

## 2 A GEOGRAPHICAL OVERVIEW OF EKURHULENI

### 2.1 LOCATION AND AREA

The Ekurhuleni Metropolitan Municipality (EMM) is one of six metropolitan municipalities in South Africa (SA) and is located in the eastern region of the Gauteng Province (Figure 2.1). It is bordered by the metropolitan areas of the City of Johannesburg in the west, and the City of Tshwane in the north-west. The Kungwini Municipality (Metsweding District Municipality), and the Delmas Municipality within the Mpumalanga Province (Nkangala District Municipality), lie to the north and east respectively. Midvaal and Lesedi are the southern bordering municipalities (Sedibeng District Municipality).

EMM stretches for approximately 45 kilometers from west to east, and for 55 kilometers from north to south, covering an area of approximately 1923 square kilometres. This large area is divided, for administrative efficacy, into the Northern, Southern and Eastern Service Delivery Regions (SDRs) (Figure 2.1).

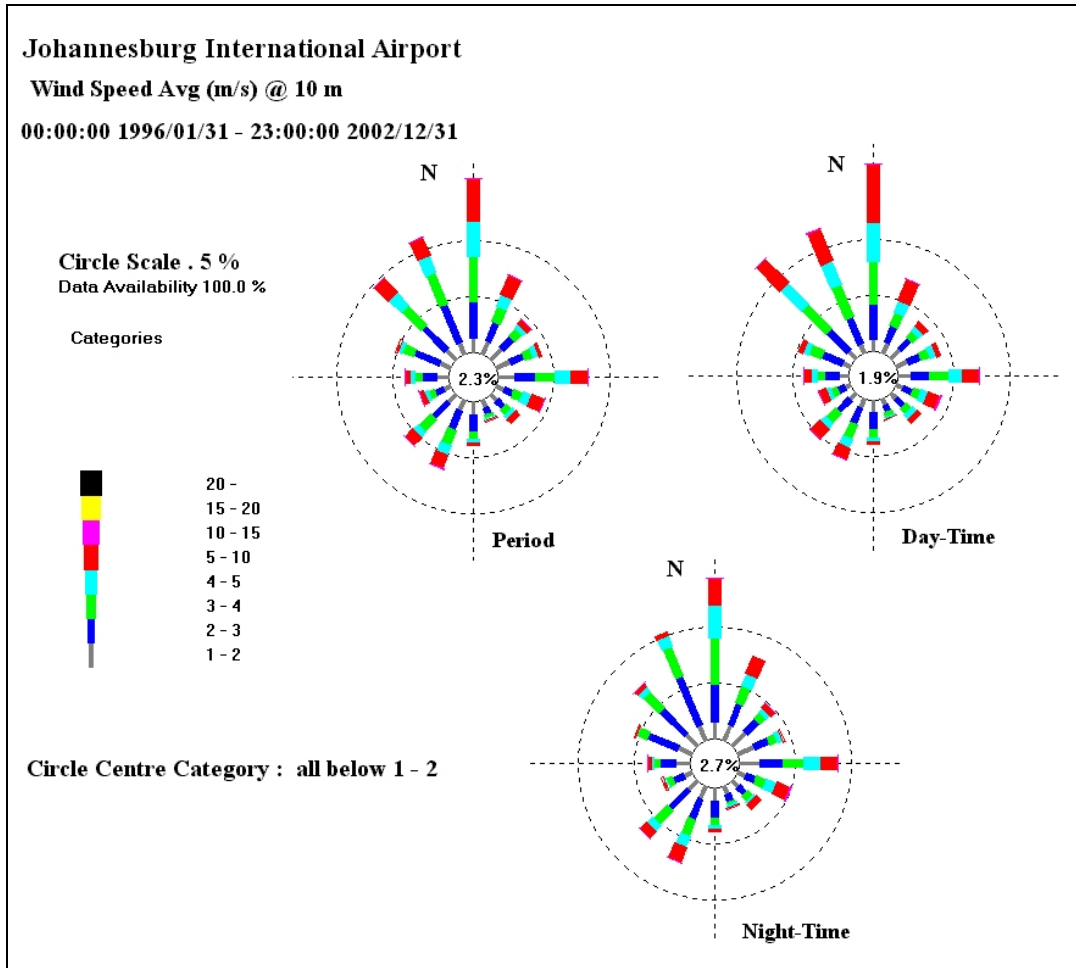
### 2.2 CLIMATE

The summer (October to March) climate is mild and neither too hot nor humid. EMM is located in the summer rainfall region of SA and therefore receives most of its rainfall during this period. While gentle soaking rains do occur, the rainfall in the area is often characterised by intense thunderstorms, which occur mainly in the late afternoon. These thunderstorms, although brief, are often ferocious, and are accompanied by thunder, lightning and occasional hail, and are generally followed by clear skies.

