

3. THE CURRENT STATE OF THE MUNICIPALITY

3.1 A FRAMEWORK OF INTERRELATED SYSTEMS

There is always tension between the reality that life and all of its components function and are experienced as a single interrelated system, and the need to disaggregate these components for the purpose of research and teaching (hence the divisions at school into subjects and at university into faculties) and administration (compartmentalisation of government into departments and ministries). The last three to four decades have seen this tension emphasise separation to the extent that governments and educational institutions have become increasingly unable to address, cohesively, the various demands made of them.

However, an holistic approach can only be effective if it is carried as a golden thread through all the activities of government including background research, proposal formulation and implementation. This places a considerable challenge on the Breede Valley SDF to go beyond the traditional rational comprehensive approach to spatial planning in order to avoid compartmentalisation and to support the achievement of holistic governance. This is done in the Breede Valley SDF through the use of a "framework of interrelated systems", which recognises that activities in the Municipality occur as a multi-layered matrix in a single space - the geographical extent of the Municipality. Although there is clearly exchange outside the boundaries, e.g. imports and exports, fiscal transfers, energy transmission and cyclical and permanent migration, ultimately the Municipality depends on the resources within its boundaries.

Figure 3.1 illustrates this relationship by showing how the 26 layers of the matrix of the Municipality's analysis are all interrelated within the spatial extent of the Municipality, even though they may be separated for the purposes of research, implementation and management. At the macro level the layers can be grouped into three categories.

Bio-physical

Natural systems are the primary or foundational layer on which all of the others rest, acknowledging the natural capital base on which the other two set of layers must feed, in a sustainable way. Thus, geology, soils and climate form the basic geomorphological relationship which gives rise to hydrological, topographical and biodiversity patterns. Agriculture and mining are included in this sub-set due to their close relationship with the natural environment.

Socio-economic

Previous research (Gasson, 1998) shows a primary correlation between population distribution and the underlying resource pattern of natural environmental distribution, rather than with the pattern of the built environment. The pattern of the built environment is a derived rather than primary relationship. It is nothing more than a reflection of how the relationship between population requirements and natural resources is resolved. Therefore, the next set of layers resting on top of the natural systems layers relates to socio-economic trends.

Built

The final set of layers deal with the built environment, and the analysis that follows will show that it is with these layers and the patterns they follow that most problems with resource sustainability occur.

Planning, heritage and environmental policy are seen as three golden threads that have a transverse relationship with all the layers of the framework.

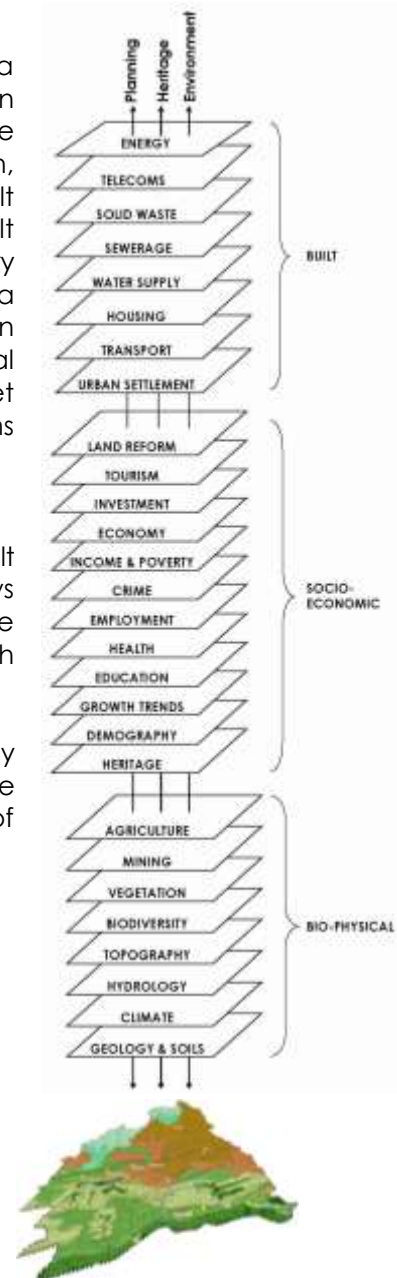


Figure 3.1.1 A Framework of Interrelated Systems

3.2 LAND

3.2.1 Geology and Soils

3.2.1.1 Geology

Figure 3.2.1.1 indicates the general pattern of the geology and soils within Beaufort West Municipality. The municipality comprises of three types of geological formations: Dolerite, Sedimentary and Mudstone deposits.

The majority of the municipality comprises of Mudstone (located mainly in the western, southern and eastern parts) and Sedimentary (located in the central and southern parts).

Dolerite is volcanic rock which pushes between sedimentary rocks. The majority of Dolerite is located around Murraysburg, Nelspoort and Rosedene. Dolerite mostly forms in shallow intrusions such as dykes.

A small percentage of Sedimentary deposits and rock types are located east of Beaufort West. Sediment consists of deposits of minerals and organic materials which are transported through wind, water mass movement or glaciers.

Mudstone (also called mudrock) is a fine grained sedimentary rock whose original constituents were clays or muds. Mudstone looks like hardened clay and, depending upon circumstances under which it was formed, it may show cracks or fissures, like a sun-baked clay deposit.

3.2.1.2 Soil and Soils Depth

Figure 3.2.1.2 shows the various soil depths in the Beaufort West Municipality. The central parts of the municipality, as well as the areas around Rosedene, Sneeuksaal, Merweville and Murraysburg, have soil depths ranging from 450mm to 750mm. A small area south east of Beaufort West has depths greater than 750mm. The majority of the municipality has shallower soil depths (less than 450mm deep).

3.2.1.3 Percentage Clay

Figure 3.2.1.3 shows the percentage of clay in the soil throughout the municipal area.

The soil in the most northern and eastern parts of the municipality contains approximately 15% clay. The central of the Municipality around Beaufort West consist of soils with a clay content of 15% to 35%.

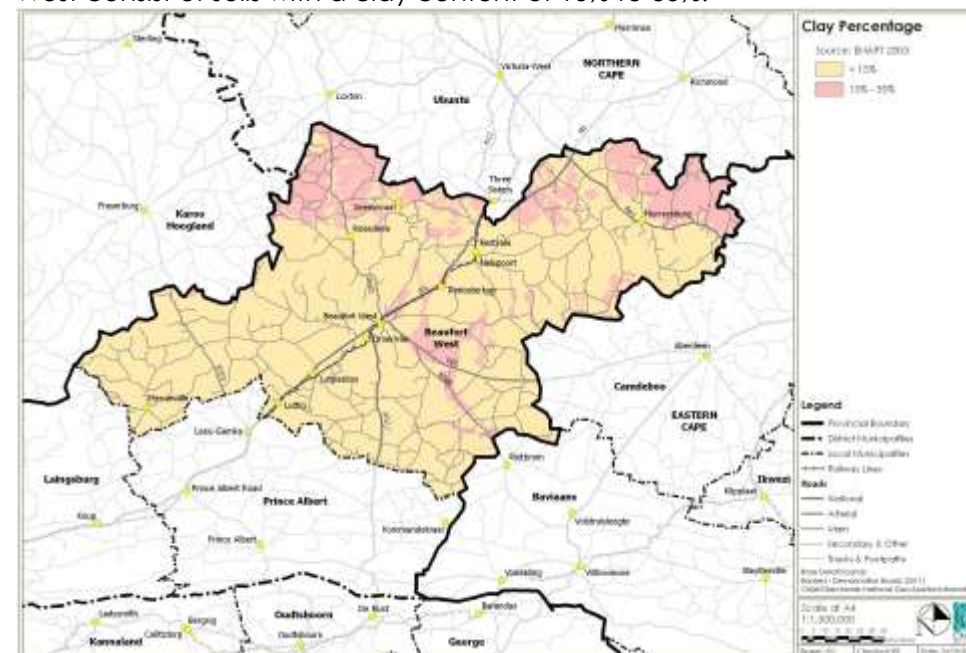
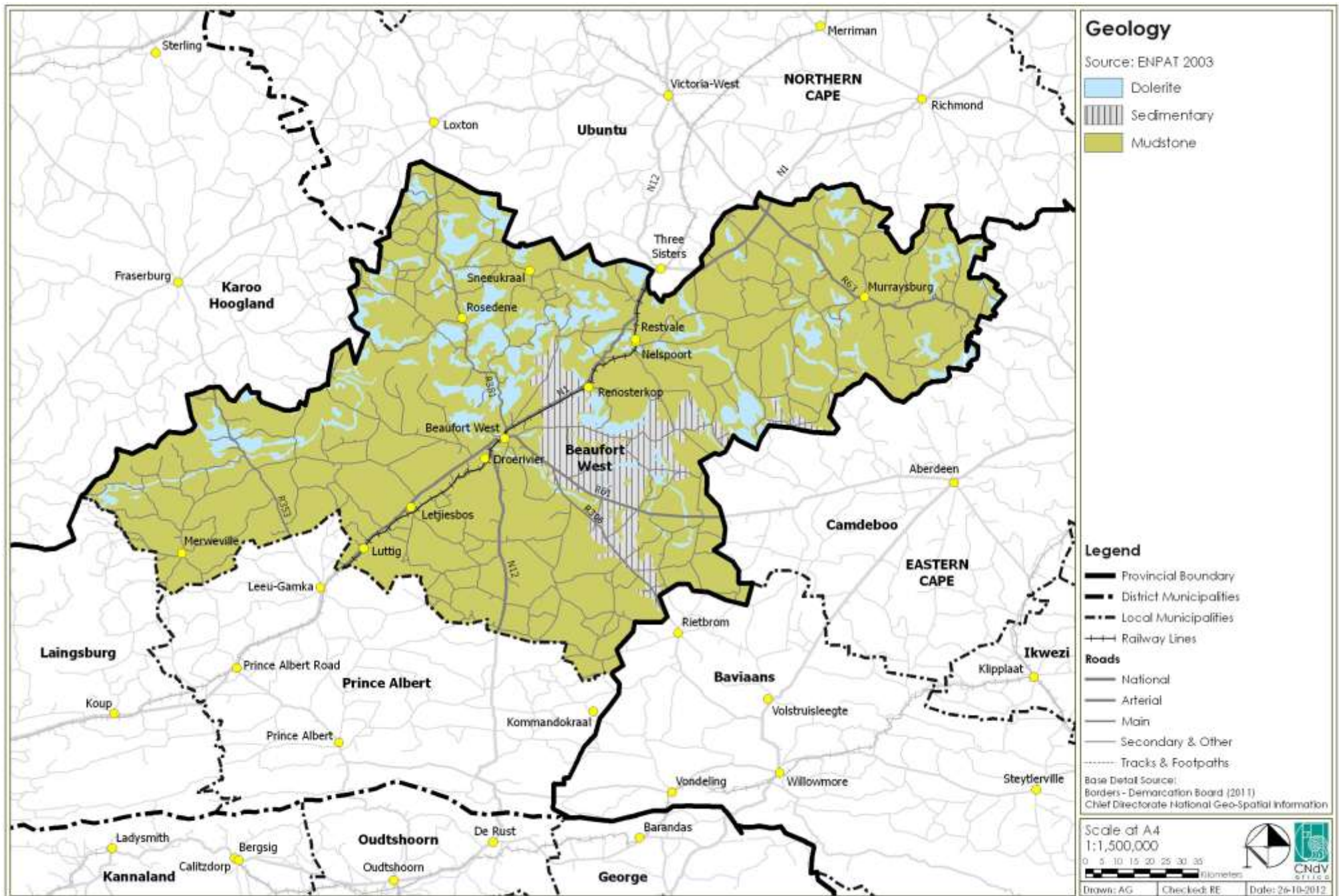


Figure 3.2.1.3 Percentage of Clay

Implications for Beaufort West Municipality

- None of the areas have a clay content higher than 35% and thus a geotechnical study in this regard is generally not required where development is planned.
- The identified dolerite areas (mainly north of Beaufort West) should be treated with special care and detailed geotechnical investigation of urban development is intended in these areas as these formations hamper development.
- Those areas with greater soil depths south east of Beaufort West have high potential for arable agriculture and should be protected accordingly. It is important from an agricultural use perspective that these soils with the greatest agricultural potential be protected from being converted to non-agricultural land uses.



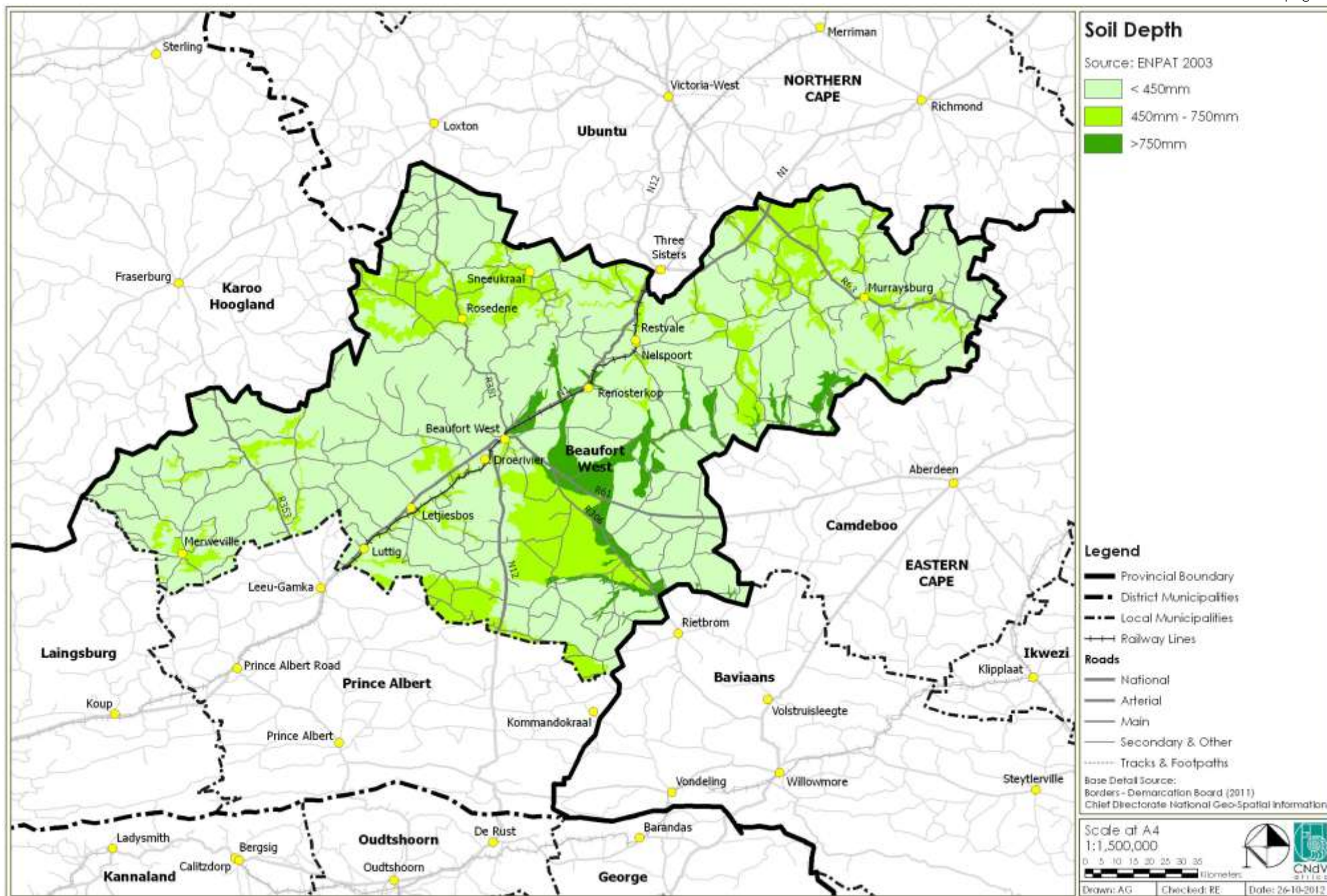


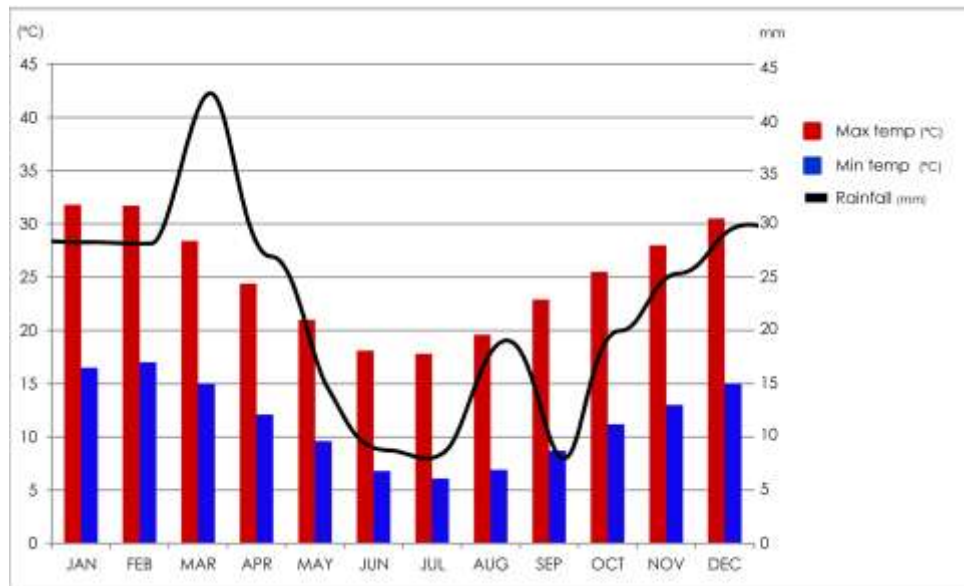
Figure 3.2.1.2 Soil Depth

3.2.2 Climate

The average annual weather data for the Beaufort West Municipality is obtained from a weather station in the town of Beaufort West.

