

NELSON MANDELA BAY MUNICIPALITY

STATE OF THE ENVIRONMENT REPORT



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We are only as healthy as the world we live in

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STATE OF THE ENVIRONMENT REPORT

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Acronyms and abbreviations

AIDS	Aquired Immune Deficiency Syndrome
ASL	Above Sea Level
BEE	Black Economic Empowerment
CMP	Coastal Management Programme
CSIR	Centre for Scientific and Industrial Research
DEAT	Department of Environmental Affairs and Tourism (national)
DEDEA	Department of Economic Development & Environmental Affairs (provincial)
DPLG	National Department for Provincial and Local Government
DWAF	Department of Water Affairs and Forestry
ECA	Environment Conservation Act
EIA	Environmental Impact Assessment
EIP	Environmental Implementation Plan
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMS	Environmental Management System
ENPAT	Environmental Potential Atlas of Southern Africa
GDP	Gross Domestic Product
GRP	Gross Regional Product
HDI	Human Development Index
HIV	Human Immuno-deficiency Virus
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
LA 21	Local Agenda 21
LM	Local Municipality
MEC	Member of Executive Council
MPA	Marine Protected Area
MSA	Municipal Systems Act
NEMA	National Environmental Management Act
NFA	National Forestry Act
NGO	Non Governmental Organisation
NHRA	National Heritage Resources Act
NLP	National LandCare Programme
NMBM	Nelson Mandela Bay Municipality
NMBOSS	Nelson Mandela Metropolitan Open Space System
NSBA	National Spatial Biodiversity Assessment
PES	Present Ecological State
PUOS	Public Open Space
PPP	Public Participation Process
PSC	Project Steering Committee
RAMSAR	Ramsar Convention on Wetlands
SAHRA	South African Heritage Resources Authority
SANPARKS	South African National Parks
SDF	Spatial Development Framework
SDI	Soil Degradation Index
SEA	Strategic Environmental Assessment
SOE	State of the Environment
SOER	State of Environment Report
STEP	Subtropical Thicket Ecosystem Plan
TB	Tuberculosis
UN	United Nations

UNCED	United Nations Conference on Environment and Development
WESSA	Wildlife and Environmental Society of Southern Africa
WWF	Working for Water
WSSD	World Summit on Sustainable Development

Glossary

Abstraction: the extraction of water from a river, dam, wetland or groundwater resource.

Afforestation: planting of a forest.

Alien invasive species: plants or animals that do not naturally occur in an area and are aggressive in their ability to replace indigenous species.

Ambient: the surrounding environment.

Anthropogenic of man-made origin.

Aquatic plants: plants growing in flooded environments.

Biodiversity: the variety of all life forms (plants, animals and micro-organisms), the genes they contain and the ecosystems of which they form a part of.

Biomass: the total mass of living tissues (plant and animal).

Biome: the largest ecosystem unit of classification.

Built environment: physical surroundings created by human activity, including houses, buildings, roads, bridges and harbours.

Catchment: a river basin, including all the land from which water flows to accumulate in that river.

Diurnal: referring to a daily cycle.

Drivers: the factors that induce change in the social/economic/ecological environment

Ecological reserve: the quantity, quality and reliability of water required to maintain the ecological functions on which humans depend.

Ecology: the study of the interaction between living organisms and their physical environment.

Ecosystem: a community of organisms (plants animals, microorganisms), interacting with each other and the physical environment in which they live. The basic unit of ecology.

Endemics: species restricted in their occurrence to a particular area.

Environment: our surroundings, including living (such as humans, animals and plants) and non-living (such as buildings, land, soil, air and water) elements. The environment also includes our social and economic surroundings.

Environmental Impact Assessment: a process of examining the effects of proposed development activities (e.g. a construction project), on the state and functioning of the natural and social environment

Environmental Management System: an organisation's overall management structure that addresses the immediate and long-term impacts of the organisation's activities, products and services on the environment.

Environmentally sustainable: In relation to the provision of a municipal service, environmentally sustainable means the provision of a municipal service in a manner aimed at ensuring that-

- The risk of harm to the environment and to human health and safety is minimised to the extent reasonably possible under the circumstances;

- The potential benefits to the environment and to human health and safety are maximised to the extent reasonably possible under the circumstances; and
- Legislation intended to protect the environment and human health and safety is complied with.

Evaporation: the process, by which water in a lake, river, wetland or other water body becomes a gas.

Habitat loss: the clearing of natural vegetation for agriculture, urbanisation, mining or industry - usually irreversible.

Hydrology: the study of the properties, distribution and circulation of water on the land surface and in the soil, underlying rocks and atmosphere.

Indicator/key indicator: a measure of something that points to a problem or condition. In-stream flow the amount of water entering a river and allowed to flow through a catchment area.

Integrated Environmental Management: the procedure of integrating economic, social and ecological considerations into sustainable development planning.

Nelson Mandela Bay Municipality: the local authority with the responsibility of providing essential municipal services to people within their jurisdiction.

Nelson Mandela Metropolitan Open Space System: a planned network of open space to facilitate agriculture, conservation, and recreational and cultural activities.

Non-point source pollution: when pollutants enter the watercourse over a diffuse area, such as stormwater and agricultural run-off.

Point source pollution: a specific pipe, culvert etc. directly discharging to a water course.

Pollution: the introduction into the environment of any substance caused by the action of man, which has, or results in, significant harmful effects to the environment

Red data species: species whose natural, wild populations have been reduced such that their survival is questionable.

Riparian: pertaining to a stream or river.

Riverine: associated with rivers.

Salinity: measure of the total salt content of water or soil

Soil erosion: loss of topsoil resulting from the reduction in vegetation cover as a result of heavy disturbances such as overgrazing, trampling and poor cropping practises.

South African Scoring System: a standardised biological index to assess the water quality of rivers

State of the Environment Report: a report on current condition and trends for the ecological, social and economic environment of a defined area

Sustainability: the ability to continue indefinitely, at current and projected levels, without depleting social, cultural and natural resources required to meet present and future needs.

Sustainable Development: The integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations.

Symbiosis: mutual dependence of two or more elements.

1 SUMMARY EVALUATION

State of the environment reporting began in South Africa in 1999 with the publication of the National SOER. Since then, it has developed to become a regular reporting tool for national, provincial and local government structures.

A State of the Environment Report is used to highlight changes in the environment, as well as the causes of these changes, and to identify appropriate responses. It includes a description and discussion of the condition of the environment within a defined study area. It is a component of the Integrated Environmental Management toolbox and is prepared to guide future decision-making and policy. The report should take into account the full scope of the term 'environment' and as such, should deal with societal, economic and biophysical issues.

This is the first SOER compiled for Nelson Mandela Bay. It describes the state of the environment through various indicators grouped into eight reporting themes, and it is preceded by a brief description of the study area. A summary evaluation of each theme is presented below.

I. LAND

Change in land use

Between 2003 and 2007 the primary change in land use in the NMBM was caused by urban expansion (+14.1%) and a reduction in near-natural areas (-10.9%). The latter outcome has had negative repercussions for the biodiversity protection and maintenance of important ecological services in the municipal area. As elaborated in the Theme: Biodiversity, more than one third of the 58 vegetation types occurring on NMBM cannot sustain further loss from developmental activities.

Between 1997 and 2007 the coastal zone within 1 km of the high water mark lost 8.5% of land in near-natural condition through commercial and industrial development projects.

Zoning

A substantial part of the zoning information is still contained in paper records and has not yet found its way into electronic databases. In Nelson Mandela Bay Municipality only 32.8% of cadastres have detailed zoning information in the GIS layer. Densely built-up areas of Port Elizabeth, Despatch and Uitenhage are well covered, but the outlying areas are not covered at all. The lack of full zoning coverage for NMBM prevents deeper analysis of spatial trends.

Property sizes

Government sponsored low-cost housing schemes continue to settle families on tiny erven of $\pm 200 \text{ m}^2$ instead of multi-storey blocks of flats. This has negative ramifications for biodiversity since small properties come with gardens (if at all!) that are too small to support small mammals, birds and lower vertebrates as breeding species.

Open space per person

Public Open Spaces (PUOS) contribute much to the quality of life. Ideally the area set aside for PUOS should be inversely proportional to the mean property size of a built-up area (allotment). People with small plots need large parks. This is not the case in the urban parts of Nelson Mandela Bay.

Formal versus informal settlements

A slum, as defined by the United Nations, is a run-down area of a city characterized by substandard housing and squalor and lacking in tenure security. The municipality's cadastral GIS layer, cross checked with 2007 high-resolution aerial photography, shows that informal urban areas (conforming to the UN definition) take up just 1000 ha, or 0.5%, of the total NMBM area. However, this gives a misleading impression of the extent of human misery. In addition to the slums fitting precisely the UN definition, there are many more urban areas where the residents do have tenure of their tiny plots, but live in shacks surrounded by squalor and also lack most types of municipal services that those in better off suburbs enjoy.

Extent of mining

Mining is of very low economic importance in NMBM as it contributes only 0.3% of Value Added Geographical Growth to the economy. Of great concern are the 'red soil' borrow pit areas found in more remote parts of the metro which appear to have all the signs of illegal operations associated with them, as mining permits invariably include the duty of rehabilitation, which is patently absent.

II. CLIMATE CHANGE AND AIR QUALITY

Trends in temperature

Data for Port Elizabeth indicated that there has been a slight increase in mean surface temperature since the late 1800s.

Trends in precipitation

Analysis of rainfall trends in the Eastern Cape indicated no gradual decreasing or increasing rainfall trend for the post-1990 period, when compared with the climate reference period 1961-1990. The same conclusion was reached for the rainfall trend in Port Elizabeth. When rainfall data for the last 40 year was analysed, a cyclical pattern was found with dryer periods occurring around 1990 and commencing again towards the end of 2007.

Extreme events

The number of disastrous flood events increased in the last four decades. There has been a linear increase in the number of flood events over the last century. Droughts have been found to occur before and after major flooding events. It remains difficult, however, to draw concrete conclusions regarding the relationship between climate change and extreme weather events for Port Elizabeth, chiefly because tremendous surface hardening from development projects has taken place over the years that would have to be factored in during the analysis.

Air quality

No co-ordinated air quality monitoring network exists in the Eastern Cape. Air quality monitoring is performed on a fragmented basis and is concentrated mainly in the Nelson

Mandela Metropolitan Municipality. An Air Quality Management Plan for the Nelson Mandela Bay Municipality is under development. A memorandum of agreement has been signed between the NMBM and the provincial Department of Environmental Affairs, identifying the need to develop an AQMP as a priority. As a result of a lack of an AQMP, no estimation on the total industrial emissions in the Nelson Mandela Bay Municipality has been undertaken. Air pollution sources that have not been measured or for which no data is available include motor-vehicle emissions, burning of refuse, the burning of vegetation, noise pollution and dust pollution. Ad hoc studies found very few instances where measured atmospheric pollution concentrations exceeded the available guideline values under the Atmospheric Pollution Prevention Act. The relatively low concentrations of key air pollutants in the Nelson Mandela Bay Municipality are largely the result of the high prevalence of strong winds in the metro. The wind disperses the emission of pollutants almost daily. Conversely, a slight haze can be observed hanging over the industrial and CBD areas of the metro after a few days without wind.

III. BIODIVERSITY

Ecosystem status: biodiversity pattern

In Nelson Mandela Bay, 57% of land classes are Endangered or Critically Endangered, with a further 26% Vulnerable to lose ecosystem functioning. In terms of the area occupied by the land classes, the Endangered or Critically Endangered account for 15.5% and 15.6%, respectively, of Nelson Mandela Bay. Only Groendal Wilderness, Lady Slipper Mountain, Koedoeskloof and the Sundays dunes at the fringes of the metropolitan area are still largely intact, whereas the midland areas are under greater threat to lose their ecological integrity. The Critically Endangered parts of NMBM are lying in a broad band in the south representing an assortment of smaller vegetation types that presumably were readily transformed from the virgin state for human purposes. Much of the Swartkops River valley is also Critically Endangered. These land classes are Critically Endangered because conversion to built-up land and the presence of severe human impacts has compromised target achievement in terms of ensuring the long-term persistence of the biodiversity pattern.

Ecosystem status: biodiversity processes

All the 11 mainstem rivers in the NMBM require safe-guarding in order to meet the required conservation targets for freshwater systems. Four rivers (Coega, Hume, Seaview stream and Swartkops) are so degraded that they require active rehabilitation measures as a matter of urgency.

All the remaining habitat of the functional sand movement corridors present at Maitland, Driftsands (Cape Recife) and along the coast from Hougham Park to Sundays River mouth require conservation and should not be further impacted upon.

Extent of formally conserved areas

With a total area of 3.9% under formal Type 1 and 2 protection NMBM falls considerably under the national average. If the three proposed reserves (Aloes, Chatty, van der Kemp's Kloof) were added, NMBM's percentage would improve to 5.0%. Only four conservancies and one stewardship are currently operative in the NMBM:

Ecosystem protection

There is a mismatch between the conservation status groups of ecosystems/land classes and the level of protection that they enjoy by being located inside existing declared nature reserves. There are many hardly or poorly conserved land classes occurring in Nelson Mandela Bay that are ill protected. Only some of NMBM's protected areas are principally managed for biodiversity protection.

Metropolitan Open Space System

The importance of the NMB MOSS is recognised in the metro's major policy documents. It covers an area of 619 km², or 31.7%. NMB MOSS includes conservation areas and public property, as well as private property. Critical Biodiversity Areas (CBA) containing critically endangered habitats, vital ecological process areas and corridors, as well as habitats for species of special concern have been defined. A Conservation Action Plan for the CBAs has been prepared to ensure the incorporation of the NMBM MOSS spatial biodiversity plan into municipal processes and to catalyse action for the conservation of NMBM's natural assets.

Invasive alien trees

Analysis of the 2007 high resolution aerial photography shows that dense stands of alien invasive trees occupied 107 km² (5.5%) of the total NMBM area of 1954 km². The distribution pattern follows closely the presence of consolidated and unconsolidated aeolian soils derived from the Table Mountain Group, and the coastal dunes, where the trees were introduced as a sand binder. Alluvial soils along the Swartkops and Elands Rivers are also infested. An Alien Invasive Species Monitoring, Control and Eradication Plan has been put in place that is integrated and aligned with the IDP. The existence and adoption by council of this progressive document is strangely at odds with the non-persecution of offenders of the weeds and invader plants regulations in the municipality. An alien eradication programme is underway in NMBM but progress has been slow.

IV. RIVERS, ESTUARIES AND THE COAST

Conservation status

All the rivers in the NMBM require conservation action. The Papenkuils River, which is also known as smelly creek by many local residents, is perhaps the best example of a river in the NMBM that has been abused and exploited to the most extreme extent. This is mainly due to the industrial activity along its banks that has caused the river course to be diverted and long stretches of its banks hardened to accommodate stormwater discharges, roads and effluent discharge.

Another example of a river that is ecologically damaged, perhaps beyond any significant rehabilitation, is the Chatty River. The Chatty River is the fourth longest river with its entire length contained within the borders of NMBM. In contrast to the Papenkuils River, the Chatty River's biggest problem arises not so much from industrial activity and the formal discharges of storm water and effluent, but from the large number of informal settlements that have been established along its banks. The major effect of the informal settlements derives from the lack of formal sanitation that leads to the discharge of raw sewage and litter into the river. The river is considered to be a major health risk by all local residents.

Faecal bacteria at bathing beaches

Since 2001 the Beach Office in Humewood is regularly testing water samples from the metro's beaches for the presence and concentrations of faecal coliform bacteria. The counts are important for public health and for the maintenance of the Blue Flag status. The results show that water quality at Brighton Beach can be considered the worst of all the beaches in the NMBM. It boasts the highest number of days when its waters were above the recommended limits for faecal coliform counts in sea water as well as the highest average coliform counts for all the beaches evaluated. The likely cause of this is the heavily polluted Papenkuils Rivers. The other beaches with coliform counts above the recommended levels are Bluewater Bay, Maitland beach and Van Stadens beach. Beachview and Sardinia Bay beaches had the lowest coliform counts.

River water quality

Of all the rivers within the NMBM, only the Swartkops River has a series of data that could be used to assess chemical water quality. Swartkops River water regularly exceeds the recommended limits for freshwater systems for chloride, potassium, sodium, sulphate and magnesium.

River degradation

Half of the metro's rivers have sections of their catchments hardened, modifying runoff and infiltration. This increases the risk of flooding during heavy rains and reduces the ability of nutrients and other elements to be assimilated in the system. Alien invasion and pollution is by far the largest contributor to river degradation in the NMBM. Most of the rivers have multiple anthropogenic pressures exerted upon them and hence the cause for being degraded, with the exception of the Baakens, Papenkuils and Brak rivers. While the Baakens and Papenkuils would have specifically one or two impacts that have influenced their ecology immensely, the Brak River may genuinely be the least degraded river in the NMBM.

V. BULK SERVICES: ENERGY, WASTE AND WATER

Energy

The percentage of households using electricity for lighting, cooking and heating in NMBM increased notably since 2001. The percentage of households using electricity for lighting, cooking and heating increased by 15.1%, 20.3% and 15.4%, respectively. The increased use of electricity in households previously dominated by wood and paraffin has not been matched with new power generation, partly explaining the nation's current electricity crisis. The manufacturing and commercial sectors also showed similar increases in the use of electricity between 2001 and 2007.

The consumption of diesel in the NMBM showed a sharp increase of 40% from 2002 to 2007, which was driven by substantial increases in the price of petrol causing people to select more fuel efficient cars with diesel engines.

NMBM has embarked on various initiatives to manage the use of energy. For instance, the installation of solar heating units at residences is encouraged via a subsidy scheme.

Solid waste

The Nelson Mandela Bay Municipality has in its service three permitted and operating waste landfill sites: Arlington, Koedoeskloof, and Aloes. The first two have remaining life

spans close to 30 years, but Aloes' capacity to accept hazardous waste will soon run out. The EIA process for the selection of a new hazardous waste site is currently underway. The majority of households in the Nelson Mandela Bay Municipality receive good refuse services through the kerbside removal of plastic bags.

Liquid waste

There are seven waste water treatment works (WWTW) in the NMBM. The combined total throughput of all WWTW equates to 195 Ml/d. All WWTW have a General Standard permit, besides the Rocklands WWTW which has a General Authorisation permit.

When compared with other large municipalities across the country, the NMBM has achieved the greatest change in percentage of households using the bucket system with fewer households using the system. The NMBM has also achieved the second highest change in the use of flush or chemical toilets, second only to the Eden District Municipality.

Water

Nelson Mandela Bay receives water from seven dams of which 6 are owned by the NMBM. The total combined dam capacity of the dams serving the NMBM is 278 269 Ml. Seven water treatment works (Linton Grange, Loerie, Churchill, Elandsjagt, Nooitgedagt, Groendal and Springs) process the water to potable standard before it is pumped to 35 reservoirs around the NMBM. Both total water abstraction and total water production has been an increasing from 2006 to 2009. The data also show that water losses in the pipelines connecting the dams with the WTW have also been increasing. This is of concern as the losses are on the high side, especially in the current drought.

Statistics of chemical tests conducted at WTW over the last five years show that less than 10% of the samples were not complying with the SANS 241 (2005) water quality standards for potable water. Parameter levels of concern are pH, turbidity, magnesium and aluminium.

VI. POVERTY

Occurrence of poverty

Based on the 2001 Stats SA data, the spatial distribution of levels of household income show that most poor people live along the New Brighton/Zwide – Bethelsdorp/Uitenhage axis, with Motherwell as a second density cluster. In these areas up to 60% of households had a monthly income of less than R4 800. In comparison, people living in the northern and southern parts are orders of magnitude better off in terms of their monthly income.

Quality of life

The results of a recent socio-economic study of 49 000 households of the poorest of the poor in the NMBM paint an alarming picture of the quality of life of the majority of NMBM's people, affirming the notion that hunger, disease and poor education describe a person in poverty:

- 7% have no formal education;
- 84% of person older than 18 years did not complete their school education;

- 96% have no tertiary qualification that would give access to good jobs;
- Only 11% have full-time formal sector employment;
- 53% rely on government grants;
- 50% have no money to spare to pay for their children's or their own education;
- 24% of households do not have enough money for food;
- 44% cut the size of your children's meals because there is not enough money to buy food; and
- 16% of children under 18 are orphaned because both parents died of HIV/AIDS related illness.

Population growth

NMBM has had a modest growth in population over the past two decades. While the number of persons increased by 3.7 % and 4.5 % for the periods 1996 – 2001 and 2001 – 2007, respectively, increasingly less persons constituted each household. The most plausible explanation for this phenomenon is that formerly large households with possibly three generations under one roof split into smaller units as standards of living increased and/or as individuals moving to the cities founded new households. The significance of the data lies in the absence of rampant population growth since the end of Apartheid. The reasons for the continuing social injustice do not lie in people numbers, but in ineffective remedial actions - however well-meaning the policies put in place are - and the failure of NMBM's economy to create sufficient employment.

VII. HEALTH

Prevalence of HIV/AIDS

The prevalence of HIV in antenatal woman in the NMBM is similar to the national average of $\pm 30\%$. A slight decrease over the years is discernible.

In 2007 only 32% of people who needed Anti Retroviral drugs (ARVs) in the NMBM were accessing them. The reason for the poor uptake appeared to be a lack of knowledge about their HIV status, fear and misinformation about ARVs and capacity of the NMBM to provide ARV treatment.

Prevalence of TB

Nelson Mandela Bay continues to have one of the highest TB case loads in the province. It is still a serious problem with 13 706 TB cases and an average of 43 TB deaths per week in 2005/2006, despite the metro receiving additional support as one of the identified "Crisis Plan" districts for TB. The TB cure rate in the NMBM is well below the national average and stood at 52.7% in 2005 and 56.2% in 2006. The small improvement shown in NMBM over the years is unacceptable given the improvement in other districts which are less resourced and have infrastructural inadequacies to address.

Underweight births

The NMBM is characterised by relatively high levels of recorded underweight births, with an estimate of 16% averaged over the years 2007 to 2009. This is significantly higher than the national target of 10%. The percentage of underweight births in the NMBM also appears to be increasing slightly in the recent past.

Access to primary health care facilities

There are 20 hospitals, 38 clinics, 28 municipal mobile health services and 12 Community Health Centres (CHC) in the NMBM. Due to the absence of a medical faculty at Nelson Mandela Metropolitan University there is no academic hospital.

VIII. ENVIRONMENTAL GOVERNANCE

Recognition of the environment within the IDP framework

Recognition of the environment in Nelson Mandela Bay is given through key sector plans of the IDP:

- Environmental Management Systems;
- State of Environment Report;
- Nelson Mandela Bay Municipal Open Space System;
- Integrated Waste Management Plan;
- Coastal Management Plan;
- Water Master Plan;
- Energy efficiency and renewable energy strategy; and
- Greening Policy.

The components of the Integrated Environmental Plan are being complemented by the Bioregional Plan, the Environmental Management Framework and the Integrated Air Quality Management Plan, all of which are currently under development.

Fulfilment of the environmental management function

Municipal staff, with the assistance of its appointed consultants, has made great strides in assessing NMBM's physical assets and needs and developing dedicated policies to manage them. Examples are the NMB MOSS Conservation Assessment and Plan, Strategic Environmental Assessment Report, Coastal Management Programme, State of Environment Report (this document), as well as the Bioregional Plan (underway).

By developing these plans and policies NMBM has demonstrated that it embraces the obligation of local government to incorporate sustainable development principles in its actions. It constitutes an appropriate response to the legislative requirements listed in the Constitution, the National Environmental Management Act, the Biodiversity Act, the Municipal Systems Act, the Integrated Coastal Management Act and others.

Compliance with environmental legislation

NMBM's environmental law enforcement function remains woefully under-resourced given that they are operating with a handful of officers in a huge area of 1958 km². Barely sufficient to prevent the worst environmental crimes in NMBM's eight Local Nature Reserves, there is no effective control in areas outside.

Recommended responses

- NMBM needs to promote co-operative governance between Directorates within the municipality, as well as with provincial and national departments in environmental management.
- NMBM should encourage managers of Directorates to take responsibility for environmental aspects that they have control over.
- All NMBM staff require environmental awareness training.

- Ensure availability of environmental sensitivity maps.
- NMBM should continually improve on its environmental management system to guide environmental decision-making.

2 INTRODUCTION

2.1 What is a State of the Environment Report?

A State of the Environment Report is used to highlight changes in the environment, as well as the causes of these changes, and to identify appropriate responses (DEAT 2004). It includes a description and discussion of the condition of the environment within a defined study area. It is a component of the Integrated Environmental Management toolbox and is prepared to guide future decision-making and policy.

It is important to recognise that State of Environment (SoE) reporting is not an end in itself. It is part of a broader process aimed at achieving sustainable resource management, through providing accurate and relevant information to the correct target audience, and influencing decisions through effective communication (DEAT 2006).

“A State of the Environment Report is a description and discussion of the condition of the environment. It provides information to inform decisions for sustainable management, and measures the impact of these decisions on the environment” (DEAT 2006).

Thus, the principles of State of Environment reporting are:

- Meet the demands of the end-user;
 - Incorporate public and stakeholder input;
 - Identify spatial and temporal trends;
 - Analyse scientific information for the benefit of decision-makers and other end-users; and
 - Work within a framework that highlights links between society, the economy and the environment.
-

2.2 Background to State of the Environment Reports

The Department of Environmental Affairs and Tourism (DEAT) launched the first National SoE Report, together with that of Cape Town, Durban, Johannesburg and Pretoria, in 1999. Since then, South Africa's SoE reporting initiative has been greatly expanded with several reports having been compiled at provincial and local level. Knysna Local Municipality within Eden is an example of a local municipality that has undertaken a State of the Environment Report. SOER has developed to become a regular reporting tool for national, provincial and local government structures.

3 LEGAL FRAMEWORK

Just as the definition of the environment covers a broad range of issues, law aimed at controlling these issues is widely distributed in national legislation. Although reporting on the state of the environment is not legislatively mandatory in South Africa, there is a solid and logical basis for its compilation and use. Various legislative structures require the government to provide the public with information on the state of the environment: The purpose of this chapter is introduce the environmental legislation that provides the motivation for producing a State of the Environment Report for the Nelson Mandela Bay Municipality.

3.1 Constitution of South Africa (Act 108 of 1996)

The Constitution of South Africa guarantees everyone an environment that is not harmful to their health or wellbeing. The Constitution further commits all levels of government to sustainable development so as to ensure that the environment is protected for present and future generations. The objectives of local government include specific reference to:

- Ensuring the provision of services to communities in a sustainable manner;
- Promoting social and economic development;
- Promoting a safe and healthy environment; and
- Encouraging the involvement of communities and community organisations in the matters of local government.

The Municipality is further bound (Section 184) to report annually to the Human Rights Commission¹ on the measures taken towards the realisation of the rights in the Bill of Rights concerning housing, health care, food, water, social security, education and the environment.

3.2 National Environmental Management Act (Act 107 of 1998)

The National Environmental Management Act (NEMA) sets out principles for environmental management aimed at guiding all government structures that may significantly affect the environment. These principles form the general framework within which environmental management and implementation plans are formulated. NEMA guides and encourages government structures to be proactive and provide information on the state of the environment. Indeed, all three tiers of government (national, provincial and local) have produced SOERs designed to improve access to relevant,

¹ The national institution established to support constitutional democracy through the promotion and protection of human rights.

accurate, up-to-date environmental information on the state of the environment. The NEMA access to information clause is arguably the most significant section for state of the environment reporting. Section 31(1) (a) of NEMA states that *“every person is entitled to have access to information held by the State and organs of state that relates to the implementation of this Act and any other law affecting the environment”*.

3.3 National Environmental Management: Biodiversity Act (Act 10 of 2004)

The Act provides for the management and conservation of South Africa's biodiversity, the protection of species and ecosystems warranting national protection, the sustainable use of indigenous biological resources, and the fair and equitable sharing of benefits arising from indigenous biological resources.

Section 48 of the Biodiversity Act stipulates that the municipality is required to report on the conservation status and positive and negative trends of various components of its biodiversity.

3.4 Municipal Systems Act (Act 32 of 2000)

The Municipal Systems Act provides for the core principles, mechanisms and processes that are necessary to enable municipalities to provide for community participation and for the integration of all activities for the overall social and economic upliftment of communities in harmony with their local natural environment. It also states that a fundamental aspect of the new local government system is the active engagement of communities in the affairs of municipalities of which they are an integral part.

The Act requires the implementation and monitoring of Integrated Development Plans, the setting of targets and key performance indicators, including environmental targets, as well as the preparation of by-laws and policies that deal with environmental issues.

3.5 Promotion of Access to Information Act (Act No. 2 of 2000)

The Promotion of Access to Information Act makes provisions and conditions specifically for right of access and application for access to information and records held by organs of the state.

3.6 Local Agenda 21

Agenda 21 is a programme run by the United Nations (UN) related to sustainable development. It is a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment. Local Agenda 21 is the local implementation of the plan, as recommended in Chapter 28 of the document.

Local Agenda 21 (LA 21) acts as a guiding principle for the development of national legislation relevant to sustainable development. An example of the application of the LA 21 guiding principles may be found in the Municipal Systems Act of 2000 (see section 3.4). The contents of the Act are well aligned with the requirements of LA 21 in that the Act says that planning must be done in a holistic way, in order that sectoral issues, such as roads, water, economic development, health, and welfare, are integrated.

4 BRIEF DESCRIPTION OF THE ENVIRONMENT

4.1 Topography

The Nelson Mandela Bay Municipality lies at the southern tip of Africa in the south Eastern Cape at the shores of the Indian Ocean. Its centre point geographical coordinates of $33^{\circ}48'S$, $25^{\circ}30'E$ have the same latitude as Cape Town, which is approximately 660 km to the west (Figure 1).

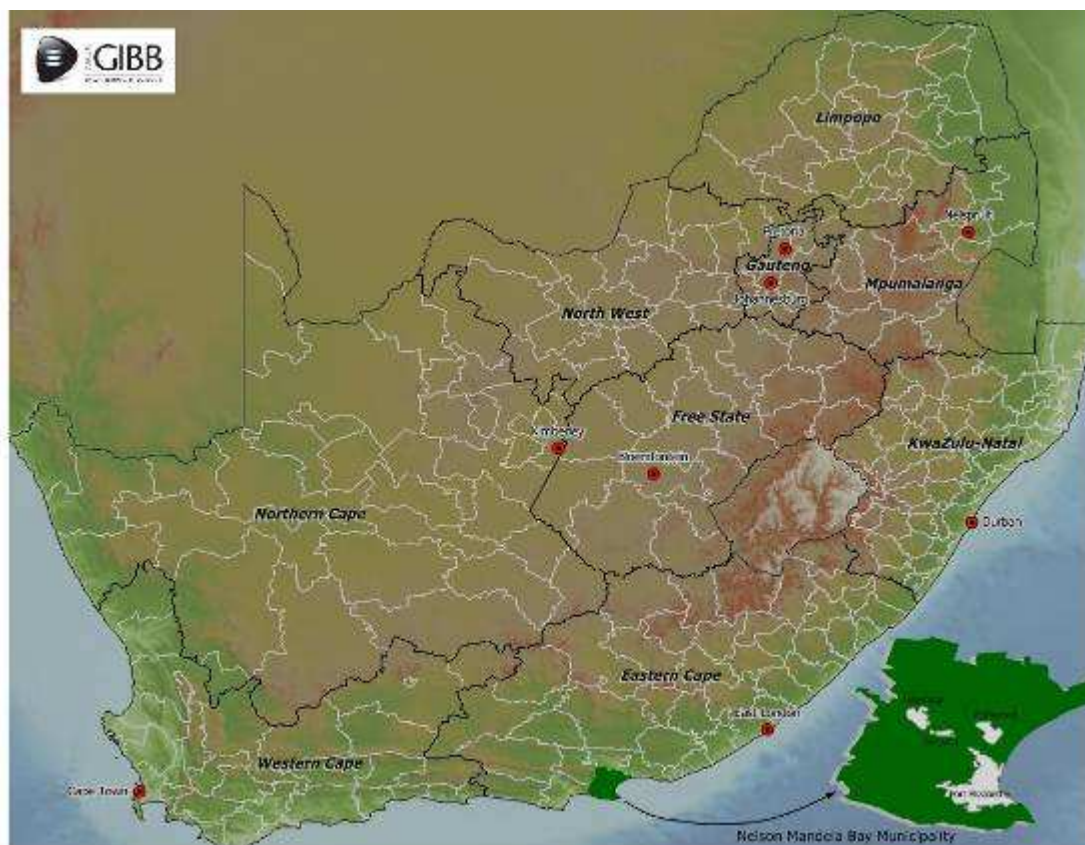


Figure 1. Location of Nelson Mandela Bay Municipality in South Africa.

The topography of the NMBM area is the result of soft marine strata filling a broad valley near the end of the east-west striking Cape Fold Belt. A combination of marine and continental erosion has reduced the topography of most of the study area to a flat, seaward sloping coastal plain averaging 75 m above mean sea level, drained by deeply incised rivers (Figure 2). High, rugged mountain terrain protrudes sharply in the north-western part of the metro. Tall dunes are conspicuous features in the south.

The NMBM coastline extends for some 110 km of the Indian Ocean between the mouths of the Sundays and Van Stadens Rivers in the east and west, respectively. The NMBM straddles the two large, half-heart shaped bays of Algoa and St Francis that are separated by the headland of Cape Recife. Their surf-swept sandy beaches interspersed with rocky outcrops vary widely in physical form owing to the combined effects of coastal orientation relative to prevailing winds, deepwater swell and sheltering by headlands.

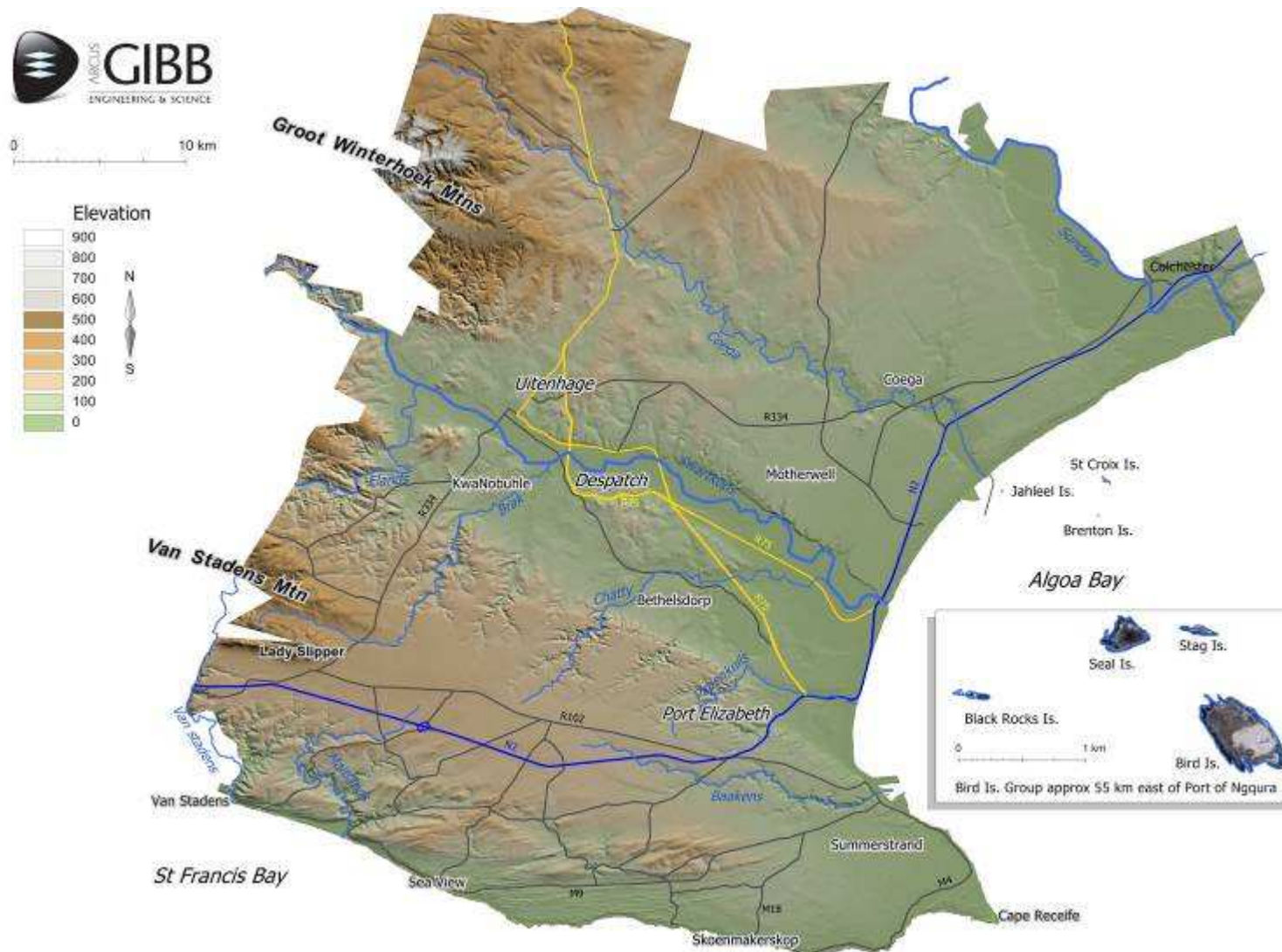


Figure 2. Topography, rivers and main roads of Nelson Mandela Bay Municipality.

Two island groups are part of the metro. They are National Parks and have no human settlements. The Bird Islands, consisting of Bird, Seal, Stag and Black Rocks are located at the eastern end of Algoa Bay 8 km opposite Woody Cape and approximately 55 km east of the Port of Ngqura. The islands of St Croix, Brenton and Jahleel (collectively: the Islands of the Cross) occur a few kilometres offshore between the mouths of the Swartkops and Sundays Rivers, the two large, perennial rivers draining extensive catchment areas that flow into Algoa Bay. In contrast, the mouths of the Maitland and Van Stadens Rivers are seasonally closed and there are no islands in St Francis Bay.

4.2 Geology and soils

4.2.1 Geology

Geology and soils, interacting with climate, are largely responsible for the varied vegetation types and high plant biodiversity found within the metro, as well as for landform described in the previous section.

Under a veneer of unconsolidated, late Tertiary materials, sedimentary strata underlie all of the municipal area. Bedrock under the southern half is essentially hard strata belonging to the Table Mountain Group (quartzites, shale) and the Bokkeveld Group (shale, sandstone). They date from Ordovician to Devonian epochs some 500 to 400 million years ago. The remainder of the municipal area lies over weak rock of the Uitenhage Group, which is of late Jurassic to Cretaceous age (200 – 140 million years old) (Carter 1987). The Uitenhage Group is made up by the Sundays River Formation, the Kirkwood Formation and the Enon Formation, which are characterised by mudstone, sandstone and conglomerate.

The hard rock of the east-west aligned Cape Fold Belt, consisting of fine-grained quartzites of Table Mountain Sandstone, protrudes into the study area as the Groendal Wilderness, the Lady's Slipper and van Stadens mountains. Along the contact with the softer Cretaceous strata to the north, the strata of the Table Mountain Group underlying the central portion of Port Elizabeth dip steeply northwards forming a marked escarpment above Bethelsdorp. Further east, Table Mountain Sandstone outcrops twice at Coega Kop and at the Algoa Bay islands. A thin band of Bokkeveld shale occurs near Bethelsdorp which is limited in appearance due to a thick covering of scree.

Three main sediment types belonging to the Uitenhage Group were deposited in the Jurassic/Cretaceous basin to the northeast of the Bethelsdorp escarpment. Small patches of Enon Conglomerate Formation crop out at Algoa Park and to the west of Bethelsdorp. The Kirkwood Formation underlies the northern part of Port Elizabeth and extends westwards from the coast in a band along the Swartkops River valley. It consists of brightly coloured mudstones and sandstones. The Sundays River Formation is exposed along the entire north bank of the Swartkops River where it forms a prominent escarpment.

The Alexandria Limestone Formation, of marine origin and 25 million years old, forms a capping of up to 12 m thick on the cretaceous strata. It is best developed on the plateau north of the Swartkops River and large outcrops occur near the Bethelsdorp salt pan.

Nanaga dunes occur along much of the coastal belt and there is a well developed system of stepped marine terraces between St Georges Strand and Summerstrand.

4.2.2 Soils

The sandy soils of the coastal Nanaga formation (e.g. Lovemore Park to van Stadens) and the alluviums of the upper Swartkops, Sundays and Coega river valleys have the best agricultural potential. Elsewhere soils have poor agricultural potential, many being shallow with rock close to the surface. Table Mountain Sandstone produces acidic, sandy, nutrient-poor soils originally covered in Fynbos, while the northern areas generally have alkaline soils on which Thicket grows.

4.3 Weather and climate

The NMBM has a warm temperate climate. The mean annual temperature is 16.9 °C (30-year average) with the average monthly temperature ranging from approximately 14 °C in winter (July) to 22 °C in summer (January). Daily mean maxima range from 25.4 °C in January and February to 19.6 °C in August, with daily mean minima ranging from 8.8 °C in July to 17.9 °C in January and February.