The autumn (April to May) and spring seasons (September) are not fixed and are sometimes short depending on the duration of summer and winter. The winter months (June to August) are characterised by intermittent cold spells, especially during July and August, and occasionally during September. Although snow is not an annual occurrence, there have been years when snowfalls have occurred, mainly during the months of July, August or September.

An annual wind rose for Johannesburg International Airport (JIA) is presented in Figure 2.2 for the period January 1996 to December 2002 (Airshed Planning Professionals 2003). Although the wind rose for the JIA is not representative of the wind conditions for the entire EMM area, it does represent the general wind patterns for the region. The area is characterised by northerly and north-westerly winds during winter and spring, and north-north-easterly and north-easterly winds during summer. Although calm conditions occur for less than 2.5% of the time, gentle to light winds ( $1-5\text{m}\cdot\text{s}^{-1}$ ) prevail for more than 80% of the time, with stronger and slightly unstable winds being experienced for approximately 15% of the time.

**Figure 2.1 Locality plan of Ekurhuleni**

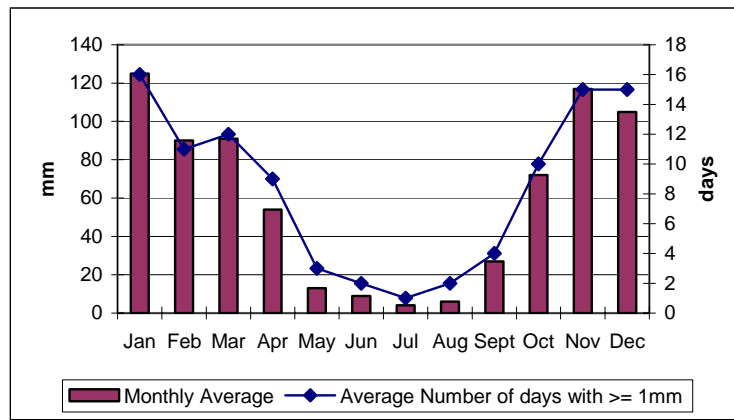


Source: Airshed Management Services 2003

**Figure 2.2 Annual wind rose for Johannesburg International Airport for the period January 1996 to December 2002**

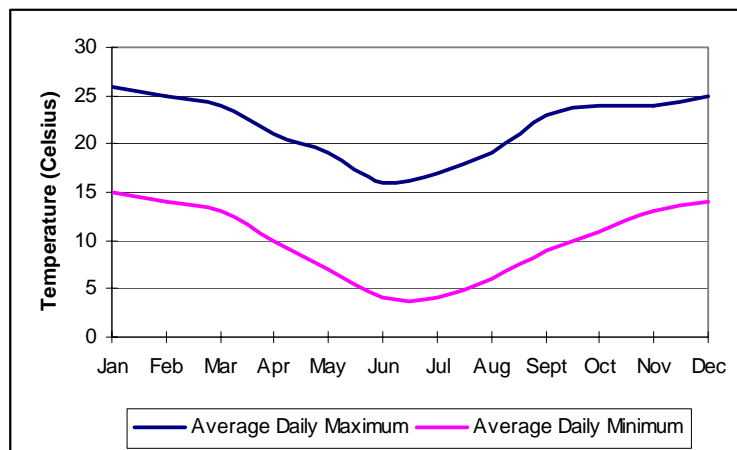
Long-term monthly rainfall and temperature statistics at JIA are presented in Figure 2.3 and Figure 2.4 respectively. The highest monthly rainfall occurs in November and January while the months of May to August experience little rainfall. December and January are the hottest times of the year.

