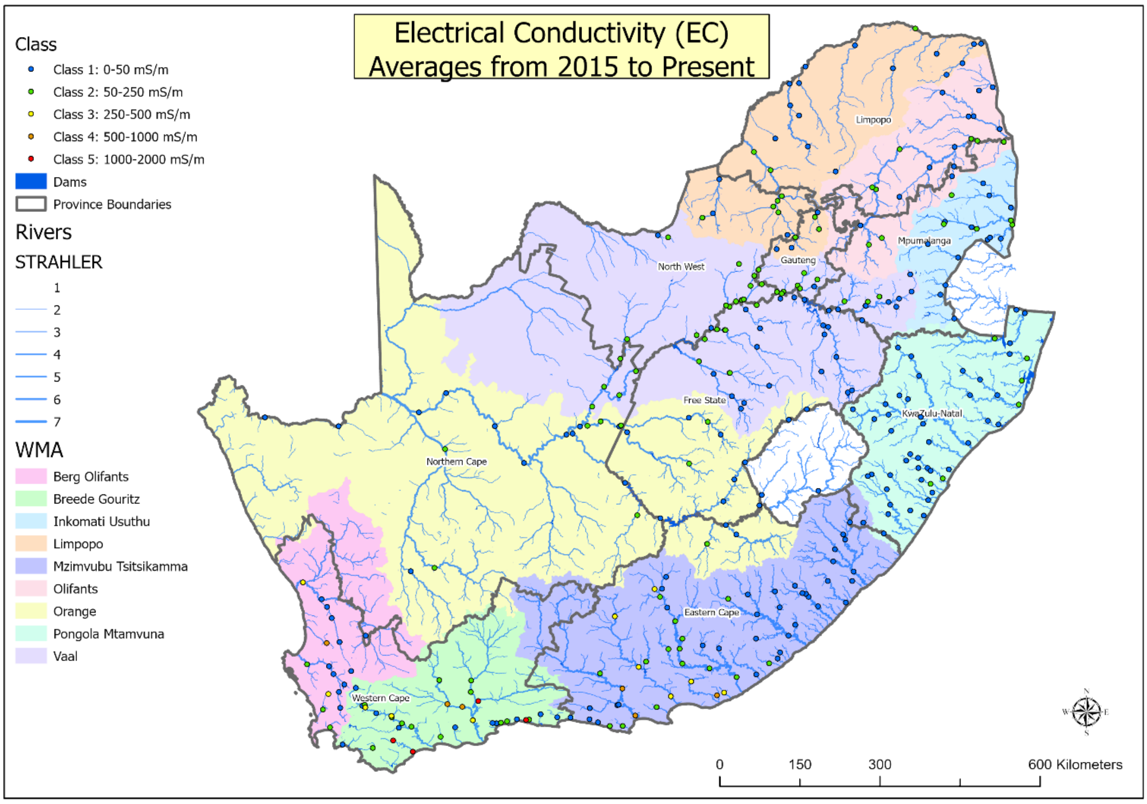


Figure 4.7:The average of the Electrical Conductivity (EC) values recorded in South Africa during the period from 2015 until the present.

Case Study: Vaal River Sulphate Levels: A Historical Overview

The persistently high sulphate (SO_4) levels in the Vaal River below Vaal Dam have long suggested the impact of mine drainage and other activities such as coal burning and the use of gypsum fertilizers, indicating pollution from industrial waste and other impacts on this section of the river. In Figure 1 below, however, it is clear that there has been a gradual reduction in sulphate levels, resulting in the successful maintenance of concentrations below the 150 mg/L management objective from 2009-2010. This achievement is largely attributed to improved catchment management and enforcement practices, which include the implementation of the Vaal River Salinity Management Programme. This program utilizes a water quality salinity model to ensure that total dissolved solids (TDS) levels remain below 600 mg/L.

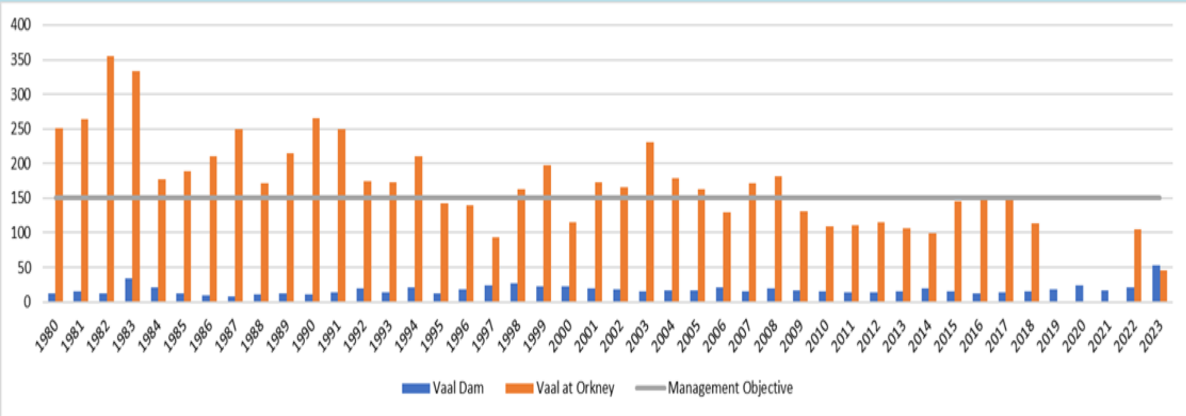


Figure 1: Vaal River Sulphate Levels Trends from 1980-2023

Case Study: National Fluoride Concentrations Overview

The impact of water fluoridation and de-fluoridation in SA is critical as these processes affects human health in both systemic and topical ways. Studies conducted on the population in SA suggest that an ideal water Fluoride level ranges from 0.54 to 0.7 mg/L (du Plessis, 1995; DWAF, 1996; SABS, 2001). However, the World Health Organization (WHO) recommends an optimal target range of 0.5 to 1 mg/L (WHO, 1994). In this specific study, the fluoride (F) levels below 0.4 mg/L were designated as the pink category, whereas those ranging from 0.5 to 1 mg/L were considered green. The yellow label was assigned to F values between 1 and greater than 1.5 mg/L, while any values equal to or above 1.5 mg/L were labelled as red (Table 1).

