EMM REGION A RSDF
STRATEGIC ENVIRONMENTAL ASSESSMENT

THE RSDF SPATIAL VISION'S IMPACT ON THE ENVIRONMENT

Prepared by METROPLAN

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REGIONAL SPATIAL DEVELOPMENT FRAMEWORK

REGION A

EKURHULENI METROPOLITAN MUNICIPALITY

MODULE 1: STRATEGIC ENVIRONMENTAL ASSESSMENT

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Commissioned by

Ekurhuleni Metropolitan Municipality

Drafted by

Metroplan Town and Regional Planners

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1 INTRODUCTION

This document contains the **Strategic Environmental Plan** for the Regional Spatial Development Framework (RSDF) for Region A, consisting of the OR Tambo International Airport, CBD of Kempton Park, Germiston and Boksburg, the Bedfordview node, as well as the industrial area of Spartan, Isando, Jet Park and Anderbolt.

The **RSDF** promotes development with **densification, mix use, retrofitting and transit-oriented development (TOD's) as key concepts**. Development is a process of growth and change, which implies improvement but also an impact on the environment in some way. It is important to ensure that development proposals supporting the key concepts are implemented according to environmental guidelines to prevent environmental degradation.

This module will focus on establishing the **environmental guidelines** that support the opportunities and constraints highlighted in the Environmental Management Framework (EMF) as well as the Biodiversity Report and the Biodiversity and Open Space Strategy (EBOSS).

As higher densities tend to generate higher levels of pollution, waste generation, energy consumption but also reduction in open spaces, the module will aim to address not only guidelines for new development but also retrofitting and preventative measures for existing developments.

2 AIM OF THE DOCUMENT

The document will focus on the following:

Section 1

Opportunities and constraints highlighted in the following documents:

- Environmental Management Framework (EMF);
- Biodiversity Report; and
- Open Space Strategy (EBOSS).

Section 2

Environmental guidelines for:

- protection & prevention pertaining to existing development or retrofitting projects;
- new development;

Section 3

Green building guidelines as an example of environmentally sound practices

3 EMF, EBOSS AND BIODIVERSITY

The EMF provides a framework that sets out the **environmental attributes** of Ekurhuleni in a way that determines environmental opportunities and constraints for development of the area while the Biodiversity Report focus on optimal biodiversity conservation. EBOSS identifies **environmental opportunities** as well as **constraints and risks** identified with development and densification of areas.

3.1 Geology

The **geological stability** of the study area is important to take into consideration for future developments. **Earth tremors** are quite common in the central area of the study area where deep gold mining takes place and extensive areas have been undermined (Figure 1). Such tremors sometimes result in the cracks appearing in buildings, roads and other structures and this should be considered in the planning process as well as densification policies.

Quartsite dominates the southern area from the west of Clayville in the north through Kaalfontein while sandstone dominates the eastern side of the study area. Surface shale is found south of OR Tambo International Airport towards Germiston (Figure 2).

