5

GROUNDWATER

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

Groundwater systems are dynamic and adjust continually to short-term and long-term changes in climate, groundwater withdrawal, and land use. Water level and quality measurements from observation wells are the principal sources of information about the hydrologic stresses acting on aquifers and how these stresses affect groundwater recharge, storage, and discharge. Monitoring information makes it possible for unseen groundwater resources to be seen so that it is sustainably managed. This chapter will look at the groundwater status for the hydrological year 2022.

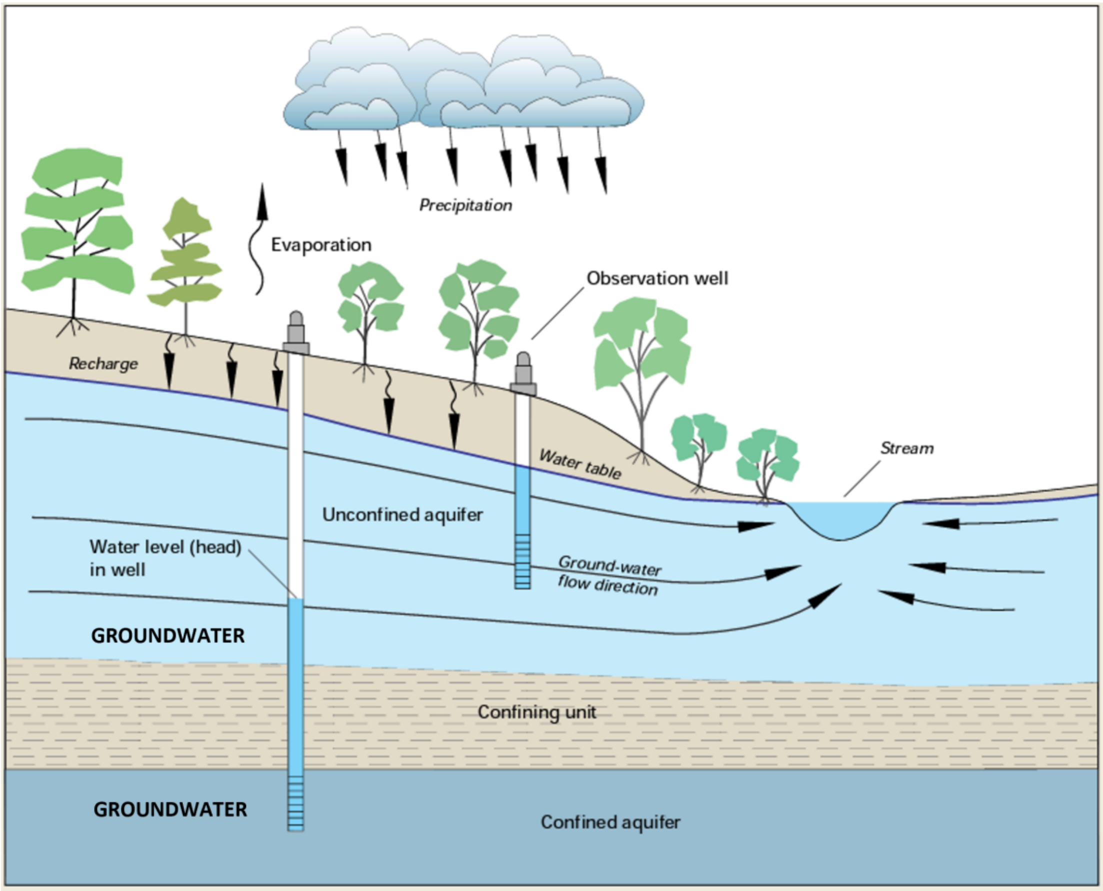

Figure 6.1 Cross Section sketch of a typical groundwater flow system showing water table and other hydrologic elements (Modified from Taylor and Charles, 2001).

6.1 Groundwater Level Status

The Department of Water and Sanitation monitors over 1 800 groundwater levels 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 historical groundwater level monitoring record is assessed per borehole to ensure significant results and understanding. The groundwater level status of the geosites is averaged within the topo-cadastral 1:50 000 map sheet grid. The groundwater level status is not linked to groundwater availability and storage levels within an aquifer but only gives an indication of the water level.