3.2.2.1 Temperature

The average monthly temperature and precipitation for Beaufort West between 1993 and 2011 is shown in Graph 3.2.2.1. The highest annual temperatures are experienced between December and February when average temperatures exceed 30°C. The lowest temperatures are experienced between June and August when the lowest annual temperatures are around 7°C.



Graph 3.2.2.1 Average Annual Temperature and Precipitation (source: Weather SA, 2012)

Figure 3.2.2.1a indicates the mean annual temperature across the Beaufort West Municipality. The lowest annual temperatures are experienced in the northern parts of the municipality and the highest annual temperatures in the south. The lowest annual temperatures in the north range between 11-

15°C and the highest annual temperatures in the south range between 16-20°C.

Figure 3.2.2.1b below indicates the annual sum of the global horizontal irradiation (1994-2010) for South Africa. The irradiation levels indicate possibilities for solar energy generation. The Beaufort West Municipality falls within an area with intermediate radiation levels estimated at between 2000-2100 kWh/m² (Solargis, 2012). The highest radiation levels exist along the northern municipal boundary.

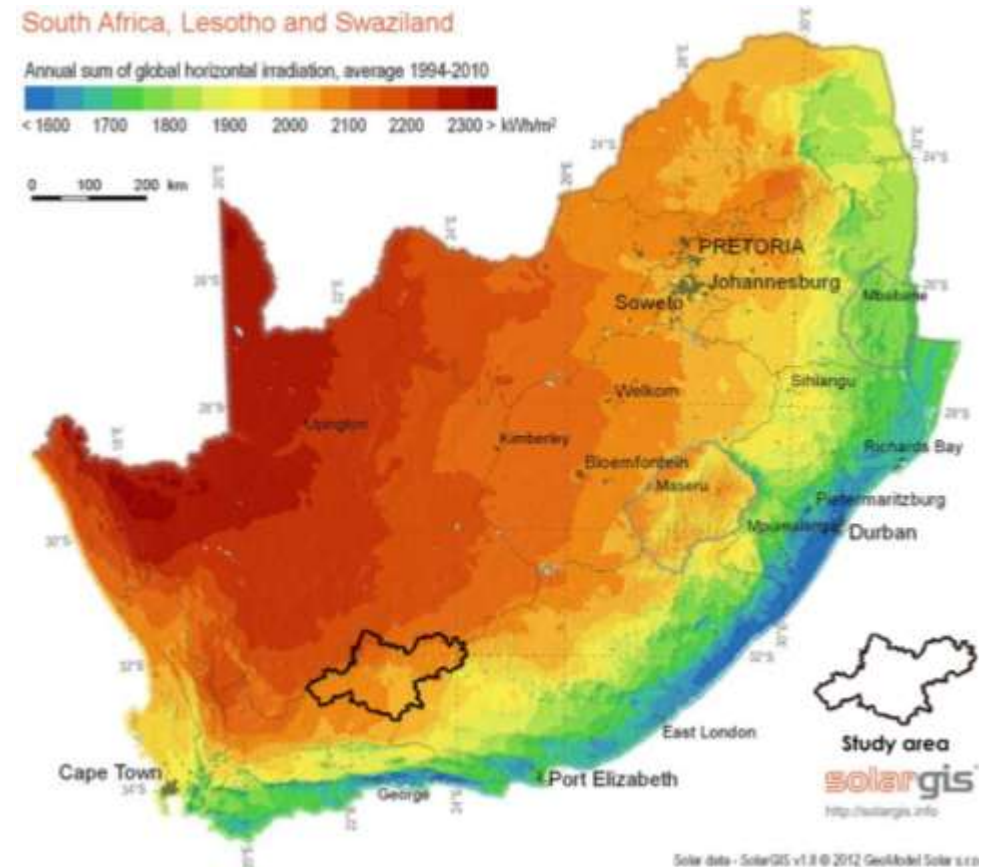


Figure 3.2.2.1b

Solar radiation map for South Africa (source: Solargis, 2012)

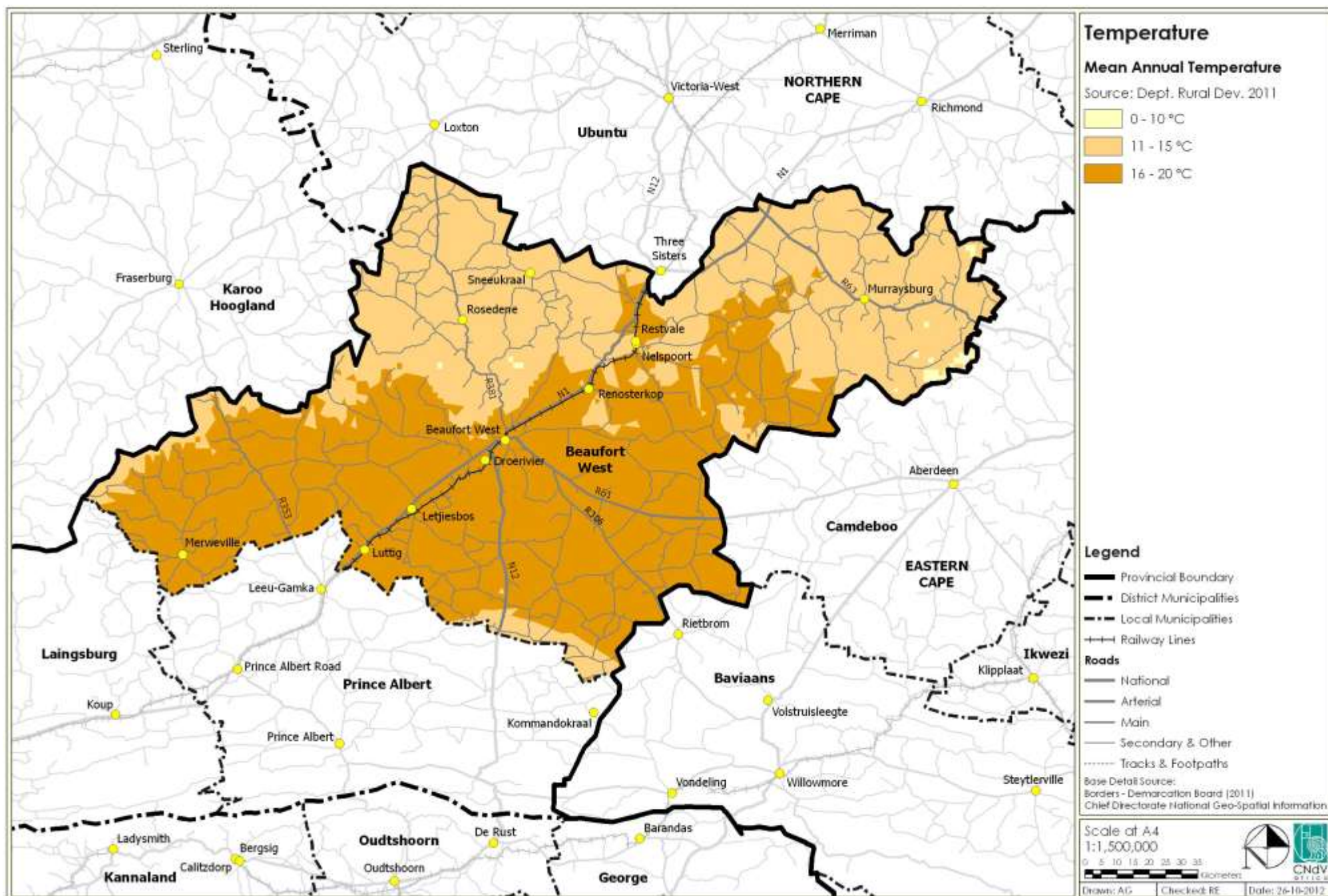


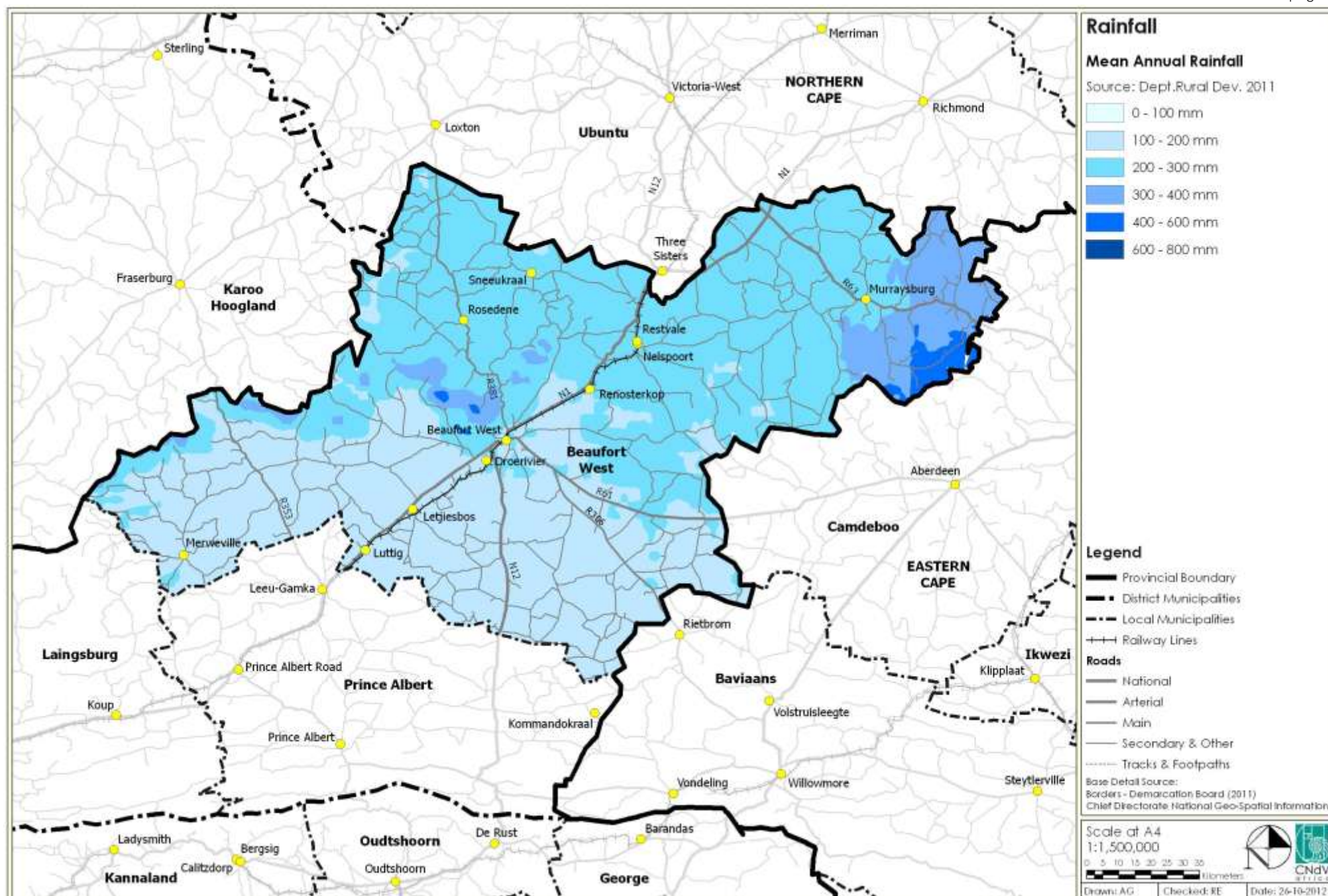
Figure 3.2.2.1a Climate: Temperature

3.2.2.2 Rainfall

Graph 3.2.2.1 indicates the average annual rainfall for the municipality. The highest average rainfall was recorded during February, March and April when figures of 30mm to 43mm were recorded. During the months of June and July the lowest average annual rainfall was recorded. During this time rainfall drops to less than 10mm per month.

Figure 3.2.2.2 shows the distribution of mean annual rainfall across the municipality. The figure indicates that the highest rainfall is experienced north of the town of Beaufort West and in the east of the municipality in vicinity of Murraysburg. In these areas rainfall of between 300mm and 600mm has been recorded.

The lower rainfall areas are situated in the south of the municipality. Rainfall of between 100mm and 200mm has been recorded here.



3.2.2.3 Wind

Figure 3.2.2.3a shows the average annual wind speed and direction for Beaufort West. This figure shows that the dominant wind direction is east, followed by east-north-east and north east. This figure also shows that no wind can be expected for 2.1% of the year.

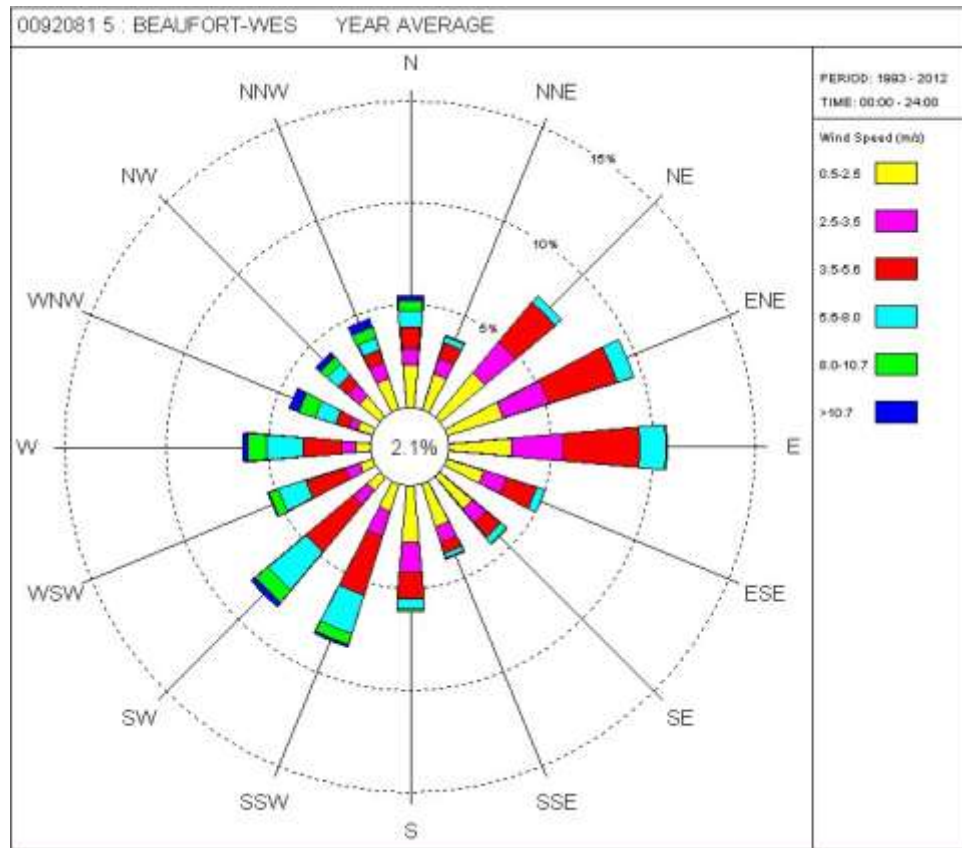


Figure 3.2.2.3a Average annual wind speed and direction for Beaufort West (source: Weather SA, 2012)

Figure 3.2.2.3b indicates the summer wind speed and direction. During the summer months the dominant wind direction is in an easterly direction. Figure 3.2.2.3c shows the average annual wind speed and direction for the winter months when the dominant wind direction is westerly.