Table 1: Fluoride guideline used in map (Adapted from WRC, 1998)

Fluoride (mg/L)	**Drinking**		**Food preparation**	**Bathing**	**Laundry**
	Health	Aesthetic			
0.5 – 1.0 Good	Insignificant health effects	No effects	Insignificant health effects	No effects	No effects
1.0 – 1.5 Marginal	Increasing effects in sensitive groups and tooth staining	No effects	Increasing effects in sensitive groups	No effects	No effects
1.5 - 3.5 Poor	Possible health effects in all individuals, marked tooth staining; and increasing risk of health effects and severe tooth staining	No effects	Possible health effects in all individuals	No effects	No effects
≥4.0 Low	Potential fluoride deficiency in sensitive groups	No effects	Health effects in all individuals	No effects	No effects

The map (Figure 2) indicates that surface water Fluoride levels are predominantly low (i.e. 0.4 mg/L and below). However, it's important to note that the minimum Fluoride level requirements for different population groups can be influenced by various factors, therefore this is not always a concern. However, the use of fluoride containing toothpaste and a well-balanced diet is always recommended where possible. A few instances of elevated fluoride levels were discovered in the Limpopo and Eastern Cape provinces, as indicated by red dots on Figure 2. In the Limpopo province, the area with high fluoride concentrations was found in the southernmost part of the Ga-Selati River, with an average level of 3.4 mg/L. Health consequences and tooth discolouration can be expected at such high Fluoride levels (refer to Table 1). These elevated Fluoride concentrations have previously been associated with the return flows from the mining complex surrounding Phalaborwa in the Ga-Selati River (Van Veelen and Dhemba, 2011). In the Eastern Cape province, a median level of 1.5 mg/L was observed at one location in Elands River. This, however, is attributed to the natural geology and land cover at that specific point, where the area consists of forests and cultivated land at Scherp Arabie *(Hohls et al., 2001).*

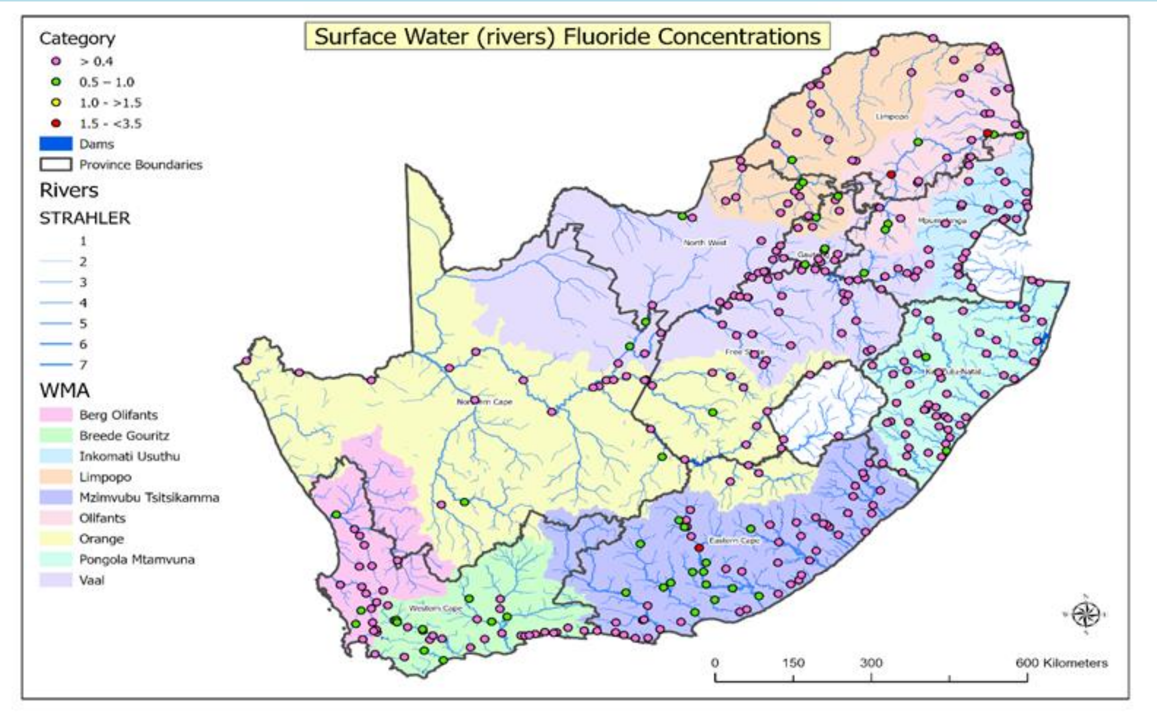


Figure 2: Map depicting median Fluoride concentrations of NCMP river sites from periods ranging from the 1970s to 2023.

4.3.2 Eutrophication

Eutrophication is the process of excessive nutrient enrichment of water that typically results in problems associated with excessive macrophyte, algal, or cyanobacterial growth. The trophic status of the water body provides a measure and description of the degree of eutrophication (nutrient enrichment) and the extent of plant growth that can be sustained. The trophic status of water resources is not only affected by nutrient concentrations but also by other factors, including abiotic, biotic, physico-chemical, and biological factors.