The Groundwater Level Status approach allows the comparison of groundwater level data of any geosite/borehole on the same scale. Figure 6.2 presents the groundwater level status for the month of September 2022 and the available data at the time of reporting. The two consecutive above-normal rainfall years, 2021 and 2022, have improved groundwater level recovery at most places and good aquifer recharge.

Figure 6.3 depicts the groundwater level status over the years from September 2019 to 2022. September 2021 and 2022 have water levels recovering, showing more geosites with above 50% GwLS, particularly in the Northern Cape Province and interior of the country. This corresponds with the increase in rainfall percentage anomalies over the past two hydrological years (see Figure 3.3 in Chapter 3), and the prevalence of above 75% GwLS in the interior can be attributed to the above-normal rainfall trends in the past two years.

Due to the localised nature of groundwater aquifers, there is an increasing need to understand better the groundwater data monitored at a local level, such as by local municipalities or villages and by other water sector institutions such as SAEON in conjunction with the national monitoring database.

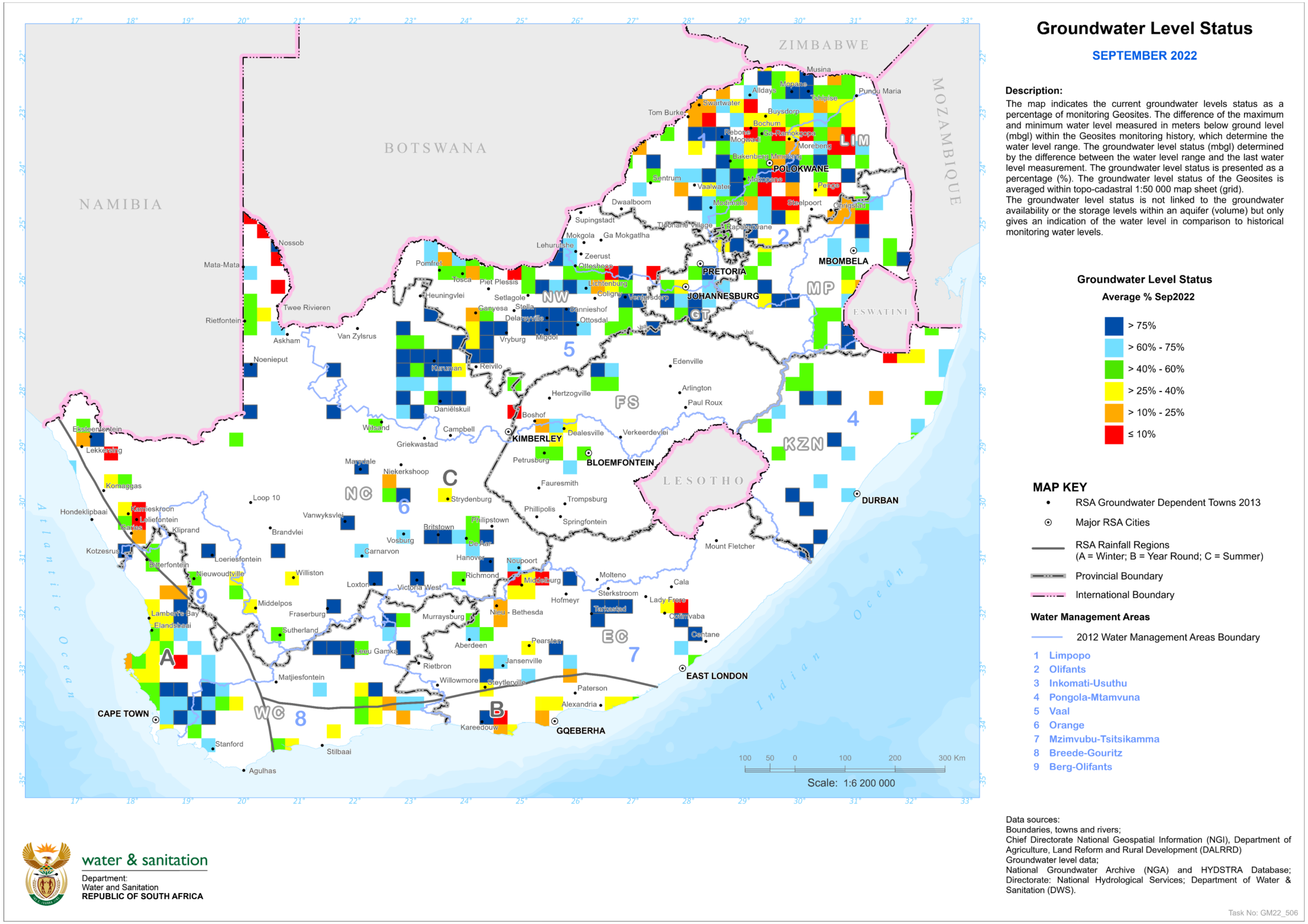

Figure 6.2 Groundwater Level Status Map – September 2022

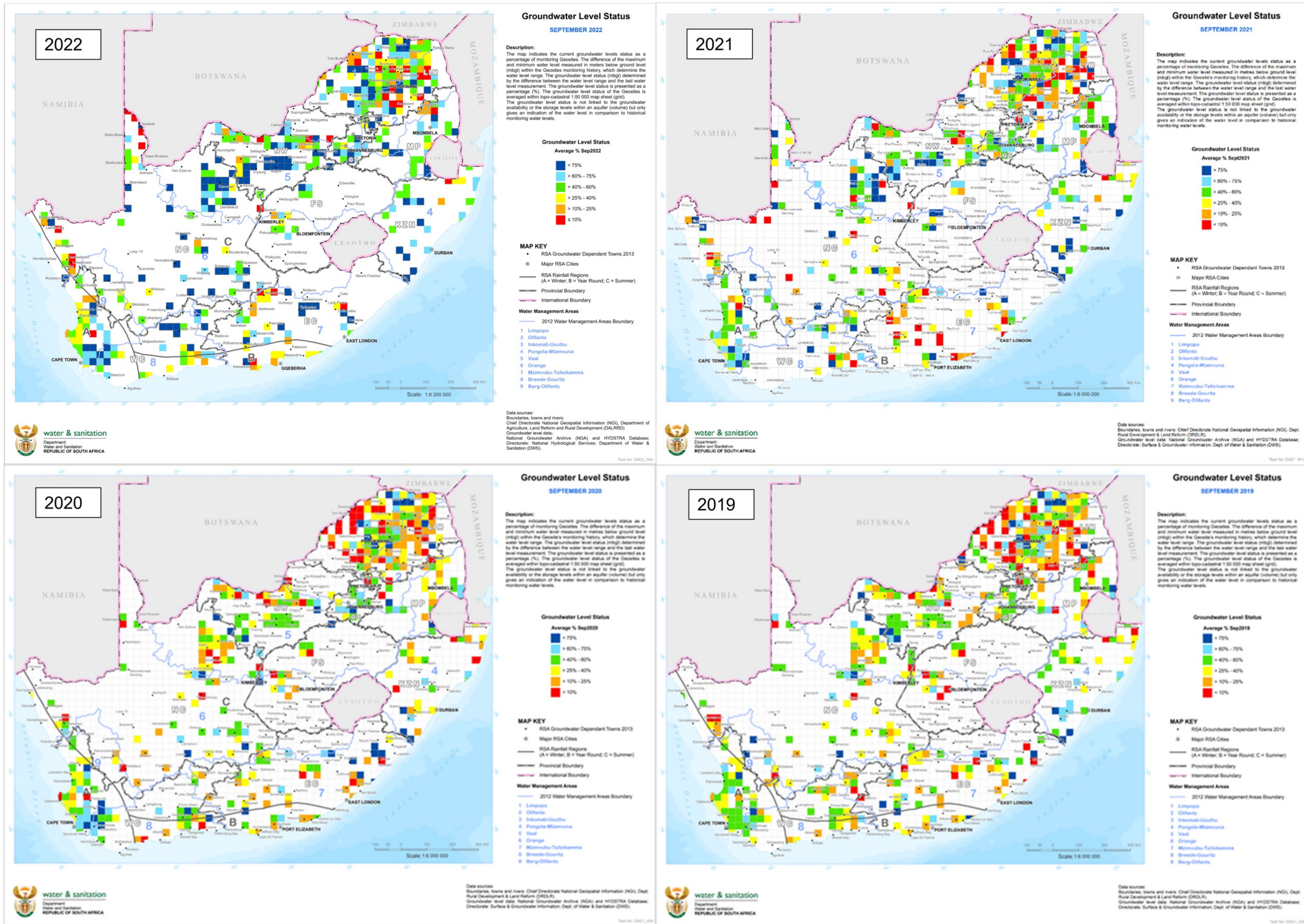

Figure 6.3 Groundwater Level Status Comparison for September month for the year 2019. 2020. 2021, 2022

6.2 Groundwater Level Risk Status

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 average GwLS is presented against the percentiles of the historical groundwater levels (Figure 6.4). The 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 a different severity range - seven percentile ranges.