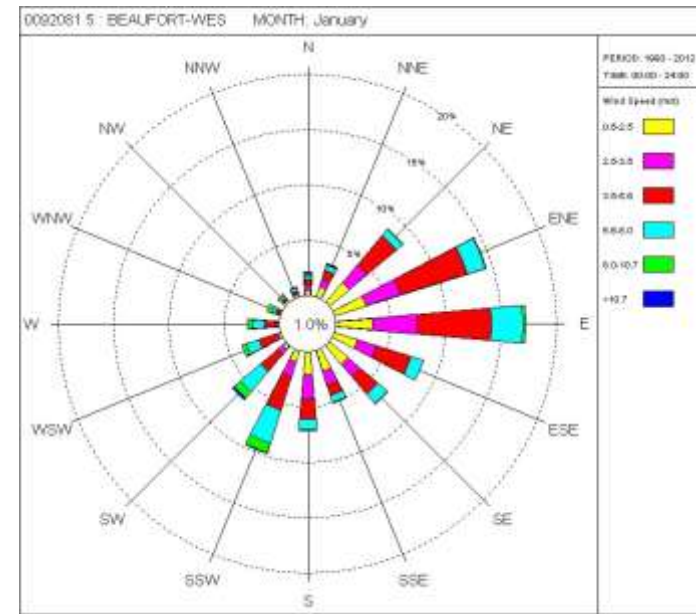


Figure 3.2.2.3b Summer wind speed and direction for Beaufort West (source: Weather SA, 2012)

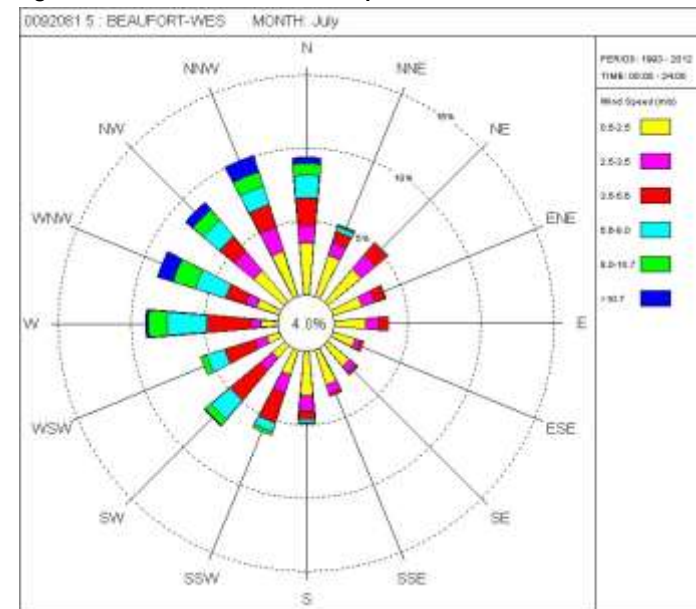


Figure 3.2.2.3c Winter wind speed and direction for Beaufort West (source: Weather SA, 2012)

Figure 3.2.2.3d indicates the estimated wind speeds for South Africa and provides an indication of the potential for generation of wind energy. The central and eastern parts of the municipality have the highest wind speeds (6 – 8m/s). This indicates that potential for wind energy generation exists in this area of the municipality.

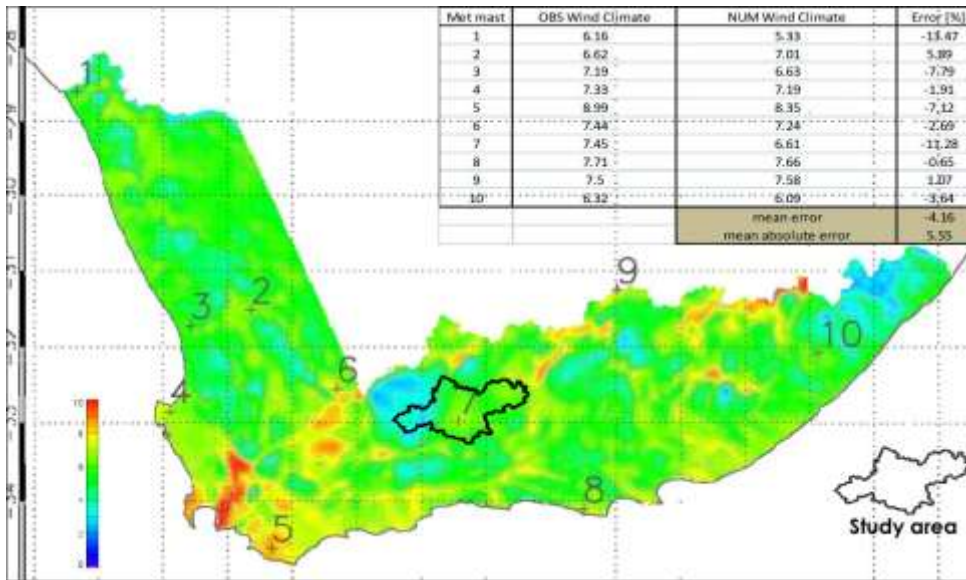


Figure 3.2.2.3d Estimated wind speeds for South Africa (source: Wind Atlas for South Africa, 2012)

3.2.2.4 Wind and Solar Farm Siting Principles

CNdV africa prepared a Strategic Initiative to introduce Commercial Land based Wind Energy Development to the Western Cape in May 2006. The purpose of this study was to develop a regional methodology for wind energy site selection. The study provided a number of site factors for locating wind energy projects. Even though no specific reference was made to solar farm siting some of the factors could be applied to solar farms.

The report highlighted the following site factors as being important:

- **Slope**

Slope is a critical factor that influences numerous aspects of the design of wind farms. These include:

- Wind Potential – slopes up to a certain gradient that are orientated towards prevailing wind directions tend to augment average wind speeds
- Visibility – wind farms on slopes will have increased visibility
- Road layout and design – slopes need to be considered in road layout to reduce the erosion potential of road run-off and rockfall and landslide potential
- Tower foundation design – this needs to consider falls across the tower platform
- Revegetation – steep road verges and cuts will require revegetation to reduce sedimentation from run-off

- **Geology**

Wind turbines impose large loads on tower foundations and hence highly stable underlying geology is essential. The existence of bedrock, subterranean voids and possible seismic activity needs to be investigated.

- **Soils**

The erosion potential of wind farms sites is determined by the combination of soils and climatic factors. Soil types need to be considered as these influence road construction and re-vegetation.

- **Rainfall**

Rainfall is a further factor that influences erosion and sedimentation that result in possible habitat and vegetation degradation. The rainfall of a specific site has a direct bearing on the road runoff, and runoff from steep slopes.

- **Surface Hydrology and Groundwater**

The hydrology of specific sites is influenced by all the factors set out above. Hydrology must be dealt with in detail as it is a critical determinant of ecosystem health. The design of roads and the treatment of runoff from

roads and disturbed surfaces must consider the reduction of sedimentation and elimination of erosion potential into any river, stream or wetland systems on the project site. Geohydrology (groundwater) is an aspect of the hydrology of a site. It influences foundation design and the retention of wetland integrity if any are associated with the site.

• **Vegetation**

At the Regional Wind Plan level, sensitive vegetation types linked to valuable landscape types should ideally have been eliminated. However, at the site level, a detailed vegetation assessment should be carried out if the proposal is not in an agriculturally disturbed area (either crops or pasture land) to ensure that no rare species exist on the project site.

The vegetation assessment should include location and condition of:

- Extent of disturbed or alien vegetation
- Extent of any natural vegetation
- Indigenous and endemic species
- Rare and threatened species

• **Terrain Stability**

Terrain stability is an important design determinant that is a function of slope, underlying geology, soil type and rainfall and usually requires specialist inputs. The design process typically has the following stages:

- i. Determination of rainfall data for the site (including extreme weather conditions)
- ii. Determination of slopes by gradient classes
- iii. Determination of natural watercourses
- iv. Determination of rocky areas
- v. Determination of soil type and permeability
- vi. Determination of areas of potential erosion
- vii. Determination of areas with high water table
- viii. Terrain stability directly influences the design of tower and transmission pylon foundations and the design of service roads. (see Figure 3.2.2.4c)

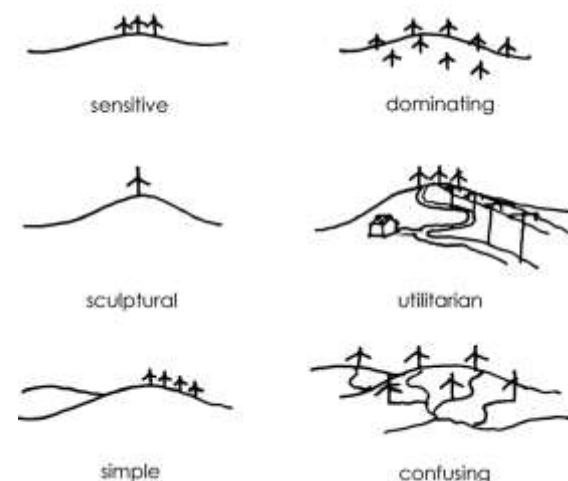


Figure 3.2.2.4 Wind and Solar Farm Siting Principles (source: Strategic Initiative to introduce Commercial Land based Wind Energy Development to the Western Cape, May 2006)

Implications for Beaufort West Municipality

- The rainfall distribution map shows that the southern areas are the drier areas.
- The Beaufort West Municipality falls in a late summer rainfall regime.
- Given the above, substantial efforts, should be made to implement rainwater harvesting not only in new development but also in existing buildings. This could help reduce water demand especially in the winter.
- The municipality has good potential for the implementation of renewable energy products, i.e. wind and solar energy, see Section 3.2.2.4.
- The following design and layout aspects should be applicable to wind energy generation projects:
 - Wind turbine layout: minimum placement distance of twice the tower height plus half the rotor diameter, with a similar hub height and a regular spacing;
 - Roads: minimum overall road lengths, minimum road widths specific to the turbines used, gentle gradients to reduce run-off velocity and terrain stability, avoid crossing steep areas, i.e. slopes >40%, hard surfacing to be avoided;
 - Substations and powerlines within the site should be buried and follow road alignments wherever possible.

Implications for Beaufort West Municipality

- The landscapes that provide resilience to climate change need to be identified and protected these are:
- Kloofs, which provide important connectivity and provide both temperature and moisture refuges.
- Topographically diverse areas, which contain important altitudinal and climatic gradients which are important for climate change adaptation as well as ensuring a range of micro-climates are protected.
- Riverine corridors, which provide important connectivity in extensive arid environments, are also important.

3.2.3 Climate change

The vision for Sustainable Energy Use in the Western Cape is for the province to have a “secure supply of quality, reliable, clean and safe energy, which delivers social, economic and environmental benefits to the Province's citizens, while also addressing the climate change challenges facing the region and the eradication of energy poverty” (White Paper for Sustainable Energy Use in the Western Cape, 2010).

The White Paper for Sustainable Energy Use in the Western Cape (2010) sets targets in respect of sustainable energy use for the province. It stipulates that 15% of electricity consumed in the Western Cape Province is to be sourced from renewable energy sources by 2014 – this has been measured against the 2006 Provincial consumption.

The policy framework recognises that in order to fulfill international commitments to sustainable development and climate change, the use of renewable energy as a source of electricity is to be promoted.

The Western Cape Climate Change Strategy (2008) identified a number of possible likely stress factors in the period 2030 – 2045 that could affect the province:

- An increase in the annual average temperature of at least 1 °C by 2050 (the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report released in February this year shows an expected increase of between 3 and 5 °C by 2100);
- Possible increase in the frequency and intensity of extreme events;
- An increase in conditions conducive to wildfires (higher temperatures and increased wind velocity);
- Reduced rainfall in the western parts of the Western Cape;
- Decreased water resources;
- Reduced soil moisture from an increase in temperature coupled with a decrease in average precipitation;
- Temperature impacts on crop activities – crop burn, drought, pests and microbes resulting in yield reductions, and loss of rural livelihoods.

The goals and objectives of this strategy, with specific reference to energy is to reduce the Provincial carbon footprint by means of air quality management; household fuel replacement; cleaner fuels for transport;

energy efficiency and renewable energy – maximizing benefits through stimulating and subsidizing innovation in clean and renewable technologies.

Four vulnerable systems were identified:

- Natural systems – water, biodiversity, and coastal and marine systems and resources
- Economic sectors – agriculture, tourism and fisheries
- Economic resources and infrastructure – energy, transport, health and air quality
- The built environment, livelihoods and disasters – social systems, extreme events (floods, fires).

As the rate of climate change accelerates it is expected that Beaufort West will experience an increase in temperatures and a reduction in rainfall. It is therefore important that the Municipality contributes to the efforts to reduce the emission of greenhouse gasses and thereby delay the impact of climate change. New urban development needs to be planned with this in mind. The changes in the climate along with aspects such as the prevailing wind direction requires that new buildings, be they for offices, commercial or especially residential use, be designed with a view to ameliorate these impacts.

Appropriate thermal treatment of buildings need to be applied to ensure they maximise the use of natural energy and minimise the use of electricity. Appropriate treatment could for example include:

- Insulating outer walls, ceilings and windows to prevent heat/cool air loss.
- Constructing buildings with lighter coloured reflective roofs to reduce heat absorption in summer which will reduce reliance on air-conditioning.
- Insulating geysers with thermal blankets; and
- Installing energy efficient lighting and appliances.

Climate change refuge areas, i.e. areas with moderate climates that provide cooler habitats where species under threat from changing climates can colonise, are:

- Mountain Kloofs, which provide important connectivity and provide both temperature and moisture refuges.
- Topographically diverse areas, which contain important altitudinal and climatic gradients which are important for climate change adaptation as well as ensuring a range of micro-climates are protected.
- Riverine corridors, which provide important connectivity in extensive arid environments. (BOTSOC, 2008)

Implications for Beaufort West Municipality

- Building orientations, architecture and materials need to sensitively respond to the aspects, below, relating to the climate in the Municipality.
- Mukbeibir suggests the following strategies: (2007)
 - artificial groundwater recharge;
 - conjunctive use of surface and ground water;
 - desalination of groundwater;
 - type relief and aid funding from RSA National Treasury;
 - dry sanitation systems such as the pit latrines and urine diversion toilets;
 - dual flush toilets;
 - education programs on water saving measures;
 - local water resource management and monitoring;
 - rainfall enhancement such as cloud seeding;
 - rainwater harvesting at the household level;
 - the use of grey water;
 - reduction of leaks programmes both at household and distribution levels;
 - regional water resource
 - saline water for toilets;
 - standby relief and critical conditions, in other words disaster planning;
 - delivery of water by tanker;
 - tariff Structures to reduce water demand; and
 - water restrictions under used to reduce water demand.
- Mukbeibir (2007) recommends the following:
 - emphasis should be placed on demand side management;
 - strict ground water management systems should be put in place;
 - a climate change awareness programme should be developed;
 - the climate induced impact on water resources should be integrated into the IDPs
 - climate refuge areas need to be protected for the colonisation of threatened species as these have more moderate climates.

3.2.4 Topography and Landscape Character, Slopes and Aspect

3.2.4.1 Topography and Landscape Character

Figure 3.2.4.1 shows the topography of the study area.

The topography of the Beaufort West Municipality gradually rises from the south west to the north and north east. The topography in the south west is between 500 and 1000m above mean sea level which rises to between 1500 and 2000m above mean sea level in the north (Nuweveld Mountains) and the east (Sneeuberge).