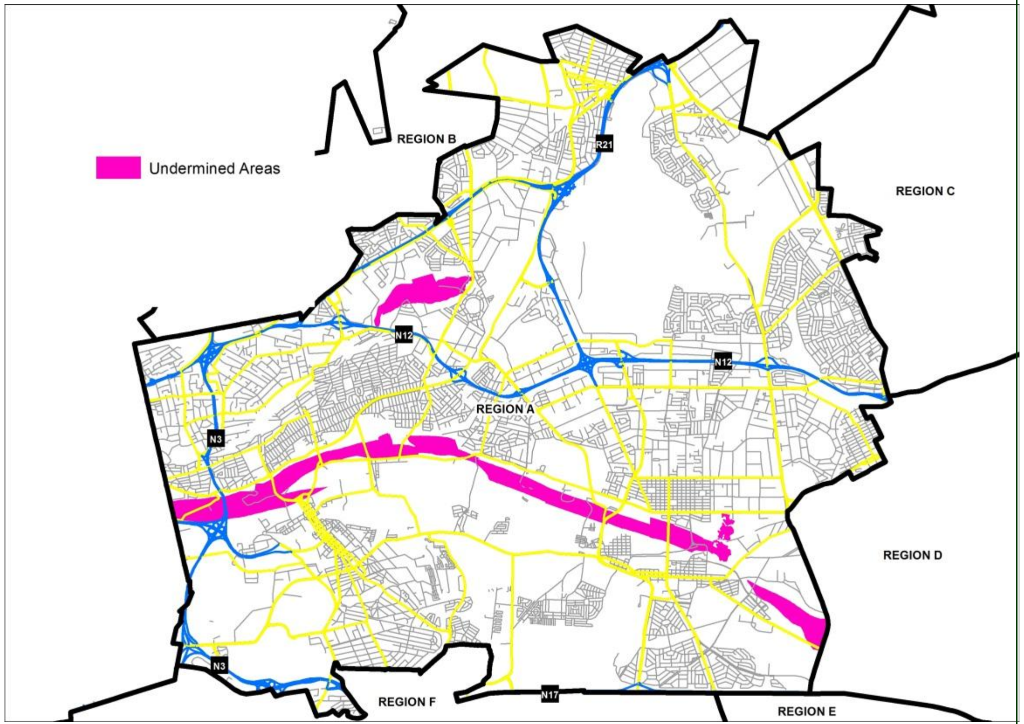

Figure 1: UNDERMINING – REGION A

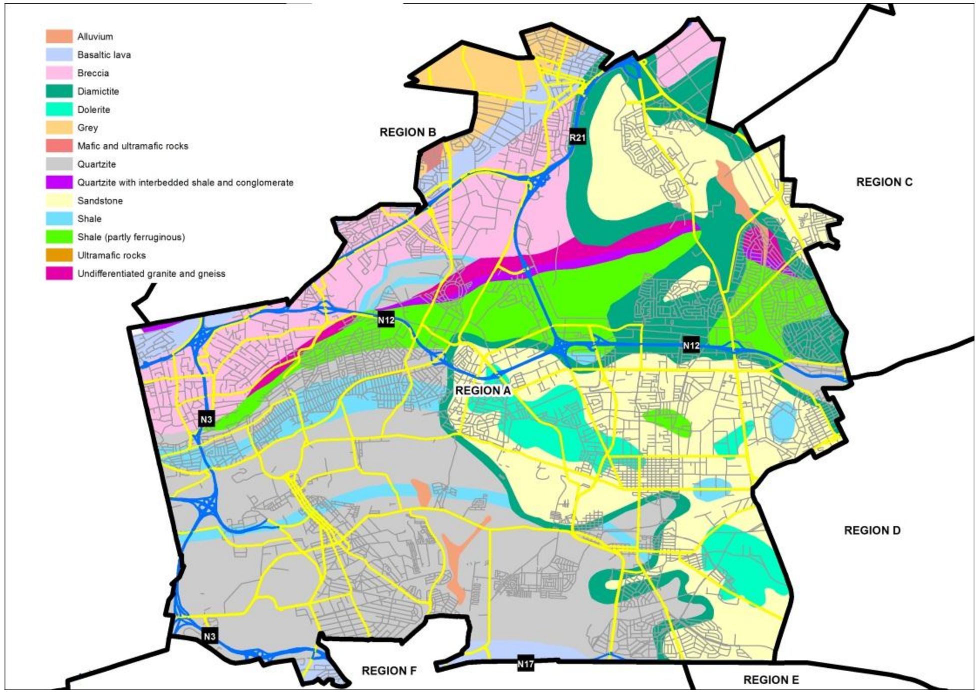

Figure 2: GEOLOGY - REGION A

3.2 TOPOGRAPHY & VEGETATION

The study area can generally be regarded as flat with few outstanding topographical features which needs to be taken into consideration when addressing potential flooding and stormwater designs as well as designs of new buildings. The area consists of the following:

- Plains with pans
- Undulating plains with pans
- Strongly undulating plains
- Ridges

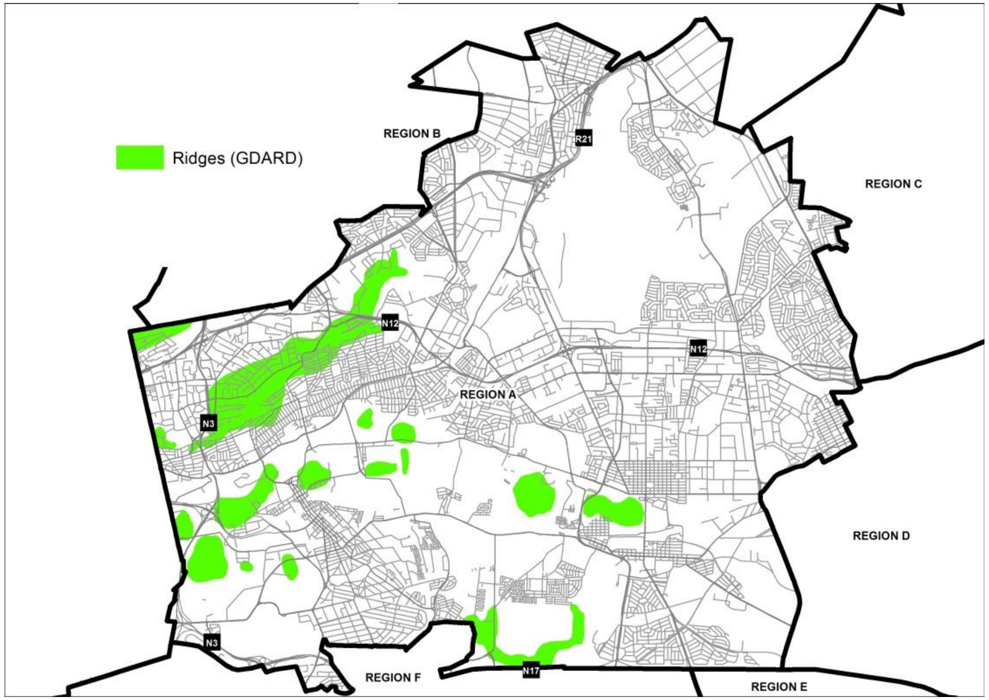

Figure 3: RIDGES

EBOSS identified various opportunities such as the protection of the fast declining portions of grassland. The entire study area falls within the Grassland Biome in which grass dominates and geophytes occur abundantly. The dominant grass type is red grass (Themeda triandra). It grows mostly on sandstones (which appear in the eastern half of the study area) and shales with deep sandy loam soils.

3.3 HYDROLOGY & WATER

The study area spans across **5 catchment areas** including Swartspruit, Upper Blesbokspruit, Natalspruit, Jukskei and Riespruit. Blesbokspruit has been accepted as a wetland under the Ramsar Convention and includes the Marievale Nature reserve (Figure 4).

