

## **7 LAND AND SOILS**

### **7.1 PRESSURES FACING LAND AND SOIL RESOURCES**

#### **7.1.1 Human settlement**

The role of people in influencing land degradation is varied. The primary form of human influence is the use of land resources for productive purposes: in other words, agriculture, the collection of plant resources for purposes such as fuel, building and, to a much lesser and more localised extent, mineral extraction and water collection. 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. A tertiary set of influences is incidental but often significant. It 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. Finally, conservation efforts are a form of human influence that are often positive.

Influences on people's productive land use include production goals, e.g. single or multicropping, single or multiple livelihood strategies; environmental and agricultural knowledge systems; technology, e.g. fencing, soil cultivation methods; and the socio economic context. This context provides a diverse, complex and interdependent range of determining influences over human impact on land resources, e.g. economic structures and relationships within society; social, political and institutional factors, including gender; land distribution arrangements; land tenure arrangements; and the structure and functioning of rural livelihoods.

#### **7.1.2 Societal development**

Some plant and animal species are threatened with extinction due to excessive harvesting for medicinal, ornamental, and horticultural purposes. Invasion and domination by alien species of plants and animals is a major problem in SA. Alien organisms out-compete indigenous species by using more resources (space, light, water, food) leading to a reduction (sometimes even local extinction) of indigenous populations, and alteration of the physical components of the ecosystems (Ballance, 2001). Human activities resulting in the introduction of alien species have had serious consequences for most natural habitats, in terms of changes in biodiversity, and altered functionality of ecosystem processes.

Urban and international demand for certain biological resources, for medicinal or horticultural purposes, also places pressure on populations of these often rare or endangered species.

#### **7.1.3 Mining**

Mining of minerals, sand and clay causes loss of soils and increases the risk of erosion of bare soils. Through the exploitation of these non-renewable resources, degradation of soil occurs.

According to GDACEL a great deal of the illegal dumping takes place below the flood line and in the mining belt. Unfortunately, most of the mining properties within the mining belt are privately owned and the rehabilitation and environmental management of the properties fall under the jurisdiction of the Department of Minerals.

#### **7.1.4 Industry**

The demand for industrial products causes increased use of heavy machinery and leads to atmospheric pollutants.

The industrial activities of man are the major sources of the dry fall-out of oxides of sulphur and nitrogen, as well as the wet deposition of acids (so-called acid rain) on soil surfaces. Man is also partly responsible for the increased carbon dioxide level in the atmosphere, leading to the deposition of carbonic acid on land.

#### **7.1.5 Energy sector**

Due to the growing demand and consumption of electricity, there is an increase in the production of pollutants from coal fired power stations, burning of mine dumps and rehabilitated spoil.

SA, which supplies two-thirds of Africa's electricity, is one of the four cheapest electricity producers in the world. Ninety-two per cent of South African electricity is produced from coal. Generation is dominated by the utility Eskom, which also owns and operates the national electricity grid.

The increased combustion of fossil fuels at Eskom power stations over a five year period are a response of the industry to an increasing demand for electricity. The increase in coal consumption is expected to continue for the next three to five years, as the demand for electricity increases.

The electrical power stations on the highveld are a major source of acid rain over the eastern escarpment of SA, affecting plantations and grassland productivity.

#### **7.1.6 Transport activities**

The increased need for transportation within an urbanised community leads to alteration of land, land use and ecosystems for use in road construction. Transport routes further lead to the reduction of land availability due to construction of routes and the need for land to dump vehicles withdrawn from use. The constructions of roads require excavation of minerals such as gravel. A growing transportation sector also means increased emissions of atmospheric pollutants, leading to acidification of soils and land.

#### **7.1.7 Agriculture**

The increasing demand for agricultural products cause impacts such as degradation of soil resources due to various pressures, including excessive use of fertilisers, overstocking, overgrazing, inappropriate crop rotations and site characteristics, machinery, pesticides and fertilisers, excessive burning causing deposition of atmospheric deposition, loss of nutrients and

fertility. This causes conflicts over land use and mismanagement of land leading to land degradation.

Arable farming practices and factors that contributed to land degradation included: increasing cultivation of marginal or unsuitable land, thus a mismatch between land use and land quality, for example, less fertile, more erodible soils, or fields on steep slopes; an ecologically excessive dependence on grain crop monoculture; labour shortages that prevented sustainable agricultural intensification; poor or politically unacceptable agricultural extension advice; insensitively delivered, and commonly rejected soil conservation programmes, which were also technically inappropriate in some instances.

The pressures on agriculture and forestry to meet national and international demands for food have encouraged the proliferation of monocultural crop production. This reduces biodiversity, and depletes soil nutrients faster than planting a variety of crops. Demand for food has also led to further pressure on marginal farmers, forcing the cultivation of unsuitable soils in risky climatic areas.

Subsidies on agrochemicals, designed to improve agricultural output, encouraged over-use of these chemicals, which have caused long-term damage to the structure and chemical nature of the soil as well as eutrophication to rivers.

Within the commercial farming sector reduced profitability of agricultural production and a reduction in government grants makes it increasingly difficult for farmers to invest money in activities designed to reduce resource degradation.

#### **7.1.8 Tourism and recreation**

The increased demand for tourism and recreation related infrastructure and activities, leads to resource exploitation with sometimes negative outcomes. Provision of sporting facilities results in changes in topography and ground surface profiles, disturbance of soils and compacted soils. Concentrations of vehicles or visitors on foot also produces localized soil compaction, often at environmentally and aesthetically sensitive sites (the attraction which brought tourists/recreationists there in the first place) and this may result in a loss of aesthetic quality and amenity in the landscape or site.

#### **7.1.9 Spatial planning and land reform**

Spatial planning and land reform has a positive impact on land through the redressing of past injustices by facilitating acquisition of land. This influences land distribution and eases pressure on resources. Land degradation is addressed through the alleviation of poverty.

#### **7.1.10 Policies and uneven distribution of wealth**

Land distribution arrangements are an obvious reflection of the political dispensation in a country. Again, SA very clearly displays in its landscape the way in which land rights have been distributed and administered. Other things being equal, the extent of productive land available to a land using

group or population will significantly influence land use practice and the potential for land degradation. If land distribution arrangements specifically expand or reduce the areas available to different groups, this is likely to have a direct impact on spatial variation in land uses and land use impacts;

Although only about 13.5% of SA is arable, 80% of the land is used for agriculture. Many centuries of exploitation and unjust land policies have left large tracts of SA degraded. Most of the siltation, erosion and water pollution problems in the area occur in the previously disadvantaged areas (i.e. Clayville) and in the disturbed mining areas in the mining belt. The main contributors to these problems are due to policies and distribution of wealth and include:

- Illegal squatting below the 1:50 year flood line;
- Insufficient storm-water management;
- The discharge of effluent into the water bodies of the study area;
- Illegal sand works in the water bodies;
- Illegal dumping (i.e. at the Bartlet Vlei area and in the Jet Park area); and
- The mining belt influences the wetlands and the water quality in the Blesbokspruit.

Internationally and within SA there is often a link between poverty and desertification. Resource-poor communities are forced to exploit their natural environment in order to survive. In SA, a partial or total breakdown in the traditional resource management systems has in effect led to open access resource use in many communal areas.

#### **7.1.11 Natural disturbances, natural processes and inherent natural characteristics**

International work shows unequivocally that soil properties are highly influential in determining whether degradation occurs at all, and if it does, then with what intensity. Soil chemistry, particle size distribution and structure all play a role in determining soil susceptibility to non-erosive degradation, but the bulk of information deals with soil erosion. Soil erodibility, the susceptibility of soil to erosion, is a critical parameter in soil loss analysis. Experimental work shows that the influence of slope is complex, and is strongly interrelated with land treatment and ground cover.

A large quantity of South African run-off plot data has accumulated in the country over the last 50 years or so, and many projects have monitored natural rainfall as one of the main variables. Notwithstanding this, reports or published information concerning fundamental research on the links between rainfall and soil losses are few in number, and although some work has linked soil losses to certain rainfall parameters in specific situations no serious effort has been made to develop a national or regional rainfall erosivity index. South Africans have generally been content to accept existing indices as satisfactory.

#### **7.1.12 Economic growth and export**

The need for economic growth, population factors, etc are driving forces which exert pressure on environment through increased demand for resources and ecosystem services, which in turn lead to exploitation and depletion of these resources. Conversion of land from natural habitats to agriculture, forestry and industrial systems to meet demands exerts a major pressure on the natural environment due to large transformed areas.

### 7.1.13 Land use

The most direct human contribution to land degradation is land use practice. Decades of inequitable land and development policies have shaped current land use patterns in SA and have resulted in severe land degradation. As a result of these policies, large numbers of people were forced into subsistence lifestyles and many of these people are still highly dependent on natural resources to meet their nutritional, medicinal, housing and energy needs (Ballance, 2001).

### 7.1.14 Physical location of South Africa

SA's terrestrial systems are fragile and must be managed carefully. Nearly 91% of the country falls within the United Nations definition of affected drylands. These are extraordinarily dry areas where the rainfall is low and potential evaporation is high. Dryland systems are often very sensitive to change. For example, crops grown in these areas are dependent on rainfall. Removal of vegetation (ground cover) from dryland areas can increase the risk of soil erosion, making the soil less fertile, and less able to support vegetation (natural or cultivated crops) in future.

### 7.1.15 Climate

Climate change alters the physical environment in ways that directly affect living organisms. Changing temperature and water availability conditions are likely to induce stresses in vegetation and component plant species, and may encourage mobile organisms to alter their distributions in the medium to long term. Climate change will possibly cause a gradually increasing pressure on the tolerance limits of native species, (i.e. if the average temperature increases by 2°C, the plant or animal species may not be able to withstand a fluctuation of a further 1°C). By causing these stresses in native species, climate change could also favour the success and spread of alien plant species.

## 7.2 STATE AND IMPACTS

### 7.2.1 Soils and soil quality

#### 7.2.1.1 Soils in the EMM

These are indicated in Figure 7.1. A description of each soil and slope unit is given below.

- Group 1 (36% of EMM): Well-drained red, apedal soils of the Hutton form (Hu) overlying weathering and hard rock and various other unconsolidated materials. In the EMM deep (>1000 mm, moderately deep 500-1000 mm, and shallow 300-500 mm Hutton soils are found with all four slope categories. This group lies from the Klipriviersberg Nature Reserve in the west, through Katlehong, Vosloorus eastwards towards Kwa Thema and further east to the eastern boundary of the EMM. Other areas of this soil-slope group lies from the west of Brakpan, eastwards through the Benoni-Brakpan-Springs mining belt towards Welgedacht in the east. Patches of this group are also seen in the northern SDR, in the Phomolong area surrounding the R561, from the R25 north-westwards through Tembisa and including Clayville

and Olifantsfontein, and in the northeast from the boundary through the Bapsfontein-Bronberg agricultural areas with small areas to the southwest of these areas.