The groundwater level value is a percentage of the groundwater level status (GwLS). The groundwater level status is not linked to groundwater availability and storage levels within an aquifer but only gives an indication of water level based on individual geosites entire historical groundwater level monitoring record.

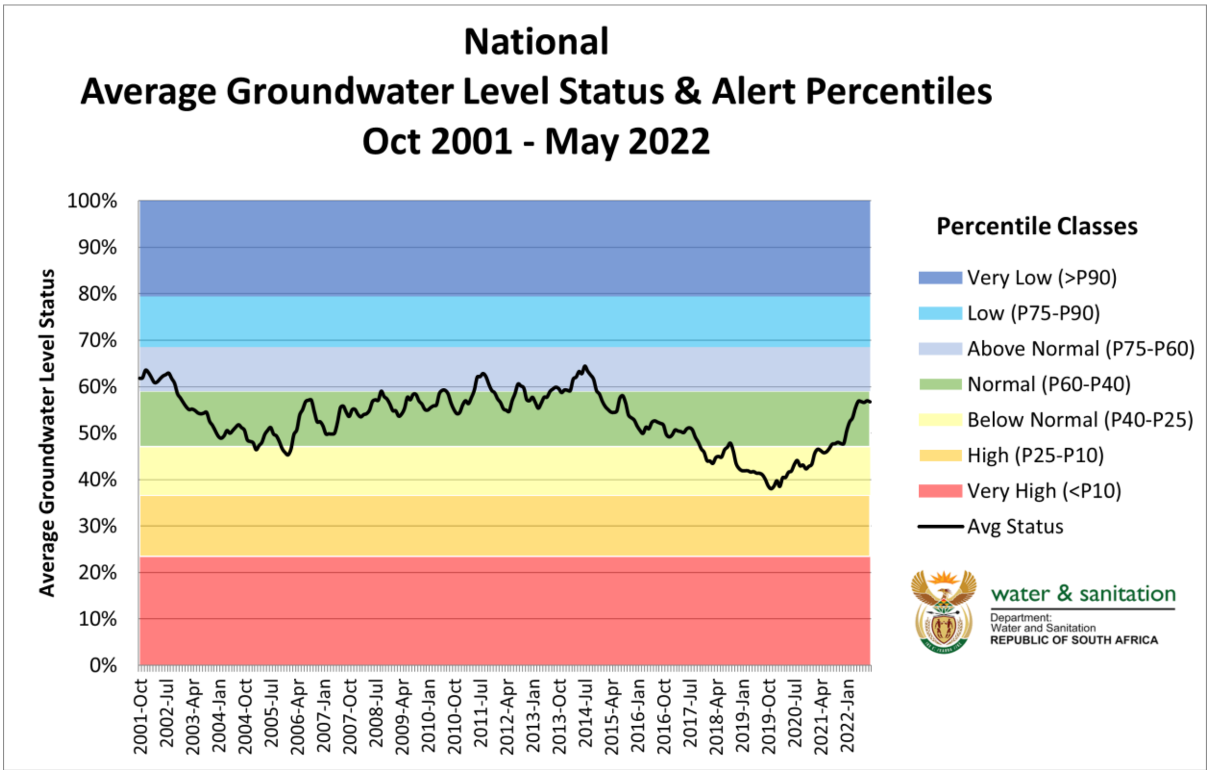

Figure 6.4 Average Groundwater Level Status Severity Graph

The national average GwLS indicated a recovery trend from below normal in 2019 to normal in September 2022. This can be attributed to the above-normal rainfall received in the current and previous years, which has recharged aquifers. There has been a decline in the number of monitoring stations with data available to put together the average groundwater level status. The decline in the number of geosites used to derive the national average GwLS in 2022 influences the average GwLS graph. Even though the average groundwater level status graph gives us an estimation of the groundwater levels across the country, it should be used with caution as it depends on the input number or geosites used to derive the average.

