THE NATIONAL STATE OF WATER RESOURCES QUARTERLY REPORT JULY TO SEPTEMBER 2014

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Acronym

Cl	Chloride
DWA	Department of Water Affairs
EC	Electrical Conductivity
FSC	Full Supply Capacity Na Sodium
NCMP	National Chemical Monitoring Programme
NEMP	National Eutrophication Monitoring Programme
SAWS	South African Weather Service
SPI	Standardised Precipitation Index
WARMS	Water Use Authorisation and Registration Management System
WMA	Water Management Area

1 Introduction

The purpose of this report is to provide an overview of the state of water resources between July and September 2014. The data used in the report was sourced from the available Department of Water and Sanitation's (DWS) monitoring networks and systems. Additional climatic data and information was sourced from the South African Weather Service (SAWS) and the Agricultural Research Council (ARC). Data are analysed and interpreted to produce a synopsis of the water situation in the country. It is important to note that there are gaps in data due to various reasons of which the main reasons are that monitoring is not consistent and in some cases data are not uploaded onto DWS systems timeously or at all.

The report gives an overview relevant to our water resources for the quarter in terms of:

- Climatic conditions:
    - rainfall,
    - temperature,
- Water quantities:
    - surface water storage
    - groundwater levels,
- Extreme events experienced in the country:
    - floods,
    - droughts,
- Water quality:
    - Surface water,
    - Groundwater, and
- Current registered water uses.

The information presented in this report is aimed at informing the planning, management and decision making processes within the DWS. The report highlights areas of concern that might require immediate intervention. Moreover, this information is aimed at assisting regional managers in assessing and/or reviewing the effectiveness of the existing monitoring programmes. Feedback from users will also be used to improve future reports in terms of methods used, interpretation and content.

2. CLIMATE

2.1 Rainfall

This season is typically marked by dry winds and light drizzle. Precipitation in July was concentrated over the winter rainfall area and to a lesser extent also along the coastal regions and the adjacent interior. The interior was mostly dry. The rainfall distribution saw a drier July, where the entire country recorded zero to below 10 mm rainfall (Figure 2.1), thus experiencing rains extremely below normal, except for the Western Cape Province (Figure 2.2). In comparison to the same period in the previous year (Figure 2.2), an increase in rainfall occurrence was observed for August and September 2014.

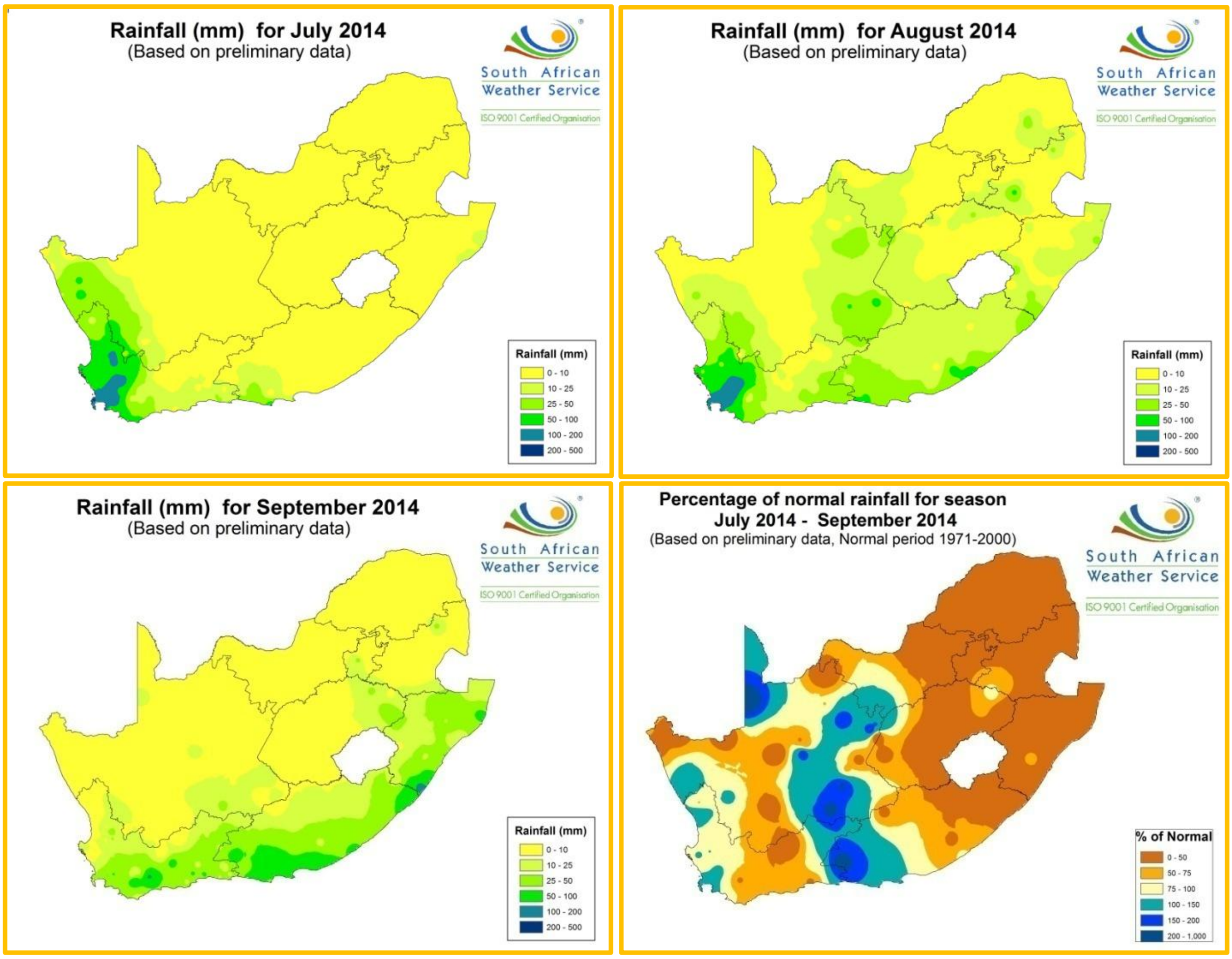


Figure 2.1: Rainfall distribution (mm) throughout South Africa, for the period July - September 2014.

The general outlook of the precipitation patterns for the quarter reveals that wet conditions only prevailed in the Western Cape, southern parts of the Eastern Cape and direct adjacent interior regions. The northern and entire eastern regions of the country experienced harsh torment of below average rainfall occurrences.

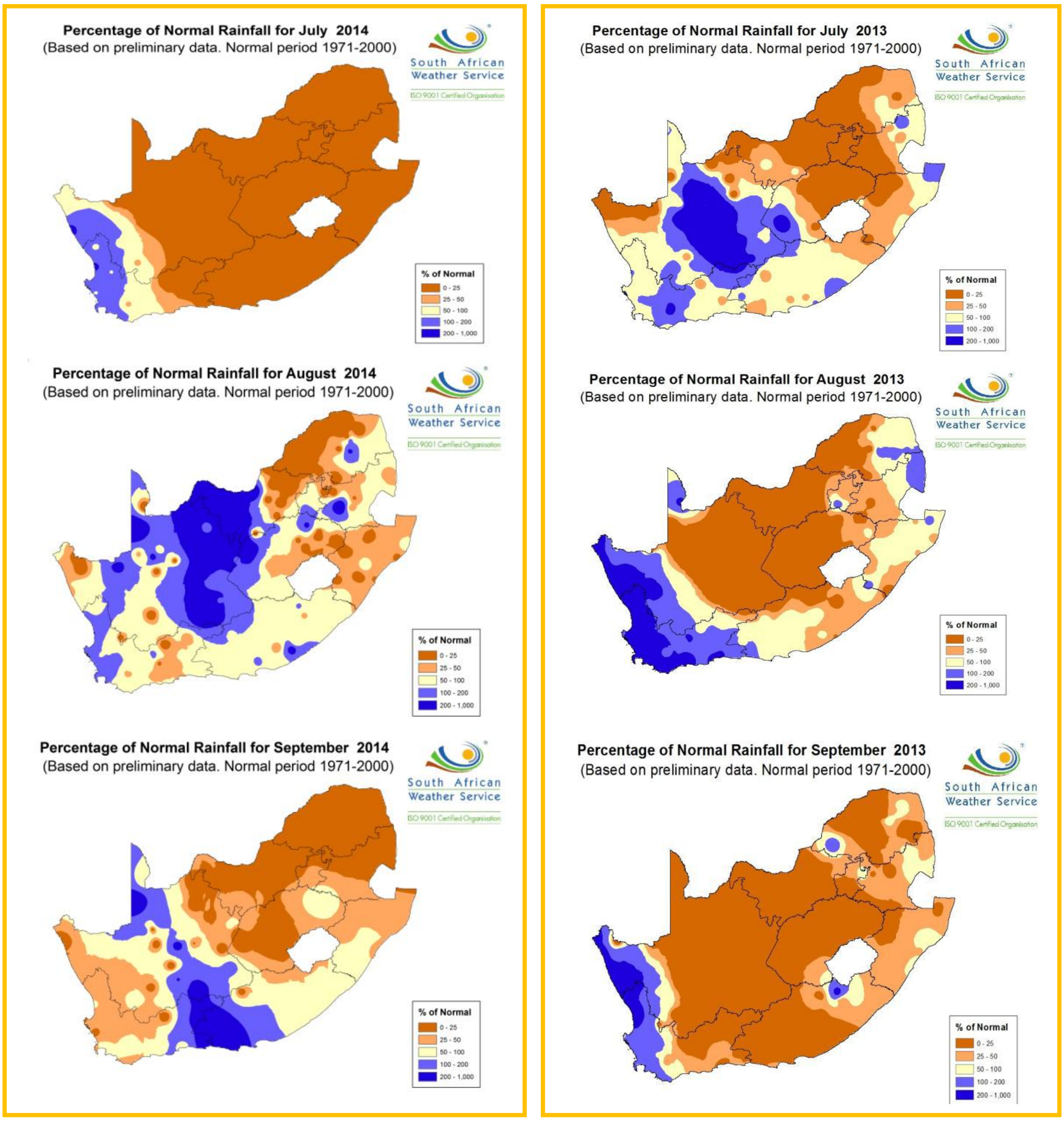


Figure 2.2: A comparison of percentage rainfall distribution throughout South Africa, for the periods July - September 2013 and 2014.

2.2 Temperature

Minimum temperatures over the interior remained relatively low, following the severe cold outbreaks during June (Figure 2.3). Frontal systems were responsible for a number of precipitation events over the winter rainfall area, spread fairly evenly throughout the month.

The forecasting system indicates above-normal minimum and maximum temperatures from late spring to mid-summer for most parts of the country, with the exception of the southern to south eastern coastal areas where below-normal minimum temperatures are forecasted (Figure 2.4). The quality of the minimum temperature forecasts, as measured by the Relative Operating Characteristic (ROC), is low for the larger part of South Africa. There is however some improvement for maximum temperatures with the eastern half of South Africa indicating good performance, especially for mid-winter (Figure 2.4).

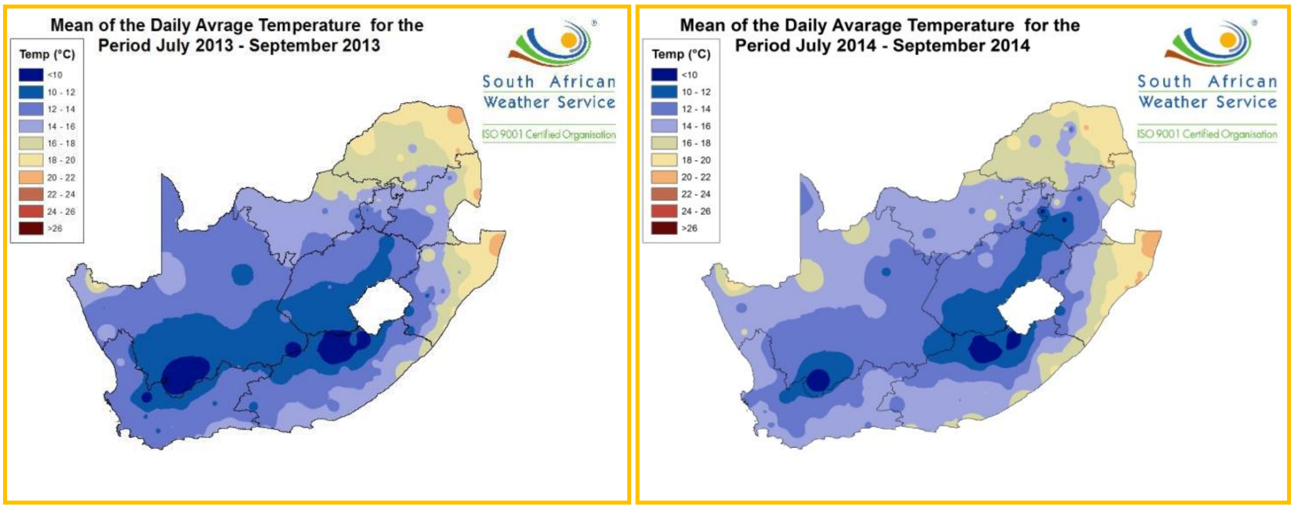


Figure 2.3: Mean daily temperatures for the period of July to September 2013 and 2014.

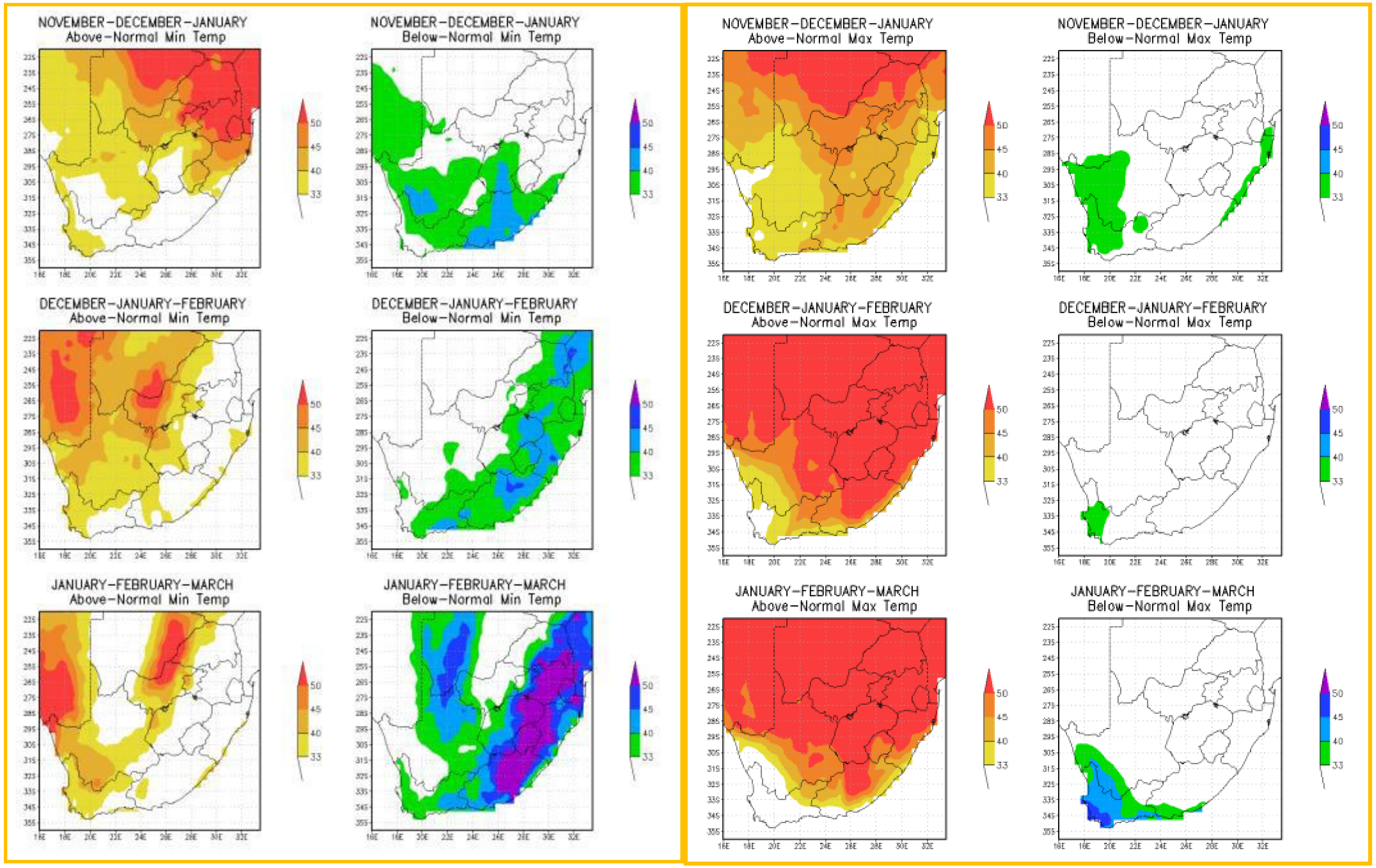


Figure 2.4: Probabilistic maximum (right) and minimum (left) temperature forecasts for the period of November 2014 to March 2015 (SAWS 2014).