Ground water quality in the study area is generally acceptable for any use although the yields from most aquifers are low. In some areas contamination with chlorides, sulphates and nitrates has been recorded and mining activity is a possible pollutant of ground water. The Biodiversity report argues that river health within the study area is generally below acceptable standards but within tolerable limits.

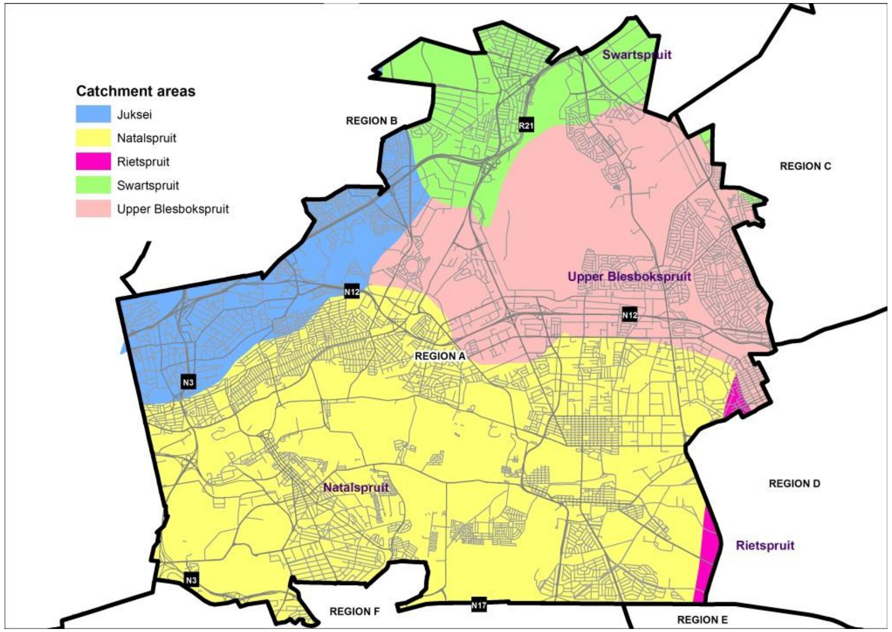

Figure 4: CATCHMENT AREAS

EBOSS identified the hydrological network as an opportunity due to the origination of important river systems that forms the backbone for the open space system. The protection of the rivers and streams will ensure improved natural drainage in the area.

3.4 AGRICULTURAL POTENTIAL

South Africa has an essentially dual agricultural economy, comprising a well-developed commercial sector and a predominantly subsistence-oriented sector in the rural areas. With only about 13% of South Africa's surface area that can be used for crop production, of which just 22% can be classified as high-potential land, it is critical for GDARD to protect the limited high potential land that is still available. It is important to note that there are no pockets of high-potential land left within Region A which increases the risk of potential flooding due to the built-up footprint and in turn emphases the **importance of the open space network** and proper stormwater planning as well as greening projects.

3.5 PROTECTED AREAS AND OPEN SPACE

GDARD earmarked the **Korsman Bird Sanctury** and the **Bill Stewart Municipal Game Reserve** as protected areas. These areas also form part of the open space network. In Region A the hydrological system provides a natural backbone to the open space network.

EBOSS identified the protection of open spaces and sports fields as an **opportunity** to protect the biodiversity. It also argues that municipal and other services servitudes and significant surface areas of shallowly undermined areas have the potential to provide important links in the open space system.

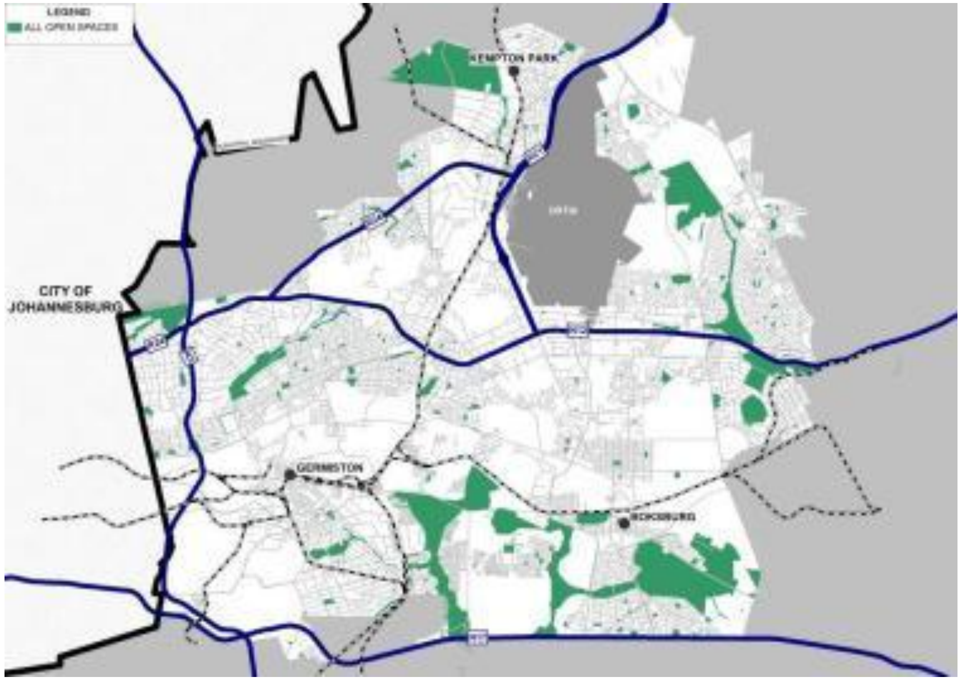

Figure 5: OPEN SPACE NETWORK

The Biodiversity report accentuates that high quality vegetation areas in conjunction with the hydrological system provide significant spatial nodes with high potential for the conservation of biodiversity. Ridges which are rare in EMM do occur in the study area although mostly not in their natural state. The ridges that are still in their natural state should be protected to ensure that less erosion and run off takes place.

