CHAPTER 2

OVERVIEW OF THE OLIFANTS/DOORN WMA

The Olifants/Doorn WMA derives its name from the main river draining it, namely the Olifants River. The word "Doorn", an archaic form of Doring, was added to the WMA name to distinguish it from the many other "Olifants" rivers in the country as the Olifants River's main tributary, in this catchment, is the Doring River. The WMA is bounded in the west by the Atlantic Ocean, and its eastern boundary lies along the Great Escarpment divide between the Great Karoo and the western branch of the Cape Fold Belt. The major water user of the area is irrigated agriculture, which sustains the economy of the area and provides most of the employment opportunities. Parts of the WMA have high conservation value, including some of the river reaches and the Olifants River estuary.

This chapter provides an overview of the WMA. **Chapter 3** provides more detailed information on each of the six sub-areas into which the WMA has been divided and **Chapter 4** provides an overview of its water resources.

2.1 LOCALITY AND PHYSICAL FEATURES

2.1.1 Locality and Development

The Olifants/Doorn WMA is located on the west coast of South Africa, extending from about 100 km to 450 km north of Cape Town. The south-western portion mainly falls within the Western Cape Province, and the north-eastern portion falls within the Northern Cape Province. Refer to **Figure 2.1** for the location and general layout of the WMA.

The major river in the WMA is the Olifants River, of which the Doring River (draining the Koue Bokkeveld and Doring area) and the Sout River (draining the Knersvlakte) are the main tributaries. The WMA incorporates the E primary drainage region and components of the F and G drainage regions along the coastal plain, respectively north and south of the Olifants River estuary, covering a total area of 56 446 km^2. The Olifants and Doring Rivers flow strongly during the winter months whilst flows only occur very occasionally in the Sout River. There are also a number of smaller coastal rivers and water courses which flow infrequently.

2.1.2 ISP Sub-areas

The WMA comprises 88 quaternary catchments and has been divided into six sub-areas[2] or "management units", corresponding to the current divisions used in surface water resource management by the Regional Office of the DWAF. Refer to **Figure 2.2** for the ISP sub-areas.

[2] The Olifants Doorn WMA was divided into only five sub-areas in the National Water Resource Strategy (NWRS). The Olifants River sub-area as defined in NWRS has been spilt into two for the purpose of this ISP (Upper Olifants and Lower Olifants). It was recognised that the two sections of the river have distinctly different water resource management characteristics.

