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A LEVEL I RIVER ECOREGIONAL CLASSIFICATION SYSTEM FOR SOUTH AFRICA, LESOTHO AND SWAZILAND

Final

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FOREWORD

This document is the final revision of the delineation of Level I River Ecoregions for South Africa. It collates the opinions and knowledge of experts in various parts of South Africa and replaces the preliminary versions that appeared as part of the Resource Directed Measures (RDM) documentation of the Department of Water Affairs and Forestry (DWAF) (Kleynhans et al. 1998a; Kleynhans & Hill 1999).

Although the Level I River Ecoregions are broadly useful for identifying the main characteristics of major rivers, their foremost purpose is to serve as a basis for the more detailed Level II delineations.

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SUMMARY

The rationale and fundamentals of the ecoregional typing of rivers entail the following:

- Chapter 3 of the National Water Act (NWA) of South Africa (Act No. 36 of 1998) refers specifically to the protection of the ecological reserve to realise long-term sustainable development.

- Chapter 14 of the NWA deals, amongst other aspects, with water resource monitoring and assessment.

- To enable the realisation of the protection and monitoring of the ecological reserve, it follows that the resource must be ecologically delineated and Resource Quality Objectives specified for various ecological components within this delineation.

South Africa is a geologically, geomorphologically, climatically and ecologically complex country, and this results in a diverse range of ecosystems, including rivers. River ecoregional classification or typing will allow the grouping of rivers according to similarities based on a top-down nested hierarchy. The purpose is to simplify and contextualise assessments and statements on ecological water requirements. One of the advantages of such a system is the extrapolation of information from data rich rivers to data poor rivers within the same hierarchical typing context. To realise the delineation of various river types within an ecological context it was decided to follow the ecoregional typing approach developed by Omernik (1987). This approach is presently applied by the USEPA as a framework for the formulation of reference conditions and to set resource quality specifications.

- Ecoregions can be identified or typed on the basis of various levels of detail. The principle of river typing is that rivers grouped together at a particular level of the typing hierarchy will be more similar to one another than to rivers in other groups.

- An ecosystems approach recognizes that ecosystem components do not function as independent systems but that they exist only in association with one another.

- Ecosystems and their components display regional patterns that are reflected in spatially variable combinations of causal factors such as climate, mineral availability (soils and geology), vegetation and physiography. These factors interact, but the importance of each factor in determining the character of ecosystems varies from place to place.

- Omernik's (1987) approach is based on patterns of terrestrial characteristics and on the premise that relatively homogenous areas exist and that these areas can be defined by simultaneously analysing a combination of causal and integrative factors. In this approach, ecoregions are regions of relative homogeneity in ecological characteristics or in relationships between organisms and their environments.

- Ecoregional classification uses multiple characteristics at each level of a typing hierarchy. Ecological regions are, then, regions within which there is relative similarity in the mosaic of ecosystems and ecosystem components (biotic and abiotic, aquatic and terrestrial).

- The delineation of ecological regions requires evaluating maps of all geographic phenomena believed to cause or reflect spatial differences in ecosystems. Where combinations of these phenomena coincide spatially, the ecosystems are likely to be similar. The process requires qualitative examination to account for the differences in generality, accuracy, and particular classifications of each map. The regions are essentially sketched (Omernik 1995; Omernik pers. comm. 1998), using expert judgement to delineate boundaries.

- Ecoregional classification is a hierarchical procedure that involves the delineation of ecoregions with a progressive increase in detail at each higher level of the hierarchy, i.e. essentially the same characteristics are used at the various levels but with more detail as one moves to a higher level in the hierarchy. In addition, the characteristics that are more or less important can vary from one place to another.

- It must be emphasized that although several terrestrial characteristics are used in ecoregional classification, the objective is to arrive at river ecoregions. Within this context, there may be terrestrial characteristics that are not of much use in typing river ecosystems. It follows, therefore, that the ecoregional typing process followed here relates primarily to river ecosystems and that any reference to ecoregions in the text are applicable to river ecosystems and are not meant to indicate the boundaries and characteristics of terrestrial ecoregions.

Based on attributes such as physiography, climate, rainfall, geology and potential natural vegetation (Kruger 1983; Schulze 1996; Low & Rebello 1996; van Riet et. al 1997), 31 Level I ecoregions were identified compared to the 18 Level I ecoregions previously delineated (Kleynhans & Hill 1999).

Following from the Level I delineation, the next phase of this project will delineate Level II ecoregions and will use the same typing attributes but in more detail. Level II ecoregions will provide a suitable link to stream channel characteristics. Stream classification is a separate hierarchy and

includes geomorphological classification according to zones, segments and reaches (Wadeson & Rowntree 1999). It is likely that the geomorphological segment level will provide information that can be linked to biological habitat segments (i.e. fish, invertebrate and riparian vegetation habitat segments) that can form a basis for the assessment and estimation of Ecological Reserve requirements.

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INTRODUCTION

The rationale for ecoregional typing in South Africa

The National Water Act (Act No. 36 of 1998) requires procedures for the determination of the Ecological Reserve, which has broadly been related to the water required to protect the aquatic ecosystems of the water resource. The Ecological Reserve refers to both the quantity and quality of water. Its protection requires specification of a class and resource quality objectives based on such a class. Focussing on ecological issues, resource quality objectives must be determined in terms of aspects such as:

- instream flow;
- water level;
- presence and concentration of particular substances in the water;
- characteristics and quality of the water resource as well as the instream and riparian habitat;
- characteristics and distribution of aquatic biota.

In addition to determination of ecological resource quality objectives, the NWA also makes provision for the establishment of a national monitoring system that must provide for the collection of appropriate data and information to assess the condition of ecological aspects such as:

- quantity of water in the various water resources;
- quality of water resources;
- rehabilitation of water resources;
- compliance with resource quality objectives;
- health of aquatic ecosystems.

It is generally accepted that ecological water requirements will vary widely due to the large diversity of abiotic and biotic conditions in South Africa. Depending on the scale, the determination of the Ecological Reserve and setting reference conditions to assess monitoring data, can be a potentially time consuming and resource intensive process. Ecological classification or typing will allow the grouping of rivers according to similarities based on a top-down nested hierarchical approach. The purpose of this approach is to simplify assessments and statements on ecological water requirements. One of the advantages of such a system is the extrapolation of information from data rich rivers to data poor rivers within the same hierarchical typing context. The ecoregional approach to river typing was developed by Omernik (Omernik 1987, 1995; Omernik & Bailey 1997) and is currently applied by the USEPA as a framework for the formulation of reference conditions and to set resource quality specifications.

Fundamentals of an ecoregional approach for South Africa

The principle of river typing is that rivers grouped together at a particular level of the typing hierarchy will be more similar to one another than rivers in other groups. Since the first attempt to type or classify South African rivers according to hydrobiological regions (Harrison 1959), a number of efforts have been made to classify rivers for various purposes (i.e. Brown *et al*. 1996; Eekhout *et al.* 1997; Everett & Quibell 1995; Noble & Hemens 1978). Although a lot of useful information was generated by these exercises, none of the procedures were refined up to the level where it could be used for the purposes of determination of the Ecological Reserve.

The South African approach that was initially the closest to the requirements of Ecological Reserve determination within a general framework was the bioregions approach (Brown *et al*. 1996). The Bioregions were developed as part of a protocol for the selection of reference and monitoring sites for the River Health Programme (RHP) the rivers component of the National Aquatic Ecosystems Biomonitoring Programme (NAEBP). Bioregions are strongly based on a bottom-up approach that takes into account known available distributional information on particular groups of aquatic biota (i.e. invertebrates and fish) at a tertiary catchment level (Midgley *et al.* 1994) to provide so-called biogeographical regions (Eekhout *et al.* 1997). During a workshop, individual scientists with knowledge on specific geographical areas endeavoured to provide a geographical context to these biogeographical regions. This process was augmented with detail information on physiography and resulted in the delineation of 18 bioregions as well as the identification of subregions (based on longitudinal river zonation) and a framework for the delineation of so-called river types (Brown *et al.* 1996). However, the applicability of the bottom-up part of this approach is dependent on the distribution records of aquatic biota being representative and relatively complete. This is to various degrees not true for all parts of South Africa and it was therefore decided that a more inclusive process should be followed for Ecological Reserve determination. This process is considered to be a nested top-down hierarchy. The Level I ecoregional typing is thus a refinement or modification of the RHP bioregion map as far as the upper level of the hierarchy is concerned i.e., the ecoregional approach only considers the physical/abiotic attributes of the geographical areas of South Africa. The ecoregional approach is intended to provide a more pragmatic basis from which ecological similarities between ecosystems can be derived and from which expected conditions can be specified. However, it must be emphasized that the biological distribution information used for bioregions should not be ignored, but should rather be used within the delineations provided by the ecoregional approach.

During a workshop on river ecoregional typing in February 1998, a decision was taken as to the conceptual approach that should be followed (Louw 1998). It was decided that the hierarchical ecoregional classification approach of Omernik (1987) should be followed for the purposes of the determination of the Ecological Reserve. Since then the development of the delineation of river types

for rivers of Mpumalanga (pilot study for the implementation of the RHP) and for the establishment of reference sites (Dallas & Fowler 2000), to a large extent followed the ecoregional approach.

CONCEPTS OF ECOREGIONAL CLASSIFICATION

Omernik & Bailey (1997) point out that an ecosystems approach recognizes that ecosystem components do not function as independent systems but that they exist in association with one another. This principle forms the basis of ecoregional classification.

Omernik (1987) defined the ecoregions of the USA on the principle that ecosystems and their components display regional patterns that are reflected in spatially variable combinations of causal factors such as climate, mineral availability (soils and geology), vegetation and physiography. These factors interact, but the importance of each factor in determining the character of ecosystems varies from place to place. Omernik's (1987) approach is based on patterns of terrestrial characteristics and on the premise that relatively homogenous areas exist and that these areas can be defined by simultaneously analysing a combination of determinants of causal factors. In this approach, ecoregions are regions of relative homogeneity in the patterns of ecological systems.

Another fundamental principle of ecoregional classification is the use of multiple characteristics at each level of a typing hierarchy. Ecological regions are then regions within which there is relative similarity in the mosaic of ecosystems and ecosystem components (biotic and abiotic, aquatic and terrestrial). Maps of single characteristics only illustrate regionalities in that characteristic. The delineation of ecological regions requires the evaluation of maps of all geographic phenomena believed to cause or reflect spatial differences in ecosystems. Where combinations of these phenomena coincide spatially, the ecosystems are likely to be similar. The process requires qualitative examination to account for the differences in generality, accuracy, and particular classifications of each map. The regions are essentially sketched (Omernik 1995; Omernik pers. comm. 1998), using expert judgement and local knowledge of ecosystem characteristics.

Ecoregional classification is a hierarchical procedure that involves the delineation of ecoregions with a progressive increase in detail at each higher level of the hierarchy, i.e. essentially the same characteristics are used at the various levels, but with more detail as one moves to a higher level in the hierarchy. In addition, the characteristics that are more or less important can vary from one place to another. In some mountainous areas, for example, altitudinal banding (where certain mosaics in the flora and fauna are also reflected in differences in precipitation, temperature, land use, soils etc.) reflects in ecological regions. In other regions, patterns in hydrology, vegetation, soils, and land-use follow distinct differences in bedrock or surficial geology (Omernik pers. comm. 1998).

For the determination of the Ecological Reserve within the framework of the ecoregional approach, the quantity and quality of water at any point in a river is a reflection of the aggregate of the characteristics of the drainage area upstream (or "up gradient") from that point. The definition of the areas within which this aggregate is similar will provide ecoregional delineation within which water quantity and quality will tend to be similar. Sets of reference sites (or conditions) for relatively undisturbed and disturbed watersheds within these regions can be used to extrapolate to other portions of each ecoregion. These reference sites/catchments can also be used to estimate contributions to larger basins that straddle more than one ecoregion (Omernik pers. comm. 1998).

Gallant *et al.* (1996) based the decision of when to delineate an area as an ecoregion on judgment that considers:

- The combination and pattern of environmental attributes present in the specific area compared to those in surrounding areas. The size and distribution of the attributes that make up a landscape pattern are important for deciding whether areas should be classified as separate regions or consolidated within a single region at a given level of regional resolution.

- That no fixed rules exist for designating a minimum area criterion for ecoregions. In Alaska, 10 000 km^2 or more is considered to be a "good" size for regions of state-level frameworks, i.e. Level I.

- That the resolution and accuracy of the reference materials imposes a limitation on the level of detail that can be depicted on an ecoregion map. Delineating regions that are more detailed than the bulk of the reference material from which they were defined is misleading. Ideally, regions should be less detailed than the components that were used to define them.

- That the intended use of the final framework affects the size and level of detail of the ecoregions. A general framework will have relatively large regions separated by smooth boundaries with fairly general descriptions listing only the major characteristics of each region. In contrast, a very refined framework will have small ecoregions (or more levels of regional hierarchy) with more intricate boundaries and more detailed descriptions of regional characteristics. Important here is that the purpose for creating the framework governs the level of detail that should be shown on the final product.

This document provides a delineation of ecoregions for South Africa at Level I of the hierarchy. Although the Level I River Ecoregions are broadly useful for identifying the main characteristics of major rivers, their foremost purpose is to serve as a basis for the more detailed Level II delineations.

This means that delineation and typing will mostly have to be done to Level II where it is expected that the determination of the Ecological Reserve becomes meaningful for management purposes. Level II ecoregions can then be linked to the river channel by following geomorphological stream classification principles (i.e. Frissell *et al.* 1986; Wadeson & Rowntree 1999).

The following summarizes the ecoregional typing and stream classification process:

Level I: This level of typing is based on the premise that ecosystems and their components display regional patterns that are reflected in spatially variable combinations of causal factors such as climate, mineral availability (soils and geology), vegetation and physiography (Omernik, 1987). In South Africa, physiography, climate, geology, soils and potential natural vegetation, have been used as the delineators of Level I.

Future delineation exercises will deal with the following:

Level II: The same characteristics as for the Level I typing is used, but in more detail. Level II typing will produce regional or sub-catchment scale ecotypes. Level II will be a suitable stage to link to stream classification. Due to the amount of detail required to progress beyond Level II (i.e. Levels III & IV), such delineations will probably not be done in the near future.

Stream Classification: This provides the approach in which the river can be typed according to a hierarchical geomorphological classification system (Wadeson & Rowntree 1999). This will be done within a particular ecoregion level (Level II at this stage). The hierarchical classification follows, in sequence:

- Segment,
- Longitudinal zone
- Reach, and
- Morphological units (more or less equivalent to habitats/biotopes).

Geomorphological segments: The level to which stream classification needs to be done will be determined by the detail required for the particular situation and whether this provides a suitable resolution and framework for management. At this stage, it seems that classification up to at least geomorphological segment level (Wadeson & Rowntree 1999), will provide this kind of information. Aspects such as channel slope, local hydrology and water chemistry will also be important considerations in the delineation of stream segments. Geomorphological segments should be identified within the context of the ecoregion (Level II in this case).

Biological habitat segments: The geomorphological segment (within its ecoregional level context) provides the physical template to which various biota respond. At this stage instream groups of biota such as invertebrates and fish, and riparian biota such as riparian vegetation provide entities that can be measured and also associated with particular environmental conditions. The geomorphological segment may be appropriate for some biota but not for others and this leads to the concept of the biological habitat segment (Ramm 1988). This means that some geomorphological segments may be combined for some biota (i.e. the species present are not different between two neighbouring geomorphological segments - this is often the situation with fish, and fish habitat segments may therefore be different from geomorphological segments). In contrast, geomorphological segments may be completely valid for, for example. riparian vegetation. It is also possible that although the species (i.e. fish) present in two geomorphological segments may be identical, the factors controlling the fish assemblages are different (i.e. different guilds of species may be more common in respective segments). The implication is that the Ecological Reserve and the factors determining it may be different although the species present are the same (cf. Kleynhans 1999).

COMPONENTS OF ECOREGIONAL CLASSIFICATION

As indicated previously, the procedure followed for Levels I and II ecoregional typing is essentially the same in the sense that the same attributes are used but in more detail at the higher level of the hierarchy (Figure 1). Stream classification is also shown in Figure 1 in order to indicate the possible linkage with the ecoregions.

Map overlays of the various variables were prepared and used to qualitatively determine ecoregions. This process was repeated several times until the resulting delineations could not be improved upon based on the available information.

The following variables are considered in ecoregional classification:

Physiography

The detail of physiographic classification systems used for South Africa varies widely. However, the approach of Kruger (1983) provides an approximation of a hierarchical system, which is considered suitable for the purposes of ecoregional typing. The focus of the physiography was on the broad terrain morphological classes (Kruger 1983).

In addition to the above, the following physiographic aspects also formed part of the overall assessment (Schulze *et al*. 1997):

Relief:

This is an expression of the distance between the top of a slope/hill and the bottom. The following relief classes are distinguished:

- 0-30 m
- 0-130 m
- 30-210 m
- 30-450 m
- 130-450 m
- 450+ m
- 450-900 m
- 130-900 m
- 900+ m

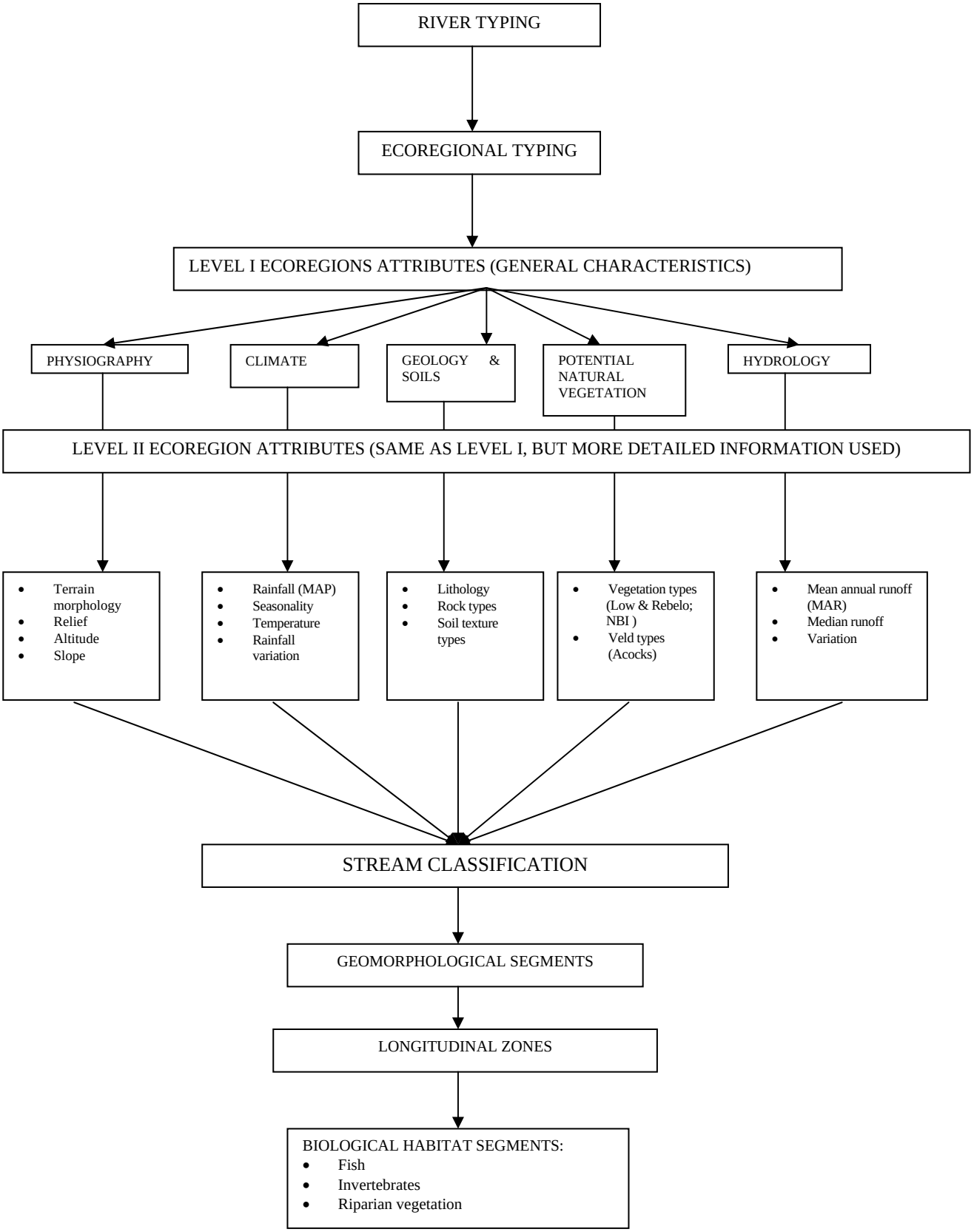


Figure 1: The ecoregional typing procedure.

The influence of relief on soil can be viewed in terms of higher tendency of soil loss and shallower soils occurring where greater relief is present. Flood peaks respond more rapidly with the steeper slopes that are associated with high relief.

Slope form (slope shape):

Concave slopes are steep near the top of the slope and flatten out towards the bottomlands. Soil moisture tends to accumulate at the foot of the slope by subsurface lateral moisture flow.

Convex slopes are flatter near the top and steepen towards the bottomlands.

Straight slopes indicate a generally even gradient down a slope.

Drainage density:

Indicates the length of river channel (km) per unit area (km^2). The higher the drainage density, the more rapidly a catchment discharges its runoff after a rainfall event.

Stream frequency:

This is the number of streams per unit area (streams/ km^2). In Southern Africa, stream frequency ranges from low (0.0-1.5), medium (1.5-6.0), high (6.0-10.5) to very high (10.5-13.5).

Area with slopes < 5%

This is usually used as an indication of the potential for cultivation. For the purposes of this document, lower percentages of flat land would indicate higher erosion and runoff potentials.

Altitude:

Topography is considered a static feature of the physical landscape, which is described by altitude, including the change of altitude over distance. Altitude as such exerts a major influence on macro-, meso- and micro- scale features of climate and on hydrological and ecological responses.

Information sources:

King (1942), Kruger (1983), Reader's Digest (1984), Brown *et al*. (1996), van Riet et al. (1997), Schulze *et al*. (1997) and US Geological Survey Relief Shading Images (1998).

Climate

Although several variables are indicative of climatic conditions, direct information is often spatially scattered and natural vegetation is often used as an indicator of climate (Rowe 1996).

Climate refers to the enduring regime of the atmosphere and represents a composite of day-to-day weather conditions and atmospheric elements within a specified place and over a long period of time (Schulze *et al.* 1997). The following individual climatic variables were considered:

Mean annual precipitation (MAP):

Information was obtained from Schulze *et al.* (1997).

Coefficient of variation (%) of annual precipitation:

It has been pointed out that on a monthly or seasonal basis, rainfall variability is considerably higher than on an annual basis. The map of inter-annual CV is thus a best-case scenario of rainfall variation (Schulze *et al.* 1997).

Rainfall concentration index:

This refers to spread of rainfall through the year where a concentration index of 100% would mean that all of a location's rainfall falls highly concentrated in one single month. A concentration index of 0% would indicate that the rainfall for each month of the year is the same. The higher the concentration index, the less spread of rainfall season over time. This is valid for high or low rainfall areas or in a winter or summer rainfall region (Schulze *et al.* 1997).

Rainfall seasonality:

Rainfall seasonality (i.e. the season during which rain predominantly falls) is indicated as (Schulze *et al.* 1997):

- All year,
- Winter,
- Early summer (December)
- Mid summer (January)
- Late summer (February)
- Very late summer (March to May)

Information Sources:

Midgley et al. (1994), Schulze *et al.* (1997).

Geology and soils

Geological information was not analysed in any detail. The map of the simplified geology of Southern Africa (Geology Map of South Africa, Lesotho and Swaziland, 1984: Council for Geoscience, Pretoria) was used as the main reference source. This indicated broad correspondence between geology, physiography and potential natural vegetation.

Information on soils followed Schulze *et al.* (1997) again with no attempt to analyse the information. The soil zone map provided indication of broad similarities between geology, physiography and potential natural vegetation.

Information Sources:

Anhaeusser & Maske (1986), Lurie (1994), Midgley et al. (1994), Schulze *et al.* (1997), van Riet *et al.* (1997) and Vegter (1995).

Potential natural vegetation

Natural vegetation is an integrated reflection of diverse variables such as climate, rainfall and geology and soils. The available vegetation classification systems for South Africa were not always done at the same scale for various parts of the country. At Level I in particular, various vegetation types (Low & Rebelo 1997) were combined for the delineation of some ecoregions.

Information Sources:

The classification of Low & Rebelo (1996) was primarily used. For broader reference purposes van Riet *et al.* (1997) and the vegetation biomes of Rutherford & Westfall (1994) were also used. In some cases, the veld types of Acocks (1988) provide information more suitable for use at the more detailed future Level II ecoregional typing. In certain parts of the country the Beta version (2004) of the National Botanical Institute's vegetation map was used.

LEVEL I ECOREGIONS FOR SOUTH AFRICA

At the resolution used for Level I ecoregions, phsysiography and vegetation types can be regarded as integrators of geology, soils, geomorphology and climate (cf. Rowe 1996). As a consequence, physiography (specifically terrain morphology) and vegetation types (or a combination of vegetation types) tended to be the primary delineators of ecoregions at Level I in terms of defining boundaries.

A total of 31 Level I ecoregions were delineated for South Africa (Figure 2).

The attributes of the delineated ecoregions are summarized and tabulated in the following section. The tables also indicate whether an attribute was used as a primary or modifying determinant of ecoregion boundaries. The summarized description for each ecoregion is limited to general attributes that are mostly related to the rivers and streams of the particular ecoregion. The following aspects are covered in the summarized section:

Terrain morphology,
Main vegetation types,
Mean annual precipitation,
Coefficient of variation of mean annual precipitation:
Drainage density,
Stream frequency,
Slopes,
Median annual simulated runoff
Mean annual temperature.

The maps used to delineate ecoregion boundaries are provided in the Appendix. Information on geology, soils, drainage density, stream frequency and percentage of slopes < 5% is presented only on maps in the Appendix.

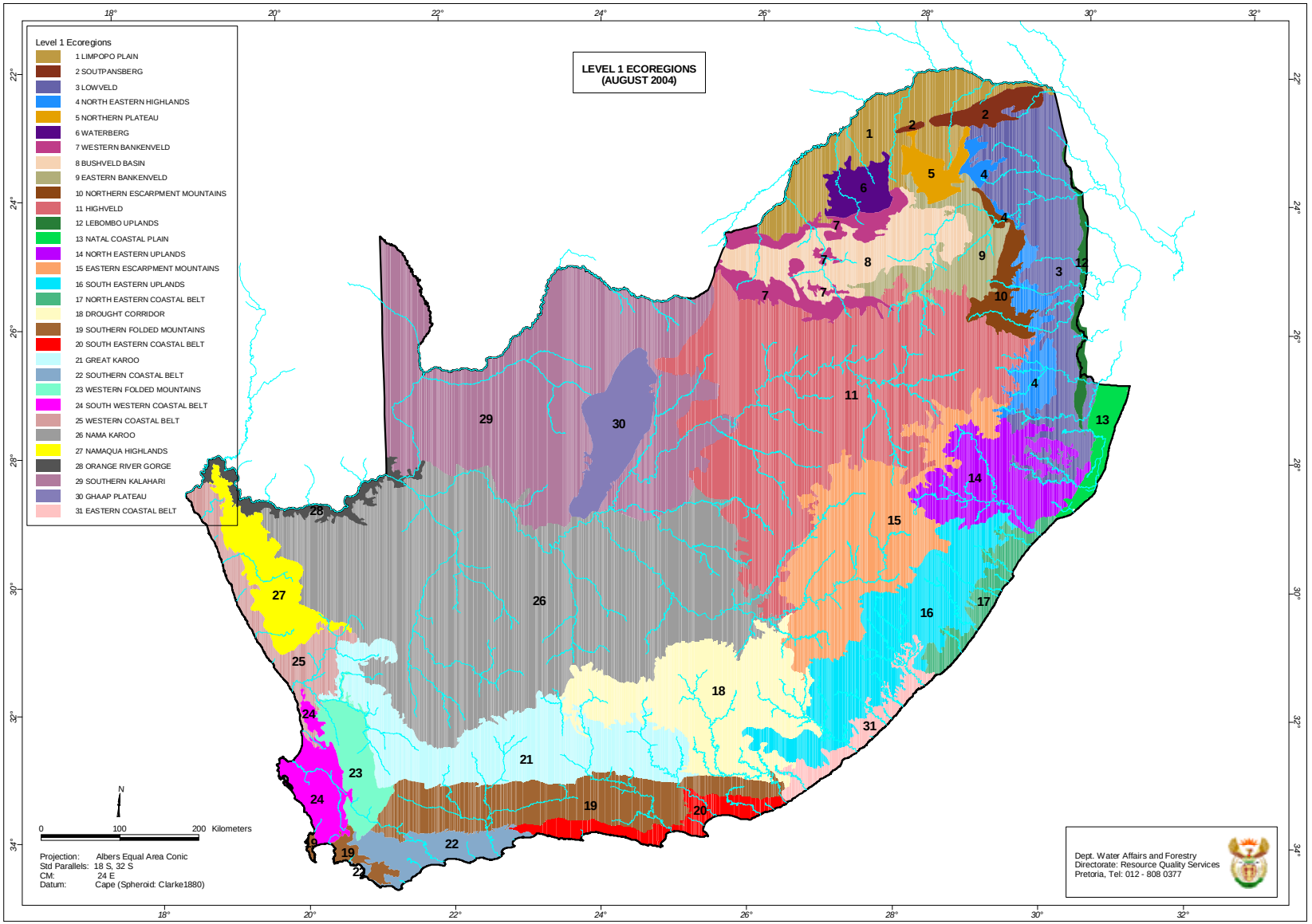


Figure 2: Level I River Ecoregions for South Africa, Lesotho and Swaziland.

ECOREGION 1: LIMPOPO PLAIN

Primary boundary determinants:
Plains and lowlands characterize this ecoregion with a low to moderate relief and vegetation consisting mostly of Bushveld types and Mopane veld, characterises this region.

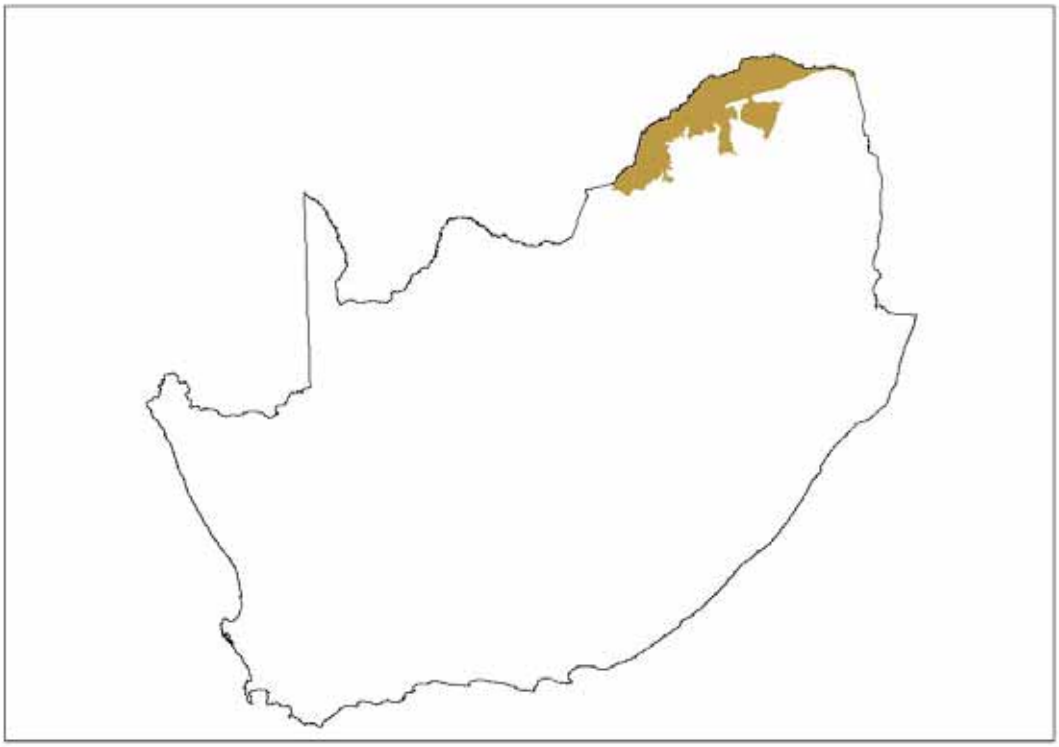
General:
This is generally a low laying, dry to arid, hot region with virtually no perennial streams originating in the area itself. Perennial rivers that traverse this region include the Crocodile (west), Marico, Mokolo, Lephalala, and Mogalakwena.

- Mean annual precipitation: Low to arid.
- Coefficient of variation of annual precipitation: Moderately high to high
- Drainage density: Mostly low but with some areas in the north having a high drainage density.
- Stream frequency: Mostly low to medium, but high in northeastern areas.
- Slopes <5%: Generally, >80% of the area.
- Median annual simulated runoff: Very low to low.
- Mean annual temperature: High to very high

Size = 39383.5 km^2

Table 1: Main attributes of the Limpopo Plain Ecoregion.

MAIN ATTRIBUTES	LIMPOPO PLAIN
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief**; Plains; moderate relief; Lowlands; Hills and Mountains; moderate and high relief; Closed hills; Mountains; moderate and high relief (limited)
Vegetation types (dominant types in bold) (Primary)	**Mopane Bushveld; Sweet Bushveld; Mixed Bushveld**; Waterberg Moist Mountain Bushveld; Clay Thorn Bushveld; Kalahari Plains Thorn Bushveld
Altitude (m a.m.s.l) (Secondary)	300-1100 (1100-1300 limited)
MAP (mm) (modifying)	200 to 600
Coefficient of Variation (%) of annual precipitation	25 to 40
Rainfall concentration index	60 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	18 to >22
Mean daily max. temp. (°C): February	26 to 32
Mean daily max. temp. (°C): July	20 to >24
Mean daily min. temp. (°C): February	16 to >20
Mean daily min. temp. (°C): July	2 to >10
Median annual simulated runoff (mm) for quaternary catchment	<5 to 60 (60-100 limited)



ECOREGION 2: SOUTPANSBERG

Primary boundary determinants:
This is a mountainous area characterised by moderate to high relief and vegetation consisting mainly of Bushveld types but with patches of Afromontane Forest. The Blouberg to the west of the Soutpansberg is included in this region.