2.3 Evaporative Demand

Potential Evapotranspiration was lower than forecasted during July and August. The lowest evaporation occurred over the south western parts of the country, where lower temperatures, cloudy periods and higher relative humidity, due to frontal systems moving across the area, resulted in lower evapotranspiration. In September the average daily evapotranspiration rate ranged from 2-3 mm per day over the southern parts and especially along the coast to more than 4 mm per day over the warmer and drier northern parts of the country (Figure2.5).

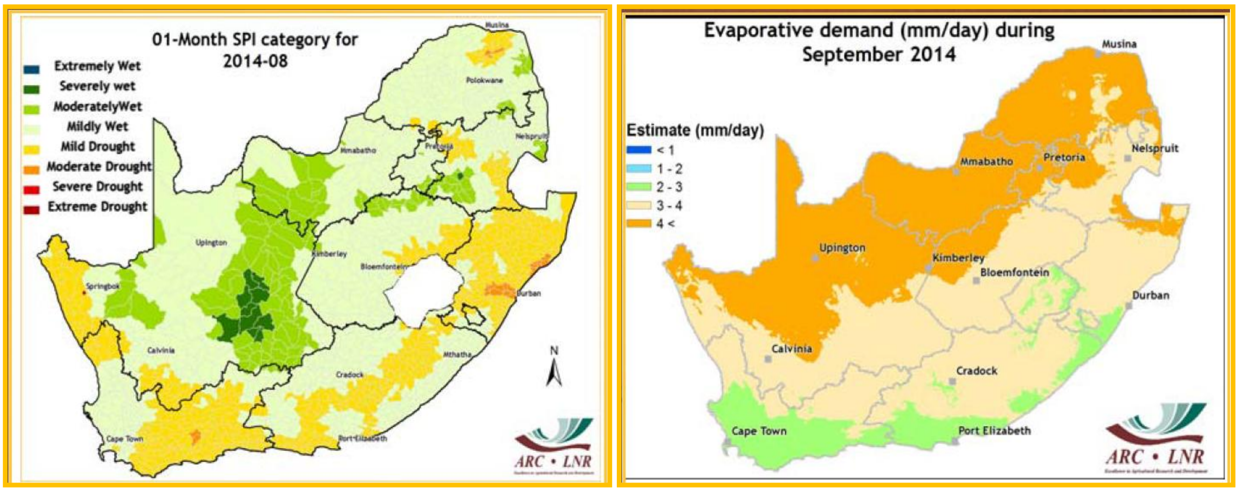


Figure 2.5: Illustration for the Evaporative demand August & September 2014 (ARC, 2014)

2.4 SURFACE WATER AVAILABILITY

2.4.1 Surface water storage

National dam water storage analysis outputs are presented in terms of the hydrological period and 2013/2014 hydrological year, which is compared with the historical hydrological record (Figure 2.6). The 2013/14 national storage is the 4th highest over the period for the past 9 years with 2010/11 being the highest. Storage percentages starting September were at 88.7% of full capacity and ended the month at 82% of full capacity – a net loss of 6.7 %, likely due to seasonal changes. National storages were slightly higher, despite low rainfall compared to the previous year. Figure 2.7 gives an overview of the status of national dam storage percentage. The Free State Province is experiencing very low to near normal storage percentages and as well as some of the dams in the Western Cape Province, despite good winter rainfall.

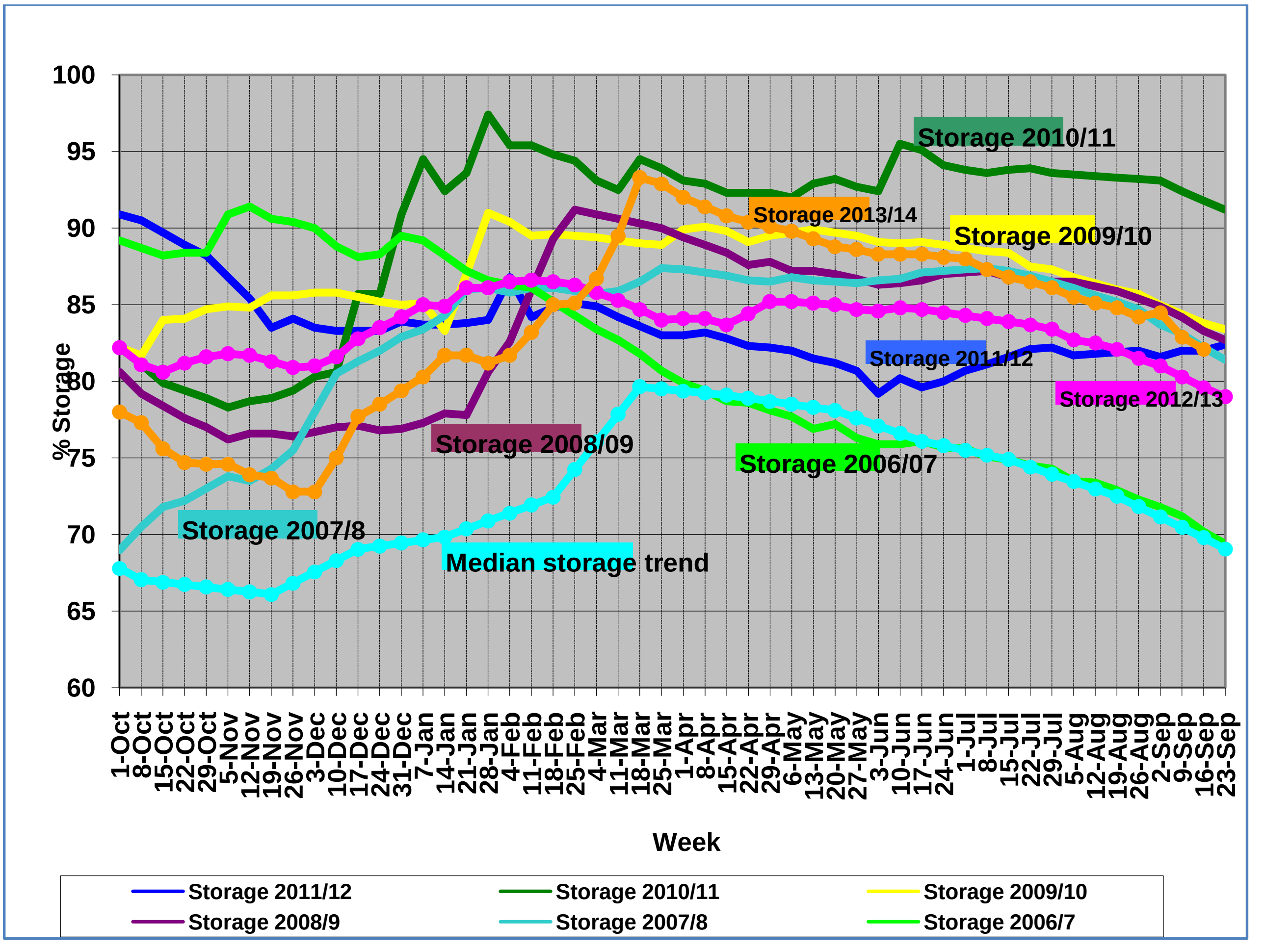


Figure 2.6: The national dam storage levels at end September from 2006 to 2014

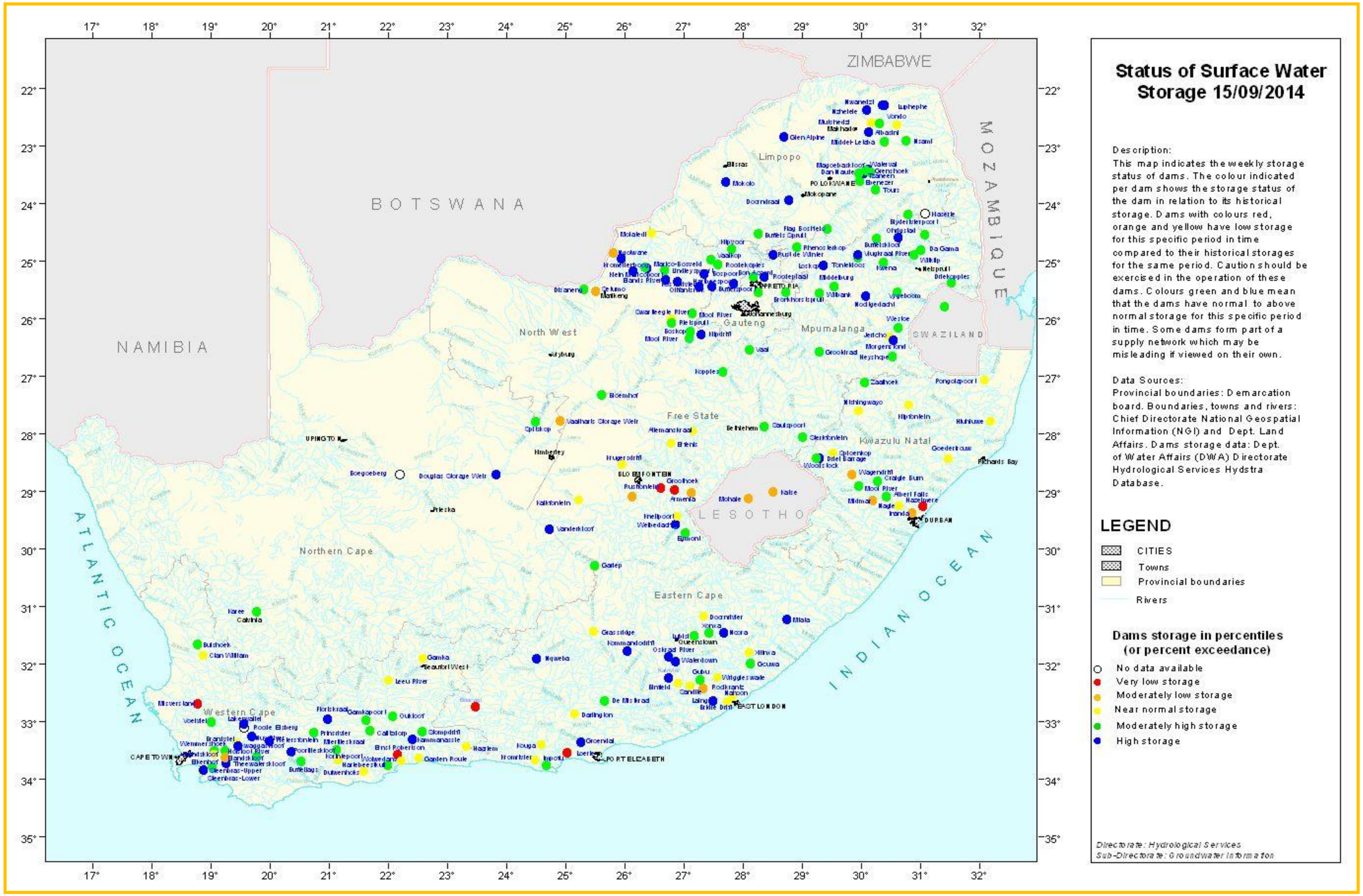


Figure 2.7: Status of surface water storage levels end September 2014

2.4.2 Provincial storage

The provincial storage levels as recorded at the end of September 2013 and 2014 are shown in Figure 3.3. In most provinces, the dam storage levels for the reporting period were slightly higher compared to the same period in the previous year. When comparing provincial storage as recorded at the end of June 2014 with the current reporting period (end September 2014), all the provinces experienced decreased storage percentages, except for the Western Cape where good winter rainfall occurred (Figure 2.8). The total water storage volume for the country as recorded at the end of September 2014 was 25 858 M m^3, which is 1173 Mm^3 more in comparison to the recorded volumes for September 2013 (24 685 M m^3).

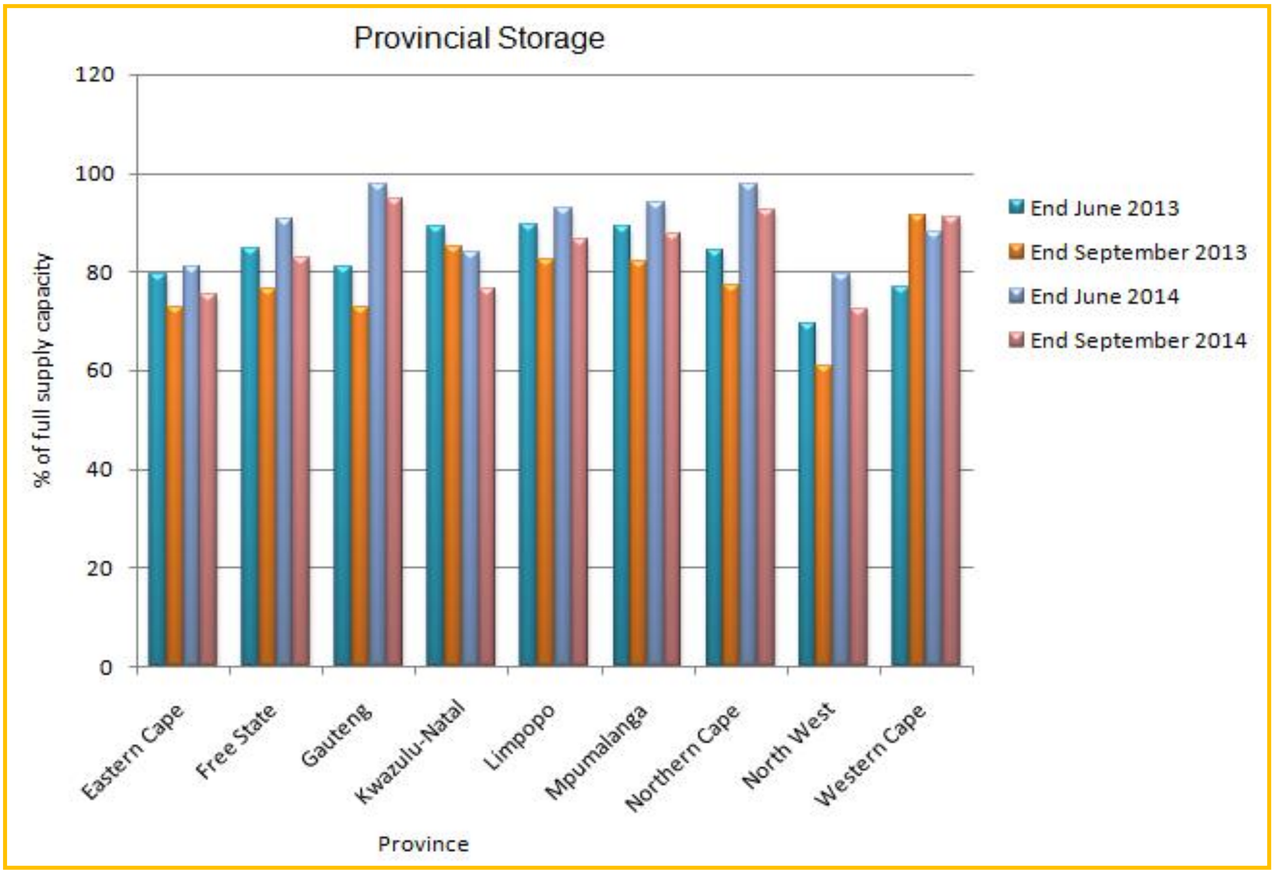


Figure 2.8: A comparison of provincial dam storage levels at end September 2013 and 2014

2.4.3 Water Management Areas storages

Storage percentages for the 19 Water Management Areas (WMAs) (Figure 2.9) is consistent with the provincial pattern for storage increases. Most of the WMA's have slightly higher storage percentage figures compared to the reporting period of the previous year, with the most increased storage percentages observed in the Middle Vaal and Crocodile West Marico WMAs. Comparing WMA storage percentages at the end of the previous quarter, with the current period it observed that storage have in general declined.