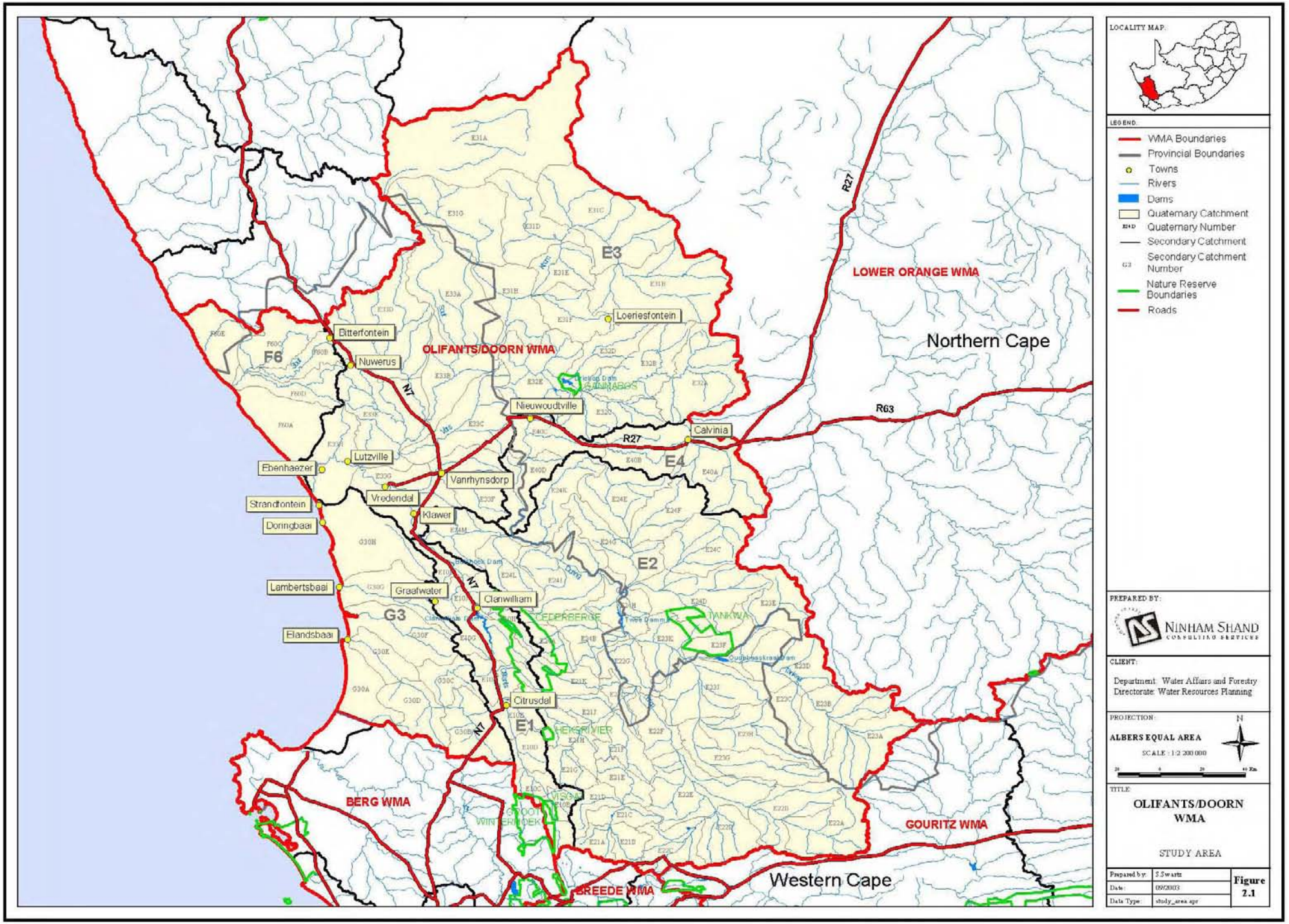

Figure 2.1: Map of the Olifants/Doorn Water Management Area

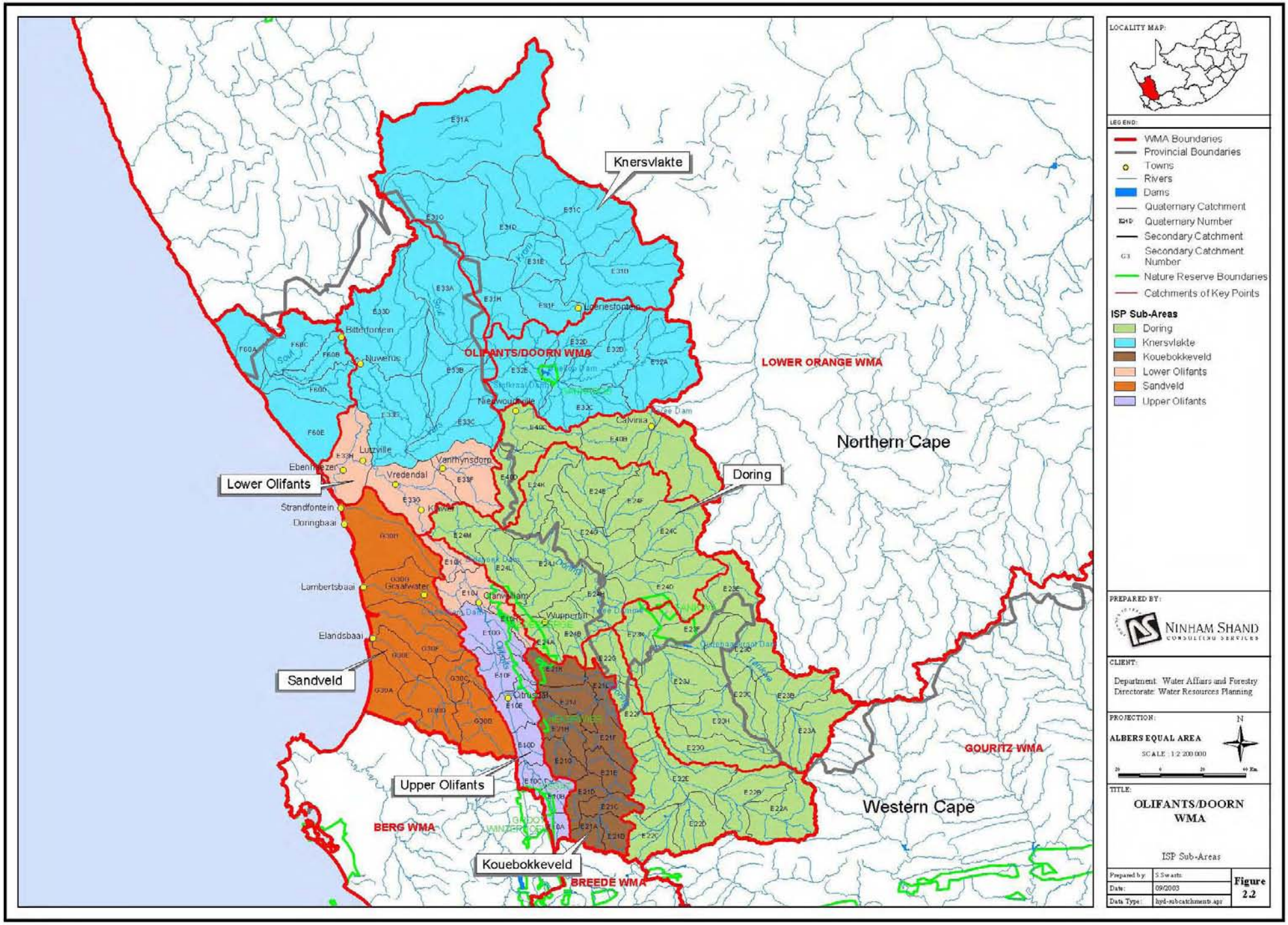

Figure 2.2: Map of the Olifants/Doorn ISP Sub-areas

These sub-areas are as follows:

- The *Upper Olifants* sub-area consisting of seven quaternary catchments (E10A-G), extending from the source of the Olifants River to the Clanwilliam Dam;
- The *Koue Bokkeveld* sub-area consisting of 11 quaternary catchments (E21A-L) draining in a northerly direction from the catchment divide between this WMA and the Breede WMA;
- The *Doring* sub-area consisting of 32 quaternary catchments (E22A-G, E23A-K, E24A-M, E40A-D) draining the south-eastern and central region of the WMA to the confluence with the Olifants River;
- The *Knersvlakte* sub-area consisting of 24 quaternary catchments (E31A-H, E32A-E, E33A-F, F60A-E) and draining the northern region of the WMA;
- The *Lower Olifants* sub-area consisting of six quaternary catchments (E10H, J, K, E33F-H,) downstream of Clanwilliam Dam;
- The *Sandveld* sub-area consisting of 8 quaternary catchments (G30A-H) within the coastal strip to the south of the Olifants River mouth.

2.1.3 Climate and rainfall

Climatic conditions vary considerably as a result of the variation in topography. Minimum temperatures in July range from –3ºC to 3ºC and maximum temperatures in January range from 39ºC to 44ºC.

The area lies within the winter rainfall region, with the majority of rain occurring between May and September each year. The mean annual precipitation is up to 1 500 mm in the Cederberg mountains in the south-west, but decreases sharply to about 200 mm to the north, east and west thereof, and to less than 100 mm in the far north of the WMA. Average gross mean annual evaporation (as measured by Symons pan), ranges from 1 500 mm in the south-west to more than 2 200 mm in the dry northern parts. Scenarios of climate-change over the next 50-100 years show this area may potentially receive up to 15% less rain in future (refer to **Figure 2.3)**.

2.1.4 Topography

The topography of the WMA is of three distinct types, namely rolling hills and sand dunes in the west along the coastal strip, rugged mountains with peaks rising to about 2 000 m above sea level in the southern area, and plains and rocky hills in the north-eastern area that are typical of the Western Karoo (**Figure 2.4**).

The Olifants River rises in the mountains in the south-east of the WMA and flows north-west. Its deep narrow valley widens and flattens downstream of Clanwilliam until the river flows through a wide floodplain downstream of Klawer. The Doring River is a fan shaped catchment. The main river rises in the south and flows in a northerly direction. It is first joined by the Groot River and then by the Tra-Tra flowing from the west and the Tankwa River from the east, before flowing in a westerly direction to its confluence with the Olifants River just upstream of Klawer.

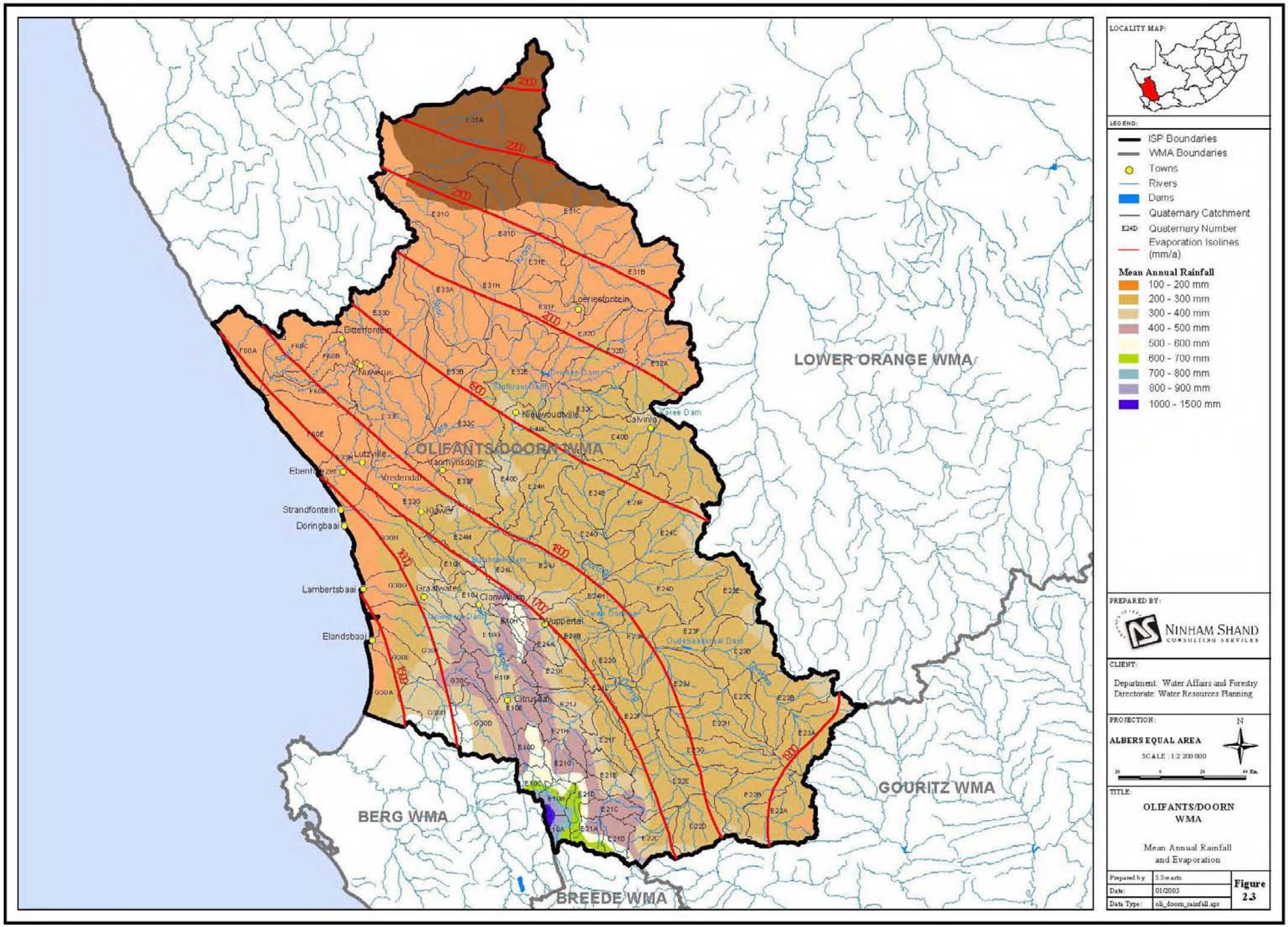

Figure 2.3: Rainfall and evaporation

The north of the WMA is flatter and much of the basin lies between 500 and 900 m above sea level. In the east there are significant mountain ranges, the Hantam near Calvinia and the Roggeveld to the south, which rise to about 1 500 m above sea level. West of Nieuwoudtville lies the Bokkeveld Mountains escarpment where the plateau elevation of about 700 m drops to about 300 m. The rolling hills and plains of the 30 to 40 km wide strip along the coast from the southern boundary of the WMA to the estuary of the Olifants River are known as the Sandveld. The deep sandy deposits overlaying the bedrock in this area are "primary" aquifers which provide a significant groundwater resource.

2.1.5 Geology

The geology of the area is dominated by sedimentary rocks of the Table Mountain Group (TMG) of the Cape Supergroup, which form the highest (almost north/south trending) mountain ranges. The rocks of the Karoo Supergroup outcrop occur largely in the eastern and northern areas of the catchment of the Doring River and comprise the valley floors of the Olifants River where it overlies the TMG. Sedimentary strata of the Vanrhynsdorp Group occur in the north, with exposures of pre-Cape metamorphic rock in the north-western and north-eastern corners of the area. The coastal plain is variably underlain by the metamorphosed shales of the Malmesbury Formation and the sandstone of the TMG. These are overlain by the more recent semi to unconsolidated sediments of alluvial, wind-blown (Sandveld Group), and marine origin as well as calcrete and ferricrete deposits.