The four trophic status classes and colour coding used to describe trophic status are provided in Table 4-1 below, and the criterion used to assign a trophic status for the dams in South Africa is outlined in Table 4-2.

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, 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

<table>
<tr><th>Statistic</th><th>Unit</th><th colspan="4">Current trophic status</th></tr>
<tr><td rowspan="2">Median annual Chl a</td><td rowspan="2">µg/L</td><td>0<x<10</td><td>10<x<20</td><td>20<x<30</td><td>>30</td></tr>
<tr><td>Oligotrophic (low)</td><td>Mesotrophic (Moderate)</td><td>Eutrophic (significant)</td><td>Hypertrophic (serious)</td></tr>
<tr><td>% of time Chl a> 30µg/L</td><td>%</td><td>0</td><td>0<x<8</td><td>8<x<50</td><td>>50</td></tr>
<tr><td></td><td></td><td>Negligible</td><td>Moderate</td><td>Significant</td><td>Serious</td></tr>
<tr><td colspan="6">Potential for algal and plant productivity</td></tr>
<tr><td>Median annual Total Phosphorus (TP)</td><td>mg/L</td><td>x<0.015</td><td>0.015<x<0.047</td><td>0.047<x<0.130</td><td>>0.130</td></tr>
<tr><td></td><td></td><td>Negligible</td><td>Moderate</td><td>Significant</td><td>Serious</td></tr>
</table>

In the current reporting period, forty-five of the sixty-one ONEMP sites were analysed for trophic status and eutrophication potential. The trophic status assessment presented in Figure 4.7 found nine (9) dams to be hypertrophic, two (2) eutrophic, three (3) mesotrophic and twenty-four (24) were oligotrophic. Seven (7) dams did not have chlorophyll-a information and only the eutrophication potential was assigned

(Figure 4.7). The nine hypertrophic dams included Rietvlei Dam, Hartbeespoort Dam, Bon Accord Dam, Klipvoor Dam, Vaalkop Dam, Roodeplaat Dam, Modimola Dam, Bronkhorstspruit Dam and Witbank Dam**,** while the eutrophic dams included Loskop Dam and Disaneng Dam as shown in Figure 4.7. Mesotrophic sites were Rhenosterkop Dam, Middle Letaba Dam and Bloemhoek Dam.

Eutrophication potential was also calculated (based on total phosphorous (TP) concentration) as serious (13 sites), significant (11 sites), moderate (10 sites), and negligible (11 sites). The hypertrophic sites and eutrophic sites were characterised by high nutrient levels with serious potential for continued algae and plant productivity. Several sites (49) distributed across the country had high nutrient levels with significant to serious potential for algae and plant productivity (Figure 4.8).

The sites with serious eutrophication problems are mainly located in densely populated areas with over capacitated sewage treatment systems, generally increasing population growth which exceed infrastructure development such as poor sewage networks and big cities full of different industries.