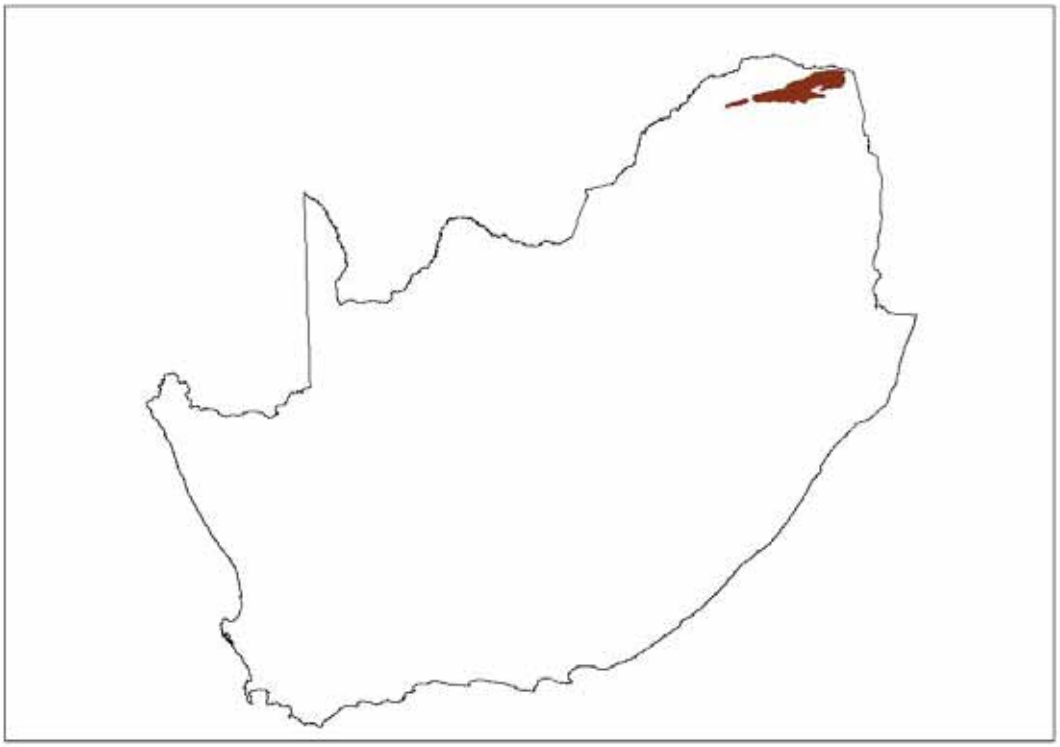
General:
Several streams have perennial sources in this region, e.g. the Luvuvhu, Mutale, Nzhelele, Nwanedzi and Brak.

- Mean annual precipitation: Generally moderate to high, but very high in isolated spots towards the east.
- Coefficient of variation of annual precipitation: Varies from very low to moderate
- Drainage density: Medium
- Stream frequency: Medium to high
- Slopes <5%: <20% of the region.
- Median annual simulated runoff: Mostly moderate but high to very high in spots in the south.
- Mean annual temperature: Mostly moderate, but very hot in the east.

Size = 7323.2 km^2

Table 2: Main attributes of the Soutpansberg Ecoregion.

Main Attributes	**SOUTPANSBERG**
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; (limited) Plains; Moderate Relief; (very limited) Lowlands; Hills and Mountains; Moderate and High Relief; **Closed Hills; Mountains; Moderate and High Relief**;
Vegetation types (dominant types in bold) (Primary)	**Sour Lowveld Bushveld; Soutpansberg Arid Mountain Bushveld;** Mopane Bushveld (very limited) Patches AfroMontane Forest.
Altitude (m a.m.s.l) (secondary)	300-1700
MAP (mm) (modifying)	200 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	55 to >65
Rainfall seasonality	Mid summer
Mean annual temp. (°C)	16 to >22
Mean daily max. temp. (°C): February	22 to 32
Mean daily max. temp. (°C): July	16 to >24
Mean daily min. temp. (°C): February	14 to >20
Mean daily min temp. (°C): July	4 to >10
Median annual simulated runoff (mm) for quaternary catchment	<5 to 200; >250 (limited)



ECOREGION 3: LOWVELD

Primary boundary determinants:

This hot and dry region is characterised by plains with a low to moderate relief and vegetation consisting mostly of Lowveld Bushveld types. Open hills with high relief and low mountains with high relief are present towards the west on the boundary with the North Eastern Highlands. In the north Mopane Bushveld and Mopane Shrubveld occur.

General:

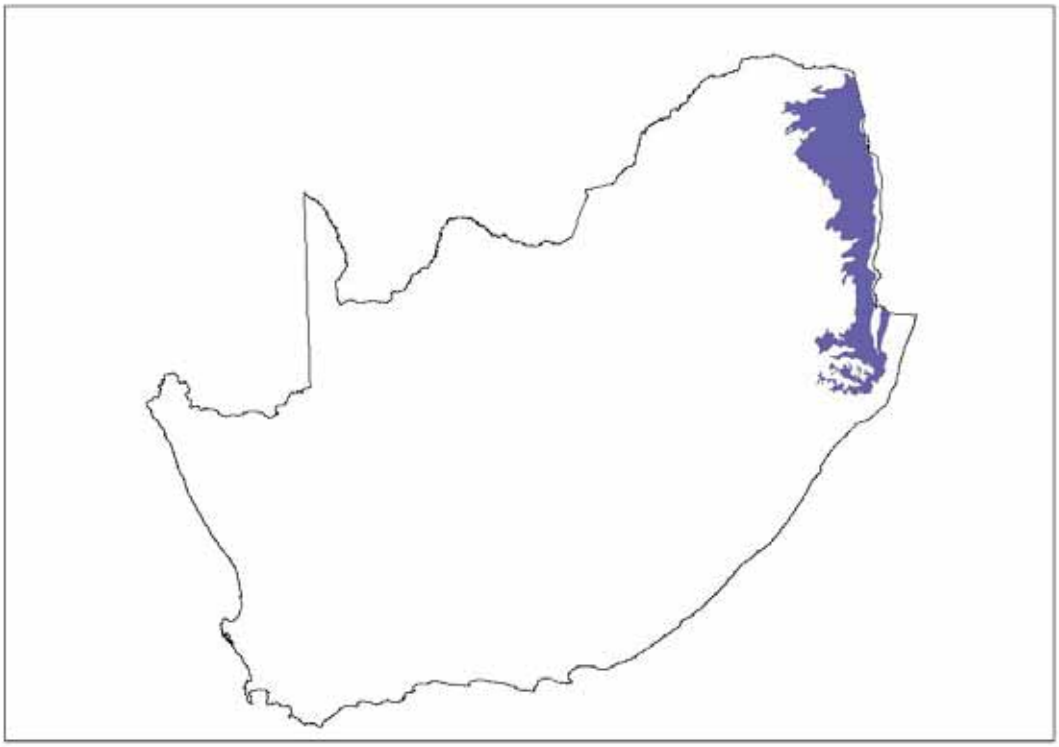
Although several large perennial streams traverse this region, e.g. White and Black Umfolozi, Mkuze, Pongolo, Great Usutu, Komati, Crocodile, Sabie, Olifants, Letaba and Luvuvhu, few perennial streams originate here.

- Mean annual precipitation: Tends to be moderate towards the west, but low over most of the region.
- Coefficient of variation of annual precipitation: Mostly moderate.
- Drainage density: Mostly low, but high in some of the central areas.
- Stream frequency: Mostly low to medium but high in some of the central areas.
- Slopes <5%: >80% of the area.
- Median annual simulated runoff: Mostly low/moderate, but moderate in areas.
- Mean annual temperature: High to very high.

Size = 56852.5 km^2

Table 3: Main attributes of the Lowveld Ecoregion.

Main Attributes	Lowveld
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; **Plains; Moderate Relief**; Lowlands, Hills and Mountains; Moderate and High Relief (limited) Open Hills, Lowlands; Mountains; Moderate to High Relief; (limited) Closed Hills; Mountains; Moderate and High Relief (Limited)
Vegetation types (dominant types in bold) (Primary)	**Mopane Bushveld;** Mopane Shrubveld; **Mixed Lowveld Bushveld;** Sour Lowveld Bushveld; Sweet Lowveld Bushveld; Natal Lowveld Bushveld; Lebombo Arid Mountain Bushveld; Mixed Bushveld North Eastern Mountain Grassland;
Altitude (m a.m.s.l) (secondary)	0-700; 700-1300 limited
MAP (mm) (modifying)	200 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	30 to >65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	16 to >22
Mean daily max. temp. (°C): February	24 to 32
Mean daily max. temp. (°C): July	18 to >24
Mean daily min. temp. (°C): February	14 to >20
Mean daily min temp. (°C): July	4 to >10
Median annual simulated runoff (mm) for quaternary catchment	10 to >250



ECOREGION 4: NORTH EASTERN HIGHLANDS

Primary boundary determinants:

This is a mountainous area characterised by closed hills and mountains with moderate to high relief and vegetation comprising North-Eastern Highveld Grassland and Lowveld Bushveld types. Patches with Afromontane Forest are scattered throughout the region.

General:

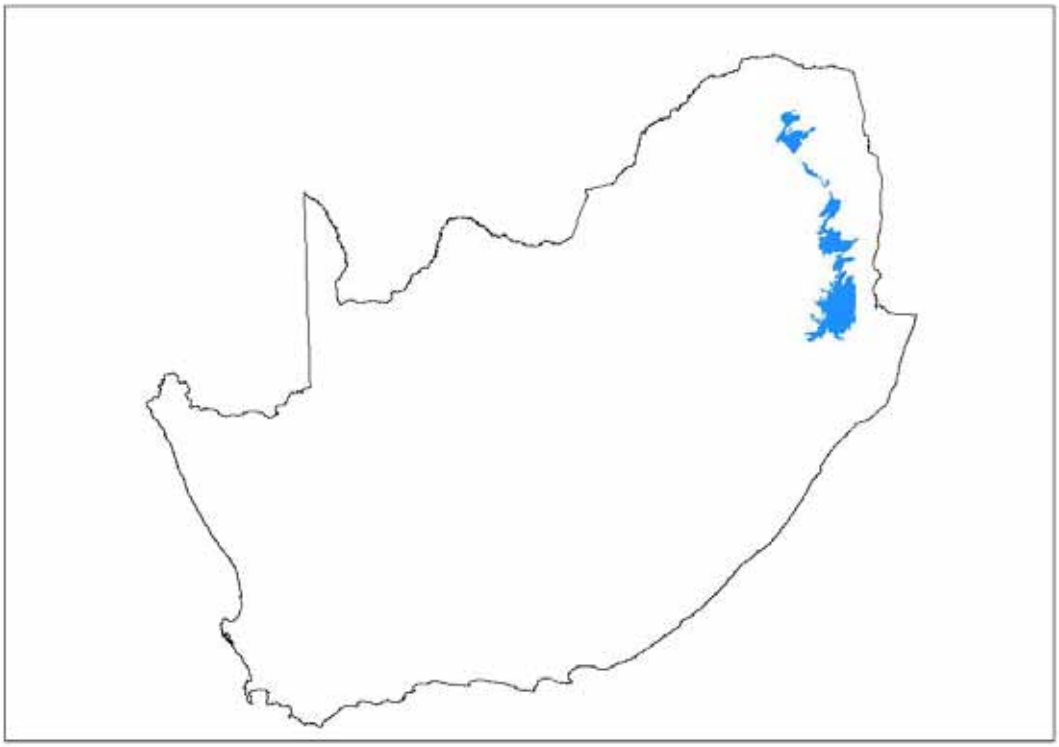
Generally, this ecoregion can be regarded as transitional between the Lowveld and the Northern Escarpment. Towards the south, larger rivers such as the Great Usutu and Pongolo have some of their sources here, while perennial tributaries commonly contribute to the flow of larger rivers along the length of the region.

- Mean annual precipitation: Moderate to high.
- Coefficient of variation of annual precipitation: Moderate to very low.
- Drainage density: Generally medium
- Stream frequency: Low/medium to medium high
- Slopes <5%: Varies from <20% to 25 – 50%.
- Median annual simulated runoff: Moderate/high to high.
- Mean annual temperature: Cool to moderate

Size = 16140.3 km^2

Table 4: Main attributes of the North Eastern Highlands Ecoregion.

MAIN ATTRIBUTES	NORTH EASTERN HIGHLANDS
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Moderate Relief** Open Hills, Lowlands, Mountains; Moderate to High Relief Closed Hills, Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Primary)	Mixed Bushveld; Mixed Lowveld Bushveld; **Sour Lowveld Bushveld;** Natal Lowveld Bushveld (limited) **North Eastern Mountain Grassland;** Patches Afromontane Forest
Altitude (m a.m.s.l) (primary)	300-1300 (1300-1500 limited)
MAP (mm) (modifying)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 30
Rainfall concentration index	50 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	16 to 22
Mean daily max. temp. (°C): February	24 to 32
Mean daily max. temp. (°C): July	18 to>22
Mean daily min. temp. (°C): February	14 to 20
Mean daily min temp. (°C): July	2 to 10
Median annual simulated runoff (mm) for quaternary catchment	20 to >250



ECOREGION 5: NORTHERN PLATEAU

Primary boundary determinants:

The topography, dominated by plains with low to moderate relief is characteristic of this plateau. Vegetation consists mainly of Mixed Bushveld, but with limited areas of North-Eastern Mountain Grassland also being prominent.

General:

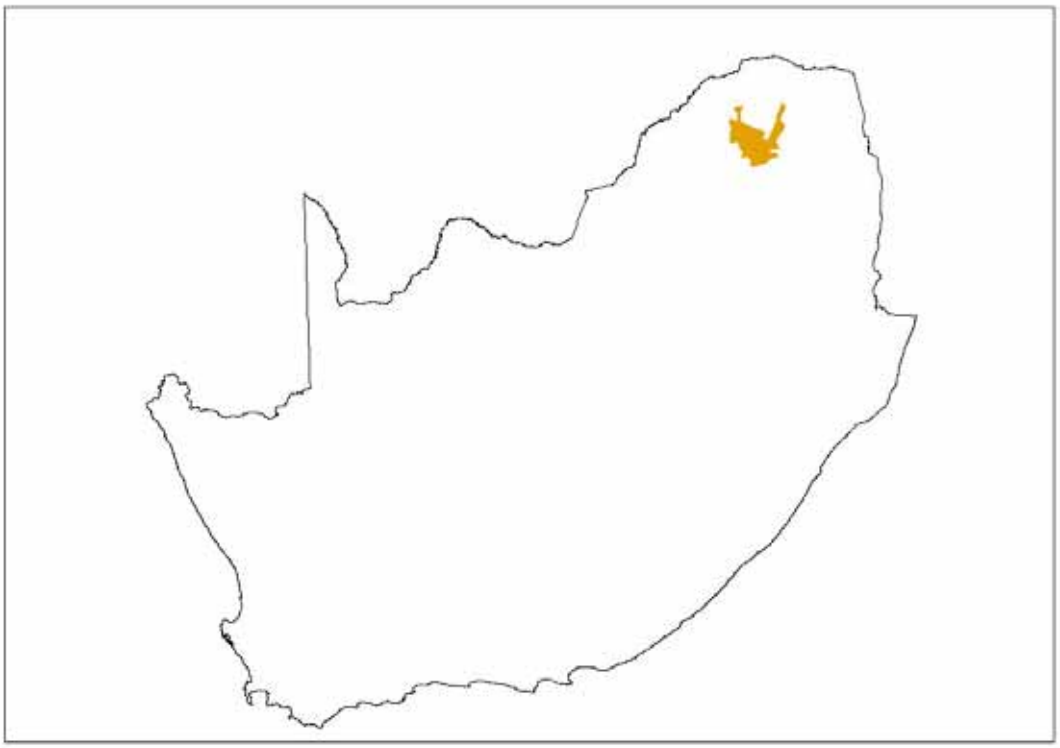
The seasonally flowing Sand River is the major river here. No perennial streams have their sources in this region. Some reflection of this is the low drainage density here.

- Mean annual precipitation: Generally moderate
- Coefficient of variation of annual precipitation: Moderate
- Drainage density: Low
- Stream frequency: Low to medium
- Slopes <5%: >80%.
- Median annual simulated runoff: Low to moderate.
- Mean annual temperature: Moderate.

Size = 7245.9 km^2

Table 5: Main attributes of the Northern Plateau Ecoregion.

MAIN ATTRIBUTES	NORTHERN PLATEAU
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief;** **Plains; Moderate Relief;** Closed Hills; Mountains; Moderate and High Relief (Limited)
Vegetation types (dominant types in bold) (Primary)	**Mixed Bushveld;** Clay Thorn Bushveld (limited): North Eastern Mountain Grassland (Limited)
Altitude (m a.m.s.l) (secondary)	900-1500 (1500-1700 limited)
MAP (mm) (modifying)	300 to 700
Coefficient of Variation (% of annual precipitation)	25 to 35
Rainfall concentration index	60 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	16 to 20
Mean daily max. temp. (°C): February	24 to 30
Mean daily max. temp. (°C): July	18 to 24
Mean daily min. temp. (°C): February	14 to 20
Mean daily min temp. (°C): July	2-5
Median annual simulated runoff (mm) for quaternary catchment	10 to 60; 60 to 80 (limited)



ECOREGION 6: WATERBERG

Primary boundary determinants:
The Waterberg is predominantly a tableland with moderate to high relief. Bushveld types dominate the vegetation with Waterberg Moist Mountain Bushveld being the most common.

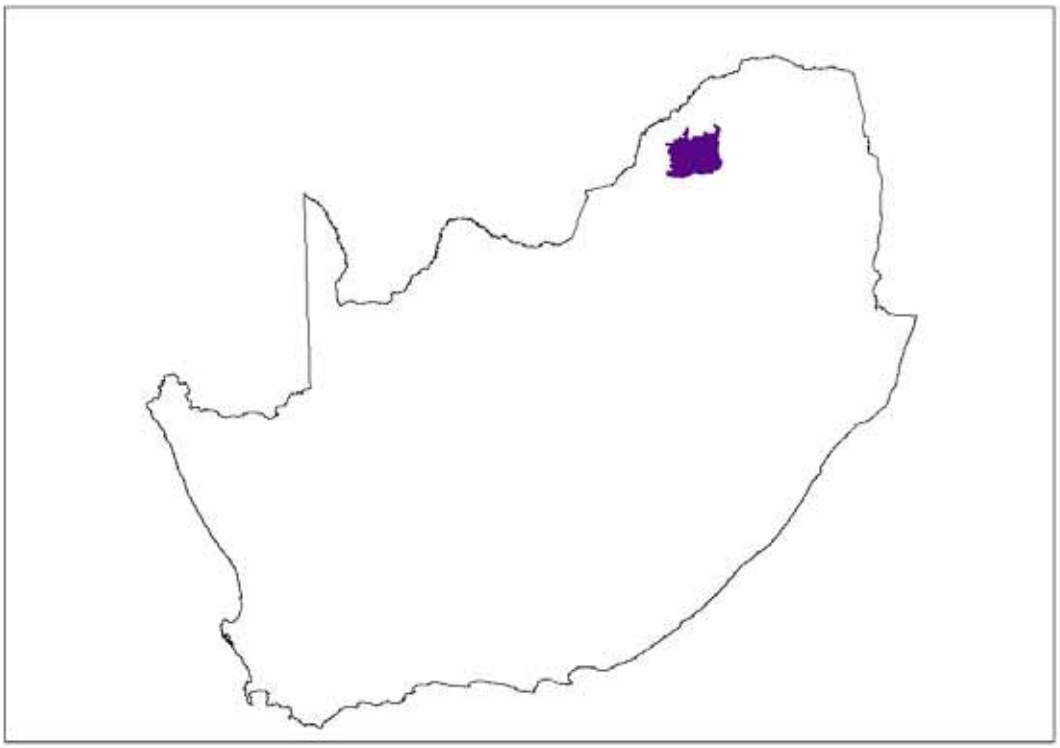
General:
The sandstones on the tableland are almost flat lying and are important escarpment shapers. Perennial rivers such as the Mogalakwena and Lephalala have their sources in the Waterberg.

- Mean annual precipitation: Generally moderate.
- Coefficient of variation of annual precipitation: Moderate.
- Drainage density: Low to medium.
- Stream frequency: Medium/high to low/medium.
- Slopes <5%: >80%
- Median annual simulated runoff: Generally moderate.
- Mean annual temperature: Moderate to moderate/high.

Size = 8844.9 km^2

Table 6: Main attributes of the Waterberg Ecoregion.

MAIN ATTRIBUTES	WATERBERG
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Lowlands; Hills and Mountains; Moderate and High Relief; **Table Lands; Moderate and High Relief.** Plains; Low Relief (limited)
Vegetation types (dominant types in bold) (Primary)	**Waterberg Moist Mountain Bushveld;** Mixed Bushveld; Sweet Bushveld (limited)
Altitude (m a.m.s.l) (Modifying)	700 –900 9limited), 900-1700
MAP (mm) (modifying)	300 to 600
Coefficient of Variation (% of annual precipitation)	20 to 35
Rainfall concentration index	60 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	14 to 22
Mean daily max. temp. (°C): February	24 to 32
Mean daily max. temp. (°C): July	16 to 24
Mean daily min. temp. (°C): February	12 to 20
Mean daily min temp. (°C): July	2 to 6
Median annual simulated runoff (mm) for quaternary catchment	<5 (limited); 10 to 60, 60 to 100 (limited)



ECOREGION 7: WESTERN BANKENVELD

Primary boundary determinants:
This region has a complex topography that varies from lowlands, hills and mountains to closed hills and mountains with the relief varying from moderate to high. Although various Bushveld and Grassland types occur, Mixed Bushveld is the most definitive vegetation type of the region.

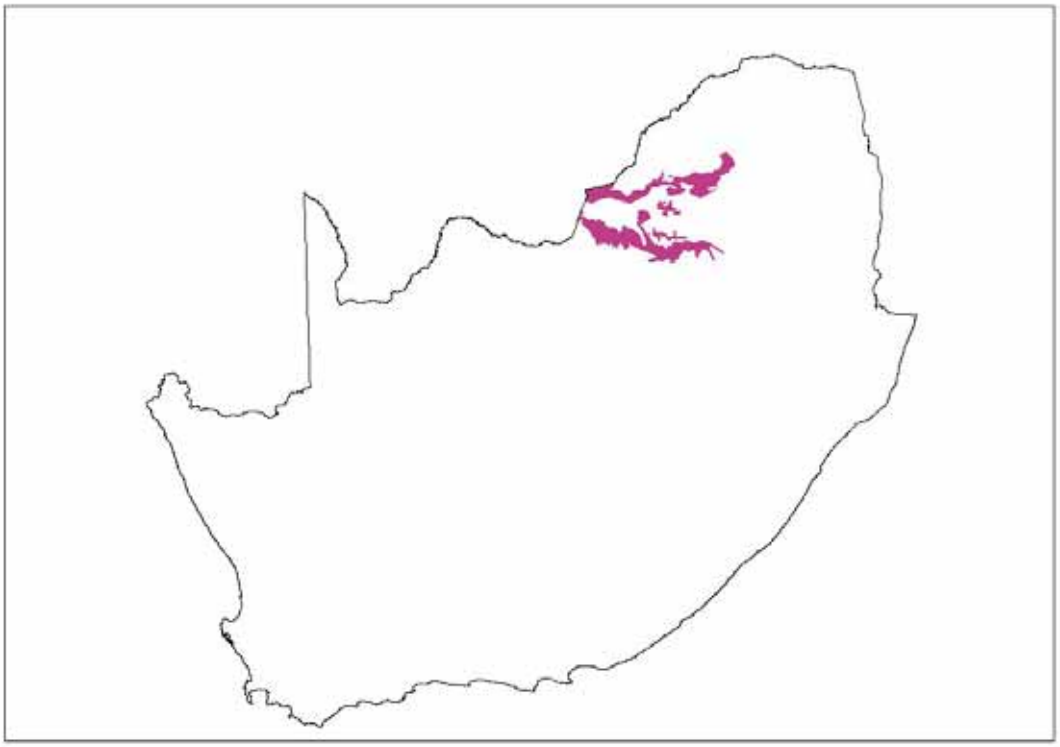
General:
Several rivers traverse this region, e.g. the Marico, the Crocodile (west), the Elands (west) and the Pienaars. Some perennial tributaries of these rivers rise in the southern part of the region in particular. The perennial tributary of the Sand River has its source in the northern part of the region.

- Mean annual precipitation: Low to moderate.
- Coefficient of variation of annual precipitation: Moderate.
- Drainage density: Moderate but low in parts.
- Stream frequency: Low to medium.
- Slopes <5%: Varies from <20%, 20-50%, 60-80% and in few cases >80%
- Median annual simulated runoff: Moderate/low to moderate.
- Mean annual temperature: Moderate to hot in limited areas.

Size = 19365.5 km^2

Table 7: Main attributes of the Western Bankenveld Ecoregion.

MAIN ATTRIBUTES	WESTERN BANKENVELD
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; Plains; Moderate Relief; **Lowlands; Hills and Mountains; Moderate and High Relief;** **Open Hills; Lowlands; Mountains; Moderate to High Relief;** **Closed Hills; Mountains; Moderate and High Relief**;
Vegetation types (dominant types in bold) (Primary)	**Waterberg Moist Mountain Bushveld; Mixed Bushveld**; Kalahari Plains Thorn Bushveld (limited); Clay Thorn Bushveld; (limited) Rocky Highveld Grassland; Dry Clay Highveld Grassland; (limited)
Altitude (m a.m.s.l) ((Modifying)	900-1700
MAP (mm) (modifying)	400 to 700
Coefficient of Variation (% of annual precipitation)	20 to 35
Rainfall concentration index	60 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	14 to 22
Mean daily max. temp. (°C): February	24 to 32
Mean daily max. temp. (°C): July	14 to 24
Mean daily min. temp. (°C): February	12 to 20
Mean daily min temp. (°C): July	0 to 6
Median annual simulated runoff (mm) for quaternary catchment	20 to 80, 80 to 100 (limited)



ECOREGION 8: BUSHVELD BASIN

Primary boundary determinants:

This region consists predominantly of plains with a low relief with Mixed Bushveld being the definitive vegetation type. In the east plains with a moderate relief and lowlands with a moderate relief occur.

General:

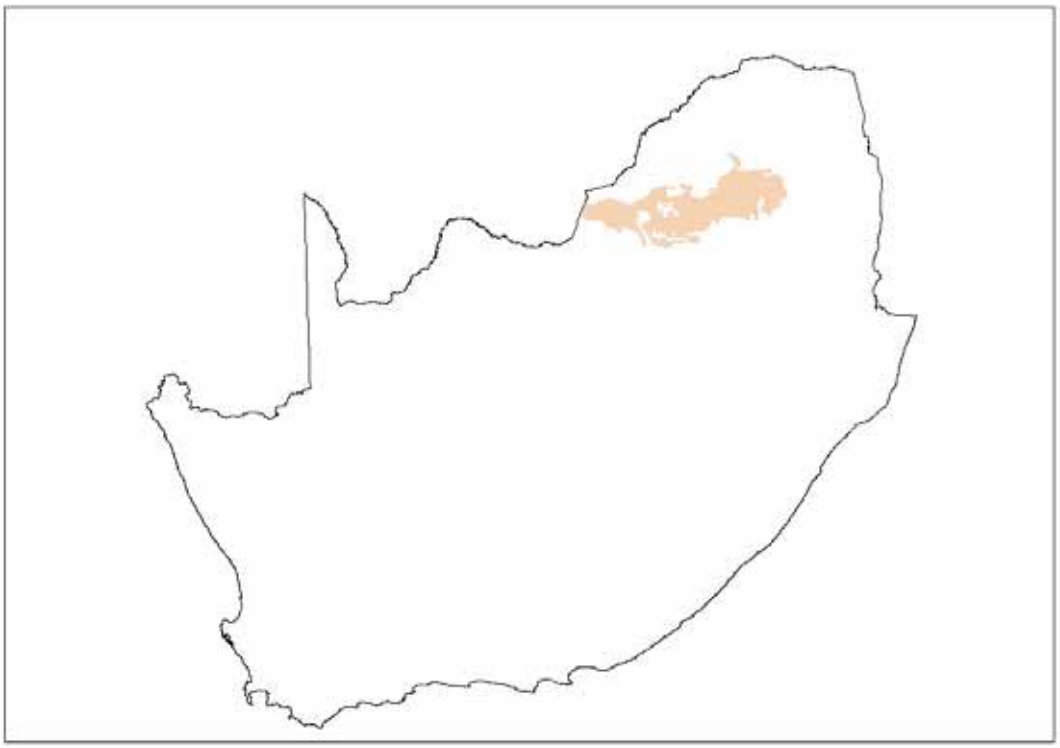
Several perennial rivers traverse the region, e.g. the Marico, Elands (West), Crocodile (West), Pienaars and Olifants. Virtually no perennial tributaries arise in the region.

- Mean annual precipitation: Moderate to low.
- Coefficient of variation of annual precipitation: Moderate
- Drainage density: Low.
- Stream frequency: Low to medium.
- Slopes <5%: >80%. Few areas 20-50% and 50-80%.
- Median annual simulated runoff: Moderately low to moderate.
- Mean annual temperature: Generally high.

Size = 32460.1 km^2

Table 8: Main attributes of the Bushveld Basin Ecoregion.

Main Attributes	Bushveld Basin
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief**; Plains; Moderate Relief; Lowlands; Hills and Mountains: Moderate and High Relief; Open Hills; Lowlands; Mountains: Moderate to High Relief; Closed Hills; Mountains: Moderate and High Relief (limited)
Vegetation types (dominant types in bold) (Primary)	**Mixed Bushveld;** Clay Thorn Bushveld; Waterberg Moist Mountain Bushveld (limited)
Altitude (m a.m.s.l) (Secondary)	700-1700 (1700-1900 very limited)
MAP (mm) (modifying)	400 to 600
Coefficient of Variation (% of annual precipitation)	25 to 35
Rainfall concentration index	55 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	14 to 22
Mean daily max. temp. (°C): February	22 to 32
Mean daily max. temp. (°C): July	14 to 24
Mean daily min. temp. (°C): February	12 to 20
Mean daily min temp. (°C): July	0 to 6
Median annual simulated runoff (mm) for quaternary catchment	20 to 100



ECOREGION 9: EASTERN BANKENVELD

Primary boundary determinants:

Closed hills and mountains with moderate and high relief together with North-eastern Mountain Grassland and Mixed Bushveld are definitive of the region.

General:

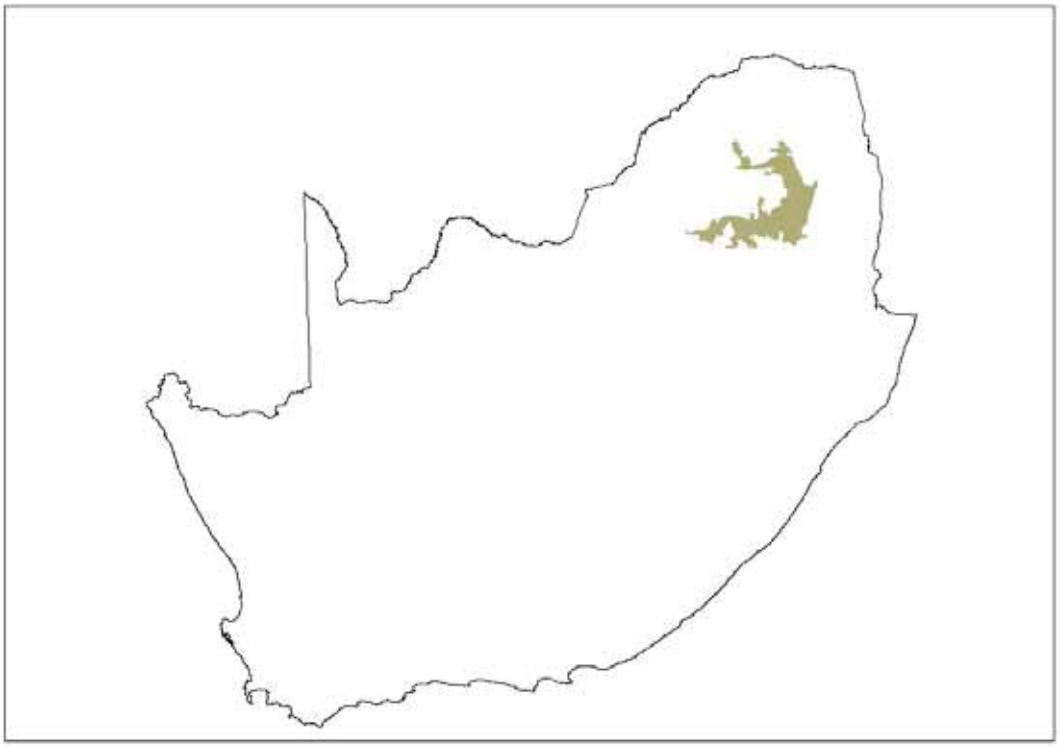
Distinctive escarpments occur along the eastern boundary in particular. Large rivers that traverse the area are the Olifants, Elands and Steelpoort with perennial tributaries in the region contributing to their flow. The Crocodile River (East) has many of its sources in this area.

- Mean annual precipitation: Moderate to moderately high.
- Coefficient of variation of annual precipitation: Low to moderate.
- Drainage density: Predominantly medium.
- Stream frequency: Medium/high but low/medium in limited areas.
- Slopes <5%: <20%, 20-50% in limited areas.
- Median annual simulated runoff: Mostly moderate but moderately high in areas.
- Mean annual temperature: Mostly moderate.

Size = 20098.8 km^2

Table 9: Main attributes of the Eastern Bankenveld Ecoregion.

