
LEGACY
ENVIRONMENTAL
MANAGEMENT
CONSULTING

2. MANAGEMENT POLICY FRAMEWORK

2.1 THE MANAGEMENT AUTHORITY

2.1.1 PROPOSED INSTITUTIONAL ARRANGEMENTS

2.1.1.1 MANAGEMENT AUTHORITY

The institutional arrangement for DGR is explained in section 1.2.2. It is recommended that the DGRMA is assigned as Management Authority for the DGR as required by the Protected Areas Act, Act No 57 of 2003 (PAA). The application document submitted to the MEC / Minister when applying for Protected Area status will describe the roles and functions of the DGRMA. The unique situation of having multiple land owners with existing infrastructure and management capacity and the institutional structure is explained in section 1.2.2. It is policy that the land owner's own facilities and capacities are used to operate the DGR as far as possible to save costs.

2.1.1.2 OUTSOURCING

It is also policy to keep a small core coordinating management capacity and thus outsourcing most services not available amongst participating land owners, to keep the overhead costs and related infrastructure costs such as administrative facilities and staff accommodation to a minimum. This policy will also counter job losses for current employees on private properties and stimulate opportunities for local SMMEs.

2.1.1.3 SOURCES OF FUNDING

The main source of funding will be from visitors through charging levies. It is policy for the DGR not to rely on income from game sales as the DGR is stocked at ecological carrying capacity and will also be carrying predators. It does however not rule out the possibility for the ad hoc sale of rare and valuable surplus animals that need to be removed or from breeding programmes. Land owners will be responsible for financial short-falls.

2.1.1.4 BUDGETS

The DGRMA will annually prepare a budget indicating the expected income and expenditures for the forthcoming year and will table this budget to the LOA members at an Annual General Meeting (AGM). It is the aim of the DGRMA to balance income with expenditures through minimising operational costs and charging an entrance/exit visitor levy that will aim to achieve sustainable financial self-sufficiency.

2.1.2 LEGAL FRAMEWORK

2.1.2.1 OBJECTIVES

The primary objective regarding protected area status is to have the DGR appropriately gazetted and the DGRMA fully mandated by law to enforce the policies, guidelines, rules and regulations of the DGR; so that the DGR and its natural resources could be protected in terms of the PAA.

It is also an objective to comply with all legal requirements by applying for the appropriate rights in terms of all infrastructure developments, game introductions and operations.

2.1.2.2 STRUCTURE

The proposed legal structure of the DGR is summarised as follows:

(i) The participating land owners within the DGR become members of the LOA as prescribed by the LOA Constitution.
(ii) The members of the LOA elect the members of the DGRMA as prescribed by the constitution of the LOA and thereby mandate the DGRMA to represent them in all matters relating to the management of the DGR.
(iii) Each member of the LOA gives a power of attorney to the DGRMA to apply for the declaration of the DGR as a Nature Reserve, to acknowledge the DGRMA as the duly appointed management authority of the DGR in terms of the constitution and as prescribed by the PAA and that the protected area status be registered against title once declared by the MEC or the Minister.
(iv) The MEC or Minister appoints the DGRMA as the management authority of the DGR, thereby vesting the powers and obligations for the management of the DGR to the DGRMA as provided for by the PAA.
(v) The relevant departments within the Limpopo Province and the Gauteng Province enter into an agreement regarding the joint responsibility for the DGR.

2.1.2.3 RULES AND REGULATIONS

The Management Authority will after proclamation restrict and regulate activities through the introduction of rules and regulations as provided for by the PAA. It is acknowledged that these rules and regulations will:

(i) Be consistent with the PAA and the Management Plan for the area;
(ii) Bind all persons in the area, including visitors; and
(iii) May as a condition for entry provide for the imposition of fines for breaches of the rules.

It is further recognised that no activities will be allowed that negatively affect the survival of any species or significantly disrupt the integrity of the ecological systems of the DGR.

2.1.2.4 LEGAL APPLICATION PROCEDURES

The following legal requirements have to be complied with:

(i) Application for Game Introductions
(ii) Section 24G Application for Flood Gates
(iii) Tourism EIA's
(iv) Protected Area Application.

Each of these is discussed below in more detail.

2.1.2.4.1 APPLICATION FOR GAME INTRODUCTIONS

Species applications were prepared as part of the comprehensive EMP and will be submitted as Species EMP's to the relevant provincial authorities (GDACE and LEDET).

2.1.2.4.2 SECTION S24G APPLICATION FOR FLOOD GATES

Section S24G application (EIA) for flood gates were prepared as part of the comprehensive EMP and will be submitted to the relevant provincial authorities (GDACE and LEDET).

2.1.2.4.3 TOURISM EIA

Tourism scoping reports were prepared as part of the comprehensive EMP and will be submitted to the relevant authorities for the tourism proposed on State land.

2.1.2.4.4 PROTECTED AREA APPLICATION

The DGR was initiated as part of the Dinokeng Project, a Blue IQ initiative (now under the auspices of the DTE) established by the Gauteng Provincial Government. The aim of the DGR is to promote economic growth, job creation and poverty alleviation by establishing a recognised ecotourism destination that is ecologically and economically sustainable.

The DGR is a collaborative effort between landowners and other stakeholders, facilitated and financially supported initially by the BIQ Projects and now through the Dinokeng Trading Entity (DTE). The DGR is managed by the Land Owners Association (LOA), through the DGR Management Association (DGRMA), a Section 21 company.

A Comprehensive Environmental Management Plan (EMP) for the DGR was commissioned by the Dinokeng Trading Entity. The completed EMP will be summarised as a Management Plan to be used by the DGRMA in the management of the DGR. The EMP was also prepared for the purposes of future applications for authorisations related to the conservation status of the DGR.

This comprehensive EMP forms the detailed background to the application and will be submitted in support of the application. LEDET have developed a policy (12/6/P – Policy 1 of 2008) (the LEDET Policy) with procedures and formats that combined with the SANBI Guidelines (2009) were used to guide this application. In the absence of an appropriate policy by GDARD, the same procedure followed and application prepared for LEDET, will be lodged with GDARD.

2.1.2.5 POSSIBLE CONSTRAINTS

The PAA sets certain restrictions on declaring areas as Nature Reserve with respect to land use. These include:

(i) Prospecting and mining

(ii) Land claims.

2.1.2.5.1 MINERAL RIGHTS

In the application for a nature reserve, the MEC's will be made aware of current prospecting and mining rights, so that the Minister can consult with the Cabinet member responsible for mining to prescribe special conditions.

2.1.2.5.2 LAND CLAIMS

In the application for a nature reserve, the MEC's will be made aware of current land claims, so that the Minister can consult with the Cabinet member responsible for land claims to prescribe special conditions.

2.1.2.6 PROCEDURE FOR PROTECTED AREA APPLICATION

2.1.2.6.1 RECOMMENDED APPROACH

To obtain Nature reserve status, it is recommended that the DGRMA applies to the MEC's of the relevant Provincial Government Agencies (LEDET and GDARD) for the proclamation of DGR as a Nature Reserve in terms of the PAA. The uniqueness of the DGR in terms of its collaborative effort and management regime should be considered.

The procedure and the content of the application were negotiated with GDARD and LEDET in a joint meeting prior to final preparation of the application. The fact that an existing nature reserve (Ditholo), private land as well as state land jointly form part of the proposed nature reserve needs to be considered.

2.1.2.6.2 OWNER CONSENT

The LOA constitution should be included as part of the application and the agreements between the LOA and the individual land owners must be available as proof of private land owner's consent. It may, however, still be necessary for land owners to enter into an agreement directly with the MEC (refer section 23 (3) of the PAA).

2.1.2.6.3 CONTENT OF APPLICATION AND MANAGEMENT PLAN

The content of the application will be in accordance with the requirements stipulated in the draft policy (Policy for the Declaration of a Nature Reserve in Limpopo) and the SANBI Guidelines (2009), as agreed during a joint meeting with the relevant officials from GDARD and LEDET.

Although the PAA requires that the Management Plan should be submitted within 12 months of the assignment, the EMP will be submitted concurrent with the application to the MEC's. The requirement to consult relevant municipalities, other organs of state, affected parties and local

communities in the process of preparing the Management Plan as well as considering Municipal IDP's, is deemed to be covered by the current process of developing the EMP from which the Management Plan will eventually be compiled.

The major aspects required by the PAA and the LEDET Policy that will be derived from the EMP include the following:

(i) The terms and conditions of any applicable biodiversity management plan;
(ii) A coordinated policy framework;
(iii) Such planning measures, controls and performance criteria as may be prescribed;
(iv) The implementation of community-based natural resource management; and
(v) A zoning of the area indicating what activities may take place in different sections of the area, and the conservation objectives of those sections.

Optional items that according to the PAA and the LEDET Policy may be included where relevant are the following:

(i) Development of economic opportunities within and adjacent to the protected area in terms of the integrated development framework;
(ii) Development of local management capacity and knowledge exchange;
(iii) Financial and other support to ensure effective administration and implementation of the co-management agreement; and
(iv) Any other relevant matter.

2.1.2.6.4 PROCEDURE

The application for having the DGR gazetted as a Nature Reserve is governed by the PAA and is the responsibility of the relevant MEC's or the Minister, on receipt of the formal application initiated by the DGRMA. The PAA (Section 35. (1)) states that the declaration of private land as a nature reserve "may be initiated by either the Minister, or the MEC or the owners of that land acting individually or collectively". Any request received by the Minister or an MEC from the owners of private land for their land to be declared must be considered by the Minister or MEC. As far as the DGRMA is concerned, they merely have to initiate the process by preparing the application and submitting it to the relevant MEC's (GDACE and LEDET) in the required format. The MECs may refer it to the Department of Water and Environmental Affairs (DWEA), based on the fact that State land is involved. It is, however, important that the DGRMA is convinced that the members of the LOA are in agreement that the DGR is proclaimed as a Nature Reserve before the MECs commence with the consultation process as prescribed by the PAA. Therefore, a formal power of attorney will be obtained from each participating land owner.

2.1.2.7 PUBLIC PARTICIPATION DURING APPLICATION FOR PROTECTED AREA STATUS

2.1.2.7.1 HISTORIC CONSULTATION

The DGR has been in consultation with all government stakeholders regarding the intended establishment of the DGR as a protected area. This consultation includes the following stakeholders:

(i) National government agencies (DEAT, DED, DLA, Land Claims Commissioner, Department of Defence, Department of Roads and Works, Department of Transport, SA National Roads Agency Ltd, Department of Water Affairs and Forestry, DME, DPW).
(ii) Provincial government agencies (GDACE / GDARD, LEDET).
(iii) Local Authorities (Metsweding District Municipality, Nokeng tsa Taemane Local Municipality).

The relevant proof of engagement will be submitted as part of the application.

2.1.2.7.2 FUTURE CONSULTATION AND PUBLIC PARTICIPATION

According to the PAA, the MEC's "... may follow such consultative process as may be appropriate in the circumstances, but must-

(i) Consult in accordance with the principles of co-operative government as set out in chapter 3 of the Constitution-
   a. The Minister and other national organs of state affected by the proposed notice; and
   b. The municipality in which the area concerned is situated;

(ii) Consult all provincial organs of state affected by any proposed notice;

(iii) In the prescribed manner, consult any lawful occupier with a right in land in any part of the area affected; and

(iv) Follow a process of public participation in accordance with section 33."

The PAA further prescribes that the intention to issue a notice has to be advertised in the Government Gazette and two regional newspapers by the MEC's; inviting written representations and or objections within 60 days of publication in the Government Gazette.

Local communities may be allowed by the MEC to make oral representations and or objections if it is deemed by the MEC that the proposed notice will affect their rights or interests.

The MEC will give due consideration to all representations or objections received or presented before publishing the relevant notice.

Where land owned by the State is included as part of the proposed Nature Reserve, the Minister (DWEA) or MEC may make that declaration only with the concurrence of the Cabinet Minister or MEC responsible for that land or where such land is held in trust by the State or an organ of State for a community or other beneficiary.

2.2 PROTECTED AREA POLICY FRAMEWORK & GUIDING MANAGEMENT PRINCIPLES

2.2.1 MANAGEMENT OBJECTIVES

The Objectives for the DGR provided below have significantly been extracted from the Dinokeng Integrated Tourism Development Framework - Volume B - Dinokeng Game Reserve Development Framework, as well as the Dinokeng Game Reserve Management Plan, 2007.

2.2.1.1 PRIMARY SOCIO-ECONOMIC OBJECTIVE

Unlike most public sector initiated game reserves, national parks and other types of protected areas in South Africa, the key objective or overall purpose of the envisaged DGR should not be the conservation of biodiversity. Rather the key objective or overall purpose of the Big Five DGR should be as follows:

(i) *To contribute significantly to economic growth and poverty alleviation in the Gauteng Province generally and the Dinokeng area specifically through the stimulation of a wildlife-based tourism industry.*

(ii) *To subscribe, subject to affordability and practical application, to the general principles and goals of the Dinokeng Blue IQ Project (now under the auspices of the DTE), more in particular the promotion and betterment of human resources in the region by assisting in the upliftment and education of the local communities and the promotion thereof.*

2.2.1.2 SECONDARY SUPPORT OBJECTIVES

Nevertheless, based on the axiom that sustained economic growth is dependent on sustainable resource utilisation, sustainable commercial development (in this case mainly tourism) and a sustainable socio-political environment, the following suite of support objectives should underpin all future development and management planning and implementation:

(i) Nature Conservation objective;
(ii) Tourism objective; and
(iii) Empowerment of the Previously Disadvantaged.

It is important to regard all three of these sub-objectives as being of similar importance for the achievement of the area's overall objective or purpose as, in as much as the key objective is dependent on them, they in turn are interdependent and reliant on each other for their individual achievement.

2.2.1.2.1 NATURE CONSERVATION OBJECTIVE

The objectives of the DGR with respect to nature conservation comprise the following:

(i) *To maintain and enhance the "pristine African" appearance of the landscape and the biodiversity in all its forms by, inter alia, conserving the existing indigenous species, reintroducing and sustainably managing all the large wild herbivore and predator species that occurred historically in the area, and reducing/removing man-made visual impairments and other forms of pollution of the landscape, including alien plants.*

(ii) *To promote the conservation and sustainable utilisation of fauna and flora on the land owned by its Members and which area is known as the Dinokeng Game Reserve, and to manage the area according to sound ecological principles;*

(iii) *To promote and further, in whatever manner it may consider advisable, the common and individual interests of its Members in regard to the commercial optimisation, protection, conservation and sustainable utilisation of fauna and flora within the DGR;*

(iv) *To manage the DGR always considering the minimum interference in the management and activities which Members may conduct on their own properties and the maximisation of managing the DGR as an ecological unit; and*

(v) *To work towards increasing the boundaries of the DGR by either incorporating more land adjacent to the DGR or by becoming part of a larger ecological unit or by merging with other similar associations such as this Association or by any other viable means.*

2.2.1.2.2 TOURISM OBJECTIVE

Following on from the above, the tourism objectives of the DGR are:

(i) *To provide tourists with outstanding game-viewing and other nature based experiences supported by a range of market compatible accommodation options that will enhance the visitor's experience further so that a thriving and sustainable tourist industry is ultimately established for the meaningful alleviation of poverty in the region.*

(ii) *To encourage tourism as a form of land-use with controlled access to land on a basis to be negotiated between tourism operators and individual Members;*

(iii) *To participate in a marketing campaign to promote the DGR as well as the commercial activities to be conducted on the properties forming part of the DGR;*

(iv) *To create and implement a sustainable income generating model for the DGR and create new employment opportunities for the communities adjacent to the DGR, through the establishment, promotion and management of tourism operations within the DGR; and*

(v) *To develop and implement a detailed Business Plan in regard to the development of the ecological objectives and the intended tourism objectives of the DGR.*

2.2.1.2.3 EMPOWERMENT OBJECTIVE

The poverty empowerment objectives of the DGR are:

(i) *To maximise income streams, job creation, small business development, investment opportunities, land redistribution and all other potential benefits and opportunities to local disadvantaged communities through sustainable tourism development, and sustainable consumptive use of natural resources where appropriate, by way of private sector concessions, shareholding and investment schemes, land redistribution schemes/ strategies and other appropriate contractual agreements with the private sector and local communities.*

(ii) *To represent it's Members in dealings with government and organs of state, the neighbouring community and the private sector and to do all such things as may be in the interests of the DGR; and*

(iii) *To promote, support or ensure compliance with any legislation or other measures affecting the DGR and in particular to obtain registration or other official recognition of the DGR as a protected area together with the DGR's distinctive logo in terms of the appropriate legislation.*

The achievement of the empowerment objective will be strongly dependent on how well the tourism objective is achieved, which in turn will be dependent on how well the conservation objective is achieved.

2.2.2 MANAGEMENT POLICIES

2.2.2.1 BIODIVERSITY MANAGEMENT

2.2.2.1.1 CONSERVATION OF FLORA AND FAUNA

A. GEOLOGY, TOPOGRAPHY AND SOILS

A.1) DESIRED STATE

The DGR endorses the fact that the soil is the basis of ecosystem functioning and will strive to ensure soil stability and productivity by combating all possible threats that could have a negative effect on soil stability especially along steep slopes and in drainage lines (wetlands).

A.2) OBJECTIVES

The specific objectives that will be pursued to achieve the desired state include the following:

(i) To ensure soil stability through the maintenance of sufficient vegetative cover;
(ii) To prevent and combat any soil erosion;
(iii) To rehabilitate existing cultivated land;
(iv) To conserve wetlands by prohibiting the development of infrastructure close to such wetlands and to manage the occurrence of fire; and
(v) To ensure that no infrastructure development will be located on sensitive soils, through the Protected Areas Act and Municipal Regulations.

A.3) POLICY AND OPERATIONAL GUIDELINES

A.3.1) Soil erosion

Visible soil erosion is not common in the DGR. That does not mean that no erosion occurs, but as a result of the flat terrain, especially in the north-western areas, gully erosion is very localised and was only observed in mapping units 8, 9, 11 and 13. Sheet erosion, mainly as a result of overgrazed conditions and wind, is more subtle and was observed in mapping units 10, 11, 12, 14 and 15.

The management plan should make provision for a limit on the number of game that should be carried on these erosion sensitive areas. Removal of the vegetation cover by overgrazing should be limited to address the soil erosion problem. Physical structures to address local gully erosion could be considered.

A.3.2) Cultivated land

Areas where cultivation took place in the past should be rehabilitated to protect soil stability and to enhance the establishment of the indigenous vegetation.

A.3.3) Wetlands

Soils that could be described as supporting a wetland were encountered on mapping units 4, 8 and 9. Protection of these wetlands is only possible with proper management of the vegetation in terms of overgrazing and fire.

A.3.4) Infrastructure development

It will be necessary to develop new infrastructure and also to maintain existing structures. Roads, watering points, lodges, power lines and other infrastructure that will be developed should take the qualities and the distribution of the soils into consideration. Maintaining roads and lodges and the collection of building material, should be considered carefully. New roads for tourists will be developed and old ones will have to be rehabilitated. Firebreak roads might also be necessary for fire prevention and control. These structures should take the distribution and qualities of the geology and soils into consideration.

A.3.5) Identification of management units

The natural components of a landscape include variations in vegetation, soils, topography and geology, function as ecological units. In considering any management practise, the landscape should be used as the basic management unit. For the DGR it is recommended that the three main geological units with its associated soils and vegetation should be used as basic management units. The following landscapes are proposed:

(i) The rhyolitic landscape;
(ii) The granite landscape; and
(iii) The Karoo Sediment landscape.

B. VEGETATION

B.1) DESIRED STATE

The DGR will strive to maintain and promote natural vegetation biodiversity in the area and to ensure suitable and sustainable habitat and nutrition for adapted fauna and not allowing overgrazing and trampling with the associated decrease in soil stability. These assets will be exposed to visitors through a sustainable ecotourism venture.

B.2) OBJECTIVES

In order to achieve the desired state in relation to vegetation, the following objectives will be pursued:

(i) To take cognisance of the natural relation and association between geology, soils and vegetation patterns and to use such units as management units in the management of the DGR;
(ii) To control the unnatural increase in density or encroachment of indigenous plant species;

(iii) To control the establishment and spread of alien plant species that occur in and around the DGR;
(iv) To identify and protect all endangered plant species that occur on the DGR;
(v) To prevent overgrazing and trampling and the associated loss in soil stability and loss of water through runoff;
(vi) To protect sensitive habitats such as wetlands and water catchments by not allowing any infrastructure development close to such areas;
(vii) To implement a near-natural fire regime; and
(viii) To implement a broad vegetation monitoring programme to ensure adaptive management.

B.3) POLICY AND OPERATIONAL GUIDELINES

B.3.1) Identification of management units

The natural components of a landscape include variations in vegetation, soils, topography and geology, function as ecological units. In considering any management practise, the landscape should be used as the basic management unit. For the DGR, it is recommended that the three main geological units with its associated soils and vegetation should be used as basic management units. The following landscapes are proposed:

(i) The rhyolitic landscape;
(ii) The granite landscape; and
(iii) The Karoo Sediment landscape.

B.3.2) Bush encroachment

Except for localised encroachment of *Acacia tortilis* and a few other plant species, bush encroachment is not a serious issue in the DGR. The areas that might be subject to bush encroachment and where similar encroachment already occurs, is in the north-western parts of the DGR, on the Karoo Sediment (Communities 10, 11, 12, 13 and 15).

The bush encroachment is mainly as a result of overgrazing and the presence of the water channel in the areas. *Acacia tortilus* trees and shrubs have increased tremendously along the channel where leaks are present. This encroachment cannot be controlled with natural or man-made fires and should be addressed by means of mechanical and chemical methods. A cautions approach should be adopted for overgrazing of these areas.

B.3.3) Alien plant control

Alien and ornamental plants in gardens and around residences were not included in the survey, but should be addressed as an issue in the management plan, especially if species occur that spread aggressively.

For the remainder of the area, the occurrence of alien plants is localised, but occur almost over the entire DGR. Infestation is at an initial stage and should be addressed as a matter of urgency to avoid future major operations and costs. Mechanical, chemical and biological methods could be used individually or in combination. Monitoring of the spread of alien plants should be conducted.

B.3.4) Management of rare and endangered plant species

The detail of the survey was not sufficient enough to identify all the red data species. Out of experience, a list of red data species that can be expected to occur on the DGR, was compiled and is provided in **Annexure 1**. Management should familiarise themselves with the species and be on the lookout for them during monitoring actions, development of infrastructure and implementation of a fire programme.

B.3.5) Overgrazing and carrying capacity

The data that was collected for each plant community (management unit) is sufficient to determine the carrying capacity for each plant community and therefore also for the entire DGR.

Overgrazed conditions were mostly encountered in the bottomlands on granite and in areas underlain by shales of the Karoo System (Communities 8, 9, 10, 11, 12, 13 and 15). As these are the areas where palatable grasses occur and permanent water is available, it can be expected that overgrazing will take place. In a free ranging game reserve where the game will move to areas of their choice, stocking rates should be based on the carrying capacity of preferred areas to prevent overgrazing.

B.3.6) Infrastructure development

Decisions on the development of infrastructure to service the DGR like roads, watering points, lodges, power lines and construction of fences, should take the distribution and occurrence of vegetation and soils into consideration. Sensitive areas and areas containing red data species should be avoided and care should be taken not to create nick-points for future erosion.

B.3.7) Fire management

The qualities and distribution of the different landscapes form the basis for drafting a fire management plan for the DGR.

B.3.8) Wetlands

Areas that could be described as wetlands are present in a few of the plant communities (management units), notably Communities 4, 8 and 9. As these areas form part of larger units, special attention should be given to their conservation.

B.3.9) Monitoring programme

The plant communities (management units) should form the basis for a broad based monitoring plan for the natural vegetation. Monitoring plots should be established in each unit and should be surveyed on a regular basis. Assistance could be provided to locate these monitoring sites and also to decide on appropriate methods that could be used.

C. WATER MANAGEMENT

C.1) DESIRED STATE

The DGR will strive to manage the water resource in such a way that maximum water yield is maintained and that existing artificial water sources will not interfere with the natural ecological processes such as game movement, local overgrazing and soil stability.

C.2) OBJECTIVES

The following objectives will be pursued in order to achieve the desired state:

(i) To acknowledge the role that water plays as medium for the transportation of nutrients to where it is needed;
(ii) To prevent increased runoff by ensuring sufficient vegetative cover;
(iii) To take notice that the Pienaars River is a regulated river and that any water management should be adapted to this fact;
(iv) To manage artificial water provision with the landscape as basis;
(v) To create artificial watering points in areas that is not sensitive in terms of soil stability and vegetation cover;
(vi) To provide artificial water in a form that is acceptable to the game;
(vii) To close down artificial watering points that is obviously located in unacceptable areas; and
(viii) To close down unused canals and to cover functional canals.

C.3) POLICY AND OPERATIONAL GUIDELINES

The sections to follow set out the policies and guidelines applicable to the implementation of the water resource management plan for the DGR.

C.3.1) Policies

The responsible authority

To be able to implement the water resource management plan, it is essential that an authority should be identified that will take the responsibility and accountability for the plan in collaboration with other relevant Authorities. In some instances, the implementation of the water resources management plan will have to be undertaken in collaboration with DWAF.

Overall ecological management objectives

The water resource management plan cannot be finalised here without input of the overall ecological management objectives as determined by the DGRMA each year, in accordance with adaptive management principles, as it could result in conflicting objectives, policies and guidelines. Guidelines for the resource management plan should be subjected to change pending the finalisation of the said objectives by the DGRMA on an annual basis. The water resource management plan presented here, therefore, includes different options that could be employed with regard to the management of water resources, the options chosen by the DGRMA being dependent on the selected management objectives.

Water resource management units

One of the principles of water resource management is that it should be based on the landscape attributes like geology, topography soils and vegetation. In the soil and vegetation surveys of the DGR, it was concluded that the three main geological areas present in the DGR, be used as units for the purpose of ecological management.

For the implementation of the water resource management the same management units are proposed:

(i) The rhyolite landscape
(ii) The granite landscape
(iii) The Karoo Sediment landscape (see Map 1 - Geology)

Taking the overall ecological management objectives into consideration, the water management objectives for each management unit must be determined.

Water resource management objectives

Although there should be an overall objective for the management of the water resources in the DGR, which will correspond with the overall ecological management objectives, it is essential that specific objectives be determined for each management unit and that the implementation of strategies to meet those objectives be regulated by appropriate guidelines. In the absence of the overall ecological management objectives, management options were generated that should be finalised at a later stage.

a. The rhyolite landscape

The rhyolite landscape is characterised by an undulating land form with broadleaved vegetation on sandy soils on the crests and wide open grassland in the bottomlands and streambeds. Natural water is restricted to seasonal spruits with an availability of between 60 and 80 percent of the year. Artificial water is restricted to a few small dams in the Boekenhout Spruit. Only one windmill that does not function occurs.

As the area is currently under-grazed, two management options could be considered. First is to supply artificial water in the area to attract game from other overgrazed areas for certain periods. The form in which the artificial water should be supplied must be such that it can be opened and closed when appropriate. The selection of the sites must be according to accepted guidelines mentioned below.

The second option could be to utilise the area for game that prefers tall grass veld like roan and sable antelope and even white rhino. In such a case, no artificial water should be considered and the emphasis should be in managing the wetlands in the area to ensure available natural water through the

year. Presence of high-density game species should not be encouraged. Accepting that roan and sable will not be introduced into the DGR as free-roaming game, this option may be less viable.

b. The Granite landscape

The granite landscape is characterised by an undulating topography with well-defined crests and bottomlands. Natural water is present in the spruits for 60 percent of the year. A few small dams and windmills occur in the bottomlands and spruits of the area. The bottomlands are sometimes overgrazed and soil erosion occurs locally.

Depending on the wildlife management objectives for the area, no additional artificial water should be provided in the area and if necessary, the existing artificial watering points should be closed. The well-dispersed natural watering points are sufficient to provide water for the game in the area.