On the outskirts of Beaufort West town there are low lying plains to the south with higher lying areas and the Nuweveld Mountains in the north. Murraysburg is surrounded by the Sneeuberge to the east and is also the highest lying settlement in the municipality. Nelspoort is situated in a lower lying area surrounded by hills and "koppies". Merweville is situated in a lower lying area with topography varying between 500 and 1000m above mean sea level. To the north of Merweville lie the Nuweveld Mountains, providing a scenic backdrop to the town.

Three different landscape character types, based on the elevation of the landscapes, are identifiable. These are cosmic, romantic and classic landscapes.

Within the Beaufort West Municipality Romantic and Cosmic landscapes were identified.

Cosmic landscapes are created by the vast open areas are found in the southern parts of the municipality. Romantic landscapes with rolling hills and mountains (Nuweveld Mountains and Sneeuberge) are found in the north of the municipality, see Figure 3.2.4.1.



Figure 3.2.4.1a Example of a cosmic landscape along the N1 national road, south of Beaufort West.



Figure 3.2.4.1b Example of a romantic landscape between Beaufort West and Nelspoort.

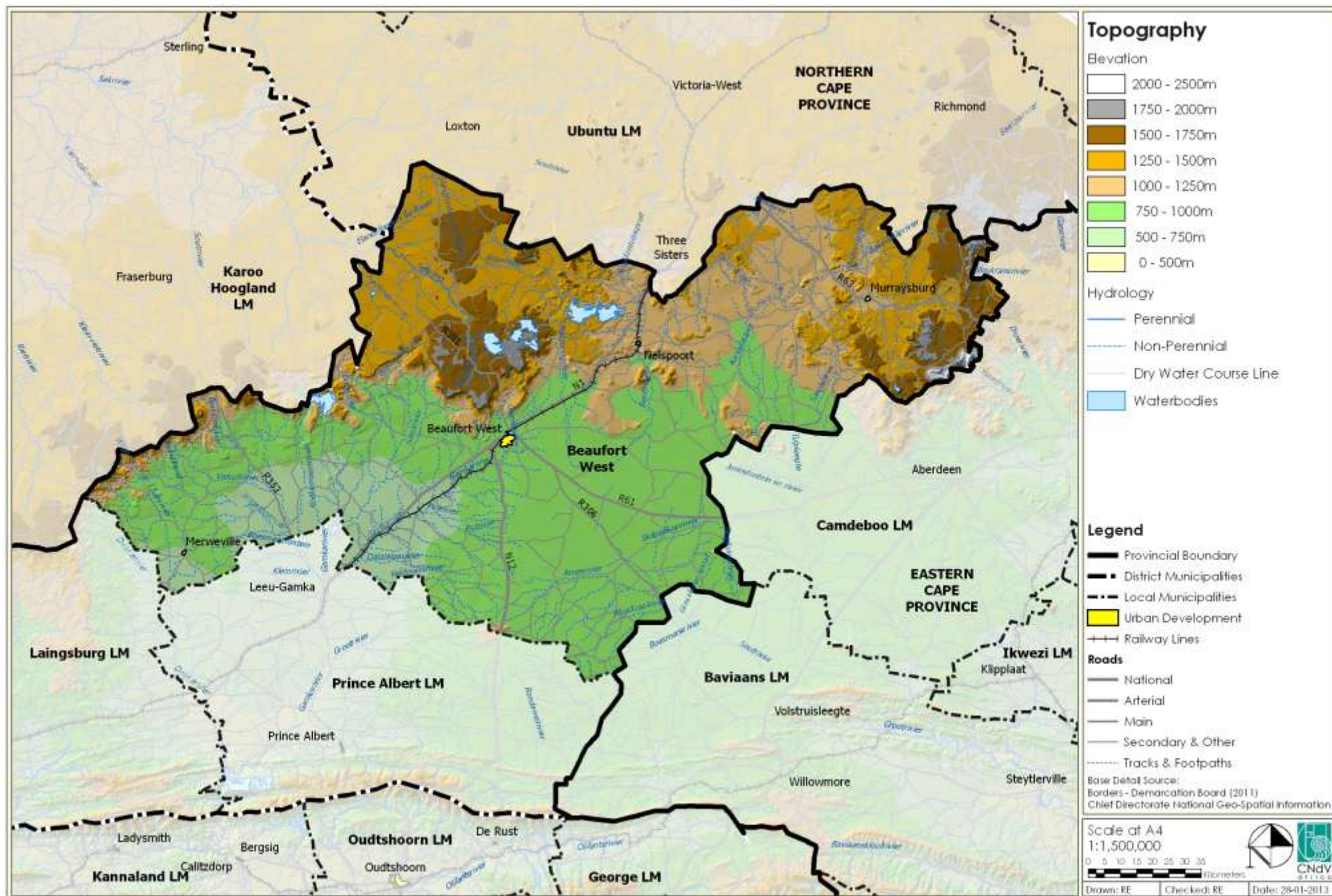


Figure 3.2.4.1 Topography

3.2.4.2 Slopes

Figure 3.2.4.2 shows that the majority of the municipality is largely flat (0 – 5%).

The steeper slopes can be found along the southern edge of the Nuweveld Mountains, north of Beaufort West. Here slopes of 20% to more than 25% are found. The areas surrounding Nelspoort and Murraysburg also have slopes greater than 25%.

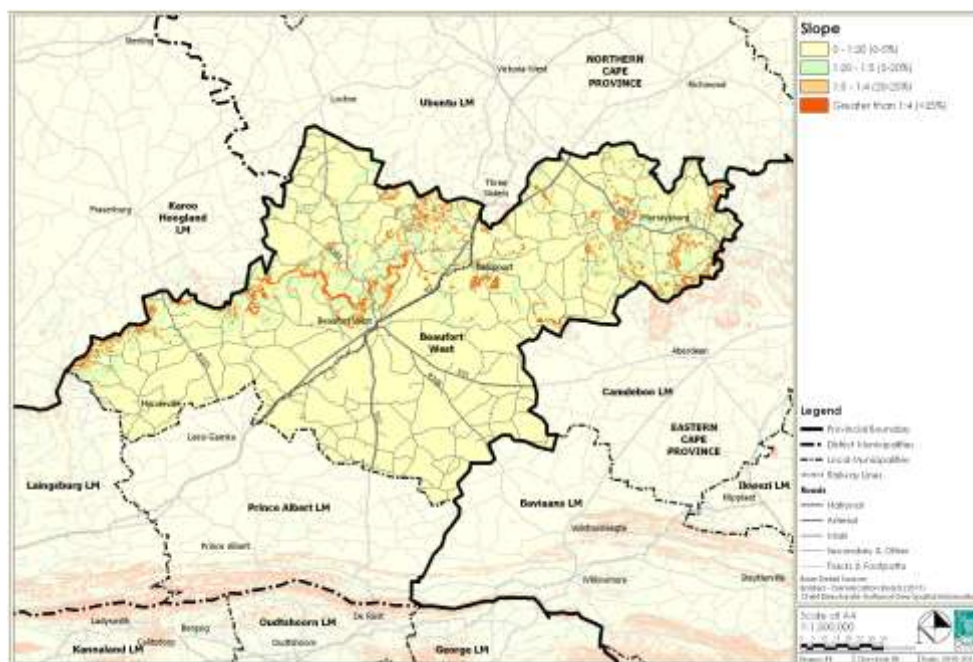


Figure 3.2.4.2 Slope

3.2.4.3 Aspect

Figure 3.2.4.3 shows the general aspects found within the municipality. In terms of aspect the majority of the municipality is flat with no prominent aspect. A large number of south facing slopes are also found throughout the municipality.

Implications for Beaufort West Municipality

- Given the steep slopes of some mountain ranges in the north and north east, settlement opportunities in the municipality should be diverted to the more level areas within the valleys, those areas with slopes of less than 1:4 as shown on Figure 3.2.4.2.
- Future urban development, particularly those for conventional Breaking New Ground, housing - subsidy/lower income housing, should preferably be located on north facing slopes. North facing slopes provide more exposure to sunlight as oppose to south facing slopes (refer to figure 3.2.4.3).
- It is also important from visual founding condition and building costs perspectives that no new developments be permitted on the steep slopes (>1:4) and on the ridges of mountains.
- Care should be taken to also reduce the potential negative impact of urban development along the scenic corridors. It will be important to determine the non-negotiable scenic routes or corridors.
- Ensure that changes in land use maintain the integrity, authenticity and accessibility of significant cultural landscapes (WCPSDF, 2009).
- Integrate development within the urban area to combat urban sprawl and reduce negative visual impact on the cultural landscape (SRK Consulting, 2011).

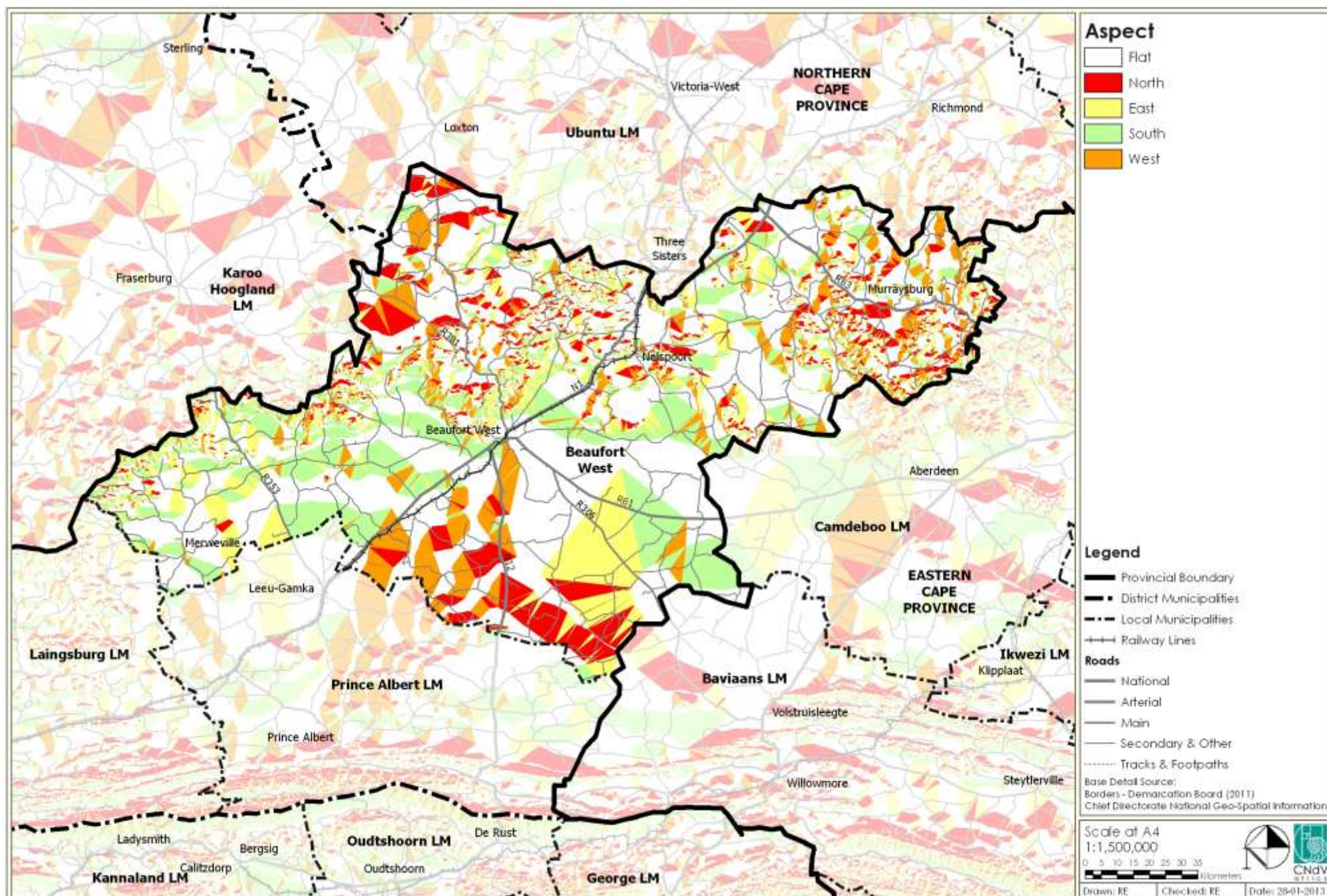


Figure 3.2.4.3 Aspect

3.2.5 Water Resources (Hydrology)

3.2.5.1 River networks

Figure 3.2.5.1 shows the distribution of the rivers and tributaries through the study area.

There is one major river which affects the municipality, the Sout River.

The Sout River flows from north to south through the northern boundary of the municipality.

A number of waterbodies are located in the northern parts of the municipality in the area around Rosedene.

3.2.5.2 Water quality status of the rivers

The NFPA (Kleynhans, 2000) defines rivers based on whether their natural conditions have been modified and their ability to contribute to the river ecosystem. Rivers that are classified Unmodified, Natural or Largely Natural with Few Modifications are considered intact and able to contribute towards river ecosystems. Previously these rivers would have been classified as Least Threatened. Modified Rivers would have been classified as Vulnerable and Largely Modified would have been Endangered. Rivers that are classified as Seriously Modified or Critically/ Extremely Modified would have been previously classified as Critically Endangered.

Figure 3.2.5.2 shows the SANBI river conservation status of the rivers in the Beaufort West Municipality.

In terms of the SANBI: National Freshwater Ecosystem Priority Areas (2007) the Sak River is classified as Largely Natural with Few Modifications.

This indicates that the rivers are in an acceptable condition but that attention should be given to prevent the rivers from further modification and degradation.

Implications for Beaufort West Municipality

- The majority of the rivers in the municipality are in an acceptable state.
- Intensive agricultural production is occurring along the banks of the Sout River. The condition of the Sout River should be improved and further modification and degradation should be prohibited.
- Appropriate policies should be formulated to achieve the above goal that specifically addresses urban and agricultural development.
- The Sout River is a key determinant of the water availability for the Municipality.