- Group 2 (0.5% of EMM): Well-drained yellow-brown, apedal soils overlying either weathering rock of the Clovelly form or hard plinthite of the Glencoe form. Only moderately deep Glencoe soils are found in the EMM with slopes of 0-5%. These Gc soil-slope groups lie on the western boundary south of Alberton and the N13 in the Klipriviersberg Nature Reserve, south of Boksburg between Groeneweid and Sunward Park east of the R21, at Dalpark south of the R554 and east of the R23, and small areas east and north of Kwa Thema.
- Group 3 (20% of the EMM): Moderately well-drained yellow-brown apedal on soft plinthite soils of the Avalon form usually overlying hydromorphic, weathering rock or unconsolidated materials. Soils are wet in the deep subsoil for short periods in the year. In the EMM moderately deep and shallow Av soil area are found with 0-5% slopes. These areas lie mostly in the south of the EMM south of Tokoza, south and east of Vosloorus, east of Tsakane and eastwards to the north of Nigel. Avalon soils are also found east and west of Alberton, in the Groeneweid/Sunward Park area, north of Vandykpark south-eastwards towards the south of Vulcania, and eastwards towards Springs and Grootvalley.
- Group 4 (1.1% of the EMM): Hydromorphic, plintic soils, somewhat poorly drained, grey structureless topsoil on soft plinthic Westleigh, Longlands, and Wasbank. All profiles overlying gleyed, weathering rock or unconsolidated materials. Soils are wet throughout most of the profile for long periods of the year. In EMM – shallow Longlands and shallow Wasbank with slopes of 0-5%. Small areas of these soils are found in the northern SDR to the east of Kempton Park stretching eastwards to the north of Benoni farms. On the southern border of the EMM this group is seen south of the R550 and at Arla Park southeast of Nigel.
- Group 5 (2% of EMM): Hydromorphic, duplex soils: somewhat poorly drained, grey structureless topsoil overlying either gleyed structures Kroonstad subsoil of yellowish subsoil with strongly developed prismatic structure of the Estcourt form. Soils are wet throughout most of the profile for most of the year. In the EMM deep Kroonstad and moderate Estcourt soils occur with slopes of 0-5%. This soil-slope unit lies in an east-west band from Atlasville and Goedeburg northwest of Benoni, eastwards through Daveyton and Holfontein to the eastern boundary of the EMM.
- Group 6 (7% of EMM): Well-drained red structured Shortlands soils mainly overlying weathering, basic rocks or materials colluviated from the weathering of similar rocks. Deep, moderately deep and shallow Shortlands occur in the EMM, with slopes of 0-15%. This group occurs mainly in the central and north-eastern areas of the EMM; and east-west band surrounding Germiston and small patches in the New Modder area and south of Kingsway. The largest part of this group lies from Senderwood and Dowerglen, through Edenglen, through Kempton Park northwards to the west of Tembisa. The group continues to the east of Tembisa in patches north and south of R25.
- Group 7 (0.5% of the EMM): Non-hydromorphic paraduplex soils, dark coloured weak blocky cutanic subsoil overlying either weathering rock of the Swartland form or unconsolidated materials of the Valsrivier form. Only Swartland soils of moderate and shallow depth and slopes of 0-15% are found in the EMM. Swartland soils occur in small patches east and west of Katlehong, west of Tsakane, and wedges between soil-slope groups 1 and 3 to the northeast of Tsakane, with small patches northeast of Kempton Park and south of Bapsfontein.

- Group 8 (2% of EMM): Non-hydromorphic high base status melanic soils with dark moderately to strongly structured topsoil overlying with strongly structured cutanic subsoil of the Bonheim form, or weathering rock of the Mayo form, or hard rock of the Milkwood form. The EMM contains deep Bonheim soils with slopes of 0-5% and shallow Milkwood with slopes of 0-15%. This group is found on the most northern boundary of the EMM northwest of the Clayville/Olifantsfontein area, as well as a small area south of Kempton Park.
- Group 9 (0.2% of the EMM): Black vertic clay soils with high base status overlying weathering rock of the Arcadia form. Moderately deep Arcadias with slopes of 0-5% are found in the EMM. Very small areas of east and west of Brakpan.
- Group 10 (10.6% of the EMM): Hydromorphic dark coloured valley bottom soils of the Katspruit, Willowbrook and Rensburg forms. If not eroded, soils are wet for most of the year. Deep Katspruit, deep Willowbrook and deep Rensburg soils with slopes of 0-5% are found in the EMM. These soil stretch from Benoni eastwards to the east of the Belsbokspruit. The largest patch lies north of Benoni north and Daveyton towards Etwatwa. Other smaller areas lie surrounding Hughes, at Marais Steyn and west of Spartan.
- Group 11 (0.3% of the EMM): Well-drained valley bottom soils of the Oakleaf and Dundee forms. Only deep Dundee soils occur in the EMM with slopes of 0-5%. A very small area on the northeastern boundary north of Clayville.
- Group 12 (19.8% of the EMM): Usually shallow brown structureless soils with low base status overlying either weathering rock of the Glenrosa form or hard rock of the Mispah form. Shallow Glenrosas, as well as shallow and very shallow Mispahs occur in the area. These soil-slope groups occur on the southern boundary north of the R550, south of Vosloorus, south, north and northwest of Tsakane, south of Nigel, in the Putfontein/Etwatwa/Holfontein area, as well as in the north south and southwest of Bapsfontein.
- Group 13 consists of urban areas and group 14 of mine dumps, excavations and slimes dams.

**Figure 7.1 Soil and Slope Units in Ekurhuleni**

### 7.2.1.2 Soil quality

Potential point sources of soil pollution in the EMM are depicted in Figure 7.2 and include various products from the sources listed below:

- **Mines:**

- **Bentonite:** The Rondebult Fireclay Quarry and the Rondebult Clay Works are situated north of the N12 and south of the Boksburg farms. Both mines are closed.
- **Clay:** 4 brickworks are currently operational in the EMM and include Clyde Bricks and east of Bredell, Holfontein Brickworks north of Holfontein, the Corobrick Springs Clay Quarry south of Nuffields, and AB Brickworks in Brentwood Park
- **Dolomite:** The Rooikraal quarry, on the southern border of the EMM, has dolomite as first commodity. This is an open surface mine.
- **Fireclay:** The Semrec Clay Quarry Pit 25 north of Beyerspark in Boksburg, Economic Fireclay works south of Boksburg south and Rietfontein Quarry are currently operational. The Elgin Fireclay quarry, Union fireclay works and Cullinan No 1 quarry are closed mines.
- **Gold:** There are 7 operational gold mines in the EMM and 19 closed mines. The open mines are located southeast and northeast of Springs, west and southeast of Germiston, southwest of Boksburg and southwest of Brakpan.
- **Kaolin:** The Van Ryn Sand & Kaolin Quarry (closed mine) are located at Crystal Park northeast of Benoni.
- **Quartzite:** The Benoni Stone Crushers is the only open quartzite mine in the EMM, while the Alpha Stone east of Benoni, SA Stone Benoni and SA Stone Brakpan are open works. There are 10 other closed works and 6 closed quartzite mines in the EMM.
- **Sand:** The Witfontein Sand Quarry northeast of Kempton Park, Olifantsfontein Sand Operation west of Clayville and the Tweefontein Quarry south of the R25 and east of the R21 are open sand mines. There are 6 other closed sand mines/quarries in the EMM.
- **Shale:** Shale was the main commodity of the Varkensfontein Quarry. This is a closed mine east of Nigel.
- **Silica:** The Cullinan silica quarry and Cullinan Minerals are closed mines.

- **Factories** are potential point sources of pollution:

- The Olifantsfontein and Clayville industrial area is situated to the north of Tembisa and accommodates predominantly heavy industrial activity and even some noxious activity.
- The Isando, Spartan and Jet Park complex is situated west of the JIA and focuses predominantly on a range of light and heavy industrial activities. In Edenvale a few smaller light industrial and commercial areas occur.
- The Germiston industrial area comprises a portion to the east of the Germiston CBD, and a portion to the west.
- The Wadeville, Alrode and Roodekop industrial areas are situated to the south and provide in a range of heavy, noxious and light industrial activities.
- In the central part of the EMM the Boksburg East, Anderbolt, Benoni South and Apex industrial areas occur. These are fairly old industrial areas focusing predominantly on heavy and noxious industrial activities.

- Further to the east are the smaller industrial areas of Brakpan (Vulcania, Fulcrum and New Era, Springs (Nuffield) and Nigel (Vorsterkroon, Pretoriusstad and Prosperita).
- **Towns, informal settlements and squatter camps** are potential non-point sources of pollution:
  - Major CBD areas include Kempton Park, Edenvale, Alberton, Germiston, Boksburg, Benoni, Brakpan, Springs and Nigel.
  - There are four major concentrations of disadvantaged residential areas predominantly situated on the urban periphery of the EMM. All four these settlements are situated on the outskirts of the urban area and are the areas furthest removed from where the bulk of the job opportunities are situated. These four areas are Tembisa, the Katorus complex (Katlhlong, Tokoza and Vosloorus), the Kwatsaduza complex (Kwa Thema, Tsakane and Duduza) and the Daveyton-Etwatwa complex. Informal settlements and squatter camps are concentrated mainly around these 4 complexes, although various informal settlements and squatters in an east-west band from the west of Germiston through to the east of Brakpan, some to the south of Daveyton, and surrounding Springs.
- **Landfill sites** are located at Rooikraal northeast of Vosloorus, Scaw Metals southeast of Alberton, Simmer&Jack west of Germiston, Weltevreden north of Brakpan, Sappi Enstra northeast of Springs, Rietfontein southeast of Kwa Thema, Nuffield southeast of Springs and Nigel.
- **Waste sites** are located in Alberton (Verwoerdpark), Simmer in Germiston, Rooikraal (northeast of Vosloorus), Verref-Rietfontein (southeast of Kwa Thema), Nuffield southeast of Springs, Weltevreden north of Brakpan, Nigel, Holfontein, Mooifontein northwest of Kempton Park, and at Tembisa.