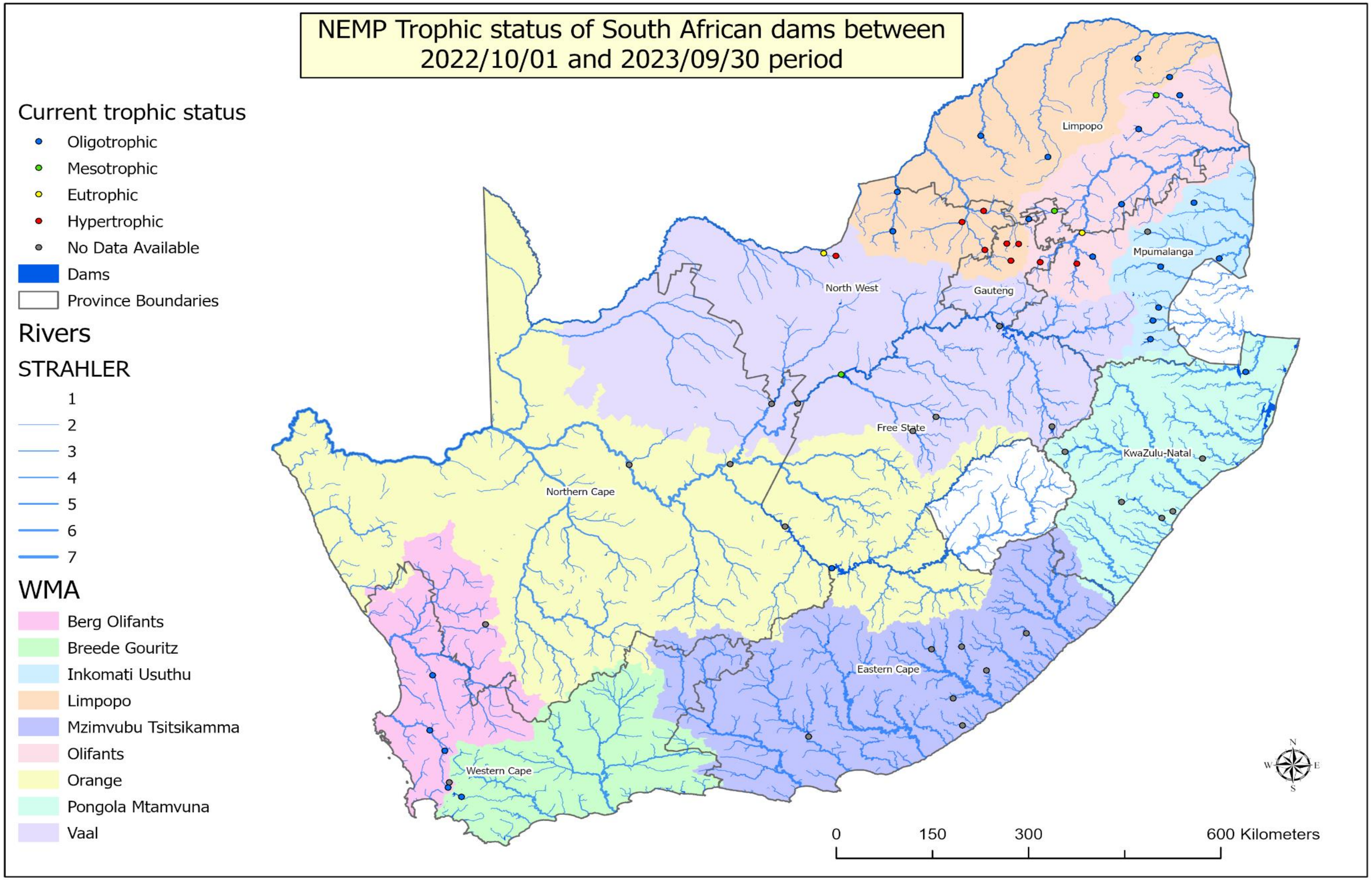


Figure 4.8: ONEMP Trophic status analysis for the sites monitored during October 2022 to September 2023 period.

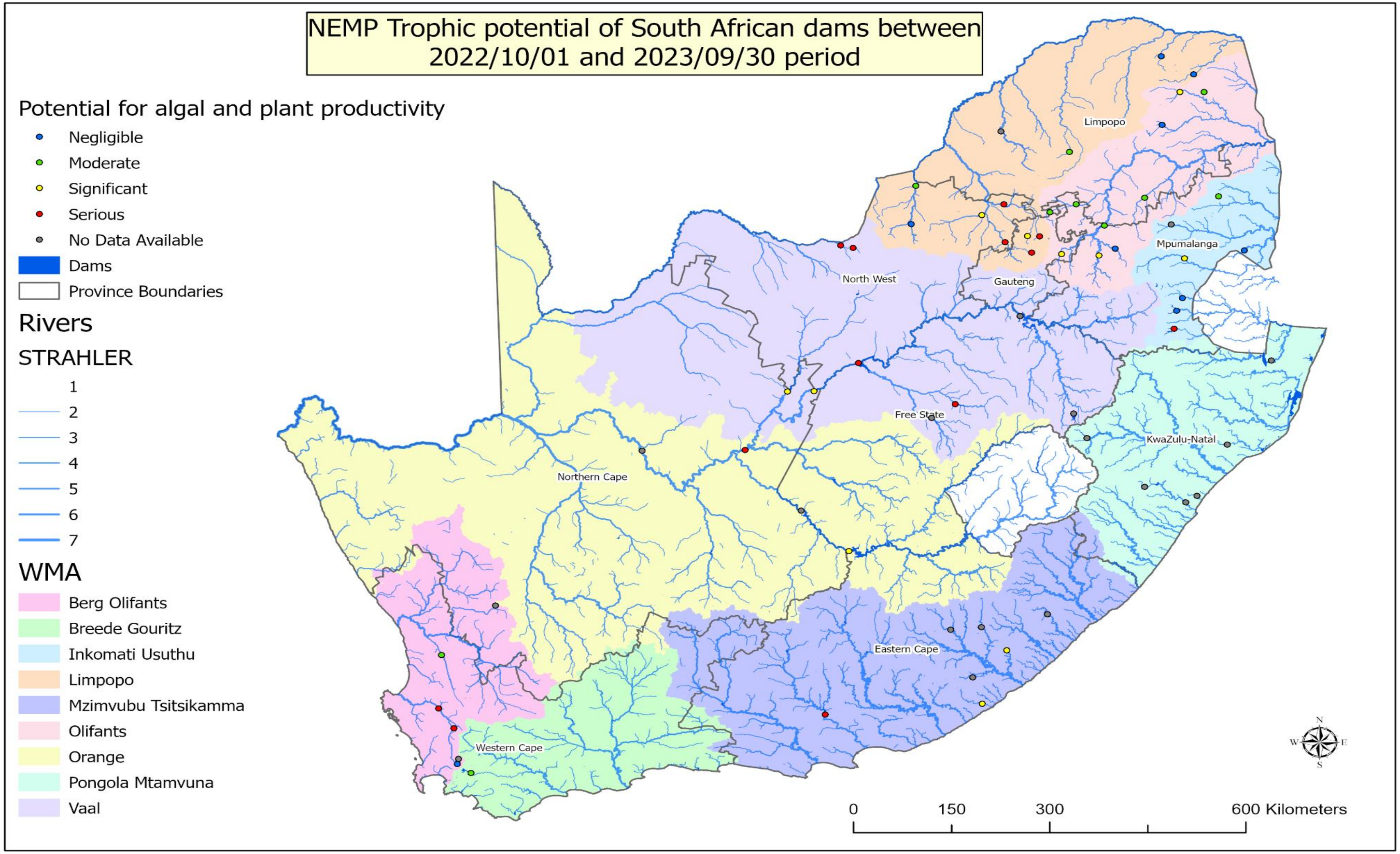
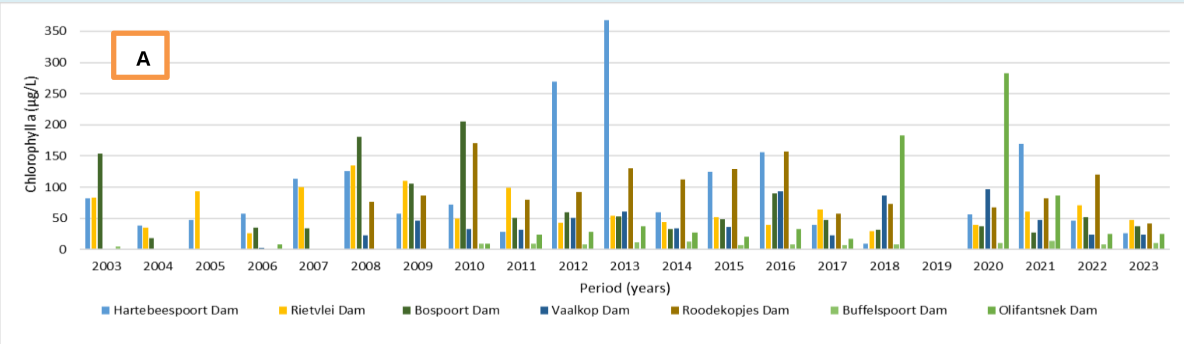


