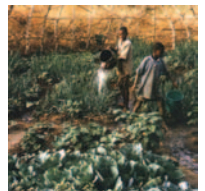




Department of Agriculture, Conservation and Environment



# Gauteng State of Environment Report 2004



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## Foreword by the MEC



This is Gauteng's second State of Environment Report (SoER) and builds on the substantial groundwork undertaken in compiling the first report, completed in

1998. Although the report does not currently fulfil any legislative reporting requirement, it does set the scene for environmental reporting which may be a legal requirement in terms of the imminent changes in reporting legislation. Whilst our province is regarded as the economic hub of the country, this growth in the economy coupled with an ever-increasing growth in the population, has meant that our ability to protect environmental quality and ensure a healthy and safe environment for our citizens is challenged. The purpose of this report is to provide pertinent and reliable information on our environment so that we can attempt to meet the challenges of this province. The report thus contains valuable and credible information on a wide variety of issues of concern to all Gauteng citizens, including policy makers, industry and business, non-governmental organisations, educational institutions and the general public. The information contained in the report is an attempt to indicate the condition of our environment and as far as possible measure progress towards the sustainable utilisation of natural resources and sustainable human and economic development. Six broad themes namely, Social Environment, Land, Water Resources, Air Quality, Biodiversity and Waste Management, have been reported on in this edition of the SoER. The report also makes a series of informed recommendations for the future, which will further the objectives of sustainability which will in turn ensure that the future generations of Gauteng have a better quality of life.

I would like to thank the many Gauteng stakeholders who have assisted the Department of Agriculture, Conservation and Environment in compiling this detailed analysis of our unique environment. Finally, I hope that this report provides you with useful information about environmental issues of importance in Gauteng as well as generating an awareness and debate on the issues.

A stylized, handwritten signature in black ink, appearing to read 'K. Mosunkutu'.

**Khabisi Mosunkutu**

**MEC for Agriculture, Conservation and Environment**





## LIST OF ACRONYMS

ARC	Agricultural Research Council	NWMS	National Waste Management Strategy
CoJ	City of Johannesburg	PWV	Pretoria, Witwatersrand, Vereeniging
CSIR	Council for Scientific and Industrial Research	RHP	River Health Programme
CTMM	City of Tshwane Metropolitan Municipality	SA	South Africa
DBSA	Development Bank of Southern Africa	SADC	Southern African Development Community
DEAT	Department of Environmental Affairs and Tourism	SD	Sustainable Development
DME	Department of Minerals and Energy	SDF	Spatial Development Framework
DLA	Department of Land Affairs	SDI	Spatial Development Initiative
DOH	Department of Health	SEA	Strategic Environmental Assessment
DPSIR	Drivers-Pressures-State-Impact Responses	SoE	State of Environment
DWAF	Department of Water Affairs and Forestry	SoER	State of Environment Report
EC	Electrical conductivity	StatsSA	Statistics South Africa
EMF	Environmental Management Framework	TDS	Total dissolved solids
EMM	Ekurhuleni Metropolitan Municipality	UNCED	United Nations Conference on Environment and Development
EIA	Environmental Impact Assessment	UNEP	United Nations Environment Programme
GAPA	Gauteng Agricultural Potential Atlas	UV	Ultra violet
GCIS	Government Communication Information System	WSSD	World Summit on Sustainable Development
GDACE	Gauteng Department of Agriculture, Conservation and Environment	WRI	World Resources Institute
GDACEL	Gauteng Department of Agriculture, Conservation, Environment and Land Affairs		
GDP	Gross Domestic Product		
GEAR	Growth Employment and Redistribution strategy		
GEDA	Gauteng Economic Development Agency		
GGP	Gross Geographic Product		
GIS	Geographic Information System		
GNRA	Gauteng Natural Resources Audit		
GOSP	Gauteng Open Space Project		
GPG	Gauteng Provincial Government		
HCRW	Health Care Risk Waste		
HSRC	Human Sciences Research Council		
IDP	Integrated Development Plan		
ISCW	Institute for Soil, Climate and Water		
IUCN	International Union for the Conservation of Nature		
IWMP	Integrated Waste Management Plan		
JIA	Johannesburg International Airport		
NEMA	National Environmental Management Act 107 of 1998		
NEPAD	New Partnership for Africa's Development		
NER	National Electricity Regulator		
NGO	Non-government Organisation		
NLC	National Land Cover		



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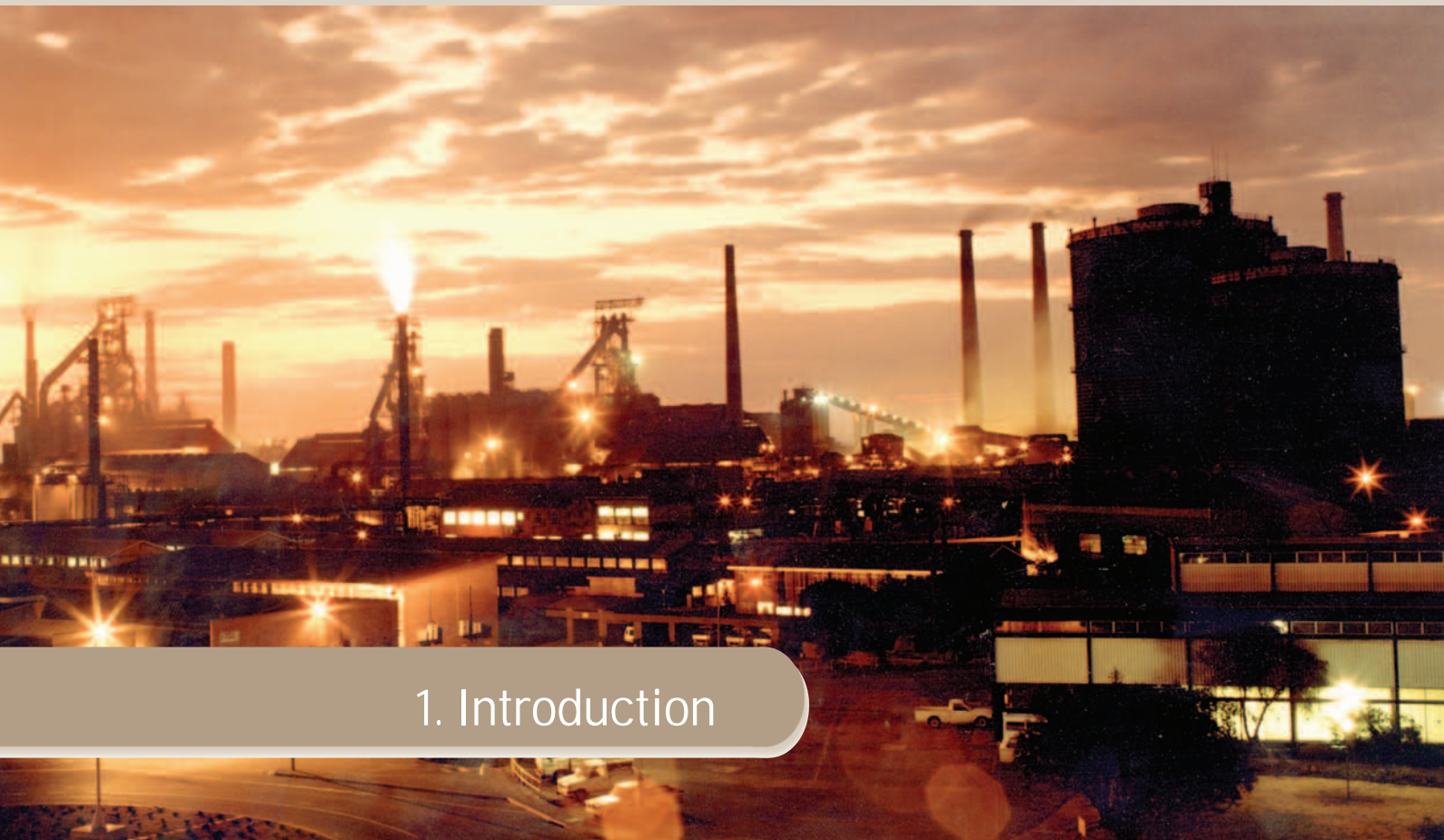
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# 1. Introduction

This State of Environment Report (SoER) has been compiled in order to assist the Gauteng Provincial Government (GPG), specifically the Gauteng Department of Agriculture, Conservation and Environment (GDACE), and other decision-makers to make informed decisions about our environment. It has also been compiled to present information to the public about the condition and quality of the environment that we live in, and to inform them about what is being done to improve the environment. The GPG will use the information presented in this report to assist in achieving sustainable development.

- The **environment** is the surroundings within which humans exist and that are made up of
- (i) the land, water and atmosphere of the earth;
  - (ii) micro-organisms, plant and animal life;
  - (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and
  - (iv) the physical, chemical, aesthetic and cultural properties and conditions that influence human health and well-being.

*National Environmental Management Act No.107 of 1998*

## Background to State of Environment Reporting

### Sustainable development

There is a growing worldwide focus on the prevention of environmental deterioration and emphasis on the intricate linkages between the **natural** environment, **economic** stability and **social** well-being. The concept of sustainable development (SD) integrates these inter-dependent components.





**Sustainable Development** is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" *World Commission on Environment and Development, 1987*

"In order to achieve sustainable development, environmental protection needs to be part of the development process and cannot be considered in isolation from it." *United Nations, 1992*

Although social and economic development and natural resource protection programmes have largely been undertaken in isolation in the past, it is hoped that the successful implementation of the concept of SD in planning and development will remedy this situation in our country. SD will strive for a healthy prosperous society, a stable growing economy and healthy ecosystems and ecological processes.

## State of Environment Reporting

A SoER is similar to a report card (DEAT, 2001) on the condition or quality of our environment, and it gives us information both on how we affect the environment and how the environment affects us. SoERs are important for comparing the environmental conditions in different geographical regions including cities, provinces and countries. Agenda 21, the world action plan detailing how to achieve sustainable development, calls for the improvement in quality and availability of environmental information, particularly in the developing world. It calls for the monitoring and reporting of performance in the economic, social and natural environments through the use of indicators. State of Environment (SoE) reporting has been developed as a tool to achieve this.

### Our reporting commitments

Although SoE reporting in South Africa (SA) is not yet a legal requirement, there is a substantive political and legal framework setting the context for SoE reporting. While the New Partnership for Africa's Development 2001 (NEPAD) confirms

SA's commitment to SD, there are many pieces of legislation, policy and international conventions, treaties and agreements<sup>1</sup> that require the supply of information to the public.

Other than improving the access to information, the national government has several performance-related reporting commitments that include notably the Annual Performance Report with regard to Agenda 21, and several Multi-lateral Environmental Agreements<sup>2</sup>. The Department of Environmental Affairs and Tourism (DEAT) will use this information for these reporting requirements, and the information will also feed into the National SoE reporting initiative.

The GPG and GDACE also have several reporting commitments that include (amongst others):

- Provincial Monitoring and Evaluation Forum;
- Reports on the World Heritage Site (UNESCO);
- Gauteng Environmental Implementation Plan; and
- Reporting for the Commission on Sustainable development.

It is the intention of GDACE to use the information presented in this and future SoERs to feed into these reporting requirements.

#### Footnotes:

<sup>1</sup> For example: African Charter on Human and People's Rights 1981, Universal Declaration of Human Rights, Aarhus Convention 1998 (of which SA is not currently a signatory), Agenda 21, the Constitution of the Republic of SA No. 108 of 1996, National Environmental Management Act No 107 of 1998, The Promotion of Access to Information Act No 2 of 2000, Municipal Systems Act No. 32 of 2000.

<sup>2</sup> UNESCO World Heritage Convention, RAMSAR Convention, the United Nations Convention to Combat Desertification, United Nations Framework Convention on Climate Change, the United Nations Convention on Biological Diversity

## What has been done in SA?

The DEAT has expanded the SoE reporting initiative in South Africa with several reports now having been completed for the national, provincial and local spheres of government. Most of these are available on the Internet. A State of Human Settlements report has also been compiled. Table 1.1 details the SoERs available on the internet.

**Table 1.1 State of Environment Reports available on the internet**

<b>National and Other Reports</b>	
National SoER	<a href="http://www.environment.gov.za/soer/nsoer/index.htm">http://www.environment.gov.za/soer/nsoer/index.htm</a>
State of the Rivers Reports: uMngeni; Letaba and Luvuvhu; Crocodile, Sabie-Sand and Olifants; Southern Gauteng; Modder; Hartenbos and Klein Brak	<a href="http://www.csir.co.za/rhp/state_of_rivers.html">http://www.csir.co.za/rhp/state_of_rivers.html</a>
State of the Estuaries	<a href="http://www.environment.gov.za/soer/soer/sector.htm#estuaries">http://www.environment.gov.za/soer/soer/sector.htm#estuaries</a>
Catchments	<a href="http://www.environment.gov.za/soer/estuary/index.html">http://www.environment.gov.za/soer/estuary/index.html</a>
<b>Provincial Reports</b>	
Gauteng preliminary 1998	Not available
North-West	<a href="http://www.environment.gov.za/soer/reports/northwest/main.html">http://www.environment.gov.za/soer/reports/northwest/main.html</a>
Mpumalanga	<a href="http://eia.csir.co.za/mpumalanga/">http://eia.csir.co.za/mpumalanga/</a>
Limpopo	<a href="http://www.environment.gov.za/soer/reports/limpopo.html">http://www.environment.gov.za/soer/reports/limpopo.html</a>
<b>Metropolitan Reports</b>	
Cape Town	<a href="http://www.capetown.gov.za/soe/">http://www.capetown.gov.za/soe/</a>
Durban	<a href="http://www.ceroi.net/reports/durban/">http://www.ceroi.net/reports/durban/</a>
Ekurhuleni	<a href="http://www.ekurhuleni.com/">http://www.ekurhuleni.com/</a>
Johannesburg	<a href="http://www.ceroi.net/reports/johannesburg/csoe/default.htm">http://www.ceroi.net/reports/johannesburg/csoe/default.htm</a>
Pretoria	<a href="http://www.iclei.org/cities21/pretoria.pdf">http://www.iclei.org/cities21/pretoria.pdf</a>
<b>Local Reports</b>	
Mangaung	Not yet available
Midrand	<a href="http://www.environment.gov.za/soer/reports/midrand_back.html">http://www.environment.gov.za/soer/reports/midrand_back.html</a>
Mogale	<a href="http://www.environment.gov.za/soer/reports/mogale.html">http://www.environment.gov.za/soer/reports/mogale.html</a>

## How do we organise and present our information?

The Drivers-Pressures-State-Impacts-Responses (DPSIR) framework is a framework that is used to organise information about the environment, and we have used it in this report. It is a common reporting framework for SoE reporting in South Africa. Table 1.2 defines the components of the framework.



<b>DRIVING FORCES</b>	Are the human activities that when combined with environmental conditions, cause environmental change	What causes environmental change?
<b>PRESSURES</b>	Are exerted on the environment as a result of human activities (driving forces)	
<b>STATE</b>	Is the condition or quality of the environment	What is the condition of the environment?
<b>IMPACTS</b>	Are the consequences of the pressures (i.e. the environmental responses)	How does this affect the environment?
<b>RESPONSES</b>	Are the societal actions taken to address the changes in the state of the environment	What are we doing and what should we do about it?

**Table 1.2**  
Definitions of the components of the DPSIR framework

## What are indicators?

Indicators are measurements that give us information about the changes in the condition of something over time.

Indicators help us define the nature and size of environmental problems, set goals for their solution, and track progress towards those goals. They are useful because they help to express a large quantity of data or complex information in a simple way (DEAT, 2001). In SoE reporting, indicators are used to describe each component of the DPSIR framework.

## Indicator selection in Gauteng

Indicators for provincial level SoE reporting in Gauteng were selected over a 6-month period. GDACE in their Draft Indicator Strategy (GDACEL, 2003) designed for the Department's reporting requirements, identified 92 indicators. These were grouped into the following themes: land use change, soil productivity, water quality, air quality, economics, waste management, health and biodiversity. This list was then modified for the purposes of SoE reporting by the project team through consultation with various stakeholders. These included various departments within all spheres of government, non-governmental organisations (NGOs), academics and specialists in the various themes, the private sector and other stakeholders.

Indicators were grouped into the following themes: Social Environment, Land, Water Resources, Air Quality, Biodiversity, and Waste Management. The criteria used for indicator selection were modified from DEAT (2002) criteria for national indicator selection, and included the following:

- The indicator must be relevant to provincial and national policy and management concerns, and to GDACE targets;
- Data considerations are important:
  - The indicator must be based on good quality data that is scientifically valid and current;
  - Data must be easily accessible and available particularly in the long term;
- The indicator must be a high order, representative one which provides simple information about a larger, more complex issue.

Some examples of indicators are:

- Daily temperature – it tells us about weather conditions;
- Colour in fruit – it tells us about how ripe the fruit is;
- The Consumer Price Index (CPIX) – gives an indication of how affordable market goods and services are; and
- The Dow Jones Sustainability Index (DJSI) – gives an indication of the financial performance of all companies listed on this index, for comparison with other companies.

The selected indicators, including a core set, and recommended future indicators (where no data is currently available), are detailed in Table 1.3.



Table 1.3 Indicators for Gauteng SoE reporting

	ISSUE	CORE INDICATORS	FUTURE INDICATORS
SOCIAL ENVIRONMENT	Population change	S1. Change in population density S2. Trends in population growth rate S3. Percentage change in migration	
	Health	S4. Infant mortality S5. Percentage change in HIV prevalence S6. Trend in diarrhoea incidence S7. Trend in respiratory disease incidence	
	Economics		S18. Number of SMMEs registered in Gauteng
	Poverty	S8. Percentage change in the Gini-co-efficient S9. Percentage change in the population living below the poverty line	
	Employment	S10. Percentage change in employment per sector S11. Percentage change in unemployment	
	Education	S12. Percentage change in adult literacy rate	S19. Public awareness of environmental issues
	Security of tenure	S13. Percentage change in housing backlog	
	Basic services	S14. Proportion of households electrified S15. Proportion of households with access to piped water S16. Proportion of households with access to adequate sanitation	
	General well-being	S17. Change in the human development index (HDI)	
	Cultural heritage		S20. Change in the access to and maintenance of cultural heritage sites
LAND	Land use	L1. Percentage change in land use per land use category L2. Change in percentage area of urban vs rural L3. Change in residential housing density	L7. Change in open space in urban areas
	Land condition	L4. Percentage of high potential agricultural land lost per land use type L5. Change in area of actual erosion L6. Vegetation condition (biomass)	L8. Areas of peat sources  L9. Soil contamination by heavy metals, organic and inorganic pollutants

	ISSUE	CORE INDICATORS	FUTURE INDICATORS
WATER RESOURCES	Quantity	W1. Discharge to surface water per sector	W10. Level of toxins in water
	Quality	W2. Surface and groundwater salinity, nutrients and microbiology W3. Eutrophication of major dams and reservoirs W4. Sulphates:chloride ratio	
	Ecology of riparian areas	W5. Aquatic Macro-invertebrates W6. Fish Assemblage Integrity Index (FAII) W8. Riparian Vegetation Index W9. Habitat Index	
	Service Provision	S15. Access to water S16. Access to sanitation	
AIR QUALITY	Climate change	AQ1. Trends in Ultra-Violet B levels AQ2. Daily variation in total column ozone AQ3. Percentage change in annual greenhouse gas emissions from activities within Gauteng AQ4. Long-term temperature trends	AQ9. Percentage change in the number of daily exceedances of the 24-hr average O <sub>3</sub> standard
	Ambient air pollution	AQ5. Trends in Levels of SO <sub>2</sub> , NO <sub>2</sub> , PM10 AQ6. Percentage change in the number of daily exceedances of the 24-hr average SO <sub>2</sub> , NO <sub>2</sub> , PM10 SA standards AQ7. Total particulates AQ8. Dust fallout	
BIODIVERSITY	Species diversity	BD1. Change in number of species, threatened species, endemic species per taxonomic group	BD7. Population trends of selected threatened species BD8. Invasive alien plant density in Gauteng
	Habitat change	BD2. Change in area of transformed and untransformed ridges BD3. Change in wetland area, percentage transformed and percentage threatened wetlands BD4. Percentage of each vegetation type transformed and conserved BD5. Percentage irreplaceable land for Gauteng and per municipal area BD6. Percentage of irreplaceable land under formal conservation status	
WASTE MANAGEMENT	Waste generation	WM1. Amount of medical waste generated WM2. Amount of mining waste generated	WM9.Amount of general waste generated WM10.Amount of hazardous waste generated
	Waste reduction	WM3. Total waste recycled per waste type (glass, paper) WM4. Disposal of general, hazardous and medical waste WM5. Available landfill space for general and hazardous waste WM6. Available treatment capacity for medical waste	
	Service provision	WM7. Number of households with refuse removal services	
	Governance	WM8. Local government expenditure on waste management	

## SoE reporting in Gauteng

The first preliminary SoER for the Gauteng province was produced in 1998. The report did not present information in the DPSIR framework, but rather had the objective of presenting available information as a baseline for important issues in the province. This 2004 report is therefore an update and extension of the preliminary report. It is important to note that SoE reporting is a dynamic process, and future revisions will provide updated and more accurate information, as it becomes available.

The main purpose of this report is to present information on the condition of the environment to decision-makers and the public in order to enhance decision making for environmental protection and sustainability. It will be used as a baseline for future management decisions and will identify opportunities for future policy reform. The Gauteng SoER process will raise and improve environmental education and awareness amongst the public. The Gauteng SoE is presented in the following ways:

- A hardcopy report;
- An A1 summary poster for use in schools; and
- Electronically on the internet.

The objectives of this report are to:

- Present available data on the following themes, where possible comparing it to that presented in the 1998 SoER:
  - Social environment
  - Land
  - Water resources
  - Air quality
  - Biodiversity
  - Waste;
- Identify gaps and limitations in information and data and make recommendations for indicators and areas for future reporting and monitoring; and
- Identify strategic priorities in terms of policy review.

It is anticipated that the SoE reporting process for Gauteng will incorporate updates every 2 years, with major indicators updated on a 5-yearly basis.



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## 2. Welcome to the Smart Province

Gauteng is the seSotho word for "Place of Gold". Despite being the smallest of the nine provinces, Gauteng is the economic powerhouse of SA and the African continent. Lying on the elevated plateau of the interior, called the Highveld, it covers approximately 17 010 km<sup>2</sup>, which represents only 1.4 % of SA's surface area. The North-West, Limpopo, Mpumalanga and Free State Provinces border Gauteng from the west, north, east and south respectively.



Figure 2.1 Map of the Gauteng Province

Gauteng contains three of SA's six metropolitan municipalities, including the cities of Johannesburg, Tshwane and Ekurhuleni, and 3 district municipalities and their local municipalities, which form the remainder of the province (Figure 2.1). An additional municipality which forms the Cradle of Humankind World Heritage Site occurs within the West Rand District Municipality.







## Climate

Gauteng enjoys a mild climate, characterised by warm, moist summers and cool dry winters. Most rainfall occurs from October to March, with a mean annual precipitation of 668mm (Dent *et al.*, 1989). This varies from 900mm in the central higher lying areas to 556mm in the lower lying northern and southern areas of the province.

Mean annual temperature varies from approximately 19.3°C in the north of the province to 16.0°C in the south. The eastern and central areas, however, experience a lower mean annual temperature of around 15.0°C. There is large variation between summer and winter temperatures, with Gauteng experiencing a daily mean temperature in January and July of 21.2°C and 9.8°C, respectively (Schulze, 1997).

Due to the long clear nights, little wind and dry air in Gauteng in winter, the occurrence of frost is common in the province. Gauteng experiences on average 30 days of frost per year (Schulze, 1997). Winter atmospheric conditions cause temperature inversions, which have the effect of keeping polluted air close to the surface, so that winter air quality over the Highveld is generally poor.

## Geology

South Africa's mining heritage is attributed to the diversity and richness of its mineral deposits, and the geology of the Gauteng area has played a major role in its development. The present landscape is a visible manifestation of the strong relationship between past earth processes and geological features (Viljoen and Reimold, 2002).

The oldest rock formation in Gauteng is the Johannesburg Granite Dome, situated between Pretoria and Johannesburg. This formed in the Archaean period (3500 – 2500 million years ago), and forms the basement on which the younger sedimentary and volcanic rocks of the Transvaal and Witwatersrand Supergroups are deposited. A large area of Gauteng contains the Proterozoic era (2500-570 million years ago) formations of the Transvaal Supergroup, notably containing the gold-bearing "Black Reef" quartz-pebble conglomerate, which has been mined on the East and West Rands. The outcrops of conglomerate of the Witwatersrand basin (the major gold-bearing rock type), just south of the Johannesburg Dome and in the Heidelberg region, have made the area world famous. These outcrops give rise to east-west ridges on resistant quartzite.

The Ventersdorp volcanic lavas outcrop in the Klipriviersberg hills south of Johannesburg and to the east and west of Heidelberg.

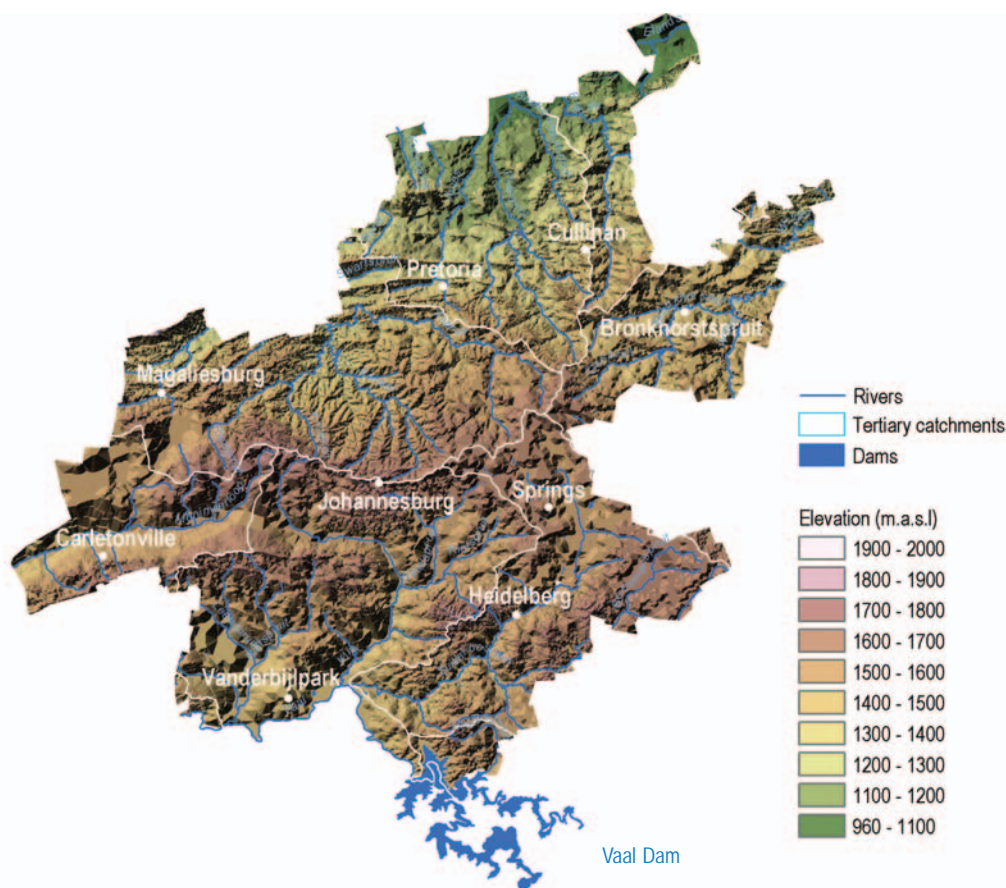


The dissolving carbonates of the Malmani dolomites of the Transvaal Supergroup are significant from both an archaeological and a safety perspective. The world famous fossil deposits at the Cradle of Humankind (CoH) occur within the dolomites, while sinkholes and subsidence of the dolomites occur on the East and West Rand.

The quartzites of the Pretoria Group of sediments overlying the dolomites have given rise to the picturesque Magaliesberg Mountains, characterised by faulting and displacement, which have produced spectacular gorges, for example, Tonquani gorge. The igneous intrusions of the molten rocks of the platinum rich Bushveld Complex were injected into the upper quartzites of the Magaliesberg layer.

## Terrain

Gauteng covers the convergence of watersheds of the Vaal, the Crocodile, and Olifants catchments. The Klipriver, Blesbokspuit, Mooi, Rietspruit, Suikerbosrand and Natalspruit rise in the east-west band of high lying areas of Randfontein, Johannesburg and Benoni (between 1 650 and 1 750 m above sea level), and drain south to join the Vaal river. This southern area of the province is characterised by relatively moderate relief (1 450 to 1 600m above sea level (a.s.l.)) between the resistant quartzite ridges near to Suikerbosrand (approximately 1 900m a.s.l.) and the east-west ridges stretching from Walkerville to Carletonville.



Source: Topography from GDACEL; Hydrology from Water Research Commission (WR90)

Figure 2.2 Topography and hydrology in Gauteng



The Apies River begins just south of the quartzite ridges south of Pretoria and flows north to join the Pienaars River, in an area of plains and lowlands, which together flow into the Crocodile River. The Crocodile River has its source close to Roodepoort (1 750m a.s.l) in an area characterised by plains with moderate relief. The Jukskei River also joins with the Crocodile and together these flow in a northerly direction into the Limpopo River on the Botswana border.

In the north-eastern corner of Gauteng, the Elands and Wilge Rivers flow north-easterly toward the Olifants River.

## Vegetation

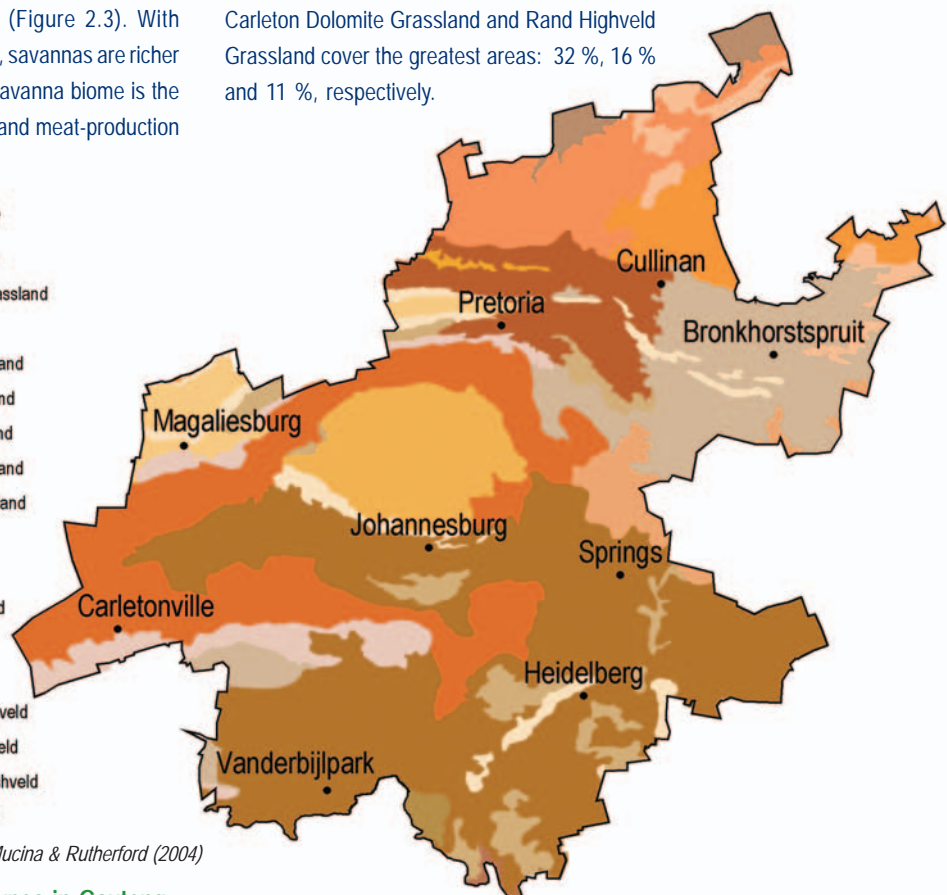
Two of SA's biomes fall within Gauteng, these being the Grassland and Savanna biomes, which comprise 71 % and 29 %, respectively, of Gauteng's surface area. In SA savannas support more than 5 700 plant species, exceeded only by the Fynbos biome. Nine different vegetation types comprise the Gauteng Savanna, of which the Central Sandy Bushveld and Marikana Thornveld are the most common, comprising 6.3 % and 5.8 % respectively (Figure 2.3). With respect to animal biodiversity, savannas are richer than any other biome. The savanna biome is the core of wildlife, eco-tourism and meat-production

industries (Bredenkamp, 2002). However, the large savanna fauna of SA are confined largely to game reserves.

The Grassland biome is one of the most threatened in SA, as a large percentage is irreversibly transformed, while only 25 % is formally conserved (Bredenkamp, 2002). Gauteng grasslands consist of eight different vegetation types, of which the Soweto Highveld Grassland, Carleton Dolomite Grassland and Rand Highveld Grassland cover the greatest areas: 32 %, 16 % and 11 %, respectively.