**Figure 7.2 Potential sources of soil pollution**

## 7.2.2 Land condition

### 7.2.2.1 Land use and land cover change

Table 7.1 contains a summary of the change in land use patterns between 1995 and 2000, as calculated from the 1995 National Land Cover (NLC) Database and the NLC 2000 data. The calculations indicate that there was an increase in natural land uses, with areas being transformed for grazing and industry. This may a function of the differences in survey and mapping methodology and scale between the two dates, and does not necessarily reflect real changes in land cover. Caution should therefore be applied when using these statistics. There was a decrease in forestry, cultivation, urban, commercial and mining land uses, while there was no change in the % of degraded land. Detailed descriptions of the land use and land cover of the EMM in 1995 and 2000, are given in Appendix A.

**Table 7.1 Land use change between 1995 and 2000**

Land use Type	1995		2000		Increase/Decrease
	%	ha	%	ha	
Natural	38.5	74 738	42.7	82 149	Increase
Degraded	0.01	19	0.01	19	No change
Transformed (grazing)	1	2 555	1.6	3 079	Increase
Transformed (forestry)	1.5	2 721	0.9	1 731	Decrease
Transformed (cultivation)	18	34 063	15.21	29 262	Decrease
Transformed (urban)	29.89	57 518	27.38	52 676	Decrease
Transformed (commercial)	2.5	4 557	2.3	4 425	Decrease
Transformed (industrial)	2.6	5 069	5.4	10 389	Increase
Transformed (mining)	6	11 147	4.5	8 657	Decrease

### 7.2.2.2 Land degradation

According to the land use discussion, 35% of the EMM consists of urban/built-up areas, with a further 26.5% of the EMM having been transformed to anthropogenic, non-urban land uses. Thus, only 38.5% of the EMM remains 'natural' features.

The Combined Degradation Index (CDI) is an index describing the combined severity and rate of soil and vegetation degradation in an area (Hoffmann, 2000). A description is provided below.



- In Gauteng the CDI is 143. Almost 96% of the EMM has a lower CDI than the Gauteng average, with only 4.1 % of the EMM having a CDI of 160, higher than the Gauteng average (Figure 7.3). 4% of the high CDI of the EMM lies in the Bapsfontein-Bronberg agricultural area on the north-eastern boundary of the EMM. This is an area of extensive agriculture, high

dolomitic soils and minimal engineering and municipal services. The other high CDI covers 0.1% of the EMM and lies on the northern border to the east of Clayville. Both these areas have the highest VDI in the EMM and second highest SDI. Alien trees, poor grassland cover and resultant poor rangeland condition characterises these areas.

- CDI value and contributing factors:
  - 82: SDI 47 and VDI 35 area surrounding the Nigel/Duduza and McKenzieville residential areas
  - 100: SDI 99 and VDI 1 east of Alberton and Germiston
  - 100: SDI 100 and VDI 0 surrounding the town of Germiston
  - 100: SDI 40 and VDI 60 northeast of Etwatwa
  - 101: SDI 99 and VDI 2 from the north of Boksburg to south of Vosloorus
  - 102: SDI 100 and VDI 2 from Etwatwa in the east, south-westwards to include Daveyton, Rynsoord, Benoni, Actonville and Watville
  - 103: SDI 100 and VDI 3 very small area to the north of Phomolong and Chlookop urban residential areas
  - 105: SDI 100 and VDI 5 Olifantsfontein-Clayville-Kempton Park-Tembisa area, as well as the Alberton-Katlehong-Tokoza area
  - 113: SDI 98 and VDI 15 Springs-Kwa Thema-Bakerton area
  - 120: SDI 100 and VDI 20 east of the R26 and north of the R550, from Brackendowns southwards to the southwestern boundary
  - 125: SDI 120 and VDI 5 Brakpan-Tsakane-Geluksdal area
  - 138: SDI 100 and VDI 38 from the southern boundary of the EMM to the south of Vosloorus, and includes Sondwaba Park, Zonkiszwe Proper and Zonkiszwe extension.



**Figure 7.3 Land degradation - Combined Degradation Index (CDI)**

### 7.2.2.3 Rangeland condition/degradation

According to the Gauteng Natural Resources Audit (ISCW, 2001)(Table 7.2):

**Table 7.2 Rangeland Condition in Ekurhuleni**

GRASS COVER	% OF AREA	ha
Good condition	31	59 816
Intermediate	9.2	17 641
Bad condition	3.1	5 696
Very low	2.9	5 488
Bare soil	0.7	1 358
Alien trees	2.8	5 439
Water	1.1	2 151

- 31% of the EMM is covered by grasslands with a good condition (> 60% cover) (Figure 7.4):
  - southwest of Alberton in the Klipriviersberg Nature Reserve and along mainly along stretches of tributaries of the Kliprivier within an area with a very low veld degradation index;
  - west and southwest of Katlehong and Tokoza along the Kliprivier tributary in an area with a moderately low vegetation degradation index;
  - south, east and north of Katlehong along the Natalspruit towards the east of Alberton and along the Elsburgspruit (tributary of the Natalspruit) south of Elsburg;
  - from the Rietspruit south of Vosloorus to the R550 and along the Rietspruit and Withokspruit to the west and south of Kwa Thema;
  - along the entire Blesbokspruit from the north and east of Nigel to the north of Benoni farms, as well as the large east-west tributary of the Blesbokspruit from the north of Bakerton to the north of Benoni;
  - along the Grootvleirivier stretching from the north-eastern boundary of the EMM through Bapsfontein;
  - along the Rietvleirivier stretching from the northern boundary to Benoni north and the west of Kempton Park;
  - along the Kaalfontein from the north-western boundary of the EMM to the Phomolong area.
- 9.2% of the EMM is covered by grasslands with an intermediate rangeland condition (40-60% cover):
  - grasslands with 40-60% cover along the western boundary of the EMM in parts of the Klipriviersberg Nature Reserve south of the N13;
  - along parks/open spaces south of Germiston;
  - in parks/open spaces east of the R26;
  - areas between Palm Ridge and Sondwaba Park;

**Figure 7.4 Grass cover and rangeland condition in 2001**

- areas southwest of Vosloorus;
  - large areas between Vosloorus and Kwa Thema;
  - sections in the informal settlements east of Nuffields;
  - areas southeast of Welgedacht;
  - patches west of Springs;
  - small areas between Daveyton and Kempton Park;
  - areas west of the Rietvleirivier;
  - patches northwest of Clayville;
  - areas south and north of Bapsfontein.
- 6% of the EMM is covered by grasslands in a bad condition, showing severe grass species change and a reduction in cover (< 40% cover), of which 3.1% is in bad condition and 2.9% in severe condition with a very low cover:
    - rangeland with bad to very low cover is found between Palm Ridge and Sondwaba Park west of the Natalspruit within an area with the second highest veld degradation index in the EMM, higher than the Gauteng average;
    - patches between Vosloorus and Kwa Thema;
    - west of the Sub-Nigel Gold Mining Company;
    - patches in the Struisbult area;
    - patches near Springs Rest;
    - various small sections between Daveyton and Kempton Park;
    - sections north of Tembisa;
    - surrounding the Rietvleirivier;
    - areas northeast of Bapsfontein within an area if the highest veld degradation index in the EMM, higher than the Gauteng average.
- 2.8% of the EMM is covered by alien trees:
    - alien trees are found in small parts of the Klipriviersberg nature reserve;
    - east of Alberton at the crossing between the N3 and N17;
    - north of the N17;
    - small patches east of Germiston, east of Benoni and north of Brakpan;
    - small patches along the entire Blesbokspruit;
    - small stands west of Kempton Park;
    - larger stands north and southeast of Clayville;
    - areas north and south of Bapsfontein.
- 0.7% of the EMM is covered by bare soil:
    - bare soil is visible in areas between Edenpark/Palmridge and Sondwaba Park in an area with the second highest soil degradation index in the EMM;
    - at the informal settlements on the outskirts of the Tsakane and Geluksdal areas within the area of the highest soil degradation index, higher than the Gauteng average;
    - areas on the outskirts of Duduza including the Masetlabe View Ext area to the south;
    - areas between Duduza and Dunnottar;
    - areas northwest and northeast of Withok Estates;
    - patches in the Struisbult area;
    - patches in the Kingsway area southwest of Daveyton;
    - patches between Daveyton and Kempton Park;
    - Kruihof area north of the R24;

- south and north of Tembisa.

The remainder of the area is covered by cultivated lands, urban areas, mines and some waterbodies.

#### 7.2.2.4 Erosion Hazard for EMM

Soil erosion resulting from surface water runoff is one of the most important and easily recognisable indicators of land degradation. The 1:50 000 soil information of the old PWV region was used in the Gauteng Natural Resources Audit as the base map for determining the soil erosion hazard of the EMM.

Erosion hazard is the rate of soil loss expected in the near future, due to rain erosion, depending on the combined and interactive effects of all erosion hazard factors: climate, topography, soil, present erosion, land use, and vegetation and cultivation systems. Erosion hazard is thus the probability of serious erosion starting in the near future (a period of about 3-5 years). When serious natural or accelerated erosion is already occurring, the erosion hazard expresses the expected intensity and rate of erosion processes. The attached erosion hazard map predicts the current and future average annual soil loss in tons/ha/year (Figure 7.5).

The erosion hazard is influenced by the physical environment as well as the mismanagement of the land. 68% of the EMM was assessed in terms of erosion hazard of grasslands (Table 7.3):

**Table 7.3 Erosion hazard in Ekurhuleni**

EROSION HAZARD	SOIL LOSS (tons/ha/year)	% OF AREA	ha
Very High	> 60	0.2	418
High	25-60	2	3874
Moderate	12-25	4.5	8588
Low	5-12	6	11626
Very Low	<5	55.5	106 489

- Only 0.2% of the EMM has a **very high** erosion hazard and a predicted loss of > 60 tons of soil per hectare per year. Various very small areas covering a total of 418 ha of the EMM, has a very high predicted future soil loss due to erosion. These include:
  - Areas in the far southwestern portions of the EMM north of the R550. This includes shallow brown structureless soils with low base status overlying either weathering rock or hard rock. These portions also lie within an area with the second highest soil degradation index and highest veld degradation index (higher than the Gauteng average) in the EMM. These two small portions lie within the Rautenbach Farm informal settlement and squatter area;