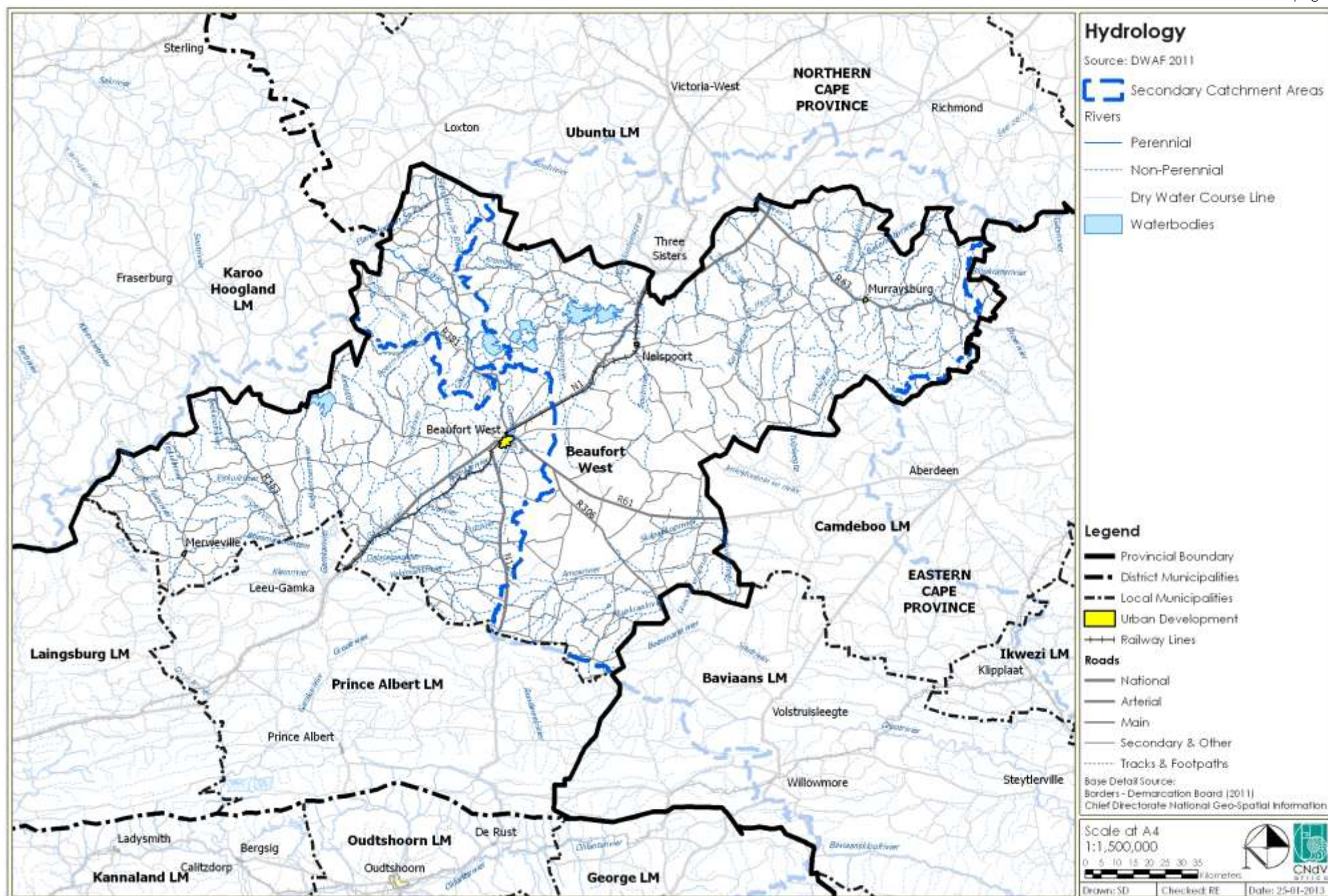


Figure 3.2.5.1 Hydrology: River Systems and Major Dams

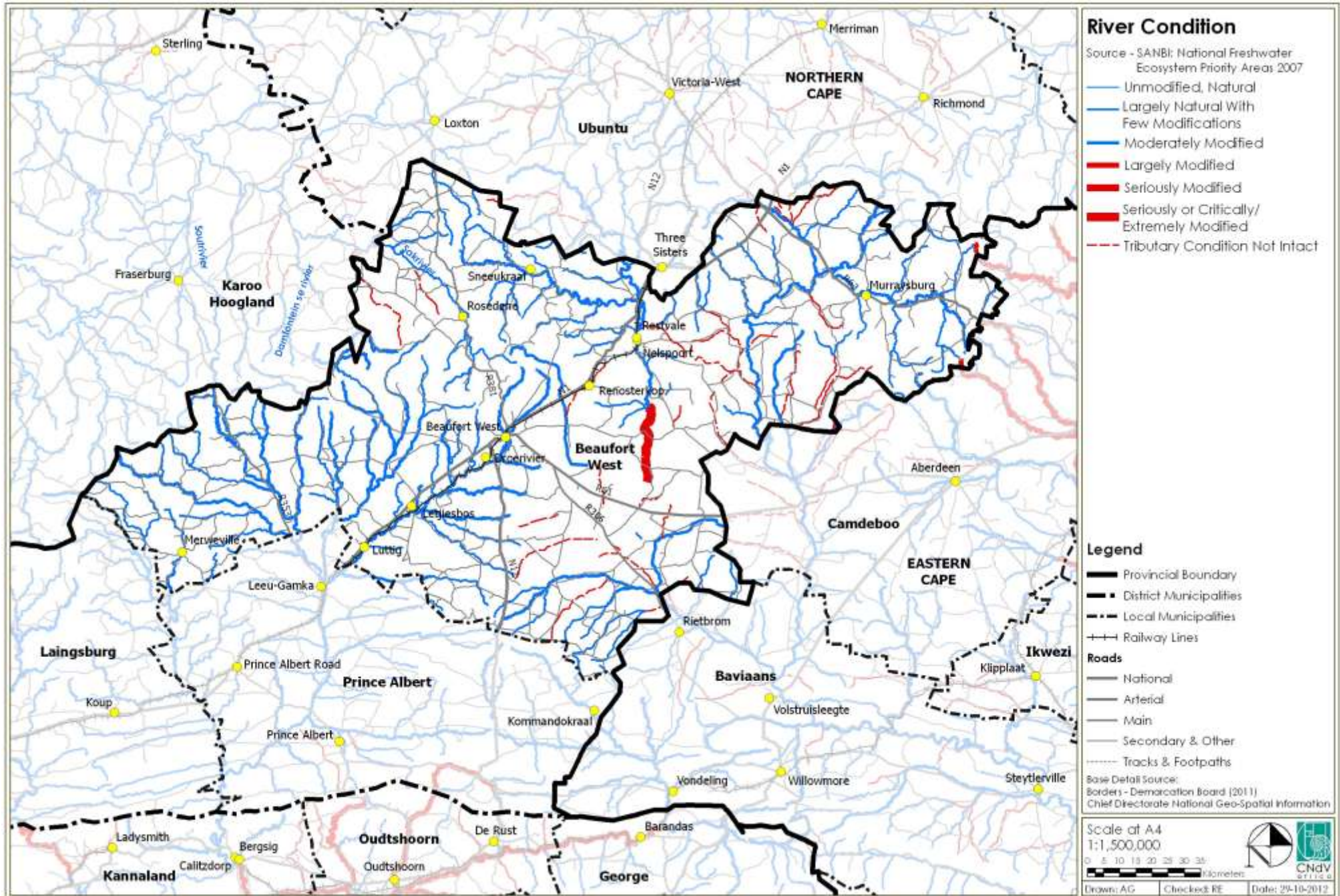


Figure 3.2.5.2 River Conservation Status



3.2.6 Biodiversity

3.2.6.1 Biomes

Figure 3.2.6.1 shows the different biomes that are present in the municipality. These biomes are in order of magnitude of land cover:

- Nama-Karoo Biome (91.51%);
- Azonal vegetation (7.56%);
- Grassland Biome (0.67%);
- Fynbos Biome (0.25%).

Nama-Karoo Biome makes up the largest area of the municipality. It is the third largest biome in South Africa. Its dominant vegetation is a grassy, dwarf shrub land. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clay soils.

Azonal vegetation is located along the rivers and at the wetlands located throughout the municipality.

Grassland biome, mostly containing Vaal-Vet Sandy Grassland, is found around small isolated area south of Rosedene.

Fynbos biome, small pockets of which are located along the western boundary of the municipality has the greatest number of plant species of any biome in the country. It includes both Fynbos and Renosterveld vegetation. Fynbos tends to grow on poor soil and is extremely rich in plant species. Renosterveld grows on richer soil and can support more animals.

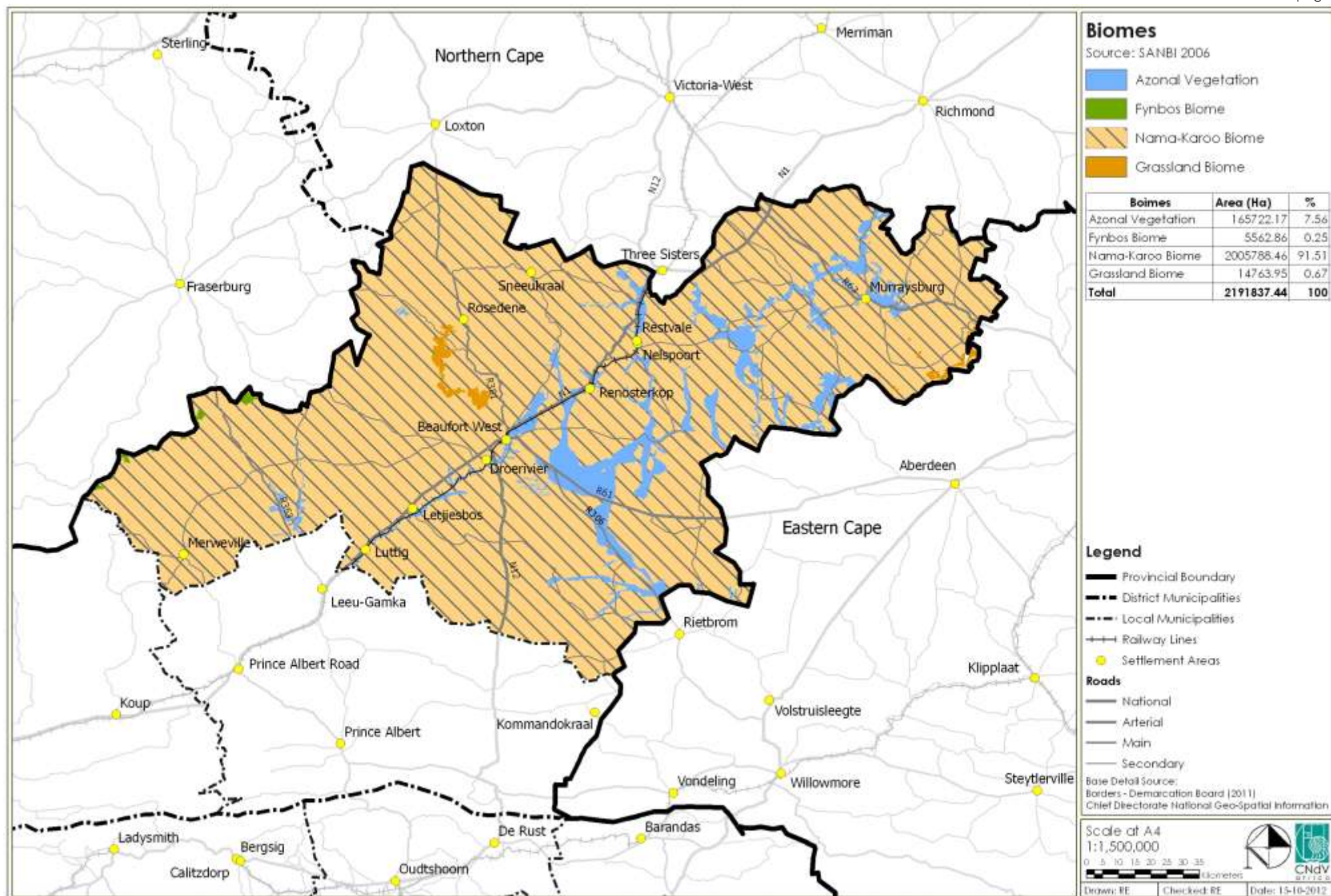


Figure 3.2.6.1 Vegetation: Biomes

3.2.6.2 Vegetation Types

Figure 3.2.6.2 shows the dominant vegetation types in the municipality:

- Lower Karoo (50.59%);
- Upper Karoo (40.92%);
- Inland Saline Vegetation (7.56%);
- Dry Highveld Grassland (0.67%);
- Shale Renosterveld (0.25%).

The southern and eastern parts of the Municipality contain the Lower Karoo vegetation type, while the northern areas contain the Upper Karoo vegetation type.

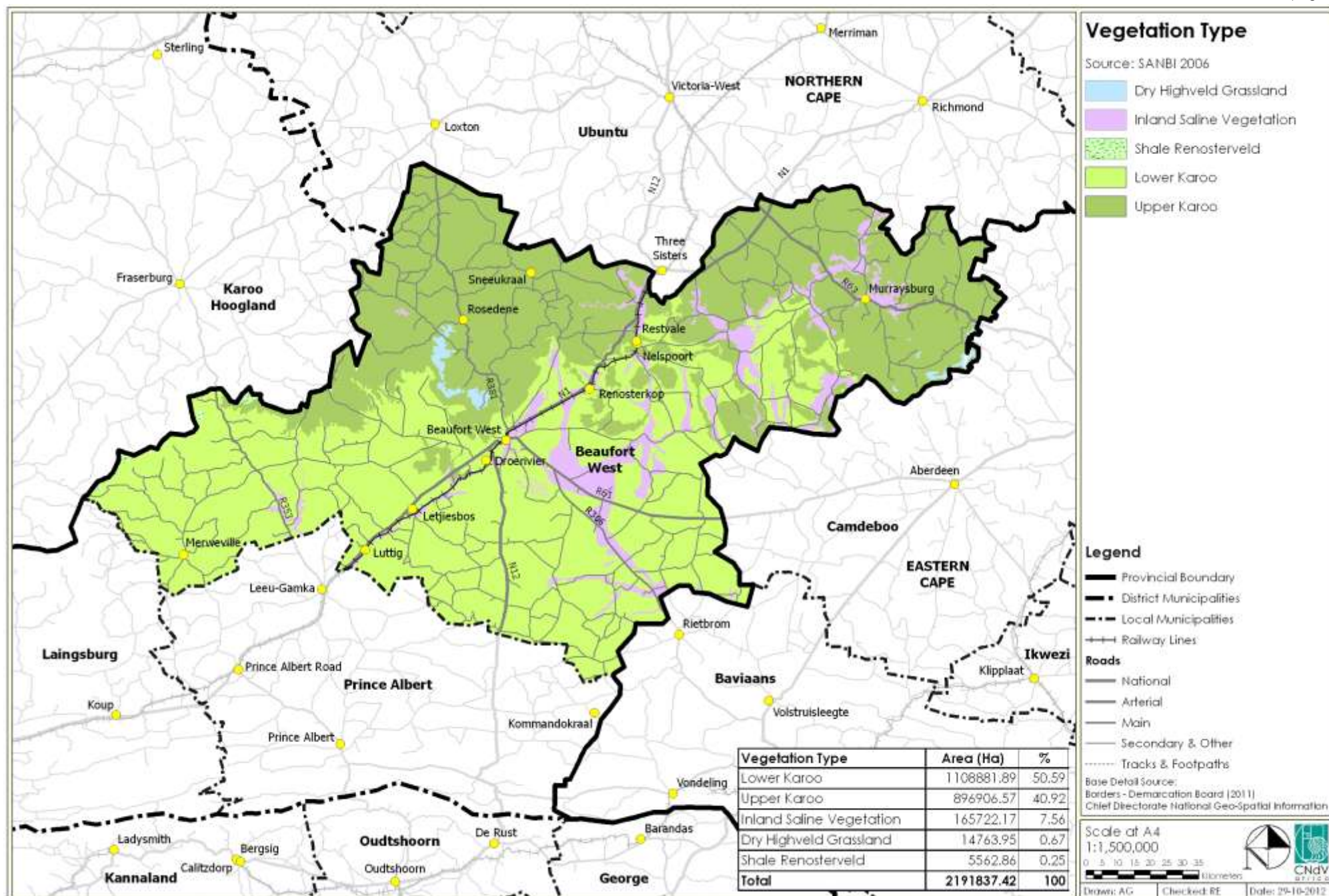


Figure 3.2.6.2 Vegetation Type

3.2.6.3 Vegetation status

Figure 3.2.6.3 indicates the Vegetation status of the Municipality.

The figure shows that none of the vegetation within the Municipality is vulnerable, endangered or critically endangered.

Implications for the Beaufort West Municipality

- Appropriate grazing systems should be implemented on veld areas so as to improve biodiversity and stock carrying capacity.
- Appropriate management of vegetation types in the municipality should be encouraged as a high priority.
- Agricultural activities should be managed to not negatively impact on natural vegetation.