Timely data capturing groundwater level data on the central database by regions is still a challenge resulting in data lag. Investment in digitising the groundwater level monitoring process (collection, transmission, processing, and dissemination) can work hand in hand with manual data collection to aid in prompt data capturing to improve decision-making.

6.3 Strategic Groundwater Resource Areas and Groundwater Quality

Strategic Water Source Areas (SWSAs) are areas of land that either (a) supply a disproportionate amount of mean annual surface water runoff in relation to their size and are considered nationally important; or (b) have high groundwater recharge and are locations where groundwater forms important national resource; or (c) are areas that meet both criteria. Water source areas are critical because they produce large volumes of water that sustain people and ecosystems. In the case of groundwater, they are the only sustainable and reliable water source (Le Maitre *et al.*2018).

Groundwater SWSAs provide water to 126 towns and rural supply schemes. Key regional centers that are highly dependent on groundwater are: Mafikeng with 75% of its water from groundwater, Lichtenburg >50%, Giyani >26% and Polokwane >11% (Le Maitre *et al.*2018).

Figure 6.5 presents the nitrate/ nitrite groundwater quality in mg/l classes according to the SANS 241 drinking water quality guidelines. Nitrate has a limit of 11 mg/l; anything above this limit is indicated in red in the map in Figure 6.5. The Strategic Water Source Areas with groundwater quality exceeding the limit are in the Free State and Limpopo Regions. The Central Pan belt (SWASA) in the Free State has a harmonic mean of 13 mg/l for nitrate. In Limpopo, the affected SWSA is Nyl and Dorps River Valley with a harmonic mean of 14 mg/l nitrate/nitrite; Giyani with 62 mg/l ; Letaba Escarpment with a harmonic mean of 21 mg/l; Vivo Dendron with a harmonic mean of 30 mg/l; Soutpansberg with 20 mg/l. All the exceedances within the SWSAs have nitrate/nitrite concentrations ranging from 13 mg/l to 62 mg/l indicative of impacts of land use activities that can still be arrested before significant groundwater pollution is allowed to take place.

The current water situation in South Africa provides strong motivation for protecting SWSAs to ensure a sustainable and equitable water supply. According to Le Maitre *et al.* (2018) there is currently no specific policy, legislation, or regulation that specifically protects Strategic Water Source Areas, including their groundwater counterparts. The legal measures available for protecting water sources include but are not limited to the National Water Act, National Environmental Management Act (NEMA), and Spatial

Planning and Land Use Management Act, to name a few. Some of the effective ways identified by Le Maitre *et al* (2018) to protect Strategic Water Source Areas are: (1) Under NEMA Section 24(2A), which allows the minister to prohibit granting of environmental authorisations in certain geographical areas; (2) Adding a chapter on Water Source Area protection to the new Water and Sanitation Act, prohibiting activities in certain geographical areas affecting water quality and quantity.