Figure 4.9: Trophic potential of the ONEMP sites for the October 2022 to September 2023 period

Case Study 1: Long-term changes in the Trophic Status of Dams in the Upper Crocodile Catchment

The trophic status of a dam is generally an indication of the level of nutrient enrichment and the resulting algal production of the particular dam. Changes in trophic status over the past two decades (2003 to 2023) for seven dams in the upper Crocodile catchment are represented in Figures 1 A and B below. The chlorophyll-*a* concentrations falling in the **eutrophic** status range were found in Olifantsnek Dam (25.5 µg/L), Vaalkop Dam (24.2 µg/L) and Hartebeespoort Dam (26.6 µg/L), while Roodekopjes Dam, Rietvlei Dam and Bospoort Dam were all found to be **hypertrophic** with mean chlorophyll-*a* values of 42.02 µg/L, 47.4 µg/L and 37.4 µg/L, respectively. Buffelspoort Dam was classified as **mesotrophic** based on its chlorophyll-*a* concentration being in the 10<x<20 range. The Total Phosphorus indicator in Bospoort Dam, Rietveli Dam, Hartbeespoort Dam and Roodekopjes Dam was in the >0.130 range, which indicates a **serious** potential for algal and plant productivity. Vaalkop Dam was in the 0.047<x<0.130 range with a mean Total Phosphorus value of 0.06 mg/L for the current year, indicating a significant potential for algal growth and plant growth, while Buffelspoort Dam and Olifantsnek Dam were found to have moderate potential for algal and plant growth.

A more comprehensive view of the two trophic status indicators for the past two decades suggests an irregular and seasonal trend in terms of the data patterns, as the fluctuations do not show constant regularity throughout the time series.



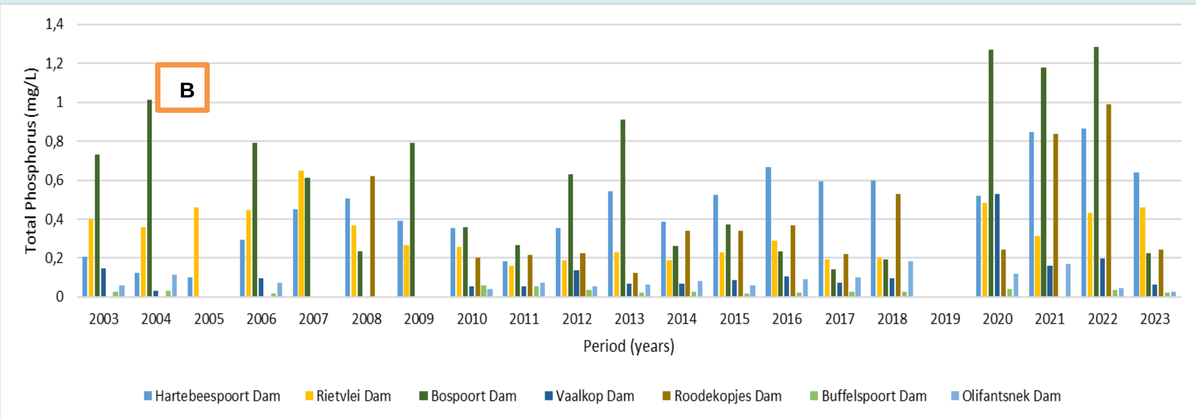


***Figure 1**. **A)** Chlorophyll-a and **B)** Total Phosphorus for the Hartbeespoort, Roodekopjes, Rietvlei, Buffelspoort, Bospoort, Olifantsnek, and Vaalkop dams.*

4.3.3 Microbial Pollution

The contamination of water resources by faecal pollutants poses significant risks to human and animal health since numerous pathogens are often associated with faeces. Microbial water quality measures the microbiological conditions of water 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. 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. The bacteria *E. coli* results are compared to the SA water quality guidelines as indicated in Table 4-3 to analyse potential microbial health risks.

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

	Potential health risks of using raw water		
	Low	**Medium**	**High**
Water use	***E. coli* counts/ 100mL**		
1. Drinking untreated water	0	1 - 10	> 10
2. Drinking partially 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
*Partially treated water is water that has undergone some form of treatment at the household level to remove or reduce contaminants but does not meet the standards for safe drinking water.			

The microbial quality of water for the current reporting period is determined based on the sampling of 43 hotspot sites in the country. Microbiological data collected from October 2022 to September 2023 (Figure 4.9) suggests that water at all 43 newly selected sites is unsuitable for drinking without treatment, as they all exhibit a high risk if consumed directly from the source. Treating water at the household level through methods such as boiling, filtration, or chlorination can help mitigate the potential health risks. However, 35% of the sampled sites still demonstrated a high risk associated with using the water even after undergoing limited treatment.