3.6 BIOLOGICAL ENVIRONMENT

Various **environmental threats** have been identified in **EBOSS** including the following:

Human settlements

- Natural vegetation is fragmented by development. Various pans have been filled in and wetlands have become isolated which increase the pressure on the functioning of ecosystems;
- fences and walls prevent natural migration of adult and juvenile Giant Bullfrog species between suitable breeding sites;
- insufficient services in some areas lead to sewage pollution, litter and solid waste pollution affecting water quality; and
- pressure on the environment due to over-harvesting of natural resources (specifically medicinal plants) due to economic status of households.

Mining activities

- Clearing of vegetation which changes the surface topography and drainage;
- surface subsidence cause by underground mining which leads to land degradation;
- large volumes of bulk waste products in the form of tailings and rock dumps lead to habitat destruction;
- acid mine drainage;
- underground mining dewaters aquifers; and
- quality decrease in water due to toxic run-off.

Industrial

- Clearing of vegetation causes habitat destruction and fragmentation;
- waste and pollution increase;
- industrial effluents seep into nearby water bodies that causes loss of biodiversity and breakdown in ecosystem functions appear; and
- high energy generation causes smog and acidification of rainwater and soil.

Transportation and road infrastructure

- Generating pollutants;
- Disposal of old vehicles requires natural land; and
- Transport networks fragment interconnected water bodies/wetlands and /or natural grasslands which creates a barrier to the migration of species.

Wetlands represent the most important habitat type in the Ekurhuleni area because of their vital role in the regulation of water, filtering capabilities and also form an ideal habitat for many bird and aquatic species (Figure 6).

According to the EMF alien invasive species in the study area mainly include Eucalyptus-species (gums) and Australian wattles (Acacia dealbata, silver wattle; Acacia mearnsii , black wattle and Acacia decurrens, green wattle). Other significant invaders include lantana, poplars, bugweed, white mulberry and privet.

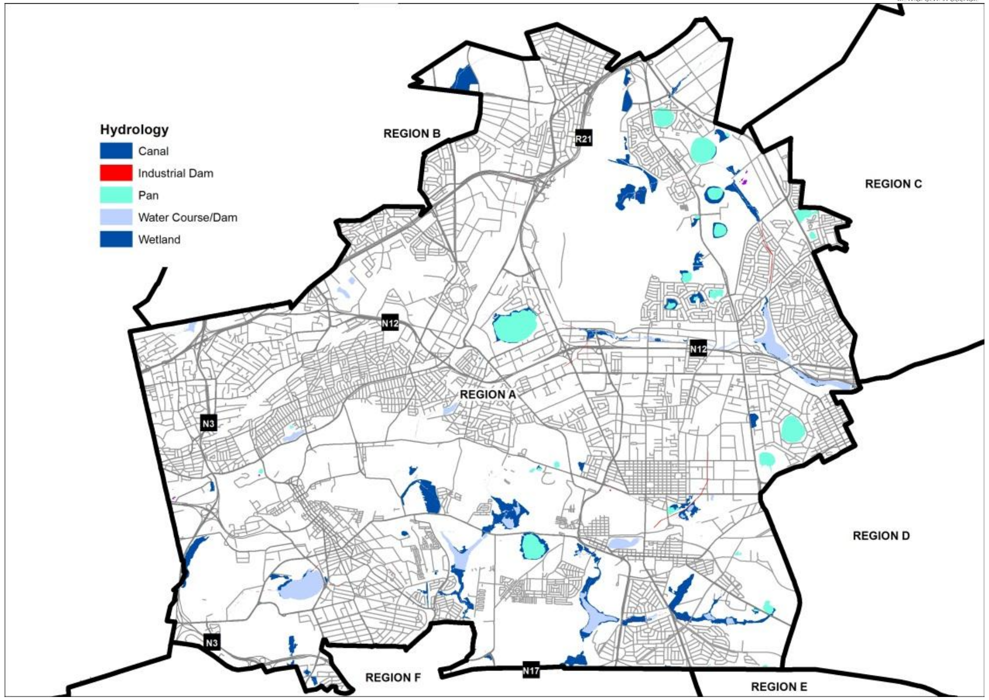

Figure 6: WETLANDS

4 ENVIRONMENTAL GUIDELINES

The environmental guidelines should always be used **in conjunction with the guidelines set out in the EMF, Biodiversity report and EBOSS.** These principles should be used as an **awareness tool**. The key issues for environmental guidelines include:

- Categorise projects in those that have significant adverse environmental and social impacts to those that have minimal environmental impact and manage them accordingly;
- where feasible, choose energy-efficient and environmentally sound processes and designs;
- ensure that control, treatment, and implementation are aligned with environmentally sound practices;
- that natural resources are protected at all times;
- ensure an integrated approach by including environmental impact as part of all developments; and
- ensure environmental contingency plans form part of development processes.