Main Attributes	Eastern Bankenveld
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; (very limited) Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; (limited) Open Hills; Lowlands; Mountains; Moderate to High Relief; (limited) **Closed Hills; Mountains; Moderate and High Relief**;
Vegetation types (dominant types in bold) (Primary)	Sour Lowveld Bushveld; **Mixed Bushveld**; Clay Thorn Bushveld (limited); Rocky Highveld Grassland; Moist Sandy Highveld Grassland; **North Eastern Mountain Grassland;** Patches AfroMontane Forest.
Altitude (m a.m.s.l) (Modifying)	500-2300
MAP (mm) (modify)	300 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 34
Rainfall concentration index	55 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	10 to 22
Mean daily max. temp. (°C): February	18 to 30
Mean daily max. temp. (°C): July	12 to 24
Mean daily min. temp. (°C): February	8 to 20
Mean daily min temp. (°C): July	0 to 8
Median annual simulated runoff (mm) for quaternary catchment	20 to 150; 200 to >250



ECOREGION 10: NORTHERN ESCARPMENT MOUNTAINS

Primary boundary determinants:

The topography of this high lying region is highly definitive and consists of closed hills and mountains with a moderate to high relief. Towards the east, a well-defined escarpment is present along the majority of the length of the region. Northeastern Mountain Grassland is the dominant vegetation type in the region with areas of Sour Lowveld Bushveld towards the east. Patches of Afromontane Forest occur regularly as an interrupted, thin band towards the eastern boundary.

General:

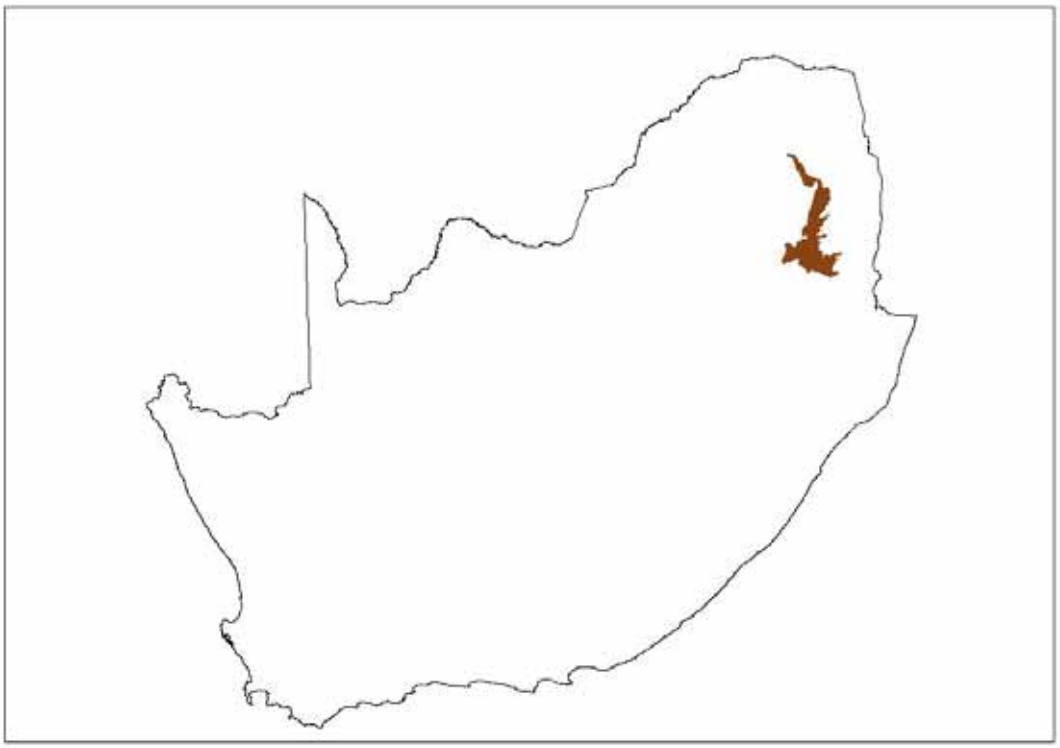
Drainage density is high and coefficient of variation of precipitation is very low. Rivers such as the Blyde, Sabie and Letaba have their sources here. Perennial tributaries of rivers such as the Crocodile, Komati and Olifants occur commonly in the region.

- Mean annual precipitation: High in most areas.
- Coefficient of variation of annual precipitation: Varies from low to very low.
- Drainage density: Low
- Stream frequency: Mostly medium to high
- Slopes <5%: <20%.
- Median annual simulated runoff: Generally high to very high
- Mean annual temperature: Cool to moderate.

Size = 10441.3 km^2

Table 10: Main attributes of the Northern Escarpment Mountains Ecoregion.

Main Attributes	Northern Escarpment Mountains
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Moderate Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Primary)	**North Eastern Mountain Grassland;** Sour Lowveld Bushveld; Mixed Bushveld (limited) Patches of Afromontane Forest
Altitude (m a.m.s.l) (Secondary)	500-900 (limited) 900-2300
MAP (mm) (modifying)	500 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	50 to 65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	10 to 22
Mean daily max. temp. (°C): February	16 to 30
Mean daily max. temp. (°C): July	12 to 24
Mean daily min. temp. (°C): February	8 to 20
Mean daily min temp. (°C): July	0 to 8
Median annual simulated runoff (mm) for quaternary catchment	40 to >250



ECOREGION 11: HIGHVELD

Primary boundary determinants:

Plains with a moderate to low relief, as well as various grassland vegetation types (with moist types present towards the east and drier types towards the west and south), define this high lying region.

General:

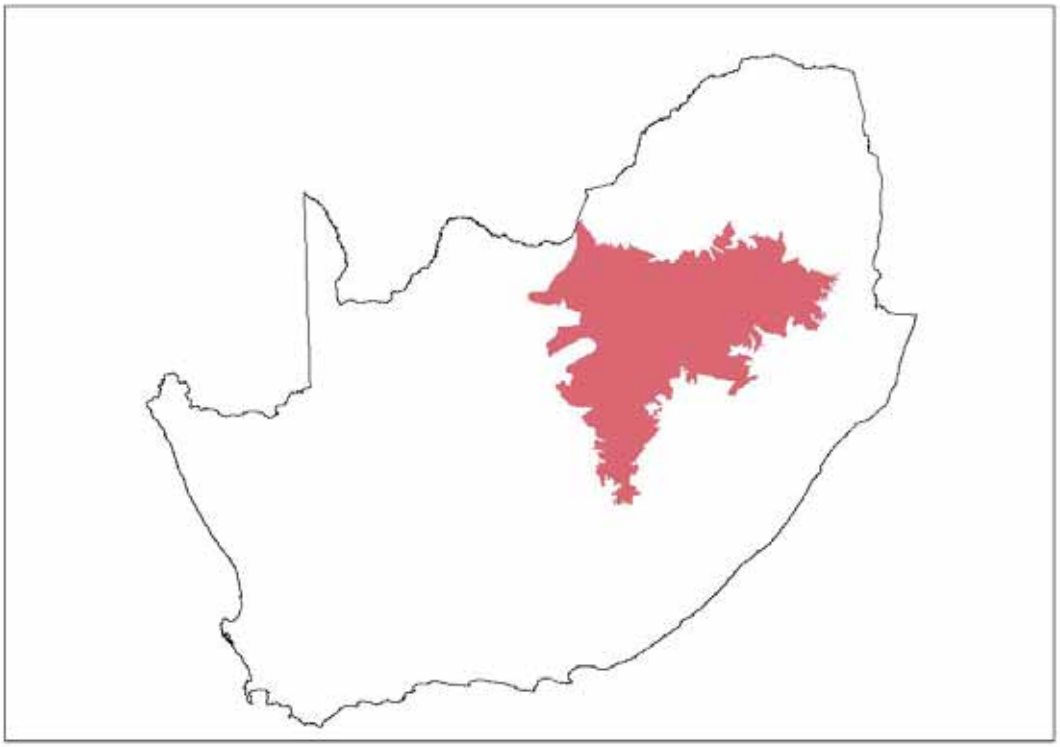
Several large rivers have their sources in the region, e.g. Vet, Modder, Riet, Vaal, Olifants, Steelpoort, Marico, Crocodile (west), Crocodile (east) and the Great Usutu,

- Mean annual precipitation: Rainfall varies from low to moderately high, with an increase from west to east.
- Coefficient of variation of annual precipitation: Moderately high in the west, decreasing to low in the east.
- Drainage density: Mostly low, but medium in some areas.
- Stream frequency: Low to medium.
- Slopes <5%: >80%, but 20-50% in a few hilly areas.
- Median annual simulated runoff: Moderately low to moderate.
- Mean annual temperature: Hot in the west and moderate in the east.

Size = 163615.1 km^2

Table 11: Main attributes of the Highveld Ecoregion.

Main Attributes	Highveld
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief;** **Plains; Moderate Relief;** Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Primary)	Mixed Bushveld (limited); Rocky Highveld Grassland; **Dry Sandy Highveld Grassland;** Dry Clay Highveld Grassland; **Moist Cool Highveld Grassland;** Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited)
Altitude (m a.m.s.l) (secondary)	1100-2100, 2100-2300 (very limited)
MAP (mm) (modifying)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	45 to 65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	20 to 32
Mean daily max. temp. (°C): July	14 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	5 to >250



ECOREGION 12: LEBOMBO UPLANDS

Primary boundary determinants:

Closed hills and mountains define this long, thin region with a moderate to high relief.

General:

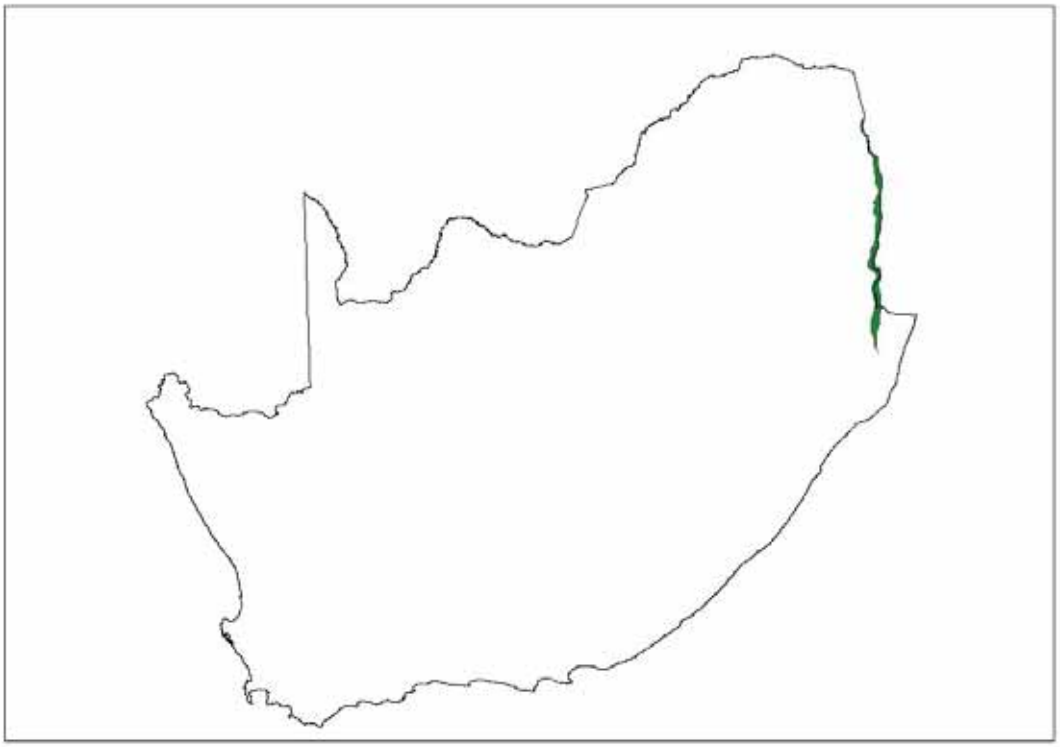
Lebombo Arid Mountain Bushveld predominantly characterizes the vegetation. Geologically, basalts and rhyolites are also distinctive. Several large rivers traverse this region, e.g. Olifants, Sabie, Crocodile, Komati, Great Usutu, Pongolo and Mkuze. However, no perennial streams originate in this region.

- Mean annual precipitation: Low in the north to moderate in the south
- Coefficient of variation of annual precipitation: Moderately high in the north to moderately low in the south.
- Drainage density: Medium.
- Stream frequency: Medium to high in the north to high to medium in the south.
- Slopes <5%: <20%.
- Median annual simulated runoff: Moderate to low.
- Mean annual temperature: High to very high.

Size = 5365.5 km^2

Table 12: Main attributes of the Lebombo Uplands Ecoregion.

Main Attributes	**Lebombo Uplands**
Terrain Morphology: Broad division dominant types in bold) (Primary)	Closed Hills; Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Secondary)	Sweet Lowveld Bushveld; **Lebombo Arid Mountain Bushveld**
Altitude (m a.m.s.l) (primary)	0-500
MAP (mm) (modifying)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	45 to >65
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	18 to >22
Mean daily max. temp. (°C): February	26 to 32
Mean daily max. temp. (°C): July	20 to >24
Mean daily min. temp. (°C): February	18 to >20
Mean daily min temp. (°C): July	6 to >10
Median annual simulated runoff (mm) for quaternary catchment	20 to 150



ECOREGION 13: NATAL COASTAL PLAIN

Primary boundary determinants:

This is a low-lying area, characterised by plains with a low relief.

General:

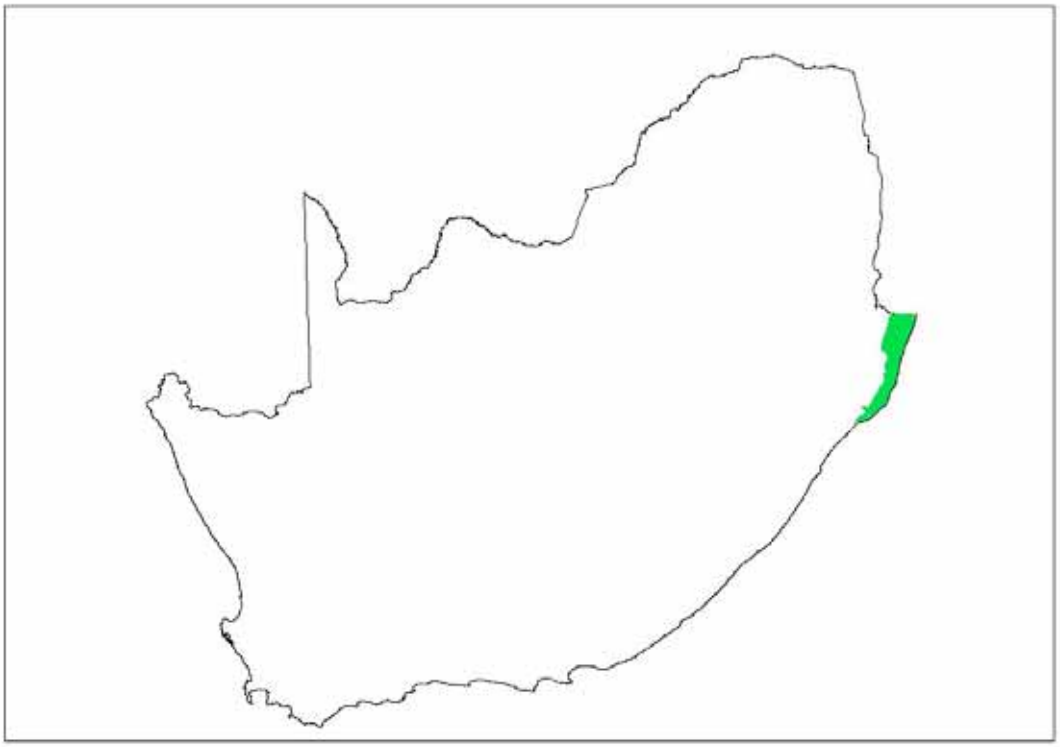
Coastal Bushveld/Grassland dominates the vegetation. Large rivers such as the Mfulozi, Mkuze and Mhlatuze traverse this region. Stream frequency is low to medium and few perennial streams originate in this region.

- Mean annual precipitation: Moderate to high.
- Coefficient of variation of annual precipitation: Low to moderate.
- Drainage density: Low.
- Stream frequency: Low to medium.
- Slopes <5%: >80%.
- Median annual simulated runoff: Moderate to high.
- Mean annual temperature: High to very high.

Size = 8273 km^2

Table 13: Main attributes of the Natal Coastal Plain Ecoregion.

Main Attributes	**Natal Coastal Plain**
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains: Low Relief**
Vegetation types (dominant types in bold) (Secondary)	**Coastal Bushveld/Grassland;** Subhumid Lowveld Bushveld; Natal Lowveld Bushveld; Patches Sand Forest. Valley Thicket (limited)
Altitude (m a.m.s.l) (secondary)	0-300
MAP (mm) (modifying)	500 to 600 (limited), 600 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 30
Rainfall concentration index	15 to 50
Rainfall seasonality	Mid to late summer
Mean annual temp. (°C)	20 to >22
Mean daily max. temp. (°C): February	26 to 32
Mean daily max. temp. (°C): July	20 to >24
Mean daily min. temp. (°C): February	>20
Mean daily min temp. (°C): July	8 to >10
Median annual simulated runoff (mm) for quaternary catchment	40 to 80; 100 to >250



ECOREGION 14: NORTH EASTERN UPLANDS

Primary boundary determinants:

This region is very diverse with lowlands, hills and mountains with moderate and high relief, as well as closed hills and mountains with moderate and high relief, being the defining characteristics.

General:

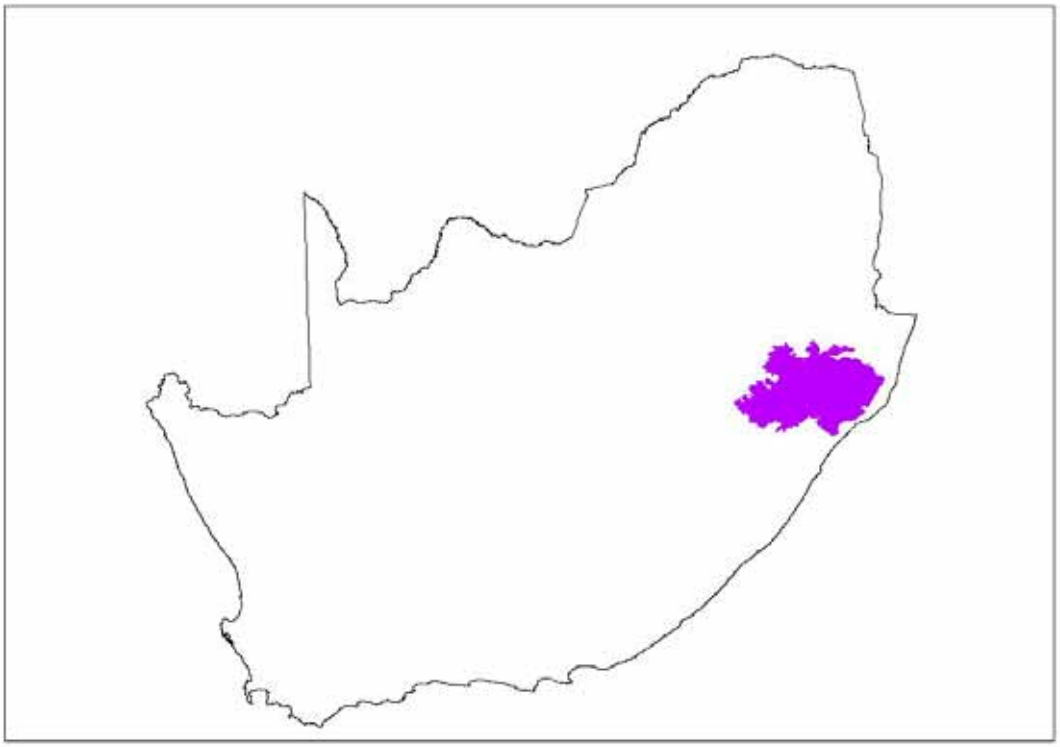
Grassland and Bushveld types, mainly Natal Central Bushveld and Valley Thicket characterize the vegetation. Large rivers such as the Thukela, Mooi, and Buffalo traverse this region while the Mhlatuze have its source in the region.

- Mean annual precipitation: Moderate to moderately high.
- Coefficient of variation of annual precipitation: Moderately low to moderate
- Drainage density: From west to east, it varies from low, medium to high.
- Stream frequency: Generally varying from east to west from low/medium, medium/high to very high
- Slopes <5%: Varying from west to east; 50-80%, 20-50% and <20%.
- Median annual simulated runoff: Varying from moderate to moderately high.
- Mean annual temperature: Moderate to high.

Size = 33593.7 km^2

Table 14: Main attributes of the North Eastern Uplands Ecoregion.

Main Attributes	North Eastern Uplands
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Moderate Relief (limited); **Lowlands; Hills and Mountains; Moderate and High Relief;** Open Hills; Lowlands; Mountains; Moderate to High Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Secondary)	Natal Lowveld Bushveld (limited); **Natal Central Bushveld;** Coast Hinterland Bushveld; Coastal Bushveld/Grassland; **Valley Thicket;** Short Mistbelt Grassland; North Eastern Mountain Grassland; Moist Upland Grassland Patches Afromontane Forest
Altitude (m a.m.s.l) (modifying)	0-100 (limited), 100-1500
MAP (mm) (modifying)	600 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 30
Rainfall concentration index	15 to 65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	14 to >22
Mean daily max. temp. (°C): February	20 to 30
Mean daily max. temp. (°C): July	16 to >24
Mean daily min. temp. (°C): February	12 to >20
Mean daily min temp. (°C): July	0 to >10
Median annual simulated runoff (mm) for quaternary catchment	40 to 250; >250 (limited)



ECOREGION 15: EASTERN ESCARPMENT MOUNTAINS

Primary boundary determinants:

This high lying region is characterized by closed hills, mountains with moderate and high relief with prominent escarpments towards the east.

General:

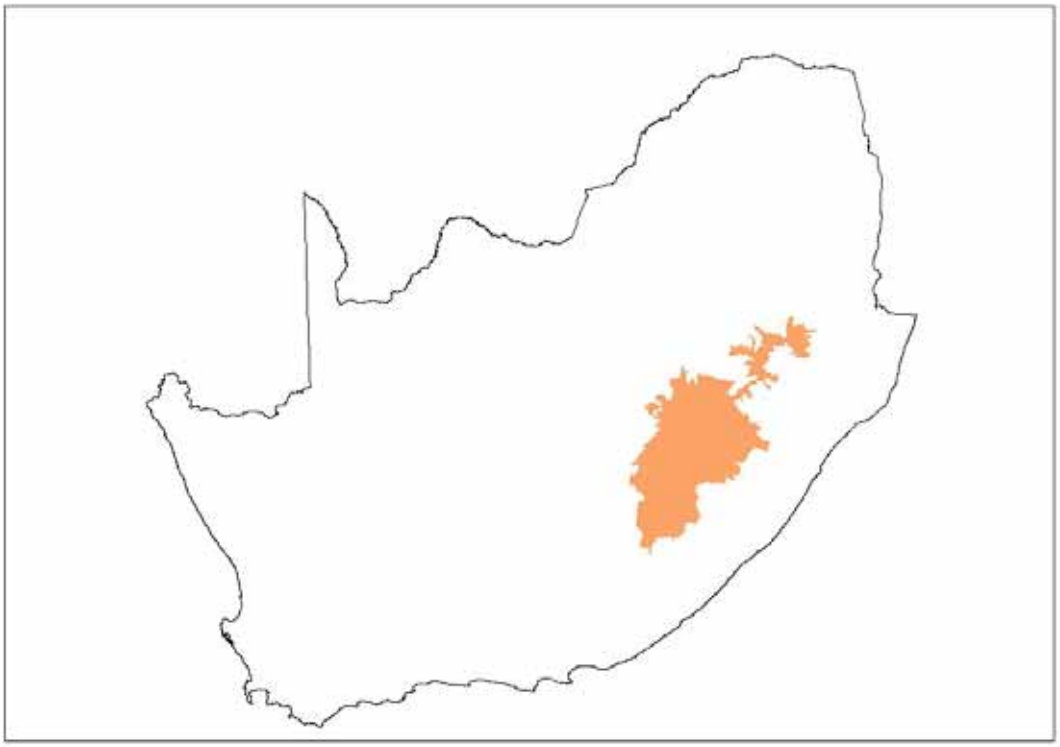
The vegetation consists of a range of grassland types with Afro Mountain and Alti Mountain Grassland being the defining types. Several major South African rivers have their sources in this region, e.g. Orange, Caledon, Wilge, Thukela, Buffalo, Mooi, Mzimkulu, Mzimvubu, Mgeni and Mkomazi,

- Mean annual precipitation: Moderate to very high.
- Coefficient of variation of annual precipitation: Very low to moderate.
- Drainage density: Medium.
- Stream frequency: Medium high.
- Slopes <5%: Generally <20%.
- Median annual simulated runoff: Moderate to very high.
- Mean annual temperature: Very low to moderate.

Size = 66504.8 km^2

Table 15: Main attributes of the Eastern Escarpment Mountains Ecoregion.

Main Attributes	Eastern Escarpment Mountains
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Moderate Relief (limited); Lowlands, Hills and Mountains; Moderate and High Relief Open Hills; Lowlands; Mountains; Moderate to High Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Secondary)	South Eastern Mountain Grassland; **AltiMountain Grassland; AfroMountain Grassland;** Moist Upland Grassland; North Eastern Mountain Grassland; **Moist Cold Highveld Grassland**; Moist Cool Highveld Grassland; Moist Sandy Highveld Grassland; Dry Sandy Highveld Grassland Natal Central Bushveld (limited); Patches Afromontane Forest.
Altitude (m a.m.s.l) Secondary	1100-3100; 3100-3500 limited
MAP (mm) (modifying)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	30 to 65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	<8 to 18
Mean daily max. temp. (°C): February	<10 to 28
Mean daily max. temp. (°C): July	<10 to 22
Mean daily min. temp. (°C): February	<6 to 16
Mean daily min temp. (°C): July	<-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	10 to >250



ECOREGION 16: SOUTH EASTERN UPLANDS

Primary boundary determinants:

A complex range of terrain morphological classes occur in this region: plains with a moderate relief, lowlands with a low relief, lowlands with a high relief, open hills with low relief, open hills with high relief, closed hills with a moderate relief and low mountains with a high relief.

General:

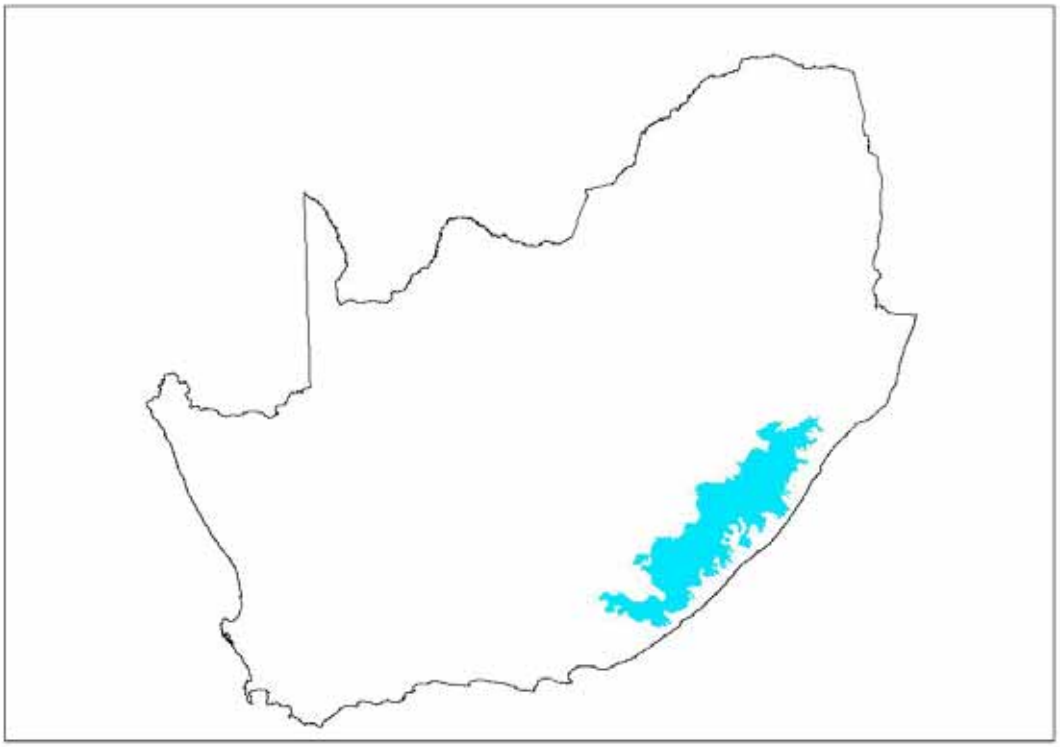
Vegetation types are equally diverse and include a variety of Grassland types, Bushveld types, Thicket types and Afromontane Forest. The most prominent amongst these are Moist Upland Grassland. A range of rivers such as, Mgeni, Mzimvubu, Mkomazi, Mzimkulu and Groot Kei traverses this region. Perennial tributaries of these rivers are also common.

- Mean annual precipitation: Generally high.
- Coefficient of variation of annual precipitation: Mostly moderate to low.
- Drainage density: Medium in the north, tending towards low in the south.
- Stream frequency: Low to medium in the south, tending towards medium high in the north.
- Slopes <5%: <20% (central areas), 20-50% (northern areas) and 50-80% (southern areas).
- Median annual simulated runoff: Moderate to high.
- Mean annual temperature: Moderate to moderately high.

Size = 54091.1 km^2

Table 16: Main attributes of the South Eastern Uplands Ecoregion.

Main Attributes	South Eastern Uplands
Terrain Morphology: Broad division (dominant types) (Primary)	Plain Low Relief (limited); Plains moderate Relief; **Lowlands; Hills and Mountains; Moderate and High Relief;** Open Hills; Lowlands; Mountains; Moderate to High Relief**;** **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Secondary)	Coast Hinterland Bushveld; Eastern Thorn Bushveld; Subarid Thorn Bushveld (very limited); Short Mistbelt Grassland; North Eastern Mountain Grassland; **Moist Upland Grassland;** Coastal Grassland (very limited); South Eastern Mountain Grassland (very limited); AltiMountain Grassland (very limited); Patches Afromontane Forest
Altitude (m a.m.s.l) (secondary)	300-500 (limited), 500-1700, 1700-2300 (limited)
MAP (mm) (modifying)	500 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 30
Rainfall concentration index	15 to 60
Rainfall seasonality	Early to very late summer
Mean annual temp. (°C)	10 to 22
Mean daily max. temp. (°C): February	20 to 30
Mean daily max. temp. (°C): July	12 to 24
Mean daily min. temp. (°C): February	8 to 20
Mean daily min temp. (°C): July	0 to 10
Median annual simulated runoff (mm) for quaternary catchment	40 to >250



ECOREGION 17: NORTH EASTERN COASTAL BELT

Primary boundary determinants:

A diversity of terrain morphological types occurs with closed hills and mountains with a moderate to high relief being the most definitive.

General:

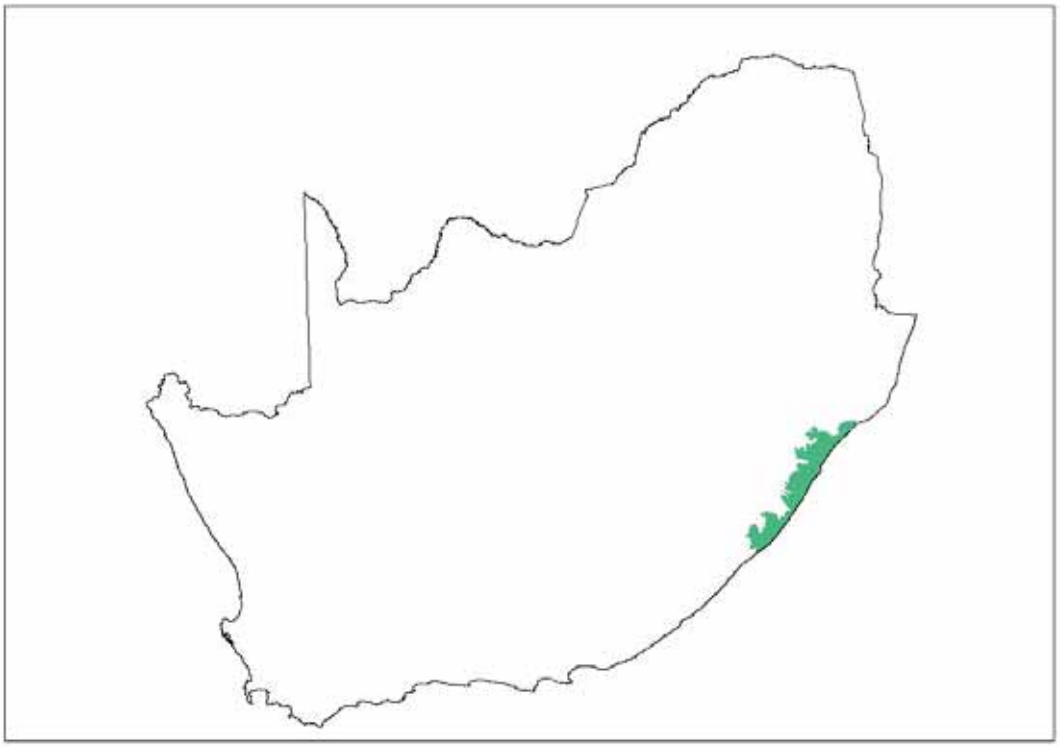
Altitude varies from sea level to 700 m.a.m.s.l. Vegetation types consist of Valley Thicket and a variety of Grassland and Bushveld types. Rivers such as the Mgeni, Mkomazi and Mzimkulu flow through this region.

- Mean annual precipitation: Predominantly high.
- Coefficient of variation of annual precipitation: Low to very low.
- Drainage density: Medium to high.
- Stream frequency: Medium/high to very high.
- Slopes <5%: Predominantly <20%.
- Median annual simulated runoff: High.
- Mean annual temperature: High.