### Vegetation Type

- Rand Highveld Grassland
- Carletonville Dolomite Grassland
- Egoli Granite Grassland
- Frankfort Highveld Grassland
- Eastern Highveld Grassland
- Soweto Highveld Grassland
- Central Free State Grassland
- Waterberg Summit Grassland
- Central Sandy Bushveld
- Moot Plains Bushveld
- Springbokvlakte Thornveld
- Marikana Thornveld
- Norite Koppies Bushveld
- Gold Reef Mountain Bushveld
- Andesite Mountain Bushveld
- Loskopdam Mountain Bushveld
- Shale Mountain Bushveld



Source: NBI Vegetation Map: Mucina & Rutherford (2004)

Figure 2.3 Vegetation Types in Gauteng



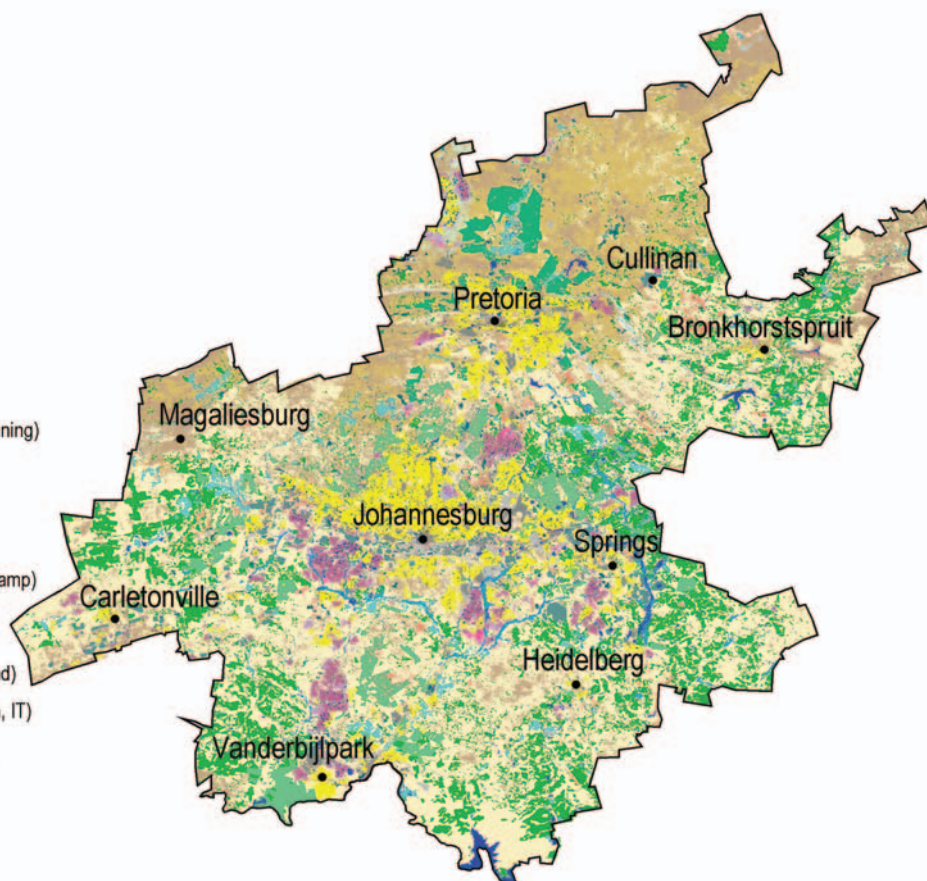
## Land and Soils

Gauteng is the most urbanised province in SA, with 17 % of its land area classified as being in 'urban' land uses (Figure 2.4). Surveys and analyses of the remaining areas indicate complex soil and land capability patterns, due to the complex geology. The deep, well drained, apedal soils of the Hutton type give rise to the 23.1 % of the province with arable potential. Another 25.3 % is deemed "marginally" arable, with the remainder suitable for grazing and wildlife. The soils of the province are dominated by plinthic, duplex and hydromorphic soils, which all carry

limitations for agricultural crop production. Further analysis of the potential for irrigation-fed crop production reveals that over 50 % of the province is not suitable for irrigated crops, but the analysis yields a map of areas to be protected for agricultural use, areas which comprise 19% of the land area of the province (GPG, 2002) (Figure 2.5). The large blocks of good potential agricultural land lie in the south-west, between Carletonville and Magaliesburg, in the south-east, around Heidelberg, and in the north-west of the province, south of Bronkhorstspuit.

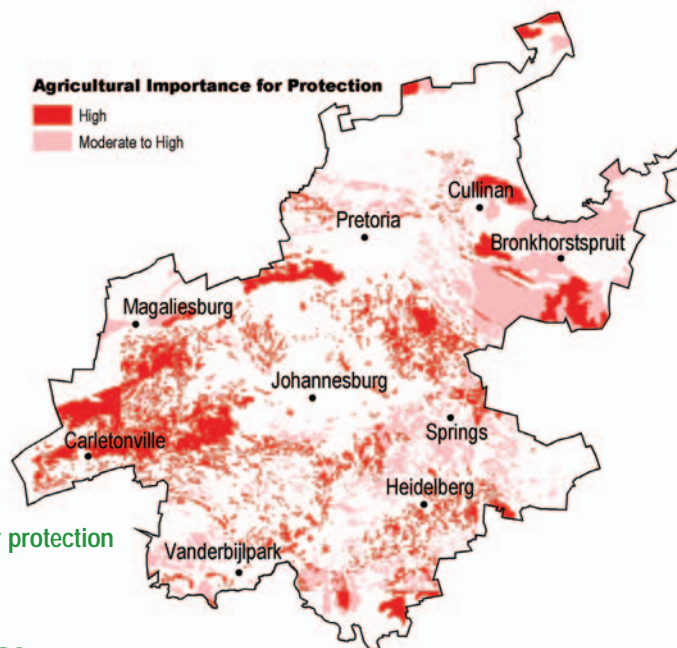
### Landcover Class

- Bare Rock and Soil (erosion)
- Bare Rock and Soil (natural)
- Cultivated, permanent, commercial, irrigated
- Cultivated, temporary, commercial, dryland
- Cultivated, temporary, commercial, irrigated
- Degraded Forest & Woodland
- Degraded Thicket and Bushland
- Degraded Unimproved (natural) Grassland
- Woodland
- Forest (indigenous)
- Forest Plantations (Acacia spp)
- Forest Plantations (Other / mixed spp)
- Forest Plantations (Pine spp)
- Improved Grassland
- Mines & Quarries (mine tailings, waste dump)
- Mines & Quarries (surface-based mining)
- Mines & Quarries (underground / subsurface mining)
- Thicket, Bushland, Bush Clumps
- Natural Grassland
- Urban / Built-up (residential)
- Urban / Built-up (residential, flatland)
- Urban / Built-up (residential, formal suburbs)
- Urban / Built-up (residential, formal township)
- Urban / Built-up (residential, hostels)
- Urban / Built-up (residential, informal squatter camp)
- Urban / Built-up (residential, informal township)
- Urban / Built-up (residential, mixed)
- Urban / Built-up (rural cluster)
- Urban / Built-up (smallholdings, grassland)
- Urban / Built-up (smallholdings, thicket, bushland)
- Urban / Built-up (smallholdings, woodland)
- Urban / Built-up, (commercial, education, health, IT)
- Urban / Built-up, (commercial, mercantile)
- Urban / Built-up, (industrial / transport :heavy)
- Urban / Built-up, (industrial / transport :light)
- Waterbodies
- Wetlands



Source: National Landcover 2000 (CSIR and ARC)

Figure 2.4 Landcover in Gauteng in 2002



Source: Gauteng Agricultural Potential Atlas (GDACE)

Figure 2.5 Agricultural importance: areas for protection

## Population and Economics

Gauteng is home to approximately 8.8 million people, which represents nearly 20 % of SA's population (Statistics South Africa (StatsSA), 2002). There is a diverse array of cultures in the province with the major languages spoken being isiZulu, Afrikaans, seSotho and English. Other languages commonly spoken include Portuguese, Italian, Greek and various Asian languages. Approximately 5.4 % of the population was not born in SA, most of who originate from Southern African Development Community (SADC) countries.

Gauteng is SA's economic powerhouse, and

economic growth and output in the province outstrips the rest of the country and indeed leads the whole African continent (GEDA, 2004). The economy grew at an average of 3.3 % per year from 1995 to 2002, which is above the national average of 2.7 %, and slightly below other developing countries. Its contribution to the national Gross Domestic Product (GDP) grew from 32,6 % in 1995 to 33,9 % in 2002.

The Gauteng economy is diverse, ranging from a thriving informal sector including street vendors, to a high-tech manufacturing and industrial sector.

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### 3. What causes environmental change in Gauteng?

#### Introduction

Drivers are defined as the “social and economic influences and activities that, when combined with environmental conditions, underpin environmental change” (DEAT, 2002). These driving forces are a complex mix of political, social and economic factors that are magnified by a high population growth rate (UNEP, 2000). Examples are societal development and human behaviour, mining and population change. There are various levels of drivers, including drivers at the international, national, provincial and local levels. These will affect the environment in different ways and at different spatial and temporal scales.

The relationship between drivers/pressures and the recipient environment is not linear; rather it consists of a network of feedback loops. For example, it is well understood that unhealthy environmental conditions exacerbate urban poverty, and in turn poverty exacerbates environmental problems (World Bank, 2003). It is often difficult to identify specific feedback loops and interrelationships between drivers and the receiving environment, and thereby the critical outcomes (UNEP, 2000).

The purpose of this chapter is to give a general background to the drivers that are affecting the

environment in the Gauteng province. Many of these drivers are common to several environmental media described in the following thematic chapters, but the pressures that they exert on each medium may be different.

Drivers have been divided into external and internal drivers. External drivers are those that relate to influences from sources at higher levels of organisation than the Gauteng province, for example international and national legislation, policy and societal development, and regional atmospheric conditions. Internal drivers are related largely to the human settlements and economic activities within the province. Although policy and legislation can be seen as drivers of environmental change, they also represent part of society's responses to environmental change. They are therefore largely dealt with under the Responses section of each theme.





## External Drivers

An assessment of the SoE in Gauteng cannot be conducted in isolation from global trends, trade and markets, international conventions, protocols, treaties and agreements<sup>1</sup>, and internationally accepted best practice. Similarly, South Africa's macro-economic strategy (Growth, Employment and Redistribution (GEAR)) and related sectoral policies, associated with the need for economic growth, job creation, export and provision of basic needs, as well as the vast body of national legislation, are drivers of environmental change. The historical and recent Apartheid **political regimes** in South Africa played a major role in the entrenchment of environmental injustice and consequent quality of the social and biophysical environment. The major influence on the spatial manifestation of environmental quality was racially segregated land ownership and use patterns, starting with the 1913 Land Act, which allocated 13 % of the land area of the country to the black 80 % of the population. The result was overcrowded, poorly or unserved, unhealthy "townships" and "bantustans", perpetrating inequitable access to natural resources that persists to this day, notwithstanding attempts to address these issues.

The **economic and political climates** in African and neighbouring SADC countries, most notably Nigeria, Zimbabwe and Mozambique, are resulting in an influx of refugees and immigrants seeking employment. With the large concentrations of people in highly urbanised areas like Gauteng, this influx of foreigners is likely to severely aggravate the disparity between societal demand and the availability of resources.

**International trade and globalisation** are seen to be inherently linked with the environment (Glazewski, 2000). World Trade Organization rules are held by many to be inimical to the interests of sound environmental management, due to the power of multi-national corporations to assert global economic imperatives over national statutes.

### Footnotes

<sup>1</sup> For example: NEPAD, RAMSAR Convention, Montreal and Kyoto Protocols, CITES

<sup>2</sup> NEPAD, African Charter on Human and People's Rights 1981, Universal Declaration of Human Rights 1948, Aarhus Convention 1998, the Constitution of the RSA, Agenda 21, National Environmental Management Act, National Water Act

<sup>3</sup> Calculated from Census 1996 and 2001 figures assuming a constant rate of increase





### Internal Drivers

#### Societal development

Societal development describes the needs, views and values of society (EMM, 2004). The uneven distribution of wealth, education, health care, energy, waste services, housing, water and sanitation facilities in the province, coupled with the proximity of many residential areas to unhealthy/hazardous areas, for example mine dumps, has focussed government's attention on the 'brown' environmental issues of the urban poor and other vulnerable groups. On the other hand, well-educated, wealthy people tend to show greater interest in the so-called 'green' issues (for example the conservation of biodiversity). These 'green' and 'brown' issues are not distinct (Goldblatt, 2002) especially in Gauteng, as urban areas place excessive pressure on natural resources, thus impacting on 'green' resources.

The prevailing values, norms and practices of the Western economic model tend to favour the over-consumption of finite resources (EMM, 2004). Business and industry's focus on profits and the need for continued access to productive resources, which is especially the case in Gauteng, compound this situation.

Civil society has a growing demand for **transparency and accountability within government** structures, and is placing renewed emphasis on the rights and interests of people, and on equality and benefit sharing within the broader society. Through various instruments<sup>2</sup> these rights are being realised, with concomitant direct and indirect effects on the environment.

Through the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 and the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, the implications of these economic, political, social and demographic influences and trends, and their interaction with the natural environment are being addressed. There has been a worldwide shift in perception from a protectionist view of natural resources to a human needs-centred view (DEAT, 1999).

The extent to which **global climate change** is driving environmental change in Gauteng is not known. It is likely that it will act as a future driver, impacting most notably on water resources and biodiversity.



### How does societal development affect environment?

#### IN A POSITIVE WAY

- It improves quality of life
- It addresses basic human needs as 'higher order' needs

#### IN A NEGATIVE WAY

- It increases the demand for resources and goods (increases consumerism)
- It leads to unsustainable land use practices
- It increases and concentrates generation of pollution and waste
- It leads to migration and rapid urbanisation

### How does human settlement affect the environment?

#### POSITIVES

- The development of appropriate green infrastructure like open spaces and parks enhances diversity protection
- The maintenance of riparian areas may protect biodiversity

#### NEGATIVES

- It changes land use and land cover
- It increases pollution and waste generation
- It increases the demand for resources
- It increases population density
- It requires the provision of infrastructure and services
- It promotes urbanisation

## Human Settlements

Urban land uses cover approximately 17 % of the surface area of Gauteng and are therefore important in relation to the conservation of biodiversity. Residential areas account for almost 9 % of land use. Overcrowding potentially gives rise to unsustainable pressures on infrastructure and resources and results in negative human health impacts. However, low density residential development takes up space, contributes to urban sprawl and there is a resultant pressure on natural resources. Gauteng has a far higher average population density (519 people/km<sup>2</sup>) than the other provinces, with the second highest being KwaZulu-Natal (102 people/ km<sup>2</sup>).

There were approximately 616 599 households in informal settlements in 2001 (CASE, 2003). Many of these settlements are located in close proximity to hazardous or unhealthy areas, such as tailings dams, rock dumps or river floodplains, where health and safety risks may be significant. Others are located in environmentally sensitive areas, such as adjacent to wetlands, making the sensitive areas vulnerable to degradation and pollution.

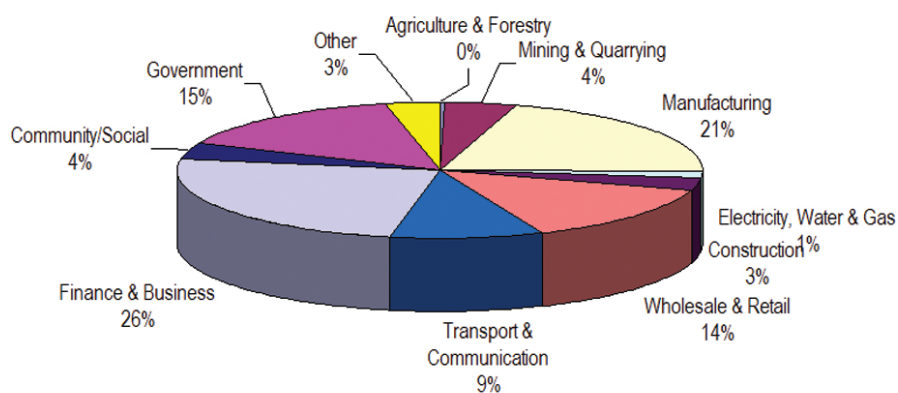
## Demographic Dynamics

Demographic dynamics is a general underlying driving force of environmental change, having both indirect and direct effects on the environment. There has been a 4.1 %<sup>3</sup> per year growth in population since 1996, partly (30 %) attributable to the high number of migrants into the province in search of employment (GPG, 2004). Population change exacerbates pressure on resources and service delivery, and in so doing creates pressures on the development of land. It contributes to land transformation, as more people require space and housing.



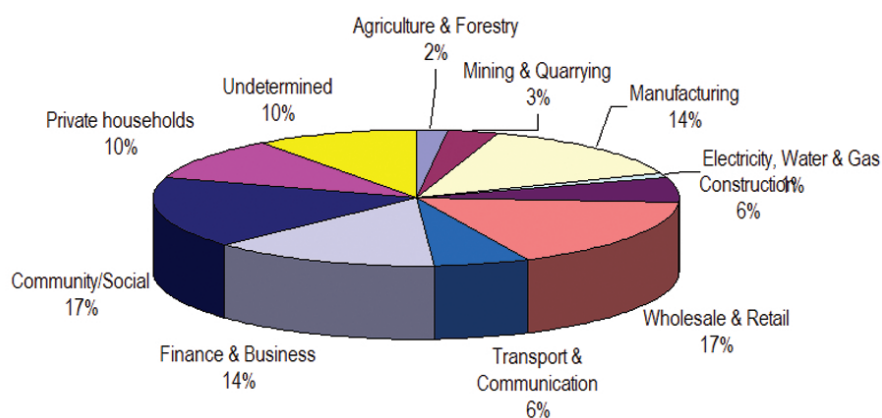
## Sectoral and Economic Drivers

This section gives a general discussion of the economic profile of Gauteng and how each sector contributes to environmental change. Sectoral contributions to the Gauteng Gross Geographic Product (GPG) for 2001 are shown in Figure 3.1, while estimated employment per sector is shown in Figure 3.2.



Source: Trade and Industry Strategy (GPG, 2003)

**Figure 3.1 Sectoral contributions to the Gauteng Gross Geographic Product in 2001**



Source: Census 2001 (StatsSA)

**Figure 3.2 Employment by sector amongst the economically active in Gauteng in 2001**



## Mining

Mining has taken place in the area for hundreds of years (GEDA, 2004), but it was the discovery of gold in the 19th century that was most significant in the development of the Gauteng economy and spatial patterns. Mining and quarrying covered approximately 31 176 hectares (1.8 %) of land in Gauteng in 2002 located primarily in the "gold corridor" stretching from the East Rand goldfields, through the Central Rand goldfields, the West Rand goldfields and most of the West Wits Line goldfield towards Carletonville (Council for Geoscience, 2002).

Although most of the mines in Gauteng are in an advanced stage of (declining) production (Council for Geoscience, 2002), in 2001 Gauteng accounted for 18.2 % of South Africa's primary mineral exports. This is the 2nd largest behind the North-West Province. Gauteng employs 24.5 % of South Africa's mining labour force (DME, 2003). However, it accounted for only 3 % of employment in the province in 2001 and employment in the mining sector declined by - 3.7 % between 1996 and 2001 (GPG, 2003).

The following commodities (number of active mines in brackets) are currently mined in Gauteng: gold (38), diamonds (1), silver (37), platinum group minerals (10), uranium oxide (7) and sulphur (5) (Council for Geoscience, 2002). The following commodities from quarrying are currently mined: dolomite and limestone (4), silica (2); refractory and brick-making clays (several) and aggregates and sand (55) (Council for Geoscience, 2002). Currently, an important contributor to gold production is the reworking and extraction of minerals from tailings dams and waste rock dumps. For example, the East Rand Gold and Uranium Company Limited (ERGO) is involved in the extraction of low concentrations of gold, silver, uranium oxide and pyrite (for sulphur) from tailings dams and rock dumps near to Benoni on the East Rand. This activity is changing the urban landscape of the Witwatersrand, by removing the old dumps.

Illegal small-scale mining in the province is

prevalent (Aucamp *pers comm.* 2003). People are reworking existing mine dumps, and are also panning for minerals in sensitive areas like wetlands. This provides income for those who are formally unemployed but poses a threat to the environment.

Despite its declining contribution to employment and the provincial economy, mining has and continues to have one of the most visible footprints on the provincial landscape and extensive influences on the environment (*see Box*), hence the prominence given to it here.

### How does mining affect the environment?

#### POSITIVES

- It makes a significant contribution to the provincial and national GDP
- It creates employment
- It sustains local mineral processing industries
- It has the potential to generate income from heritage tourism

#### NEGATIVES

- It changes the topography and visual character of the land
- It contaminates surface and groundwater resources
- It contaminates and degrades soils through salinization, acidification, pollution
- It alters ground water dynamics and surface water body flow regimes: excess groundwater pumped from the mines has augmented river flows, in some cases dramatically
- Subsidence in dolomitic areas is a major hazard in Gauteng
- It poses a radiation hazard
- Tailings dams generate dust and water pollution
- It destroys natural habitats, impacting on biodiversity
- It creates zones which poses health and safety risks to nearby settlements

### Manufacturing

Gauteng has a well-established manufacturing base, which is the largest and most diversified in Africa (Blue IQ, 2004). It accounts for the 2nd largest contribution to the GGP of Gauteng (20.5 %), next to the financial sector (GPG, 2003), and employs 399 270 people (14 %) (StatsSA, 2003). Industrial areas covered approximately 28 823 hectares in 2002 (1.7 %), with the highest coverages in Ekurhuleni, Johannesburg and Tshwane.

Manufacturing is weighted in favour of traditional heavy industry (Blue IQ, 2004). The strongest sub-sectors are iron and steel, followed by other (non-wood furniture, jewellery, recycling, sports goods and toys), fabricated metals, motor vehicles and parts and industrial chemicals (GPG, 2003). In recent years there has been significant movement towards higher value-added manufacturing in

industries such as automotive assembly and components manufacture (specifically for information technology and telecommunications), metal fabrication, food and beverages, containers, packaging and plastics, pharmaceuticals and toiletries. The "high-tech" corridor in Midrand is the most rapidly developing area in the country (GCIS, 2003).

A 3.3 % average growth in the sector is predicted from 2002-2007 and this will partly be achieved through the implementation of the Blue IQ High Value-Added Manufacturing initiative. Specific projects involve the Wadeville-Alrode Industrial Corridor and the JIA Freezone (Industrial Development Zone) in Ekurhuleni, the Gauteng Automotive Cluster located in Tshwane, Johannesburg and Ekurhuleni, and the City Deep Transport Logistics Hub in Johannesburg.

### How does manufacturing affect the environment?

#### POSITIVES

- It stimulates the economy
- It stimulates social development
- Changing the economy from raw material production to value added manufacturing should benefit the environment (less pollution)

#### NEGATIVES

- It is one of the largest consumers of primary resources, namely energy (contributing to the greenhouse gas budget) and water
- It generates air, noise, water and soil pollution
- Illegal manufacturing developments alter land use and affect catchment hydrology, such as being established within 1:50 year floodlines





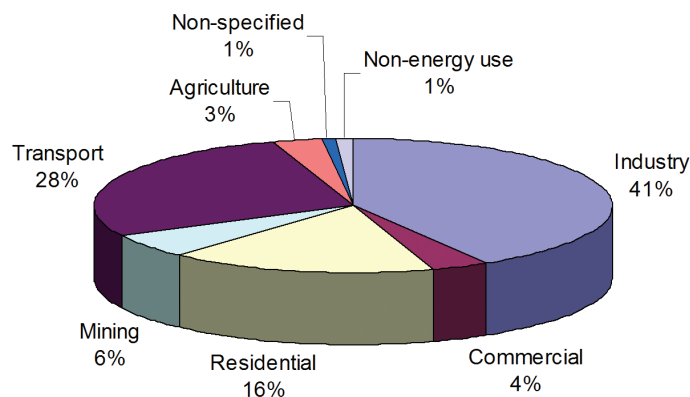
## Energy

The combustion of fossil fuels for energy releases into the atmosphere approximately 80 % of human-induced greenhouse gas emissions (WRI, 2004). Electricity generation emissions from coal and oil refining to produce petroleum products, coal mining and gas extraction, wood burning and the burning of coal and oil to produce heat for industrial and other purposes, are the largest source of carbon dioxide (CO<sub>2</sub>) and sulphur dioxide (SO<sub>2</sub>) emissions in SA (DEAT, 1999). The production and consumption patterns of energy are thus major drivers of environmental change in Gauteng. The SA economy is energy intensive and is primarily based on coal (DME *et al.*, 2002). Coal contributes to 73 % of primary energy, while it contributes 93 % as the main source of energy in the generation of electricity (NER, 2001). This is different from global

electricity sources where coal, hydro and gas contribute 37 %, 29 % and 22 %, respectively. Other minor sources of energy in SA include biomass, natural gas, hydro-power, nuclear power, solar power and wind.

Electricity generation<sup>4</sup> contributes 1.4 % to the Gauteng GGP (GPG, 2003) and is generated mainly by Eskom. Most of the Eskom power stations, which produce 95.9 % of South Africa's electricity (NER, 2001) are located in Mpumalanga (Kendal, Grootvlei and Matla) on the border of Gauteng, and in the Free State (Lethabo), just south of Vanderbijlpark. Municipal power stations include Pretoria West & Rooiwal in Tshwane, while Kelvin A and Kelvin B in Johannesburg are privately owned.

The main consumers of energy in SA are industry, and the domestic/residential and transport sectors (Figure 3.3).



Source: Energy Digest for South Africa 2002 (Department of Minerals and Energy)

**Figure 3.3 Sectoral consumption of energy in South Africa in 2000**

### How does energy affect the environment?

#### POSITIVES

- It is essential for industrial production and human well-being

#### NEGATIVES

- South Africa's reliance on coal and fossil fuels for power generation and domestic energy needs results in increased greenhouse gas emissions
- Particulates and other emissions result from the transport sector
- Poor air quality results in human health risks
- The use of wood, coal, gas, paraffin and candles for domestic use poses a safety risk

#### Footnotes

<sup>4</sup> includes gas and water

<sup>5</sup> includes the storage and communication sectors

<sup>6</sup> includes forestry which is non significant in Gauteng



### Transport

Over the past 30 years, the transport sector's share of CO<sub>2</sub> emissions globally has increased at a faster pace than other sectors (WRI, 2004). From 1971 through 1997, transport-related CO<sub>2</sub> emissions from industrialized countries nearly doubled. Globally, the transport sector now contributes 25 percent of all the CO<sub>2</sub> emissions released into the atmosphere. Approximately 80 % of those emissions are from road transport (WRI, 2004).

Because Gauteng is highly urbanised, with a concentration of industrial activity, there is consequently a high level of commercial road transport activity (this is also partially due to government policy, which has favoured road over rail transport). Gauteng has the highest live vehicle population in the country (Dept of Transport, 2001), accounting for 37 % of the country's vehicles. Transport is a major driving force in the province. Transport and communication contributed 9.4 % to the GGP in 2001 (GPG, 2003), employing approximately 168 478<sup>5</sup> people (StatsSA, 2003).

Commuter transport is also a major environmental issue in Gauteng. The paucity of mass public transport systems has made private vehicle use and minibus taxi use the dominant forms of commuter transport. Future plans to reduce reliance on private vehicles include the recapitalisation of the taxi industry and the Gautrain Rapid Rail Link, a Blue IQ project linking Johannesburg with Pretoria and Johannesburg International Airport (JIA). Gautrain is expected to have beneficial impacts on commuter vehicle volumes, a more efficient use of space compared with road design and improved safety levels (Gautrans, 2002).

### How does transport affect the environment?

#### POSITIVES

- It is an essential component of the economy through the movement of people and goods

#### NEGATIVES

- The transport sector is one of the largest contributors to greenhouse gas emissions and particulates
- Vehicle emissions are thought to be a major cause of respiratory and other diseases
- Transport networks fragment natural habitat
- Linear transport infrastructure may cause barriers to human movement between communities
- Transport poses a significant risk to human safety

### Agriculture

Agriculture<sup>6</sup> is a small component of the provincial economy, accounting for 0.4 % of GGP (GPG, 2003) and employing 67 648 people (2.34 % of the work force) in 2001 (StatsSA, 2003).

The major agricultural enterprises in Gauteng are livestock (including piggery), poultry, horticulture and crop production (DACEL, 2003). An important component of the sector is maize production, while ground-nuts, sunflowers, cotton and sorghum are grown in the Bronkhorstspuit, Heidelberg and Cullinan areas. Enterprises are geared towards providing the urban areas of the province with daily fresh produce (GCIS, 2003). Most agriculture is commercial dryland, although areas of irrigated cultivation occur in the Bapsfontein area on the East Rand, in Randfontein and Mogale City on the West Rand, in the Wonderboom area north of Tshwane, and along the Klip River towards Vereeniging in the south.

There are an estimated 30 000 smallholdings in Gauteng (DACEL, 2001), located in all metropolitan and district municipalities in the province. They are generally found in peri-urban

areas, with some located in more remote areas. Smallholdings are viewed as an important component of the agricultural industry, given the scarcity of farming land and the need to redress historical land ownership imbalances.

and many protected areas of great natural beauty, for example, the Klipriviersberg, Suikerbosrand Nature Reserve and the Magaliesberg mountain range. Plans for a Big 5 game reserve in Dinokeng are underway.

### How does agriculture affect the environment?

#### POSITIVES

- It one of the largest generators of foreign exchange although small in Gauteng
- It can alleviate household food insecurity

#### NEGATIVES

- The transformation of natural habitat causes fragmentation and reduces biodiversity
- Inappropriate agricultural practices cause degradation and lower the ability of natural resources to sustain livelihoods
- It affects water quality in terms of sediment loads and contamination by pesticides

### How does tourism affect the environment?

#### POSITIVES

- It promotes conservation of natural habitats and cultural precincts
- It generates a high ratio of jobs per unit investment
- Income generating opportunities over a range of service and skills levels can be generated
- It increases environmental awareness
- It creates recreational opportunities

#### NEGATIVES

- It can lead to degradation of the natural and cultural assets if poorly managed and over-exploited

### Tourism

Tourism is an important component of South Africa's and of Gauteng's economy. Of the 5.78 million tourist-days recorded in South Africa in 2001, 50 % visited Gauteng for an average of 3 days (Gauteng Tourism Authority, 2004). In 2002, the number of tourist visits to Gauteng was 7.16 million (CASE, 2003), the majority for business purposes or shopping. A number of analysts consider tourism to be largely unexploited in the province. The sector is expected to grow substantially with the help of the Blue IQ tourism initiative.

There are a wide variety of tourist attractions in the province, ranging from urban tourism, including shopping, music, dining and sport, to cultural and natural heritage. The province boasts the Blesbokspruit RAMSAR wetland in Ekurhuleni, the Cradle of Humankind World Heritage Site in north-western Gauteng, the Cullinan diamond mine in north-eastern Gauteng



### Spatial planning

The Gauteng Spatial Development Framework (SDF), local municipality SDFs, Spatial Development Initiatives (SDIs) and Environmental Management Frameworks (EMFs) are important factors influencing environmental change. All SDFs are required to assess the environmental opportunities and constraints while EMFs aim to integrate social, economic and biophysical considerations in planning. The Gauteng SDF identifies the East Rand-Pretoria corridor via the R21 as a major economic growth area. Since this borders a zone of land that has been identified by GDACE for protection for agricultural land use, this policy framework may have undesirable spin-off effects on agriculture in the province. (Agriculture has been identified as a priority issue by GDACE).

#### How does spatial planning affect the environment?

##### POSITIVES

- It aims to conserve both the built and natural environments
- It influences the direction of spatial development and mobility routes
- It can prioritise and fast track industrial, residential, agricultural, tourism and infrastructure programmes
- It targets development in specific locations
- It influences the intensity of land use

##### NEGATIVES

- Poor spatial planning can be disastrous for environmental management and urban sustainability

### Land Reform

The national Department of Land Affairs has up until 31 December 2003 settled 9 180 land claims in Gauteng (DLA, 2004). This has involved 9 173 households, 44 476 beneficiaries on 3 453 hectares of land. Further, approximately 734 black farmers have acquired agricultural land with the assistance from government programmes (DACE, 2003).





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## 4. Social Environment

The social environment refers to how people and communities behave, their relationships, education and occupation, and the conditions in which they live. In the context of this report, the well-being and poverty related components of the social environment and how these relate to the physical and natural environments, are the points of focus. It is important to note that elements of the social environment overlap and interact with the natural environment. Poverty tends to increase people's reliance on the natural environment and may heighten the vulnerability to environmental degradation.

As Gauteng is the most densely populated and economically developed province in SA, the social environment is of particular importance when assessing Gauteng's overall state of the environment. Further, with high levels of poverty, social development and social justice are crucial pre-conditions for the achievement and maintenance of a healthy social and natural environment. Gauteng makes the largest contribution to the South African economy - 33.9 % of the national GDP in 2002 (GEDA, 2004), - yet many of its residents still live in poverty. Social development in Gauteng necessitates that special attention be given to poverty eradication.

### What affects people in Gauteng?

#### Demographic Dynamics

Changes in population directly and indirectly affect poverty and human well-being. If population growth is faster than growth in the supply of housing, employment and provision of basic services, human well-being will be negatively effected.

#### Population Growth Rate

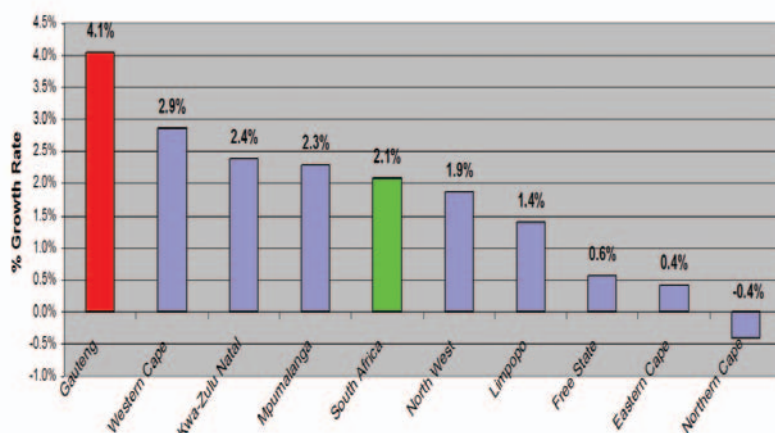
Figure 4.1 illustrates that Gauteng province, at almost twice the national growth rate, has the highest population growth rate in the country. 30 % of this is due to an influx of migrants from within and outside of South Africa. The concentration of migrants in close proximity to residents of low-income suburbs and informal settlements has increased urban density in some areas.







Correspondingly poor living conditions have been compounded by increased levels of unemployment. It is expected, however, that the rates of natural increase will decrease due to the effects of HIV/AIDS, leading to a decline in population growth rates (van Aardt, 2002).



Source: Census in Brief: 1996 & 2001 data: Source StatsSA Census

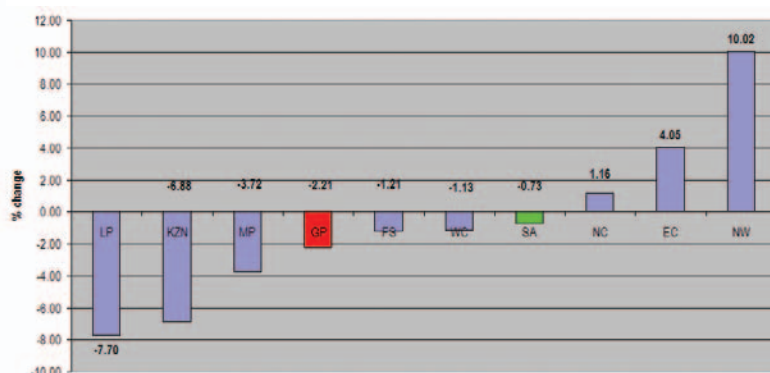
Figure 4.1 Average Annual Population Growth Rate (1996 - 2001)

## Education and Employment

Levels of education and employment directly influence the social environment, especially the rate of social development. Low levels of education limit people's access to employment opportunities as well as constraining the growth of the economy. Economic growth and global competitiveness in turn can be constrained by a lack of appropriately skilled people.

### Percentage change in the adult literacy rate

Gauteng has the second highest adult literacy rate in SA (92 %), behind the Western Cape (94 %). Figure 4.2 illustrates that Gauteng experienced a 2.21 % decline in the adult literacy rate between 1996 and 2001. This decline could be attributed to a number of processes: an influx of illiterate people into Gauteng, and/or an increase in the pressure on the education system by a growing population. An increase in illiteracy may in turn result in higher levels of poverty as illiterate people have fewer opportunities to earn a living in a modern economy, exacerbated by the fact that the provincial 'smart' economy requires a highly skilled labour force.