The environmental guidelines can be divided into two categories. The first are guidelines pertaining **existing built up areas as well as retrofitting projects** and the second are applicable for all **new developments**.

4.1 PROTECTION & PREVENTION

As the state of the environment will have a direct bearing on the welfare and well-being of people living in that vicinity the environment should be protected by existing as well as new developments.

Urban green space provides a unique landscape that supports a diversity of flora and fauna and provides an ever-expanding human population with direct access to nature. The presence of high quality biodiversity in urban areas also provides additional environmental and economic benefits including cleaner air and water, more attractive properties and recreational areas. It is thus important that these existing systems and resources which are minimal in Region A are safeguarded.

The following **guidelines should be implemented for existing built-up areas and retrofitting projects**:

- Optimal use of renewable and non-renewable resources;
- conservation of cultural and heritage resources;
- protection and conservation of biodiversity and natural resources;
- protected areas to be integrated into open space network;
- ensure applicable legislation and policy is considered and followed in land use planning and development;
- alignment with GDARD targets;
- protection of red data species;
- planning of waste management;
- promotion of the following:
    - alternative energy
    - energy efficiency
    - water storage
    - recycling
    - greener buildings (as discussed in the green building codes section); and
- implementation of National Waste Management Strategy for higher density areas.

4.2 NEW DEVELOPMENT

Environmental principles guide all stakeholders to manage an already fragile environment. Some principles as set out by the National

Environmental Management Act (NEMA) include a holistic evaluation, internalisation of externalities, the precautionary principle, sustainable development, sense of place and processes such as the considering of alternatives. Further guidelines to take into consideration include the following:

- All planning and development to be guided by the EMF which implies that the following be considered before there is any development:
  - disturbance of ecosystems with resulting loss of biological diversity;
  - pollution and degradation of the environment;
  - disturbance of landscapes and sites of heritage and cultural sites;
  - production of waste avoided, minimised, re-used, recycled or disposed of in a responsible manner;
  - non-renewable natural resources to be used responsibly and equitably and must take into account the consequences of the depletion of the resources;
  - the development, use and exploitation of renewable resources and the ecosystems of which they are part must not exceed the level beyond which their integrity is jeopardised
  - a risk-averse and cautious approach, which takes into account the limits of current knowledge about the consequences of decision and actions be applied; and
  - negative impacts on the environment and on people's environmental rights must be anticipated and prevented, and where they cannot be prevented, minimised and remedied.

- all development to align with the Open Space Strategy (EBOSS);
- protection of natural resources at all times;
- aligning with the objectives of the MSDF:
  - Protect, highlight and link natural elements of EMM to form a high quality, tactile and functional living environment and movement system for fauna, flora and humans;
  - Link-up with, and enhance the man-made elements of EMM (i.e. making open spaces such as squares, the servitudes of important internal roads and other service servitudes part of the open space network; and
  - Include as many of the EMM public open spaces as possible in linear linages;
- implementation of National Waste Management Strategy for higher density developments;
- recognition that landscapes and buildings operate as integrated and sustainable systems
- Address biodiversity issues
  - Not only is biodiversity an important and indispensable part of the planning process but its consideration at an early stage in the design process is also of benefit of the developer in saving costs to implement retroactive measures.

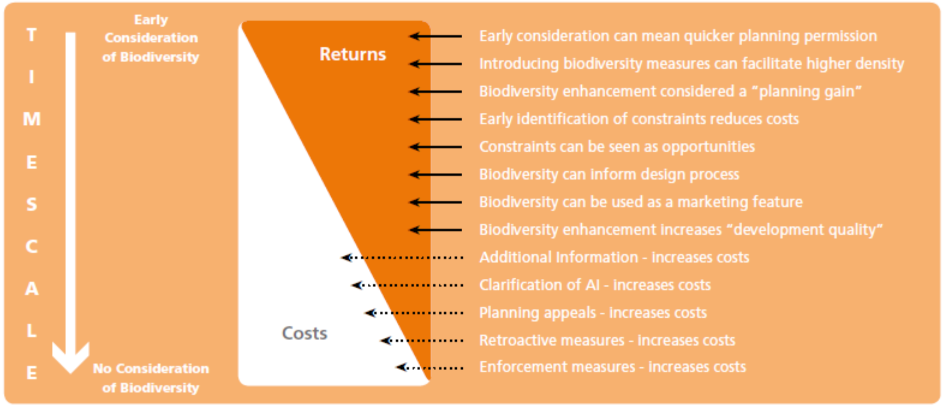

Figure 7: BIODIVERSITY COSTS (source: Green City Guidelines, 2011)

- All new development should make a positive contribution to its valued natural qualities by means of creating a microclimate. This can be achieved by:
    - creation of courtyards and open spaces between developments; and
    - landscaping and vegetation to enhance stormwater and open space networks

CREATE NEW CROSS-SITE PEDESTRIAN LINKS.
Image: HPA Architects.

Figure 8: MICROCLIMATE (Source: HPA Architects)

- Placement of new buildings to connect with open spaces, taking into consideration sunlight to adjoining buildings

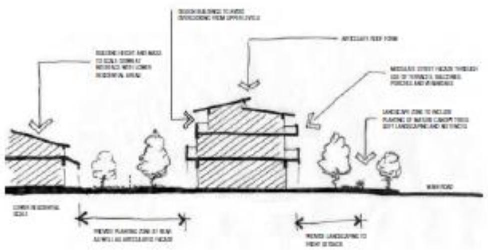

Figure 9: OPEN SPACES (Source HPA Architects)

- Making efficient use of natural resources, energy and water throughout the full life cycle and promoting the following:
    - alternative energy
    - energy efficiency
    - water conservation
    - waste minimisation and recycling
    - greener buildings (as discussed in the green building codes section); and

5 GREEN BUILDINGS

Green building practices will be used as an **example of environmentally sound practices** that needs to be developed by EMM to ensure a sustainable environment.