The weather of the NMBM area is mainly dependent on atmospheric depressions that move over the region in an easterly direction followed by anticyclones (Lubke *et al.* 1988). In winter, the approaching depression is preceded by a coastal low-pressure system accompanied by a north-easterly wind changing either to northerly or north-westerly berg winds. Following the low-pressure system, the westerly to south-westerly wind brings cooler weather with low cloud. As the depression passes, there is a tendency for more wind and rain to occur. Winds are often strong, sometimes giving rise to gales and rain lasting from 12 to 36 hours. In summer, the passage of coastal low pressure systems are followed by cloudy, occasionally rainy weather brought about by following cells of high pressure.

This region of the South African coast experiences strong winds and occasional gales regardless of the season. The prevailing direction of these winds is west-south-west to south-west. Fresh winds (of $>8 \text{ m s}^{-1}$) are fairly frequent, with the highest prevalence of strong winds in September to December (Stone *et al.* 1998). Winds at the NMBM reflect the seasonal variation of the atmospheric circulation systems, and the influence of coastal lows. Westerly to south-westerly winds are the most prevalent, but during the summer months, easterly to south-easterly winds are almost as frequent. During winter, offshore (north-westerly) winds occur more frequently than in summer.

The Eastern Cape falls in a transitional region between the summer rainfall of the KwaZulu-Natal and Transkei coasts and the winter rainfall of the Western Cape. The summer months are the driest. The 30-year average of the mean annual precipitation is 610 mm, but rainfall can vary between places from 400 mm to 1200 mm, a considerable

range given the generally low relief of the area. A combination of low rainfall and nutrient-poor soils makes agriculture marginal in most parts of the metro. An average of 8 rain days has been recorded per month with only minor seasonal variation. The annual mean relative humidity of the air is 78%. The NMBM can expect about 16 thunderstorm days per annum (Stone *et al.* 1998). The region experiences 17 days per annum where rainfall is in excess of 10 mm.

4.4 Flora and fauna

4.4.1 Flora

In a global context South Africa is considered megadiverse as it is particularly rich in plant biodiversity, harbouring approximately 10% of all plant species worldwide. This exceptional floristic diversity coupled with a high level of endemism comes to a defining point in the NMBM, as this is where five of South Africa's seven biomes meet:

1. Fynbos,
2. Subtropical Thicket,
3. Nama Karoo,
4. Grassland, and
5. Forest.

Stewart *et al.* (2005) identified 12 broad habitat units, divided into a complex mosaic of 58 vegetation types, in the NMBM area (Figure 3), which is underlining its unparalleled biodiversity. The dominant vegetation biomes are Fynbos and Subtropical Thicket. Chapter 7 of this State of the Environment Report will present further detail on the distribution and the conservation status of the vegetation types found in the NMBM. Regrettably, at least one third of the natural environment has already been lost due to urban expansion, cultivation, overgrazing, mining and alien plant infestation.

4.4.2 Fauna

Historically, the fauna of the study area matched the plant diversity. Large game, such as elephant, buffalo and lion, were all present. Leopard roamed the Baakens River valley until a century ago and hippopotamus frequented the major river systems. All the larger predator species have been exterminated and most large antelopes (kudu, bushbuck etc.) are now confined to nature conservation areas at the fringes of the metro. An exception to this trend is the continued occurrence of marine mammals along the coast. Nine species of whales, dolphins and seals are relatively common in the area, albeit some only seasonally (Klages 2002). Most smaller mammals have persisted to this day, continuing in finding sufficient habitat on smallholdings and in the more rural parts of the NMBM. The metro boasts an impressive bird and reptile list, which is a reflection of the variety of vegetation types present.

The NMBM is situated at the eastern extreme of the Cape Floral Kingdom, which has been identified as one of the global biodiversity hotspots since it will be hit very hard by climate change. Drought, increased intensity and frequency of fire and climbing temperatures may well mean an untimely end to the fascinating diversity of flora and fauna in the municipal area.

Vegetation types

- 1 Albany Dune Thicket
- 2 Algoa Dune Thicket
- 3 Baakens Forest Thicket
- 4 Baakens Grassy Fynbos
- 5 Baviaans Spektboom Thicket
- 6 Betheldorp Bontveld
- 7 Bushy Park Indian Ocean Forest
- 8 Cape Recife Bypass Dunefield
- 9 Chelsea Forest Thicket Mosaic
- 10 Coastal
- 11 Coastal Hummock Dunes
- 12 Coega Estuary
- 13 Coega Estuary Floodplain
- 14 Colchester Strandveld
- 15 Colleen Glen Grassy Fynbos
- 16 Driftsands Bypass Dunefield
- 17 Driftsands Dune Fynbos
- 18 Goudini Grassy Fynbos
- 19 Grass Ridge Bontveld
- 20 Groendal Fynbos
- 21 Groendal Fynbos Thicket
- 22 Humewood Dune Fynbos
- 23 Intermediate Beach
- 24 Kooiboskloof Karoo Thicket
- 25 Kragga Kamma Indian Ocean For
- 26 Lady Slipper Mountain Fynbos
- 27 Lonsdale Transitional Grassy Fynb
- 28 Malindi Dunefield
- 29 Malindi Grassy Fynbos
- 30 Motherwell Karoo Thicket
- 31 Pan
- 32 Rocklands Rendster Bontveld
- 33 Rocklands Valley Thicket
- 34 Rocky Beach
- 35 Rowan Park Grassy fynbos
- 36 Sandy Beach
- 37 Sardinia Bay Forest Thicket
- 38 Schoenmakerskop Rocky Shelf F
- 39 Skurweberg Grassy Fynbos
- 40 St Francis Dune Fynbos Thicket I
- 41 Sundays Doringveld Thicket
- 42 Sundays River
- 43 Sundays River Floodplain
- 44 Sundays Spektboom Thicket
- 45 Sundays Thicket
- 46 Sundays Valley Thicket
- 47 Swartkops Escarpment Valley Thi
- 48 Swartkops Estuarine Floodplain
- 49 Swartkops Estuary
- 50 Swartkops River
- 51 Swartkops River Floodplain
- 52 Swartkops Salt Marsh
- 53 Thornhill Forest and Thornveld
- 54 Van Stadens Afmontane Indian
- 55 Van Stadens Forest Thicket
- 56 Van Stadens River
- 57 Walmer Grassy Fynbos
- 58 Wetland

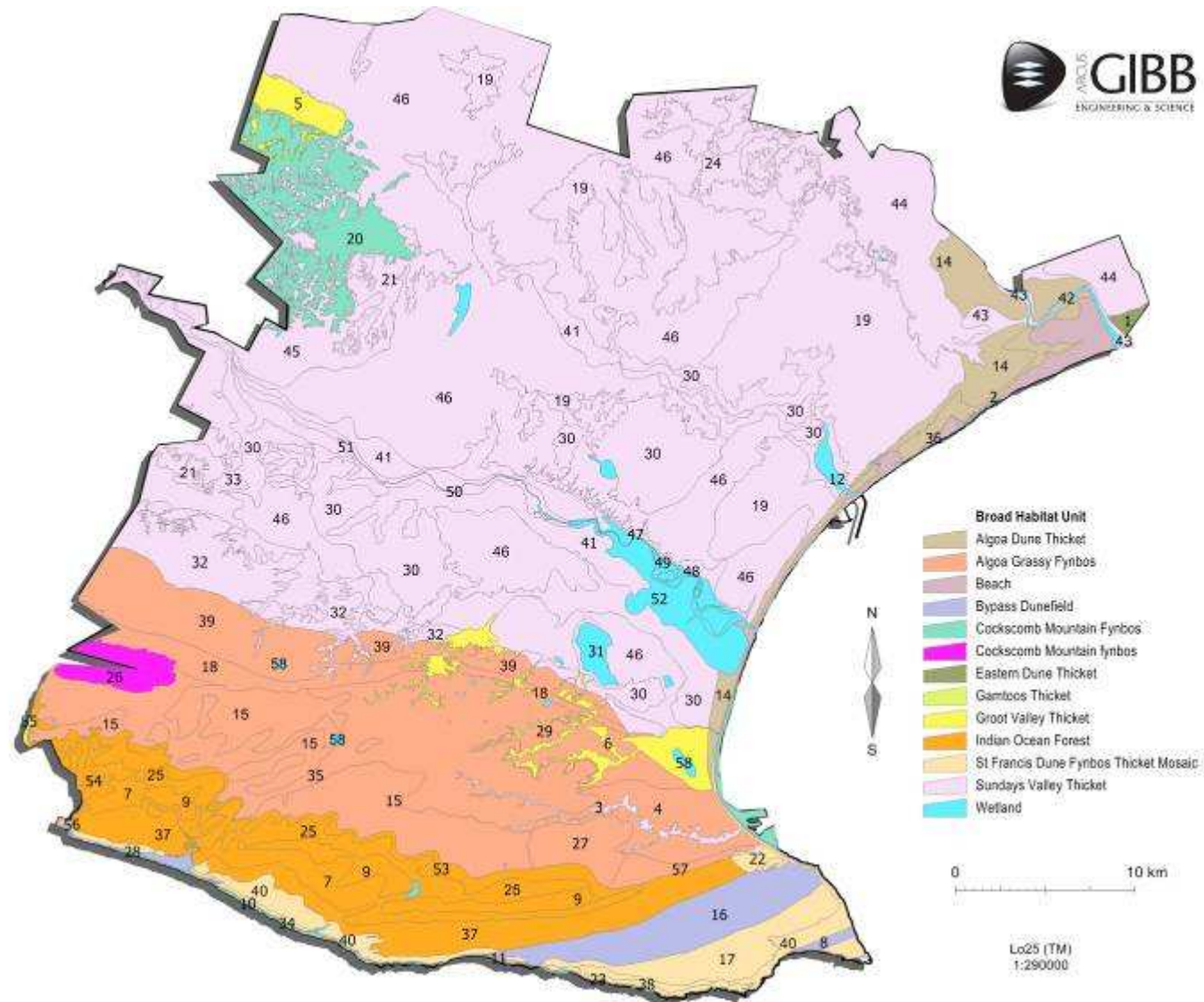


Figure 3. NMBM broad habitat units (after Stewart et al. 2005).

4.5 Demographics

According to the census conducted by Statistics South Africa, the NMBM had just over 1 million inhabitants in 2006 living on 1954 km² (Statistics SA 2006). This makes NMBM the 185th largest municipality in SA (out of 257) and the 36th largest municipality in the Eastern Cape (out of 41). The entire Eastern Cape had approximately 6.9 million inhabitants in 2006. Blacks are the dominant population group followed by Coloureds in the NMBM (Figure 4).

According to the IDP, NMBM comprises 289 000 formal homes, 35 000 informal houses and 49 000 backyard shacks. The population density varies greatly across the metropolitan area (Figure 5). Most people live along the New Brighton/Zwide – Bethelsdorp/Uitenhage axis, with Motherwell as a second density cluster. In comparison, the northern and southern parts are orders of magnitude less populated. Population density is a key determinant of the biodiversity conservation potential of an area as Figure 6 demonstrates. Nearly all wild animals have been squeezed out of the Motherwell township, while Walmer still offers meaningful habitat for invertebrates, birds and even small mammals. In wards 40 and 53 outside the urban fence wildlife has an even better chance of surviving.

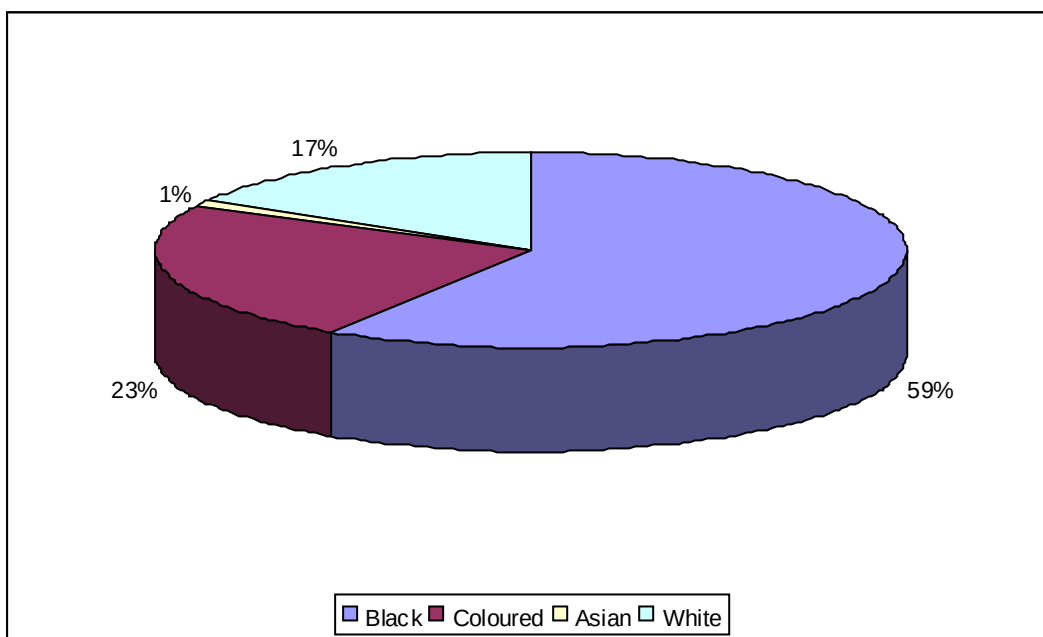


Figure 4. Racial composition of Nelson Mandela Bay Municipality (2001 census).

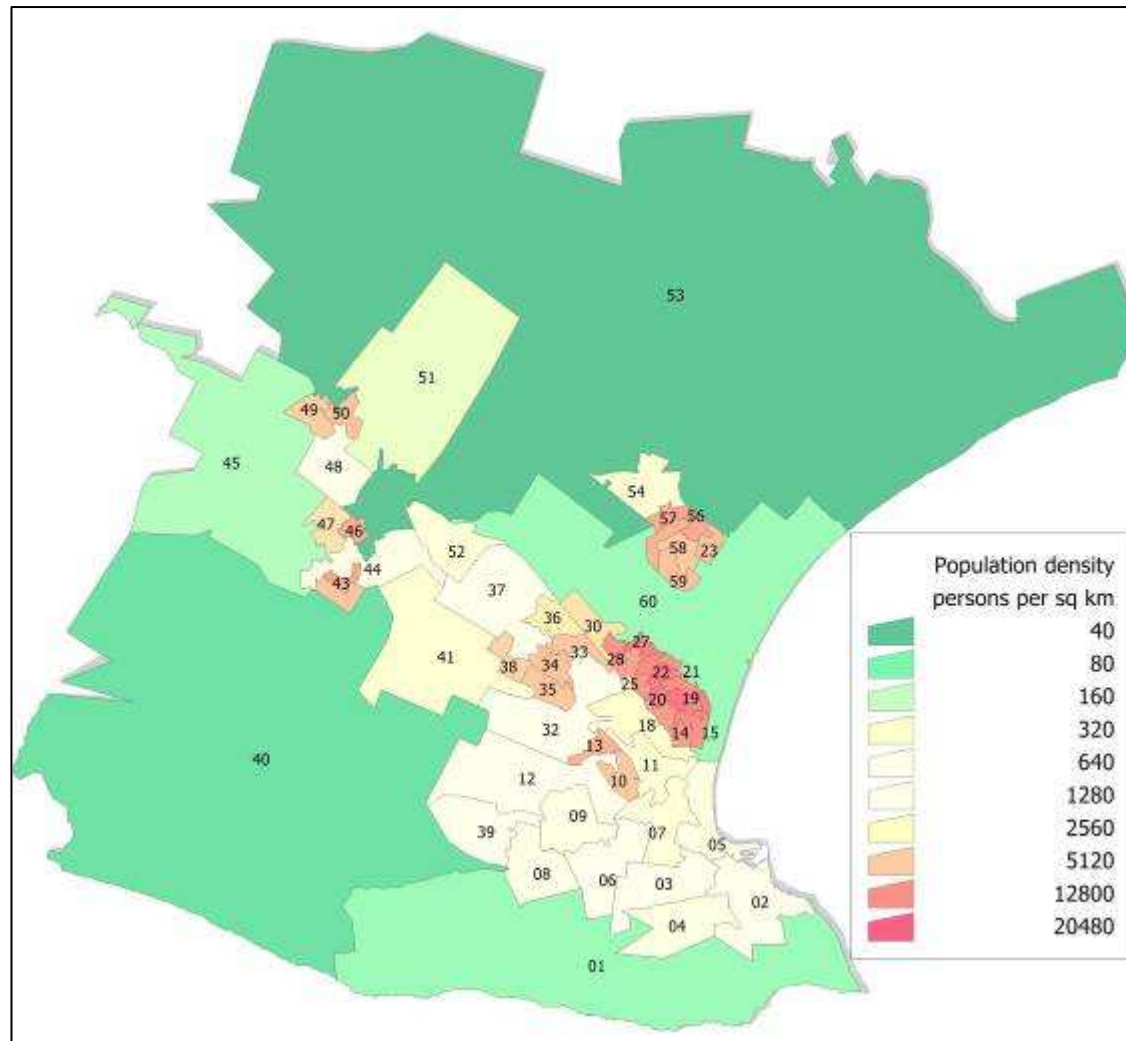


Figure 5. Population density per km² in Nelson Mandela Bay by electoral ward according to the 2006 census.



Figure 6. Comparison of dwelling density between the low-cost settlement at Motherwell NU 31 (left) and affluent Walmer (right). The left image contains 168 dwellings on 3.66 ha while the right image contains 15 houses on the same area of land. Note how trees and bushes in Walmer provide microhabitat for fauna and that there are no trees present in the township.

4.6 History

The Khoisan people were the original inhabitants of much of what is now the metropolitan area before the southward expanding Bantu arrived in about 800 AD and later European colonisation commencing in 1652 AD with the founding of the Cape colony.

Written history records Portuguese seafarers as the first European discoverers of the South African east coast and as name givers of prominent landmarks. Bartolomeu Dias, who landed on St Croix Island in Algoa Bay in 1488, gave the name “Ilheus Chaos” (Flat Islands) to the Bird Islands. In 1497, Vasco da Gama, successor to Dias, entered Algoa Bay and gave Cape Recife its name of “Cabo do Arricife”. The bay was later named “Baia de Lagoa” by navigator and cartographer Manuel de Mesquita Perestrelo in 1576, which referred to the lagoon historically situated at the mouth of the Baakens River.

In the late 18th the Xhosa, the most southerly of the Nguni tribes, who had been gradually migrating south west, made the first tentative contact with the Dutch Trekboers trekking northeast from the Cape Colony in search of good farmland.

Soon after the United Kingdom invaded and occupied the Cape Colony during the Napoleonic Wars, Fort Frederick was built, overlooking the mouth of the Baakens River as a permanent military post.

In 1820 a party of 4 000 British settlers arrived by sea, encouraged by the government as a means of consolidating their territory. At this time the seaport town was founded by Sir Rufane Donkin, the Acting Governor of the Cape Colony, who named it after his late wife, Elizabeth. The town expanded, building a diverse community comprising European, Cape Malay and other immigrants, and particularly rapidly so after 1873 when the railway to Kimberley was built. In 1861 the town was granted the status of autonomous municipality.

In 1804, J A Uitenhage de Mist, Commissioner-General of the Batavian Republic, instructed Captain Alberti to select a site for the new drostdy. Alberti chose a site on the banks of the Zwartkops River Valley, because of a favourable climate and abundant water supply. The city of Uitenhage was incorporated in the new Nelson Mandela Metropolitan Municipality in 2001 together with Port Elizabeth, the town of Despatch and the surrounding agricultural areas.

Originally developed in 1942, Despatch is a relatively young town, which officially obtained municipal status in 1945. The name of the town was derived from the brick industry, as it was from a railway siding in the late 1800s near Uitenhage, that the bricks were dispatched.

4.7 Political administration

When apartheid ended in 1994, the four former provinces of South Africa and the semi-independent Bantustans were abolished and replaced with nine fully integrated provinces. The nine provinces are further subdivided into 52 districts: 6 metropolitan and 46 district municipalities. The 46 district municipalities are further subdivided into 231 local municipalities as well as 20 District Management Areas. Nelson Mandela Bay became one of the six metropolitan municipalities that perform the functions of both district and local municipalities.

With an area of 1958 km² the NMBM is one of the smaller administrative subdivisions, both in a national and in an Eastern Cape context. It is governed by the Executive Mayor, who is the political head and a Municipal Manager, who is the administrative head.

The city has 120 Councillors, being 60 Ward Councillors and 60 Proportional Representative Councillors, as voted by residents in elections. The Executive Mayor governs together with the Speaker, who is the Chairperson of the Metropolitan Council, the Deputy Executive Mayor and a team of nine Chairpersons of Portfolio Committees (Table 1) within an Executive Mayoral Committee system.

Table 1. List of Portfolio Committees of NMBM. A 10th Portfolio (Special Projects) also exists.

Number	Portfolio
1	Budget and Treasury
2	Economic Development, Tourism and Agriculture
3	Health and Environment
4	Housing and Land
5	Human Resources and Corporate Administration
6	Infrastructure, Engineering, Electricity and Energy
7	Recreation and Culture
8	Safety and Security
9	Constituency Services

Under the leadership of the Municipal Manager, NMBM is administered through 8 directorates (Figure 7).

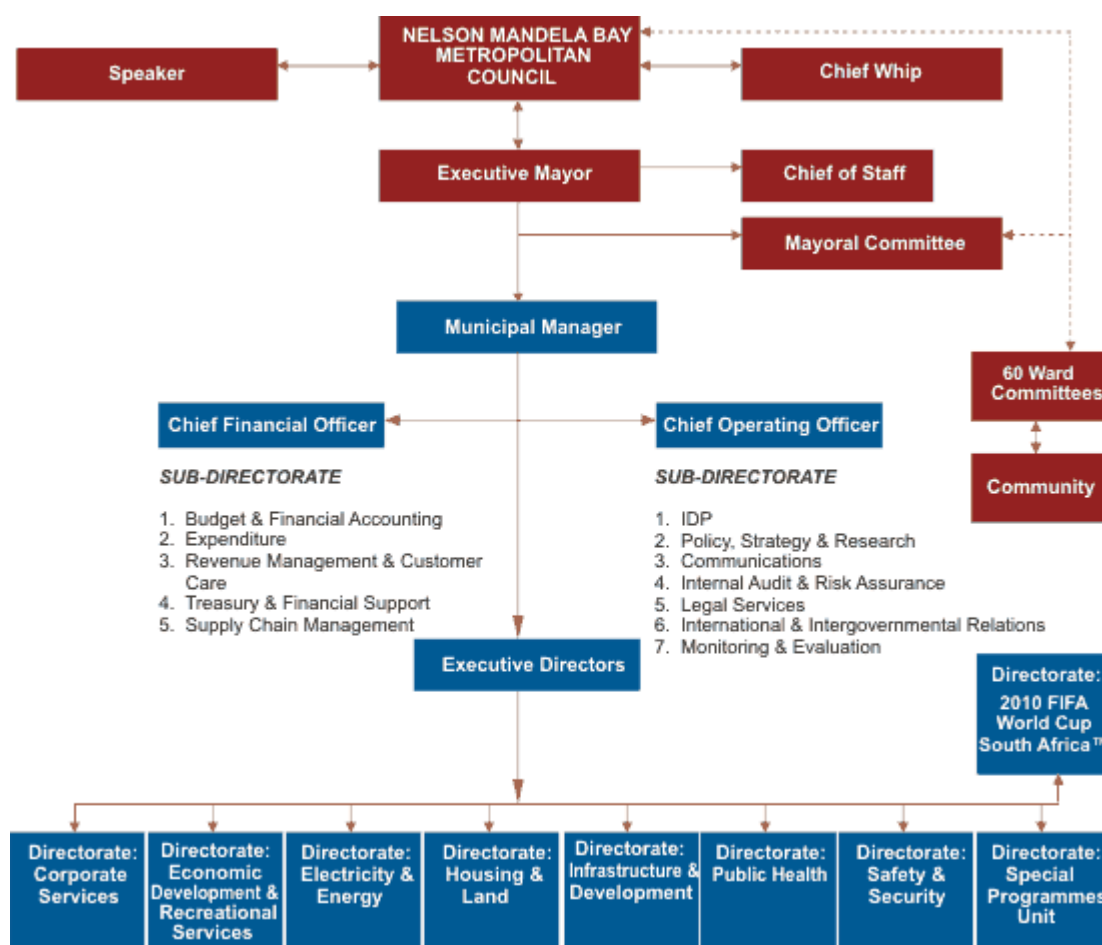


Figure 7. Structure of NMBM Directorates.

On a political level, environmental matters are addressed through the Health and Environment Portfolio Committee and on an administrative level through the Directorate: Public Health, which has five Sub-directorates (Environmental Health Services, Environmental Management, Occupational Health, Safety & Wellness, Primary Health Care, Waste Management) and three Units (Integrated HIV/AIDS, Parks & Cemeteries, Administrative Support & Special Programmes).

4.8 Economy

4.8.1 Industry

Nelson Mandela Bay is the largest single economy in the whole province. The main economic sector is manufacturing providing 31% of formal employment (Table 2). A significant player in this respect is the automotive industry, which is hosting two of the six vehicle assemblers in South Africa, namely General Motors and Volkswagen. Catalytic converter production has grown at a rapid rate as well. Other main manufacturing industries include food processing, furniture, textiles and clothing, and light engineering.

Table 2. Economy of NMBM by sector as GGVA (Value Added Geographical Growth) (NMBM IDP).

Sector	Percent
Agriculture	0.7
Community services	27.0
Construction	2.4
Electricity	1.6
Finance	14.1
Manufacturing	31.1
Mining	0.3
Trade	13.2
Transport	9.7
Total	100.0

The single biggest industrial development initiative is the 11 470 ha Coega Industrial Development Zone and the deepwater Port of Ngqura situated at the mouth of the Coega River. As the Coega IDZ develops and attracts more tenants over time it is likely to occupy the first place in the economy of the NMBM. Other important industrial areas include:

Markman – This industrial area primarily caters for the heavier type of industry. Although there has historically not been much demand for industrial land here due to its perceived distance from the city, this is expected to change because of its strategic proximity to the Coega IDZ.

Perseverance – This area has the advantage of being located close to the Ibhayi residential area and thus provides conveniently located employment opportunities. Two large recent developments (South African Breweries and Corning) have resulted in this area being almost fully developed.

Airport – Developed as an area for industries dependent on air transport. The area is underdeveloped and vacant space exists.

Struandale – This is an older industrial area close to labour sources with limited expansion potential.

Korsten – This is an older industrial area with older buildings and smaller industries.

Deal Party – This is an old industrial area and is fully developed.

Uitenhage – The Volkswagen plant is located here. Capacity for growth exists at Jagtvlakte where the Auto Cluster is being developed.

Greenbushes – This is a relatively new industrial area which started with the rezoning of residential holdings in the area known as Ericadene. Due to demand, additional properties north of the Old Cape Road have also been rezoned in the form of upmarket industrial parks. These industries provide much needed economic opportunities to the impoverished Kuyga settlement nearby.

Generally, the existing industrial areas are environmentally degraded with poor aesthetics and poor pollution control. This is in stark contrast to the Coega IDZ which is setting high standards in terms of environmental quality and aesthetics.

4.8.2 Tourism

The tourism industry also plays an important role. Port Elizabeth is famous for its beaches and also serves as the starting point for the Garden Route, as well as other tourism routes to the rest of the Eastern Cape Province. Between 2004 and 2009 foreign tourist arrivals climbed from 375 000 to 456 000, while the grand total value of the tourism industry in the NMBM increased from R3 542 million to R7 896 million in the same period (NMBM IDP).

4.8.3 Key socio-economic statistics

On the negative side, 16 years after the end of Apartheid NMBM is still showing a highly skewed distribution of income and wealth.

- Unemployment rate (including discouraged job seekers): $\pm 35\%$;
- 107 000 of the 289 000 households living in formal homes are classified as indigent;
- 44% of households access at least one social grant; and
- 20% of residents have no or very limited schooling.

Stewart & van Gend (2007) attribute part of this poor record to the metropolitan spatial configuration that has aggravated poverty, inequality and inefficiency. In essence, land use management in NMBM has not facilitated sustainable development.

5 THEME: LAND

5.1 Introduction

5.1.1 Land as a resource

Good land is a scarce resource, subject to competing uses. Such competing uses include agricultural production, residential development, commercial development, public parks and other amenities, and last but not least the conservation of our natural assets. In South Africa, land is presently not only one of the most defining political and developmental issues, but also perhaps the most intractable (Thwala 2003). On the one hand there is an almost insatiable demand for land by the previously disenfranchised majority of the people who historically were kept off it by Apartheid's settlement planning, forced removals and the Bantustan system. Possibly as many as 3.5 million Africans were forcibly removed and relocated to the homelands and black townships between 1960 and 1983. On the other hand, there is the imperative to leave certain land parcels as undeveloped in order to maintain the ecosystem services provided by high levels of biodiversity (see Theme: Biodiversity).

5.1.2 Land use

Land use profoundly influences the productivity and condition of the land, as well as its biodiversity integrity. One of the important outcomes of the National Spatial Biodiversity Assessment (Driver *et al.* 2005) was that the unsustainable utilisation of land resources, chiefly through agriculture and poorly controlled urban development, has led to a decline in productivity of land within South Africa and ultimately to land degradation. In the Eastern Cape, urban expansion, farming and the demand to meet the resources of an increasing population are all contributing factors leading to a loss of land productivity. Secondary pressures, such as climate change, desertification and alien plant invasion, are further contributing factors (GIBB 2010). It is therefore of considerable interest to assess the state of the environment in Nelson Mandela Bay with regards to land.

5.2 Drivers and pressures

Change in land use patterns is the result of change in human behaviour driven by socio-economic forces. Humans influence land use in four ways (Hoffman *et al.* 1999):

1. The primary form of human influence is the use of land resources for productive purposes, namely farming, fuel wood, building material, mineral extraction and water collection.
 2. A secondary form of human influence is the use of land resources for other economic and social purposes that do not directly depend on resource extraction or interference with biotic processes, for example, settlement, infrastructure and recreation.
 3. A tertiary set of influences comprises the unintended and often remote impacts of economic activity on land resources, for example, pollution of (sub)surface and atmospheric water resources by industry, alien plant invasion and climate change.
 4. Finally, conservation efforts are a form of human influence that is often positive.
-

Each one of the drivers named in the above listing is operating in NMBM as shown in section 5.3.

5.3 State

5.3.1 Land use

'Land use' is a description of how people utilize the land and socio-economic activity associated with it. Despite the two terms often being used interchangeably, 'land cover' describes which parts of the land retain their natural cover (such as indigenous vegetation, water systems or bare rock) and which parts have been changed by human hand, for example by housing, cultivation or forestry. Remote sensing of land cover can be used to determine land use, the spatial extent of transformation.

Stewart's (2009) land use assessment for NMBM (area: 1958 km²) in the year 2007 employed aerial photography combined with field surveys. A brief summary is presented in Table 3.

Table 3. Percent land use in 2007.

Type	Area [%]
Agriculture	14.5
Alien plants (high density)	5.5
Dam	0.2
Formal urban	10.8
Informal urban	0.9
Mine	1.9
Near-natural area	61.8
Recreational open space	2.5
Road, rail, airfield	1.6
Tree plantation	0.2
Waste site and dumping ground	0.1
Total	100.0

Comparing the above results with an earlier assessment (Stewart *et al.* 2004) shows that the primary change in land use in the NMBM between 2003 and 2007 was caused by urban expansion (+14.1%) and a reduction in near-natural areas (-10.9%). The latter outcome has had negative repercussions for the biodiversity protection and maintenance of important ecological services in the municipal area. As elaborated in the Theme: Biodiversity, more than one third of the 58 vegetation types occurring on NMBM cannot sustain further loss from developmental activities (Stewart 2009).

5.3.2 Changes in the coastal zone

Changes in the coastal zone in respect of surface hardening between 1997 and 2007 within 1 km of the high water mark were investigated for this SOER. Results are reported in the Theme: Rivers, estuaries and the coast. In brief, the overall change in

the NMBM coastal zone from near-natural to fully transformed condition during the decade amounted to +8.5%.

Stewart's (2009) land cover assessment for NMBM also compared changes in land cover in the coastal zone (as defined above) between 2003 and 2007. Similar to the results obtained for the entire metropolitan area (section 5.3.1), the most notable reduction was observed in the natural areas (-31.2%).

5.3.3 Zoning

According to municipal records sourced for this SOER, NMBM presently consists of slightly less than 256 000 cadastrals or land parcels. The Title Deed of each land parcel can restrict the way in which it may be developed, for instance by prescribing the maximum number of allowed storeys. In addition, each cadastre is subject to a system of legal requirements and regulations ensuring that land is used only according to its permitted land use or zoning rights. Zoning rights and their accompanying restrictions are specified in zoning schemes. Since zoning schemes partition municipalities into areas dedicated to residential land use, parts reserved for industry, etc., they are of great importance in supporting sustainable and equitable land development.

The South African system of land surveying is equal to the best in the world. The country's cadastre, or parcel-based land information system, is highly accurate. Unfortunately, a substantial part of the zoning information is still contained in paper records and has not yet found its way into electronic databases. In Nelson Mandela Bay Municipality only 32.8% of cadastrals have detailed zoning information in the GIS layer. Densely built-up areas of Port Elizabeth, Despatch and Uitenhage are well covered, but the outlying areas are not covered at all. These outlying properties are likely to have an 'agriculture' zoning, or none at all: the zoning is 'undetermined', which requires consent before they can be built on. The lack of full zoning coverage for NMBM prevents deeper analysis and so only rudimentary information is provided in Table 4.

Table 4. Zoning of the Nelson Mandela Bay municipal area in broad zoning categories.

Zoning	Area [km ²]	Area [%]
Agriculture, Undetermined	1603	81.8
Business, Commercial	45	2.3
Industrial	31	1.6
Open Space	18	0.9
Residential	179	9.1
Other	82	4.2
Total	1958	100.0

5.3.4 Property sizes

Property sizes reflect the monetary value of land, especially so in urban situations. The basic spatial statistics of adjoining cadastrals - how many times the original farm has been carved up into ever smaller pieces - can tell much: whether this is a rural or an urban area, whether people are rich or poor, and in some cases even how property is inherited from one generation to the next.

Average South African property sizes have more than halved to what they were 30 years ago. This is mainly due to the increase of subdivision of property over the last three decades, with city council programmes directly or indirectly encouraging high-density developments inside the urban fence. This is a trend that is set to continue as demand for property remains lively in the middle and lower segments of the property market, both through the emergence of a black middle class (who cannot afford more than a smallish property) and through government sponsored low-cost housing schemes that continue to settle families on tiny erven of $\pm 200 \text{ m}^2$ instead of multi-storey blocks of flats. All this has negative ramifications for biodiversity since small properties come with gardens (if at all!) that are too small to support small mammals, birds and lower vertebrates as breeding species.

Table 5 illustrates the mean erf size of a sample of allotments in urban Port Elizabeth according to current municipal data (cadastral GIS layer). The sample includes historically 'white' areas, as well as 'coloured' and 'black' townships. Their positions are shown in Figure 8. There is a strong inverse correlation between the average property size per electoral ward and the map of population density shown in Chapter 3 (Figure 5).

5.3.5 Open space per person

'Open space' is the counterpart of developed land. It has its surface open to the sky, is deliberately set aside and publicly regulated to serve conservation and urban shaping functions, as well as providing outdoor recreation opportunities. Public Open Spaces (PUOS) contribute much to the quality of life by bringing nature into the city. Because Private Open Space is becoming rare (see section 5.3.4), ideally the area set aside for PUOS should be inversely proportional to the mean property size of a built-up area (allotment). People with small plots need large parks. Table 5 illustrates that this is not the case in the urban parts of Nelson Mandela Bay.

Table 5. Mean erf size and area of Public Open Space for a sample of allotments in urban Port Elizabeth.

Suburb	Allotment number	Mean Erf Size [m^2]	Sample size	No. of PUOS	Total PUOS Area [ha]	Total Allotment Area [ha]	PUOS %
Cotswold	5	1017	793	15	16.6	255.1	6.5%
Gelvandale	8	339	4326	23	22.9	382.8	6.0%
Kabega	12	886	2689	91	136.9	669.6	20.4%
Korsten	13	322	3275	8	4.1	574.5	0.7%
KwaNobuhle	46	273	21833	*			
Lorraine	36	995	2532	78	64.9	653.0	9.9%
Sunridge Park	24	1526	648	30	34.7	206.2	16.8%
Walmer	32	1592	2185	16	57.2	660.0	8.7%

*No PUOS declared, only Open Space 1 + 2 present

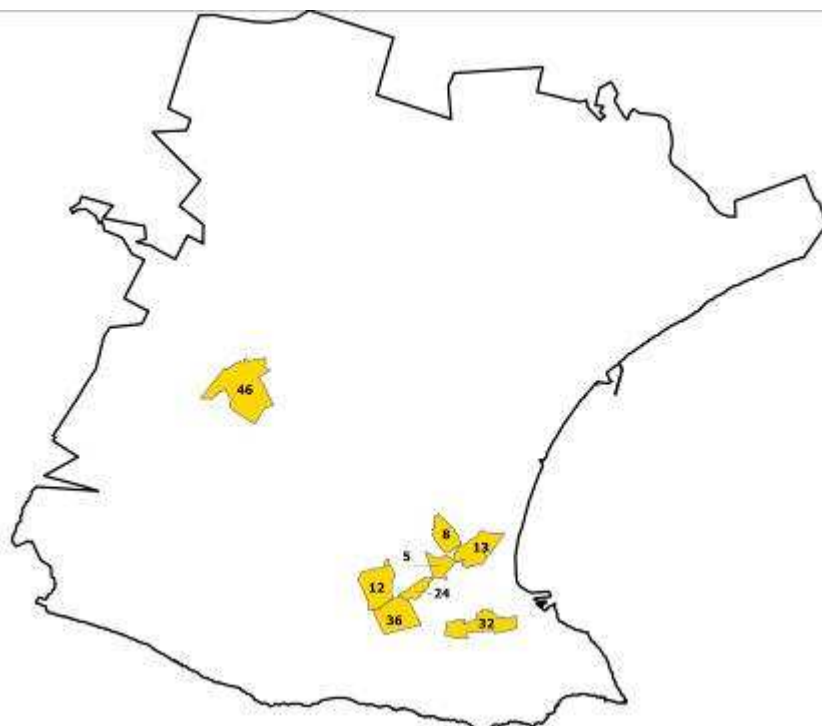


Figure 8. Positions of the sample of allotments in urban Port Elizabeth that were investigated for the relationship between mean erf size and area of PUOS.

5.3.6 Formal versus informal settlements

Informal settlements (slums, shantytowns) are an ubiquitous reality of South African society. They are crowded areas, with high-density populations of people who have no right to the land. Made of wood, cardboard, tin and other scrap material, whole families live in a single shack, the size of a garden shed. Municipal services are typically absent, such as running water, sewerage or electricity. Squatter camps are hard on people and the environment and therefore present a burden and a liability to society. It is for this reason that a State of the Environment Report should attempt to quantify the extent of informal settlements so that progress made towards their elimination may be tracked. This is provided in Figure 9

A slum, as defined by the United Nations agency UN-HABITAT (Human Settlements Programme), is a run-down area of a city characterized by substandard housing and squalor and lacking in tenure security. The municipality's cadastral GIS layer, cross checked with 2007 high-resolution aerial photography, shows that informal urban areas (conforming to the UN definition) take up just 1000 ha, or 0.5%, of the total NMBM area.

However, this gives a misleading impression of the extent of human misery. In addition to the slums fitting precisely the UN definition, there are many more urban areas where the residents do have tenure of their tiny plots, but live in shacks surrounded by squalor and also lack most types of municipal services that those in better off suburbs enjoy. An example from Soweto-on-Sea is shown in Figure 10. The yellow boundaries show that these erven are officially numbered and that there is tenure, but substandard housing and absence of services are evident.





Figure 10. The poor standard of housing and the absence of most municipal services render the demarcated even functionally no different in terms of quality of life from neighbouring officially recognised 'informal settlements'.

5.3.7 Extent of mining in NMBM

Mining is of very low economic importance in NMBM as it contributes only 0.3% of Value Added Geographical Growth to the economy (see Table 2 in section 4.8.1). However, of all land uses listed in Table 3, open cast mining is arguably one of the most conspicuous one and also one with the most transformative power. This is most evident through the study of aerial photographs where this activity is very visible to the observer (Figure 11). The commercial production of table salt in evaporation pans is the most obvious mining activity in NMBM, followed by clay and stone mining operations. Of great concern are the 'red soil' borrow pit areas found in more remote parts of the metro which appear to have all the signs of illegal operations associated with them, as mining permits invariably include the duty of rehabilitation, which is patently absent.