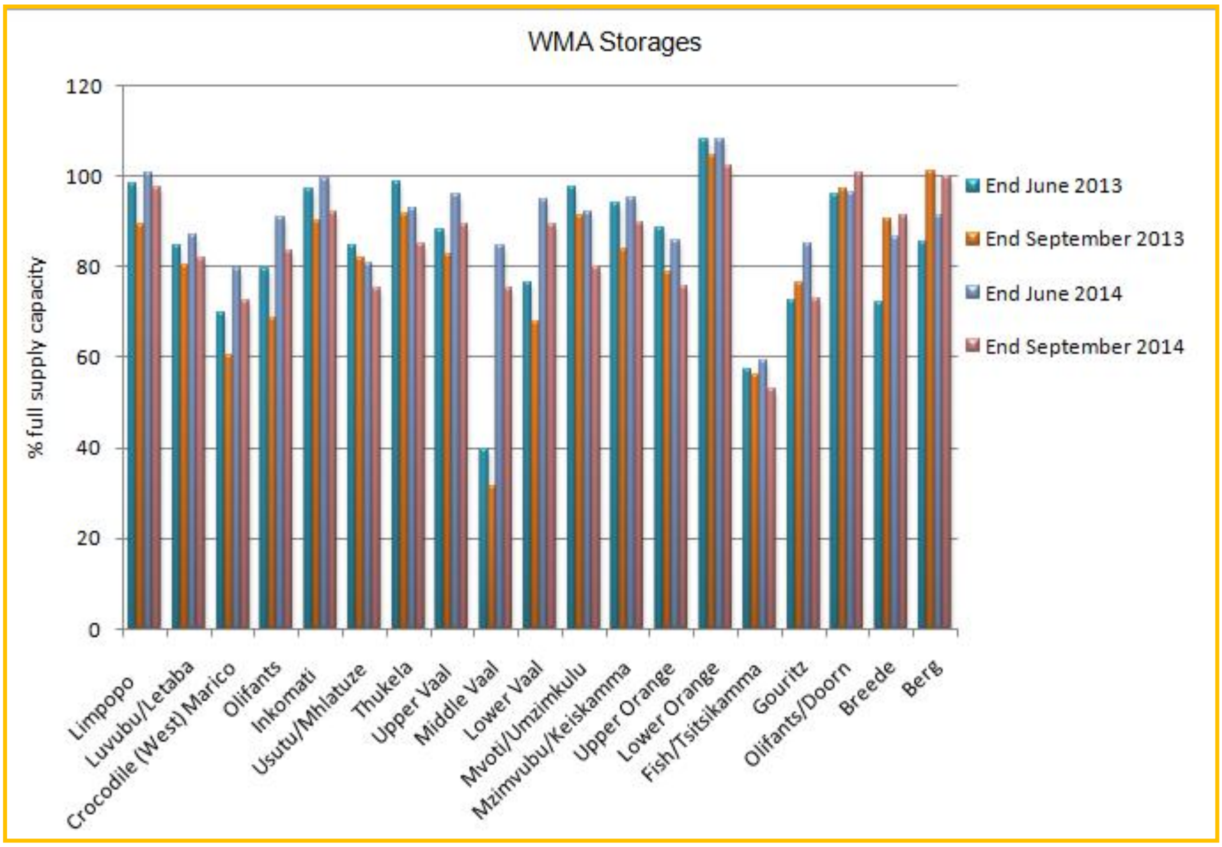


Figure 2.9: A comparison of dam storage levels per Water Management Area at end September 2013 and 2014.

2.4.4 Low storage

Although the rainfall distribution and the reservoir storage percentages have a positive outlook in the country, it appears that not all the storage dams benefited from high runoff. Most of the dams with low storage percentages were based in the Eastern Cape and Free State Provinces. Unsurprisingly so; the rainfall distribution as shown in Figure 2.1, presents how July and September 2014 were somewhat dry spell for those provinces in comparison to the rainfall received in some other parts of the country.

Dams in the North West, Middleburg in Mpumalanga and Bloemhof in Free State showed significant increase in storages during the reporting period (Table 2.1). This is a great improvement ompared to how they perfomed in the previous year; dams in North West and Free State were very low.

On the other hand, the Eastern Cape Province, which showed very high levels of storage the previous year presented a significant decline Table 2.2).

Table 2.1: Dams showing year on year increase in storage

Dam	River	Province	End September 2013	End September 2014
Nooigedacht	Komati	M	59.5	94.7
Middelburg	Little Olifants	M	28.4	86.7
Toleni	Toleni	EC	66.1	86.3
Ncora	Tsomo	EC	56.8	87.9
Oxkraal	Oskraal	EC	59.5	92.6
Kommandodrift	Tarka	EC	65.6	84.6
Prinsrivier	Prins	WC	11.9	22.3
Disaneng	Molopo	NW	44.1	81.3
Rietspruit	Rietspruit	NW	52.4	92.2
Lindleyspoort	Elands	NW	20.7	79.4
Koster	Koster	NW	32.3	94.1
Swartruggens	Elands	NW	29.8	99.2
Marico-Bosveld	Groot-Marico	NW	32.6	96.5
Olifantsnek	Hex	NW	38.1	88.2
Vaalkop	Elands	NW	51.7	80.7
Warmbad	Buffelspruit	LP	# 33.4	# 78.2
Glen Alpine	Mogalakwena	LP	57.6	95.9
Bronkhorstspruit	Bronkhorstspruit	G	59.2	91.5
Welbedacht	Caledon	FS	17.2	46.4
Egmont	Witspruit	FS	50.7	82.5
Bloemhof	Vaal	FS	32.5	86.5
Spitskop	Harts	NC	59.8	94.2

Table 2.2: Dams showing year on year decrease in storage

Dam	River	Province	End September 2013	End September 2014
Goedertrouw	Mhlatuze	KN	94.0	65.2
Mlanga	Mlanga	EC	82.4	57.6
Corana	Corana	EC	85.0	51.0
Gcuwa	Gcuwa	EC	97.1	69.3
Rooikrantz	Buffalo	EC	80.8	58.3
Nqweba (Van Ryneveldspas)	Sondags	EC	85.6	69.3
Ernest Robertson	Grootbrak	WC	99.6	42.2
Oukloof	Cordiers	WC	74.4	61.5
Fika-Patso	Namahadi	FS	70.0	55.9
Groothoek	Kgabanyane	FS	12.1	# 0.0
Rustfontein	Modder	FS	35.0	20.7
Kalkfontein	Riet	FS	43.3	26.4
Tierpoort	Tierpoort	FS	15.9	1.4

2.4.5 Restrictions

Observations on the storage performance provincially and as per WMA present a National picture where one could conclude that during the reporting period, storage levels were never a big problem. Indeed, with the storage improvements observed in most of the reservoirs, restrictions were never recommended nor imposed. However due to prevailing low rainfall conditions in the Eastern Cape and Free Stare, restrictions in the following municipalities were kept in enforcement:

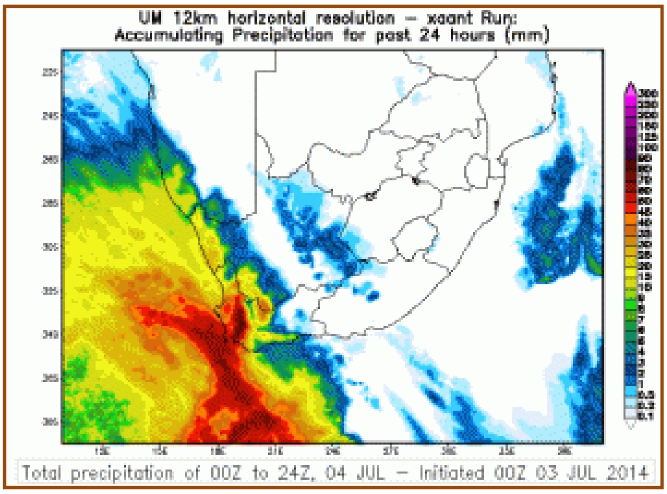
- Kgetleng Rivier Municipality which receives water from Koster Dam has permanant restrictions on domestic use (50 %) and on irrigation use (75 %). The users are subject to permanent restrictions due to over utilisation from the dam.
- The Algoa system to Nelson Mandela Bay Metro is also permanently under 10% restriction on domestic use due to infrastructural constraints to transfer water from the Orange River system. The infrastructural constraints have no impact on irrigators.
- 15% restrictions on domestic use and 50% restrictions on Agricultural were continuously imposed on the Mangaung municipality in Bloemfontein.

2.5 Extreme events

The extreme conditions considered in this report are floods and drought.

A strong cold front hit parts of the Western Cape in early July and later in the month. Heavy rains hit across the Cape Peninsula, Cape Winelands District, Overberg and the West Coast District, resulting in localised flooding also of the Cape Metropolitan areas.

High-lying areas of the Western Cape province experienced a little snow, also extending into mountainous regions of south of the Northern Cape province.



A prediction of 24 hour accumulated rainfall (mm) based on the SAWS' UM model (Red shades exceed 45 mm per day and indicate heavy rain).

A recorded wind speed of approximately 110km/h preceded cold temperatures over the Western, Eastern, and Southern Cape that eventually spread to the central parts of the country, KwaZulu-Natal and Gauteng. Due to the heavy rain, various areas across the Cape Peninsula were affected, mainly impacting on low-lying areas (SABC, 2014). The City of Cape Town assisted residents low-lying in areas with relief efforts. Reports estimate that 72 informal settlements (about 26 000 people) were quoted to have been affected due to the intense weather.

Low-lying areas affected by floods

Warnings were issued in the Eastern Cape as a large part of the province remained in an icy grip as the resultant temperature drop. On Friday 29 August, most mountain passes were closed and roads affected. Livestock also had to be moved to safe areas. Snow affected areas included Lady Frere, Hogsback, Dordrecht, Steynsburg, Lootsberg, Molteno, Elliot and Ugie.

Snowfall fell also in various parts of the country; in the Western and Eastern Cape, to southern Lesotho and the Drakensberg mountains in Kwazulu-Natal in areas (Drankensberg , Kokstad and Bergville) and the Southern Free State (Zastron). Weather predictions indicated very rough seas with waves in excess of 6m, predicted for the coastal areas (*SA Weather Services).* The storms was caused by a cut-off low pressure system

Heavy snow enveloped the Eastern Cape as temperatures plummeted. (SABC, August 2014)

3. SURFACE WATER QUALITY

Anthropogenic activities such as mining, irrigation, discharges from wastewater treatment works (WWTW) and industrial waste have a high probability of modifying the quality of both surface and ground water. The physical, chemical and biological water characteristics influence the ability of aquatic ecosystem to sustain their health. Freshwater bodies have a limited capacity to process the pollutants that enter the river and therefore cannot handle large loads of pollutants in the system. A severe impact on the quality of water may affect the aquatic ecosystems and in some cases human health. Some ecosystems are sensitive to small changes in water quality while others are resistant to large changes.

The major water quality problems facing the country are eutrophication, faecal pollution, salinisation and acid mine drainage (AMD). Malfunctioning and overloading of WWTW result in poor effluent quality, which introduce faecal pollution in the river system. The runoffs from irrigated land where fertilisers were used cause an increase in nutrients which result in eutrophication. Increasing nutrient enrichment may result in abundance of cyanobacteris or blue green algae which produce cyanotoxins. Closed mines are contributing to the problem of AMD. Polluted water contributes to high costs for treatmentwill also cost municipalities lots of money for treatment against pathogens, however the biggest a concern that the decision makers should be aware of is the health of

Microbial pollution, eutrophication and chemical analysis were conducted to assess the status of the country's surface water resources quality. Data used were mainly extracted for DWS databases.

3.1 Microbial Pollution

Faecal pollution is one of the water quality challenges the country is facing. The current microbial monitoring programme undertaken by DWS focuses only on hotspots and therefore does not reflect the current status in the whole country. The source of the problem is mainly from the discharge of untreated or poor quality effluent from waste water treatment works into the river system and runoffs from overflowing manholes. The works are not operating effectively due to lack of maintenance or sufficient capacity to treat increasing inflow of waste water into their systems. The malfunctioning or overloaded WWTW usually produce effluents of poor quality which is discharged into the river. In some cases the effluent is not even chlorinated although it presents with very high coliforms and *E. coli.* This introduces faecal contamination in the river water.

Figure 3.1 presents areas affected by faecal pollution based on the DWS monitoring programme. According to Figure 3.1 some areas in the North West, Gauteng, Western Cape, Limpopo and KwaZulu-Natal have a serious problem of faecal pollution.

Water users may be exposed to health risks if they use contaminated water for direct drinking from the resource; full-body contact recreation; irrigation of crops that will be consumed raw (uncooked and unwashed; and the ingestion of partially treated water with no disinfection. According to Figure 3.2 drinking untreated water poses a health risk in areas such as the, Gauteng, Mpumalanga, North West, and Limpopo Province. It should be noted that the results as indicated on Figure 2.2 do not represent the whole country as these were the main hotspots that the DWS decided to focus on. The high health risk is due to faecal contamination in the area, which is mostly originating from defunct sewage works. In some areas waste water is treated but not effectively as per design specifications and therefore still poses a risk of using the water for drinking.

There is also a risk that contaminated water can impact on agriculture, mostly in irrigated crops. The quality of water used by farmers for irrigation purposes can have a detrimental impact to the quality of the crops they produce. Majority of the farmers in the country, especially small scale farmers, draw water for irrigation from nearby rivers and streams without knowing the level of microbial pollution level. Irrigation with faecal coliforms polluted river water has a high probability that fruit and vegetables can become contaminated with pathogens. Figure 2.2 also indicates the areas that are at high health risk if eating raw crops and using water for recreation subject to microbial water contamination. Therefore, scrutinizing microbial contamination on permanent basis should be an important component of the protection strategy in these areas. Farmers using river water for irrigation from these areas as indicated on Figure 2.2 should be made aware of the risks it poses for their crop production and health.