**Figure 7.5 Erosion hazard in Ekurhuleni**

- Small patches within the Klipriviersberg Nature Reserve;
- An area between the N17 and the Hippo-Unified Crusher mining area west of Farrar Park, corresponding with soil-slope group 3 having limited soil depth;
- Small soil patches with a very high erosion hazard lie scattered within the mine dump west of the R23 to the west of Tsakane;
- Small patches west of Nigel on a slimesdam and south of the Spaarwater Gold Mine;
- An area on the Sallies Gold Mine slimes dump northwest of Kwa Thema;
- A patch on a mine dump west of an unnumbered main road to the northeast of Bakerton;
- On the edges of the Power Crushers-Modrea mine dumps and the Kingsway-Springs urban edges, as well as in parts of the Lindelani informal settlement;
- To the north of Kingsway north of the N12;
- On the edge of a mine/slimes dump south of the Van Ryn Sand and Kaolin Quarry west of Daveyton;
- To the east of Daveyton in the open spaces east of the Chris Hani informal settlement, and east of the Blesbokspruit north of the N12 in the Holfontein area;
- The edge of a wetland north of Rynfield;
- To the northeast of Kempton Park at the Witfontein san quarry and northwest of Kempton Park on the edge of the Chloorkop industrial area;
- To the west of Clayville west of the Kaalfontein on a mine dump southwest of the Olifantsfontein Sand Operation and at Clayville Sand;
- Scattered areas north-eastwards from Tembisa and Kempton Park to Bapsfontein within commercial drylands. North of Bapsfontein these areas fall within an area with the highest veld degradation index (higher than the Gauteng average) and a moderately high soil degradation index, resulting in the highest combined degradation index in the EMM.
- Only 2% of the EMM have a **high** erosion hazard, meaning a predicted soil loss of 25-60 tons/ha/year. Areas of high erosion hazard are located:
  - North of the R550, with patches within the Rautenbach Farm informal settlement and Palm Ridge Ext. 2, Phases 5 and 6 informal settlements;
  - East of the R550 on the southern border of the EMM within areas of commercial drylands in an area with the second highest combined degradation index in the EMM, of which the veld degradation index is higher than the Gauteng average;
  - Large patches on the mine dump west of Tsakane west of the R23;
  - Areas west and north of Nigel mostly on the edges of industrial areas and on mine dumps;
  - On the edges of the mine dump northwest of Kwa Thema;
  - Small patches within the Klipriviersberg Nature Reserve;
  - Areas between Sunward Park and Groeneweid north of the R554;
  - Areas on the outskirts of mine dumps south of the R554;
  - Larger stretches southeast of Daveyton north and south of the N12 and east and west of the Blesbokspruit, mainly within the cultivated commercial dryland area between Holfontein and Welgedacht;
  - Small areas west of Clayville on a mine dump southwest of the Olifantsfontein Sand Operation and at Clayville Sand;

- Various patches north and south of the R25 within commercial drylands and unimproved grasslands.
- 4.5% of the EMM has a **moderate** erosion hazard with a predicted loss of 12-25 tons/ha/year:
  - Patches with a moderate erosion hazard are located surrounding areas with a high and very high erosion hazard, and can clearly be seen north of the R550 on border southwest of Tokoza and south of Vosloorus, on mine dumps west of Tsakane, informal settlements and squatters of Duduza and Tsakane, areas within the Nigel mining belt and Nigel industrial area, on the edges of the mine dump northwest of Kwa Thema, areas west of Brakpan, stretches within the cultivated commercial dryland area between Holfontein and Welgedacht including the informal settlements and squatters of Gugulethu, Everest, Skoonplaas and Lindelani, areas west of Clayville including cultivated commercial drylands, mine dumps, industries, quarries and sand mining operations, and lastly various patches north and south of the R25 within commercial drylands and unimproved grasslands east of Kempton Park and Tembisa towards Bapsfontein.
- Land with a **low** erosion hazard (5-12 tons/ha/year) covers 6% of the EMM:
  - Areas of low erosion hazard can be seen in association with all the above mentioned areas of moderate erosion hazard.
- 55.5% of the EMM is covered by land with a **very low** erosion hazard (< 5 tons of soil loss per hectare per year):
  - The largest portion of the EMM has a very low erosion hazard. This corresponds with all the undisturbed areas of the EMM, including unimproved grasslands, water bodies and wetlands, thicket and bushland, as well as most smallholdings within the EMM.

### 7.2.3 Land capability, agricultural potential and grazing potential

#### 7.2.3.1 Land capability

As with the soil-slope groupings described in Section 7.2.1 in the state of soils, urban areas and disturbed sites of mines, excavations and slime dams have no land capability class.

Land Capability classes were obtained from the 2002 GAPA data and were based on the soil-slope units described in Section 7.2.1 with the dominant limiting factors influencing the suitability for selected land uses being the main contributing factor to the land capability class selection. A map of land capability and areas for each class are presented in Figure 7.6 and Table 7.4 respectively.

**Class I Arable** (6% of the EMM): This class has no limiting factors that restrict the use of the land for crop cultivation. The deep Hutton1 soil-slope group conforms to all the criteria for this land capability class, as the soil is deep (> 1000 mm) and nearly level (slopes 0-5%). Within this land capability class soils are well drained, easily worked, need ordinary management practices to maintain productivity and the soil climate is favourable for growing many of the common field crops. This class is highly suitable for dryland maize production and high suitable for general irrigated crops, as well as tomatoes, spinach and cabbage.

**Table 7.4 Area of land capability classes in the EMM**

CLASS	% OF AREA	ha
I (Arable)	6	11 833
ii (Arable)	30	57 175
iii (Arable)	22	41 061
iv (Arable)	13	25 340
V (Grazing)	22	42 357
VI (Grazing)	1	2 062
VII (Grazing)	1	2 326
VIII (Wildlife)	5	8 732

In the EMM LC Class I lies to the east of Benoni south of the Jetpark industrial area north and south of the N12 in the vicinity of Witfield, and from Jensen Park and Morganridge east of the R21. Larger stretches of LC Class I can be seen in the northeast and east of the EMM from the south of Bapsfontein stretching to the west and north of Daveyton, and along the eastern boundary from the east of Holfontein to the south of the R554. Smaller patches lie to the east, west southeast and southwest of Nigel, including the Arla Park area and south of Ceruitville.

**Class II Arable** (30% of the EMM): This class covers most of the EMM and has few limitations which reduce the choice of plants or require moderate conservation practices, with farming practices being easy to apply. Cultivation can thus occur but with slightly less choice of crops and management practices than Class I. In the EMM this class includes various soil-slope units with different dominant limiting factors. The deep Hutton2 group has a high clay content, moderately deep Hutton6 has a limiting soil depth (500-1000 mm), moderately deep Hutton7 has a limiting soil depth and high clay content, both moderately deep Avalon6 and 7 have a limiting soil depths and impeded internal drainage in the subsoil, moderately deep Glencoe1 has a limiting soil depth and moderately deep Glencoe2 has a limiting soil depth and high clay content. Slopes are all between 0 and 5%. All soil-slope groups in this LC Class, except for the two Avalon groups, are moderately-highly suitable for dryland maize production and irrigated crops. The Avalon groups are moderately-highly suitable for dryland maize production, but due to the impeded internal drainage in the subsoil, only moderately suitable for irrigation of tomatoes, spinach and cabbage and have a low suitability for general irrigated crops.

In the EMM this LC class lies in the southern SDR from the south of Tokoza, through the south and north of Vosloorus, eastwards to the east and west of Kwa Thema and then southeastwards to the west and north of Nigel. The class also runs from the west of Brakpan and Springs northeastwards to the north and east of Daveyton, as well as in the from the northern and northwestern boundary of the EMM west of Clayville, southeastwards to the north and east of Tembisa, east of Kempton Park and west and including Bapsfontein.

**Figure 7.6 Land capability in Ekurhuleni**

**Class III Arable** (22% of the EMM): Severe limitations, which may reduce the choice of plants and require special conservation practices are present in this class. Cultivation can occur but has more restrictions than class II, with conservation practices more difficult to apply and maintain. Rainfall efficiency and low clay content limit the suitability of the deep Hutton4 group, while the dominant limiting factors within the moderately deep Hutton9 group are rainfall efficiency, limiting soil depth and low clay content. The shallow Hutton10 group has a limiting soil depth of 300-500 mm. Moderately deep Glencoe3 is limited by rainfall efficiency and soil depth and shallow Avalon9 by limiting soil depth and impeded internal drainage in the subsoil. Within the Shortlands group, deep Shortlands2's limiting factors include soil depth, moderate to strong structure and high clay content, deep Shortlands3 moderate to strong structure, high clay content and rainfall efficiency and moderately deep Shortlands4 limiting soil depth, moderate to strong structure and high clay content. Deep Bonheim1 and 2 are both limited by a moderate to strong structure and high clay content, while deep Dundee1 has low clay content, flood hazard and textural variations. Lastly shallow Glenrosa3 has a limiting soil depth. This class has a low-moderate suitability for dryland maize production, a very low-moderate/high suitability for general irrigated crops and low to high suitability for irrigation of tomatoes, spinach and cabbage depending on the soil-slope unit.

In the EMM this LC class covers areas on the southern border of the municipality south of Tokoza and Vosloorus, west, north and south of Tsakane, and west, north and east of Nigel. In the north this LC class surrounds Daveyton in the east, west, south and north, with further areas surrounding LC classes I, II, IV and V between Bapsfontein and Deveyton.

**Class IV Arable** (13% of the EMM): This class has very severe limitations that is more restricted than the crop choices in Class III, and requires very careful and more difficult management and conservation practices. The deep Kroonstad1 group is limited by a low clay content and impeded internal drainage, moderate Swartland1 by limiting soil depth, moderate to strong structure and high clay content, moderate Swartland2 by limiting soil depth, moderate to strong structure and rainfall intensity, moderately deep Arcadia2 by limiting soil depth, moderate to strong structure and high clay content and lastly shallow Glenrosa1 by limiting soil depth. This class has a low to no suitability for dryland maize production, a moderate to no suitability for general irrigated crops, and low to no suitability for irrigation of tomatoes, spinach and cabbage.

In the EMM this class lies in small areas on the southern boundary, west of Tsakane and west of Nigel. A larger class representation occurs in the Klipriviersberg Nature Reserve on the east, from Delmore Gardens to Reiger Park west of Boksburg, near the suburb of Edenvale, surrounding Phomolong and in the Rynfield area. Some very small areas occur further north.

**Class V Grazing** (22% of the EMM): This class is generally not suited to cultivation with little or no erosion hazard, but contains other limitations making it more suitable to pasture, range, woodland and wildlife. Limiting factors include wet or frequently flooding soils, stony soils and climatic limitations or a combination of the above. Low lying areas, stony or rocky areas with a low gradient and saturated areas fall within this class. Hutton11R and 13R have rock outcrops and limiting soil depths and are situated south of Tokoza and north and south of Vosloorus, as well as in the north of Tembisa in the upslopes of the Kaalfontein. The shallow Longlands2, and shallow Wasbank1 and 2 groups have impeded internal drainage and limiting soil depth. Moderate Estcourt2 and 3

have impeded internal drainage, difference in clay content between the topsoil and subsoil, and a water erosion hazard. Shallow Shortlands6R, shallow Swartland3R and shallow Milkwood 1R have a limiting soil depth, moderate to strong structure and rock outcrops, while shallow Shortlands 7R has a limiting soil depth, rainfall efficiency and rock outcrops. The Katspruit, Willowbrook and Rensburg soil-slope group 10 (Section 7.2.1) all have impeded internal drainage and flood hazard. This class has no to low suitability for dryland and irrigated crops, with the exception of the Shortlands soils which have a moderate suitability to irrigation of cabbage, tomatoes and general irrigated crops.