These practices benefit not only building professionals but also homeowners, communities and the environment, and afford everyone the opportunity to take the first steps towards a more sustainable future. Green buildings are a sure way to meet certain objectives such as using energy, water, and other resources more efficiently; and reducing the overall impact to the environment.

The following section is an **example of a Smart Building Handbook developed by the City of Cape Town** that can be implemented to ensure environmental sound developments **supporting the key concepts of densification, TOD's and retrofitting of the RSDF**.

Green buildings offer a range of benefits including:

- Reduced operational costs;
- Reduced resource consumption;

- Improved employee health, well-being and productivity;
- Reduced exposure to new environmental regulations (e.g. Carbon tax);
- Reduced exposure to utility price increases;
- Attractiveness to staff;
- Building environmentally aware businesses and households; and
- Improving and future-proofing asset value.

As buildings are responsible for between 40-60% of greenhouse gas emissions green buildings will significantly contribute towards environmental protection.

5.1 GREEN BUILDING PRINCIPLES

To deliver the benefits of green building, these principles must be implemented in the planning, design, operation, management and maintenance of any building project and should not be seen as add-ons, but rather as an integral part of the design and construction process.

The guiding principles are based on buildings to be:

- be locally appropriate;
- conserve the natural environment;
- use resources efficiently and effectively;
- be approached on a life-cycle basis;
- minimise waste;
- use renewable resources;
- implement sustainable procurement;
- utilise locally sourced materials and skills;
- maximise the health and well-being of users;
- allow real-time monitoring and evaluation; and
- leave a positive legacy.

These principles are explored in more detail below.

5.1.1 BE LOCALLY APPROPRIATE

Green buildings should be in sync with the social, economic and cultural context within which they are situated. The community which a development will serve should be involved from the beginning to ensure that the project responds appropriately to the local context, and creates sustained benefits for the community in the long term. The process of engagement with the local community in any project should focus on participation and not just consultation, and should as such be process-focused and not just product-focused.

5.1.2 CONSERVE THE NATURAL ENVIRONMENT

Green buildings imply an environmentally sensitive approach to the design and construction of the built environment, and an approach that aims to conserve the natural resources and ecosystems that sustain life in the area. The built environment must contribute to green corridors in the city's open spaces that will enable conservation areas to be ecologically linked. Ecologically sensitive areas must be conserved and degraded areas restored.

5.1.3 USE RESOURCES EFFICIENTLY AND EFFECTIVELY

Green buildings should be designed to maximise the efficiency of energy, water and materials use and to optimise resource use to achieve the desired function. Building projects should take advantage of emerging technologies, management systems and behavioural change to affect efficient resource use throughout planning, design, construction and operation.

5.1.4 Apply a full life-cycle approach

When deciding about the design of a building and the specific materials from which it is to be made, the entire life cycle of products must be considered in order to select the best overall option. Particular consideration should be given to the resource intensity (embodied water or carbon) and end-of-life effects (toxicity, recyclability) of materials. Life-cycle costing should also be used to select design solutions that optimise the cost over the life of the building, not just upfront.

5.1.5 Minimise waste

Green buildings should aim to eliminate waste in their construction and operation by selecting materials and systems that are reusable or recyclable, and eliminating those that are not, through careful procurement and the design of efficient systems in closed cycles where waste streams are utilised in other systems. This requires a systems-thinking approach to the planning and design phases, aiming to emulate nature by reusing, constantly recycling and putting to use discarded resources elsewhere, in adjacent systems.

5.1.6 Use renewable resources

Resources and materials that can be sustainably renewed through natural processes and sustainable cultivation are preferred to resources from non-renewable sources. Solar energy, harvested rainwater and sustainable timber (certified by the Forest Stewardship Council) are examples of renewable resources. Projects should make use of certification systems to verify that materials are sourced from sustainably managed areas.

5.1.7 Implement sustainable procurement

The procurement of goods and services for the planning, operation, management and maintenance of buildings should take environmental considerations into account. Sustainable procurement includes a wide range of factors, including the selection of low-toxicity and renewable materials, local products and services as a mechanism for local job creation, and materials and equipment based on life-cycle assessments. Every project should state procurement criteria that are suited to the project type and location as well as its immediate environmental and social impacts.

5.1.8 Utilize locally sourced materials and skills

Products and materials sourced and manufactured in the vicinity of a development reduce the energy embodied in transporting materials over long distances to the site. Furthermore, the use of local materials boosts the local economy and promotes job security for people living in the area.

5.1.9 Maximise the health and well-being of users

Developing healthy environments for people to live, work and play in should be a primary goal when designing and constructing the built environment.

Avoiding the impacts of toxic emissions from materials in the indoor environment and during their manufacture requires particular attention. Indoor environments also have strong effects on occupant well-being and productivity especially attributes such as the amount and quality of light and colour, the sense of enclosure, the sense of privacy, access to window views, connection to nature, sensory variety, and personal control over environmental conditions. Consideration should be given to natural light, indoor air quality, visual comfort and thermal comfort in the built environment.