Table 2.1: Geology and Hydrogeology of the Olifants/Doorn WMA

Hydrogeological Province (Sub-province)	ISP sub-areas	Geology/Hydrogeology	Aquifers
Adamastor			
Cederberg	Sandveld Upper Olifants W Koue Bokkeveld (E21G, H, J, K) W Lower Doring (E24A, J, L, M, lower part of E24K) Lower Oorlogskloof (E40D)	- Tertiary-Quaternary alluvials - Sandveld Group - (Bokkeveld Group) - Table Mountain Group (TMG) - Klipheuwel Group - Cape Granite Suite - Malmesbury Group	Tertiary-Quaternary alluvials Sandveld Group Skurweberg Aquifer Peninsula Aquifer
Knersvlakte	Lower Olifants/Sout Goerap	- Sandveld Group - (upper TMG) - Nama Group - Gariep Group - Namaqua Metamorphic Complex (NMC)	Sandveld Group Nama quartzites and limestones
Western Karoo			
Tankwa Karoo	Upper Doring E Koue Bokkeveld (E21A-F, L) Tankwa E Lower Doring (E24B-H, upper part of E24K)	- Tertiary-Quaternary alluvials - Lower Beaufort Group - Ecca Group - Dwyka Formation - Witteberg Group (in S) - Bokkeveld Group - (upper TMG)	Tertiary-Quaternary alluvials Witpoort Aquifer Bokkeveld sandstones
Hantam	Upper Oorlogskloof (E40A-C) Hantams Kromme	- Tertiary-Quaternary alluvials - Karoo dolerites - Ecca Group - Dwyka Formation - (upper TMG) - (Nama Group) - (NMC)	Alluvials in Calvinia Karoo dyke and sill structures, in conjunction with sandstone members in otherwise generally shaly units

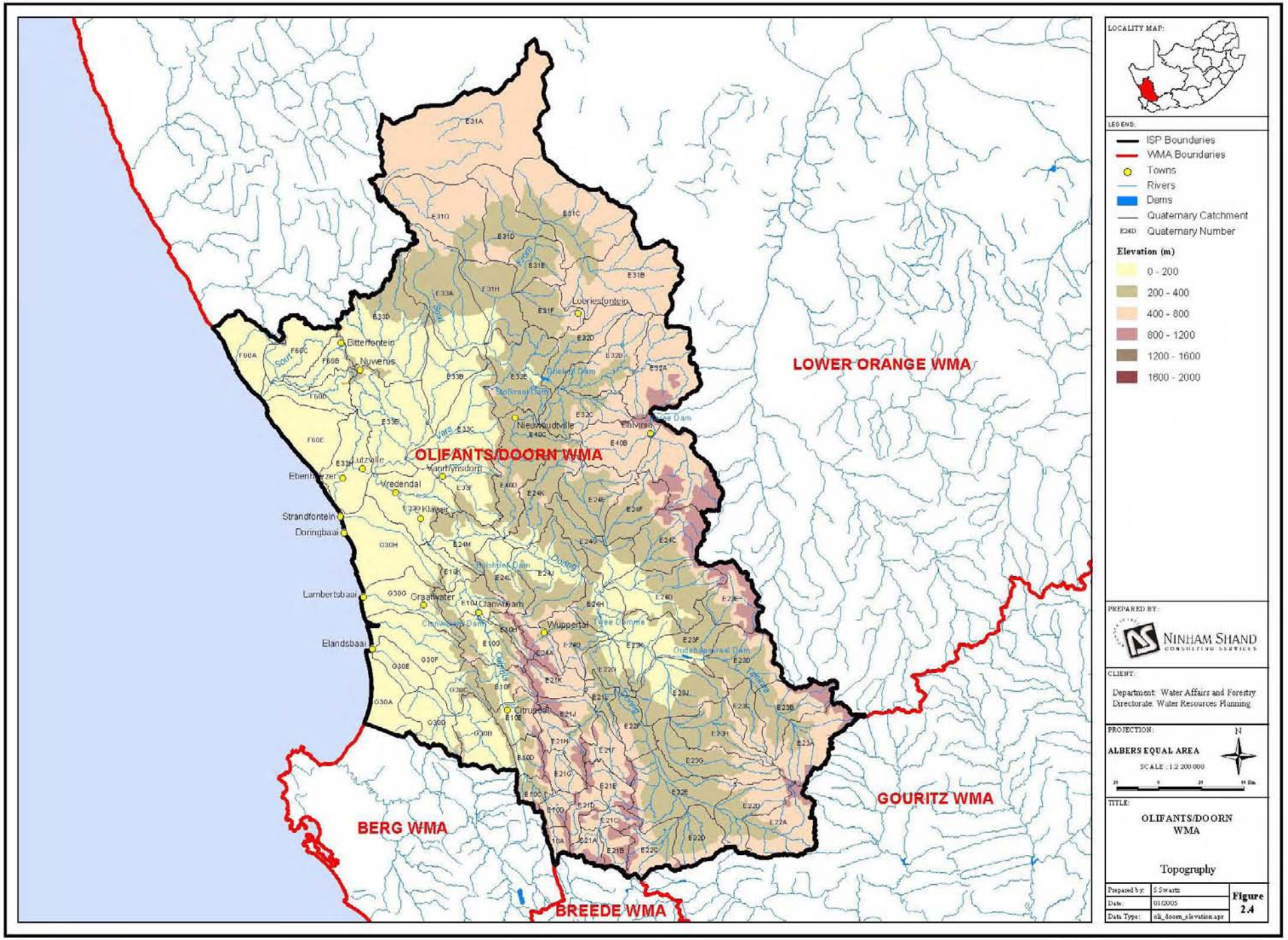

Figure 2.4: Topography

2.1.6 Vegetation

Due to the diverse soil types and variance in rainfall distribution, vegetation is varied and includes at least six veld types and several thousand plant species. Karoo and Karroid Types, False Karoo Types, Temperate and Transitional Forest Types, Scrub Types, and Sclerophyllous Bush Types dominate the Olifants/Doorn WMA and these are described in more detail below.

Karoo and Karroid types dominate the WMA, occupying some 75% of its area. The flora is characteristically low, typically less than 1 m in height, and includes scrub, bushes, dwarf trees and a few grasses. This vegetation type occurs where rainfall typically ranges between 150 mm and 500 mm, but does reach a maximum of up to 900 mm in some of the river valleys. Karoo and Karroid bushveld occurs at any altitude from sea level to 1 700 m above mean sea level (MSL).

False Karoo occurs predominantly in the north of the WMA, with small patches also occurring along the eastern and south-eastern boundaries. It is typified by low vegetation but, in contrast to Karoo type, contains more grassy elements. The areas occupied by this veld type are typically very arid and in parts may receive less than 100 mm of rainfall per annum. This veld type generally occurs below 1 200 m in elevation.

Temperate and Transitional Forest and Scrub is found in small patches towards the southern boundary of the WMA. As the name implies this veld type is typical of relatively temperate habitats. Temperate and transitional forest and scrub includes areas of forest, grasslands and fynbos and may be found from sea level up to 1 350 m. Rainfall is typically high, ranging from 650 to 1 150 mm per annum, although it may be somewhat lower within the coastal renosterveld and fynbos elements of this veld type, where it typically ranges between 300 to 500 mm per annum.

Sclerophyllous Bush is found in a broad band along the south-western portions of the WMA, just inland from the coast. This vegetation type, also referred to as Fynbos, contains a bewildering array of species which are characteristically small leafed (hence the term Sclerophyllous Bush). No single species dominates and there is a tremendous spatial turnover in species composition. The areas occupied by the Sclerophyllous Bush veld type are typically fairly mesic, receiving in excess of 500 mm, and up to 1 500 mm, of rainfall per annum.

Invasive alien plants (IAPs) cover an area of approximately 122 km^2, spread across the WMA. Much of the infested area is in the riparian zones. Acacias, Pines, Syringa, Eucalyptus and Prosopis are among the top ten genera of invading alien plants, which account for about 80% of the total water use by invasive alien plants. IAPs in the WMA are being eradicated through the DWAF Working-for-Water programme. This is further addressed under **Strategy No 8.6.**

2.1.7 Environmental protection and sensitive areas

Important conservation areas include the Tankwa-Karoo National Park, the Verlorevlei in the Sandveld (which enjoys Ramsar status), the Cederberg Wilderness Area, and the northern

section of the Groot Winterhoek Wilderness Area. The Olifants River and its tributary, the Doring River, are important from a conservation perspective, because they contain a number of species of indigenous fish that occur in no other river systems, and that are endangered. In addition, reaches of some of the tributaries are virtually unspoiled by human manipulation and are of high to very high ecological importance. The Olifants River estuary is still in a relatively pristine condition and is of high ecological importance. Lists of wilderness sites are included in **Appendix 2.**

The present condition of the river at the outlet of each quaternary catchment was determined in the 2002 Water Resource Situation Assessment (WRSA) in terms of habitat integrity, and referred to as the present ecological status class (PESC). The PESC was used to estimate the quantities of water required to maintain the rivers in their present condition. The NWRS assumed the management class of the rivers at the outlets of each sub-area as follows:

Table 2.2: NWRS Management Class of Rivers in each Sub-Area

Sub-area	Management class at catchment outlet (1)
Kouebokkeveld	B
Sandveld	C, D (2)
Olifants	D
Knersvlakte	C
Doring	C

1) A = Rivers of highest ecological status, D = Rivers of low to medium ecological status.
2) Varies for different coastal rivers.