Spatial variability in mean annual precipitation (MAP) is presented in Figure 2.5. There is not a large variation in MAP over EMM, although MAP does increase with height.



Source: South African Weather Services

**Figure 2.3 Monthly average rainfall for 1960-1991**



Source: South African Weather Services

**Figure 2.4 Average daily maximum and minimum temperatures for 1960-1991**

**2.2.1 Climatic conditions and implications for air quality**

The diffusion of pollutants into the atmosphere is dependent on climatic conditions and local atmospheric stability, which may vary on a daily and seasonal basis. During winter, the Highveld is dominated by a high-pressure system, which is characterised by subsidence that results in clear skies, light winds, and temperature inversions. These conditions are unfavourable for pollution dispersion and diffusion. During summer, moist unstable conditions dominate, resulting in conditions that are conducive to rapid pollution dispersion and air mixing. The Highveld, and more specifically the EMM area, is dominated by northerly and north-westerly winds in winter and north-north-easterly winds in summer. This is primarily due to the southerly migration of the high pressure cell, which also results in winds becoming more north-easterly and more north-westerly in spring and autumn respectively.

**Figure 2.5 Mean annual precipitation in Ekurhuleni**

### 2.2.1.1 Temperature inversions

Temperature inversions on flat terrain usually occur under clear skies, and calm and dry conditions. Low level temperature inversions (not greater than 300 m from the earth's surface) occur at night and frequently during winter. Temperature inversions result in stable air conditions below the temperature inversion and limit mixing of air between air above and below the inversion layer. This results in a build up of pollutants below the inversion boundary layer that may exceed acceptable pollution levels.

## 2.3 TOPOGRAPHY AND LAND USE

### 2.3.1 Topography

EMM is located on the higher lying central band that runs across the Gauteng Province. The topography is generally flat and ranges from 1460 to 1760 metres above sea level (Figure 2.6). Higher lying areas and ridges are present on the western side of EMM, in the area stretching from the north of Germiston to the Klipriviersberg in the south-west of Alberton. The presence of numerous mine dumps, slimes dams, quarries and open cast pits has altered the localised topography of EMM, and it is common to see a mine dump or slimes dam protruding above the natural horizon.

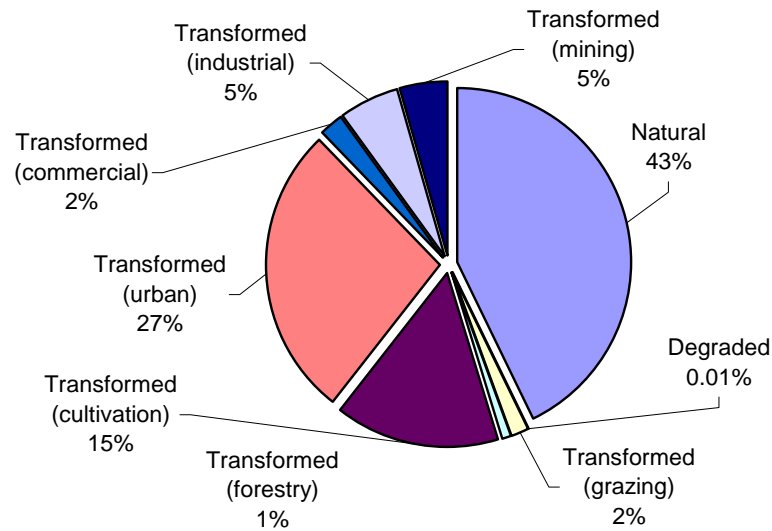
### 2.3.2 Land use and land cover

Proportional contributions of land uses and a map thereof are presented in Figure 2.7 and Figure 2.8 respectively. A map of land cover is presented in Figure 2.9. The three major land cover classes are natural untransformed areas, cultivated land and urban residential zones. The natural untransformed areas have the potential to play an important role in the maintenance of ecosystems and processes. The following are notable patterns in land use:

- There is a central, east-west orientated mining and industrial activity belt, which served as the core around which towns were established;
- A belt of residential developments surrounding the industrial activity belt; and
- Rural/agricultural areas to the northeast and in the central portion in the southern part of EMM.

The mining belt was historically the core around which the various towns and settlements were established. Four major concentrations of mines and quarries exist: Reiger Park between Germiston and Boksburg, the area east of Benoni, an area east and south of Springs, and 3 sites in the vicinity of Kwatsaduza. The first 3 areas are respectively known as the Germiston/Boksburg, the Benoni/Brakpan/Springs and the Springs/Nigel mining belts. Mining occurs in a linear form, along a belt which runs to the north of the Germiston and Boksburg Central Business Districts (CBDs), and then along a broad strip of land roughly between the Benoni CBD and Daveyton to the north, and Brakpan and Springs to the south. To the south between Springs and Nigel another major concentration of mining activity exists.

## Figure 2.6 Topography of Ekurhuleni



Source: National Land Cover 2000

**Figure 2.7 Proportional land use in Ekurhuleni in 2000**

Most of the urban activity is concentrated along the western edge and central spine of EMM. The road, engineering and social infrastructure strongly correlates to this urban form.

The largest complex of small-holdings is situated in an east-west band lying east of Kempton Park and north-west of Daveyton. The second largest complex is situated west of KwaThema, surrounding the Sallies Gold Mine and Springs Municipal Crushers. There are other smaller patches of agricultural holdings scattered throughout the metropolitan area.

The EMM has an evenly distributed, multi-nodal structure. The CBDs, however, currently experience problems of urban decay, as the cream of the retail component of the CBDs have been drawn away to the four main shopping malls in the area - Eastgate, East Rand Mall, Lakeside Mall and Alberton Mall. Commercial activities make good use of the main transport routes to provide access to such activities. Furthermore, there is an imbalance in the distribution of land use for commercial activity, which is concentrated within higher income areas (Kempton Park, Edenvale, a portion of Bedfordview, Boksburg Central, Benoni Central, Brakpan and small portions of Springs). In common with most 'black' townships in the country, there is very little formal commercial activity within the township complexes.

Industrial activities are largely located within the south-western part of the metropolitan area, in areas such as Germiston and Alrode. These areas tend to be located near mining land, and wedged between lower income areas (Katorus, southern Benoni, KwaThema, Tsakane, small portion of Springs and areas north of Etwatwa) and the higher income areas (between Alberton and Katlehong, Germiston and Spruitview/Leondale). Within Kempton Park and Edenvale, some industrial activity developed around the airport due to the agglomeration benefits and access to airfreight transport facilities. Industrial activities are also closely linked to the railway system.

Farming activities (cultivation) are grouped in the north-eastern part of EMM, where more than a third of the land is cultivated. This includes areas surrounding Bapsfontein, areas north of the Benoni Agricultural Holdings and east of the R21 highway. Smaller agricultural activities lie just south of Sunward Park, while the remaining agricultural activities are grouped on the southern border of the metropolitan area. .

A more detailed description of the land cover and land use is given in Appendix A. It should be noted that differences in land cover may be due to the scale differences between the 1995 and 2000 data sets.