5.1.10 ALLOW REAL-TIME MONITORING AND EVALUATION

Building managers and homeowners play an important part in ensuring the optimal performance of green building systems. The effective operation of buildings requires an environment rich in data on building performance, at least in terms of energy use, water use and internal conditions. Real-time feedback on building performance is the only way for facilities managers to be alerted to poorly performing systems.

5.1.11 LEAVE A POSITIVE LEGACY

The lifespan of buildings often far exceeds that of the developers, professionals or owners who initiate the buildings. They also have a significant impact on the resource efficiency, social interactions and environmental connectedness of our cities. The decisions we take now in the design of the built environment will affect the very fabric of our city for decades to come – decades in which the threats of climate change, food security and fresh-water availability will become increasingly real.

5.2 SUSTAINABLE RESOURCE MANAGEMENT

Reducing the energy consumption of a building not only reduces its impact on the environment, but also the running costs of the building. By incorporating energy-efficient and renewable energy options into a building, the demand for electricity during peak consumption times is reduced. Below ways to reduce energy consumption as pertained in the Cape Town Smart Building Handbook are discussed as an example of sustainable resource management :

5.2.1 REDUCE ENERGY CONSUMPTION

5.2.1.1 Passive solar design

Passive solar design reduces the demand for resources to improve indoor comfort, such as heating or air conditioning. It also provides for effective natural lighting, reducing the need for artificial lighting, as well as natural ventilation. Key considerations in passive solar design include:

- orientation;
- shading;
- ventilation openings; and
- glass selection.

Passive solar design should allow sun penetration in winter to reduce heating requirements, while shielding the internal space from direct sunlight in summer.

5.2.1.2 Insulation

Perhaps the most important component of energy efficiency in any building is insulation. Properly insulated ceilings and walls mean that indoor spaces are less vulnerable to temperature fluctuations, remaining cooler in summer and warmer in winter than non-insulated spaces, often eliminating the need for air conditioning for much of the day.

Furthermore, if air conditioning or heating is needed in peak hours or extreme temperatures, the conditioned air will remain at a comfortable temperature substantially longer in an insulated space, thus saving on a building's energy bill. Not all insulation has a low environmental impact, though, and there are some important considerations when selecting insulation:

- Insulation that has a high recycled content typically has a lower environmental impact than insulation from virgin materials.
- Some insulation is manufactured with ozone depleting chemicals, so be careful to enquire about insulation with zero ozone-depleting potential when considering your options.

5.2.1.3 Ceilings

The installation of a ceiling is the most cost-effective energy-efficiency measure, as most heat is gained or lost through the roof, especially if it is constructed from a conducting material, like corrugated iron. This is particularly important to consider in low-cost housing developments. Although eliminating ceilings may be cost-effective at first, it creates an unnecessary energy burden for the occupant in the long term.

5.2.1.4 Air ventilation

The selection of heating, ventilation and air-conditioning (HVAC) systems has a major environmental impact in terms of energy use, occupant health and comfort, and, in some instances, water too. HVAC systems come in a variety of configurations, but all primarily fulfil two functions:

- Provision of fresh air to indoor spaces (ventilation)
- Comfort control (heating and cooling)

In terms of ventilation, the lowest environmental impact can be achieved through natural ventilation using windows that can be opened. Where forced ventilation is a necessity (in some commercial buildings, for example), the following should be carefully considered:

- 'Mixed-mode' functionality, i.e. providing mechanical HVAC only when natural ventilation is not able to meet the internal conditions.
- Displacement ventilation, i.e. providing fresh air at a low level and using buoyancy to move it through the space.
- Diffuser selection and placement to reduce the likelihood of 'dead spots', typically known as air change effectiveness (can be determined by means of computational fluid dynamics (CFD) modelling during design).

Provision of greater fresh-air quantities than the minimum provision in the building code (5 L/s/ person), with potentially significant health benefits to building occupants that services a number of rooms or floors may be more energy-efficient than using many single-room units. However, individual preferences in thermal comfort levels must also be considered. Any centralised systems must be checked regularly to ensure that the ducts do not leak, as this reduces the energy efficiency of the unit. Only air conditioners with a seasonal energy efficiency ratio (ratio of the seasonal energy output to the seasonal energy input) of 10 or more should be used.

5.2.1.5 Tight construction

It is important to ensure that a building is constructed so that it is tightly sealed. This means that doors and windows must be properly fitted and sealed, and there should be no cracks in the construction that allow unwanted airflows in and out of the building. In windy locations, consider building an entrance hall with two doorways to prevent draughts.

5.2.1.6 Electricity

Using energy-efficient electrical installations is one of the cheapest and easiest ways to reduce energy costs, and thus improve the economic and environmental performance of existing developments. Newer equipment is often more energy-efficient than old equipment. Choose appliances such as energy efficient geysers and stoves, and refrigerators free from chlorofluorocarbons (CFCs).

Although these may initially be more expensive, they reduce electrical costs and environmental impacts in the long term. Photovoltaic (PV) cells can be used to generate renewable electricity independently, but this is generally quite costly. It is better to store the excess electricity that is generated in the national electricity grid, rather than using batteries, which contain toxic chemicals and heavy metals that are a problem to dispose of safely.

5.2.1.7 Lighting

The use of natural daylight instead of artificial lighting is obviously the most sustainable and efficient way of saving energy. Ensure that living and working spaces have an acceptable level of illumination without using artificial lighting during daytime by designing windows and skylights that are orientated to maximise the natural light without glare or overheating.