The DWAF Directorate: Resource Directed Measures (RDM) has commissioned a Comprehensive Reserve Determination Study[3] (2003-2005) for the WMA. A separate Groundwater Reserve Study was undertaken in the Sandveld (Conrad, 2003). The formal public process leading up to Ministerial decisions on Management Classes and Reserves will be undertaken at a later stage.

There are several sites given protection as Natural Heritage Sites in the Olifants/Doorn WMA. The main rivers and their tributaries are rich in sites of archaeological/cultural interest. The nature of these sites is diverse, but consists mainly of Late Stone Age artefacts, including rock paintings, cave deposits and open scatters of debris related to occupation. Earlier material, in the form of Middle and Early Stone Age artefact scatters, is also present but less numerous. Colonial material in the form of building remains and graves also occurs. Lists of heritage sites are included in **Appendix 2.**

[3] This study is being undertaken by Southern Waters Ecological Research and Consulting cc. The groundwater Reserve and wetlands Reserve determinations will not be undertaken in this study.

2.1.8 Olifants River Estuary

The mouth of the Olifants River is permanently open. Tidal influence has been noted up to 36 km upstream during spring tides. Increased salinities caused by seawater intrusion can occur up to 15 km upstream, at the end of summer, when the freshwater input is low (Olifants/Doring River Basin Study Phase 1, 1998). The Olifants River estuary has the highest botanical importance rating of all South African estuaries investigated (Coetzee, 1997). Its botanical importance derives from the good condition and large areas of intertidal and supratidal salt marsh in the lower reaches. The estuary is particularly sensitive to decreases in river flow, flood frequency and the quality of river water.

The Olifants estuary is one of only three permanently open estuaries on the west coast of South Africa, the others being the Berg and the Orange. It therefore represents a critical habitat to many estuarine-associated fish species. Seasonal extremes in salinity mean that the benthic invertebrate species diversity is relatively low, with only 45 species recorded. Thirty fish species from 21 families have been recorded in the Olifants River estuary. The percentage of fish species in the estuary which are partially or entirely estuarine-dependent is higher than elsewhere in South Africa. This means that degradation of the estuary may have a significant impact on west coast fish (Olifants/Doring River Basin Study Phase 1, 1998).

The estuary supports at least 86 species of estuarine waterbirds and has a wide range of habitats. It plays an important role in bird migration and is considered to be in the top ten South African locations of importance for conservation of waterbirds (Olifants/Doring River Basin Study Phase 1, 1998).

2.1.9 Wetlands

There are wetlands and seeps throughout the WMA that play a critical role in ecosystem health. Many of these are not mapped or categorised. The most renowned wetlands in the WMA are those along the coast.

The coastal wetlands of Verlorevlei, Die Vlei (Wamakervlei), Wadriftsoutpan and Lambert’s Bay in the Sandveld are vulnerable due to the pressure placed on the groundwater resource by over-utilisation and pollution. The wetland area at Verlorevlei has been designated Ramsar status as a wetland of international importance. Verlorevlei is situated approximately 25 km south of Lambert's Bay, between the villages of Elandsbaai and Redelinghuys and is one of the largest natural wetlands along the west coast of South Africa. Several rare species are found at the site including the white pelican and eight other threatened bird species. A survey in the 1980s reported a total of 6 829 individual birds from 60 different species in the environs of Verlorevlei. Over multiple surveys more than 75 different species have been recorded. The site is one of the ten most important wetlands for wading birds in the south-western Cape Province, providing feeding, nesting and resting facilities to a large variety of birds.

2.1.10 Surface water-groundwater interaction

There is very little quantitative knowledge of surface-groundwater interaction in this WMA. Concerns have been raised about the impact of groundwater abstraction on the ecosystems.

Baseflow is low to zero in the regolith-dominated sub-areas of the Doring and Knersvlakte, indicating a very low, negligible groundwater contribution to surface water bodies. In the TMG-dominated areas of the WMA, elevation and depth of boreholes are more critical factors to consider than distance from a river in regulating groundwater abstraction with regards to impact on base flow. Most of the base flow in rivers originates from perennial springs and seep zones. Interaction between surface and groundwater from the TMG within the river course is limited to a few areas, where the Bokkeveld Formation is eroded.

Most of the streams and rivers in the upper regions and the relatively dry areas of the WMA are considered to be either (definitions by Vegter and Pitman, 1996):

- Detached (piezometric level always below streambed, no groundwater discharge);
- Intermittent (piezometric level slopes towards stream, recharge occurs occasionally) or
- Famished (piezometric level slopes towards the stream, but groundwater does not reach it due to evapo-transpiration.

Relevant surface-groundwater interaction is therefore limited to perennial springs and rivers embedded in alluvial aquifers.

2.2 DEMOGRAPHY, LAND USE AND DEVELOPMENT

2.2.1 Population

The Olifants/Doorn WMA is the least populated WMA in the country with approximately 0.25% of the national population residing in the area. In 1995, approximately 113 000 people lived in the WMA. **Table 2.3** details the population in each sub-area. More than half of the population live in urban or peri-urban areas, and the rest in rural areas. About 65% of the population is concentrated in the south-western portion of the WMA in the Koue Bokkeveld, Upper and Lower Olifants and Sandveld sub-areas. Population density over the Doring and Knersvlakte sub-areas is low (NWRS, 2004).

Table 2.3: Population in 1995

Sub-areas	Population
Upper and Lower Olifants	52 600
Koue Bokkeveld	9 700
Sandveld	26 400
Doring	15 800
Knersvlakte	8 500
TOTAL	**113 000**

(Source: NWRS WMA Report Figure 6)

A national study (Schlemmer *et al*, 2001) was undertaken by DWAF to develop water-use scenarios to the year 2025 for the NWRS. The average growth rate of the population in the area between 1980 and 1990 was about 0.5% per year. In most parts of the WMA the urban populations increased at about 0.5% per year and the rural population decreased at between 1% and 2% per year. The exception was the magisterial district of Vredendal where the

population of the town of Vredendal grew at 7% per year, to increase from 5 000 to 10 000 people between 1980 and 1990. The rural population in this magisterial district also grew at about 2% per year during the same period.

The general trend of an increasing urban population and associated decreasing rural population is expected to continue and can be attributed to the lack of strong economic stimulants, migration of young people and the impacts of HIV/AIDS (NWRS, 2004). Despite the general trend towards urbanisation, the 2025 base scenario suggests that little change can be expected in future urban growth in this WMA. It is anticipated that migration out of the WMA and HIV/AIDS will result in little overall growth.

There is strong in-migration of seasonal workers during the harvest and planting seasons. The number of migrants is believed to be tens of thousands (pers. comm. N Wullschelger, IWRM Project, 2003). This influx occurs particularly in the Koue Bokkeveld and Upper Olifants.

2.2.2 Land use and ownership

The mean annual precipitation over much of the area is less than 200 mm, with the result that, except in the wetter south-west, the climate is not suitable for dryland farming on a large scale. Consequently, more than 90% of the land in the Olifants/Doorn WMA is used as grazing for livestock, predominantly for sheep and goats. An estimated 2 190 km^2, or some 4% of the land area is cultivated for dryland farming.

Approximately 497 km^2 is under irrigation, of which almost 50% lies within the Upper and Lower Olifants sub-areas. Irrigated citrus, deciduous fruits, grapes and potatoes are grown on a large scale in the WMA and provide the mainstay of this WMA's economy (NWRS, 2004). In addition to the intensive irrigation practised along the Olifants River, significant irrigation also takes place in the Koue Bokkeveld (18%) and along the rivers and from groundwater in the Sandveld sub-area (10%).

Urban areas are small, covering a total land area estimated at only 31 km^2. There are a few small rural settlements, but they occupy an insignificant area of land. Mining activities include mining of heavy minerals, granite quarrying and offshore diamond dredging.

The ownership of land is dominated by the white farmer sector. Resource-poor farmers have limited access to good quality agricultural land and have been historically sidelined in terms of access to water. This WMA is water stressed and there is limited surplus available from existing sources. Additional water resource developments will be required for any further irrigation development. Although the local authorities and the provincial departments of land and agriculture have programmes in place to actively transform this ownership pattern, progress has been slow.