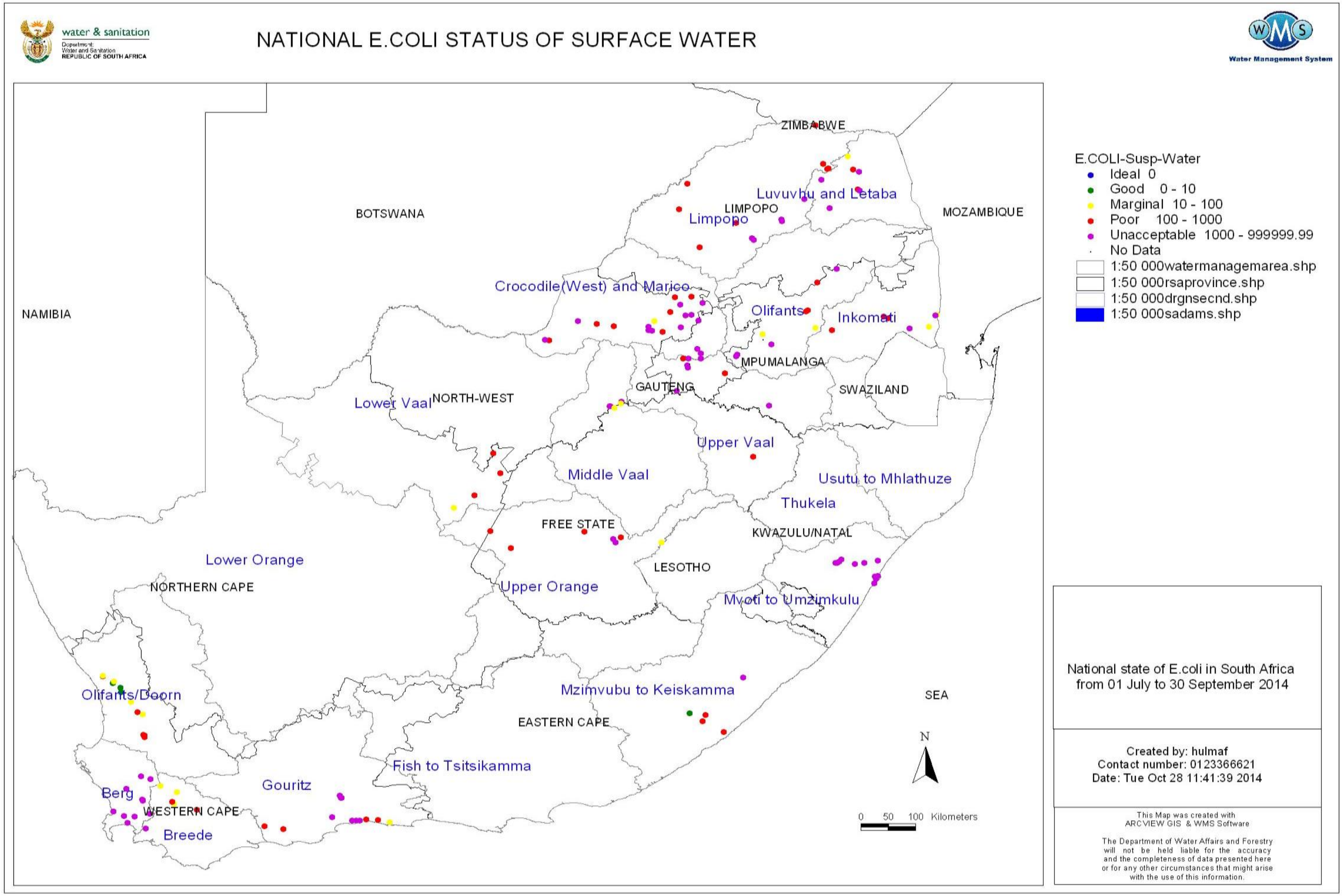


Figure 3.1: The status of *E. coli* in hotspots areas

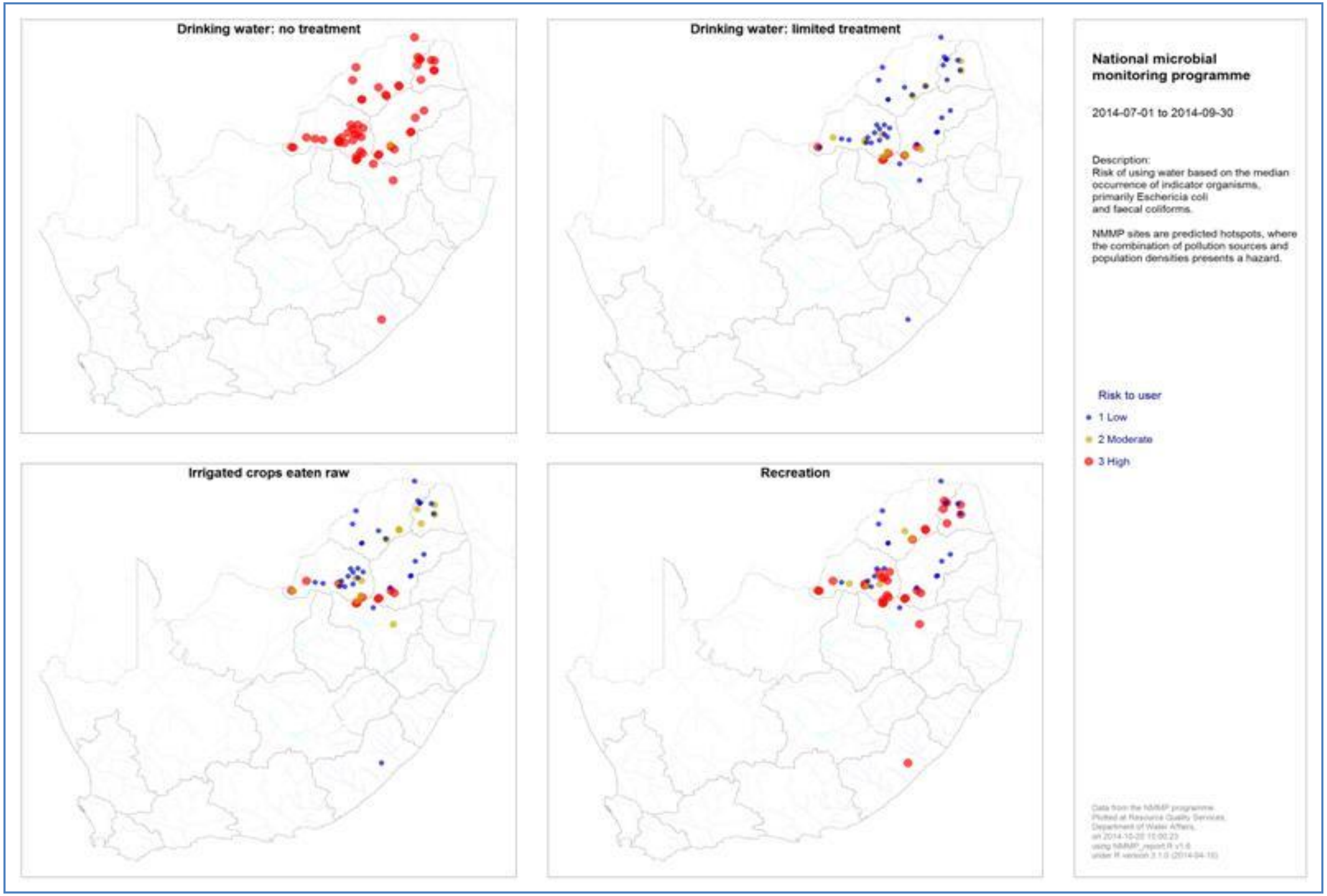


Figure 3.2: Levels of risks for use of water contaminated with E Coli organisms

In the Vaal WMA the Soweto area is the most affected by faecal pollution. The status of *E. coli* in the areas are very high on all four users. Figures 3.3 and 3.4 show the status of faecal pollution in Eldoradopark at Road Bridge and Goudkoppie on the Klipspruit. In the Giyani the WWTW has been impacting the over the past ten years but things have improved in the past two years (Figure 3.5). In the Olifants WMA, Kwaguqa on the Brugspruit downstream Ferrobank WWTW is impacted seriously (Figure 3.6). The water runs down and is abstracted for Water Treatment Works for water supply. Figure 3.7 shows the status of faecal pollution in Naauwpoort downstream of Naauwpoort WWTW on the Noupoortspruit.

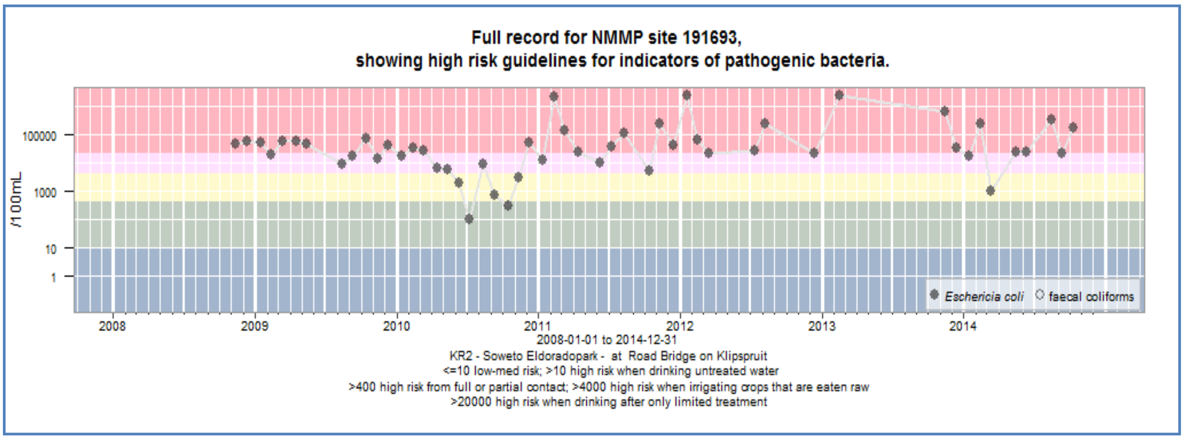


Figure 3.3: The status of faecal coliforms in Eldoradopark at Road Bridge on Klipspruit

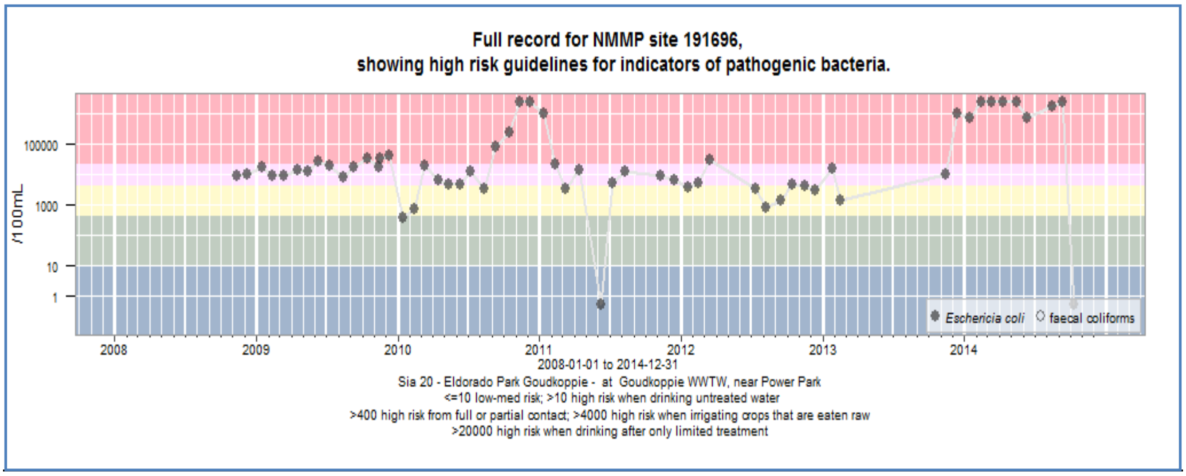


Figure 3.4: Eldorado Park, Goudkoppie at Goudkoppie WWTW near Power Park

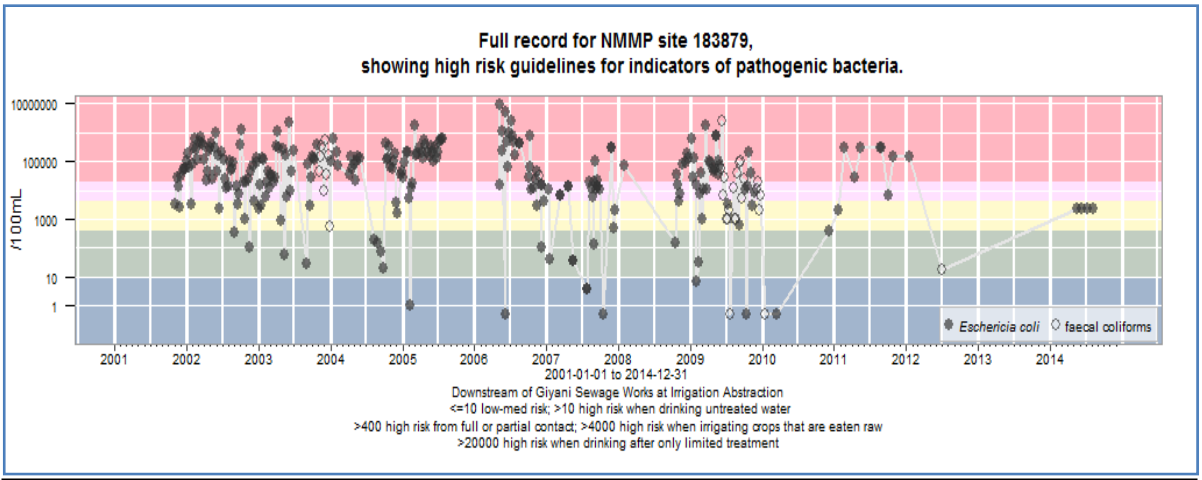


Figure 3.5: The status of faecal pollution downstream of the Giyani WWTW

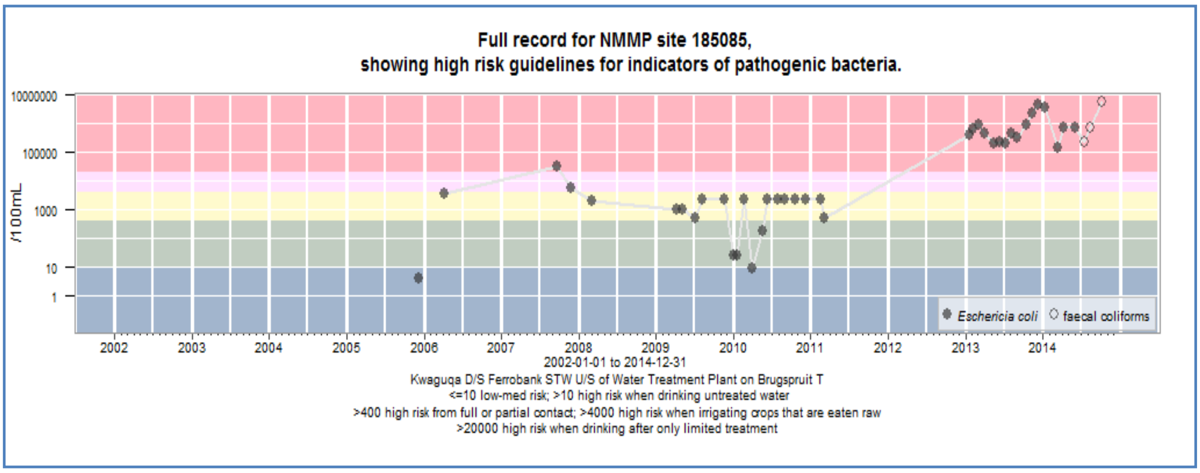


Figure 3.6: The status of faecal pollution on the Brugspruit downstream Ferrobank WWTW

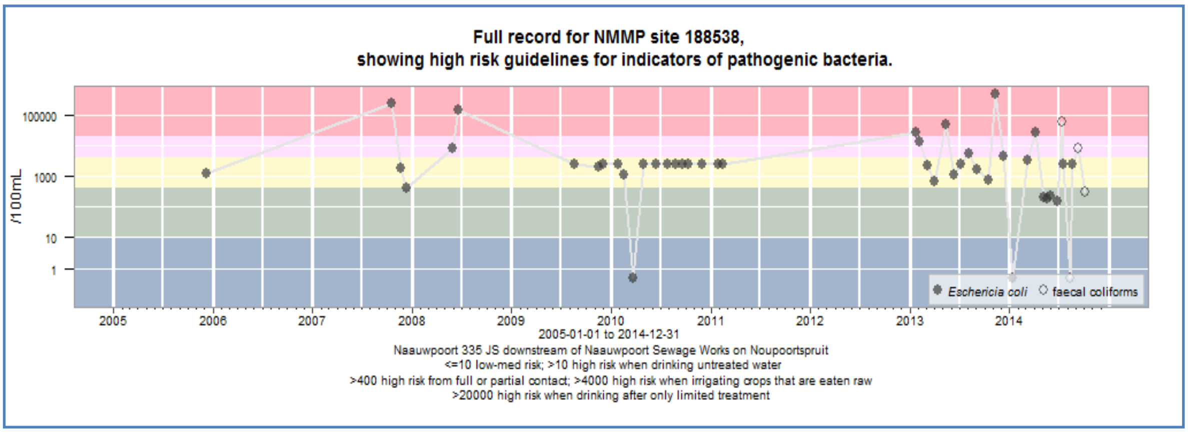


Figure 3.7: The status of faecal pollution in Naauwpoort downstream of Naauwpoort WWTW on the Noupoortspruit

3.2 Eutrophication

One of the main problems in water quality is nutrient enrichment in freshwater resources. High nutrient concentrations are the result of cultural and natural influxes of nutrients and may be due to irrigation return flows that contribute to the nitrogen and phosphate loads in rivers and or untreated sewage that overflows into rivers that contribute to increased nitrogen loads and bacterial pollution. Figure 3.8 shows the nutrient cycle within the water system, the causes and consequences of nutrient enrichment. Excessive nutrient loads in river systems can lead to occurrence of toxic and unsightly algal blooms. Eutrophication is the process of nutrient enrichment and the excessive plant growth in water bodies. It can lead to water quality deterioration, algal toxin production, taste and odour problems, oxygen depletion, decline of more desirable fish species, the clogging of waterways. It can also affect flocculation and chlorination processes in water treatment plants.