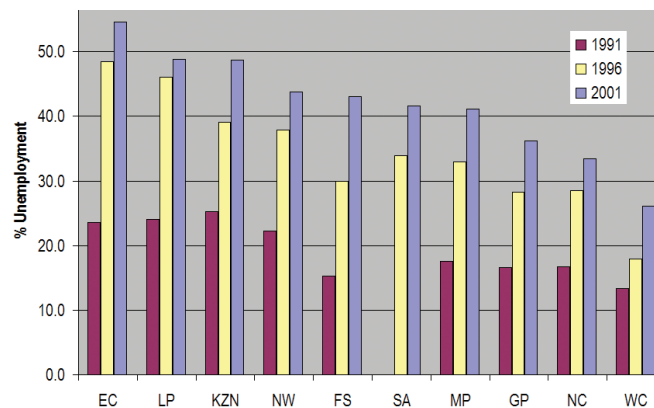


Source: Census in Brief: 2001 data  
StatsSA; Socio-economic and  
demographic profiles of provinces  
1999 data: (DBSA; Development  
Information Business Unit)

Figure 4.2 Percentage  
Change in Adult Literacy  
Rate (1996 - 2001)

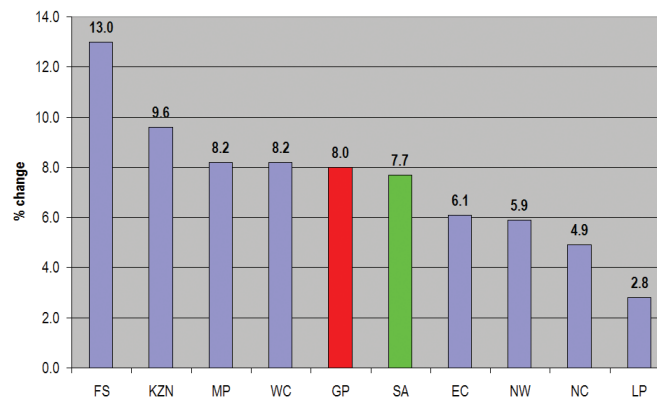
### Change in overall unemployment rate

Unemployment in Gauteng has increased from 16.6 % in 1991 to 36.2 % in 2001 (Figure 4.3). This represents an 8 % increase between 1996 and 2001, which is slightly higher than that for the country as a whole (Figure 4.4).



Source Census in Brief: 2001 data: Source: StatsSA; Gauteng State of the Environment Report, 1998

**Figure 4.3 Percentage unemployment per province for 1991, 1996 and 2001**



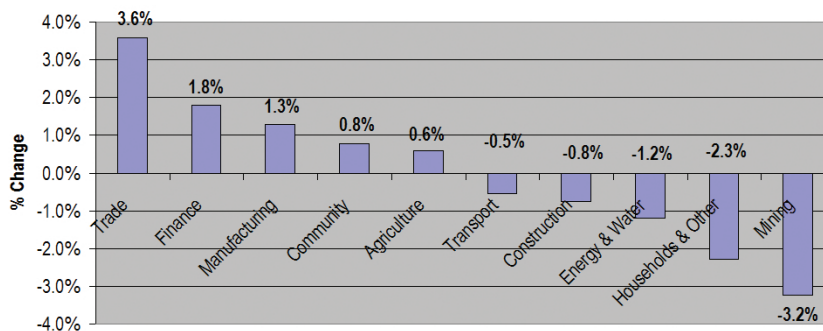
Source Census in Brief: 2001 data: Source: StatsSA; Gauteng State of the Environment Report, 1998

**Figure 4.4 Percentage change in unemployment rate per province between 1996 and 2001**

### Percentage change in employment per economic sector

It is important to consider what economic sectors are responsible for the increasing levels of unemployment. Figure 4.5 illustrates that employment has grown in certain economic sectors and shrunk in others. The sector that has experienced the largest increase is the trade sector, with the mining sector experiencing the most substantial reduction.





Source: Census in Brief: 2001 data: Source: StatsSA; Provincial Profile 1999 Gauteng, StatsSA, Population census 1996

**Figure 4.5 Percentage change in employment per economic sector (1996 - 2001)**

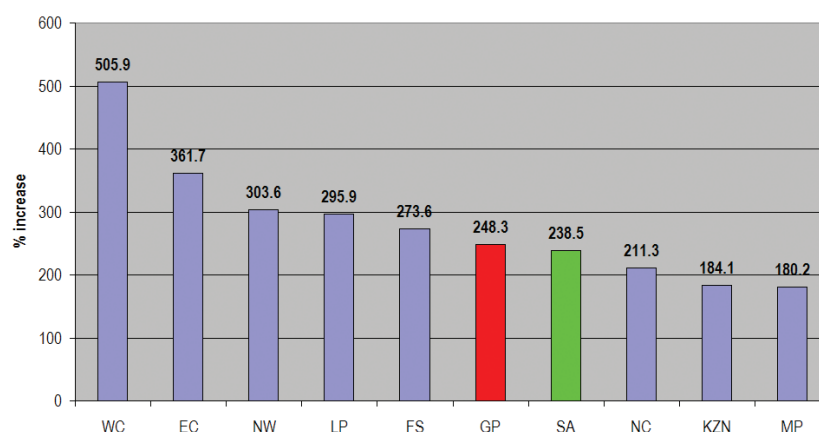
A decline in the number of people employed in the traditional sectors, such as mining, construction and transport is of concern, as it is these sectors that have traditionally employed residents of the low-income sectors of Gauteng. Furthermore, the economic development strategy of the province, to promote hi-tech, value-added services (financial) and manufacturing, may exacerbate the progressive exclusion of the poorly educated and unskilled from the economy.

## Health

Poor levels of public health place immense pressure on human well-being. The sick and terminally ill are often not able to work and earn an income to support themselves and their families and they may turn to natural resources to feed themselves. Poor public health also sets in motion a vicious cycle of increasingly poor environmental quality and deteriorating public health, as disease-bearing microbes are easily spread in the environment, leading to greater vulnerability to them. This is especially the case with waterborne diseases, which commonly afflict the poor.

### Percentage change in HIV/AIDS prevalence

HIV/AIDS is the most serious health issue currently facing SA. An increase in HIV prevalence will negatively affect health, since it makes its victims vulnerable to innumerable common diseases, particularly diseases associated with poverty. An increase in HIV prevalence will also lead to pressures on health, social welfare resources and infrastructure such as cemeteries. This will in turn impact on the economy as resources are diverted from productive purposes to support the sick and their dependents. Studies show that HIV/AIDS is most prevalent among the economically active people in the population. Although the increase in HIV prevalence from 1995 to 2001 for Gauteng is similar to that for South Africa (Figure 4.6). Prevalence increased from 23.9% to 29.8% in this period, compared with 24.8% prevalence for SA as a whole. Potential causes are the migrant and transient nature of the Gauteng population.



Source: Department of Health Annual Report 2001/2002; 1999 data: Department of Health

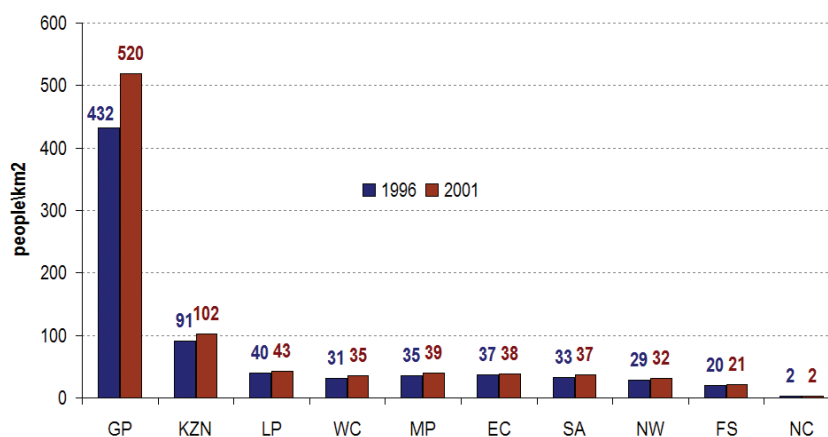
**Figure 4.6 Percentage increase in HIV prevalence among women at antenatal clinics between 1995 and 2001**

## How are our people doing?

### Population

#### Population density

As can be seen in Figure 4.7, Gauteng Province is by far the most densely populated province in the country and has experienced the largest increase in population density between 1996 and 2001. Figure 5.1 on Page 31 demonstrates that the highest densities of people in the province are found in and around the cities of Johannesburg and Pretoria. Many of the low-income suburbs, such as Alexandra, Soweto, Tembisa and Mamelodi, situated on the periphery of urban centres, display population densities in excess of 100 people per hectare, denoting overcrowding in these areas.



Source: Census in Brief: 1996 & 2001 data (StatsSA)

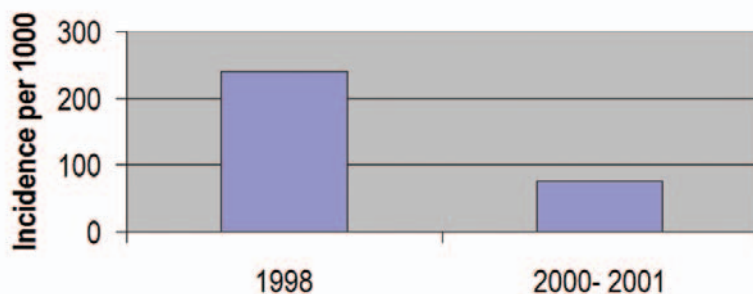
**Figure 4.7 Population Density (1996 - 2001)**



## Health

### Diarrhoea incidence rate

The incidence of diarrhoea in children younger than 5 years decreased between 1998 and 2001 (Figure 4.8). This is likely to have taken place due to the increase in access to safe drinking water.

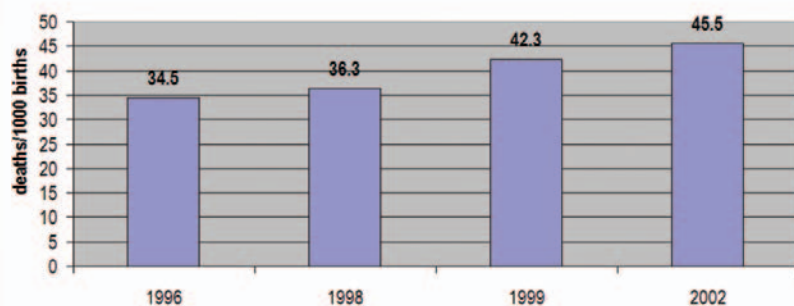


Source: National Report On Dhis Data: Gathering, Analysing And Using Information To Accelerate PHC Delivery: (DOH)

Figure 4.8 Diarrhoea incidence in children younger than 5 years

### Infant mortality rate

Figure 4.9 indicates that the provincial infant mortality rate has increased over the past 6 years. Almost 5 % of infants died in 2002, a surprising statistic given the decline in diarrhoea incidence (normally a major indicator of infant mortality). Causal links are difficult to establish, but may include malnutrition, a health care system that is overburdened, or the high prevalence of HIV/AIDS in mothers (Figure 4.10).



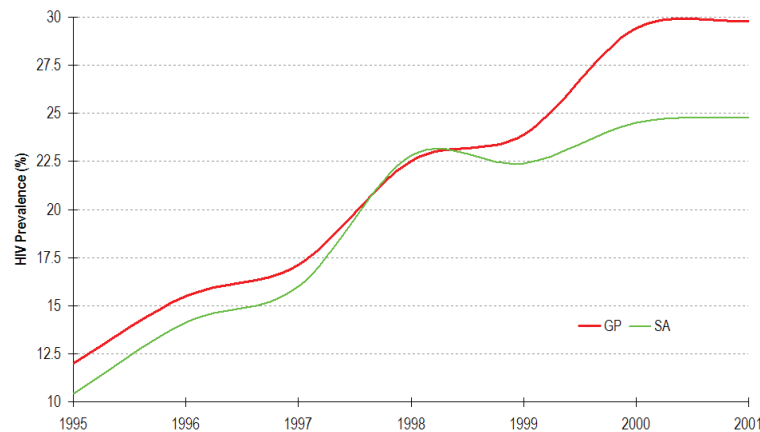
Source: Socio-economic and demographic profiles of provinces 1996 data (DBSA; Development Information Business Unit); Key Performance Indicators GPG: 1998, 1999 & 2002 data (SA Demographic Health Survey & Actuarial Society of SA)

Figure 4.9 Infant Mortality Rate in Gauteng Province (1996-2002)

### HIV/Aids prevalence rate

Figure 4.10 illustrates that HIV prevalence in women attending ante-natal clinics in Gauteng has increased more than for SA in the period 1995 to 2001. Provincial comparisons show that the only province with a noticeably higher HIV prevalence is KwaZulu-Natal. Van Aardt (2002) estimates that the total number of HIV positive people will continue increasing until 2008 to a figure of approximately 1.5 million, whereafter the number will decrease rapidly due to AIDS-related deaths.





Source: Dept of Health, National HIV Sero-Prevalence survey in SA 2001

**Figure 4.10 HIV prevalence of women attending ante-natal clinics (1995-2001)**

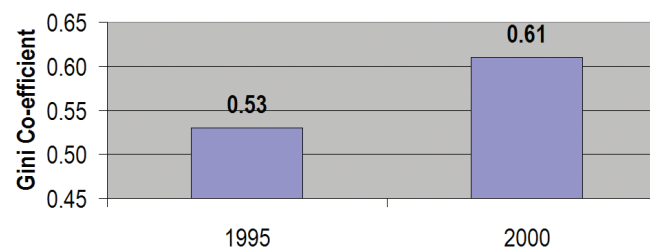
### Respiratory disease

Although there is a lack of data which directly links air pollution to the incidence of respiratory disease in South Africa, increasing evidence from developing countries shows the negative effects of air pollution on human health. There is increasing evidence that biomass smoke exposure increases the risk of childhood acute respiratory infections, particularly pneumonia and asthma, chronic bronchitis and chronic obstructive pulmonary disease, especially among women (WHO, 2002). Other more serious diseases associated with air pollution include cancer and pulmonary tuberculosis. A cause for concern therefore is that many households in informal areas in Gauteng are using wood and coal for domestic energy uses, which causes high levels of indoor pollution.

## Poverty

### Percentage change in Gini Co-efficient

The Gini Co-efficient is a measure of the extent of the wealth gap that exists between rich and poor. Figure 4.11 illustrates that the Gini Co-efficient in South Africa has increased in the period from 1995 to 2000, showing a trend towards a less even spread of income across the population. The widening of the wealth gap has social well-being and poverty implications in that the quality of life in the low income residential areas is likely to deteriorate as the wealth gap widens.



Source: Key Performance Indicators GPG: 2000 data: (StatsSA Income & Expenditure Survey, 2000)

**Figure 4.11 Gini Co-efficient for Gauteng Province (1995 and 2000)**



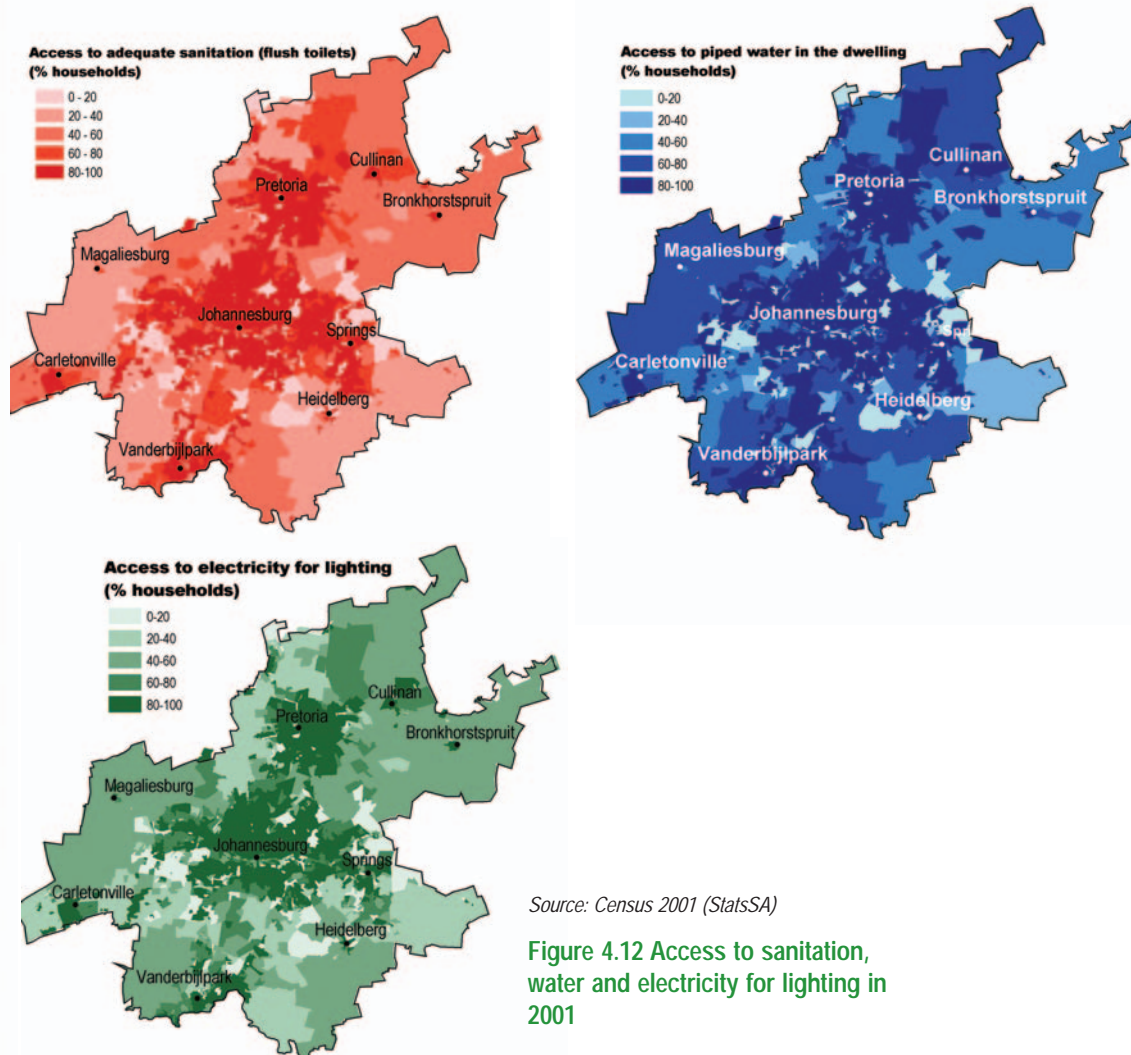


## Households in Poverty

The number of households living in poverty in Gauteng (defined as those households with an income of less than R1200 per month) increased by 8 % from 25 to 33 % from 1999 to 2000 (CASE, 2003). Poverty is closely associated with other socio-economic and environmental variables. Areas of poverty are often characterised by high fertility and mortality rates and population growth. A likely cause of this increase in poverty is the high immigration rate coupled with the increase in the unemployment rate. In Gauteng many poor areas are located in close proximity to unhealthy land, for example, floodplains, industrial zones, slimes dams.

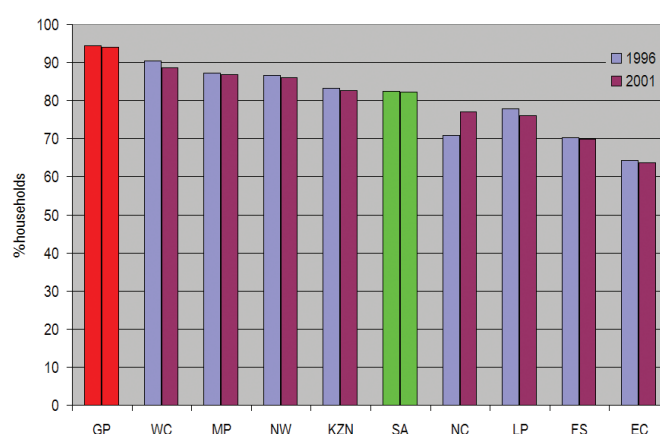
## Basic Services

Access to basic services, namely sanitation, safe drinking water and electricity, are considered to be good indicators of the quality of life in low-income areas. Although Gauteng has the highest service levels in the country (see below), there remain areas in the province where less than 20% of households have access to sanitation, piped water, and electricity for lighting. These are mainly located in informal settlements located in the peri-urban areas of the province.



### Access to sanitation

Gauteng has the highest levels of access to adequate sanitation facilities<sup>1</sup> in SA (Figure 4.13). There has been a slight decrease (0.3 %) in access to sanitation in Gauteng between 1996 and 2001, probably attributable to difficulties in keeping pace with in-migration.

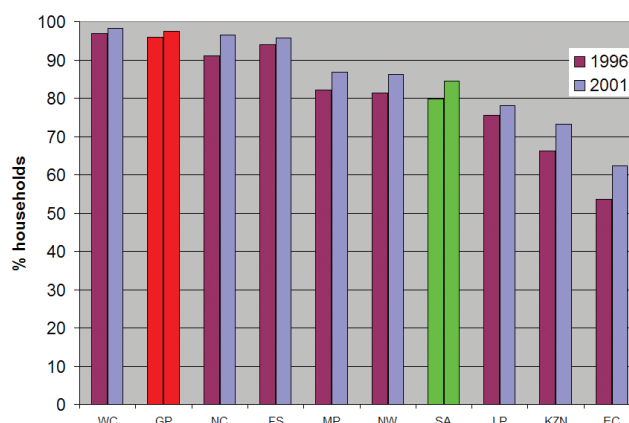


Source: Census in Brief: 2001 data (StatsSA); Socio-economic and demographic profiles of provinces 1999 data: (DBSA: Development Information Business Unit)

**Figure 4.13 Household access to sanitation in 1996 and 2001**

### Access to water

Figure 4.14 illustrates that 97.5 % of the households in Gauteng have access to water<sup>2</sup>, which is high relative to other provinces and the national figure (84.5 %). This is due to the sizeable rural nature of other provinces, where a greater percentage of households are likely to lack access to basic services. There was a marginal increase in access (1.5%) between 1996 and 2001. Access to safe drinking water dramatically reduces vulnerability to waterborne diseases, such as diarrhoea and cholera.



#### Footnotes

<sup>1</sup> Adequate sanitation is defined as households having at least a pit latrine

<sup>2</sup> Access to water in this case is defined as those households with access to piped water within 200m of the dwelling

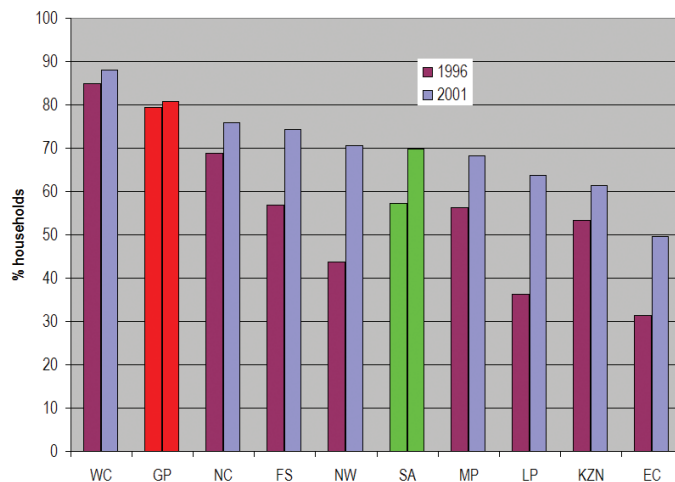






## Access to electricity

Gauteng is second to the Western Cape in terms of household access to electricity, with 80.79 % of households having access (Figure 4.15). This represents a 1.4 % increase from 1996 to 2001, the smallest increase of the provinces. Access to electricity as an energy source is seen as a crucial factor influencing air pollution levels and the consequent health implications. Certain areas, particularly informal areas, have low levels of access to electricity.



Source: Census in Brief: 2001 data: Source: (StatsSA); Socio-economic and demographic profiles of provinces 1999 data: (DBSA)

**Figure 4.15**  
Household access to electricity for lighting in 1996 and 2001

## How does this affect the environment?

- The socio-economic environment is fundamentally a driver and a source of pressures on all other themes. Indicators of these appear in the relevant chapters.
- Poverty and lack of services exert pressures on solid waste, water and air quality, biodiversity and the consumption of resources.
- These in turn all affect human health.

## What are we doing about it?

International Responses	<ul style="list-style-type: none"> <li>• Millennium Development Goals</li> <li>• New Partnership for Africa's Development (NEPAD)</li> <li>• Johannesburg Plan of Implementation</li> <li>• Johannesburg Declaration</li> </ul>
National Responses	<ul style="list-style-type: none"> <li>• The Constitution of the Republic of SA</li> <li>• Restitution of Land Rights Act (22 of 1994)</li> <li>• Housing Act (107 of 1997)</li> <li>• Population Policy for South Africa (1998)</li> <li>• HIV/AIDS Strategic Plan for South Africa (2000-2005) and South African National AIDS Council</li> <li>• Prevention of Mother to Child Transmission Programme for HIV AIDS</li> <li>• Consolidated Municipal Infrastructure Programme (CMIP)</li> <li>• Working for Water Programme</li> </ul>

## Provincial Responses

- The Gauteng Declaration
- Poverty Alleviation Projects (basic amounts of free water and electricity)
- Short term job creation programmes e.g. (Community Based Public Works Programme, Zivuseni Programme to Maintain Provincial Assets)
- The LABMAX programme aimed at maximising labour intensity
- Blue IQ initiatives for industrial and tourism development
- Gautrain development
- GDACE Food Garden Programme
- School Nutrition Programme
- Urban Regeneration Projects such as The Kathorus Special Integrated Presidential Project (KSIPP) and Kliptown Urban Renewal Project, Alexandra and Bekkersdal
- Adopt a Cop and Tiisa Thuto school crime prevention programmes

## Proposed indicators

- It is recommended that information on the public awareness of environmental issues be investigated for the province and an indicator be developed for this. A useful index is the Barometer of Sustainability.
- An indicator to describe security of tenure is recommended.
- The number of jobs created through the Blue IQ projects needs to be evaluated.
- An indicator of crime should be included in future reports, as crime is one of the major factors influencing human well-being in SA. Crime statistics are available but were not included in this report.
- The percentage of the population living in adequate housing needs to be reported on in future reports.
- The percentage of the population with access to public health facilities should be reported.

## What does the social environment link to?

- Land
- Water Resources
- Air Quality
- Biodiversity
- Waste

## Notes about data

Given the variability of the data in terms of historical data and different values and estimates between different studies and publications, it has not been possible to achieve a consistent quality of information across the chapter.

There are limited published studies that have been conducted in SA on the relationship between air pollution, particularly that resulting from domestic energy use, and respiratory diseases.





## Conclusions

The high population growth rate and density in Gauteng, the result of high levels of migration into the province, its economic status and the historical political regime, are the major current and past pressures influencing human well-being. Relative to other provinces, households in Gauteng have high levels of access to basic services, despite the persistence of some significant discrepancies. It is encouraging to note that the incidence of water related diseases appear to be on the decline, no doubt linked to the high levels of access to water and sanitation.

Of particular concern, however, are the rapidly increasing levels of unemployment and HIV/AIDS prevalence. Gauteng has the highest rate of increase of HIV prevalence in SA, with close to 1 in every 3 women testing HIV positive. It is important to address the spread of the disease, as it threatens to undermine the efforts of government and its partners to improve the social well-being of its citizens. Of further concern is the widening gap between the rich and poor, and the increasing levels of poverty in the province.

This SoER has focused on the major biophysical and social environmental issues faced in the province. However, there are two areas which are recommended for reporting on in the update of this report: these are the built environment and cultural heritage resources. As host to the most prominent modern metropole on the African continent and to a World Heritage Site which represents early Hominid history, and as the most urbanised province in South Africa, a major component of the Gauteng environment has been omitted from this report.

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The need for the development of land in response to increasing population as well as for economic growth, on the one hand, needs to be weighed up against its protection for maintaining healthy ecosystems and natural resources, on the other.

## 5. Land

Land is an important resource in Gauteng. Gauteng's urban form primarily evolved from the mining industries and inequitable land and development policies. Many of the towns and cities in Gauteng, particularly on the East and West Rands, developed primarily as a result of the presence of exploitable mineral resources. The subsequent spatial segregation of urban areas along racial and income lines resulted in the urban poor being located far away from the areas of industrial activity within the province. This led to an urban form characterized by fragmented development and urban sprawl.

Unsustainable land use patterns have implications for the condition of the land. Land condition is defined as the state, suitability and nature of the land resource. Changes in land condition are described by type and geographic location. These may include physical soil condition, diversity or density of vegetation cover, thickness of topsoil, alkalinity conditions, etc. Land degradation can limit the capacity of land and water resources to support agriculture, forestry, fisheries, and human settlements.

There is a relative unavailability of developable land in Gauteng, when conflicting development objectives are considered. The need for the development of land in response to increasing population as well as for economic growth, on the one hand, needs to be weighed up against its protection for maintaining healthy ecosystems and natural resources, on the other. The need for Strategic Environmental Assessments (SEAs), Environmental Management Frameworks (EMFs) and Spatial Development Frameworks (SDFs) is emphasised if sustainable use is to be made of the land resources in Gauteng. Importantly, the principle of opportunity cost of land in the interests of the broader society needs to be considered against the instrumental costs, when considering appropriate land uses in the above processes.





## What affects land in Gauteng?

### Pressures related to human settlements and demographics

There are many individual pressures relating to human settlements and population growth. Migration has contributed to the increased population growth and expansion of human settlements, with a consequent unequal distribution of wealth and high population density. Pressures are therefore exerted on resources and the capacity of government to provide services. For example, in Midrand, inadequate sanitation, such as blocked and leaking sewerage pipes and flooded manholes, has caused bacterial and nutrient contamination of soil (IUCN, 1999).

A high demand for urban and industrial land inflates the value of land. This has a negative impact on the gross margins that can be achieved in agriculture. Land value has also had major implications for other sectoral activities, such as residential developments. Low-cost project-linked subsidy housing developments and new, speculative, middle to higher income property developments are being located on the urban periphery where land is cheaper, for example, Diepsloot and the housing estates being located

in the north-west arc of Johannesburg. High land prices also contribute to the decentralisation of industry and other non-residential land uses, further exacerbating urban sprawl.

Urban expansion and unregulated development is seen to be causing the loss of high potential agricultural land and threatening environmentally sensitive areas.

### Growth in the industrial/manufacturing sector

The past growth in the industrial/manufacturing sector has resulted in increased release of discharges and emissions, with a consequent negative impact on the air, water and land resources of the province. Industrial activities are the major source of dry fall-out of oxides of sulphur and nitrogen, as well as wet depositions of acids (acid rain) on soil surfaces. Inadequate environmental management and the lack of clean technology exacerbate this.



### Poor and unsustainable agricultural practices

The increasing demands for agricultural products cause various pressures, such as over-utilisation of fertilisers and chemicals, improper pesticide disposal, increased use of machinery, inappropriate crop rotations and improper farming on marginal lands i.e. the mismatch of land use and land suitability. Agricultural activity on essentially unsuitable land necessitates artificial inputs (as above), thus raising the issue of the opportunity costs of land, that is, what is then the optimal use of land in terms of all the costs and benefits? There are no indicators for the monitoring of this pressure, although soil salinization and acidification are proposed.

### Unutilised and unrehabilitated mining land

Gauteng has an abundance of unutilised (rehabilitated but sterilised or only wildlife potential) and unrehabilitated mining land including tailings dams and waste rock dumps. Also undermining has left large tracts of land fallow and subject to development constraints. It is estimated that 15 000 – 16 000 ha of land has been sterilised by

160 tailings dams and cannot be used for human settlement development (GPG, 2004).

### Transport routes increase susceptibility to degradation

The construction of transport routes fragments land, causing potential biodiversity and habitat destruction and increasing the susceptibility of land to degradation. Furthermore, the construction of roads requires excavation of minerals such as gravel. The development of transport corridor, encouraged by spatial planning, also contributes to mobile pollution.

### Lack of sustainable energy practices

The burning of fossil fuels for power generation, particularly in Mpumalanga, is a major cause of acid rain in South Africa. Also, pollution from domestic fuel burning is a cause of acid deposition on soils and increasing reliance on private vehicles and small public transport units (taxis) will add to the problems associated with fossil fuel burning. There is no current information on this for the Gauteng province.



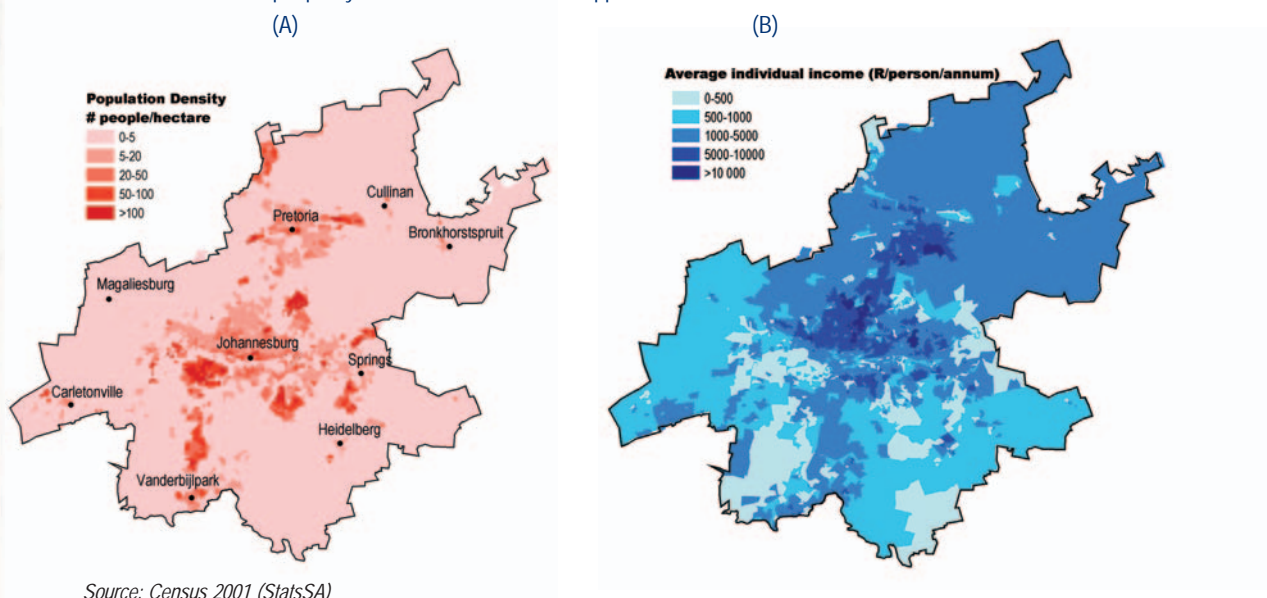


## How is our land doing?

### Land use

#### Distribution of residential densities

Figure 5.1 shows that middle and upper-income residential areas, mainly in the northern suburbs of Johannesburg and Tshwane, supporting low densities, are located near to most of the urban opportunities, whereas low-income areas, supporting medium and high population densities are mostly located on the urban periphery and isolated from urban opportunities and services.