**Figure 2.8 Land use in Ekurhuleni in 2000**

**Figure 2.9 Land cover in Ekurhuleni in 2000**

## 2.4 SURFACE WATER

### 2.4.1 Catchments and watercourses

The EMM area covers the convergence of the watershed between the Limpopo and the Vaal catchments. The Limpopo catchment in EMM contains part of three quaternary catchments including the Swartspruit, Jukskei and Kaalspruit (Figure 2.10), which drain in a northerly direction into the Crocodile River and Hartebeespoort Dam. There are six quaternary catchments in the Vaal catchment in the EMM which drain south towards the Vaal Dam. These include the Upper, Middle and Lower Blesbokspruit, Rietspruit, Natalspruit and Klip River catchments.

Brief descriptions of the watercourses and their primary contributions in EMM are given in Table 2.1 below. Urbanisation has altered the flow regime of all rivers and streams in the area, and as such, the current flow patterns bear little resemblance to the pre-developed flow regime.

**Table 2.1 Description of watercourses in the EMM**

River	Source and description	Primary contributions
Klip River	City of Johannesburg; flows south-easterly across the south west corner of the EMM to join the Rietspruit and Vaal rivers	Runoff from urban and industrial areas, sewage effluent and some localised agricultural inflows during rainfall events.
Rietspruit	A tributary of the Klip river, source in the upper areas just south of Benoni; flows south-westerly to join the Rietspruit	Runoff from urban and industrial areas, sewage effluent and some localised agricultural inflows during rainfall events.
Natalspruit	Upper areas of Alberton; flows south easterly to join Elsburgspruit which has its source in Germiston and Boksburg	Runoff from urban and industrial areas, sewage effluent and some localised agricultural inflows during rainfall events.
Blesbokspruit	Smallholdings north of Benoni and the north of Daveyton; flows south through Springs and Nigel outskirts to the Vaal River; System of conservation importance including RAMSAR site and Marievale Nature Reserve	Discharges of excess minewater from mining areas, particularly Grootvlei, as well as agricultural inflows and sewage effluent from the Daveyton and informal surrounds
Kaalspruit/Olifantspruit	Kempton Park/Tembisa; flows north into Midrand joining a tributary from the Clayville industrial area	Informal settlements along river banks result in high microbial contamination; municipal sewage lines; Clayville industrial area; Olifantsfontein sewage works; agricultural runoff in Olifantspruit
Rietvleirivier	Kempton Park and smallholdings north of Benoni; flows north past JIA	Upper catchment mainly from industrial; lower catchment mainly from agricultural
Grootvleirivier	Bapsfontein; flows north-westerly and joins with the Rietvlei and on towards Irene and Centurion	Agriculture

**Figure 2.10 Surface water in Ekurhuleni**

### 2.4.2 Dams and pans

There are many in-stream dams located on the watercourses and tributaries (Figure 2.10) which were mainly created for agricultural or mine water storage purposes (e.g. Angelo Pan of ERPM). Dams in the urban areas, for example in Benoni and Boksburg, as well as dams on golf courses and the dams within the watercourses where nature reserves have been established, may be considered to have a recreational and/or ecological use.

There are also a number of endoreic pans (collecting water but having no primary outflow for example Bullfrog Pan) in the EMM, principally in the flat agricultural areas in the north-east. Other pans occur within more urbanised areas, for example Homestead Lake and Rynfield Dam which were damned for mining purposes, Leeuwpans, Jan Smuts, and Rolfes Pan in Jetpark.

### 2.4.3 Wetlands

Wetlands are lands that are transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface or where the land is periodically covered by shallow water (National Water Act 36 of 1998) (NWA). This results in the land supporting vegetation that is adapted to life in saturated soil, and biological and chemical processes that take place often under anoxic conditions.