Size = 12476.8 km^2

Table 17: Main attributes of the North Eastern Coastal Belt Ecoregion.

Main Attributes	North Eastern Coastal Belt
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains: Low Relief (limited) Plains: Moderate Relief (limited); **Closed Hills, Mountains; Moderate and High Relief;** Table Lands; Moderate and High Relief
Vegetation types (dominant types in bold) (Secondary)	**Coastal Bushveld\Grassland; Coast Hinterland Bushveld;** Coastal Grassland Subarid Thorn Bushveld; **Valley Thicket;** Short Mistbelt Grassland (limited); Patches Coastal forest and Patches Afromontane Forest
Altitude (m a.m.s.l) (Secondary)	0-700
MAP (mm) (modifying)	700 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 30
Rainfall concentration index	15 to 50
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	16 to 22
Mean daily max. temp. (°C): February	24 to 30
Mean daily max. temp. (°C): July	18 to 24
Mean daily min. temp. (°C): February	14 to >20
Mean daily min temp. (°C): July	4 to >10
Median annual simulated runoff (mm) for quaternary catchment	60 to >250



ECOREGION 18: DROUGHT CORRIDOR

Primary boundary determinants:

Lowlands, hills and mountains with moderate and high relief, and closed hills and mountains with moderate and high relief, are characteristic of this region. South Eastern Mountain Grassland and Eastern Mixed Nama Karoo are the dominant vegetation types.

General:

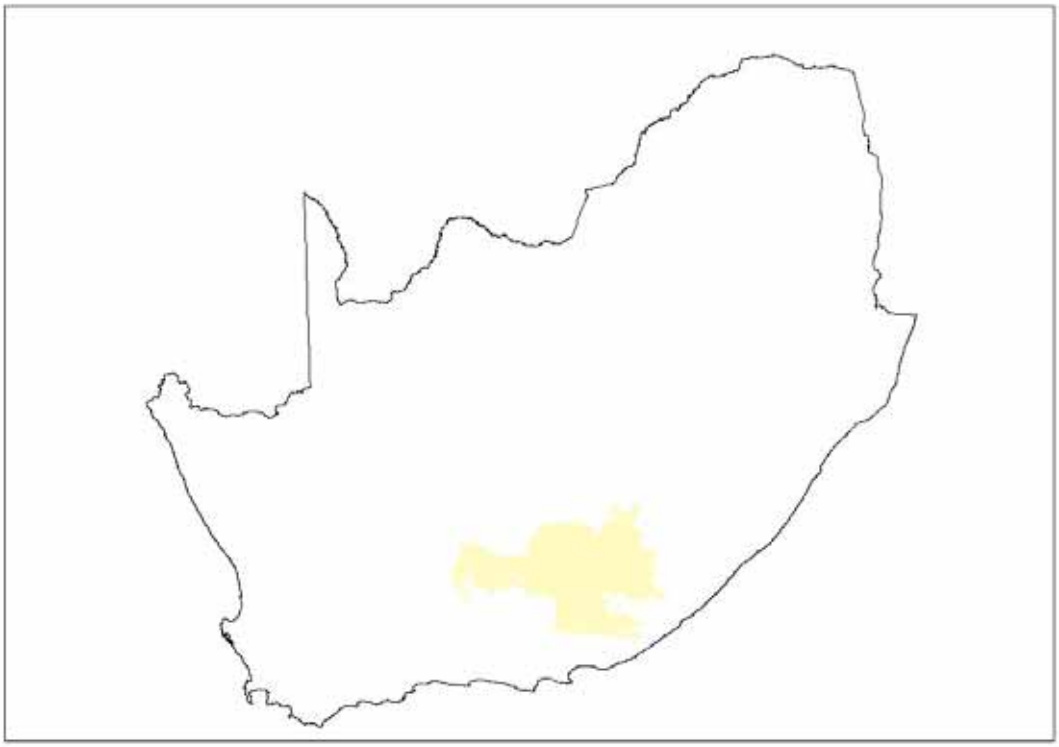
The Great Fish River is the prominent river in the region.

- Mean annual precipitation: Generally low.
- Coefficient of variation of annual precipitation: Moderately high to high.
- Drainage density: Low but medium in some areas.
- Stream frequency: Low/medium to medium high.
- Slopes <5%: Varies from <20% to 50-80%.
- Median annual simulated runoff: Mostly low to moderate.
- Mean annual temperature: Moderate to high.

Size = 62675 km^2

Table 18: Main attributes of the Drought Corridor Ecoregion.

MAIN ATTRIBUTES	DROUGHT CORRIDOR
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief (very limited); Plains Moderate Relief (limited); **Lowlands; Hills and Mountains; Moderate and High Relief;** Open Hills; Lowlands; Mountains; Moderate to High Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Primary)	Dry Sandy Highveld Grassland; **South Eastern Mountain Grassland;** Moist Upland Grassland; Subarid Thorn Bushveld; Eastern Thorn Bushveld; **Eastern Mixed Nama Karoo;** Central Nama Karoo (limited); Upper Nama Karoo; Valley Thicket (limited); Xeric Succulent Thicket; Patches Afromontane Forest
Altitude (m a.m.s.l) (modifying)	100-300 (limited), 300-1900, 1900-2100 (limited)
MAP (mm) (Secondary)	100 to 500, 500-700 (limited)
Coefficient of Variation (% of annual precipitation)	20 to 40
Rainfall concentration index	15 to 455
Rainfall seasonality	Late to very late summer
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	22 to 30
Mean daily max. temp. (°C): July	10 to 22
Mean daily min. temp. (°C): February	8 to 20
Mean daily min temp. (°C): July	-2 to 10
Median annual simulated runoff (mm) for quaternary catchment	<5 to 100; 100 to 150 (limited)



ECOREGION 19: SOUTHERN FOLDED MOUNTAINS

Primary boundary determinants:

This region has a diverse topography but closed hills and mountains with a moderate to high relief, are dominant.

General:

The vegetation is likewise highly diverse with various Fynbos, Karoo, Renosterveld and Thicket types, but Mountain Fynbos, Grassy Fynbos and Little Succulent Karoo are generally distinctive. The Gourits River and its main tributaries traverse this area. Other significant rivers include the Palmiet, Gamtoos and its tributaries, Keurbooms, Kromme, Rivier-Sonder-End and the Breede rivers. The Berg River has its source in this region.

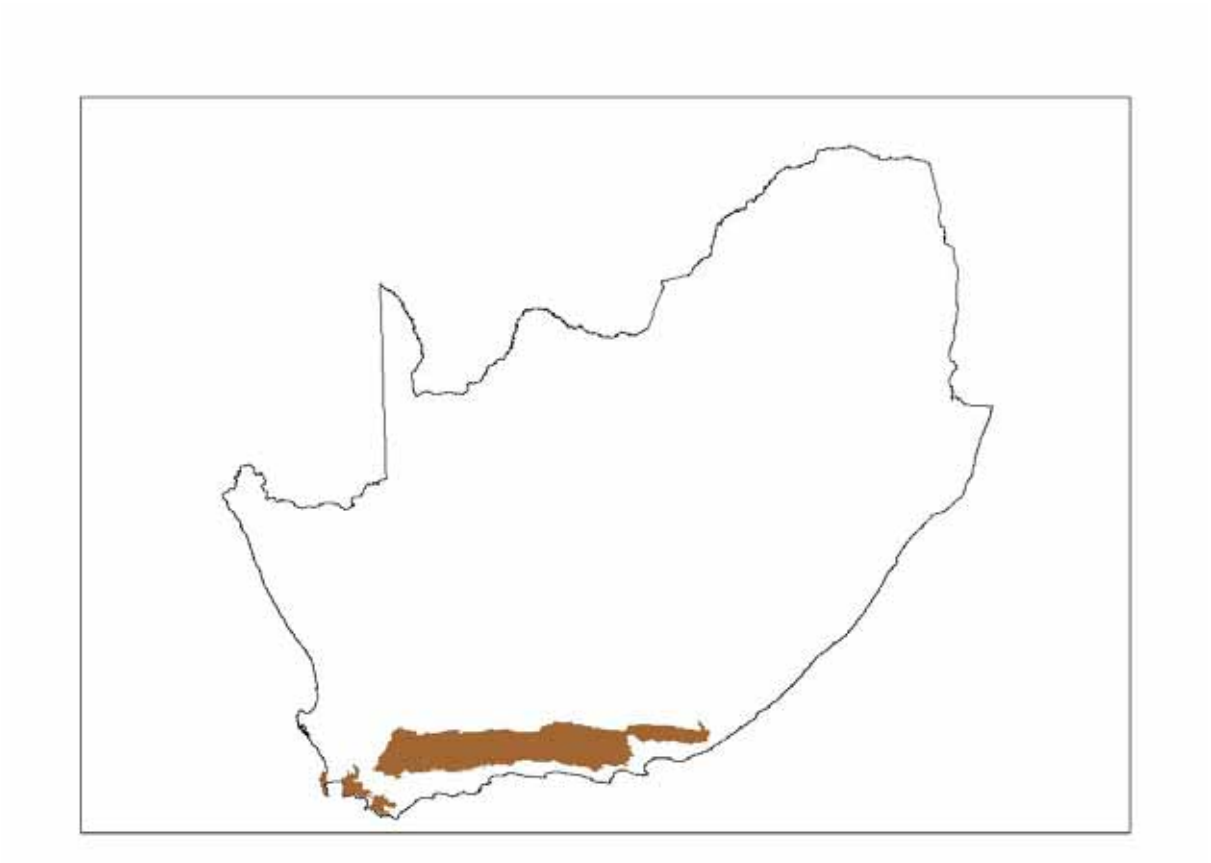
- Mean annual precipitation: Generally low but moderate to high towards the south.
- Coefficient of variation of annual precipitation: Moderate to high.
- Drainage density: Predominantly medium but low in some areas.
- Stream frequency: Medium/high to low/medium.
- Slopes <5%: Mostly <20%.
- Median annual simulated runoff: Varies from low to very high but predominantly moderate.
- Mean annual temperature: Moderate but low in patches.

Size = 49394.7 km^2

Table 19: Main attributes of the Southern Folded Mountains Ecoregion.

Main Attributes	Southern Folded Mountains
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief (limited); Plains Moderate Relief (limited); Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to High Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Secondary)	Patches Afromontane Forest; Xeric Succulent Thicket (limited); Valley Thicket (limited); Spekboom Succulent Thicket; **Grassy Fynbos; Mountain Fynbos;** Limestone Fynbos; Sand Plain Fynbos (Limited); South and South West Coast Renosterveld; Central Mountain Renosterveld; West Coast Renosterveld (very limited) Eastern Mixed Nama Karoo; Central Nama Karoo; Great Nama Karoo (limited); Eastern Thorn Bushveld (very limited); **Little Succulent Karoo;** Lowland Succulent Karoo (very limited);
Altitude (m a.m.s.l) (Primary)	0-300 limited; 300-1900, 1900-2100 (limited)
MAP (mm) (modifying)	100 to 1500
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	<15 to 55
Rainfall seasonality	Very late summer to winter to all year
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	18 to 32
Mean daily max. temp. (°C): July	10 to 22
Mean daily min. temp. (°C): February	10 to 20

Main Attributes	Southern Folded Mountains
Mean daily min temp. (°C): July	0 to 10
Median annual simulated runoff (mm) for quaternary catchment	<5 to >250



ECOREGION 20: SOUTH EASTERN COASTAL BELT

Primary boundary determinants:

Although plains occur in this region, closed hills and mountains primarily characterize the topography with a moderate to high relief. Altitude varies mostly from sea level to 500 m.a.m.s.l. Fynbos, Renosterveld, Grassland, and Thicket vegetation types occur, but the dominant types are Afromontane Forest and Mesic Succulent Thicket.

General:

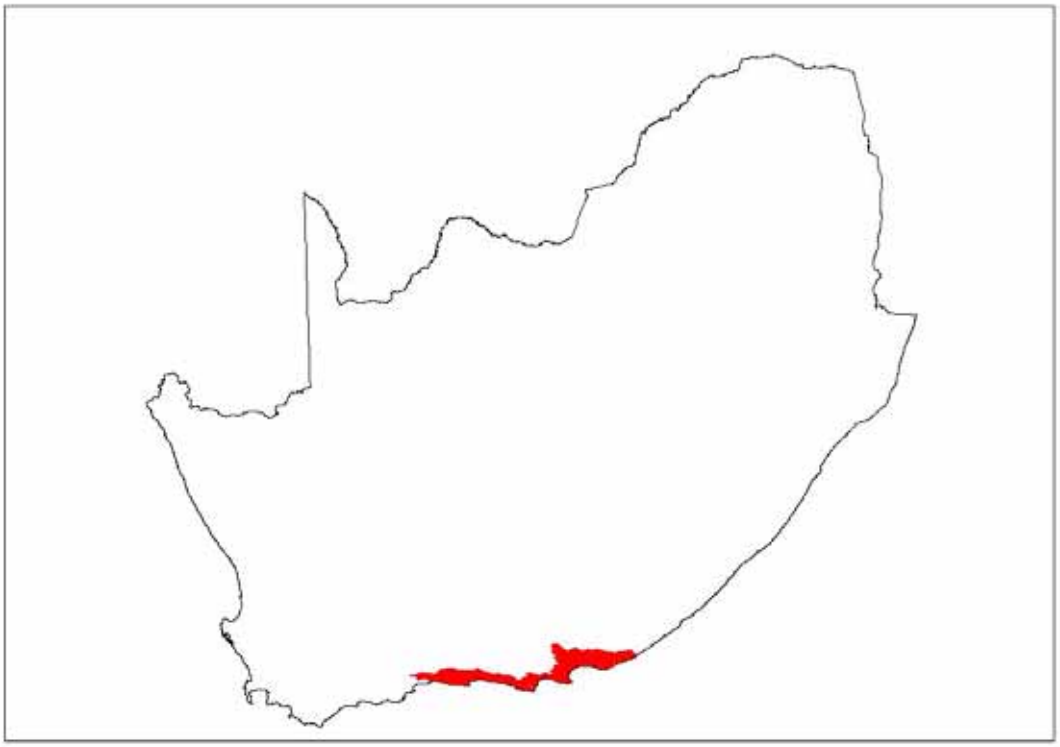
The Swartkops, Gamtoos and Keurbooms Rivers flow through this region.

- Mean annual precipitation: Moderate to high.
- Coefficient of variation of annual precipitation: Low to moderate.
- Drainage density: Low to medium.
- Stream frequency: Low/medium to medium/high in limited areas.
- Slopes <5%: >80% but significant areas <20%.
- Median annual simulated runoff: Moderate to very high.
- Mean annual temperature: Moderate to moderately hot.

Size = 13084.5 km^2

Table 20: Main attributes of the South Eastern Coastal Belt Ecoregion.

MAIN ATTRIBUTES	SOUTH EASTERN COASTAL BELT
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief (limited); Plains Moderate Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Primary)	Dune Thicket; **Mesic Succulent Thicket;** Valley Thicket; Xeric Succulent Thicket Coastal Grassland; Eastern Thorn Bushveld; Grassy Fynbos (limited); Mountain Fynbos; South and South West Coast Renosterveld; **Afromontane Forest**;
Altitude (m a.m.s.l) (primary)	0-500; 500-1300 limited
MAP (mm) (modifying)	300 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	<15 to 30
Rainfall seasonality	All year to very late summer, to winter
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	22 to 30
Mean daily max. temp. (°C): July	12 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	2 to 10
Median annual simulated runoff (mm) for quaternary catchment	10 to >250



ECOREGION 21: GREAT KAROO

Primary boundary determinants:

Plains with low to moderate relief are often distinctive, but significant areas with closed hills and mountains with moderate to high relief are present. Prominent escarpments occur in the north and northwest. Vegetation consists of a diversity of Nama Karoo, Succulent Karoo, Renosterveld and Thicket types, but the dominant types are Central Nama Karoo and Great Nama Karoo.

General:

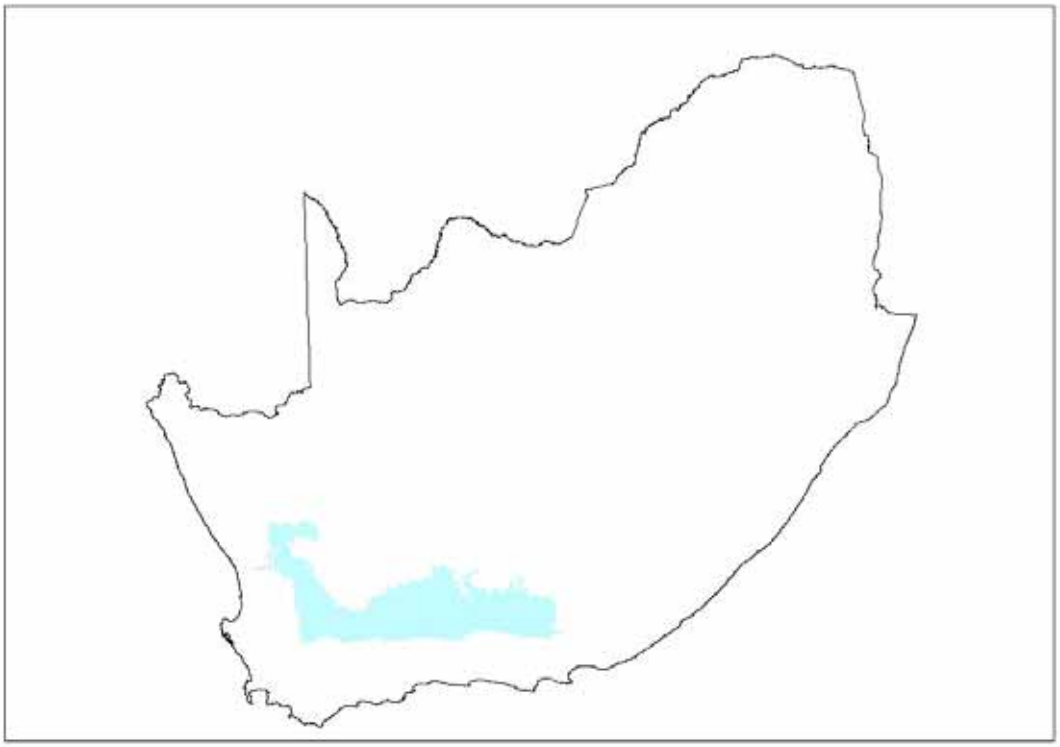
Rivers such as the Doring, Upper tributaries of the Gourits and Gamtoos flow through this region.

- Mean annual precipitation: Arid to low.
- Coefficient of variation of annual precipitation: High but very high in areas.
- Drainage density: Varies from low to medium to high.
- Stream frequency: Low/medium, medium/high to high.
- Slopes <5%: Varies from <20% to >80%.
- Median annual simulated runoff: Very low to low.
- Mean annual temperature: Moderate to moderately high.

Size = 63743.8 km^2

Table 21: Main attributes of the Great Karoo Ecoregion.

MAIN ATTRIBUTES	GREAT KAROO
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief**; Plains Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills, Lowlands; Mountains; Moderate to High Relief; **Closed Hills; Mountains; Moderate and High Relief;** Table-Lands: Moderate and High Relief
Vegetation types (dominant types in bold) (Primary)	Valley Thicket (limited); Spekboom Succulent Thicket (limited); **Central Nama Karoo;** Eastern Mixed Nama Karoo (limited); **Great Nama Karoo;** Upper Nama Karoo; Bushmanland Nama Karoo (limited) Lowland Succulent Karoo; Upland Succulent Karoo; Little Succulent Karoo (limited) Escarpment Mountain Renosterveld;
Altitude (m a.m.s.l) (secondary)	100-300 (limited), 300-1700; 1700-1900 limited
MAP (mm) (modifying)	0 to 500
Coefficient of Variation (% of annual precipitation)	30 to >40
Rainfall concentration index	15 to 65
Rainfall seasonality	Very late summer to all year
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	26 to >32
Mean daily max. temp. (°C): July	12 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	0 to 8
Median annual simulated runoff (mm) for quaternary catchment	<5 to 40; 40 to 60 (limited)



ECOREGION 22: SOUTHERN COASTAL BELT

Primary boundary determinants:

Closed hills and mountains with moderate to high relief are characteristic but plains are also significant. South and Southwest Coast Renosterveld dominate vegetation. Altitude varies from sea level to 700 m.a.m.s.l.

General:

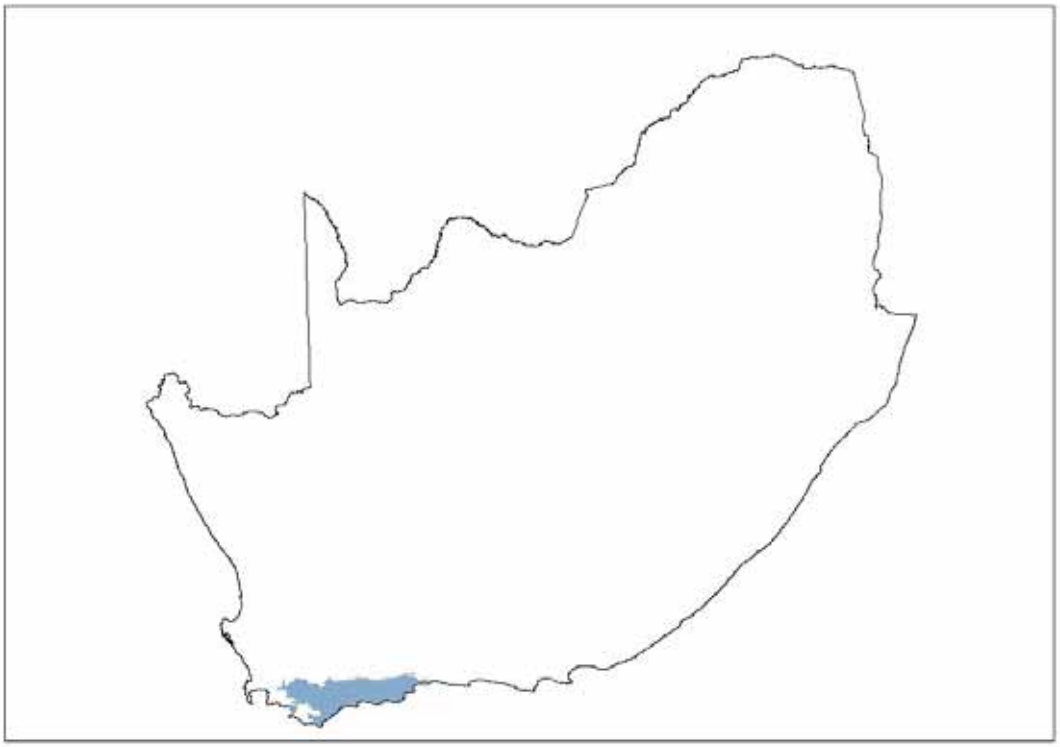
Rivers such as the Gourits, Breede and Sout flow through this region. Several short coastal rivers rise here.

- Mean annual precipitation: Moderate.
- Coefficient of variation of annual precipitation: Mostly moderate/high.
- Drainage density: Low to medium.
- Stream frequency: Low/medium to medium/high.
- Slopes <5%: <20% and >80%
- Median annual simulated runoff: Moderate.
- Mean annual temperature: Moderate/high.

Size = 15387.2 km^2

Table 22: Main attributes of the Southern Coastal Belt Ecoregion.

MAIN ATTRIBUTES	SOUTHERN COASTAL BELT
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; Plains Moderate Relief; Open Hills; Lowlands; Mountains; Moderate to High Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Secondary)	**South and South West Coast Renosterveld;** Central Mountain Renosterveld; Limestone fynbos; Mountain Fynbos; Laterite Fynbos (limited); Dune Thicket; Patches Afromontane Forest
Altitude (m a.m.s.l) (Primary)	0-700; 700-1500 (limited)
MAP (mm) (modifying)	300 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	<15 to 50
Rainfall seasonality	Winter to all year
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	22 to 30
Mean daily max. temp. (°C): July	12 to 20
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	4 to 10
Median annual simulated runoff (mm) for quaternary catchment	10 to >250



ECOREGION 23: WESTERN FOLDED MOUNTAINS

Primary boundary determinants:

Tablelands and plains are present but closed hills and mountains with moderate to high relief are distinctive. Prominent escarpments occur along the east and north west of the region.

General:

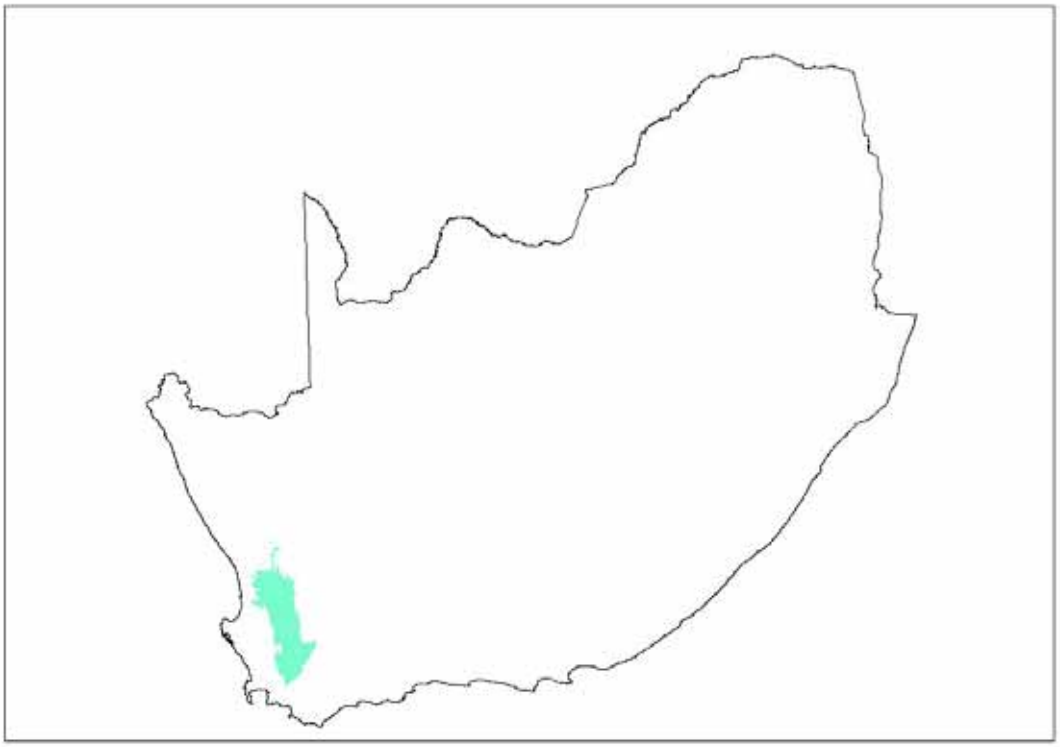
Mountain fynbos is the dominant vegetation type. The Olifants and Breede rivers rise in this region.

- Mean annual precipitation: Varies from moderate/high in the south to low in the north.
- Coefficient of variation of annual precipitation: Mostly high.
- Drainage density: Low to medium.
- Stream frequency: Mostly medium/high but low/medium in patches.
- Slopes <5%: <20% but >80% in limited areas.
- Median annual simulated runoff: Very high in the south to moderate/low in the north.
- Mean annual temperature: Moderate/low to moderate high.

Size = 15159.3 km^2

Table 23: Main attributes of the Western Folded Mountains Ecoregion.

Main Attributes	Western Folded Mountains
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief (limited); Plains Moderate Relief (limited); Lowlands; Hills and Mountains; Moderate and High Relief; **Closed Hills; Mountains; Moderate and High Relief;** Table-Lands: Moderate and High Relief
Vegetation types (dominant types in bold) (Secondary)	**Mountain Fynbos;** Central Mountain Renosterveld; West Coast Renosterveld (very limited); Little Succulent Karoo; Upland Succulent Karoo (very limited); Strandveld Succulent Karoo (very limited) Central Nama Karoo (1 patch);
Altitude (m a.m.s.l) (secondary)	100-300 (limited), 300-1700, 1700-2500 (limited)
MAP (mm) (modifying)	100 to 1500
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	30 to >65
Rainfall seasonality	Winter
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	18 to >32
Mean daily max. temp. (°C): July	10 to 20
Mean daily min. temp. (°C): February	8 to 18
Mean daily min temp. (°C): July	0 to 8
Median annual simulated runoff (mm) for quaternary catchment	<5 (limited); 5 to >250



ECOREGION 24: SOUTH WESTERN COASTAL BELT

Primary boundary determinants:

Plains with a moderate to low relief are characteristic of the region. Altitude varies from sea level to 900 m.a.m.s.l. Although significant areas of Fynbos, Succulent Karoo and Thicket occur, the dominant vegetation type is West Coast Renosterveld.

General:

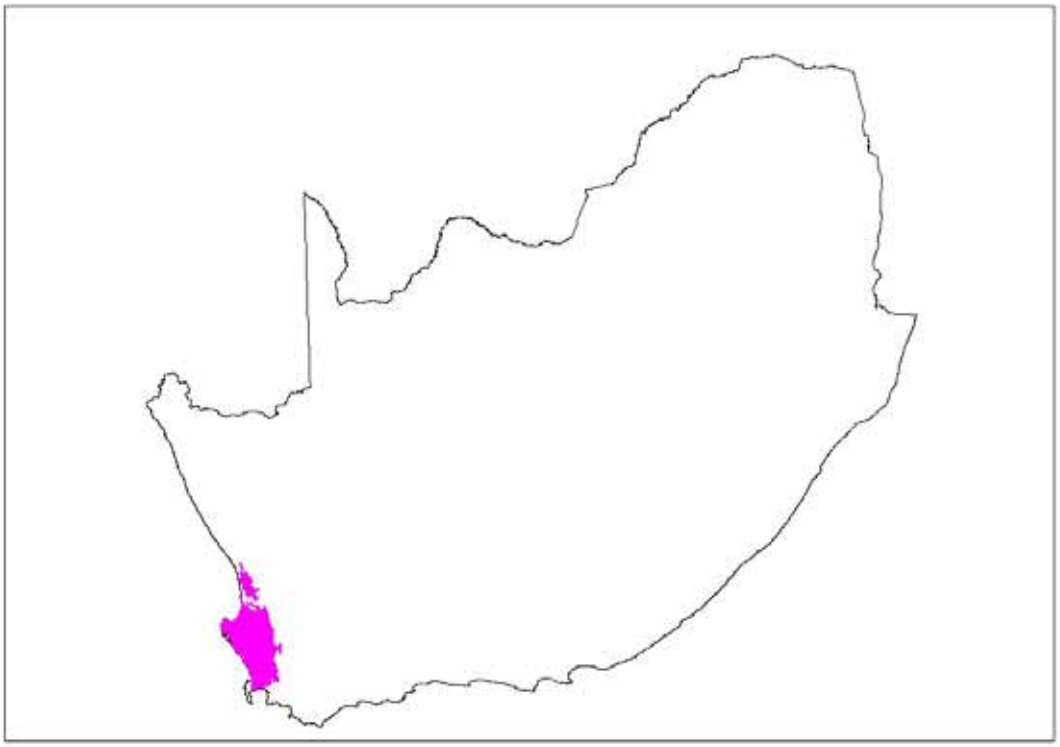
The Berg and Diep rivers flow through this region.

- Mean annual precipitation: Moderate in a limited area in the south, decreasing to low in the north.
- Coefficient of variation of annual precipitation: Moderate/high in the north with a restricted area being low in the south.
- Drainage density: Low.
- Stream frequency: Low/medium.
- Slopes <5%: Predominantly >80%.
- Median annual simulated runoff: Very low in the north to moderate/high in the south.
- Mean annual temperature: Moderate/high.

Size = 14628.4 km^2

Table 24: Main attributes of the South Western Coastal Belt Ecoregion.

Main Attributes	**South Western Coastal Belt**
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; **Plains Moderate Relief**; Closed Hills; Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Primary)	Sand Plain Fynbos; Mountain Fynbos; **West Coast Renosterveld;** Dune Thicket; Strandveld Succulent Karoo
Altitude (m a.m.s.l) (secondary)	0-300; 300-900 limited
MAP (mm) (modifying)	0 to 1500
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	30 to 60
Rainfall seasonality	Winter
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	24 to 32
Mean daily max. temp. (°C): July	12 to 20
Mean daily min. temp. (°C): February	12 to 18
Mean daily min temp. (°C): July	4 to 10
Median annual simulated runoff (mm) for quaternary catchment	<5; 20 to >250



ECOREGION 25: WESTERN COASTAL BELT

Primary boundary determinants:

Plains with low and moderate relief are typical of this region.

General:

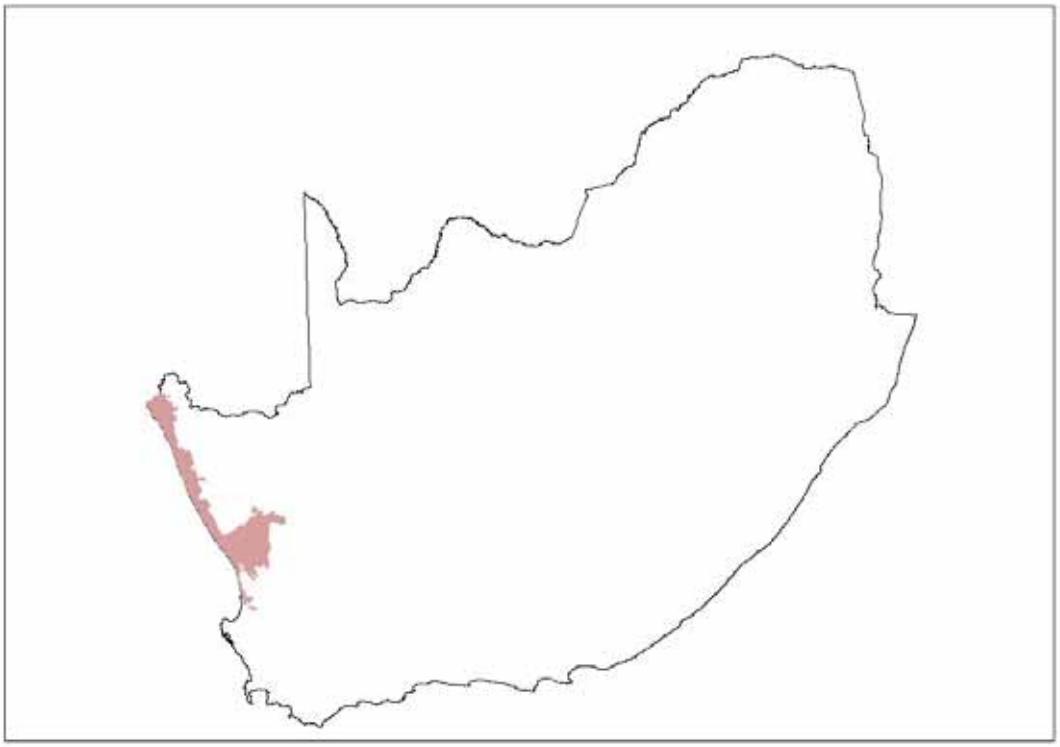
Altitude varies from sea level to 700 m.a.m.s.l. Vegetation types consist of Succulent Karoo types. The Olifants, Doring, Sout, Groen and Buffalo rivers traverse this region while the Orange River flows through the northern part.