The group 10 soil-slope unit stretches from Benoni eastwards to the east of the Belsbokspruit. The largest patch lies north of Benoni north along the Rietvleirivier and along the Blesbokspruit north, south and east of Daveyton towards Etwatwa. Other smaller areas lie surrounding Hughes where it is wedged between LC Class I to the northwest and southeast and LC Class VIII to the northeast, at Marais Steyn and west of Spartan. The remainder of the soils in this land capability class lies along the river courses in the EMM, including the Kaalfontein in the north, the Natalspruit and Rietspruit in the south and the and the Blesbokspruit in the east, as well as in rocky areas. The shallow Shortlands6R lie in combination with the moderate Swartland1 in the Klipriviersberg Nature Reserve on the east. Both these soil types have limiting soil depth and moderate to strong structure.

**Class VI Grazing** (1% of the EMM): This class is generally not suited to cultivation with severe limitations limiting these areas to range, woodland or wildlife. This class has continuing limitations that cannot be corrected, such as steep slopes, severe erosion hazard, stoniness, part erosion problems, shallow rooting zone, excessive wetness, low water holding capacity, salinity, sodicity and severe climate. The Hutton12R has rock outcrops, limiting soil depth and steep slopes of 5 to >45%. The shallow Glenrosa4R has limiting soil depth and rock outcrops, and the shallow Mispah1 and 3 have limiting soil depth. The Hutton and Mispah soils have no to very low suitability for both dryland and irrigated crops, while the Glenrosa soils have a low suitability for tomatoes, spinach and cabbage.

Shallow Mispahs lie from Delmore Gardens to Reiger Park west of Boksburg surrounding LC class IV. Huttons lie in to the northeast of Tembisa, with the Glenrosas occurring northwest of Tembisa and north of Bapsfontein.

**Class VII Grazing** (1% of the EMM): This class has severe limitations restricting land use largely to grazing, woodland or wildlife, due to limitations such as very steep slopes, erosion, shallow soils, stones, wet soils, salts or sodicity and unfavourable climate. Within the EMM this class consists only of the very shallow Mispah2 soil-slope group with a limiting soil depth of < 300 mm. This area lies to the west of Tokoza and Katilehong, and in the north of Bapsfontein. The area has very low to no suitability for either dryland or irrigated crops.

**Class VIII Wildlife** (5% of the EMM): Limitations preclude this class for commercial plant production and restricts its use to recreation, wildlife, water supply and aesthetic purposes. Limitations cannot be corrected. Within the EMM the very shallow Mispah4R soil-slope group falls in this LC class. This group has limiting soil depth, rock outcrops and steepness of > 45%. The area has no suitability for either dryland or irrigated crops. Class VIII lies in patches on the

southern boundary south of Tokoza, northeast and southwest of the crossing between the N3 and R103, northern areas of the Klipriviersberg Nature Reserve stretching north-eastwards towards the north and east of Alberton, south of Reiger Park and west of Farrar Park, surrounding the N12 west of Benoni, northeast of Kempton Park northwest of Clayville, west and northeast of Bapsfontein.

### 7.2.3.2 Agricultural Potential

Agricultural potential classes were obtained from the 2002 GAPA data and were based on a combination of the general agricultural suitability for irrigated crops and the groundwater potential of the area. Groundwater availability and agricultural suitability classes were ranked as follows:

*Groundwater availability:*

High (> 5 l/s)

Moderate-High (2-5 l/s)

Moderate (0.5-2 l/s)

Low (0.1-0.5 l/s)

*Agricultural suitability:*

1. Highly suitable

2. Moderate-Highly suitable

3. Moderately suitable

4. Low suitability

5. Low-None

General potential for irrigation is described in the land capability section above. Resulting agricultural potential classes were determined as indicated in Table 7.5, a map of which is presented in Figure 7.7.

**Table 7.5 Resulting Agricultural Potential**

		GROUNDWATER AVAILABILITY			
		HIGH	MODERATE-HIGH	MODERATE	LOW
AGRICULTURAL SUITABILITY	1. HIGH	HIGH	HIGH	HIGH	MODERATE-HIGH
	2. MODERATE-HIGH	HIGH	MODERATE-HIGH	MODERATE-HIGH	MODERATE
	3. MODERATE	MODERATE-HIGH	MODERATE	MODERATE	LOW
	4. LOW	MODERATE	LOW	LOW	LOW-NONE
	5. VERY LOW -NONE	LOW-NONE	LOW-NONE	LOW-NONE	LOW-NONE

**Agricultural Potential Class 1** (High – 13% of the EMM): This class has groundwater availability of moderate, moderate to high and high, with agricultural suitability classes of moderate to high and high. High agricultural potential only exists in the southwest, small sections in the southeast and east, and areas in the north. This group mostly corresponds with land capability classes I and II as described in the section above, with small sections of land capability class III also included. These areas lie to the north of Clayville, the north of Tembisa, the east of Tembisa, west of Bapsfontein, southeast of Bapsfontein, patches east of the R51 near Benoni farms, between Holfontein and Welgedacht and east and southeast of Welgedacht, in the Arla Park area and south of Ceruitville to the south of Nigel, and large sections along the far southwestern boundary, southeast of Tokoza, south, east, west and north of Vosloorus, and between Vosloorus and the west of Tsakane.

**Figure 7.7 General agricultural potential for irrigated crops**

**Agricultural Potential Class 2** (Moderate-High – 12% of the EMM): This class has groundwater availability classes from low-high and agricultural suitability classes of moderate, moderate to high and high. This class lies mostly in the central and eastern portions of the EMM and appears as scattered portions from the west of Clayville in a southeast band to the north of Nigel.

**Agricultural Potential Class 3** (Moderate – 7.5% of the EMM): Groundwater availability classes from low-high and agricultural suitability classes of low – moderate/high. Most of the Klipriviersberg Nature Reserve is covered by this class of moderate agricultural potential. Other areas in this class lie to the south of Tokoza, east of Vosloorus, west and east of Tsakane, east of Kempton Park, north, east and northeast of Daveyton and to the northeast and southwest of Bapsfontein.

**Agricultural Potential Class 4** (Low – 2.5% of the EMM): Groundwater availability classes from low to moderate-high and agricultural suitability classes of low – moderate. Limiting factors in this class include low (0.1-0.5 l/s) to moderate to high (2-5 l/s) groundwater yields and no-moderate suitability to irrigated vegetables. Slopes vary between 0-15% and limiting soil factors include limiting soil depth, impeded internal drainage in the subsoil, rainfall intensity, rock outcrops, moderate to strong structure, high clay content, low clay content, flood hazard and textural variations. Land Capability classes II-V are included in this group. In the EMM this class lies south of the R550 southeast of Zonkizizwe, a small patch east of Sonwaba Park, west of Tokoza, the northern section of the Klipriviersberg Nature Reserve, east of Verwoerdpark, west of Brackendowns, north of Sunward Park, at Marais Steyn, west of Spartan, east and northeast of Kempton Park, northeast of Bapsfontein and northwest of Clayville.

**Agricultural Potential Class 5** (Low-None – 65% of the EMM): Groundwater availability classes from low-high and agricultural suitability classes of low to very low-none. Land Capability classes V-VIII which are not suited to cultivation are included in this group. A wide variety of soil and slope limiting factors are also included in this group. This group also includes all the urban areas, mines, excavations and slime dumps. This area covers most of the western, central and western areas of the EMM.

#### *7.2.3.3 Areas to be protected for agricultural use*

The next step in the GAPA process was to identify areas to be protected specially for agricultural use. The agricultural potential classes 1 (High) and 2 (Moderate-High) were merged with the Land Capability Classes I and II to achieve this objective. All areas where any of these overlap will be areas shown as High on Figure 7.8. Areas where agricultural potential classes 1 and 2 occur, but overlap with Land Capability classes other than I and II, were labeled Moderate-High. The same applies for areas where Land Capability classes I and II overlap with moderate to no agricultural potential classes. The GAPA identified 41% of the EMM as requiring a high or moderate-high protection for exclusive agricultural use.

Areas of **high** agricultural protection importance cover 22% of the EMM. These areas lie to the north and east of Clayville, the north and east of Tembisa, and large stretches from the east of Tembisa, southeastwards to the east of Kempton Park, west of Bapsfontein stretching southeast and south to the north and west of Daveyton and east of the R51 near Benoni farms, patches

northwest of Boksburg from the north of Hughes to the southeast of Boksburg west, from Dersley east of the R51 towards Holfontein and Welgedacht and east and southeast of Welgedacht towards the south of the R554. Small patches also occur in the Arla Park area and south of Ceruitville to the south of Nigel, and sections along the far southwestern boundary, southeast and east of Tokoza, south, east, west and north of Vosloorus, east of Katlehong towards Vosloorus and north and northeast of Katlehong and Vosloorus.

Areas of **moderate to high** agricultural protection importance cover (19%) lie mostly in the southeastern region if the EMM from the north of the Nigel industrial area northwestwards surrounding the Tsakane, Kwa Thema, Springs and Brakpan areas to the southwest, east and northeast of Boksburg and Brakpan. Areas to the southeast, east and north of Daveyton also require moderate-high conservation for agricultural purposed. Small agricultural patches also lie within the Klipriviersberg Nature Reserve, south and east of Kempton Park, surrounding Bapsfontein and small sections north of the JIA.

#### 7.2.4 Impacts on soils and land

Industrial and agricultural activities, together with expansion of human settlements, have generated large amounts of substances, which are harmful to humans and ecosystems. Some pollutants have very long-term effects, and continue to damage ecosystems even after the amount of pollutant being released is reduced or stopped altogether. Soil degradation due to these above-mentioned activities encompasses physical degradation (compaction, crusting, structural deterioration, erosion and desertification), chemical degradation (acidification, salinisation, sodicity, alkalination, nutrient depletion, pollution and toxicity) and biological degradation (decline in soil organic matter, loss of biodiversity and soil sterility). The principle effects of land degradation are impoverishment of the soil, causing greater susceptibility to droughts and making agricultural production more difficult and expensive; silting of water storage reservoirs such that they become uneconomic to operate; silting of rivers and estuaries; and the modification of both land- and water-based ecosystems.