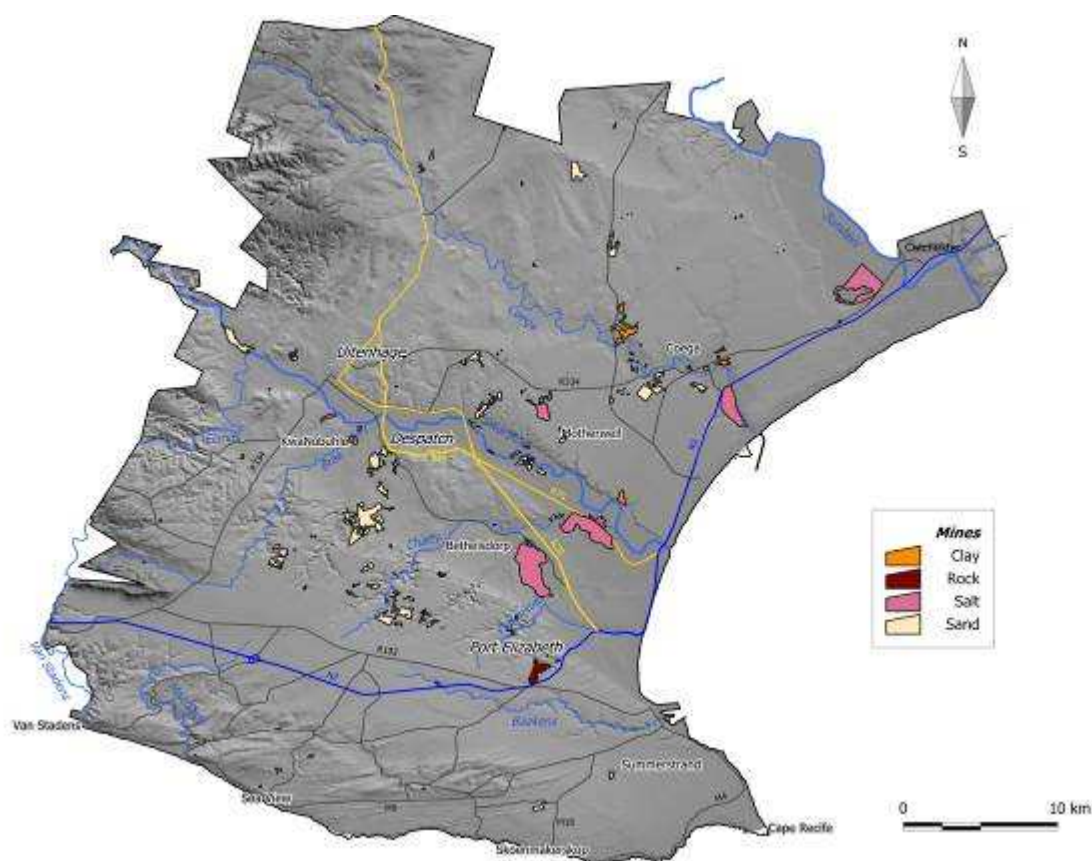


Figure 11. Mining in Nelson Mandela Bay Municipality.

Demand for mining is expected to continue with increased development. Mining and a number of other major land uses, such as urban agriculture, commonage, land for cultural practises etc. have not been included in the SDF, which have significant environmental considerations and potential implications on the essential critical biodiversity, and essential ecological process/support areas. The majority of the areas targeted for mining fall within the NMBM CBAs.

5.4 Indicators

The indicators used to assess the state of land in Nelson Mandela Bay, as determined in GIBB (2009), are listed below.

1. Land use
2. Zoning
3. Property sizes
4. Public open space
5. Formal versus informal settlements
6. Extent of mining in NMBM.

The six indicators listed above were enumerated in section 5.3 of this report. Incomplete data regarding the zoning of property prevented answering indicator 2 comprehensively.

5.5 Impacts

Many types of human use transform the land and if conducted in an unsustainable manner they lead to land degradation. Typical impacts associated with land degradation drivers are:

- Loss of ecosystem integrity
- Natural habitat loss
- Veld degradation
- Soil degradation
- Habitat fragmentation
- Alien plant invasion
- Reduction in water quantity and quality
- Diminishing agricultural returns
- Increased land conflicts (agricultural production vs. urban development)
- Desertification.

5.6 Responses

5.6.1 Municipal responses

The Spatial Development Framework is NMBM's chief response to the management of land (NMBMM 2009). The SDF is a plan outlining the desired spatial development of the metropolitan area as contemplated in Section 26(e) of the Municipal Systems Act (Act 32 of 2000). In addition to setting out basic guidelines for a land use management system, it also highlights priority investment and development areas. The SDF is an integral component of the IDP and translates this plan into its spatial implications to provide broad, overall development guidelines that are reviewed annually. As such it

gives strategic guidance in respect of the location and nature of anticipated future development in the municipality (Figure 12).

According to the SDF capacity still exists for further infill opportunities on open land situated between Uitenhage, Despatch and Port Elizabeth. This will reinforce the primary, northwest - southeast development axis along Uitenhage Road. The Swartkops River estuary and the resultant limited opportunities to cross it impede development to the north. However, Motherwell and its planned extensions dominate the northern side of the estuary. Future expansion from Motherwell extending westwards toward Uitenhage is foreseen in the short to medium term (2010 - 2020).

Planning and management of urban growth of Nelson Mandela Bay requires that non-renewable natural resources be used wisely so that long-term development in ecological, social and economic terms is encouraged. This and other principles of sustainability are firmly supported in the text of the SDF where it is stated that development should occur in an integrated and balanced fashion so that improved living conditions can be achieved without endangering sensitive natural environments or depleting natural resources. The incorporation in the SDF of the metropolitan open space system (NMMOSS), the formulation of land use policies in peri-urban areas and the land use management system for supporting and monitoring development constitute important responses to the land issue. Local Agenda 21 will also be an important tool to achieve sustainability and in particular the conservation of the natural environment.

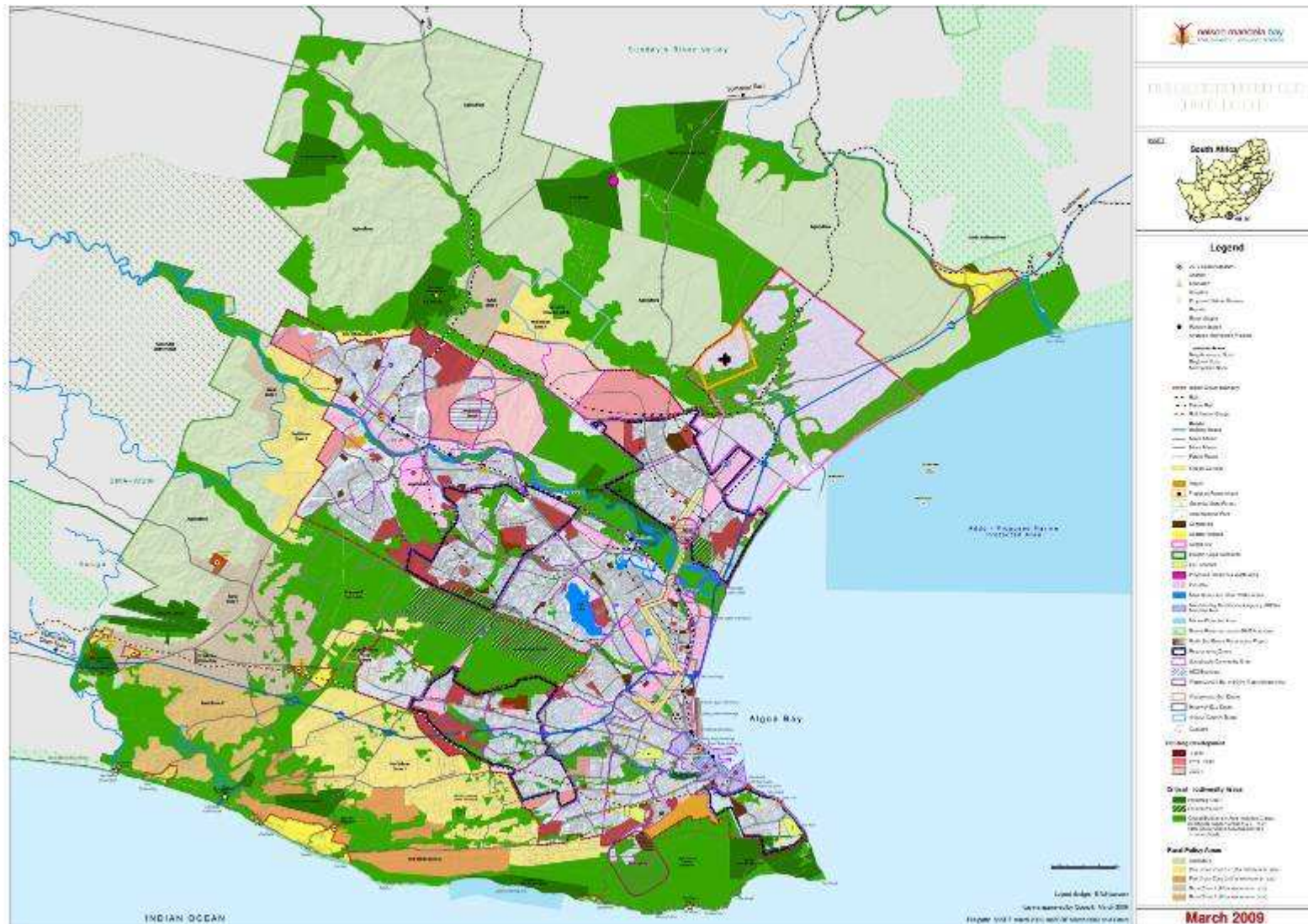


Figure 12. Spatial Development Framework map of Nelson Mandela Bay Municipality as approved in March 2009.

5.6.2 Provincial responses

At a policy level, management of land use in the Eastern Cape is guided by the Eastern Cape Biodiversity Conservation Plan (Berliner & Desmet 2007) and by the Eastern Cape Provincial Growth & Development Plan 2004 – 2014 (Eastern Cape Office of the Premier 2005).

5.6.3 National responses

Government responses at the national level in terms of policy and legislation consist of:

Conservation of Agricultural Resources Act (Act 43 of 1983) - The objectives of this Act are to provide for the conservation of the natural agricultural resources of the Republic through the maintenance of the production potential of the land; by the combating and prevention of erosion and weakening or destruction of water sources and wetlands; and by the protection of vegetation and combating of weeds and invader plants.

The **Subdivision of Agricultural Land Act, (Act 70 of 1970)** prevents the subdivision of viable agricultural portions smaller than 9 ha.

National Environmental Management Acts - The objective of these Acts is to ensure responsible management of the environment as a communal resource so that the needs of current generations and those of future generations are met and safeguarded.

National Action Programme on Combating Land Degradation - The United Nations Framework Convention on Climate Change and the Convention to Combat Desertification requires South Africa to draw up a National Action Programme, which will be integrated into a regional programme for the Southern African Development Community (SADC) region.

National Landcare Programme (NLP) – The programme aims to have communities and individuals adopt an ecologically sustainable approach to the management of the environment and natural resources, while improving their quality of life.

Working for Water (WfW) Programme – The main goals of the WfW programme are to improve the ecological integrity of natural ecosystems through the control of invasive alien plants; to enhance water security; restore and rehabilitate degraded land in order to secure the productive potential of land and thereby provide economic benefits and social upliftment.

5.7 Linkages and inter-dependencies

Land issues have an influence on and are influenced by almost all other themes discussed in this report.

6 THEME: CLIMATE CHANGE AND AIR QUALITY

6.1 Introduction

This section focuses primarily on air quality in the Nelson Mandela Metropolitan Municipality. Climate change has been included in this chapter as one of its main drivers is air quality. Climate change is generally less well defined and is surrounded with much controversy.

6.1.1 Climate change

The driving force behind climate change is the rise of greenhouse gas concentrations in the atmosphere. Heat from the sun enters the earth's atmosphere and warms the earth's surface. As the surface of the earth heats up it releases infrared radiation. A proportion of this solar radiation is reflected back into space by the clouds in the troposphere and the earth's surface. Water vapour and carbon dioxide in the troposphere trap some of the infrared radiation, preventing it from escaping the earth's atmosphere and naturally maintaining the earth's warm climate. This trapping of heat is called the "greenhouse effect". The increased carbon dioxide and other greenhouse gasses (such as methane) absorb increasing amounts of infrared radiation emitted from the earth's surface, in turn increasing the average temperature of the atmosphere (DEA 2005).

Carbon dioxide is widely considered the most important greenhouse gas based on emission quantities per year. According to the United Nations, South Africa is the third highest producer of carbon dioxide per capita in the world, and our per capita greenhouse gas emissions are estimated to be above the global average, being higher than that of most developing nations, and equivalent to certain developed nations (DEA 2009). Unnaturally high concentrations of carbon dioxide in the earth's atmosphere have amplified the naturally occurring greenhouse effect. This has led to an increase of 0.6 °C in the earth's surface temperature, most of this increase occurring after 1975. Current evidence suggests that most of the observed warming over the last 50 years is likely to have been due to human activities. Manifestations of this warming include retreating polar ice-caps and glaciers (DEAT 2004).

It is the opinion of many that extreme weather events are linked to climate change. Typical weather and climate related disasters include tropical cyclones, storm surges, floods, landslides, droughts, severe thunder storms and extreme heat and cold. For the period 1992 - 2001 natural disasters worldwide were linked to more than 622 000 deaths, affecting over 2 billion people. Economic losses due to hydro-meteorological losses were estimated at US\$ 446 billion (SAWS 2007).

1.1.1 Air quality

The National Environmental Management: Air Quality Act (Act 39 of 2004) recognises that "quality of ambient air in many areas of the Republic is not conducive to a healthy environment for the people living in those areas, let alone promoting their social and economic advancement". South Africa had no official air quality standards up until 2009, and as such the European standards were followed. These international standards have greatly contributed to the development of our own air quality standards, which include

the SABS guideline (SANS 1929: 2005) and the National Air Quality Standards (2009), promulgated under the Air Quality Act.

Air pollutants vary in terms of their residence times in the atmosphere and the impacts associated with them. Gases such as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and chlorofluorocarbons (CFCs) generally persist in the atmosphere and as such have received international focus due their respective implications for global warming and depletion of stratospheric ozone. Pollutants such as nitrogen dioxide (NO₂), sulphur dioxide (SO₂), carbon monoxide (CO), and particulate matter (PM) are primarily important on a local and regional scale. These pollutants may have local and regional impacts on human wellbeing and the environment (DEA 2009). Further, the impacts associated with ambient air quality and indoor pollution levels may target different communities. Poor communities in townships, for example, will be exposed to high indoor pollution levels due to poor ventilation and the burning of fossil fuels. These communities are often situated close to industrial areas and will therefore experience poor ambient air quality in addition to unacceptable indoor air quality.

Some areas will be more prone to impacts associated with poor air quality than others. Pollution dispersion is largely influenced by climate, topography, and the height at which emissions are released. Ground level emissions released during the burning of fossil fuels, for example, are not easily dispersed and could reduce the local ambient air quality rather severely. On the other hand, pollution released higher up, from chimney stacks for example, is more easily dispersed but is affected by the presence of inversion layers. This generally has a marked impact on the local ambient air quality as inversion layers, which form close to the ground, prevents the further vertical movement of pollutants, causing accumulation of the pollutants at ground level (Zunckel *et al.* 2002).

The primary source of air pollution in the NMBM is the industrial areas in Port Elizabeth, Uitenhage and Despatch, especially with the motor vehicle, tyre and other general motor part manufacturers located along the Swartkops River corridor. The Coega IDZ in Port Elizabeth is the largest industrial area in the Eastern Cape Province and has the potential to contribute greatly to air pollution. The highest ground level concentrations of pollutants may be expected at Coega during the months of May to July (Zunckel *et al.* 2002) when inversions are more frequent. Other sources of air pollution in the metro include heavy motor vehicular traffic in the NMBM Central Business District (CBD) and along the major transport axis (R75, N2 National Road and Cape Road), as well as gas emissions from landfill sites. Fortunately, Nelson Mandela Bay does benefit from regular coastal onshore and offshore winds, which disperse high concentrations of pollutants. During a period of low or no wind activity, the effect is clearly visible when the CBD is viewed from a distance (Figure 13).



Figure 13. Haze visible over Port Elizabeth as seen on a windless day.

6.2 Drivers and pressures

6.2.1 Climate change

In the NMBM, industrial processes, the burning of fossil fuels and urbanisation are the main contributors to climate change. These drivers are also commonly found to be principal agents in climate change in many other urbanised areas in South Africa (CSIR 2004). The main pressures associated with these drivers are poor air quality caused by the release of noxious and harmful gasses including nitrogen dioxide (NO₂), carbon dioxide (CO₂), carbon monoxide (CO), sulphur dioxide (SO₂), hydrocarbons, and other particulate substances (PM). Urbanisation causes the loss of vegetation cover, reducing the uptake potential of the remaining vegetation. The drivers and pressures of climate change also cause poor ambient and indoor air quality, however the temporal and spatial changes associated with climate change occur at a large scale and over extended periods of time.

Losses in uptake potential of CO₂ are exacerbated by the conversion of natural vegetation to agriculture. The burning of fossil fuels further aggravate the high concentrations of CO₂ in the atmosphere by releasing more CO₂, ultimately contributing to the gradual increase of the earth's surface temperature. Globally, the main factors causing the increased release of carbon dioxide to the atmosphere are industrialisation, inefficient use of energy, inefficient methods of production and excessive global consumption. Many of these issues are also evident on a local scale such as in the NMBM.

6.2.2 Air quality

Nelson Mandela Bay is one of two major economic regions in the Eastern Cape Province. Its healthy local economy is largely driven by the motor vehicle industry, manufacturing industry and the Coega Industrial Development Zone. Nelson Mandela Bay is also the largest urban centre in the Eastern Cape, with several townships and informal settlements occurring within the urban footprint. The burning of fossil fuels in impoverished communities and the timber milling industry, the building sector, and commercial industries largely contribute to air pollution in Nelson Mandela Bay. Possible similarities may be drawn with other industrial areas. The conclusions from a study in a highly polluted industrialised area in South Africa revealed that approximately 70% of the particulate matter in the ambient air resulted from domestic fossil fuels and dust, and that industry and motor vehicles emissions contributed merely 30% (Terblanche 1998).

Other noticeable air pollutants in Nelson Mandela Bay include dust pollution, foul smells from landfill sites and waste water treatment works, and the release of noxious gases through vehicular emissions. Dust pollution largely originates from the building sector, where the NMBM is experiencing a low-cost housing backlog of approximately 80 000 houses, and from untarred roads in the metro. Dust pollution associated with untarred roads has proven to impact the air quality in suburban areas significantly, especially in previously disadvantaged communities. Vehicular emissions contribute to carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxide and volatile hydrocarbons.

6.3 State

6.3.1 Climate change

The South Africa Environmental Outlook Report highlighted that the results from global circulation models indicate an increased summer rainfall over the central and eastern plateau of South Africa (DEAT 2006). Limited data, however, exist on a fine scale for the Eastern Cape region. Projected climate changes that are likely applicable to the Eastern Cape are summarised as follows:

1. A net drying on the western two-thirds of the sub-continent is predicted,
2. East-coast regions are likely to become wetter,
3. Ambient air temperature is predicted to rise across the country, with the interior experiencing an increase of up to 3 - 4 °C above current levels.

The Department of Environmental Affairs and Tourism analysed and reported on long-term mean temperature data obtained from the Goddard Institute for Space Studies (DEAT 2010). No homogeneity adjustments were made on the data, which exhibit strong cyclical changes in intervals of decades. In South Africa, much of the last decade showed annual ambient temperatures higher than the long-term average. It is very difficult to attribute this phenomenon to global warming as it cannot be proved statistically because the temperature record is too erratic to draw definitive conclusions (DEAT 2010). Data for Port Elizabeth indicate that there has been a slight increase in mean surface temperature since the late 1800s (Figure 14).

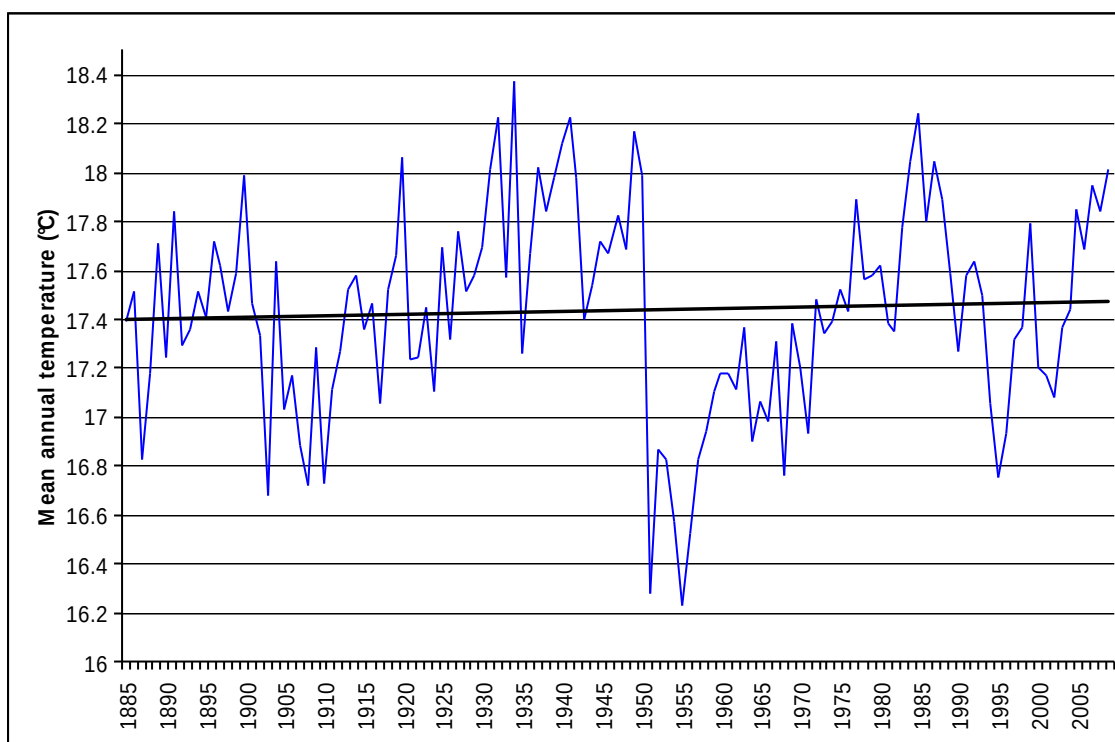


Figure 14. Long term mean surface temperature for Port Elizabeth.
The black line indicates the observed linear trend.

Analysis of rainfall trends in the Eastern Cape (CSIR 2004) indicated no gradual decreasing or increasing rainfall trend for the post-1990 period, when compared with the climate reference period 1961-1990. The same conclusion was reached for the rainfall trend in Port Elizabeth. When rainfall data for the last 40 year was analysed (Figure 15), a cyclical pattern was found with dryer periods occurring around 1990 and again towards the end of 2007.

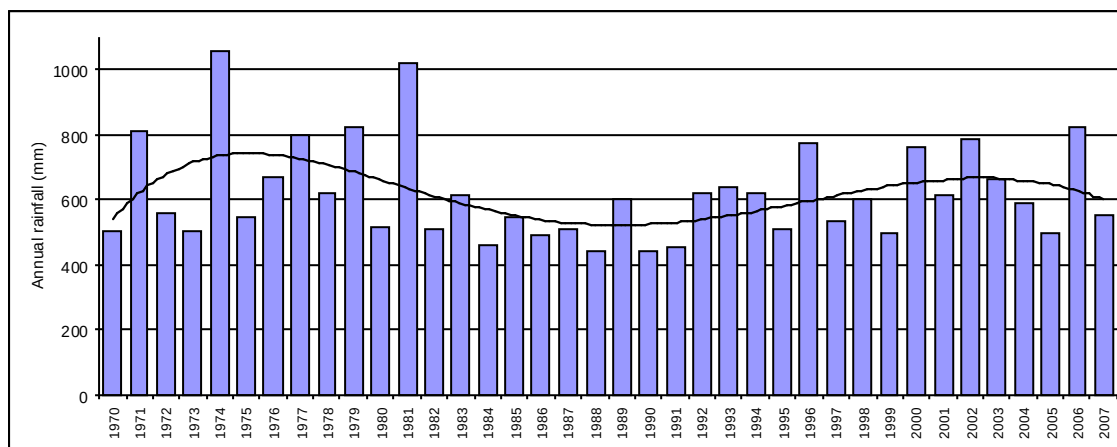


Figure 15. Annual precipitation in Port Elizabeth from 1970 to 2007.
The black line indicates the cyclical emerging trend.

It is concluded that rainfall and temperature data collected over a longer time period may be able to distinguish between natural cycles in rainfall and temperature or resulting from climate change. With this said, it is predicted that the Eastern Cape Province will be one of the areas worst affected by climate change in South Africa (Rogers 2003). In fact, Nelson Mandela Bay has been identified as one of four sensitive regions highly vulnerable to storm damage driven by extreme weather events (Hughes 1992). In September 2008, the Nelson Mandela Metro was particularly hard hit by an extreme weather event causing widespread damage to infrastructure and coastal properties along the metro coastline.

The dependence of communities on fossil fuels for cooking and heat decreases the indoor air quality. A South African study involving informal households using paraffin for cooking revealed that sensitive individuals in all of the households were at risk of experiencing adverse health effects from exposure to NO_2 emissions (Muller *et al.* 2003). The main energy sources used in the Eastern Cape were found to be paraffin and wood, with rural areas relying more heavily on these fuels than urban areas (CSIR 2004). The main energy sources in the Nelson Mandela Bay Municipality are electricity, gas and paraffin (Figure 16). Household dependence on these energy sources is illustrated with an increasing dependence on electricity for cooking, with high dependence on gas and paraffin to the left and high dependence on electricity to the right of Figure 16. All the wards showing a high dependence on gas and paraffin represent poor and disadvantaged communities in the Nelson Mandela Bay Municipality that opt for the cheaper source of energy. Utilisation of wood is considerably less when compared to the percentage household dependence in the Eastern Cape as a whole. Households that still do utilise wood are located in the peri-urban wards where wood is still easily collected.

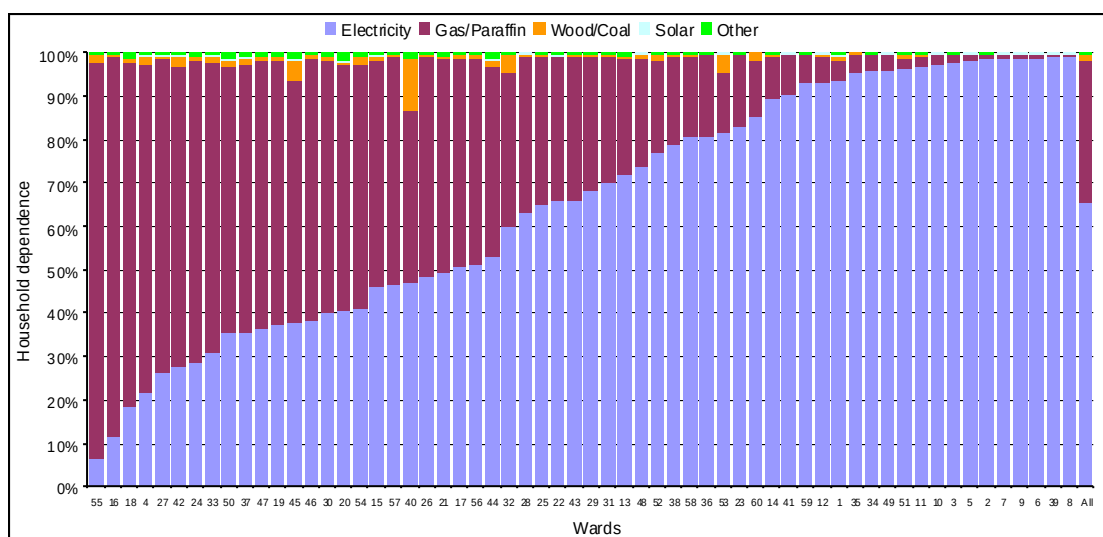


Figure 16. Household dependence on different energy sources for cooking in the Nelson Mandela Bay Municipality. Dependence is shown per ward and the municipal area as a whole (far right).

Extreme weather events have been an integral part of Nelson Mandela Bay's history. Since the early 1900s, 34 flooding events have been identified within the boundaries of Nelson Mandela Bay. Of the 34 flooding events, three were classified as catastrophes, one disaster, eleven very serious, eight serious, and eleven classified as important (SAWS 2007). The three catastrophic flooding events that have severely affected the metropolitan area were the "Great Flood" of 1908, the destructive 1968 flood and widespread flooding in 1981. It is predicted that areas closer to mountains or ridges have a better chance of exceptional falls than those on the coastal plains, e.g. around the ridge of Lovemore Heights, seawards of Newton Park, near the Lady Slipper (St Albans and Greenbushes) and in and around Uitenhage near the mountains (SAWS 2007).

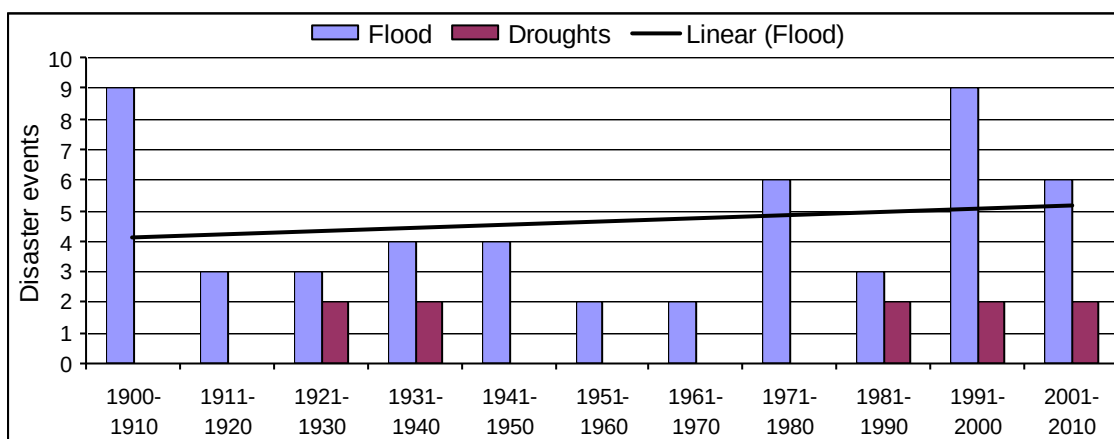


Figure 17. Number of flood and drought disaster events in Nelson Mandela Bay per decade since the turn of the 20th century. The black line indicates the linear trend of floods over time.

According to media sources and SAWS and DWAF records, the number of disastrous flood events increased in the last four decades. It is evident from Figure 17 that there has been a linear increase in the number of flood events over the last century. Droughts have been found to occur before and after major flooding events (SAWS 2007). Periods where water restrictions or drought were declared have occurred at least twice per decade in the last three decades (SAWS 2007). The last significant drought and flood period occurred in the mid 2000s when water restrictions was declared in 2004, followed by very serious floods in late 2004 and 2006, followed by water restrictions in 2009. It remains difficult, however, to draw concrete conclusions regarding the relationship between climate change and extreme weather events for Port Elizabeth, chiefly because tremendous surface hardening from development projects has taken place over the years that would have to be factored in during the analysis.

6.3.2 Air quality

The State of the Environment Report for the Eastern Cape (CSIR 2004) found that no co-ordinated air quality monitoring network existed in the Eastern Cape. Air quality monitoring was performed on a fragmented basis and was concentrated mainly in the Nelson Mandela Metropolitan Municipality. Ad hoc studies found very few instances where measured atmospheric pollution concentrations exceeded the available guideline values under the Atmospheric Pollution Prevention Act 45 of 1965.

Air quality management in the Nelson Mandela Bay Municipality falls under the administration of the Air Pollution and Noise Control division of the Environmental Health Services sub-directorate. The Air Pollution and Noise Control division has six staff members in its employ to manage, measure and monitor air pollution in the metro. The NMBM has been monitoring NO_x (oxides of nitrogen), NO₂, SO₂, O₃, PM10 and smoke on a regular basis at several stations across the metro.

The NMBM uses two methods to measure air pollutants. Air pollution from both stationary (e.g. factories) and mobile (e.g. cars) sources are measured using a bubbler system, which involve gases being bubbled through solutions in which particular pollutants undergo a measurable reaction. The second method the NMBM uses is an Open Path Monitoring System (OPSIS). Fixed bubbler stations are deployed at Deal Party (automotive and industrial area), City Hall (central business district), Perseverance (industrial area), Despatch (sewage works, residential and light industrial), Uitenhage Industrial Park (industrial area), and Uitenhage (residential area). The bubbler stations measure SO₂ and smoke (PM10). One fixed OPSIS measuring station is located on the roof of the General Motors SA automotive plant in North End. This location represents a busy road intersection with light and heavy industries adjacent to a residential area.

Average annual SO₂ concentrations at bubbler stations in the metro (Figure 18) from 1998 to 2008 indicate that the SO₂ concentration for all the years was below the 125 µg/m³ limit proposed by the National Ambient Air Quality Standards (DEA 2009a; DEAT 2009) and SANS 1929:2005 limits. The SO₂ concentrations measured at Deal Party, Perseverance and Despatch exceeded the 20 µg/m³ limit, as adjusted by the WHO in 2005, for most of the years measurements were taken. Bubbler measurements started in October 1998, thus the 1998 annual averages are based on only three months. Further, data for only the first six months of the 2008 was available.

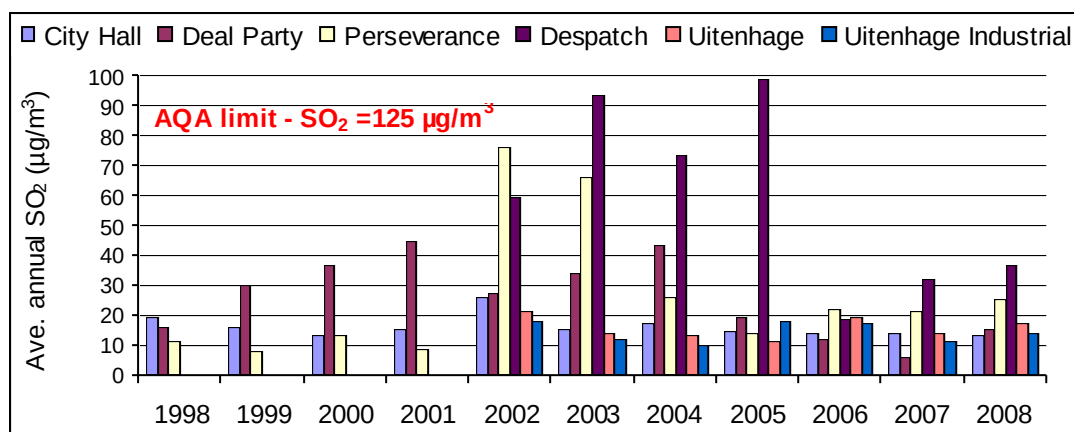


Figure 18. Average annual SO₂ concentrations at six bubbler measuring stations in the Nelson Mandela Bay Municipality.

The OPSIS measuring station in North End measured SO₂, NO₂, PM10 and O₃ (ozone) since 1998. In 2007 the Open Path Monitoring System became defective and was sent for repairs. As a result no data pollutants concentrations were measured in North End. Results from the measuring station indicate that the 24 hourly average SO₂ and NO₂ concentrations for all the years were below the South African standard limit of 125 and 188 µg/m³ for SO₂ and NO₂ (Figure 19), respectively.

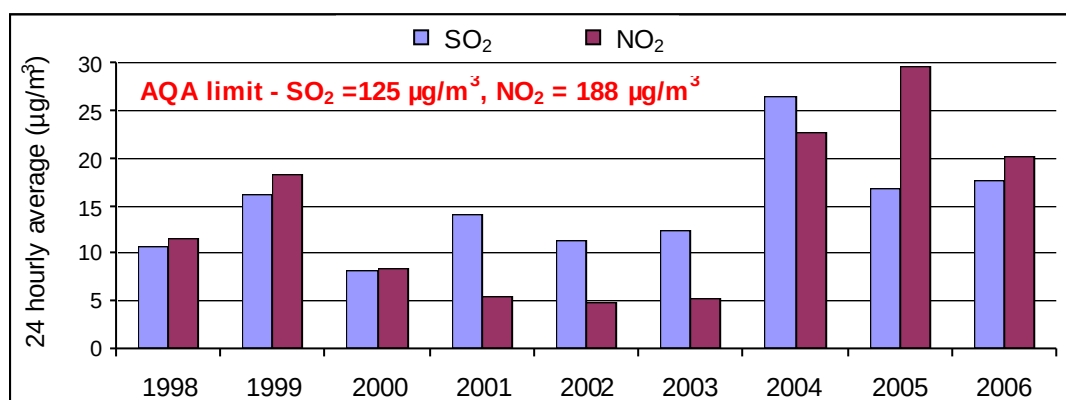


Figure 19. Average 24 hourly concentrations of SO₂ and NO₂ as measured by OPSIS.

Average one-hourly ozone concentrations in North End showed a steady decline from 1998 to 2002, where the concentrations remained seemingly stable. Ozone concentrations in the North End area were almost an order of magnitude lower than the SA air quality standard limit and SANS (1929:2005) limit, which are set at 226 and 200 µg/m³, respectively (Figure 20).

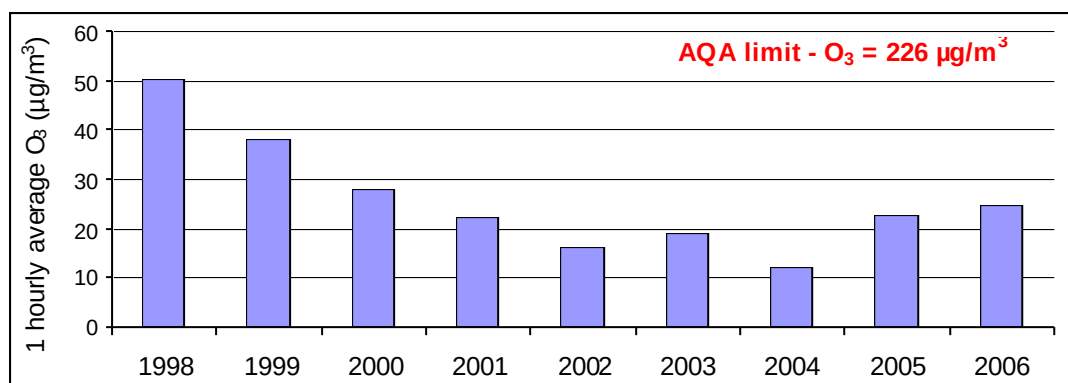


Figure 20. Average one hourly concentrations of ozone in North End as measured by OPSIS.

An Air Quality Management Plan (AQMP) is under development for the Nelson Mandela Bay Municipality. A memorandum of agreement has been signed between the NMBM and the provincial Department of Environmental Affairs, identifying the need to develop an AQMP as a priority. As a result of a lack of an AQMP, no estimation on the total industrial emissions in the Nelson Mandela Bay Municipality has been undertaken. Air pollution sources that have not been measured or for which no data is available include motor-vehicle emissions, burning of refuse, the burning of vegetation, noise pollution and dust pollution.

The relatively low concentrations of key air pollutants in the Nelson Mandela Bay Municipality are largely the result of the high prevalence of strong winds in the metro. The wind disperses the emission of pollutants almost daily. Conversely, a slight haze can be observed hanging over the industrial and CBD areas of the metro after a few days without wind (Figure 13).

From the averaged data at each station, no exceedances of the ambient air quality standards were observed. Data on the daily levels of the pollutants reported on above could not be assessed, and therefore no daily exceedances could be reported.

6.4 Indicators

6.4.1 Climate change

The chosen indicators to assess climate change in the Nelson Mandela Bay Municipality are shown in Table 6. Trends in climate change are difficult to substantiate over a short period of time. Long term temperature and precipitation data was therefore obtained from the South African Weather Service at the Port Elizabeth airport. Statistics relating to climate change events such as floods and fires were obtained from NMBM: Disaster Management.

Table 6: State of Environment indicators for Nelson Mandela Bay Municipality: climate change.

Issue	Indicator
Climate change trends	Average annual maximum and minimum temperature
	Average annual precipitation
Climate change events	Number of climate change related disasters per year (floods, droughts, wildfires)

These two indicators were assessed in section 6.3.1.

6.4.2 Air quality

The chosen indicators to assess climate change in the Nelson Mandela Bay Municipality are shown in Table 7.

Table 7: State of Environment indicators for Nelson Mandela Bay Municipality: air quality.

Issue	Indicator
State of air quality	Average concentrations of key atmospheric pollutants (SO ₂ , NO ₂ , PM10)
	Percentage of days not meeting ambient air quality standards at selected measuring stations
	Air Quality Management Plan
	Number of staff responsible for air quality management in the NMBM
	Number of industries registered under the Air Quality Act

All but the last indicator in Table 7 were addressed in section 6.3.2. No information on the number of industries registered under the Air Quality Act could be obtained.

6.5 Impacts

6.5.1 Climate change

The natural rainfall cycles in the greater Nelson Mandela Metropolitan area are seemingly becoming more erratic. The region experienced one of its wettest years in 2006, but experienced one of its driest years only two years later in 2008. The Nelson Mandela Bay Municipality are currently experiencing one of the worst drought periods in 100 years. Water resources are expected to run dry towards the end of 2010 if no significant rains are received to alleviate the water shortage. If this scenario occurs, it will have major ramifications on the wellbeing of citizens in the Nelson Mandela Bay Municipality. Many people will be at risk of contracting water-borne diseases, and those that can afford water purifiers will carry a financial burden.