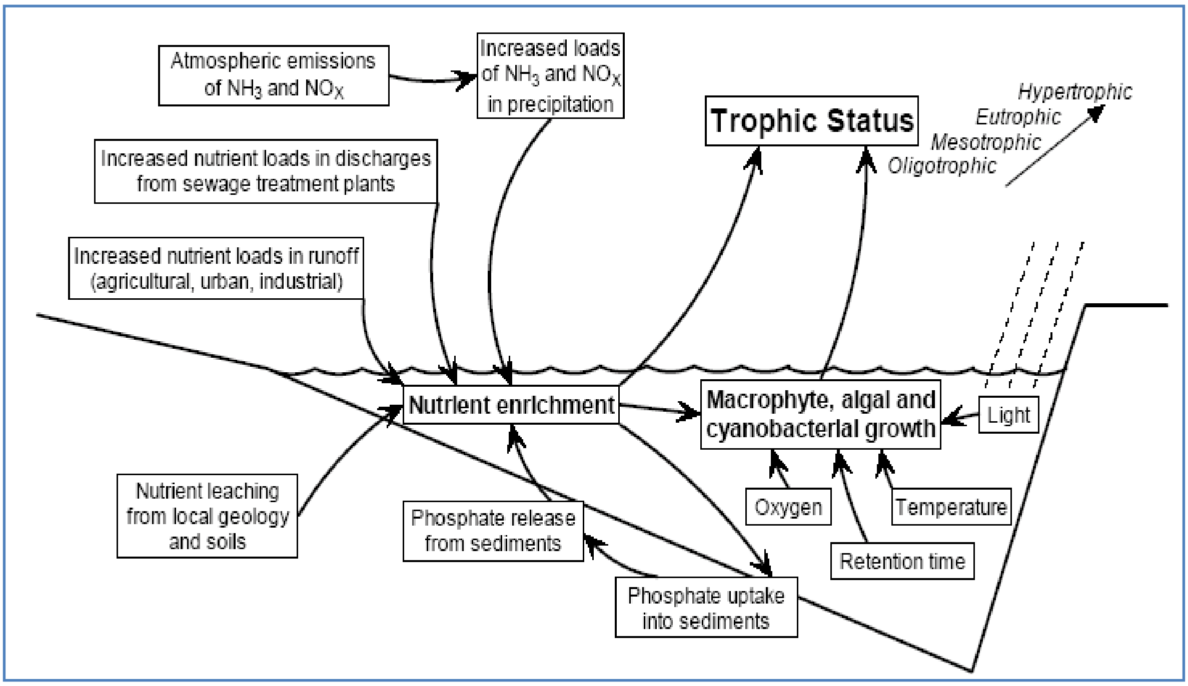


Figure 3.8: The nutrient cycle within a water system, causes and consequences of eutrophication (DWA, 2002).

Eutrophication is a serious problem in a number of catchment areas in the country. Although dams such as Haartebeespoort and Rietvlei are having special attention to deal with the problem, it appears the current strategy is not working well as the problem continues unabated. During this period Roodekoppies is the most affected dam during this period as it presents with very high levels of Chlorophyll a. The Roodeplaat Dam has moved from eutrphic to hypertrophic status. Table 3.1 shows the status of dams during the reporting period. The table has been created from data provided by the Eutrophication Monitoring Programme and therefore does not cover all the dams.

Table 3.1: List of Dams affected by eutrophication

<table>
<tr><th>Dam</th><th>River</th><th>Previous trophic status</th><th>Current Trophic Status</th></tr>
<tr><td>Roodekoppies</td><td>Crocodile</td><td rowspan="6">Hypertrophic</td><td rowspan="9">Hypertrophic</td></tr>
<tr><td>Rietvlei</td><td>Hennops</td></tr>
<tr><td>Juskei D/S Bruma Lake</td><td>Juskei</td></tr>
<tr><td>Klipvoor</td><td>Pienaars</td></tr>
<tr><td>Bospoort</td><td>Hex</td></tr>
<tr><td>Hartebeespoort</td><td>Crocodile</td></tr>
<tr><td>Roodeplaat</td><td>Pienaars</td><td rowspan="2">Eutrophic</td></tr>
<tr><td>Bronkospruit</td><td>Bronkospruit</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

3.3 Salinisation

Salinity is a measure of the content of salt in water. In South Africa, freshwater ecosystems are threatened by increasing salinity in rivers. The salinization of the country freshwater resources is a significant water quality problem and need to be addressed seriously. In freshwater ecosystems this may be caused by anthropogenic processes such as agricultural runoff, mainly due to fertilizers and flow regulation causing the accumulation of salt downstream. Mining and industries are other land based activities contributing to salinity in rivers across the country. Electrical Conductivity (EC) is used as an indicator to measure salt content in surface water.

According to Figure 3.9 the southern coastal parts of the country present with unacceptable high EC levels which indicate high salinity. In the Western Cape where there is intensive agricultural activities such as citrus and grapes, use of fertilizers is extensive. This could be contributing significantly in salinisation of rivers such as Sout and Berg Rivers in the area. There is also high possibility that accumulation of salt may be due to natural processes such as salty sea water intrusion inland and geology in the area. Interestingly, areas that are affected by defunct coal mines that discharge wastewater high in salt content into rivers do not show any form of salinity.

High amount of salt in water pose a hazard for the environment including biota. It can also destroy the structure of soils and those affected soils may reduce crop yields. It is usually common that exposure to high salinity results in depletion of biotic reservoirs as a result of low reproduction cycle on aquatic organisms.

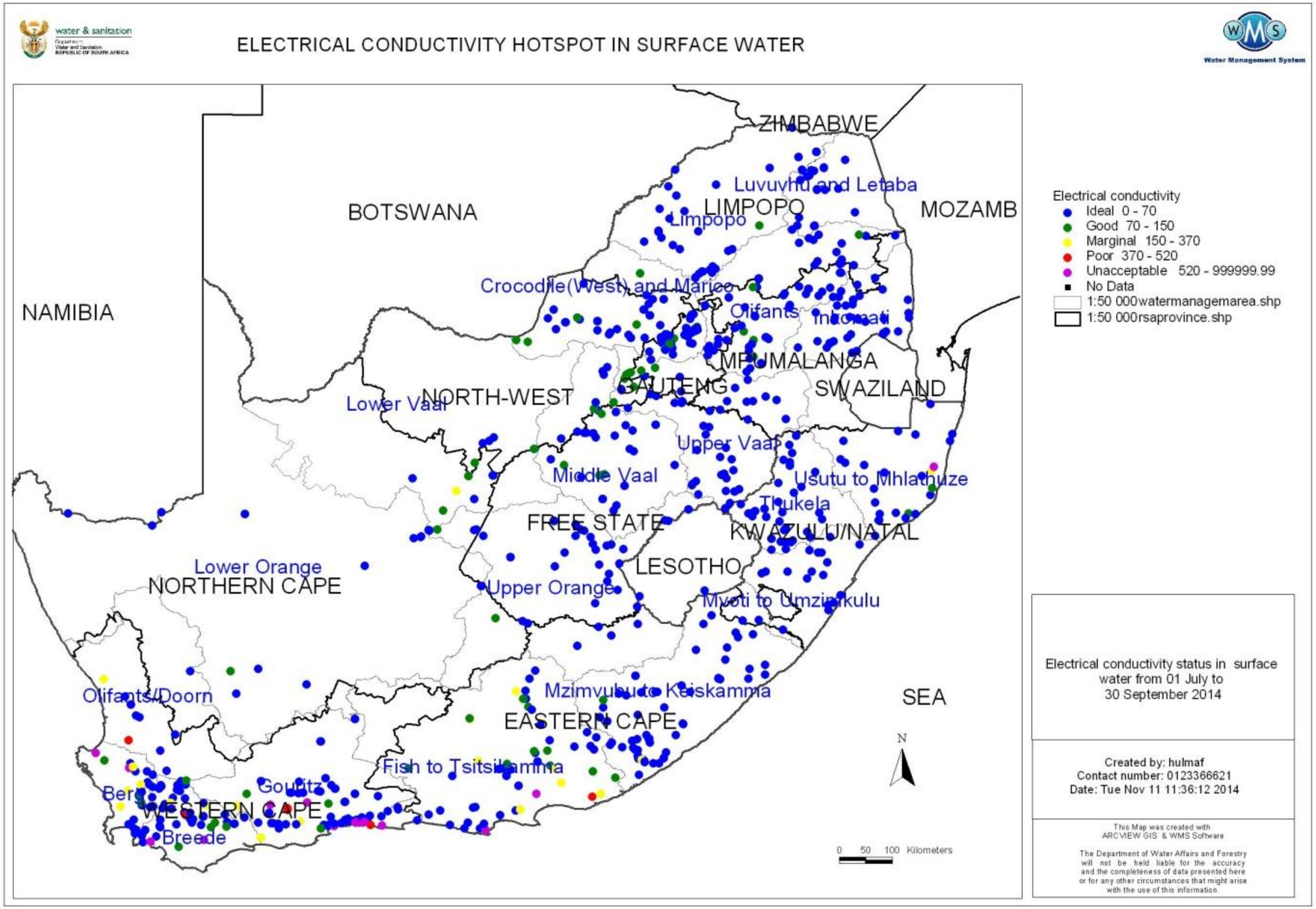


Figure 3.9. Distribution of Electrical Conductivity in surface water from 01 July to 30 September 2014.

4 GROUNDWATER

This reporting period was preceded by a dry winter season over most parts of the country, except the Western Cape which falls under the winter rainfall season and the southern Cape which receives rainfall throughout the year. Groundwater levels are expected to have declined further from the preceding dry quarter in the summer rainfall regions, whilst minor recharge is expected for the winter rainfall region. No major groundwater quality changes are expected generally, except in a localised scale where mining and industrial activities are taking place, and where wastewater is not properly managed.

4.1 Groundwater levels

The number of active stations used to monitor groundwater levels is shown on the map presented as Figure 4.1. It should be mentioned that some stations are no longer active due to various reasons, including vandalism and theft. It is unfortunate that the KwaZulu-Natal Province has so few groundwater monitoring stations in the national system and yet there are extensive forestry plantations (Eucalyptus), including agriculture irrigation and coal mining which already impact the resource.

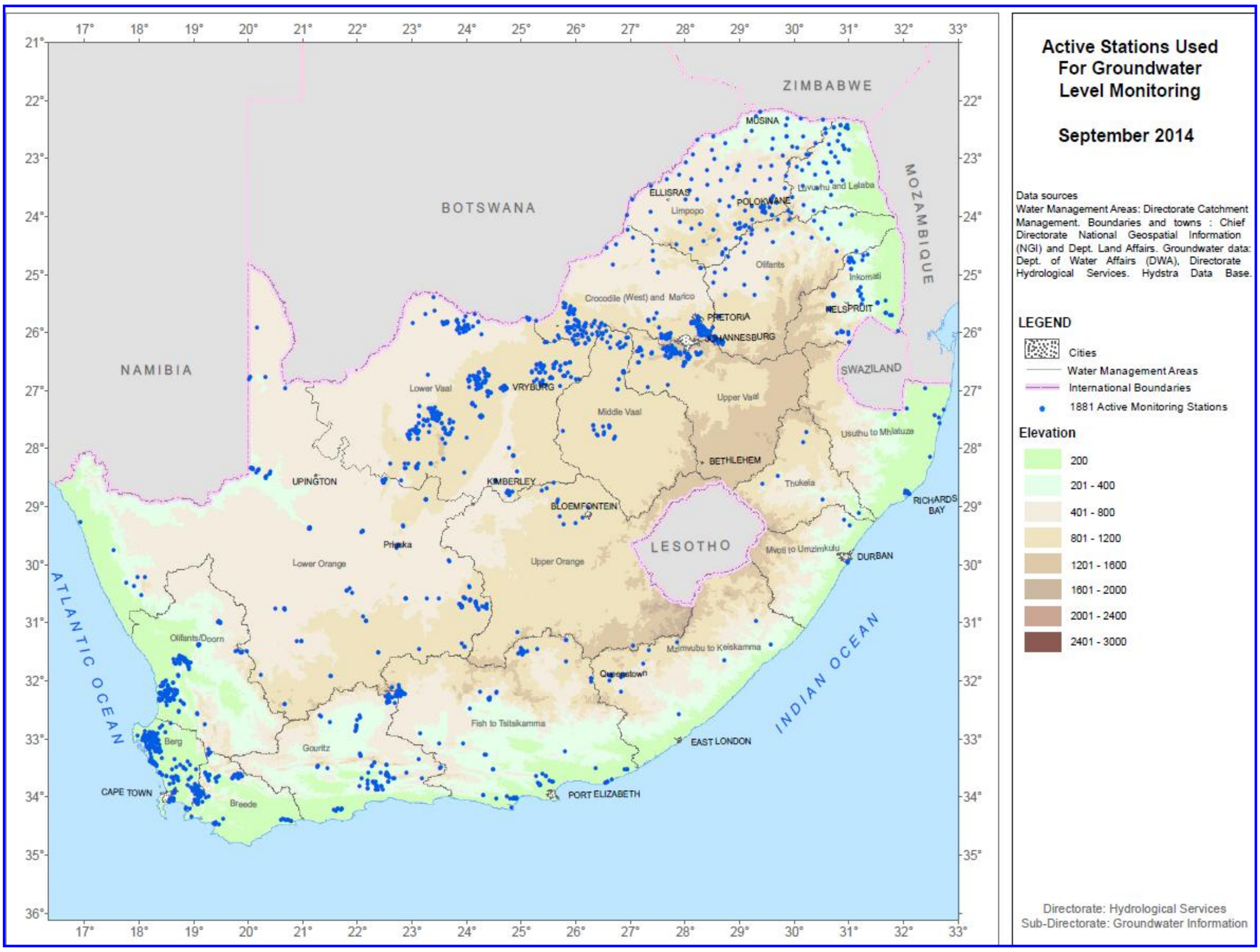


Figure 4.1: Active groundwater level monitoring stations as at September 2014

During this quarter, according to the Standardised Precipitation Index, the western winter rainfall areas experienced normal to above-normal precipitation conditions, while the rest of the country, especially towards the east and south, experienced a dry to extremely dry winter. An area to highlight would be the Uitenhage Artesian Basin which is normally recharged during this period but recorded a decline of about 0.35 m in water levels since May 2014 (see Figure 4.2), these levels are lower compared to the same period last year.