Based on the focus of the DGR towards ecotourism, a diversity of species at low density is required for game viewing. If this management option is accepted, a rotational water provision system with existing artificial watering points could be considered.

c. The Karoo Sediment landscape

The Karoo Sediment landscape is flat country with sweet veld and is normally overgrazed. The highest concentrations of game occur in this area and nothing should be done to attract more game to the area. The main canal stretches right though the middle of the area and the Pienaars River is on the eastern boundary.

The first option is that no additional water should be provided in the area and that the closure of certain artificial watering points should commence as soon as possible. Actions must include the covering of the main canal, the sealing of the leaks in the canal and maintenance of the dense riparian vegetation along the Pienaars River to ensure that game will not drink there. Unused canals as indicated on Map 9 (Hydrology) must be filled up with soil and rehabilitated. The two quarries that are replenished with water from the canal must be managed and opened and closed on a rotational basis.

The second option is to remove some of the artificial watering points and to manage the remainder in such a way that game can be forced out of the area by closing the water and attracting the game to other areas in the DGR where water and green grazing is available like in the Rhyolite landscape.

Water resource protection

The protection of the natural water resources of the DGR must be the main objective. To meet this objective, the following actions should be taken:

a. Wetlands

(i) No structures or constructions will be allowed closer than 100 meters from a wetland.
(ii) If possible, wetland should be separated from adjacent areas and should receive special management in terms of fire, utilization, pollution and water conservation.

b. Alien plants

(i) Alien plants should be eradicated, because it competes with the natural vegetation for resources including the water resource.
(ii) Mechanical and chemical methods should be applied without risk to the indigenous vegetation.
(iii) Co-operative programmes with other stakeholders should be investigated.

c. Overgrazing

(i) Overgrazing and increased runoff is the reason for the biggest loss of water.
(ii) By ensuring a good and healthy grass cover, water flow will be slowed down and that will result in higher infiltration into the subsoil.

(iii) Any practice that will result in the removal of the vegetation cover should be terminated.

d. Fire

(i) Indiscriminate use of high intensity fires in the wrong season of the year results in bare areas for long periods with a lot of water loss and increased runoff.
(ii) Fire management treatments should be selected that enhance water protection.

e. Erosion control

(i) The best control on sheet and gully erosion is a protective plant cover.
(ii) If gully erosion already exists, structure to reclaim the area such as weirs and gabions should be constructed.
(iii) Such areas should be protected against grazing and fire.

f. Pollution

(i) Pollution of the water resource can be remote or it may be local.
(ii) Remote pollution of the water resources should be tackled through co-operative strategies with neighbours and the State.
(iii) Local pollution should be managed by not allowing sewerage to enter the watercourses.
(iv) Limit proximity of developments to a watercourse.
(v) Initiate a water quality monitoring system.

Monitoring

A programme for the monitoring of the water resource of the DGR must be implemented. This should include water quantity and quality as well as the influence of artificial and natural water provision on the vegetation.

C.3.2) Guidelines

When implementing the water resource management plan, the following guidelines should be adhered to.

Opening of new artificial watering points

Guidelines involved in opening a new watering point are:

a. Location:

(i) New artificial watering points should not be located on soils sensitive to erosion.
(ii) It should not be located in areas where natural water did not occur in the past.
(iii) Sweet veld areas must be avoided.
(iv) Rather stabilise existing natural watering points.
(v) The topography must be considered (not on steep slopes).

b. Density

(i) Watering points must not be too close to each other.
(ii) Distance between watering points will depend on the habitat and game species involved.
(iii) Watering points should be manageable (close and open).

c. Form

(i) The form in which the water is provided must suit the preferred game species.
(ii) Large open expanses of water are alien to this landscape.
(iii) No large dams will be allowed.
(iv) Riparian vegetation should not be removed to create a watering point.
(v) No dams will be allowed in wetlands.

Closing of artificial watering points

Guidelines involved in closing existing watering point are:

a. Windmills

(i) When closing down windmills the structure must be removed and the borehole must be sealed.
(ii) Troughs and reservoirs must be removed.
(iii) The area must be rehabilitated.

b. Dams

(i) The removal of existing stabilised dams is not recommended.
(ii) Small dams that pose a threat to the ecology must be removed completely and the area must be rehabilitated.
(iii) Dams in wetlands and vleis must be removed.

c. Canals

(i) Main canals must be covered.
(ii) Leaks from the canal must be repaired.
(iii) Unused canals must be filled up with soil and rehabilitated.
(iv) Bush encroachment along canals must be managed.

D. FIRE MANAGEMENT

D.1) DESIRED STATE

The DGR accepts fire as a natural phenomenon in the maintenance of vegetation composition and structure. In managing the vegetation a near-natural fire regime will be applied in such a way that neighbouring areas will not be negatively affected.

D.2) OBJECTIVES

In order to achieve the desired state for fire management in the DGR, the following objectives will be pursued:

(i) To implement a near-natural fire regime in the management of the vegetation;
(ii) To use landscapes as management units in the application of a fire programme;
(iii) To set clear objectives for each landscape;
(iv) To protect sensitive plant communities such as wetlands and riparian vegetation from severe fires;
(v) To involve neighbouring areas in the application of a fire policy and to ensure that they are not negatively affected; and
(vi) To implement a fire monitoring programme to ensure adaptive management.

D.3) POLICY AND OPERATIONAL GUIDELINES

D.3.1) Veldfire Management Plan for the DGR

After considering the advantages and constraints of fire as a management tool, the directives for fire legislation and prevention and the principles involved, a long-term veldfire management plan for the DGR can be developed. The fire management plan includes the following components:

The responsible authority

To be able to implement the fire management plan, it is essential that an authority be identified that will take the responsibility and accountability for the plan. That may be a person or a committee appointed by the DGRMA, or could even be undertaken by the DGRMA itself. For convenience, the appointed authority will be referred to as “The Committee” in further discussion of the fire management plan.

The DGR Fire Protection Association (FPA) should be involved in the process. No such association has been established in the DGR as yet and it is recommended that the DGRMA should apply as a FPA.

Fire management units

Because different vegetation communities react differently to fire, each community should be treated separately. Due to the size and geographical distribution of the plant communities in the DGR, it is impossible to use them as management units for fire.

It is, therefore, recommended that plant communities with comparable attributes be combined to form landscapes that should form the basic management units for fire. Analysis of the plant communities of the DGR showed that communities that occur on specific geological formations have enough similarities to combine them into landscapes that will serve as management units for fire, but also for other management considerations like, water provision, utilisation, etc. The following three managements units are recommended (see geology, soils and vegetation descriptions and associated maps – Maps 1, 2 and 8):

(i) The rhyolite landscape in the southeast of the DGR (Communities 1, 2 and 3);
(ii) The granite landscape in the central parts of the DGR (Communities 5, 6, 7 and 8); and
(iii) The Karoo Sediment landscape in the western, north-western and north-eastern DGR (communities 10, 11, 12, 13, 14 and 15).

Due to their sensitivity, communities 4 (Rhyolitic floodplains and riparian vegetation complex) and 9 (Floodplain and riparian vegetation complex on granite and Karoo Sediments) should be excluded from any fire management treatments.

Fire management objectives for each management unit

Fire management objectives should be determined for each of the three management units that will correspond with other management objectives for the areas. The fire objective should compliment, for example, the ecotourism objective, game utilisation objective, artificial water provision objective, etc. According to the vegetation structure and composition of the three proposed management units, the following fire management objectives could be formulated:

a. The rhyolite landscape

The communities that occur in this landscape do not show signs of serious bush encroachment, but some areas tend to become dominated by Increaser I grass species that indicates that the veld is under-utilised. Where the veld is sweeter (Community 3), there is almost no bush encroachment. The fire objective for this landscape should be to remove moribund grass material on an irregular basis (approximately every 3 years) to stimulate utilisation by game. This could be achieved through a cool fire after the first rains in spring and with a fuel load of between 3,000 and 4,000 kg/ha. The fire should be applied on a day when the temperature is under 20°C with moderate wind and a relative humidity of below 50 percent. By following this approach, game will be attracted from other areas in the DGR where permanent overgrazing occurs.

b. The granite landscape

The granite landscape varies from a tall tree savanna (Community 6) to a more closed, high shrubveld (Community 5). The communities of the landscape all have a small potential of bush encroachment and overgrazing, especially in the bottomlands. The fire objective will be to accumulate enough fuel to sustain an irregular hot fire to combat local bush encroachment, but not to stimulate overgrazing. This could be achieved through a low frequency (± every 5 years), hot fire before the first rain in spring and with a fuel load of between 3,000 and 4,000kg/ha. Day temperatures of above 20°C and a relative humidity of below 50 percent will ensure the required results.

c. The Karoo Sediment landscape

The Karoo Sediment landscape is characterised by flat plains with sweet veld, which is usually overgrazed and results in local areas of bush encroachment. Due to the sweet nature of the grazing in these areas, the game will always concentrate here and the situation is further influenced by the availability of permanent water in both the Pienaars River and the channel that runs through the area. The fire objective for this landscape will be to protect the area against accidental fires and only allow natural fires that will occur most probably at a very low frequency (± every 10 years) in above normal rainfall years. Bush encroachment along the channel should be removed by chemical and mechanical means.

Sensitive plant communities

Sensitive plant communities in the DGR are usually associated with the rivers and streams. Although the riparian forest on the granitic and Karoo Sediment areas (Community 9) is sensitive, it is usually not subjected to fire, because the grass fuel load is very low (naturally or overgrazed). The vlei areas (wetlands) are, however, subjected to fire and should be protected by firebreaks or by reducing the fuel load of the area during short dry periods in the rainy season with an out of season burn.

The vleis in the rhyolitic area (Community 4) are very sensitive wetlands and are usually covered with a dense grass layer. These areas should also be treated separately from the fire management policy of the surrounding areas. This could be done by means of firebreaks or out of season removal of grass fuel by means of cool fires.

Fire prevention and control measures

To be able to implement a fire management plan, the necessary precautionary measures should be in place. These measures are prescribed in the National Veld and Forest Fire Act (1998), but site specific measures should also be included. "The Committee" of the DGR should take the responsibility to:

(i) Establish a Fire Protection Association for the DGR, including its stakeholders and neighbours. Appoint fire control officers and convene meetings for exchange of information and take control.
(ii) Ensure that there are firebreaks established on the perimeter of the DGR, around lodges, private property and any other structures. The firebreaks could be graded, burnt or slashed.
(iii) Separate the above proposed three landscapes that will be used as fire management units by means of firebreaks and also subdivide the units into smaller blocks for the implementation of the fire management plan. Use should be made of existing roads, but if new firebreaks have to be constructed care should be taken not to position it against steep slopes, sensitive soils or ecotones.
(iv) Purchase the necessary fire fighting equipment and appoint and train staff to execute the fire management plan.
(v) Familiarise them self with the contents of fire danger ratings for the area.
(vi) Use existing private Working on Fire services to combat unscheduled fires.

Fire objectives for the current year

Based on the management objectives for each landscape, climatic data and the available information from the monitoring programme, "The Committee" must decide what percentage and which blocks will be scheduled for burning in each fire management unit every year. These blocks must then be inspected and a final list of areas to be burned that season must be compiled. Protection of sensitive areas should be reviewed every year.

Flexibility in the implementation of the fire management plan

The DGR is surrounded with neighbours with different forms of land use. It can be expected that accidental fires will enter the DGR from time to time. These fires must be restricted to the smallest area possible, by actively putting it out. The areas that burned should then be included in the anticipated scheduled fires for that specific season. If the area that burned in accidental fires for the season exceeds the area that was scheduled for the year, no further scheduled fires should be burnt.

Fire monitoring programme

"The Committee" must ensure that all information regarding fire in the DGR be collected and analysed. Such information should include, amongst others, the areas burnt, size of the burn, date of the fire, what caused the fire, climatic conditions, effect of the fire, actions taken, etc. This data should be used to facilitate the implementation of the fire management plan in successive years.

Review the fire management plan

The fire management plan, like any other management plan, is not cast in concrete. As more information becomes available, "The Committee" must review and adapt the fire management plan to ensure that the stated objectives are reached. The fire management plan must be reviewed every five years.

D.3.2) Procedure for Implementing the Fire Management Plan

With the fire management plan in place, it becomes the responsibility of "The Committee" to implement the plan. The fire management plan for the DGR is complex and, therefore, a step-by-step procedure for every year, with all the different actions involved in the execution of the plan, is provided.

Step 1: Convene a meeting of "The Committee" that is responsible for implementing the fire management plan.

Step 2: Decide on the objectives of fire for the year. This must be done for the DGR as a whole, each landscape and also for sensitive areas.

Step 3: Based on the objectives, climatic conditions and monitoring data, schedule the different blocks for burning.

Step 4: Do an inspection of the scheduled block to confirm that it is suitable for a fire.

Step 5: Draw up a final list of blocks scheduled for a burn.

Step 6: Decide on protection and/or preferential treatment of sensitive areas (Wetlands, riparian vegetation, etc.).

Step 7: Prepare fire prevention structures and firebreaks, check equipment and train the staff.

Step 8: Combat any accidental fires.

Step 9: Incorporate accidental fires in the programme and adapt scheduled blocks.

Step 10: Choose appropriate day or days for applying the fire. Take cognisance of fire danger ratings.

Step 11: Inform the members of the FPA and neighbours of the intention to burn with dates.

Step 12: Select appropriate methods to be used, such as ignition method, type of fire, time of day and ambient climatic conditions, on site. The selection should ensure that the objectives are met.

Step 13: Ensure that all safety precautions are met (firebreaks, staff and equipment).

Step 14: Record environmental conditions before, during and after the fire for monitoring purposes.

Step 15: Apply the fire.

Step 16: Ensure that the area is safe before leaving (burning stumps, dung or still burning areas).

Step 17: Complete fire application register for monitoring purposes.

Step 18: Report back to responsible authority.

E. GAME CARRYING CAPACITY

E.1) DESIRED STATE

The desired state with regard to carrying capacity is that a diverse range of native ungulates and predators will be stocked in sufficient numbers that they are readily seen by visitors to the DGR.

E.2) OBJECTIVES

In order to achieve the desired state that animals will be readily seen in the DGR, the diverse ungulate population of species suitable for the area will be stocked and managed as close to ecological carrying capacity as possible. The DGR will rigorously monitor the system and apply adaptive management (Bell, 1984; Walker, 1998) to maintain a dynamic equilibrium in the system.

E.3) POLICY AND OPERATIONAL GUIDELINES

E.3.1) Policy

The policy is that South Africa ungulate species that are suitable for the DGR will be stocked and then their populations managed as close to ecological carrying capacity as possible in order to provide a marketable game viewing experience for tourists. As the DGR has been subject to human and domestic livestock impact, it will be acceptable that extra-limital species e.g. impala, blesbok, blue wildebeest and white rhino (Roberts, 1951; Sidney, 1966; du Plessis, 1969; Skinner & Chimimba, 2005 and Owen-Smith pers comm.) can be supported in the DGR.

E.3.2) Guidelines

It is recommended that the DGRMA adopt the following objective and guiding principles to underpin the management of the DGR's vegetation–wildlife dynamics and the recommended stocking rate.

Objectives

Within the constraints imposed by geology, soils and rainfall, the habitats and wildlife populations will be managed using " Best Practices" to present a commercially viable "Big Five" product and at the same time conserve populations of rare and threatened species. The management of rare and threatened species, in particularly roan and sable antelope, will be considered for intensive production in camps.

The guiding principles for wildlife management in the DGR will be as follows:

(i) Adaptive Management will be essential to ensure that the objectives for vegetation and wildlife populations on the DGR are achieved.

(ii) The management of wildlife populations on the DGR will be to cost-effectively manage viable populations of those species that are largely indigenous to the area, in such a way that visitors will be able to enjoy a high quality wildlife experience and have an excellent chance of seeing four of the "Big Five" over a 48 hour visit.

(iii) Limits of Acceptable Change must be established, on a general level for all species, then at a species specific level for those that can be cost-effectively monitored and those that are considered important to the DGR's objectives. (This is not a part of the present consultancy.)

(iv) Species composition – in order to provide high quality viewing of predators, it will be necessary to manage the prey populations close to ecological carrying capacity. (In doing

this, competition for grazing will mean that efforts to retain populations of sable, roan and tsessebe will be fruitless. Therefore these species are no longer considered as being suitable for the DGR.)

(v) In the EMP for black rhino, advice is given against stocking a breeding nucleus of this species in the short term. The reasons are because of the limited population that can be stocked, the risk of man induced mortality on the roads and from poaching, and the fact that black rhino will add very little to the "Big Five" viewing experience.

(vi) Genetic diversity - in small populations, there is a minor concern that a small gene pool can result in inbreeding and loss of vigour. This is not considered critical in the population sizes recommended for the DGR. With respect to the key species to be introduced in the DGR, all the southern white rhino alive today stem from the relict population of ten animals in Zululand nearly 100 years ago. No concerns with loss of genetic diversity in this species have ever been raised and one must assume that it is not a problem yet.

In the case of elephant, the fact that a number of unrelated bulls will be in the founder introduction, together with the fact that it will be at least 15 years before any bull is likely to mate with its own daughter, means that any plans to cater for possible genetic issues at present are premature. This should only be considered when the first female calves born in the DGR are nearing puberty.

The Hluhluwe-Umfolozi lion population stemmed from one adult male and it was more that than 25 years before it was brought under consideration that there could be a genetic problem in that population. If the replacement of a pride male in the DGR is done with a new unrelated male every six years, it will be more than adequate to avoid the loss of genetic diversity.

(vii) Sustainable utilisation – an objective for the DGR is that 'Best Practices' will be applied to manage the DGR in the context of the national and regional economic necessities. It is important to the region, that only where animal populations can be utilised sustainably without detracting from the experience of other users of the area, that this form of use is practised. Once a sustainable balance between predators and prey is achieved, there could still be a few animals available for removal, which could take the form of hunting.

(viii) For practical purposes, there is no getting away from concepts of useable energy production by vegetation and energy requirements by herbivores and predators. This translates to biomass and numbers. In our view, in a closed system such as the DGR, monitoring and managing according to the concept of carrying capacity is well within the capability of the DGRMA and staff and is the most practical option to manage the vegetation-wildlife balance at present.

The Principle of Adaptive Management

One cannot simply recommend a stocking rate, without recommending the principle by which this stocking rate should be managed.

Ecosystem management is a complex and dynamic process that is best achieved by using an adaptive management system. The principle of 'Adaptive Management' (Bell 1984, Walker 1998) is a systematic approach where, based on present and often incomplete knowledge of the operation of the system, a clearly defined objective is chosen and the most appropriate management is implemented to achieve this objective. The management procedure is recorded and evaluated and the results are monitored. Because the outcomes of management are not always guaranteed, the results are evaluated against the assumptions on which the management was based. Divergence from the expected results

will provide knowledge that enables greater understanding of the system. Alternatively, the objective may have to be reviewed or the management procedure changed where appropriate.

Limits of Acceptable Change

The manner in which the management staff of the DGR must check whether they are on track with their expectations in managing the ecosystem is to set ecosystem endpoints that reflect a desired state. To define this desired state, it is necessary to set limits within which this desired state should fall. These are the 'Limits of Acceptable Change' (LACs). These reflect pre-agreed-on 'worry levels' or 'Thresholds of Concern' which, when exceeded (or confidently predicted are about to be exceeded) become the impetus for consideration of management action (Rogers & Biggs 1999). They also represent targets to which management must aim to return before the action taken is considered as having been effective. In this way monitoring and management actions (and indeed research supporting these) become sensibly and meaningfully linked to a common set of objectives.

As more understanding of the DGR is acquired, the limits of acceptable change must be refined for habitats, plant and wildlife species and the wild ambience of the DGR itself.

Managing for a high quality tourism product

To meet the expectations of any investors and the tourist market, the aim is that over a 48 hour period under normal conditions, visitors will have the following likelihood of seeing key species:

Species	Likelihood of viewing
Elephant	100%
White rhino	100%
Lion	50%
Buffalo	50%
Leopard or Cheetah	10%
Hippo	100%

E.3.3) Species Composition

The species composition is that which is dictated by what species already occur on the DGR and those that the DGRMA propose to reintroduce. Little emphasis has been placed on gemsbok, mountain reedbuck and springbok as these species are neither doing well, nor endemic to the area. A degree of latitude is recommended in what ungulates should be stocked as strictly speaking, blue wildebeest, white rhino and impala also did not occur in the area of the DGR (Roberts, 1951; Sidney, 1966; du Plessis, 1969; Skinner & Chimimba, 2005; Owen-Smith *pers comm*., 2009).

It is recommended that no effort is made to retain the populations of gemsbok or springbok and it is hoped that under predation and a greater level of competition, these will eventually die out. Because the blesbok population is well over 200 at present, it is felt that the species should be left in place. As happened in Suikerbosrand, it is expected that cheetah predation will control this population.

The nyala have been left as most of the population is confined to the environs of a camp and under a normal level of predation, nyala co-exist with bushbuck (Tello & van Gelder 1975, Anderson, 1976).

E.3.4) Carrying Capacity and Stocking Rate

The calculation of carrying capacity can be done in several ways and some may be more refined than others. What must be considered is that the measure varies from year to year depending on rainfall, and that the measure must be regarded as a guideline that management refines as vegetation and animal monitoring and the inputs of adaptive management are evaluated.

What the Agricultural Research Council's Range and Forage Unit has found to be the most practically applicable measure is to use the Rainfall: Herbivore Biomass model of Coe et al. (1976; Peel pers comm.). For this reason, this method has been used here. Using this method, the vegetation study and map (Map 8) completed as part of this project does not change the final biomass figure. The view is, therefore, that any difference is only likely to be in the proportion of feeding styles and species composition. The order of magnitude of any change in these proportions will be virtually a cosmetic one. It is recommended that management should "tweak" these species numbers within a particular feeding style, depending on species availability, market forces and the impacts of predation.

The following broad range in carrying capacity is recommended in Table 2.1 for the DGR, based on the general equations (Coe et. al., 1979), using an average annual rainfall of 630mm.

Table 2.1 The DGR range in Stocking for DGR rate as determined from Coe et al. (1976)

Range in stocking rate	Kg/Km^2	LSU/ Km^2
lower limit	2672	6
average	4285	9
upper limit	5858	13

Experience in the Lowveld indicates that the most appropriate carrying capacity range as calculated by the Coe et al. (1976) method is probably closer to the maximum than to the average figure (M Peel, pers. comm.). Taking this into account in the range obtained in Table 2.1, a carrying capacity of 5,858kg per km², or 7.7ha per LSU is adopted. At 7.7 ha per LSU, it is slightly higher than Grossman's (2005) estimate of 9 Ha per LSU. It gives an overall ungulate density of 30 animals per km².

The proposed stocking rate is illustrated in Table 2.2. While the current size of the DGR is approximately 18,500ha, the stocking rate provided in Table 2.2 is based on an assumed rounded area of approximately 19,000ha. (Note: Due to roads, dams and other developments such as residential buildings, etc., not all of the 18,500ha of the DGR will support herbivores).

Table 2.2 Proposed Carrying Capacity and initial stocking rate for DGR

	Average weight	Biomass at K	% of Total	Biomass (Km^2)*	Number of Animals	Biomass
Bulk grazers						
White rhino	1727	86350	7.75	575.67	**50**	86350
Hippo	1321	19815	1.78	132.10	**15**	19815
Buffalo	495	99000	8.89	660.00	**200**	99000
Zebra	216	216000	19.40	1440.00	**1000**	216000
Waterbuck	205	41000	3.68	273.33	**200**	41000
			41.51			
Selective grazers						
Blue wildebeest	180	180000	16.17	1200.00	**1000**	180000
Blesbok	61	18300	1.64	122.00	**300**	18300
Tsessebe	125	5000	0.45	33.33	**40**	5000
Hartebeest	120	18000	1.62	120.00	**150**	18000
Gemsbok	150	0	0.00	0.00	**0**	0
Warthog	30	7500	0.67	6.41	**250**	7500
Mtn reedbuck	23	0	0.00	0.00	**0**	0
			20.55			

	Average weight	Biomass at K	% of Total	Biomass (Km^2)*	Number of Animals	Biomass
Mixed feeders						
Elephant	3750	67500	6.06	450.00	**18**	67500
Eland	460	161000	14.46	1073.33	**350**	161000
Impala	41	65600	5.89	437.33	**1600**	65600
Ostrich	60	9000	0.81	60.00	**150**	9000
Springbok	30	0	0.00	0.00	**0**	0
Nyala	62	2480	0.22	16.53	**40**	0
			27.44			
Browsers						
Black rhino	818	0	0.00	0.00	**0**	0
Giraffe	828	57960	5.21	386.40	**70**	57960
Kudu	140	56000	5.03	373.33	**400**	56000
Bushbuck	**30**	3000	0.27	20.00	**100**	3000
Total		**1113505**	**10.50**	**7379.78**	**5933**	0
Recommended Biomass		**1113020**				

** Based on 5,858kg/km² and an area of 19,000ha, which excludes areas covered by roads and developments where stock will not be accommodated.*

F. DISEASE MANAGEMENT

F.1) DESIRED STATE

The desired state with respect to disease management is that wildlife or other animal diseases will not be a limiting factor with regards to the animal populations in the DGR.

F.2) OBJECTIVES

The DGRMA will continuously monitor for possible signs of animal diseases in the DGR and will immediately take all necessary steps to address any such disease if detected amongst the DGR's animal populations.

F.3) POLICY AND OPERATIONAL GUIDELINES

F.3.1) Disease Transmission Discussion on Species Basis

Standard operating procedures below should be followed before animals are introduced on the DGR or when surplus animals are caught on the DGR and sold to outside properties.

a. Elephant

Wild elephant populations are not known to carry any diseases that could pose a threat to other wildlife species in South Africa. However, they can act as a mechanical carrier that can introduce external parasites like ticks to new areas. Certain tick species could carry diseases that will pose a threat to livestock like cattle. Heartwater and corridor disease are the two main diseases of concern, which may be passively moved to new areas via their respective tick hosts.

Elephant must be sprayed with a topical acaricide at the capture site before introduction on the DGR, which will kill external parasites. Additionally a systemic drug (Cydectin or Dectomax) can be given to control internal and external parasites. No diagnostic tests for diseases are done.

b. White rhinoceros

Potential diseases that could be transmitted by translocated rhinoceros:

(i) Wild rhinoceros populations are not known to carry any diseases that could pose a threat to other wildlife species in South Africa.
(ii) Two tick born diseases namely heartwater in the *Amblyomma* spp. tick and corridor disease in certain *Rhipicephalus* spp. ticks could under very rare conditions passively be translocated to new areas. This is very unlikely and has never been recorded.

Precautionary steps to prevent diseases from being transported to new areas with translocated rhinoceros:

(i) During the chemically immobilised period before the animal is loaded a thorough examination of each rhinoceros must be conducted to confirm that the animal is healthy.
(ii) Every rhinoceros must be sprayed externally with an effective acaricide to kill all ticks. A pour-on can also be administered on their backs to ensure that all ticks are killed. **Important:** Triatix should never be used on rhinoceros as an acaricide because it may cause ileus of the gastro-intestinal tract.
(iii) No diagnostic tests for diseases are done.

c. Disease free buffalo

A very detailed protocol for the disease-free calf project and disease control precautions can be obtained from the local state veterinarian. ***No buffalo should be introduced or removed from the property without being certified by the Onderstepoort Veterinary Institute as free from Foot-and-mouth disease, Brucellosis, Bovine tuberculosis and Corridor disease (Theileriosis). All four diseases are notifiable diseases (See Annexure 3).***

Potential diseases that could be transmitted by translocated buffalo:

(i) Bovine tuberculosis is the most important disease that must be tested when buffalos are introduced on the DGR.
(ii) Corridor disease (*Theileriosis*) is an endemic disease found in a large percentage of buffalo in Theileria infected areas. All animals and transport trucks should be treated with an effective acaricide at the capture site before the animals are introduced.
(iii) Foot-and-mouth disease is endemic in buffalo in the conventional red line areas.
(iv) Brucellosis is an exotic disease found in buffalo and can act as a zoonosis.
(v) Heartwater, *Amblyomma* spp. tick and corridor disease, in certain *Rhipicephalus* spp. ticks may carry corridor disease and heartwater passively by transporting buffalo.