The predicted increase in average temperature is expected to also have a significant impact on the water resources of the Nelson Mandela Bay Municipality. Drier and warmer summers are expected to cause a higher demand on water for consumption by water users in the metro. Higher evaporation rates will further decline available water sources, in some instances causing salinisation. Diminishing water supplies will impact directly on in-stream flow requirements, which are important for maintaining aquatic and riparian biological diversity.

Higher temperatures coupled with the drying trend are expected to have devastating impacts on the rivers, estuaries and wetlands in the Nelson Mandela Bay Municipality. Diminishing water resources will inevitably mean increased abstraction of water from rivers causing reduced flows. Changes in precipitation and run-off are likely to alter the frequency and duration of estuarine mouth closures. Apart from delaying the flushing of pollutants and increase sediment deposition, changes in mouth conditions will cause changes in the estuarine biological community structure. This could potentially increase the vulnerability to local extinction of certain faunal groups. This may be a serious cause of concern in the Swartkops, Papenkuils, Baakens, Chatty and Coega Rivers, which are all regarded as polluted to varying degrees. Drought periods are further likely to desiccate wetlands and threaten seasonal ecosystem interactions within the wetland. Ultimately, the goods and services that ecosystems provide may be seriously altered.

The tourism and economic sectors are also expected to undergo changes. The incidence of malaria in South Africa has increased dramatically in the past decade, and the impact of this on the tourism industry has been noted. Tourists are increasingly opting to travel to malaria-free areas such as the Eastern Cape Province for game viewing, despite the absence of very large parks here (Turpie *et al.* 2002). Other economic sectors could be affected by changes in temperature and precipitation patterns include agriculture, fisheries, the manufacturing industry, finance and investment, transport, communication and trade, and construction.

Prolonged high temperatures during drought periods are likely to increase the prevalence of wildfires due to increased berg-wind conditions. This poses a major threat for protected areas and sensitive vegetation in the Nelson Mandela Bay Municipality. A large part of the Van Stadens Flower Reserve, which is home to some critically endangered plant species, such as *Cyclopia longifolia*, was devastated by wildfires.

Further impacts may include changes in the distribution of alien invasive species, as well as changes in indigenous species distribution and interactions.

Extreme weather events and sea level rise, which are predicted impacts of climate change, are likely to threaten people and infrastructure in the coastal low lying areas of Nelson Mandela Bay. Extreme weather events may cause wide spread damage to housing and transport infrastructure, while sea level rise could cause flooding in homes and suburbs, especially in the townships and disadvantaged communities in the Swartkops River flood plain, which was rated most vulnerable to flooding.

6.5.2 Air pollution

Poor health is one of the main effects of poor air quality in industrialised areas. Poor indoor air quality brought about by the burning of fossil fuels has a direct effect on the inhabitants of a dwelling. SO₂ and nitrogen oxides, for example, causes respiratory irritation and infections, and can aggravate existing respiratory diseases, especially asthma. Indoor air pollution from coal-burning has been established as one of the risk factors for the development of acute respiratory illnesses (ARI). These impacts are especially prevalent in poor communities dependent on wood and coal for cooking food and warmth. These impacts further decrease the longevity of individuals suffering from diseases compromising their bodies immune system.

One of the prominent emissions during the burning of wood and coal is carbon monoxide (CO). Together with tailpipe emissions from motor vehicles, CO can also impact the ambient air quality in an area. Common health conditions associated with high levels of CO are hypoxia, neurological problems and cardiovascular disease.

The burning of fossil fuels can also have ecological and economical impacts. Smoke plumes produced by the burning of wood and coal can cause changes decreases in plant productivity, decreases in rainfall, and cause economic losses, e.g. due reduced visibility affecting transport.

Ground-level ozone (O₃) is a major health concern as it damages lung tissue, reduces lung function and weakens the body's defences against viruses and bacteria. It is produced in a complex reaction between hydrocarbons, NO₂ and sunlight. Therefore, increases in ambient air pollution and higher ambient temperatures are likely to result in rising ozone levels in the lower atmosphere. Fortunately, the current levels of O₃ are noticeably low and O₃ generation can be controlled by reducing the concentrations of nitrogen dioxide and hydrocarbons in ambient air.

6.6 Responses

6.6.1 Climate change

Current responses

- The Department of Environmental Affairs and Tourism has drafted a **National Climate Change Response Strategy** for South Africa (DEAT 2004).
-

- The Department of Environmental Affairs has implemented the **National Environmental Management: Air Quality Act 39 of 2004**, which has moved the responsibility for air quality management, monitoring and implementation of response strategies to local government level.
- The integration and implementation of **Local Agenda 21**, which requires local government to engage with local communities, minority groups business and organisations to commit and develop strategies at achieving sustainable development. The South African 'custodian' for Agenda 21 is the Department of Environmental Affairs and Tourism (DEAT).
- Implementation of the **Kyoto Protocol**, which was intended to bring about reductions in greenhouse gas emissions from its signatories for the period 2008-2012, while promoting increased energy efficiency and the use of renewable energies. Although South Africa as a developing country does not have to reduce its emissions, implementation of the guidelines should still be encouraged.
- Integration of the **IDP - Vision 2020**. The Nelson Mandela Bay Municipality aims to practise social justice in a culture of public participation guided by an efficient, accountable, non-racial, non-sexist municipality that focuses on sustainable environmental, social and economic development, improving quality of life of its communities in a secured, safe and tourist friendly environment.
- Implementation of the **Integrated Development Plan**.
- The Nelson Mandela Bay Municipality is in the process of developing a **Climate Change Response Strategy**.
- **Go-Green** environmental awareness campaign. The objective of this campaign is to emphasize initiatives by the Nelson Mandela Bay Municipality and to highlight actions that can be taken resident of Nelson Mandela Bay to contribute to sustainable utilisation of resources and minimising environmental impact.
- Compliance of **Bus Rapid Transport buses** to EU emissions standards.
- Introduction, awareness and training with regards to the **Green Procurement Policy** of the NMBM.
- **Spekboom carbon sequestrating project** in the Valley Thicket biome.

Recommended responses

- Implementation and integration of the **National Climate Change Response Policy** on local government level. Within the framework of the Response Strategy, it is recommended that a study into risks and key adaptations specific to the Nelson Mandela Bay Municipality be conducted.

6.6.2 Air quality

Current responses

- The **National Framework for Air Quality Management in the Republic of South Africa** (2007). The framework aims to attain and maintain compliance with ambient air quality standards and to give effect to obligations in terms of international agreements.
- Development and integration of an **Air Quality Management Plan** into the Integrated Development Management Plan.
- The NMBM has drafted an **Air Pollution Control By-law** to controlling air pollution within the area of the municipality's jurisdiction, and to ensure that air pollution is avoided, or minimized and remedied.

- The NMBM has initiated the upgrade to municipal standards of all remaining gravel roads in the metro, which equates to the upgrade of more than 400 km of existing untarred roads.

Recommended responses

- Once completed, the Air Quality Management Plan should be incorporated into the Nelson Mandela Bay Municipality Integrated Development Plan, Spatial Development Framework and Disaster Management Plan.
- Refinement of the Air Quality Management System to record and provide current, reliable and uninterrupted data for future monitoring of air pollution levels, and setting local air quality standards.
- Implementation of Diesel Vehicle Emission Testing strategy.
- Development and implementation of strategies to measure and control emissions from air, rail and ocean transport.

6.7 Linkages and inter-dependencies

Air quality influences and is influenced by a range of other features discussed elsewhere in this report. These include:

Biodiversity: Changes in air quality and ultimately climate change are likely to impact terrestrial, freshwater and marine biodiversity to varying degrees. It may cause changes in species distribution, community structure and eventually ecosystem dynamics.

Land degradation: Climatic change is likely to cause increase ambient temperature, which in turn may cause changes in land-use patterns, e.g. in low-lying areas and drought-stricken agricultural land.

Coasts and estuaries: Sea-level rise due to climate change is expected to have an impact on the coastal environment, while changes in temperature and rainfall patterns will change the nature of freshwater delivery to coastal estuaries. Extreme weather events will have an impact on both coasts and estuaries.

Urban development: Climate change may severely impact in environmental conditions due to climate change may affect population dynamics in the area. It is possible that marginalized populations in rural areas will increase rates of migration to urban areas.

Economics and poverty: Poor air quality and climate change may severely affect low-income households living in poverty in informal settlements, particularly with exposure to extreme weather events, and the trauma associated with it. Damage caused by extreme weather events may put a significant financial burden on a region trying to develop its economic potential.

Health and education: High concentrations of indoor and ambient atmospheric pollutants may increase the incidence of respiratory diseases in the Nelson Mandela Bay Municipality.

Waste management: Emissions originating from landfill sites, the incineration of hazardous and medical waste, and treatment of liquid waste contributes to poor air quality and can become a nuisance to surrounding areas. Waste management activities and strategies will thus directly influence air quality in the Nelson Mandela Bay Municipality.

6.8 Identified gaps

Studies focussing on the impact of climate change in the Nelson Mandela Bay Municipality must be initiated.

Little air quality data is available and the monitoring system is not fully operational. The NMBM must ensure the implementation of an upgraded monitoring system to monitor important air pollutants daily.

The NMBM and Coega IDZ must collaborate to work closer together in monitoring and managing air quality in the NMBM.

7 THEME: BIODIVERSITY

7.1 Introduction

7.1.1 Species richness and ecosystem services

The word biodiversity is used to mean the variety of life on our planet, measurable as the variety within species, between species, and the variety of ecosystems. South Africa has a very substantial share of global biodiversity within its borders, ranking third of any country in the world. South Africa's biological diversity and high level of endemism comes to a defining point in the NMBM, as this is where five of South Africa's seven biomes meet.

Our biological heritage is important to us in many ways – providing us with ecosystem services like clean water, contributing directly to the economy through industries like fishing and tourism, supporting livelihoods by providing food, medicines and building materials and generally improving our health and well-being. The value of biological diversity has three components:

1. Many species have a direct value through the products that can be harvested, for instance, many medicines used throughout the world have active ingredients extracted from plants and animals.
2. The pollination of agricultural crops by insects is an example of the indirect value where aspects of biodiversity bring economic benefit without the need to consume the resource.
3. There is also an ethical value to the diversity of life. Although it does not always lend itself to economic valuation in monetary terms, we still appreciate the beauty of the rose flower.

Through the most powerful human influence, habitat destruction and ill-conceived developments, biodiversity is under threat world-wide. The focus is frequently on the accelerated rate of disappearance of a species in the face of human influence. Species are lost at a rate never seen before in the fossil record of Earth. To counteract this mass extinction, conservation action is needed that is effective in maintaining the ecosystem services (e.g. fishing, grazing, clean water and air) provided by high levels of biodiversity.

7.1.2 Conservation planning

Biodiversity encompasses more than just species richness. We should ensure that we protect representatives of as many types of community and ecosystem as possible. By conserving suitable habitat we are also improving the survival chances of the species and populations contained therein. Living landscapes preserve the option value of biodiversity – the potential to provide benefits in the future. To protect biodiversity effectively, we need to conserve (Driver *et al.* 2003):

- A representative sample of all biodiversity; and
- The ecological and evolutionary processes that allow this biodiversity to persist over time.

The systematic approach to conservation planning involves setting quantitative conservation targets, for instance the number of hectares of river corridor that need to be set aside to remain undeveloped. Quantitative conservation targets show how much we need to conserve in order to achieve the goal of living landscapes. This chapter explores how close we have come to this goal in Nelson Mandela Bay.

7.1.3 Biodiversity assessments

In recent years the metropolitan area has been subjected to several biodiversity conservation assessments, either through dedicated local studies or through overlapping regional and national assessments. Use was made of this information when this chapter was compiled.

Stewart *et al.* (2005) produced a biodiversity conservation assessment for an open space system for Nelson Mandela Bay. This seminal work was created as part of the Cape Action for People and Environment (C.A.P.E.) programme. C.A.P.E., and also the STEP (Subtropical Thicket Ecosystem Planning) project, had identified Nelson Mandela Bay as an area of great importance for the conservation of Lowland Fynbos and Coastal Fynbos/Thicket communities (Cowling *et al.* 1999, Pearce & Mader 2006). The work by Stewart *et al.* (2005) set the foundation for the Nelson Mandela Metropolitan Open Space System (NMMOSS), which is introduced in section 7.3.5.

Owing to their overarching coverage, the National Spatial Biodiversity Assessment (NSBA) included the NMBM area (Rouget *et al.* 2004), as did the Eastern Cape Biodiversity Conservation Plan, which was compiled as a single, user friendly, biodiversity land use decision support tool (Berliner & Desmet 2007) in order to integrate various conservation planning initiatives overlapping with the Province of the Eastern Cape.

More recent work by Warrick Stewart and co-workers is also of relevance. In response to the development of very large tracts of land since the early 2000s, Stewart & van Gend (2007) produced the Strategic Environmental Assessment of the NMBM Spatial Development Framework. Its aim was *inter alia* to identify the opportunities and constraints that the natural environment poses on various land uses recommended in the SDF.

A logical progression from the earlier work constitutes the Conservation Assessment and Plan for the Nelson Mandela Bay Municipality (Stewart 2009). This systematic conservation assessment analysed to which extent biodiversity patterns, ecological processes and species of special concern have been irreversibly lost due to human actions.

In 2009 NMBM appointed SRK Consulting to develop the biodiversity sector plan for the metropolitan area, based on the Final NMBM Conservation Assessment and Plan (Stewart 2009). In due course the biodiversity sector plan will be gazetted as a Bioregional Plan in terms of the Biodiversity Act (Act 10 of 2004). Once gazetted, the Bioregional Plan will inform and guide land use planning and decision-making by all relevant sectors whose policies and decisions impact on biodiversity, thus facilitating the conservation and sustainable use of biodiversity.

7.2 Drivers and pressures

Important driving forces putting pressure on the biodiversity resources of Nelson Mandela Bay are:

- Population growth;
- The demand for economic growth to provide wealth and job creation;
- Demand for housing and associated services for historically disadvantaged people;
- Unsustainable extraction of natural resources as a result of poverty or greed;
- Poor land use practices promoting soil erosion and infestation by invasive alien plants;
- Altered veld fire regimes and runaway fires;
- Poor waste and pollution management;
- Climate change; and
- Lack of understanding (ignorance of the importance of conserving biodiversity).

With an estimated annual population growth rate of $\pm 1\%$ for the period 2001 – 2008 (Lehola 2008) more and more South Africans are born every day whose basic human needs for food, freshwater and fuel are making unprecedented demands on our global and local ecosystems. Beyond the necessities of survival, there is increasing demand of society for more material goods and services.

South Africans already consume more resources per capita than people in any other African nation. As previously disadvantaged people strive to increase material wealth and the comforts and conveniences they have been denied before the new political dispensation, the strain on natural resources and biodiversity will only increase.

Ignorance of the importance of conserving biodiversity through lack of understanding should not be underestimated as a contributing factor. Subjects dealing with the conservation of our biological heritage are only recent arrivals in the school curriculum and the demand for environmental education by appropriately qualified teachers exceeds the supply by far.

7.3 State

7.3.1 Ecosystem status: biodiversity pattern

The National Spatial Biodiversity Assessment (NSBA, Driver *et al.* 2005) used maps of land classes, such as vegetation types or habitat types (e.g. Gourits Valley Thicket), to represent biodiversity features (pattern and process), habitat transformation and future land use pressure, across the nation. By using land classes incorporating expert knowledge about biological characteristics as surrogates of biodiversity (Lombard *et al.*, 2003), the problems associated with incomplete species-based inventories, collection bias and extrapolating from one species group to another are overcome. In the absence

of comprehensive data sets of the occurrence and status of species of conservation concern in NMBM, the NSBA approach of using land classes as stand-ins for biodiversity was used by Stewart (2009) in the Conservation Assessment and Plan for the Nelson Mandela Bay Municipality. It is also adopted for this report.

A total of 58 land classes covering 1954 km² have been identified by Stewart *et al.* (2005) in the Nelson Mandela Bay Municipality. The classification of how intact and well functioning they are is commonly based on four categories (Table 8):

Table 8. Definition of ecosystem status categories of land classes.

Remaining natural habitat %	Category	Definition
80 - 100	Least Threatened	Still largely intact
60 - 80	Vulnerable	Reasonably intact, but nearing the threshold beyond which they will start to lose ecosystem functioning
20 - 60	Endangered	Have lost significant amounts of their original natural habitat, impairing their functioning
0 - 20	Critically Endangered	Have so little of the original habitat left that not only their functioning has been severely impaired, but species are being lost

The ecosystem status measures the amount of habitat lost in ecosystems (measured as land classes) relative to the conservation targets for those ecosystems. In Nelson Mandela Bay 57% of land classes are Endangered or Critically Endangered, with a further 26% Vulnerable to lose ecosystem functioning (Figure 21). In terms of the area occupied by the land classes, the Endangered or Critically Endangered account for 15.5% and 15.6%, respectively, of Nelson Mandela Bay (Figure 22).

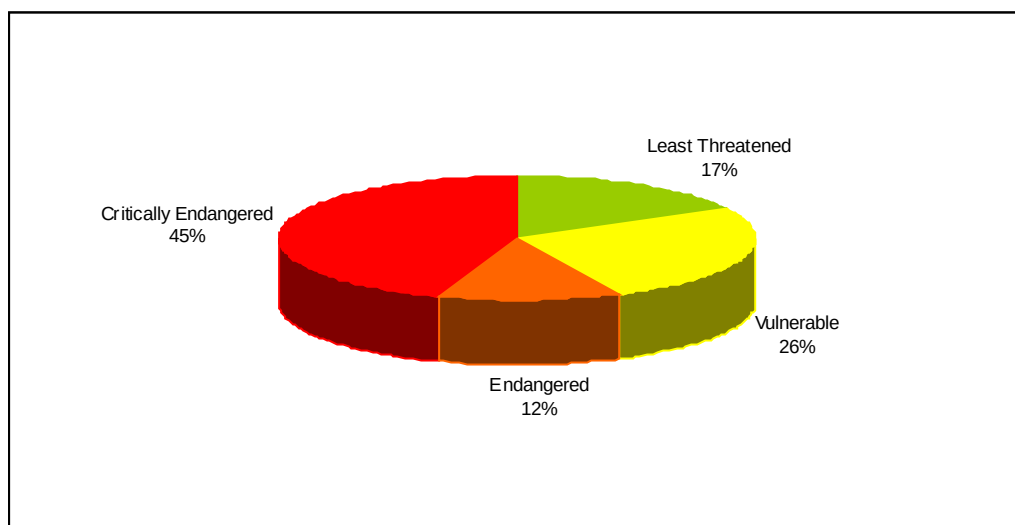


Figure 21. Percent breakdown of the ecosystem status of NMBM land classes.

Only Groendal Wilderness, Lady Slipper Mountain, Koedoeskloof and the Sundays dunes at the fringes of the metropolitan area are still largely intact, whereas the midland areas are under greater threat to lose their ecological integrity (Figure 22). The Critically Endangered parts of NMBM are lying in a broad band in the south representing an assortment of smaller vegetation types that presumably were readily transformed from the virgin state for human purposes. Much of the Swartkops River valley is also Critically Endangered. These land classes are Critically Endangered because conversion to built-up land and the presence of severe human impacts has compromised target achievement in terms of ensuring the long-term persistence of the biodiversity pattern.

According to Stewart (2009), all the remaining habitat of 20 of the 58 vegetation types in Nelson Mandela Bay need to be conserved in order to meet their respective conservation targets. Of the 20 vegetation types, wetlands are at the top of the list with 11, followed by four forest and three fynbos types, as well as two dune fields. These 20 vegetation types cannot sustain further loss of habitat.

Of the still remaining intact patches of Colleen Glen Grassy Fynbos and Lorraine Transitional Grassy Fynbos 96.8 % and 82.6%, respectively need to be set aside in order to attain their conservation targets. A further 12 vegetation types require close to half of their remaining extent to be conserved (Stewart 2009).

7.3.2 Ecosystem status: biodiversity processes

The approach to systematic conservation planning explicitly acknowledges the importance of including ecological process conservation into protected area systems design. In the NMBM context, rivers and coastal dune fields can act as effective conduits in safeguarding the future survival of plants and animals, as they link the mountains with the sea or provide for longshore movement. The basic concept is to facilitate the exchange of genetic information between species members and to promote natural evolutionary processes.

Riparian corridors typically possess a diverse array of species and environmental processes and can play an important role in maintaining regional biodiversity (Naiman *et al.* 1993). The ecological diversity of riparian corridors is related to variable flood regimes, geomorphic channel processes, altitudinal climate shifts and upland influences on the fluvial corridor. Effective riparian management could ameliorate many ecological issues related to land use and environmental quality (Rodriguez-Iturbe *et al.* 2009, Ward *et al.* 2004). Likewise, coastal corridors play an important part in supporting the biological mechanisms responsible for the dispersal of plant propagules (pollen, seeds, pods, fruits), as well as the recombination of genes between sexually mature animals between different parts of the African continent.

Stewart (2009) assessed the ecological integrity of the NMBM's 11 riverine systems, namely Baakens, Coega, Hume, Maitland, Papenkuils, Seaview, Shark, Sundays, Swartkops and van Stadens Rivers. He concluded that all the mainstem rivers in the NMBM require safe-guarding in order to meet the required conservation targets for freshwater systems. Four rivers (Coega, Hume, Seaview stream and Swartkops) are so degraded that they require active rehabilitation measures as a matter of urgency. A

more in-depth assessment of the aquatic systems of Nelson Mandela Bay is provided in the Theme: Rivers, estuaries and the NMBM coast.

The dune fields are absolutely essential for the sand household of the NMBM's beaches (McLachlan *et al.* 1994). All the remaining habitat of the functional sand movement corridors present at Maitland, Driftsands (Cape Recife) and along the coast from Hougham Park to Sundays River mouth require conservation and should not be further impacted upon (Stewart 2009).

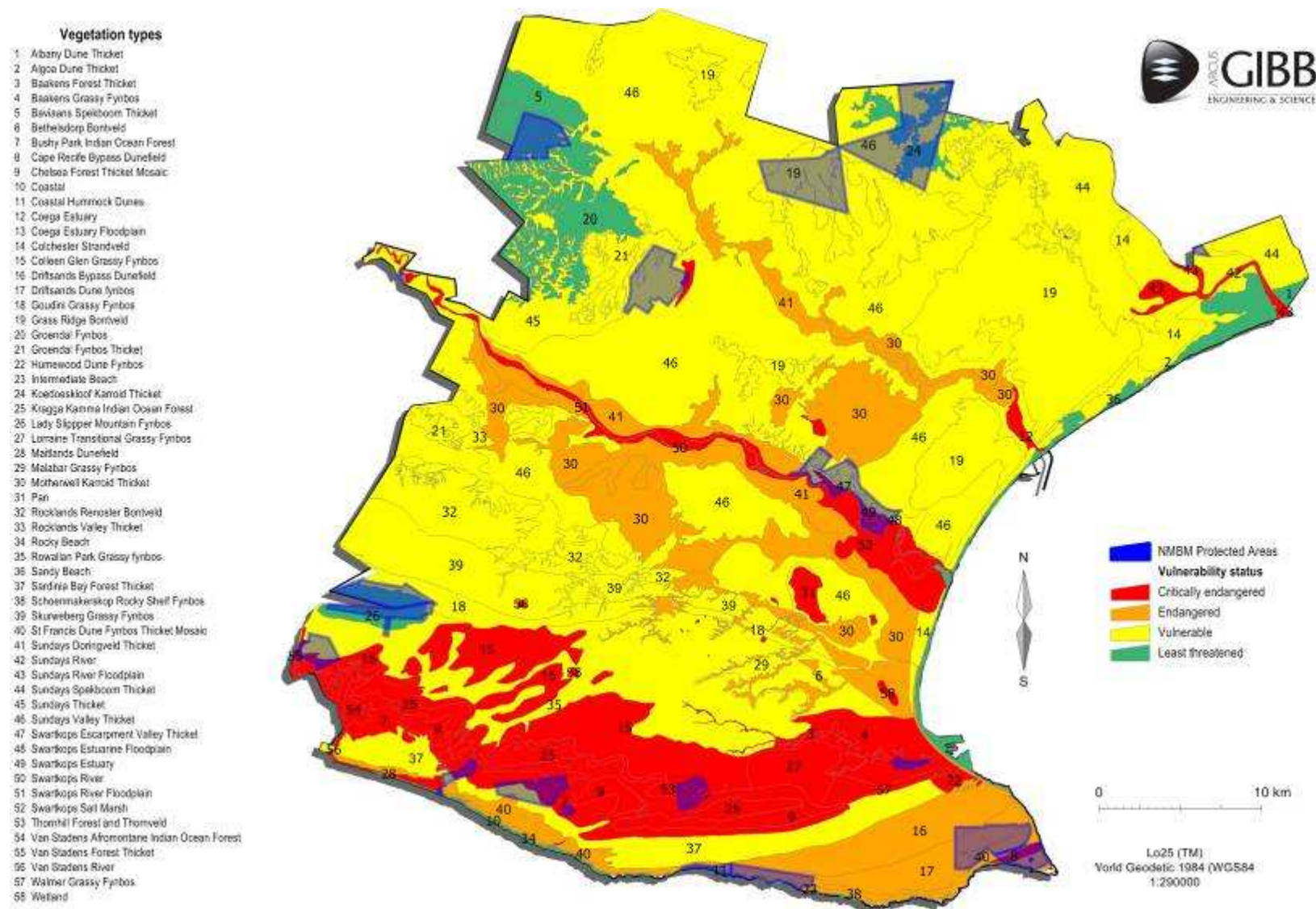


Figure 22: Ecosystem status of the 58 land classes occurring in Nelson Mandela Bay (from Stewart et al. 2005).

7.3.3 Extent of formally conserved areas

Areas receiving statutory protection are very important for biodiversity conservation. There are many types of protected areas and they do not confer equal amounts of protection to the vegetation type/land class in which they are located. National Parks, Provincial Nature Reserves, Local Nature Reserves and Department of Forestry Nature Reserves present the highest level of formal protection. At the other end of the scale are private game farms and stewardships that are informal by nature (un-gazetted) and do not provide secure long-term protection of biodiversity. Still, for the valuable contributions that they make – albeit at a variable quality – they have been included in this analysis where information was available.

Currently, nearly 6% of land in South Africa is under protection in Type 1 and Type 2 protected areas (Rouget *et al.* 2004). With a total area of 3.9% under formal Type 1 and 2 protection NMBM falls considerably under the national average (Table 9, Figure 22). If the three proposed reserves (Aloes, Chatty, van der Kemp's Kloof) were added, NMBM's percentage would improve to 5.0%. Type 3 protected areas contribute a further 1.5% to this total.

Table 9. Conservation areas in Nelson Mandela Bay. NMBM total area = 195412 ha.

Name	Reserve type	Hectares
Type 1		
Addo Elephant (part)	National Park	763
Groendal Wilderness Area (part)	Provincial Nature Reserve	14
Island State Forest	Provincial Nature Reserve	487
Cape Recife	Local Nature Reserve	323
Lady's Slipper	Local Nature Reserve	365
Maitland	Local Nature Reserve	128
Sardinia Bay/Sylvic	Local Nature Reserve	606
Settlers Park	Local Nature Reserve	79
Swartkops Valley	Local Nature Reserve	912
The Springs	Local Nature Reserve	931
Van Stadens	Local Nature Reserve	361
Total		4969
Type 1 (proposed)		
Aloes	Proposed Local Nature Reserve	226
Chatty	Proposed Local Nature Reserve	1162
Van der Kemp's Kloof	Proposed Local Nature Reserve	778
Total		2166
Type 2		
Nelson Mandela Metropolitan University	Private Nature Reserve	840
Grassridge	Private Nature Reserve	1369
Van Stadensberg	Natural Heritage Site	579
Witteklip	Private Nature Reserve	29
Total		2817
Type 3		
Kragga Kamma Game Park	Game Park	197
Paardekop Game Farm	Game Park	680
Seaview Game Park	Game Park	31
Tregathlyn Game Farm	Game Park	2099
Total		3007
Grand total		12959

Private game farms, conservancies and stewardships may well help to achieve conservation goals across the land, but due to the low level of protection that they are afforded and frequent changes in their status owing to variable membership of constituent land parcels they are assigned a lower status. Four conservancies and one stewardship are currently operative in the NMBM:

1. Cape Recife Conservancy
2. Sardinia Conservancy
3. Chelsea-Buffelsfontein Conservancy
4. Blue Horizon Bay Conservancy
5. Van Stadens Stewardship.

It should be noted that the conservancies listed above and the protected areas shown in (Table 9) differ considerably in their management. Whereas all Local Nature Reserves have scientifically formulated management plans, the same cannot be said for some of the other types (e.g. most conservancies). Much remains to be done in Nelson Mandela Bay until all types of protected areas will reach their full potential in supporting bioregional conservation goals. This is quantified in the next section.

7.3.4 Ecosystem protection

It is informative to compare the level of ecosystem functioning (Figure 22) with the formal protection level enjoyed by each of the land classes in Nelson Mandela Bay. This tells how well the protected area network in the municipality is performing in terms of representing terrestrial biodiversity.

A total of 41 land classes/ecosystems identified by Stewart *et al.* (2005) are represented in NMBM's protected areas of Type 1, 2 and 3 (as defined in Table 9, although mostly as small areas only that often fall short of making a meaningful contribution towards their persistence (Figure 22).

Table 10 shows that there is a mismatch between the conservation status groups of ecosystems/land classes and the level of protection that they enjoy by being located inside existing declared nature reserves. For instance, NMBM's Critically Endangered Colleen Glen Grassy Fynbos and Lorraine Transitional Grassy Fynbos are not present in any of the protected areas, but 8 of the 10 Least Threatened land classes receive protection in reserves, notably vegetation types occurring at Groendal and the Cockscomb Mountains. A plausible explanation for this mismatch is that Nelson Mandela Bay's network of protected areas was not established to conserve a representative sample of its biodiversity. Rather, the nature reserves etc. were mostly created in scenic places where the economic potential of the landscapes was low and where land was cheap (Driver *et al.* 2003). As Stewart (2009) has noted, only a portion of NMBM's protected areas have strong legal protection and are principally managed for biodiversity protection, while the Type 3 reserves are under private control and have weak legal protection and/or are not principally managed for biodiversity protection,

In conclusion there are many hardly or poorly conserved land classes occurring in Nelson Mandela Bay that are ill protected. The acquisition by NMBM of land parcels for biodiversity protection – as yet not achieved – may also be needed to ameliorate this situation.

Table 10. Evaluation matrix of ecosystem status by protection status (i.e. represented in Type 1, 2 and 3 protected areas) for the 58 land classes occurring in the NMBM.

	Least Threatened	Vulnerable	Endangered	Critically endangered
Protected	8	10	6	17
Not protected	2	5	1	9
Total	10	15	7	26

7.3.5 MOSS

Most large South African cities have a Metropolitan Open Space System (MOSS) in place. 'Open space' is the counterpart of developed land. It has its surface open to the sky, is deliberately set aside and publicly regulated to serve conservation and urban shaping functions, as well as outdoor recreation opportunities. Obeying an important conservation principle, the open spaces are linked by corridors in order to facilitate the movement of fauna and flora within the city and with undeveloped areas beyond. International experience has shown that biodiversity conservation is a prerequisite for sustainable development (Cowling *et al.* 1999); where sustainability is defined as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (Brundtland Commission 1987). A key aspect of sustainable development is the manner in which settlements are shaped and spatially orientated within the environment. Moughtin (1997) states that in the development process there should be presumptions in favour of conservation, and a premium should be placed on the conservation of natural resources, wildlife and landscapes.

Efforts to devise a Metropolitan Open Space System for Port Elizabeth date back to the 1990s (PE MOSS). Strategic planning by the C.A.P.E. programme at the start of the millennium identified Nelson Mandela Bay as a priority area for fine-scale (1:10 000) systematic conservation planning. The outcome of this process was the 2003 Nelson Mandela Metropolitan Open Space System (NMMOSS) as detailed in Stewart *et al.* (2005).

By its very nature a Metropolitan Open Space System is a living plan that is updated and modified in response to development pressures on the natural environment arising from social imperatives and political demands. In 2007, as part of the Strategic Environmental Assessment of the NMBM Spatial Development Framework (Stewart & van Gend 2007), an updated NMB MOSS Conservation Assessment and Plan was developed with the final report being released in 2009 (Stewart 2009).

In its current form (Figure 23) the NMB MOSS covers an area of 619 km² or 31.7%. NMB MOSS includes conservation areas (Table 9) and public property, as well as private property.

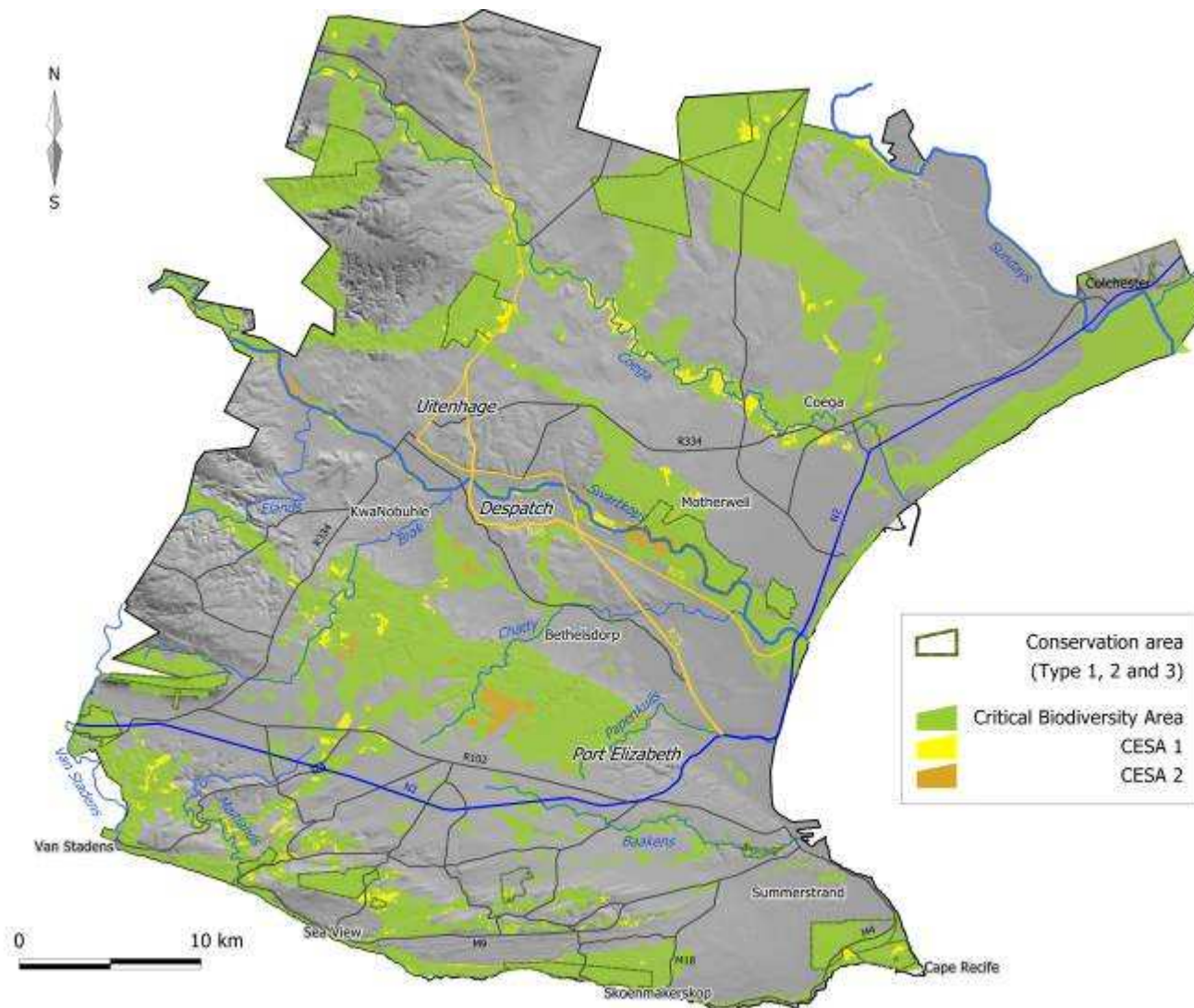


Figure 23. The Critical Biodiversity Areas and Ecological Support Areas of the NMMOSS (from Stewart 2009).

The green areas depicted in Figure 23 harbour the remaining natural habitat and critical ecosystem processes identified in the NMBM Conservation Assessment and Plan (Stewart 2009). By analysing the municipal area on an even by even basis or, where they were impractically large, by using 200 x 200 m grid cells, the study delineated Critical Biodiversity Areas (CBA) containing critically endangered habitats, vital ecological process areas and corridors, as well as habitats for species of special concern. Critical Ecosystem Support Areas consisting of agricultural land (CESA 1) and even some severely disturbed land parcels (CESA 2) were also defined.

The priority areas shown in Figure 23 have been grouped into 28 clusters of implementation sites. Specific actions required for each of the 28 clusters are provided in the NMB MOSS Conservation Action Plan (WESSA & NMBM 2008). The purpose of this Action Plan is to ensure the incorporation of the NMBM MOSS spatial biodiversity plan into municipal processes and to catalyse action for the conservation of NMBM's natural assets. Indeed, introducing the ecological value of the land that the present owners hold in trust for the well-being of future generations remains the greatest task for the NMB MOSS administrators in NMBM.

7.3.6 Invasive alien trees

Plants of alien origin tend to spread and invade ecosystems and become problem plants in areas away from their natural habitats. Alien, or exotic plants may be either noxious weeds or invasive. Noxious weeds are alien plants with no known useful economic purpose. They should be eradicated and cultivation or even tolerance of the presence of these species cannot be allowed. Invasive alien plants may, by contrast, serve useful purposes as ornamentals, or as sources of timber. However, due to their aggressive nature they will, if uncontrolled, invade into niches in a wide range of ecosystems. They should be managed and be prevented from spreading into areas with natural vegetation or in river catchments where they intercept water runoff and starve rivers, dams and estuaries of their freshwater supply. Cultivation of these species could be allowed, but only with strict control measures to prevent their escape.

Many species of alien plants can be found within South Africa. Their presence is the result of a long history of plant introductions (on purpose and accidental) that goes back hundreds of years. The large-scale planting of woody aliens (trees) in Port Elizabeth is attributed to Superintendent J.S. Lister who used Australian wattle trees to stabilise coastal dune fields. Pines, eucalyptus gums and hakeas are also common (Table 11).

Table 11. Common alien trees in the NMBM. These species have the ability to spread aggressively into natural habitats without the direct assistance of people.

Common name	Scientific name	Origin
Rooikrans	<i>Acacia cyclops</i>	Australia
Black Wattle	<i>Acacia mearnsii</i>	Australia
Port Jackson Willow	<i>Acacia saligna</i>	Australia
Ink Berry	<i>Cestrum laevigatum</i>	South America
Red Gum	<i>Eucalyptus camaldulensis</i>	Australia
Silky Hakea	<i>Hakea sericea</i>	Australia

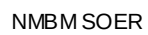


Figure 24. Distribution of dense stands of alien invasive trees in Nelson Mandela Bay. The locations of the small commercial tree plantations in the west are also shown.

Analysis of the 2007 high resolution aerial photography shows that dense stands of alien invasive trees occupied 107 km² (5.5%) of the total NMBM area of 1954 km². The distribution pattern follows closely the presence of consolidated and unconsolidated aeolian soils derived from the Table Mountain Group, and the coastal dunes where the trees were introduced as a sand binder. Alluvial soils along the Swartkops and Elands Rivers are also infested.

The realities of the detrimental influence of problem plants on the natural resources of South Africa have been well documented. Invader plant species produce a significant change in plant community composition and structure, and ecosystem processes. From a nature conservation perspective, the mere presence of an alien invader plant species is a threat. However, not only do alien invader plant species pose an ecological threat, but potentially they have dire social and economic ramifications as well. For instance, a far-reaching ecological, as well as economic and social implication is the depletion of South Africa's water resources that alien invader plant species incur.

The mandate to combat these plants rests with the Department of Agriculture through the Conservation of Agricultural Resources Act (Act 43 of 1983), as amended, where they are defined as weeds and invader plants. The Act places the responsibility of action to control alien infestations firmly with each landowner. Moreover, the National Veld and Forest Fire Act (Act 101 of 1998) requires that landowners must, under the rules of fire protection, control alien invading plants. Sadly, these legal requirements are seldom enforced in the NMBM.

NMB MOSS documents affirm the necessity to control alien invading plants. To this end an Alien Invasive Species Monitoring, Control and Eradication Plan has been put in place that is integrated and aligned with the IDP. The existence and adoption by council of this progressive document is strangely at odds with the non-persecution of offenders of the weeds and invader plants regulations in the municipality.

Since 2006 NMBM created seven jobs to control alien plants in its conservation areas. During the period 2006 – 2011, 314 ha of alien plants were cleared at an average of 78.5 ha per annum. However, since 2009, only 18 ha have been cleared, indicating a decline in the initial good work.