Reduction of vegetation and biomass production through land degradation will lead to a reduction in soil structure, water infiltration, lower aggregate stability, nutrient cycling and storage and energy capture. The erosion hazard of bare soil with no protective cover and litter on the soil surface will also be much greater than soil covered with perennial vegetation.

Soil erosion has an effect on the physical and chemical properties of the soil. Sediment movement by erosion contributes significantly to shifts in soil fertility. The types of damage caused by accelerated erosion are:

- Loss of agricultural potential when soil mineral particles, soil organic matter and nutrients are removed that provide water and nutrient supplies for plant growth.
- Deterioration of water and air quality due to increased turbidity, dust and pollution of adsorbed chemicals on the sediment.
- Deposition of sediment that buries productive land and infrastructure and the silting of dams and rivers.

**Figure 7.8 Areas to be reserved for agriculture**

Impacts due to agriculture as a driver and the related pressures such as the increasing demand for agricultural products are summarised below:

- excessive use of fertilisers cause soil salinisation;
- overstocking, overgrazing, inappropriate crop rotations and site characteristics cause soil loss;
- inappropriate soil conservation planning cause soil erosion;
- heavy machinery cause soil compaction;
- pesticides and fertilisers cause soil contamination;
- excessive burning causing deposition of atmospheric deposition and related soil acidification;
- all the above cause loss of nutrients and soil fertility.

Industrialized society produces a wide variety of chemical and radioactive wastes of which most are disposed of on land. Other industrial impacts soil compaction due to heavy machinery, soil contamination due to deposition of atmospheric pollutants (acidification) and degradation of sensitive ecosystems. Acidification causes plant and nutrient loss, accelerated mineral weathering, soil biota changes, reduced CEC, mobilisation of aluminium and heavy metals. Aluminium and heavy metals are toxic to biota, namely plants and soil organisms. N-producing organisms become inhibited when pH drops below 5.5.

Poverty, population growth and the consequent pressures for housing, food, water and other commodities, together with the pressure for increased production, has led to the rapid expansion of human settlements, cultivation and forestry, mining and other industrial activities and waste generation. Together, these have transformed about 25% of SA's terrestrial habitats from their natural state. This puts pressure on the terrestrial systems in three ways:

- Firstly, the environment is the ultimate receptacle for waste products, and the large volumes that are currently generated challenge this capacity. This problem is acute in urban areas, where waste is concentrated into localised areas, and the surrounding area is under pressure to provide suitable disposal sites.
- Secondly, the environment is often used as a "detoxifier" of waste. Many harmful substances (such as oil) are broken down by naturally occurring bacteria or other micro-organisms, leaving less-toxic or non-toxic substances such as water and carbon dioxide. High urbanisation and industrialisation rates pressure the environment's capacity to do this, due to the large volumes of pollution, and the highly toxic nature of some of the substances produced. Many local authorities are encountering soil and groundwater pollution problems, particularly with solid waste dumping, and where pollutants are contained in sewage sludge.
- Thirdly, the release of waste and pollutants into the environment put pressure on the natural functioning of ecosystems.

Mining places restrictions on the development of the land, thus land use options post-mining. Desk-top information is available regarding the impact of mining operations for most of the mining land in EMM. A generalised set of building or land use restrictions exists for undermined land which relates specifically to the depth of undermining:

- In essence, a zone on the surface is empirically defined between the outcrop of the gold reef and 244 metres below the surface of the shallowest horizon on which development was severely restricted.

- No building may be erected within a zone commencing 3 meters on the foot-wall side of the outcrop and extending to where the reef of stope is 91.4 metres below the surface.
- No building where people sleep or congregate may be erected where the hanging-wall of the shallowest stope or economic reef is from 91.4 metres to 244 metres below surface.
- Such buildings as area allowed in terms of the above table must be reinforced and be of concrete, wood or steel frameworks and have panels of corrugated steel, asbestos or other flexible material.
- Finally, no mining is allowed within 45 metres of the surface. This is a more recent restriction, and is to prevent reclamation mining taking place under buildings that may have been constructed on potentially mineable economic reef.

Mining also exploits non-renewable resources, and causes degradation of soil resources, chemical pollution, dust pollution, contamination of soil, loss of soil due to open cast mining (most of the mines in the EMM), high extraction rates result in surface cracking, ponding and soil erosion, soil contamination from unstable tailings dumps and unrehabilitated mines. Gold mining activities result in contamination of soil through contaminated water. Poisonous substances like cyanide and mercury were used in the processing of gold-bearing ores which has led to the contamination of water and soil with toxic elements such as fluoride and boron and has resulted in mine soils commonly having a pH below six. Opencast mining activities are associated with a serious loss of soil potential and soil erosion. Many disused mines were never rehabilitated and have unstable tailings dumps, which are not properly sloped, contoured or compacted, resulting in heavy seepage of pollutants into the ground and erosion into nearby streams. These mine tailings contain heavy metals, sulphates, and gypsum.

It is conservatively estimated that the rehabilitation of mining areas will cost over R1 billion<sup>1</sup>, and considering that mining contributes only 2% to the economy and covers approximately 5% of the land surface, the degradation relative to other land uses is far more extreme, and implications for management and rehabilitation more severe. Although many mines and quarries have approved Environmental Management Programme Reports (EMPRs) and closure cost estimates, and are under the authority of the Department of Minerals and Energy (DME), there are many old disused mines with no legally responsible owners (Aucamp 2003, *pers comm.*), and thus no funds for rehabilitation.

The energy sector causes a reduction in soil productivity due to deposition of pollutants from coal fired power stations (such as Kelvin in the EMM), burning mine dumps and rehabilitated spoil.

Tourism activities cause soil loss, compaction and degradation. Footpath erosion, dirt road compaction and erosion, cave formation destruction, degradation of sensitive ecosystems are related impacts. A variety of tourism activities can affect soil loss, soil compaction, erodability or geological degradation. Compaction of soil from 4x4 vehicles and tourists on un-tarred roads and footpaths may lead to increased runoff and higher rates of erosion.

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<sup>1</sup> A data base of mines in the EMM was compiled from DACEL's Gauteng Open Space Project and data received from the Department of Minerals and Energy. The costs of rehabilitation were estimated from previous experience and local knowledge, and include demolishing infrastructure, sealing of shafts and revegetation of tailings dams and rock dumps. Water pollution aspects are not defined and so have not been included in the estimate.

Within the transport industry, impacts include leakage from fuel pipelines, soil contamination, fuel and oil spills and degradation of sensitive ecosystems. Leakage from pipelines conveying fuels (petrol and diesel) for the motor industry can cause serious threats to the environment through soil and water contamination. Similarly, accidents and spills from underground storage tanks, or from trucks and rail cars transporting resources, may also result in water and soil pollution.

## 7.3 RESPONSES

### 7.3.1 Policy

The **Convention to Combat Desertification (CCD)** was signed by SA on 9 January 1995. It is aimed at encouraging integrated development which prevents or reduces land degradation, rehabilitates partly degraded land and reclaims desertified land. One of the obligations within the CCD is to develop a National Action Programme (NAP) with strategies and priorities for combating desertification.

**United Nations Framework Convention on Climate Change (UNFCCC):** The Framework Convention on Climate Change (FCCC) was signed by SA in 1994 and ratified in August 1997. The convention addresses the threat of global climate change by urging governments to reduce the sources of greenhouse gases.

**Protocol for the Protection of the Ozone Layer:** (Montreal Protocol) To prevent further depletion of the ozone layer by reducing emissions of CFCs

**Convention on the Prevention of Pollution by Dumping of Wastes and other Matter:** To prevent dumping of waste from ships, and to minimise the risk of oil spills.

Changes in **sectoral policies** have mainly been towards more sustainable practices. For example the NWA requires a change in pricing structures to reflect the true environmental and social costs of water, and to effectively manage water demand. Land reform has permitted access for all South Africans to terrestrial resources and agricultural activities, resulting in changing settlement patterns. Reforms in energy policy, as set out in the draft Energy Policy (White Paper, 1998) include aims to improve residential air quality, introduce safety standards, remove subsidies, to promote cleaner technologies and use of renewable sources of energy, introduce environmental performance auditing, and to establish emissions reduction programmes.

In terms of the Municipal Systems Act (MSA) (Act 32 of 2000) all municipalities (i.e. Metros, District Municipalities and Local Municipalities) have to undertake an IDP process to produce. The IDP is a single, inclusive and strategic plan for the development of the municipality which:

- Links, integrates and co-ordinates plans and takes into account proposals for the development of the Municipality;
- Aligns the resources and capacity of the municipality with the implementation of the plan;
- Is compatible with national and provincial development plans and planning requirements binding on the municipality in terms of legislation (RSA, 2000a).

The development of IDPs can facilitate environmental management throughout the planning process. Phase 4 of the IDP process (Integration), requires the preparation of an Integrated Environmental Programme. The purpose of this programme is to assist in addressing urgent environmental issues and to ensure that envisaged projects have no negative impact on the natural environment (RSA, 2000a).

The SDF is a framework giving strategic guidance in respect of the location and nature of development in the municipality. Desired patterns of land use are indicated in terms of the SDF, although room for interpretation and further refinement still consists. The SDF is development orientated, to allow for growth and changing circumstances. It indicates broad, desirable land use patterns and is therefore not a mechanism intended to evaluate individual land use applications. A hierarchy of plans should be developed to provide mechanisms for the evaluation of individual land use proposals, consisting of:

- SDFs for the three SDRs. The overall Metro SDF should be refined to achieve detailed land use proposals within the three SDRs. This would ensure that the overall spatial objectives for the Metro are followed through to Regional level, while providing an adequate level of detail to assess development proposals.
- Precinct Plans and policies for specific areas. Where the need for a fine level of detail with proposals up to individual erf level persists, or where specific trends and tendencies require an overall policy approach, precinct plans and policies are used as mechanisms to guide decision making.

The **SDF** provides some strategic guidance as to where the EMM needs to focus in the allocation of its resources. Five main elements from the SDF were isolated as geographic entities which could give guidance as to where the priority capital investment areas are. These elements are:

- The four Core Economic Areas (JIA and R21, Central Activity Belt, Alrode/Wadeville, and Far East Activity Belt);
- The five Infill Priority Areas (Germiston Mining belt, Boksburg Mining belt, Benoni East Mining belt, Daveyton South and Springs North);
- The eight Strategic Development Areas (Olifantsfontein/Clayville, Kaalfontein, Pomona/Benoni North, Daveyton North, KwaThema-Duduza, Tsakane West, Boksburg South, Katorus South);
- The four Service Upgrading Priority Areas (Tembisa, Kwatsaduza, Katorus, Daveyton Etwatwa);
- The identified Public Transport Corridors indicated on the SDF.