Precautionary steps to prevent diseases from being transported to new areas with translocated buffalo:

(i) At capture topical acaricides must be sprayed onto the buffalo. Pour-on dips are also used to treat the buffalo for external parasites. Dectomax or Cydectin are routinely given systemically to treat internal and external parasites.
(ii) During capture blood must be taken for laboratory tests for Bovine tuberculosis, Foot-and-mouth disease, Brucellosis and Corridor disease. A comparative Bovine tuberculosis skin test must be done at capture. The skin test must be read 72 – 96 hours after capture.
(iii) All buffalo captured must be quarantined until the test results are released by the state veterinarian. When an animal in a group tests suspicious for Bovine tuberculosis then that whole group is quarantined separately and the positive animal is slaughtered and a thorough post mortem and laboratory examination is done to confirm the presence or absence of Bovine tuberculosis.

d. Hippopotamus

Hippopotamus is unknown for any disease transmission in the wild. During anthrax outbreaks hippopotami must not be introduced from diseased areas. Care must be taken to introduce hippopotami from areas feeding on pastures infected with brucellosis.

e. Zebra

Potential diseases that could be transmitted by translocated zebra:

(i) African horse sickness and equine encephalosis are the two main diseases which may be carried by zebra and can be introduced to horses.
(ii) Zebra can passively carry external parasites (*Rhipicephalus* spp. and *Amblyomma* spp.) that may have contagious diseases like heartwater and corridor disease.

Precautionary steps to prevent diseases from being transported to new areas with translocated zebra:

(i) Zebra should be treated for internal and external parasites at capture with topical acaricides and pour-on and with systemic Dectomax or Cydectin. **Important:** Triatix should never be used on zebra as an acaricide because it may cause ileus of the gastro-intestinal tract.

f. Rare and endangered antelope

Rare and endangered antelope like tsessebe, roan antelope and sable antelope is expensive and will require special quarantine procedures or diagnostic testing depending from their origin.

Potential diseases that could be transmitted by translocated rare and endangered species:

(i) Foot-and-mouth disease may be transmitted to other species if the animals are from diseased areas.
(ii) Oestrid fly larva can be carried by these antelope species.
(iii) Bovine tuberculosis can be present in these antelope species but have not been recorded in any of them to date.
(iv) Theileria species could be transmitted by these antelope species but it is not certain what significance this may have.
(v) External parasites (*Rhipicephalus* spp and *Amblyomma* spp) carrying infectious diseases like heartwater and corridor disease may passively be transported to the nature reserve with these species.

Precautionary steps to prevent diseases from being transported to new areas with translocated rare and endangered species:

(i) All antelope must be treated with external and pour-on acaricides to “clean” them of external parasites before transportation to the DGR. A systemic treatment in the form of Dectomax or Cydectin will be given to treat internal and external parasites (including the *Oestrus* spp. larva).

g. Predators

Predators like lion, leopard, cheetah, hunting dogs and spotted hyena may be introduced in the future and the following precautions must be taken, regardless their origin.

Potential diseases that could be transmitted by translocated predators:

(i) Bovine tuberculosis can be carried by any one of the above-mentioned predators except for wild dogs in which it has never been diagnosed.
(ii) Rabies can infect any of the above mentioned predators. It has, however, never been diagnosed in wild animals within an area of high level biodiversity, similar to the biodiversity potential that the DGR could achieve through good management. The risk does, however, remain and the necessary precautionary measures should be taken by the DGR.
(iii) Internal parasites could be carried to new areas like the zoonoses *Trichinella* spp. and *Echinococcus* spp.
(iv) External parasites carrying contagious diseases could also be carried passively to new areas.

Due to the illegal movement of animals that does take place in the wildlife industry, the origin of animals cannot always be guaranteed. The risk of disease in predators therefore remains too high not

to take precautionary steps to ensure that diseases are not transported to the DGR. It is, therefore, essential that animals be tested and vaccinated before they are introduced into the DGR as a protection measure that will reduce risks and which could prevent significant financial damages to the DGR.

Precautionary steps to prevent diseases from being transported to new areas with translocated predators include:

(i) A comparative skin test, which must be read at 72 hours, must be done on every predator to check for Bovine tuberculosis. Only predators that have tested negative must be introduced on the DGR, regardless of their origin.
(ii) All predators must be treated externally with a spray or pour-on acaricides to treat external parasites. Dectomax or Cydectin and a recognised deworming treatment must be given to all introduced predators prior to movement.
(iii) Rabies vaccination must be done to all predators 21 days before they are introduced into the DGR with a killed vaccine at the capture site, to prevent a carrier state.
(iv) All carnivore species should be vaccinated with a killed parvo vaccine 21 days before introduction onto the DGR with a killed vaccine at the capture site to prevent a carrier state.
(v) Rabies and killed parvo vaccines can be given as boosters in the holding bomas 3 to 4 weeks after capture and prior to release into the DGR.
(vi) All large feline must be tested for feline aids before they are introduced on the DGR as an ideal, regardless their origin. Feline Aids or Feline Immunodeficiency Virus (FIV) occurs in most large populations and although not a serious threat, can reduce the immune system and, therefore, increase vulnerability to other diseases.

F.3.2) Disease Management and Control

Parasite Control

The philosophy to control parasites is based on the following factors:

(i) Use dipping products that will not be harmful to wildlife.
(ii) Alternate dipping compounds to minimise tick resistant strains developing.
(iii) Use a combination of methods at the same time.

The control programme implemented must not remove all the ticks. Low tick numbers is necessary for wildlife to maintain immunity against indigenous diseases.

Dipping will only be used, if required, in captive breeding pens in the DGR and not on the greater DGR, where game roam free.

a. Oxpeckers

Wild birds and domestic fowl can be efficient predators of ticks. Oxpeckers (*Buphagus africanus* and *B. erythrorhynchus*), domestic fowl (*Gallus domesticus*), guinea fowl (*Numida meleagris*) and cattle egrets (*Bubulculus ibis*) are the species considered to have the most significant effects on tick populations. However, researchers report 21 species of birds that perch on tick-infested cattle and ticks were found in the crop or gizzard of 14 of these species. Only the oxpecker species are considered to be specific predators of ticks, and all proposed predatory bird species have been found to be present in the face of very high infestations when other factors were favourable for ticks.

Red-billed oxpeckers *Buphagus erythrorhynchus* and yellow-billed oxpeckers *Buphagus africanus* are limited to the savanna areas of Africa. The distribution of these birds is limited by the occurrence of large mammals that carry the main food source (ticks) for these birds.

The organophosphate dips with which cattle were dipped in the past, have led to a decrease in the distribution of these birds. During the political unrest and war in the south-eastern parts of Zimbabwe in the 1970s, cattle ranchers temporarily left the area. This resulted in the yellow-billed oxpeckers reappearing in this area and in the northern part of the Kruger National Park. This phenomenon proves that if harmful dips are absent the birds will slowly repopulate the area.

Research has shown that the daily food intake per bird is approximately 15 gram. This is equivalent to 7,200 fully engorged larvae of the bont tick *Amblyomma hebraeum*. The number of ticks eaten by the birds daily depends on the types of tick available and their stage of development. The mean daily intake is around 408 ticks per bird. This translates into a total of 150,000 ticks eaten by each bird in a year. However, the effectiveness of the birds is far greater when seen in terms of the reduction in offspring of these ticks. A female blue tick *Boophilus decoloratus* and a bont tick *Amblyomma hebraeum* can lay from 2,500 to 18,000 eggs respectively. By removing the adult tick, the accumulative production of larvae in a given area will be reduced substantially.

When oxpeckers are to be introduced on a nature reserve, certain habitat requirements have to be met to ensure a successful introduction project. Animals with which the oxpeckers associate must be tolerant towards these birds because they have sharp nails and will irritate animals with sensitive hides. In the Kafue National Park in western Zambia, the most common hosts of the oxpeckers are the eland, hippopotamus, rhinoceros, sable antelope and roan antelope. The host preference with which the oxpeckers associate vary in size, shape, behaviour and habitat preference. The choice of a host may also change through the course of a day. The oxpeckers concentrate on rhinoceroses during the hottest part of the day. There is a direct relationship between the water requirements of roan antelope and that of oxpeckers. These birds usually use animals near waterholes as a platform from which they can fly to the water.

Studies showed that the surface area of the range of a red-billed oxpecker in the Kruger National Park varied from 26 to 27km^2. The maximum straight-line distance that these birds move is 8km. Therefore, a minimum introduction area of 200km^2 or 20,000ha will be necessary for the effective introduction when it is assumed that the range is circular in shape.

Oxpeckers nest in hollow tree trunks and show a preference for Leadwood (*Combretun imberbe*) trees. Only one male and one female will breed, but a group of five birds helps to feed and protect the chicks. Two to three eggs are laid from October to December. The eggs hatch after 12 days, and the chicks remain in the nest for 30 days. The chicks are fed until they are 90 days old. Feeding consists of 68% of the daily activities of an oxpecker. Parasites are collected from animals in various ways: they are pecked off or are cut off with cutting movements, or by making combing movements through the fur of the host. Flying insects are also caught on the wing. The birds also feed on open wounds by pecking off the scabs; they peck at the raw flesh of a wound to sustain themselves on blood.

It is strongly recommended to introduce oxpeckers in the Dinokeng area with the help of the Endangered Wildlife Trust (refer to **Annexure 4**).

The following factors are important for the introduction of oxpeckers to the DGR:

(i) The area has to be at least 200km^2 in size. Therefore, a few land owners should cooperate jointly.

(ii) Suitable host mammals for the ticks, such as rhinoceros, giraffe, eland and impala, must occur on the DGR.

(iii) When wildlife are introduced on the DGR or cattle on neighbouring ranches are dipped, pyrethroid compounds such as Bayticol, Curatick, Decatix, Drastic Deadline, Ektoban, Sumitic or Triatix should be used.
(iv) The introduction of birds should take place in the winter so that breeding birds are not removed from their original area.
(v) A viable population of at least 20 birds should be introduced. It is also advisable to try to capture and introduce birds from the same flock.
(vi) The birds must be kept in an aviary on donkeys for at least a month before they are released* (see note on housing of oxpeckers).
(vii) The birds should be released in the early morning in the vicinity of large mammals and waterholes.

* *Note on housing of oxpeckers*:
The technique involves the housing of donkeys and oxpeckers in an aviary and the rotation of donkeys on a daily basis, in order for them to pick up ticks from the veld.

The size of the walk-in aviary must be 5m (wide), 10m (long) and 2m high. The aviary must be divided in two sections: an open roofed entry section of 4m long and the main roofed aviary of 6m long. The aviary must be strong enough to house donkeys and the mesh small enough to keep rodents out. The bottom part must be enforced up to the shoulder height of a donkey.

A minimum of 10 donkeys is necessary and they must be rotated in pairs on a daily basis on a five day cycle (i.e. 2 donkeys in the aviary per day, so that each pair will be housed in the aviary every fifth day). The oxpeckers can open up old wounds and if donkeys are rotated every five days, the wounds can get time to heal.

When changing the donkeys, they are chased into the entry section and the birds are left behind in the main section of the aviary. This section is important to prevent the birds from escaping from the aviary when the donkeys are changed.

The donkeys should be replaced in the evening. Water and food (lucerne) must be provided for the animals during the day. The donkeys that are kept outside must be placed in a tick infested area to pick up ticks as food for the birds.

The birds will roost at night in metal pipes of 10cm diameter and 30cm long, which can be placed horizontally in the roof of the aviary. Shade must be provided by partially covering the roof of the main section of the aviary. Water for the birds must be placed on a level at which the donkeys cannot spill it.

The birds must be kept for 4-6 weeks in the aviary to settle. When they are released, the donkeys must be kept in the vicinity of the aviary and the doors left open for the birds to leave at their own time.

Oxpeckers as a pest to cattle farmers
In the Limpopo province some cattle farmers complained about birds inflicting wounds on new borne calves. This phenomenon is unlikely if there is enough food available on the common hosts like impala, kudu and waterbuck. Dairy cattle with cuts on their teats can also be hassled by these birds. Medicine (e.g. sulpha antibiotics) with a bitter taste can be used as a topical treatment on these wounds to discourage the birds from opening the wounds and delay the healing process.

Lesions on the withers and the sides of the thoracic area in buffalo and cattle are caused by a micro-filarial worm, *Parafilaria bassoni*. Bleeding spots from a raised nodule, where the worm is situated in the superficial tissues, can be seen from November to February. Secondary infection of these wounds can happen, but the parasite itself does not affect the buffalo adversely. Oxpeckers will feed on these bleeding spots, causing ulcers and eventually open wounds. Infected buffalo and cattle can be treated

with Ivomec at 1ml per 50kg of body mass to control the parasite. The birds fulfil a mechanical debriding role of wounds in nature.

Operation oxpecker

Operation oxpecker is a programme of the Endangered Wildlife Trust's, Poison Working Group, focusing on the conserving of oxpecker populations on private and State land in South Africa. It endeavours expanding these populations in areas where oxpeckers occurred historically.

Main activities include:

(i) Conduct population surveys of oxpeckers in their current distribution range.
(ii) Draft protocols for keeping, breeding, translocation and introduction of oxpeckers.
(iii) Conduct feasibility studies of areas where oxpeckers historically occurred.
(iv) Translocate oxpeckers on a trial basis.
(v) Influence landowners to use oxpecker friendly dips.
(vi) Influence manufacturers to phase out oxpecker incompatible dips.
(vii) Convince central and provincial government officials to issue oxpecker friendly dips to poor community farmers.

Additional information on Operation Oxpecker (refer to **Annexure 4**).

Chickens on cattle

Indigenous chickens (*Gallus gallus domesticus*) are well known to consume ticks in their diet. In a study, the numbers of ticks found in the crops and gizzards of 16 chickens ranged from none to 128, with an average of 28. Only 20 percent of the ticks were engorged. This can be a valuable community project where the indigenous chickens can be introduced to cattle farmers bordering the DGR to reduce tick strains that are resistant against acaricides.

Mr. Mike Bosch on a farm close to the DGR bred a local chicken for African conditions. The "Boschveld Chicken" has reduced the need for dipping on his farm from 26 times a year to 14. This leads to fewer chemicals in the environment and the ox-peckers have returned to his farm. The Boschveld Chicken is a cross between three indigenous chicken breeds of Africa, (Venda, Matabele and Ovambo). It is the only synthetic indigenous chicken breed in Africa. The registration of the breed is currently in process by the Department of Agriculture.

Characteristics of the Boschveld Chicken include:

(i) Boschveld chickens can assist in control of external parasites, e.g. ticks, lice, flies and maggots, on other livestock.
(ii) The chickens survive and produce on what nature can provide.
(iii) Can withstand the varying climatic conditions of Africa and keep producing well in free range conditions.
(iv) Have inbred hardiness, to withstand poultry diseases.
(v) Egg production starts at 20 weeks and a hen produces 240 eggs per annum.

b. Diatomite

Diatomaceous earth is a naturally occurring, soft, chalk-like sedimentary rock that is easily crumbled into a fine white to off-white powder. This powder has an abrasive feel, and is very light, due to its high porosity. The typical chemical composition of diatomaceous earth is 86% silicon, 5% sodium, 3% magnesium and 2% iron. There are 14 trace elements present like selenium and copper. Diatomaceous earth consists of fossilised remains of diatoms, a type of hard-shelled algae. It is used as a filtration aid, as a mild abrasive, as a mechanical insecticide, as an absorbent for liquids, as cat litter, as an activator in blood clotting studies and as a component of dynamite. As it is also heat-resistant, it can be used as a thermal insulator.

The biggest driving force in the development of new insecticides has been the desire to replace toxic insecticides with “green products” to minimise the negative effects on the ecology and to improve biodiversity in wilderness areas. The notorious DDT was introduced as a safer alternative to the lead, mercury and arsenic compounds which had been used before. It is true, that when used under the correct conditions, almost any chemical substance is 'safe', but when used under the wrong conditions most insecticides can be a threat to health and/or the environment.

Some insecticides have been banned due to the negative effects on animals and/or humans. This occurs with DDT and a number of related compounds due to the process of bioaccumulation, wherein the chemical, due to its stability and fat solubility, accumulates in the fat of organisms. DDT was often used in the past as a pesticide to control mosquitoes and malaria. DDT kills insects that are consumed by fish that are again caught by the fish eagle (food chain). DDT reduces the thickness of the egg shells on predatory birds like the fish eagle. The shells sometimes become too thin to be viable, causing reductions in bird populations.

Farmers in the Northern Cape noticed that wild animals visited certain areas and rolled in the soil. The observations that followed from this behaviour showed that there was a marked decline of the parasitic load on these animals. This observation was confirmed when containers filled with diatomite was placed in trees and animals came to rub against the containers. Several trials followed and a marked effect was observed after a period of six weeks. The mechanism of action is unclear. Some researchers believe that it has a mechanical action through the morphological structure of diatomite that has sharp spikes and damages the body surface of the parasite. Chemical action is probably more likely but no scientific evidence exists to prove this theory.

Application

(i) *External:* The rolling method, where (Rol Mat 200 – 300kg) material is spread over a small area. Game animals will come and roll at these places. The diatoms come in contact with the parasite that will shrink and die eventually.

(ii) *Internal:* A 5% concentrate of diatomite can be added to a salt phosphate lick or added to the food. Diatoms Fostec P6 (Reg. No. V 20812) is commercially available and is recommended to feed during autumn to avoid phosphate deficiencies (botulism) and control parasites more effectively in the animal. Highest population of parasites occur in the animal during winter and on the veld in summer.

More information can be obtained from Mr. Isak Maritz (refer to **Annexure 4**).

c. Licks

Winter is the best time to use licks as a deworming tool because round worms, spend the winter in their hosts. The licks are best introduced in July as a combination of salt phosphate with a deworming agent such as Ivomec added to the lick. The Safari block was commercially developed for this purpose and can be obtained from the local cooperation. Wildlife will accept licks better in winter because the veld is usually in poor condition. The DGR area is not known to have mineral deficiencies. Licks are, therefore, only recommended as a precautionary measure and to offer the best possible nutritional balance. Animals will only use the licks if a particular deficiency occurs. It is, therefore, advisable to monitor usage and adjust the provision of licks accordingly.

The following guidelines must be followed with anthelmintic licks:

(i) Introduce rock salt or licks consisting coarse salt to ensure that the animals do not have a salt hunger and get use to the lick area. As soon as the animals have accepted the salt licks, they can gradually be replaced by unmedicated mineral licks, such as 50% salt, 5% calorie 3000 and 45% dicalsiumfosphate. After the animals have accepted these licks, it can be medicated with anthelmintics. The anthelmintics must be alternated with products such as diatomite to prevent resistance forming strains of different parasites.

(ii) The best results are obtained by placing out several licks over the whole DGR close to water points. When more aggressive animals such as eland are present, sufficient licks should be provided at each point to avoid competition. Licks for giraffe can be provided on a wooden platform tied with a chain to trees at the appropriate feeding height.
(iii) The licks should be inspected on a regular basis to determine which wildlife species are utilising them. Licks containing urea must be placed in containers with holes drilled in the bottom to prevent rainwater accumulating in the container. Dissolved urea is toxic and will lead to mortalities in wildlife if they take this water in.
(iv) Warthog and Burchell's zebra tend to take large bites out of lick blocks. In doing so, they also tend to overturn or break the blocks. When zebras are present on a game ranch, as will be the case for the DGR, the licks should be anchored firmly to the ground or placed in metal or concrete frames at ground level. More than one block must be put in an area because zebra will kick and cause injuries to other wildlife species.
(v) In the effective control of worms it is important that wildlife must have free access to licks for two to four weeks. This will ensure that even shy animals will take in sufficient amounts of the anthelmintic.

Carcass disposal of sick animals

a. Burning of carcasses

A carcass is usually only burnt during outbreaks of a disease such as anthrax. It is a time-consuming technique with ecological implications, but is effective in limiting the spread of a disease from a focal point. The removal of bones is important to prevent animals such as giraffe from chewing on bones and contracting botulism.

The ecological effects of burning carcasses include the following:

(i) The removal of carcasses puts pressure on scavengers, such as spotted and brown hyenas and vultures. These animals then have to move about more, and further, in search for food. In doing so, they can spread the disease more rapidly.
(ii) The bacteria found in old bones are removed from the ecosystem and the onset of disease outbreaks such as botulism and anthrax is prevented.
(iii) Wild animals eat bones to satisfy their mineral requirements during the winter. Supplementary licks therefore have to be provided to alleviate this deficiency when the carcasses and bones on a nature reserve are burned.
(iv) Burning of carcasses during dry winter months must be done with care to prevent unwanted veld fires.

b. Burying of carcasses

The most effective way to control a disease is to burry a carcass after it was diagnosed with an effective disease. Lime must be put on the carcass before soil is placed back over the carcass. The carcass must be buried at least 1 meter deep to prevent scavengers from opening the trench. Expensive equipment is needed to burry carcasses effectively.

c. Disposal of carcasses by feeding it at vulture restaurants

A vulture restaurant is an area where fresh disease- and poison-free meat and/or carcasses of domestic livestock or wild mammals are put out for vultures and other scavengers like brown hyena. Hyena can crush bones to produce splinters that can be consumed by vultures and prevent calcium deficiencies in these birds. This practise is a natural way to get rid of carcasses in a controlled way and limit the disease risks involved.

Requirements of a vulture restaurant are the following:

(i) Enough food must be available from the surrounding community to ensure a constant supply. Feeding vultures and scavengers at vulture restaurants can contribute to the survival of these birds, especially during periods of food scarcity and when their offspring must be raised. Farmers put out domestic livestock that have died from diseases

such as redwater or heartwater. Carcasses that have been struck by lightning will not be consumed by vultures.

(ii) Carcasses must not be used from animals poisoned or treated with veterinary drugs [e.g. barbiturates, diclofenac (NSAID) non- steroidal anti-inflammatory drugs].

(iii) The restaurant must be far away from power lines (ESKOM). The birds will use the lines as a perch and can be electrocuted. Big trees that border a large open area (200 m x 200 m) make it possible that the birds can take off and land easily. Long grass must be slashed in order that the birds can see. This practise will enable the birds to see the carcass from the air and not feel threatened in an enclosed area while they are feeding.

(iv) The restaurant must be situated in a quiet area with minimum human activity where the birds can feed undisturbed. The restaurant should not be close to a tourist camp because rotten meat will have an unpleasant smell.

(v) The spot must be placed away from runways to prevent birds striking aircraft.

(vi) A shallow, round waterhole from cement with the following dimensions (300 mm deep, 3 000 mm in diameter and not more than 200 mm above ground level) can be erected within 50 meters from the feeding area. This will enable the vultures to use waterholes that can be disinfected if anthrax breaks out in the area and prevent the birds from spreading the disease mechanically to other water sources.

(vii) The restaurant must be placed in area where vultures occur naturally.

(viii) The old bones at the restaurant must be burned on a monthly basis to prevent botulism outbreaks. Endangered or threatened species can be vaccinated on an annual basis.

Advantages

(i) Conservation of vultures: Supplying safe food sources during times when food is limited increases the survival rate of the birds.

(ii) The restaurant is a cost effective way of carcass of disposal.

(iii) Bones can be broken with a hammer in smaller pieces that vultures can consume the splinters to prevent calcium deficiencies in the birds.

(iv) The vultures can be a tourist attraction to the DGR.

(v) Education includes talks at schools, farmer associations and public meetings and individual visits of these groups to the restaurant. This can also include conflict resolution between carnivores and neighbouring farmers.

(vi) Research and monitoring: Due to the ringing of birds the distribution range can be obtained from these restaurants.

Disadvantages

(i) When old carcasses are not burnt or buried it can be a source of disease e.g. botulism when animals consume the bones (pica).

(ii) Rotten meat can cause a smell that will be unpleasant for tourists.

Immunisation

It is difficult to immunise many types of wild animal because they cannot be herded into a conventional boma to be injected. The practical problems on a single wildlife area include knowing which animals have already been immunised, how long the vaccine provides protection, and how much vaccine must be administered to each animal. If inoculation for immunisation is to be done, the following aspects have to be considered:

Technique

The game rancher or manager should consider the following questions before starting the inoculation:

(i) Which animals are most susceptible?

(ii) Are rare animal species to be immunised?

(iii) What are the ages and sexes of the animals to be immunised?

The technique is basically the same for all the diseases, but anthrax will be used as an example here. A four-seater helicopter can be used, from which three marksmen can shoot darts at the animals. An alternative is to use a two-seater helicopter to herd the animals into a capture boma from where they can be immunised with a pole syringe in a holding crush or mass crate. Every animal that has been immunised is marked with a white paint patch on the back and then released. While searching for herds to drive towards the capture boma, large animals such as giraffe or kudu bulls can be darted directly from the helicopter.

Quarantine

Quarantine is applied in South Africa mainly to control foot-and-mouth disease but a set of quarantine pens is important in future for the DGR if they want to sell buffalo. The pens can also be used for game auctions, to treat sick or injured wild animals or to keep animals for an observation period before they are released on the DGR. However, pens are expensive to erect and requires specialised knowledge to manage animals in the bomas. There are existing game release bomas within the boundaries of the DGR that can be used for these purposes. Quarantine is of practical value only for rare wild animals, such as the buffalo, rhinoceros, sable antelope and the roan antelope. The guidelines for quarantine pens appear in **Annexure 5**.

F.3.3) Disease Monitoring Plan

Wildlife demography

The number, density and distribution of animals on the DGR are important and species of the greatest concern must be identified and mapped each year after the annual game census. Over a period of time this information will indicate the preference habitat on the DGR for each individual species. When there is a disease outbreak the managers will be able to locate specific species in a short period of time, saving costs and mortalities in animals.

Wildlife disease monitoring and surveillance

This is the key element for the early detection of disease patterns of the area. It is recommended that the staff must be trained at the Wildlife Unit, Faculty Veterinary Science, Onderstepoort (refer to **Annexure 4**) to take samples of dead animals for diagnostic purposes. A mortality register must be kept with the following information: animal species, sex, age, GPS coordinates, which samples have been taken and the diagnosis made. This information must also be mapped on an annual basis. GIS technology can be used to analyse this data for management purposes.

Contingency Response Plans

According to Bengis there are two different kinds of pro-active response plans for outbreaks of disease, namely:

(i) *Generic Response Plans for a range of diseases:*
These plans are made with reference to possible outbreaks in a range of species, habitats and geographic locations, and for a range of infectious agents with different characteristics of transmission, persistence and other epidemiological factors. Generic plans facilitate responses to outbreaks of new or unanticipated diseases.

(ii) *Response plans for specific diseases:*
Risk analysis must be undertaken to identify the disease threat with greatest likelihood of occurrence in area or region concerned. Response plans specifically for these diseases in susceptible wild animal species must then be made. These plans may be highly detailed with respect to susceptible species, and the protection, control or eradication options available, while generic plans must remain more general.

This plan will be based on two specific diseases that will threaten the communities on the DGR boundary. Tuberculosis can be spread from cattle of the communities to infect expensive animals in the DGR like buffalo. The disease can also spread from the cattle to the people using the products like

milk and meat. It is of outmost importance to test all cattle bordering the DGR on an annual basis for tuberculosis and brucellosis. Animals that test positive must be slaughtered according to the regulations of notifiable diseases as described by the Animal Health Act No (1023) of 2002, which is exercised by the state veterinarian (see **Annexure 14**). Refer to the list of notifiable diseases in **Annexure 3**.

The second important disease is rabies that can be spread from wildlife to the domestic dog population on the boundaries of the DGR. It is very important to vaccinate dogs on an annual basis against rabies and parvovirus infections.

Funding
It is essential to establish an emergency fund of at least a million rand to initiate a quick response to a disease outbreak. This fund can be managed by the South African Veterinary Foundation (refer to **Annexure 4**) on behalf of all the owners in the DGR. This is the most important administration delay in an effective control plan of a disease outbreak. The lack of mobilising resources within hours can lead to a situation where a disease can spread like a veld fire and can be uncontrollable within days.