7.3.7 Indigenous tree planting

According to the Five Year IDP Implementation Framework a minimum of 2500 indigenous trees are planted each year by workers of the Sub-directorate Parks and Cemeteries, which is in line with NMBM's 5-year Greening Plan. It is the declared intention of NMBM to accelerate tree planting greatly in preparation for the FIFA Soccer World Cup of 2010 where Port Elizabeth is one of the host cities. Furthermore, the greening of the routes is an integral part of the Bus Rapid Transport (BRT) system presently under implementation. Approximately 900 indigenous trees (mostly the evergreen *Syzygium cordatum* (waterbessie)) are scheduled to be planted along the 107 km of BRT routes (Letsunyane & GIBB 2009).

7.4 Indicators

The indicators to assess the state of biodiversity resources in Nelson Mandela Bay, as determined in GIBB (2009), are listed below.

1. Areas of sensitive, vulnerable, highly dynamic and stressed land classes as surrogates of biodiversity in the municipal area.
2. Percent of plant biodiversity conservation targets being met.
3. Area and % of municipal area under local protected status.
4. Match/mismatch of land of conservation importance in the municipal area under protected area status.
5. Percent of Critical Biodiversity Areas contained within formal conservation areas.
6. Percent of local protected areas with a management plan.
7. Recommendations for land classes requiring formal protection (as Nature Reserves).
8. Land acquired for biodiversity protection reasons.
9. Area and % of municipal land currently invaded by alien species.
10. Is there an adopted Alien Invasive Species Monitoring, Control and Eradication Plan that is integrated and aligned with the IDP?
11. Degree of follow-up work of alien invasive species eradication.
12. Contribution to job creation: conservation areas.
13. Biodiversity corridors respected or made dysfunctional.
14. Number of farms being members of a conservancy.
15. Hectares of alien plant species being cleared.
16. Number of trees planted per annum.

The 16 indicators listed above have been enumerated in section 7.3 of this report. In summary, measured against the National Guidelines for State of Environment Indicators (DEAT 2002) NMBM's ecosystems are under severe pressure, resulting in habitat change, as well as diminishing ecosystem services.

7.5 Impacts

The drivers of biodiversity loss often act in combination (change in land use frequently goes together with changed fire regimes in fynbos) and so the resulting impacts are impossible to apportion neatly. This is, of course, a reflection of the multitudes of inter-dependencies of patterns and processes in the natural world. A selection of the most important impacts of the loss of biodiversity must suffice here.

7.5.1 Habitat fragmentation and loss

Habitat fragmentation and habitat loss is an important cause of the decline in biodiversity resources. The more specific the food and habitat needs of a species are, the greater its vulnerability to agricultural activity, roads, cities and associated sources of pollution. First in the firing line are the larger predators (Leopard, Caracal, Honeybadger) of which there will soon none be left, but there are many other animals and plants threatened by extinction in Nelson Mandela Bay. At the bitter end, the only surviving species will be human commensals (rats, cockroaches etc.) whose habitat

requirements correspond to the degraded state associated with human activity. For all species that became extinct in the process the potential to provide benefits in the future - the option value of biodiversity – is lost forever.

7.5.2 Urban sprawl

Urban sprawl is the leading cause of habitat loss and thus biodiversity loss in Nelson Mandela Bay. Government's roll-out of ambitious infrastructure projects, including the Port of Ngqura and Coega Industrial Development Zone adjacent to it, have strongly increased demand for land. As social imperatives dictate ever larger housing projects for the needy (there is an estimated backlog of 60 – 80 000 houses in the metro), the erstwhile gap in built-up land between Port Elizabeth and Uitenhage has vanished altogether. With it the Thicket refugia of untransformed land for wildlife have fallen victim to the bulldozer.

7.5.3 Pollution

Often, large development projects and the concomitant surface hardening increase the susceptibility of the land to wind and water erosion. Not only does this degrade the land further, it also increases the siltation of streams that are already stressed from water abstraction and polluted stormwater runoff. As the land area for natural ecosystems shrinks, there is less natural capacity to filter pollutants and detoxify waters and less capacity to cycle nutrients and compost organic wastes. Species and ecosystem services decrease as a consequence. Pollution from chemical contaminants certainly poses a further threat to species and ecosystems. While not commonly a cause of extinction, it likely can be for species whose range is extremely restricted.

7.5.4 Alien invasives

With increasing globalisation, free trade and tourism, natural barriers to species movements are being ameliorated or eliminated. Over 900 species of alien plants can be found within South Africa. Unfortunately, the South African environment is particularly prone to invasions and this has an adverse effect on biodiversity. Natural communities consist of a multitude of species and the sustainability of a community depends upon the interactions between species, climate and soil. Alien invasions disrupt this interaction and change the community. For instance, the introduction and establishment of plant invaders in complex multi-species plant communities upsets the intricate set of competitive balances that are in operation. This disruption often results in dominance by the invader over the other species. Over time the rich multi-species community is transformed into a species-poor community within a degraded environment. South Africa, as a signatory to the Convention on Biodiversity, makes the conservation of biodiversity a national commitment and therefore also the responsibility of every landowner, including government itself.

7.5.5 Climate change

A changing global climate threatens species and ecosystems. The distribution of species is largely determined by climate, as is the distribution of ecosystems and biomes. Climate change may simply shift these distributions but, for a number of reasons, plants and animals may not be able to adjust. The pace of climate change almost certainly will be more rapid than most plants are able to migrate. The presence of roads, cities, and other barriers associated with human presence may provide no opportunity for distributional shifts if no allowance has been made for biodiversity corridors in landscape planning.

7.6 Responses

7.6.1 Mainstreaming biodiversity into socio-economic agendas

Increasing numbers of people placing greater demands on the natural environment are compromising ecological integrity at an unprecedented rate. Mainstreaming biodiversity considerations into socio-economic agendas holds most promise to turn the situation around. Principally, it is necessary to:

- Integrate the protection and management of biodiversity resources with all human development by means of local, regional and national conservation initiatives;
- Build capacity in the areas of conservation assessment, taxonomy, green technology and knowledge transfer;
- Increase capacity in environmental law enforcement, management and education;
- Strengthen existing biodiversity conservation programmes to identify ecosystems, species and genetic resources that are at imminent risk of extinction; and
- Implement strong countermeasures to slow down the speed with which the loss of biodiversity occurs.

7.6.2 Mainstreaming biodiversity into land use planning in the NMBM

Recognising the need to mainstream biodiversity in land use planning and decision-making on the municipal level, NMBM has developed the NMB MOSS Conservation Action Plan (WESSA & NMBM 2008). The purpose of this Action Plan is to ensure the incorporation of the NMBM MOSS Spatial Biodiversity Plan into the municipal planning process and to safeguard and enhance the NM MOSS through interventions and cooperative government, as well as civil society involvement and mobilisation.

NMB MOSS VISION

A sustainable and representative conservation network that allows the people of NMBM to enjoy their natural heritage, contributes to a clean and healthy living environment and provides functioning ecosystem services for the long-term social, economic and environmental prosperity of Nelson Mandela Bay.

This well articulated Action Plan spells out the vision for the NMB MOSS, from which three strategic objectives are derived, namely (1) *the management of the NMB MOSS for public enjoyment and biodiversity conservation* though (2) *the development and implementation of appropriate plans, tools and interventions* for (3) *adequate conservation network protection and enhancement*.

For sound environmental and practical reasons, in the NMB MOSS Conservation Action Plan (WESSA & NMBM 2008) interventions to safeguard NMB MOSS have been clustered into 28 implementation sites. Specific actions that need to be undertaken have been identified in the Action Plan. The challenge is now to bring these actions to fruition.

8 THEME: RIVERS, ESTUARIES & COAST

8.1 Introduction

8.1.1 Scope

This theme considers the quality and quantity of water as part of an integrated aquatic system, as well as the dynamics of the catchments from which the various rivers flow. Coupled to this is the coastal system and the impacts associated with it. For the purpose of this report, the coast comprises the coastal waters as far as they are influenced by land and land-associated activities, the sea shore, which is the area between the low and high water marks, and the coastlands, which are inland areas above the high water mark that influence or are influenced by their proximity to coastal waters.

8.1.2 Rivers

The Nelson Mandela Bay Municipality has 11 influential rivers and streams (Figure 25). Two of the rivers, the Sundays and Van Stadens Rivers, border the NMBM on the east and west respectively. Of the 11 rivers, the major influence on Algoa Bay stems from the Swartkops, Papenkuils and Baakens Rivers. While the Coega River (62 km) is the longest river within the NMBM boundaries, the Swartkops River (second longest) and a small section of the Sundays River estuary are considered to be the most influential in terms of the services they provide and their degree of intactness.

The Swartkops catchment is approximately 1 555 km² and is bordered on the north and west by the Groot Winterhoek Mountains and rapidly descends to the coastal plains of Port Elizabeth. The catchment consists of four tertiary sub-catchments. The river system consists of two main (Elands and Kwazunga rivers) and two subsidiary tributaries (Brak and Chatty rivers) (Institute for Water Research *sine anno*). The length of the Swartkops River within the NMBM boundary is 54 km.

The Sundays River is a major system within the Eastern Cape, supporting a number of farms with its water all the way from its origins in the Compassberg Mountains near Nieu Bethesda. The river is 250 km long. Only 24 km of the lower section of the Sundays River falls within or borders the NMBM boundary.

The Papenkuils River has a much smaller catchment area of approximately 600 km² and enters Algoa Bay approximately 8 km north of Cape Recife (Watting & Emmerson 1981). For the last 3 km of its course, the river flows through the industrial areas of North End and Deal Party and for this entire section the river bed and banks have been canalized with concrete. The urban areas of Gelvandale and Algoa Park, together with one municipal rubbish dump, are situated at the head of the river, while industrial effluents contribute to the flow in the region of the mouth.

The mean annual runoff for all river catchments within the NMBM is approximately 150 · 10⁶ m³ (Goudie 2006). The only serviceable water resource within municipal boundaries is the Groendal dam in the extreme west. Dams and their importance for NMBM's water supply are discussed under the Theme Bulk Services: energy, waste & water.

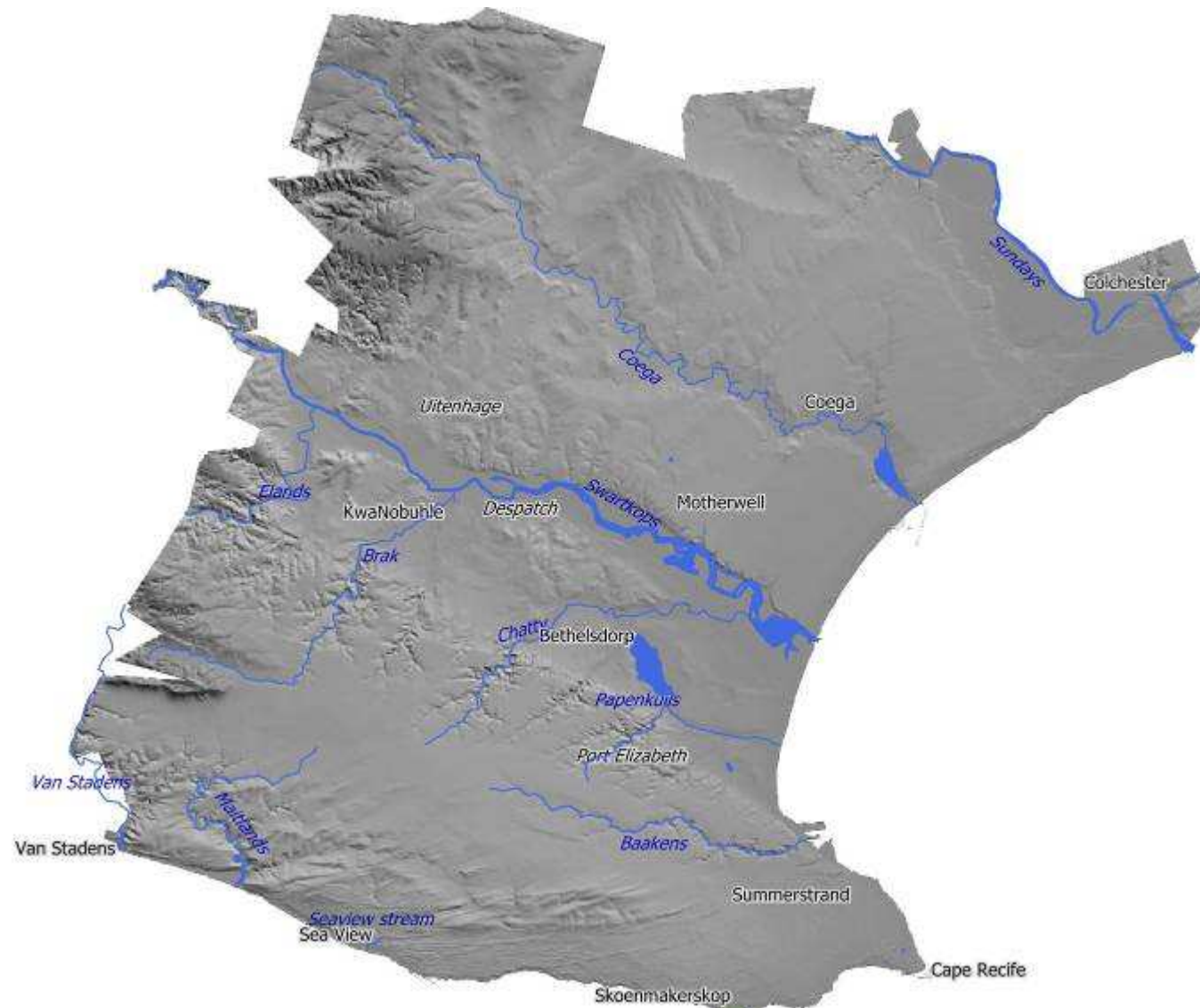


Figure 25. The rivers and major streams in the NMBM.

8.1.3 Groundwater resources

Alluvial deposits occur principally along the flood plains of the Sundays, Gamtoos and Swartkops Rivers. The aquifer consists of an assemblage of unsorted boulders, pebbles, sand and clay (<http://www.dwa.gov.za/Groundwater/maps/pebrochure.pdf>). The borehole yields range from 0.1 - 15 $\text{l}\cdot\text{s}^{-1}$. The overall average borehole yield is slightly above 2.9 $\text{l}\cdot\text{s}^{-1}$ (Shahin 2002).

8.1.4 Coast

NMBM's remarkable diversity of landscapes includes the coast. The NMBM coastline extends for some 90 km of the Indian Ocean between the mouths of the Sundays and Van Stadens Rivers in the east and west, respectively. The NMBM thus straddles the two large, half-heart shaped bays of Algoa and St Francis that are separated by the headland of Cape Recife. Their surf-swept sandy beaches interspersed with rocky outcrops vary widely in physical form owing to the combined effects of coastal orientation relative to prevailing winds, deepwater swell and sheltering by headlands.

The most exposed coastal stretches are those areas where the waves approach the coast normally (i.e. at a right angle). This occurs on the sandy beaches between the Van Stadens and Maitland Rivers, and also westwards towards the Gamtoos River outside the municipal boundary. The rocky wave-cut platforms east of Maitland up to Cape Recife are also very exposed, although local sections may be more sheltered as a result of offshore reefs, for instance Sardinia Bay. People speak of the western side as the 'wild side'. This is as much a reflection of the prevailing wind and wave conditions as it is an expression of the relative lack of human development on that side of the coast. For a long period Schoenmakerskop was the only village of note. During the 1980s and 1990s Kini Bay, Beachview and Seaview have attracted large numbers of new permanent residents and seasonal visitors, transforming the erstwhile tranquil small villages into suburbs with a vibrant momentum of growth and concomitant pressure on the coastal environment. Most of the 400 residential erven at Blue Horizon Bay have now been developed. The village was placed into the dunes halfway between the Van Stadens and Maitland Rivers with little concern for the sensitive environment in the late 1970s and early 1980s.

The town of Port Elizabeth owes its existence to the shelter from the major oceanic swells approaching from the south. Until the 18th century this was the only safe anchorage along the southeastern Cape coast. Adding to the safety is the gradual shelving of the nearshore beach profile. Accordingly Port Elizabeth's protected bathing beaches are situated here, offering a perfect combination of warm water, calm sea and fair breezes. These include Pollock Beach, Hobie Beach, Humewood Beach and Kings Beach. The heart of Port Elizabeth is bisected by Settlers Park and the small Baakens River, which discharges into the harbour.

North of the harbour the degree of shelter decreases as the alignment of the coast reapproaches the east-west orientation. The construction of the Port Elizabeth harbour caused an immediate decrease in the amount of sand supplied to New Brighton beach, thereby accelerating littoral erosive forces between the harbour and the Swartkops River (Heydorn 1986, Klages 2009).

Eddy currents occurring around the Swartkops River mouth together with the river's sandbanks lend some shelter to Bluewater Bay beach. Along the beach from the

Swartkops, past St Georges Strand and past the Coega valley towards Sundays River mouth the salient features of the coastline are the vast stretches of sandy beaches backed by extensive dune fields. Since the early 2000s the new deepwater Port of Ngqura and its associated Coega Industrial Development Zone have been built here.

8.1.5 Islands

Algoa Bay contains seven islands falling into two groups: the Islands of the Cross (St Croix group) and the Bird Islands. The islands serve as breeding, nursing and roosting grounds for large numbers of seabirds and marine mammals. According to BirdLife International (2009) these islands are of considerable importance as they are the only islands along a 1 777 km stretch of coastline between Dyer Island near Cape Agulhas and Inhaca Island in Mozambique. The combined surface area of these islands is said to be 40 hectares (BirdLife International 2009). The islands are closed to the public and managed as National Parks.

8.1.6 Local oceanography

The most prominent oceanographic feature of the region is the Agulhas Current that carries warm tropical water south-westwards past the south coast of South Africa. (Klages *et al.* 2003). Under the influence of the predominately westerly winds, irregular influxes of Agulhas water enter the sheltered Algoa Bays with the associated warm-water fauna, especially in winter (Klages *et al.* 2003). Average surface temperatures vary from about 15 °C in August to 20 °C in February (Schumann *et al.* 1995). Wind-induced upwelling, associated with easterlies may result in sea temperatures dropping as low as 14°C in summer (Schumann *et al.* 1982, 1988). The inshore, northeastward trending littoral drift counter current carries sand along the coastline, eroding it at some places and depositing sand at others to form new beaches. Apart from these major currents there are smaller rip currents and backwashes along the coast that can differ from day to day.

8.1.7 Living resources

The Agulhas Bank is of high biological importance. Along this coast vigorous phyto- and zooplankton production supports commercially exploitable concentrations of epipelagic shoaling fishes, such as Anchovy and Sardine, which in turn form the food base for a remarkable diversity and abundance of predatory fish, seabirds and marine mammals (Smale *et al.* 1994). Coupled with the abundance of shellfish, the richness in natural resources has attracted humans to these shores for hundreds of years. Estuaries not only provide a sheltered environment for breeding and juvenile marine fish species, but also provide a rich supply of food for summer migratory birds. Many bird species classified as of conservation concern are reliant on the estuaries for the provision of feeding and breeding areas.

8.1.8 Marine Protected Areas

The significance of the islands in Algoa Bay was acknowledged when they were formally protected as nature reserves during the 1980s and incorporated into the Greater Addo Elephant National Park (GAENP) in 2002. The Bird Island Group Marine Protected Area (MPA) was declared in 2004 to protect the marine environment and its biodiversity within its designated 450 hectare area.

In January 2009, a 20 km radius area was closed to purse-seine fishing around the world's largest African penguin colony at St Croix Island, Algoa Bay (Pichegru *et al.* 2010).

At Sardinia Bay Marine Protected Area no fishing is allowed between beacon PECR1 near Schoenmakerskop and beacon PECR2 near Bushy Park, extending one nautical mile seawards from the high-water mark.

8.1.9 Coastal tourism

The region is a popular tourism and recreational destination. Tourism is one of the larger economic sectors of NMBM. Although tourism contributes greatly to economic activity in the region, these activities are seasonal, with many visitors coming to the region only during the peak summer holiday season.

8.2 Drivers and pressures

The inland water resources are under severe pressure from diverse sources as detailed below.

8.2.1 Population growth and economic and urban development

Between 1996 and 2001 the population of the NMBM increased by 3.5%. In concert with population growth NMBM has experienced extensive economic development and urban expansion. The urban expansion and economic development in turn puts pressure on water services. One facet of economic and urban development has been the increase in housing project delivery. The Zanemvula Human Settlement Project to be rolled out in the NMBM is the biggest human settlement project in the Eastern Cape and one of the biggest in the country. The project will deliver approximately 15 000 units with basic social and economic amenities. In addition to this project are other low cost housing projects emerging from the National Reconstruction and Development Programme (RDP). Together with the National Water and Sanitation Programme they have contributed to increased water demand. As an illustration of increasing water demand, NMBM water usage increased from 89 751 Mℓ/a in 2006, to 10 1452 Mℓ/a in 2009, which equates to a 12% increase in demand. A further pressure on the water resource as with most coastal towns and metropolitans is the influx of tourists over the holiday season, introducing a spike in water demand.

8.2.2 Industrial activities

Industries consume water and are often sources of pollution. Economic expansion in South Africa, together with favourable export markets, has led to an increase in the number of industries in the country. The major industrial drive comes from the Coega Industrial Development Zone. This massive project has already changed the Algoa Bay landscape. The harbour is situated at the mouth of the Coega River which has now drastically changed. The increase in storm water runoff will have major effects on what enters Algoa Bay.

8.2.3 Agriculture

Agricultural activities are known to not only compromise water quality by abstraction but also its contribution of nutrients that eventually leads to eutrophication of freshwater systems.

8.2.4 Alien invasives

Alien invasive plant and animal species, introduced by human actions either accidentally or for commercial purposes, are proving a major threat to the quality and quantity water, as well as to the biodiversity of freshwater systems.

By stabilising sand dunes and disrupting natural sand transport along the coast, the presence of invasive alien plants (notably Rooikrans *Acacia cyclops* but also many others) have altered coastal habitats resulting in loss of biodiversity.

Industrial ports and yacht harbours are well recognised as having numerous impacts on the marine environment. One of these impacts is the introduction of alien (invasive) organisms through ballast water release and hull fouling. Many ecologists consider alterations caused by invasive alien species to biological diversity as a threat second in impact to habitat destruction. This threat is growing daily with the accelerated rate of species' movements through trade, transport, travel and tourism. Their effects are exacerbated by global change, and chemical or physical disturbance to species and ecosystems. Every alien species that becomes established in a new environment alters the composition of native biological communities in some way. These alterations can disturb the structure and functioning of the invaded ecosystem and have profound socio-economic impacts.

8.2.5 Climate change

Even without climate change, it is predicted that, within a few decades, South Africa will be using up most of its surface water resources. The most significant impacts of climate change on water resources are the potential changes in the intensity and seasonality of rainfall. While some regions may receive more surface water flow, future problems are likely to include water scarcity, increased demand for water, and water quality deterioration.

Climate change may also alter the magnitude, timing, and distribution of storms that produce flood events. Arid and semi-arid regions, which cover nearly half of South Africa, are particularly sensitive to changes in precipitation, and desertification, which is already a problem in South Africa, could intensify.

Coastal areas are prone to threats from natural causes such as tidal surges and sea-level rise. The influence of climate change on ecosystem functioning is unknown. Climate change may induce regime shifts (e.g. sardines to anchovies), or result in radical changes to the recruitment success of certain species. The location of South Africa at mid-latitudes and at the confluence of two major ocean current systems makes the whole ecosystem vulnerable to large-scale climate changes. This is in some way mitigated by the opportunistic nature of many of the key organisms present, which are highly adaptable to changed circumstances.

8.2.6 Modification of freshwater runoff

Development within the catchments of the rivers and estuaries has negatively affected the dynamics of these alluvial landscapes and has modified the natural sedimentation patterns that determine the nutrient and energy flows in coastal areas. The situation is exacerbated by water abstraction and impoundment (dams), as well as the presence of alien invasive vegetation, which have reduced freshwater runoff into the estuaries and have modified river flow. The scarcity of fresh water could be a constraint on future development options.

8.2.7 Overfishing and poaching

South African marine resources are intensively harvested at present, both by boat-based fisheries and from the shore where linefish populations are severely threatened by (legally licensed) recreational fishermen. Community-supporting resources of the coastal environment are in many places under severe threat from poaching. Studies on the ecosystem effects of fishing have identified severe impacts on the ecosystem health. These include substrate damage by trawls, removal of selected components, the non-sustainable utilisation of resources due to illegal activities or under-reported catches, by-catch mortality and dumping, incidental mortality of associated bird and mammal predators, and insufficient food for predators.

8.2.8 Marine pollution

Marine-generated litter and petroleum-based pollutants spoil bathing beaches. Some oil spills have had disastrous consequences for seabirds.

Marine outfalls discharging stormwater runoff from hardened urban areas (e.g. Papenkuils River and Baakens River) affect nearshore water quality through petrochemical pollutants and heavy metals that they contain.

Stormwater runoff from coastal cities is an extremely important yet underrated source of pollution for the marine environment. Apart from the visible forms of pollution (e.g. plastic bags) that are washed into stormwater drains by rainwater and then discharged to the marine environment, the unseen contaminants are probably of far more importance. Motor vehicles deposit various forms of pollutants on tarred roads through exhaust emissions and engine leaks. Two of the most important pollutants in this respect are oil and lead. When rain falls these contaminants are washed from the tar into the sewer and from there they end up in the sea with consequent negative impacts to the ecological functioning of this system. When pollutants accumulate within surficial sediment they can become toxic to benthic fauna, which can lead to developmental deformities and loss of reproductive capacity. Moreover, these pollutants can be passed on and magnified in the food chain when eaten by a predator. Such magnification can have disastrous effects, including the incomplete development of eggshells of birds (De Kock & Randall 1984) and increased susceptibility to disease in marine mammals (Cockcroft *et al.* 1991).

8.3 State

8.3.1 Physical state of NMBM coast and inland waters

The NMBM has a coastline of approximately 116 km stretching from the Sundays River in the east to the Van Stadens River in the west. Besides the aforementioned rivers there are a number of streams and rivers discharging into the bay and the south coast. With most of the urban/industrial area concentrated in the east or along the bay, it comes as no surprise that the rivers and streams draining from this side of the metropole have the worst water quality. The most influential of these are the Swartkops and Papenkuils Rivers.

The longest rivers in the metro are the Coega and the Swartkops Rivers. The Swartkops River has a higher flow though as the Coega River flow is sub-surface for most of its length. The Coega River has also proven not to be as resilient as the Swartkops River. The Swartkops River, despite its over-exploitation through abstraction and the concentration of industrial and urban activities along its banks, has somehow managed to maintain some ecological functioning and relatively high productivity.

The Papenkuils River, which is also known as smelly creek by many local residents, is perhaps the best example of a river in the NMBM that has been abused and exploited to the most extreme extent. As mentioned above, this is mainly due to the industrial activity along its banks that has caused the river course to be diverted and long stretches of its banks hardened to accommodate stormwater discharges, roads and effluent discharge.

Another example of a river that is ecologically damaged, perhaps beyond any significant rehabilitation, is the Chatty River. The Chatty River is the fourth longest river with its entire length contained within the borders of NMBM. In contrast to the Papenkuils River, the Chatty River's biggest problem arises not so much from industrial activity and the formal discharges of storm water and effluent, but from the large number of informal settlements that have been established along its banks. The major effect of the informal settlements derives from the lack of formal sanitation that leads to the discharge of raw sewage and litter into the river. The river is considered to be a major health risk by all local residents.

8.3.2 Conservation status of rivers in the NMBM

The latest available ecological assessment of the rivers in the NMBM is provided in Stewart (2009). According to the Conservation Assessment and Plan for the Nelson Mandela Bay Municipality, the Coega, Hume and Swartkops Rivers, as well as the Seaview Stream are no longer intact based on ecological status categories modified from Kleynhans (2000) and as defined in the Stewart (2009). Coupled to this, a further 59 tributaries to all the major rivers in NMBM are not intact.

Provision of an up-to-date index of the health of NMBM's rivers and estuaries is hampered by the absence of recent dedicated studies of scientists in the physical, chemical and biological disciplines. None of the NMBM rivers appear in the State of the Rivers Report that was generated by the River Health Programme for the Fish to Tsitsikamma WMA in 2007 (RHP 2007).

8.3.3 Change in land cover in the coastal zone

With reference to Chapter 2 of the Integrated Coastal Management Act (24 of 2008), change in land cover between 1997 and 2007 within 1 km of the high water mark was investigated. During the 10-year period the most conspicuous change from near-natural condition to full land transformation and substantial surface hardening occurred at Coega, where the Port of Ngqura was built at the estuary mouth and where the Industrial Development Zone was established. Minor changes in land cover occurred at Bluewater Bay, in Summerstrand, at Noordhoek, and through the expansion of the residential settlements of Beachview and Bluehorizon Bay in the west of the NMBM (Figure 26). The total change in the NMBM from near-natural to fully transformed condition during the decade amounted to +8.5%.



Figure 26. Change in land cover 1997 – 2007 in the coastal zone.

8.3.4 Number of Blue Flag beaches.

Blue Flag Awards, is a European-based campaign which measures beaches against strict environmental, tourist and safety standards. The Blue Flag is given to beaches that meet 14 criteria spanning three aspects of coastal management: water quality, environmental education and information, and safety and services, which include excellent life-saving standards, good parking and clean ablution facilities. The Blue Flag is awarded for one year only based on the performance of that beach during the previous season. Since South Africa joined the campaign in 2001, 26 South African beaches have been Blue Flag winners, 22 of these multiple winners.

Table 12. The criteria used to measure water quality for the Blue Flag beaches are as follows:

Department of Water Affairs & Forestry (DWAF) Quality Guidelines for Recreational Use (Second revision, 1996) (Applicable to freshwater)	Target guideline for full-contact recreation (i.e. total immersion) : <130 faecal coliforms per 100 ml
LUSHER (1984) Water quality criteria for the South African coastal zone. South Africa National Programmes Report No 94 (December 1984).	Faecal coliforms per 100 ml
	Max. 100 (50 % of samples)
	Max. 400 (90 % of samples)
	Max. 2 000 (99 % of samples)
SOUTH AFRICAN 'BLUE FLAG' CRITERIA (2001)	Faecal coliforms per 100 ml
	Guideline value: Max. 100 (in 80% of samples)
	Imperative value: Max. 2000 (in 95% of samples)

The Beach Office in Humewood is regularly testing water samples from the metro's beaches for the presence and concentrations of faecal coliform bacteria since December 2001. The counts are important for public health and for the maintenance of the Blue Flag status. The results presented in Table 13 show that water quality at Brighton Beach can be considered the worst of all the beaches in the NMBM. It boasts the highest number of days when its waters were above the recommended limits for faecal coliform counts in sea water as well as the highest average coliform counts for all the beaches evaluated. The likely cause of this is the heavily polluted Papenkuils Rivers. The other beaches with coliform counts above the recommended levels are Bluewater Bay, Maitland beach and Van Stadens beach. Beachview and Sardinia Bay beaches had the lowest coliform counts.

Surprisingly the Algoa Bay beaches had the lower average coliform counts compared to the beaches in the western region of NMBM (Table 13). This points at an unmanaged sewage discharge situation of the Maitlands and the van Stadens Rivers.

Table 13. Water quality according to coliform counts of the 12 main beaches along the NMBM coast.

Beach	No of days over the limit	Average levels	No of samples	Highest value
Wells Estate	5	90	69	2100
Bluewater Bay beach	7	135	53	2100
Brighton beach	16	1364	52	21000
Kings beach	7	57	73	1590
Humewood beach	2	33	73	1020
Hobie beach	5	49	73	1250
Pollok beach	2	19	72	430
Sardinia bay	0	13	30	60
Beachview	0	10	37	30
Beachview - tidal pool	1	26	33	380
Maitland	2	651	36	21000
Van Stadens	3	598	37	21000

8.3.5 River water quality

Water quality refers to the suitability of water for human consumption, for irrigation and for natural aquatic ecosystems. The term water quality describes the physical, chemical, biological and aesthetic properties of water that determine its fitness for a variety of uses and for the protection of aquatic ecosystems (DWAF 1996). Many of these properties are controlled or influenced by chemical constituents which are either dissolved or suspended in water.

Of all the rivers within the NMBM, only the Swartkops and Sundays rivers have a series of data that could be used to assess water quality. In fact even the Sundays River does not have any consistent monitoring within the NMBM boundary. The statistics presented below is for the Swartkops River and estuary only, where the concentrations of elements are similar to those of seawater due to tidal influence.

Chloride

The chloride levels at Settlers Bridge on the Swartkops Estuary (20 011 mg/l) and in the Chatty River (26 647 mg/l) near the Bethelsdorp/Veeplaas area had concentrations above the DWAF (1996) recommended limits for freshwater systems. At chloride levels greater than 1 200 mg/l, the water becomes unacceptably salty. In humans, if the water was consumed, nausea and disturbance of the electrolyte balance may occur, especially in infants, where fatalities due to dehydration are highly likely. Chloride levels at the Yacht Club at Redhouse, Swartkops River was also slightly above the recommended limit. The high chloride levels observed at the three locations are caused by tidal action pressing seawater upstream.

Fluoride

Fluoride levels at all the stations are well below the 1.5 - 3.5 mg/l threshold for marked dental mottling with associated tooth damage due to softening of enamel. At fluoride

levels greater than 100 mg/l acute fluoride poisoning may occur, marked by vomiting and diarrhoea.

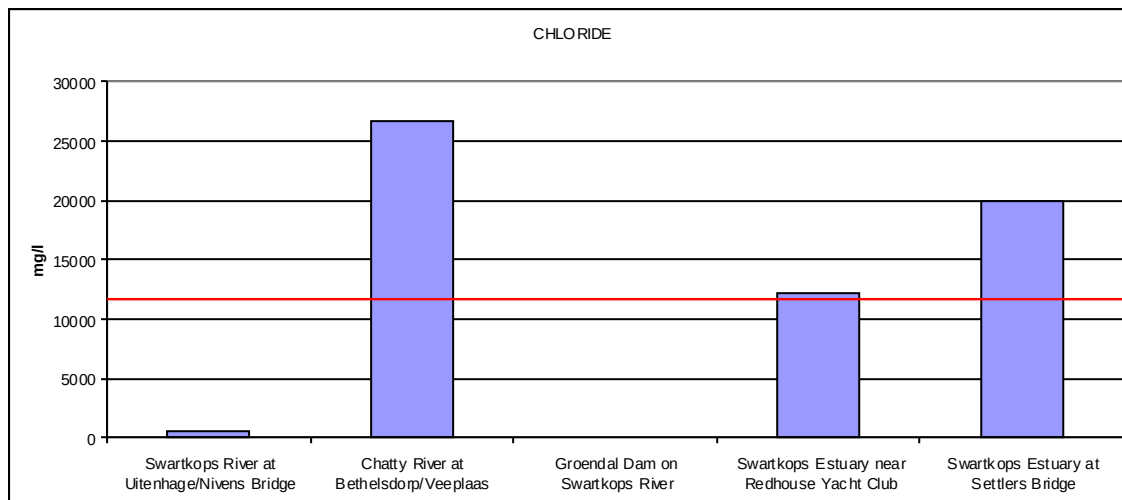


Figure 27. Water quality of the Swartkops River: chloride. The red line represents the DWAF water quality limit at which health risks come into effect.

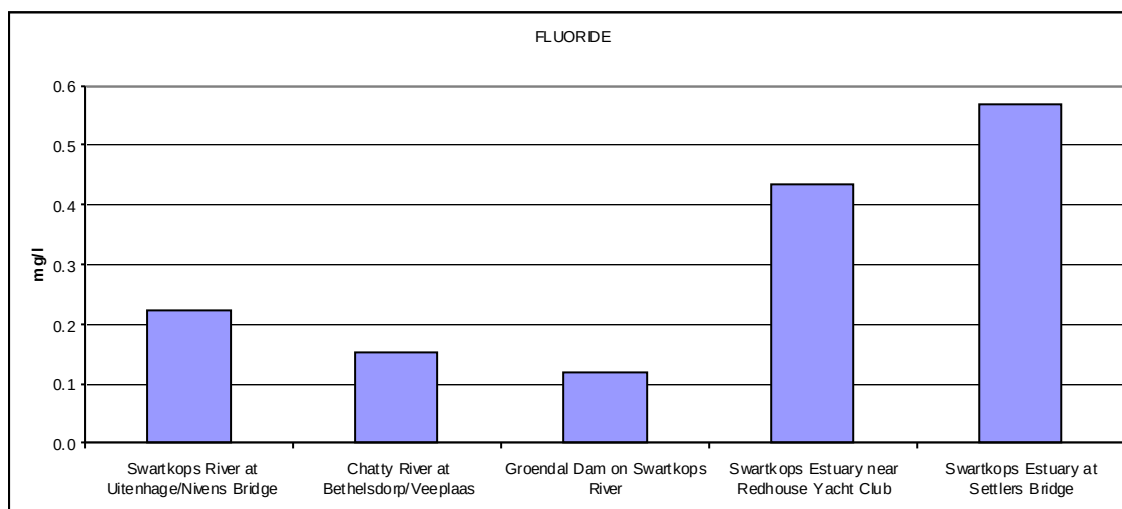


Figure 28. Water quality of the Swartkops River: fluoride.

Potassium

Once again the sites at Chatty River, Redhouse and Settlers Bridge had potassium levels above the safety levels as recommended by DWAF (1996). The potassium concentrations at these three sites are 587.9 mg/l, 317.6 mg/l and 370.1 mg/l respectively. The dangers associated with these levels are that besides the bitter taste associated with the water, these are also dangerous concentration for infants and persons with renal disease.

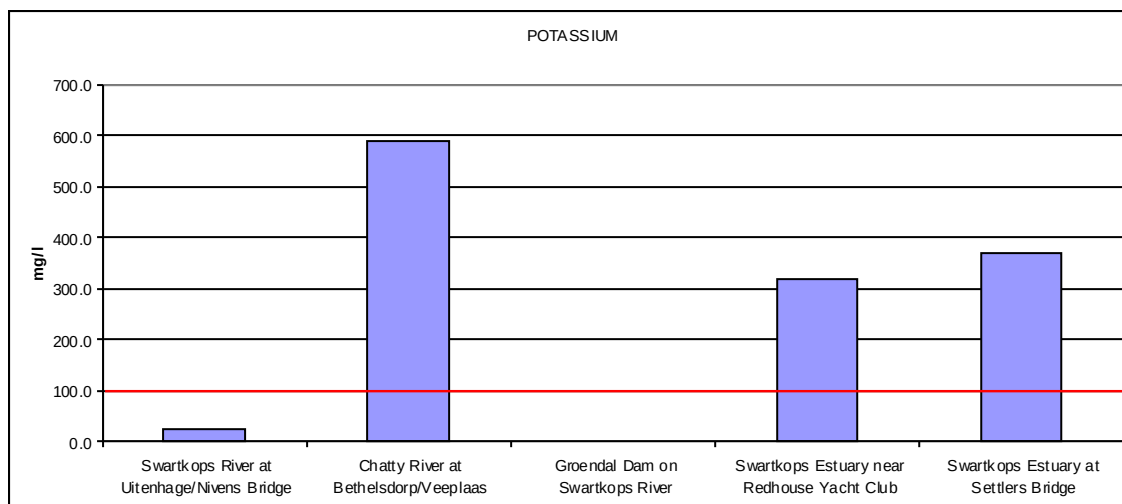


Figure 29. Water quality of the Swartkops River: potassium. The red line represents the DWAF water quality limit at which health risks come into effect.

Sodium

Sodium levels are once again highest for the above three sites. At concentrations way above 6 000 mg/l, individuals may experience severe health effects with disturbance of electrolyte balance. Nausea and vomiting is likely. At these levels the water becomes extremely undesirable for infants or persons on a sodium-restricted diet.

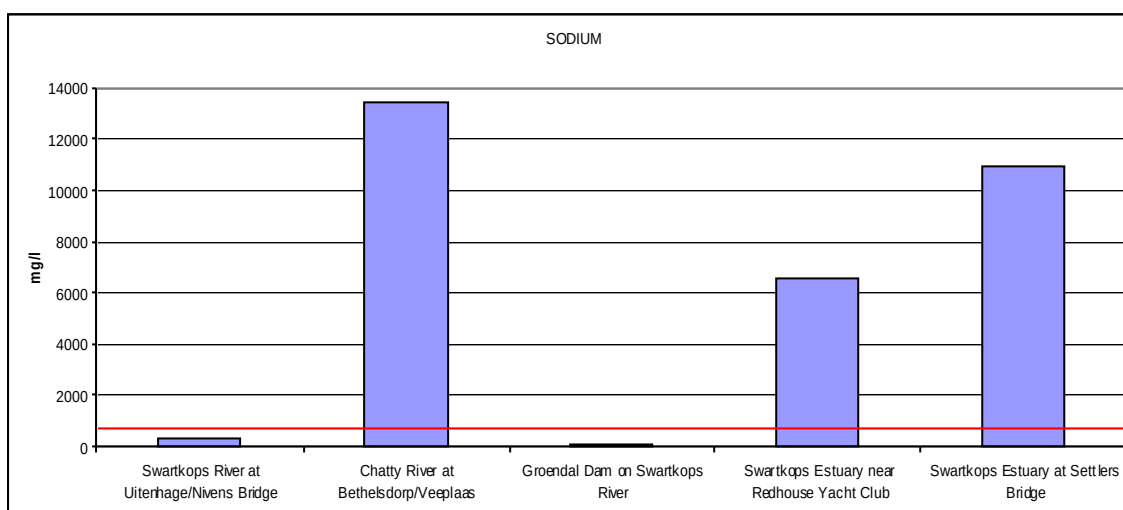


Figure 30. Water quality of the Swartkops River: sodium. The red line represents the DWAF water quality limit at which health risks come into effect.