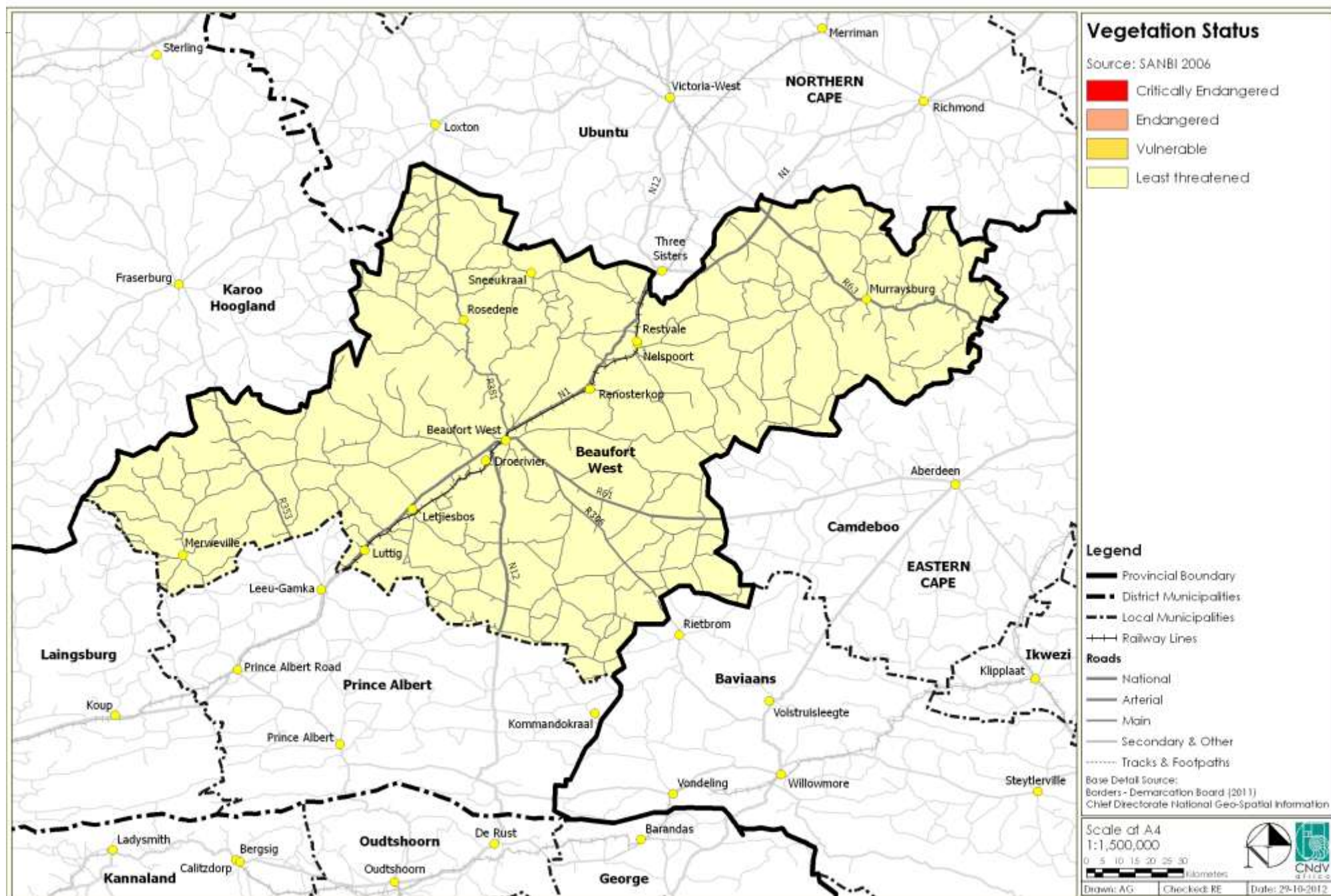


Figure 3.2.6.3 Vegetation Status

3.2.6.4 Critical biodiversity areas

Figure 3.2.6.4a shows the critical biodiversity areas in the Beaufort West Municipality. These areas include the critical terrestrial areas. See Figure 3.2.6.4a and Table 3.2.6.4a.

Critical Biodiversity Areas		
Biodiversity Type	Area Ha	% LM
Critical Terrestrial Areas	1306099	60%
Sub Total	1306099	60%
Protected Areas		
Formal Protected Areas	88354	4%
Sub Total	88354	4%
Area of Municipality	2191912	

Table 3.2.6.4a Critical Biodiversity Areas

A Central Karoo Biodiversity Assessment was prepared in 2009 for the Western Cape Department of Environmental Affairs and Development Planning. The identified Critical Biodiversity Areas as per this assessment are illustrated in Figure 3.2.6.4b.

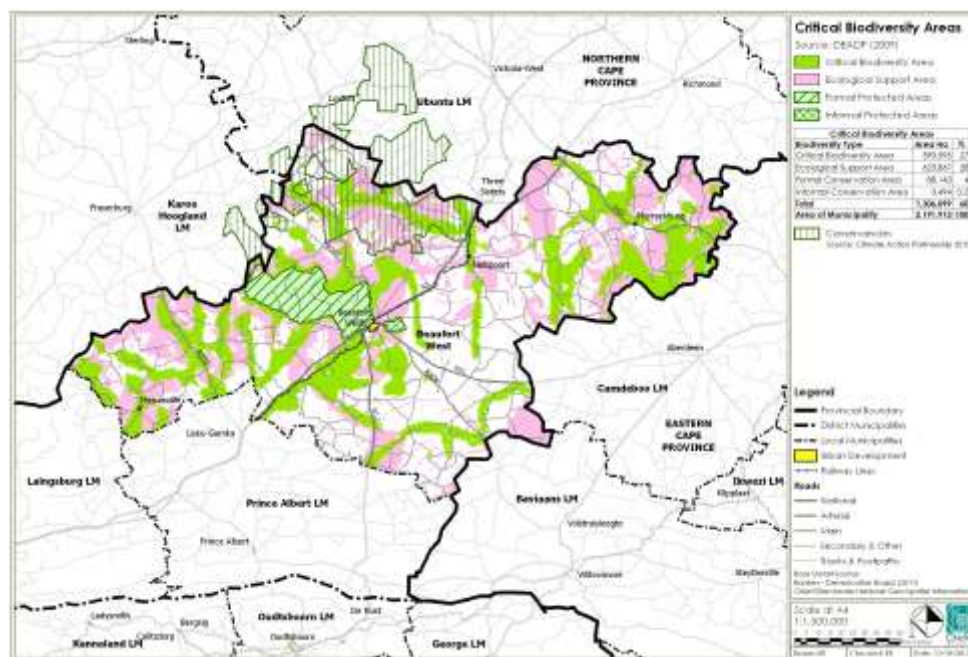


Figure 3.2.6.4a Critical Biodiversity Areas

The assessment concluded with the following management objectives for each identified Critical Biodiversity Area (CBA), refer to Table 3.2.6.4b.

CBA Map Category:	Formal Protected Areas and Informal Conservation Areas	Critical Biodiversity Areas	Ecological Support Areas	Other Natural Areas	No Natural Areas Remaining
Desired Management Objective:	Maintain natural land. Rehabilitate degraded to natural or near natural and manage for no further degradation.		Maintain ecological processes	Sustainable Management within general rural land use principles	Favoured areas for development. Sustainable Management within general rural land use principles

Table 3.2.6.4b Desired Management Objectives per mapped CBA (source: Central Karoo Biodiversity Assessment, 2009)

Implications for Beaufort West Municipality

- Development in close proximity or within endangered plant species areas must be avoided and discouraged, see Figure 3.2.6.4a.
- Strategies and management guidelines are to be developed as a priority to protect Critical Biodiversity Areas, see Figure 3.2.6.4b, which receive no formal protection.
- For all types of development, footprints should be minimised. The focus should be on selecting alternatives that maximise the retention of indigenous habitats, species and ecological processes.
- Search and rescue is important for all development, especially when this may result in the irreversible loss of rare or threatened plant populations.
- If development is proposed in degraded examples of vegetation types, biodiversity offsets should be investigated where equal-sized or larger areas of the same vegetation type are secured for conservation by funding from the developers.
- Appropriate management of vegetation types in the municipality should be encouraged as a high priority.
- Agricultural activities should be managed to not negatively impact on natural vegetation.
- Care should be taken over critically endangered areas located within the municipality.

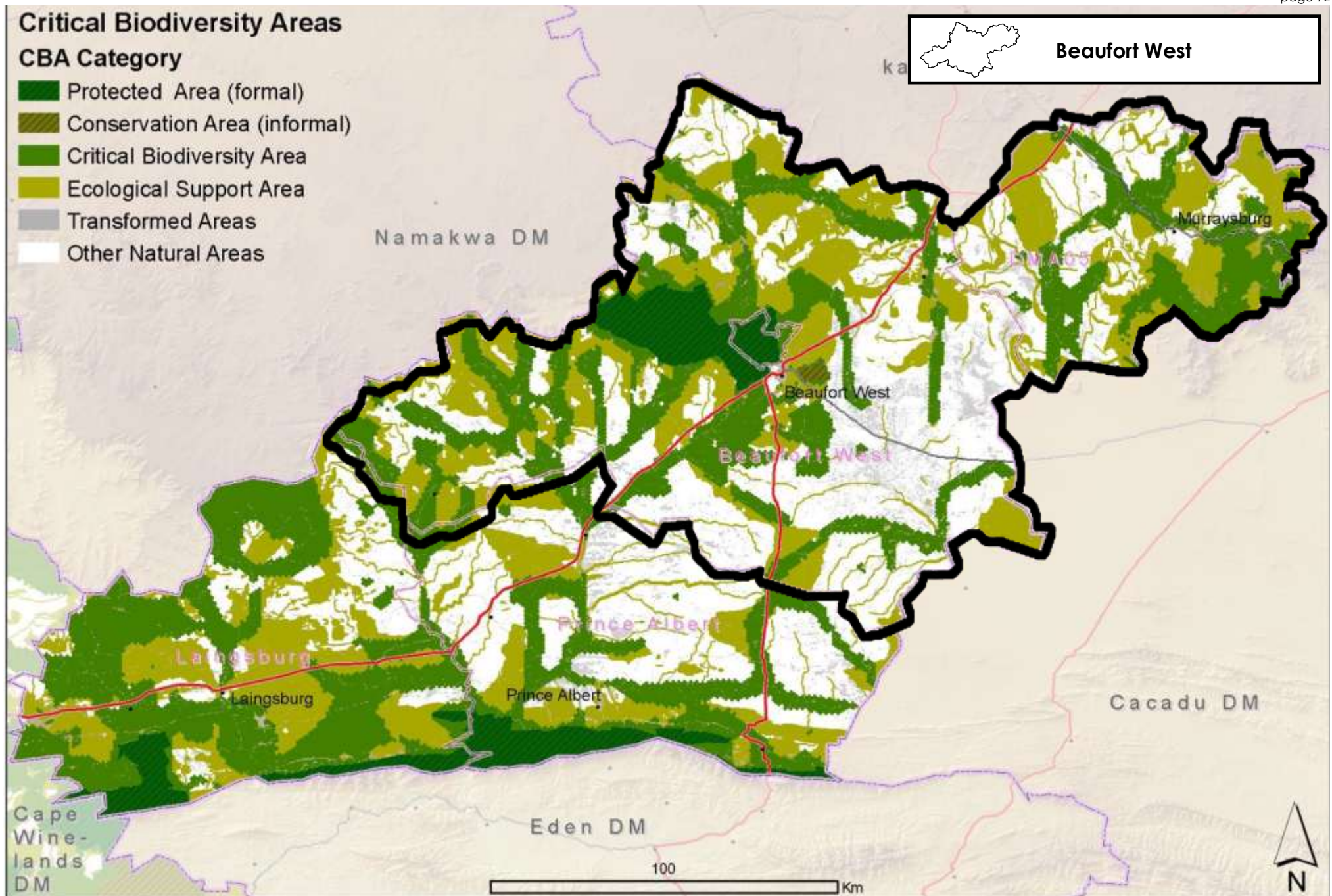


Figure 3.2.6.4b Critical Biodiversity Areas CBA Categories (source: Central Karoo Biodiversity Assessment, 2009)

3.2.7 Biodiversity Conservation

3.2.7.1 Conservation

Figure 3.2.7.1 shows that 4.2% of the Municipality is protected through mechanisms such as:

- National Parks: 96%;
- Informal protected areas: 4%.

The Karoo National Park is located in the central area of the Municipality, west of Beaufort West.

One private nature reserve (informal protected area) is located in the central area of the Municipality, west of Beaufort West.

A Riparian Habitat Rehabilitation Project is underway in and around the municipality. The purpose of the rehabilitation project is to repair river systems. These rivers have been damaged by poor farming practices and other human activities and has lead to the Riverine Rabbit (an important biological indicator species) becoming endangered. The project consists of four conservancies of which the Sakriver Conservancy and the Kromriver Conservancy fall within the Beaufort West Municipality. Refer to Figure 3.2.7.1 for the location of these conservancies.

Implications for Beaufort West Municipality

- Vegetation within the municipality is classified as Least Threatened. Proper management and policies should be ensured to maintain this status.
- No urban development should be permitted in the areas identified as CBAs or the Protected Areas, see Figure 3.2.6.4a.
- Promote and encourage the actions taken to improve riverine environments, especially the Riparian Habitat Rehabilitation Project undertaken by the Climate Action Partnership.

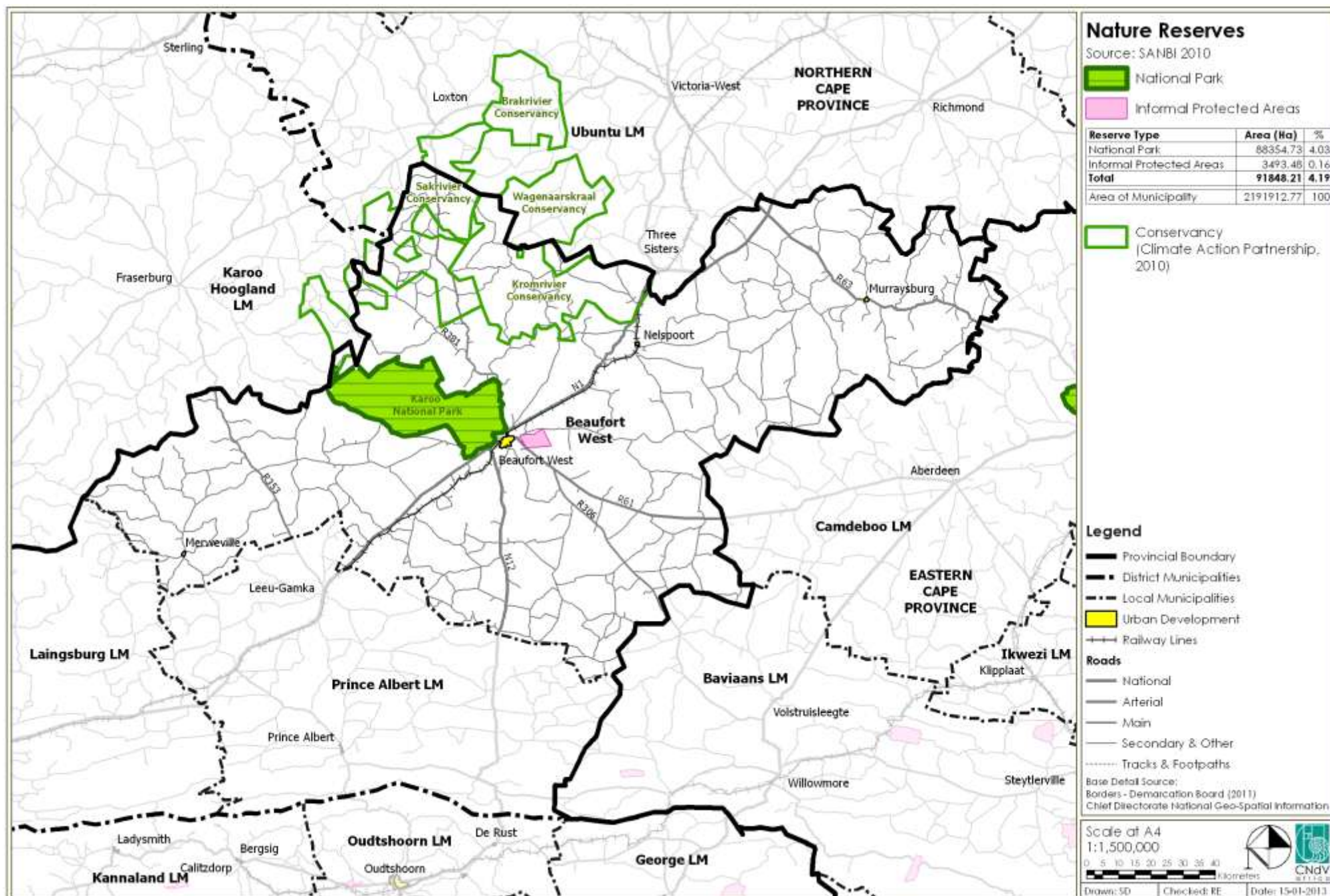


Figure 3.2.7.1 Reserves, Protected Areas and Conservancies

3.2.8 Agriculture

This section of the report focuses on the role of the agricultural sector in the economy of Beaufort West Municipality. It provides an overview of the trends in agriculture and establishes the economic value of agriculture in the municipality, particularly with regard to the pressure of an urban edge.

3.2.8.1 Land Capability

Figure 3.2.8.1 shows the land capability based on the soil classification only (this does not consider water availability). This shows that soil suitable for arable agriculture are mostly located in the western (near Merweville) and eastern areas (near Murraysburg) of the municipality. The majority of the municipality is suitable for grazing of livestock.