Communication
Communication channels between owners, neighbours and scientists are the back bone of disease management of the DGR. It is recommended that an advisory committee must be established with all parties concern that can meet on a three monthly basis and inform the communities about the activities in the DGR. The committee must have representatives of the private land owners, state veterinarians, community leaders, Gauteng Nature Conservation Department, Onderstepoort Faculty Veterinary Science and private individuals with specific expertise.

Education
It is essential that all staff members and other participants in the disease control programme must receive adequate and appropriate training to fulfil their roles. The shortage of trained personnel at all levels is a major constraint to the planning and implementation of a disease management plan. *The treatment or control measures envisaged should not be worse than the disease.* This statement is important to educate communities why their animals must be tested and vaccinated on the boundary of the DGR. The State Veterinarian Department should also be involved in undertaking collaborative education programmes.

F.3.4) Conclusions
The success of the disease management plan will depend on the following five pillars:

a. Education of Communities
Communities on the boundaries of the DGR must be educated on vaccination programmes for rabies, distemper and parvo in their dogs and anthrax and botulism in their cattle. Annual monitoring and testing of their cattle against tuberculosis and brucellosis is necessary for the prevention of these diseases that can spread to humans. The community must also be aware that they can have mortalities of MCF in their cattle when contact with blue wildebeest occurs. It is a function of the state veterinarian to visit the area and test the cattle on an annual basis and to vaccinate all dogs against rabies.

b. Monitoring Programme of Mortalities
The training of staff by Onderstepoort Faculty of Veterinary Science to collect samples from fresh carcasses is very important to make a diagnosis at an early stage. Management will be in a position to act pro-actively and avoid animal losses in the DGR and from the communities on the boundaries.

c. Emergency Fund
An emergency fund where the money is available within 24 hours will assist in a rapid response by management and avoid bureaucracy causing time constraints on control measures.

d. Strict Policy – Sources of Animals Introduced

Planning of animals introduced on the DGR is important and should include research on the history of diseases in animals from areas where introductions will take place. Contact the nearest state veterinarian for the information needed.

e. Strict Testing of Cattle on the Boundaries of the DGR

An aggressive annual monitoring plan against tuberculosis and brucellosis for cattle on the boundaries of the DGR cannot be overemphasised.

G. NATURAL RESOURCE HARVESTING

G.1) DESIRED STATE

The desired state is that the DGRMA will manage the sustainable utilisation of selected renewable natural resources in the DGR by the local community and that the community values this activity and a sense of ownership of the DGR is developed. The utilisation will be subject to this not having a detrimental impact on the primary objectives of the DGR and having the written consent of respective landowners.

G.2) OBJECTIVES

The objectives of providing access to renewable natural resources are to foster an awareness of "ownership" of the DGR amongst *bona-fide* members of the local surrounding communities and to demonstrate that the benefits are not just for the landowners. Where resources from the DGR, such as thatching grass, can be used to create employment, the DGRMA will actively engage with communities to help relevant SMMEs become viable.

G.3) POLICY AND OPERATIONAL GUIDELINES

G.3.1) Policy

The utilisation of renewable natural resources by members of the local community will be encouraged, subject to planning by the DGRMA and collection under controlled conditions, where public safety will be paramount.

G.3.2) Guiding Principles

The guiding principles for resource utilisation are as follows:

(i) The utilisation of indigenous fauna and flora will be on a sustainable basis;
(ii) Alien species will be utilised until they are eliminated;
(iii) Non-renewable resources such as quarry material may be utilised on a case by case basis and subject to the landowner's consent and NEMA;
(iv) No harvesting will be done on privately owned land without the landowner's written approval; and
(v) The DGRMA will manage any harvesting process to ensure compliance with agreed criteria and to ensure human safety.

G.3.3) The Resources

The resources potentially available are: thatch grass, medicinal plants, firewood and game meat.

a. Thatch grass

Thatch grass is abundant and can provide a potential harvest. In order that any collection of thatch is done on an organised basis, the DGRMA will undertake the following:

(i) The ecologist and section rangers will identify areas where thatch can be collected in a particular year and secure the agreement of landowners;
(ii) The DGRMA will inform local community representatives and local thatching companies;
(iii) The management staff will arrange with interested parties dates, times, fire precautions and security arrangements for when thatch can be collected;

(iv) Field staff will oversee the collection process and provide a field ranger (or similar representative) at the collection site;
(v) Staff will record the number of bundles collected and their value to the community.

b. Medicinal plants

The logistical requirements of managing individuals searching for and collecting medicinal plants in a "Big 5" reserve are going to be difficult and costly for the DGR. The following procedures are recommended:

(i) The ecologist will make recommendations on which medicinal plants can be sustainably harvested from the DGR;
(ii) Any collection of medicinal plants will be arranged through a recognised herbalist organisation;
(iii) Any collection will be planned by the DGRMA and the collectors accompanied by the ecologist or a section ranger and a field ranger (or similar representatives);
(iv) The amount of plant material that can be taken will be controlled by the section ranger and a database kept of the species, GPS location and the persons involved.

c. Firewood

Other than landowners collecting firewood for their own use, it is felt that this resource is not in sufficient quantity to allow collection by the neighbouring community. Dead wood that is available plays a role in returning nutrients to the system and providing a habitat for other species.

Landowners will be able to collect firewood on the own properties for their own use. Priority must be the use of the alien species growing in the DGR.

d. Game meat

The provision of game meat as a regular protein source will not be possible. However, there will be occasions when the DGRMA may be able to provide game meat for special occasions whereby the bond between the DGR and Community will be strengthened. The senior management staff of the DGRMA will decide if and when game meat can be donated. The actual harvesting and donation process will be managed by the Senior Ranger (or similar representative) and the DGRMA.

H. GAME UTILISATION

H.1) DESIRED STATE

The desired state is that the DGRMA achieve and manage a dynamic balance between the habitats and the ungulates and predator populations of the DGR and that the predator populations play the major role in maintaining ungulate populations within the recommended stocking rate. Where necessary, and on occasions where possible, game may have to be utilised by removal and it is desirable that this is done in a process that is beyond reproach.

H.2) OBJECTIVES

The objectives are that any game removals are decided on and the removal implemented in a professional and responsible manner.

H.3) POLICY AND OPERATIONAL GUIDELINES

H.3.1) Guiding Principles

The guiding principles for game utilisation will be:

(i) A sustainable harvest of trophy animals will be possible, despite any impacts of predation, and management removals of species such as impala and the mega-herbivores may also be necessary from time to time. The population and vegetation monitoring will enable the DGRMA to make informed decisions on when and where harvesting should take place.

(ii) The decision to permit sport hunting for sale as trophies, or for biltong by landowners, is a value judgement that will be resolved internally by the DGRMA. The decision whether to allocate a hunting quota in any year will be based on data and the costs and benefits will also be carefully evaluated. The DGRMA accepts that the decision whether to sanction removals by hunting may change according to circumstances.

(iii) All harvesting must be done in a professional manner and according to the document "Dinokeng Big 5 Game Reserve Game Utilisation Guidelines".

(iv) Any decisions on game removals will be made as early in the season as possible. This will be as soon as a judgement can be made on the outcome of the rainy season and its impact on the vegetation and calf survival. This will probably be by March. An early decision will enable the marketing of any removals to be done before the season commences.

H.3.2) Setting the Annual Removal Quota

The database

The DGRMA will maintain a database on game numbers, removals, predation data and rainfall and veld conditions. These will be used annually by the ecologist and DGRMA to evaluate whether game removals are necessary for adaptive management, or if they are feasible from a viewpoint of sustainable utilisation.

Guidelines to Trophy Quotas

Even in the presence of predation, an off-take of trophy animals will be possible. Data from safari concessions with predators in Zimbabwe (Martin & Thomas, 1991), suggest the sustainable off-take quota for trophy animals, as provided in Table 2.3. The figures provided in Table 2.3 should only be accepted as guidelines, as the impacts of predation will differ in the DGR and must be taken into account. Trophy quality will be recorded and the data used in the decision making process.

Table 2.3 Sustainable trophy-hunting applied in Zimbabwe Safari areas

Species	Quota %
Elephant	1
White rhino	5
Hippo	4
Giraffe	2
Buffalo	2
Eland	1.5
Zebra	5
Wildebeest	3
Waterbuck	2
Kudu	5
Impala	3*
Tsessebe	3*
Nyala	2
Warthog	5
Lion	8**
Leopard	8**

Note: ** These percentages are considered very conservative*
*** These figures are high if top quality old males are a goal of management*

H.3.3) Management Removals

Where a species population is to be reduced for management purposes, such as habitat over-utilisation in an area, the number to be removed will be evaluated using the most recent game count data, local information on the numbers in the area of concern and the evaluation of the vegetation monitoring. As the DGR will be applying adaptive management, the response to management removals will be measured and further removals undertaken if necessary.

In the case of management removals, these will preferably be undertaken by live capture. This has the advantage of being area specific and completed in a short time period. Records will be kept of species, numbers, sexes and ages removed.

I. BREAKOUT POLICY

One may ask, which species in the DGR can be classified as dangerous game? These are clearly the "Big 5" and hippo. However, this is not exclusively the case as a giraffe, kudu or eland that breaks out and is trapped in the road reserve of the N1 has the potential to cause a loss of human life or damage to property.

Under South African law, a wild animal is "*res nullius*" and when it leaves one property and moves on to another, it no longer falls under the "ownership" of the owner of the first property, but is now under the "ownership" of the owner of the second property. Where animals can be proved to have originated from a property, *res nullius* does not apply and animals escaping from the DGR will still be owned by the DGR and be the DGRMA's responsibility. In the case of potentially dangerous game, the DGRMA cannot ignore the responsibility of working towards a rapid and safe resolution to any such problem. (Note that all game in the DGR belongs to the DGRGE and is managed on their behalf by the DGRMA).

I.1) DESIRED STATE

The desired state is that there are no dangerous game breakouts from the DGR, but that if these occur actions must be taken so that that they are resolved speedily with no injury to humans or animals.

I.2) OBJECTIVES

The objectives are that if a breakout occurs, it is detected early and the problem is resolved as rapidly as possible by DGR staff in collaboration with the SAPS and relevant Nature Conservation authorities and that no injury or loss of human life or property takes place. Where possible, and without compromising human safety, the animal will be recaptured and relocated back to the DGR or to another suitable location. Any media attention will be objective and fair towards the DGR.

I.3) POLICY AND OPERATIONAL GUIDELINES

I.3.1) Policy

The DGRMA accepts responsibility to speedily and humanely resolve any dangerous game "Break-out" from the DGR. In doing so, the DGRMA will use "Best Practices" in animal management and will regard human life and safety as the priority criteria in the judgment of what actions to take. Fair compensation for any loss or damage will be made.

I.3.2) Operational Guidelines

Guiding Principles

The guiding principles for the policy are as follows:

(i) The primary objective in any breakout will be to ensure "Human Safety" above all else. All actions taken will have this in mind.

(ii) The actions taken will be in accordance with current "Best Practices" in wildlife management and the law. (There is no written document on "Best Practices", but rather these embrace values such as treating animals humanely when they have to be killed, not leaving a wounded animal in the veld, putting the safety of people first, etc.).

(iii) The prevention of a breakout by a potentially dangerous animal is preferable to solving the problem after it has happened.

(iv) While the recapture of an animal may be desirable, this must not be allowed to jeopardise the primary objective. The practicality of a capture operation must be evaluated against a swift and safe resolution to the problem. The latter will take precedence if there is any question of doubt.

(v) Under reasonable circumstances, the DGRMA will provide realistic compensation for any material losses suffered as a consequence of one of the "Big 5" or hippo breaking out of the DGR.

(vi) The break out of lion, buffalo and elephant will not be tolerated (refer decision processes in Figures 2.1 to 2.5).

Actions to be taken

a. Prevention

Knowing that preventing any "break-out" will be better than resolving a "break-out" once it has occurred, the DGRMA places high emphasis on the following:

(i) Fence Maintenance:

Having effective and well maintained fences is the most cost-effective means of preventing "break-outs". There is already a system in place to patrol and repair the fence on a daily basis. However, the DGRMA cannot be complacent and assume that this is always done. Human

nature being what it is, senior staff must run checks to ensure that fences are being patrolled according to expectations and that any gates are shut.

(ii) Monitoring of dangerous game:

The monitoring of dangerous game is described in the species EMP's. In essence, the lion will be radio-tracked and their presence known at any time. All other dangerous game sightings must be recorded and reported on a daily basis for at least a year after the species has been introduced. It will be impossible to check on each animal every day, however, if sightings made by DGRMA staff, lodge staff and volunteers in the LOA are recorded and mapped, these will give a picture of the areas where the risk of break-outs are the highest.

(iii) Taking pre-emptive action:

There will be occasions when pre-emptive actions can be taken to r3educe the risk of any breakout. This has been particularly successful in the case with young male lion that are on the verge of being evicted from the pride territory (Anderson, 1981).

b. Insurance

The DGR will take out a public liability insurance that will cover loss of life and damage to property by any dangerous game that might break out of the DGR.

c. The resources required

The staff requirement

The key staff member is going to be a person (or persons) with experience in dealing with problem animals, in particular lion and elephant. At present, Mr. L van Rooyen has this experience, but he should have an understudy who will be able handle situations when he is not available and support him when he is on duty.

Trackers: The DGR must employ at least two competent trackers. If these staff members are also able to use a firearm it will be an added advantage.

The response team will consist of an experienced team leader, at least one tracker and at least two field rangers, with a 4x4 vehicle and necessary equipment. Either the head ranger or his deputy will lead the DGRMA response team.

The Equipment required

The equipment required is listed in Table 2.4.

Table 2.4 Equipment required for break out

Equipment	Description	Number
4x4 Vehicle		1
Rifle .458	Open sights	1
Rifle .375	H&H plus low powered scope for night use	1
Ammunition .458	Solids-monolithic Soft nose	20 rounds 20 rounds
Ammunition .375	Solids-monolithic Soft nose	20 rounds 20 rounds
Spotlight	With red filter	2
Portable battery	12V, rechargeable	2
Hand torch		3
Handheld radio		4
Vehicle radio		1
First Aid Kit		1
Calling up equipment	MP3 with distress call of squealing pig, with amplifier and speakers	1

d. Immediate Actions

The immediate actions to be taken on learning of, or even having good grounds to suspect, a breakout are:

(i) Inform the relevant authorities: Police – local, Gauteng conservation authorities, the local schools where children may have to walk through the suspect risk area, the local municipality.
(ii) Mobilise the response team and attempt to locate the animal/s without disturbing them further.
(iii) Inform all staff, residents and lodge operators in the DGR.

e. Precautionary actions

Contact details

The DGRMA will ensure that all local authorities have the contact details for DGR management staff so that there will be easy communication should a breakout occur. These details will include cell phones and landlines.

Safe behaviour

The DGRMA will provide guidelines to members of the local public, particularly to school children, on the precautionary behaviour that should be observed if a dangerous animal is out of the DGR. In summary these would be:

Lion:

(i) Avoid travelling on foot at night or at dusk until the problem has been solved.
(ii) Walk in groups and talk loudly.
(iii) Do not approach a kill in the hope of getting meat off it.
(iv) When challenged by a lion – do NOT run. Walk slowly backwards.
(v) Kraal cattle and goats at night.
(vi) Report any sighting of spoor, dung, calling or kills to the DGR and police immediately.

Elephant:

(i) Avoid travelling on foot at night or at dusk until the problem has been solved.
(ii) Walk in groups and talk loudly.

(iii) If elephant are seen, keep downwind and move away.
(iv) If challenged by elephant, run and where possible get across an obstacle that is difficult for elephant to cross e.g. a donga, canal, steep bank. Alternatively, use dense large dense tree clusters as an escape route.
(v) Report any sighting of spoor, dung, sounds or signs of fresh damage to the DGR and police immediately.

Rhino:
(i) Walk in groups and talk loudly.
(ii) Do not disturb any rhino that is seen and keep downwind.
(iii) If challenged, climb a tree to at least two metres above the ground or get behind a tree of at least 15 cm in diameter and keep it between you and the animal.
(iv) Report any sightings of spoor, dung, sounds or signs of fresh damage immediately to the DGR and SAPS.

Buffalo & Hippo:
(i) Avoid travelling on foot at night or at dusk in the area frequented by the hippo until the problem is solved.
(ii) Do not approach or disturb the animals.
(iii) Report any sightings of spoor or dung immediately to the DGR and SAPS.

f. Decision guidelines

In the case of a breakout, the degree and type of threat will vary from species to species, and for that reason the responses will not all be the same. The following flow charts have been adapted from those initially developed for the mitigation of Human-Wildlife conflict in Mozambique (Anderson & Pariela, 2005) and since adapted by FAO (Lamarque *et al*,. 2008).

Leopard have been omitted as there are leopard present outside the DGR, also leopard leaving the DGR is unlikely to be detected. Actions taken with a known leopard breakout will be similar to those for lion, except that recapture will be very difficult as it involves getting the animal to enter a cage trap.

In these guidelines, there are cases where the option of leaving the animals at their new location may also be a sensible option. For example, a hippo may break out and end up in a dam on a private game farm. If the owner is prepared to assume the ownership and responsibility for the animal, this could be the best solution to the problem. (This was done in the case of two elephant that broke out of Songimvelo Game Reserve in Mpumalanga).

Lion:
If the early attempts to solve a lion problem are not successful, the lion/s become very wary and reaching a solution becomes very difficult. It is, therefore, essential that the first attempt to resolve a lion problem is successful. If as kill is made, it should not be disturbed but used as the bait to which the lion will return to be either captured or shot. It will generally be pointless returning a male lion that has broken out of the DGR if it is a sub adult or has been evicted from the pride and if it is captured, a new home should be sought for it. Refer to Figure 2.1.

Elephant:
Any elephant breakout is likely to be as a result of intra-specific aggression, particularly if it is a male. The likelihood of this happening to the same animal again is high and the option of relocating the animal elsewhere must be high on the list of choices of what to do when the animal is captured. Refer to Figure 2.2.

Rhino:
Unless a rhino is on the N1 and a threat to traffic, the recapture of a rhino will be the automatic choice of action and a capture team must be put on standby immediately if a breakout is detected. If the

animal is a mature male, it is likely that it was driven out of the DGR by another male. Rather than return the animals to the population so that the process can be repeated, it should be translocated to another property. The option of selling it where it is can also be explored. Refer to Figure 2.3.

Buffalo:
The primary concern with a buffalo breakout is the possible transmission of diseases from the buffalo to cattle. As the buffalo in the DGR must be "disease-free", this should not be a factor, but precautions should nevertheless be taken. Any cattle in the vicinity of a breakout buffalo should be moved to another camp and when buffalo are recaptured or destroyed, the animal or carcass must be tested for Bovine Tuberculosis and *Theileriosis.* In the event that a breakout buffalo is found to be positive for either of these diseases, this will immediately be reported to the State Veterinarian for an official ruling on what steps must be taken with the buffalo in the DGR. In the event of negative test results, the animal will be released from the boma, back into the DGR. Refer to Figure 2.4.

Hippopotamus:
Depending on the size of the water body in which it has taken refuge, the recapture of a single hippo is an expensive and protracted process. If the hippo has moved to a safe location and does not have to be dealt with immediately, the most practical option may be to sell it to the new landowner or to shoot it. Refer to Figure 2.5.

The Dangerous Game Breakout Policy: Standard Operating Procedures is provided in **Annexure 9.**

g. Authority for DGRMA staff to take action outside the DGR

It may not always be possible to secure assistance from the respective provincial authorities to deal with a situation where an animal may have to be destroyed. At times it may be necessary for the DGRMA staff to take action, such as shooting an animal beyond the boundaries of the DGR. It is essential that this is done within the parameters of the law and the DGRMA will ensure that the necessary authority is obtained as a precaution.

h. Media attention

The breakout of a potentially dangerous animal from the DGR will inevitably attract media attention. If the media are shunned, they will become more persistent and it is best to present the facts in an objective manner.

The DGRMA will establish a protocol to deal with the media and only designated DGRMA members and staff will be permitted to talk to the media.