Sulphate and magnesium

For sulphate and magnesium, the Chatty River, Redhouse and Settlers Bridge had the highest levels for both species. At sulphate levels above 1 000 mg/l individuals may suffer from diarrhoea. Similarly, magnesium levels in excess of 400 mg/l as found at these three sites may cause severe scaling and diarrhoea.

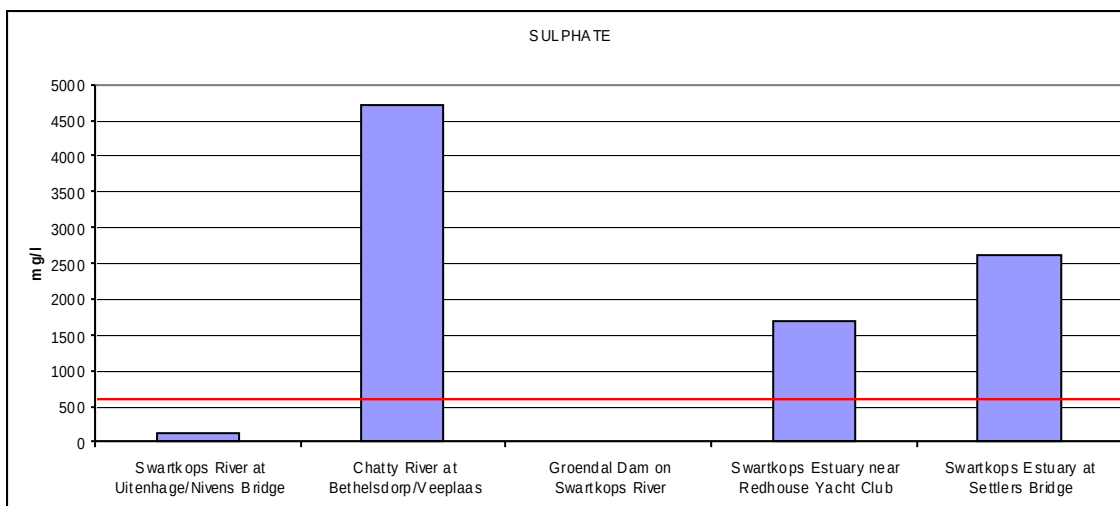


Figure 31. Water quality of the Swartkops River: sulphate. The red line represents the DWAF water quality limit at which health risks come into effect.

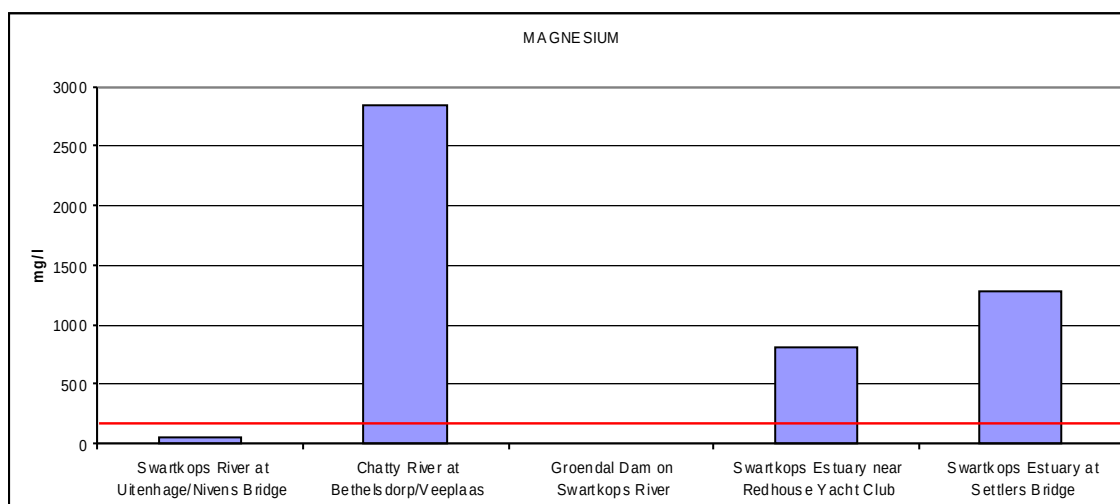


Figure 32. Water quality of the Swartkops River: magnesium. The red line represents the DWAF water quality limit at which health risks come into effect.

Nitrate

Nitrate levels at all sites are below the threshold levels at which any adverse effects may occur.

pH

The pH levels at the sites are well within expected levels. Toxic levels are expected at pH below 6 and above pH 9. At these pH proteins may become denatured or otherwise benign elements may become toxic.

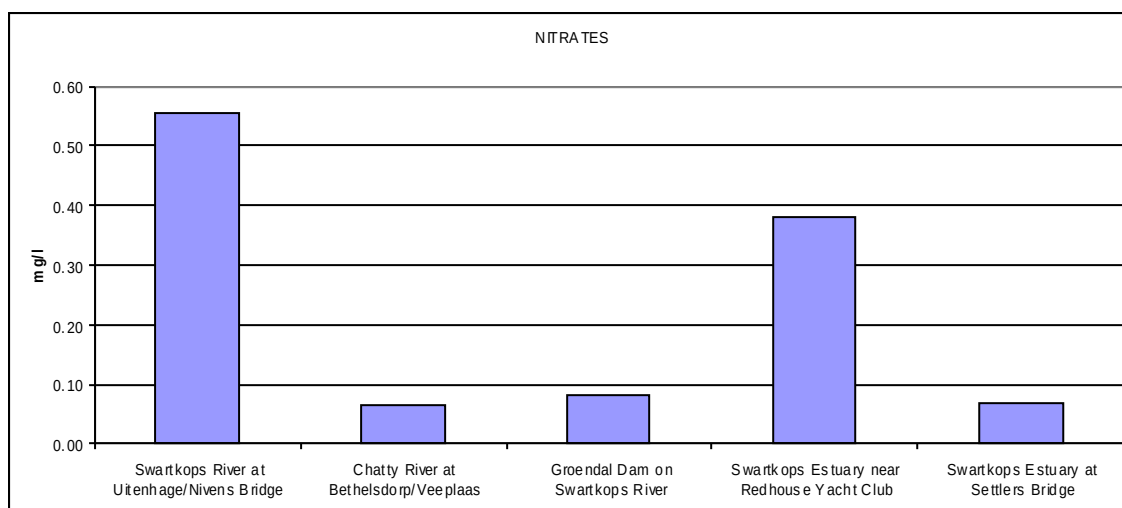


Figure 33. Water quality of the Swartkops River: nitrate.

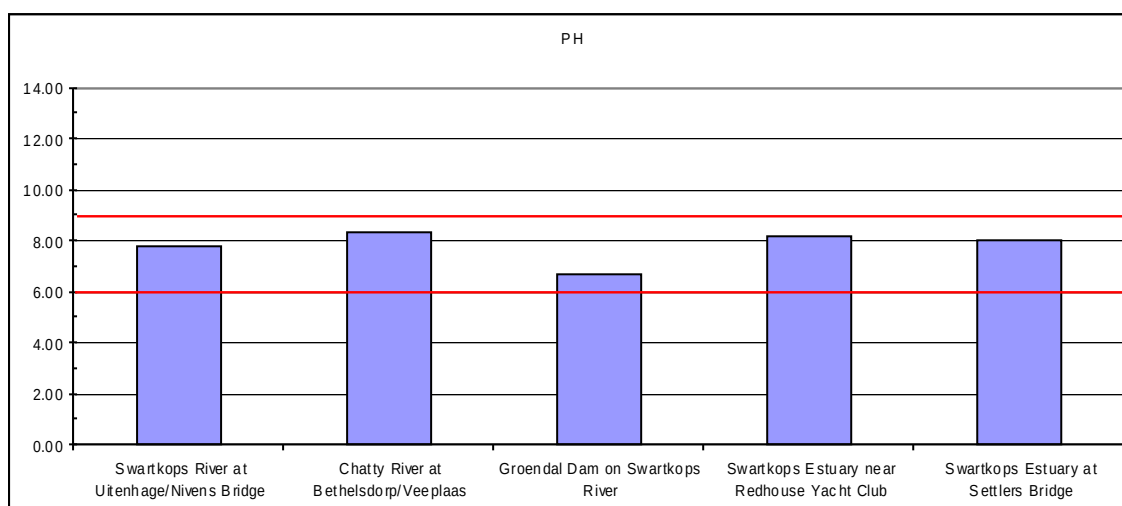


Figure 34. Water quality of the Swartkops River: pH. The red lines represent DWAF water quality limits at which health risks come into effect.

In summary, the water of the lower reaches of the Swartkops River is not suitable for human consumption.

8.3.6 Degradation pressures

There are other physical effects associated with the state of NMBM rivers that have water quality consequences. These are defined as degradation pressures and refer to the state of a river in terms of the levels of development on its banks and other anthropogenic pressures, like water abstraction and introduction of alien species. Half of the metro's rivers have sections of their catchments hardened, modifying runoff and infiltration. This increases the risk of flooding during heavy rains and reduces the ability of nutrients and other elements to be assimilated in the system.

Table 14 shows that alien invasion and pollution is by far the largest contributor to river degradation in the NMBM. Most of the rivers have multiple anthropogenic pressures exerted upon them and hence the cause for being degraded with the exception of the Baakens, Papenkuils and Brak rivers. While the Baakens and Papenkuils would have specifically one or two impacts that have influenced their ecology immensely, the Brak River may genuinely be the least degraded river in the NMBM.

Table 14. Degradation pressures

Degradation pressure	River and wetland environmental state	Affected Rivers									
		Van Stadens	Maitlands	Baakens	Papenkuils	Chatty	Brak	Elands	Swartkops	Coega	Sundays
Catchment hardening through urban development	Catchment hardening modifies runoff into rivers, with reduced infiltration, greater risk of flooding during heavy rains, and reduced base flow in the drier seasons.			X	X	X			X	X	
Increased number of storage dams	Storage dams interrupt the natural flow regimes of the river, as well as ecosystem and geomorphological processes along the river channel.	X	X					X	X	?	X
Over-abstraction	Over-abstraction reduces the availability of water for ecological processes in the river. It also modifies the natural flow regime, reducing the habitat suitability for in-stream organisms. Reduced flows also threaten the integrity of estuaries at the river mouth.	?	X			X	?	X	X	X	X
Invasive alien plants	Invasive aliens occupy riparian zones, invade wetlands, and choke up tributaries. In so doing, they modify the runoff characteristics of the catchment, out-compete natural vegetation, reduce the habitat available to aquatic organisms and cause deep erosion of river channels and banks.	X	X	X	X	X	X	X	X	X	X
Presence of alien fish	Invasion by exotic species reduce the population of indigenous fish.	X	X				?	?	?		?

Degradation pressure	River and wetland environmental state	Affected Rivers									
		Van Stadens	Maitlands	Baakens	Papenkuils	Chatty	Brak	Elands	Swartkops	Coega	Sundays
Poor agricultural practices	Draining of wetlands for ploughing reduces the ability of a catchment to act as a sponge, absorbing excess water during heavy rains, and releasing it slowly during drier periods. Overgrazing reduces water infiltration in the river catchment.	X	X			X	X	X	X	X	X
Pollution (fertilizer and pesticide runoff, runoff from roads and informal settlements, runoff from feedlots, industrial and domestic discharge).	Pollution modifies the water quality of natural aquatic systems. This results in algal blooms and excessive growth of certain vegetation types. This modifies ecosystem interactions within the aquatic environment. Some aquatic species such as the stone-fly (Plecoptera) are directly threatened by changes in the chemical and physical properties of water.	X	X	X	X	X	X	X	X	X	X

8.4 Indicators

The indicators to assess the state of rivers, estuaries and the coast of Nelson Mandela Bay, as determined in GIBB (2009), are listed below.

- Length of river, estuaries.
- Shoreline and islands under formal protection.
- Conservation status of rivers in the NMBM: reported from the State of the Rivers Report (NSBA) as near-threatened, vulnerable, endangered, etc.
- Estuarine Health Index.
- Number of Blue Flag beaches.
- Percentage water samples that meet Blue Flag quality standards
- Trends in commercial fish catches landed in the port of Port Elizabeth.
- Land cover change in the littoral active zone.
- Locations of marine outfalls.
- Houses at risk in the 50 year flood line for the metro's major rivers.

Quantitative data for three indicators could not be provided. Specific catch statistics for Port Elizabeth are not available. Although locations of the marine outfalls for the waste treatment works are known, there are many more stormwater outlets discharging into the sea. Flood lines for the majority of rivers in the NMBM are not documented.

8.5 Impacts

The state of inland and coastal water resources has a number of impacts for the Nelson Mandela Bay Municipality.

8.5.1 Availability of water

Changes in flow regime due to degraded wetlands, overgrazing, catchment hardening and alien invasion means that there are more floods in the wet season and reduced base-flow in the dry season. A large proportion of the mean annual runoff of a river flows to the sea as floods, reducing the year round availability of water for human use. In response managers have to build more storage dams at great expense, which further impacts the natural integrity of not only the river system but also other associated systems.

8.5.2 Cap on economic and agricultural expansion

The current over-abstracted state of rivers in NMBM implies that economic developments which require bulk water (e.g. Coega IDZ) could become limited. Furthermore the limited availability of water is likely to lead to changes in irrigation methods, a conversion to less water-intensive farming and more efficient use of water by the industrial sector.

8.5.3 Greater vulnerability to droughts and floods

The NMBM has effectively reached its carrying capacity in terms of water availability. Exceeding the carrying capacity of water reserves has led to serious water shortages during drought years. In contrast, the increased likelihood of flooding due to catchment degradation could threaten marginal communities and developments in low-lying areas.

During the compilation of this report, the NMBM was declared a disaster area due to a long period of drought and the overexploitation of its freshwater resources.

8.5.4 Loss of ecosystem goods and services

A healthy and intact river and associated riparian ecosystem, wetlands and catchment provides numerous functions. It ensures moderate, year round flows, the break-down of pollutants and pathogens, and reduces suspended sediments, among others. These services reduce the cost of providing healthy potable water. The loss of these goods and services leads to poor quality water.

In 2010, the Redhouse River Mile swim, which takes place on the Swartkops River had to be moved to the Sundays River due to water quality concerns. This cost the event organisers a lot of money and inconvenienced many participants.

The National Spatial Biodiversity Assessment of 2004 (Lombard *et al.* 2004) identified nine major impact categories in the coastal zone. With the exception of mining, which is of no significance in the coastal parts of NMBM, the coastal impacts that are important nationally are also acting in this region. Table 15 summarises the impacts in the context of the responsible drivers and pressures.

Table 15. Impacts from environmental degradation in the coastal zone.

No.	Drivers	Impacts
1	Rampant coastal development, ribbon and leapfrog development	Job losses in the agricultural sector Increased cost of traffic Public transport and services infrastructure solutions Loss of biodiversity and conservation resources Loss of the scenic qualities of the NMBM coast, one of its main marketing features
2	Modification of freshwater runoff, catchment issues of rivers feeding estuaries	Change of natural sedimentation patterns Changes in estuary mouth dynamics Changes in nutrient and energy flows (e.g. salinity, temperature) Reduction in freshwater runoff Loss of biodiversity and conservation resources
3	Non-extractive recreational activities, incl. boating, offroad vehicles	Disturbance of breeding animals, e.g. waterbirds Litter pollution Noise Trampling of sensitive vegetation Increased fire risk Bow wave wake damage to estuary shores
4	Harvesting of marine living resources, fishing, by-catch mortality and dumping, poaching	Severely threatened linefish populations Critically endangered shellfish populations Deterioration of marine ecosystem health Substrate damage by trawls Substrate damage by prawn pumps Incidental mortality of associated bird and mammal predators Insufficient food for predators
5	Waste management practises	Litter pollution of beaches and estuary shores Deterioration of water quality Acute poisoning Oiling of seabirds Toxic effects in wildlife, fish and invertebrates Loss of scenic qualities
6	Alien invasive species	Disruption of natural sand transport patterns through alien plants Biodiversity losses Knock-on socio-economic impacts
7	Climate change, global warming, sea level rise	Flooding and destruction of coastal properties Regime shifts (e.g. Sardines to Anchovies) Radical changes to the recruitment success of certain marine species
8	Mariculture	Habitat loss Eutrophication Introduction of invasive species Spread of disease
9	Mining	Large amounts of top soil is removed in minor mining operations.

8.6 Links and inter-dependencies

Of the many inter-dependencies with key themes discussed in this report, two stand out: Biodiversity: as areas of great diversity of life, rivers, estuaries and the coast make a major contribution to NMBM's overall biodiversity.

Economics: coastal tourism contributes greatly to economic activity in the municipality.

Biodiversity - loss of biodiversity within inland water ecosystems constitutes a cumulative loss within the combined environment for the region.

Poverty - poor quality water affects livelihoods, while limited water availability is likely to constrain economic growth.

Urban Development – limited availability of water affects the ability of municipalities to provide potable water for urban development.

Health and Education – poor quality water, particularly water containing microbial pathogens, is likely to affect the health of people within the metropolitan.

8.7 Responses

8.7.1 Current responses

There are numerous national and regional initiatives aimed at improving the management of inland water:

- Working for Water: Working for Water is a national initiative driven by the Department of Water Affairs and Forestry to eradicate alien invasive vegetation in river catchments.
- Working for Wetlands: The Working for Wetlands Project undertaken by the South African National Biodiversity Institute, which focuses on the rehabilitation and wise use of wetlands in South Africa.
- River Health Programme: The River Health Programme assesses the biological and habitat integrity of rivers in order to identify areas of unacceptable ecological deterioration and to reflect the effectiveness of river management policies and actions. A State of Rivers Report has yet to be completed for this region.
- Ecological Reserve: The National Water Act of 1998 requires that water in a river be set aside for sustaining healthy river ecosystems.

8.7.2 Identified gaps

- Detailed data on coastal land use (including rivers and estuaries) and population density.
 - Lack of detailed river quality data for all the rivers in NMBM;
 - Lack of synthesised gauging weir statistics; and
 - Lack of detailed ground water quality data.
-

9 THEME: BULK SERVICES: ENERGY, WASTE & WATER

9.1 Introduction

This chapter will report on the state of bulk services in the Nelson Mandela Bay Municipality. These bulk services include the provision of energy (electricity), removal and disposal of all types of waste, and supply of water to water users in the metro.

Energy, in the broader sense of the word, not only refers to electricity, but includes the use of materials such as wood, coal, petrol diesel, paraffin, candles, and even animal dung. Electricity within South Africa is largely generated by coal-fired power stations. These power stations generate up to 79.7% of South Africa's power (SRK 2004). On a national scale, power stations are currently at capacity resulting in increasing pressure to utilise energy in an efficient and sustainable manner in local municipalities and metropolitan areas. The Eastern Cape Province does not have any capacity for power generation and must thus import all its power from outside its boundaries, mainly Gauteng and the Western Cape.

The recent shortages in energy supply in South Africa have again highlighted the need for forward planning in the energy sector. The value of energy planning has been recognised by some proactive municipalities, which have taken the first steps towards implementation. The Nelson Mandela Bay Municipality (NMBM) is the first municipality that developed a regional Integrated Energy Plan (IEP) in April 2006. Revision 2 of the EP was conducted in 2009 (NMBM 2009).

Waste includes solid waste, hazardous and medical waste, mining waste sewage, sludges, wastewater, effluent, ash, etc. The production of solid, liquid and hazardous waste is an unavoidable by-product of economic development and an increasing population in South Africa. Growth in the packaging and fast-food industry in South Africa, for example, has caused increased waste to landfill in recent years, contributing increasingly to poor air quality, poor public health, environmental pollution, and ultimately global warming. Illegal dumping is prevalent causing pollution to surface and ground water systems.

The availability of good quality potable water is vital in the survival of all living resources and systems. As with the natural systems, there is a large range of human activities that require safe and clean water. The availability of potable water for consumption and sanitation, amongst others, is thus a limiting factor in the improvement of people's health, alleviating poverty and promoting sustainable development. In 2004, the consumption of freshwater per capita was just over 1 200 kilolitres per person per year of available fresh water. As a result, South Africa is regarded as a water stressed country (CSIR 2004). It is thus imperative to take stock of the state of the water resources and service delivery in Nelson Mandela Bay in order to identify future needs and challenges with regards to water availability.

9.2 Drivers and pressures

The primary underlying driving force behind the pressures currently associated with the consumption of energy, utilisation of water resources and generation of waste in the Nelson Mandela Bay Municipality is economic development, population growth and migration of people to urban areas.

9.2.1 Energy consumption

Drivers associated with increased energy consumption include increased disposable income, urbanisation and migration of people, increasing vehicular traffic, and changes in the economic climate in the region.

- Increasing disposable income due to economic development in urban centres around the country causes changes in the consumption of energy. Economic growth also creates opportunities for employment, consequently attracting poor people from rural communities in search of employment and prosperity. This pressure has measurable impacts on housing availability and the local economic climate.
- Increasing the resident population in urban centres exerts pressure on the transport systems amongst others. Transport systems sways under further pressure as a result of the poorly developed public transport systems in South Africa. The consumption of energy South Africa, however, is very sensitive to changes in economic markets. Economic downturn conversely has a marked effect on energy consumption as industries and households take the precautionary approach to maintain their status quo. This has further knock-on effects generally manifesting in decreased consumption of electricity and fuel.
- The Government's Reconstruction and Development Programme (RDP) strives to supply all people with basic service including a dwelling and electricity. This results in a greater electricity demand putting greater pressure on the energy resources in South Africa. The reality, however, is that one quarter of South African city dwellers are considered to be living in "energy poverty" and unable to afford elevated electricity costs. Despite electrification, households continue to make use of fossil fuels, which pose health and safety risks to households.

9.2.2 Waste production

Drivers associated with increased waste production are similar to those listed above. More specific drivers related to waste production include increased commercial and industrial development, which translates to more waste being produced by the residential, industrial and commercial sectors. Increased housing in urban areas requires increased collection of household sewage and solid waste. Increased packaging for products typically results in more household waste. Lack of awareness towards waste minimisation, as well as real recycling incentives to waste generators, are contributing to sustained high levels of waste to landfill practises, and unscrupulous illegal dumping of solid waste.

9.2.3 Water services

Water services infrastructure, and quality and quantity of potable water in Nelson Mandela Bay are threatened by aging infrastructure, increasing tourism, residential and

industrial related water demand, pollution and alien invasive species. The Nelson Mandela Bay Municipality has spent large proportions of the water services budget during the last few years for repairing or replacing dilapidated or dysfunctional infrastructure. In the last decade, residential and industrial development has caused changes in the demand for available water supply in South Africa. Increasing tourism, especially during the build-up to the 2010 Soccer World Cup, has contributed to a high demand for water in urban South Africa. Pollution of water resources generally occurs through the runoff of organic and industrial effluent into water courses, and in some parts illegal dumping is fouling water sources. Alien invasive plant and animal species are also regarded as a major threat to the quality and quantity water resources in South Africa. Uncontrollable natural events such as floods and droughts are also important drivers influencing water availability, quality and quantity, and impacting on the management of all waste services.

9.3 State

9.3.1 Energy

The percentage of households using electricity for lighting, cooking and heating in the Nelson Mandela Bay Municipality increased notably since 2001 (Figure 35). The percentage of households using electricity for lighting, cooking and heating increased by 15.1, 20.3 and 15.4%, respectively (Stats SA 2008). The increased use of the electricity in households previously dominated by wood and paraffin has not been matched with new power generation, explaining the nation's current electricity crisis.

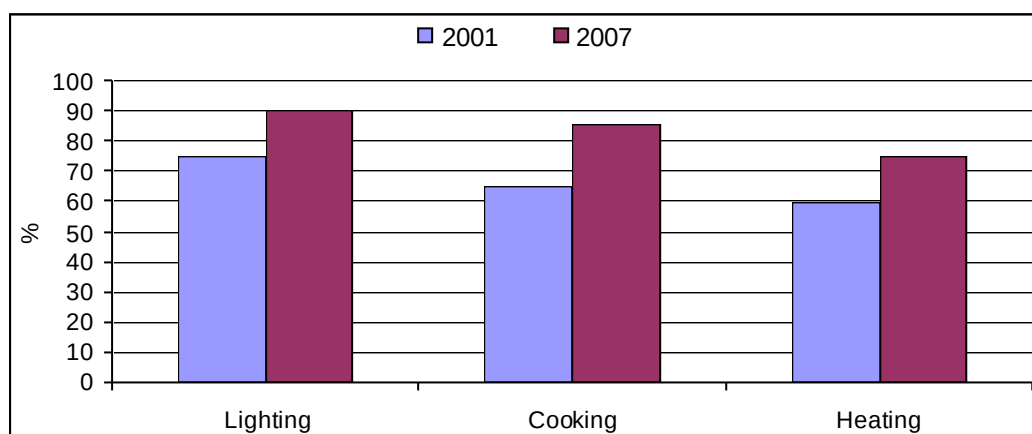


Figure 35. Percentage of households in the NMBM using electricity for lighting, cooking and heating.

Energy usage in the Nelson Mandela Bay Municipality was quantified during 2002, 2004 and 2007, and is presented in Figure 36. The main energy usage in the NMBM was experienced in the three main sub-sectors, namely the electricity, petrol and diesel sub-sectors. Electricity and petrol usage decreased slightly over time. Although percentage diesel usage is lower than the petrol usage, diesel usage showed a marked increase over time. Paraffin, coal/wood, heavy furnace oil (HFO), and liquid petroleum gas (LPG) showed either decreases in usage or remained stable (NMMM 2009).

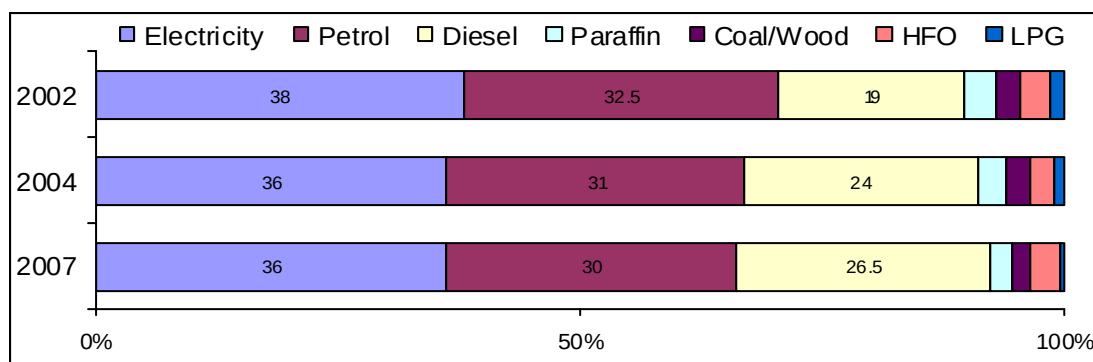


Figure 36. Energy usage by energy carrier type expressed as a percentage. Numbers in the bars represent actual percentage share of selected carrier types.

The dramatic growth in the demand for diesel in the last few years is largely the result of increased demand and production for diesel powered vehicles and the increased economic growth in the NMBM. If the growth in the consumption of diesel over the respective years is expressed in litres, it converts to a real increase of over 40% (NMMM 2006).

When the electricity usage per sub-sector is considered (Figure 37), the manufacturing and commercial industry uses the most electricity proportionate to the total electricity consumption in Nelson Mandela Bay (~ 59% year on year). Domestic usage and usage by local government (including losses) generally represented ~ 33% and ~ 8% of the total electricity usage. The losses included with local government usage represent technical and non-technical losses on the grid that are subsidised by the service provider, the NMBM.

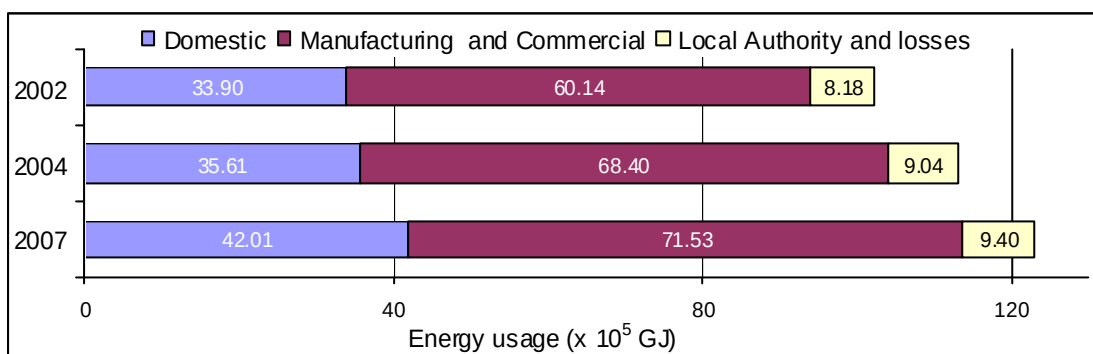


Figure 37. Electricity usage per sub-sector in the NMBM. Numbers in the bars represent actual energy consumption in Giga Joules.

The increased electricity consumption over time can be attributed to the boom in the housing industry and implementation of the government low cost housing policies. The electrification programme of NMBM has extended the network to more than 29 500 new low-income households during the period under review. Furthermore, the economic growth together with low interest rates stimulates the sale of household appliances and as a result more electricity is consumed. Although the total consumption of electricity increased over the period in question, the demand for electricity decreased slightly from

10.6 to 8.7%. This is attributed to the economic cool down that seemingly started in mid-2009.

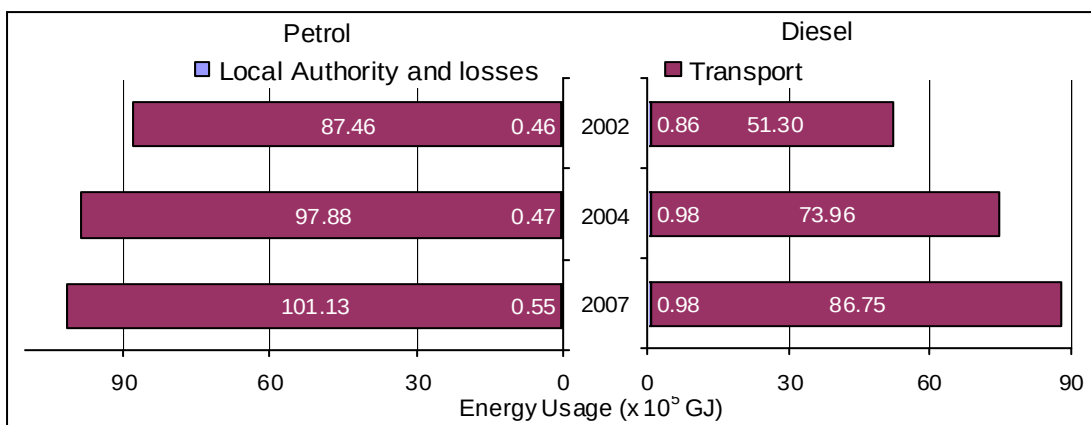


Figure 38. Petrol and diesel usage per sub-sector in the NMBM. Numbers in the bars represent actual energy consumption in Giga Joules.

Diesel and petrol are almost exclusively utilised in the transport sector (~ 99%), with the local authority consuming less than 1×10^5 Giga Joule per annum for each of the energy carriers (Figure 38). The consumption of diesel in the NMBM showed a sharp increase over the period in question, with the 2004 figures showing an increase of 44.2% since 2002. The 2007 consumption figures show a declining but still relatively high demand in diesel with an increase in consumption of 17.3% during the period. Although petrol also experienced year on year increase in consumption the 2004 and 2007 figures showed a moderate 11.9% and 3.3 % increase in consumption. The Nelson Mandela Bay Municipality (2009) believes that the increase in demand for petrol and electricity can be related to the increased economic growth in Nelson Mandela Bay.

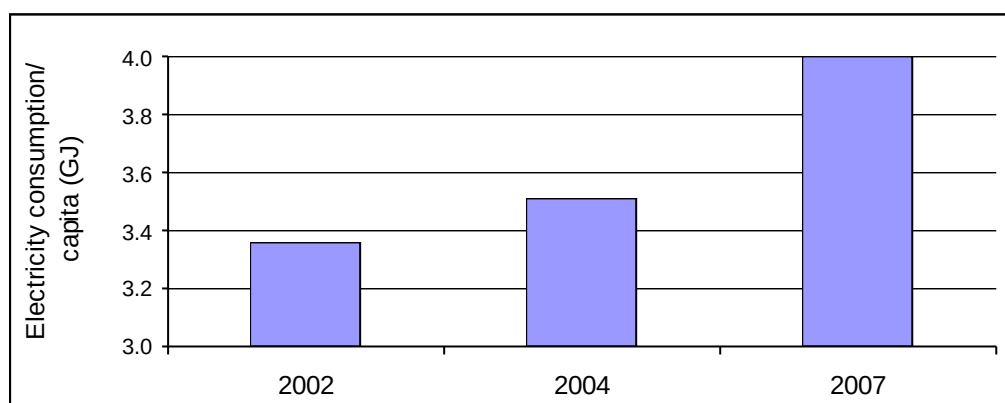


Figure 39. Average yearly electricity consumption per capita in the NMBM.

The average yearly consumption per capita in the NMBM has increased steadily over the period in question (Figure 39). This is expected given that the dependency of households on electricity in the NMBM for lighting, cooking and heating has increased over the period of interest.

The Nelson Mandela Bay Municipality is spearheading the installation of 60 000 to 100 000 solar heaters in medium to high income residences. NMBM is encouraging the installation of these solar heating units by subsidising a portion of the cost to make purchase more affordable.

9.3.2 Solid waste

Landfill sites

The Nelson Mandela Bay Municipality has in its service three permitted and operating waste landfill sites: Arlington, Koedoeskloof, and Aloes (Figure 41, Table 16). Arlington is a class G:L:B- landfill site, which means it is suited for general waste only. Koedoeskloof is a class H:h and can receive low hazardous liquid waste. Aloes is the only privately operated landfill site in the NMBM and is operated by EnviroServ. This landfill site is classed as H:H and is the only landfill site that can receive high hazard waste. There are 71 transfer stations scattered throughout the metro (Figure 41). Eleven of the transfer stations are privately owned, whilst the rest (60) are managed by the metro. The Nelson Mandela Bay Municipality conducts borehole monitoring and three-monthly stormwater monitoring. An audit report is produced every six months as part of the conditions of the permits.

Table 16. Attributes of landfill sites in the Nelson Mandela Bay Municipality

Landfill site	Arlington	Koedoeskloof	Aloes
Class	G:L:B-	H:h	H:H
Permit	Yes	Yes	Yes
Monitored	Yes	Yes	Yes
Owner	NMBM	NMBM	EnviroServ
Total lifespan (yrs) *	28	26	
Total lifespan remaining (yrs) *	28	26	
Existing disposal space remaining (yrs) *	28	7 (19)	

* based on a survey conducted in September 2007.

Currently, the Koedoeskloof landfill site only has 7 years existing available airspace at left at the present rate of waste inflow. The metro commissioned a complete stormwater design for Koedoeskloof. Therefore, once the final stormwater design has been approved and the site fully developed within the existing permitted area an additional 19 years lifespan will be available.

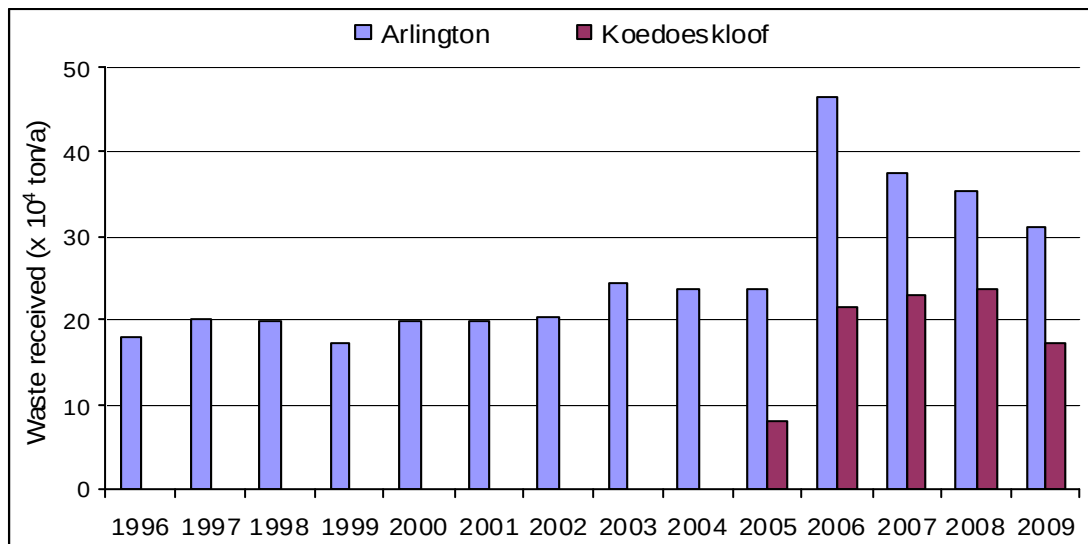


Figure 40. Total waste in tonnes received by Arlington and Koedoeskloof landfill sites.

The total amount of waste received by Arlington waste disposal site remained largely constant from 1996 to 2005, after which it increased drastically to 464551 tons in 2006 (Figure 40). The tonnage to landfill post 2006 has steadily been decreasing and has not yet reached levels prior to 2006. Waste to landfill at the Koedoeskloof landfill site are in the same range as the pre-2006 figures at Arlington, and is seemingly remaining constant. The Arlington tonnage in 1996 was measured over 10 months, and the Koedoeskloof tonnages for 2005 and 2009 over 6 and 10 months, respectively.

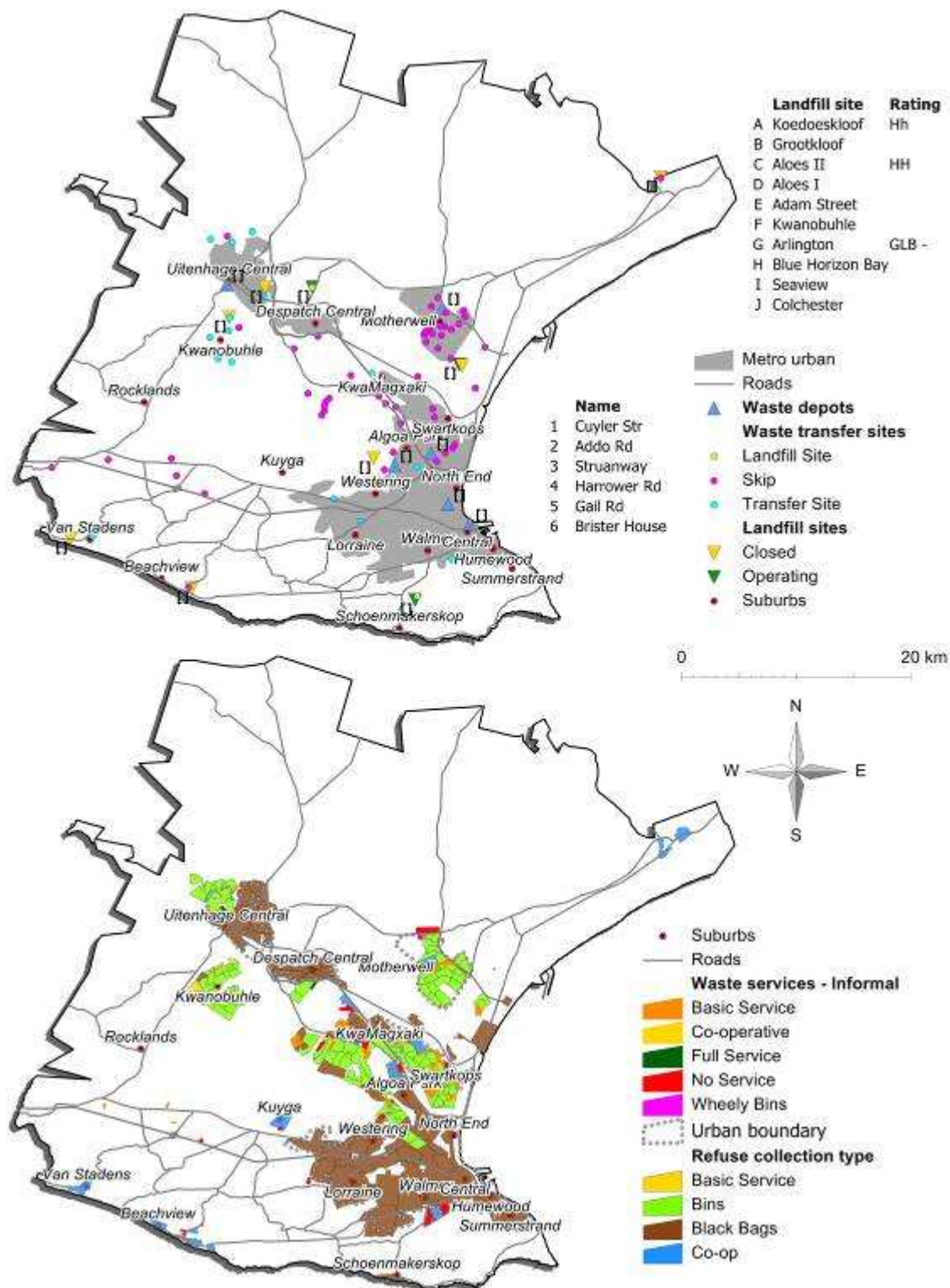


Figure 41. Waste depots, waste transfer sites, land fill sites (above) and waste collection types and service in the Nelson Mandela Bay Municipality.