Furthermore, the findings indicated that 41% of the sites were unsuitable for irrigating crops intended for raw consumption, and 67% of the sampled sites were deemed unsuitable for recreational activities, posing a high risk of infection for individuals engaging in such activities. These recreational activities include full-contact activities such as swimming, washing laundry, and events like baptisms.

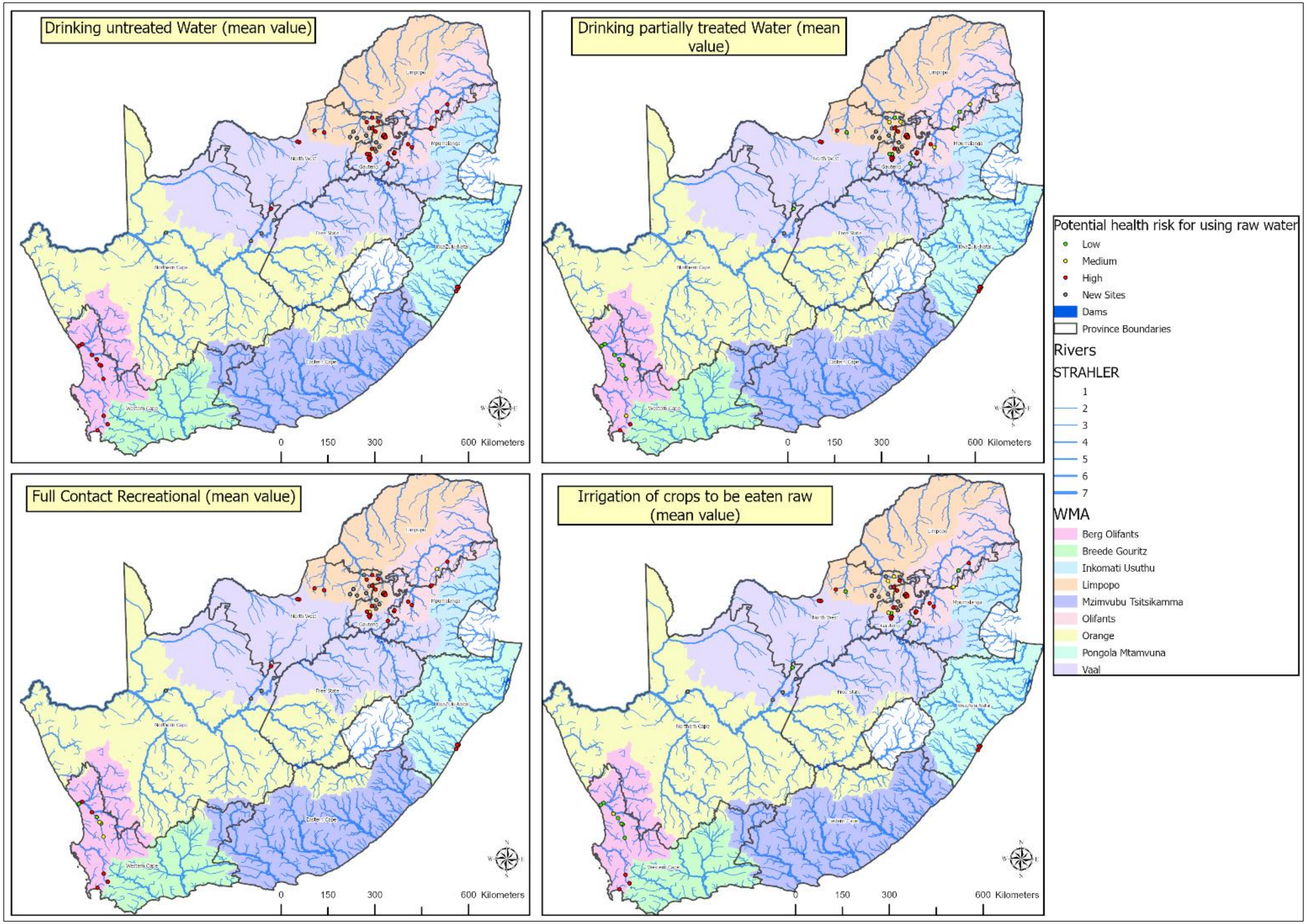


Figure 4.10 : Data representation of faecal pollution (October 2022 - September 2023)

4.3.4 Ecological Status

The riverine macroinvertebrates were assessed at 455 sites during the 2021/22 hydrological year using the Macroinvertebrate Response Assessment Index Version 2 (MIRAI v2). Some sites used other indices in addition to the MIRAI. The Riparian Vegetation Response Assessment Index (VEGRAI) was done at 212 sites, fish indices at 165 sites, the Index of Habitat Integrity (IHI) at 118 sites, and the Geomorphology Driver Assessment Index (GAI) at 46 sites. The Guidelines for interpreting River EcoStatus results are provided in Table 4-4, and the 2021/22 results are shown in Figure 4.11

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

ECOLOGICAL CATEGORY	GENERIC DESCRIPTION OF ECOLOGICAL CONDITIONS	GUIDELINE SCORE (% OF MAXIMUM THEORETICAL TOTAL)
A	**Unmodified/natural.** Close to natural or close to predevelopment conditions within the natural variability of the system drivers: hydrology, physico-chemical and geomorphology. The habitat template and biological components can be considered close to natural or 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

Figure 4.11 depicts the distribution and condition of macroinvertebrates monitored at various sites. The majority (272) of the country's sites, or approximately 60%, were moderately modified (C). Most river systems had moderately modified conditions as their dominant condition. The upper portions of the Crocodile West catchment are located in Gauteng's industrial and urban areas and thus are heavily impacted. The Jukskei River, Modderfonteinspruit Riverand Crocodile Rivers upstream of Hartbeespoort Dam, Hartbeesspruit just upstream of Roodeplaat Dam, the Apies and Hennops Rivers were all in very poor condition (D/E and E).