In conclusion, the **SDF** should not be used in isolation from the IDP for the EMM. Furthermore, the SDF constitutes more than a plan indicating desired land uses, but puts forward spatial objectives and strategies for the EMM. Future capital investment in the Metro should be undertaken within the ambit of the SDF, while a hierarchy of plans should be developed to guide development and land use decisions. The EMM SDF identified various objectives, including:

- to promote the development of a compact urban structure which optimise the utilisation of all resources, such as land;
- to create a sustainable and continuous open space network which will protect, highlight and link all natural elements of EMM;
- to optimise food production capacity of the surrounding agricultural areas;

A uniform **Land Use Management System** (LUMS) should be developed, to serve as a land use management and statutory mechanism. There are currently various town planning schemes in operation in the EMM area. This implies that although the SDF, precinct plans and policies ensure that the same spatial objectives prevail in the Metro area, different procedures with different time frames have to be followed to apply for changes in land use rights. This is confusing and problematic from an administrative and developmental point of view. A uniform Land Use Management System would ensure that the same procedure could be followed to apply for a change in land use rights, whether the application is lodged in Nigel or in Alberton.

Decentralisation of decision-making within SA is been entrenched in local municipal structures using mechanisms such as IDPs and the Integrated **Sustainable Rural Development Strategy** (ISRDS). SA has a three-tier system of governance, National, Provincial and Municipal. The trend in SA is toward project planning and implementation to take place through the municipal structures. National and provincial structures need to ensure that a suitable environment exists to support the local initiatives. The IDP process is designed to allow civil society to directly input into this municipal planning.

### 7.3.2 Legislation

#### **The Constitution of the Republic of South Africa Act No. 108 of 1996**

#### **National Environmental Management Act No. 107 of 1998**

**Draft regulations under the Minerals and Petroleum Resources Development Act No 28 of 2002:** Part IV, Section 56 – Regulations regarding soil pollution and erosion control, for people holding as mining right or permit in terms of the Act.

**Minerals Act 50 of 1991:** constituted the first substantial mining legislation aimed at environmental conservation. The Act determines that considerations relating to surface rehabilitation may operate as a prerequisite to the granting of prospecting permits or mining authorisation. The Act also subjects any land user to the rehabilitation plan of the relevant authority. The definition of mining and prospecting includes quarrying as it also results in the disturbance or removal of vegetation and thus requires rehabilitation.

**Soil Conservation act 76 of 1969:** allows the Minister of Agriculture to issue a directive, ordering a landowner to apply measures that prevent soil erosion.

**National Forest Act, Act 84 of 1998:** prevents the burning of vegetation, the grazing of cattle on recently burnt vegetation or any other unsustainable practice that may affect forest resources. Soils, stones and any other geological formation within forests are regarded as forest resources and are protected within declared protected forests.

**Conservation of Agricultural Resources Act, Act 43 of 1983:** The purpose of this Act is to “provide for control over the utilization of the natural agricultural resources... in order to promote

the conservation of the soil....and for matters connected therewith". The Act lays out some of the control measures that may be used to positively promote the conservation of soil as well as schemes which are impacting on soil conservation. Some of the control measures include the cultivation of virgin soil as well as the utilisation and protection of land which is cultivated; and the irrigation of land, prevention or control of waterlogging or salination of land, utilization and protection of vleis, marshes, water sponges, water courses and water sources, and the regulation of the flow pattern of run-off water. Furthermore, the Minister may establish a scheme for assistance which may be granted to land users in respect of:

- the construction of soil conservation works;
- the reparation of damage by natural forces;
- the restoration or reclamation of eroded, disturbed, denuded or damaged land.

**Mines and Works Act, Act 27 of 1956:** The provisions of the Minerals Act and of regulations made in terms of the Mines and Works Act relating to the rehabilitation of mining surfaces are aimed, to a large measure, at soil conservation.

**Agriculture White Paper, 1995:** The promotion of agricultural development depends on the protection of land and water resources. The Agriculture White Paper emphasises the following points:

- The responsibility for rehabilitation of mismanaged land will rest with the land user;
- Integrated land-use planning and community participation will be encouraged to
- ensure optimum management and utilisation of the natural resources; and
- The government will ensure the protection of those plant species that are essential in
- maintaining national food security and are in the long-term economic interest of the
- country.

**White Paper on Integrated Pollution and Waste Management in South Africa:** Section 4.2.3 of the IP&WM White Paper addresses waste and pollution issues in a mediabased approach. The policy on land pollution considers the following: urban, industrial, mining, rural and agricultural land. The loss of arable land through compaction and alien invasion is not, however, covered in the White Paper. Soil erosion is also not covered per se, except under the water medium, where it is regarded as a pollutant. Issues which are considered in the policy include:

- Injudicious/over-use of fertilisers;
- Inappropriate utilisation of agricultural chemicals;
- Unsustainable farming practises;
- Irrigation with sewage sludge;
- Over irrigation; and
- The impact of agricultural chemicals such as pesticides, herbicides, and fertilisers on surface water and groundwater quality (RSA, 2000b).

**White Paper on the Energy Policy of the Republic of South Africa (1998):** Government's energy policy was drafted with the recognition that the energy sector has large environmental impacts, yet it can contribute significantly to economic growth. The policy recognises the need to reduce use of fuelwood (the main source of energy in rural areas). It also recognises that over-harvesting of natural resources including fuelwood results in environmental degradation, soil erosion and desertification (Willis et al, 2000). The policy also mentions that the Department of

Mineral and Energy Affairs will participate with DWAF and the Department of Land Affairs in a national social forestry programme for the benefit of rural households.

**White Paper on South African Land Reform Policy (1997):** As issues of land tenure are addressed in SA, and previously marginalised communities are assured of tenure, the way in which communal land is managed may change significantly.

### 7.3.3 Programmes and initiatives

**The South African LandCare Initiative:** based on the initiative that has been very successful in Australia, has also recently been launched (Discussion document: Implementation Framework for the LandCare programme, 1998). Based on the ideal of sustainable agricultural resource utilization, it includes natural resource, sociological, political and economic dimensions, as the basis for establishing a conservation ethic.

**Stock Reduction Scheme:** This scheme was applied in commercial rangeland areas, and ran from 1969-1978. Its main objectives were to reduce the number of stock on rangelands, withdraw eroded and vulnerable areas from grazing, and institute judicious management practices on remaining rangelands. Targeted regions included the Succulent Karoo, Nama Karoo and western parts of the Savanna and Grassland Biomes. Although R54 million was spent on the scheme (1978 value), concluded that this amount could not be justified given the inherently low production potential of its target areas.

**National Grazing Strategy (NGS):** Announced in 1985, its main objective was to *"use, develop and manage the natural and cultivated pastures in the RSA"*. Progress with the scheme seemed mixed after 6 years, with slow research progress and implementation of a national monitoring system. The status of this scheme is in flux in the light of the current focus on the BATAT initiative (Broadening Access to Agriculture), which focuses on communal and emerging small-scale farmers.

**Drought Assistance schemes:** Numerous government funded drought assistance schemes have been announced over the last several decades. The most recent being the Disaster Drought Assistance Scheme for stock farmers in the RSA (effected during 1990). This scheme, it is suspected, favoured continued farming by the most indebted commercial farmers, preventing foreclosure of a number of farms and thus representing a "lost opportunity for land reform".

Apart from the initiatives mentioned above, SA has become involved in the **WOCAT** programme (World Overview of Conservation Approaches and Technologies) through the National Department of Agriculture and the Institute for Soil, Climate and Water of the Agricultural Research Council. Their goal is to contribute to sustainable use of soil and water through collection, analysis, presentation and dissemination of soil and water technologies and approaches world-wide, to promote improved decision-making and land management. Their approach was used in the recently released landmark study on Land Degradation in South Africa.

**Spatial Development Initiatives:** To co-ordinate and centralise development, minimising fragmentation of habitats.

SEAs, Environmental Impact Assessments (EIAs), Environmental Management Plans: To ensure impacts of development or practices are understood, that environmental damage is minimised, and that already damaged environments are rehabilitated.

Working for Water Programme (WfW): To remove alien vegetation from catchment areas, thereby improving run-off and biodiversity, and to create jobs. WfW is however not active in the EMM.

LandCare Initiative, National Grazing Strategy, Stock Reduction Schemes, Responsible Care Programme: To promote sustainable production techniques, minimising damage to vegetation and soil.

Standards & Guidelines (e.g. for water quality) To regulate pollution and maintain high quality of resources.

A primary objective of the **Urban Development Boundary** is to protect agricultural land from urban expansion and/or urban sprawl. Land uses on agricultural holdings and farms outside the urban edge should, however, in turn support the urban edge, by promoting active farming and agriculture. A transitional land use zone between urban and rural land uses, referred to as peripheral land uses is prevalent in EMM (as in most urban areas). This area specifically needs to be managed carefully to prevent urban uses occurring outside the defined urban edge. The protection of land values outside the urban edge is a further important consideration, as declining land values in peripheral areas are associated with under-utilisation of land, neglect, intrusion of illegal uses and even shack farming, which eventually result in urbanisation in order to combat these problems.

The SDF therefore supports the protection of ***pure agricultural uses in areas earmarked for agriculture and agricultural holdings.***

## 7.4 MONITORING

### 7.4.1 Information and data gaps

- Soil:**
- area of land affected by acidic soils;
  - area of land affected by salinity;
  - area of land affected by contamination;
  - area of land under best practice management;
  - area of revegetation;
  - soil lost per year due to water erosion – rates of national soil erosion.

### 7.4.2 Recommended future indicators

**Soil sampling:** must be done at the same time of the year to eliminate seasonal variation. Periodic and repeated sampling should reflect the degree of degradation and rapidity of change within indicators. Soil pH, organic carbon, EC, ESP, clay content, degree of leaching and P status should be monitored to determine the rate of changes and their possible long-term effects.

**Changes in land condition:** (land degradation)  $SDI+VDI=CDI$  – changes in the condition, suitability and nature of land resource. Changes in land degradation per type of land cover. Changes include physical and condition, diversity/density of vegetation cover, thickness of soil, alkaline conditions and establishment of contour vegetation strips. Measures change in productive capacity, environmental quality and sustainability of land resources. Measures as the extent of improvement or deterioration per type of land use.