Although many of the wetland habitats in the EMM have been degraded and some lost, they represent one of the most important ecosystems in the EMM due to their substantial hydrological, biological or ecological role in the natural functioning of the catchments in the Metro. Many of the water courses and pans form part of these wetlands, most notably is the man-made Blesbokspruit wetland system, which is one of the larger wetland systems in the highveld and part of which (near to Springs) was designated a RAMSAR Site in 1996. A detailed description of the site is given in Appendix B. Other extensive areas of wetland ecosystem occur in the Klip River, Elseburgspruit and Natalspruit river systems, the Rietspruit, and the Rietvleirivier in the north. Figure 2.10 details the distribution of wetlands in the EMM.

Although the wetlands have developed naturally as a result of the presence of water in the river systems, their extent has largely been created and modified by human activities in the catchments. The extensive mining activities in the area have created preferential stream flow paths, impounded water, and contributed significant volumes of mine water to the surface systems that would naturally have been determined by rainfall seasonality.

Similarly urbanisation has contributed significant volumes of urban run-off and purified sewage effluent to the surface watercourses, which not only bring in increased water volumes, but also contribute nutrient loads, which in turn enhance aquatic plant growth and proliferation. The

contribution of the Johannesburg Southern sewage works to the Klip River system is a very significant quantitative and nutrient load, as are the 18 sewage treatment plants within the EMM.

Although mine waters and sewage effluents contribute to the development of the wetland systems in the water courses of EMM, the wetlands also provide an important role in further purifying the waste water discharges, as well as assimilating extraneous pollutant loads, particularly in the form of non-point source discharges. The wetland systems also provide valuable storm water flow and flood attenuation capacity, as well as providing important ecological and aesthetic value to the river systems. The EMM wetlands are particularly important and of high conservation value considering that many provide these services for the waters flowing into the Vaal River, which provides water to most of Gauteng.

## **2.5 GEOLOGY**

The area underlying EMM has rocks that vary from Swazian to the Mesozoic Eras (Figure 2.11). These include basement granite-gneisses, arenaceous and argillaceous sediments of the Witwatersrand and Ventersdorp Supergroups to sediments and dolomites of the Transvaal Sequence. A cover of younger Karoo Supergroup overlies the older rocks. Unconsolidated to semi-consolidated sediments are restricted to the major river courses.

For the most part, EMM is structurally stable. Block faulting occurs in the Kempton Park area, north of Germiston and Benoni. The Chuniespoort Group east of Tembisa is truncated by a thrust fault. Other, smaller faults occur near Benoni and east of KwaThema. Several, large-scale lineaments (probably dolerite dykes), with a southeast-northwest trend, cut across the municipal area. Other structures, such as joints and slip-surfaces may be important locally, but cannot be identified and analysed at this scale. Other structural concerns that may not be shown at this scale but are very important for development are the susceptibility of the Chuniespoort dolomites to the formation of sinkholes.

**Figure 2.11 The geology of Ekurhuleni**

## 2.6 VEGETATION

EMM falls within SA's Grassland Biome (Low & Rebelo 1996). The grassland biome is one of the most threatened in SA, with 60-80% irreversibly transformed, while only 2% is formally conserved (Bredenkamp 2002). The biodiversity status is shown in Table 2.2. The area includes two grassland vegetation types, according to Low & Rebelo (1996), namely Moist Cool Highveld Grassland (39, Bredenkamp & van Rooyen 1996b) and Rocky Highveld Grassland (34, Bredenkamp & van Rooyen 1996a); the former vegetation type covers approximately 55% of the area, while the latter covers 45%. The distribution of vegetation types is shown in Figure 2.12.

**Table 2.2 Biodiversity status of the grassland biome**

Taxonomic group	Number of species (Grassland)	Number of endemic species (Grassland)	% endemism (Grassland)
Mammals	89	18	44
Birds	349	31	58
Reptiles	84	17	20
Amphibians	36	18	29
Invertebrates	unkown	unkown	unkown
Plants	>3 370	unknown	unknown