3.2.8.2 Agricultural Land Use Pattern

Figure 3.2.8.2 shows the different types of agricultural/farming practices in the municipality. This map shows that there are very few areas of cultivated land. Cultivated land can mainly be found in patches near Murraysburg. Cultivated land only amounts to 6459ha or 0.30% of the total municipal area. The majority, 92.75%, of the municipality is covered with grass and shrubs.

The nature of the agricultural activities in the Beaufort West municipal district is directly derived from the type of soils in the area and the water availability, in essence the associate natural resource endowment. Mainly two types of agricultural activities take place, lucerne and feed-grain production (on the \pm 1000 ha irrigation land available) and livestock production mainly small stock (sheep) with livestock farming being the biggest.

3.2.8.3 Water Requirements for Agriculture

Figure 3.2.8.2 indicates the extent of cultivated land in the municipality. Only 0.3% of the municipal land is cultivated.

There is thus a very insignificant requirement for water in the Beaufort West Municipality.

3.2.8.4 Agriculture's contribution to GVA

Central Karoo District contributes 2.36% to Provincial total and 0.56% to National total GVA for the "Agriculture, hunting, forestry and fishing"-sector. Beaufort West local municipal area's contribution is respectively 1.25% and 0.30% for Provincial and National for the said sector.

Figure 3.2.8.4 indicates the sectors contributing to the GVA of the Beaufort West Municipality.

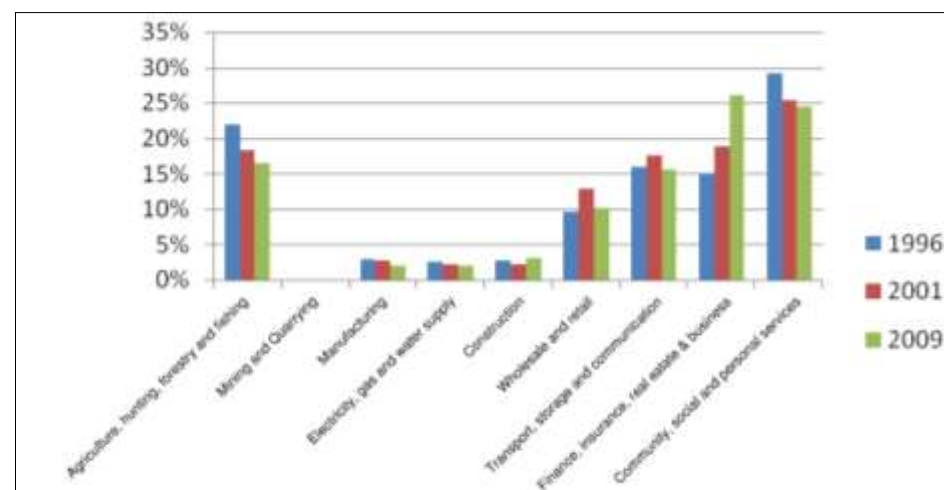


Figure 3.2.8.4 GVA composition for Beaufort West Municipality (source: OABS, 2013)

Although the contribution of the "Agriculture, hunting, forestry and fishing"-sector to total GVA for Beaufort West Local Municipal area declined for the period 1996 to 2009 from 22% to 17%, it still seems to be a the third most important contributor to the local economy and remains one of the main drivers.

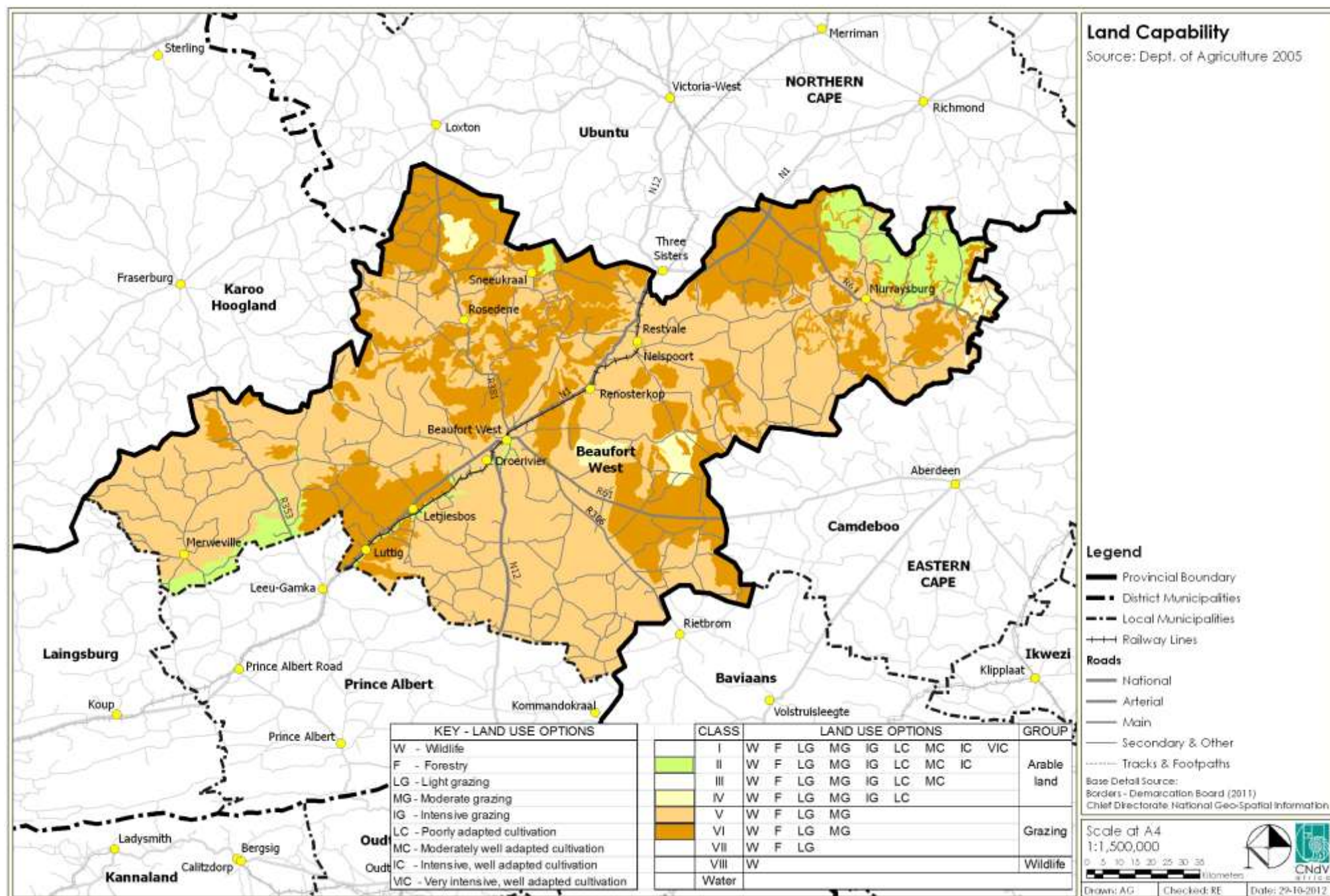


Figure 3.2.8.1 Land Capability

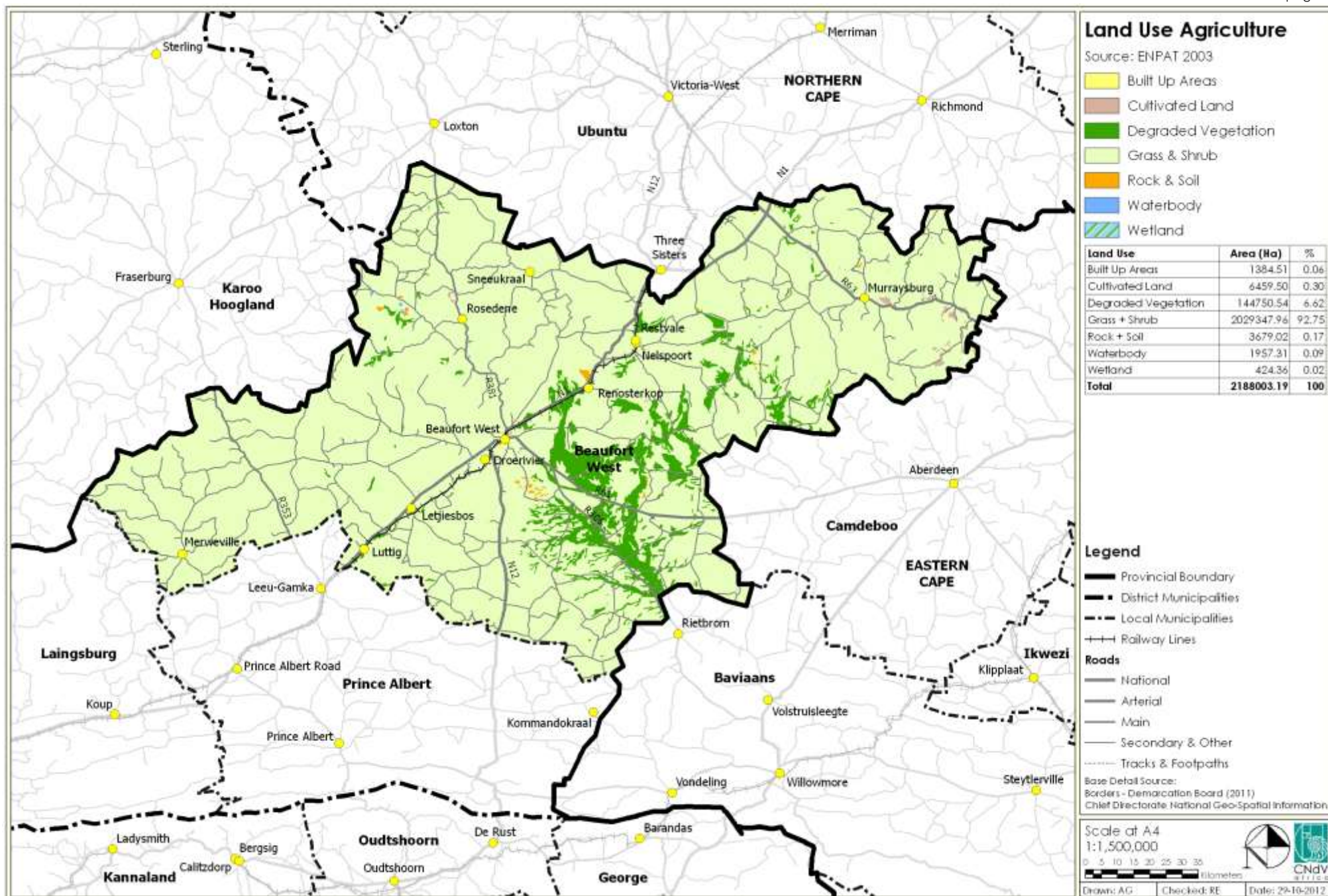


Figure 3.2.8.2 Agricultural Land Uses

3.2.8.5 Types of agricultural businesses

The following is a list of the most significant agri-businesses operating in the Beaufort West Municipality:

- BKB (farmers supplies)
- Beaufort Melkery (diary)
- Beaufort Netwerk/Karoo Netwerk (dairy products)
- Beaufort West Verspreiders (building, farmers supplies)
- Landbank

Karoo Lamb as a brand and geographical indicator is currently being established, which holds potential for growth in the agricultural sector, as the lamb is well-known. Springbok ranching is beginning to be used as an alternative to sheep farming in some areas of the Karoo, which is to a small degree replacing sheep.

Increasingly, farmers are being pressurised by lobby groups and consumers to commit to 'Fair Game' practices in animal husbandry, particularly because of the violent and cruel manner in which traditional predators (jackals, leopards) are being killed with 'gin traps'.

This shift requires new farming practices, and has implications for the carrying capacity of the land.

3.2.8.6 Enterprise contribution to agricultural production

Table 3.2.8.6a indicates a breakdown of the enterprises contributing to the agricultural sector of Beaufort West. The table indicates that the largest income was generated from animals and animal products.

District	Field crops	Horticulture	Animals	Animal products	Other products
	R '000				
Beaufort West	7 433	1 045	35 221	13 811	7
Western Cape	1 295 835	5 976 340	1 581 884	1 713 253	562 646

Table 3.2.8.6a Gross farming income by main division (source: OABS, 2013)

Figure 3.2.8.6b indicates gross farming income earned from field crops. Maize for grain is the biggest enterprise in this regard.

District	Total	Summer cereals			Winter cereals			Fodder crops			
		Maize for grain	Grain sorghum	Other	Wheat	Barley	Other	Lucerne	Maize for silage	Teff	Other
		R '000									
Beaufort West	7 433	5 837	0	0	127	20	0	1 293	132	0	26
Western Cape	1 243 910	36 621	9 350	512	983 339	99 774	30 058	47 554	2 466	2 801	31 435

Table 3.2.8.6b Gross farming income from field crops (source: OABS, 2013)

Table 3.2.8.6c indicates gross income earned from horticultural products. In this regard deciduous fruit is the largest.

District	Total	Vegetables						Fruit	Other Horticulture	
		Green mealies and sweet	Tomatoes	Carrots	Cabbage and red cabbage	Green beans	Other	Deciduous	Tea	Other
		R '000								
Beaufort West	1 045	7	20	1	1	11	2	664	74	265
Western Cape	4 851 160	24 707	93 615	39 805	31 800	8 435	26 180	4 352 090	65 764	208 764

table 3.2.8.6c Gross farming income from horticultural products (source: OABS, 2013)

Table 3.2.8.6d indicates that sheep farming is the biggest enterprise within livestock farming. Wool and mohair are the biggest income generators in terms of livestock product sales.

District	Total	Livestock sales						Livestock product sales			
		Dairy cattle	Beef cattle	Sheep	Angora goats	Boer goats	Pigs	Milk and cream	Wool	Mohair	Hides and skins
	R '000										
Beaufort West	49 032	22	2 628	28 716	1 477	160	150	20	6 646	6 088	1 057
Western Cape	3 295 137	86 360	172 570	355 419	9 978	5 011	123 571	838 035	128 861	18 937	7 163

District	Poultry sales		Poultry product sales			Game farming	Other animals and animal products
	Chickens	Ostriches	Chicken eggs	Ostrich skins	Ostrich feathers		
	R '000						
Beaufort West	0	1 773	0	0	0	295	0
Western Cape	379 836	442 476	309 074	72 113	21 246	6 663	317 824

Table 3.2.8.6d Gross farming income from animals and animal products (source: OABS, 2013)

Table 3.2.8.6e shows an average contribution obtainable from a typical farm.

	Total District	Average Farm
Number of farms (commercial)	197	1
Total agricultural (ha)	1 651 894	8 385
Total arable (ha)	1 013	5
Jobs	449	2
GDP contribution	R 57 517 000	R 291 964
Export	R 1 218 500	R 6 185

Table 3.2.8.6e Average Farm Contribution (source: OABS, 2013)

3.2.8.7 Farmworkers

There are about 591 farm employees who are employed in the Beaufort West agricultural sector, of which 307 are employed full-time and 284 part-time, see Table 3.2.8.7a. Of the total number of employees, approximately 77% (457 individuals) are male.

District	Paid employees							
	Total		Farm managers / Farm foremen		Full-time employees		Casual and seasonal workers	
	Male	Female	Male	Female	Male	Female	Male	Female
	Number							
Beaufort West	457	134	40	3	253	11	164	120
Western Cape	126 999	96 176	5 133	708	63 472	28 894	58 394	66 574

Table 3.2.8.7a Paid employees according to occupation

Table 3.2.8.7b reflects the minimum wages for farm workers since 2003. Area A refers to a more urban area and Area B a more rural environment.

YEAR	Area A			Area B		
	Rand/hr	Rand/mnth	Annual Remuneration	Rand/hr	Rand/mnth	Annual Remuneration
1/03/2003	R 4.10	R 800	R 9,600	R 3.33	R 650	R 7,800
1/03/2004	R 4.47	R 871	R 10,455	R 3.66	R 714	R 8,564
1/03/2005	R 4.87	R 950	R 11,395	R 4.03	R 786	R 9,429
1/03/2006	R 5.10	R 994	R 11,928	R 4.54	R 885	R 10,620
1/03/2007	R 5.34	R 1,041	R 12,492	R 5.07	R 989	R 11,868
1/03/2008	R 5.59	R 1,090	R 13,080	R 5.59	R 1,090	R 13,080
1/03/2009	R 6.31	R 1,232	R 14,780			
1/03/2010	R 6.74	R 1,317	R 15,800			
1/03/2011	R 7.51	R 1,376	R 16,512			
1/03/2012	R 7.71	R 1,503	R 18,036			
1/03/2013	R 11.66	R 2,275	R 27,298			

Table 3.2.8.7b Minimum wages for farm labourers (OABS, 2012)

It should be highlighted that, although the agricultural sector only contributes between 5%-10% of total Provincial GVA the associated job opportunities it creates should not be underestimated along with its

forward and backward economic linkages which creates further spin-offs in both the primary and secondary economy.