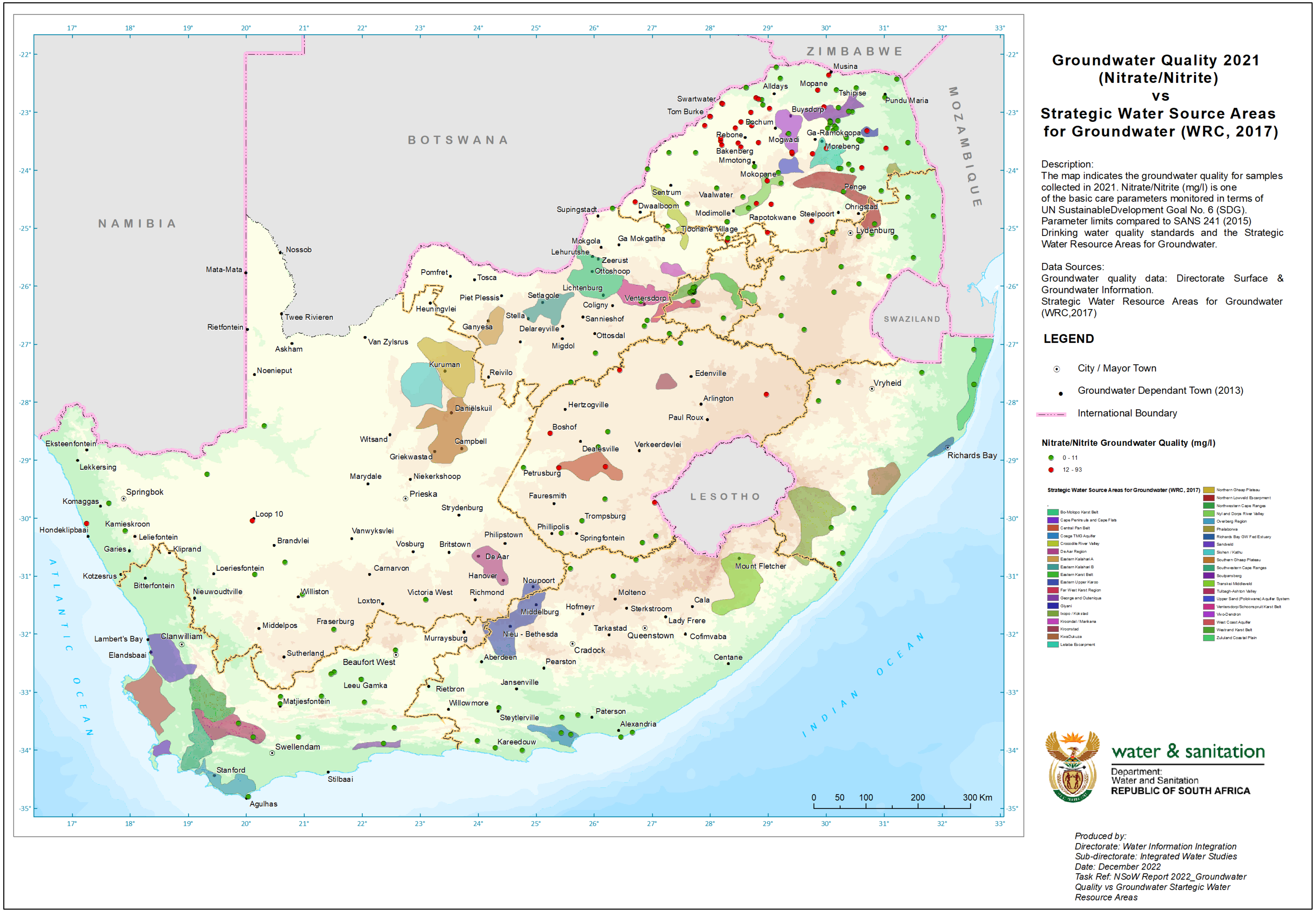

Figure 6.5 2021 Groundwater Quality within Strategic Water Source Areas for Groundwater

Groundwater quality is important because it determines suitability for drinking and other purposes. The 2021 groundwater quality status depicted in Figure 6.5 is compared to the SANS 241 (2015) drinking water quality requirements for nitrate parameter in treated water. It is important to note that the groundwater quality status presented is for untreated groundwater. Although most groundwater in its natural state is of excellent quality, this is not generally true for all groundwater. In areas such as Limpopo and Free State where the untreated groundwater quality is above the SANS 241 drinking water limit for nitrate, it is recommended that the quality in these areas showing high nitrate concentrations is treated to meet the SANS 241 permissible limit for consumption purposes. Groundwater quality awareness campaigns should be conducted in communities that use groundwater without treatment.

6.4 Groundwater Use Per Economic Sector

Groundwater is registered in terms of the provisions in the National Water Act, of 1998. This information is available on the Departments WARMS database (https://www.dws.gov.za/Projects/WARMS/default.aspx), from which the Provincial figures of the currently registered water use per sector have been derived for up to September 2022. The economic sectors compared for groundwater use in the nine provinces are Agriculture irrigation, agriculture watering livestock, mining, schedule 1, water supply service, and others (aquaculture + industry + power generation + recreation).

A minimum of a third and more of groundwater is used in most provinces for agricultural irrigation. The Free State and Northern Cape Provinces have about two-thirds of groundwater used for agriculture irrigation. Limpopo and the Eastern Cape Provinces use groundwater predominately for agriculture, irrigation, and water supply service. In Limpopo, about half of the groundwater used is for water supply services. The Eastern Cape Province is the second largest user of groundwater for water supply service. Mpumalanga Province has two-thirds of its groundwater used in the mining sector. Most of South Africa’s coal mining activities are situated in Mpumalanga Province. Figure 6.6 illustrates pie charts for groundwater use per economic sector of the nine provinces.