2.2.3 Socio-economic overview

The WMA is marked by inequality in income distribution along racial and urban/rural divides. The agriculture-dominated economy of the WMA shows a pattern of depopulation. A skewed age and skills profile exists with decreasing numbers of young educated people remaining in the area. Land ownership remains dominated by its former apartheid structure and previously

disadvantaged communities struggle with a lack of skills and capital to alter their *status quo*. In a needs assessment carried out in the 1990s, security of tenure, adequate housing and access to productive land were identified as the key development needs amongst the disadvantaged majority (Olifants/Doring River Basin Study Phase 1, 1998).

The northern and eastern parts of the WMA are characterised by high unemployment, are sparsely populated, have poor infrastructure and high poverty levels.

Despite significant contributions to the labour economy, gender-based discrimination limits economic growth of women in the WMA. Low levels of education and training, poor health and nutritional status and limited access to resources contribute to this barrier (Olifants/Doring River Basin Study Phase 1, 1998). Women are under-represented in decision-making structures. Traditional and social barriers limit women's participation and widen power gaps.

Entrepreneurial skills as well as general training are required together with infrastructural and financial support, in order to reverse the trend towards increasing poverty in the area (Olifants/Doring River Basin Study Phase 1, 1998).

2.2.4 Economic development

Nationally the agriculture sector contributes 4.6% to the Gross Domestic Product (GDP). In this WMA the agricultural sector contributes far more to the local economy (43.3%) than any other sector (see **Figure 2.5**). In 1997, the contribution to the Gross Geographic Product (GGP) of the WMA totalled R1.9 billion. Whilst emphasising the importance of agriculture in the regional economy of the WMA, it also highlights the relatively low level of activity in other sectors. The contribution from the Olifants/Doorn WMA to the national GDP is the lowest of any WMA in the country.

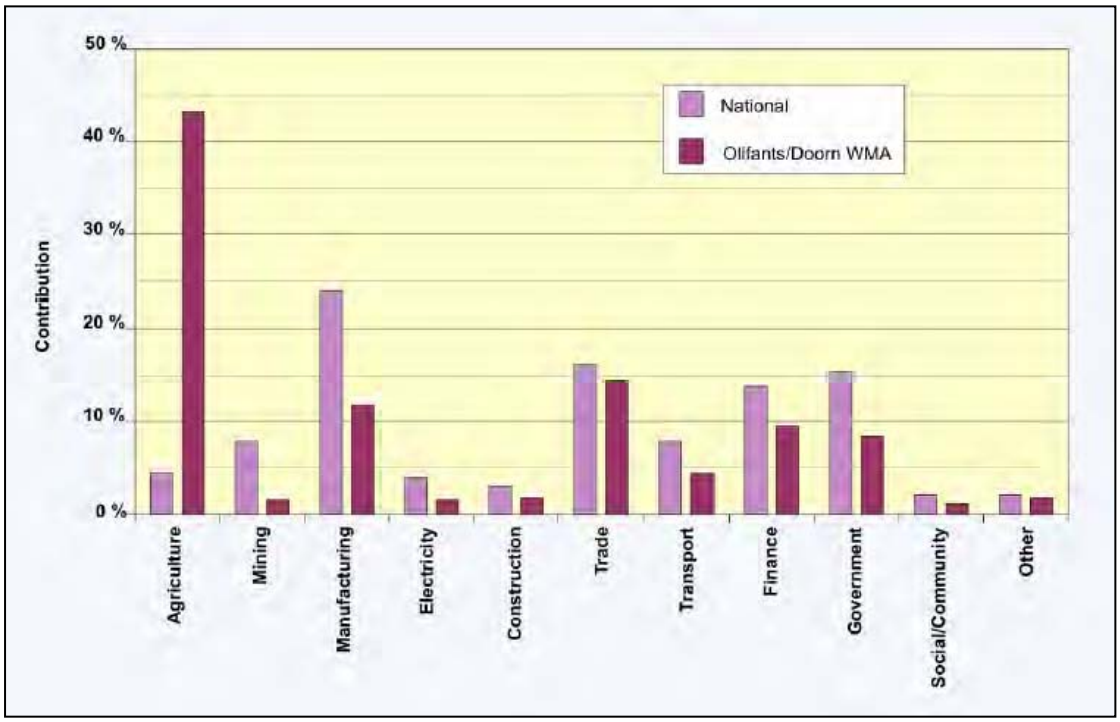

Figure 2.5: Sectoral contribution to the economy (source: Schlemmer, 2001)

Of the total labour force of 58 600 people, 8% were unemployed in 1994, which was much better than the national average of 29%. Approximately 75% of the labour force was active in the formal economy. 50% of the formally employed labour force worked in the agricultural sector, 20% in the government sector and only 9% in trade (all values are referenced to Schlemmer, 2001).

2.2.5 Agriculture and irrigation

Agricultural activities in this sector include a wide variety of crop types, many of which are high value produce. The cultivation of wine and table grapes, rooibos tea, citrus, deciduous fruit, wheat, potatoes, flower cultivation and wildflower harvesting, livestock and fisheries contribute to the sector. Wine and dried fruit are important value-added products.

Although it is estimated that a total area of about 497 km^2 of land is under irrigation, some of this is irrigated only in years when sufficient water is available. It is estimated that an average area of about 400 km^2 of crops grown under irrigation is harvested annually.

2.2.6 Strategic water use

The only power station in the area is a small privately owned hydro-electric installation (non-consumptive water user) at Clanwilliam Dam which once supplied additional electricity to the town of Clanwilliam. This facility has not been functional for the past few years due to the high operational costs.

2.2.7 Mining and industry

The only major mine in the area is the Namakwa Sands heavy minerals mine which is situated on the coast in the north-west of the WMA and is supplied with water via an allocation out of the Olifants River canal. There are also several granite quarrying operations in the vicinities of Vredendal and Vanrhynsdorp. Dredging for marine diamonds occurs offshore.

Industries in the WMA are small and the majority of them are concerned with the processing and packaging of agricultural products. Approximately only 3 million m^3/a of water is currently required by the mining and industrial sectors.

2.2.8 Forestry

Small commercial timber plantations, totalling 10 km^2, are established in the mountainous high rainfall areas in the south-west of the WMA, with very little impact on the water resource (total use one million m^3/a but negligible impact on available yield).

2.2.9 Tourism

Tourism is an important and growing component of the WMA economy. Clanwilliam Dam and the Cederberg Wilderness Area support numerous tourism-based businesses. The major

towns of the area have experienced a growth in tourism over the past 10 years. The coastal towns suffer from water shortages over the summer tourist season due to peak demand.

2.2.10 Institutional arrangements

There are no water boards in the Olifants/Doorn WMA and the municipalities are the responsible water services authorities. The water services authorities are:

- West Coast District Council;
- Namakwa District Council;
- Boland District Council *(very small area included in WMA 17)*;
- Central Karoo District Council *(very small area included in WMA 17)*;
- Cederberg Municipality;
- Matzikama Municipality;
- Witzenberg Municipality;
- Hantam Municipality;
- Kamiesberg Municipality;
- Karoo Hoogland Municipality;
- Franswil Municipality.

The following water user associations have been established in the WMA:

- Lower Olifants River;
- Citrusdal;
- Clanwilliam;
- Vanrhynsdorp.

Eleven catchment forums have been established to build capacity in water resource management and to inform the development process of the Olifants/Doorn Catchment Management Agency (CMA) and these cover the entire WMA. The DANIDA IWRM project played a key role in these developments.

The WMA falls within both the Western Cape and Northern Cape provinces. The DWAF has a catchment manager based in the Bellville Regional Office who manages the entire WMA, until management functions can be progressively transferred to the CMA to be established. Where appropriate, provincial inputs to DWAF managerial decisions can be provided through both the Western Cape and Northern Cape Provincial Liaison Committees (PLCs), and their Co-ordinating Committee for Agricultural Water (CCAW) sub-committees. The main members of the CCAW are the DWAF Regional Office and the Provincial Department of Agriculture, but other provincial departments, the DWAF Head Office Planning Directorates and some national departments such as Land Affairs and DEAT also provide input. The CCAWs, previously known as the Irrigation Action Committees, are specifically responsible for liaising on the issue of irrigation water and irrigation development, including provision of water for resource-poor farmers.

2.2.11 International links and links with other WMAs

The WMA borders on the Lower Orange WMA to the north and east, the Gouritz, Breede and Berg WMAs in the south, and the Atlantic Ocean in the west. The Olifants/Doorn WMA area does not border on any neighbouring country and is not linked to any other country through the transfer of water.

The only inter-water management area transfer is a transfer of 2.5 million m^3 per year from the Breede WMA (H20C) to the Olifants/Doorn WMA via the Inverdoorn canal for irrigation purposes. No water transfer from this WMA to other WMAs is taking place nor is any planned.