Reflective and angled ceilings will also bring more light deeper into a building. Energy-efficient light bulbs can substantially reduce energy costs. Compact fluorescent light bulbs (CFLs) use less than a quarter of the energy required to power a conventional light bulb for the same amount of time, and last ten times longer. Each CFL will save between 500 kg and 1 ton of carbon dioxide (CO_2) emissions in its lifetime. Although they currently still cost more than conventional light bulbs (R15 to R50), the amount of money spent on replacing light bulbs is reduced. CFLs last for around 10 000 hours, where a conventional incandescent bulb lasts just 1 000 hours on average. Here are some limitations that need to be considered when using CFLs:

- On/off cycling: CFLs are sensitive to being switched on and off frequently, and this reduces their rated lifespan.
- Dimmers: Not all CFLs can be used on dimmer switches. They can however be used with a timer or a three-way fixture. (Note: Some manufacturers, such as Philips, have recently introduced 'dimmable' CFL bulbs to the market, so this limitation is being addressed.)
- Outdoors: CFLs can be used outdoors, but should be covered or shaded from the elements. Low temperatures may reduce light levels. (Check the package label to see if the bulb is suited for outdoor use.)
- Retail lighting: CFLs are not spotlights. Retail store display lighting usually requires narrow focus beams for stronger spotlighting. CFLs are better suited for area lighting.
- Hazardous waste: CFLs contain small amounts of mercury. Although the mercury poses no threat while in the bulb, it is a problem for the environment, and the bulbs must therefore be disposed of at a hazardous waste disposal facility. Although CFLs come with these handling and disposal issues, the large energy savings they achieve compared to incandescent light bulbs are of greater overall environmental benefit. Another new technology that is even more efficient than CFLs is light-emitting diodes (LEDs) which:
    - use a fraction of the energy a CFL uses;
    - have a longer lifespan;
    - can shine brighter;
    - have many different applications; and
    - are currently the best green lighting technology available.

5.2.1.8 On-site generation: Photovoltaic panels

Solar photovoltaic (PV) panels generate electricity from sunshine. A panel could produce around 70 watts at 12 volts for roughly six or seven hours per day (about 0,4 kWh/day). A complete off-grid system includes a battery to store PV-generated electricity for night-time use, and a regulator to protect the battery from overcharging or over discharging. These components should all be matched to one another. PV panels may be connected in series or parallel for larger systems, depending on the electricity requirements.

5.2.1.9 Water heating

Solar water heaters are simply roof-mounted water panels that operate by heating water in black pipes using the power of the sun. Other, more complex systems using vacuum tubes, for example, are also available. Solar water heaters are usually fitted with electricity back-up.

Solar water heaters can save 25–40% of normal electricity use, and typically pay for themselves in three to five years. Financing a solar water heater through a bond translates into immediate monthly cost savings for a household.

Although heat pumps do not use solar energy, they use about one third of the energy of a conventional geyser and, as such, are a much greener option. Geyser blankets and pipe insulation can be manufactured from any heat-resistant insulating material that is wrapped around the geyser and hot-water pipes. Most modern geyser cylinders do not need geyser blankets, but any geyser or piping that feels warm to the touch is losing heat and needs insulation.

A vertical geyser is significantly more energy-efficient than a horizontal geyser. Installing geyser blankets and insulating all hot-water pipes can save about 5–10% of the energy used to heat water.

Geyser timers are devices that are installed on household geysers and that operate by switching the geyser on and off at specified times, thus providing hot water only when it is needed. All solar water heaters with electricity back-up should be fitted with a timer in order to ensure best use of the sun's power.

5.2.1.10 Recommendations for energy efficiency

- Install solar hot-water systems or heat pumps.
- Install properly insulated ceilings.
- Place and size windows to make optimal use of natural light, winter heating and ventilation without creating draughts, gaining too much heat in summer or losing heat in winter.
- Avoid the use of air conditioning, or at least ensure that the correct size air conditioner is installed and that use of the unit is minimised.
- Ensure that the building is constructed so as to be tightly sealed to prevent unwanted air flows. Doors and windows must be appropriately sized and fitted with seals.
- Energy-efficient electrical installations should be used.
- Ensure that artificial lighting is designed so that light is focused where necessary, such as on areas where tasks are being performed, with more ambient light elsewhere. Avoid the use of 'up-lighting' to reduce light pollution
- Ensure that energy-efficient light bulbs, such as CFLs or LEDs, are used where possible.
- Consider the installation of independent renewable electricity generators, such as PV panels.
- Further reduce the electrical energy used to heat water by installing geyser blankets, pipe insulation and a geyser timer.
- Install low-flow shower heads.

6 CONCLUSION

The guidelines highlighted in this document support the opportunities as per the EMF, Biodiversity plan as well as EBOSS. In order to achieve the key RSDF proposals of densification, TOD's and retrofitting the guidelines will raise awareness to:

- protect the limited open space and natural resources;
- take cognisance of the environmental constraints;
- promote environmental opportunities;
- promote links to the existing open space network,
- promote alternative energy and energy efficiency;
- promote water storage and water wise developments; and
- promote greener buildings and greener implementation processes.

To properly give effect to the proposals contained in the RSDF Ekurhuleni should ensure that sufficient implementation plans for EBOSS are in place and that green building codes are developed.