Waste collection

Recycling activities is undertaken at Arlington by a service provider for a period of three years. The majority of households in the Nelson Mandela Bay Municipality receive good refuse services through the kerbside removal of plastic bags (Figure 42).

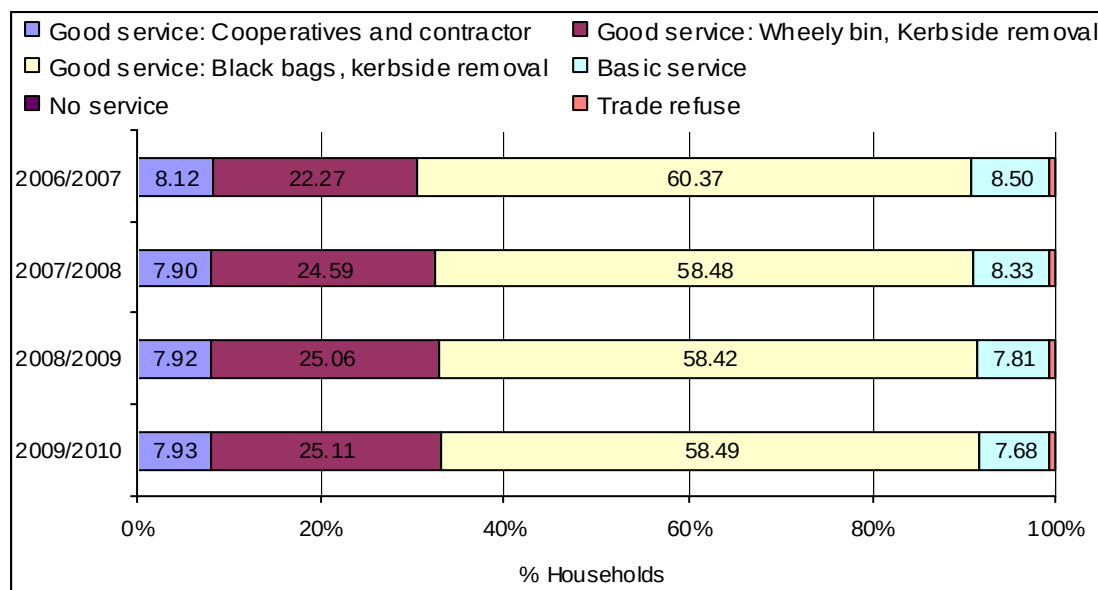


Figure 42. Percentage households eligible for municipal refuse services.

Liquid waste

The number of households using flush or chemical toilets in the NMBM has increased during the period 2001 to 2007 (Figure 43). The use of the bucket system has notably decreased over the period in question, and fewer households have to contend with no sanitation.

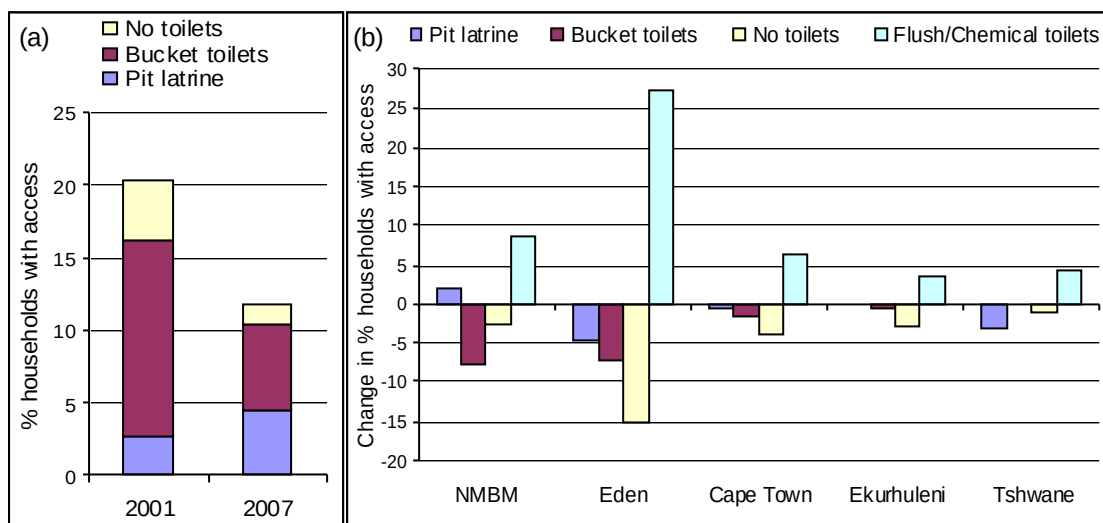


Figure 43. Percentage of households in the NMBM with access to pit latrines, bucket toilets and no toilets (a), and change in the percentage of households with access to pit latrines, bucket toilets, no toilets and Flush/chemical toilets in the Nelson Mandela Bay Municipality, Eden District Municipality, City of Cape Town, Ekurhuleni, City of Tshwane from 2001 to 2007 (b).

When compared with other large municipalities across the country, the NMBM has achieved the greatest change in percentage of households using the bucket system with fewer households using the system (Figure 43). The NMBM has also achieved the

second highest change in the use of flush or chemical toilets, second only to the Eden District Municipality.

There are seven waste water treatment works (WWTW) in the NMBM (Table 17). The Fish Water Flats WWTW is the largest in the NMBM with a throughput of 132 Mℓ/d. The combined total throughput of all WWTW equates to 195.08 Mℓ/d. All WWTW have a General Standard permit, besides the Rocklands WWTW which has a General Authorisation permit.

Table 17. Capacity and permit type of NMBM waste water treatment works

WWTW	Capacity Mℓ/d	Permit
Fish Water Flats	132	General Standard
Cape Recife	9	General Standard
Driftsands	12	General Standard
Despatch	8.9	General Standard
Kelvin Jones	24	General Standard
KwaNobuhle	9	General Standard
Rocklands	0.18	General Authorisation

All waste water discharged from the WWTW is treated and approximately 2.71% of the treated discharged effluent is recycled and reused. Four outfall sewer discharge effluent directly into the sea, but the amount of effluent discharged is unknown. During 2008 to 2009, the cumulative capacity utilised through all treatment works in the NMBM ranged from 72 to 84%, while the average for the 2008/2009 period was ~78%.

9.3.3 Water

Nelson Mandela Bay receives water from seven dams of which 6 are owned by the NMBM. The total combined dam capacity of the dams serving the NMBM is 278 269 Mℓ (Figure 45). Seven water treatment works (Linton, Lorie, Churchill, Elandsjagt, Nooitgedagt, Groendal and Springs) process the water to potable standard before it is pumped to 35 reservoirs around the NMBM. Both total water abstraction and total water production has been an increasing from 2006 to 2009 (Figure 44). The data also show that water losses in the pipelines connecting the dams with the WTW have also been increasing. This is of concern as the losses are on the high side, especially in the current drought.

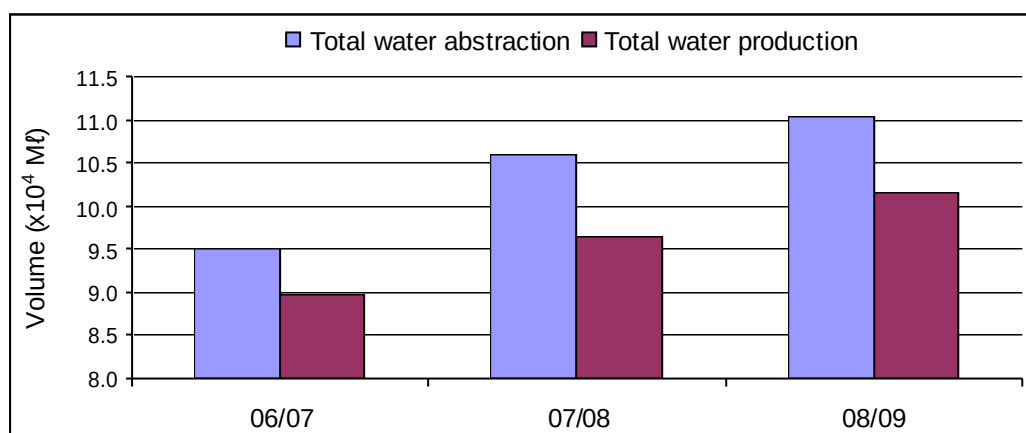


Figure 44. Total volume of water abstracted all dams and potable water produced by the NMBM water treatment works.

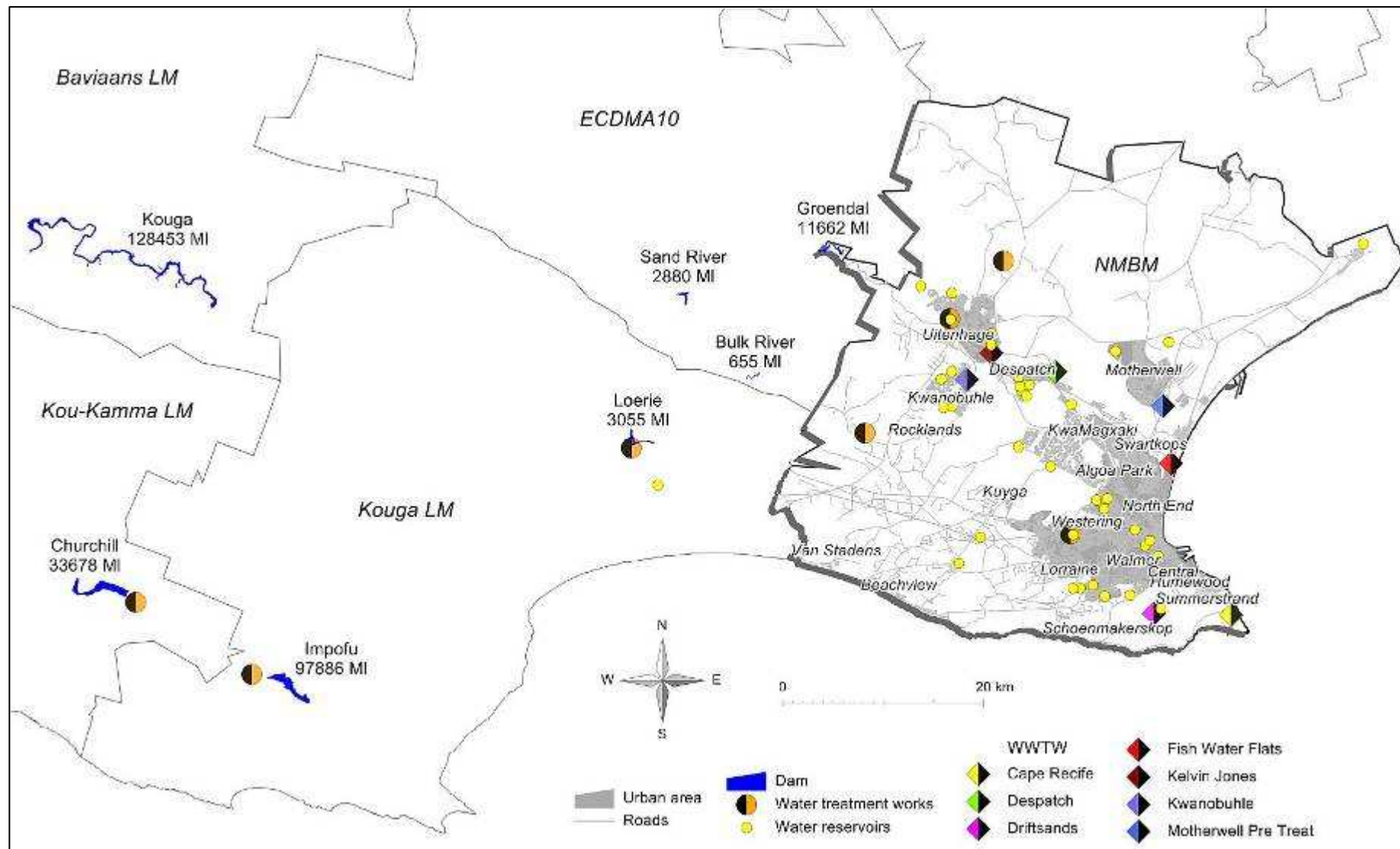


Figure 45. Dams, with storage capacity in Ml, supplying the Nelson Mandela Bay Municipality with water. The locations of waste water treatment works (WWTW), water treatment works and reservoirs are demarcated on the map.

With the exception of the Groendal Dam, the other five metro-owned dams supplying the metro with water are located outside the boundary of the NMBM (Figure 45). The capacities of the NMBM dams range from 655 Ml (Bulk River Dam) to 128 453 Ml (Kouga Dam), as can be seen in Figure 45.

Analysis of past dam level trends indicate that we are currently experiencing one of the most severe droughts in at least 20 years (Figure 46). During the last twenty years the combined total capacity of dams in the NMBM region has dropped below the 50% mark, which is roughly the point where intervention is required and water restrictions must be considered. The 1991/1992 period was particularly dry, with another notable dry period occurring in 2006. The current dry period (2009/2010) is seemingly headed towards the 1991/1992 levels, and if the 20 year rainfall cycle is considered drought conditions may still persist for one or two years.

Potable water is produced by six water treatment works (Churchill, Elands, Groendal, Linton, Loerie and Nooitgedagt WTWs) treating the water supply of Nelson Mandela Bay. Most of the parameters have been treated very successfully over the last five years to a potable standard with less than 10% (limit often referred to as 90th percentile) of the samples not complying with the SANS 241 (2005) water quality standards for potable water (Table 18). Electrical conductivity, which is considered as a good measure of water quality with higher conductivities indicating lower water quality (Knysna Municipality 2005), was very low in the almost all of the measured samples. Parameter levels of concern are pH, turbidity, magnesium and aluminium. The percentage of samples not meeting the SANS 241 standards (indicated in red) were particularly high (>10%) in 2006, 2007 and 2008, however, fell below the 10% mark in 2009. It is very likely that the current drought in the eastern and southern Cape has a notable impact on the water quality. This trend was also observed in the Coega IDZ and was attributed to the current drought period (SRK 2009)

Table 18. Selected physical and chemical parameters of six water treatment works.

Parameter	Units	SANS 241 Max. limit	2005			2006			2007			2008			2009		
			No.	%	Ave.	No.	%	Ave.	No.	%	Ave.	No.	%	Ave.	No.	%	Ave.
pH		9.5	145	8.97	9.14	273	5.86	8.66	289	8.65	8.84	304	14.47	8.77	94	9.57	8.85
EC at 25°C	mS/m	150	145	0.69	45.48	273	0	42.23	287	0	39.83	303	0	36.70	94	0	36.57
Turbidity	NTU	1	143	23.78	0.94	273	19.78	0.83	275	18.91	0.98	243	26.75	1.04	94	5.32	0.62
Calcium	mg/l	150	144	0.69	37.89	270	0	44.39	287	0	45.43	252	0.40	38.20	90	0	41.57
Magnesium	mg/l	70	145	0	29.46	270	13.70	32.15	287	14.63	30.49	251	15.14	30.60	90	6.67	30.79
Iron (Total)	mg/l	0.2	141	7.80	0.05	269	4.83	0.04	287	4.18	0.19	244	6.97	0.26	90	4.44	0.04
Aluminium	mg/l	0.3	140	7.14	0.10	227	19.82	0.44	242	22.73	0.46	214	15.89	0.47	88	5.68	0.14
Sodium	mg/l	200	137	0	48.92	271	0	48.60	290	0	43.63	239	0	41.53	91	0	42.07
Potassium	mg/l	50	137	0	2.44	270	0	2.43	287	0	2.38	233	0	1.80	90	0	2.10
Sulphate	mg/l	400	145	0	16.70	247	0	25.77	272	0	27.46	225	0	24.09	68	0	19.18
Chloride	mg/l	200	145	0	92.57	240	0.83	72.58	271	0	61.65	219	0.46	66.77	59	0	62.01
Manganese (Total)	mg/l	0.1	142	0	0.004	270	0	0.007	287	1.05	0.155	248	0	0.200	90	5.56	0.021
Total Dis-solved Solids	mg/l	1000	143	0.70	240.15	270	0.37	237.35	287	0.70	286.97	303	0	221.50	94	1.06	231.33
Fluoride	mg/l	1	145	1.38	0.07	257	0	0.19	274	2.19	0.40	239	1.67	0.43	77	0	0.24

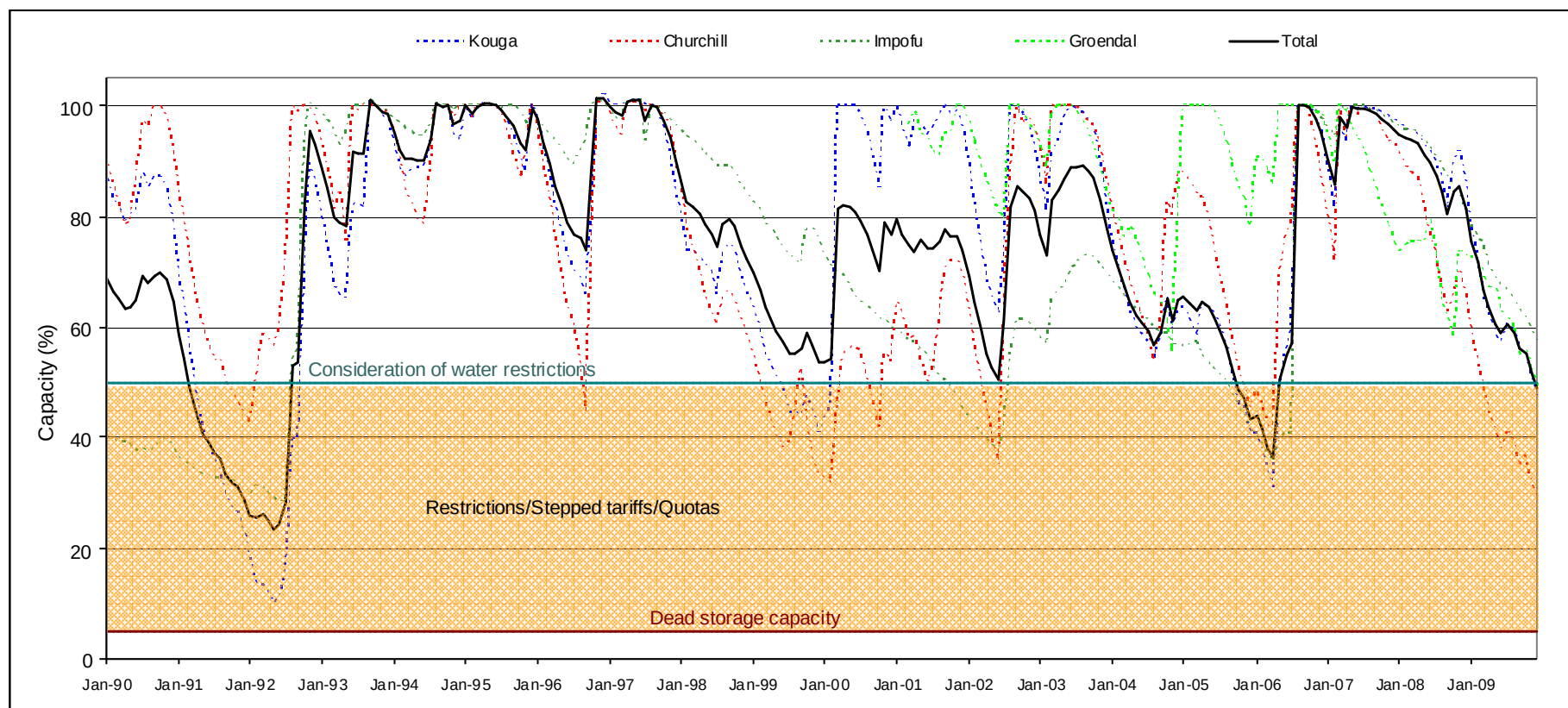


Figure 46. Fluctuations in the Koug, Churchill, Impofu and Groendal Dam levels over a 20 year period. Fluctuations in the total combined dam capacities for all the dams supplying the Nelson Mandela Bay Municipality with water are represented by the solid black line.

The capital budgets for the management of water services were R105.8 million, R171.8 million and R223.3 million for the 2007/2008, 2008/2009 and 2008/2010 financial years, respectively. Financial forecasting by the Nelson Mandela Bay Municipality set the budget for the 2010/2011 financial year at R170.4 million for the management of water services.

9.4 Indicators

The chosen indicators to assess bulk services in the Nelson Mandela Bay Municipality are shown in Table 19.

Table 19. State of the environment indicators for Nelson Mandela Bay Municipality: bulk services.

Issue	Indicator
Energy and electricity	Main source of heating, cooking and lighting of households
	Electrical energy use per capita
	% households connected to electricity supply, % households paying their electricity bill *
	No of solar heaters installed and subsidised
	Current and future household vs commercial/industrial usage
Waste services	Number of waste/landfill sites and transfer stations by type
	Available lifespan (capacity) of landfill sites
	Number of landfill sites with a license
	Total tonnage per year received by municipal landfill sites
	% of licensed landfill sites that are being monitored for compliance
	Nature and volume of solid waste recycling activities
	Number of waste-related public awareness activities in the NMBM
	% of households eligible for kerb side removal of solid waste
	Number of waste disposal trucks *
	Hazardous waste disposal *

Issue	Indicator
Water services	Number of households on a ward basis connected to water-borne sanitation
	Number and capacity of waste water treatment plants in the NMBM
	WWTW licensing
	Volume of treated effluent discharged through outfalls into the sea *
	Percent of treated effluent reused by effluent return schemes
	% of wastewater discharged but not treated
	% of treatment capacity utilization
	Total capacity of storage dams
	Trends in dam water levels
	Water quality of NMBM main dams
	Intensity of use of surface and ground water resources
	Total potable water production (seasonal breakdown)
	Total water demand per sector (kℓ per day)
	Water demand per capita (kℓ per day)
	% exceedance of DWAF guidelines for selected potable water quality variables
	% households with access to portable water within 200 m of dwelling #
	Total budget allocated for the maintenance of water infrastructure

* Data could not be obtained, # No recent comparable data could be obtained

The indicators in Table 19 are discussed in sections 9.3.1, 9.3.2, 9.3.3 and 9.3.4.

9.5 Impacts

9.5.1 Energy consumption

The continued depletion of fossil fuels and increased consumption of electricity is a significant impact resulting from urbanisation and economic development in Nelson Mandela Bay. Increased disposable income further contributes to increased waste to landfill in Nelson Mandela Bay. The net migration of people into the urban areas of Nelson Mandela Bay Municipality results in increased need for housing and urban expansion causing greater energy consumption through development. Secondary impacts include greater pressure on service delivery and maintenance of municipal systems.

The increasing population size in urban centres such as Nelson Mandela Bay exerts increasing pressure on the transport systems. Poorly developed public transport systems result in increased vehicular traffic. This contributes to a culture of high energy consumption and impacts on the air quality in Nelson Mandela Bay. The consumption of energy in Nelson Mandela Bay, as in the rest of South Africa, is sensitive to changes in economic markets. Knock-on effects in the recent economic downturn has manifested in decreased consumption of electricity and fuel.

9.5.2 Waste generation

The main impacts associated with waste generation originate from economic development and urbanisation causing the production of increased quantities of solid and liquid waste in Nelson Mandela Bay. Impacts include increased effort to maintain and improve refuse removal and waste water treatment services in Nelson Mandela Bay. Increased waste generation contributes to increased waste to landfill, which reduces the lifespan of landfill sites and also increases the incidences of illegal dumping in Nelson Mandela Bay. The generation of higher quantities of liquid waste and sewage contributes to increased incidences of pollution of ground, surface and coastal waters. Illegal dumping and pollution ultimately constitutes a health risk, especially to residents of communities located close to these pollutants.

9.5.3 Water services

Dilapidated and dysfunctional water services infrastructure causes notable losses of potable and untreated water, contributing to the water crisis in Nelson Mandela Bay. Further, economic development and population growth in the region is resulting in increased water demand for domestic and industrial use. The Coega Industrial Development Zone, and to a smaller degree the recently established Greenbushes Industrial Park, for example, are consuming increasing volumes of water as tenants establish within these zones and become operational. The increasing tourism industry driven by the increasing popularity of Nelson Mandela Bay as a holiday destination and venue of international sporting events (Iron Man Triathlon and 2010 Soccer World Cup venue) exerts further pressures on the available water resources in the region. Industrial and organic pollution, and the presence of water hyacinth, especially in the Swartkops River, reduces the quality and quantity of the water resources in the region. These factors ultimately result in a measurable loss of biodiversity in our natural water systems and consequently suggest the impoundment of greater volumes of water.

9.6 Responses

9.6.1 Energy consumption

- The Department of Minerals and Energy released a White Paper on Renewable Energy which has set targets of 10 000 GW/h renewable energy (4%) contribution to final energy consumption by 2013.
- The Nelson Mandela Bay Municipality is embarking upon supply management programmes aimed at creating renewable energy alternatives. These include

gas generation, landfill to gas generation, generation from reclamation works and wind farm projects.

- The Nelson Mandela Bay Municipality is implementing demand management programmes that will fast track energy efficiency possibilities in the top 100 industrial consumers, all municipal infrastructure and domestic opportunities.
- The roll out and installation of solar water heaters in 60 000 to 100 000 dwellings.
- The Nelson Mandela Bay Municipality is geared at creating consumer awareness by establishing a joint energy centre supported by NMBM, Coega and various other role players.
- The implementation of a smart metering system for remote switching of geysers, swimming pool pumps, under floor heating systems and large air condition systems that are used only for comfort;
- Installation of energy efficient lights, CFLs in all Metro and Government buildings, as well as street lights. Active promotion of CFLs with all electricity customers;
- Implementing energy efficient street lights;
- Awareness campaign on energy efficiency practices;
- The Coega Development Corporation is investigating the viability of a 300 kW wind turbine, including research into solar energy, geothermal energy, 350 MW Peaking Power Plant, 2400 MW CCGT Plant and potentially a crude oil refinery.

9.6.2 Waste generation

- The Polokwane Declaration was agreed upon to reduce waste to landfill. Ambitious goals were set for reducing waste generation and disposal by 50% and 25% respectively and a commitment was made to develop a plan for zero waste by 2022.
- The National Environmental Management: Waste Act seeks to integrate and regulate solid waste management within South Africa.
- Plastic Bag Regulations seek to reduce packaging requirements and the use of harder plastics.
- The Nelson Mandela Bay Municipality thus far implemented a ward based cleaning programme in 24 wards and will be expanding to 30 wards by 2011.
- Eight co-operative programmes have also been established in Nelson Mandela Bay to assist communities in litter-picking and street sweeping.
- Educational programmes have been implemented by the Nelson Mandela Bay Municipality through the Go-Green campaign, and by non-profit organisations such as the Zwartkops Trust.

9.6.3 Water services

- The Working for Water (WfW) programme aims to maintain and improve water supply in catchments and rivers by create jobs and promoting the sustainability of South African biodiversity by removing alien plant species, which generally consume water at a higher rate than native vegetation.
- Water Services Development Plan (WSDP) is prepared yearly in terms of the Water Services Act 108 of 1997. It sets out the way in which the water services authority plans to deliver water services to households and businesses in Nelson Mandela Bay.

- The Nelson Mandela Bay Municipality is in the process of developing the Amanzi WTW north of Motherwell. A WTW is also planned inside the Coega Industrial Development Zone to treat water for industrial needs.

9.7 Linkages and inter-dependencies

The following linkages are noteworthy:

Climate change: The burning of fossil fuels releases greenhouse gases that is likely to contribute to global warming. Positive linkages include the opportunities in carbon credits trading through the planting of spekboom.

Biodiversity: Pollution through illegal dumping and wastewater disposal are diminishing the ability of ecosystems to bounce back from perturbations, in turn impacting on biodiversity.

Coast, estuaries and inland water: Waste water and pollution are impacting on water quality of estuarine and freshwater systems and the in-shore coastal waters.

Poverty: The availability of potable and industrial water strongly influences the potential to accommodate sustained economic growth in Nelson Mandela Bay in the future.

Urban development: The availability of water and electricity strongly influences the Nelson Mandela Bay Municipality's potential ability to provide potable water and electricity services to residents of Nelson Mandela Bay to support future population growth.

Health: The availability of clean and potable water to all residents of Nelson Mandela Bay influences social issues such as health and equity. Illegal dumping of waste and pollution can also contribute to diminishing health of individuals and communities.

9.8 Identified gaps

The following gaps are noted:

- Actual data on electricity consumption per municipal subarea.
- Actual data in terms of waste generation. Most of the figures used in this report are based in estimation though population figures and resultant extrapolation. This is largely unreliable and actual disposal figures at landfills are required.

10 THEME: POVERTY

10.1 Introduction

Poverty can be defined in many ways, but always implies that people living in poverty are significantly worse off than their fellow citizens and have less access to resources such as education, transport, health care or social networks. Poverty often creates a vicious cycle where the conditions under which poor people live lead to bad health, malnutrition or isolation. These effects can diminish productivity and drive poor people further into poverty.

10.1.1 Economic overview

The state of a country's economy and the occurrence of poverty are closely intertwined. A growing economy can decrease poverty levels if it creates sufficient, sustainable employment opportunities. On the other hand, high levels of poverty, often corresponding with low levels of education and lack of skills, can weaken economic growth and diversity.

Africa's failure to grow as rapidly as the rest of the developing world has left a legacy of poverty and hunger. Sub-Saharan Africa has seen a huge increase in the number of people living in absolute poverty – from 214 million in 1981 to 391 million in 2005, with only a small decrease in percentage terms over the same period, from 53.7 to 51.2 percent (Committee on World Food Security 2009).

At the time of writing of this State of the Environment Report the macro-economic climate of South Africa was characterised by change and uncertainty:

- Owing to a favourable external environment and strong domestic demand, accommodated by rapid credit expansion, South Africa enjoyed a buoyant economy in the mid-2000s.
- The global financial crisis of late 2008 sharply changed the outlook for an already slowing economy and posed new challenges for macroeconomic policies. A sharp decline in external demand and a slump in the prices of some major export commodities weakened the economy further. Large capital outflows, triggered by investor withdrawal from emerging market assets contributed to an elevated perception of risk.
- On the other hand, perceptions of uncertainty were offset somewhat when the national elections in April 2009 returned the African National Congress (ANC) to power by a comfortable margin and Jacob Zuma was elected president. The new government has emphasized its commitment to policy continuity in key areas and to improving the delivery of public services.
- Financial markets have begun to stabilize recently, driven by global shifts in financing to emerging market economies, rather than South Africa specific factors. Portfolio inflows have returned. By contrast, output and demand remain weak, but recent indicators suggest that the economy is on a path of recovery.
- South Africa continues to face formidable medium-term structural challenges (e.g. the electrical power crisis) largely reflecting its apartheid legacy.

- The central challenge for macroeconomic policies in this uncertain global environment is to strike the right balance between supporting domestic demand and maintaining price and external stability.

10.2 Drivers and pressures

The key drivers and pressures that influence levels of poverty in NMBM include:

- **Standards of education:** the level of education of the work force influences employment levels, because skilled people can be employed in a larger range of jobs.
- **Job creation and unemployment levels:** if a poorly performing economy falls behind in job creation, unemployment levels will increase and with it the prevalence of poverty.
- **Health:** health care can be widely unavailable to the poor and sick persons cannot earn an income to lift them out of their poverty.
- **Population growth:** a fast growing population makes it increasingly difficult to feed everyone as competition becomes fiercer and resources become depleted.
- **Apartheid legacy:** during the Apartheid years when society was segregated along racial lines, non-whites were mostly found in low level and poorly paid jobs, which cemented poverty of the majority of the population of South Africa.

10.3 State

10.3.1 Poverty levels

According to information collected by the Human Sciences Research Council's annual South African Social Attitudes Survey (HRSC 2006), the majority of South Africans perceived themselves as lacking enough food and income to meet all their household needs. The survey showed that the occurrence of poverty in South Africa continues to have a strong racial bias. Compared to the other racial groups in South Africa, black people are still way behind in terms of access to enough food as well as income for their household needs.

Statistics South Africa remains the most important source of demographic data, including levels of poverty, although the last census providing data on an electoral ward level is now rather dated (2001). Based on the 2001 Stats SA data, the spatial distribution of levels of household income corroborate the findings of the HRSC surveys cited above. Most poor people live along the New Brighton/Zwide – Bethelsdorp/Uitenhage axis, with Motherwell as a second density cluster. In comparison, people living in the northern and southern parts are orders of magnitude better off in terms of their monthly income (Figure 48).

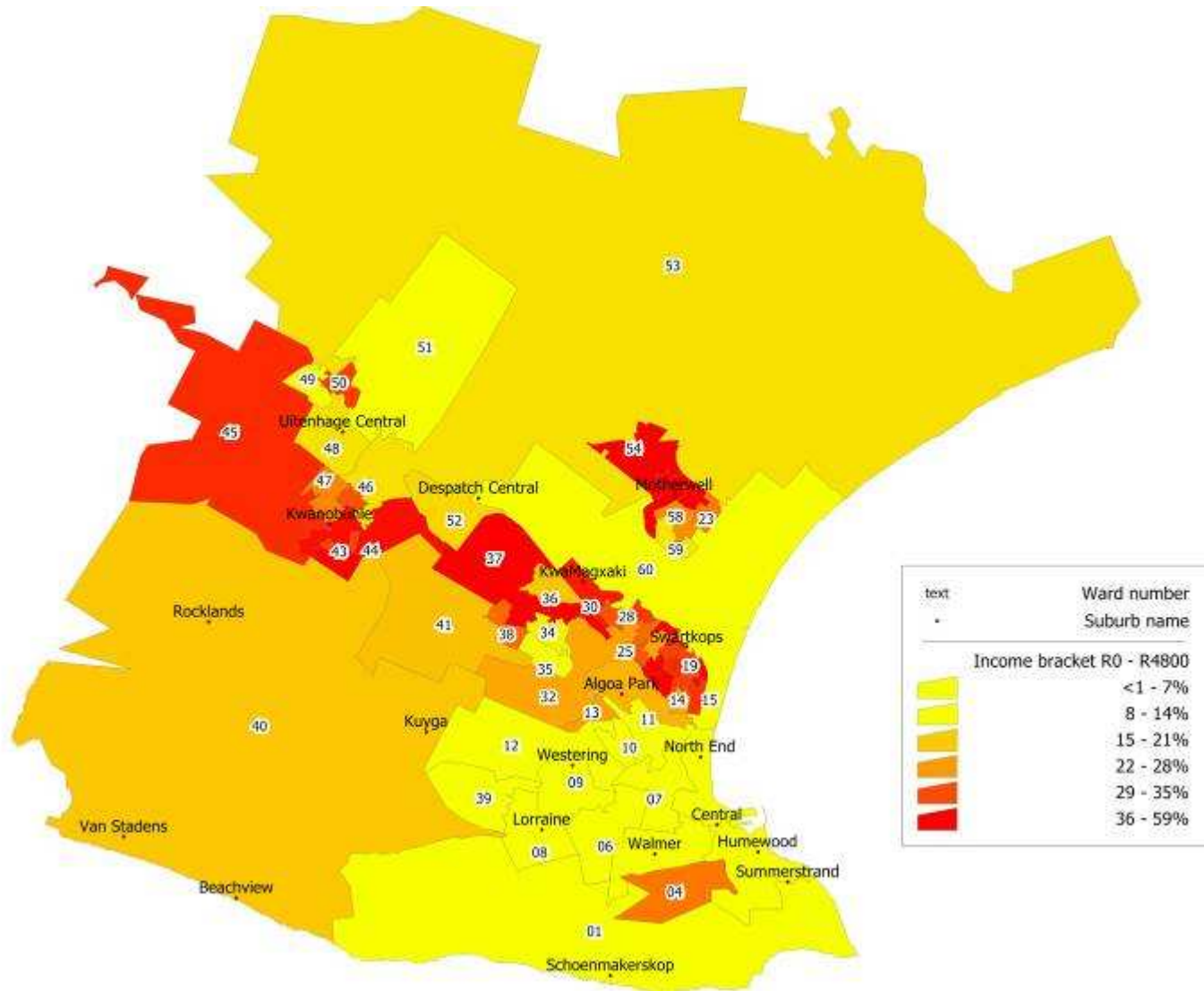


Figure 48. Monthly household income brackets in NMBM by electoral ward.

10.3.2 Quality of life

A recent socio-economic study conducted by Development Partners (2008) for Nelson Mandela Bay Municipality has provided greater detail on the quality of life of people residing in so-called 'change areas', the same areas shown in red in Figure 48. Change areas exhibit significant dwelling change between 1996 and 2006. The highest population density occurs here (Figure 5) and the majority of NMBM's inhabitants live here.

The results of the study (Development Partners 2008) paint an alarming picture of the quality of life of the majority of NMBM's people, affirming the notion that hunger, disease and poor education describe a person in poverty:

- 7% have no formal education;
- 84% of persons older than 18 years did not complete their school education;
- 96% have no tertiary qualification that would give access to good jobs;
- Only 11% have full-time formal sector employment;
- 53% rely on government grants;
- 50% have no money to spare to pay for their children's or their own education;
- 24% of households do not have enough money for food;
- 44% cut the size of your children's meals because there is not enough money to buy food; and
- 16% of children under 18 are orphaned because both parents died of HIV/AIDS related illness.

10.3.3 Population growth

NMBM has had a modest growth in population over the past two decades (Table 20). While the number of persons increased by 3.7 % and 4.5 % for the periods 1996 – 2001 and 2001 – 2007, respectively, increasingly less persons constituted each household (Statistics SA 2001, 2008). The most plausible explanation for this phenomenon is that formerly large households with possibly three generations under one roof split into smaller units as standards of living increased and/or as individuals moving to the cities founded new households.

Table 20: Population trends of Nelson Mandela Bay Municipality.

	1996	2001	2007
Persons	969 771	1 005 779	1 050 930
Gain in persons		36 008	45 151
Rate of increase		3.7%	4.5%
Households	225 912	260 799	276 881
Gain in households		34 887	16 082
Rate of increase		15.4%	6.2%

The significance of the data presented in Table 20 lies in the absence of rampant population growth since the end of Apartheid. The reasons for the continuing social injustice do not lie in people numbers, but in ineffective remedial actions - however well-meaning the policies put in place are - and the failure of NMBM's economy to create sufficient employment.

10.3.4 Health and poverty

Sub-Saharan Africa's low growth has not only reduced domestic resources available for investing in infrastructure, agricultural development, health, education and nutrition, but it has also aggravated the HIV/AIDS crisis, which involves a vicious spiral of poverty and disease. In rural areas the fight against HIV and AIDS is lagging badly and needs to be intensified with expansion of HIV and AIDS services to rural areas and major improvements to social safety nets.

A graph shown in the socio-economic study conducted by Development Partners (2008) shows for the disadvantaged population that was under investigation a striking deviation from a 'normal' mortality by age distribution in that general mortality (all persons at all ages) clearly peaks prematurely in the case of two central and adjacent age cohorts, namely people between the ages of 25 and 35, as well as between the ages of 35 and 45. This situation probably reflects the effect of HIV/AIDS and TB on this population segment (see Theme: Health).

10.4 Indicators

The following indicators to assess the state of poverty in Nelson Mandela Bay were chosen from the list provided in GIBB (2009):

1. Household income distribution.
 2. Levels of education.
 3. Unemployment rate.
 4. People receiving social grants.
 5. Population growth rate.
 6. Population density.
 7. Levels of adequate nutrition.
 8. Mortality rate.
-

10.5 Impacts

High levels of unemployment, poverty and inequality have the following consequences:

- Lowers personal esteem;
 - Increases social tension;
 - Increases existing levels of crime and violence;
 - Exacerbates the impact of the HIV/Aids epidemic;
 - Places a financial burden on the municipal budgets;
 - Hampers local and regional economic growth, because of the skills shortage affecting the tertiary sector, as well as the limited source of disposable income; and
 - Discourages foreign investment.
-

10.6 Responses

Developing Nelson Mandela Bay as a leading South African metropolitan municipality, while at the same time combating poverty and hunger, using non-renewable natural resources more efficiently and adapting to climate change are the main challenges NMBM will face in the coming decades.

Poverty has many dimensions and causes, and there is no single action to be taken in order to reduce it significantly. What is clear though is that we cannot significantly reduce poverty, especially within a human rights approach, without good governance at all levels, from the global to the local.

Metropolitan municipalities have a mandate to advance socio-economic growth, development and service delivery. In responding to this mandate the NMBM has launched various initiatives aimed at creating an enabling environment for enterprise development, trade and foreign direct investments. At a policy level Nelson Mandela Bay Municipality has responded to the poverty crisis through:

- The Nelson Mandela Bay Human Resources Development Strategy and Plan of 2007;
- The Assistance to the Poor (Free Basic Services) Policy of 2008;
- The Disability Policy of 2007;
- The Gender and Women Empowerment Policy of 2007;
- The Policy on Senior Citizens of 2007;
- The Youth Development Policy of 2007.