2.3 WATERWORKS

2.3.1 Olifants River (Vanrhynsdorp) Government Water Scheme

The Bulshoek Weir and a canal system to irrigate land extending along the Olifants River to close to its mouth were completed in 1923. In 1935 construction of the original Clanwilliam Dam was completed, to make more water available for the scheme. Since then, improvements and extensions to the scheme have been made at intervals. A substantial raising of the Clanwilliam Dam was carried out in the late 1960s. Clanwilliam Dam and Bulshoek Weir are state-owned. The Lower Olifants River Water User Association (LORWUA) operates Bulshoek Weir. These dams are the storage components of the Olifants River (Vanrhynsdorp) Government Water Scheme which is operated and maintained by LORWUA. The last Dam Safety Report stated that the Clanwilliam Dam wall requires strengthening to meet the national safety requirements. According to the Departmental priority list the strengthening would be implemented by 2010.

Water is released from Clanwilliam Dam (live storage 122 million m^3) into the river to flow to Bulshoek Weir (live storage 5.7 million m^3), some 30 km downstream. Downstream of the weir water is distributed by a canal system consisting of main and distribution canals totalling 186 km in length. It is estimated that canal conveyance losses are of the order of 28%. **Strategy No. 9.1** deals with responses to this conveyance loss. The canal system is used for irrigation, domestic and industrial supplies for towns and for supply to the Namakwa Sands Mine, and a number of small mining activities.

Farmers with land between the dam and the weir abstract 18 million m^3/a from the releases by pumping directly from the river and the Clanwilliam canal scheme, supplying approximately 1 673 ha. The canal from the Clanwilliam Dam also supplies 1 million m^3/a for domestic use in Clanwilliam. If the abstraction from tributary rivers is also taken into account, a total of approximately 27 million m^3/a is used for irrigation in the catchment area between the Clanwilliam Dam and Bulshoek Weir.

Other than Clanwilliam Dam and the Bulshoek Weir there are no other large state-owned dams in the WMA. There are numerous farm dams throughout the Upper Olifants and Doring catchments.

2.3.2 Other Irrigation Schemes

There are also a large number of privately owned irrigation schemes, namely:

- In the Koue Bokkeveld and in the Agter Witzenberg area (upper reaches of the Olifants River) a large number of farm dams have been constructed for the irrigation of deciduous fruit and vegetables. The total irrigated area is approximately 8 600 ha.
- At the confluence of the Tankwa and Doring Rivers water is abstracted from the Doring River for the irrigation of 350 ha of land from the water works of the Elandskaroo Irrigation Board.
- Oudebaaskraal Dam on the Tankwa River (quaternary E23F) is the largest privately owned dam in South Africa, with live storage of 34 million m^3. It seldom fills completely and supplies water irregularly to approximately 320 ha of land.
- Along the Olifants River upstream of Clanwilliam Dam there are numerous small individual private schemes with various abstraction systems, including pump stations, small diversion weirs, canals and off-channel dams mainly to irrigate citrus. The total irrigated area is approximately 10 700 ha.

2.3.3 Groundwater

a. Geohydrology

The major portion of the WMA is underlain by a shallow "regolith" (intergranular/-weathered-and-fractured) aquifer (refer to **Figure 2.6**). The fractured-rock aquifer systems in this WMA include the TMG Aquifers in the *Cederberg sub-province*, and parts of the Witteberg Group in the *Tankwa Karoo sub-province*. Another fractured-rock system is represented by Karoo dolerites in the *Hantam sub-province* on the eastern side of the WMA. Primary intergranular (porous sandy) aquifers occur most extensively in the western coastal (*Knersvlakte sub-province* and western Cederberg) and northern parts of the WMA. In the northern parts of the WMA (Knersvlakte and Hantam), these primary aquifers are related to alluvial deposits found on the older Tertiary land surfaces (e.g., Knersvlakte north of Vanrhynsdorp) around the drainage basin of a major river system that formerly connected the upper Orange (Senqu) and Vaal systems to the palaeo-Olifants River mouth.

b. Spring and borehole distribution

The mapped distribution of springs in this WMA (**Figure 2.6**) is based on the systematic hydrocensus survey of the Citrusdal Artesian Groundwater Exploration (CAGE) Project. Spring location is closely correlated with the TMG aquifers and "hydrotect" structures. It is assumed that there are many other springs in this WMA that are not shown in the available database. In the southern part of the Cederberg sub-province, particularly the E10 tertiary sub-catchment, hot springs emerge within the Peninsula Aquifer.

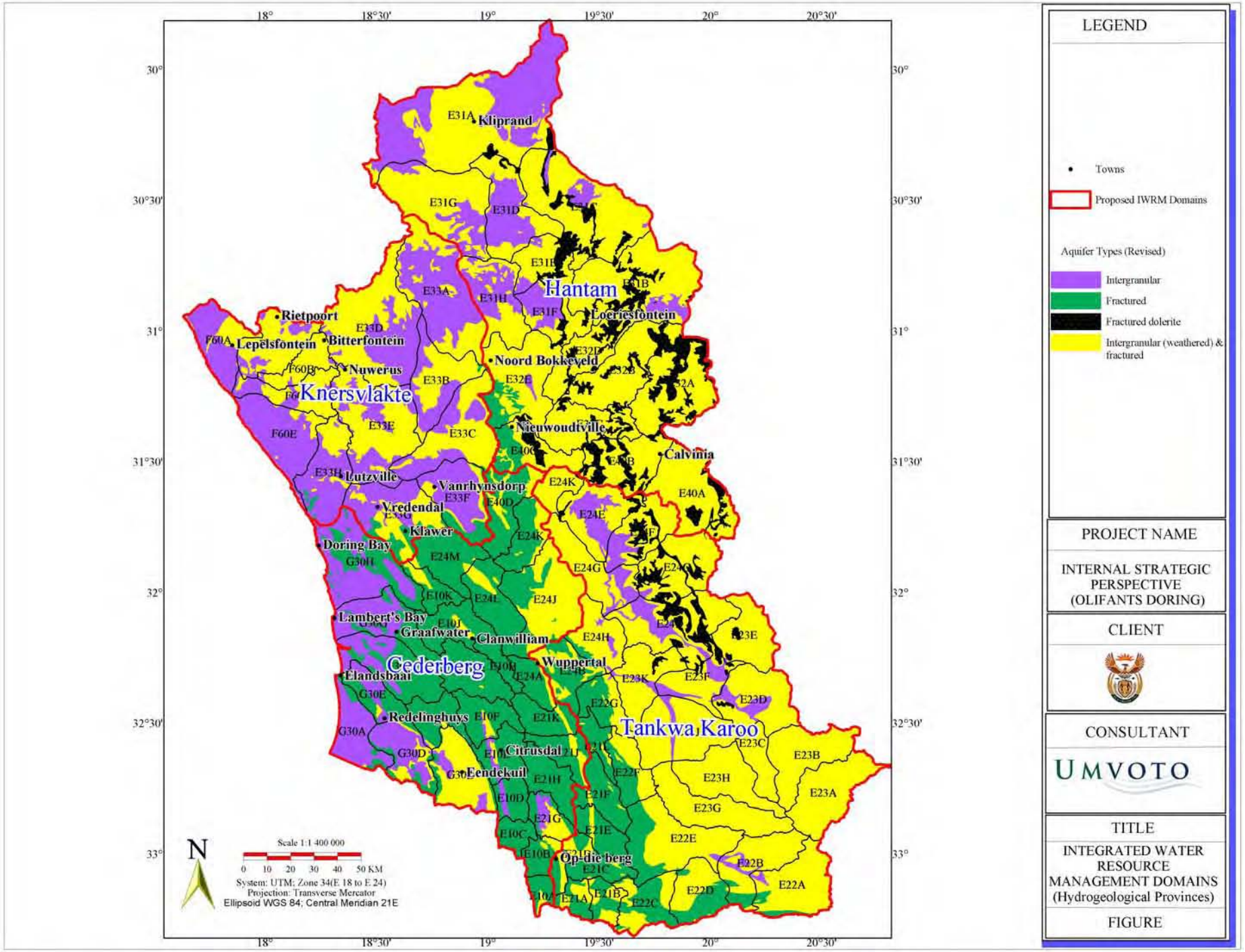

Figure 2.6: Hydrogeological sub-provinces showing naturally occurring springs

The borehole distribution on the National Groundwater Database (NGDB) reflects the actual pattern of use as well as an area-specific focus in data collection in the past (see **Appendix 4** for more detail).

There is a high density of boreholes in the Calvinia-Nieuwoudtville area (from shallow regolith, Karoo dyke and alluvial aquifers), and in TMG aquifers along the arid coastal plain between Elands Bay and Doring Bay. This reflects groundwater dependence.