Source: Bredenkamp 2002

The Rocky Highveld Grassland is a transitional vegetation type between typical grasslands of the high inland plateau and the bushveld of the lower inland plateau. It occurs at altitudes of between 1500–1600 m. The habitat in which this vegetation type occurs is rocky mountains, hills, ridges and plains of quartzite, conglomerate, shale, dolomite and sometimes andesitic lava. The vegetation has an abundance of grass species and dicotyledenous forbs, while a woody vegetation component occurs as sheltered islands of temperate mountain bushveld within the grassland. Common Typical woody species include *Acacia caffra*, various *Rhus* species, *Ehretia rigida*, *Maytenus heterophylla*, *Euclea crispa*, *Zanthoxylum capense*, *Dombeya rotundifolia*, *Protea caffra*, *Celtis Africana*, *Ziziphus mucronata*, *Tapiphyllum parvifolium*, *Vangueria infausta*, *Canthium gilfillanii*, *Englerophytum magalimontanum*, *Combretum molle*, *Anclyobotrys capensis*, *Olea europea* subsp. *Africana* and *Grewia occidentalis* (Bredenkamp & van Rooyen 1996a). According to Acocks (1953) this is a fire maintained grassland, which would develop into savanna if fire were excluded. The distribution of woody elements is most strongly influenced by frost during winter. Grassveld vegetation is restricted to exposed sites in the irregular, high altitude landscape, especially on the crests of rocky hills and ridges (Bredenkamp & van Rooyen 1996a).

The Rocky Highveld Grassland is highly threatened by urbanisation, industrialisation and mining, and to a lesser degree agriculture (Bredenkamp & van Rooyen 1996a). Approximately 65% is transformed and only 1.38% conserved.

The Moist Cool Highveld Grassland is a widespread vegetation type in Gauteng and the Free State, occurring at altitudes of between 1 400 m to 1 600 m. In pristine conditions Redgrass (*Themeda triandra*) dominates entirely, with only a few other species occurring, particularly dicotyledenous forbes. When overgrazed other shrubs and grasses invade.

Grazing is an important process for this vegetation type, but when overgrazed it converts to Karoo type (Bredenkamp & van Rooyen 1996b).

The conservation status of this vegetation type is very poor, with approximately 72% transformed and 0.29% conserved. Cultivation has led to the ploughing up of most of this vegetation type. The remnant patches of natural vegetation are intensively grazed and are consequently often degraded.

### **Natural Habitats**

Much of the natural grassland habitat in EMM has been replaced by urbanisation and industrial development (35%), mining activities (4.5%), agriculture (15.21%) and forestry plantations (0.9%); grazing lands amount to a further 1.6%. The invasion of woody alien species has further diminished the areas of natural habitat remaining. The extent of transformed land in the EMM is thus 57% of the total surface area. The remaining natural environment comprises terrestrial and aquatic habitats. The aquatic environment comprises water bodies, covering 1.5% of the EMM surface area, and wetlands, covering 5% of the EMM surface area. The terrestrial environment comprises ridges (0.94%) and unimproved grassland (28.7%).

### **Open spaces**

Since 57% of the EMM's surface area comprises anthropogenic activities, open spaces, such as those along water courses and parks within residential areas, must be considered to contribute significantly to potential habitat and conservation resources. Also, open spaces in the form of "servitudes" which link open spaces to natural watercourses, play an important role in stormwater management.



**Figure 2.12 Vegetation types, natural habitats and untransformed grassland**

## 2.7 SOCIO-ECONOMIC CONTEXT

### 2.7.1 Local government

The EMM is one of three metropolitan municipalities in the Gauteng Province. In December 2000 nine disestablished local authorities were consolidated. These were Alberton, Benoni, Boksburg, Kempton Park, Tembisa, Germiston, Springs, Nigel, Brakpan, Lethabong, Khyalami and the Eastern Gauteng Services Municipality (EMM 2003).

The consolidation into one large metropolitan municipality has led to restructuring within the EMM. One of the aims of the EMM is to ensure that its top management reflects the demographics of the region and that more leadership and real delivery on the ground would be provided. The restructuring is expected to reduce the operating budget and increase the capital budget of the EMM. The EMM is also striving to develop partnerships with national and provincial government, businesses and communities to ensure good governance and shared responsibility (Butcher 2003).