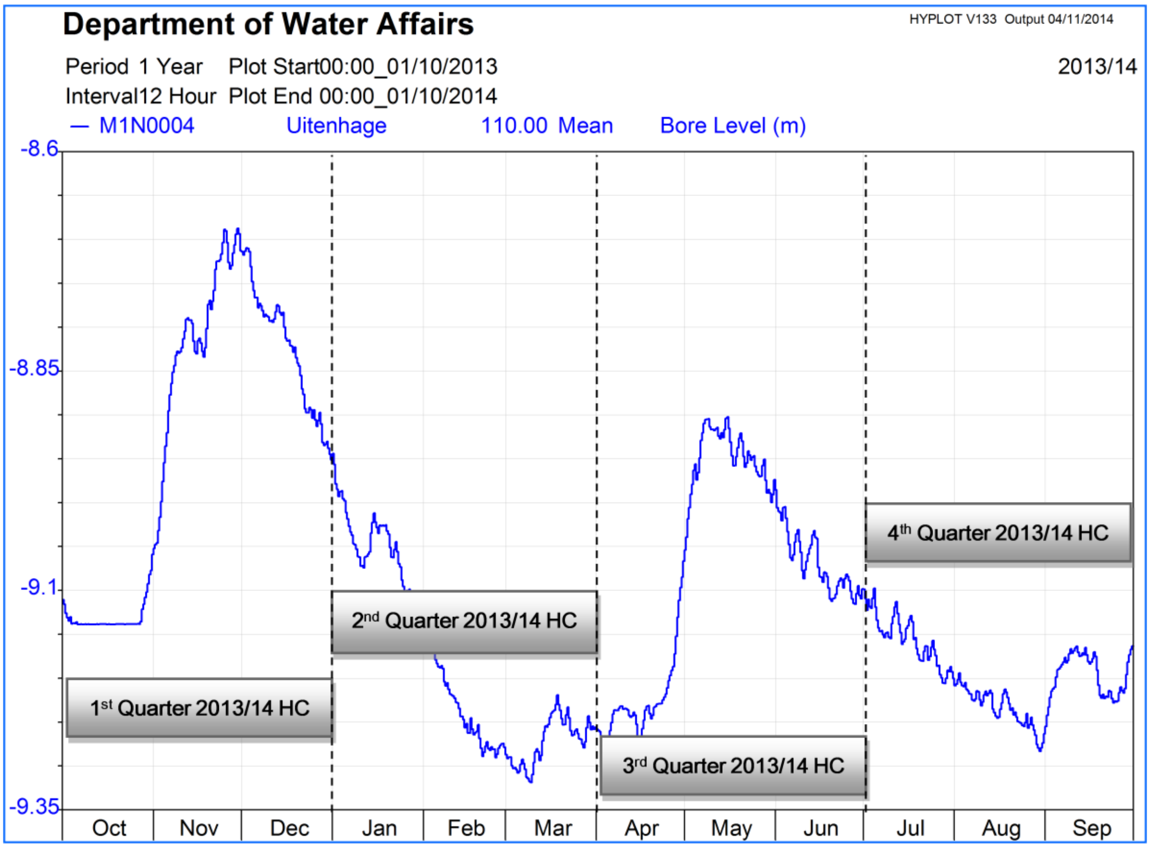


Figure 4.2: Groundwater level response at M1N0004 monitoring site of the Uitenhage Artesian Basin

The highlighted land-based activities in KwaZulu-Natal Province could impact the groundwater levels coupled with the long term gradual declining trend currently being experienced in this Province.

Limpopo Region reported that 67% of groundwater levels monitored are currently higher compared to the same period last year, and in comparison to historical levels the current groundwater levels are well above the level of concern. However, local deviations from the general trend are present in some places due to over-abstraction and/or a combination of factors.

Karstic aquifers, especially in the North West Province, have been declining due to over-abstraction mainly for irrigation and for water supply services e.g. Maloney's eye in Mafikeng.

The general national groundwater level trend is a gradually declining one (over the past season or over the past 5 years, 10 years – if it is more than seasonal, it is a concern!); however, it is not course for concern yet since this is regarded as a long term cycle which could be stabilised in the coming seasons of the near or distant future.

4.2 Groundwater quality

Due to the much slower flow conditions of groundwater in comparison to surface water, the quality response of groundwater is assessed as a long-term process, with observations commencing in 1993. The groundwater quality, based on the salinity is reasonably stable with slight seasonal variations. Poor water quality however, is expected in areas affected by mining and industrial activities, especially on a local scale (see mining impact example on Photo 1).

During this reporting period, based on the Electrical Conductivity map in Figure 4.3, the quality was reasonably stable with slight variations. Generally, the quality ranged from marginal to good, with isolated cases of poor conditions. Although there are cases of deteriorating groundwater quality, the trends are generally stable across the country.

The Fish to Tsitsikamma WMA however, has consistently shown poor and unacceptable EC concentration levels from certain boreholes. This could be attributed mainly to salt-water intrusion in coastal aquifers and to some extent, agricultural activities.

There are concerning cases of localized pollution in some parts of the country, e.g. the northern sub-catchment of the Lower Orange, i.e. the Nossob and Auob systems flowing from Namibia. The poor water quality in these remote parts of the Northern Cape is a natural occurrence. Groundwater with in particular high EC, in some places high nitrate and high fluoride is the result of old aquifers that is not recharged regularly. The long term contact of groundwater with the host rock, without the inflow of recent recharge allows for exchange of cations and anions present in the host rock with water. These reactions result in increased EC concentrations as well as increase in concentrations of the other constituents (present in the host rock) mentioned.

Photo 1: AMD impact resulting from abandoned coal mines in Vryheid KZN Province

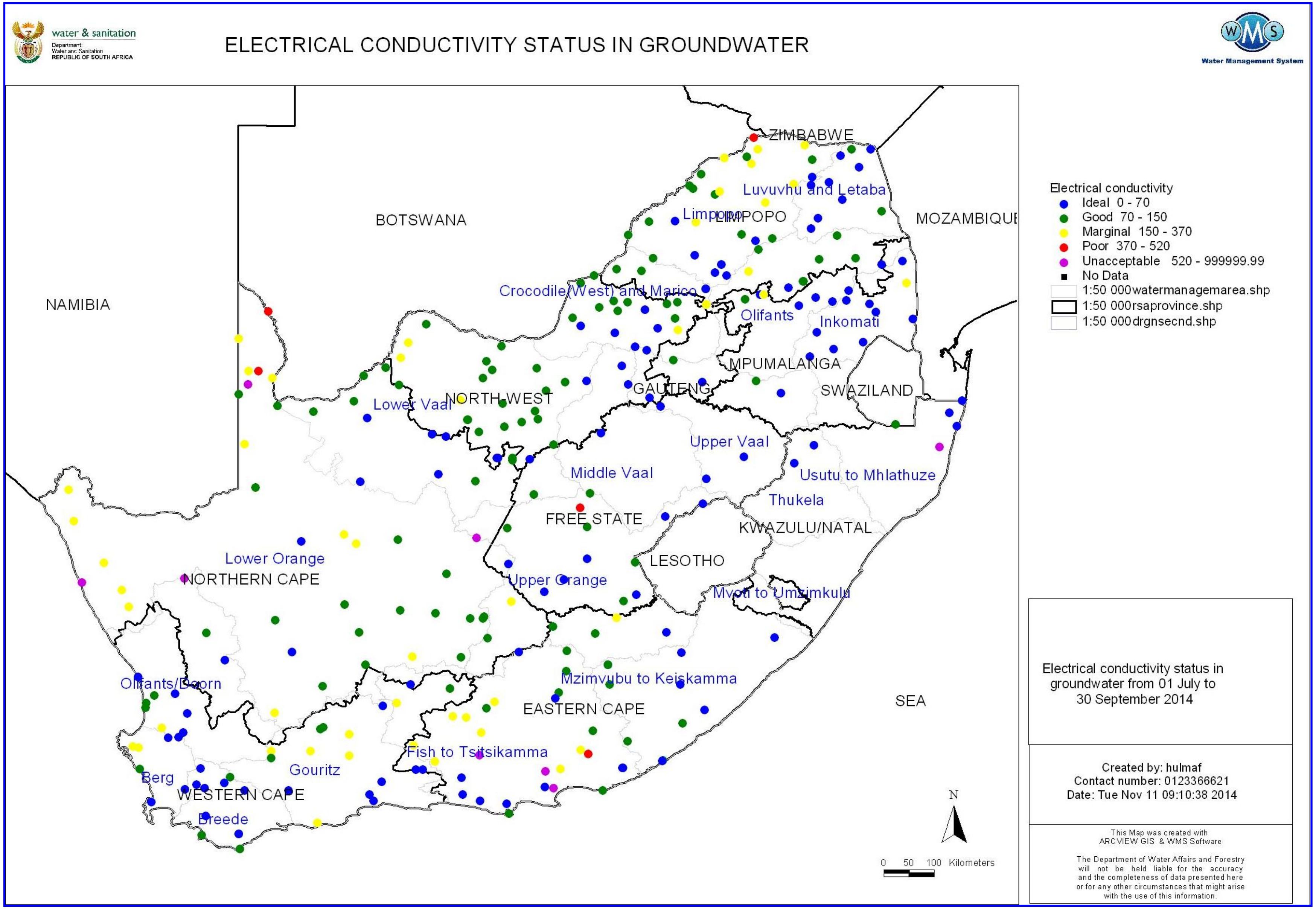


Figure 4.3: Electrical Conductivity status in groundwater

Figure 4.4 shows the status of nitrate concentrations in groundwater. Natural nitrate levels in groundwater are generally very low (typically less than 10 mg/l NO_3), but nitrate concentrations increase due to human activities, such as agriculture, industry and domestic effluents. Nitrate generally move relatively slow in soil and groundwater (unless the pressure in the aquifer is high), and therefore, it is predicted that current polluting activities will continue to affect nitrate concentrations for several decades. Figure 4.4 indicates generally good nitrate levels for the most part of the country except where agriculture (both stock and crop) is practiced extensively. These include parts of Limpopo, Northwest and Free State (along the Vaal River) Provinces, and also the Fish to Tsitsikamma WMA. Seemingly, nitrate levels in some parts of Limpopo are increasing to higher concentration levels than previously measured.

Figure 4.5 shows the status of fluoride concentrations in groundwater as measured across the country. Fluoride is a chemical that occurs naturally within many types of rock, which is thus freely available in nature in varying concentrations. It has become one of the most important toxicological environmental hazards globally. When ingested in small quantities it is beneficial in promoting dental health, whereas higher concentrations may cause fluorosis (a condition in humans due to exposure to excessive amounts of fluorine and its compounds). High fluoride occurrence in groundwater is expected from sodium bicarbonate-type water, which is calcium deficient; and that is mainly in basement aquifers such as granite and gneiss, in geothermal waters, and in some sedimentary basins. The occurrence of fluoride in groundwater is due to weathering and leaching of fluoride-bearing minerals from rocks and sediments. However, it can also be aresult from other activities such as:

- Runoff and infiltration of chemical fertilizers in agricultural areas,
- Septic and sewage treatment system discharges in communities with fluoridated water supplies, and
- Liquid waste from industrial sources.

High concentration levels are mainly on the parts of the country that are characterised by basement aquifers especially in the Northern Cape. Such high levels could also be attributed to agricultural activities and industrial effluents in the Limpopo Province although it also exists naturally. Sewage and industrial effluents could have a more detrimental impact in terms of fluoride pollution on a local scale.