Source: Census 2001 (StatsSA)

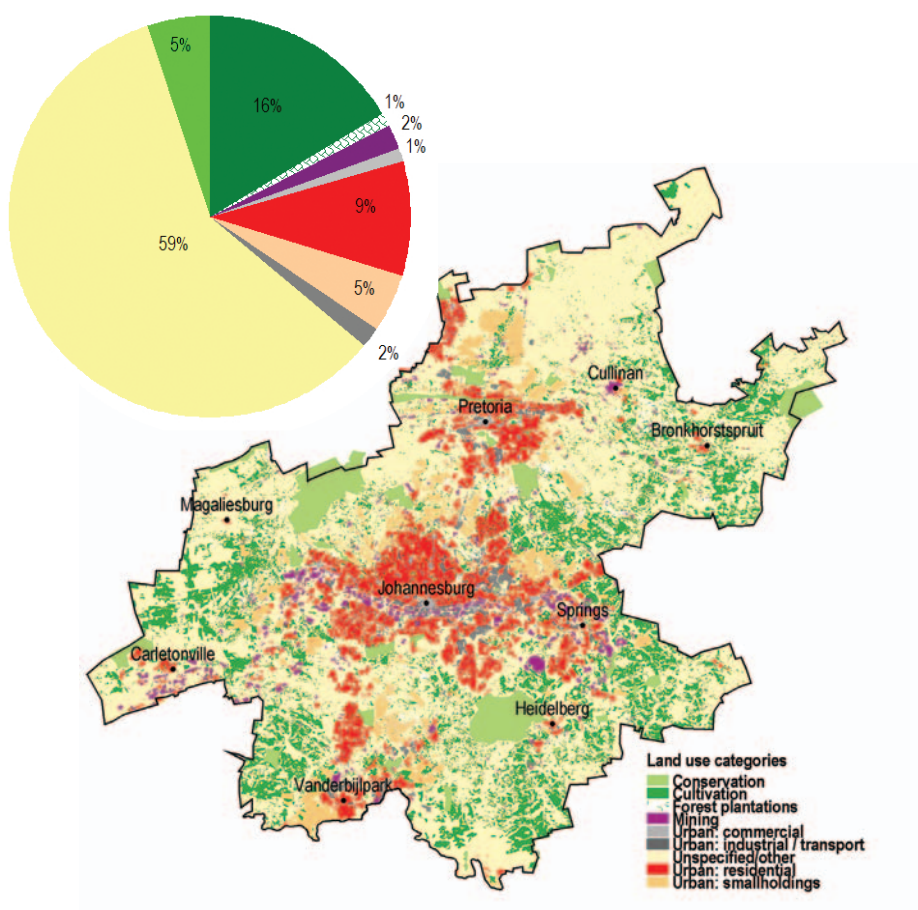
Figure 5.1 Comparison of (A) population and housing distribution with (B) income levels

### Land use change

The distribution and proportion of land uses for the year 2002 is shown in Figure 5.2. Unfortunately, changes in land uses cannot be properly assessed by comparing the 1995 land cover data, because this was drawn from a coarser scale of 1:250 000, while the 2002 map was drawn at 1:50 000. Many differences therefore are due to scale. What is evident is that the area of cultivation and smallholdings was over-estimated in the 1995 data, due to the lower scale (1:250 000). Similarly, the area of untransformed land was under-estimated. For the next State of the Environment Report, the 2002 map will be used as a baseline, because it is more accurate. Nevertheless, from these maps the following are apparent:

- Urban development is concentrated in two centres, namely, Johannesburg and Pretoria. These two centres are rapidly merging along the Ben Schoeman Freeway (N1) and R21;
- There is a smaller urban concentration in the south, the Vanderbijlpark-Vereeniging complex;
- The Johannesburg and Ekurhuleni Metropolitan Areas are largely surrounded by smallholdings and conservation areas; Cultivated agricultural lands are mostly concentrated on the south, west and eastern edges of the province;
- The largest growth in residential land use appears to have taken place on the urban peripheries, i.e. the trends associated with the 'apartheid city' are being perpetuated.

Although when comparing the two abovementioned maps, land coverage in general remained static between 1995 and 2002, it is the view of GDACE that this is not the case, due to the number of environmental impact assessments evaluated since 1998 in what were 'greenfield' sites (undeveloped sites). However, there are no accurate data on this as yet.



*The Unspecified/other category includes natural grassland, thicket and bushland, waterbodies and wetlands  
Source: National Landcover 2000 (CSIR/ARC); Gauteng Open Space Project 3 (GDACE 2003)*

**Figure 5.2 Land use in Gauteng in 2002**

### Area of urban and rural land use

Although 17 % of the land in Gauteng constitutes urban land uses, 16 % of Gauteng's area falls within the 2000 Urban Edge Boundary. This will serve as a baseline for future change analyses. It is evident that development is not taking place within the delineated urban edge, but that urban sprawl is occurring.

## Land condition

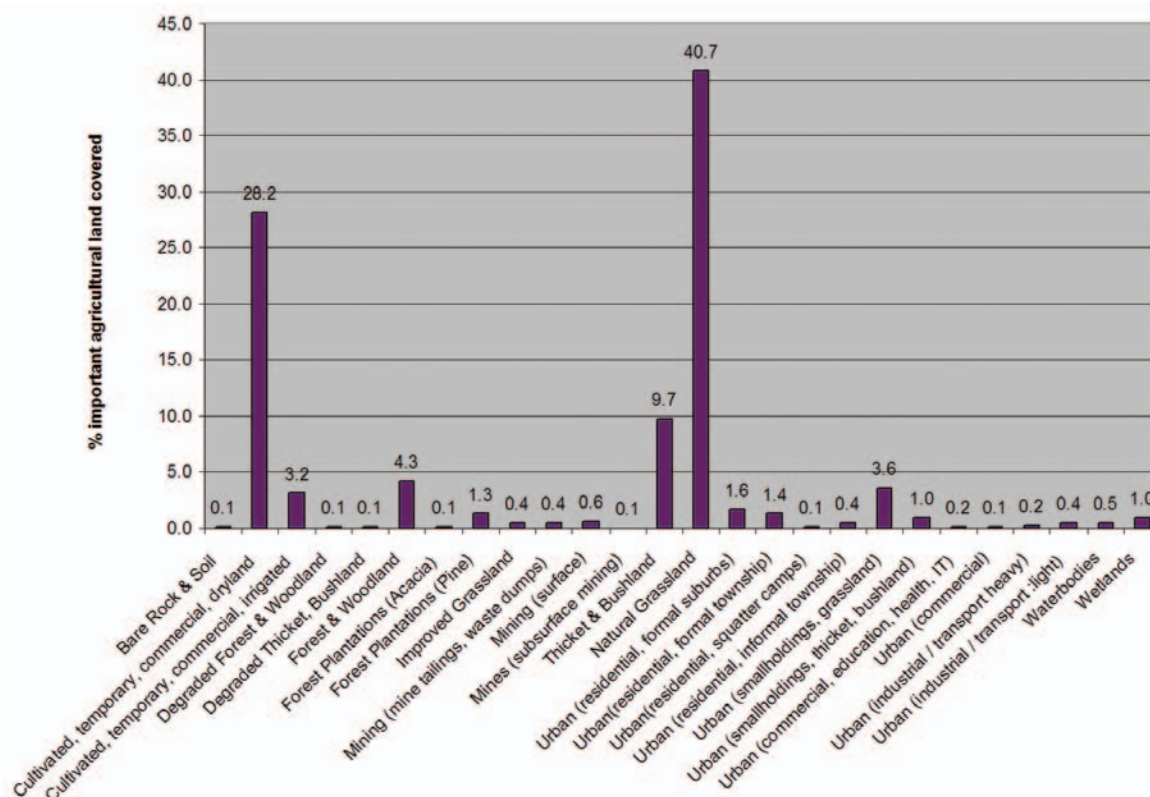
### Status of high potential agricultural land

The loss of high potential agricultural land due to urban sprawl was one of the identified key environmental issues in Gauteng in the Gauteng Environmental Implementation Plan (GPG, 2002). Estimates by the National Department of Agriculture indicate that only  $\pm 12\%$  of South Africa's land surface is arable (GPG, 2004), and 13% is irrigable. Furthermore, only 4% of the country's land area is high or moderate potential land. Gauteng falls within this area.

Approximately 28.7% of Gauteng has been identified as land that needs to be protected for agricultural use (calculated from the Gauteng Agricultural Potential Atlas). The emphasis of this is on areas with potential for irrigated crop production. This is made up of 15.1% high

potential and 13.6% moderate-high potential land. These areas lie mainly within the West Rand District Municipality, with smaller, more fragmented portions in the north and the East Rand, as well as south and east of Heidelberg (Figure 2.5). In 2002 16.4% of land was cultivated.

Although it was not possible to report on the loss of high potential lands by different land cover classes due to the scale differences in land cover data mentioned above, Figure 5.3 indicates the availability of high potential agricultural land in the province. Only 28.2% of this land is currently cultivated, while a large proportion is undeveloped (40.7). It should be noted that significant portions of this high potential, undeveloped land is regarded as being of high conservation importance.



Source: Calculated from GAPA and NLC 2000

Figure 5.3 Landcover categories on high and moderate to high potential agricultural lands in 2002

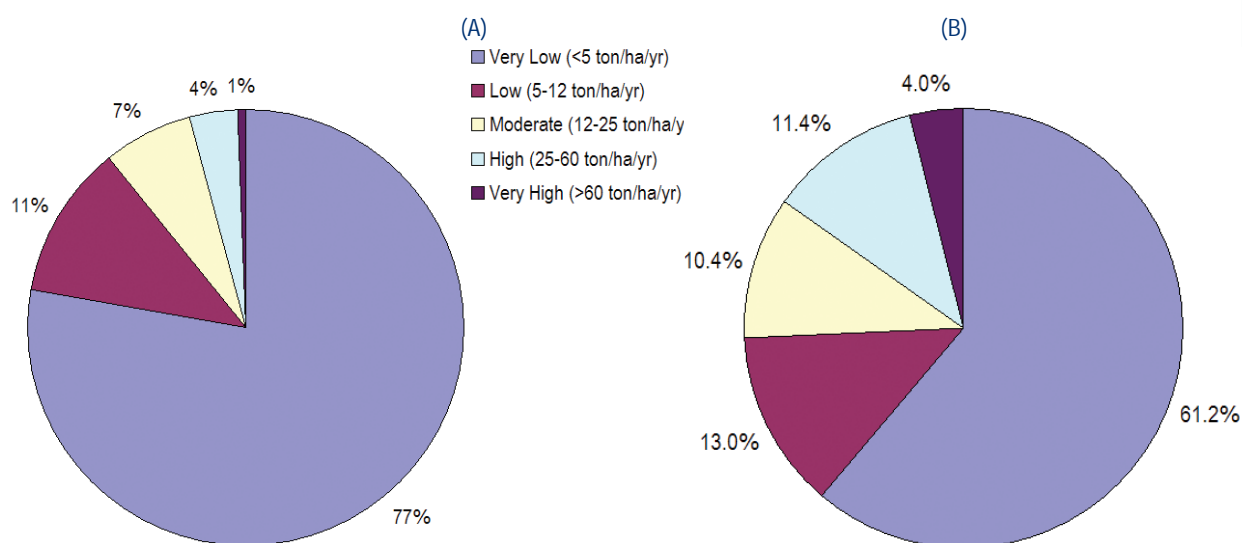


### Soil loss

In order to identify high priority soil loss areas due to erosion within Gauteng, the actual areas of erosion as mapped in the NLC 2000 (2002) data were compared with the predicted soil loss areas from the Gauteng Natural Resources Audit (ISCW, 2001).

Erosion hazard is the probability of serious erosion starting in the near future (a period of

about 3-5 years). When serious natural or accelerated erosion is already occurring, the erosion hazard expresses the expected intensity and rate of erosion processes. Figure 5.4A summarises the proportions of predicted erosion hazard categories for Gauteng. Most of Gauteng has a very low to low predicted soil loss. Only 5 % falls into the high to very high categories.



Source: Calculated from Gauteng Natural Resources Audit (ISCW, 2001) and NLC 2000

**Figure 5.4 Area of (A) predicted erosion hazard classes and (B) actual eroded areas in 2002 covered by predicted erosion classes**

In 2002 as mapped, no sheet erosion was visible in Gauteng, but rather 598 hectares of bare rock and soil due to donga and gully erosion had occurred. These actual eroded areas were compared to the predicted categories (Figure 5.4B). Most of the areas of actual erosion were categorised as areas with very low erosion potential, while 15 % were categorised as high to very high potential. This means that there is not likely to be a significant increase in erosion in the province in the short-term.

### Vegetation condition

Gauteng is not severely degraded, with 33 % of the area that was mapped showing good rangeland condition meaning > 60 % grass cover, just over 16 % having an intermediate condition of 40-60 % grass cover, just over 10 % showing severe grass species change and reduction in cover (bad and very low cover) and only 1.0 % having bare soil. Gaps in data on the edges of the province were not mapped as these extended over the satellite image coverage boundary.

### Land degradation

According to Hoffman (2000) Gauteng was evaluated to be the second least degraded province in South Africa, following the Free State. The combined degradation index of Gauteng was 143, with only the Free State at 134 being lower. This index describes the combined severity and rate of soil and veld degradation, on a scale of – 97 to 1 111. Gauteng has the lowest veld degradation index in South Africa (31 on a scale of 0-540) and the fourth lowest soil degradation index (113 on a scale of –97 to 650).

### Soil contamination

The 1998 Gauteng SoER stated that the major sources of soil contamination in Gauteng were hydrocarbon leakages from petrol filling stations, improper pesticide disposal from the agricultural sector, chemical spillages from organic chemical industries, acidification from mine waste dumps, and heavy metal pollution from sewage and metal industries (GDACEL, 1998). No updated information is available for this.

## What are the consequences?

### Rapid and unplanned urbanisation

The population growth rate of 4.1 % per annum generates growing demand for the provision of basic services i.e. housing, roads, water, sanitation and electricity. Another result is that communities locate themselves in marginal, unsuitable, environmentally poor and sensitive areas, without good shelter and basic services.

Where informal settlements are replaced with formalised development, the negative impacts are improved and often result in positive impacts.

#### Positive impacts:

- Social improvements: security of tenure, wealth creation, the provision of education facilities and health facilities
- The provision of well constructed housing and basic services
- Improved access to social facilities and reduced travelling time between home, social facilities and work opportunities.

### Decline in contribution of agriculture to the GGP

The long-term effects of pollutants and rapid land transformation potentially pose a threat to optimal agricultural production, and potentially a decline in the contribution of agriculture to the GGP. The contribution of agriculture to GGP has declined, along with mining, but it cannot necessarily be causally linked to urban expansion. Furthermore, most of Gauteng's high potential agricultural land remains, but it is not all being used for cultivation (cultivation patterns do not necessarily correlate with the land's productive potential) .

#### Negative impacts include:

- An increase in the housing backlog, partly as a result of rapid urbanisation
- Formalisation of peripheral settlements resulting in the perpetuation of the segregated, fragmented 'apartheid city', and its spatial disadvantages, such as long commuter distances leading to high transportation costs, increased pollution, etc.
- Degradation of the environment resulting in:
  - Reduction in biodiversity (species, habitats and ecological functioning)
  - Disruption of ecosystem services, notably wetland and riverine pollution assimilation capacity;
- Degraded systems have a decreased ability to cope with change i.e. climate change, and are more susceptible to alien infestation.

## What are we doing about it?

International Responses	<ul style="list-style-type: none"> <li>Stockholm Convention on Persistent Organic Pollutants</li> </ul>
National Responses	<ul style="list-style-type: none"> <li>Environment Conservation Act (73 of 1989)</li> <li>Development Facilitation Act, 1995 (Act No.67 of 1995)</li> <li>Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000)</li> <li>Demarcation Act, 1998 (Act No. 27 of 1998)</li> <li>Land Administration Act (2 of 1995)</li> <li>Land Reform (Labour Tenants) Act (3 of 1996)</li> <li>Land survey Act (8 of 1997)</li> <li>Land Titles Adjustment Act (111 of 1993)</li> <li>Resolution of Land Rights Act (22 of 1994)</li> <li>Subdivision of Agricultural Land Act (10 of 1970)</li> <li>Land Use Management Bill of South Africa</li> <li>Minerals and Petroleum Resources Development Act No 28 of 2002 and draft regulations thereof;</li> <li>Soil Conservation Act (76 of 1969)</li> <li>Environmental Impact Assessment Regulations (1182 and 1183) 1997</li> <li>National Agricultural Extension Forum</li> </ul>
Provincial Responses	<ul style="list-style-type: none"> <li>Gauteng Planning And Development Act, 2003 (Act 3 of 2003)</li> <li>Gauteng Spatial Development Framework</li> <li>Gauteng Planning Bill</li> <li>Gauteng Open Space Project – Phase 3</li> <li>Buffer Zones Project – Phase 2</li> <li>Gauteng Agricultural Potential Atlas</li> <li>Gauteng Natural Resources Audit</li> <li>Gauteng Smallholdings Audit</li> <li>Bronberg Ridge System Strategic Environmental Assessment</li> <li>Development of Environmental Management Frameworks for sensitive areas threatened by development pressures</li> <li>Dinokeng Blue IQ project including an Integrated Tourism Development Framework and negotiations for the proposed Dinokeng Game Reserve</li> <li>Cradle of Humankind Blue IQ project</li> <li>Establishment of a Provincial Advisory Committee to advise the Land Bank on financing of agricultural enterprises</li> <li>Land Redistribution and Agricultural Development Programme (LRAD)</li> <li>Gauteng Farmer Settlement Programme (GFSP)</li> <li>Household Food Security Programme               <ul style="list-style-type: none"> <li>GDACE runs a food garden programme which has helped put food on the table for over 12 000 Gauteng households over the last seven years</li> <li>In October 2003 a new programme was launched targeting an initial 1 000 households with food garden starter packs and tools in three of the most impoverished informal settlements</li> </ul> </li> <li>GDACE input into local authority IDPs, SDFs, and SEAs of SDFs</li> <li>The Agricultural Research Council's Vegetable, Ornamental Plant Institute (VOPI) provides training and empowers farmers to supply reliable, good quality produce on a continuous basis.</li> <li>There is a Peat Working Group through which all applications to mine peat in Gauteng is processed</li> </ul>
Local authority responses	<ul style="list-style-type: none"> <li>Integrated Development Plans</li> <li>Spatial Development Frameworks</li> <li>State of Environment Reports</li> </ul>





## Proposed Indicators

The following indicators are proposed for future use:

- Soil contamination by heavy metals, organic and inorganic pollutants. No current data is available. It should be measured 5 yearly at local level throughout the province.
- Soil acidification, soil salinisation, number of people with agricultural purpose water rights
- Change in open space (passive and active in urban areas).
- Property value of agricultural land vs. urban/industrial land.
- Areas of unrehabilitated, rehabilitated and sterilised mining land.
- Wasted and degraded land in mining zones per GDP in the mining sector – decoupling between mining GDP and wasted and degraded land – ratio decline would mean mining sector impact less on land degradation.
- Areas of peat sources in Gauteng.

## What does this chapter link to?

- Social Environment
- Air quality
- Waste
- Water
- Biodiversity

## Notes about data

- All percentages shown have been calculated using a total area of 1 701 000 ha for Gauteng as used by the Department of Land Affairs. Total areas calculated from the GAPA and GNRA data sets do not equal this total for various reasons.
- In the GAPA data (soils, land capability, agricultural potential, areas to be protected for agriculture), the PWV region was surveyed at a 1:50 000 scale and the remaining portions of Gauteng at a 1:250 000 scale. This therefore does not allow the accurate estimation of areas.
- Due to inconsistencies in the ortho-rectification process of satellite imagery for the National Landcover 2000 project, there is an inaccuracy in geographical positioning of the data. There may therefore be inaccuracies in the data presented for areas of high potential land occupied by various land uses.
- The Urban Eye 1999 land cover data set was not used in land use change analysis as the data comprises both 1: 50 000 (for urban areas in 2001) and 1:250 000 data (for other areas from the 1995 landcover data set. There are also 2 1:50 000 sheets for which there is no data.
- An accurate change analysis of land use was not possible due to the difference in scales between the NLC 2000 data (1:50 000) and the 1995 NLC data (1:250 000).
- Rangeland condition data from the GNRA is insufficient as there are large areas of the province for which there is no data.

## Conclusions

The spatial pattern of land use in Gauteng is inefficiently and inequitably structured. The urban poor are distant from urban opportunities, while density is in many instances inversely related to adequate service provision.

In general, Gauteng's residential densities are low when compared to other cities of similar size and function. For example Sao Paulo in Brazil has a population density of 6896 people per km<sup>2</sup>. The SDFs prepared by the various municipalities in Gauteng, still tend to support the same urban form and densities, densities that are not economically sustainable.

The National Housing Board Subsidy Programme, and in particular the project linked subsidies, are only viable when developed on undeveloped land situated on the urban periphery, i.e. agricultural land. Further, these developments are governed by a minimum stand size in the region of 250m<sup>2</sup>, giving a gross density yield of 100 people per hectare. This factor further leads to perpetuating the current urban trends.

Much of the high potential agricultural lands are untransformed and preliminary analysis suggests bush encroachment to be a greater threat to this land than urbanization. The smaller proportion of these areas is currently under cultivation, and a sizeable proportion of cultivated land is on lower potential land, that is, there is only a loose correlation between land potential and production. Despite the presence of this undeveloped, good potential land, the contribution of agriculture to GGP has fallen over the past decade. The reasons for this must be sought elsewhere than development pressure and urban expansion.

The data described in this section confirms statements in the land degradation study by Hoffman (2000) that Gauteng is the second least degraded province. Erosion levels are low and cannot be considered important at this stage. The mining of peat and soil loss and degradation through acidification, salinisation and sterilisation, depicted as soil contamination by heavy metals,

radio-active elements, organic and inorganic pollutants are issues that need to be assessed.

These issues could possibly be better mitigated through a more sectorally integrated land use planning approach. Furthermore, innovative land use and planning incentives and guidelines need to be investigated to halt the current trend towards less efficient settlement patterns and to encourage more sustainable development patterns.

Due to the data limitations and inconsistencies mentioned above, it is recommended that a central archive of data be established, which will standardise data parameters and allow more successful integration and analysis for future reporting. Many of the data sets are an amalgamation of different scales of data and it is recommended that the areas at a lower scale are updated in order to standardise scales.



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## 6. Water Resources

Gauteng lies in the upper reaches of three water management areas (WMAs): the Crocodile West-Marico, Upper Vaal and Olifants River. Naturally, Gauteng's water resource would come from surface runoff and ground water, however due to the high demand for water, Gauteng imports raw water from outside the province (for example the main supply to the province is from the Vaal river which receives input from the Lesotho Highlands Project). Some of this imported resource is returned to the water system by means of industrial and domestic discharges.

Surface waters comprise both flowing rivers and lakes or dams, with many of the smaller tributaries being seasonal in nature (i.e. dry in the winter). The aquifers<sup>1</sup> found in the Gauteng province are diverse due to the varied and complex geology of the province. The aquifers can be grouped into four hydrogeological types (DWAF, 1999A) namely: intergranular (alluvial – found in valley bottoms); fractured aquifers; karstic (dolomitic) aquifers; and intergranular and fractured aquifers (in the weathered zone). The quality of water in these resources is highly variable depending on the geology, ecological setting and influence of man.

Water is a fundamental natural resource and is indispensable to life. SA is located largely in a semi-arid part of the world, and so its water resources are scarce. Although renewable, water is a finite resource, which requires careful management and protection. Water is highly susceptible to pollution and continued deterioration of water quality in some parts of SA has lead to the Department of Water Affairs and Forestry (DWAF) and the DEAT to adopt a more comprehensive approach of integrated pollution control and waste management.

### Footnotes

<sup>1</sup> An aquifer is a geological formation which has structures or textures that hold water or permit appreciable water movement through them (National Water Act 36 of 1998)



## What affects our water resources?

### Increased demand for access to water and sanitation due to urban development and population growth

The growing population and economic development in the province have increased the domestic and industrial demand for water. Added to this, the extraction and processing of mineral resources, and the agricultural activities in Gauteng, place pressures on the water resources. These pressures result in the need for additional water management infrastructure such as dams, pipeline systems or additional treatment works to ensure that water resources are available to meet the ever increasing demand.

There is a loss of groundwater recharge potential due to increased runoff from increasing urbanisation which reduces the availability of this resource both to human consumers and the aquatic ecosystems fed by groundwater resources (e.g. via springs).

### Increased pollution loads to water resources

Pollution of water resources occurs in the form of point-source releases (for example discharges from sewage treatment works) and diffuse inputs via air or soil (for example fall out of air borne particulate matter from the burning of coal). Currently, DWAF is developing a Water Management System (WMS) database, which collects information on volumes of point source discharges entering water resources. Data from WMS is currently not available.

An example of how increased urban development is increasing pollution loads can be seen in the overloading and lack of maintenance of sewage systems, most of which are operated by service providers such as the municipalities, East Rand

Water Care Company (ERWAT) and Magalies Water. Data provided by Johannesburg Water indicate that there is a small increase in the volumes of sewage effluent being discharged to surface waters and greater increases are expected for works located on the edges of urban development zones. In more rural areas, sewage treatment is handled by privately owned package treatment works or septic tank systems. The destruction of wetlands due to inadequate sanitation, particularly in poor areas, is occurring at a rapid rate.

Other sources of pollution include mining; storm water runoff; use of fertilizers, pesticides, herbicides in agriculture; uncontrolled dumping of wastes close to and in water resources and leachate from waste disposal facilities.

### Aquifer dewatering and rewatering

Aquifer dewatering (in active mining areas enabling deep level mining) and aquifer rewatering (in old mining areas where groundwater levels are being re-established), is a major issue in Gauteng. Potential risks include the formation of sinkholes in the Dolomite areas and decanting of potentially polluted water in low lying areas. For example, groundwater from abandoned mines on the West Rand, which is at a higher elevation, is migrating towards the lower elevations at active mines on the East Rand resulting in the need for continuous discharges.



## What is the quality of our water?

### Surface and groundwater quality

Indicators that have been selected to show the current status and temporal trends include:

#### Chemical – inorganic chemical:

- **Total dissolved solids (TDS)** is used to indicate the salinity of surface water resources. TDS levels indicate the suitability of water for various uses such as domestic consumption, agriculture or industrial activities. High levels are generally related to discharges from industrial and mining activities.
- **Sulphate/chloride ratio** is used to indicate influence of mining on increased salinity (for surface waters only).

#### Eutrophication:

- **Nitrate ( $\text{NO}_3$ )** is used to represent the nutrient status of water resources. High levels are generally related to influences from agricultural and urban activities, for example sewage effluent discharges.
- **Phosphate ( $\text{PO}_4$ )** is also used to represent the nutrient status of water resources. High levels are generally related to urban activities such as the use of detergents.

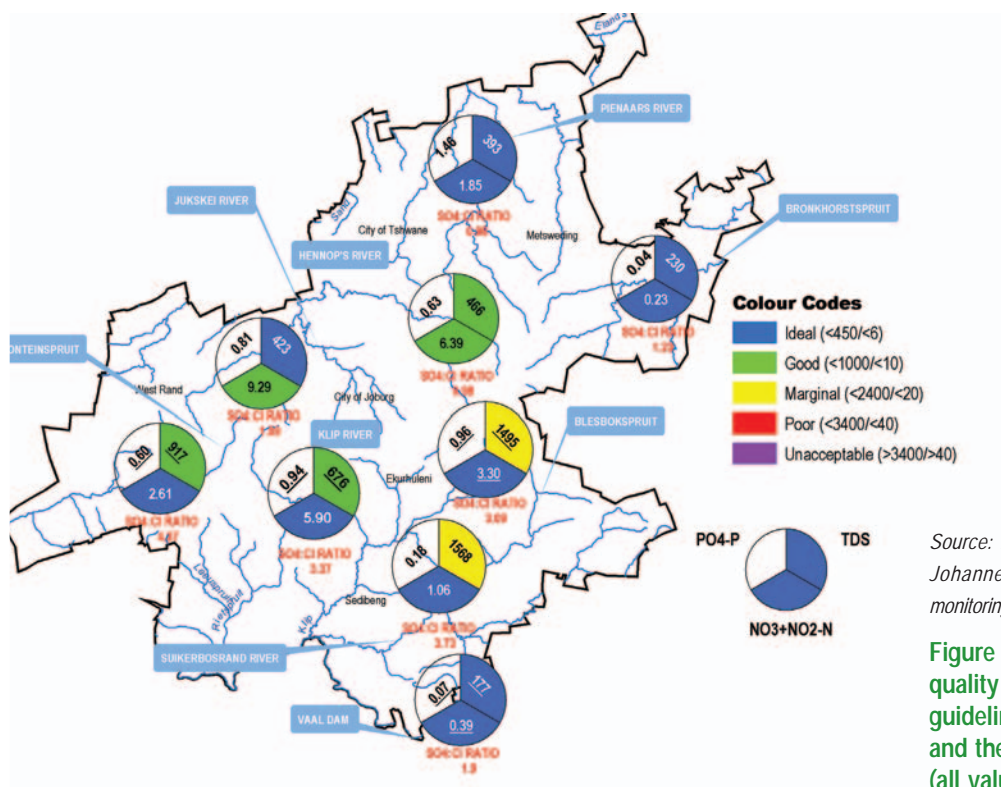
#### Microbiological:

- **Faecal coliform** levels are used to indicate levels of microbiological contamination, which poses possible risks to health and recreational activities. Ingestion of or contact with water contaminated with faecal coliforms results in dysentery, diarrhoea and skin infections.

The quality of surface water is represented spatially in Figure 6.1 by comparing the results of water quality monitoring for TDS, phosphate and nitrate (90<sup>th</sup> percentile value for the period 1999 to 2003) in Gauteng for different rivers to DWAF's water quality guidelines for consumptive domestic use in the case of TDS and nitrate (DWAF, 1999B). There is no domestic guideline for phosphate. Sulphate/chloride ratios are also presented in red in this figure.

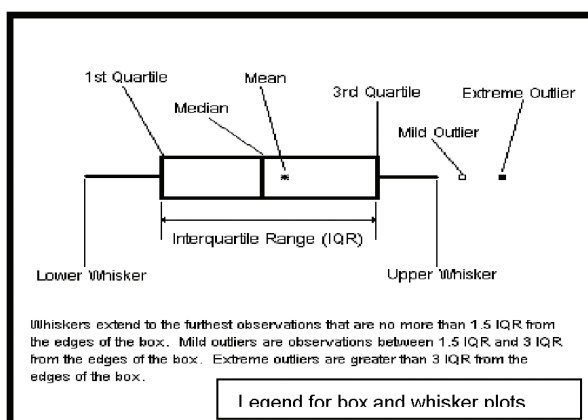
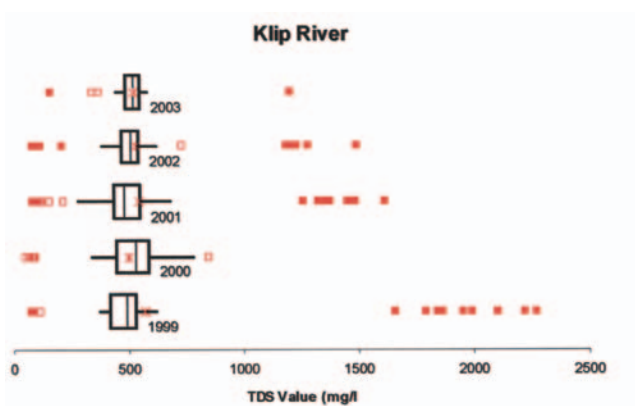
Catchment management forums have been formed in some of the water management areas (WMA) and each catchment management forum has, or is in the process of developing, specific in-stream water quality guidelines. Table 6.1 shows the ideal range of water quality guidelines for TDS,  $\text{NO}_3$ ,  $\text{PO}_4$  and faecal coliforms for some of the rivers found in Gauteng (note that not all the catchments have water quality guidelines yet). Some of the guidelines set by the catchment management forums are more stringent than DWAF's guidelines for domestic use. Values exceeding the guidelines developed by the catchment management forums have been underlined in Figure 6.1. Box and whisker plots for three of Gauteng's rivers for the individual years 1999 to 2003 are given in Figure 6.2 to show possible temporal changes.

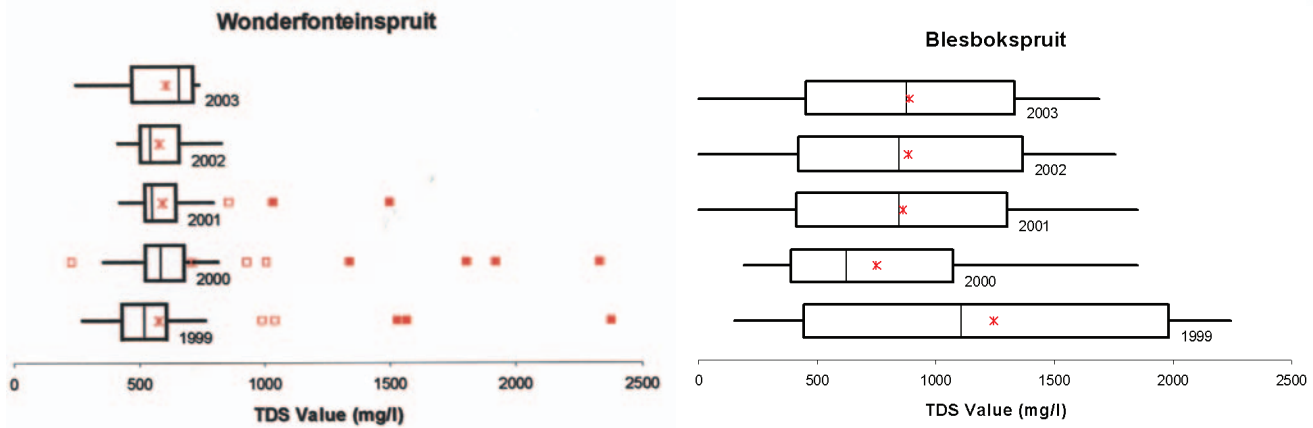




Source: DWAF, Rand Water, City of Johannesburg, City of Tshwane monitoring data

Figure 6.1 Surface water quality in terms of guidelines for domestic use and the Special Standard (all values in mg/l)





Source: DWAF, Rand Water, City of Johannesburg, CTMM

**Figure 6.2:** (pages 54 and 55) Box and Whisker plots for the years 1999 to 2003 in the Klip River, Blesbokspruit and Wonderfonteinspruit

**Table 6.1** Water quality guidelines for different rivers in Gauteng

	EC (mS/m)	TDS (mg/l)	NO <sub>3</sub> +NO <sub>2</sub> (mg/l)	NO <sub>3</sub> (mg/l)	PO <sub>4</sub> (mg/l)	Faecal coliforms (counts/100ml)
DWAF National Domestic Water Quality Guidelines	70	450	6		1.0	<1
Klip River	<80			<2	<0.2	<1000
Blesbokspruit & Suikerbosrand	<45			<0.5	<0.2	<126
Vaal Barrage	<30			<1.0	<0.25	<131
Vaal Dam	<10			<0.1	<0.05	<10
Wonderfonteinspruit	40	280	5		0.1	-

Source: DWAF

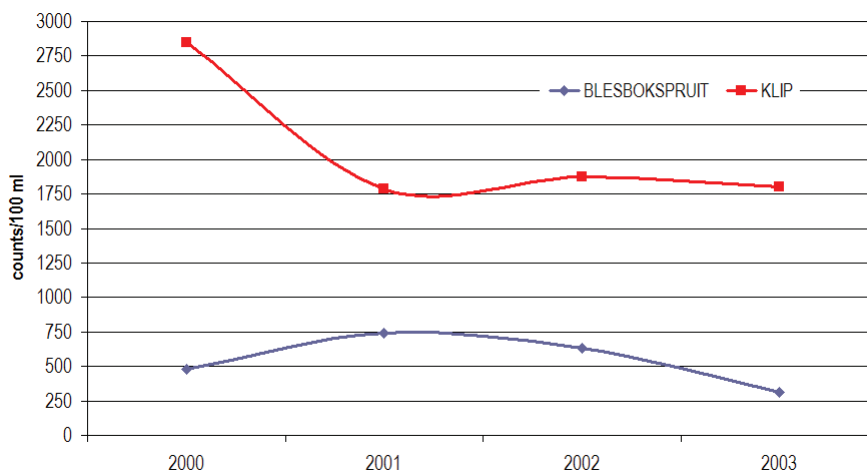
Sulphate/Chloride ratios and salinity values are elevated along the east-west mining belt (Blesbokspruit, Klipriver and Wonderfonteinspruit), and also increase towards the south in the Suikerbosrand River, indicating the polluting influence of the mining industry. The Blesbokspruit shows the highest concentrations of TDS, however both the Klip and the Wonderfonteinspruit also show high TDS values, though less frequently (Figure 6.2). No obvious temporal variation is apparent.