- Mean annual precipitation: Very low/arid.
- Coefficient of variation of annual precipitation: High to very high.
- Drainage density: Low.
- Stream frequency: Low/medium.
- Slopes <5%: >80%.
- Median annual simulated runoff: Very low.
- Mean annual temperature: Moderate/high.

Size = 20398.8 km^2

Table 25: Main attributes of the Western Coastal Belt Ecoregion.

Main Attributes	Western Coastal Belt
Terrain Morphology: Broad division (dominant types in bold) (primary)	**Plains; Low Relief**; Plains Moderate Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Secondary)	**Lowland Succulent Karoo**; Upland Succulent Karoo (limited); Strandveld Succulent Karoo Mountain Fynbos (limited)
Altitude (m a.m.s.l) (Secondary)	0-700, 700-1100 (limited)
MAP (mm) (modifying)	0 to 200
Coefficient of Variation (% of annual precipitation)	30 to >40
Rainfall concentration index	45 to 65
Rainfall seasonality	Winter
Mean annual temp. (°C)	16 to 20
Mean daily max. temp. (°C): February	24 to >32
Mean daily max. temp. (°C): July	16 to 24
Mean daily min. temp. (°C): February	14 to 18
Mean daily min temp. (°C): July	2 to 10
Median annual simulated runoff (mm) for quaternary catchment	<5, 20-40 (limited)



ECOREGION 26: NAMA KAROO

Primary boundary determinants:

Topography is diverse but plains with a moderate to high relief and lowlands, hills and mountains with moderate to high relief are dominant. Vegetation consists almost exclusively of Nama Karoo types.

General:

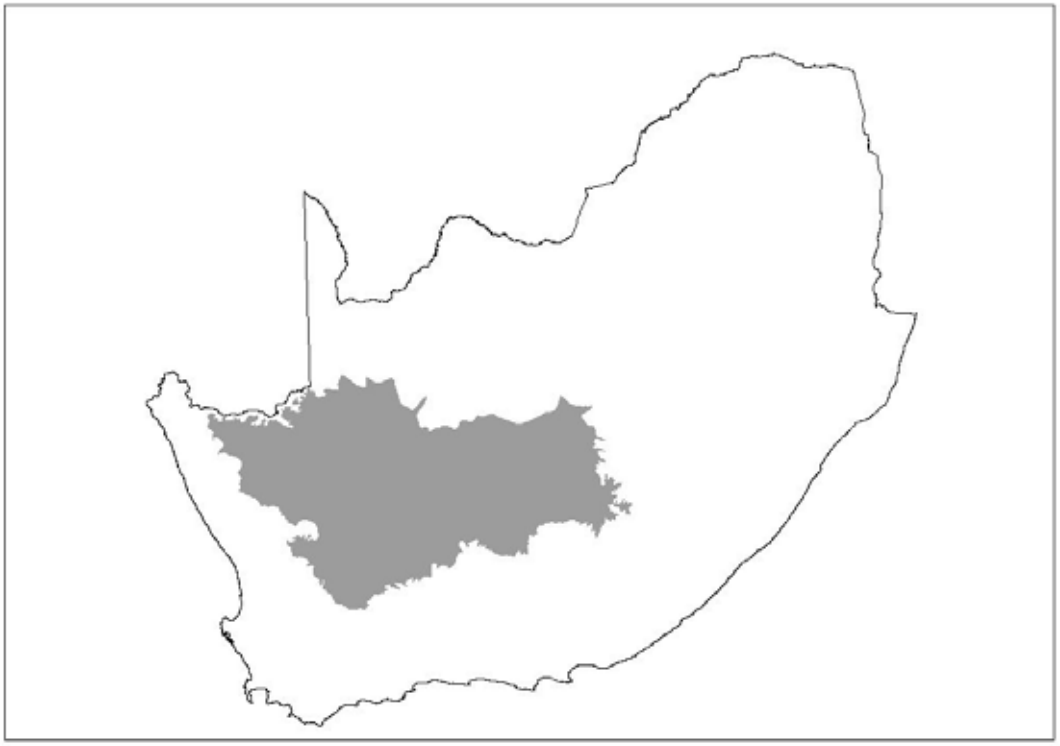
Perennial rivers that traverse this region are the Riet and Orange. Rivers draining extensive parts of the region, such as the Hartbees, are seasonal.

- Mean annual precipitation: Moderate/low in the east, decreasing to arid in the west.
- Coefficient of variation of annual precipitation: Moderate/high in the east to very high in the west.
- Drainage density: Generally low, but medium to high in some parts.
- Stream frequency: Low/medium but significant areas with low/high and high frequencies.
- Slopes <5%: Mostly >80% to 50-80%, but significant areas with 20-50% and <20%.
- Median annual simulated runoff: Moderate/low in the east, decreasing to arid in the west.
- Mean annual temperature: Moderate/low in the east, increasing to moderate/high in the west.

Size = 234554.2 km^2

Table 26: Main attributes of the Nama Karoo Ecoregion.

Main Attributes	Nama Karoo
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief**;** **Plains Moderate Relief;** **Lowlands; Hills and Mountains; Moderate and High Relief;** Open Hills, Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Primary)	Eastern Mixed Nama Karoo; Upper Nama Karoo; **Bushmanland Nama Karoo;** Orange River Nama Karoo; Great Nama Karoo (very limited) Lowland Succulent Karoo (limited); Upland Succulent Karoo Escarpment Mountain Renosterveld
Altitude (m a.m.s.l) (secondary)	300-1700, 1700-1900 (limited)
MAP (mm) (modifying)	0 to 500
Coefficient of Variation (% of annual precipitation)	30 to >40
Rainfall concentration index	15 to >65
Rainfall seasonality	Late to very late summer to Winter
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	26 to >32
Mean daily max. temp. (°C): July	10 to 22
Mean daily min. temp. (°C): February	12 to 18
Mean daily min temp. (°C): July	0 to 6
Median annual simulated runoff (mm) for quaternary catchment	<5 to 60



ECOREGION 27: NAMAQUA HIGHLANDS

Primary boundary determinants:

Closed hills and mountains with moderate to high relief are distinctive in this region. Dominant vegetation types consist of Succulent Karoo types and Renosterveld.

General:

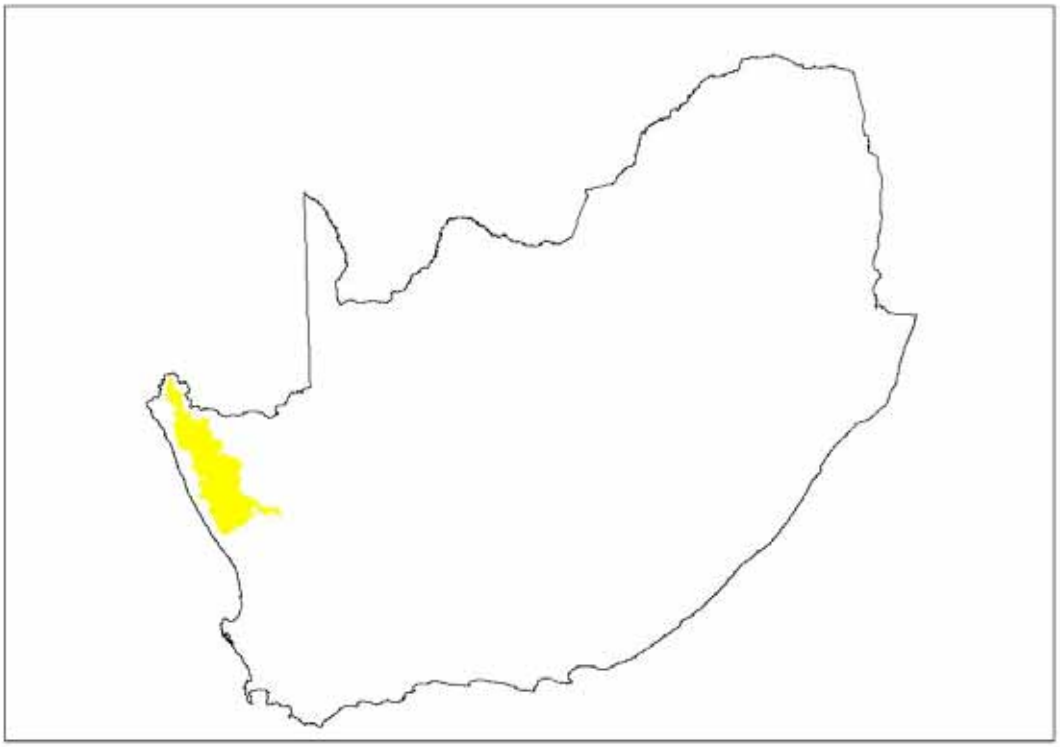
The Buffalo and Groen rivers have their sources in the region while Orange River flows through the northern part.

- Mean annual precipitation: Predominantly arid.
- Coefficient of variation of annual precipitation: High, very high in the north.
- Drainage density: Medium.
- Stream frequency: Medium/high.
- Slopes <5%: <20%.
- Median annual simulated runoff: Very low to low.
- Mean annual temperature: Moderate to moderately high.

Size = 21743.7 km^2

Table 27: Main attributes of the Namaqua Highlands Ecoregion.

Main Attributes	Namaqua Highlands
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief (limited); **Closed Hills, Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Primary)	Bushmanland Nama Karoo (limited); **Upland Succulent Karoo;** Lowland Succulent Karoo; North West Mountain Renosterveld; Patches Mountain Fynbos
Altitude (m a.m.s.l) (secondary)	100-1300; 1300-1500 limited
MAP (mm) (modifying)	0 to 200
Coefficient of Variation (% of annual precipitation)	30 to >40
Rainfall concentration index	30 to 65
Rainfall seasonality	Winter
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	22 to 32
Mean daily max. temp. (°C): July	12 to 22
Mean daily min. temp. (°C): February	12 to 18
Mean daily min temp. (°C): July	2 to 8
Median annual simulated runoff (mm) for quaternary catchment	<5 to10; 20 to 40



ECOREGION 28: ORANGE RIVER GORGE

Primary boundary determinants:

Closed hills and mountains with a moderate to high relief characterises the topography. Orange River Nama Karoo is the dominant vegetation type.

General:

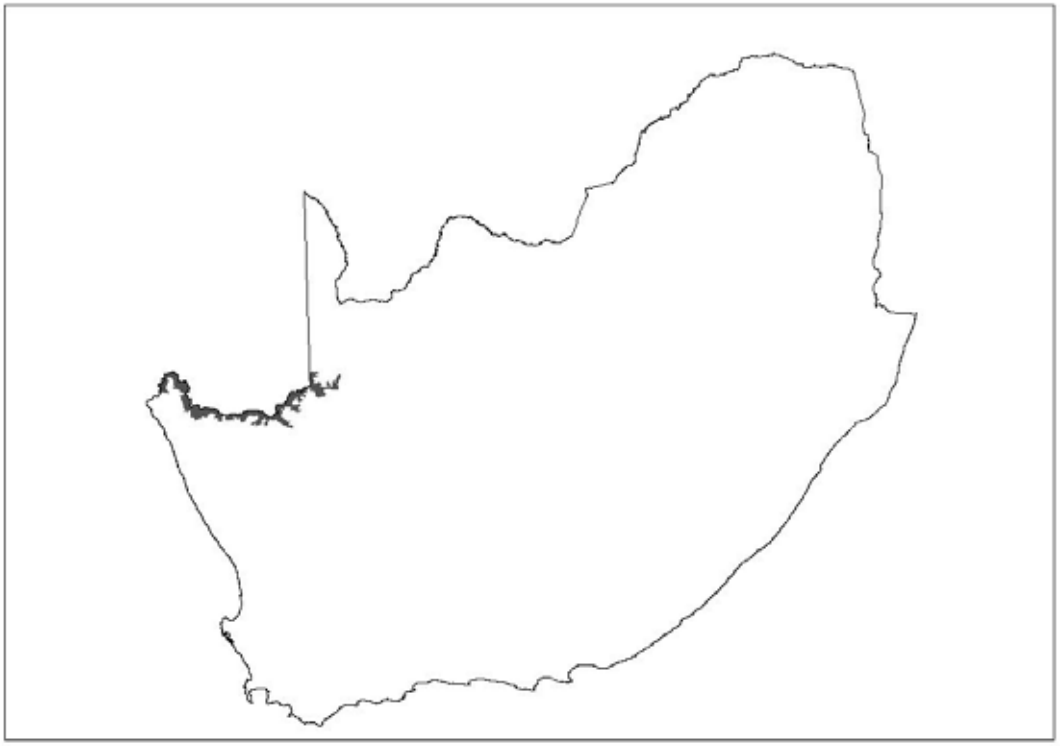
This ecoregion is situated along the lower section of the Orange River. No perennial streams rise in this region.

- Mean annual precipitation: Arid.
- Coefficient of variation of annual precipitation: Very high.
- Drainage density: Medium.
- Stream frequency: Medium high.
- Slopes <5%: <20%.
- Median annual simulated runoff: Very low.
- Mean annual temperature: High.

Size = 8435.3 km^2

Table 28: Main attributes of the Orange River Gorge Ecoregion.

Main Attributes	**Orange River Gorge**
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains Low Relief (limited); **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Primary NBI)	Upland Succulent Karoo; **Orange River Nama Karoo**
Altitude (m a.m.s.l) (secondary)	0-1100
MAP (mm) (modifying)	0 to 100
Coefficient of Variation (% of annual precipitation)	35 to >40
Rainfall concentration index	30 to >65
Rainfall seasonality	Very late summer to winter
Mean annual temp. (°C)	16 to 22
Mean daily max. temp. (°C): February	30 to >32
Mean daily max. temp. (°C): July	16 to 24
Mean daily min. temp. (°C): February	14 to 20
Mean daily min temp. (°C): July	2 to 10
Median annual simulated runoff (mm) for quaternary catchment	<5



ECOREGION 29: SOUTHERN KALAHARI

Primary boundary determinants:

Vegetation consists of a variety of Kalahari Bushveld types.

General:

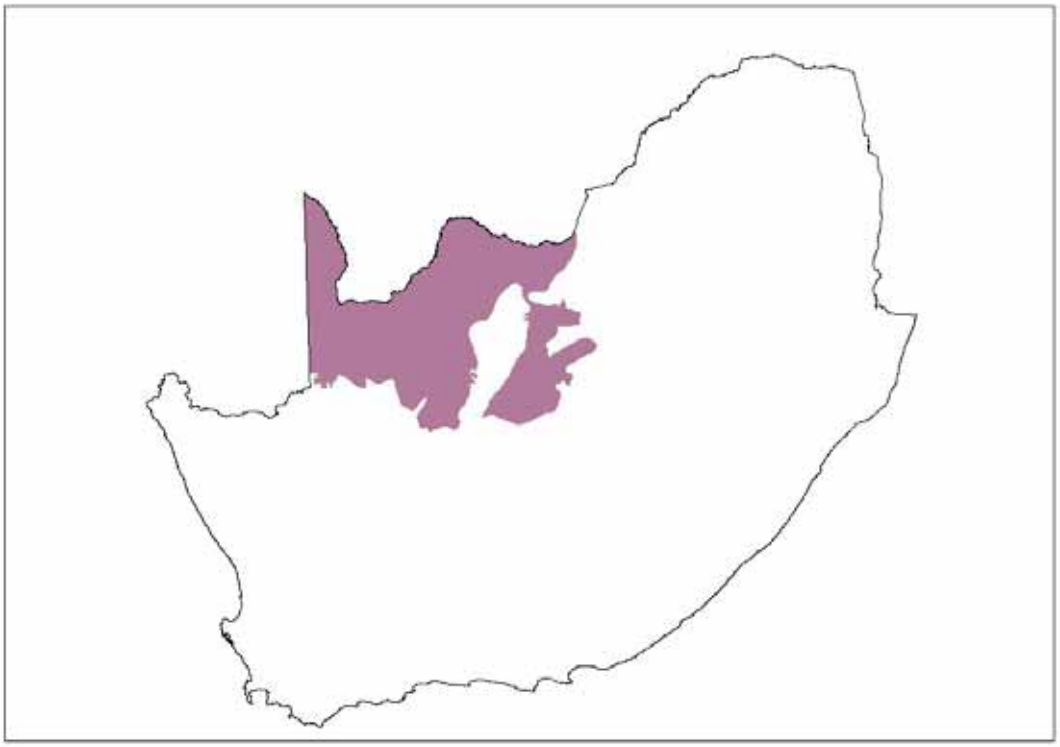
Terrain morphological types consist of plains with low to moderate relief in the east, and open hills, lowlands and mountains with moderate to high relief in the west. The western part of the region consists of dune hills. The lower part of the Vaal River flows through the region, while others such as the Harts, Molopo, Kuruman and Nosob are seasonal.

- Mean annual precipitation: Moderate/low in the east, decreasing to arid in the west.
- Coefficient of variation of annual precipitation: Moderate/high in the east to very high in the west.
- Drainage density: Low in the east to medium in the west.
- Stream frequency: generally low/medium, but with patches medium/high.
- Slopes <5%: Generally >80 in the east, >20-50% in the west with patches <20%.
- Median annual simulated runoff: Low/moderate in the east to very low in the west.
- Mean annual temperature: Moderate/high to high.

Size = 152829.6 km^2

Table 29: Main attributes of the Southern Kalahari Ecoregion.

Main Attributes	Southern Kalahari
Terrain Morphology: Broad division (dominant types in bold) (Secondary)	**Plains; Low Relief;** Plains Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief (limited) **Open Hills, Lowlands; Mountains; Moderate to High Relief;** Closed Hills; Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Primary)	Orange River Nama Karoo (limited); Karroid Kalahari Bushveld; **Shrubby Kalahari Dune Bushveld;** Thorny Kalahari Dune Bushveld (limited);Kalahari Mountain Bushveld; **Kalahari Plains Thorn Bushveld;** Kalahari Plateau Bushveld; **Kimberley Thorn Bushveld**
Altitude (m a.m.s.l) (modifying)	500-1700; 1700-1900 limited
MAP (mm) (modifying)	0 to 500
Coefficient of Variation (% of annual precipitation)	30 to >40
Rainfall concentration index	50 to >65
Rainfall seasonality	Mid to very late summer
Mean annual temp. (°C)	14 to 22
Mean daily max. temp. (°C): February	28 to >32
Mean daily max. temp. (°C): July	14 to 22
Mean daily min. temp. (°C): February	14 to 20
Mean daily min temp. (°C): July	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	<5 to 60



ECOREGION 30: GHAAP PLATEAU

Primary boundary determinants:

This is an extensive dolomitic area characterized by plains with a low to moderate relief. A distinctive escarpment occurs along the east of the region. Kalahari Bushveld types are distinctive with Kalahari Plateau Bushveld being the most prominent.

General:

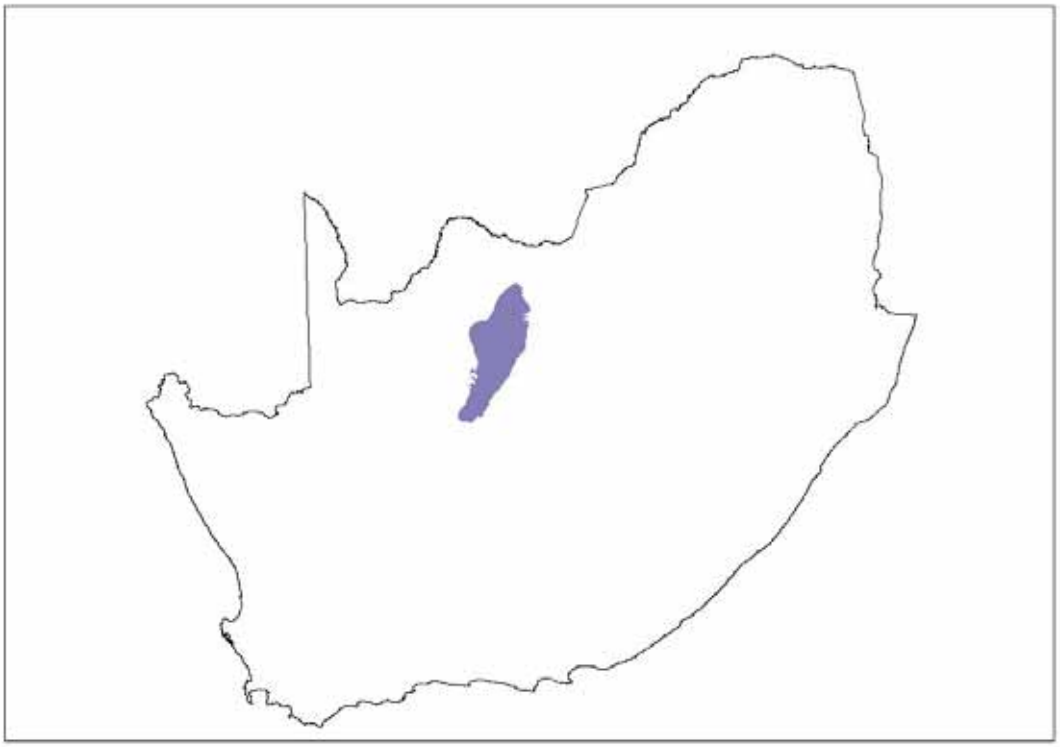
The Kuruman River has its source in the region.

- Mean annual precipitation: Moderate/low.
- Coefficient of variation of annual precipitation: Moderate high.
- Drainage density: Low.
- Stream frequency: Low/medium.
- Slopes <5%: >80%.
- Median annual simulated runoff: Moderate/low.
- Mean annual temperature: Moderate/high to high.

Size = 21326.6 km^2

Table 30: Main attributes of the Ghaap Plateau Ecoregion.

Main Attributes	**Ghaap Plateau**
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief**; Plains Moderate Relief; Closed Hills; Mountains; Moderate and High Relief (limited)
Vegetation types (dominant types in bold) (Primary)	**Kalahari Plateau Bushveld;** Kimberly Thorn Bushveld; Kalahari Mountain Bushveld (limited); Kalahari Plains Thorn Bushveld
Altitude (m a.m.s.l) (secondary)	900-1700
MAP (mm) (modifying)	200 to 500
Coefficient of Variation (% of annual precipitation)	30 to 40
Rainfall concentration index	55 to 65
Rainfall seasonality	Mid to late summer
Mean annual temp. (°C)	16 to 20
Mean daily max. temp. (°C): February	28 to 32
Mean daily max. temp. (°C): July	16 to 20
Mean daily min. temp. (°C): February	14 to 18
Mean daily min temp. (°C): July	0 to 2
Median annual simulated runoff (mm) for quaternary catchment	<5 to 40



ECOREGION 31: EASTERN COASTAL BELT

Primary boundary determinants:

The main terrain morphological type in this region is closed hills and mountains with a moderate to high relief.

General:

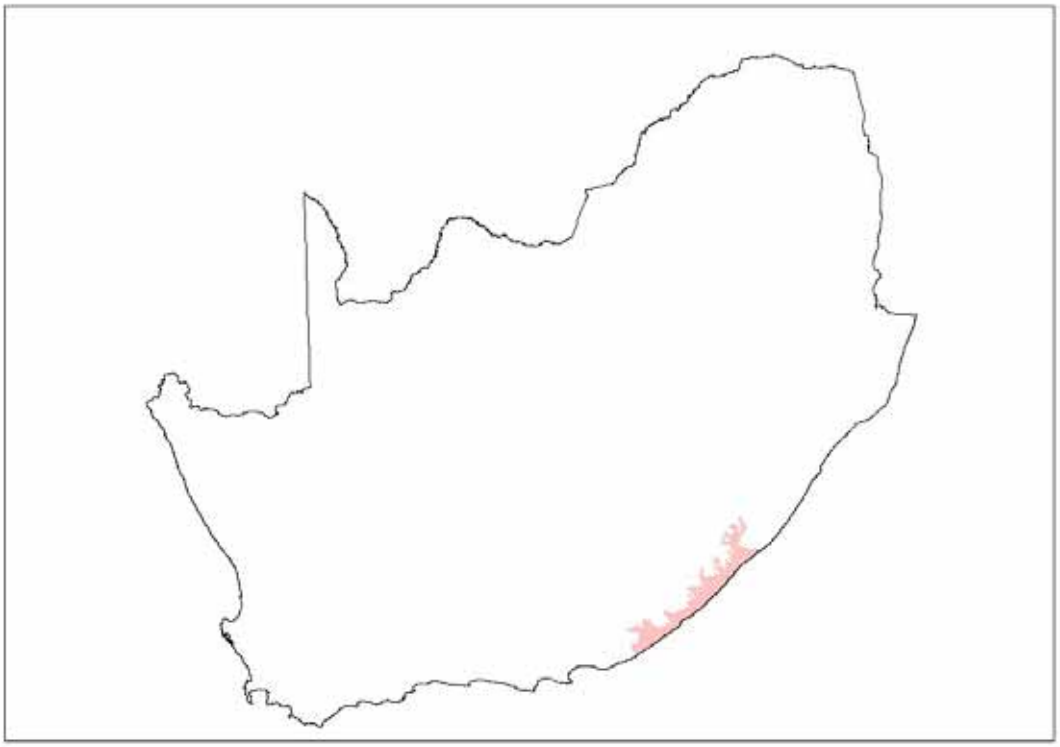
Altitude varies from sea level to 700 m.a.m.s.l. Vegetation types consist of a variety of Thicket, Grassland and Bushveld types. Rivers such as the Mzimvubu and Groot Kei flow through this region.

- Mean annual precipitation: Predominantly high.
- Coefficient of variation of annual precipitation: Low to very low.
- Drainage density: Medium to high.
- Stream frequency: Medium/high to very high.
- Slopes <5%: Predominantly <20%.
- Median annual simulated runoff: High.
- Mean annual temperature: Moderate.

Size = 12058.4 km^2

Table 31: Main attributes of the Eastern Coastal Belt Ecoregion.

MAIN ATTRIBUTES	EASTERN COASTAL BELT
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains: Moderate Relief (limited); **Closed Hills, Mountains; Moderate and High Relief;**
Vegetation types (dominant types in bold) (Secondary)	Coastal Bushveld\Grassland (Limited); **Eastern Thorn Bushveld**; **Valley Thicket;** Dune Thicket (limited); Short Mistbelt Grassland (limited); Coastal Grassland Patches Coastal forest and Patches Afromontane Forest
Altitude (m a.m.s.l) (Secondary)	0-500, 500-900 (limited)
MAP (mm) (modifying)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	<15 to 50
Rainfall seasonality	Early to very late summer to all year
Mean annual temp. (°C)	16 to 20
Mean daily max. temp. (°C): February	24 to 28
Mean daily max. temp. (°C): July	18 to 22
Mean daily min. temp. (°C): February	14 to 20
Mean daily min temp. (°C): July	4 to >10
Median annual simulated runoff (mm) for quaternary catchment	20 to >250



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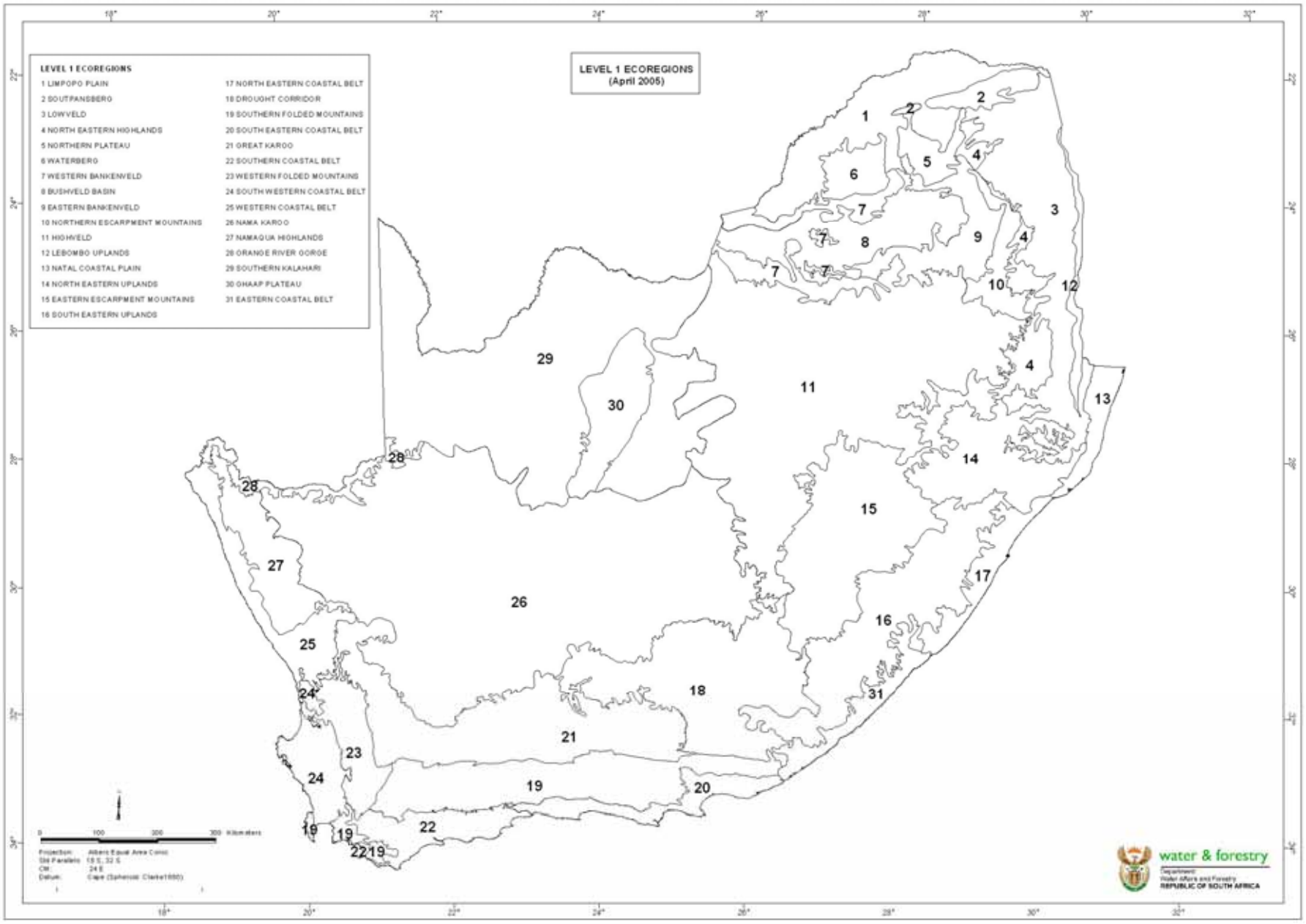
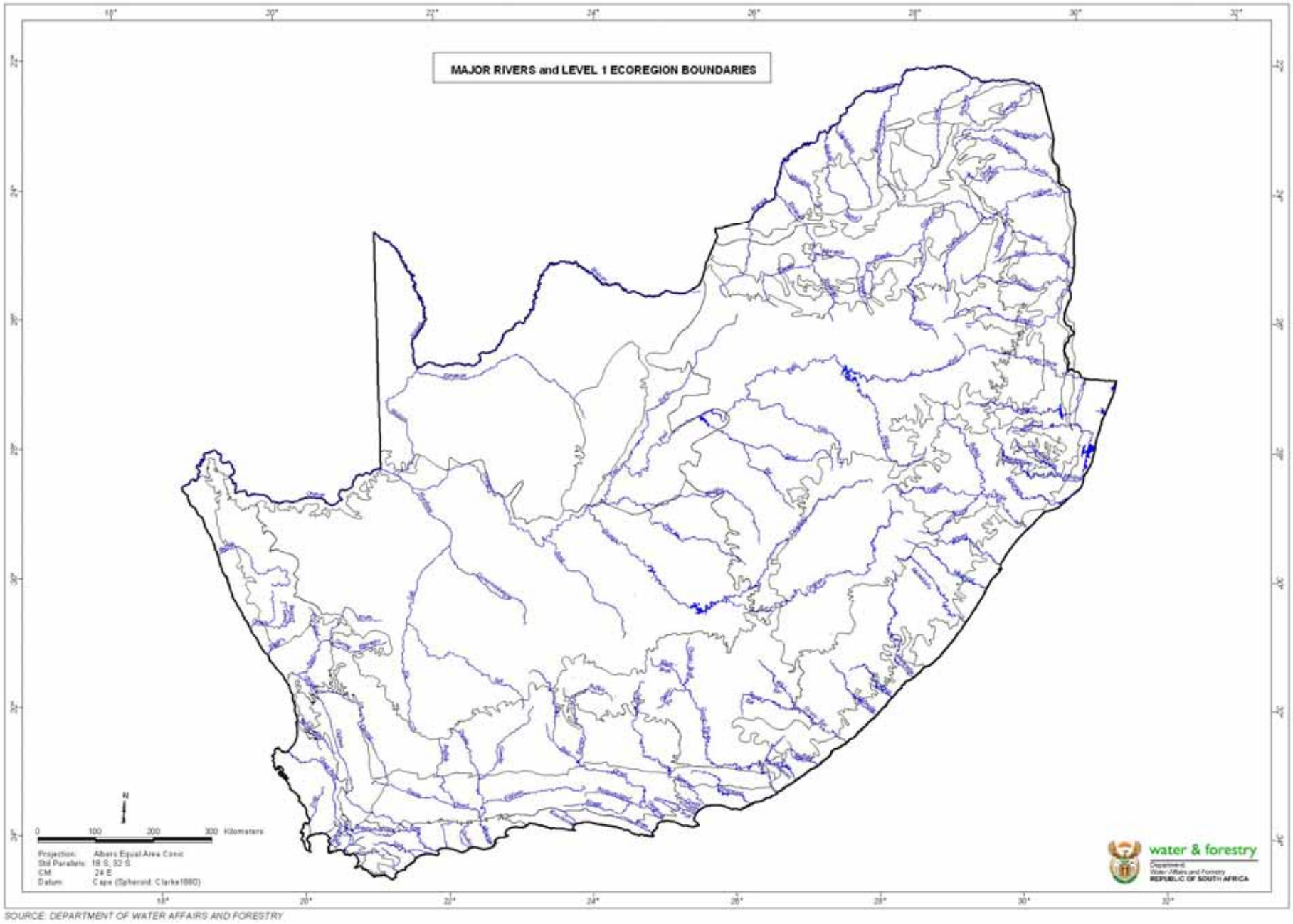
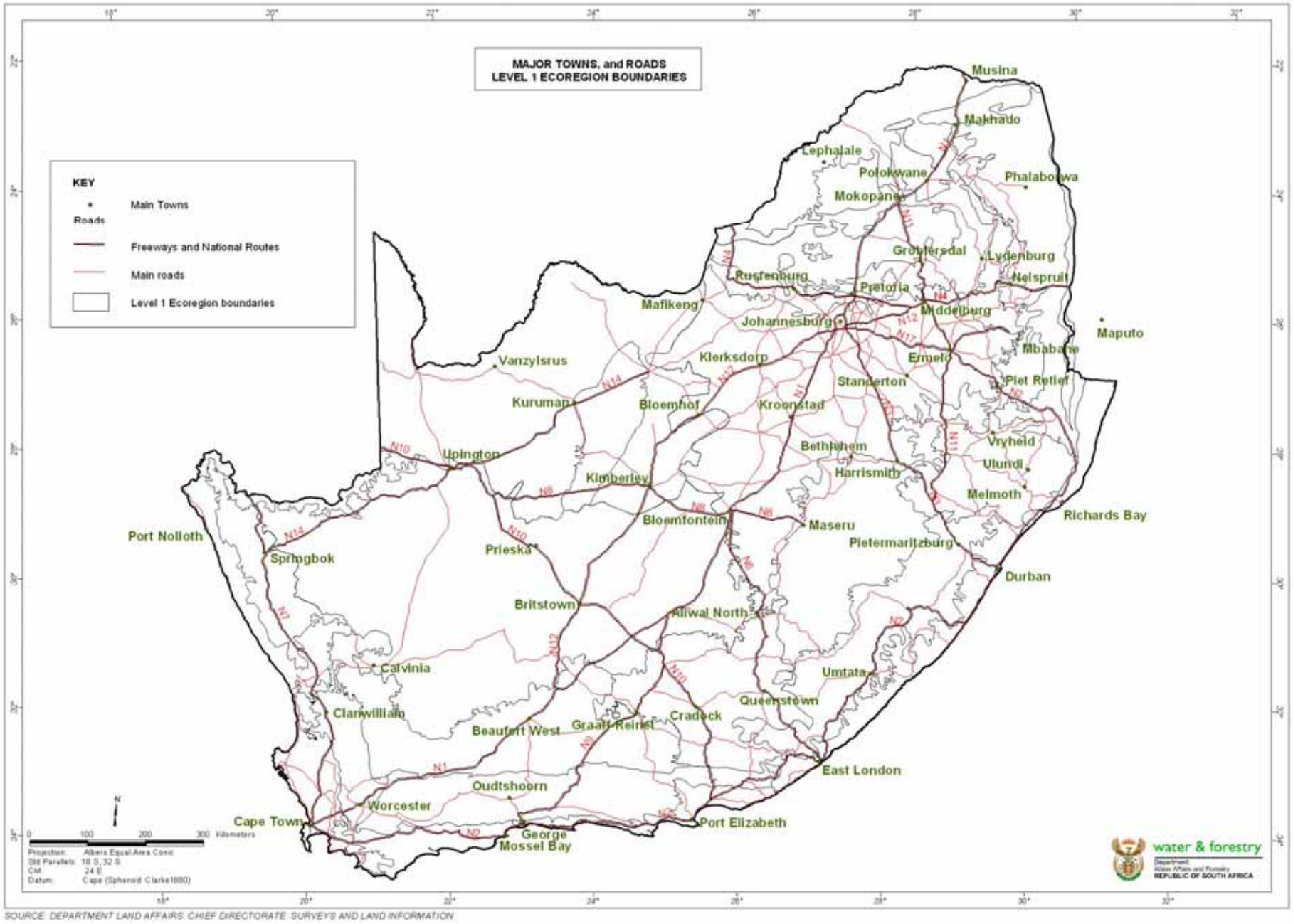
APPENDIX:

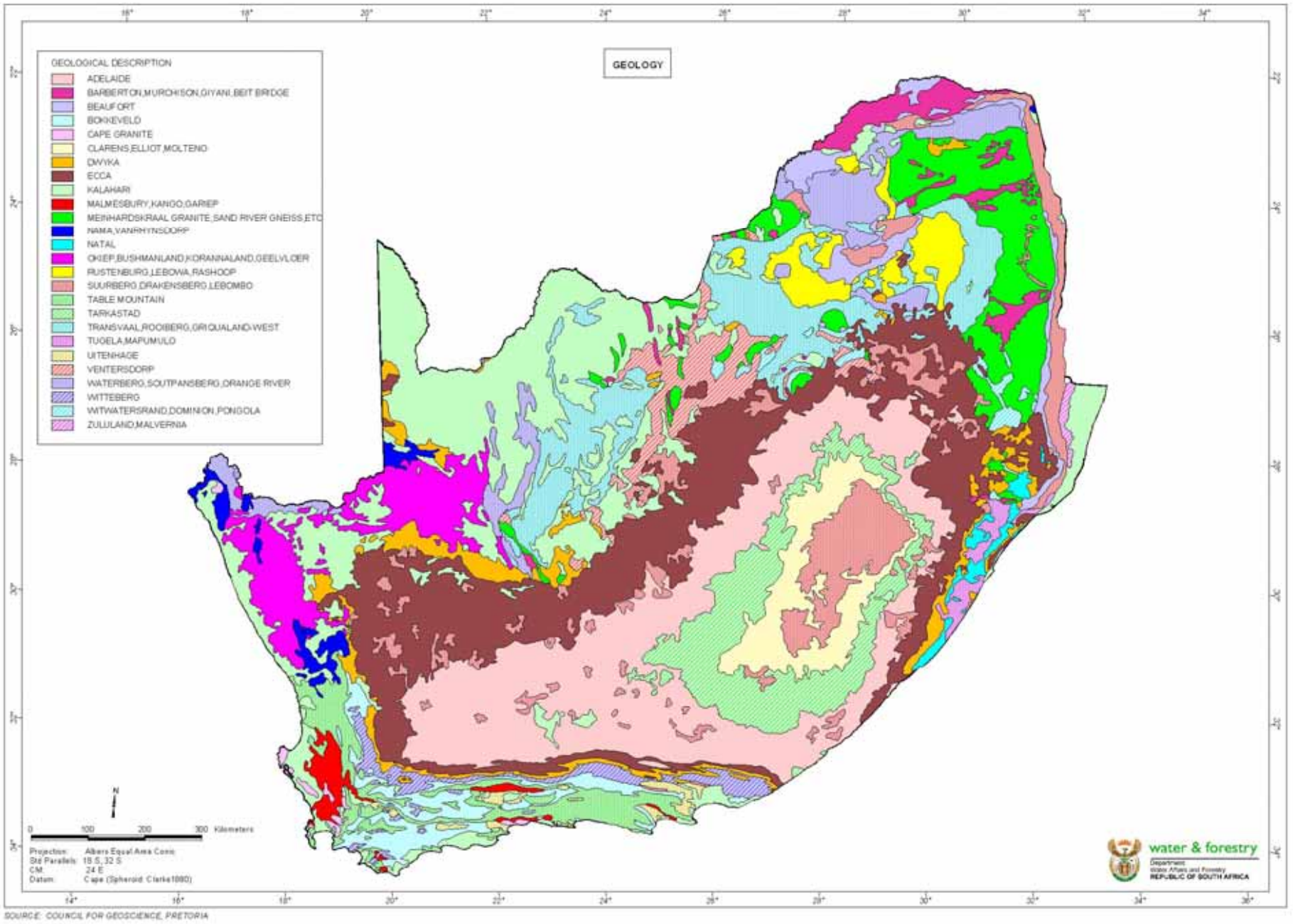
List of maps:

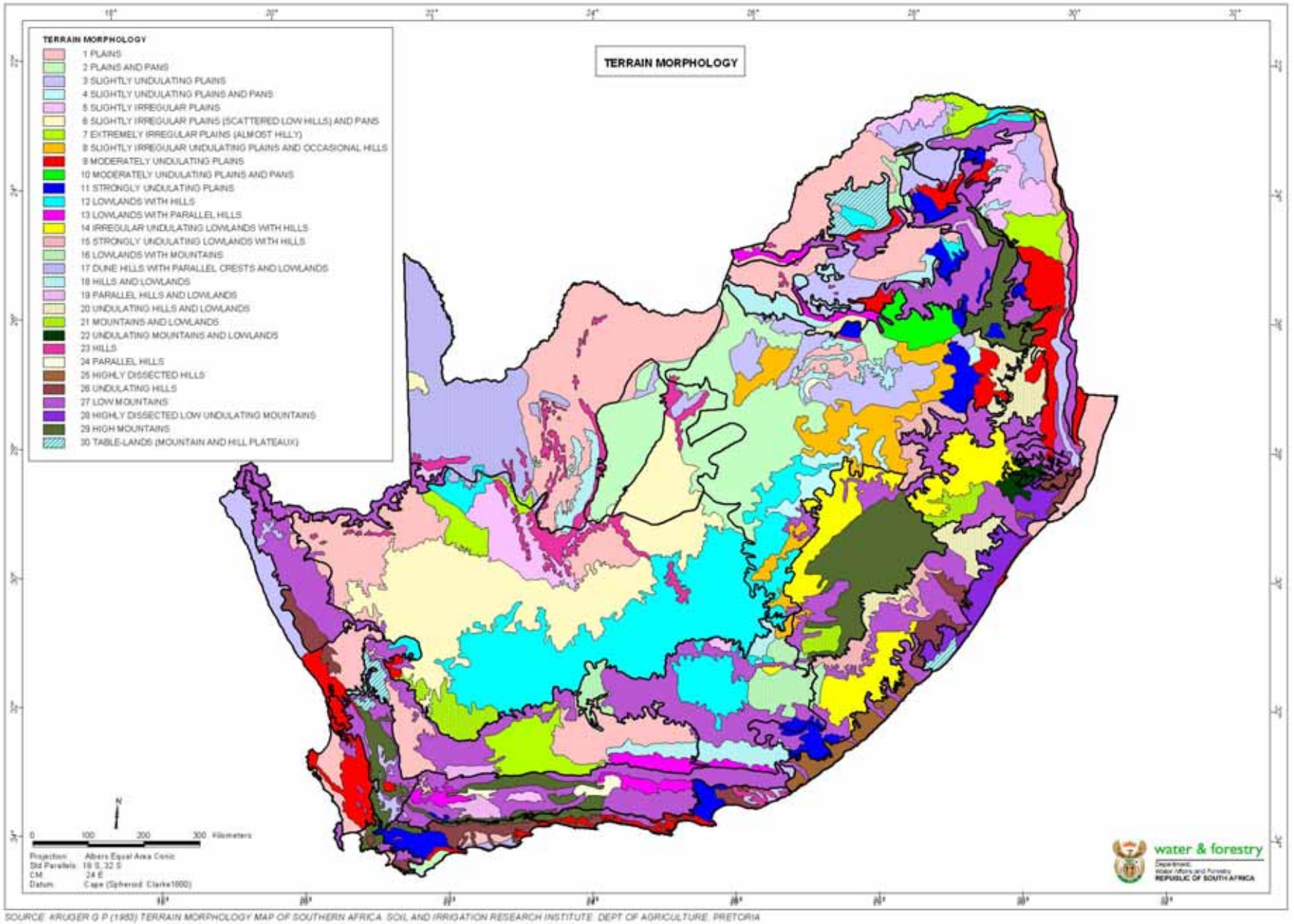

LEVEL 1 ECOREGIONS
1 LIMPOPO PLAIN
2 SOUTPANSBERG
3 LOWVELD
4 NORTH EASTERN HIGHLANDS
5 NORTHERN PLATEAU
6 WATERBERG
7 WESTERN BANKENVELD
8 BUSHVELD BASIN
9 EASTERN BANKENVELD
10 NORTHERN ESCARPMENT MOUNTAINS
11 HIGHVELD
12 LEBOMBO UPLANDS
13 NATAL COASTAL PLAIN
14 NORTH EASTERN UPLANDS
15 EASTERN ESCARPMENT MOUNTAINS
16 SOUTH EASTERN UPLANDS
17 NORTH EASTERN COASTAL BELT
18 DROUGHT CORRIDOR
19 SOUTHERN FOLDED MOUNTAINS
20 SOUTH EASTERN COASTAL BELT
21 GREAT KAROO
22 SOUTHERN COASTAL BELT
23 WESTERN FOLDED MOUNTAINS
24 SOUTH WESTERN COASTAL BELT
25 WESTERN COASTAL BELT
26 NAMA KAROO
27 NAMAQUA HIGHLANDS
28 ORANGE RIVER GORGE
29 SOUTHERN KALAHARI
30 GHAAP PLATEAU
31 EASTERN COASTAL BELT
LEVEL 1 ECOREGIONS
(April 2005)
water & forestry


MAJOR RIVERS and LEVEL 1 ECOREGION BOUNDARIES
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S; 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department: Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: DEPARTMENT OF WATER AFFAIRS AND FORESTRY

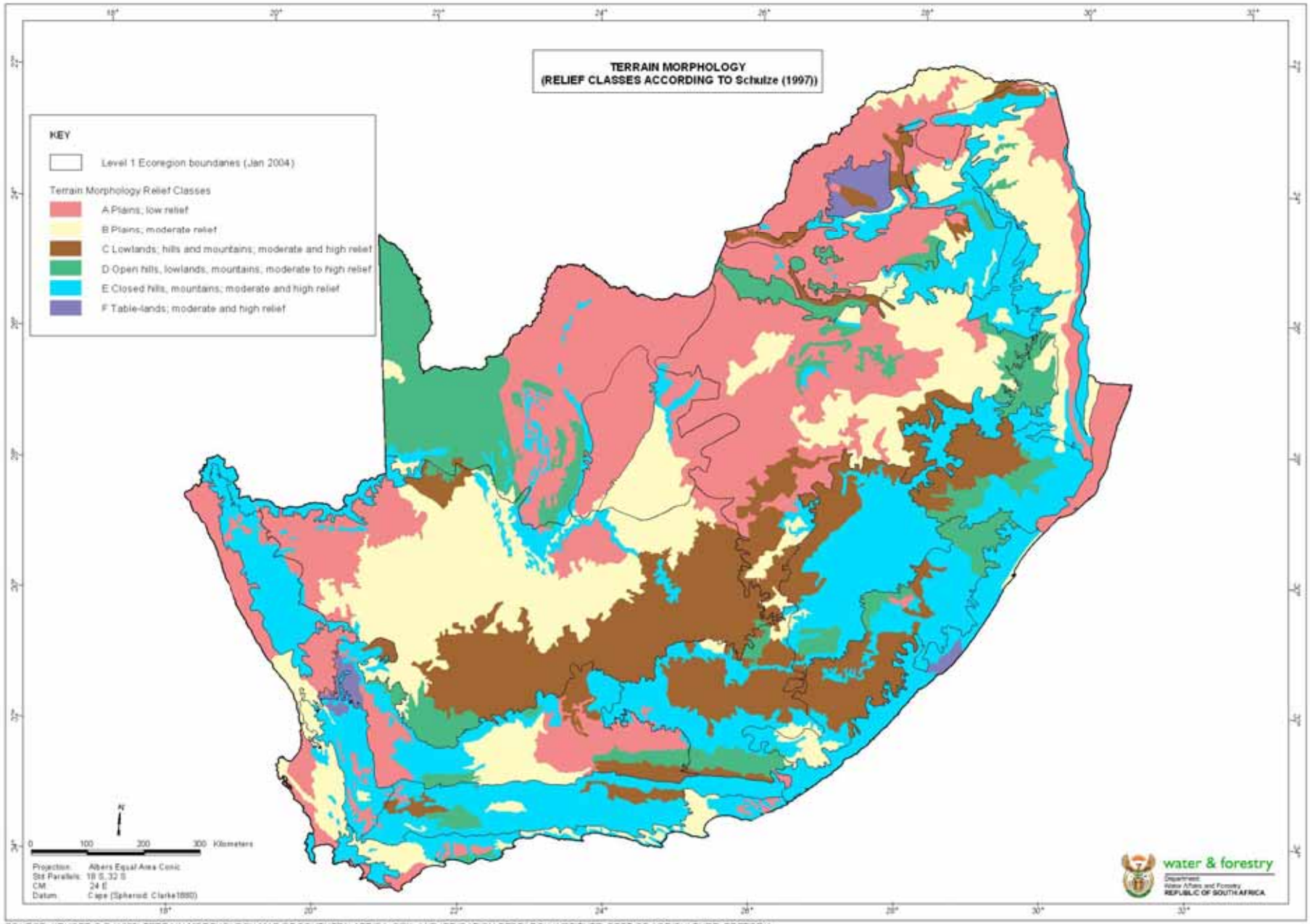


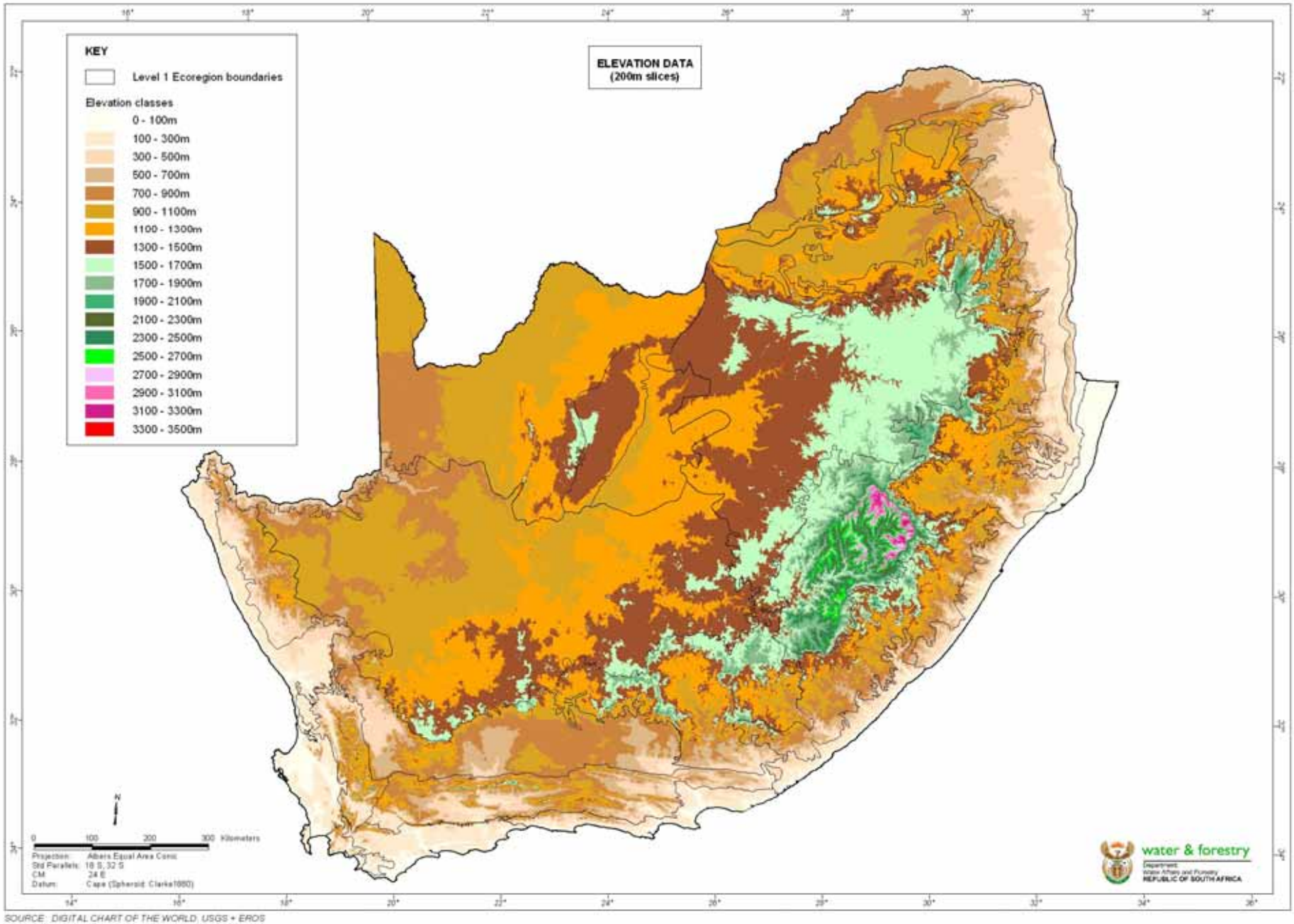
SOURCE: DEPARTMENT LAND AFFAIRS: CHIEF DIRECTORATE: SURVEYS AND LAND INFORMATION

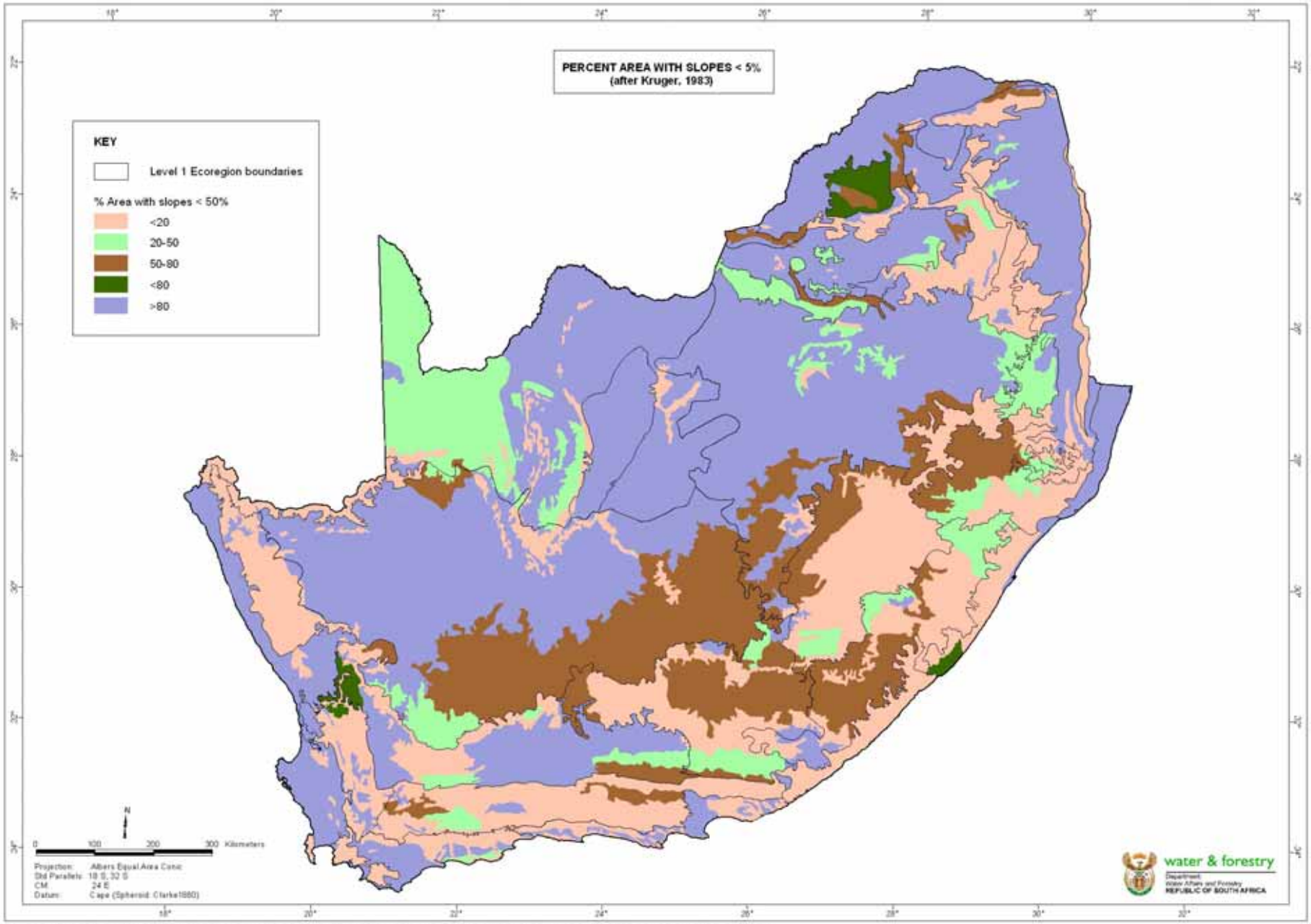

GEOLOGY
GEOLOGICAL DESCRIPTION
ADELAIDE
BARBERTON,MURCHISON,GIYANI,BEIT BRIDGE
BEAUFORT
BOKKEVELD
CAPE GRANITE
CLARENS,ELLIOT,MOLTENO
DWYKA
ECCA
KALAHARI
MALMESBURY,KANGO,GARIEP
MEINHARDSKRAAL GRANITE,SAND RIVER GNEISS,ETC
NAMA,VANRHYNSDORP
NATAL
OKIEP,BUSHMANLAND,KORANNALAND,GEELVLOER
RUSTENBURG,LEBOWA,RASHOOP
SUURBERG,DRAKENSBERG,LEBOMBO
TABLE MOUNTAIN
TARKASTAD
TRANSVAAL,ROOIBERG,GRIQUALAND-WEST
TUGELA,MAPUMULO
UITENHAGE
VENTERSDORP
WATERBERG,SOUTPANSBERG,ORANGE RIVER
WITTEBERG
WITWATERSRAND,DOMINION,PONGOLA
ZULULAND,MALVERNIA
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: COUNCIL FOR GEOSCIENCE, PRETORIA

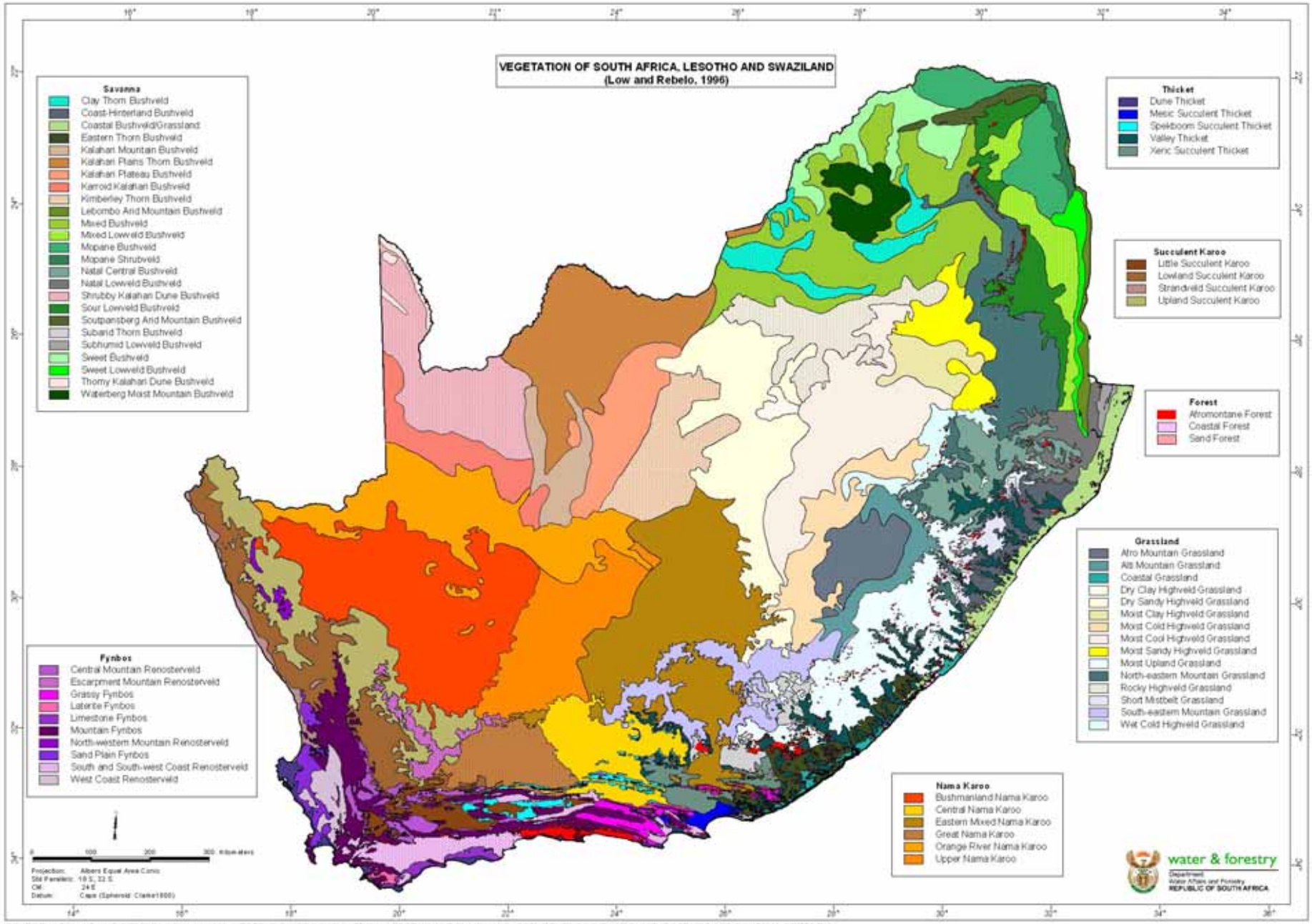


SOURCE: KRUGER G P (1983) TERRAIN MORPHOLOGY MAP OF SOUTHERN AFRICA. SOIL AND IRRIGATION RESEARCH INSTITUTE, DEPT OF AGRICULTURE, PRETORIA

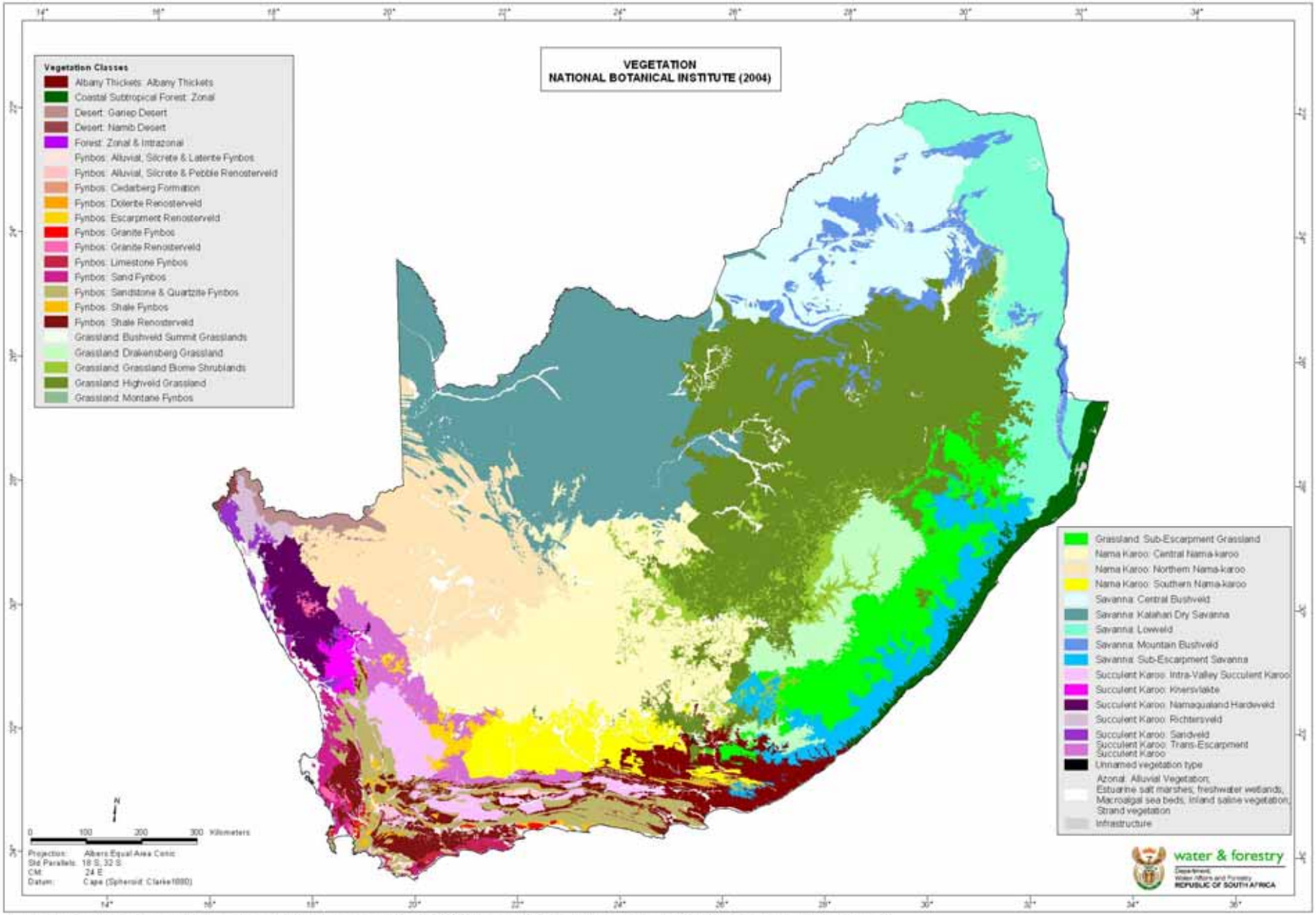

TERRAIN MORPHOLOGY
(RELIEF CLASSES ACCORDING TO Schulze (1997))
KEY
Level 1 Ecoregion boundaries (Jan 2004)
Terrain Morphology Relief Classes
A Plains; low relief
B Plains; moderate relief
C Lowlands; hills and mountains; moderate and high relief
D Open hills, lowlands, mountains; moderate to high relief
E Closed hills, mountains; moderate and high relief
F Table-lands; moderate and high relief
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department: Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: KRUGER G P (1983) TERRAIN MORPHOLOGY MAP OF SOUTHERN AFRICA. SOIL AND IRRIGATION RESEARCH INSTITUTE, DEPT OF AGRICULTURE, PRETORIA
IN: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA


KEY
Level 1 Ecoregion boundaries
Elevation classes
0 - 100m
100 - 300m
300 - 500m
500 - 700m
700 - 900m
900 - 1100m
1100 - 1300m
1300 - 1500m
1500 - 1700m
1700 - 1900m
1900 - 2100m
2100 - 2300m
2300 - 2500m
2500 - 2700m
2700 - 2900m
2900 - 3100m
3100 - 3300m
3300 - 3500m
ELEVATION DATA
(200m slices)
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: DIGITAL CHART OF THE WORLD, USGS + EROS

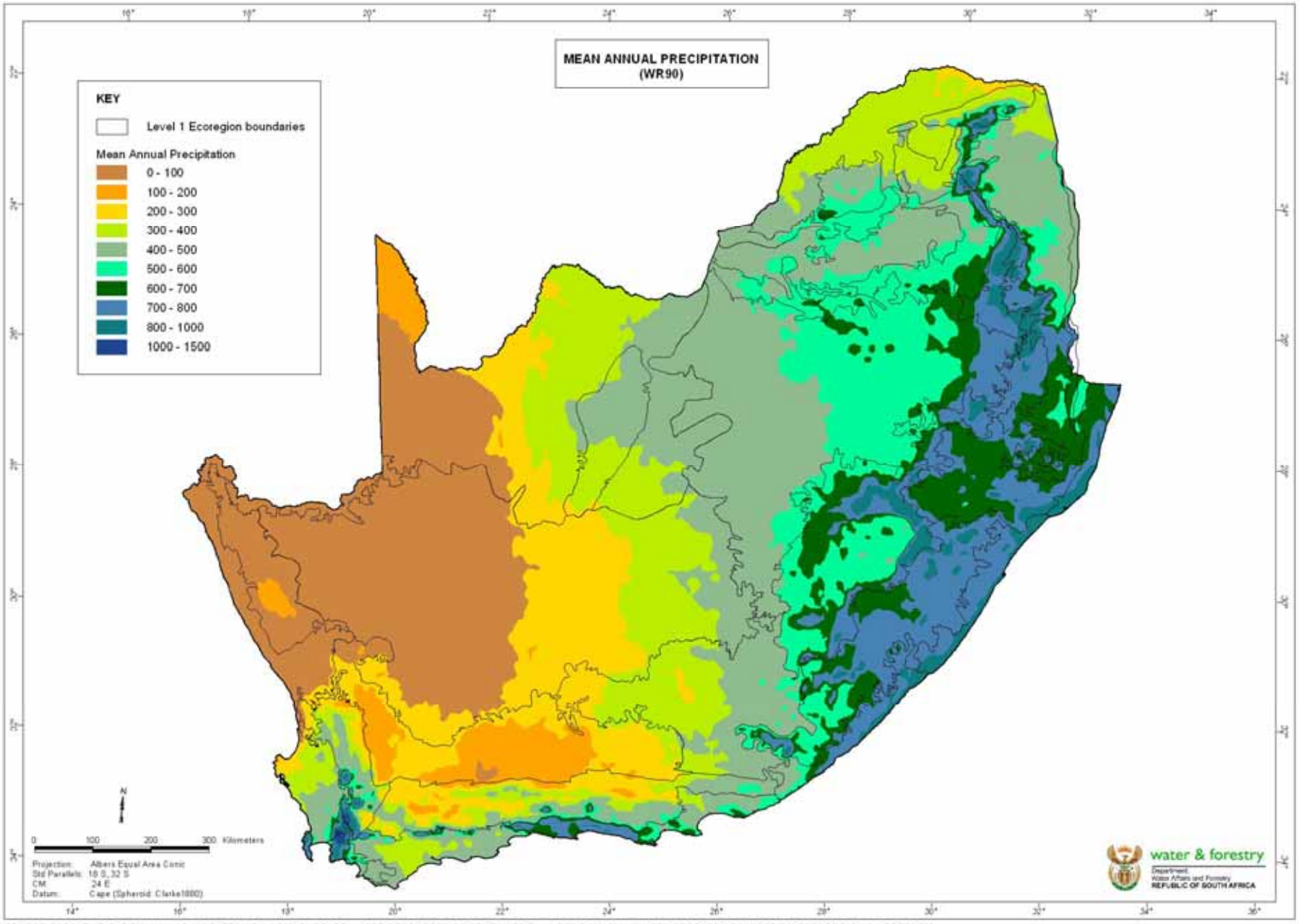

PERCENT AREA WITH SLOPES < 5%
(after Kruger, 1983)
KEY
Level 1 Ecoregion boundaries
% Area with slopes < 50%
<20
20-50
50-80
<80
>80
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: KRUGER G P (1983) TERRAIN MORPHOLOGY MAP OF SOUTHERN AFRICA. SOIL AND IRRIGATION RESEARCH INSTITUTE. DEPT OF AGRICULTURE. PRETORIA



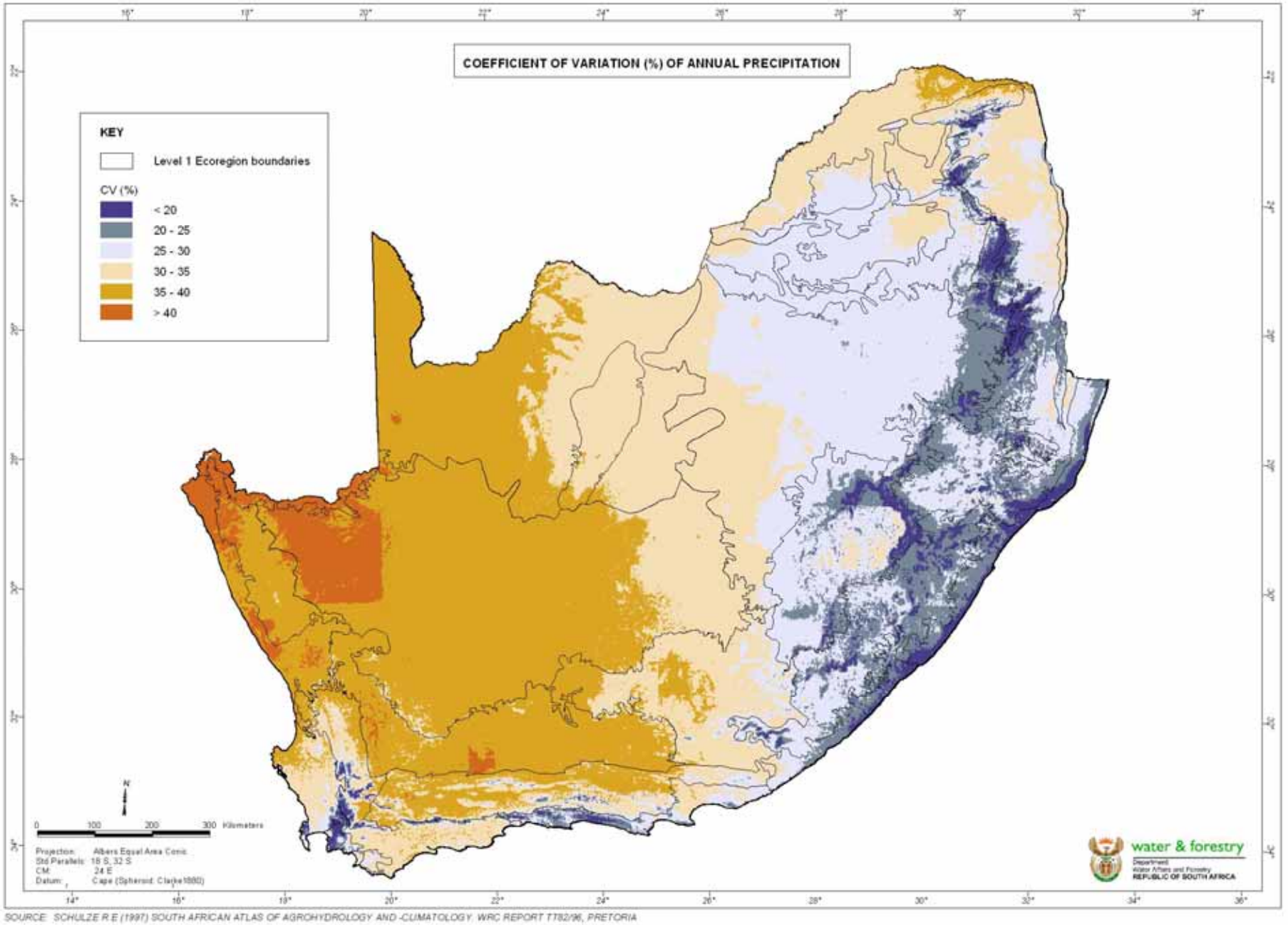
SOURCE: LOW, A B AND REBELO, A G (eds) 1996. VEGETATION OF SOUTH AFRICA, LESOTHO AND SWAZILAND. DEPARTMENT OF ENVIRONMENT AFFAIRS AND TOURISM, PRETORIA

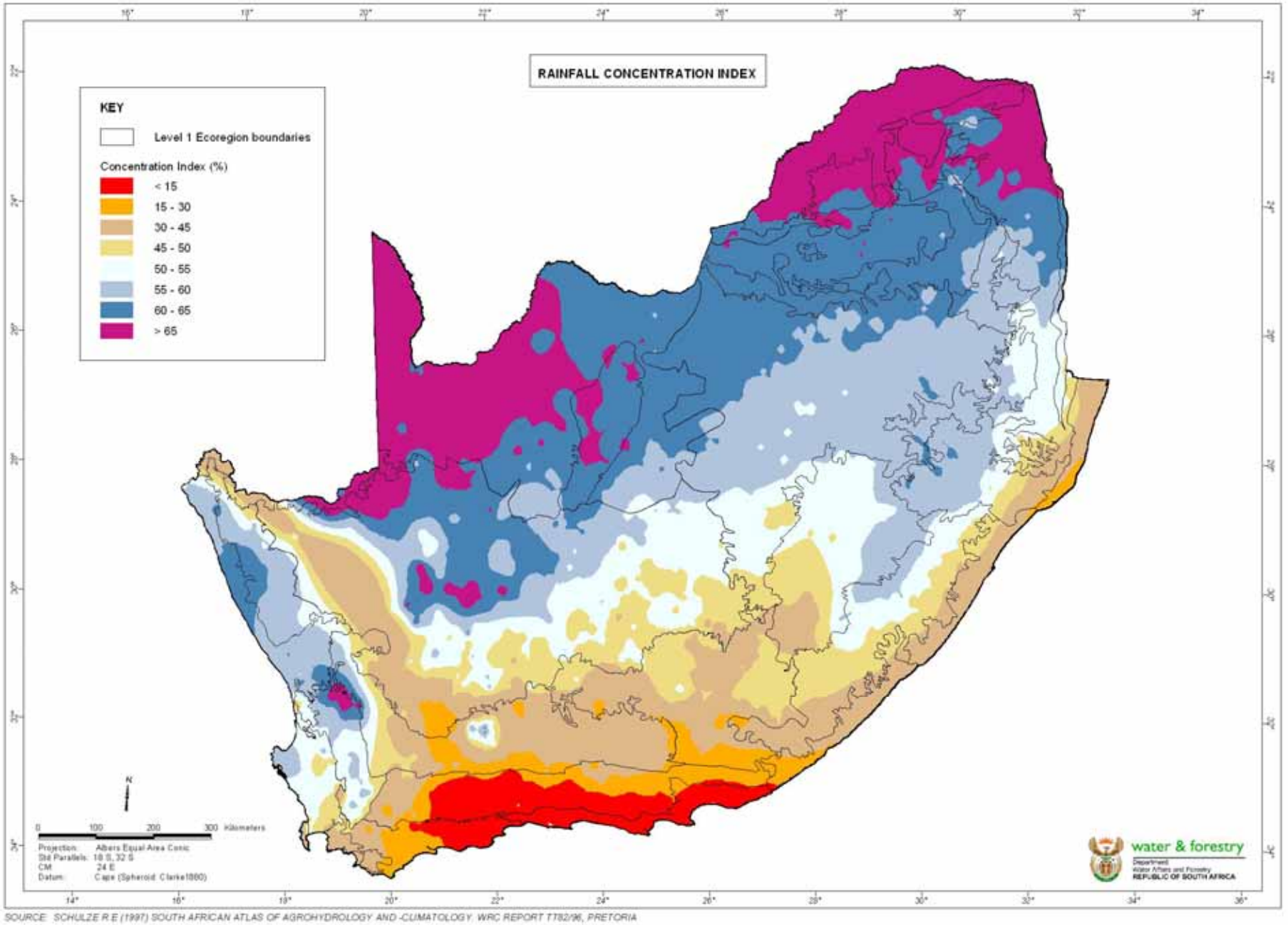


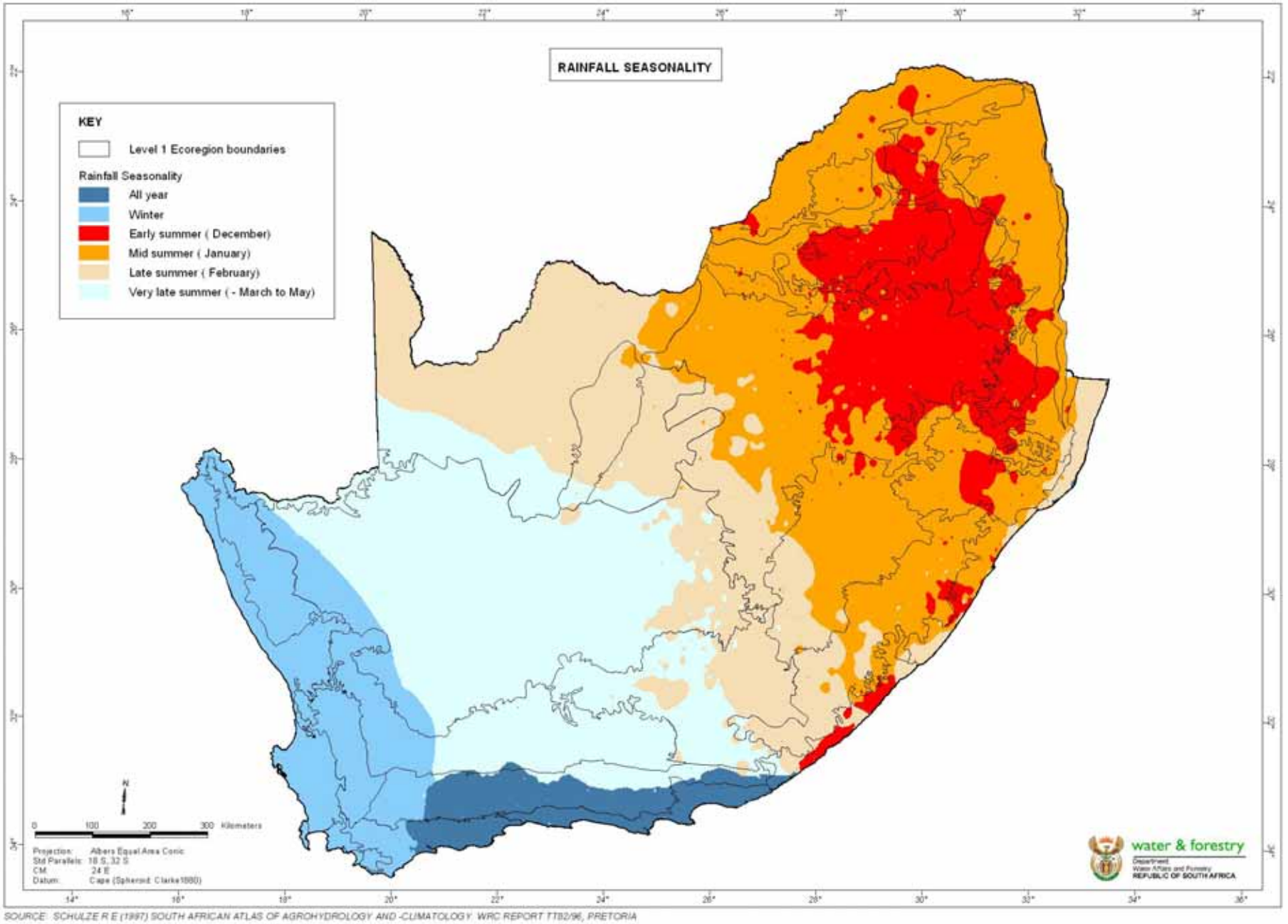
SOURCE: VEGETATION MAP OF SOUTH AFRICA, LESOTHO AND SWAZILAND. BETA VERSION 4.0 (2004) NATIONAL BOTANICAL INSTITUTE AND DEPT OF ENVIRONMENTAL AFFAIRS AND TOURISM

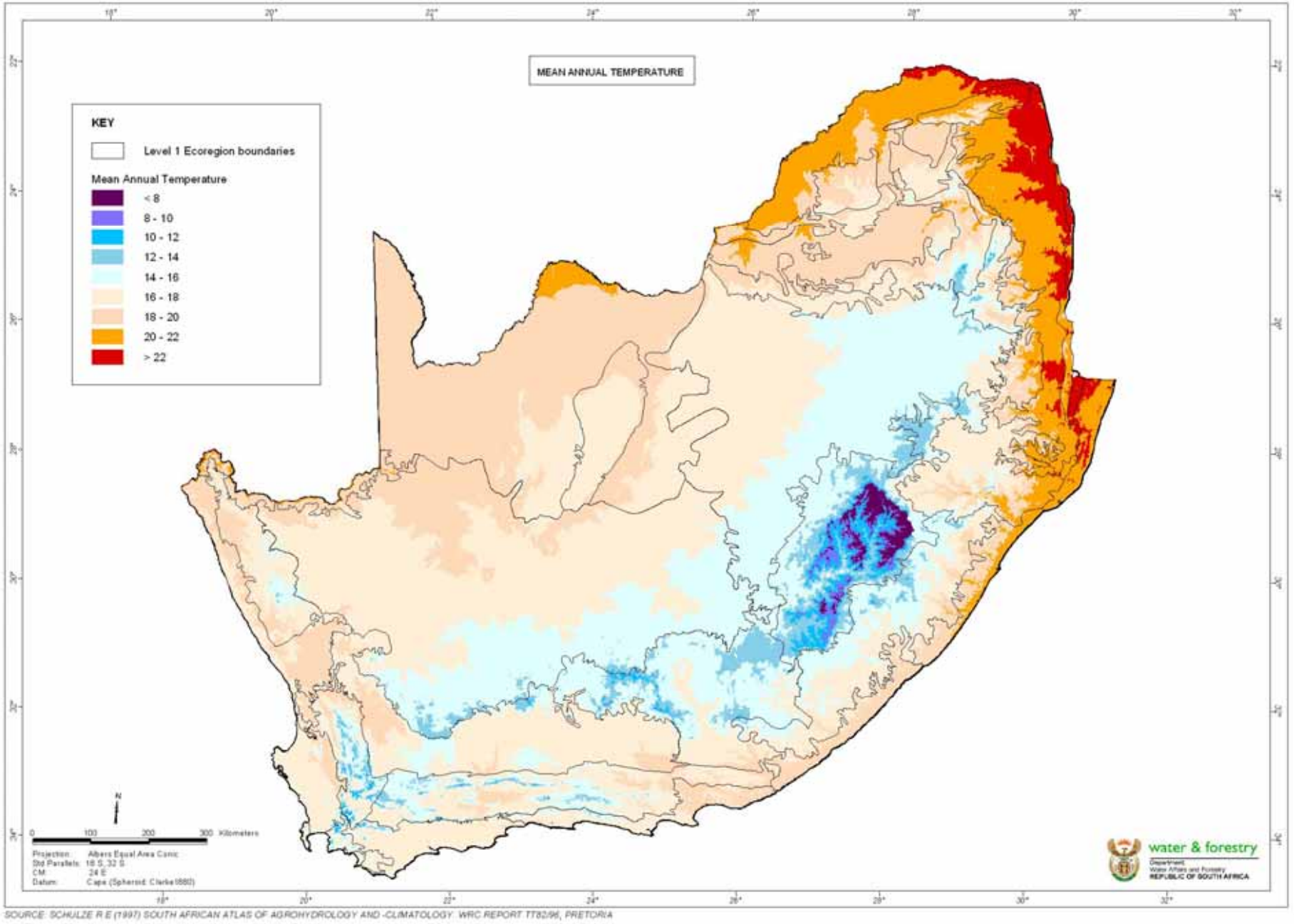


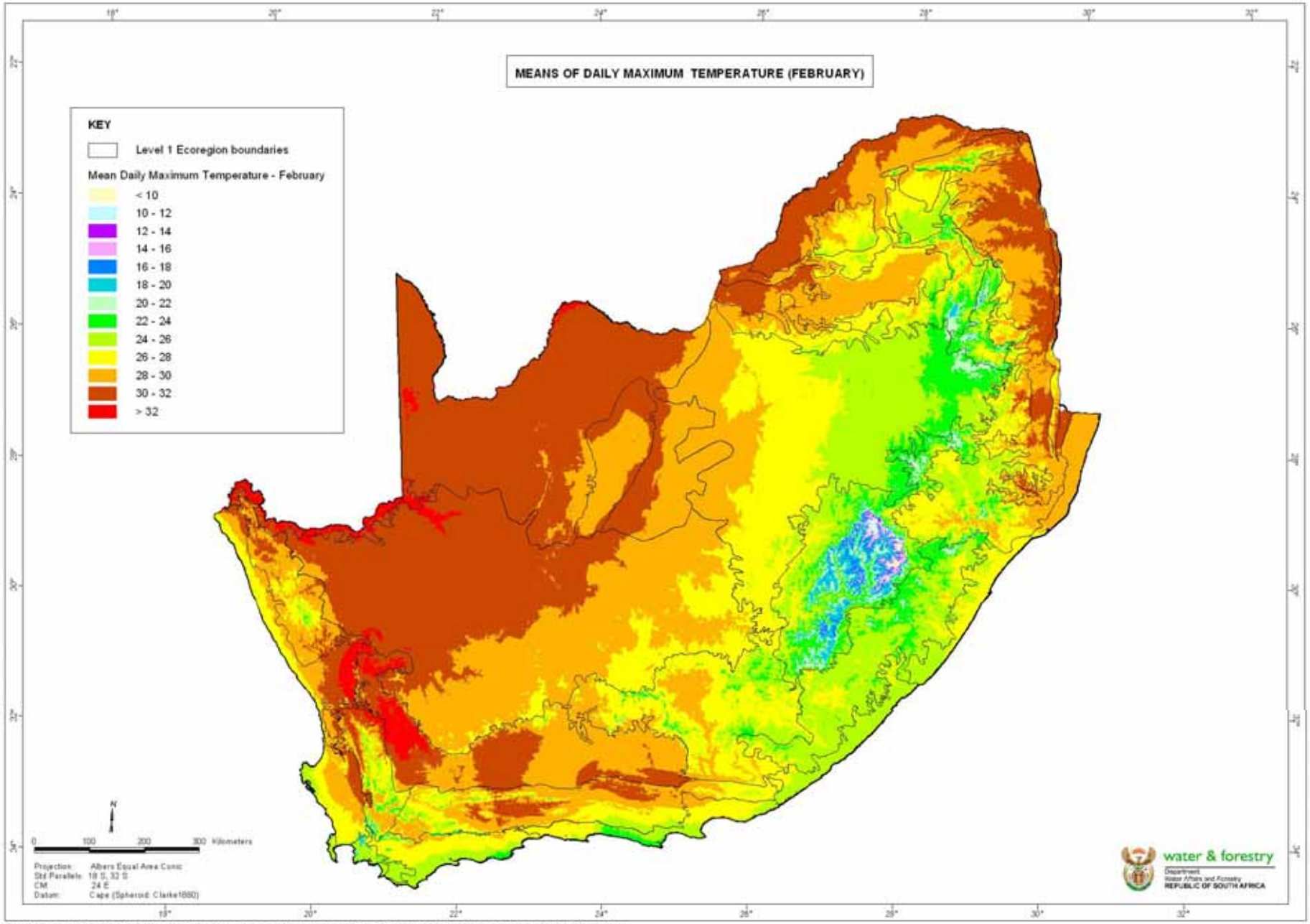
SOURCE: MIDGLEY D C, PITMAN W V & MIDDLETON B J (1990) SURFACE WATER RESOURCES OF SOUTH AFRICA - USER'S MANUAL. WATER RESEARCH COMMISSION REPORT 298/1/94. PRETORIA

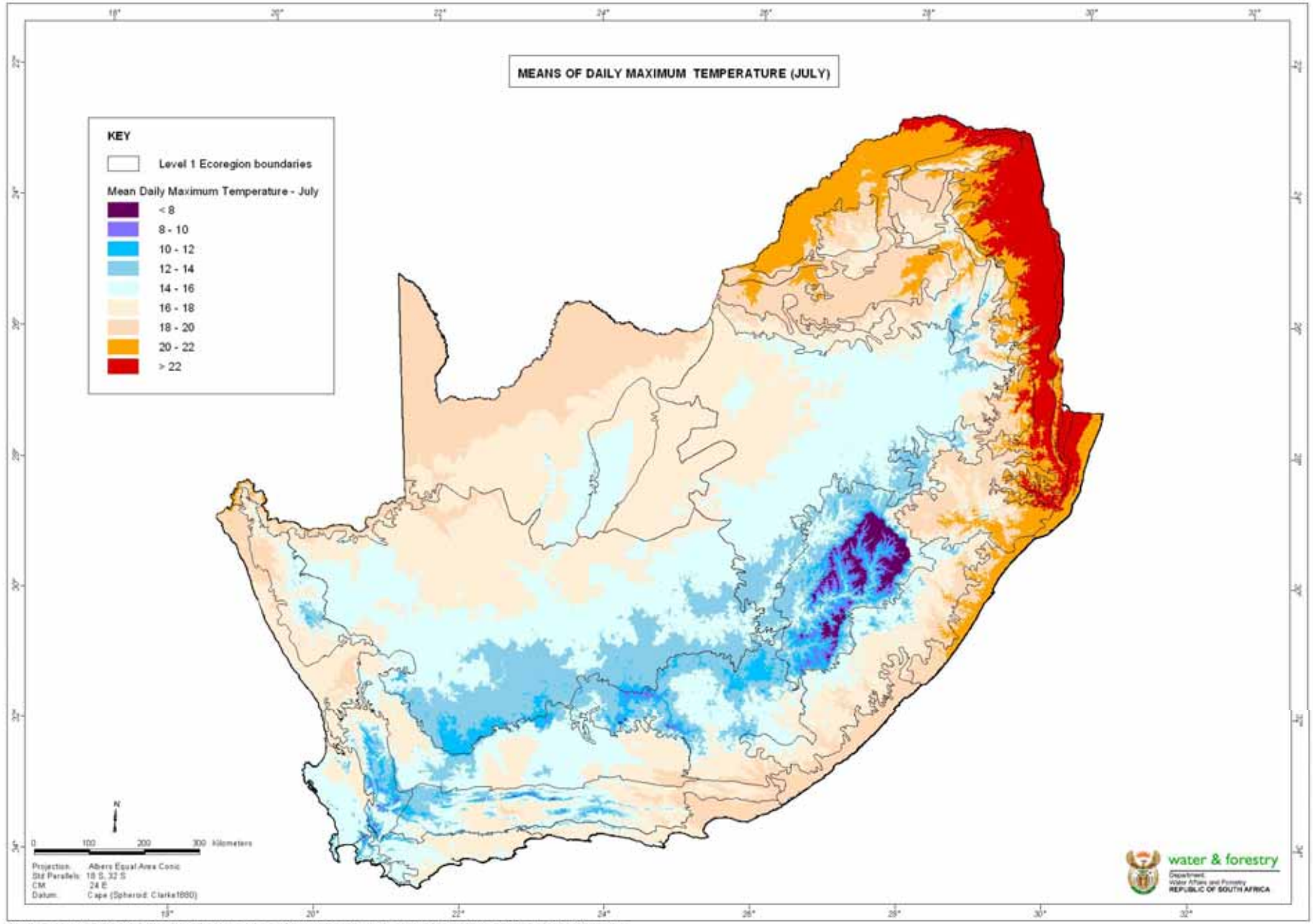

COEFFICIENT OF VARIATION (%) OF ANNUAL PRECIPITATION
KEY
Level 1 Ecoregion boundaries
CV (%)
< 20
20 - 25
25 - 30
30 - 35
35 - 40
> 40
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: SCHULZE R.E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA

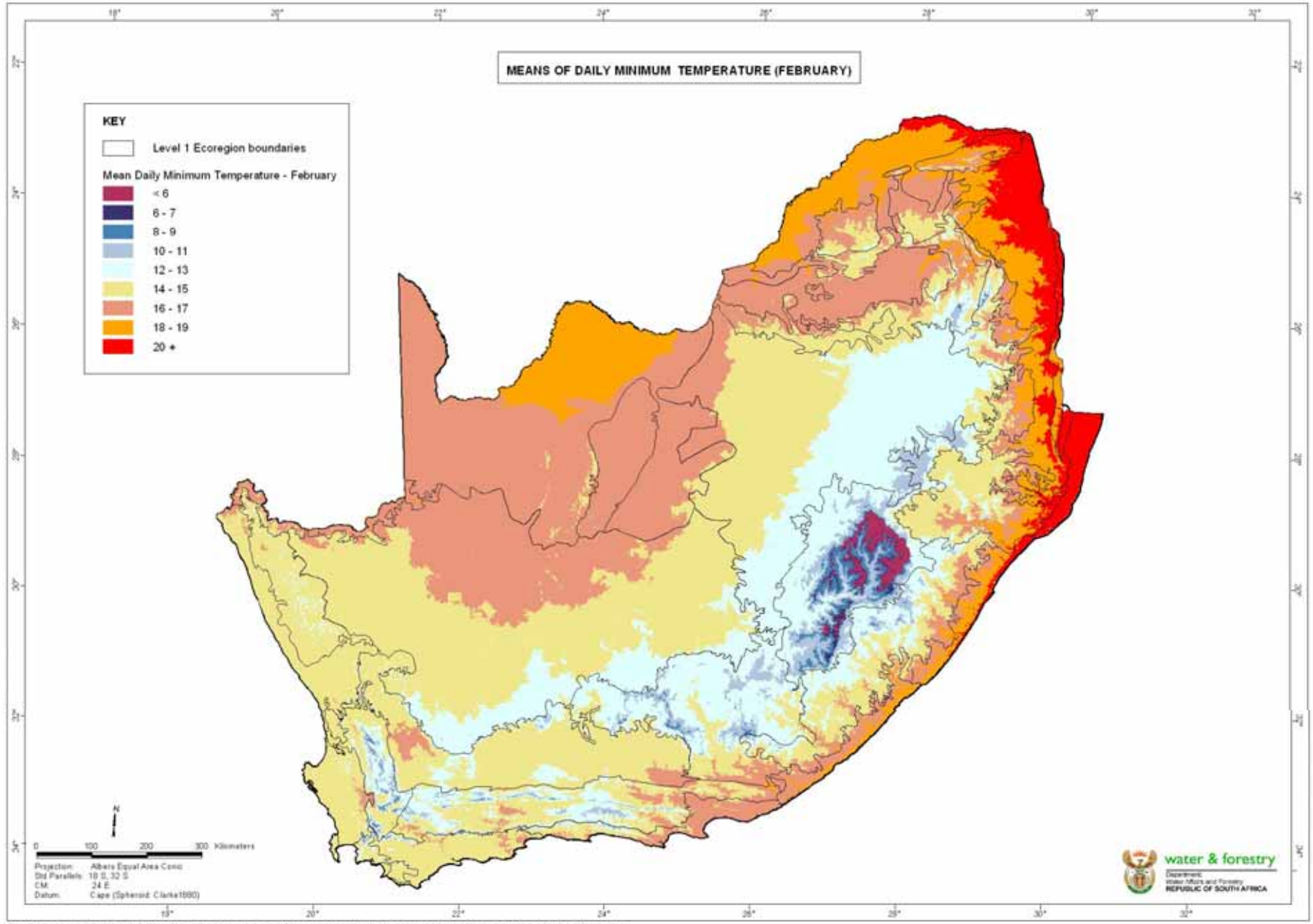

RAINFALL CONCENTRATION INDEX
KEY
Level 1 Ecoregion boundaries
Concentration Index (%)
< 15
15 - 30
30 - 45
45 - 50
50 - 55
55 - 60
60 - 65
> 65
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: SCHULZE R.E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA


RAINFALL SEASONALITY
KEY
Level 1 Ecoregion boundaries
Rainfall Seasonality
All year
Winter
Early summer (December)
Mid summer (January)
Late summer (February)
Very late summer (- March to May)
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA