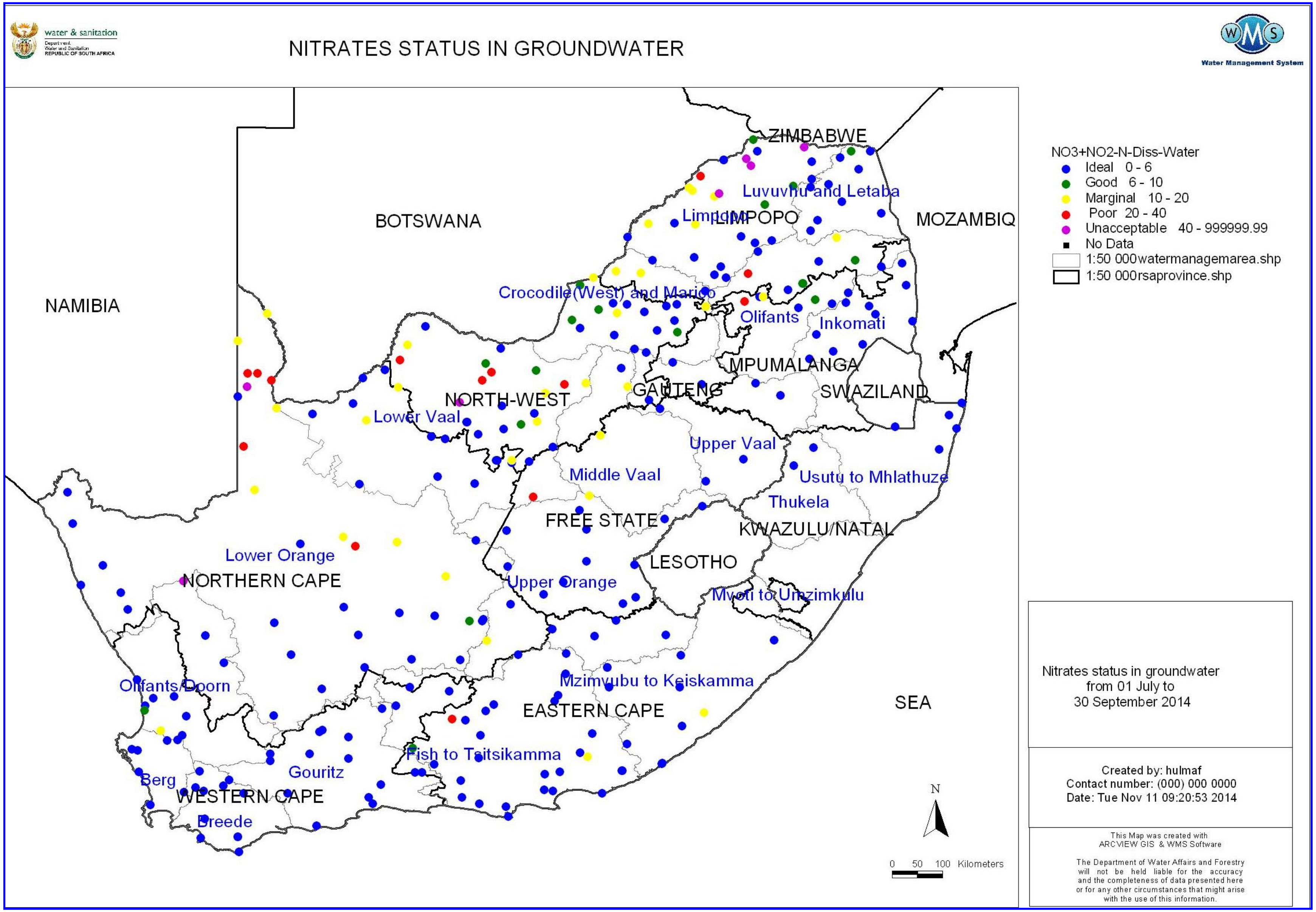


Figure 4. 4: Nitrate concentration levels in groundwater

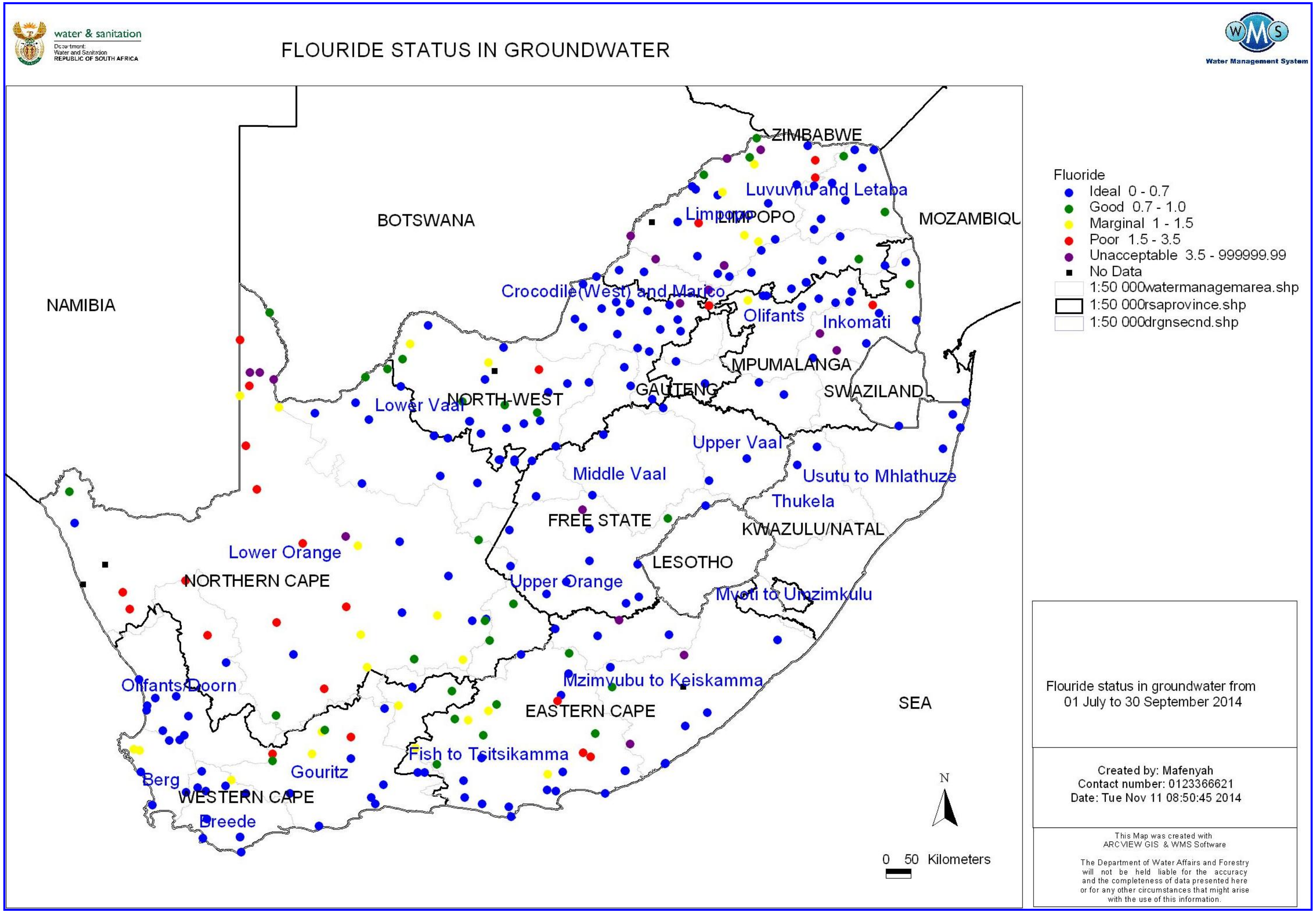


Figure 4.5: Fluoride concentration levels in groundwater

5. WATER USE

5.1 Registered water use volumes

Registered water use volumes at the end of September 2014 indicate that the irrigation agriculture is still the largest water use sector (57%) of all registered water uses in the country. Second to that is water use for industries (20%, urban and non-urban) and 17% of water use is for water supply services by municipalities and water boards. Other notable water uses includes 5% of total water use for commercial business and 3% of total water use for mining (Figure 5.1 and Table 5.1). This is very similar to the situation one year ago.

In terms of water use per WMA, 15% of all water use in the country is from the Upper Vaal WMA, which includes the largest part of the Gauteng Province. The WMA with the second largest registered water use volume is the Inkomati WMA with 10% of total registered water use (Figure 5.2).

According to Figures 5.3 – 5.7 and Table 5.2, the WMAs with the largest agricultural irrigation (> 50%) as a percentage of the total volume of the registered water use per WMA are Inkomati (54 %), Luvulvhu – Letaba (63%), Crocodile (W) & Marico (66%), Limpopo (71%), Lower Vaal (79%), Gouritz (83%), Fish-Tsitsikamma (84%), Thukela (87%), Upper Orange (88%), Lower Orange (92%), Breede (94%) and Olifants-Doorn (97%).

The WMAs with the largest mining (> 5%) as a percentage of the total volume of the registered water use per WMA are the Crocodile(West) & Marico (5%), Middle Vaal (7%), Lower Vaal (8%) and Olifants (23%).

The WMAs with the largest water supply (> 20%) as a percentage of the total volume of the registered water use per WMA are Limpopo (21%), Luvulvhu-Letaba (29%), Thukela (30%), Middle Vaal (45%), Mvoti-uMsimkulu (47%) and Mzimvubu-Keiskamma (53%).

The WMAs with the largest industrial and commercial use (> 20%) as a percentage of the total volume of the registered water use per WMA are Crocodile (W) & Marico (20%), Inkomati (23%), Mvoti-Mzimkulu (30%), Usutu-Mhlatuze (34%) and Upper Vaal (85%) which includes Gauteng Province, the economic hub of the country.

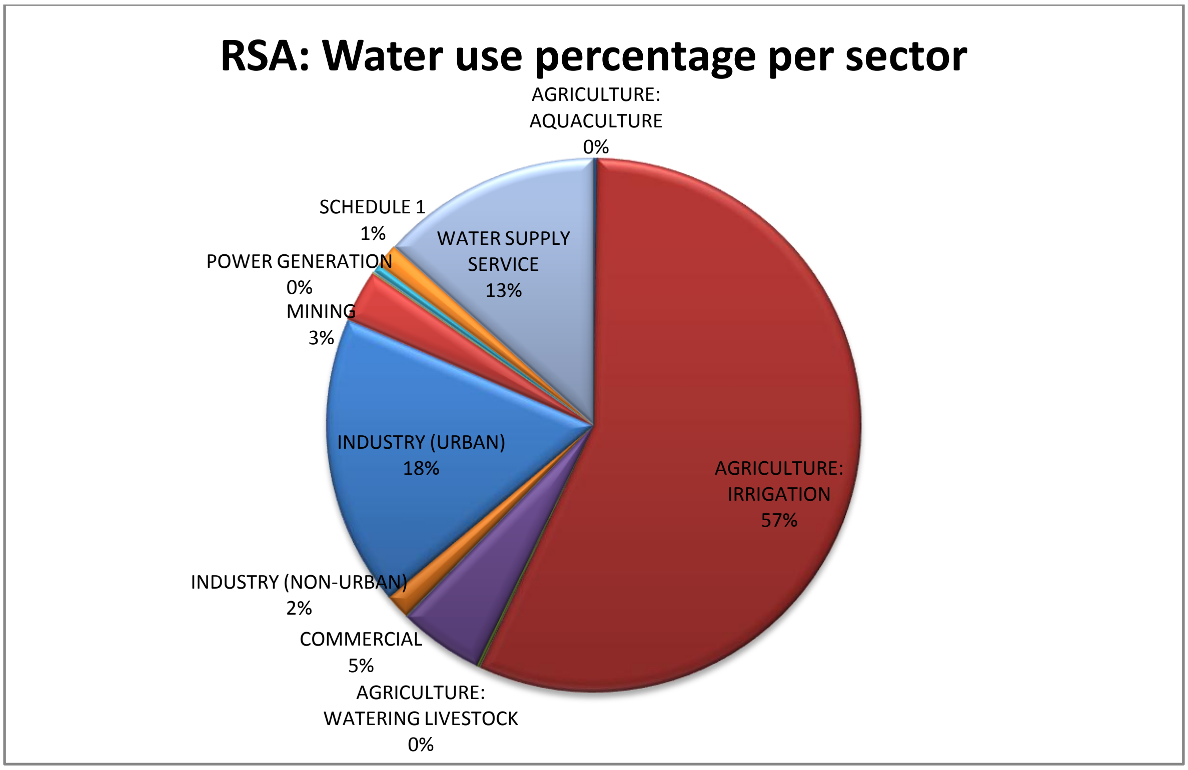


Figure 5.1: RSA water use per sector (rounded to the nearest percentage)

Table 5.1: Total registered water use volumes as at end September 2014

Sector Name	Registered water use (m^3)	Percentage of total use
AGRICULTURE: AQUACULTURE	10 665 131.00	0.22
AGRICULTURE: IRRIGATION	2 760 215 600.30	56.73
AGRICULTURE: WATERING LIVESTOCK	12 284 259.21	0.25
COMMERCIAL	247 766 270.55	5.09
COMMUNITY WOODLOT	2 205 825.29	0.05
INDUSTRY (NON-URBAN)	74 463 477.82	1.53
INDUSTRY (URBAN)	855 688 729.78	17.59
MINING	151 333 259.23	3.11
POWER GENERATION	4 070 867.00	0.084
RECREATION	1 690 716.13	0.03
SCHEDULE 1	25 843 845.26	0.53
URBAN (EXCL. INDUSTRIAL & DOMESTIC)	68 306 789.07	1.40
WATER SUPPLY SERVICE	650 525 954.83	13.37

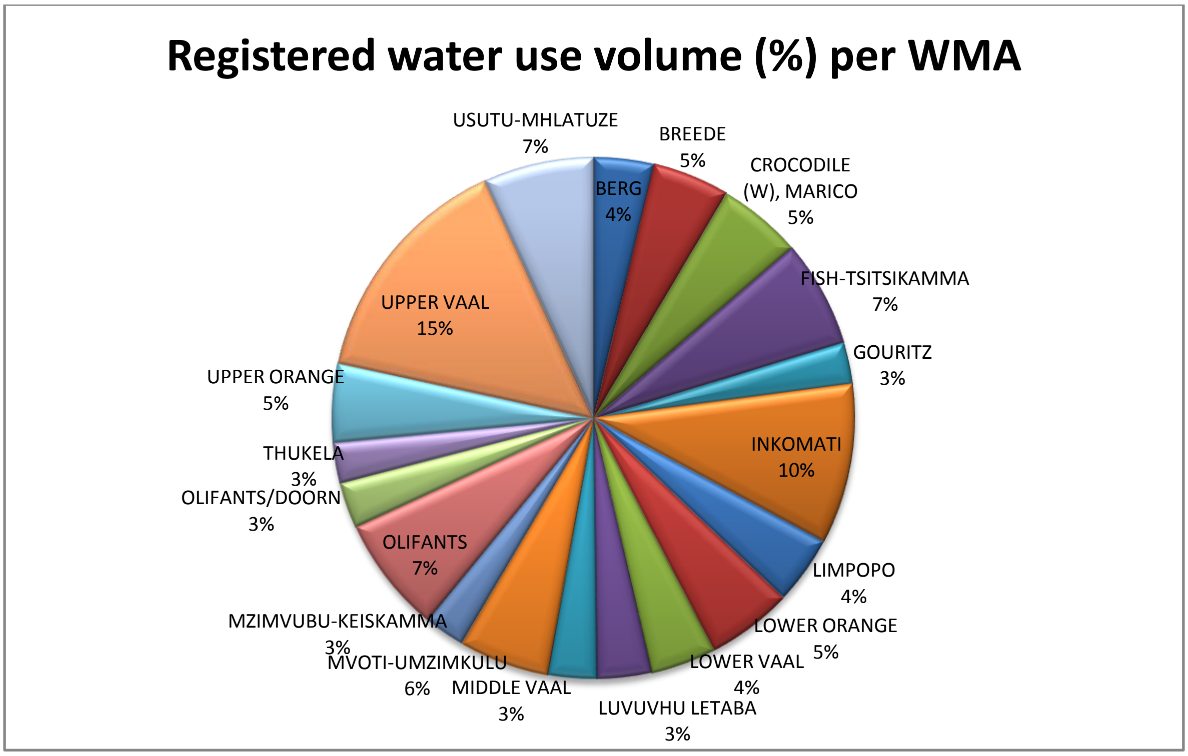


Figure 5.2: Registered water use volume per WMA as percentage of total registered use