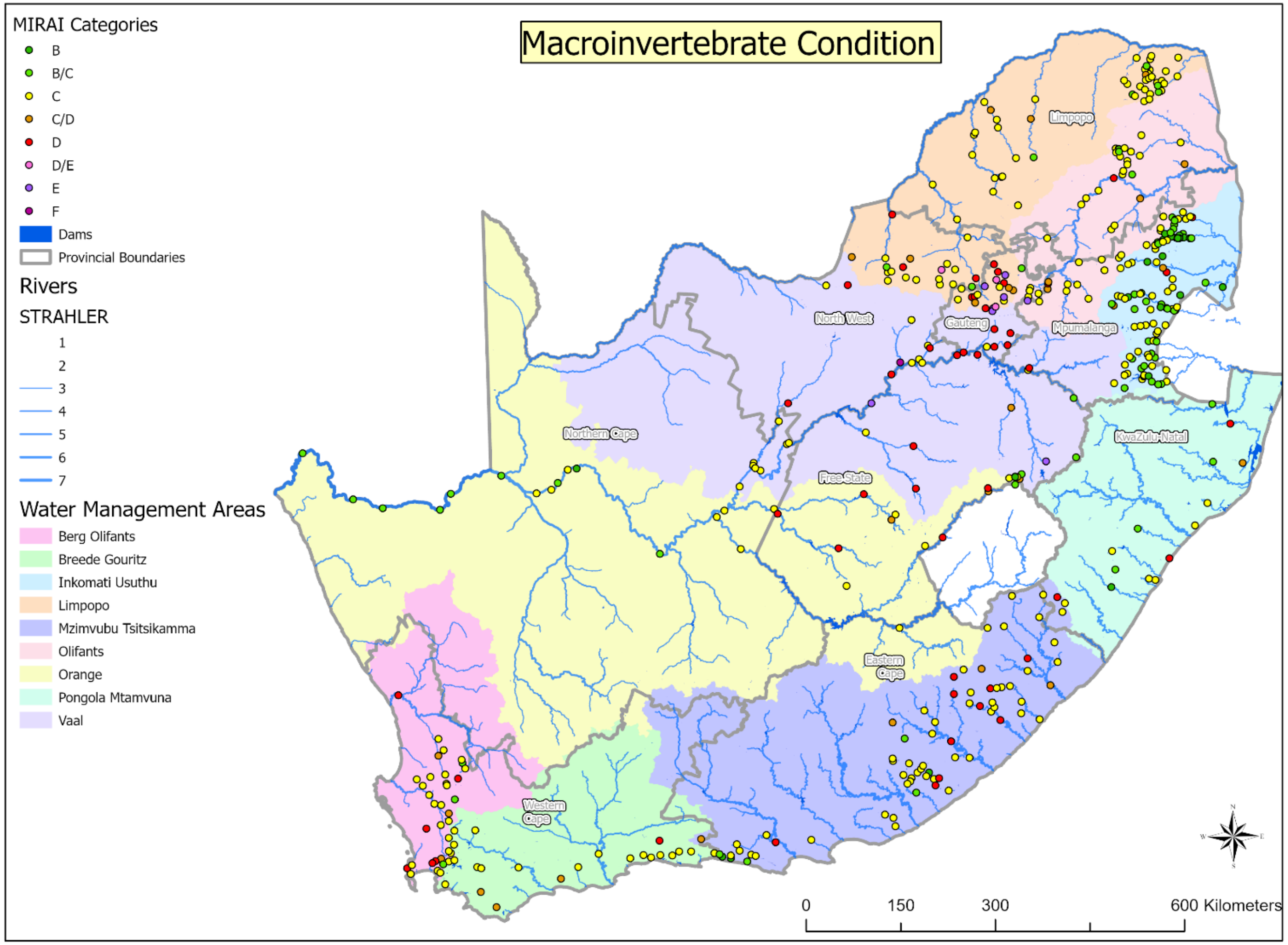


Figure 4.11: Summary of Ecological Categories reflecting the macroinvertebrate condition for selected sites monitored during 2021-2022 hydrological year. The colour of the circles indicates the Ecological Condition with green representing relatively good conditions (B and B/C) while the red and purple reflect relatively poor condition.

Figure 4.12 shows that the Sabie (20 sites), Komati (14 sites), and Usuthu (13 sites) catchments had a high proportion of sites in largely or nearly largely natural conditions (B and B/C categories). The remaining largely natural sites were either in the upper reaches closer to the source 4 (Magalies, Debengeni, Berg, and Breede-Gouritz sites), protected areas (Eerste, Klerkspruit, Perskeboomspruit, Glen Reenenspruit, Ribbokspruit), or rural areas (the former Transkei, Mkomazi, Mhlatuze, and Pongola catchments).