Figure 2.1 The decision process for actions to resolve a lion break out

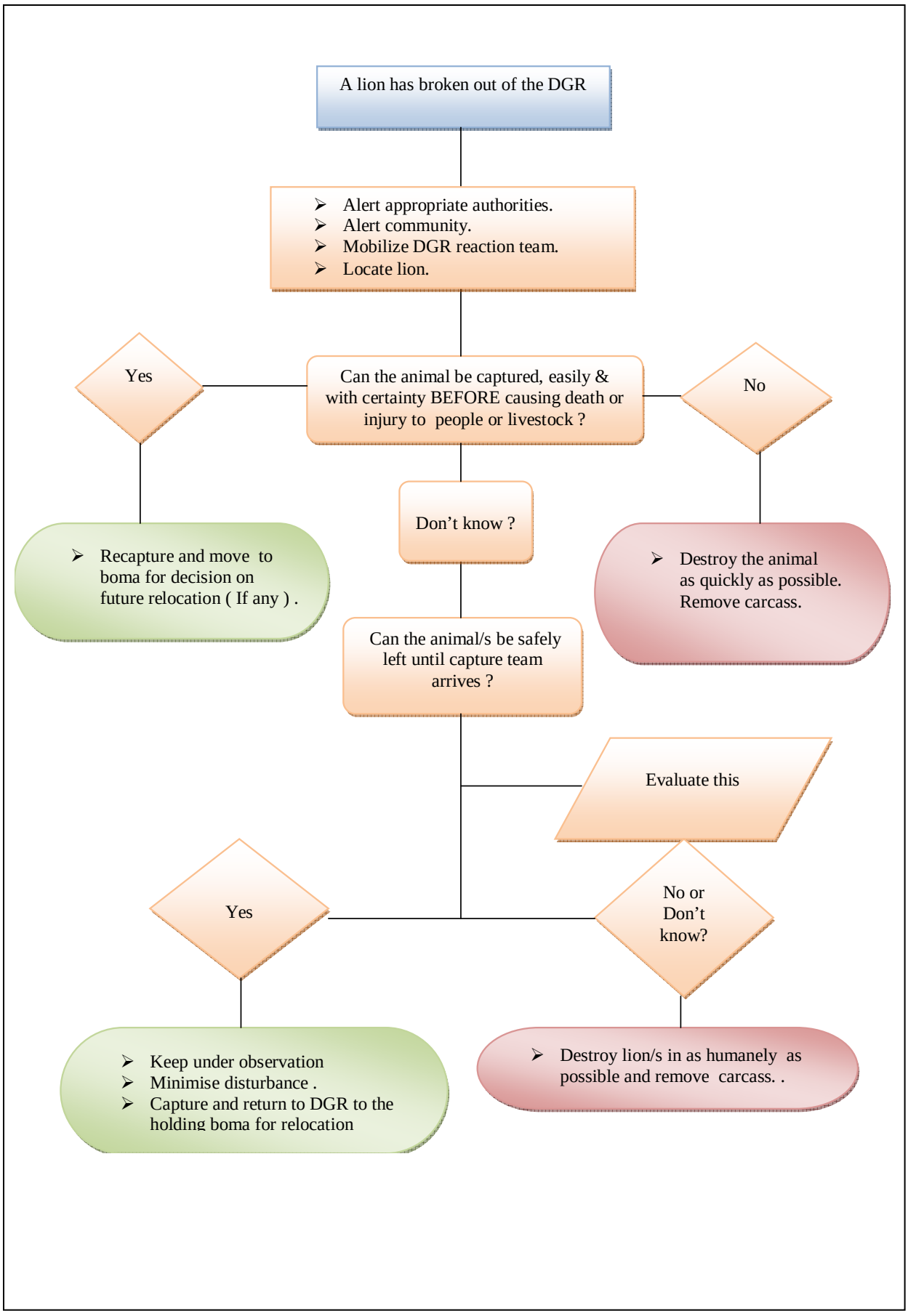


Figure 2.2 The decision process for actions to resolve a elephant break out

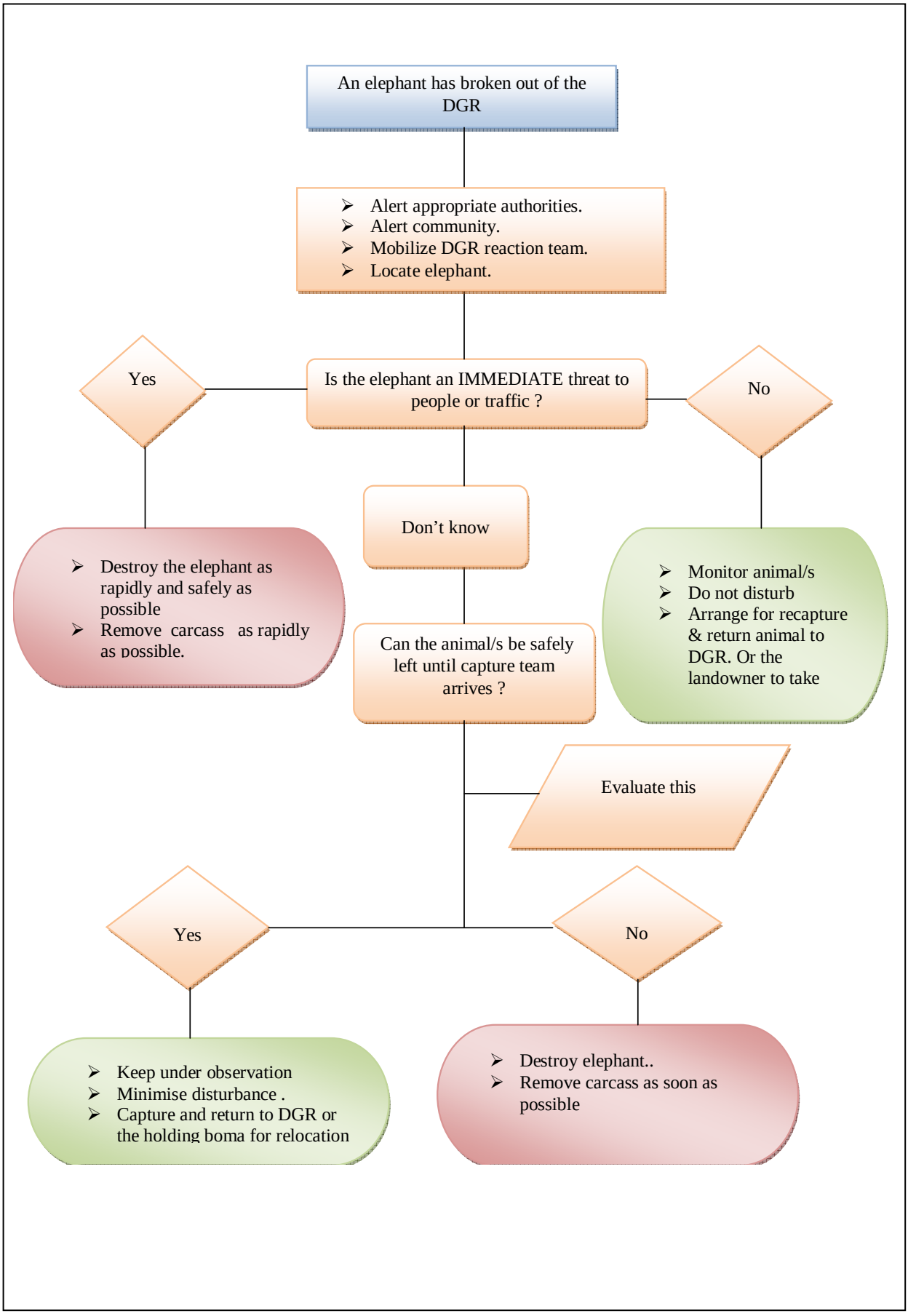


Figure 2.3 The decision process for actions to resolve a rhino break out

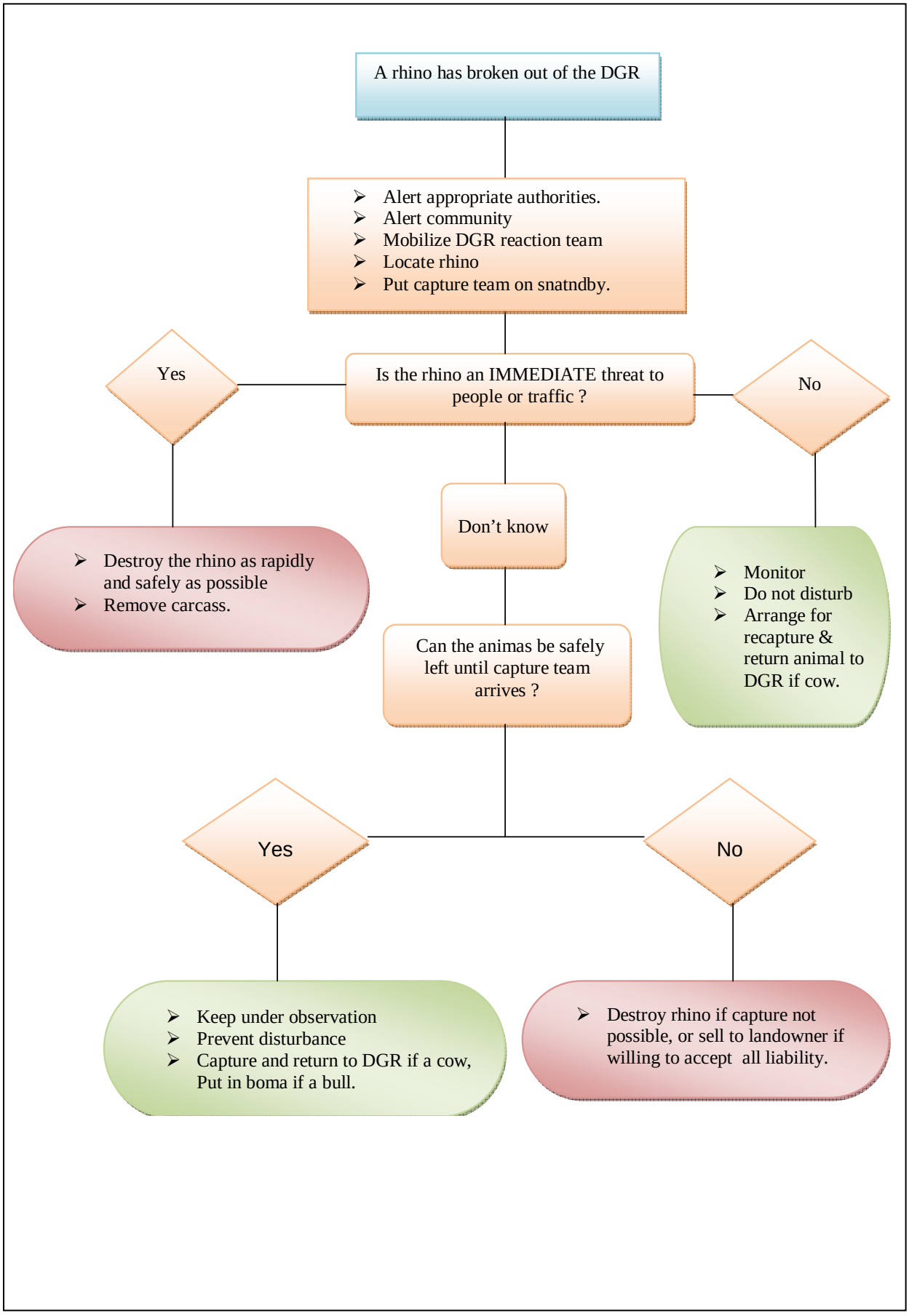


Figure 2.4 The decision process for actions to resolve a buffalo break out

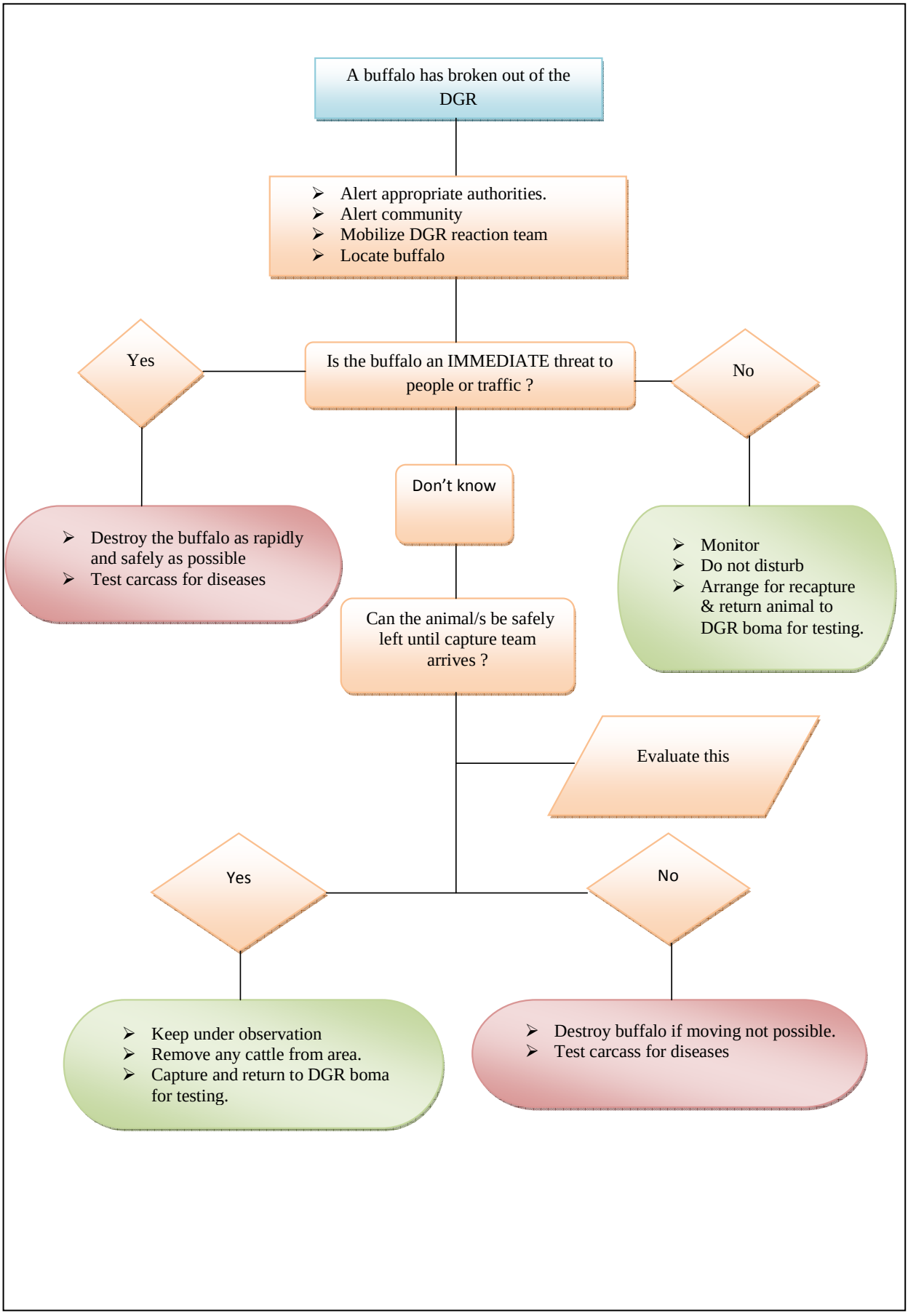
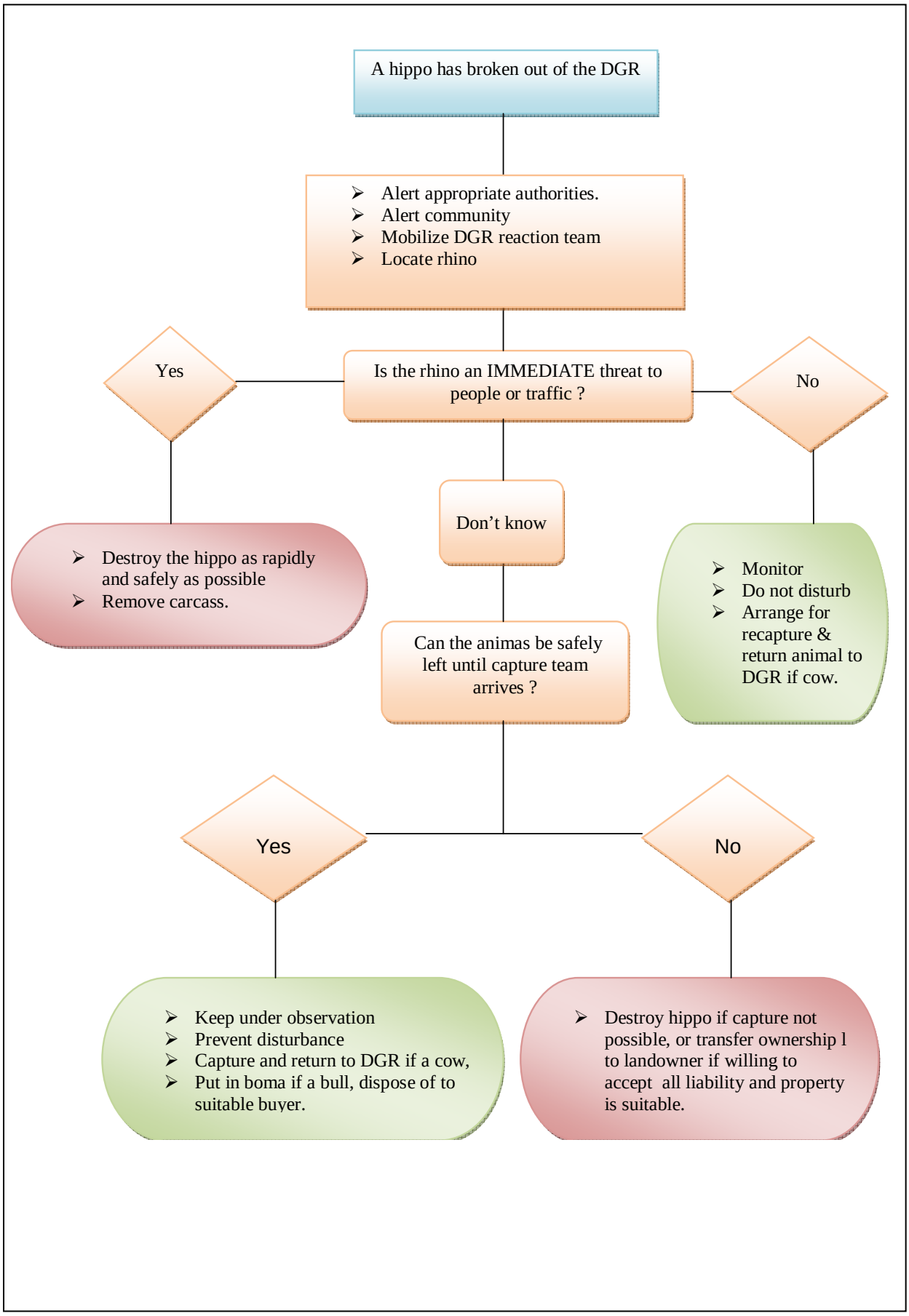


Figure 2.5 The decision process for actions to resolve a hippopotamus break out



J. SPECIES PROTECTION

J.1) DESIRED STATE

The desired state is that any unnatural mortality is kept to a minimum.

J.2) OBJECTIVES

The objectives are that the monitoring, adaptive management and security implemented by the DGRMA is such that unnatural mortality is not a constraint on the growth rate of animal populations.

J.3) POLICY AND OPERATIONAL GUIDELINES

J.3.1) Policy

The Policy is that adaptive management and security management of the DGR will be implemented at a level that ensures that unnatural animal deaths will not have any significant negative impact on the animal populations.

J.3.2) Poaching

From the *Status Quo* assessment, the species of greatest concern are obviously white and black rhino, with the former being the most vulnerable. If the efforts to save these two species are successful, then these actions will provide an umbrella coverage to other less vulnerable species against poaching.

The primary concern of the DGR is that people are deterred from poaching in the DGR, rather than being apprehended after they have killed an animal.

Night patrols and observation posts (OPs) are going to be essential and at least one set of night viewing equipment will be valuable, as with these it is possible to detect a spotlight being used from much further than with the naked eye.

J.3.3) Information gathering

It is evident that the DGR protection force will be facing a rhino poaching threat from organised criminal syndicates and it is not a case of “If” but “When”. While most of the recent rhino poaching has been carried out on foot and by people armed with rifles, there have been recent cases where rhino have been killed with drugs administered by a dart and a dart gun. There have also been incidents of animals that are thought to have been shot from a helicopter. These all point to highly organised groups of individuals being involved.

It is essential that the DGR becomes involved in information gathering. What is important is to gain information on the potential threat. The demand from residents of Chinese and Vietnamese extraction for rhino horn has become a very serious problem to the country and the fastest growing Chinese community in the country is at Bronkhorstspruit (Wikipedia), less than 100km from the DGR. It is essential that the DGR establish a close working relationship with the provincial conservation authorities and keep abreast of developments.

It is also recommended that the DGRMA consult with a specialist for advice on the gathering of information. (Recommended contact: P. Lategan: dlategan@telkomsa.net or 083 579 2631).

J.3.4) Dehorning of rhino

Where tourism is a prime reason for any development, visitors will always prefer to see rhino carrying their horns. However, the possibility of de-horning animals, as a deterrent to poaching, must always be considered as an option. In the DGR, this needs not apply to all animals, but only to those that spend most of their time away from the tourist roads.

(Note: The owner of a large population of rhino in Mpumalanga, where the animals are managed for live sale and not for tourism, has recently de-horned his entire population of over 100 animals as a precautionary measure).

J.3.5) Canals and river banks

The canals that run through the DGR pose a threat to mammals and reptiles that may fall into them. It is important that where game is likely to cross a canal, suitable reinforced crossings are made and packed with an earth base. An added precaution will be to place shallow sloping metal grids in the canal that will allow species such as rhino and buffalo, particularly calves, to climb out. There is no set design for this but a practical person can design a ramp that will be suitable. For smaller animals, a floating ramp with one side connected to the bank (see Figure 2.7) will enable animals to climb out of a canal.

Figure 2.6 Canal that poses a potential hazard to animals, particularly rhino and buffalo calves

Figure 2.7 Example of a ramp to enable smaller mammals to escape from a canal

There are also stretches of the Pienaars River bank that are too steep for an animal to climb out if it has fallen in. The DGRMA must make an inspection of these potentially vulnerable areas and cut entry/exit slopes at high risk areas, which will enable animals to climb out.

J.3.6) Predation

The monitoring of both prey and predator populations as part of the ongoing management of the DGR will give an early warning should predation begin to impact negatively on one species. This can be corrected by the application of Adaptive Management and the manipulation of the predator numbers or even habitats. It is anticipated that initially some species populations will be naïve towards lion predation and these may experience disproportionate losses until they have learned to react to lion with greater caution.

J.3.7) Conclusion

Provided that the DGR is managed according to the habitat management guidelines provided and monitoring and Adaptive Management are practiced, there should be no cause for concern on the protection status of any specie, other than to prevent poaching.

2.2.2.1.2 MANAGEMENT OF LARGE MAMMALS

The DGR has been established in the Gauteng Province to promote tourism and for the creation of a high quality tourism destination that will result in the socio-economic upliftment of the communities in the adjoining areas. Key to this objective is that the destination will be the first Gauteng game reserve to support free roaming Big 5 species, namely lion, elephant, rhino, buffalo and leopard.

A. MANAGEMENT OF ELEPHANT (*Loxodonta africana)*

A.1) MOTIVATION FOR INTRODUCTION OF ELEPHANT

Elephant are a key tourism and popular photographic species. Adult bulls are generally placid, except when they are in musth and become aggressive. With knowledgeable guides, bulls can be approached on foot with comparative safety, and this provides an unforgettable experience for visitors.

A.1.1) Objectives

This single species management plan is an integral component of the overall management plan for the DGR, and has been drafted specifically for the procurement of a Threatened or Protected Species permit from the Gauteng Department of Agriculture, Conservation and Environment. The specific objectives of this plan are:

(i) To provide guidelines for the sourcing, introduction and management of elephant (*Loxodonta africana*) in the DGR. Reference should be made to other documents where elephant introductions are discussed (Wildlife Group of the South African Veterinary Association, 1991; Anderson, 1993; Bothma, 2002)

(ii) To ensure that the introduction of elephant into the DGR is sustainable, and conforms to acceptable, ethical and recommended practices as advised by recognised authorities including; the Department of Environmental Affairs and Tourism (DEAT), the Gauteng Department Agriculture, Conservation and Environment (GDACE), the EMOA and South African National Parks (SANParks). Special note must be taken of section 9 of the NATIONAL NORMS AND STANDARDS FOR THE MANAGEMENT OF ELEPHANTS IN SOUTH AFRICA (National Environment Management Act 10 of 2004).

A.1.2) Goals

The introduction of elephant into the DGR will fulfil the following goals and objectives:

(i) Conservation – the low numbers of elephant that the DGR can carry will play little meaningful role in the conservation status of the elephant population in the country. However, what will be valuable is the creation of an awareness of elephant for visitors and neighbours who may never otherwise have an opportunity of seeing elephant in the wild.

(ii) Tourism – elephant bulls in particular, because of their sheer size, are excellent tourism animals and fulfil the Big 5 objective of the DGR. It will be an objective that visitors have an excellent chance of seeing an elephant over a 48 hour visit.

(iii) Hunting may, under certain exceptional circumstances, be used as a management tool to utilise old animals and persistent problem animals.

The introduction of elephant into the DGR conforms to the objectives of the DGR and is supported by the Gauteng Provincial Government.

A.2) HABITAT REQUIREMENTS

Elephant are mixed feeders, with bulls eating a higher proportion of grass than cows and immature animals (O'Connor, *et al.* in press). Habitat requirements vary across their range in southern Africa, from savanna to forest, but not in true desert or open grasslands (Skinner & Chimimba, 2005).

Water provision is important as they drink regularly and calves require water daily in the dry season.

The DGR meets the habitat requirements of elephant as it provides a diverse mix of woody plants and grass for feed and sufficient large trees for shade. There are enough assessable water points, except along the Pienaars River, where steep sided banks make access for elephant calves a risky task.

A.2.1) Vegetation

The vegetation has been described by Skosana and Westfall (2005) and more recently by Gertenbach & Bredenkamp (2009).

Management Intent:

1. The overall EMP will provide a comprehensive vegetation survey of the current DGR area in order to refine the vegetation synopsis provided above.
2. The DGRMA will undertake to monitor the vegetation of the DGR on an annual basis.
3. Setting the "Thresholds of Potential Concern" (**Annexure 10**) for the impact of elephant on biodiversity in the DGR will be a priority for the DGRMA.

A.2.2) Water Provision

Water requirements:

Elephant adults drink on average every 43hrs, and the longest period in between drinking episodes, 72hrs. Breeding herd adults drink up to 86.61*l* at a time, and bulls twice the amount (Young, 1970).

Distribution around a water source

Distribution around waterholes is similar for wet and dry season, although herds move larger distances in the wet period. Adults walk on average 17.5km/day (Young, 1970) (15km, O'Connor *et al.* in press), while a weak calf can cover around 5km/day. If a mother only has to drink every 43hrs, a calf should survive if water-points are less than 6km apart (Young, 1970).

Implications for water provisioning in DGR

Foraging range for elephant is limited to approximately 15km from water (O'Connor *et al.* in press), although Young (1970) would suggest that this would be closer to 31km. However in the DGR, even during the dry periods, few surface water areas will be further than 5km apart). Therefore, given the current spatial and temporal availability of water, elephant in DGR are unlikely to be water stressed and their distributions are unlikely to be water limited.

Concern is expressed here on the extensive distances of the Pienaars River with very steep banks. Much of this distance presents a high risk for elephant and particularly rhino.

Management intent:

1. The DGRMA will liaise with land owners regarding the potential closure of some waterholes given the excessive number of water points in the DGR.
2. The DGRMA are advised to check the length of the Pienaars River for areas where suitable access points may need to be developed to allow game to drink safely.

A.2.3) Fire

Fire has little impact on elephant with the exception of serious burns or fatalities that may occur if animals are encircled by fire in long grass or reeds.

Management Intent:

1. A detailed and comprehensive fire plan will take cognisance of the management and safeguarding of the elephant population and this will form part of the overall EMP.
2. The fire management of the DGR will be used specifically to provide grazing by removing moribund and accumulated material.
3. Fire breaks will be made to safe guard areas prone to run away fires, especially in areas near the busier roads.
4. The DGRMA will form a FPA for the DGR area. This forum will establish the size, management requirement and time of fires in the DGR in accordance with the EMP. All areas burned will be recorded on maps. Initial surveys will be undertaken to assess fuel load of the plant communities in which a burn is intended.
5. Whenever fire is used as a management tool, care will be taken to ensure that large mammals are not trapped by fires.

A.2.4) Drought

Elephant are dependent on water. When water sources dry up in time of drought the animals will move to other areas in order to find water sources. Being mixed feeders, and highly mobile, elephant should be able to move to areas where feed is available on the DGR.

Management Intent:

1. The DGRMA will maintain elephant numbers at the determined ecological carrying capacity to avoid excessive stocking rates that would lead to excessive tree damage and calf mortality during periods of drought.
2. In extreme drought conditions the DGRMA will not undertake feeding of elephant. If necessary, elephant numbers may be reduced.
3. The DGRMA will ensure that in the event of natural water sources drying up, some selected artificial watering points will be re-activated and maintained.

A.3) BEHAVIOURAL ECOLOGY

A.3.1) Social Behaviour and Reproduction

The complex social structure of elephant is organised around a system of herds composed of related females and their calves. African elephant herds can form temporary aggregations, reaching over 1,000 individuals, mainly in East Africa. These associations occur during drought, human interference, or any change brought to the normal pattern of social life.

In the savanna subspecies, each family unit usually contains approximately 10 individuals, although several family units may join together to form a ‘clan’ consisting of 6 to 70 members led by a large female. Forest elephant live in smaller family units. Small, temporary associations of males also exist; the members of such groups join and leave at will. Adult bulls are often seen with cow-calf groups.

When threatened, elephant will group around young calves and the matriarch, the leader of the group, may attack the foe. Young elephant stay with their mother for many years and are also cared for by other females in the group, especially by young females known as ‘allomothers’.

From a tourism and management point of view, the period of heightened sexual activity or "musth" in bulls is important. This is a period when bulls show heightened levels of aggression and great risk for people. It is indentified by swollen temporal glands and a green tinge to the penis which constantly dribbles urine (Poole & Moss, 1981).

Young elephant wean after some 18 months, although they may continue nursing for over 6 years. Male elephant leave their natal group at puberty and tend to form much more fluid alliances with other males. This species is extremely long-lived (up to 70 years) and although females may reach sexual maturity at 10 years old they are mostly fertile between 25 and 45. Males need to reach at least 20 years of age in order to successfully compete for mating.

Breeding
Usually, a single calf is born every 2.5-9 years, generally over the wet season and after a gestation period of 22 months. Females can remain fertile until 55- 60 years old.

Diet
The diet of elephant consists mainly of leaves and branches of bushes and trees, but they also eat grasses, fruit, and bark. This selection varies depending on the time of year; during the rainy season the elephant will feed more on grass than during the dry season. Bulls eat significantly more grass than cows and calves.

Management intent:

1. It is not expected that natural interactions and behaviour will occur as cows will be on contraceptives and the DGR will carry a higher than normal proportion of adult bulls. If the DGR is expanded sufficiently to carry a population of at least 50 animals, then the wisdom of stocking a normally structured population can be re-assessed. (This option will mean that the population growth rate will be higher than that in the founder population and management measures will have to be implemented to control the population density).

A.3.2) Spatial Organisation

Territoriality is not present in elephant and so it is not an issue of concern in the DGR. Adult bulls' home ranges are much larger than those of the area of the DGR, so it can be expected that the bulls will range over the entire DGR and the breeding herd will remain in areas of preferred habitat.

Management intent:

1. The fact that elephant have home ranges that are not defended allows a higher number of bulls to be carried with a greater opportunity of elephant sightings.

A.3.3) Sex Ratio

Elephant are born at a 1:1 sex ratio and in large populations it is pubertal bulls that disperse from the breeding herd. In very large populations, the sex ratio is still close to parity (Whyte, 2001).

Management intent:

1. The following sex-age ratios will be introduced into the DGRMA:
    a. 5 adult bulls over the age of 20 years and up to 9 animals in a breeding herd. Should young bulls disperse from the breeding herd, they will be left to mature within the population. A higher ratio of adult bulls to cows will be maintained in order to enhance the chances of visitor "Sightings".

2. As the contraception of cows will be carried out, the bull:cow sex ratio is dictated by tourist viewing opportunity, rather than optimising the breeding success.

A.3.4) Densities

The proposed density of elephant is one elephant per 1,000ha. Adaptive Management (Walker, 1998) and the monitoring of vegetation and the elephant population will be vital activities to maintain an acceptable elephant density.

Management Intent:

1. The potential impact of elephant populations on trees is a concern of the DGRMA. It is intended that the elephant population will be managed at a density that biodiversity, particularly large riparian trees are not lost to the DGR.

A.4) INTRODUCTION OF ELEPHANT

New legislation classifies elephant as a 'Threatened or Protected Species' (TOPS). The introduction, transfer, conveyance, holding and movement of a threatened or protected species require specialised permits. All required permits acquisitions and stipulations will be adhered to, and followed according to the laws of South Africa, especially section 9 of the NATIONAL NORMS AND STANDARDS FOR THE MANAGEMENT OF ELEPHANTS IN SOUTH AFRICA (National Environment Management Act 10 of 2004).

The introduction process will be a staggered one, with the breeding herd being released before any bulls are introduced.

A.4.1) Source Population

Elephant will be sourced from populations where adult animals are habituated to open vehicles with tourists and fences, such as the Timbavati, Klaserie, Sabi Sand and Kruger National Park.

Elephant from populations in Pilanesberg and Hluhluwe-Umfolozi stem primarily from introductions of calves. As these are not entirely natural herd structures yet, their introduction is not advised.

Management Intent:

1. The DGRMA will consider elephant from larger, extensive areas where populations are used to fences and open tourist vehicles. From the areas listed above, the founder population should be genetically heterogeneous but this is not a prime consideration for elephant in the DGR.
2. Because of their aggressive reputation, no elephant will be sourced from the Madikwe population.

A.4.2) Founder Population

What is important for Big Five game viewing is an elephant "Sighting" – this sighting can be either one good view of a single elephant or a view of a breeding herd. As bulls spend much of their time alone, the chances of having "Sightings" with five adult bulls is greater than the chance of "Sighting" a single breeding herd of ten animals. In order to increase the opportunities of sightings, the recommendation here differs from that in the 2005 plan which recommended only one adult bull. It is recommended that at least five adult bulls are introduced and one small breeding herd not more than seven animals.

Management Intent:

1. The founding population will initially be 12 individuals, however, the DGRMA will maintain the population according to the recommended carrying capacity of 18 animals.
2. The founder population will consist of one breeding herd of NO MORE than seven animals and five adult bulls.

A.4.3) Management of Female Fertility

In order to slow the rate of increase of the population, it will be policy to use the contraception of females to increase the interval between calves to at least 10 years. As the founder population in the

breeding herd will be small, the initial assessment of how many and which cows will have to be subjected to contraception will be based on their status at the time of capture.

The method of contraception of elephant cows is an evolving science and the use of *porcine zona pallucida* (Bothma & van Rooyen, 2006) to inhibit sperm penetration of the egg is not advised. In this case, the cow experiences regular oestrus and is mated by bulls but does not conceive – this is traumatic for the cow and the breeding herd and especially for any small calf that she may have at foot.