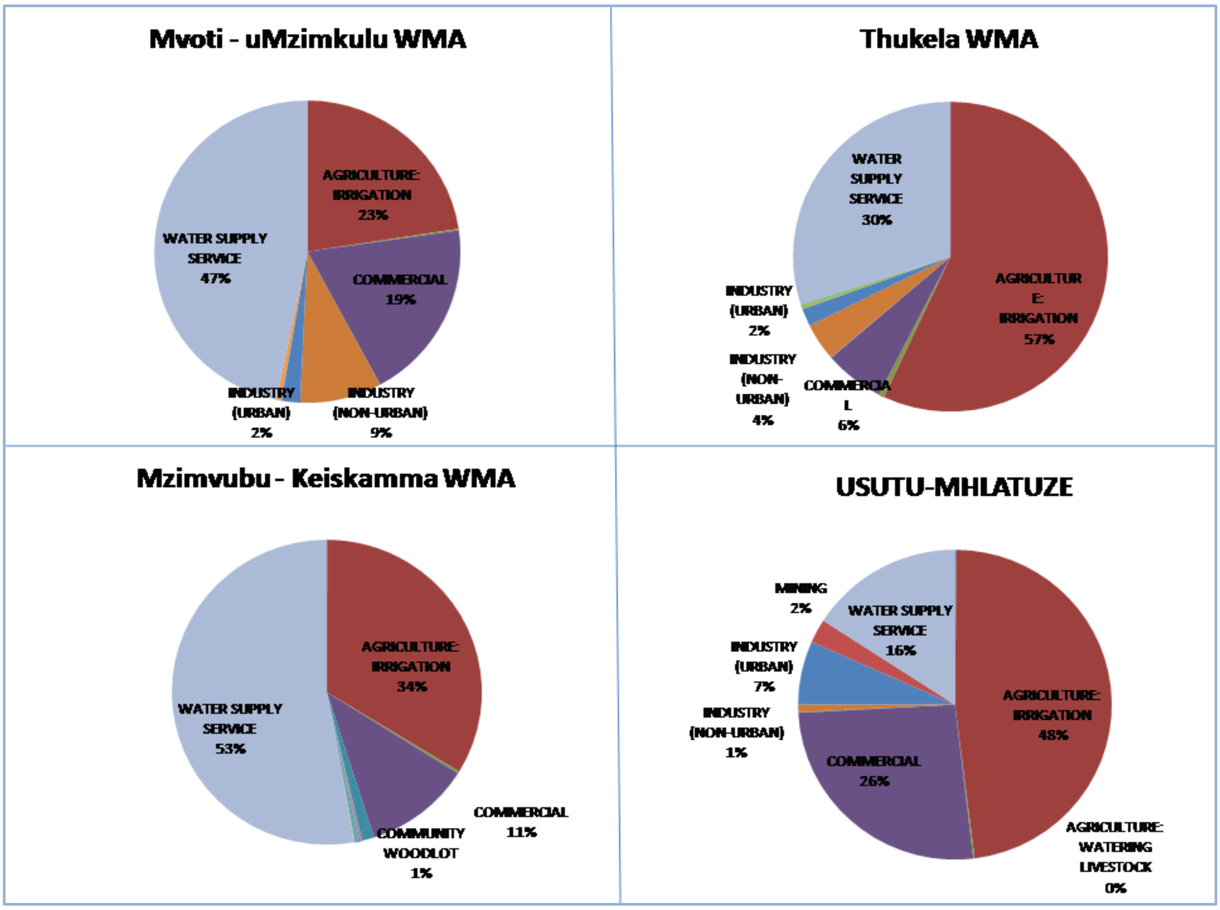


Figure 5.3: Registered water use per WMA – KwaZulu-Natal areas

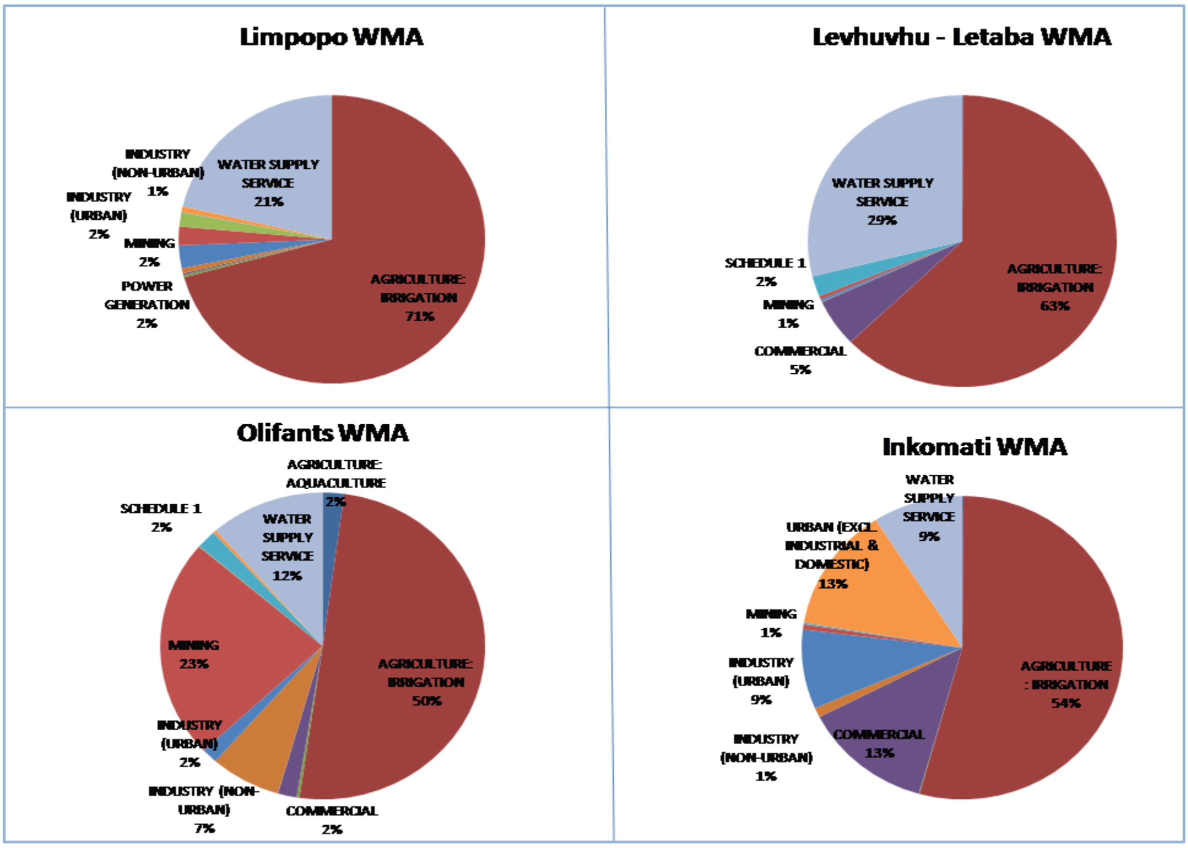


Figure 5.4: Registered water use per WMA – Limpopo and Mpumalanga areas

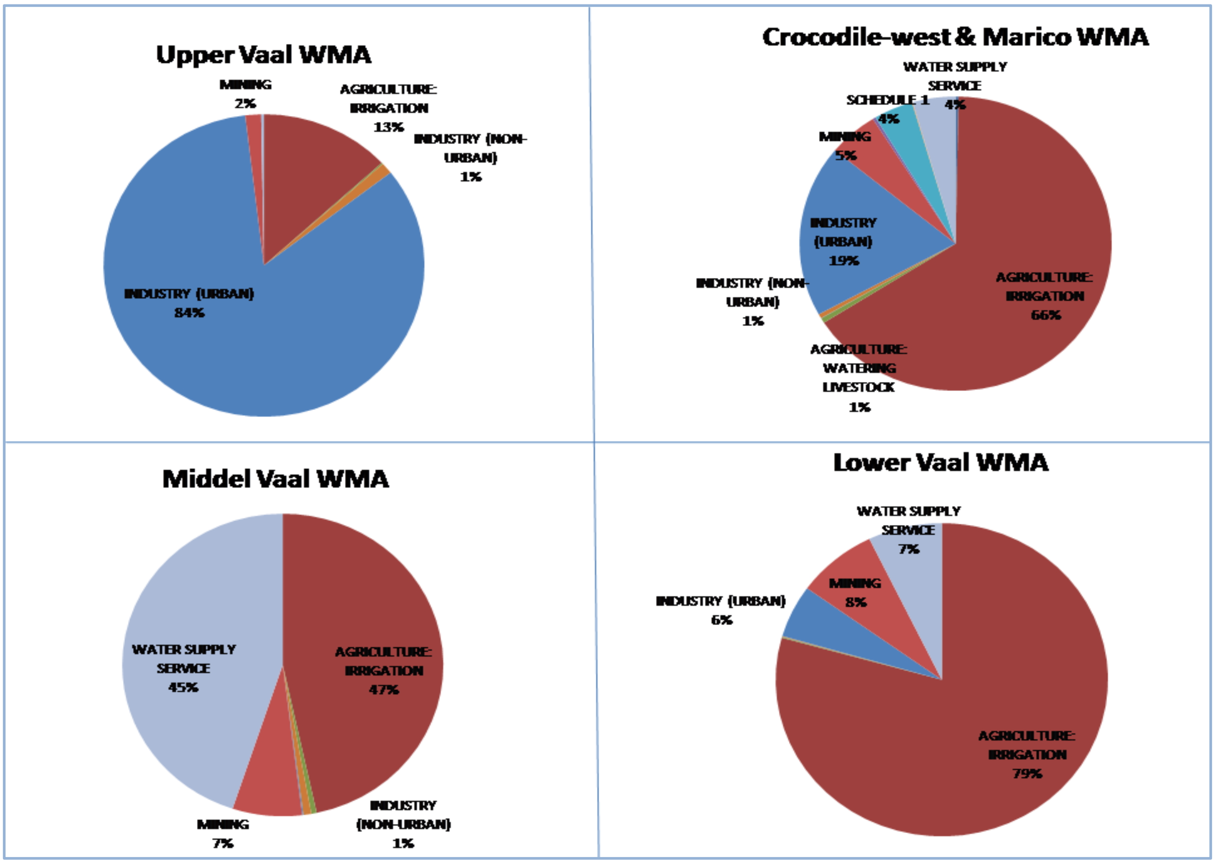


Figure 5.5: Registered water use per WMA – Vaal and Crocodile (West)Marico

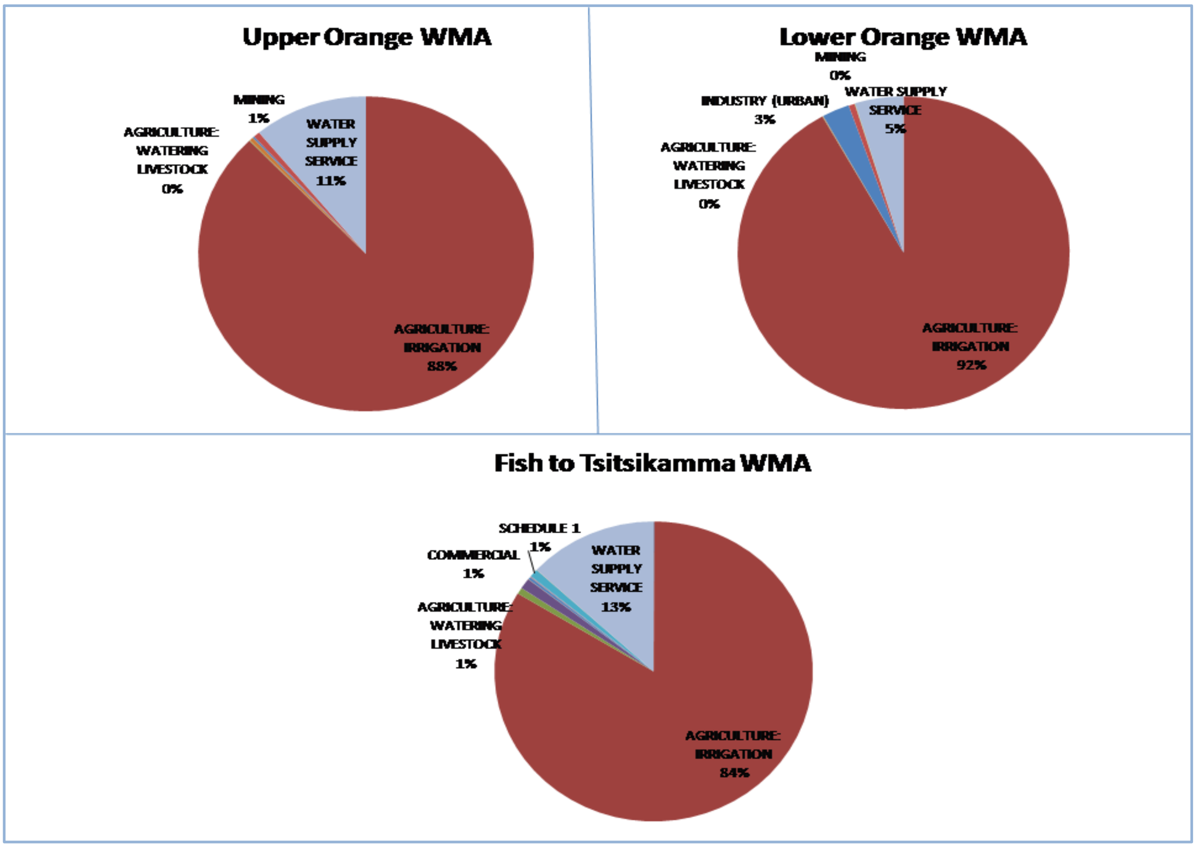


Figure 5.6: Registered water use per WMA – Orange River and Eastern Cape

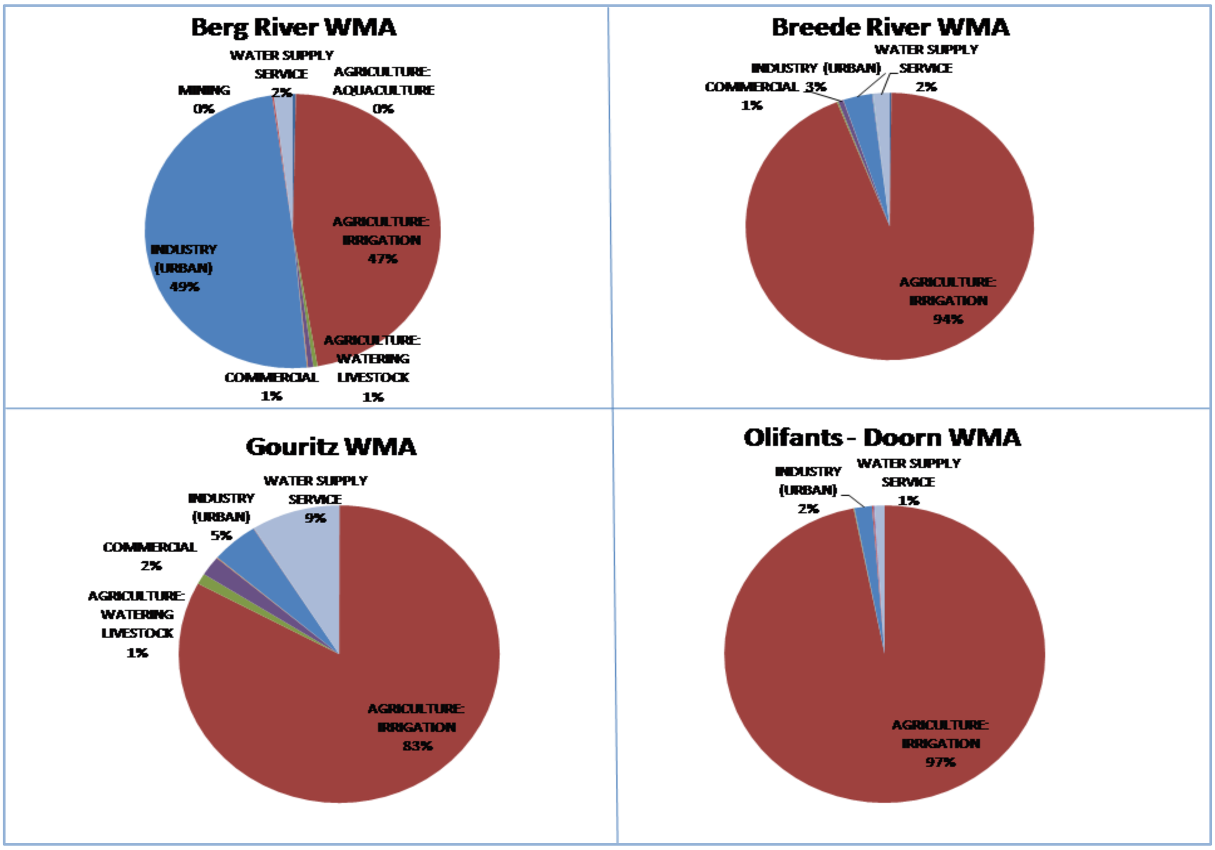


Figure 5.7: Registered water use per WMA – Western Cape areas

Table 5.2: Registered water use per sector per WMA (m^3)

WMA Name	Aquaculture	Irrigation	Livestock watering	Commercial	Community woodlot	Industry (Non Urban)	Industry (Urban)	Mining	Power generation	Recreation	Schedule 1	Urban	Water Supply
BERG	602 460	85 114 843	849 272	1 040 234	1 895	179 125	89 261 091	331 271		74 835	53 810	481	3 626 758
BREEDE	408 365	217 708 382	355 187	1 314 998		51 268	7 538 696	8 772		161 159	138 338	26 197	4 254 124
CROCODILE (W), MARICO	750 756	166 209 652	1 364 250	4 484	81 130	1 220 013	47 853 439	13 060 391		776 754	10 312 255	204 879	11 226 490
FISH-TSITSIKAMMA	232 268	269 886 352	2 217 192	3 708 783	7 203	110 858	860 840	122 871	83 353	202 564	2 805 947	76 657	42 266 958
GOURITZ	42 142	104 564 586	1 463 390	2 711 388		110 920	5 994 494	46 057		34 644	45 832		11 205 723
INKOMATI	444 893	261 455 142	305 288	63 133 087	8 959	4 951 872	40 638 326	2 751 886		20 708	823 541	64 045 342	43 761 284
LIMPOPO	4 000	145 110 651	538 864	366 745		1 176 393	5 196 812	4 285 096	3 169 499	3 375	111 842	1 311 044	43 733 219
LOWER ORANGE		237 930 428	88 355			146 113	6 917 726	1 543 902	155 525				12 186 036
LOWER VAAL	2 916	157 100 604	164 272		51 184	154 804	10 737 914	15 599 623		1 173			14 225 886
LUVUVHU LETABA	92 620	102 938 338	10 375	8 623 911	33 841	68 564	449 660	597 489			3 737 565	22 207	47 320 721
MIDDLE VAAL	913	68 482 807	788 625			1 171 852	169 243	10 290 397			500		66 009 736
MVOTI-UMZIMKULU	58 502	61 322 360	469 937	52 631 164	46 231	23 438 847	5 358 523	25 044		10 861	153 522	1 282 838	127 116 793
MZIMVUBU-KEISKAMMA	25 946	41 371 108	281 682	13 709 992	1 562 535	102 628	119 381	95 821	3 675	136 069	478 024	111 910	64 918 797
OLIFANTS	7 420 892	176 401 543	992 841	6 522 521	94 829	24 700 826	5 642 586	81 315 015	158 815	2 916	6 959 018	1 214 250	40 115 916
OLIFANTS/DOORN		134 358 035	88 733	29 236		1 250	2 437 871	181 800		150 000	7 750		1 424 145
THUKELA	2 375	69 657 164	690 712	7 542 143	56 383	4 803 352	2 223 775	17 392	500 000	2 607	128 882		36 612 961
UPPER ORANGE		207 342 587	170 353			906 284	415 273	1 450 674					26 003 342
UPPER VAAL	83 333	94 414 921	1 006 527	2 927		8 605 324	601 820 936	11 393 340		74 297	232	6 806	1 957 048
USUTU-MHLATUZE	492 750	158 846 097	438 406	86 424 658	261 637	2 563 185	22 052 145	8 216 420		38 754	86 787	4 178	52 560 017
Grand Total	**10 665 131**	**2 760 215 600**	**12 284 259**	**247 766 271**	**2 205 825**	**74 463 478**	**855 688 730**	**151 333 259**	**4 070 867**	**1 690 716**	**25 843 845**	**68 306 789**	**650 525 955**

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