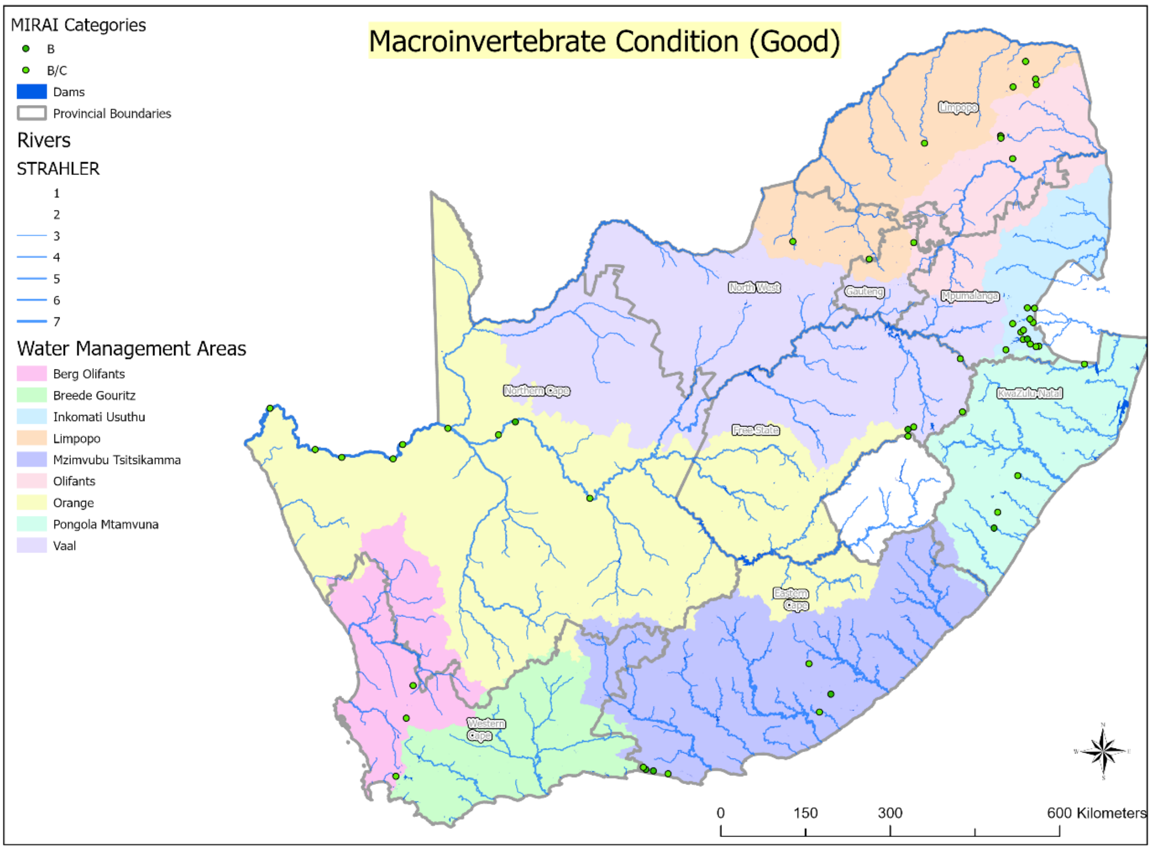


Figure 4.12: Monitored sites with good ecological condition.

The majority (85%) of the sites monitored in the 2021/22 hydrological year were also monitored in the previous years. The river condition trends depicted in Figure 4.12 show that approximately 57% of sites remained in the same category as the previous reporting period; most of these were sites in the C category. Sites in moderately modified condition (C category) seem to be resilient and not easily responsive to changes, maintaining basic ecosystem functions, provided the catchments around them are not subjected to severe disturbances. There was an improvement at 27% of the sites and a decline in ecological condition at 16%.

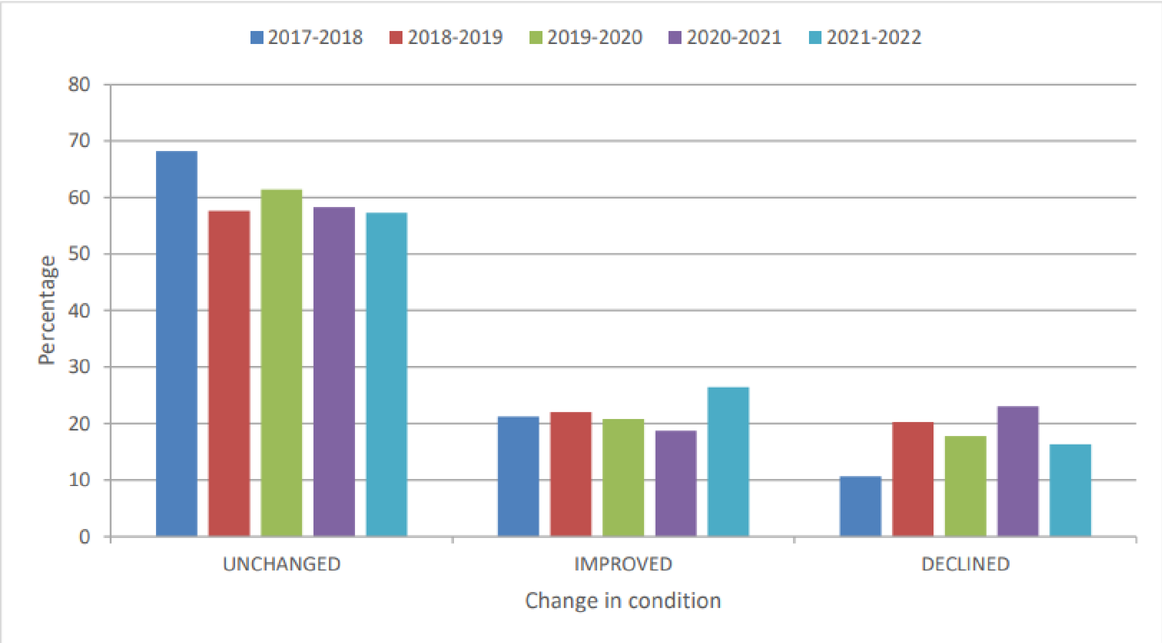


Figure 4.13: Trends of ecological condition at monitored sites