Recent indications are that the use of GnRH antagonist will require less frequent application, (no booster after two weeks). The use of GnRH stops the female's ovarian cycle for at least a year and the side–effects are less traumatic for her. (More detail on this can be obtained from Dr Cobus Raath 082-577-2779). It is our view that this should be investigated as the contraception method of choice.

Management Intent

1. That the contraception of females will be the preferred method for controlling the growth rate of the elephant population
2. That the contraception method used must have the least disruptive effect on the cow and the breeding herd.

A.4.4) Acclimatisation and Release

The release must be a soft release, not directly from the transport crates into the DGR, but the animals do not need to be kept in the boma for more than four days. As elephant are not territorial, the release of bulls can be staggered over more than one capture season if necessary.

There is a boma on the DGR that can be strengthened and adapted for elephant (J. Stevens *pers comm.*). This boma has been described in detail in the White Rhino EMP by Funston (2008) and in 8.2 below.

The boma will have to be upgraded to accord to the DEAT norms and standards (**Annexure 11**) and detailed in terms of section 9 of the NATIONAL NORMS AND STANDARDS FOR THE MANAGEMENT OF ELEPHANTS IN SOUTH AFRICA (National Environment Management Act 10 of 2004).

If a single breeding herd of six or more elephant is to be introduced, then the boma will have to be increased in size to two hectares.

Management Intent:

1. The elephant will undergo a soft release, where they are held in the boma for up to four days, which will allow them to recover from the journey and to become sensitised to the fact that the fences they encounter will be electrified.
2. The release itself must be done with a minimum of fuss and the animals must be allowed to leave the boma of their own accord.

A.5) CONTAINMENT

A.5.1) Perimeter Fence Specifications

A Big 5 compliant fence was erected in 2007 / 2008. The fence conforms to the following specifications:

(i) An electrified perimeter game proof fence of 2.4 m height with a minimum of 24 strands (non-electrified);
(ii) Electrified on the inside of the game fence with at least five strands of electrical wires, with a minimum diameter of 2.24 mm.
(iii) Trip line 0.6 m from fence base and electrified.
(iv) Bottom strand: at ground level with 225 mm double offset brackets.

(v) Second strand: at 500mm above ground level with 225mm double offset brackets.
(vi) Third strand: 1m above ground level with 225mm double offset brackets.
(vii) Fourth strand: 1.5 m with 225 mm or 450 mm double offset brackets
(viii) Top strand: on top of fence (2.4m above ground level) with 450 mm double offset brackets
(ix) Earth strand: (double offset) 10 cm on the inside of each live wire strand
(x) Minimum voltage of 6000 V should be maintained on the whole peripheral electrified fence.
(xi) Energisers large enough to maintain at least 6000 V over a distance of 8 km and that do not release less than 6 Joules.

A.5.2) Release Boma Specifications

A boma described in the white rhino EMP (Funston, 2008) was constructed into which the large game animals will initially be released when necessary. The boma can therefore be adapted for elephant by being upgraded according to the standards in **Annexure 11**.

The following sets out the characteristics of the boma:

(i) The boma has been placed close to the centre of the DGR and has access to water for utilisation after release.
(ii) The boma size is 100m x 100m. The boma includes sufficient dense vegetation to provide security and food.
(iii) The boma has adequate clean drinking water and includes the possibility for mud-wallowing.
(iv) The fence has been electrified with seven strands, with the offsets to the inside, and a voltage of 6000 – 9000 V maintained.
  a. First strand at ground level
  b. Second strand: 300mm
  c. Third strand: 600mm
  d. Fourth strand: 1,0 m above ground level
  e. Fifth strand:1,5m
  f. Sixth strand: 2m
  g. Seventh strand: 3m, with an additional earth strand.
  h. Double offset brackets are used for all strands.
(v) The boma has been electrified (3 strands) on the outside, to prevent contact with previously introduced game.
(vi) The inside and outside of the fence is serviced by a three meter wide road to facilitate easy maintenance of the fence and will highlight any efforts of individuals to escape. The road on either side of the fence will also serve as a firebreak.
(vii) Large trees inside the camp next to the fence have been cut down as to prevent electrical shorts on fence.
(viii) The offloading ramp has been placed outside the fence. The gate closing the ramp is also electrified when closed.
(ix) There is a separate wide gate (6m) for boma releases.

The boma and the off-loading ramp are easily accessible for large, low-bed transport trucks with good compacted roads leading to the paddock to prevent the trucks from overturning or getting bogged down.

It must be ensured that the boma is strengthened according to the specifications in **Annexure 11**.

A.6) RISK ASSESSMENT OF INTRODUCTIONS

A number of risks and threats are faced through the introduction of elephant to the DGR. Many of these risks and threats are faced by all reserves planning the introduction of elephant. The DGRMA will manage to reduce these risks and threats and the following mitigation measures will be implemented.

A.6.1) Predation

With the low numbers of lion and the single pride male, predation is not considered a serious factor. If lion did ever kill an elephant calf, it would not be a concern as it would just slow down the rate of growth of the elephant population.

Management Intent:

1. Low numbers of lion will be introduced as per the overall EMP (to be concluded). Lion prides will be kept at small numbers. The availability of other more easily killed prey species will ensure that predation of elephant calves by lion will not be a significant factor.

A.6.2) Inter-Species Conflict

As the male elephant to be introduced to the DGR will all be adults, it is not expected that the DGR will experience the killing of rhino by young bulls in musth (Slotow & Van Dyk, 1999).

Management Intent:

1. The elephant bulls to be introduced into the DGR will all be adults and they will be introduced at least a month after the breeding herd has left the release boma.
2. Any incident of rhino deaths where an elephant is the culprit will be evaluated and dealt with in an expedient and professional manner and in accordance with section 9 of the NATIONAL NORMS AND STANDARDS FOR THE MANAGEMENT OF ELEPHANTS IN SOUTH AFRICA (National Environment Management Act 10 of 2004).
3. The DGR is aware of the potential for elephant caused rhino mortality and although this is not expected, management will react appropriately if it does occur.

A.6.3) Drowning

Flooding in low lying riverine areas, during times of heavy rains and floods should also be considered as the steep banks of the Pienaars river make getting out very difficult. This concern should be addressed by the DGRMA.

Management Intent:

1. This is highly unlikely and is not considered to be an issue of concern. If an elephant calf is lost to drowning it will slow the growth rate of the population.
2. The DGRMA will evaluate whether more safe access points need to be created on the Pienaars River.

A.6.4) Disease Management

Elephant do not carry foot-and-mouth disease and therefore pose no threat to the disease-free status of the Gauteng Province. Tuberculosis of the respiratory system has not been recorded in elephant natural conditions.

A.6.5) Drought

Drought situations do not pose a threat to elephant populations if Adaptive Management is practised to keep animal's biomass within carrying capacity of the DGR and to remove animals if the rainy season is excessively below normal.

A.6.6) Shortage of Suitable Habitat

Given the current size of the DGR and the on-going plans to expand the game reserve, this threat is not of high concern.

Management Intent:

1. The DGRMA will continue to extend the DGR to a maximum size of 120,000 ha.
2. The ecological carrying capacity and stocking rate will be reviewed on an annual basis, in conjunction with assessments of the responses to the Adaptive Management practices. The

elephant population will be held at or below the recommended level to ensure that suitable natural habitat is always available to the population.
3. An annual vegetation assessment will be undertaken as per the overall EMP and its recommendations. The potential loss of biodiversity of vegetation due to elephant impact will monitored.
4. Thresholds of Potential Concern (**Annexure 10**) for vegetation will be established and monitoring will be aimed at ensuring the habitats remain within these limits.

A.6.7) Poaching

Due to the close proximity of the National Highway and other roads utilised by the general public in the DGR area, as well as formal and informal settlements on the south western boundary of the DGR, the DGRMA recognises the potential of illegal hunting of animals in the DGR. The DGRMA further recognises that elephant may be particularly targeted due to the value of their ivory.

General Poaching Management Intent:

1. Law enforcement recommendations are made in the overall plan. It is a concern, however, that the DGR may not reach the levels of staff numbers and equipment required.
2. Daily fence patrols will be conducted to ensure the integrity of the fence and to limit trespass, theft and poaching.
3. Armed security guards will man all access/exit gates to the DGR on a 24 hour basis.
4. A Police Reservists Unit must be formalised as soon as possible in the DGR. This unit must undertake operations such as patrols of the area and establishment of a community information network. The Unit has been approved by the SAPS and radio and cellular contact will be incorporated into the unit. These additional security measures assist with raising the overall security standards of the area, will also benefit the safeguarding of the DGR rhino and elephant populations.
5. The DGRMA will employ field rangers who will be trained and equipped to deal with all poaching or illegal entry situations in the DGR.
6. All ivory from natural mortality will be individually marked by being stamped with a metal punch. This will be stored safely and controlled through the applicable GDACE policies.
7. An anti-poaching unit will be established in the DGR. If this role is outsourced, the unit will report to the DGR manager.
8. All poachers that are apprehended will be prosecuted.

Management Intent Specific to Elephant:

1. DGR staff, Guides and landowners will be instructed to report elephant sightings in the DGR to the park headquarters.
2. Security patrols of the perimeter fence and public roads as per the Infrastructure Policy of the DGR are undertaken on a daily basis and all fence damages repaired. The breach of the fence by any game or people is immediately reported to the Implementation Manager. In the first month after release, the movement of elephant along a fence must be reported to the DGR manager as soon as possible.
3. Community involvement and education programmes will be undertaken with the assistance of the DTE and the local authority. Special attention will be made to educate neighbours and staff on actions to take and avoid if an elephant has broken out of the DGR or is close to the fence.
4. Staff working in the DGR will be instructed on what actions to take and avoid should they encounter elephant – either in a vehicle, on foot or on a bicycle.
5. The movement of staff within the DGR will be done by vehicle wherever possible.
6. The DGRMA will try to ensure a flow of benefits from the DGR to the neighbouring communities that will contribute to the social and economic development thereof and thereby reduce the risk of subsistence poaching.

A.6.8) Breakouts

As the DGR borders partially on a densely populated semi-urban area, prevention of breakouts and the implementation of standard operating procedures in alignment with the "Break Out" action plan will be undertaken.

It is sufficient to note here that human life and safety is the first priority for the DGR and the DGRMA. The control of any breakout must be in accordance with the requirements specified in section 9 of the NATIONAL NORMS AND STANDARDS FOR THE MANAGEMENT OF ELEPHANTS IN SOUTH AFRICA (National Environment Management Act 10 of 2004).

Management Intent:

The prevention of break outs can be assisted through the following management interventions and actions by the DGRMA:

1. Adequate water distribution and food availability will be present in the DGR, so that these resources are not limiting and thereby cause animals to challenge the fence.
2. Monitoring and management of elephant movements will be done and although not intensive, this will give an indication of the areas where problems are most likely to occur.
3. Areas considered as high risk such as those bordering on agricultural lands, should be strengthened and the operation of the electric fence will be checked daily to reduce the likelihood of breakouts.
4. Daily maintenance and monitoring of all fences to ensure constant electrical charge is in operation.
5. The manager of the DGR will have had experience with hunting elephant and be able to deal with an emergency situation should one arise. Authority for him to act in an emergency situation will be obtained from the respective provinces and the SAPS. (Plans for employing a competent deputy for the reserve manager will be developed and implemented).
6. A dangerous game break out policy has been compiled for the DGR, which indicates exact procedures to follow in the event of a break out.

A.7) UTILISATION

Elephant bulls have a potentially high trophy value (up to R 150,000). However, in the DGR their tourist value will always be higher than hunting value and it is only under exceptional circumstances that an elephant bull will be offered as a trophy. These circumstances are:

(i) That the bull in question is a persistent fence breaker.

(ii) That the bull shows repeated unusually aggressive behaviour and is considered a risk to human life.

(iii) That the bull is very old and unlikely to survive for very long.

(iv) That the bull has escaped from the DGR and is in a situation where it is possible to utilise it as a trophy. (DGR staff must use their judgement on this: An example would be a bull that has settled on another property where access for transport is not possible, or where the animal is a persistent fence breaker).

No elephant cows will be sold as trophies to hunters and if a cow has to be put down for any reason, this will be done by the DGR manager.

All hunting will be done in accordance with section 9 of the NATIONAL NORMS AND STANDARDS FOR THE MANAGEMENT OF ELEPHANTS IN SOUTH AFRICA (National Environment Management Act 10 of 2004).

A cost analysis will be undertaken by the DGR Game Enterprises Ltd as the legal owner of the game in the DGR, to determine the most cost effective utilisation option for any elephant bull to be removed. The various options that will be considered and general guidelines that will be adhered to are either Live Sale/Purchase or Hunting.

A.7.1) Live Sale/Purchase

The sale of elephant bulls alive will not be undertaken for "Put and take" hunting elsewhere. The DGR will not be a part of any unethical hunting of elephant.

Management Intent:

1. As live sales are ever contemplated, the DGRMA will ensure that these are not to destinations where animals are part of a "Canned Hunt" operation.

A.7.2) Hunting

Trophy hunting will be accepted as an integral part of the DGR management. However, with the low number of elephant bulls, it will be done very rarely and then, only when a particular bull needs to be removed for safety or humane reasons

Management Intent:

1. Only problem bulls are considered to be a danger to human life or property, ones which have broken out of the DGR, or animals that are old and frail will be hunted. Each case will be decided taking into account all options.
2. A representative of the Gauteng Nature Conservation Unit will be invited to all hunts and should be present for the full duration of the hunt.
3. In any area visible to the public, all visible signs of the hunt must be removed with the carcass directly after the hunt. In addition to this, all traces of blood and other body fluids should be eliminated if the site is in an area that may be seen by tourists.
4. Tusks must be registered with the Gauteng Nature Conservation unit.
5. The DGR endorses the ethical standards of hunting as established by the SA Hunters Association, the Professional Hunters Association of South Africa (PHASA), and Safari Club International (African Chapter).
6. All hunts will be conducted according to the accepted Hunting Rules and Regulations of the DGR as accepted by the LOA EXCO and DGRMA.
7. When any elephant is to be hunted as a trophy, it must be done with minimum publicity and the DGRMA must have logical reasons for doing so. If the media or general public question the hunt, straightforward and factual answers must be given and only by one person designated as the official DGR spokesperson.

A.8) VETERINARY IMPLICATIONS

Elephant capture is a specialised process and will only be undertaken in the DGR by a qualified wildlife veterinarian. Furthermore, transportation should be undertaken under the supervision of a qualified registered person or company. Recognised transportation procedures will be adhered to.

Veterinarian assistance during transportation and delivery will remain the responsibility of the seller. Therefore as the elephant will be sourced from large, reputable areas the veterinarian care of these institutions will be used, i.e. elephant delivered from South African National Parks will be accompanied by one of their internal veterinarians.

In instances where a veterinarian cannot be provided as well as in daily management circumstances the services of a local veterinarian will be used.
Local vets in the area that have provided services previously or that have been approached to offer services include:

- Dr. Douw Grobler
- Dr. Andre Uys
- Dr. Tersius Zagt

B. MANAGEMENT OF BLACK RHINO (*Diceros bicornis minor*)

Together with white rhino, the black rhino can be a tourism draw-card and popular photographic species. However, unlike the readily seen white rhino that prefers open grassy savannas, which facilitates viewing, black rhino prefer closed habitats and are less easily seen. Also, unlike the placid and easily approachable white rhino, black rhino are more alert and are frequently aggressive. Unless conditions are absolutely perfect (wind direction and good trees to climb) they are not suitable for tracking on foot.

B.1) HABITAT REQUIREMENTS

Black rhinos are exclusively browsers, and in South Africa they feed on a wide selection of species with the preferred feed being *Acacia Karroo* (Hitchins, 1969). They prefer closed habitats and do best in thickets but occur in habitats ranging from woodland to open savannah and semi-desert to montane forests.

Water provision is vital for black rhino as they drink daily if water is available, usually just at dusk or early evening. Dry season drinking patterns can be limited to drinking once every second day. They can however go without water for four days (Bothma, 2002).

Black rhino often utilise mud wallows during the hot weather, primarily to help keep cool.

The DGR meets the habitat requirements of black rhino but it is not optimum in terms of feed.

B.1.1) Vegetation

The favoured food species is *Acacia Karroo* (Hitchins, 1969) and this is present in the DGR, but not in any great density. The vegetation of the DGR is regarded as suitable but not optimal for black rhino habitat.

There is sufficient woody vegetation to satisfy their need for shelter, shade and resting areas.

Management Intent:

1. The DGRMA will incorporate the detailed black rhino habitat assessment once the area has reached 50,000ha.
2. The DGRMA will monitor the vegetation on an annual basis as per the original vegetation assessment.

B.1.2) Water Provision

The provision of water in the DGR is facilitated through artificial watering points, dams along rivers and spruits and perennial rivers. Water provision for black rhino in the DGR is not a limiting factor given the extent of these natural and artificial watering points. More than one water point has been shown to lessen friction between territorial males, thus potential mortality through fighting at water holes in the DGR area is unlikely to be problematic.

The presence of the Pienaars river, Boekenhoutspruit, Kaallaagtespruit and Elands river will allow black rhino territories to be well spread, which will minimise territorial conflict at water points.

Further to water provision, black rhino require mud wallows in summer and dust baths in the dry season. Due to the number of natural water bodies situated in the DGR, such as the Kaallaagte and Boekenhoutskloof spruits, black rhinos will be able to develop their own wallows. In addition there are many earth dams available which provide suitable areas for wallowing.

The water canals are a hazard to black rhino, and any calf falling into one is likely to be lost.

Management intent:

1. The DGRMA will check the length of the Pienaars River for areas where suitable access points may need to be developed to allow game to drink safely.

B.1.3) Fire

Fire has little impact on black rhino with the exception of serious burns or fatalities that may occur if animals are encircled by fire in long grass or reeds.

Management Intent:

1. A detailed and comprehensive fire plan will take cognisance of the management and safeguarding of the black rhino and this will form part of the overall EMP.
2. The fire management of the DGR will be used specifically to provide grazing by removing moribund and accumulated material.
3. Fire breaks will be made to safeguard areas prone to runaway fires, especially in areas near the busier roads.
4. The DGRMA will form a FPA for the DGR area. This forum will establish the size, management requirement and time of fires in the DGR in accordance with the EMP. All areas burned will be recorded on maps. Initial surveys will be undertaken to assess fuel load of the plant communities in which a burn is intended.
5. Whenever fire is used as a management tool, care will be taken to ensure that large mammals and particularly black rhino are not trapped by fires.

B.1.4) Drought

Black rhino are dependent on water. When water sources dry up in time of drought the animals will move to other areas in order to find water sources and territorial conflict will occur.

Management Intent:

1. The DGRMA will maintain black rhino bull numbers at 75% of the determined ecological carrying capacity* to reduce the intensity of inter territorial conflict during periods of drought. (* *Ecological carrying capacity has not been set for black rhino at this stage as it will mean reducing the numbers of other browsers. When a decision is made to introduce black rhino, the stocking rate for these will be reduced accordingly*).
2. If conditions warrant it, the DGRMA will consider the reduction of impala, nyala, kudu and elephant numbers to ensure that a shortage of adequate feed is not a threat to the black rhino population.
3. In extreme drought conditions the DGRMA will not undertake artificial feeding of the black rhino in the veld. If necessary, black rhino will be captured and fed in temporary bomas on their territories until range conditions have improved.
4. The DGRMA will ensure that in the event of natural water sources drying up, some selected artificial watering points will be re-activated and maintained.

B.2) BEHAVIOURAL ECOLOGY

B.2.1) Social Behaviour and Reproduction

Black rhino are solitary animals with the exception of coming together to mate; mothers and calves will sometimes congregate in small groups for short periods of time. Males are not as sociable as females although they will sometimes allow the presence of other rhinos. Territories vary in size depending on the availability of food and water. Generally they have smaller territories and larger density in habitats that have plenty of food and water available, and *vice versa* if resources are not readily available.

Black rhino have a reputation for being extremely aggressive. Due to their very poor eyesight they will often charge if they sense a threat. Black rhinos will fight each other, and they have the highest rates of intra-specific mortal fight related deaths for any large mammal: around 50% of males and 30% of females die from fighting-related injuries.

They are browsers, eating leafy plants, branches, shoots, thorny wood bushes and fruit. Their diet helps to reduce the amount of woody plants which results in more grasses growing for the benefit of other animals. They have been known to eat up to 220 different species of plant and can live up to 5 days without water during drought.

They browse for food in the morning and evening. In the hottest part of the day they are most inactive, resting, sleeping and wallowing in mud when it is available.

Adults are solitary in nature, coming together only for mating. Mating does not have a seasonal pattern but births tend to be towards the end of the rainy season in drier environments.

The gestation period is 15 to 16 months. The single calf weighs approximately 35–50 kg at birth, and can follow its mother around after just three days. Weaning occurs at around 2 years of age. The mother and calf stay together for 2–3 years until the next calf is born; female calves may stay longer, forming small groups. The young are occasionally taken by spotted hyena and lion. Sexual maturity is reached from 5–7 years old for females and 7–8 years for males. The life expectancy in natural conditions (without poaching pressure) is from 35 – 50 years.

Management intent:

1. The DGRMA will manage a population with a bias towards females so as to reduce conflict and mortality with territorial bulls fighting.
2. Black rhino bulls will not be stocked at a density higher than 1:4000 ha.

Note: Natural sex ratios of black rhino are slightly more than 1:1 in favour of males, so management will involve the removal of males from the population

B.2.2) Densities

When the decision is made to stock black rhino in the DGR, the carrying capacity of impala, nyala, giraffe and kudu will be reduced to compensate for this.

Black rhino population densities are determined both by the social constraint and the food supply. Social disruptions, which can include fatal fighting, generally exert an influence on populations at high densities well before ecological constraints such as food supply take effect.

Management Intent:

1. To prevent losses due to fighting by bulls, an allocation of the density of bulls will not exceed one per 4,000 ha until detailed monitoring indicates that this can be revised.

B.3) INTRODUCTION OF BLACK RHINO

New legislation classifies black rhino as a ‘Threatened or Protected Species’ (TOPS). The introduction, transfer, conveyance, holding and movement of a threatened or protected species require specialised permits. All required permits, acquisitions and stipulations will be adhered to and followed according to the laws of South Africa.

B.3.1) Source Population

Management Intent:

1. Black rhino bulls, of the sub species minor, will be sourced from populations where lion are present so that they will not be naïve towards danger from lion. Black rhino from game reserves or ranches with electric fences will also be more aware of fences and be less likely to challenge those on the DGR.

B.3.2) Founder Population

The Rhino Management Group now recommends a founder population of 20 animals into areas that can hold at least 50. The DGR will take a more conservative approach because of the more open habitats which can, therefore, not make an introduction of this size. With the present area of the DGR, an introduction of 20 animals will probably immediately exceed an ideal stocking rate.

Management Intent:

1. If the DGRMA decide to introduce black rhino, the pilot introduction will be 10 animals with no more than four adult bulls.
2. Where possible, animals from both the Mkuze and Umfolozi-Hluhluwe bloodlines will be procured.

B.3.3) Introduction and Release

The best method for introducing black rhino to a large property is to introduce the entire founder population in as short a time as possible – a month at the most. This should be a hard release from several points (J. Flamand pers. comm.). A hard release being where animals are released directly from the transport crate into the field at a number of points, rather than being held for a while in a boma. If this process is not followed and the release takes place in phases, there is an increased risk of fighting between territorial bulls and the newcomers.

In the DGR scenario, if a few bulls are to be introduced initially, this will be co-ordinated so that it is done rapidly and at several different points. If this cannot be done, then the first animal will be a hard release and once it has settled down, the remainder will be soft releases into bomas, and if these are on properties separated from the first animal by a fence before incorporation into the main body of the DGR, then so much the better. (A protracted release process will only be implemented as new properties are incorporated into the DGR).

Black rhino adapt to a boma very easily – unlike white rhino. People experienced in the management of the species in bomas will be involved in this process.

When cows are released into the DGR, with territorial bulls already present, the risk of fighting will have to be reduced. Any cows to be introduced will then have to be soft releases into the properties before the fences between the core DGR block and these properties have been removed. This will give the animals time to get acquainted while separated by a fence.

Management Intent:

1. Whether to do soft or hard releases will be determined by the specific situation according to the guidelines presented above.

B.4) CONTAINMENT

B.4.1) Perimeter Fence Specifications

A Big 5 compliant fence was erected in 2007 / 2008. The fence conforms to the following specifications:

(i) An electrified perimeter game proof fence of 2.4 m height with a minimum of 24 strands (non-electrified);
(ii) Electrified on the inside of the game fence with at least five strands of electrical wires, with a minimum diameter of 2.24 mm.
(iii) Trip line 0.6 m from fence base and electrified.
(iv) Bottom strand: at ground level with 225 mm double offset brackets.
(v) Second strand: at 500mm above ground level with 225mm double offset brackets.
(vi) Third strand: 1m above ground level with 225mm double offset brackets.
(vii) Fourth strand: 1.5 m with 225 mm or 450 mm double offset brackets
(viii) Top strand: on top of fence (2.4m above ground level) with 450 mm double offset brackets
(ix) Earth strand: (double offset) 10 cm on the inside of each live wire strand

(x) Minimum voltage of 6000 V should be maintained on the whole peripheral electrified fence.
(xi) Energisers large enough to maintain at least 6000 V over a distance of 8 km and do not release less than 6 Joules.

The Terms of Reference as accepted for the awarded fencing tender can be consulted for further specifications.

B.4.2) Release Boma Specifications

A boma was constructed into which the large game animals will initially be released when necessary. The boma can therefore be used to teach black rhino to respect electric perimeter fence. The boma will also be used on an ongoing basis for rehabilitation and treatment of sick/injured wildlife where deemed necessary.

The following sets out the characteristics of the boma:

(i) The boma has been placed close to the centre of the DGR and has access to water for utilisation after release.
(ii) The boma size is 100m x 100m. The boma includes sufficient dense vegetation to provide security and food.
(iii) The boma has adequate clean drinking water and includes the possibility for mud-wallowing.
(iv) The fence has been electrified with seven strands, with the offsets to the inside, and a voltage of 6000 - 9000 V maintained.
    a. First strand at ground level
    b. Second strand: 300mm
    c. Third strand: 600mm
    d. Fourth strand: 1,0 m above ground level
    e. Fifth strand:1,5m
    f. Sixth strand: 2m
    g. Seventh strand: 3m, with an additional earth strand.
(v) Double offset brackets are used for all strands.
(vi) The boma has been electrified (3 strands) on the outside, to prevent contact with previously introduced game.
(vii) The inside and outside of the fence is serviced by a three meter wide road to facilitate easy maintenance of the fence and will highlight any efforts of individuals to escape. The road on either side of the fence will also serve as a firebreak.
(viii) Large trees inside the camp next to the fence have been cut down to prevent electrical shorts on fence.
(ix) The offloading ramp has been placed outside the fence. The gate closing the ramp is also electrified when closed.
(x) There is a separate wide gate (6m) for boma releases.

The boma and the off-loading ramp are easily accessible for large, low-bed transport trucks with good compacted roads leading to the paddock to prevent the trucks from overturning or getting bogged down.

B.5) RISK ASSESSMENT OF INTRODUCTIONS

A number of risks and threats are faced through the introduction of black rhino to the DGR. Most of these risks and threats are faced by any reserve planning the introduction of black rhinos. The DGRMA will assess these risks and threats and mitigating measures will be followed.

B.5.1) Predation

Lion and spotted hyena do predate on young black rhino.

Management Intent:

1. Low numbers of lion will be introduced as per the lion EMP (Funston 2008). Lion prides will be kept at small numbers. Prey species such as impala, zebra and wildebeest, will be stocked in numbers that will provide a sufficient buffer against rhino predation. The availability of other more easily attainable prey species will ensure that predation of black rhino by lion is minimal.
2. The possible introduction of spotted hyena is under review at the moment. If it does take place, clan sizes will be small and unlikely to threaten black rhino calves.