There is an uneven spread of boreholes throughout the rest of the ISP area, with localised concentrations in the Koue Bokkeveld, in the Vanrhynsdorp area, and around Bitterfontein in southern Namaqualand. In all except in the alluvial and TMG instances mentioned above, the number of boreholes reflects good groundwater sources in spite of rather arid to semi-arid climatic conditions. The abstraction pattern shows a relatively high level of summer-season groundwater dependence, from whatever aquifer sources are locally available. The groundwater resource has not been systematically explored and developed, and its monitoring is uneven.

c. Aquifer recharge and yield

The recharge to the TMG aquifers is highest in the high mountains along the southern catchment boundary divide, around the Koue Bokkeveld and southern Cederberg ranges, which generally favours the exposed Peninsula Aquifer as the most sustainable source. In contrast to this, the estimated recharge in the northern part of the WMA, and over a wide area of the Tankwa Karoo in the rain shadow east of the Cederberg ranges, is less than 10 mm/a. The yields obtained to date (**Figure 2.7**) and the recharge distribution together indicate that the TMG fractured-rock aquifers should be the main groundwater exploration targets in this region.

The good correlation between the recharge and median yield map favours the use of groundwater for bulk water supply in the Upper Olifants (conjunctive use) and Sandveld (primary use) sub-areas.

The area of highest median yield (>5 ℓ/s) is shown on current DWAF maps to occur in parts of the TMG in the Agter Witzenberg and Koue Bokkeveld areas in the extreme south of the WMA, near Vanrhynsdorp in carbonate aquifers of the Nama Group, in primary aquifers in drainage channels leading to the Wadrif primary aquifer near Lamberts Bay, and along the Tra-Tra River northeast of Wuppertal. The southern and western portions of the TMG aquifers are shown to be associated with median yields in the range 2-5 ℓ/s, but this data appears to not account for recent high-yielding (>20 ℓ/s) boreholes in the Peninsula Aquifer around the Citrusdal area. The northern parts of the TMG and the Bokkeveld-Witteberg aquifers south of Wuppertal are associated with median yields between 0.5 and 2 ℓ/s. Higher areas of the western Karoo are shown to have similar (0.5-2 ℓ/s) median yields. Lower yields (0.1-0.5 ℓ/s) are obtained from areas underlain by Namaqua basement (regolith) aquifers, and along the lower Ecca Group strata in the Tankwa Karoo. Lowest yields (<0.1 ℓ/s) are reported from the Dwyka Formation in the Tankwa Karoo and from the Namaqua basement near the coast, north of the Olifants River mouth.

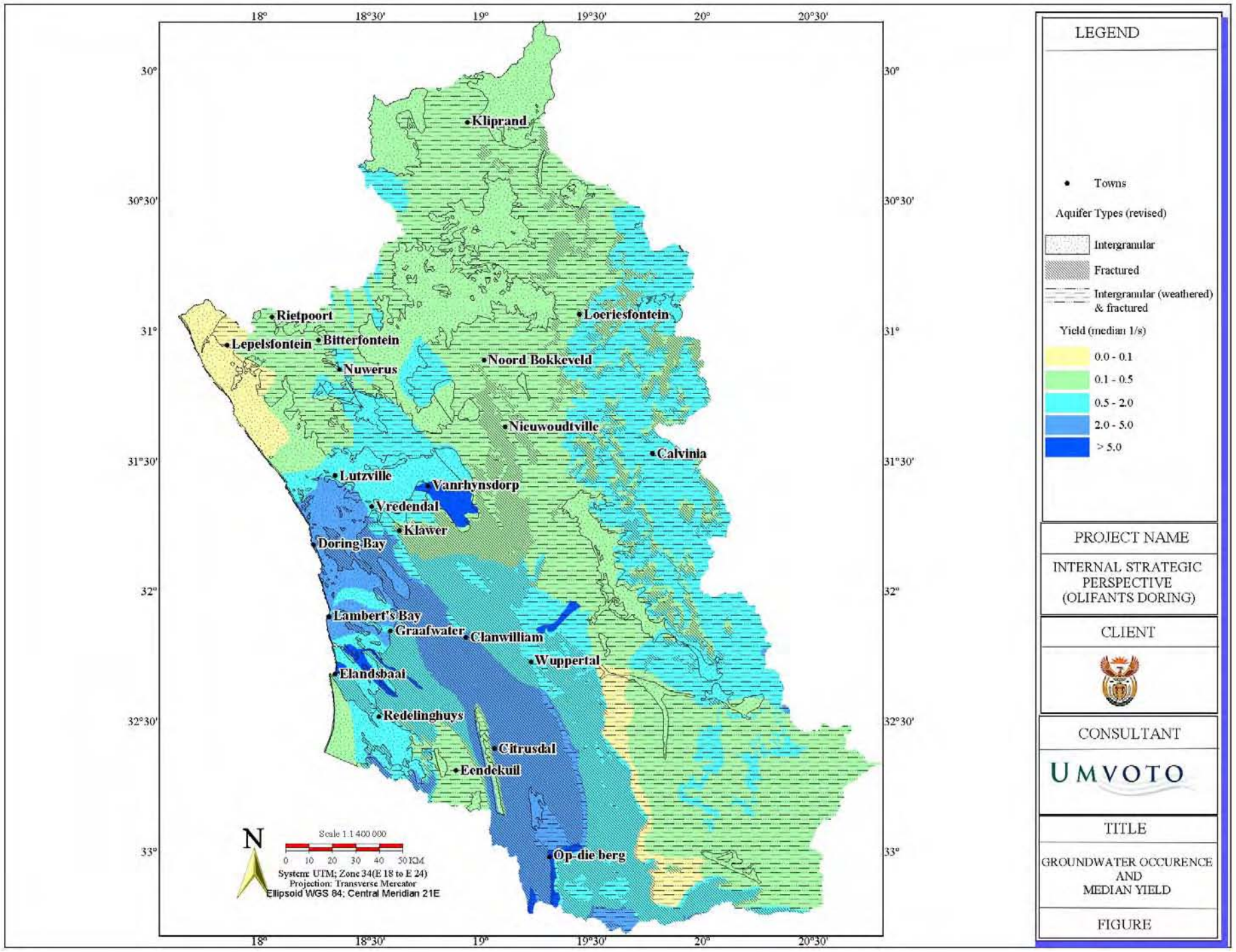

Figure 2.7: Groundwater Yields

2.3.4 Local water supply schemes

The water supply to towns in the WMA is detailed in **Appendix 9.**

Surface Water Supplies

The towns in the Olifants/Doorn WMA are all relatively small and most are supplied from local sources via infrastructure owned and operated by local authorities. There are a few exceptions, such as Klawer, Vredendal, Vanrhynsdorp, Lutzville, Ebenhaezer, Strandfontein and Doringbaai which are supplied via the Lower Olifants Government Scheme. The towns of Citrusdal and Clanwilliam obtain water directly from the Olifants River. Clanwilliam also abstracts from the Jan Dissels River upstream of its confluence with the Olifants River. The towns that are not supplied from the state-owned schemes have their own municipal supplies from local surface or groundwater sources.

Groundwater Urban and Rural supplies

Towns that are dependent or partially dependent on groundwater supplies are Loeriesfontein, Calvinia, Nieuwoudtville, Vanrhynsdorp, Bitterfontein-Nuwerus, Doringbaai, Lamberts Bay, Graafwater, Leipoldtville and Elandsbaai. Citrusdal supplements its summer water supplies with groundwater.

Southern Namakwaland Government Water Scheme

The Southern Namakwaland Government Water Scheme supplies desalinated groundwater from boreholes to the small towns of Bitterfontein and Nuwerus. This was implemented because of the severe shortage of suitable sources of surface water in those areas and groundwater of unfit quality. This scheme has recently been extended to supply the Rietpoort and Molsvlei communities.

2.3.5 Future requirements and identified infrastructural development options

Chapter 4 discusses the yield balance of the WMA in detail. This section provides a generalised picture of the future water requirements. There is not much growth anticipated in the urban areas within the WMA. There is however demand in the Koue Bokkeveld, Sandveld and Upper Olifants for agricultural expansion. The agricultural expansion in the Lower Olifants is currently limited by the infrastructural constraints of the canal and the fact that the yield of Clanwilliam Dam is over-allocated at a 1:50 year assurance of use. The historical agricultural growth and the demand for new allocations for resource-poor farmer initiatives, provides impetus to consider future development options. It should be noted that the ecological water requirements (EWR) are currently being determined in a Comprehensive Reserve Determination Study and provision for meeting the EWR must be a consideration when deliberating development options.

Reconciliation options are thoroughly discussed in **Chapter 6.** The development options shown in **Table 2.4** and **Figure 2.8** are possibilities that have been investigated for the WMA. It should be noted that the development of many of these options would be mutually exclusive. Currently the raising of Clanwilliam Dam is considered to be the most favourable surface water development option and is the subject of a feasibility study (see **Section 2.3.1**).