3.2.8.8 Food security

The Beaufort West local municipal area is well endowed in terms of its natural resources for the production of a number of agricultural produce and livestock farming. In terms of food security this area is a contributor not only in terms of the local supply within Beaufort West but as national and international supply base.

• Food and fibre sources – farm gate to shop

- The United Nations Food and Agriculture Organisation (FAO) have determined daily dietary requirements of approximately 2000 plant calories and 500 animal calories per day;
- Upper income diets can increase this intake to 7 500 to 8000 plant and 2 500 animal calories per day;
- 2 500 calories per day is adequate for a vegetarian diet.
- Land requirements for plant and animal calories are 2000 calories per m² per annum for plant foods and only 200 calories per m² per annum for animal foods, i.e. producing animal protein requirements (10 times as much land as plant protein);
- A community of 49586 (Census, 2011) requires the following land for its food and fibre needs depending on its diet and income status, see Table 3.2.8.8.

Land required for food security					
	Diet	C/day	People	C/m²/year	Total Ha
Upper Income	Plant	8000		2000	580
	Animal	2500		200	1810
	Number of People		3967	Sub-total	2390
Lower Income	Plant	2000		2000	1665
	Animal	1000		200	8325
	Number of People		45619	Sub-total	9990
Total			49586	Total	12380
All Vegetarian		2500	49586	2000	2262

Table 3.2.8.8 Land required for food security: Beaufort West Municipality (source: Kilimakore Synergetics. A Study on the Revitalisation of Rural Towns in South Africa, May 2010)

Note: the impact of animal and plant food consumption vs an all vegetarian diet can be seen on the demand for agricultural land ($\pm 32700\text{ha}$'s vs $\pm 3000\text{ha}$'s).

- Approximately 0.3% of the land in the municipality, i.e. 6459ha is cultivated. There is also 2029347 ha of grass and scrubland in the municipality, parts of which are being used for livestock farming.
- It is estimated that 12380ha of land is required for food security, see Table 3.2.8.8, in the Beaufort West Municipality. In terms of dietary requirements for plants, 2245ha is required and 10135ha is required for animal foods. There is thus sufficient land available to supply for the needs of the current population of the municipality.
- There are indications that the current formal food and grocery distribution network, mainly in the form of corner shops, supermarkets and shopping centres, will come under increasing pressure as a result of food inflation and decreasing purchasing power among most income groups but particularly the poor.
- A separate informal marketing channel should be developed in the form of a network of farmers' markets which could allow prices at the farm gate to increase but retail prices to drop by circumventing the agents and middlemen and formal retailers in the distribution channels, see box below indicating distribution chain issues for small growers.

CASE STUDY: Lettuce Value Chain : Stellenbosch

Organic lettuce grown on Stellenbosch commonage:

Sold to packer at R7.15/kg

Packer sells lettuce to retailers | 28/3/2008 prices

Retailers sell lettuce at R68/kg

Grower now sells direct at Stellenbosch market at R40/kg

Kelly C, 2008. Value Chain in Agriculture Service Industry

3.2.8.9 Impact of Climate Change

It is important to determine the extent to which adapting/adjusting to the predictable climate variability reduces the adverse impacts of climate change and the economic value of these climate change damages.

Global warming has taken centre stage in the international arena over the past decade. The Global warming phenomenon presents us as human society with a unique mix of challenges that arise from the fact that global warming is a global public concern. The associated cost of preventing or slowing down has overwhelming scientific and economic uncertainties and sheds a shadow of uncertainty for decades, perhaps even centuries to come (OABS, 2013). Along with the current globalisation, politic-, technology-, legislation-, environmental etc. issues, the current and futuristic climate changes faced, in the light of global warming, could be argued as one of the most threatening challenges facing the world today (OABS, 2013). The unimpeded growth of greenhouse gas emissions across the globe is raising the earth's temperature, with potentially severe climatic and environmental effects. The consequences include melting glaciers, higher precipitation levels, more and more extreme weather events and shifting seasons as highlighted by IFPRI (2009). Human society across the world would need to alter their current "lifestyle" to adapt accordingly; these alterations include "where we live, how we produce, how we earn our daily livings" etc. (OABS, 2013). Although, climate change in itself is an extremely complex issue, other elements such as global population- and income growth further threatens food security across the world.

The agricultural sector is a critical mainstay of local livelihoods and national GDP in some countries in Africa. Agriculture contributions to GDP vary across countries, but assessments suggest an average contribution of 21% (ranging from 10% to 70%), (OABS, 2013). Even where the contribution of agriculture to GDP is low, the sector may still support the livelihoods of very large sections of the population, so that any reduction in output will have impacts on poverty and food security. This sector is particularly sensitive to climate, including periods of climate variability. In many parts of Africa, farmers and pastoralists also have to contend with other extreme natural resource challenges and constraints such as poor soil fertility, pests, crop diseases and a lack of access to inputs and improved seeds. These challenges are usually aggravated by periods of prolonged droughts and floods (OABS, 2013).

The main expected features of climate change is the raise in temperature, variability in precipitation, changes in precipitation patterns, changes in the growing season, changes in rainfall pattern, etc. Therefore, the aforementioned variables will definitely impact on the availability of water, for both rain-fed and irrigated agricultural production. Water availability is the most important limiting factor for crop production in the Beaufort West area. Furthermore, animal production will also be adversely affected in the light of dryer periods throughout the year. Given the extent of production in this area it could have implications in terms of food security.

Implications for Beaufort West Municipality

The following implications were derived from the Beaufort West Agricultural Sector Overview report prepared by OABS Development (2013):

- Increased summer temperatures results in crop damage.
- A loss of biodiversity and resultant loss of ecosystem services (a 30% loss of species is projected in a worst case scenario);
- Increased fire (due to increased temperature, likely spread of alien vegetation and loss of biodiversity) and flood (rainfall events is likely to be fewer but heavier) risks, impacting on crops, livestock, and settlements.
- Regulating water demand especially for agricultural purposes.
- Protecting ecological water reserves.
- Monitoring biodiversity closely and eradicating alien vegetation.
- Evaluating livelihoods based on threatened resources.

3.2.9 Building Materials and Mining

Figure 3.2.9.1 shows the location of mineral deposits throughout the municipality. There are currently no mining activities within the municipality.

The minerals deposits found within the municipality include (DRDLR, 2007):

- Molybdenum
- Uranium
- Uranium Molybdenum

The majority of mineral deposits occur in the central western parts of the municipality.

The South African economy is highly dependent on electricity for industrial, commercial and domestic energy needs (Econometrix, 2012). Future economic growth is thus closely related to the availability of sustainable sources of energy. In this regard the Department of Energy intends to shift the balance of the primary energy supply inputs to include 48% from coal, 14% from nuclear, 16% from renewable energy and 9% from open cycle gas turbines by 2030.

Shale gas reserves have been identified in the Karoo and could hold a transformational opportunity for providing energy to support the continual growth of the South African economy. In order to determine the viability of the resources a proper assessment is required. Desktop estimates predict that the shale gas resources of the Southern Karoo area could be a reserve of 450 trillion cubic foot (TCF), believed to be the fifth largest reserve in the world (Econometrix, 2012).

To determine the viability of extracting the potential gas resources the Department of Energy has issued Technical Co-operations permits to a number of prospecting corporations, Falcon Oil and Gas Ltd., Shell, Sunset Energy, Sasol/Chesapeake/Statoil joint venture and Anglo Coal, refer to Figure 3.2.9.2 for details on the areas of the permits.

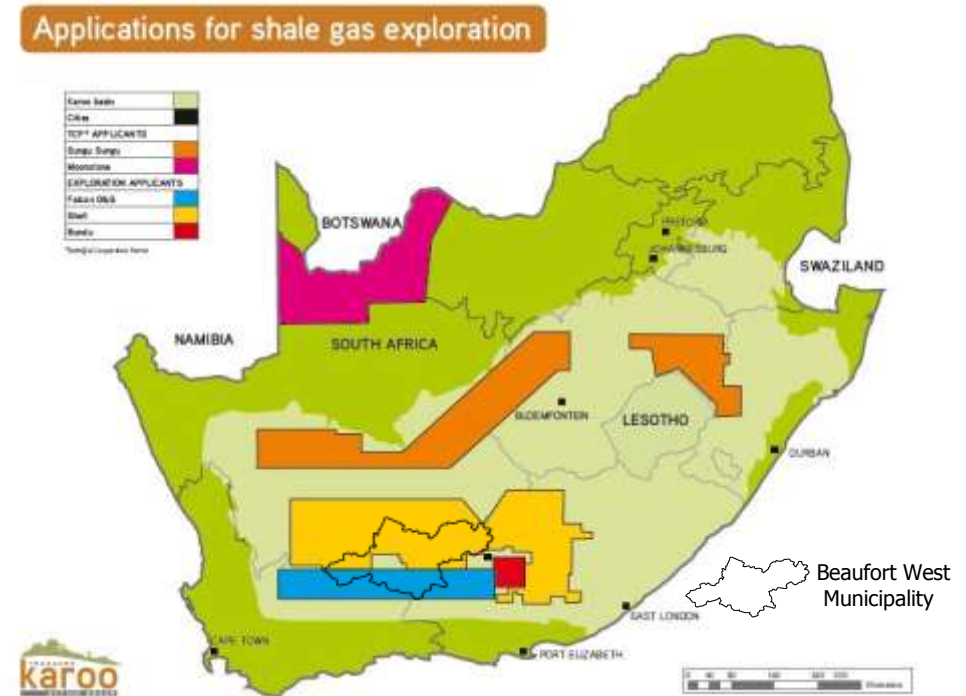


Figure 3.2.9.2 Applications for shale gas exploration (source: Econometrix, 2012)

Econometrix were commissioned by Shell to conduct an economic study on the benefits for South Africa of extracting the shale gas resources of the Karoo. The study considered two resource assumptions, a 20 TCF (Scenario A) and a 50 TCF (Scenario B) resource, refer to Table 3.2.9.

The study concluded that the economic benefits of exploiting the shale gas resources could have significant benefits for South Africa. Not only will it provide a secure source of energy, it will also produce a significant amount of employment in upstream and downstream production, estimated to be 854757 jobs. The findings of the report are however controversial given that the study was completed for Shell, one of the prospecting corporations.

Scenario Label	A	B
Upstream Production		
Resource Assumption TCF	20	50
Production Years	25	25
Project Value added Rm	759512	2142212
Project Employment - Man years	1377495	3885241
Maximum Employment	67278	189758
Downstream Production		
Project Value added Rm	1246535	2872904
Project Employment - Man years	5951114	13715606
Maximum Employment	288539	664999
Combined Upstream and Downstream		
Project Value Added Rm	2006046	5015116
Project Employment - Man Years	7328608	17600846
Maximum Employment	355817	854757

Table 3.2.9 Test scenario summary of macro economic model output (source: Econometrix, 2012)



Figure 3.2.9.3 Fracking in Pinedale, Wyoming (www.empowernetwork.com)



Figure 3.2.9.4 Fracking near Aztec Ruins and Mesa Verde, New Mexico (Google Earth, 2009)

Uranium Mining

Tasman Pacific Minerals Ltd. Holds prospecting rights to two areas in the Beaufort West Municipality, Areas 1 and 2 as depicted on Figure 3.2.9.1. Drilling has occurred in these locations to determine the viability of mining the molybdenum and high-grade uranium. The findings thus far have been very positive and could lead to the extraction of these minerals through open pit mining, in the near future. Should mining commence at the two sites the intention would be to locate a central processing facility near Area 1, south of Beaufort West.

Implications for Beaufort West Municipality

- The municipality should develop adequate measures for protecting the natural environment against any negative impacts as a result of shale gas extraction.
- The municipality should ensure that the maximum economic benefits are derived from the potential shale gas resources.
- The viability of extracting the mineral resources located within the boundaries of the municipality should be investigated as this could have valuable economic benefits, especially the two potential mining sites south-east and north-west of Beaufort West town.

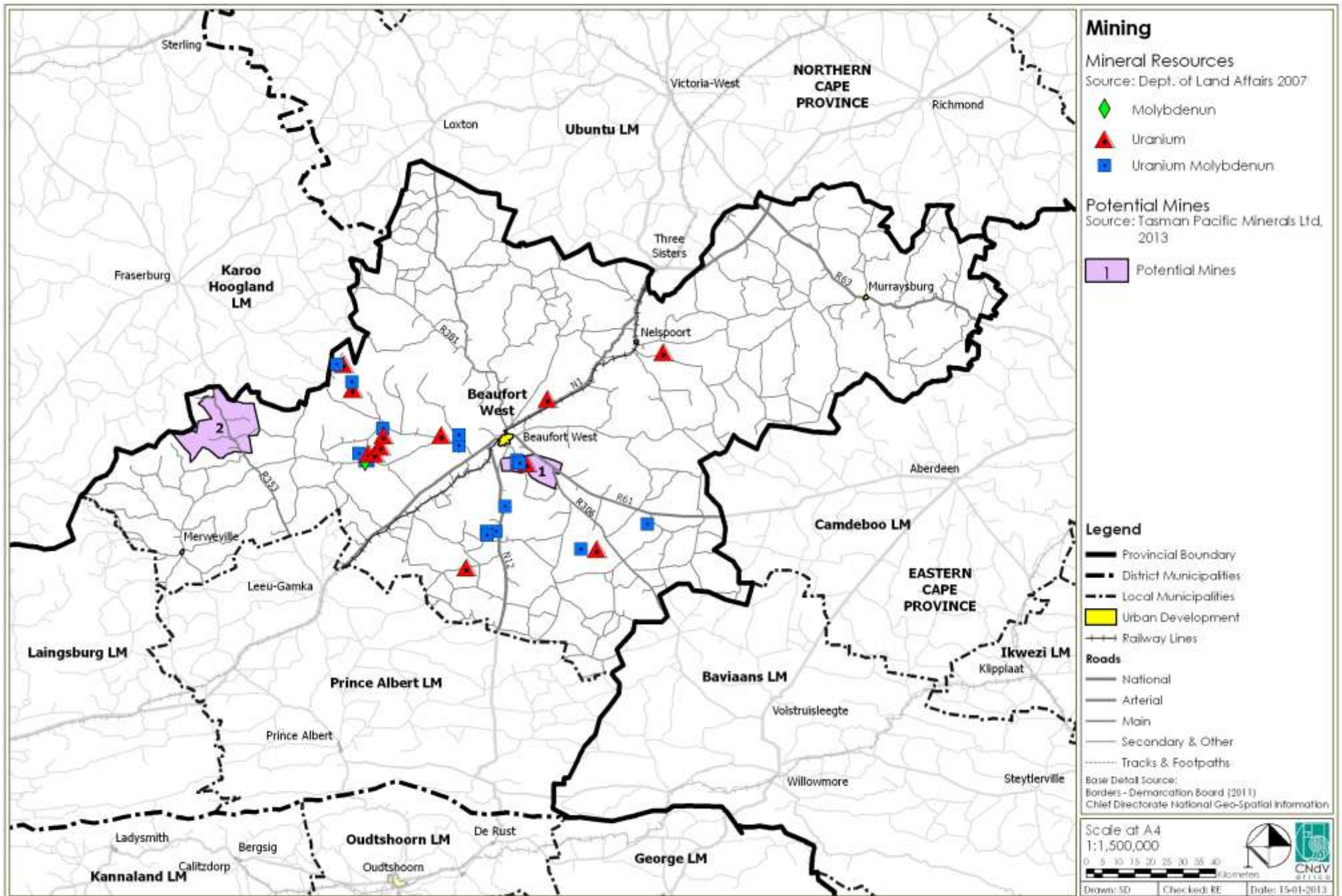


Figure 3.2.9.1 Mining