- Total annual sales of persistent organic pollutants
- Wasted and degraded land in mining zones per GDP in the mining sector – decoupling between mining GDP and wasted and degraded land – ratio decline would mean mining sector impact less on land degradation.
- Quality of mining operations (ongoing and final rehabilitation programmes)
- Enforcement of the Conservation of Agricultural Resources Act – indication of measures that area being taken by NDA to prevent degradation of soil and natural veld
- Permanent loss of agriculturally productive land - land not covered by stubble, debris, crop and other veld material, as a % of total area under agriculture
- Land degradation per GDP in the agricultural sector = information on decoupling between the agricultural contribution to GDP and land degradation – ratio decline would mean the agricultural sector is impacting less on land degradation

**Decentralised local-level natural resource management:** measure of the extent to which higher level government devolved management of natural resources to local communities, as well as changes in the allocation of powers of resource management. Numbers of which local communities and local government share resource management.

**Loss of soils due to mining:**

- State of wasted and degraded land in mining zones (are closed mines in the EMM rehabilitated or being rehabilitated, and assessed in terms of future land use);
- Loss of arable land;
- Soil loss through development;
- Area of mining in a given area;
- Cumulative area mined.

**Erosion hazard:** A range of erosion indicators could be applied based on the erosion hazard map, to gain a better understanding of the current erosion hazard in the EMM, for long-term erosion monitoring, such as:

- Erosion hazard under cultivated permanent crops;
- Erosion hazard under cultivated temporary crops;
- Erosion hazard under bare soil;
- The area under each land use type falling within highly erodible land vs non-highly erodible land.

## 7.5 CONCLUSIONS

### 7.5.1 Soil, land and land use constraints within the EMM

The most salient environmental constraints of the study area with regards to soils, land and land degradation are:

- **The dolomite areas:** Apart from the doline and sinkhole formation risks that occur in bad dolomitic zones, the ground water pollution potential in dolomitic areas is also regarded as high. Due to the above-mentioned risks special precautionary measures for developments on dolomite are applicable. The Bronberg/Bapsfontein area is described as having high dolomitic soils. GDACEL do not generally support development on dolomitic areas.
- **Undermining:** Due to the large number of mining activities that used to take place in and around the study area, undermining could limit developments in certain areas. 70% of the mines/mining works in the EMM have closed down. The legacy of the EMM mining history includes:
  - Mine Dumps and Slimes Dams;
  - Radiation;
  - Vacant Mine Sites;
  - Pollution;
  - Shallow undermining;
- **The DACEL buffer zone policy document:** the buffer zone policy document is a decision support tool to enable informed decision-making amongst GDACEL and other spheres of government regarding proposed developments in close proximity to mining areas, sewage plants, industries, waste and hazardous landfill sites. The EMM has a large number of industrial areas and related land uses in close proximity to residential areas. These may be significantly affected in terms of nuisance and health. This needs to be considered in future planning.
- **Noise:** Due to the high noise levels that occur on a strip of land to the north of the JIA, GDACEL does not support the development of residential areas or any other activities that could be affected by the high noise levels. GDACEL will only consider proposed development that has exemption from complying with the noise regulations and suitable mitigation measures must be supplied as part of the environmental document (pre-application checklist and/or Scoping Report) that will be submitted to GDACEL for approval.
- **Siltation, erosion and water pollution:** Most of the siltation, erosion and water pollution problems in the area occur in the previously disadvantaged areas (i.e Clayville) and in the disturbed mining areas in the mining belt. The main contributors to these problems are:
  - Illegal squatting below the 1:50 year flood line;
  - Insufficient stormwater management;
  - The discharge of effluent into the water bodies of the study area;
  - Illegal sand works in the water bodies;
  - Illegal dumping (i.e. at the Bartlet Vlei area and in the Jet Park area);
  - The mining belt influences the wetlands and the water quality in the Blesbokspuit.
- **Illegal dumping of normal and hazardous waste:** According to GDACEL a great deal of the illegal dumping takes place below the flood line and in the mining belt. Unfortunately most of the mining properties within the mining belt are privately owned and the rehabilitation and

environmental management of the properties fall under the jurisdiction of the Department of Minerals.

### 7.5.2 Worst affected areas in the EMM in with regards to soils and land

From the description of soils, land and land degradation in the EMM, the most prevalent problems and causes area as follows:

- Sources of soil pollution namely mines, factories, towns, informal settlements, squatters, landfill sites and waste sites, are described in Section 7.2.1.2 and shown on Figure 7.2.
- The area with the highest SDI (120), slightly higher than the Gauteng average, covers 11.5% of the EMM and includes the Brakpan-Tsakane-Geluksdal area, as well as the informal settlements and squatters of the Tsakane/Duduza areas. Within this SDI class, lies one open and two closed quartzite works/mines, as well as an open and two closed gold mines. Areas with a high soil erosion hazard falls within this high SDI category.
- There are two areas in the EMM having a CDI of 160, higher than the Gauteng average. 4% of the high CDI of the EMM lies in the Bapsfontein-Bronberg agricultural area on the north-eastern boundary of the EMM. This is an area of extensive agriculture, high dolomitic soils and minimal engineering and municipal services. The other high CDI covers 0.1% of the EMM and lies on the northern border to the east of Clayville. Both these areas have the highest VDI in the EMM and second highest SDI. Alien trees, poor grassland cover and resultant poor rangeland condition characterises these areas.
- Rangelands in a bad condition, showing severe grass species change and a reduction in cover, are found between Palm Ridge and Sondwaba Park west of the Natalspruit within an area with the second highest veld degradation index in the EMM, higher than the Gauteng average; patches between Vosloorus and Kwa Thema; west of the Sub-Nigel Gold Mining Company; patches in the Struisbult area; patches near Springs Rest; various small sections between Daveyton and Kempton Park; sections north of Tembisa; surrounding the Rietvleirivier; areas northeast of Bapsfontein within an area if the highest veld degradation index in the EMM, higher than the Gauteng average.
- Areas covered by bare soil are visible in areas between Edenpark/Palmridge and Sondwaba Park in an area with the second highest soil degradation index in the EMM; at the informal settlements on the outskirts of the Tsakane and Geluksdal areas within the area of the highest soil degradation index, higher than the Gauteng average; areas on the outskirts of Duduza including the Masetlabe View Ext area to the south; areas between Duduza and Dunnottar; areas northwest and northeast of Withok Estates; patches in the Struisbult area; patches in the Kingsway area southwest of Daveyton; patches between Daveyton and Kempton Park; Kruihof area north of the R24; south and north of Tembisa.
- Areas with a very high erosion hazard and a predicted loss of > 60 tons of soil per hectare per year are indicated in Figure 7.5.
- Areas of agricultural potential class 5 (Low-None) cover 65% of the EMM. Groundwater availability classes from low-high and agricultural suitability classes of low to very low-none, as well as land capability classes V-VIII which are not suited to cultivation, are included in this group. A wide variety of soil and slope limiting factors are also included in this group. This group also includes all the urban areas, mines, excavations and slime dumps. This area covers most of the western, central and western areas of the EMM.

### 7.5.3 Future land use development in the EMM

According to the EMM Environmental Status Quo, the GDACEL position regarding agricultural land is as follows:

- It does not support the loss of moderate to high agricultural land in Gauteng;
- Due to the low % of agricultural land available and the fact that much of this has already been subdivided, no development on these areas will be supported except when on the boundary of already developed areas with established infrastructure.
- There is a need to protect the remaining agricultural resources and activities including the rural-residential areas (smallholdings) like Nortens Home Estate, Bredell, Pomona and Witfontein.

Land suitable for agriculture is limited within the EMM (only 13% of the EMM has a high agricultural potential, with the potential on 12% of the remainder of the EMM being moderate-high). With increasing population and industrial demands for this scarce natural resource, it is of utmost importance that the production capacity of arable land and pastures be improved and maintained. The further expansion of soil acidity must be stopped and acidified areas reclaimed. Acidity awareness amongst soil users should be fostered and enhanced.

A primary objective of the Urban Development Boundary within the EMM (as part of the Spatial Development Framework, 2003) is to protect agricultural land from urban expansion and/or urban sprawl. A transitional land use zone between urban and rural land uses, referred to as peripheral land uses is prevalent in EMM (as in most urban areas). This area specifically needs to be managed carefully to prevent urban uses occurring outside the defined urban edge. The protection of land values outside the urban edge is a further important consideration, as declining land values in peripheral areas are associated with under-utilisation of land, neglect, intrusion of illegal uses and even shack farming, which eventually result in urbanisation.

The SDF therefore supports the protection of ***pure agricultural uses in areas earmarked for agriculture and agricultural holdings***( Figure 7.8).

- Areas of **high agricultural protection importance** cover 22% of the EMM. These areas lie to the north and east of Clayville, the north and east of Tembisa, and large stretches from the east of Tembisa, southeastwards to the east of Kempton Park, west of Bapsfontein stretching southeast and south to the north and west of Daveyton and east of the R51 near Benoni farms, patches northwest of Boksburg from the north of Hughes to the southeast of Boksburg west, from Dersley east of the R51 towards Holfontein and Welgedacht and east and southeast of Welgedacht towards the south of the R554. Small patches also occur in the Arla Park area and south of Ceruitville to the south of Nigel, and sections along the far southwestern boundary, southeast and east of Tokoza, south, east, west and north of Vosloorus, east of Katlehong towards Vosloorus and north and northeast of Katlehong and Vosloorus.
- Areas of **moderate to high agricultural protection importance** cover (19%) lie mostly in the southeastern region of the EMM from the north of the Nigel industrial area northwestwards surrounding the Tsakane, Kwa Thema, Springs and Brakpan areas to the southwest, east and northeast of Boksburg and Brakpan. Areas to the southeast, east and north of Daveyton also require moderate-high conservation for agricultural purposes. Small agricultural patches

also lie within the Klipriviersberg Nature Reserve, south and east of Kempton Park, surrounding Bapsfontein and small sections north of the JIA.

Specific areas earmarked for agriculture and agricultural holdings include:

- The Bronberg agricultural area in the north of the Ekurhuleni Metro;
- The agricultural holdings between Bronberg and the urban edge.
- Agricultural areas between Daveyton and Springs both inside and outside the urban edge. These areas are constrained by undermining.
- Agricultural areas north of the Nigel CBD. These areas are constrained by undermining, but are actively used for agriculture.
- Agricultural holdings and agricultural areas in the south of EMM beyond the urban edge.
- A section of agriculture within the urban edge east of Katorus. This area is actively used for agriculture and the policy directive is to protect this agriculture for as long as possible.

The proposed SDF shows the integration of the area into a functional unit, with various sectors forming an integrated system:

- the north-south corridor will be developed as the main industrial node;
- the areas surrounding the two major east-west roads (N12 and N17) will be mixed use areas, including residential, commercial and retail;
- the land with the highest agricultural potential is situated on the northern (established node near Bapsfontein) and southern boundaries (smaller farming activities to be developed) of the Metropolitan area, where agricultural nodes are to be established.

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