Although not shown in Figure 6.1, the available data shows that poor levels of faecal coliform are evident in the Pienaar's, Hennops, Klip River,

Suikerbosrand rivers and the Vaal Dam. The trends in faecal coliform levels in the Klip River and the Blesbokspruit are shown in Figure 6.3. Faecal pollution of these rivers has historically been a problem (DWAF, 1999C). Currently, the faecal coliform levels are unacceptable in terms of DWAF's water quality guidelines for consumptive domestic use (should be less than 1 count per 100 ml) (DWAF, 1999B).

Due to data limitations for groundwater quality, it is difficult to indicate the current status of groundwater in the province and whether the quality is deteriorating with time.





Source: Rand Water

Figure 6.3 Faecal coliform trends in the Klip River and Blesbokspruit from 1999-2003

## Ecological status of rivers in Gauteng

The River Health Programme (RHP) monitors the ecological status of rivers in Gauteng. Information obtained from biological indices (habitat integrity, aquatic invertebrates, fish population and riparian vegetation) is used to assess the health of river systems. Table 6.2 summarises the ecological status of rivers in the south of Gauteng. No rivers remain in their natural state, although the habitat and riparian vegetation remain largely intact in the Upper Klip River (near Soweto) and Middle Blesbokspruit respectively. Aquatic biota and water quality are generally in poor to fair condition. In comparison to status of other provincial rivers,

for e.g. the Crocodile, Sabie-Sand, Olifants and the Free State River systems (River Health Programme 2003, 2001A and 2001B) the ecological status of the rivers in Gauteng is generally fair to poor.

Information on the status of the rivers in the north of Gauteng will be available in 2005. It is thought that rivers in the north are of a similar ecological state to those in the south, with the exception of Skeerpoort River. This river has its source in dolomitic cave systems and is still relatively pristine except for the exotic riverine vegetation that occurs downstream.

Table 6.2: The ecological status of southern Gauteng rivers

River Health Indicator	Upper Klip	Natalspruit	Lower Klip	Suikerbosrand	Rietspruit	Upper Blesbokspruit	Mid Blesbokspruit	Lower Blesbokspruit
Habitat	Good	Fair	Fair	Fair	Poor	Poor	Fair	Fair
Aquatic Invertebrates	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Fair
Fish Populations	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Riparian Vegetation	Fair	Fair	Poor	Poor	Not determined	Poor	Good	Poor



**River Health Indicators**

<i>Habitat:</i>	<i>Instream availability and habitat diversity</i>
<i>Aquatic Invertebrates:</i>	<i>A variety of organisms (snails, insect larvae, crabs &amp; worms) requires specific habitat types and water quality for part of their life cycle</i>
<i>Fish populations:</i>	<i>Fish are good indicators of the longer term influences on a river reach and general habitat conditions</i>
<i>Riparian vegetation:</i>	<i>Healthy riverbanks maintain the form of the river channel, provide habitat for species (aquatic and terrestrial) and filter sediment minerals and light</i>

**River Health Category**

<i>Natural:</i>	<i>No negligible modification of habitat and biota</i>
<i>Good:</i>	<i>Some human-related impact; biodiversity largely intact</i>
<i>Fair:</i>	<i>Significant pressure from development and land use; sensitive species may be lost</i>
<i>Poor:</i>	<i>Natural functioning disrupted; extensive use of river ecosystem</i>

Source: River Health Programme, 2003

## Eutrophication of water bodies in Gauteng

Eutrophication refers to the enrichment of water bodies with plant nutrients, particularly phosphorus and nitrogen compounds. It is a natural phenomenon that normally occurs during the life of an impoundment and can take thousands of years to occur. 'Cultural' eutrophication is an unnatural process caused by increased nutrient loading as a direct result of human activities. Agricultural and urban run-off, municipal and industrial wastewater effluents, and septic tanks all contribute plant nutrients. Most of the major dams in Gauteng have unacceptable levels of eutrophication (Table 6.3), which have implications for human health and recreation.

**Table 6.3 Trophic classification of Gauteng's major dams (Oct 2002 to Sep 2003)**

Dam name	Trophic status
Bon Accord	Hypertrophic: Serious potential and current algal productivity
Bronkhorstspuit	
Hartebeespoort	
Rietvlei	
Roodeplaat	
Roodepoort	Mesotrophic: Serious potential and significant current algal productivity
Vaal Barrage	Oligotrophic: Significant potential and current algal productivity
Vaal	Mesotrophic: Significant potential and current algal productivity

Oligotrophic	Low in nutrients and not productive in terms of aquatic animal and plant life.
Mesotrophic	Intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems.
Eutrophic	Rich in nutrients, very productive in terms of aquatic animal and plant life and showing increasing signs of water quality problems.
Hypertrophic	Very high nutrient concentrations where plant growth is determined by physical factors. Water quality problems are serious and can be continuous.

Source: <http://www.dwaf.gov.za/iwqs/eutrophication/NEMP/hempdam.htm> (DWAF 2002)



## How does this affect our environment?

- Increased need (and related cost implications) for water management infrastructure or water conservation and demand management measures to provide adequate supply to meet the increasing demand. There are potential ecological consequences results from these measures such as importing water from different catchments or creating dams.
- Due to high pollution loads in many areas, there will be increased water treatment costs specifically for waters with high concentrations of salts.
- Poor riparian ecology as a result of high pollution loads of surface waters will result in a degradation and loss of aquatic life.
- The aesthetic value of water resources will be lowered, due to unsightly algal blooms and dirty water. There may be a consequent reduction in tourism and investment income.
- Irrigation of crops with contaminated ground and surface water leads to reduced crop productivity and diversity.
- Ingestion of contaminated water or consumption of affected crops resulting in health deterioration (skin infections, vomiting, gastro-intestinal problems). Having said this however, incidences of diarrhoea have decreased in the province, mainly due to the increase in access to piped water. These health-related effects may therefore be localised and difficult to track on a provincial level.

## What are we doing about it?

International Responses	<ul style="list-style-type: none"> <li>● RAMSAR Convention</li> <li>● Millennium Declaration and WSSD Targets</li> </ul>
National Responses	<ul style="list-style-type: none"> <li>● National Water Act</li> <li>● Water Services Act</li> <li>● Minerals Act</li> <li>● Minerals and Petroleum Resources Development Act</li> <li>● GDACE participation in DEAT &amp; DWAF working groups</li> <li>● Working for Water Programme</li> <li>● National Waste Management Strategy</li> </ul>
Provincial Responses	<ul style="list-style-type: none"> <li>● Rivers Health Programme</li> <li>● GDACE Strategic Plan 2003/04 – 2005/06</li> <li>● Input to various municipal IDPs</li> <li>● Consideration of NEMA principles and sustainable development issues in departmental approvals and programmes</li> <li>● Development and implementation of compliance and enforcement guidelines</li> <li>● Participation in catchment management forums – Blesbokspruit and Klip River forums</li> <li>● Co-ordination with other provincial departments and local municipalities on EIA authorisations, mining authorisations, water use licences</li> <li>● Progressive implementation of National Waste Management Strategy</li> <li>● Use of Cleaner Technology Capital Fund to provide technical assistance to companies and municipalities seeking to implement cleaner technology initiatives</li> </ul>

## Proposed Indicators for future monitoring

An indicator for the monitoring of toxins in water is proposed. Currently there is no specific toxicity data available and limited metal, organics, endocrine disruptors data. This proposed indicator should be regarded as a significant issue for future SoE reporting.

## What does this chapter link to?

- Waste management
- Social environment
- Biodiversity

## Notes about data

- The quality of groundwater could not be effectively presented due to the following difficulties:
  - groundwater data was not well spatially spread;
  - data density was poor;
  - details of specific location of the sampling points and hydrological setting are not always available;
  - data not always collected in a systematic way i.e. seasonally or monthly.
- Although surface water quality data was received from the regulatory bodies, consistency of the data from the different sources was a problem. There were data gaps for many sampling points in the Gauteng area.
- There is a need for an integrated monitoring programme and database for both surface and groundwater resources, as there is widespread duplication of monitoring at points in the Klip River and Blesbokspruit.
- Water quality data from the district municipalities in the west and south was also difficult to obtain. Where possible, data from DWAF was used in these instances.
- Up to date estimates of sectoral consumption discharge of water/effluent was not available.

## Conclusions

Surface water quality in Gauteng is generally marginal to good with the exception of microbiological contamination. No obvious temporal change can be seen. There is no clear indication, based on the available data, of any significant impact on the groundwater quality. The temporal trend in the groundwater quality is unknown.

DWAF is responsible for regulating abstraction from and discharges to water resources. DWAF's WMS is currently being developed which will incorporate: monitoring and discharge information provided by dischargers; receiving water quality monitoring data recorded by DWAF; and water use licence conditions. It will enable DWAF to assess the compliance of water service providers, industry and mines with their legal requirements. In addition, the National Groundwater Database is being updated with water quality and ground water level information. Once these systems are in place, it will be possible to get a better understanding of the pressures affecting water resources and the resultant impacts on both a spatial and temporal basis.

Until then water management is continuing by means of regulatory control on new or upgraded developments using the environmental authorisation and/or water use licence processes. Equally important is the development and implementation of enforcement processes to ensure that these legal requirements are complied with. In support of these processes, an adaptive management cycle can be used based on a cycle of: setting goals and objectives; developing action plans (with assigned responsibilities for the various stakeholders); monitoring and reporting; auditing and lastly strategic reflection and review. These tools must be used to ensure effective and equitable distribution of this precious resource.



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## 7. Air Quality

The air quality of any region is controlled by the climate, topography, natural and anthropogenic activities that occur in that and surrounding regions concerned. A deterioration in air quality results from the emission of gaseous and particulate matter into the atmosphere. Depending on the levels and nature of emissions, polluted air has the potential to impact negatively on the environment. Air pollution may result in disturbances to ecosystems, climatic conditions, biogeochemical cycles and human health. Air movement is an important means of dispersing airborne matter, such as seeds, gas and dust particles. However, it is also capable of transporting pollutants, thus the effects of pollution in one area may be felt in another area hundreds of kilometers away. Air movement and mixing is dependent upon differences in high and low pressures and the occurrence of temperature inversions. Atmospheric constituents are removed from the air through the process of wet or dry deposition or through chemical reactions. Wet deposition is effective in removing both particulate and gaseous pollutants. Topography plays an important role in controlling the level of air pollution either by providing a drainage pathway to transport pollution from source to areas down-gradient or acting as a barrier to pollution movement.

With respect to Gauteng, all of the above-mentioned factors play a role in determining air quality in the region. As an example, Gauteng has the highest population density, highest concentration of industries, largest vehicle population, a very stable and well-defined inversion layer during winter, which in combination result in very high levels of pollution during the winter months. In contrast, during summer, whilst the sources of air pollution are largely in place except for a reduction in domestic coal usage, the increase in summer rainfall and change in wind patterns results in relatively lower levels of air pollution.

The comparison of air quality between different

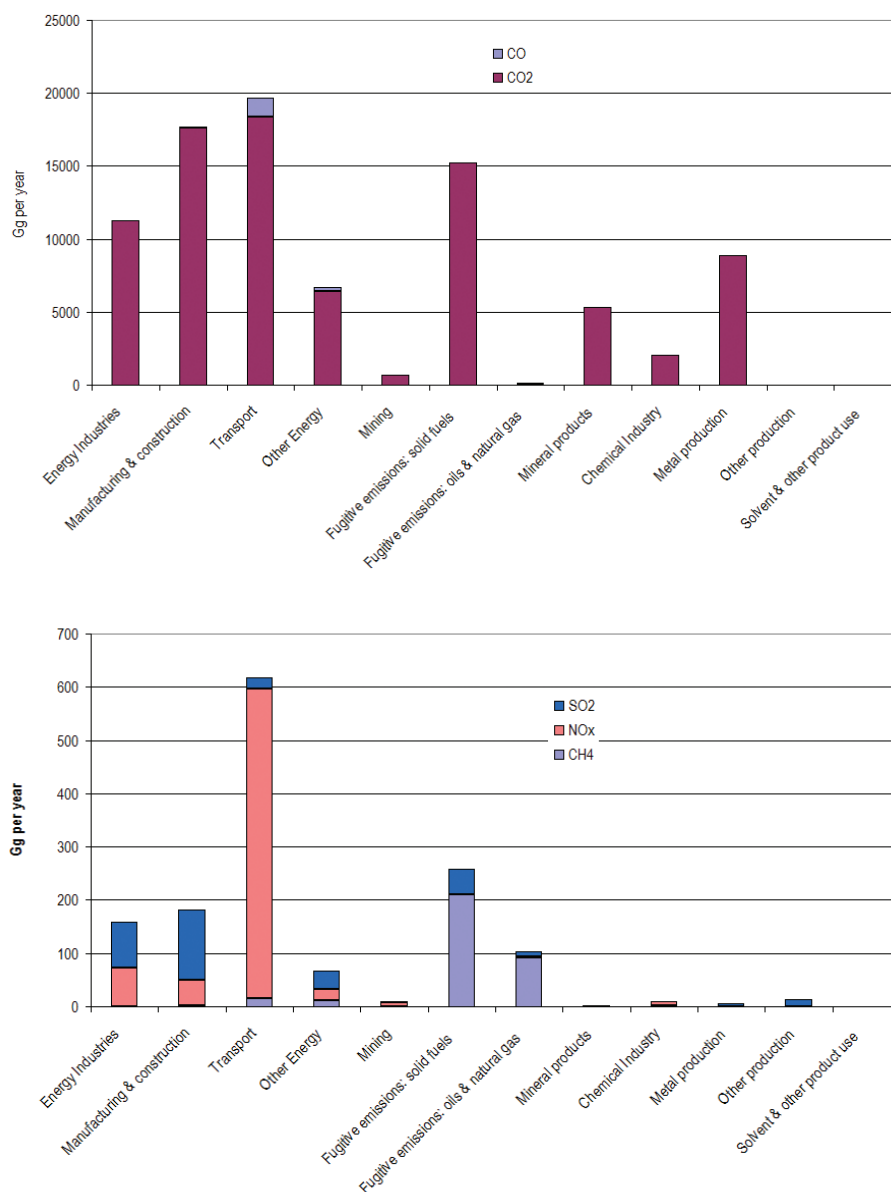
regions in SA is complex as the nature of the sources of pollution differs. In Gauteng cities and in Cape Town, a high level of particulates in low income areas is the main concern (Goldblatt, 2002). Although particulate matter is a cause for concern in Cape Town it is a secondary pollutant since the primary source of pollution is due to gaseous pollution from motor vehicle emissions. These pollutants are chemically transformed during the day into secondary particulate forming the 'Brown Haze' or photochemical smog especially during the summer months. In eThekweni, the main source of pollution is heavy industry with  $\text{SO}_2$  and volatile organic compounds being the pollutants of concern.



## What affects the air we breathe?

### Gaseous and particulate emissions from industrial processes

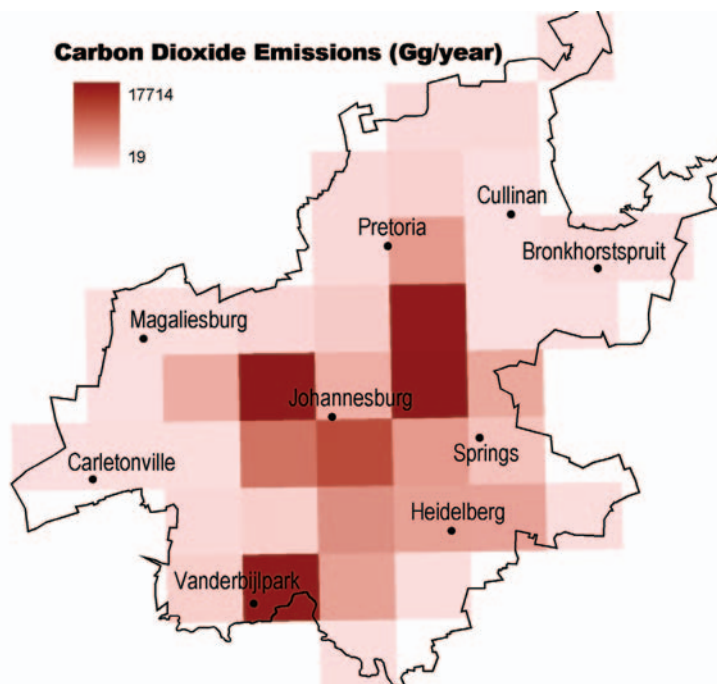
Industrial processing is one of the primary sources of priority hazardous pollutants, which include sulphur dioxide, particulate matter, greenhouse gases ( $\text{CO}_2$ , CO,  $\text{CH}_4$  and  $\text{NO}_x$ ) and volatile organic compounds. Increasing industrial production exerts pressure on the quality of ambient air i.e. an increasing level of air pollutant emissions resulting in deterioration in ambient air quality.



Source: CSIR Safari 2000 study

Figure 7.1 Sectoral sources of greenhouse and criterion trace gas emissions in Gauteng



**Carbon Dioxide Emissions (Gg/year)**

Source: CSIR Safari 2000 study

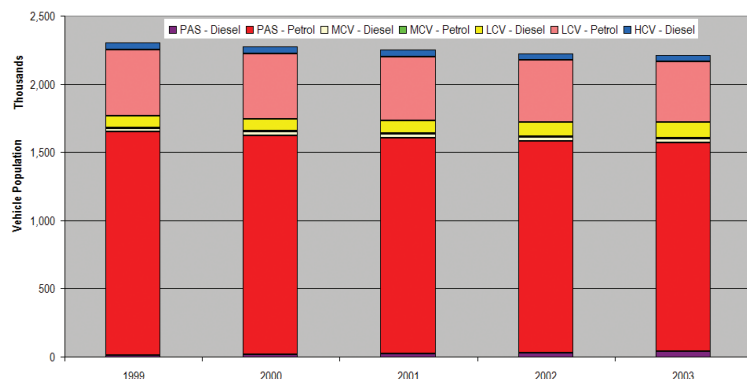
**Figure 7.2 Map of carbon dioxide emissions over Gauteng**

The sectoral sources of greenhouse and pollutant gas emissions are shown in Figure 7.1, while the spatial distribution of the total average yearly carbon dioxide emissions from all sources is shown in Figure 7.2. Fuels combusted in transport and manufacturing are the largest sources, while the distribution of CO<sub>2</sub> emissions is related closely to the location of industry and areas of high traffic volumes in Gauteng.

## Gaseous and particulate emissions from motor vehicles

Exhaust emissions from motor vehicles have been identified as a significant source of air pollution in urban areas. Vehicle emissions include greenhouse gases (CO, CO<sub>2</sub>), particulate matter (carbon and lead), ozone precursors (NO<sub>x</sub> and VOCs – volatile organic compounds) and sulphur dioxide. In Gauteng, motor vehicle transport is the primary mode of transport for passengers and goods. Gauteng has the

largest vehicle population in the country (Figure 7.3).



PAS = passenger; HVC = heavy commercial vehicles; MCV = medium sized commercial vehicles;

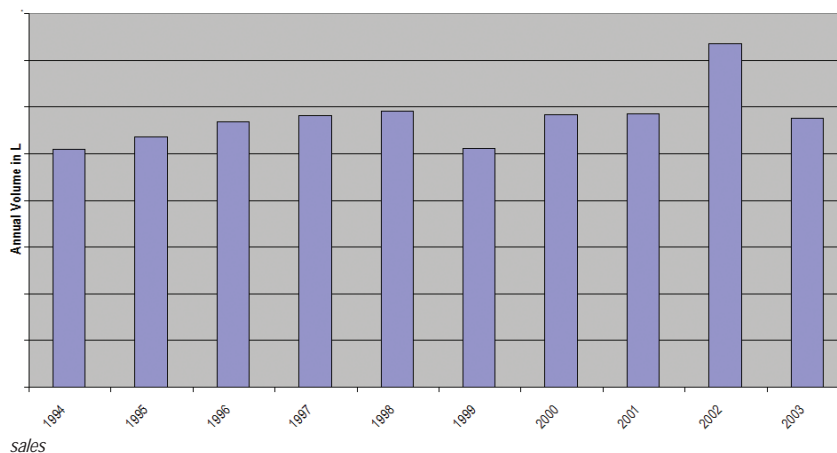
LCV = light commercial vehicles

Source: NAAMSA, 2003 - [www.autoparc.co.za](http://www.autoparc.co.za), Vehicle Population for Gauteng 2003

**Figure 7.3 Vehicle population in Gauteng**

Although the vehicle population has decreased slightly, overall fuel sales have increased over the last ten years (Figure 7.3 and Figure 7.4). This suggests that there is an increase in the number of vehicle kilometres travelled. The increase in fuel sales indicates that the pressure on air quality due to motor vehicle emissions is probably rising (however, improved engine combustion efficiencies may counteract this tendency).





Note that fuel sales for 1999, 2002 and 2003 are actual figures and the rest of the data is based on extrapolated values i.e. Gauteng fuel sales = 28% of national sales

Source: SAPIA Website 2003 [www.mbindi.co.za/sapia/rsacons.htm#qcsf](http://www.mbindi.co.za/sapia/rsacons.htm#qcsf) NAAMSA 2003 - [www.autoparc.co.za](http://www.autoparc.co.za)  
**Figure 7.4 Annual fuels sales for Gauteng from 1994 to 2003**

## Dust emissions from abandoned mine dumps and operational tailings dams

Although mining activity is on the decline in Gauteng, historical mining activities have left a host of mine dumps scattered around the province. In addition to this, operational mines also operate tailings dams, waste rock dumps and ore stockpiles. These are a major source of dust emissions in areas where they occur, especially during the late winter and early spring months, when wind speeds peak over Gauteng. These dust emissions pose a nuisance and health risk to nearby receptor communities. The number of abandoned mine dumps are decreasing as a result of reworking and reclamation of the land for other land uses. As a result of negotiations initiated by GDACE, the major dust problem around mine tailings in Boksburg has been significantly reduced following revegetation of the major dams in the area. Dust from mine tailings on the west rand remain problematic (Annegarn *pers comm.*, 2004). Completion of reclamation operations in Springs and the far East Rand over the next 2 years should see a substantial reduction in wind blown dust in these areas.

## Gaseous and particulate emissions from domestic fuel usage

Pressures from human settlement are primarily associated with the use of coal as a domestic energy source in low-income townships and informal settlements. This has long been an issue of concern in Gauteng. A source apportionment study in Soweto indicated that domestic coal combustion contributed approximately 70 % of the ambient total particulate matter ( $PM_{10}$ ) loading (Annegarn *et al.*, 1998). A similar study in the Vaal Triangle showed that it contributed on average 36.5 % to the atmospheric particulate load, rising to 65 % in winter (Engelbrecht *et al.*, 1998) (Figure 7.1). Emissions from coal combustion include volatile organic compounds and greenhouse gases.

**Table 7.1 Source contributions to particulate matter in the Vaal Triangle**

Source	Source Contribution (%) Based on Direct Source Apportionment	
	Mean Annual <sup>(1)</sup>	Worst Months (May/June) <sup>(2)(3)</sup>
Domestic coal burning	36.5	64.6
Refuse combustion	10.9	23.4
Road dust, vehicle tailpipe emissions and local soil (wind-blown)	16.9 <sup>(4)</sup>	6.0
Mine tailings dam dust (wind-blown)	1.8	-
Sulphate	8.9	4.5
Elemental Carbon	3.4	-
Unknown	21.6	1.4

Notes: (1) Calculated based on average contribution estimated to occur during winter, spring and summer.

(2) Calculated based on the three winter samples that were analysed.

(3) Local building operations, found to account for 0.1%, are not included in the table.

(4) Comprises: 9.5% road dust, 2.4% vehicle tailpipe emissions and 5.0% wind-blown local soil.

Source: Engelbrecht et al. (1998) Mintek Special Publication No. 17

## Energy from coal based power generation

Although Gauteng is a significant consumer of electrical energy, the province imports most of its electricity needs from the national power supply grid. Most of the electricity generation occurs in Eskom's coal fired power stations located on the Mpumalanga Highveld. However, numerous industries generate their own energy using coal as a primary energy source. Emissions from these operations add to the total pollution load in the form of particulate matter and greenhouse gases.

## Climate and local regional/national/global atmospheric movements

The diffusion and dispersion of pollutants is dependent upon climatic, weather conditions and local atmospheric stability, which varies 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, air mixing and wet deposition by rainfall. Although summer conditions improve localised air quality, trans-boundary transport of air pollution occurs between neighbouring areas, provinces and countries continue to influence air quality in the province. The Highveld is dominated by westerly and north-westerly winds in winter and north-north-easterly winds in summer.

## Occurrence of veld fires

Veld fires are widespread across the province, occurring in autumn, winter and early spring. In addition to controlled burning for fire-breaks and veld management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows.

Emissions from veld fires are similar to those generated by coal and wood combustion. Whilst veld fire smoke primarily impacts visibility and landscape aesthetic quality, it also contributes to the degradation of regional scale air quality.

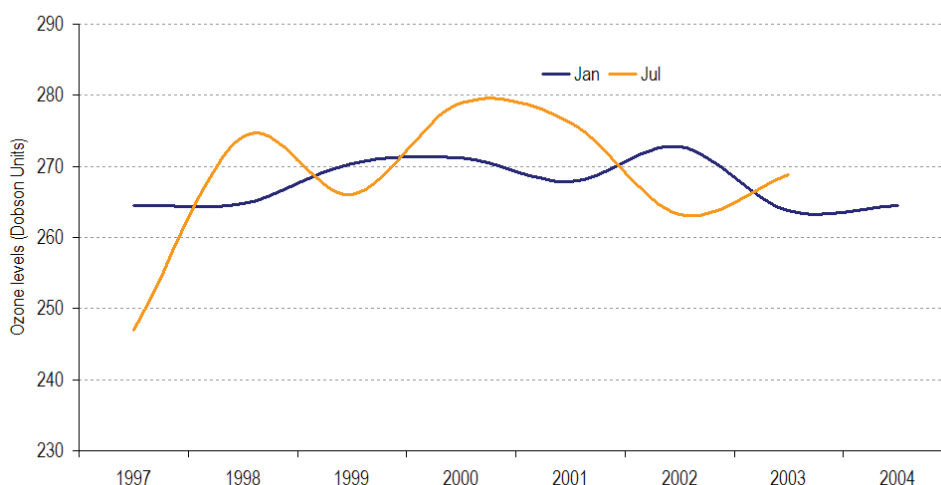


## What is the condition of our air?

The indicators used to describe the state of air quality in Gauteng have been divided into two groups, namely, climate change indicators and priority ambient air quality indicators. One of the limitations of the available data is that ambient data are limited to urban areas, particularly the Johannesburg metropolitan area.

### Climate change - Total Column Ozone

Total column ozone levels over Johannesburg during January (summer) have not changed dramatically from 1997 to 2004. There is no convincing trend in winter levels, although greater fluctuation has occurred and the level appears to be increasing during July (Figure 7.5). Although reasons for the increase in ozone during winter are complex, two likely causes are: a recovery on the stratospheric ozone layer, or, more likely, an increase in tropospheric (near surface) ozone during winter, when greenhouse gas emissions peak over the Highveld.



Source: NASA TOMS website <http://jwocky.gsfc.nasa.gov/satellite> 2004

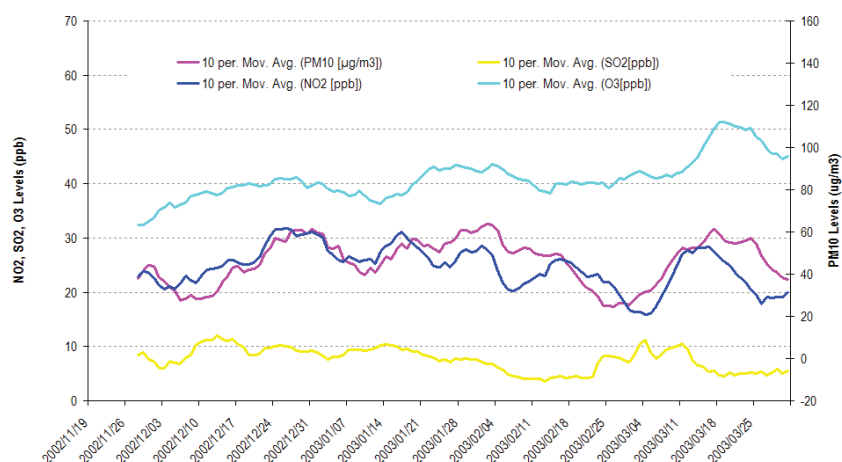
**Figure 7.5 Summer and winter total column ozone trends for Johannesburg (1997-2004)**

### Ambient air quality trends of priority pollutants

The data presented here are for Johannesburg and Kempton Park only, due to poor data coverage in the rest of the province. The following indicators were chosen to represent trends in ambient air quality:

- Sulphur dioxide ( $\text{SO}_2$ ),
- Nitrogen dioxide ( $\text{NO}_2$ ) and or  $\text{NO}_x$ ,
- particulate matter up to 10mm ( $\text{PM}_{10}$ ) and
- Ozone ( $\text{O}_3$ ).

Movements for these parameters over a 5-month period spanning summer are presented in Figure 7.6. Although there are fluctuations in the concentrations of all pollutants over Alexandra (Johannesburg), an increasing trend can be inferred only for ozone levels. None of the priority pollutants exceed the DEAT 24hr guidelines over the time span represented. However, the time span represented in this data is too short to demonstrate real temporal trends in ambient air quality.



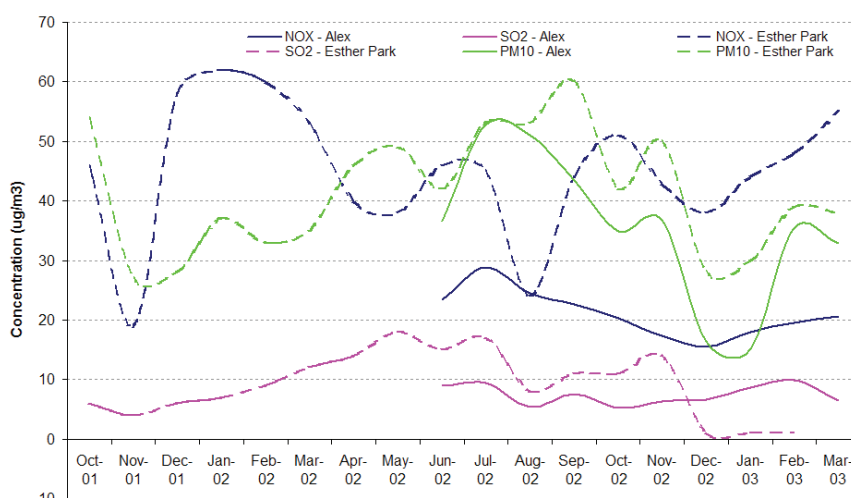
Air quality that is typical of a mixed residential area (Alexandra) i.e. formal, semi formal and informal areas that uses coal as a primary energy source. The data presented here represent 10-day moving averages of daily measurements.

DEAT 24-hr Standards as follows:  $\text{NO}_2 = 100\text{ppb}$ ;  $\text{SO}_2 = 100\text{ppb}$ ;  $\text{PM}_{10} = 180\text{ug/m}^3$ ; There is no standard for ozone.

Source: Johannesburg Metropolitan Council, 2004; Airkem, 2003

**Figure 7.6 Ambient air quality (priority pollutants) in Alexandra, Johannesburg (November 2002 to March 2003).**

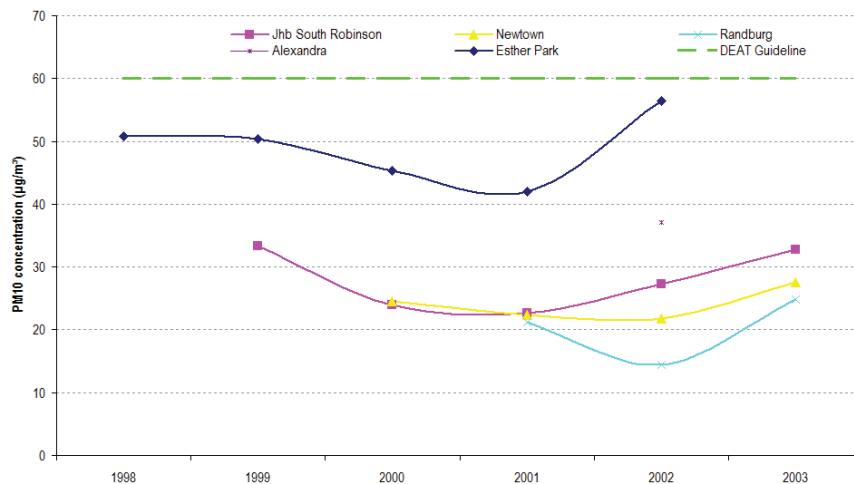
Esther Park in Ekurhuleni is both a formal and informal residential area, and is also characterised by heavy industry. Alexandra is a low-income residential area. In general the pollutant concentrations of Esther Park exceed those of Alexandra, potentially indicating the influence of industry on air pollution levels (Figure 7.7).



Source: Johannesburg Metropolitan Council, 2004; Airkem, 2003

**Figure 7.7 Comparison of priority pollutant concentrations between Alexandra and Esther Park (October 2001 to March 2003)**

PM10 levels have been increasing since 2001 (Figure 7.8). However, PM10 levels at most sites (with the exception of peaks in Alexandra) are below the DEAT national annual guideline of  $60\text{ug/m}^3$ . It is significant that PM10 (single data point) for Alexandra and Esther Park are notably higher than that measured at the other three sites over a similar period, confirming the role of domestic coal combustion as a significant source of PM10. The two non-residential areas have similar PM10 levels. Randburg, a residential, non-industrial area, which uses electricity as the primary source of energy, has the lowest levels of PM10.