B.5.2) Inter-Species Conflict

The Pilanesberg National Park did experience a number of white rhino mortalities as a result of aggressive adolescent behaviour by young elephant bulls in musth and similar behaviour could be expected towards black rhino. Studies in the Pilanesberg National Park and Hluhluwe-Umfolozi Game Reserve showed that the introduction of larger, mature bulls to the population facilitated the establishment of a hierarchal system in elephant bulls. This ensured that elephant bulls in the population did not enter musth at earlier ages. Once the mature bulls from the Kruger National Park had been introduced the elephant induced mortalities of white rhinos stopped (Slottow & Van Dyk, 1999; Slottow *et al*, 2000).

Management Intent:

1. In order to avoid rhino mortality due to young elephant bulls, in the DGR, the DGRMA will introduce at least four mature elephant bulls to the DGR. These bulls will only be introduced after the introduction of the elephant breeding herd and no juvenile bulls are recommended for introduction in the founder population.

B.5.3) Risk to people

Black rhino are aggressive and frequently charge people when caught unawares or just when they feel in the mood to do so.

Management intent:

1. In order to reduce the risk of accidents and injury:
2. Staff working in the DGR will be transported by vehicle to and from work.
3. All staff will be instructed on how to react when on foot or bicycle in the presence of black rhino.

B.5.4) Risk of vehicle-black rhino accidents

Black rhino occasionally charge vehicles and are sometimes killed in the process.

Management intent:

To reduce the risk of vehicle-black rhino accidents, the DGRMA will undertake the following:

1. All drivers working in the DGR will be instructed on how to react when in a possible confrontational situation with black rhino.
2. Signposts warning of wild animals will be erected along the district roads and the speed limits will be strictly enforced.

B.5.5) Drowning

Flooding in low lying riverine areas, during times of heavy rains and floods, should also be considered as rhinos are poor swimmers.

Management Intent:

1. The DGRMA will inspect reaches of the Pienaars River where there are considerable distances with very steep banks that could be hazardous to rhino. Suitable access/exit points will be made where it is considered advisable.

B.5.6) Disease Management

Rhino do not carry foot-and-mouth disease and therefore pose no threat to the disease-free status of the Gauteng Province. Tuberculosis of the respiratory system has not been recorded in black rhinos under natural conditions.

B.5.7) Drought

Drought situations do pose a threat to black rhino populations due to their dependence on water and that they are browsers. For mitigation and drought management actions see above.

B.5.8) Shortage of Suitable Habitat

Given the current size of the DGR and the on-going plans to expand the DGR, this threat is not of high concern.

Management Intent:

1. The DGRMA will continue to extend the DGR to a maximum size of 120,000ha.
2. The ecological carrying capacity will be evaluated on an annual basis or in conjunction with assessments of an adaptive management process and the population will be held below this size to ensure that suitable habitat is available to the population.
3. An annual vegetation assessment will be undertaken as per the overall EMP and its recommendations.

B.5.9) Poaching

Due to the close proximity of the national highway and other busy district roads utilised by the general public in the DGR area, as well as formal and informal settlements on the south western boundary of the DGR, the DGRMA recognises the potential of illegal hunting of animals in the DGR. The DGRMA further recognises that black and white rhino may be particularly vulnerable due to the value of their horns and other commodities on the illegal market. The DGRMA takes note that the over 100 rhino poached in South Africa during 2008 indicates the seriousness of the threat.

General Poaching Management Intent:

1. A poaching risk analysis of the area will be incorporated in the overall EMP.
2. Daily fence patrols will be conducted to ensure the integrity of the fence and to display asset securing vigilance.
3. Armed security guards will man all access/exit gates to the DGR on a 24 hour basis.
4. A Police Reservists Unit will be established in the DGR and has begun operations such as patrols of the area and establishment of community informants. The Unit has been approved by the SAPS and radio and cellular contact will be incorporated in the unit. These additional security measures will assist with raising the overall security standards of the area, and will benefit the safeguarding of the DGR rhino.
5. The DGRMA will employ an adequate force of field rangers who will be trained and equipped to deal with all poaching or illegal entry situations in the DGR. The density of field rangers operating in the DGR once it reaches 50,000ha in size will not be less than 25 men in the field at any time.
6. All legal rhino horn stockpiles will be managed, monitored and protected, through the applicable GDACE policies.
7. An anti-poaching unit will be established as part of their security infrastructure or an external security consultant will be appointed to do anti-poaching. This company will report directly to the DGRMA.

Management Intent Specific to Black Rhino:

1. When black rhino are introduced, weekly tracking and monitoring of the rhino population will be undertaken.

2. Security patrols of the perimeter fence and public roads as per the Infrastructure Policy of the DGR are undertaken on a daily basis and all fence damages repaired. The breach of the fence by any game or people is immediately reported to the Implementation Manager.
3. Community involvement and education programmes will be undertaken with the assistance of the DTE and the local authority.

B.5.10) Cost of Conservation

For rhino conservation to have a long term future, it is essential that (political and public) support be in place and fostered. Effort is required to integrate local communities into the conservation efforts in order to sustain the flow of benefits (conservation and reserve) that will contribute to the social and economic development of the area. Successful rhino conservation is not cheap and the risk remains that in the event that financial output is decreased the management of the rhino populations may deteriorate.

Management Intent:

1. The DGRMA will secure the necessary financial inputs and manpower from DGR tourism, together with funds from supporting donor organisations. Other funds from the use of wildlife in the DGR will also be allocated to support this need.
2. The DGRMA will facilitate, with the assistance from the Gauteng Provincial Government, the integration of the local communities into the rhino conservation efforts and the DGR support structures.
3. The DGRMA will ensure a flow of benefits from the DGR to the neighbouring communities that will contribute to the social and economic development thereof.

B.5.11) Breakouts

As the DGR borders on a densely populated semi-urban area, prevention of break-outs is a priority. The implementation of standard operating procedures in alignment with the break-out policy and action plan will be undertaken.

Management Intent:

The prevention of break-outs can be assisted through the following management interventions and actions by the DGRMA:

1. Adequate water distribution and food availability to be maintained.
2. Monitoring and management of game numbers.
3. Areas considered as high risk such as areas bordering on agricultural land should be strengthened or stone-packed to reduce likelihood of break-outs.
4. Daily maintenance and monitoring of all fences to ensure constant electrical charge.
5. Weekly monitoring of all black rhino will be done.
6. The management of bulls at 75% of ecological carrying capacity of an even sex ratio population.

A dangerous game break-out policy has been compiled for the DGR. This indicates exact procedures to follow in the event of a break-out. (see Dangerous game break-out policy in section 2.2.2.1.1(I)).

B.5.12) Danger to staff

Black rhino are more alert and aggressive than white rhino and they frequently charge vehicles and people on foot.

Management intent:

The DGRMA members and the reserve manager will instruct staff and contractors on the actions to take and avoid in order to reduce the risk of injury due to black rhino.

B.6) UTILISATION

The DGR Game Enterprises Ltd (DGRGE) favours the management of the population to produce an optimal off take for live sale. If black rhino have to be removed, a cost analysis will be undertaken by the DGRGE as the legal owner of the game in the DGR, to determine the most cost effective utilisation option. The only option that will be considered will be live sale or donation to another protected area or reputable captive facility.

B.6.1) Harvesting for Growth

All current continental, regional or national African rhino strategies and policies have set minimum metapopulation growth targets of at least 5% per annum and sometimes higher. These minimum target growth rates are well below the suspected R max (maximum sustainable per capita rate of increase) of around 9% for African rhino and hopefully metapopulation growth will exceed these minimum target levels. To achieve these minimum target growth rates will require actively managing longer established populations for more rapid growth.

Management intent

1. The DGR black rhino population will be managed for production and a detailed plan and programme will be developed when the introduction is planned.

B.6.2) Reproductive Performance

Reproductive performance of black rhino populations has been used to demonstrate differences between populations and to highlight these differences over time (Hitchins & Anderson, 1983).

Management Intent:

1. Records will be kept of calving interval and the age of first calving of females. The Limits of Acceptable Change has still to be established for black rhino but when these are set, any extension of calving interval or increase in the age of sexual maturity beyond these limits will signal the need to implement Adaptive Management of either the habitats or the population.

B.7) VETERINARY IMPLICATIONS

Black rhino capture is a specialised process and will only be undertaken in the DGR by a qualified wildlife veterinarian. Furthermore, transportation will be the responsibility of the seller and will only be undertaken under the supervision of a qualified registered person or company. Recognised transportation procedures will be adhered to.

Veterinarian assistance during transportation and delivery will remain the responsibility of the seller.

Local vets in the area who have provided services previously or who have been approached to offer services include:

- Dr. Douw Grobler
- Dr. Andre Uys
- Dr. Tersius Zagt

If planned ahead, the following vets who have exceptional experience with black rhino can also be contacted: Dr. Pete Morkel and Dr. Cobus Raath.

C. MANAGEMENT OF BUFFALO (*Syncerus caffer*)

Buffalo play an essential role in the grazing succession as a bulk grazer (Bell, 1971), making short and more nutritious grasses more available to intermediate and selective grazers. They are also a major drawcard for trophy hunting and old bulls are popular photographic subjects. Breeding herds and bachelor herds are generally placid, and with knowledgeable guides, bulls can be approached on foot with comparative safety. Like approaching elephant and rhino on foot, this provides an unforgettable experience for visitors.

C.1) MOTIVATION FOR INTRODUCTION OF BUFFALO

C.1.1) Objectives

This single species management plan is an integral component of the overall management plan for the DGR. The specific objectives of this plan are:

(i) To provide guidelines for the sourcing, introduction and management of buffalo (*Syncerus caffer*) in the DGR.

(ii) To ensure that the introduction of buffalo into the DGR is successful and economically viable, and conforms to acceptable, ethical and recommended practices as advised by recognised authorities, including GDACE.

C.1.2) Goals

The introduction of buffalo into the DGR will fulfil the following goals and objectives of the DGR:

(i) The primary goal is to manage a disease free buffalo population in the DGR, within to be agreed Limits of Acceptable Change, so that will serve the following:

a. Conservation role – The buffalo population will play a keystone role as a bulk grazer in the grazing succession.

b. Tourism role – Buffalo bulls in particular, because of their rugged appearance and dangerous reputation, are excellent tourism animals and fulfil the Big 5 objective of the DGR. It will be an objective that visitors have an excellent chance of seeing a buffalo over a 48 hour visit.

c. Economic role - Planned and sustainable trophy hunting will be used as a management tool to utilise old bulls and to generate a valuable source of income. If managed well, the production of an annual off-take of "Disease free" animals and a few trophy bulls will provide a significant boost to the DGR's revenue.

The introduction of "Disease free" buffalo into the DGR conforms to the objectives of the DGR and is supported by the Gauteng Provincial Government.

Because it is expected predators will not exert any significant control over the buffalo population, we believe that once the population reaches 200 animals, and provided that the sex-ratio remains biased towards females, a significant harvest can regularly be realised (see examples from the Madikwe model simulation in **Annexure 12** (Stalmans *et al*, 1994).

If this situation can be perpetuated and clean buffalo prices remain stable, then buffalo have the potential to generate a greater income to DGR than any other species. For this reason, it is recommended that the population is managed for both game viewing and the production of disease - free animals for live sales.

It is believed that the impact of predation on buffalo can be further reduced if the lion population are managed according to the EMP (Funston, 2008) so that coalitions do not exceed one adult male per coalition. This will reduce the likelihood of lion killing buffalo.

Buffalo removals will be done by live capture. It will be simple for the DGRMA to sell buffalo "in the veld" to a contractor who then catches and re-sells them to the final destination. However, to earn more per animal, it is recommended that when the time comes to sell buffalo that the DGRMA becomes actively involved in marketing through to the final destination and engages the capture operator as an "agent" to catch and transport the animals. This does mean that the DGRMA will enter into an element of risk, but the reward in terms of greater income per animal will be higher.

C.2) HABITAT REQUIREMENTS

Buffalo are bulk grazers that require water regularly. Water provision is important as they drink regularly and calves require water daily in the dry season.

The DGR meets the habitat requirements of buffalo as it provides a wide variety of palatable grasses and sufficient woodland for cover and shade. There are enough assessable water points, except along the Pienaars River, where steep sided banks make access for buffalo a risky task.

C.2.1) Vegetation

The vegetation has been described by Skosana and Westfall (2005), and more recently by Gertenbach (this plan).

Management Intent:

1. The overall EMP will provide a comprehensive vegetation survey of the current DGR area in order to refine the vegetation synopsis provided above.
2. The DGRMA will undertake to monitor the vegetation of the DGR on an annual basis.
3. Setting the "Thresholds of Potential Concern" (**Annexure 10**) for the impact of buffalo on grazing in the DGR will be a future priority for the DGRMA.

C.2.2) Water Provision

Water requirements:

Buffalo adults drink on average some 3.4 litres per 100kg. During the hot dry period animals can drink twice a day. Drinking intervals can vary between 6 and 28 hours.

In the hot season buffalo, particularly bulls, frequently wallow in order to cool down. Buffalo will use the same wallows as white rhino (Funston, 2008).

Implications for water provisioning in DGR

Foraging range of buffalo for water is limited to 17km (Young, 1970). Even during the dry periods, few surface water areas will be further than 5km apart. Therefore, given the current spatial and temporal availability of water, buffalo in the DGR are unlikely to be water stressed and their distributions are unlikely to be water limited.

Concern is expressed here on the extensive distances of the Pioneers' river with very steep banks. Much of this distance presents a high risk for large mammals.

Management intent:

1. The DGRMA will liaise with land owners regarding the potential closure of some waterholes given the excessive number of water points in the DGR.
2. The DGRMA are advised to check the length of the Pienaars River for areas where suitable access points may need to be developed to allow game to drink safely.

C.2.3) Fire

Fire has little impact on buffalo with the exception of serious burns or fatalities that may occur if animals are encircled by fire in long grass or reeds.

Management Intent:

1. A detailed and comprehensive fire plan will take cognisance of the management and safeguarding of the buffalo population and this will form part of the overall EMP.
2. The fire management of the DGR will be used specifically to provide grazing by removing moribund and accumulated material.
3. Fire breaks will be made to safe guard areas prone to run away fires, especially in areas near the busier roads.
4. The DGRMA will form a FPA for the DGR area. This forum will establish the size, management requirement and time of fires in the DGR in accordance with the EMP. All areas burned will be recorded on maps. Initial surveys will be undertaken to assess fuel load of the plant communities in which a burn is intended.

5. Whenever fire is used as a management tool, care will be taken to ensure that large mammals are not trapped by fires.

C.2.4) Drought

Buffalo are dependent on water. When water sources dry up in time of drought the animals will move to other areas in order to find water sources. Being bulk grazers, and highly mobile, buffalo should be able to move to areas where feed is available on the DGR.

Management Intent:

1. The DGRMA will maintain buffalo numbers at the determined ecological carrying capacity to avoid excessive stocking rates that would lead to excessive over-grazing and calf mortality during periods of drought. Depending on cost-benefits, it may be desirable to allow buffalo to increase above the 200 limit and reduce the numbers of zebra. (This will be a decision to be made sometime in the future).
2. In extreme drought conditions, the DGRMA will not undertake feeding of the buffalo in the DGR. If necessary, buffalo will be captured and temporarily held in bomas and fed until suitable conditions for their release return.
3. The DGRMA will ensure that in the event of natural water sources drying up, some selected artificial watering points will be re-activated and maintained.

C.3) BEHAVIOURAL ECOLOGY

C.3.1) Social Behaviour and Reproduction

Social behaviour:

Buffalo are gregarious, occurring in herds of up to several thousand individuals. These herds are relatively stable associations, with the smaller herds forming into larger ones temporarily. Buffalo herds move seasonally in search of adequate grazing and water. There may be family cohesion of females within the herd: family ties in the males do not last beyond three years of age. Old and young bulls may leave the herd and form small bachelor herds.

There is an established hierarchy, both within bachelor herds and large herds. Old bulls can become harassed and leave the herd.

Reproduction:

Buffalo mate and give birth strictly during the rainy seasons. Birth peak takes place early in the season while mating peaks later. A bull will closely guard a cow that comes into heat, while keeping other bulls at bay. This is difficult as cows are quite evasive and attract many males to the scene. By the time a cow is in full estrous only the most dominant bull in the herd/sub-herd is there. Cows first calve at five years of age, after a gestation of 11.5 months. Newly born calves remain hidden in vegetation for the first few weeks while being nursed occasionally by the mother before joining the main herd. Calves are held in the centre of the herd for safety. The maternal bond between mother and calf lasts longer than in most bovids. However when a new calf is born the bonding ends and the mother will keep her previous offspring out of the way with horn jabs. Nevertheless the yearling will still tag along for another year or so. Males leave their mothers when they are two years old and join the bachelor groups.

Diet:

Buffalo are primarily grazers that will occasionally eat forbs and shrubs. During the warm wet season, buffalo spend less time feeding than they do during the warm dry season. They graze primarily during the cool hours of the day and at night in the hot season.

Management intent:

1. It is intended that the buffalo will be free ranging and will feed on natural veld and that natural interactions and behaviour will occur.

C.3.2) Spatial Organisation

Territoriality is not present in buffalo and so it is not an issue of concern in the DGR. Adult bulls have home ranges which are much larger than those of the area of the DGR, so it can be expected that the bulls will range over the entire DGR and the breeding herd will remain in areas of preferred habitat.

Management intent:

1. If buffalo were territorial, then the DGR would only be able to support fewer bulls than their social structure allows. The fact that they have home ranges and bachelor herds that are not defended allows a higher number of bulls to be carried and benefits the optimisation of a possible return from trophy hunting.

C.3.3) Sex Ratio

Within the prescribed carrying capacity of buffalo in the DGR, the sex ratio will be managed to be one that will produce the highest income to the DGR, whether this is in the form of live sales or the production of trophy bulls. The prevailing market forces will dictate whether management will be for the production of bulls for hunting, or for the live sale market for breeding animals. The former will require the early removal of cows to favour a higher proportion of bulls within the buffalo biomass, the latter will mean managing for as high a proportion of breeding cows as possible. These numbers will be decided by the data from the field and applying adaptive management.

Management intent:

1. The sex-age ratio of buffalo to be introduced into the DGR will largely depend on funds and availability. Because of the potentially very costly impact of lion predation on buffalo, it is important to have a number of adult bulls in the herd to provide a measure of protection against lion predation. It has been found in the Kruger National Park, that male lion predate more heavily on buffalo that other prey species and kill a greater proportion of buffalo than lionesses (Funston *et al.,* 1998). With only one adult male lion per pride, it is expected that the level of lion predation on buffalo; herds will be reduced if there are enough adult bulls in the herd for some degree of protection. A founder population of four adult bulls and at least 22 cows and heifers will be constructive in that the bulls will give a measure of protection of the herd from lion predation and the number are more than enough for breeding purposes.

C.3.4) Densities

The proposed density of buffalo is 1:90ha, close to the range described by Bothma & van Rooyen (2006:86) for natural populations under a similar mean annual rainfall. Adaptive Management (Walker, 1998) and the monitoring of grazing and the buffalo population will be vital activities to provide the information needed for management decisions and to maintain a productive buffalo population.

Management intent:

1. It is intended that the density of buffalo will be managed at a level to ensure optimal production to generate revenue for the DGR.

C.4) INTRODUCTION OF BUFFALO

The introduction, transfer, conveyance, holding and movement of a threatened or protected species require specialised permits. All required permits acquisitions and stipulations will be adhered to, and followed according to the laws of South Africa.

C.4.1) Source Population

Buffalo will be sourced only from populations which are “Disease-free” and where the animals have been exposed to lion predation: e.g. Pilanesberg and Madikwe.

Buffalo from Madikwe are preferred as the Pilanesberg population stems from the Addo gene pool and the trophy quality is not as good as the animals from more diverse founder stock in Madikwe.

Management Intent:

1. The DGRMA will consider buffalo only from "Disease-free" herds where animals are also familiar with lion.
2. The DGRMA will supplement this founder population should funds become available.

C.4.2) Founder Population

What is important is to obtain a founder population that is large enough to make a realistic impact on game viewing and to be able to reach the desired carrying capacity for buffalo in less than 20 years. It is recommended that at least 25 animals are introduced in the founder population and at least three of these must be large bulls.

Management Intent:

1. The founding population will initially be 25 individuals. However the DGRMA will maintain the population according to the recommended carrying capacity of 200 animals.
2. The founder population will consist of cows, heifer and calves and at least three large bulls.

C.4.3) Acclimatisation and Release

The release must be a soft release, not directly from the crates into the DGR, but the animals do not need to be kept in the boma longer than overnight. As buffalo are not territorial, the release of additional animals can be staggered over time as funds and animals become available.

There is a boma on the DGR that will be suitable for the introduction of buffalo (J.Stevens *pers comm.*). This boma has been described in detail in the White Rhino EMP by Funston (2008) and in the release boma specifications provided below.

Management Intent:

1. The buffalo will undergo a soft release that will allow them to recover from the journey and to become sensitised to the fact that the fences they encounter will be electrified. They can be released within 24 hours of arrival, provided they are in good health.
2. The release itself must be done with a minimum of fuss and the animals must be allowed to leave the boma of their own accord.
3. The sex/age composition of the introduced animals will be recorded before release.
4. The implanting or microchips and taking of blood samples will not be necessary, but could be undertaken, if required, for recordkeeping purposes.

C.5) CONTAINMENT

C.5.1) Perimeter Fence Specifications

Clean, disease-free buffalo from either Madikwe of Pilanesberg will be accustomed to fences and the DGR fence specs below conform to the standards required by the province for Big 5.

A Big 5 compliant fence was erected in 2007/2008. The fence conforms to the following specifications:

(i) An electrified perimeter game proof fence of 2.4 m height with a minimum of 24 strands (non-electrified);
(ii) Electrified on the inside of the game fence with at least five strands of electrical wires, with a minimum diameter of 2.24 mm.
(iii) Trip line 0.6 m from fence base and electrified.
(iv) Bottom strand: at ground level with 225 mm double offset brackets.
(v) Second strand: at 500mm above ground level with 225mm double offset brackets.
(vi) Third strand: 1m above ground level with 225mm double offset brackets.
(vii) Fourth strand: 1.5 m with 225 mm or 450 mm double offset brackets
(viii) Top strand: on top of fence (2.4m above ground level) with 450 mm double offset brackets
(ix) Earth strand: (double offset) 10 cm on the inside of each live wire strand

(x) Minimum voltage of 6000 V should be maintained on the whole peripheral electrified fence.
(xi) Energisers large enough to maintain at least 6000 V over a distance of 8 km and that do not release less than 6 Joules.

C.5.2) Release Boma Specifications

A boma described in the white rhino EMP (Funston, 2008) was constructed into which the large game animals will initially be released when necessary. The boma, described below, will be suitable for buffalo.

(i) The boma has been placed close to the centre of the DGR and has access to water for utilisation after release.
(ii) The boma size is 100m x 100m. The boma includes sufficient dense vegetation to provide security and food.
(iii) The boma has adequate clean drinking water and includes the possibility for mud-wallowing.
(iv) The fence has been electrified with seven strands, with the offsets to the inside, and a voltage of 6000 – 9000 V maintained.
    a. First strand at ground level
    b. Second strand: 300mm
    c. Third strand: 600mm
    d. Fourth strand: 1,0 m above ground level
    e. Fifth strand:1,5m
    f. Sixth strand: 2m
    g. Seventh strand: 3m, with an additional earth strand.
(v) Double offset brackets are used for all strands.
(vi) The boma has been electrified (3 strands) on the outside, to prevent contact with previously introduced game.
(vii) The inside and outside of the fence is serviced by a three meter wide road to facilitate easy maintenance of the fence and will highlight any efforts of individuals to escape. The road on either side of the fence will also serve as a firebreak.
(viii) Large trees inside the camp next to the fence have been cut down as to prevent electrical shorts on fence.
(ix) The offloading ramp has been placed outside the fence. The gate closing the ramp is also electrified when closed.
(x) There is a separate wide gate (6m) for boma releases.

The boma and the off-loading ramp are easily accessible for large, low-bed transport trucks with good compacted roads leading to the paddock to prevent the trucks from overturning or getting bogged down.

C.6) RISK ASSESSMENT OF INTRODUCTIONS

A number of risks and threats are faced through the introduction of buffalo to the DGR. Many of these risks and threats are faced by all reserves planning the introduction of buffalo. The DGRMA will manage to reduce these risks and threats and the following mitigation measures will be implemented.

C.6.1) Predation

The lion EMP deliberately insists that each pride will only have one adult male and the offspring will be managed to ensure that no coalition is formed. This will reduce the chances of buffalo being killed (Funston *et al*., 2008) as this is speciality of male coalitions. It will always be important to keep at least three or four adult bulls in a buffalo breeding herd for protection against lion predation and it is hoped that lion predation will not be a factor.

Management Intent:

1. Low numbers of lion will be introduced as per the overall EMP. Lion prides will be kept at small numbers. The availability of other more easily killed prey species will ensure that predation of buffalo by lion will not be a very significant factor.

C.6.2) Disease Management

As the buffalo to be introduced to the DGR will all be adults, it is not expected that disease will be a problem. However, EVERY precaution must be taken to ensure that the buffalo herds remain "Disease Free". The diseases of greatest concern are: Foot & Mouth, *Brucellosis*, Bovine Tuberculosis and Corridor disease or Theileriosis. Further background on these in relation to buffalo production can be obtained from Bothma & van Rooyen (2006).

Management Intent Specific to Buffalo:

1. The buffalo to be introduced into the DGR will only be from a "Disease free" population.
2. Any buffalo that die or are killed must be autopsied and examined for diseases that are of concern.
3. Any rhino and elephant introduced to the DGR from areas where *Theileriosis* is prevalent (Kruger or Lowveld) must be "tick free" when they are introduced into the DGR.

General Management Intent:

1. The DGR is aware of the potential for any of the above mentioned diseases infecting the herd in the DGR. The DGRMA will ensure that animals are only procured from herds that are definitely disease-free.
2. It is a concern that the additional white rhino are to come from Kruger and this presents a risk of introducing *Theileriosis* infected ticks to the DGR, which could infect buffalo in the DGR (as has happened in Loskop Dam Nature Reserve). Elephant and rhino to come from Kruger or other reserves in the Lowveld should be sprayed at capture so that any *Rhipicephalus appendiculatis* ticks on the animals are killed).

C.6.3) Drowning

Flooding in low lying riverine areas, during times of heavy rains and floods should also be considered as the steep banks of the Pienaars river make getting out very difficult. This concern should be addressed by the DGRMA.

Management Intent:

1. This is a low risk but if buffalo are lost to drowning it will slow the growth rate of the population.
2. The DGRMA will evaluate whether more safe access points need to be created on the Pienaars River.

C.6.4) Drought

Drought situations will not pose a serious threat to the buffalo populations if Adaptive Management is practised to keep herbivore biomass within carrying capacity of the DGR and to remove animals if the rainy season is excessively below normal. Only under extreme conditions will buffalo be captured and held in bomas and fed until veld conditions dictate they can be released into the DGR again.

C.6.5) Shortage of Suitable Habitat

Given the current size of the DGR and the on-going plans to expand the DGR, this threat is not of high concern.

Management Intent:

1. The DGRMA will continue to extend the DGR to a maximum size of 120,000 ha.
2. The ecological carrying capacity and stocking rate will be reviewed on an annual basis, in conjunction with assessments of the responses to the Adaptive Management practices. The

buffalo population will be held at the recommended level to ensure that recruitment is high and suitable habitat, particularly grazing, is always available to the population.
3. An annual vegetation assessment will be undertaken as per the overall EMP and its recommendations. The potential loss of biodiversity of vegetation due to buffalo and other grazer impact will be monitored.
4. Under extreme drought conditions, the DGRMA will consider capture and feeding of the buffalo herd in a boma until conditions improve.

C.6.6) Poaching

BACKGROUND

Due to the close proximity of the National Highway and other roads utilised by the general public in the DGR area, as well as formal and informal settlements on the south western boundary of the DGR, the DGRMA recognises the potential of illegal hunting of animals in the DGR.