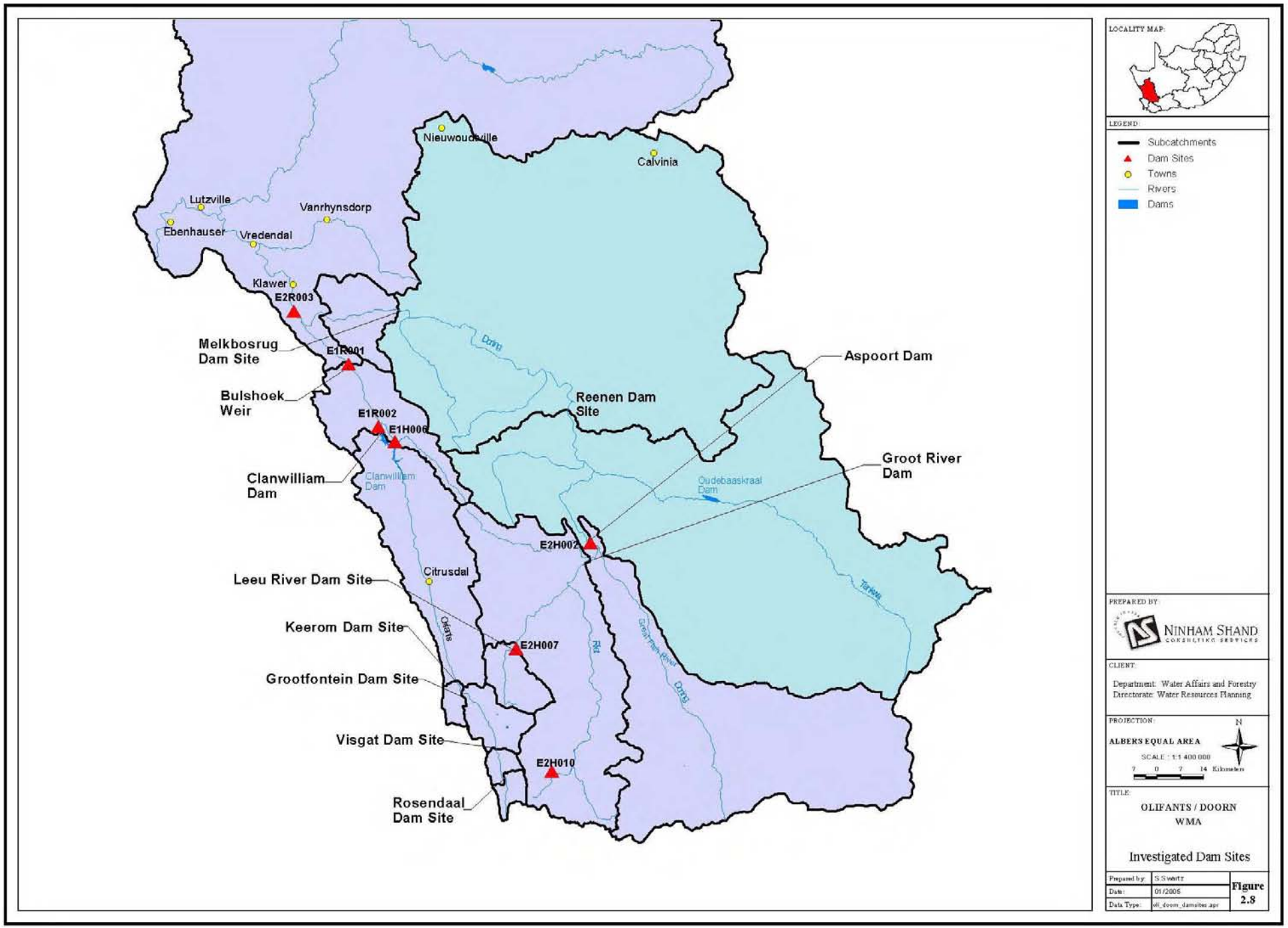

Figure 2.8: Basin Study indication of investigated dam sites

Table 2.4: Investigated Infrastructure Development Options

Name	Details	Location	Related Studies
OLIFANTS RIVER			
Additional off-channel farm dams	Cumulative capacity of 14 Mm^3 with a yield of 10 Mm^3/a	Upper Olifants	o Olifants Doring River Basin Study Phase 1 (1998) o Situation Assessment (2002)
Clanwilliam Dam Raising	Maximum additional capacity of 240 Mm^3 increase the yield by 40 Mm^3/a	Clanwilliam	o Olifants Doring River Basin Study Phase 1 (1998) o Situation Assessment (2002) o Olifants Doring River Basin Study Phase 2 (2003) o Raising of Clanwilliam Dam (starting 2004)
Grootfontein Dam	138 million m^3 capacity dam with a yield of 90 million m^3/a	Upper reaches of the Olifants River (downstream of the Visgat Gorge and at the head of the Citrusdal Valley)	o Olifants Doring River Basin Study Phase 1 (1998)
Keerom Dam	153 million m^3 capacity dam with a yield of 100 million m^3/a.	Upper reaches of the Olifants River (immediately upstream of the confluence with the Ratel River). Investigated as an alternative to Grootfontein Dam.	o Olifants Doring River Basin Study Phase 1 (1998)
Rosendaal Dam	26 million m^3/a capacity with a yield of 14 million m^3/a	Upper Olifants (Agter Witzenberg) 27 km directly north of Ceres	o Olifants Doring River Basin Study Phase 1 (1998) o Situation Assessment (2002) o Citrusdal Irrigation Board Study
Leeu River Dam	Unknown	Koue Bokkeveld on the Leeu River	Unknown
Visgat	Unknown	Upper Olifants (Agter Witzenberg)	Unknown
DORING RIVER			
Additional off-channel farm dams	Estimated capacity of 8 Mm^3 with a cumulative yield of 5 Mm^3/a	Lower Doring	o Olifants Doring River Basin Study Phase 1 (1998)
Aspoort Dam	395 Mm^3 capacity dam with a yield of 76 Mm^3/a	Aspoort on the main stem of the Doring River (Elandsdrift)	o Prov Government North Cape Study (1996) o Olifants Doring River Basin Study Phase 1 (1998) o Situation Assessment (2002)
Groot River Dam	159 million m^3/a capacity with a yield of 64 Mm^3/a	300 m downstream of the confluence with Matjies River on the farm Elandsdrift	o Olifants Doring River Basin Study Phase 1 (1998)
Melkboom Dam	388 Mm^3 capacity dam with a yield of 50 Mm^3/a	3 km upstream of the measuring and diversion weir, which is 1km upstream of the old Clanwilliam-Klawer Road	o Olifants Doring River Basin Study Phase 1 (1998) o Situation Assessment (2002) o WODRIS (2004)
Melkbosrug Dam	Capacity of 397 Mm^3 and a yield of 116 Mm^3 if no further abstraction upstream for irrigation	Lower Doring River, 37 km upstream of the confluence with Olifants River	o Olifants Doring River Basin Study Phase 1 (1998) o WODRIS (2004)
Brandewyn Dam	Input required from WODRIS	Off channel- close to confluence of Olifants and Doring	o WODRIS (2004)
Reenen Dam	Unknown	On the Doring River	Unknown
GROUNDWATER SCHEMES			
Wellfield T1	Capacity estimated between 5 and 20 Mm^3/a each	At the confluence of the Doring River with the Olifants River two wellfields on each side of Doring River to abstract groundwater from Peninsula Aquifer	WODRIS (2004)
Wellfield T2	Estimated Capacity between 3 and 10 Mm^3/a	On the right bank of the Olifants River, above the Bulshoek Weir. Wellfield abstract groundwater from Peninsula Aquifer	WODRIS (2004)
Wellfield T3	Estimated Capacity between 3 and 10 Mm^3/a	At the left bank of the Sandlaagte valley. Wellfield at Skurfkop Syncline to abstract groundwater from Peninsula Aquifer	WODRIS (2004)
Wellfield T4	Capacity was not assessed.	Brandewyn River valley above confluence with Doring River Wellfield in Brandewyn River Valley to abstract groundwater from both Skurweberg and Peninsula Aquifers	WODRIS (2004)
Wellfield T6	Capacity was not assessed	Katmakoep area between Vredendal and Strandfontein Wellfield in Katmakoep area to abstract groundwater from the Peninsula Aquifer	WODRIS (2004)
Aquifer Storage Recovery Scheme T5	Pump in and store water from the Olifants River	Sandlaagte Valley Aquifer -Storage Recovery Scheme in unutilised Sandlaagte Aquifer	WODRIS (2004)
Aquifer Storage Recovery Scheme T7	Pump in and store water from the Olifants River	Aquifer Storage Recovery Scheme in under-utilised Vanrhynsdorp dolomitic aquifer	WODRIS (2004)
Boschkloof Wellfield	Wellfield to supplement municipal bulk water supply for Citrusdal. Potential sustainable yield 15 – 20 Mm^3/a	Citrusdal	Citrusdal Municipality (1998)
CAGE	Estimated capacity of 45 Mm^3/a	Peninsula Aquifer in E10 catchment	CAGE (2000)