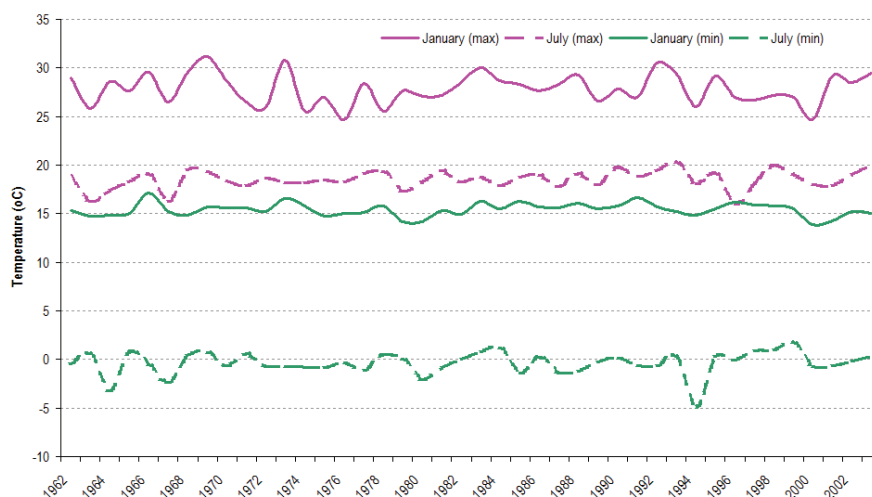


Source: Johannesburg Metropolitan Council, 2004; Mintek, 2004; Airkem, 2003

**Figure 7.8 PM10 levels in selected urban areas**

## How does this affect the environment?

- Air pollution has a generally negative impact on the environment: There is evidence that both indoor and ambient air pollution increases the risk of respiratory disease. The World Health Organisation estimates that indoor air pollution as a result of the use of coal and wood for heating and cooking, is responsible for 2.7 % of the global disease burden (WHO, 2004). It is submitted that this is the most serious air quality issue in the province in terms of health related impacts.
- Poor air quality results in a deterioration in visibility and aesthetic landscape quality of the region, particularly in winter due to atmospheric inversions.
- Poor air quality causes a nuisance to people living in proximity to the sources, particularly odours, eye nose and throat irritations and cleanliness issues (particulates, in the latter case).
- The emission of greenhouse gases results in global warming. Long-term temperature trends are shown in Figure 7.9. Carletonville was chosen as a background site, since it had long-term data and is some distance from any of the major urban areas of Gauteng. There are no discernible trends evident in the 41 year period presented.



Source: SAWS, 2004

**Figure 7.9 Long-term temperature trends for Carletonville (1962 to 2003)**



- Depletion of stratospheric ozone results in an increase in UV radiation, which in turn increases the risk of skin cancer. There is however no evidence for the increase in atmospheric UV level over South Africa (DEAT, 1999).
- Examples of negative ecological impacts include changes in soil and water chemistry (increased salt loading, acidification), resulting in a reduction in crop yields, destruction of sensitive biomes and loss of biodiversity.
- Destruction of property as a result of corrosion, due to wet deposition of gaseous and particulate air pollutants.

## What are we doing about it?

An holistic approach to the management and improvement of air quality is at a very early stage of development, because air management in South Africa is primarily a national government function, the emphasis of which had in past been placed on heavy industrial sources of pollution.

<b>International Responses</b>	<ul style="list-style-type: none"> <li>● Montreal Protocol on substances that deplete the Ozone Layer</li> <li>● United Nations Framework Convention of Climate Change</li> <li>● Kyoto protocol</li> <li>● Air Pollution Information Network Africa</li> <li>● Clean Air Initiative Africa</li> </ul>
<b>National Responses</b>	<ul style="list-style-type: none"> <li>● Atmospheric Pollution and Prevention Act No. 45 of 1965</li> <li>● National Environmental Management: Air Quality Bill</li> <li>● National Electrification programme</li> <li>● DME has implemented a clean household energy strategy involving alternate fuels, education, electrification and insulation of households</li> <li>● DME initiative piloted in Orange Farm and Zamdela in 2003 on a low smoke method for lighting fires</li> <li>● Phasing out of leaded fuels by 2006</li> </ul>
<b>Provincial Responses</b>	<ul style="list-style-type: none"> <li>● Gauteng Strategic Plan for Air Quality Management</li> <li>● Air quality management conditions for all listed activities under the EIA process</li> <li>● Setting up of a provincial air monitoring network to be run by district and metropolitan municipalities</li> <li>● Testing of alternate energy for vehicles, e.g. methane</li> <li>● Gauteng Mining Environmental Forum and GDACE's initiative to reduce mining dust in Boksburg</li> <li>● Strategic Environmental Assessment for the Vaal Triangle</li> </ul>
<b>Local Responses</b>	<ul style="list-style-type: none"> <li>● Various air monitoring initiatives including Johannesburg Metropolitan Municipality, Airkem Forum in Ekurhuleni, Project SAM (Soweto Air Monitoring) and certain private industry conducts continuous air monitoring</li> <li>● Air Quality Management Plan for Johannesburg including the addition of 15 monitoring stations</li> <li>● Joburg initiative on low smoke imbawula for street vendors</li> </ul>

The distribution of air quality monitoring stations in Gauteng is shown in Figure 7.10 below.

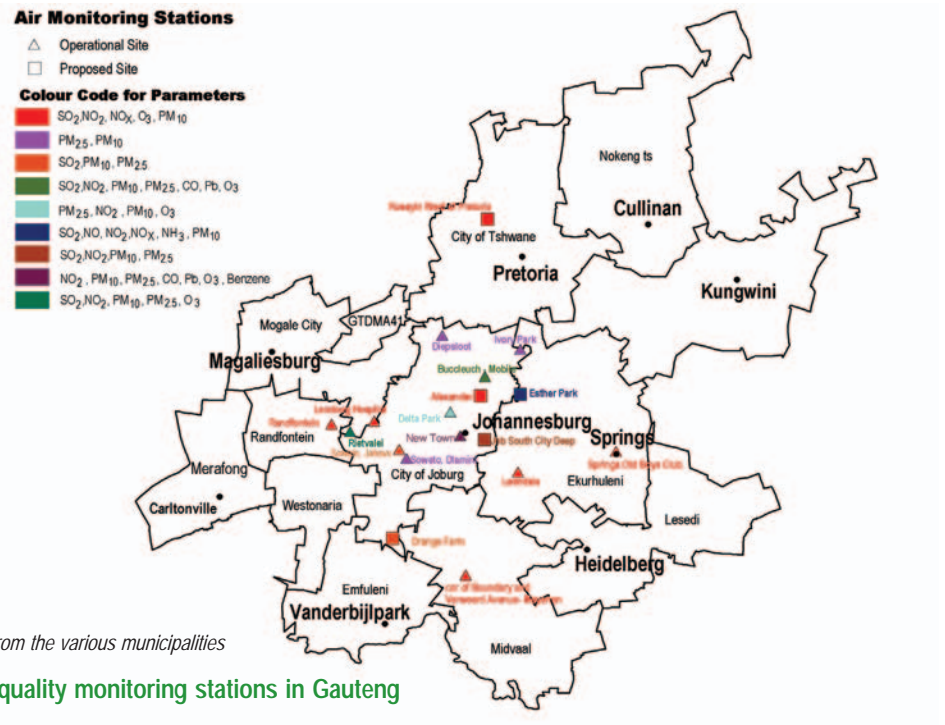


Figure 7.10 Distribution of air quality monitoring stations in Gauteng

## Proposed Indicators for future monitoring

- Annual consumption of ozone depleting substances: Gauteng should be committing to meeting requirements of the Montreal Protocol and this indicator will measure its performance in this regard.

## What does this chapter link to?

- Manufacturing, Transport, Energy
- Land use and condition
- Social Environment

## Notes about data

There is poor geographical coverage in air quality data for Gauteng. This will be improved through the provincial monitoring network currently being set up.

There is little quantitative data available for Gauteng on the impacts of poor air quality. Whatever data is available is either outdated or restricted, because the studies conducted had a limited scope. In general the studies that have been conducted indicate that in areas with consistently poor air quality, there is an abnormally high incidence of respiratory illness.

Data received also was aggregated into different averaging periods, so ambient air quality had to be expressed in absolute terms rather than relative to a health based standard.

## Conclusions

The limited ambient air quality data that is available suggests that air quality in Gauteng is deteriorating. Air pollution levels are highest in areas where coal is used as a primary domestic energy source, heavy industrialised areas and areas along the main traffic routes. The increasing use of roads for the transportation of passengers and goods, instead of mass transport systems, will add to the existing pollution load. Although there is limited data, the available literature indicates the incidence of respiratory illnesses is either caused or exacerbated by poor air quality. It should be emphasised that this is the major air quality issue in Gauteng, and it needs to be urgently addressed.

New air quality legislation is long overdue and any further delays will set back current initiatives

to improve ambient air quality. Government, business and individuals need to take collective responsibility for local, regional and international air quality issues, especially with respect to the use of CFC free refrigerants and the reduction of greenhouse gas emissions.

The lack of ambient air quality data will be a major shortcoming of future initiatives to air quality management and the need for a province-wide ambient monitoring network and emissions inventory is an absolute necessity for air quality managers in the province. It is recommended that further work be done in the analysis of ambient air quality data in order to represent the data in terms of the health based standards, as indicated in the list of indicators.



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## 8. Biodiversity

Biodiversity is the variability amongst living organisms and the ecological complexes in which these organisms occur. This diversity encompasses different levels of biological organization, including genes, individual organisms, populations, species, communities and landscapes (Noss, 1990; Franklin, 1993) and includes the ecological processes within and between these organisational levels (Scott *et al.*, 1995). These different levels of biological organisation are reflected in the goals of the White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (DEAT, 1997). This biodiversity policy commits SA to conserving 'the diversity of landscapes, ecosystems, habitats, communities, populations, species and genes in South Africa' (Pfab, 2002). While species and genetic level considerations have dominated conventional conservation biology, it is imperative that future biodiversity conservation moves away from this species approach towards a new integrative approach, which additionally targets higher-level biodiversity (Pfab, 2002).

Although Gauteng is the smallest province in South Africa, most of the country's income is generated by the industrial and economic activities, including mining and agriculture, found within its boundaries. In view of the rapid expansion of the urban areas that are encroaching, particularly on the poorly conserved highveld grassland, it is imperative that conservation of this province's biodiversity be prioritised (Pfab and Victor, 2002).

### What affects biodiversity in Gauteng?

#### Human Settlements

The rapid expansion of human settlements (and increased population numbers) including residential, mining, manufacturing, retail, transport and agriculture is resulting in increased demand for, transformation and degradation of natural land.

Habitat destruction/transformation and fragmentation through urbanisation is the most serious threat posed to the survival of threatened plants of Gauteng (Pfab and Victor, 2002). Habitat loss, fragmentation and degradation also represent the greatest threats to threatened bird,







mammal, reptile, amphibian and invertebrate species in Gauteng.

The expansion of **informal settlements in proximity to sensitive areas**, for example wetlands, poses a threat to these areas. People living in informal settlements may not have access to running water and wetlands may act as ablution and washing facilities. Absence of proper sanitation and waste facilities can further lead to destruction of wetland habitats. This can cause destruction of wetlands and the riparian habitats associated with them. Uncontrolled veld fires may threaten the already sensitive grasslands on the highveld.

**Increased demand for resources**, unsustainable resource use practices and harvesting of natural resources, legal and illegal trade pose important threats to biodiversity. Of the Gauteng threatened plant species, 35 % are collected and traded to a greater (e.g. *Aloe peglerae* and *Encephalartos middelburgensis*) or lesser degree (actual and potential) for horticultural purposes. Only 63 % of threatened plants collected and traded are protected by legislation (the Gauteng Nature Conservation Ordinance of 1983). A number of geophytes that occur in Gauteng i.e. *Urginea sanguinea* and *Hypoxis hemerocallidea* are at risk of over exploitation due to harvesting for the medicinal plant trade and current levels of harvesting are not sustainable (Williams 2003).

**Pollution and degradation of natural habitats**  
Water pollution due to mining, urban and industrial effluents, inadequate sewage management, agricultural activities, waste disposal and seepage impacts on water quality, and hence the biodiversity which they support. Eutrophication is also an issue in many water bodies, particularly wetlands, resulting in encroachment by reeds, problem water plants and exotics. Dumping, edge effects (especially the encroachment of weedy vegetation) and off-road vehicles results in the degradation of remnant natural areas.

## Societal development

The **lack of information, knowledge, and awareness** of environmental issues and the will to protect environmental assets places huge pressure on biodiversity.

## Development

**Unregulated/unplanned development** – lack of EIA/SEA. Development has historically enjoyed priority over conservation in Gauteng. Development, for residential and business purposes as well as industrial expansion, population growth and invasion of open spaces, has often been allowed to take place in close proximity to sensitive environments and wetlands through inappropriate land-use planning. The construction of transport routes fragments habitats and loss of linkages threatens the maintenance of genetic flow between remnant natural areas. 10-14 % of the province's surface area is sealed through surface hardening, of which the road network contributes 2 %. Road zone effects (the area over which significant ecological effects extend outward from the road) influence 63 % of the province.

## Tourism and Recreation

The creation of **protected areas** for the conservation of biodiversity, natural and cultural heritage assists in conserving threatened biodiversity, important habitats and ecosystem services. Of particular note in Gauteng are the Cradle of Humankind World Heritage Site, and the Blesbokspruit RAMSAR wetland, both of which are protected by international legislation, as well as Suikerbosrand Nature Reserve and Dinokeng.



## How is our biodiversity doing

### Species Diversity

Gauteng province represents a relatively large percentage of South Africa's biodiversity in a small area. More plant species occur per unit area in Gauteng than in any other province (Low and Rebelo, 1996). Table 8.1 indicates the percentage of South Africa's biodiversity found in Gauteng, and the percentage of each of the taxonomic groups in Gauteng comprising threatened and endemic species. Gauteng is also important for biodiversity as it is topographically diverse (diversity of habitats will support a diversity of species), 71% of the province falls within the grassland biome which is second only to fynbos in terms of species richness (Cowling *et al.*, 1991), and it is situated on the ecotone between grassland and savanna.

**Table 8.1 Summary of species composition for Gauteng**

Taxonomic group	Percentage of SA's total species found in Gauteng (Total number of species occurring in South Africa)	Number of species in Gauteng
Plants	11% (21572 <sup>1</sup> )	2411 <sup>2</sup>
Mammals	50% (258 <sup>3</sup> )	130 <sup>4</sup>
Birds <sup>5</sup>	47% (694)	483 <sup>6</sup>
Reptiles	24% (363 <sup>7</sup> )	87 <sup>8</sup>
Amphibians <sup>9</sup>	27% (111)	30
Invertebrates <sup>1</sup>	16% (4784) <sup>2</sup>	752 <sup>3</sup>

#### Footnotes

<sup>1</sup> Source: PRECIS (2004). The number of plant taxa recorded for South Africa (including subspecies and varieties and excluding naturalised and cultivated species).

<sup>2</sup> Source: PRECIS (2004). The total number of plant taxa recorded for Gauteng includes subspecies and varieties and excludes naturalised and cultivated species.

<sup>3</sup> Source: James Harrison (le Roux 2002)

<sup>4</sup> Source: Dr Dean Peinke (2004) (GDACE) (Appendix B). This number excludes exotic mammals in the province and animals in captivity.

<sup>5</sup> Source: James Harrison (le Roux 2002)

<sup>6</sup> Tarboton (1997) lists 483 species for Gauteng province, of which 285 are resident, 66 are regular visitors, 37 are erratic visitors and 95 are vagrants.

<sup>7</sup> Source: Bill Branch (le Roux 2002)

<sup>8</sup> Source: Jacobsen 1955, includes 35 lizards, 1 amphibian, 47 snakes, and 4 tortoises

### Red Data species per taxonomic group

This indicator reports on the number of species categorised according to the new IUCN categories and criteria (IUCN Species Survival Commission criteria Version 3.1 2000) (Table 8.2). Details of threatened species and their threatened status according to these are attached as Appendices A – D. These Appendices refer to national assessments. Due to the threats in Gauteng, provincial assessments would yield significantly higher numbers of threatened species. The conservation status of many invertebrates in Gauteng is still in the process of being established. Only butterflies have been assessed both on a global IUCN Red List and Regional SA Red Data Book level (M. Forsyth. pers. comm.).



**Table 8.2 Summary of the Red Data status for each taxonomic group in Gauteng**

Taxonomic group	Number of species in Gauteng	Percentage Threatened species (Number of threatened <sup>13</sup> species)	IUCN Red Data category (% of Gauteng total)					
			EX	CR	EN	VU	NT	DD
Plants	2411	0.9% (22) <sup>14</sup>	1 (0.04%)	8 (0.33%)	8 (0.33%)	6 (0.25%)	12 (0.5%)	6 (0.25%)
Mammals <sup>15</sup>	130	7.7% (10 <sup>16</sup> )	0	1 (0.8%)	3 (2.3%)	6 (4.6%)	1 (0.8%)	2 (1.5%)
Birds <sup>17</sup>	483	1.9% (9)	1 (0.2%)	0	0	9 (1.9%)	10 (2.1%)	0
Reptiles <sup>18</sup>	87	0% (0)	0	0	0	0	0	0
Amphibians <sup>19</sup>	30	0% (0)	0	0	0	0	1 <sup>20</sup> (3.3%)	0
Invertebrates	752	0.2% (1 <sup>21</sup> )	0	0	0	1 (0.13%)	1 (0.13%)	0
Total			2	9	11	22	25	8

Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). Red Data categories include CR, EN and VU as well as extinct (EX), Near Threatened (NT) and Data Deficient (DD)

According to the priority ranking scheme for Red Data plants in Gauteng (Pfab, 2002), the top five Red Data plants in Gauteng (in decreasing order of importance) are *Khadia beswickii*, *Delosperma purpureum*, *Delosperma macellum*, *Ceropegia decidua* subsp. *pretoriensis*, *Lotononis adpressa* subsp. *leptantha*.

Nineteen of the 44 threatened bird species that are breeding residents, regular visitors or regular migrants to Gauteng (Tarboton, 1997) were prioritized for conservation attention in the province (Appendix D).

Thirty-seven invertebrate species have been prioritised for conservation action (Appendix C) since they are believed to be either rare or under

potential threat. GDACE is concerned about the status of all these invertebrates.

### Number of endemic species per taxonomic group

An endemic refers to a species that is limited in its distribution to a specific geographical area. This makes them particularly sensitive to anthropogenic threats and extinction and their conservation is the sole responsibility of the people in the region in which they occur. Almost 1 % of plants and 2 % of invertebrates indigenous to the province occur nowhere else in the world, while no mammals, birds, reptiles or amphibians are endemic to Gauteng (Table 8.3).

<sup>9</sup> Source: James Harrison, *Frog Atlas Project*, Cape Town. (2004)

<sup>10</sup> Source: Marianne Forsyth (2004) (GDACE). The taxonomic groups reflected in the SoE are those currently prioritised by GDACE for conservation action.

<sup>11</sup> Total Invertebrate numbers only include the following taxonomic groups, since these are the groups with which DACEL is primarily concerned: butterflies (820), spiders (3000) and scorpions (100).

<sup>12</sup> This total only includes butterflies (211), fruit chafer beetles (81), spiders (265) and Scorpions (11) and dung beetles (184).

<sup>13</sup> The distinction between threatened and Red Data species should be noted: the former includes only species that are critically endangered (CR), Endangered (EN) or Vulnerable (VU) while the latter includes all species listed according to the IUCN Species Survival Commission criteria. Only threatened species have been included in the above figures.

<sup>14</sup> Source: M Pfab (pers.comm.). (2004)(GDACE) (Appendix A).

<sup>15</sup> Source: Dr Dean Peinke(2004) (GDACE)

<sup>16</sup> Source: Dr Dean Peinke (2004) (GDACE) (Appendix B).

<sup>17</sup> Source: Barnes (2000). Although 44 threatened bird species occur in Gauteng only 19 have been prioritised for conservation attention since 5 are visitors and 20 are vagrants whose presence in the province is highly unpredictable in time and the responsibility for their conservation must rest with the provinces and countries within the core of their range.

<sup>18</sup> Source: Branch (1988b)

<sup>19</sup> Source: Frog Atlas Project, Avian Demography Unit, Cape Town

<sup>20</sup> Giant Bullfrog (*Pyxicephalus adspersus*).

<sup>21</sup> Source: Marianne Forsyth (2004) (GDACE) (Appendix C).

Table 8.3 Endemic species per taxonomic group

Taxonomic group	Total no of species for Gauteng	Percentage endemic species (Number of endemic <sup>22</sup> species)	No of species endemic to Gauteng (% of Gauteng total)	No of species endemic to South Africa (% of Gauteng total)
Plants	2411	0.7% (16 <sup>23</sup> )	16 <sup>24</sup> (0.7%)	290 <sup>25</sup> (12.0%)
Mammals	146	5.5% (8 <sup>26</sup> )	0	8 <sup>27</sup> (5.5%)
Birds	326	1.0% (7)	0	7 <sup>28</sup> (2.1%)
Reptiles	87	2.5% (9 <sup>29</sup> )	0	9 <sup>30</sup> (10%)
Amphibians	30	4.5% (5)	0	5 <sup>31</sup> (16.7%)
Invertebrates	752	2.1% (16 <sup>32</sup> )	16 <sup>33</sup> (2.1%)	unknown

## Habitat change

### The condition of our ridges

Due to their high spatial heterogeneity ridges provide vital habitat for many threatened species (DACEL, 2001a). Seventy four percent of the 22 globally threatened (CR, EN, VU) plant species occur on the ridges and hills of Gauteng, while at least three threatened mammal species, several bird species of conservation concern, three rare reptile species and Red Data butterflies inhabit ridges. The Bronberg, Magaliesberg (Pretoria) and Klipriviersberg (Johannesburg) are particularly important since at least 40 % of Gauteng's threatened plant species are confined solely to these ridge habitats (DACEL, 2001a,

Pfab and Victor, 2002). The survival and behaviour of invertebrates, many of which are important pollinators, are often dependent on the ridge environment. Ridges are particularly suitable as future refuges for biodiversity in an urbanized landscape as they function as islands even within a natural landscape. They also form natural wildlife corridors, which promote ecological processes and benefit regional and local biodiversity.

Approximately 13 % of Gauteng's surface area comprises ridges, 14 % (32 185 ha) of which are transformed. Only 7.5 % of Gauteng's ridges fall inside protected areas and a further 11.5 % fall inside conservancies and proposed conservancies. Ridges have been grouped into 4 classes based on the degree to which they are transformed (DACEL, 2001a) (Table 8.4).

<sup>22</sup> Information on endemic plants and invertebrates applies to Gauteng while information on endemic birds, mammals, reptiles and amphibians pertains to South Africa.

<sup>23</sup> Source: M Pfab (pers.comm.), (2004) (GDACE) (Appendix A)

<sup>24</sup> Source: Ms M. Pfab, GDACE 2004. Plants endemic to Gauteng are listed as A1 in Appendix A

<sup>25</sup> Source: Checklist of South African Vascular Plants. Unpublished Sabonet Report.

<sup>26</sup> Source: Dr Dean Peinke (2004) (GDACE) (Appendix B).

<sup>27</sup> Source: Dr D. Peinke, GDACE (2004). Mammals are classed as endemic if they are endemic to South Africa.

<sup>28</sup> Source: Dr W. Tarboton, unpublished report. Birds are classified as endemic if they occur in South Africa. South African endemics that occur in Gauteng have been included here.

<sup>29</sup> Source: Branch (1988a)

<sup>30</sup> Source: Branch (1998)

<sup>31</sup> Source: Frog Atlas Project, Avian Demography Unit. Five frog species that occur in the Gauteng province are endemic to South Africa (including Lesotho and Swaziland). No species are specifically endemic to the Gauteng province.

<sup>32</sup> Source: Marianne Forsyth (2004) (GDACE) (Appendix C).

<sup>33</sup> Source: Forsyth (2004). Gauteng endemic invertebrates include: 1 butterfly, 1 fruit chafer beetle and 14 species of spiders.





**Table 8.4 Summary of transformed status of ridges in Gauteng**

Ridge class (percentage transformed)	Percentage of Gauteng's transformed ridges included in class (area in hectares)	Ridges included in this class
Class 1 (0-5% transformed)	6% (2 048 ha)	Suikerbosrand, Perdeberg, Witwatersberg and parts of the Magaliesberg range, Gatsrant and Witwatersberg.
Class 2 (5-35% transformed)	48% (15 218 ha)	Parts of the Magaliesberg range, World Heritage site, Klipriviersberg, Bronberg, Daspoortrand, Kwaggasrand, Gatsrand and Skurweberg.
Class 3 (35-65% transformed)	20% (6 560 ha)	Northcliff, Roodepoort and Krugersdorp ridge and parts of the Daspoortrand.
Class 4 (65-100% transformed)	26% (8 260 ha)	Melville koppies and Linksfield ridge.

## The condition of our wetlands

According to the National Water Act 36 of 1998, wetlands are defined as land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil. Wetlands include rivers, lakes, pans, seeps and vleis.

Wetlands provide a range of services, functions, and products that have direct social, economic and cultural value and are integral to the survival and well-being of almost all South African communities. These systems have indispensable ecological value, being repositories of biodiversity and providing essential life support for a range of plant and animal species. The conservation and wise use of all wetlands is therefore in the national interest, not only from a biodiversity perspective, but also for water resource conservation and management.

Various wetland studies in SA suggest that 35 – 60 % of our wetlands have been lost. Wetlands cover 1.5 % of Gauteng's surface area and water bodies cover 0.8 %. Approximately 52 % of Gauteng's wetlands are threatened<sup>34</sup>, 44 % partially threatened<sup>35</sup> and only 4 % are not threatened. SA currently has 17 wetlands

designated as having international importance in terms of the RAMSAR Convention. Of these only six are inland freshwater wetlands, the Blesbokspruit within Gauteng province being one of them.

The protection of Giant Bullfrog populations at Bullfrog Pan and Glen Austin is considered crucial to the long-term conservation of this species in the Province. GDACE is in the process of identifying additional areas that are important for sustaining the breeding, foraging and migration requirements of this species and all pans are considered potential habitat.

## The condition of our vegetation types

The grasslands of South Africa have been identified as being inadequately protected (DEAT, 1997). Grasslands are of particular conservation concern because so much of them have already been transformed (approximately 70 %), they are highly fragmented and they are poorly conserved. Less than 1 % of highveld grassland is conserved nationally (Low and Rebelo, 1996), far less than the recommended national conservation targets which range between 24% and 27% (Table 8.5) (Driver *et al.* 2004).

Of the area of each vegetation type found in Gauteng 40-50 % of the Moot Plains Bushveld, Marikana Thornveld, Rand Highveld Grassland

### Footnotes

<sup>1</sup> Threatened wetland is defined as one which is 100% covered by threatening landcover (W.Coetze. pers.comm.)

<sup>2</sup> Partially threatened wetland refers to one that is 5% or more covered by a threatening landcover (W. Coetze. pers.comm.)

and Carleton Dolomite Grassland have been transformed by anthropogenic activities in the province. 50-70 % of Egoli Granite Grassland, Eastern Highveld Grassland and Soweto Highveld Grassland have been transformed. Most of the vegetation types in Gauteng have less than 4 % conserved, including Egoli Granite Grassland that is unique to the province and of which less than 40% remains. Since the national target for conservation of this vegetation type is 25 %, 62.5 % of the remaining area of this vegetation type needs to be conserved. Eastern Highveld Grassland and Central Free State Grassland are at the limits of their ranges in Gauteng, so their poor conservation status is of little concern. Three vegetation types are reasonably well conserved in the province; these are Norite Koppies

Bushveld (26 %), Andesite Mountain Bushveld (23 %) and Gold Reef Mountain Bushveld (15 %). Levels of transformation for the different vegetation types are likely to be far higher (than what has been stipulated in the report) as indicated by satellite imagery – at least half of the areas considered natural are actually recovering secondary grasslands (M.Pfab. pers.comm). National conservation targets have been met (or almost) in Gauteng for Andesite Mountain Bushveld and Norite Koppies Bushveld (Table 8.5). These targets are severely under-achieved for 60% of vegetation types and all the grassland vegetation types.

**Table 8.5: Summary of the status of vegetation types in the Gauteng Province and the national conservation target for each vegetation type.**

Biome	Vegetation type	Percentage of Gauteng comprising each vegetation type	Percentage of each vegetation type found in Gauteng	Percentage of vegetation type, occurring in Gauteng, transformed in 2002	Percentage of vegetation type, occurring in Gauteng, conserved in 2002	National Conservation Target (Percentage)
Savanna	Andesite Mountain Bushveld	4.23	35.61	13.67	22.84	24
	Central Sandy Bushveld	6.29	6.95	14.62	17.17	18
	Gold Reef Mountain Bushveld	3.07	25.68	20.18	16.29	24
	Loskopdam Mountain Bushveld	2.09	17.15	1.44	5.38	24
	Marikana Thornveld	5.76	38.68	39.55	5.16	18
	Moot Plains Bushveld	2.32	13.59	29.79	1.35	18
	Norite Koppies Bushveld	0.23	15.03	14.52	25.77	24
	Shale Mountain Bushveld	3.91	64.86	22.51	2.35	24
	Springbokvlakte Thornveld	1.20	2.28	6.61	7.54	18
	Waterberg Summit Grassland	3.29	23.16	16.96	1.49	24
Grassland	Carleton Dolomite Grassland	15.75	29.05	40.75	7.89	24
	Central Free State Grassland	0.47	0.50	25.16	0	24
	Eastern Highveld Grassland	2.10	2.79	63.48	0	25
	Egoli Granite Grassland	6.43	100.00	52.16	0.67	25
	Frankfort Highveld Grassland	0.18	0.31	1.76	0	25
	Rand Highveld Grassland	11.26	18.56	36.22	3.68	27
	Soweto Highveld Grassland	31.44	33.66	50.17	1.56	25
	Waterberg Summit Grassland	3.29	23.16	16.96	1.49	24

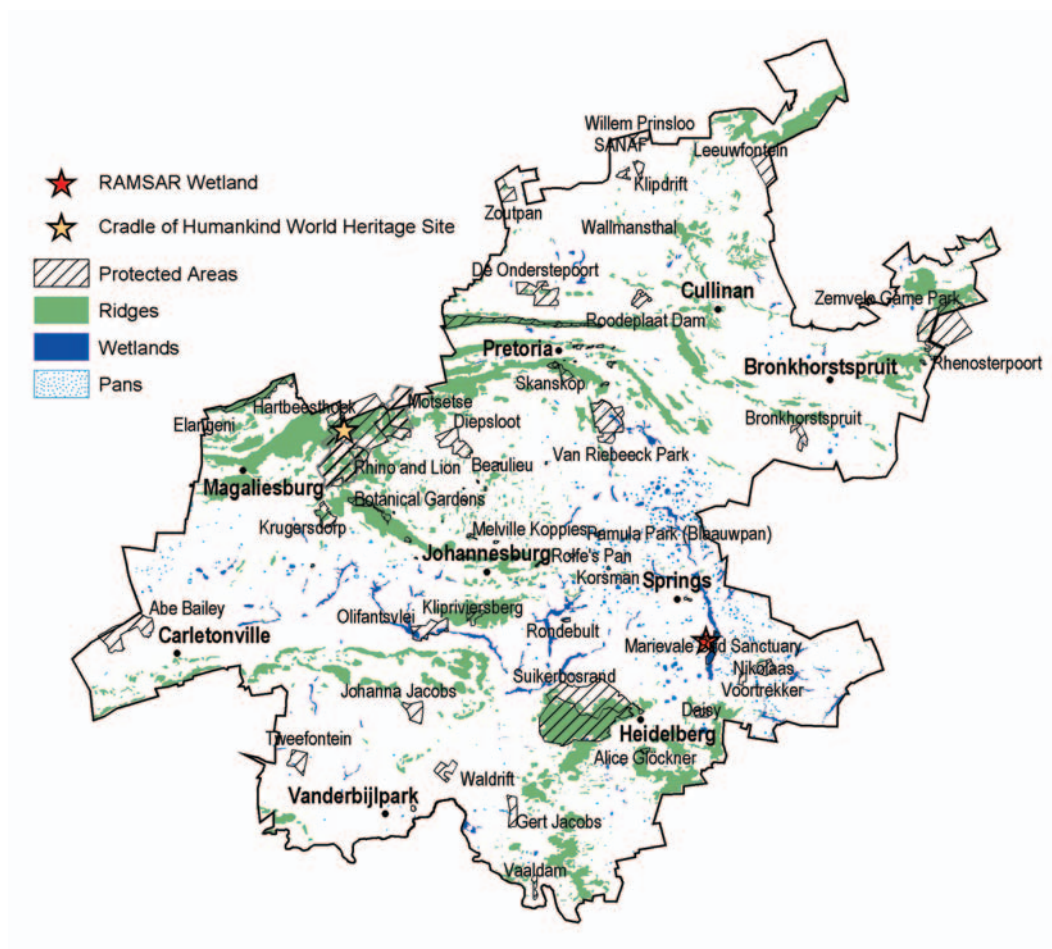
Source: Mucina and Rutherford (2003). Percentage transformed and conserved was calculated using NLC 2000 data.



## Protected areas

Formally protected areas comprise 5 % of the province (86 600 ha) (Figure 8.1). South Africa is obliged to address conservation of these areas as a signatory to the UN Framework Convention on Biodiversity. Since the 1998 Gauteng SoER was compiled, conservancies have contributed towards increasing the area of Gauteng under protection. These conservancies, although not formally protected, comprise 0.7 % of Gauteng's surface area (10 859 ha) and an additional 429 ha of land is proposed for additional

conservancies (0.025 %). Suikerbosrand has been increased in size from its original 11 642 ha to 20 069 ha and now covers approximately 1.2 % of Gauteng's surface area. At least 78 % of the threatened taxa of Gauteng occur within some sort of conservation area (DACEL, 2001a; Pfab and Victor, 2002). Protected areas afford adequate protection to only 16% of the biodiversity of the province, while just over 20% of the biodiversity is not protected at all (DACEL, 2003).



Source: Gauteng Open Space Project 3 (GOSP3) (GDACEL 2003); NLC 2000

Figure 8.1 Protected areas, ridges and wetlands in Gauteng



## Percentage of total area irreplaceable

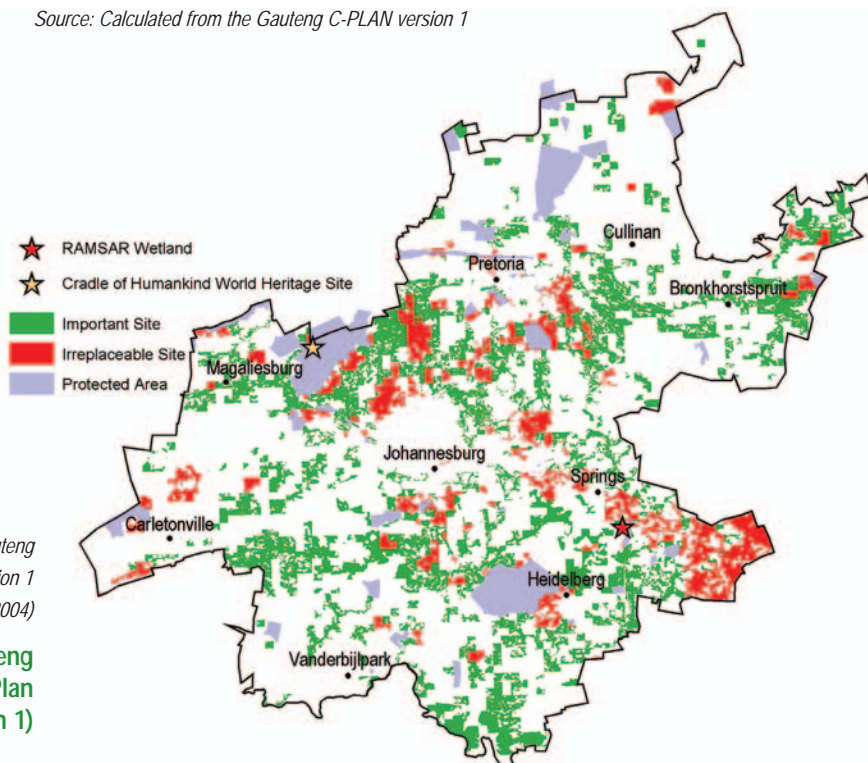
According to the Gauteng Conservation Plan (version 1), (Figure 8.2), 6.22 % of the province, is considered irreplaceable and requires formal protection/conservation. An additional 19 % is considered important for the conservation of biodiversity within the province.