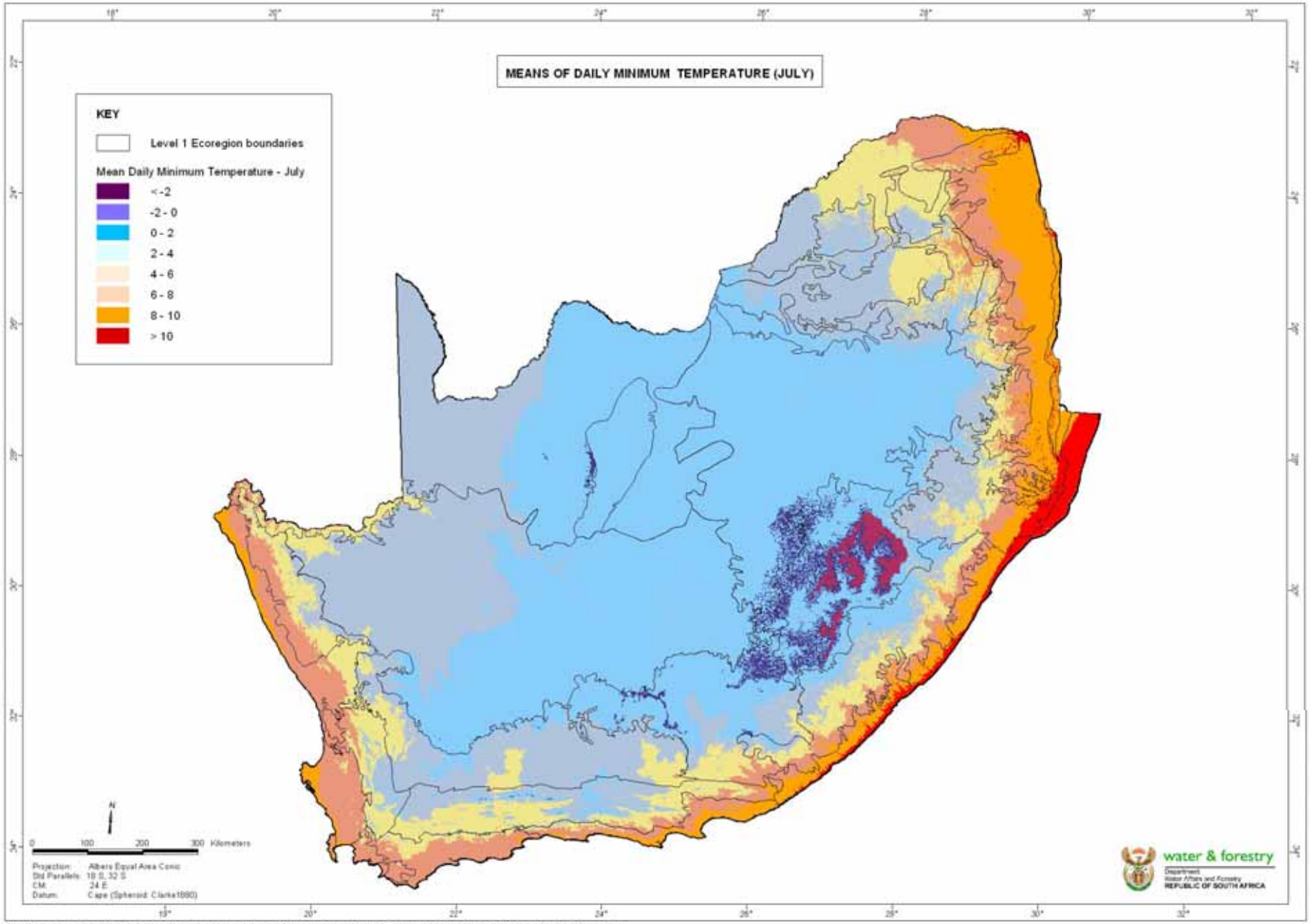

MEAN ANNUAL TEMPERATURE
KEY
Level 1 Ecoregion boundaries
Mean Annual Temperature
< 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
> 22
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke 1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA


MEANS OF DAILY MAXIMUM TEMPERATURE (FEBRUARY)
KEY
Level 1 Ecoregion boundaries
Mean Daily Maximum Temperature - February
< 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
22 - 24
24 - 26
26 - 28
28 - 30
30 - 32
> 32
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department: Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA

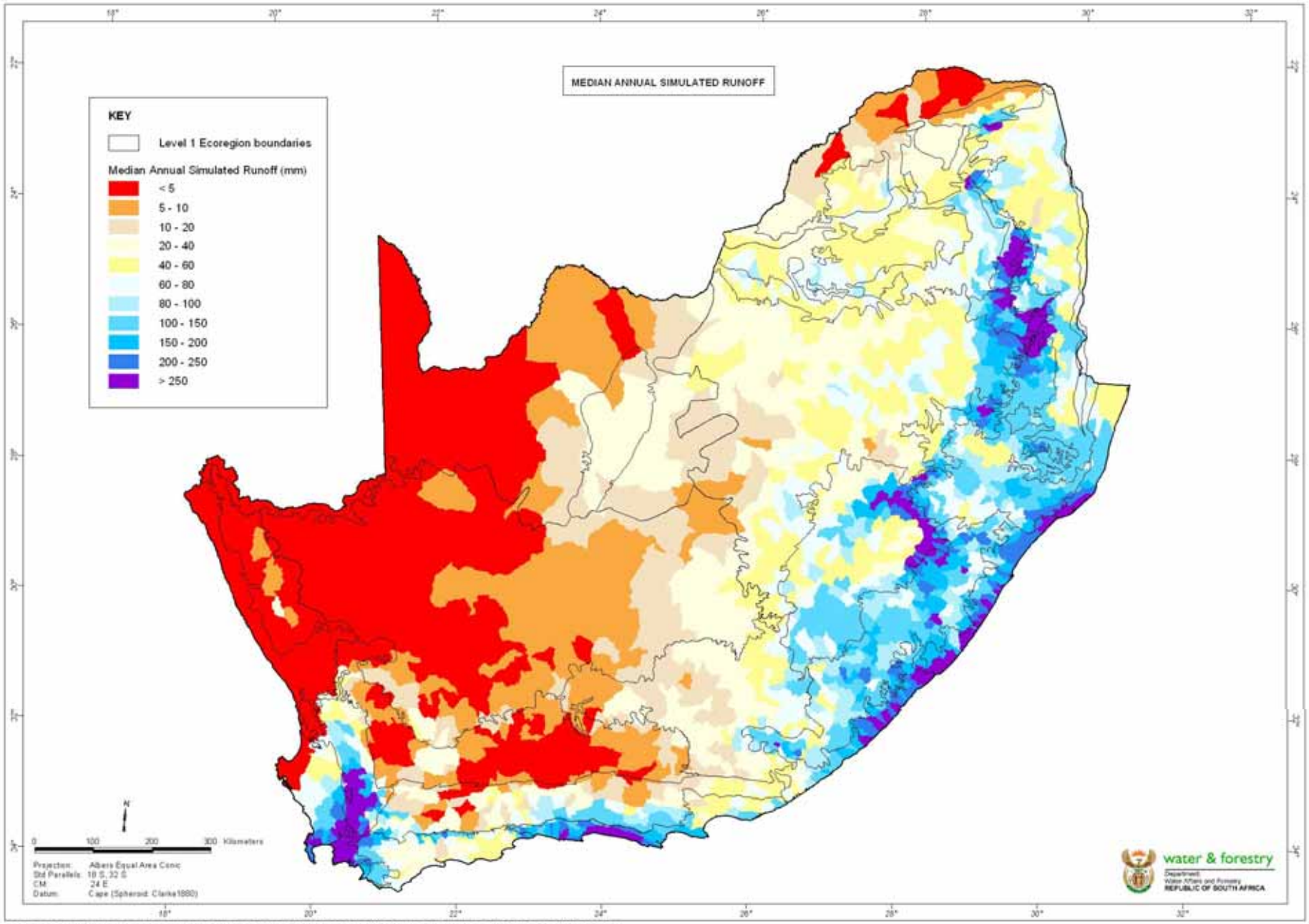

MEANS OF DAILY MAXIMUM TEMPERATURE (JULY)
KEY
Level 1 Ecoregion boundaries
Mean Daily Maximum Temperature - July
< 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
> 22
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA



SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA



SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA


MEDIAN ANNUAL SIMULATED RUNOFF
KEY
Level 1 Ecoregion boundaries
Median Annual Simulated Runoff (mm)
< 5
5 - 10
10 - 20
20 - 40
40 - 60
60 - 80
80 - 100
100 - 150
150 - 200
200 - 250
> 250
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
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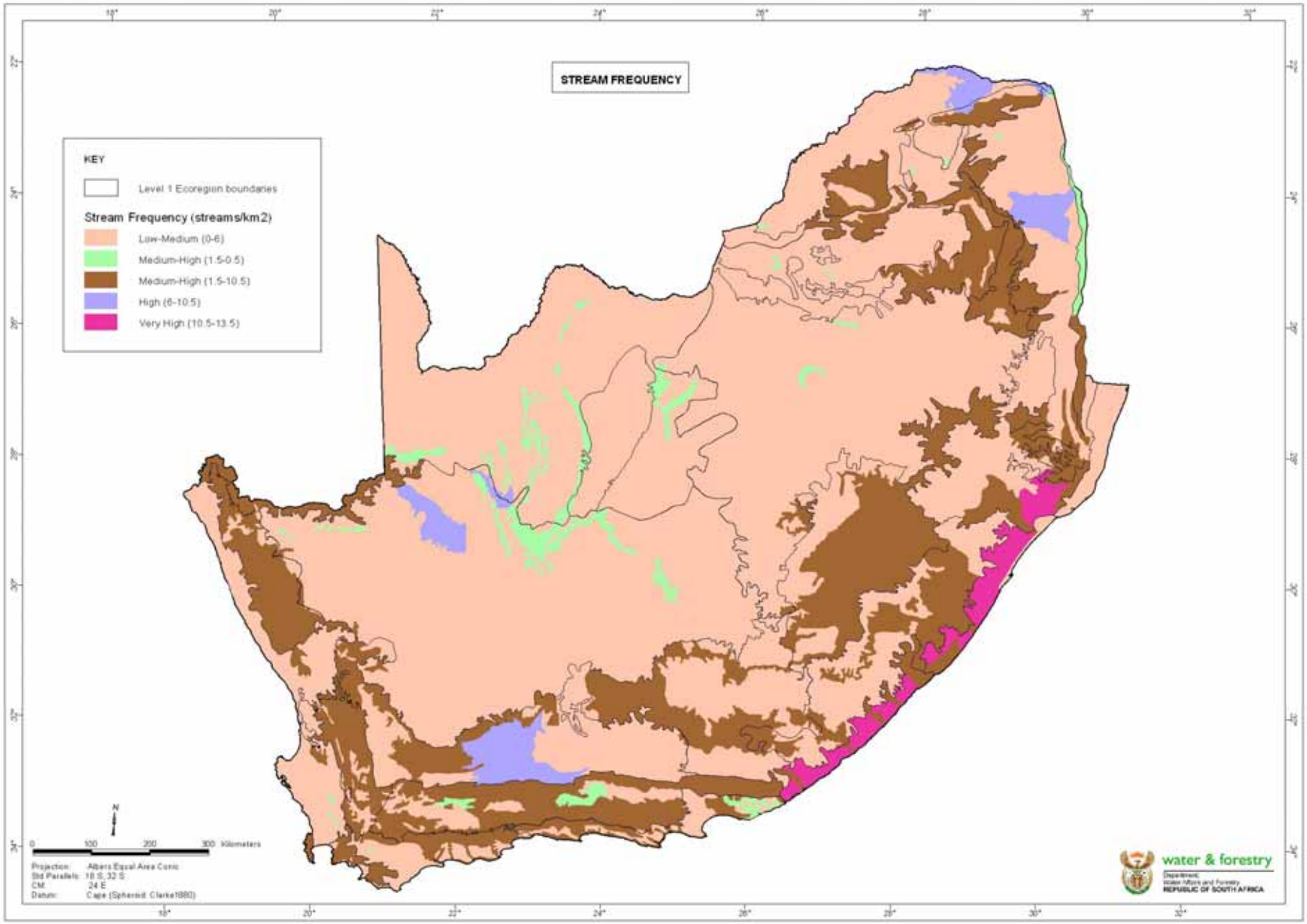
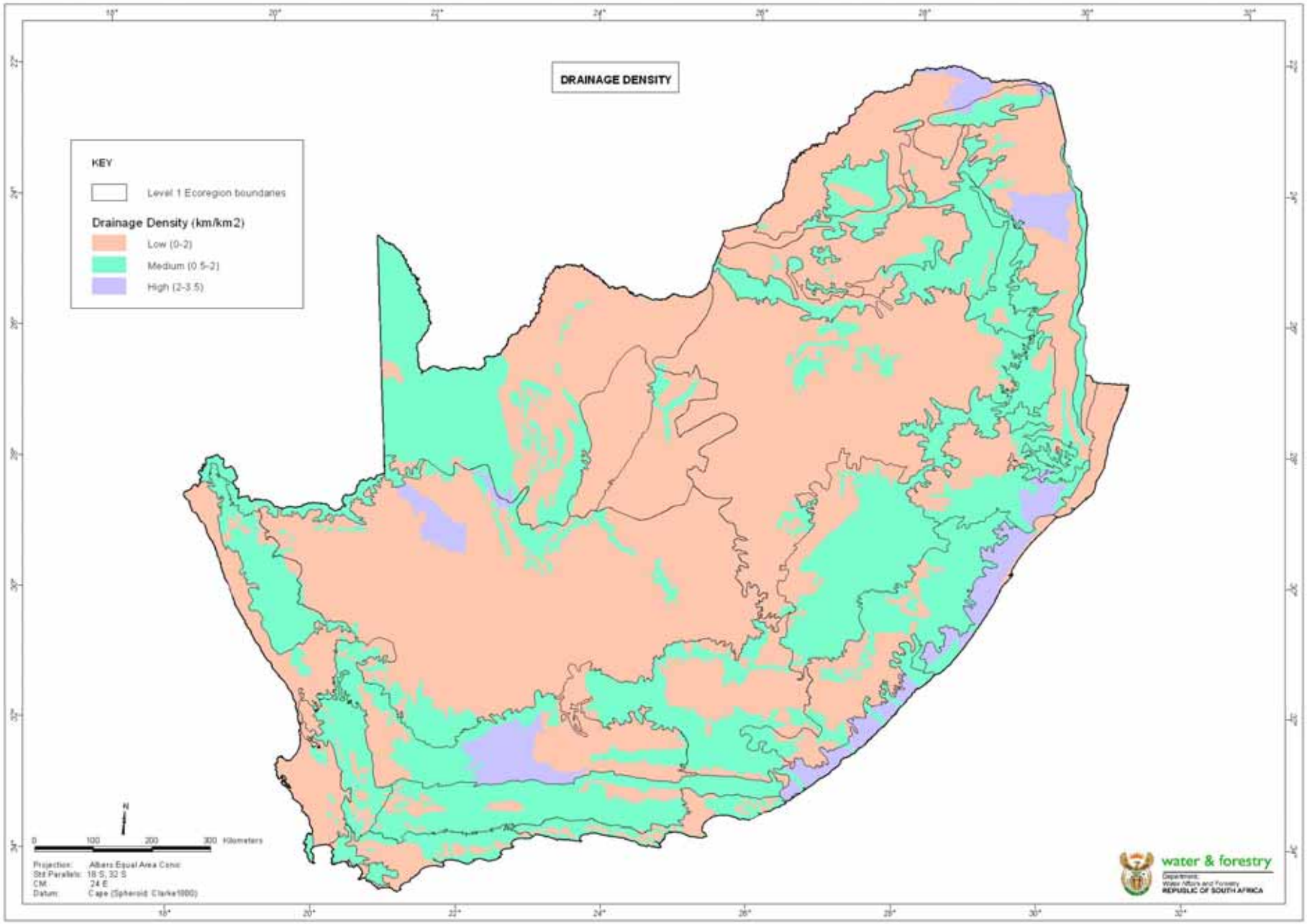
SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA


STREAM FREQUENCY
KEY
Level 1 Ecoregion boundaries
Stream Frequency (streams/km2)
Low-Medium (0-6)
Medium-High (1.5-0.5)
Medium-High (1.5-10.5)
High (6-10.5)
Very High (10.5-13.5)
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA
SOURCE: KRUGER G P (1983) TERRAIN MORPHOLOGY MAP OF SOUTHERN AFRICA. SOIL AND IRRIGATION RESEARCH INSTITUTE. DEPT OF AGRICULTURE. PRETORIA


DRAINAGE DENSITY
KEY
Level 1 Ecoregion boundaries
Drainage Density (km/km2)
Low (0-2)
Medium (0.5-2)
High (2-3.5)
N
0 100 200 300 Kilometers
Projection: Albers Equal Area Conic
Std Parallels: 18 S, 32 S
CM: 24 E
Datum: Cape (Spheroid: Clarke1880)
water & forestry
Department:
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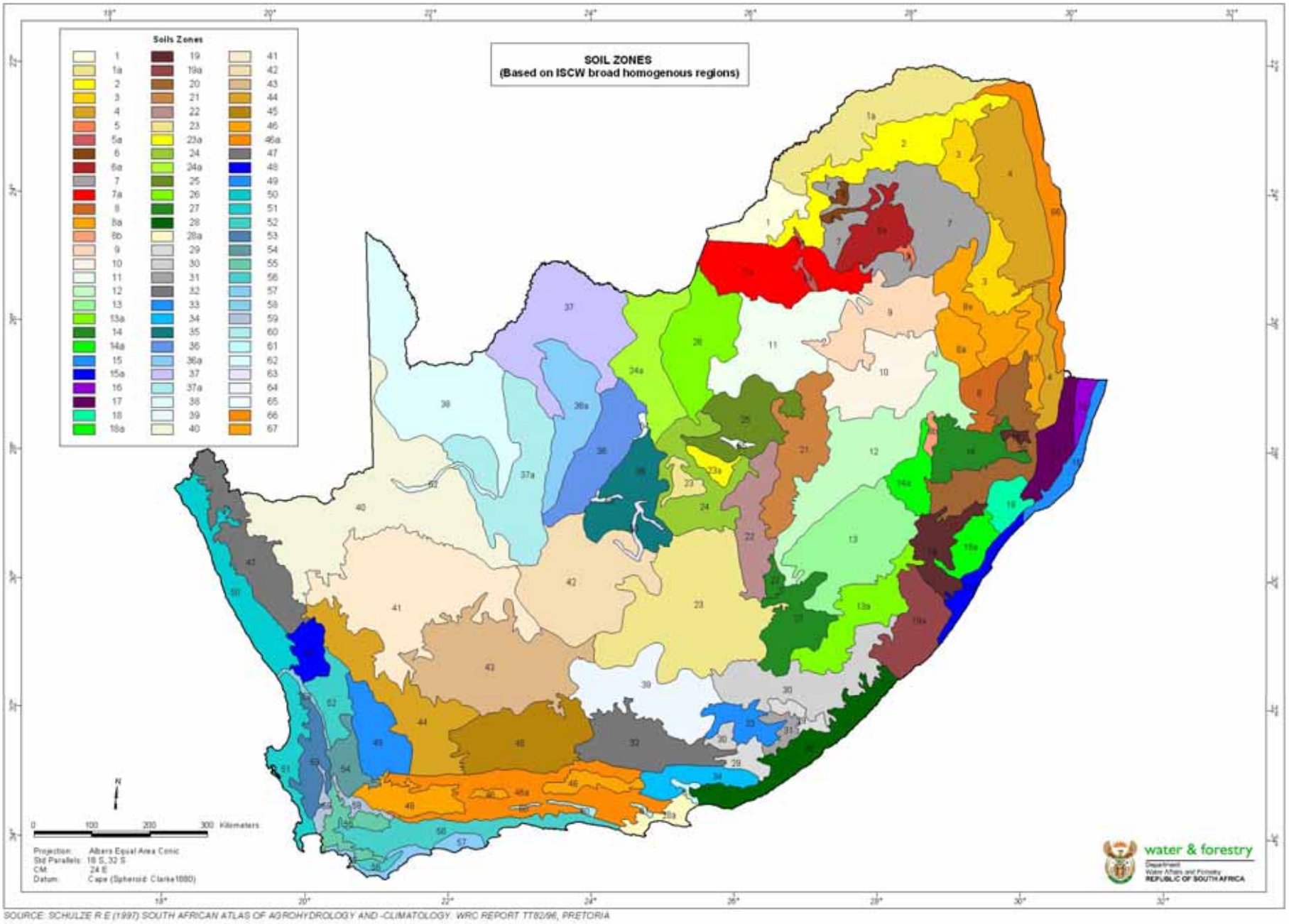

SOURCE: SCHULZE R E (1997) SOUTH AFRICAN ATLAS OF AGROHYDROLOGY AND -CLIMATOLOGY. WRC REPORT TT82/96, PRETORIA

Soil Zone	Soil Depth				Texture Class				Soil Form/Series											
	Range	%	Range	%	Class	%	Class	%	Code	%	Code	%	Code	%	Code	%	Code	%	Code	%
1	>900	70	450-900	25	LmSa-SaLm	70	SaCl-Cl	30	Hu35	30	Sd21	20	Ar40	10	Av35	30				
1a	>1000	80	200-450	15	Sa-SaLm	100			Hu35	80	Ms10/Ms20	10								
2	500-1000	100			LmSa-SaLm	100			Hu35	40	Gs12/Gs15	30	Hu36							
3	900-1200	100			SaClLm	70	SaCl-Cl	25	Hu16/Hu26	50	Hu17/Hu27	20	Sd11	10	Rock	10				
4	450-850	100			LmSa-SaLm	100			Gs15	50	Hu35	20	Ms10							
5	500-900	50	>900	50	LmSa-SaLm	65	SaClLm-SaCl	25	Hu25	50	Hu27	15	Av26/Av36							
5a	800-1200	30	300-700	60	SaClLm-SaCl	30	Sa-SaLm	60	Hu36/Hu37	30	Gs12/Gs15	60								
6	150-400	20	500-1000	70	LmSa-SaLm	100			Ms10/Ms11	10	Gs13/Gs14	20	Cv24/Cv26							
6a	>900	100			SaClLm	30	SaCl-Cl	50	Hu36	30	Hu37	15	Ar40	35	Sd21	15				
7	600-1000	30	100-400	55	SaClLm-SaCl	15	LmSa-SaLm	80	Ms10	50	Cv24	20	Sd21	10	Rock	15				
7a	300-500	20	600-1000	70	LmSa-SaLm	25	SaClLm-Cl	70	Gs16	20	Ar40	40	Sd21	10	Hu37	10				
8	500-1000	100			LmSa-SaLm	60	SaClLm-SaCl	30	Av15/Av16	20	Gc15/Gc16	20	Cv16	20	Cv17/Cv18	10	Lo21	10		
8a	250-450	25	500-900	65	LmSa-SaLm	80	SaClLm	15	Gs15/Gs18	50	Cf31	20	Hu35/Hu36	10	Cv36	10				
8b	400-800	15	>900	80	SaClLm	50	SaCl	40	Hu16	60	Hu17	20	Gs18/Gs19	10						
9	750-1000	85	200-500	10	LmSa-SaLm	20	SaClLm	70	Hu26	40	Av16/Av26	30	Cv16/Cv26	10	Ms11	10				
10	800-1200	70	400-800	30	SaCl-Cl	100			Ar40	60	Sw41	20	My21	15						
11	100-400	20	500-1000	80	SaLm-SaClLm	100			Ms10/Gs18	20	Hu24/Hu26	70								
12	450-1000	80	>1000	20	SaLm	100			Kd13/Es13	45	Av26	20	Cv26	10	We13	10				
13	500-1000	70	<500	25	SaCl	100			Ma11/Ia11	40	Hu17/Cv17	25	Ms10/Gs19	20	Gf12	10				
13a	500-900	65	>900	30	LmSa-SaLm	40	SaClLm-SaCl	55	Pn26/Kd17	25	Va31	20	Sd11	15	Hu17/Cv17	15	Bo31	20		
14	450-1000	70	>1000	30	SaLm	20	SaClLm-SaCl	70	Cf21	15	Lo21	15	Va41	10	Gs15	10	Sw40/Sw41	15	Av26	20
14a	450-850	100			SaClLm	30	SaCl	65	Lo22	15	Va41	15	Sw41	15	Gs18	15	Av26	15	Kd16	10
15	>1000	100			Sa	90	SaClLm-SaCl	10	Fw10/Fw11	80	Cv30/Cv31	15	Du10/Oa47	5						
15a	400-900	60	>900	35	Sa-LmSa	20	SaLm-SaCl	75	Gs15	50	Hu25	10	Fw12b	10	Hu26	10	Bo30	10		
16	>1000	100			Sa	90	LmSa-SaLm	10	Fw10/Fw11	90	Cv30/Cv31	10								
17	300-800	70	>900	20	SaLm-SaClLm	60	SaCl-Cl	30	My21	30	Sd21	20	Ar40	20	Ms10/Ms20	20				
18	400-1000	100			SaClLm-SaCl	100			Hu26/Hu27	25	Sd11/Sd12	20	Gs16/Gs19	20	Ms10	15	No10	15		
18a	450-1000	100			SaClLm	100			Gs17/Gs18	35	Bv26	25	Sd11	20	Ia10	10	Rock	5		
19	400-900	30	>900	65	SaClLm-SaCl	100			Hu17	35	Cv17	25	Ia10	10	Gf11/Gf12	15	Lo22	10		
19a	400-900	50	>900	45	SaLm-SaClLm	100			Hu16/Hu17	20	Gs18	35	Ms10	10	Sd10/Sd11	15	Kp10	10	Rock	5
20	150-450	50	500-900	45	SaLm-SaClLm	30	SaClLm-SaCl	65	Ms20/Gs28	45	Hu16/Hu17	20	Sd20/Sd21	15	Cv16	10				
21	200-500	40	500-800	55	SaClLm-SaCl	100			Va40/Va41	30	Sw40/Sw41	10	We13	10	Bo41	10	Ms11	20	Kd16	10
22	400-800	100			SaClLm-SaCl	100			Va30/Va31	15	Va40/Va41	25	Bo31/Sw31	25	Mw21	15	Ms10/Gs16	15		
23	100-400	30	450-1000	65	SaClLm-SaCl	65	SaLm	30	Ms10/Gs16	25	Ss16	30	Va11/Va21	25	Hu26	10				
23a	200-500	20	500-900	75	SaLm-SaClLm	25	SaClLm-SaCl	70	Va41	20	Sw40/Sw41	20	Ss16/Ss26	20	Gs16	10	Ms22	20		
24	>900	100			Sa-LmSa	60	SaLm	35	Cv31	10	Hu31	10	Cv34	35	Hu34	20	Hu36	10	Cv36	10
24a	200-700	50	700-1200	50	Sa-LmSa	50	SaLm-SaClLm	50	Ms10/Gs13	15	Cv30/Cv33	20	Hu30/Hu33	10	Cv36/Hu36	40	Ss23	10		
25	600-900	60	>900	35	Sa-LmSa	25	SaLm-SaClLm	70	Av36	50	Av34	15	Hu36	10	Cv36	10	Cv34	10		
26	600-900	75	>900	20	SaClLm	80	SaCl	l20	Av36	40	We13	20	Hu36	15	Bv36	10	Va41	10		
27	300-600	60	600-1000	35	SaClLm-SaCl	100			My11/Mw11	20	Bo31	20	Ms10	10	Hu36	20	Sw30	20	Rock	10

Soil Zone	Soil Depth				Texture Class				Soil Form/Series											
	Range	%	Range	%	Class	%	Class	%	Code	%	Code	%	Code	%	Code	%	Code	%	Code	%
28	450-900	100			SaClLm	100			Gs16	20	Hu36/Hu37	40	Sd21	20	Sw11/Sw31	15				
28a	100-300	60	450-900	35	LmSa-SaLm	100			Ms10	40	Cf11	15	Sw30/Sw31	15	Oa33/Oa36	10	Rock	10		
29	100-300	80	500-1000	20	LmSa-SaLm	100			Ms10	55	Hu36	20	Oa36	10	Rock	10				
30	100-300	60	300-800	35	SaLm	60	SaClLm-SaCl	40	Ms10	40	Gs16	20	Sw31	20	Ss26	15				
31	300-600	50	600-1000	45	SaLm-SaClLm	100			Gs16	30	We12	25	Ms10	20	Cv36	10	Oa36	10		
32	200-500	75	500-900	20	Sa-LmSa	70	SaLm-SaClLm	30	Ms20/Gs23	60	Hu33	20	Ss23	10						
33	100-400	70	450-800	20	SaLm	60	SaClLm	40	Ms10	60	Gs16	15	Hu36/Cv36	10	Oa36	10				
34	100-300	35	450-900	60	SaLm	35	SaClLm-SaCl	60	Ms10	35	Sd31	20	Va11	15	Hu46	10	Rock	15		
35	200-450	25	450-900	70	LmSa-SaLm	45	SaClLm	50	Hu36	30	Hu34	20	Ms10/Ms20	25	Ms22	20				
36	100-350	90			Sa-LmSa	100			Ms22	70	Ms10/Ms20	25								
36a	50-300	60	450-900	40	Sa-LmSa	100			Hu33	60	Hu36	20	Rock	10						
37	>900	100			Sa-LmSa	100			Cv30/Cv33	45	Hu30/Hu33	40	Fw20	10						
37a	100-300	20	300-1000	60	Sa-LmSa	70	SaLm-SaClLm	25	Hu31/Hu34	60	Hu36	20	Ms10	15						
38	>900	100			Sa	100			Hu30	90	Hu33	5								
39	400-500	80	600-1000	15	LmSa-SaLm	60	SaClLm	30	Ms10/Ms20	50	Oa46	20	Hu36	15	Sw11/Sw31	10				
40	200-500	70	600-1000	25	Sa-LmSa	100			Hu34	35	Hu31	20	Hu44	10	Ms20	20	Rock	10		
41	200-500	60	600-900	35	Sa-LmSa	50	SaLm-SaClLm	45	Ms20	35	Cv43	20	Hu43/Hu46	10	Oa46	25				
42	100-400	25	450-900	70	LmSa-SaLm	100			Hu34	40	Hu44/Hu45	25	Ms10/Ms20	20	Oa44/Oa46	10				
43	100-400	100			LmSa-SaLm	80	SaClLm	15	Ms10/Ms20	50	Hu44	35	Sw10	10						
44	100-400	60	400-800	35	SaLm-SaClLm	100			Ms10/Ms20	40	Hu46	20	Sw20/Sw40	15	Rock	15				
45	200-500	70	500-1000	45	LmSa	60	SaLm-SaClLm	35	Ms20	60	Gs24	20	Oa16/Oa26	15						
46	300-600	70	700-1200	30	LmSa-SaLm	100			Ms10	50	Hu34	30	Oa33	15						
46a	50-200	80	400-900	15	Sa-LmSa	80	SaLm-SaClLm	15	Ms10	35	Sw10/Sw11	10	Rock	50						
47	50-300	100			Sa-LmSa	100			Ms10	25	Hu35	10	Rock	60						
48	100-400	80	400-900	15	Sa-LmSa	100			Hu35/Hu45	65	Ms10	15	Cv35	10	Rock	5				
49	100-350	60	400-800	35	SaLm-SaClLm	100			Ms10/Gs16	45	Ms20/Ms22	20	Hu36	20	Oa26	10				
50	300-600	30	600-1000	65	Sa-LmSa	100			Hu32	30	Hu35	25	Cv35	20	Fw22	10	Ms10	10		
51	>900	80	500-900	15	Sa-LmSa	100			Fw10/Fw11	65	Cv11/Cv14	15	Hu23	15						
52	100-400	60	400-900	35	LmSa-SaLm	100			Ms10	35	Gs13/Cf11	20	Hu33/Hu34	20	Sw30	10	Rock	10		
53	200-500	70	500-900	25	SaClLm	60	LmSa-SaLm	35	Ss24/Sw31	50	Hu13/Hu16	20	Kd21/Es41	15	Ms10/Gs16	10				
54	100-400	75	400-900	20	LmSa-SaLm	70	SaClLm	30	Ms10	35	Gs13/Gs16	20	Sw30	10	Hu33	10	Rock	20		
55	50-200	100			LmSa-SaLm	100			Ms10/Gs14	15	Rock	80								
56	100-450	60	450-900	35	LmSa-SaLm	50	SaClLm-SaCl	45	Ms10/Ms20	25	Gs23/Gs26	30	Sw31/Sw41	20	Hu33/Hu36	10	Cv33/Cv36	10		
57	<400	20	400-900	15	Sa	80	SaClLm-SaCl	15	Fw10/Fw11	40	Cv30/Cv31	20	Ms20	20	Kd20	15				
58	450-900	40	>900	55	Sa-LmSa	25	SaLm-SaClLm	70	Cv34/Hu34	30	Gs14	20	Oa24/Oa26	20	Pn34	15	Du10	10		
59	450-900	65	>900	30	SaLm	25	SaClLm-SaCl	70	Sw41	20	Hu33/Hu36	20	Cv36	15	Gs16	15	Oa36	25		
60	450-900	100			SaClLm	100			Sw30/Sw31	40	Ss16/Ss26	25	Av36	10	Hu36	10	Kd13/Es13	10		
61	450-900	20	>900	75	LmSa-SaLm	20	SaClLm	75	Oa26/Oa46	45	Cv43	20	Va20/Va40	20	Hu46	20				
62	>1000	100			SaLm	60	SaClLm-SaCl	35	Du10	50	Oa46/Oa47	30	Oa36	15						
63	450-900	40	>900	55	LmSa-SaLm	40	SaClLm-SaCl	55	Hu33/Hu36	30	Oa26/Oa46	30	Va41	20	Sw20/Sw40	15				

Soil Zone	Soil Depth				Texture Class				Soil Form/Series											
	Range	%	Range	%	Class	%	Class	%	Code	%	Code	%	Code	%	Code	%	Code	%	Code	%
64	100-200	20	>900	75	LmSa-SaLm	35	SaClLm-SaCl	60	Hu33/Hu36	40	Sd21/Sd31	10	Va41	20	Sw41	15	Ms10/Ms20	10		
65	>900	100			SaLm	15	SaCl-Cl	80	Ar40	30	Va41/Va42	30	Oa33/Oa36	20	Rg10/Rg20	15				
66	400-900	50	>900	45	SaClLm	20	SaCl-Cl	75	Sd11	40	Gs18	15	Hu37	15	Bo41	10	Ar40	10		
67	400-900	30	>900	65	SaClLm	30	SaCl-Cl	65	Va31/Va41	25	Sw30/Sw31	20	Ss16/Ss26	20	Hu36/Hu37	15	Oa36/Oa37	10		