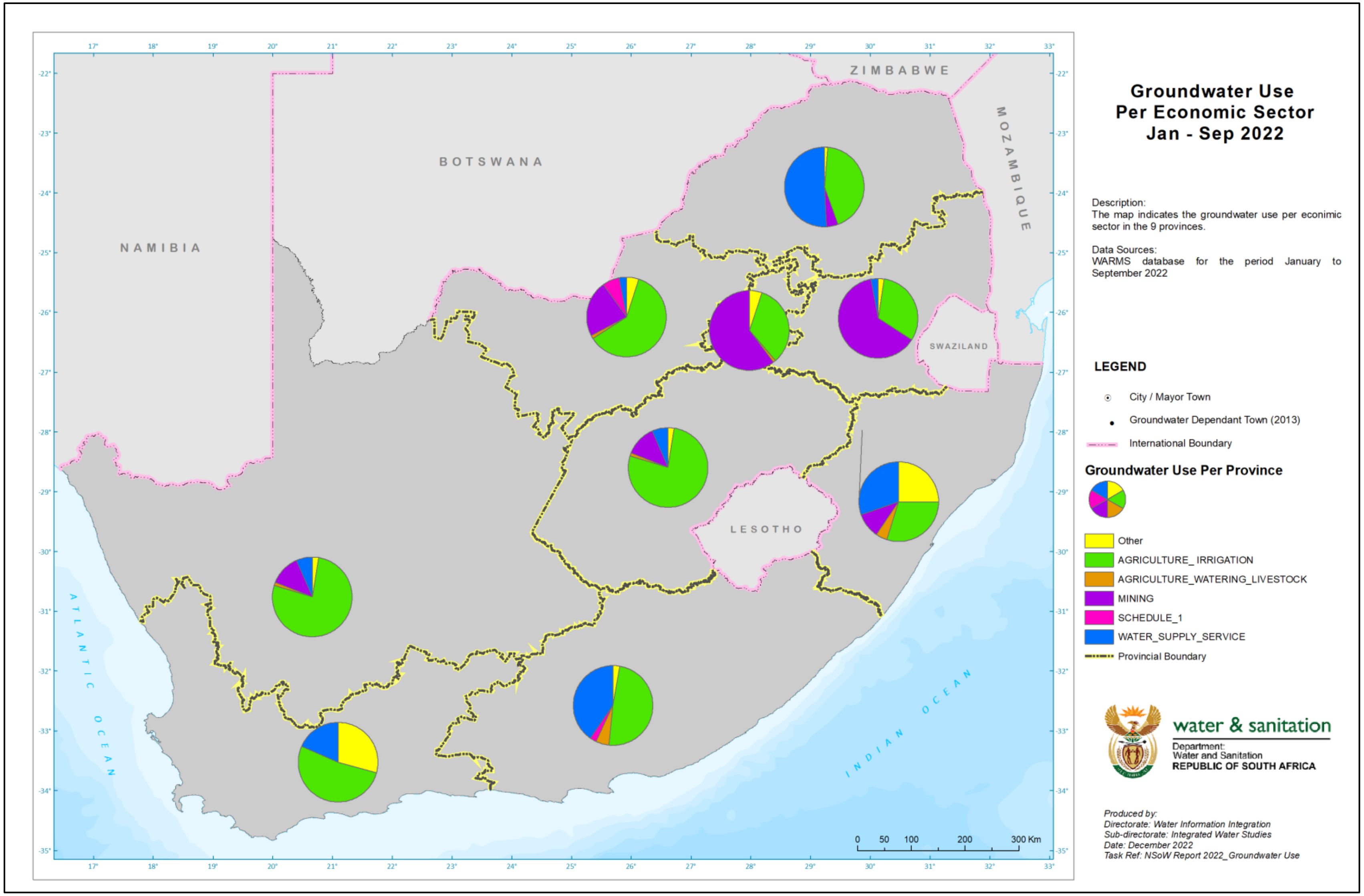

Figure 6.6 Groundwater Use Per Economic Sector - 2022