With 18.6 % designated irreplaceable, Lesedi is a priority for immediate conservation action (Table 8.6). Priority conservation is required within the CoJ and the EMM, with 8% of these municipalities designated irreplaceable and significantly under-represented by existing protected areas (Table 8.6).

**Table 8.6: Percentage of each municipality considered irreplaceable and important**

Municipality	Percentage irreplaceable	Percentage important
City of Johannesburg	7.8%	19.4%
City of Tshwane	7.3%	15.0%
Ekurhuleni	7.7%	20.7%
Emfuleni	0.8%	11.7%
Kungwini	4.95	26.5%
Lesedi	18.6%	22%
Merafong	3.7%	1.9%
Midvaal	3%	27.9%
Mogale	5.3%	26.2%
Nokeng Tsa Tsamane	2.2%	9.9%
Randfontein	2.8%	10%
Tshwane	6.2%	13%
Westonaria	0%	33.1%
World Heritage Site	9%	7%

Source: Calculated from the Gauteng C-PLAN version 1



Source: Gauteng  
Conservation Plan Version 1  
(GDACE 2004)

**Figure 8.2 Gauteng  
Conservation Plan  
(Version 1)**



## Alien invasion

The most important alien invaders in Gauteng include Black Wattle, *Eucalyptus camaldulensis*, *Acacia* mixed species and *Salix babylonica* (Table 8.7), which occur in medium dense stands (>25 % cover), especially the *Acacia* species. Two aquatic invaders fall just outside the top 10 since they only occupy a relatively limited area. All these species are undoubtedly more widespread in the province and there are certainly many other species, such as *Rubus*, which are more widespread than is shown by these data. There are 129 invasive plant species (taken from the South African Plant Invaders Atlas Database, ARC, Plant Protection Research Institute), 4 mammals, 5 birds, 3 reptiles, 1 amphibian and 4 invertebrates present in Gauteng.

**Table 8.7 The most important invader plant species in Gauteng**

Species	Habitat	Total invaded area (ha)	Density (area invaded/ total area mapped) (%)
<i>Acacia mearnsii</i>	r,l	9 962	29.78
<i>Eucalyptus camaldulensis</i>	r,l	8 086	28.44
<i>Acacia mixed species</i>	r,l	3 267	67.51
<i>Salix babylonica</i>	r	4 504	31.16
<i>Populus canescens</i>	r	4 044	27.42
<i>Acacia decurrens</i>	r,l	2 681	36.02
<i>Eucalyptus sideroxylon</i>	r,l	1 427	34.80
<i>Salix species</i>	r	1 507	24.99
<i>Eucalyptus species</i>	r,l	900	40.76
<i>Acacia dealbata</i>	r,l	1 324	24.94

('Habitat' indicates the primary habitats invaded by the species (r = riparian, l = landscape)

Source: Versveld et al. (1998)

## What are the consequences of pressures on biodiversity?

- The potential failure to meet provincial/national conservation targets may result in the loss of intrinsic value of biodiversity and loss of ecosystem functioning resulting in local extinction of species and global/national extinction of endemic species;
- The degradation of ecosystems leads to the loss of landscape quality/amenity;
- Degradation leads to the loss of goods and services provided by wetlands, rivers and natural habitats;
- There may be a decrease in productivity (economic) and long-term sustainability due to over-exploitation of natural resources and degradation of natural environments;
- The degradation and loss of wetlands may result in degradation of water resources and water quality – there may be a consequent increased prevalence of human diseases, and the loss of biodiversity and ecosystem processes associated with these wetlands;
- There may be a long-term loss of tourism revenue due to the degradation of natural habitats and mismanagement of natural areas;
- The development of reserves and community-based conservation programmes assists in poverty alleviation, for example the Working for Water Programme. Currently 2320 individuals are employed by this programme in Gauteng, comprising 8.22% of the national total employed by the programme;

## What is being done about biodiversity?

International Responses	<ul style="list-style-type: none"> <li>● United Nations Convention on Biodiversity;</li> <li>● Convention on International Trade in Endangered Species of Fauna and Flora (CITES);</li> <li>● Bonn Convention – Convention on the Conservation of Migratory Species of Wild Animals;</li> <li>● RAMSAR Convention and the Amendment Protocol - Convention on Wetlands of International Importance specifically as waterfowl habitat (RAMSAR);</li> <li>● World Heritage Conservation Act 49 of 1999</li> </ul>
National Responses	<ul style="list-style-type: none"> <li>● National Environmental Management: Protected Areas Bill</li> <li>● National Environmental Management: Biodiversity Bill</li> <li>● Conservation of Agricultural Resources Act 43 of 1983</li> <li>● National Policy on the Convention of Migrating Wild Animals;</li> <li>● National Parks Act, 1976 (Act 57 of 1976);</li> <li>● The White Paper on the Conservation and Sustainable Use of South Africa's Biodiversity (July, 1997);</li> <li>● National Veld and Forest Fire Act;</li> <li>● The Criminal Procedures Act (Act No. 51 of 1989);</li> <li>● National Working for Water Programme;</li> <li>● National Policy on the Rehabilitation of Wildlife;</li> <li>● National Spatial Biodiversity Assessment;</li> <li>● National Wetland Inventory;</li> <li>● Working for Wetlands.</li> </ul>
Provincial Responses	<ul style="list-style-type: none"> <li>● Transvaal Nature Conservation Ordinance 12, 1983</li> <li>● Gauteng Open Space Project;</li> <li>● Draft Wetland Policy;</li> <li>● Draft Buffer policy for Nature Reserves;</li> <li>● Development Guidelines for Ridges;</li> <li>● Red Data Plant Policy for Environmental Impact Evaluations;</li> <li>● Draft Policy for regulating the Export of Indigenous Plant Species from the province of Gauteng to International Destinations;</li> <li>● Gauteng Biodiversity Gap Analysis Project;</li> <li>● River Health Programme;</li> <li>● Ongoing development of Environmental Management Frameworks for Alexandra, Loch Vaal, Kungwini West, N1/R21 quadrant;</li> <li>● Bronberg Strategic Environmental Assessment;</li> <li>● Dinokeng Master Plan &amp; World Heritage Site (Blue IQ);</li> <li>● Community based natural resource project at Abe Bailey Nature Reserve;</li> <li>● Systematic conservation planning for Gauteng;</li> <li>● Klipriviersberg management plan;</li> <li>● Gauteng Conservancy Association;</li> </ul>
Local Responses	<ul style="list-style-type: none"> <li>● Interim Blesbokspruit Management Committee</li> <li>● Magaliesberg Advisory Committee</li> <li>● Meyersdal Conservation Group</li> </ul>



## Proposed Indicators for future monitoring

There are 2 indicators proposed for future monitoring in updates of the SoER:

- Population trends of selected threatened species such as *Aloe peglerae* need to be monitored so that changes in threatened status can be detected.
- Extent of alien invasion in Gauteng province i.e. map showing spread of aggressive alien invasive species A potential indicator could be % of Gauteng province invaded by alien species.

In addition the following could be potential future indicators:

- The percentage of provincial targets met for conservation of threatened species, vegetation types, ridges and wetlands.
- Medicinal plant use of Gauteng's threatened species. A potential indicator could be the percentage of threatened plants traded that are harvested in Gauteng.

GDACE will continue with systematic conservation planning and with drafting and implementation of relevant conservation policy.

## What does biodiversity link to?

- Land
- Water Resources
- Social Environment

## Notes about data

- C-Plan analysis is based on a 1km grid size at present which is known to result in an overestimate of area of irreplaceable sites.
- Total species numbers for insects were unavailable at the time of producing this report. The majority of taxonomic work and data collection for invertebrates is focused on the following groups: butterflies, beetles, fruit chafer beetles, spiders and scorpions; information on other invertebrate groups has not been included in this report.
- Frog and Bird Atlas Data is based on the number of quarter degree grid cells in the province, thus the total numbers, threatened and endemic species may be an overestimate of what actually occurs in this province since species that occur in other provinces may be included in these estimates.
- Recent genetic studies have led to several species splits and the number of birds for Gauteng thus needs to be updated accordingly using this information.
- Sixty-three percent of Gauteng's surface area is "natural" (NLC 2000). However, Based on 114 samples in Meyerton, Centurion and Pretoria areas: only 50 % of "natural" area is actually natural, 38% of natural land is actually secondary grassland/old fields, 12% of natural land is actually developed or planted pastures. Thus based on ground truthing 30% of the province is actually untransformed and 70% of all Gauteng's natural habitat has been lost (M Pfab, *pers. comm.*).
- The figures obtained by Versveld *et al.* (1998) need to be viewed with circumspection, since (a) the alien species in the extensive urban and peri-urban areas of the Pretoria –Witwatersrand – Vereeniging area generally have not been mapped, and (b) only the Vaal River catchments above the Vaal Barrage have been thoroughly mapped. Mapping at a scale of 1:50 000 or greater would significantly increase the invaded areas shown above. The 1998 alien data for the province is currently inadequate and new estimates are required.

## Conclusions

Habitat destruction/transformation and fragmentation through urbanisation is the most serious threat posed to the survival of threatened plants (Pfab and Victor, 2002), birds, mammals, reptiles, amphibians and invertebrate species in Gauteng. Thus stopping or reversing loss of sensitive areas is essential. Development proposals that threaten Red Data species and their habitats need to be evaluated using provincial policies i.e. Red Data Plant Policy for Environmental Impact Evaluations (DACEL, 2001b). To ensure that the genetic diversity and evolutionary potential of Gauteng threatened species, and plants in particular, are conserved, it is vital that all subpopulations (Lammi *et al.*, 1999) are protected from development and further fragmentation. With management and monitoring, rare plant species are able to survive and persist in large urban areas; therefore urban open spaces play an important role in biodiversity conservation (Stalter *et al.*, 1996 cited in Pfab and Victor, 2002), provided such areas are appropriately managed. Existing protected areas are inadequate for the protection of biodiversity in Gauteng, since areas important for the conservation of biodiversity (irreplaceable sites) did not form the basis for the historical selection of formally protected areas. Grassland conservation is poor. Protection of irreplaceable sites will result in an almost four-

fold increase in biodiversity protection. Priority conservation is required for the City of Johannesburg and Ekurhuleni Metropolitan Municipality, with 8 % of each being irreplaceable. The focus of conservation action, in terms of biodiversity protection, has shifted from protecting individual species to conserving habitats and ecosystems. Future indicators need to incorporate processes associated with species distribution patterns. Climate change represents one such process that may be influencing the distribution of sensitive species; trends in weather patterns; range shifts and changes in flowering times for sensitive species and shifts in migration times all need to be investigated (W Foden, *pers.comm.*). The Gauteng Nature Conservation Ordinance of 1983 needs to be updated to include all threatened plant species. Furthermore a provincial law enforcement strategy is required to apprehend illegal collectors while they are active and to investigate local and international traders advertising these species for sale. *Ex situ* cultivation programmes should be established to satisfy the trade demand (Pfab and Victor, 2002). Wetland monitoring: Research needs to look at the catchment scale and assess the health and functioning of wetlands and establish a link between rehabilitation and sustainable livelihoods.

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## 9. Waste Management

Waste is defined in the Government Gazette, 24th August 1990, as “any undesirable or superfluous by-product, emission, residue or remainder of any process or activity, any matter, gaseous, liquid or solid, or any combination thereof.”

The formal classification of waste is made according to the human health or environmental risk that it may pose, and consequently requirements for safe handling and disposal. Classes include:

- **General waste** – is waste that does not pose an immediate threat to man or the environment, i.e. household and garden waste, builders’ rubble and some dry industrial and business waste. It may, however, with decomposition and rain infiltration, produce leachate, which is unacceptable.
- **Hazardous waste** – is waste containing or contaminated by poison, corrosive agents, flammable or explosive substances, chemical or any other substance which may pose detrimental or chronic impacts on human health and the environment.
- **Health care risk waste (HCRW)** – is waste generated at health care facilities such as hospitals, clinics, laboratories and research institutions, medical, dental and veterinarian practices, and includes infectious, pharmaceutical and diagnostic waste.
- **Mining/Metallurgical and Power Generation waste** – is waste from any minerals, tailings, waste rock or slimes produced by, or resulting from, activities at a mine or works, and ash produced by, or resulting, from the generation of electricity.

As much of the industrial and agricultural waste is handled by the generator directly, or indirectly, and makes limited use of local authority service provision, the subsequent discussion will focus on domestic and hazardous waste.



## What affects waste management in Gauteng?

Integrated Waste Management (IWM) maintains that waste management can be planned in advance because the nature, composition and quantities of waste generated can be predicted. Advanced planning means that an orderly process of waste management can ensue. This includes:

- **Waste Prevention:** the prevention or avoidance of the production of certain wastes, sometimes by regulation, as illustrated by the thin plastic bag ban;
- **Waste Minimisation:** the economic reduction of the volume of waste during production, by means of different processes, or uses, or 'clean' technology implementation;
- **Resource Recovery:** recycling of wastes of one process as raw materials for a second, or the recovery of energy through incineration or biodegradation;
- **Waste Treatment:** being the reduction in hazardous character of the waste, or its volume, to ease environmental or human health risks and impacts;
- **Waste Disposal:** being the environmentally safe disposal of waste. This has traditionally been by disposal to Landfill sites, although the Polokwane Declaration of 2001 adopts a goal of 50 % reduction in waste disposal by 2012 and zero waste disposal by 2022.

Whilst recognising the good intentions of the Polokwane Declaration, as society grows and develops a more formal basis, the pressures to provide sustainable waste management services and facilities inherently increases. Pressures on waste management are discussed below.

### Increased demand for waste service provision

Due to increased population growth and urban and industrial development, there is an increased demand for waste service provision in terms of

storage and collection facilities and services, handling and transportation, treatment and ultimately disposal services and facilities.

### Increased demand for waste minimisation, recycling and recovery

In line with international norms, the National, Provincial and Local Authorities, as well as society and industry at large, is encouraged, in cases by regulation, to seek to implement measures and means by which waste generation and disposal rates can be economically reduced, including the adoption of cleaner technologies, separation and reclamation/recycling of wastes etc.

### Land use, physical and environmental limitations

Limitations on the location and operation of waste management facilities in Gauteng include proximity to human settlements, topography, geology and hydrology. Facilities should be located to pose the least environmental risk, but economical for waste transportation, encouraging consideration of regional facilities serving larger population and industry groups.



### Lack of capacity for effective governance

Notable pressures affecting the capacity to effectively manage waste in Gauteng include the following points:

- Economic constraints limit the ability of local government to provide an optimum waste management service infrastructure, vehicles and staffing.
- There are limited refuse removal services in poor areas.
- There is generally a lack of enforcement of the national and municipal laws and regulations.
- Ineffective waste legislation does not allow local, provincial and national authorities to effectively and efficiently penalise waste polluters.
- Lack of encouragement of waste minimisation and recycling in the general public.
- Un-maintained parks and open spaces encourage illegal dumping.
- There is uncontrolled scavenging, poor monitoring and maintenance at landfill sites.
- There is a large amount of littering in residential areas (streets, taxi ranks, stations, etc).
- Remnants of a historical culture of non-payment for waste services in some instances.

### How is our waste management doing?

The condition of Gauteng's waste management is examined by describing the three components, namely waste generation, service delivery and waste disposal.

#### Waste Generation

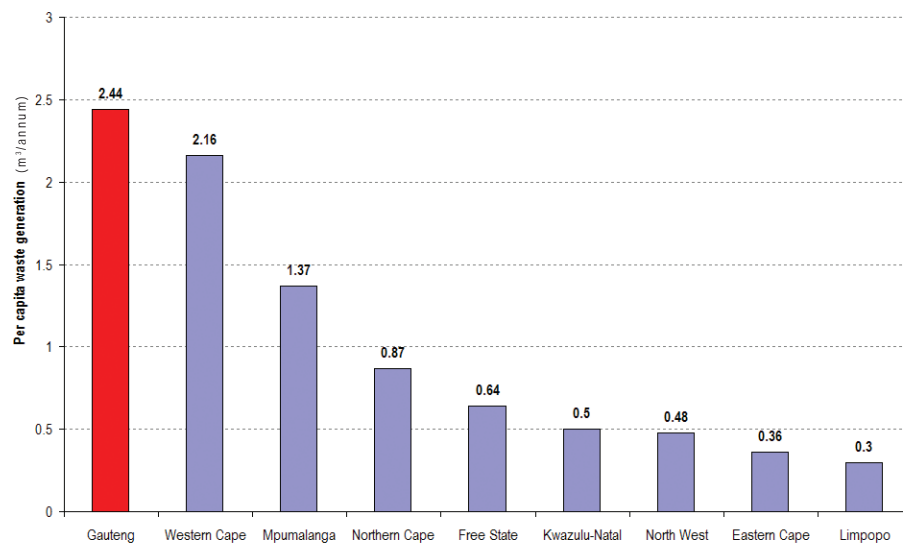
##### Total general waste produced per capita per year

Waste generation rates are often considered to reflect the economic status of society, the more affluent the society the greater waste produced per capita. Figure 9.1, taken from the National Waste Management Strategy Baseline Study (1998) indicates that Gauteng generated the highest volume of general waste in SA and had the highest per capita waste generation of 2.44 m<sup>3</sup>/capita/annum. This suggests a more affluent society, but is also due to greater commercial, business and industrial development contributing to waste disposed to landfills in the province.

The Gauteng preliminary SoER indicates waste generated from households and requiring collection and disposal in Gauteng as roughly 146 kg/capita/annum (ranging from half that for the poorest and twice that for the most affluent). Extrapolating to a projected population for Gauteng for 2003 of 9 013 900, (population growth of 2 % since 2001 census and a 10 % increase in waste generation per capita, as identified by the Johannesburg Status Quo Report in 2003), waste generation of approximately 480 kg/capita/annum is estimated.







Source DWAF, 1998

**Figure 9.1 Provincial per capita generation of general waste**

The apparent increase in per capita waste generation between 1998 and 2003 is, however, unfortunately not as significant as appears as the 1998 figures reflect waste collected and not total waste generated which may be assumed to have been greater. However, it still appears that there has been a material increase in waste generated requiring collection and disposal over the period.

### Waste generation benchmarking

Table 9.1 illustrates a benchmarking of international per capita waste generation rates, indicating that Gauteng remains generally low in waste production per capita, particularly compared to the supposedly more environmentally conscious USA, UK, Sweden, Netherlands and Denmark.

**Table 9.1 Waste generation rates in selected countries (kg/capita/annum)**

Country	Generation Rate (kg/capita/annum)	Country	Generation Rate (kg/capita/annum)
Australia	690	Japan	410
Austria	560	Korea	360
Belgium	550	Mexico	310
Canada	350	Netherlands	610
China	380	New Zealand	380
Denmark	660	Norway	620
Finland	560	OECD countries	540
France	510	Poland	260
Germany	540	Portugal	350
Hungary	450	Russia	340
Ireland	560	Sweden	450
Israel 700		United Kingdom	560

Source: OECD Environmental Data Compendium Feb 2004

### Hazardous waste generation

The Gauteng preliminary SoER did not specifically consider hazardous waste generation rates, and in the absence of requirements to report waste data there are limited statistics on the practical status of hazardous waste generation in Gauteng. A study undertaken for GDACEL in 1999 provided projections for hazardous waste generation for Gauteng (Table 9.2), which suggests that it can be expected that associated with the population growth in Gauteng there would be industrial growth and its hazardous wastes, as well as the recognition that some wastes that had previously been accepted for disposal to general waste sites would now need to be considered, and handled as, hazardous wastes.

**Table 9.2: Projected hazardous waste production (m<sup>3</sup>/annum) in Gauteng**

Waste class*	Produced 1996	Produced 2000	Produced 2010
3.00	37427	44599	66552
4.00	15665	34677	46525
5.00	3632	472	6537
6.00	28216	34237	49578
8.00	29576	36669	57335
9.00	1674127	2168393	3438829
<b>Total</b>	<b>1788643</b>	<b>2323047</b>	<b>3665356</b>

\*SABS, 1995 Waste class 3 = Flammable liquids; 4 = Flammable solids; 5 = Oxidising substances and organic peroxides; 6 = Toxic and infectious substances; 8 = Corrosives; 9 = Other miscellaneous substances.

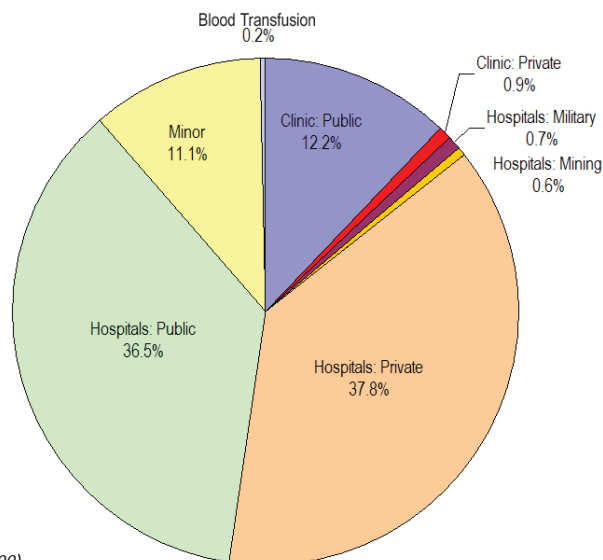
Source: GDACEL, 1999

### Health care risk waste generation

The Gauteng preliminary SoER also did not specifically consider health care risk waste. However, the safe handling of HCRW has subsequently received much recent attention in response to acknowledged limitations on service provision in Gauteng, and increasing health care waste generation rates. Health care waste is sub-classified as:

- Infectious waste including pathological (anatomical) waste and sharps (needles, blades, etc);
- Chemical waste including pharmaceutical, genotoxic and toxic metal waste and gases; and
- Radioactive waste derived for x-rays, medical isotopes etc.

A total of 1 553 tonnes of HCRW was generated in Gauteng in 2003 whilst 1 842 tonnes was treated in Gauteng. 324 tonnes was imported into Gauteng for treatment and 35 tonnes exported from Gauteng for treatment in 2003 (DACEL, 2004). Figure 9.2 shows the major contributors to HCRW generation in Gauteng (DACEL, 2000).

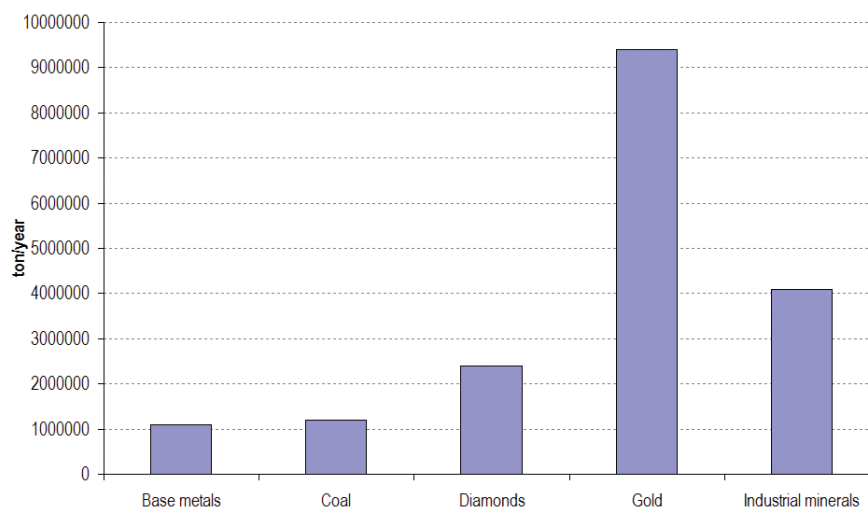


Source: DACEL (2000)

**Figure 9.2 Contributors to health care risk waste generation in Gauteng**

### Mining waste

Little information is available on the quantities of mining waste produced in Gauteng. Data represented in Figure 9.3 from the Baseline Study (DWAF, 1997) show that gold mining produced the most waste in the province, followed by industrial minerals.



Source: DWAF (1997)

**Figure 9.3: Waste production by mining type in Gauteng (tonnes/annum)**

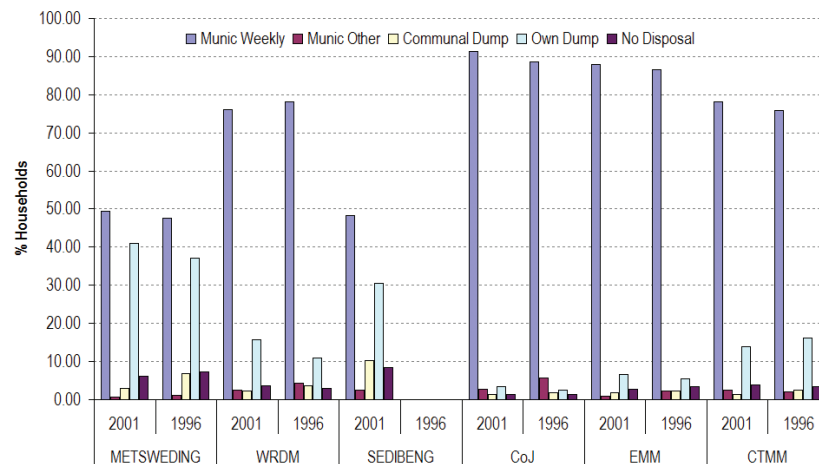
The gold mining industry reduced production by 17.6 % between 1998 and 2003 (Chamber of Mines, 2004). It can therefore be assumed that a corresponding reduction in mining waste generations also occurred for the period, and may be expected to further decline as a number of mining activities in Gauteng work towards the end of their active life.



## Service delivery

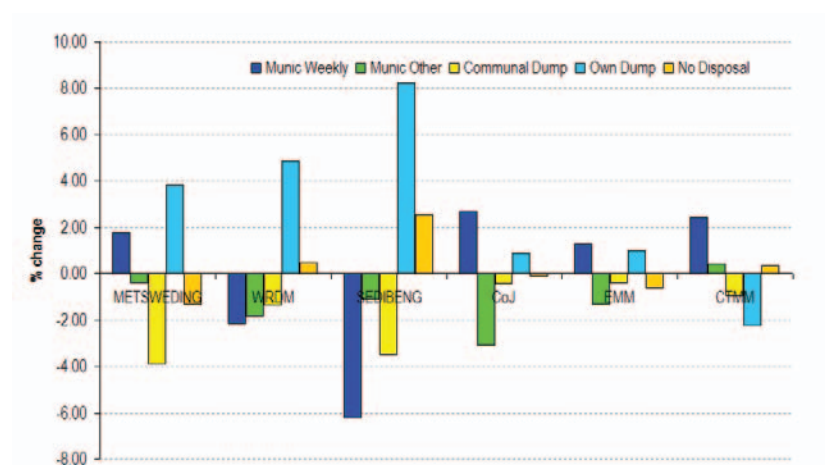
Domestic waste management service provision is assessed in terms of household refuse removal services. A comparison was drawn between statistics collected from the National Census conducted in 1996 and 2001. Most municipalities have high percentages of households with weekly refuse removal services, with the exception of Metsweding and Sedibeng. These two also have the highest levels of households with no access to refuse removal services (Figure 9.4). It is concerning that in Sedibeng an increased proportion of households have no access to refuse removal services, while fewer households are serviced weekly (Figure 9.5). In Sedibeng, West Rand and Metsweding more households are making use of informal dumps.

It is evident that there is a large difference between service delivery in terms of refuse removal, between the Metropolitan municipalities (Johannesburg, Ekurhuleni and Tshwane), and the District municipalities (Metsweding, Sedibeng and West Rand), although the West Rand has levels of service delivery equal to Tshwane.



Source: Calculated from Census 2001 and Census 1996

Figure 9.4: Percentage of households with refuse removal services in 1996 and 2001



Source: Calculated from Census 2001 and Census 1996

Figure 9.5 Percentage change in households with waste services from 1996 to 2001

## Waste disposal

### General waste

The majority of domestic residential and commercial, business and industrial waste from urban areas is disposed to landfill sites. These landfill sites are generally operated by the local authority in whose area the site is located, or by private service providers.

Although some of the industrial waste is handled by local authority services, and private service providers handle much of this stream, most of the waste generated by industry (especially metallurgical) and agriculture in Gauteng, is disposed of on the industrial or agricultural premises, with little information available on quantities, qualities or management thereof. Table 9.3 indicates the available airspace and lifespan (as estimated from the end 2003) for some of the landfills in Gauteng. Only sites with adequate data are shown below.

Notes:

GLB:	Waste Class:	General	Size: Large	B: no significant leachate
GLB:	Waste Class:	General	Size: Large	B: significant leachate
GMB:	Waste Class:	General	Size: Medium	B: no significant leachate
GMB:	Waste Class:	General	Size: Medium	B: significant leachate
GSB:	Waste Class:	General	Size: Small	B: no significant leachate
HH:	A containment landfill which accepts all hazardous waste, i.e. with hazard Ratings 1 – 4			

Sources: DWAF, PIKITUP, EMM, CoJ, CTMM, Sedibeng District Municipality

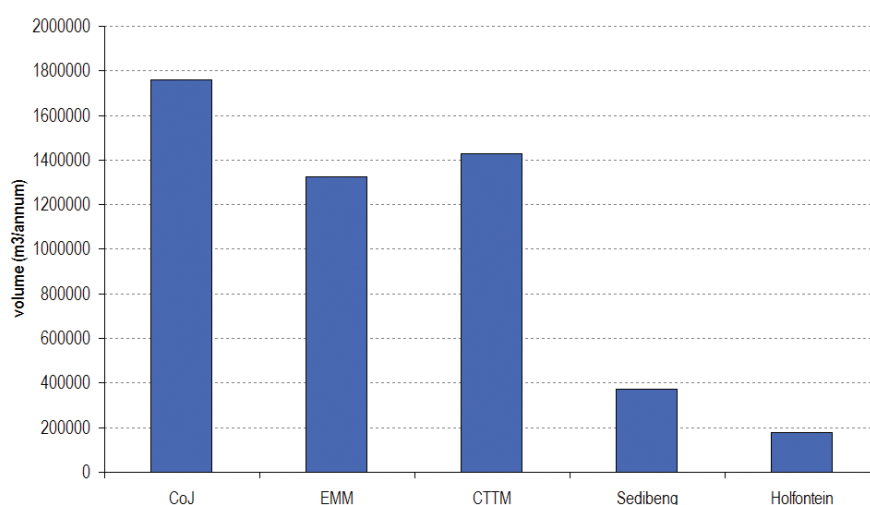
**Table 9.3: Landfill space at selected sites in Gauteng**

Site Name	Location	Classification	Available Airspace (m³)	Airspace utilisation (m³/annum)	Lifespan (years)
Robinson Deep	Johannesburg	GLB-	2 775 577	419 020	6.1
Limbros Park	Johannesburg	GLB-	920 000	466 835	2.8
Goudkoppies	Johannesburg	GLB+	11 068 922	357 335	36.5
Marie Louise	Johannesburg	GLB-	7 510 967	388 725	21
Ennerdale	Johannesburg	GMB-	766 440	127 750	10
Northern Works (proposed)	Johannesburg	GLB-	Not available	10 000 000	Not available
Weltevreden	Ekurhuleni	GLB-	8 700 000	300 000	29
Simmer and Jack	Ekurhuleni	GLB-	3 240 000	360 000	6 – 9
Rooikraal	Ekurhuleni	GLB	8 700 000	360 000	29
Rietfontein	Ekurhuleni	GLB+	7 020 000	180 000	39
Platkop	Ekurhuleni	GLB-	4 914 000	126 000	39
Zesfontein (proposed development)	Ekurhuleni	GLB-	19 200 000	192 000	100
Soshanguve	CTMM	GMB-	1 800 000	120 000	10 – 15
Onderstepoort	CTMM	GLB-	4 800 000	192 000	20 – 25
Derdepoort	CTMM	GSB	504 000	168 000	3
Hatherly	CTMM	GLB-	6 600 000	132 000	50
Garstkloof	CTMM	GLB-	1 080 000	216 000	5
Valhalla	CTMM	GMB	32 000	192 000	2 months
Kwaggasrand	CTMM	GMB-	1 176 000	168 000	5 – 7
Ga-Rankuwa	CTMM	GMB-	3 600 000	144 000	20 – 25
Temba	CTMM	GSB	96 000	96 000	6 – 12 months
Boitshepi	Sedibeng	GLB+		270 000	
Palm Springs	Sedibeng	GSB/GMB- (provisional)	264 000	13 200	20 years
Zuurfontein	Sedibeng	GLB-	136 800	91 200	± 1.5
Hoffontein	Ekurhuleni	HH	7 300 000	180 000	40.6

As noted in terms of the waste generation per capita, there appears to have been a significant increase in waste disposed to landfill between 1998 and 2003. This may be expected to have occurred as a result of the increased level of waste collection service provision, specifically in terms of waste collection from informal settlements, central business areas and industry. Available data indicates that there are approximately 87 recognised landfill sites in Gauteng, for which disposal data is available for only 47 sites and which amounts to approximately 6 200 000 tonnes for 2003. 61 of the sites have classification: 2 sites as H:H (Margolis being closed), 2 sites as H:h, 16 sites as GLB-, 5 sites as GLB+, 26 sites as GMB-, 2 as GMB+, 6 sites as GSB-, 1 site as GSB+ and 2 sites as GCB-. 35 waste facilities (40% of the sites), including 2 transfer stations and 2 recycling centres, were permitted by DWAF from 1996 to 2003 for Gauteng.

The available airspace on existing landfill sites in Gauteng appears to be approximately 120 million m<sup>3</sup>, as an available lifespan of approximately 22 years. However, it is recognised that available landfill sites are not evenly distributed relative to waste generation location.

Figure 9.6 shows the annual waste volumes disposed of in the various municipalities in Gauteng. CoJ experiences the largest disposal of waste.



Sources: CoJ, EMM, CTMM, Sedibeng, Enviroserv Holdings (2004)

**Figure 9.6: Annual waste volumes disposed at landfill sites in Johannesburg, Ekurhuleni, Tshwane, Sedibeng and at the Holfontein hazardous waste disposal site**

### Hazardous waste

Holfontein, near Springs, is currently the only operating H:H hazardous waste disposal site in Gauteng, and is operated by a private waste contractor, Enviroserv Holdings(Pty) Ltd. In 1997, 204 751 tonnes of hazardous waste was received by Holfontein (DACEL, 1999) compared with a volume of 180 000 tonnes in 2003. The decrease in tonnage experienced at Holfontein could be attributed to delisting of previously hazardous waste to a lower hazard rating influencing its disposal requirements, on-site waste treatment by industries, changes in raw material usage, the implementation of cleaner technologies by industry, and reduced and mineral processing.