The three SDRs comprise the following areas (Figure 2.1):

- **Southern SDR:** Germiston (as regional centre), Alberton, areas of Boksburg and sections of Freeway Park, amongst others.
- **Eastern SDR:** Springs (as regional centre) Nigel, KwaThema, Tsakane, Duduza, part of Benoni, Brakpan and Boksburg, and the Etwatwa-Daveyton area.
- **Northern SDR:** Kempton Park (as regional centre), Tembisa, part of Benoni, Edenvale and part of Germiston, including Bedfordview and Primrose.

### 2.7.2 Socio-economic background

According to the 1996 Census, the population of EMM was just over 2 million people. Based on 2001 census data, this figure has grown by approximately 4 % per annum (an increment of 90 623 people per year). The population is estimated at 2,4 million, which is 28 % of the total population of the Gauteng Province. Three-quarters of the EMM population is black. Population densities are high, well in excess of 1000 people/km<sup>2</sup> in some areas, most notably in the settlements (townships) of historically disadvantaged communities. These settlements are situated on the outskirts of the urban areas and accommodate approximately 65 % of the total population of the EMM (EMM 2003).

21.89 % of the population still reside in informal and inadequate housing. Although the majority of the households in the EMM have access to water, sanitation and electricity, much of the bulk infrastructure network is in need of upgrading and expansion to accommodate the rapidly growing population (EMM 2003).

According to the 2001 census figures, approximately three-quarters of the people in EMM fall within the potentially economically active age group (between 15 and 64 years). The 2001 census data reflects that the rate of unemployment amongst this group is approximately 40 %. The Ekurhuleni Urban Economic Development Review (EMM 2002) indicates that poverty levels in the

EMM are racially unevenly distributed, with poverty levels amongst the black population ranging from 40 to 46 %, against approximately 6 % of whites. Despite the unequal distribution of wealth within the EMM, poverty levels compare favourably with the figures for SA as a whole.

Health care services are provided by the numerous hospitals and clinics distributed throughout the EMM. However, not all facilities provide a full range of services and some facilities in densely populated areas experience severe capacity problems. Other community services and facilities, including public safety and security, sports, recreation as well as arts and culture are generally concentrated in and around the CBDs of the EMM. The EMM IDP states that initiatives are in place to provide adequate facilities and services in marginalised areas (for example, the establishment of Multi-Purpose Service Delivery Centres).

A century ago the area the EMM was the world's largest producer of gold (EMM 2003). Although mining now contributes only about 2 % to the economy of the EMM, the growth of a substantial manufacturing and industrial support base has resulted in the EMM contributing some 23 % to the Gross Geographic Product (GGP) of the Gauteng Province. Approximately 40 % of all industrial activity in Gauteng derives from the EMM area, which is the largest industrial area in the country. It is therefore not surprising that the Gauteng Spatial Development Framework (GSDF) has identified the EMM as a core focus area for future economic development in the Gauteng Province.

Manufacturing, together with wholesale and retail trade, collectively contributed approximately half of the GGP for the EMM in 2001. The services and finance sectors also make significant contributions to the local economy, with finance showing the strongest growth of all sectors in recent years. In terms of employment opportunities, manufacturing and mining are the largest and smallest contributors respectively (EMM 2003).

The informal sector in EMM is thriving with the majority of informal trade occurring in the townships. Informal sector activity is also evident in the CBDs and around industrial hubs (EMM 2002).

Adequate transport linkages make EMM highly accessible. Towns within the metropolitan area are linked by highways as well as national and provincial roadways of high standards. The Germiston Railway Centre is a major east-west and north-south rail interchange, while the sub-continent's import and export requirements are serviced by JIA, as well as the host of regional and municipal airports within the EMM area.

## 2.8 REFERENCES

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