On a practical level, the Integrated Development Plan 2006 – 2011 of the Nelson Mandela Bay Metropolitan Municipality has allocated budgets for a number of programmes aimed at eradicating poverty, focusing on the following:

- Implementation of the Expanded Public Works Programme (job creation and learnerships);
- SMME and co-operative development;
- Provision of free basic services;
- Repair of leaks in indigent households;
- Unemployed graduates training;
- Bursaries and learnerships;
- Procurement processes;
- 2010 Soccer World Cup related programmes and initiatives;
- Ward-based cleaning programmes;
- Special sector capacitation (women, youth and the disabled); as well as
- Implementation of urban renewal programmes.

10.7 Linkages and inter-dependencies

The following linkages are noteworthy:

Governance: Economic growth and poverty alleviation are easier to address with good governance. Widespread poverty can contribute to a breakdown of good governance by undermining political stability and the rule of law;

Health: HIV/Aids also increases poverty, whereas poverty worsens the living conditions of the poor living with the disease as well as their ability to cope with the disease;

Bulk services: The availability of water, both for potable and industrial purposes, strongly influences economic growth and hence options for combating poverty.

10.8 Identified gaps

Up-to-date demographic data on a ward basis would be very useful for comparison with the 2001 national census conducted by Stats SA.

11 THEME: HEALTH

11.1 Introduction

In terms of the socio-economic environment, health is an important determinant of quality of life. It also influences a region's resilience, stability and economic potential; because good health enables people to actively participate in their social environment and to work productively. In terms of the biophysical environment, environmental pollution poses both a direct and indirect threat to the health and safety of residents and visitors to NMBM.

Acquired immune deficiency syndrome (AIDS) is a disease of the human immune system caused by the human immunodeficiency virus (HIV). HIV/AIDS in the region are discussed in this chapter as well as the prevalence of tuberculosis (TB) in the region. Underweight births and child mortality rates, their immediate causes and chronic diseases that contribute to it are assessed. Access to and quality of health care services are also presented, as well as the access to sanitation services. The chapter then concludes with recommendations based on the findings.

11.2 Drivers and pressures

The key drivers and pressures influencing human health are:

Poverty: Poor people suffer from greater ill health due to multiple factors, such as inadequate housing, poor water supply and sanitation, poor nutrition and less access to resources, such as health care, education, transport and/or social networks;

Costs: Quality health care can be very expensive. Many poorer households are not able to afford these costs, resulting in health problems not being treated;

Access to health and basic services: Access to clean water and basic sanitation is essential for good social and biophysical health. However, inequalities exist in terms of access to health and basic services, between different population groups and between income groups;

Population growth: The population of NMBM has increased by 4.5% between 2001 and 2007 (Statistics South Africa 2008). This increase in population puts stress on the capacity of existing health facilities;

Apartheid legacy: The health systems under apartheid were divided along racial lines. There were wide disparities in the standards of health care between different population groups. The legacy of this system continues amongst most disadvantaged communities who continue to have less access to health facilities;

HIV/AIDS: A high incidence of HIV/AIDS makes the population more vulnerable to secondary infections, such as TB, that places further stress on the capacity of existing health facilities;

Environmental conditions: Factors such as air and water quality, toxic exposure, illegal dumping and environmental pollution, all affect social and biophysical health; and

Education: Health education is a major issue in NMBM, because a lack thereof can lead to significant health issues, particularly the spread of HIV/Aids.

11.3 State

Priority health issues identified for the NMBM are the prevalence of HIV/AIDS and TB, underweight births; and access to primary health facilities.

11.3.1 Prevalence of HIV/AIDS

Pregnant women in antenatal clinics testing positive for HIV/AIDS

South Africa has one of the largest HIV sentinel surveillance systems in the world. Annual antenatal² HIV surveys are internationally recognised as tools for monitoring HIV trends and provide the basis for estimating HIV prevalence in the general population.

In 2008 an HIV sentinel survey was carried out at 1 457 sentinel sites strategically located in all the 52 health districts of South Africa targeting 36 000 pregnant women seeking antenatal care for the first time during the current pregnancy within the survey period. The estimated prevalence of HIV infections among pregnant women aged 15 – 49 and seeking care in public health clinics in South Africa was found to be hovering around 30% from 2005 – 2008 (National Department of Health 2009). The prevalence of HIV in antenatal woman in the NMBM and the Eastern Cape is similar to the national average (Table 21). A slight decrease over the years is discernible.

*Table 21: HIV prevalence among antenatal clinic female attendees in the NMBM.
(Source: Department of Health, 2009 - 2008 National Antenatal Sentinel HIV
and Syphilis Prevalence Survey, South Africa)*

	2005	2006	2007	2008
NMBM	32.9%	31.9%	28.9%	29.0%
Eastern Cape Province	28.0%	28.6%	28.8%	27.6%
South Africa	30.2%	29.1%	28.0%	?%

ARV intake

In 2007 only 32% of people who needed Anti Retroviral [drugs] (ARVs) in the NMBM were accessing them. The reason for the poor uptake appeared to be a lack of

² Before the end of the pregnancy

knowledge about their HIV status, fear and misinformation about ARVs and capacity of the NMBM to provide ARV treatment (NMBM Integrated HIV and Aids Plan 2007).

Government medical facilities dispensing ARVs within the NMB health district (Figure 51) include

SUB-DISTRICT A

Primary health care: KwaZakhele CHC, Motherwell CHC,
New Brighton CHC and Zwide Clinic
Hospital : Dora Nginza Hospital

SUB-DISTRICT B

Primary health care: Laetita Bam CHC, Rosedale Clinic
Hospital: Uitenhage Hospital

SUB-DISTRICT C

Primary health care: Chatty Clinic, Masakhane Clinic, Walmer Fourteenth Avenue Clinic
Hospital: Livingston Hospital, Empilweni TB Hospital, Jose Pearson TB Hospital

There is poor intake of ARVs by children nationally. It is likely that this is also problem in NMBM. The major reasons for poor intake by children include (NMBM Integrated HIV and Aids Plan 2007):

- Few children are tested for HIV;
- Care givers bring them in too late;
- At clinic level, the vast majority of problems lie with the failure of health workers to assess, treat and refer children appropriately.

The HIV prevalence rate amongst antenatal clinic (ANC) clients tested in NMBM was 31.9%, according to the national survey, whereas the low District Health Information System value of 18.3% was one of the largest discrepancies between survey and routine data for a district. It is likely to be a consequence of different methodologies being used. The condom distribution rate continued to decline in recent years from 7 in 2003/04 to a low of 5.3 condoms per man, per year, in 2007/08, which is concerning (Day *et al.* 2009).

11.3.2 Prevalence of TB

Tuberculosis (TB) is a major public health problem in South Africa. South Africa was ranked fifth on the list of 22 high-burden TB countries in the world in 2006. According to the World Health Organization's (WHO) Global TB Report 2009, South Africa had nearly 460 000 new TB cases in 2007, with an incidence rate of an estimated 948 cases per 100 000 population in 2007 – a major increase from 338 cases per 100 000 population in 1998 (US AID 2009).

The Department of Health has had a national TB Control Programme in place since 1994/5 and adopted the World Health Organisation Directly Observed Treatment Short Course Strategy (DOTS) in 1999. It claims to be the most effective public health strategy for reducing tuberculosis transmission. DOTS has several elements: government commitment to TB control, TB diagnosis by sputum smear microscopy for patients who report a cough lasting three weeks or longer, standardized and directly

observed drug therapy, an efficient and reliable drug supply system, and an efficient recording and reporting system with assessment of treatment results. Despite these measures the number of cases and the defaulter rate remain high (DOH 2006).

The TB cure rate is the proportion of TB cases that have taken TB treatment for a full six months, and as a result no longer have TB bacilli in their sputum. The WHO target for the cure rate is 85%. South Africa as a whole is still far off that target, aiming for an increase of 10% each year.

Nelson Mandela Bay continues to have one of the highest TB case loads in the province. The TB cure rate in the NMBM is well below the national average and stood at 52.7% in 2005 and 56.2% in 2006. The small improvement shown in the Nelson Mandela Bay Metro over the years is unacceptable given the improvement in other districts which are less resourced and have infrastructural inadequacies to address.

Thus, TB is still a serious problem in the NMBM with 13 706 TB cases and an average of 43 TB deaths per week in 2005/2006 (NMBM 2007), despite the metro receiving additional support as one of the identified “Crisis Plan” districts for TB (Day *et al* 2009).

Extreme drug resistant TB is classified as cases that are resistant to 3 or more of the 6 second-line of TB drugs. This is called XDR-TB. XDR-TB data is not captured on any electronic database. A case study at Jose Pearson Hospital conducted by Velen *et al.* (2009) confirmed the high mortality rate (51%) of this form of TB.

The main drivers of the epidemic are environmental conditions, malnutrition, lack of access to facilities, medication and treatment, and uncompleted treatment. Specifically within NMBM, overcrowding, poor ventilation and lack of access to water and sanitation in the poorer areas are large contributing factors. Adequate TB control is dependent on numerous district level support systems, such as transport, drug supply management and supervision, as well as training of staff and increasing capacity. Within the NMBM, TB and respiratory infections are the second most common illnesses that patients are treated for.

11.3.3 Underweight births

Low birth-weight rate refers to the proportion of babies born alive who weigh less than 2 500 g at birth. The NMBM is characterised by relatively high levels of recorded underweight births with an estimate of 16% averaged over the years 2007 to 2009. This is significantly higher than the national target of 10%. The percentage of underweight births in the NMBM also appears to be increasing slightly in the recent past (Table 22). In 2009 the percentage underweight births increased by 0.48% from 2007 (Chabula-Nxiweni, pers comm.)

Table 22. Trends in underweight births in the NMBM from 2007 to 2009.

Year	Total births	Total < 2500g	% < 2500g
2007	23 358	3 679	15.75
2008	23 718	3 842	16.20
2009	21 311	3 458	16.23

Black Africans have the highest underweight birth proportions in the NMBM, averaging 10.8% over the three year period of 2007 to 2009. This means that in the recent past, one in every ten African babies were born underweight. This may also be an underestimate as underweight births are not always recorded. Coloureds are a distant second at 4.6% and Indians have the lowest underweight birth average at 0.02% over the same period. The Indian figure is so low that it does not display correctly in Figure 49.

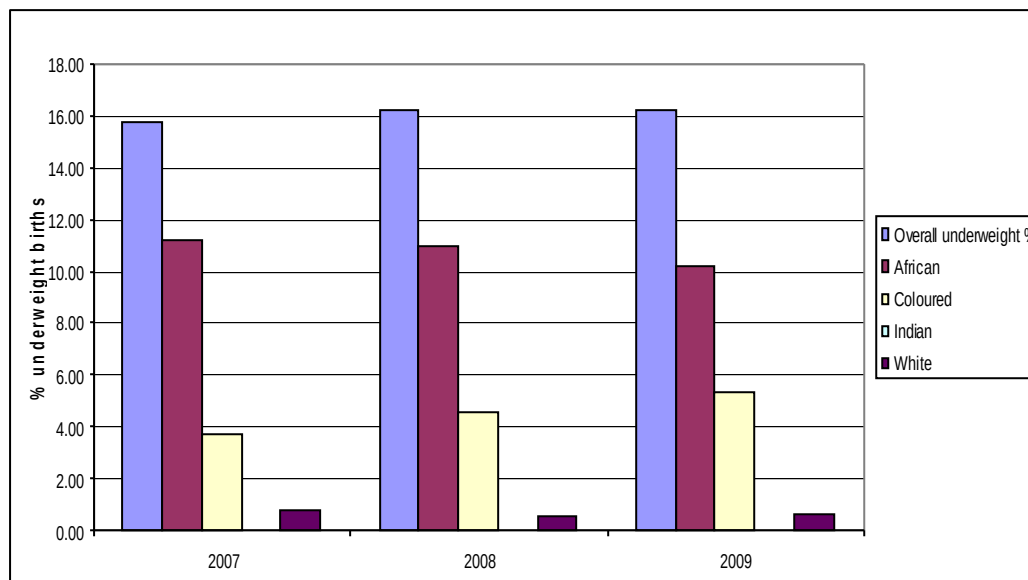


Figure 49. Underweight birth trends in the NMBM for the years 2007 to 2009. (Health Department System, NMBM, 2010).

11.3.4 Infant mortality rate (IMR)

The synthetic measure of child wellbeing, child survival and health in particular, is child mortality. While a child would die from a certain disease (immediate cause), the rates of child mortality synthesize the effect of various causes, which occur at various levels. Thus, the health and survival of mothers themselves are important underlying causes for child survival and healthy growth, as well as knowledge of and access to proper nutrition and care at household level. Equally important are the access to and quality of health services, which are provided at community level.

Infant mortality rate (IMR) and under-5 mortality rate (U5MR) are measured in relation to the total number of live births during a specific year and are the most commonly used indicators of child survival. IMR refers to the annual number of deaths of children who have not reached the age of one year per 1 000 live births for that year. U5MR refers to the annual number of deaths of children who have not reached the age of five years per 1 000 live births for that year.

No data for infant mortality was available for Nelson Mandela Bay Municipality. For both the Eastern Province and South Africa the IMR has shown a slight decrease since 2005 (Table 23). However, the number of child deaths in these areas remains unacceptably high.

It is impossible to decide to what extent it represents an increase in child mortality, as opposed to simply an increase in the completeness of registration. As many births and

deaths still go unrecorded, under registration remains a challenge to the production of reliable data on infant and child mortality.

Table 23. Infant and child mortality rates for the Eastern Cape and South Africa for the years 2005 to 2008.

	2005		2006		2007		2008	
	Infant	Child	Infant	Child	Infant	Child	Infant	Child
Eastern Cape	63	94	62	91	60	89	59	87
South Africa	49	77	48	73	46	71	45	69

11.3.5 Stillbirths

The stillbirth rate measures the number of babies born dead out of 100 000 total births. The stillbirth rates are for public sector facilities only and do not give a full community picture, especially in those places where there are a significant number of home deliveries.

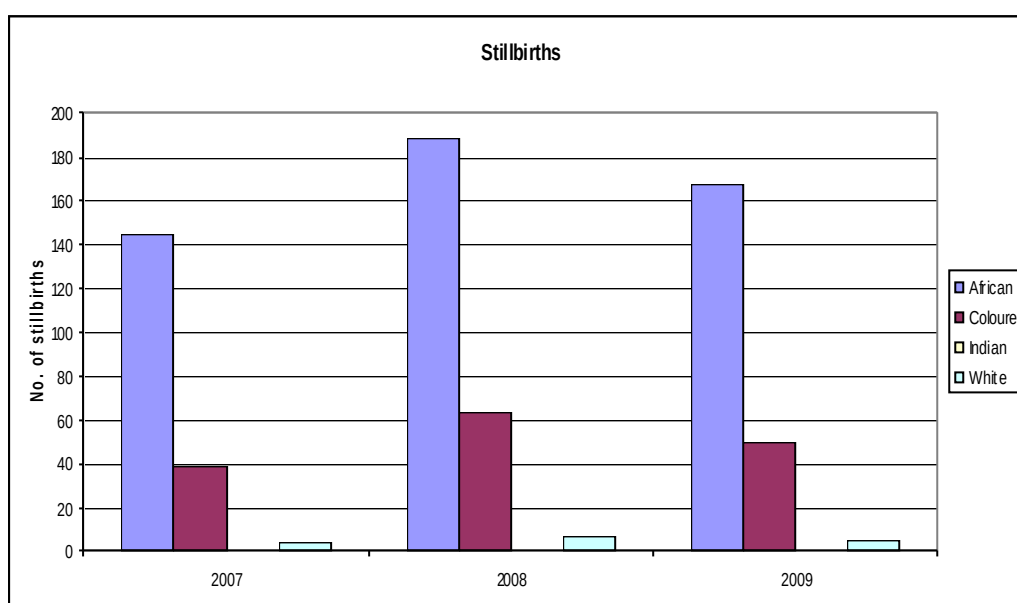


Figure 50. Number of stillbirths within the NMBM in 2007/09 according to race. The Indian figure is so low that it does not display correctly.

For all populations groups combined, stillbirth totaled 187, 258 and 222 for 2007, 2008 and 2009 respectively. The significant drop in the stillbirth (from 258 to 222 stillbirths) rate value in 2008 to 2009 could be caused by missing data and should be investigated. The average stillbirth rate in South Africa in 2007/08 was 23.0%. The sharp increase in the immunization coverage and the very high Caesarean section rate of 32.8% in 2007/08 seem unrealistic and also need attention (Day *et al.* 2009).

11.3.6 Access to toilet facilities

Households within the NMBM use (other than an ordinary flush toilet) either pit latrines, the bucket system, or have no toilet facilities at all. Table 24 shows the percentage of households using each specific facility in 2001 and 2007. For comparative reasons the percentages for the NMBM, Eastern Cape and South Africa are also provided.

The figures show that the percentage of households which used pit latrines increased since 2001 in the NMBM (2.6% in 2001 to 4.4% in 2007) and the Eastern Cape (27.4% in 2001 to 29.3% in 2007) but showed an overall decrease in South Africa (28.5% in 2001 to 27.3% in 2007). The percentage of households with no toilet facility and those using the bucket system has decreased largely over the seven year period. However, focus on the remaining households should not be lost and the NMBM should strive to have all households equipped with their own toilet facility.

Table 24. Census data for 2001 and 2007 for NMBM, Eastern Cape and South Africa on access to toilet facilities, in percent.

Type	Census 2001			Census 2007		
	NMBM	E. Cape	South Africa	NMBM	E. Cape	South Africa
Pit latrines	2.6%	27.4%	28.5%	4.4%	29.3%	27.3%
Bucket systems	13.6%	5.7%	4.1%	5.9%	2.8%	2.2%
No toilet	4.2%	31.3%	13.6%	1.5%	23.5%	8.3%

11.3.7 Access to water

In general, an increase in access to piped water will result in improved health outcomes in the form of a reduction in cases of water-borne diseases which ultimately leads to a healthier population.

However, it is not enough to just have access to piped water, but that it also needs to be within easy reach. The government policy is that piped water had to be within 200 metres in order to be easily accessed. When looking at the percentage of access to piped water within 200 metres across the Eastern Cape, there were 16 municipalities that were below the national average by 2007.

Province-wide there was an increase in the percentage of households which had access to piped water between 2001 and 2007. Seemingly there was no practical scope to increase NMBM's rate between these years, but it was close to 100% in the first place. This is far above the Eastern Cape percentage of 70.8% by 2007, as well as the national average of 72.1% in 2001 and 74.4% in 2007. The most progress in NMBM was made by bringing piped water into people's homes as Table 25 shows.

Table 25. Percentage of households having access to piped water in NMBM (Census 2001 and Community Survey 2007).

	Census 2001		CS 2007	
	NMBM	Eastern Cape	NMBM	Eastern Cape
Piped water inside dwelling	46.7	18.3	71	29.9
Piped water inside yard	33.0	19.5	16.4	13.9
Piped water from access point outside the yard	18.9	25.4	11.0	27.1
Total piped water	98.6	63.2	98.4	70.9

1.1.1. Access to primary health facilities

Health facilities

Table 26 shows that there are 20 hospitals, 38 clinics, 28 municipal mobile health services and 12 Community Health Centres (CHC) in the NMBM. Due to the absence of a medical faculty at Nelson Mandela Metropolitan University there is no academic hospital. It is understood that Livingstone Hospital is being upgraded to serve as a Regional Hospital.

NMBM has a total population of 1 050 930 and a total of 70 health facilities, therefore the ratio of health facilities to population is 0.007 %.

Table 26. Health facilities in NMBM (Source: WC Sustainability Atlas 2006).

Health facility	NMBM
Academic hospital	-
Regional hospital	-
Provincial hospital	9
Private hospital	5
Prison hospital	2
Specialised hospital	1
Clinic	37
Dental clinic	Forms part of other health facilities.
Satellite clinic	1
Mobile service	Number of buses could not be established.
Community health centre	11
Occupational Health Centre	1
Primary Health Care Service (PHC)	3
Midwife obstetrics unit	Forms part of other health facilities.
Reproductive health service	Forms part of other health facilities.
Total	70

The per capita expenditure on Primary Health Care (PHC), of R264 in 2007/08, is the lowest amongst the metros and below the national average. The PHC facility utilization rate decreased in 2007/08 but was still higher than the national average of 2.2%, and the highest amongst the metros.

The hospital bed utilisation rate remains just under 80%. The cost per patient day equivalent in 2007/08 has decreased from the high value in 2006/07, but is still much higher than the SA average. The nurse clinical workload at 34.2 patients per nurse per year, although much lower than in 2006/07, was much higher than the national average but there appear to be numerous missing data errors with this indicator. The clinic supervision rate in 2007/08 showed that only half of all clinics in the district were visited by a supervisor once a month (Day *et al.* 2009)

Location of healthcare facilities in relation to settlement density

NMBM is divided into three health sub districts (Figure 51). Most clinics and hospitals are situated in sub district C. Health care facilities are clustered according to population density within NMBM (Figure 51). The number of health facilities and expenditure on health services and personnel is approximately constant throughout the rural and urban areas within the NMBM. The areas of concern where access to health care facilities is poor are Seaview, Van Stadens and Maitlands. Many areas are dependent on mobile clinic services, however these are not always regular (GRKK, 2002). Transport access to primary health facilities for immediate and follow-up care is critical. The majority of people in need of primary healthcare do not own vehicles. However, the NMBM has busses, available for the public, which travel in and out of town daily enabling them to access healthcare facilities.

11.4 Listed and suggested indicators

Listed below are the suggested health indicators for the NMBM as determined in GIBB (2009):

- Pregnant women in antenatal clinics testing positive for HIV/AIDS (percent);
- People suffering from TB (number per 100 000);
- Underweight births (percent);
- Infant mortality rate;
- Access to sanitation facilities; and
- Access to and location of healthcare facilities in relation to population density.

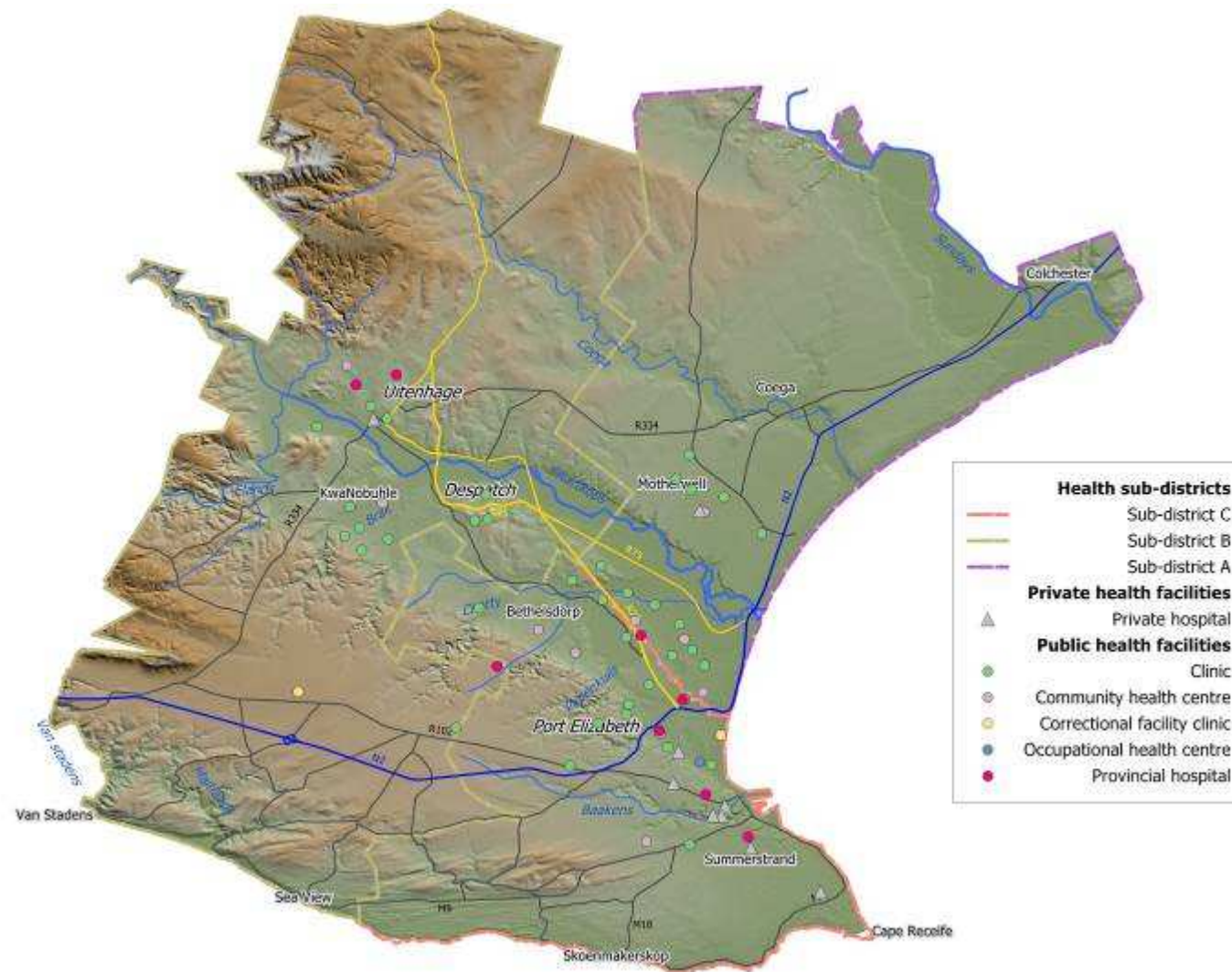


Figure 51. Health care sub-districts and major health care facilities in NMBM

11.5 Impacts

The impact of health on the socio-economic and biophysical environment is as follows:

- Exacerbates the impact of the HIV/Aids epidemic and in turn, HIV/AIDS impacts on all aspects of development. The impact of AIDS and the requirements of households, affected by the epidemic will in turn affect economic activities and municipal services, especially health facilities;
- The economy of the NMBM is compromised due to a loss of labour force leading to a loss of productivity and income per capita and ultimately contributing to economic decline;
- Decreased economic productivity and increased unemployment, because individuals who are in a state of ill health have greater difficulty securing and maintaining stable employment;
- Additional welfare payments for sickness and disability place further financial burden on the district;
- Places a huge strain on social services in the district;
- Poor-health, particularly diseases such as HIV/AIDS and TB is likely to heighten both the level and the depth of poverty, because income originally intended for education and nutrition is now diverted to medical care and funeral costs, and unemployment results in the reduction in household income; and
- An increased incidence of poor health places additional strain on the capacity of already stressed health facilities, resources and staff.

11.6 Responses

It is recommended that the NMBM implement the following initiatives and strategies:

- The National TB Control Programme aims to identify 80% of people who have TB and to cure them at the first attempt. NMBM should give the Control Programme its full support;
- NMBM must continually improve the access to, and efficiency of, its health care services;
- Equitable and effective access to appropriate health care infrastructure, both for immediate and follow-up care should be available to all citizens;
- The distribution of free condoms should continue;
- HIV/AIDS prevention should be a priority issue for all spheres of government;
- There is a need to intensify HIV/AIDS treatment programmes, and especially prevention campaigns. Community and home-based care should be better utilised and strengthened as an effective tool in the fight against HIV/AIDS
- Health and in particular, HIV/Aids awareness and education efforts must continue;

- The establishment of public facilities offering voluntary counselling and testing should be prioritized;
- Different methodologies result in estimates which at times are contradictory. Analysis of trends is thus complex given that there are numerous sources of data, which are based on different methodologies. It is therefore advised that the NMBM produce a fixed method for collecting data and also decide on which sources of data they will use in order to be consistent from year to year; and
- Gathered data should also be logged constantly by each sector to avoid gaps which could result in inaccuracies.

11.7 Linkages and inter-dependencies

Most themes covered in this report are linked to health, but those of key significance are:

Poverty – the general health of people living in poverty is far worse than that of more affluent citizens. Poverty often creates a vicious cycle where the conditions under which poor people live lead to bad health, malnutrition or isolation. These effects can diminish economic productivity and drive poor people further into poverty and bad health. All of these factors can decrease economic growth;

Water, sanitation and waste – inadequate provision of and poor access to sanitation and potable water increase people's susceptibility to diseases such as diarrhoea and cholera. Poorly managed waste services and practices can increase the risks of poor health and the spread of disease;

Air quality and climate – air pollution has an impact on overall health levels, especially diseases such as asthma, pneumonia and lung and heart diseases. Also, it is predicted that climate change is likely to change and increase the spread of malaria risk areas globally;

Inland water – the availability of sufficient and clean water for consumption, food preparation and personal hygiene is essential for good health;

Urban development – the characteristics of the urban environment such as quality of housing, quality of municipal services such as potable water provision, sanitation and waste removal as well as access to transport and health facilities have a direct impact on the health of people.

12 THEME: ENVIRONMENTAL GOVERNANCE

12.1 Introduction

Environmental governance commonly refers to the way in which structures of society manage the environment. This includes municipalities. Municipalities are faced with a complexity of legal obligations to safeguard the environment in all land use planning and decision-making. Through the Constitution and the National Environmental Management Act, and more specifically the Municipal Systems Act, Nelson Mandela Bay Municipality is obligated to take all reasonable measures to manage the environment and its sustainability.

The Municipal Systems Act (Act 32 of 2000) sets out the legislation guiding developmental local government. According to the definitions in Chapter 1, '*environmentally sustainable*' means the provision of a service that aims to ensure that risks of environmental harm and risks to human health and safety are minimised to the extent reasonably possible under the circumstances, and the potential benefits in these areas are maximised to a similar extent, while legislation intended to protect the environment and human health and safety is complied with.

Chapter 5 of the Act requires that municipalities develop an Integrated Development Plan (IDP) as the principle strategic planning instrument guiding and informing all planning, budgeting, management and decision-making in the municipality. An IDP should be based on a long-term vision through integrating planning and management across people, economy and the environment.

12.2 Drivers and pressures

Important driving forces putting pressure on environmental governance within NMBM are:

Agenda 21 is an internationally agreed commitment to sustainable development signed in Rio de Janeiro at the United National Conference on Environment and Development (UNCED). Local Agenda 21 is the chapter in Agenda 21 that describes the role of local government in the implementation of Agenda 21. Municipalities therefore have an internationally agreed commitment to implementing Local Agenda 21. The IDP is a primary vehicle for South Africa's implementation of Local Agenda 21.

The **Constitution of South Africa** - Municipal officials are bound by two provisions in the Constitution that deal directly with the duty of municipalities in relation to the environment. Section 24 provides that *"everyone has the right to an environment that is not harmful to their health or well-being; to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and*

secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.” Section 152 of the Constitution states clearly that local government must “*ensure the provision of services to communities in a sustainable manner*”, and must “*promote a safe and healthy environment*”.

National Environmental Management Act (NEMA) creates a legal duty on municipal officials to protect the environment and promote conservation. Section 2 of NEMA outlines development and decision making principles which are binding on all organs of state.

Public lobbying, particularly through the media, provides a continual backdrop for environmental improvement in the municipality where the public generally portray a watch-dog type role, where they are quick to alert to areas of environmental negligence.

Lack of capacity. The lack of capacity is probably the most significant driver when it comes to environmental management. Financial, human and physical resources are required to implement the function.

Poor cooperative governance. Communication between various government structures needs much improvement and results in a misunderstanding in terms of roles and responsibility, sharing resources and duplication of effort.

12.3 State

12.3.1 Recognition of the environment within the IDP framework

The Integrated Development Plan (IDP) is the municipality's principal strategic planning document. “A safe, secure, healthy and sustainable environment” is specifically listed amongst its strategic objectives during the 2009/10 IDP review period. On a day to day basis, the responsibility for the achievement of that strategic objective falls on the NMBM Directorate Public Health, Sub-directorate Environmental Management. As stated in the IDP, Environmental Management is responsible for protecting, maintaining and ensuring the sustainable utilisation of Nelson Mandela Bay's globally important biodiversity and environmental assets, as well as guiding the municipality with respect to environmental compliance and sustainability. In this regard, the following tasks, listed in the five-year IDP implementation framework, have been identified as important contributions. They are components of the Integrated Environmental Plan, one of the key sector plans of the IDP:

- Environmental Management Systems;
- State of Environment Report;
- Nelson Mandela Bay Municipal Open Space System;
- Integrated Waste Management Plan;
- Coastal Management Plan;
- Water Master Plan;

- Energy efficiency and renewable energy strategy; and
- Greening Policy.

The components of the Integrated Environmental Plan are being complemented by the Bioregional Plan, the Environmental Management Framework and the Integrated Air Quality Management Plan, all of which are currently under development.

12.3.2 Capacity within NMBM to implement its environmental management function

Required capacity

The United Nations Development Programme (UNDP) defines capacity as *“the ability for individuals, organisations, institutions and societies (individually and collectively) to perform functions, solve problems and set and achieve objectives.”* An evaluation of capacity essentially involves an assessment of whether the required resources and skills are in place. The required resources in turn comprise the following:

- Financial – capital and operating budgets;
- Human – managerial, supervisory, technical, support;
- Facilities and equipment – offices; vehicles, IT; and
- Systems – managerial, financial, reporting, administrative, communication.

Similarly, the required skills comprise the following:

- Technical expertise through competent training; and
- Experience gained in real-life situations.

Historically there has been very little capacity available within all spheres of government for environmental management. Key elements that have contributed to the shortage of skills and capacity for environmental management include:

- Environmental management is continually in competition with the provision of other basic services such as water, electricity and housing provision;
- Environmental management was not considered a priority in the past and legislation regulating it was only developed in the last 20 years. Even though the environment is considered one of the three pillars of sustainability, it is still not at the forefront of decision making;
- Environmental management is still an emerging science with few education opportunities or programmes. Formal training in environmental management as a science is usually offered as short courses in tertiary institutions; and
- Environmental management is a science that requires multi-disciplinary skills. For example it is an environmental science, with elements of, biodiversity; coastal; air quality, human health, safety, engineering and financial disciplines.

Structure and staffing

Environmental Management is one of five Sub-directorates in the NMBM Directorate of Public Health. It is tasked with:

- The promotion of biodiversity through the planning, development and implementation of NMB MOSS and the eco-tourism strategy;

- The rendering of an administrative and management service for the nature reserves and other natural areas in the municipal area;
- Vegetation control service on NMBM's undeveloped open spaces and property;
- The development and implementation of a Corporate Environmental Management System for the Metro;
- The development of an Educational Awareness Policy and Programme and its implementation;
- The development and implementation of a Coastal Management Programme;
- The coordination and facilitation of the submission and receipt of land use and environmental authorisation applications to the competent authority, the provincial Department of Economic Development & Environmental Affairs;
- Coordination of development and implementation of NMBM's energy efficient and renewable energy strategies and action plans.

As of mid-2009, the staffing plan of the Sub-directorate Environmental Management made provision for four divisions, each headed by a manager at the level of assistant director. Presently, only three divisions are operative, as available positions in the climate change unit have not been filled:

1. **Conservation Operations** render a service for the management of biodiversity corridors, undeveloped public open spaces and nature reserves.
2. **Environmental Interpretation and Education** provide an environmental interpretation, awareness and education service.
3. **Environmental Development and Planning** provide an environmental legislative guidance service for the planning and development of environmental strategies
4. When operative, **Climate Change** will provide a strategic climate change response, mitigation and adaptation service.

The present staff complement of the Sub-directorate Environmental Management comprises approximately 50 officers, ± 75 rangers and labourers, as well as some contract staff. Most staff are employed in the conservation operations division as they see to the smooth running of the Sub-directorate's outdoor operations. All senior staff in positions of leadership is well trained, mostly with tertiary qualifications. However, the number of vacancies among officer positions is of concern.

Budget allocation

The latest budget figures available are from the draft 2010/11 – 2012/13 municipal budget. They show a total municipal operating budget of R5.5 billion, with a capital budget of R2.9 billion.

A 'vote' is defined as one of the main segments into which a budget of a municipality is divided into for the appropriation of funds. Revenue and expenditure by vote of the Directorate of Public Health for the 2010/11 financial year amount to R314.5 million and R567.3 million, respectively. When summed in terms of the standard classification of the Government Finance Statistics (which allows comparison across municipalities), the figures for revenue and expenditure change to R206 million and R440 million, respectively, as they are reported under the category of 'economic and environmental

services'. Within this category, 'environmental protection' is allocated R1.35 million in revenue and R54.8 million in expenditure.

It should be noted that budget of the Directorate of Public Health is divided between its five Sub-directorates (Environmental Health Services, Environmental Management, Occupational Health, Safety & Wellness, Primary Health Care, Waste Management). Public documents do not reveal how the total budget is split between them. Assuming that the sub-category 'environmental protection' of the Government Finance Statistics reporting system represents a reasonably accurate description how much money is dedicated to the protection of biodiversity, the management of parks and reserves, and related research & development, it is worth noting that the R54.8 million in expenditure quoted above is just 1% of NMBM's entire budget.

12.3.3 NMBM's performance in fulfilling its environmental management function

The examples and performance assessments provided in the foregoing chapters of this State of the Environment Report have demonstrated that the municipal staff, with the assistance of its appointed consultants, has made great strides in assessing NMBM's physical assets and needs and developing dedicated policies to manage them. Highlights are:

- Environmental Management System
- NMB MOSS Conservation assessment and Plan
- Strategic Environmental Assessment Report
- Coastal Management Programme
- Integrated Air Quality Management Plan
- Alien Invasive Management Plan
- Integrated Waste Management Plan
- Water Services Development Plan
- State of Environment report (this document).

A Bioregional Plan in terms of the Biodiversity Act (Act 10 of 2004) for NMBM is well underway. This is in alignment with the National Biodiversity Strategy. In addition, the following important municipal planning documents have been developed and are being updated on an ongoing basis:

- Integrated Development Plan
- Spatial Development Framework
- Various Local Spatial Development Frameworks
- Various Conservation Development Frameworks
- Rural Land Use Management Policy
- Urban Densification Policy
- Tourism Master Plan.

Although not strictly falling into the group of frameworks and policies mentioned above, it worth noting that NMBM has developed a Disaster Management Plan & Framework (Strydom 2005), which amongst others contains environmental vulnerability maps for the metropolitan area.

By developing these plans and policies NMBM has demonstrated that it embraces the obligation of local government to incorporate sustainable development principles in its actions. It constitutes an appropriate response to the legislative requirements listed in the Constitution, the National Environmental Management Act, the Biodiversity Act, the Municipal Systems Act, the Integrated Coastal Management Act and others.

On a more practical and applied intervention level, the Sub-directorate Environmental Management through its Corporate Environmental Task Team (CETT) committee reviews all EIA applications where the municipality is the applicant, and then liaises with the regional office of the provincial Department of Economic Development & Environmental Affairs in matters of mutual interest.

The NMBM's six-strong environmental education division, which works from the Settlers Park office, reaches out to more than 25 000 persons per year through its environmental awareness programmes. The main target of the education programme is school pupils, but also includes other sectors of society, especially through activities on environmental calendar days (e.g. Arbour Day). The Sub-directorate Environmental Management also lends support to the four conservancies and one stewardship currently operative in the NMBM:

NMBM's environmental law enforcement function remains woefully under-resourced given that they are operating with a handful of officers in a huge area of 1958 km². Barely sufficient to prevent the worst environmental crimes in NMBM's eight Local Nature Reserves, there is no effective control in areas outside.

12.4 Indicators

The indicators, as determined in GIBB (2009), provide a cursory indication of environmental governance by the NMBM:

1. Institutional capacity for environmental management
2. Compliance with environmental legislation
3. Alignment of the Integrated Development Plan with the National Biodiversity Strategy and the bioregional plan.
4. Presence of a Strategic Environmental Assessment for the Spatial Development Framework
5. Presence of an Air Quality Plan
6. Presence of an Integrated Waste Management Plan
7. Consideration of environmental aspects in the Disaster Management Plan
8. Presence of a Water Services Development Plan
9. Percentage of municipal budget allocated to environmental matters.

All of the 9 indicators listed above have been enumerated in section 12.3 of this report, or have been dealt with under the Theme: Biodiversity.

12.5 Impacts

The impacts of poor environmental governance are far reaching but largely influence the following:

- Uncontrolled and inappropriate development;
 - Poor land use planning;
 - Uncontrolled resource extraction and utilization;
 - Loss of biodiversity;
 - Land degradation; and
 - Pollution of the environment (e.g. air, water, soil, coastal waters etc.).
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12.6 Responses

- NMBM needs to promote co-operative governance between Directorates within the municipality, as well as with provincial and national departments in environmental management.
 - NMBM should encourage managers of Directorates to take responsibility for environmental aspects that they have control over.
 - All NMBM staff require environmental awareness training.
 - Ensure availability of environmental sensitivity maps.
 - NMBM should continually improve on its environmental management system to guide environmental decision-making.
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12.7 Linkages and inter-dependencies

All themes covered in this report are linked to environmental governance.

12.8 Identified gaps

Since this is the first state of the environment report for NMBM, certain data has not been interpreted, such as detailed budgetary allocations to provide an indication of environmental performance as described in the indicator section of this chapter.

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