Enviroserv Holdings also operate other waste sites for general waste and co-disposal of limited hazardous waste with general waste. Ekurhuleni's Platkop and Rietfontein sites are permitted to receive limited hazardous waste for controlled co-disposal.





## Health care risk waste

HCRW storage, collection and transportation in many instances does not meet the required standards and there is limited awareness and education on HCRW management, the resultant poor segregation of HCRW results in some HCRW being disposed as general waste to landfills.

Of the 70 incinerators located at 58 Health Care Facilities in Gauteng, only 58 (83 %) were operational and only 25 (37 %) registered with the regulatory authorities in 2000 (Table 9.4). It appears that the situation has not substantially improved since then. Sanumed a division of Enviroserv, currently service the majority of HCRW generators in Gauteng and operate 2 facilities in Germiston and Roodepoort areas incinerating approximately 3 540 tonnes per year and 2 facilities in Rietfontein for approximately 2 000 tonnes per year. Pikitup operate an incinerator at the Springfield complex of the Robinson Deep landfill in Johannesburg where approximately 260 tonnes per year of HCRW is incinerated.

**Table 9.4: The status of HCRW treatment facilities in Gauteng**

Type of institution	Number with incinerators	Number of incinerators	Number operational	Registration certificates
Private hospitals	14	14	13	5
Provincial hospitals	32	38	28	11
Miscellaneous*	8	11	10	2
Waste service co's	4	7	7	7
TOTALS	58	70	58 (83%)	25 (37%)

*\*This category includes the waste management companies and the Johannesburg Metro*

*Source: DACEL (2000)*

By September 2003 substantive progress had been made in pilot studies undertaken in Gauteng. A study into the composition of the health care waste stream has been conducted, two pilot studies had been started in February 2002 and Gauteng had adequate capacity to meet HCRW disposal needs (DACEL, 2003). In August 2003 a conference on Healthcare Waste Management in Africa Today was held in Johannesburg. GDACE's commitment to HCRW management was reiterated by effecting the implementation of the HCRW strategy, through the regulations that will be promulgated soon, and meeting the deadline of early 2004 for the closure of non-compliant treatment technologies (DACEL, 2003).

## What are the consequences of the condition of waste management?

The consequences associated with non-sustainable waste management in Gauteng are difficult to quantify. However, potential consequences may be identified to include the following:

- Long term effects of pollutants entering the surface or groundwater resources, air and soil affecting the fitness for use, and availability of the resource for use. More specifically:
  - Pollution of watercourses and groundwater by leaching of pollutants from waste inappropriately disposed of, or where waste management service provision is inadequate, particularly evident for dense urban informal settlements.
  - Pollution of watercourses and groundwater by leaching of pollutants from waste residue deposits, particularly mine and power station waste dumps.

- Air pollution by dust releases from particularly mine residue deposits, but also general and hazardous waste sites (methane gas production) and HCRW incinerators.
- Nuisance from odours of waste degradation in landfill sites, waste disfiguring the environment especially plastic bags, and littering where waste service provision is limited.
- Reduced biological diversity in the areas of waste management operations, as a result of land disturbance or effects of emissions and discharges from the waste facilities.
- Increased waste management costs to provide safe and effective long-term disposal sites for increasing waste loads, including treatment of wastes to render them less environmentally available, and effective closure and rehabilitation of historically inadequate waste sites.
- Increased pressures through the negative societal impacts of inadequate service provision fostering illegal waste dumping, littering and abuse of open spaces.
- Increased health and environmental risks associated with inadequate waste collection and disposal services, and informal salvaging on landfill sites.
- Poverty encourages salvaging on waste sites for recyclables, refuge materials, fuel and food.
- Reduced recreational value of land and water resources by inadequate waste services.
- Reduced tourism and investment by negative impressions of widespread littering, illegal waste dumping and perceived ineffective management of general and hazardous waste.
- Environmental risks as many waste sites which do not meet the Minimum Requirements stipulated by DWAF, requiring upgrading to the specifications, or closure and rehabilitation.
- Establishment of industries on smallholdings contributes to illegal dumping of waste.

## What is being done to improve waste management?

International Responses	<ul style="list-style-type: none"> <li>• Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1989</li> <li>• Fourth ACP-EEC Convention, 1989</li> <li>• Bamako Convention on the Ban of the Import and Control of Transboundary Movement of Hazardous Wastes within Africa</li> </ul>
National Responses	<ul style="list-style-type: none"> <li>• National Constitution 1996</li> <li>• National Environmental Management: Waste Management Bill (2000)</li> <li>• Environment Conservation Act (73 of 1989)</li> <li>• National Water Act (36 of 1998)</li> <li>• Atmospheric Pollution Prevention Act (45 of 1965). Pending update.</li> <li>• Hazardous Substances Act (15 of 1973)</li> <li>• Fertilizers, Farm Feeds and Agricultural Remedies (36 of 1947)</li> <li>• National Waste Management Strategy</li> <li>• Minimum Requirements for Waste Disposal by Landfill 1998</li> <li>• Polokwane Declaration 2001</li> <li>• Recycling Initiatives</li> </ul>

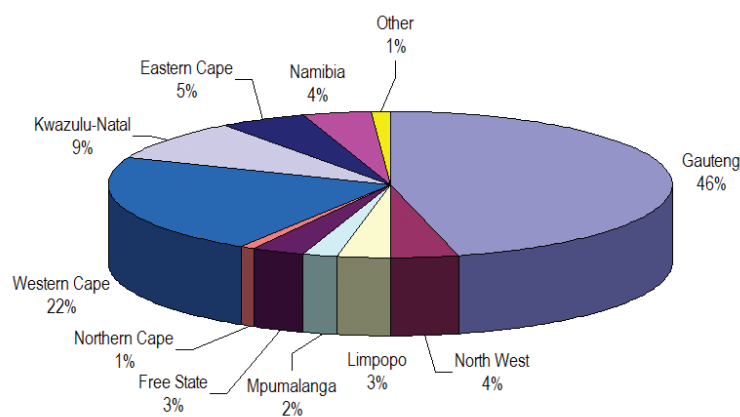


<b>Provincial Responses</b>	<ul style="list-style-type: none"><li>• "Bottle ke Botho" Clean Town, Ward and Clean School competitions</li><li>• Industrial Buffer Zones project</li><li>• Health Care Risk Waste Project</li><li>• Development of a Health Care Risk Waste Information System</li><li>• Provincial Waste Recycling and Minimisation Strategy</li><li>• Provincial General Waste Management Strategy</li><li>• Provincial Health Care Risk Waste Management Strategy</li><li>• Provincial Hazardous/Industrial Waste Management Strategy</li><li>• Recycling Initiatives</li><li>• Cleaner Technology and Remediation fund</li><li>• Maintenance of a Landfill Evaluation Information Management System</li><li>• Review of IDPs and EIPs regarding Waste Planning</li><li>• Development of IWMP Guidelines for Local Authorities (current)</li><li>• Development of HCRW regulations (current)</li><li>• Closure of non compliant HCRW facilities by 2004 (current)</li></ul>
<b>Local Authority Responses</b>	<ul style="list-style-type: none"><li>• Extension of service delivery</li><li>• Development of Integrated Waste Management Plan (IWMPs) strategies for Integrated Development Plans (IDPs)</li><li>• Local recycling centres &amp; initiatives, especially in Ekurhuleni</li><li>• Local garden refuse centres, mainly in Johannesburg</li><li>• Implementation of penalties for illegal waste disposal</li><li>• Landfill gas recovery project in Ekurhuleni</li><li>• Projects to license operational and closed waste sites in Tshwane</li><li>• Liaison with business for paper, glass, cans etc segregation and recovery</li></ul>

## Waste recycling

Recycling forms an integral facet of Integrated Waste Management for the protection of human health and the environment, and the achievement of the goals of the Polokwane declaration. The economic viability of recycling wastes is dependent upon the waste composition and its ability to be separated, or segregated, into a marketable commodity. Over 50 % of the general waste currently being disposed of in landfills in South Africa has the potential to be recovered for recycling or re-use, specifically paper, glass, beverage cans and metal (DWAF, 1998), whilst present recycling in Gauteng appears to be <10%. It is however recognised that it is difficult to segregate waste effectively and a market for the materials must exist. Short-term target recyclables of 15-20 % could be more realistically attainable. It is noted that during the World Summit on Sustainable Development (WSSD) in Johannesburg September 2002, daily waste generation peaked at 26 tonnes whilst approximately 76 tons of waste were recycled during the summit, and some summit venues had recycling rates of over 50%.





Source: <http://www.glassrecycling.co.za> (2004)

**Figure 9.7: Historical performance of glass recoveries and recoveries per province**

**Table 9.5: Recycling initiatives active in Gauteng**

Source: City of Johannesburg (2003)

Organisation	Initiatives
Mondi	4 recycling depots in Gauteng (Midrand, Pretoria, Tulisa Park & Springs). Approximately 120 000 tonnes/ annum processed.
Sappi	Estimated 730 000 tonnes of waste paper are landfilled per annum nationally. Historically, War on Waste (WOW) campaign which focuses on school collections
Nampak	Strategy now focused on the buy back sector of the recycling market
Glass Recycling Association	Collection of cardboard, newspapers, magazines and office waste at about 36 000 tonnes/annum. Nampak has established buy-back centres run by an independent entrepreneur who is trained and supported by Nampak.
ECOWASH	Year on year glass recovery tonnages have steadily increased, from 54 000 tons in 1985 to present day in excess of 100 000 tons, or 1 in 5 containers being recycled, and there is potential to increase this to 40%. Focus on the reuse of spirit bottles (e.g. brandy, gin and whiskey) by the distillers.
Rose Foundation	Return rate of bottles is currently between 30 – 35%, of which 25% is through formal collection (hotels, bars, bottle stores) and remaining bottles are collected by the informal sector (landfill and garden sites). Rose (Recovery of Oil Saves the Environment) manages the environmentally acceptable collection, storage and recycling of used lubricating oil in South Africa.
Collect-a-Can	National recovery rates are currently 10% of the lubricating oils.
Plastics Federation of South Africa	Recovery of steel used beverage cans for recycling, and steel from aerosol, aluminium, food, oil and paint cans. Recovery grew from 18% in 1993 to 63.5% in 2000
Packaging Council of South Africa	123 recyclers operating in SA, 54 are located in Gauteng. No definitive data available regarding the active companies and volumes recycled. A range of education and awareness programmes are undertaken by the Federation to promote plastics recycling, including hot-spot cleanups, workshops and newsletters.
	"Best industry estimates" of recycling within the packaging and related industries

## What does waste management link to?

The consequences and impacts of waste management inherently link to other indicators of environmental health and sustainability, particularly:

- Water resource, the focus being on water quality deterioration and pollution;
- Biodiversity;
- Social environment, the focus being on human health;
- Air quality, the focus being on visual and odour nuisance; and
- Land, the focus being on provision of suitable locations for landfills and waste services.





## Notes about data

Local municipality waste management service departments were contacted for information in terms of the state of waste management in Gauteng, including Tshwane, Johannesburg, Ekurhuleni, West Rand, Mogale, Randfontein, Merafong, Sedibeng and Metsweding. Enviroserve was contacted in terms of hazardous waste management, and industry groups in terms of waste generation and recycling initiatives. The DME was contacted via GDACE in terms of mining and metallurgical waste generation information and the Chamber of Mines, whilst the Gauteng Sustainable Healthcare Waste Management project (SHCWM) was consulted in terms of healthcare waste management information. Unfortunately, accurate waste management data remains limited and fragmented. Data needs for subsequent SoE updates, can be identified to include the integrated and sustained collection and collation of data on:

- Waste generation, collection (service provision), recycling and disposal.
- Hazardous waste generation and management.
- HCRW, recognising that a SHCWM project website reporting system has recently been initiated for Gauteng.
- Mining, metallurgical and power generation waste.
- Agricultural waste.

## Conclusions

Although accurate waste management information remains lacking in Gauteng, as may be expected there appears to have been an increase in waste produced per capita per annum between 1998 and 2003, as well as the provision of waste collection servicing and overall waste disposed to landfill. It appears therefore that the adoption of the Polokwane Declaration of zero waste by 2022 remains optimistic. However, in terms of international benchmarking Gauteng remains significantly less waste rich than most developed countries as a result of the dominance of lower economic sectors, with associated lesser waste, of the domestic waste profile in Gauteng.

Hazardous waste disposal appears to have declined over the period as a result of improvements in industry activities and some reduction in minerals processing, as also reflected as a reduction in mining waste generation. HCRW has increased in quantity, and it remains a problem to resolve effective and appropriate HCRW management.

Recycling initiatives are being adopted and appear to be increasingly successful for glass, cans, paper and oil, with opportunities available for plastics, tyres etc. The importance of public awareness and understanding of waste management and recycling should be stressed at all levels and action plans formulated and implemented in this regard.

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## 10. Conclusion

As Gauteng is the industrial and economic engine of the country and the continent, with a corresponding high level of urban settlement, and bearing in mind our past political history, unique challenges to the achievement of ecologically sustainable development exist.

Poor air quality, particularly indoor air quality in low-income households is arguably the most serious environmental issue that we are faced with in Gauteng. The results presented in this report show that air quality meets acceptable levels of ambient pollutants; however the perception is that despite the rapid electrification of households, indoor air pollution continues to be a problem, negatively impacting on the health and well-being of Gauteng's people. There is also a poor air monitoring network in the province given the concentration of populations and extent of industrialisation.

Many of the water systems in Gauteng have been irreversibly transformed and continue to be degraded by human activities, thus limiting their ecological functionality. Mining and industry have had the greatest impact on water quality. As Gauteng is an importer of water and because population growth and economic development are increasing the demand

for water, it is likely that the availability of water will become a major issue in the near future.

Land resources in Gauteng are unsustainably distributed. Housing densities are low relative to other developing cities around the world, and this low density results in the inefficient use of space and urban sprawl. Land is also inequitably structured where the urban poor are located far from opportunities. Many of these areas are poorly serviced. On the positive side, Gauteng is the second least degraded province in SA, although the levels of soil contamination are not known. Because of the lack of reliable data the extent to which urbanisation is threatening high potential land cannot be definitively addressed in this report. Patterns of cultivation show poor correlation with land capability, suggesting that the reasons for a decline in the contribution of agriculture to the GGP are complex. It is important to note that much of the high potential agricultural land is unutilised, providing opportunity for agricultural development. However, many of these areas have also been identified as being of importance for conservation purposes. The opportunity costs of all plans and strategies affecting land need to be evaluated.



Despite being small and highly urbanised, Gauteng boasts a diverse natural heritage. Of particular note are our assets of international significance, the Cradle of Humankind World Heritage Site and the Blesbokspruit RAMSAR wetland. Furthermore, the province is endowed with a wealth of biodiversity, particularly a heterogeneous landscape with consequent high plant species diversity. Sadly these assets are threatened, mainly by habitat destruction and fragmentation through urbanisation. The protected area network in Gauteng is insufficient to protect biodiversity, although GDACE are taking steps to address this. The importance of urban open space for the protection of biodiversity needs to be borne in mind.

Although Gauteng is less waste rich than other areas internationally due to higher levels of poverty, the generation, collection and disposal of waste have increased over the past few years. Improved industrial technologies and less mining waste has decreased the amount of hazardous waste generated. The successful management of HCRW poses a significant challenge in Gauteng. Although recycling initiatives are becoming increasingly successful, it is submitted that a major mind-shift among the population needs to take place, with regards to waste minimisation. The Polokwane Declaration of achieving zero waste by 2022 is optimistic for Gauteng.

The people of Gauteng are relatively well-off in comparison to the other provinces in SA. The Human Development Index (HDI) is a composite measure of the ability of people to live long, informed and comfortable lives. The index ranges from 0 to 1, with 1 being ideal. Gauteng in 1999 had the highest HDI value in SA (0.69), being

higher than that for SA (0.58) (DBSA). It is concerning that it has decreased from 0.82 in 1991. While Gauteng has generally high levels of access to basic services, there are pockets characterised by poor living conditions, and the province is struggling to match the extension of services to the rapidly growing population. The high levels of in-migration into the province, of largely unskilled and poorly educated people, is concerning given the emphasis on the development of high-tech value added industry. One of the major limitations to this study is the availability of reliable and accurate data. This report had to rely on easily available data sets, some of which have not been updated. It is recommended that more resources be allocated to developing an integrated and comprehensive database for the province on which periodic analyses can be performed. For those themes where there are glaring omissions, notably air quality, public health (respiratory disease), built environment resources, urban expansion, comprehensive research should be conducted to establish a baseline from which monitoring will occur. Further, research and analysis on the causal relationships pertinent to Gauteng should be conducted in order to transform the DPSIR framework into a meaningful, non-generic one.

Given that SoE reporting is a dynamic process, it is recommended that the built environment and cultural heritage resources are included in future updates.

Despite the problems and challenges mentioned above, it is encouraging to note that the GPG is committed to improving the quality of life of the inhabitants in Gauteng through ecologically sustainable development.



## 11. Acknowledgements

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## Appendix A

Red Data Plant Species recorded from Gauteng. Flowering season and suitable habitat are indicated to assist with field surveys. Red Data priority groupings are indicated including, in descending order of priority, A1, A2, A3 and B priority groupings. Priority groupings are not applicable (N/A) to near threatened species. Species listed as A1 are endemic to the province, A2 endemic to Gauteng + one other province or country, A3 endemic to Gauteng and two other provinces or countries etc.

SPECIES	CONSERVATION STATUS	FLOWERING SEASON	SUITABLE HABITAT	PRIORITY GROUPING
<i>Agrostis eriantha</i> var. <i>planifolia</i>	DD	December	Plants grow in typical bankenveld grassveld on flat or undulating plains. The grass grows in amongst other grass species often in full sunlight.	A1
<i>Aloe peglerae</i>	EN	July-August	Rocky places, often on gravelly quartzite, confined mainly to the Magaliesberg range, usually on the northern slopes and summit; scanty grassland, very little soil.	A2
<i>Barleria rehmannii</i>	NT	December-March	Sandy and gravelly soil, open bushveld, rocky slopes.	N/A
<i>Bowiea volubilis</i>	NT	September-April	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest.	N/A
<i>Brachiaria subulifolia</i>	NT	September-November	Frequently in damp or seepage areas on sandy soils.	N/A
<i>Brachystelma discoideum</i>	VU	November	Savanna in gravelly sandy soil.	A3
<i>Calamagrostis epigeios</i> var. <i>capensis</i>	NT	January-May	Vleis.	N/A
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	CR	December-April	Direct sunshine or shaded situations, rocky outcrops of the quartzitic Magaliesberg mountain series, in pockets of soil among rocks, in shade of shrubs and low trees, can be seen twining around grass spikes.	A1
<i>Ceropegia turricula</i>	NT	December-February	Unknown.	N/A
<i>Cineraria longipes</i>	EN	March-May	Koppies to the south of Johannesburg, amongst rocks and along seep lines in association with <i>Pteridium</i> .	A1
<i>Cleome conrathii</i>	CR	May	On stony slopes, usually on sandy soil, open to closed deciduous woodland, quartzites, red sandy soil, all aspects, 1515m.	A3
<i>Cucumis humifructus</i>	EN	January & April	Woodland and grassland, on deep sand.	B
<i>Delosperma davyi</i>	DD	August-March	On dolomite rocks at the edge of dense, shady scrub above river.	A1
<i>Delosperma framesii</i>	DD	August-March	Ridges, hills.	A1
<i>Delosperma gautengense</i>	EN	August-March	Among rocks of Magaliesberg quartzite in grassland in transition to sour grassveld.	A1
<i>Delosperma leendertziae</i>	DD	August-March	Rocky ridges.	A2



SPECIES	CONSERVATION STATUS	FLOWERING SEASON	SUITABLE HABITAT	PRIORITY GROUPING
<i>Delosperma macellum</i>	CR	August-March	In loose gravel in open places near trees.	A1
<i>Delosperma purpureum</i>	CR	August-March	Quartzite slopes: S aspect, usually on steep dipping rock strata forming slabs/sheets; skeletal soil associated with "sheet rock mat formation" typified by the sedge <i>Coleochloa setifera</i> .	A1
<i>Delosperma vogtsii</i>	EN	August-March	On rather steep south facing slopes of quartzite in mountain grassveld.	A1
<i>Encephalartos lanatus</i>	NT	March-September	Open to closed woodland on the slopes of sheltered wooded kloofs or ridges and sheltered rocky ledges.	N/A
<i>Encephalartos middelburgensis</i>	CR	Unknown	Open and grassy with rather sparse bush and tree cover in sheltered valleys, steep rocky slopes.	A2
<i>Eulophia coddii</i>	EN	Early December	Steep hillsides on soil derived from sandstone, grassland or mixed bush.	A2
<i>Eulophia leachii</i>	VU	December-January	Bushveld under trees on stony, black and heavy soils.	B
<i>Frithia humilis</i>	VU	December-February	Sandy flat areas associated with rough rocky outcrops.	A2
<i>Frithia pulchra</i>	NT	December-January	Shallow soil pockets between small, gravelly quartzite stones on large flat slabs of rock. On summits and top of Magaliesberg.	N/A
<i>Gladiolus robertsoniae</i>	NT	October-December	Grassland, shale slopes.	N/A
<i>Habenaria bicolor</i>	NT	January-March	Terrestrial in drained grassland, recorded from about 1800m.	N/A
<i>Habenaria mossii</i>	EN	March-April	Open grassland on dolomite or in black sandy soil.	A1
<i>Heteranthera callifolia</i>	NT	February	Swampy areas, vleis, pans or rock pools.	N/A
<i>Holothrix micrantha</i>	EN	October	Terrestrial on grassy cliffs, recorded from 1500 to 1800 m.	A1
<i>Holothrix randii</i>	VU	September-January	Grassy slopes & rocky ledges.	B
<i>Khadia beswickii</i>	CR	October-March	Open areas on shallow surfaces above rocks in grassland.	A1
<i>Kniphofia typhoides</i>	NT	February-March	Heavy, black clay soil, climax <i>Themeda triandra</i> grassland, low lying marshy ground - pans or vleis.	N/A
<i>Lepidium mossii</i>	DD	Unknown	Unknown.	A2
<i>Lithops lesliei</i> subsp. <i>lesliei</i> var. <i>rubrobrunnea</i>	DD	April	Grassland with dark pinkish-red ferruginous shaly siltstone.	A1
<i>Lotononis adpressa</i> subsp. <i>leptantha</i>	CR	February-May	Open grassland.	A1
<i>Macledium pretoriense</i>	EX	April	Hillsides.	A1
<i>Melolobium subspicatum</i>	CR	October-May	Grassland.	A1

SPECIES	CONSERVATION STATUS	FLOWERING SEASON	SUITABLE HABITAT	PRIORITY GROUPING
<i>Nerine gracilis</i>	VU	February-March	Undulating grasslands in damp, moist areas; the plants grow in full sun in damp depressions, near pans or on the edges of streams; grassland, riverbanks, vleis.	A2
<i>Nuxia glomerulata</i>	NT	October-June	On open hillsides, rocky western slopes or in deep rocky ravines.	N/A
<i>Trachyandra erythrorrhiza</i>	VU	September-October	Marshy areas, grassland, usually in black turf marshes.	A3

Source: Threatened plants for Gauteng were obtained from GDACE (2004), including the most recent updates to Pfab & Victor (2002)'s list. Pfab & Victor (2002) updated the list of threatened plants in Gauteng according to the updated IUCN Species Survival Commission (2000) criteria. The new system differs from the earlier approach in that it targets more specifically taxa that are in danger of going extinct rather than those that are simply rare, using quantitative methods of assessment



## Appendix B

Wild Mammals of Gauteng considered to be threatened according to the IUCN Species Survival Commission (2000) and species that are endemic to South Africa.

SCIENTIFIC NAMES	COMMON NAMES	ENDEMIC TO SA	IUCN
<b>ORDER INSECTIVORA</b>			
<b>Family Soricidae</b>			
<i>Myosorex varius</i>	Forest Shrew	Y	
<b>Family Chrysochloridae</b>			
<i>Chrysospalax villosus</i>	Rough-haired golden mole	Y	VU B1+2c
<i>Amblysomus hottentotus</i>	Hottentot golden mole	Y	
<i>Amblysomus julianae</i>	Juliana's golden mole	Y	CR B1+2c
<b>ORDER CHIROPTERA</b>			
<b>Family Vespertilionidae</b>			
<i>Miniopterus schreibersii</i>	Schreiber's long-fingered bat		LR/nt
<i>Rhinolophus blasii</i>	Peak-saddle horseshoe bat		LR/nt
<b>Family Hipposideridae</b>			
<i>Cloeotis percivalli</i>	Short-eared trident bat		LR/nt
<b>ORDER RODENTIA</b>			
<b>Family Pedetidae</b>			
<i>Pedetes capensis</i>	Springhare		VU A1cd
<b>Family Muridae</b>			
<i>Dasymys incommis</i>	Water rat		DD
<i>Rhabdomys pumilio</i>	Striped mouse		DD
<i>Mystromys albicaudatus</i>	White-tailed rat	Y	EN A3c
<b>ORDER CARNIVORA</b>			
<b>Family Hyaenidae</b>			
<i>Hyaena brunnea</i>	Brown hyaena		LR/nt
<b>Family Felidae</b>			
<i>Acinonyx jubatus</i>	Cheetah		VUC2a(i)
<i>Panthera pardus</i>	Leopard		
<i>Panthera leo</i>	Lion		VUC2a(i)
<i>Felis nigripes</i>	Small spotted cat		VUC2a(i)
<b>Family Canidae</b>			
<i>Lycaon pictus</i>	Wild dog		EN C1
<b>Family Mustelidae</b>			
<i>Lutra maculicollis</i>	Spotted-necked otter		VuA1c
<b>ORDER PERISSODACTYLA</b>			
<b>Family Rhinocerotidae</b>			
<i>Ceratotherium simum</i>	White rhinoceros		NT
<b>Family Equidae</b>			
<i>Equus zebra hartmannae</i>	Hartmann's zebra	Exotic	EN A1b

SCIENTIFIC NAMES	COMMON NAMES	ENDEMIC TO SA	IUCN
<b>ORDER ARTIODACTYLA</b>			
<b>Family Giraffidae</b>			
<i>Giraffa camelopardalis</i>	Giraffe		LR/cd
<b>Family Bovidae</b>			
<i>Tragelaphus angasii</i>	Nyala		LR/cd
<i>Tragelaphus strepsiceros</i>	Kudu		LR/cd
<i>Taurotragus oryx</i>	Eland		LR/cd
<i>Redunca arundinum</i>	Reedbuck		LR/cd
<i>Kobus ellipsiprymnus</i>	Waterbuck		LR/cd
<i>Hippotragus niger</i>	Sable antelope		LR/cd
<i>Hippotragus equinus</i>	Roan antelope		LR/cd
<i>Oryx gazella</i>	Gemsbok		LR/cd
<i>Syncerus caffer</i>	African buffalo		LR/cd
<i>Connochaetes gnou</i>	Black wildebeest	Y	
<i>Connochaetes taurinus</i>	Blue wildebeest		LR/cd
<i>Alcelaphus buselaphus</i>	Red hartebeest		LR/cd
<i>Damaliscus dorcas phillipsi</i>	Blesbok	Y	LR/cd
<i>Damaliscus lunatus</i>	Tsessebe		LR/cd
<i>Aepyceros melampus melampus</i>	Impala		LR/cd
<i>Antidorcas marsupialis</i>	Springbok		LR/cd
<i>Oreotragus oreotragus</i>	Klipspringer		LR/cd
<i>Ourebia ourebi</i>	Oribi		LR/cd
<i>Pelea capreolus</i>	Grey rhebok	Y	

The above inventory is based on information in the following references:

- 2003 IUCN Red list of threatened animals.
- Mills G & Hes L. 1997.
- Newbery C. 1995.
- Rautenbach IL. 1982.
- Skinner JD & Smithers RHN. 1990.
- Smithers RHN. 1986.

## Appendix C

### Gauteng Province Threatened, Rare and of conservation concern Invertebrates

Species	Taxon	IUCN Red List Status	SA Red Data Book Status	Preliminary Regional Assessment	Gauteng endemic
<i>Aloeides dentatis dentatis</i>	Butterfly	VUD2	Endangered/CD		Yes
<i>Chrysoritis aureus</i>	Butterfly	LR/nt	Endangered/CD		Near (Gauteng, OFS)
<i>Metisella meninx</i>	Butterfly	NE	Vulnerable		No
<i>Gegenes hottentota</i>	Butterfly	NE	Data deficient		No
<i>Harpactirella flavipilosa</i>	Baboon spider	NE	NE	Data Deficient	No
<i>Harpactira hamiltoni</i>	Baboon spider	NE	NE: In Nature Conservation Ordinance 1983	Rare	Near (Gauteng, OFS, KZN)
<i>Pycnacantha tribulus</i>	Spider	NE	NE	Very Rare	No
<i>Brachionopus pretoriae</i>	Trapdoor spider	NE	NE	Data Deficient	Yes
<i>Idiops fryi</i>	Trapdoor spider	NE	NE	Rare	Near (Gauteng, OFS)
<i>Idiops pretoriae</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Idiops gunningi</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Homostola pardalina</i>	Trapdoor spider	NE	NE	Rare	Near (Gauteng, Mpumalanga)
<i>Homostola zebrina</i>	Trapdoor spider	NE	NE	Data Deficient	No
<i>Galeosoma hirsutum</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Galeosoma pilosum</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Galeosoma robertsi</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Galeosoma planiscutatum</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Galeosoma pallidum</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Galeosoma scutatum</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Segregara monticola</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Segregara transvaalensis</i>	Trapdoor spider	NE	NE	Rare	No
<i>Moggridgea paucispina</i>	Trapdoor spider	NE	NE	Rare	No
<i>Ancylotrypa nuda</i>	Trapdoor spider	NE	NE	Data deficient	Near (Gauteng, NW province)
<i>Ancylotrypa rufescens</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Ancylotrypa brevipalpis</i>	Trapdoor spider	NE	NE	Rare	Near (Gauteng, NW province)
<i>Ancylotrypa pretoriae</i>	Trapdoor spider	NE	NE	Data deficient	Near (Gauteng, NW province)
<i>Gorgyrella schreineri minor</i>	Trapdoor spider	NE	NE	Data deficient	Yes
<i>Stasimopus robertsi</i>	Trapdoor spider	NE	NE	Rare	No



Species	Taxon	IUCN Red List Status	SA Red Data Book Status	Preliminary Regional Assessment	Gauteng endemic
<i>Stasimopus suffucus</i>	Trapdoor spider	NE	NE	Rare	Yes
<i>Stasimopus oculatus</i>	Trapdoor spider	NE	NE	Rare	No
<i>Calommata simoni</i>	Trapdoor spider	NE	NE	Very Rare	Yes
<i>Hadogenes gunningi</i>	Scorpion	NE	NE	Threatened	Near (Gauteng, NW province)
<i>Hadogenes gracilis</i>	Scorpion	NE	NE	Threatened	Marginal in Gauteng (NW province species)
<i>Hadogenes longimanus</i>	Scorpion	NE		Threatened	Marginal in Gauteng (Mpumalanga species)
<i>Opisthophthalmus pugnax</i>	Scorpion	NE	NE	Endangered	Near (Gauteng, NW province)
<i>Ichneustoma stobbiai</i>	Fruit Chafer beetle	NE	NE	Preliminary Evaluation using IUCN software: Critically Endangered	Yes
<i>Trichocephala brincki</i>	Fruit Chafer beetle		NE	Preliminary Evaluation using IUCN software: Vulnerable	Near (Gauteng, NW province)

Source: Marianne Forsyth, 2004 (GDACE).

**NOTE:**

**NE** = Not Evaluated – these species have not yet been assessed against the criteria for extinction risk (IUCN Red List or SA Red Data Book).

**Data Deficient:** Insufficient data to determine the degree of threat/extinction risk.

**Preliminary Regional Assessment:** These species depict the preliminary assessment of extinction risk regionally done by Gauteng Nature Conservation/ Specialists using the Global IUCN Red List Criteria as guidelines. The following specialists have been pivotal in conservation information support and assigning conservation status:

- o Spiders: Dr Ansie Dippenaar-Schoeman (ARC-PPRI)
- o Scorpions: Dr Lorenzo Prendini (AMNH)
- o Butterflies: Graham Henning and Peter Roos (Lepidopterists' Society of Southern Africa)



## Appendix D

Threatened bird species that are priorities in Gauteng.

Species (Common)	Species (Scientific)	Threatened Status
Cape Vulture	<i>Gyps coprotheres</i>	VU
Blue Crane	<i>Anthropoides paradiseus</i>	VU
Lesser Kestrel	<i>Falco naumanni</i>	VU
Grass Owl	<i>Tyto capensis</i>	VU
African Marsh Harrier	<i>Circus ranivorus</i>	VU
White-backed Night Heron	<i>Gorsachius leuconotus</i>	VU
White-bellied Korhaan	<i>Eupodotis cafra</i>	VU
Martial Eagle	<i>Polemaetus bellicosus</i>	VU
African Finfoot	<i>Podica senegalensis</i>	VU
Blue Korhaan	<i>Eupodotis caerulescens</i>	NT
Melodious Lark	<i>Mirafraga cheniana</i>	NT
Lesser Flamingo	<i>Phoeniconaias minor</i>	NT
Secretarybird	<i>Sagittarius serpentarius</i>	NT
Black Stork	<i>Ciconia nigra</i>	NT
Lanner Falcon	<i>Falco biarmicus</i>	NT
Half-collared Kingfisher	<i>Alcedo semitorquata</i>	NT
Greater Flamingo	<i>Phoenicopterus ruber</i>	NT
Yellow-billed Stork	<i>Mycteria ibis</i>	NT
Red-billed Oxpecker	<i>Buphagus erythrorhynchus</i>	NT

Source: C. Whittington-Jones, 2004 (GDACE)

Bird Species Endemic to South Africa that occur in Gauteng.

Blue Korhaan	<i>Eupodotis caerulescens</i>	Endemic
Ground Woodpecker	<i>Geocolaptes olivaceus</i>	Endemic
Greater Doublecollared Sunbird	<i>Nectarinia afra</i>	Endemic
Cape Weaver	<i>Ploceus capensis</i>	Endemic
Pied Starling	<i>Spreo bicolor</i>	Endemic
Sentinel Rock Thrush	<i>Monticola explorator</i>	Endemic
Rock Pipit	<i>Anthus crenatus</i>	Endemic
Cape Vulture	<i>Gyps coprotheres</i>	Near-endemic
Blue Crane	<i>Anthropoides paradiseus</i>	Near-endemic
Melodious Lark	<i>Mirafraga cheniana</i>	Near-endemic
Cape Rock Thrush	<i>Monticola rupestris</i>	Near-endemic
Greywinged Francolin	<i>Francolinus africanus</i>	Near-endemic
Fiscal Flycatcher	<i>Sigelus silens</i>	Near-endemic
Cape White-eye	<i>Zosterops pallidus</i>	Near-endemic
Fairy Flycatcher	<i>Stenostira scita</i>	Near-endemic
Black Harrier	<i>Circus maurus</i>	Near-endemic

Source: C. Whittington-Jones (GDACE)