General Poaching Management Intent:

1. Law enforcement recommendations are made in the overall plan. It is a concern however that the DGR may not reach the levels of staff numbers and equipment required.
2. Daily fence patrols will be conducted to ensure the integrity of the fence and to limit trespass, theft and poaching.
3. Armed security guards will man all access/exit gates to the DGR on a 24 hour basis.
4. A Police Reservists Unit will be established in the DGR and this unit will begin operations such as patrols of the area and the establishment of a community information network. The Unit has been approved by the SAPS and radio and cellular contact will be incorporated into the unit. These additional security measures assist with raising the overall security standards of the area, which will benefit the safeguarding of the DGR rhino.
5. The DGRMA will employ field rangers who will be trained and equipped to deal with all poaching or illegal entry situations in the DGR.
6. An anti-poaching unit will be established in the DGR. If this role is outsourced, the unit will report to the DGR manager.
7. All poachers that are apprehended will be prosecuted.

Management Intent Specific to Buffalo:

1. DGR staff, guides and landowners will be instructed to report sightings of trespassers in the DGR to the park headquarters.
2. Security patrols of the perimeter fence and public roads as per the Infrastructure Policy of the DGR are undertaken on a daily basis and all fence damages repaired. The breach of the fence by any game or people is immediately reported to the Implementation Manager. In the first month after release, the movement of buffalo along a fence must be reported to the DGR manager as soon as possible.
3. Community involvement and education programmes will be undertaken with the assistance of the DTE and the local authority. Special attention will be made to educate neighbours and staff on actions to take and avoid if a buffalo has broken out of the DGR or is close to the fence.
4. Staff working in the DGR will be instructed on what actions to take and avoid should they encounter buffalo – either in a vehicle, on foot or on a bicycle.
5. The movement of staff within the DGR will be done by vehicle wherever possible.
6. The DGRMA will try to ensure a flow of benefits from the DGR to the neighbouring communities, which will contribute to the social and economic development thereof and thereby reducing the risk of subsistence poaching.

C.6.7) Breakouts

As the DGR borders partially on a densely populated semi-urban area, prevention of breakouts and the implementation of standard operating procedures in alignment with the “Break Out” action plan will be undertaken.

It is sufficient to note here that human life and safety is the first priority for the DGR and the DGRMA.

Management Intent:

1. The prevention of break outs can be assisted through the following management interventions and actions by the DGRMA:
2. Adequate water distribution and food availability to be maintained so that these resources are not limiting and thereby cause animals to challenge the fence.
3. Monitoring and management of buffalo movements will be done and although not intensive, this will give an indication of how the animals are adapting to the DGR and whether there are areas where problems are likely to occur.
4. Daily maintenance and monitoring of all fences to ensure constant electrical charge is in operation.
5. The manager of the DGR will have had experience with hunting buffalo and be able to deal with an emergency situation should one arise. Authority for him to act in an emergency situation will be obtained from the respective provinces and the South African Police Service (SAPS). (Plans for employing a competent deputy for the reserve manager must be developed and implemented).
6. A dangerous game break out policy has been compiled for the DGR, this indicates exact procedures to follow in the event of a break out.

C.7) UTILISATION

Buffalo bulls have a potentially high trophy value (up to R40,000). Once the buffalo reach carrying capacity, the DGRMA will have to evaluate whether to manage the herd for trophy production or the production of live animals for the open market. This will be a call to be made at the time, depending on the relative cost benefits of each option. A model to optimise the production of trophy animals in free-ranging herds has been developed (Stalmans *et al*. 1994). An example, adapted for the Madikwe Game Reserve buffalo population (International Conservation Services, 2006), is shown in **Annexure 12**. This can be adapted for the DGR when the need arises.

In the short term, the circumstances that will make a bull considered as a possible trophy are:

(i) That the bull in question is a persistent fence breaker.
(ii) That the bull shows repeated, unusually aggressive behaviour and is considered a risk to human life.
(iii) That the bull is very old and unlikely to survive for very long.
(iv) That the bull has escaped from the DGR and is in a situation where it is possible to be hunted and utilised as a trophy (Such as being on a farm where urgent action is not necessary and capture logistics are difficult and risky).

No buffalo cows will be sold as trophies to hunters because this means hunting the animal out of the breeding herd and will make the herd “wild” and less relaxed for game viewing. If a cow has to be put down for any reason, this will be done by the DGR manager.

All hunting will be done in accordance with highest ethical standards.

A cost analysis will be undertaken by the DGR Game Enterprises Ltd as the legal owner of the game in the DGR, to determine the most cost effective utilization option for any buffalo bull to be removed. The various options that will be considered and general guidelines that will be adhered to are:

C.7.1) Live Sale/Purchase

The sale of buffalo bulls alive will not be undertaken for “Put and take” hunting elsewhere. The DGR will not be a part of any unethical hunting of buffalo.

M**anagement Intent:**

1. If live sales of bulls are ever contemplated, the DGRMA will ensure that these are not to destinations where animals are part of a "Canned Hunt" operation.

C.7.2) Hunting

Trophy hunting will be accepted as an integral part of the DGR management. However, with the initial low number of buffalo bulls, it will be done very rarely and only then when a particular bull needs to be removed as for the reasons listed above.

Management Intent:

1. Only bulls are considered to be suitable for hunting or any which may have broken out of the DGR will be hunted. Each case will be decided taking into account all options.
2. In any area visible to the public, all visible signs of the hunt must be removed, with the carcass, directly after the hunt. In addition to this, all traces of blood and other body fluids should be eliminated if the site is in an area that may be seen by tourists.
3. The DGR endorses the ethical standards of hunting as established by the SA Hunters Association, the Professional Hunters Association of South Africa (PHASA), and Safari Club International (African Chapter).
4. All hunts will be conducted according to the accepted Hunting Rules and Regulations of the DGR as accepted by EXCO.

C.8) VETERINARY IMPLICATIONS

Buffalo capture is a well known process, but because of the high values of the animals, it will only be undertaken in the DGR by a qualified game capture organization with experience in buffalo capture. Capture, transport and delivery will be the responsibility of the seller.

Veterinarian assistance during transportation and delivery will remain the responsibility of the seller.

Local vets in the area that have provided services previously or that have been approached to offer services include:

- Dr. Douw Grobler
- Dr. Andre Uys
- Dr. Tersius Zagt.

D. MANAGEMENT OF HIPPOPOTAMUS (*Hippopotamus amphibious*)

There are currently a reported number of eight hippopotami in the DGR (DGR, 2005), which are presently confined to the northern part of the DGR, mostly in the Ditholo Military Nature Reserve and Mongena Game Ranch area. The current age and sex ratio of the eight hippopotami are not known.

Hippopotami generally contribute significantly to the wildlife experiences of game reserve visitors and are easily viewed due to their habitat requirements and restricted ranges around rivers, dams and other water bodies.

D.1) MOTIVATION FOR INTRODUCTION OF HIPPOPOTAMI

D.1.1) Objectives

The specific objectives of this species management plan are to:

(i) To provide guidelines for the management of the current DGR hippopotami as well as the sourcing and management of additional hippopotami. Additional hippopotami will only be considered as replacement of hippopotami already in the DGR, not to increase the present population.

(ii) To ensure that an introduction of any additional hippopotami into the DGR conforms to acceptable and recommended practices.

D.1.2) Goals

(i) DGR would potentially ensure the protection of a self-sustained small population separated from current hippopotamus populations elsewhere in South Africa. Introductions should be done close to existing large dams. The current dams should be adequate as far as breeding (birth and rearing of claves) is concerned.

(ii) Surplus hippopotami in the DGR could be captured and relocated to other protected areas at a later stage, or possibly hunted as trophy animals. There is currently still a demand for hippopotami for relocation purposes.

These recommendations are specifically aimed at the current DGR area (±18,500ha) and should be reviewed if the protected area is increased, or when additional large dams are constructed.

D.2) HABITAT REQUIREMENTS

Deep enough water to submerge in is an essential habitat requirement, and nearby grassland is the other important habitat need. Breeding herds prefer gentle sloping, firm bottoms in the water bodies they occupy. Daytime resting places may be several kilometres from night time foraging areas.

The species is a bulk grazer and an adult consumes approximately 40 kg grass/24 hr (±1-1.5% of body weight). Hippopotami are known to have a significant impact on vegetation and soils in close proximity to dams, rivers and other water bodies when present at high densities. The grazing impact of hippopotamus in such areas often results in undesirable impact, particularly if it also leads to accelerated soil erosion.

The DGR has sufficient suitable habitat for a small population of hippopotamus, both as far as the available dams and rivers, and potential grazing areas in the vicinity of the water bodies are concerned. The larger dams and rivers will provide sufficient, suitable habitat for hippopotami to disperse in the DGR. The available water bodies should be adequate to support such a small population of hippopotamus during periods of drought.

Fire usually has little or no impact on hippopotami. Intensely grazed areas near dams and rivers are usually not subject to intense fires.

Management intent:

1. Potential grazing impact by hippopotami in the vicinity of water bodies frequented by the majority of hippopotami will be monitored.
2. Possible closure of existing larger dams and the establishment of new dams will be done considering the distribution and movement patterns of hippopotami.

D.3) BEHAVIOURAL ECOLOGY

D.3.1) Social Behaviour and Reproduction

The hippopotamus is a highly gregarious species in the water, but solitary when foraging except for females with offspring. Crowding typically occurs during the dry season when suitable water bodies are more limited but often disperse widely during the rainy season. Long distances across land are sometimes covered during the rainy season to occupy temporary pools far away from perennial water. Hippopotami generally forage up to approximately 5 km from the water but are known to go as far as 15 km during periods of drought.

Mature hippopotamus bulls typically defend stretches of 50-100m of rivers or lakeshore areas and shallows. Territorial turnovers may occur at short intervals (every few months) or a couple of years, mostly depending on the variability of water levels. Territorial males usually tolerate bachelor males within their areas provided that the bachelor males behave submissively. Intraspecific aggression

between males can be fierce and can result in males being driven out, sometimes leading to serious injuries and even mortalities.

Females reach reproductive age at four years and males at around seven years. Gestation is 225-257 days. Hippopotamus calves are mostly born throughout the year but calving peaks have been recorded in some areas.

Management Intent:

1. Hippopotami will be maintained at the suggested carrying capacity to avoid localised overgrazing and possible excessive intraspecific aggression, particularly during periods of drought.
2. Identified male hippopotami causing high levels of intraspecific aggression will be removed, either through live capture or more probably through trophy hunting as such individuals are also likely to be problematic elsewhere.

D.3.2) Age and Sex Ratios

Hippopotami are difficult to age and sex reliably according to various age/sex classes. However, adult males are usually identifiable particularly as they tend to be more solitary. The natural sex ratio is usually 1:1 but in smaller systems it is advisable to consider a sex ratio in favour of females.

Management Intent:

1. Hippopotami will be maintained at a typical 1:1 sex ratio, or a ratio marginally in favour of females (1:2).
2. The number of mature (breeding) hippopotami males will be limited to two individuals.
3. No attempt will be made to manage the DGR hippopotami to specific age and sex categories because of the difficulty in ageing of the species in the field.

D.4) INTERSPECIFIC INTERACTIONS

Large carnivores, such as lion and spotted hyenas, often prey on hippopotamus calves and sub-adults although even adult hippopotami are sometimes killed. The possibility of predation on the hippopotamus in the DGR can therefore not be ruled out as lion and eventually spotted hyenas will also be introduced. Leopard scavenge on hippo carcasses but it is unlikely that leopard in the DGR will pose a threat to hippopotami.

No specific or significant interactions between hippopotami and other ungulates in the DGR are expected.

D.5) INTRODUCTION OF HIPPOPOTAMI

Hippopotami will only be introduced to replace individual hippopotami (should not exceed approximately 15 animals). All provincial and other permit requirements would be adhered to for any hippo relocation activity. The introduction of hippopotami into the DGR will primarily be considered to replace adult breeding males.

D.5.1) Source Population

When deemed necessary, hippopotami will be sourced from populations relatively close to the DGR to avoid long relocation periods, primarily to replace hippopotami removed from the DGR.

Hippopotami are periodically captured in areas where they are in conflict with agricultural activities, which would provide the most likely source if replacement hippopotami are to be considered for release into the DGR. While the DGR contains and is bordered by formalised agricultural activities, these activities do not consist of irrigated crops or other extensive crop fields along rivers, stream or dams where such conflicts are likely to occur and is therefore not considered to be problematic for the DGR. In addition, there is currently no evidence that crop feeding by hippopotami can become truly habitual.

Management Intent:

1. Hippopotami for introduction will be sourced from large populations relatively close to DGR, such as the Olifants/Blyde River, Sabie and Crocodile River systems, where populations are genetically heterogeneous.
2. No known "problem hippopotami", such as particularly aggressive individuals, will be considered for possible release into DGR.

D.6) CONTAINMENT

The electrified DGR boundary fence is adequate to contain hippopotami within the DGR. The current river gates spanning the river crossings should also be efficient to avoid any movement of hippopotami out of the DGR. It is, however, critical that river gates should be inspected on a regular basis and at least twice daily during times of strong river flow or floods.

Hippopotami are very powerful and aggressive animals which will attempt to even climb walls if footholds are present. Special care must be taken with the containment and care of hippopotami in bomas. It is essential that people should not be visible to contained hippo.

The capture and relocation of hippopotami are specialised activities. Guidelines for capture, transportation, handling and care of captive hippopotami are given by Viljoen (2002) and particularly by Maritz (1993). These specifications should be followed whenever hippopotami are to be captured, contained, moved or released.

Hippopotami are easily contained with a double strand of electric fence (25mm and 50 cm high).

D.7) UTILISATION

A hippopotamus is currently worth approximately R41,000 (based on the average 2008 game auction prices).

Management Intent:

1. In the event of a break out the DGRMA management will adhere to the break out policy (Anderson, 2009b) and exterminate the animal if necessary to protect humans and property.
2. It is recommended that any excess male or older females, or identified problem hippopotami should be hunted.
3. Ethical standards of hunting as prescribed by the SA Hunters Association, the Professional Hunters Association of South Africa (PHASA) and Safari Club International (SCI) should be adhered to.
4. All hunts should also be conducted according to the accepted hunting rules of the DGR (DGR Annual General Meeting, Appendix 2: Hunting Rules and Regulations of the DGR).
5. All visible signs of the hunt, including the entire carcass, must be removed immediately after a hunt.

D.8) VETERINARY IMPLICATIONS

It is highly recommended that the services of an experienced wildlife veterinarian should be used whenever a hippopotamus needs to be handled, moved or relocated. The responsibility of veterinary care during transportation and delivery of hippopotami will depend on the conditions agreed to between the various parties involved.

The hippopotamus is not considered to be an important disease transmitter. The main cause of disease-related mortality in hippopotami is anthrax *Bacillus anthracis* which should pose no problem in the case of the DGR

Detailed general veterinary guidelines for animals released into new areas are described in the Disease Management section of the EMP.

E. MANAGEMENT OF LEOPARD (*Panthera pardus*)

E.1) MOTIVATION FOR INTRODUCTION OF LEOPARD

Several leopard sightings have been reported in the DGR during the past couple of years (Stevens *pers. comm.*) but there is no information on the possible number present.

Leopard generally contribute significantly to the wildlife experiences of visitors to game reserves. Leopard sightings, with a couple of exceptions, in game reserves are generally rare but with time some individual leopard could become habituated to the presence of game viewing vehicles.

E.1.1) Objectives

The specific objectives of this species management plan are to:

(i) To provide guidelines for the management of leopard in the DGR;
(ii) To ensure that an introduction of additional leopard into the DGR conforms to acceptable and recommended practices.

E.1.2) Goals

(i) DGRMA would potentially ensure that a small, self-sustained small leopard population would be protected and managed in the DGR.
(ii) The leopard population will be managed as part of the overall DGR objectives.

These recommendations are specifically aimed at the current DGR area (±18,500 ha) and should be reviewed if the protected area is increased.

E.2) HABITAT REQUIREMENTS

Leopard have a wide habitat tolerance and distribution range, which include savanna, grassland, scrubland, forest and montane habitat types. Leopard depend on areas with broken terrain and dense vegetation for stalking cover and as refuge from other large predators and people.

E.2.1) Vegetation

The vegetation of DGR is suitable to support a wide range of ungulate species (estimated ungulate carrying capacity ±5,858 kg/km^2; Anderson, 2009), many of which would be potential prey to leopard.

Management intent:

1. No specific vegetation management strategies will be required for managing the DGR leopard population.

E.2.2) Water Provision

A number of both natural and artificial water points such as rivers, streams and dams are present in the DGR. Water provision for leopard is not required as the present number and distribution of water points in DGR will provide sufficient water to support a range of wildlife. The species is also able to exist in semi-arid areas.

Management intent:

1. No specific water management strategies will be required for managing the DGR leopard population.

E.2.3) Fire

Fire could influence the movements and distribution of some of the leopard's potential prey species. Leopard are, however, able to effectively hunt a variety of animals and changes in the distribution of some potential species as a result of fires would not directly impact on leopard.

Management intent:

1. No specific fire management strategies will be required for managing the DGR leopard population.

E.2.4) Drought

Leopard, similar to most other larger carnivores, are often able to increase their hunting success during periods of drought when potential prey animals concentrate around available water points.

Management intent:

1. No specific management strategies will be required for managing the DGR leopard population during periods of drought.

E.3) BEHAVIOURAL ECOLOGY

The leopard is solitary and territorial. Home range sizes are highly variable. Female ranges often overlap (up to as much as 70%) and male ranges may or may not overlap. Reported home range sizes vary from 10 to 60 km^2 and densities appear to vary between 0.36 leopard/10 km^2 and 0.77 leopard/10 km^2, except in very arid areas where the density can be as low as 0.06 leopard/10km^2.

Other larger carnivores such as spotted hyena and lion can kill leopard cubs, and even kill or injure sub-adult leopard although this is most unlikely.

E.3.1) Reproduction

Breeding can occur from two years onwards with a gestation period of 90-100 days. Cubs are generally born at intervals of approximately 25 months. Adult leopard only associate long enough to mate.

The weaning of cubs occurs at three months. Females may leave their cubs for periods up to 30 hours. Young leopard become independent as sub-adults at approximately 22 months.

Management Intent:

1. The DGRMA will support natural interactions between individual leopards.
2. The DGRMA will also recognise the fact that food competition is likely to occur between the larger carnivores in the DGR, and that mortalities are possible as a result of interspecific aggression.
3. The DGRMA will, as far as possible, consider a meta-population management approach by removing and replacing individual leopard. Removal could potentially also be by means of controlled trophy hunting activities.

E.3.2) Hunting

Leopard prey on a wide range of prey animals, from rodents to antelope twice its own weight. The leopard's diet could also include various avian species, reptiles and invertebrates. Primates such as baboon are sometimes also killed but contrary to popular belief baboon usually only comprise a rather small percentage of a leopard's kills. Leopard frequently scavenge as well.

The range of potential prey species currently present in the DGR is considered to be adequate to support a small population of leopard.

Management Intent:

1. The DGRMA recognises that predation by leopard could possibly contribute to a population decline of certain prey species.
2. The DGRMA also recognises that an abundant food supply and minimal interspecific competition amongst the larger carnivores could result in an increase of the DGR's leopard population. Such an increase in numbers could potentially put pressure on individual leopard to disperse out of DGR.

E.3.3) Age and Sex Ratio

The leopard's sex ratio is close to a 1:3 ratio in free-ranging areas and therefore the suggested sex ratio for leopard in the DGR is 1:3. The sex and age classes of leopard already present in the DGR are unknown and can therefore not be taken into account at this stage.

Management Intent:

1. It is recognised that the leopard's average sex ratio is approximately 1:3 and therefore this sex ratio will be considered in management actions effecting leopard in the DGR.

E.4) GENETIC MANAGEMENT

Inbreeding, or a lack genetic variety, is a problem frequently encountered by small isolated populations and would potentially affect susceptibility to environmental stress as well as survival and growth. Inbreeding can be addressed through a meta-population management approach by the removal (and possible exchange) of some individuals and introducing replacement individuals from an area other than the original population's source.

It is unlikely that the leopard in the DGR would face an inbreeding challenge in the short- to medium-term. It is expected that the unknown number of resident leopard would breed with introduced individuals. It is also possible that the resident leopard are not entirely geographically isolated at this stage. However, it would be important that leopard introduced in the future should be sourced from regions other than the immediate surroundings or from the same areas(s) as the first introduced leopard.

Management Intent:

1. Introduced leopard should be sourced from different geographical areas, ideally geographically separated as far as possible (also see 2.2.2.1.2 (E.6.1) - Source Population).
2. Leopard should preferably not be sourced from areas close to the DGR.
3. Consideration should be given to a possible meta-population management strategy whenever feasible. For this purpose individual leopard may be captured and relocated to other protected areas in exchange for other leopard.
4. Detailed records should be kept of all leopard relocations, including the exact localities from where leopard were sourced, and the exact destinations when leopard are moved out.

E.5) LEOPARD CARRYING CAPACITY

Leopard density in habitats similar to the DGR, and with relatively abundant potential prey availability, is ± 0.60 – 0.90 adult leopard/10km^2. Lion (6 adults) will also be introduced (Funston, 2009) as well as the proposed three cheetah (Anderson, 2009b) and four spotted hyenas (Viljoen, 2009a). The only other large carnivore present in the DGR is an unknown number of brown hyenas (Viljoen, 2009b). The leopard carrying capacity should consider the DGR's ability to sustain the proposed lion, cheetah and hyena populations.

The suggested carrying capacity for leopard in the DGR (±200 km^2) is eight adult leopard. This is a conservative carrying capacity. Because there is a very high probability that some leopard are still present in the DGR, the recommended initial leopard introduction should not exceed three adults.

E.6) INTRODUCTION OF LEOPARD

All provincial and other permit requirements would be adhered to for a leopard introduction. Leopard are classified as a "Threatened or Protected Species" under the South African Biodiversity Act (Act 10 of 2004), and specifically as a "Vulnerable Species" which "faces a high risk of extinction in the medium-term future".

E.6.1) Source Population

Leopard chosen to be introduced into the DGR will be carefully selected from populations, preferably the eastern Lowveld region of Mpumalanga Province and north and north-eastern Limpopo Province.

Leopard have a well-known homing tendency and therefore it is recommended that no leopard from areas near to the DGR should be considered for introduction. Such leopard are more likely to attempt fence breaks. Furthermore, it would also have a genetic advantage to only consider leopard from sources well beyond the boundaries of the DGR area (see section 2.2.2.1.2 (E.4) - Genetic Management).

There would be no need to wait for three suitable leopard (three young adults or sub-adults: one male and two female) to become available at the same time. Individual leopard can be free-released whenever feasible.

Management Intent:

1. The introduction of leopard could take place at any stage and whenever suitable individuals become available (up to three young adults or sub-adults; no more than one male).
2. Leopard will be obtained from populations with acceptable genetic diversity, such as areas well within the leopard's broader distribution range.
3. Only "wild" individuals will be considered for introduction and not any captive bred or rehabilitated leopard. Such leopard should be able to hunt independently without the need for food supplements.
4. No known "problem" leopard, such as known domestic stock killers, will be introduced.
5. Leopard should preferably not be introduced from areas in the vicinity of the DGR as such a leopard would be more likely to attempt to return to its original area.
6. Leopard should not be sourced from known BTB (bovine tuberculosis) areas.

E.6.2) Founder Population

There is clear evidence that some leopard are already within the boundaries of DGR. A leopard was sighted near Mongena during 2008 and another one was found in a snare in the southern part of the DGR. Regular leopard sightings have also been reported for the northern part of the DGR (Stevens *pers. comm*.). It is assumed that the resident leopard population is relatively small as most of the DGR properties were not fully protected areas prior to the establishment of the DGR.

Management Intent:

1. The total number of introduced number of leopard will be approximately three young adults or sub-adults (one male and two females).
2. At least one of the leopard will be from a different area than the other two leopard to ensure genetic heterogeneity.

E.7) CONTAINMENT

The DGR perimeter fence constructed in 2007/2008 is Big 5 Compliant in accordance with the requirements of the Gauteng Department of Agriculture, Conservation & Environment (GDACE). The fence conforms to the following specifications:

(i) An electrified perimeter game proof fence of 2.4 m height with a minimum of 24 strands (non-electrified);
(ii) Electrified on the inside of the game fence with at least five strands of electrical wires, with a minimum diameter of 2.24 mm.
(iii) Trip line 0.6 m from fence base and electrified.
(iv) Bottom strand: at ground level with 225 mm double offset brackets.
(v) Second strand: at 500mm above ground level with 225mm double offset brackets.
(vi) Third strand: 1m above ground level with 225mm double offset brackets.
(vii) Fourth strand: 1.5 m with 225 mm or 450 mm double offset brackets

(viii) Top strand: on top of fence (2.4m above ground level) with 450 mm double offset brackets
(ix) Earth strand: (double offset) 10 cm on the inside of each live wire strand
(x) Minimum voltage of 6000 V should be maintained on the whole peripheral electrified fence.
(xi) Energisers large enough to maintain at least 6000 V over a distance of 8 km and do not release less than 6 Joules.

The river gates spanning the river crossings in the DGR will not necessarily stop the movement of leopard in or out of the protected area. Leopard tend to frequent drainage systems and can therefore be expected to come into contact with the river gates.

Leopard have been successfully free-released in other areas and therefore it is suggested that leopard should also be free-leased into the DGR as the perimeter is considered to be mostly effective for containing or restricting the movement of leopard. A boma for release purposes will therefore not be required.

Management Intent:

1. Leopard will be free-released into the DGR without the need of a containment boma.
2. Releases will not be done close to any of the perimeter fences or internal fences.
3. Human activities and any possible disturbance should be avoided at the release site during the release and for the immediate period after the release (first 2-3 days).

E.8) RISK ASSESSMENT

The introduction of any large carnivore will always have some risk. Indications are that some leopard are already present in the DGR but as far as it is known no specific leopard-related problems have been reported.

Leopard are often difficult to fully contain even with electrified “game-proof” fences, particularly at river crossings. It is therefore very possible that even the leopard currently present in the DGR have been moving in and out of the DGR area at times.

Any leopard break out events will be addressed according to the prescribed break out policy for the DGR (Anderson, 2009c).

Potential problems and estimated risk (low risk = 1/10; high risk = 10/10):

(i) Occasional fence breaks and movement into neighbouring areas (6/10)
(ii) Killing of livestock and domestic animals in neighbouring areas following a fence break (5/10)
(iii) Killing of livestock and domestic animals within the DGR’s “island properties” following a fence break (6/10).
(iv) Injury to humans in the DGR (1/10)
(v) Injury to humans in neighbouring areas following a fence break (1/10).

Management Intent:

1. All leopard to be released into the DGR will be radio collared to allow tracking of movements, both inside the DGR and outside in case of a fence break.
2. If possible, escaped leopard will be immobilised and returned to the DGR if possible. Any leopard posing an immediate threat to humans will be destroyed if capture is not feasible. This will be done in accordance to the DGR break out policy.
3. Individual leopard identified as habitual fence breakers should be anaesthetised, or removed/relocated to other suitable areas.

E.9) POPULATION GROWTH AND REGULATION

Limited information is available on the leopard's population growth but it is assumed that a population can increase when competition is limited and potential prey species abundant. It is also possible that there will be a greater pressure on individual leopard, particularly sub-adults, to disperse when the population increases. This could increase the probability of fence breaks and conflict with humans and property, both outside the DGR and in the excluded "island properties" within the DGR area.

Management Intent:

1. The DGRMA will attempt to manage the leopard population by removing individual leopard whenever there are indications of increased dispersal pressure. This can possibly be done as part of a meta-population management strategy if feasible, and/or by means of trophy hunting in some cases.
2. The DGRMA will also consider the ***vasectomy of a male leopard if necessary. For this purpose a DGR male leopard will have to be captured and immobilised.***

E.10) UTILISATION

An adult leopard is currently (2009) worth approximately R40,000 – R60,000.

Trophy hunting in general, and the hunting of large cats in particular, frequently result in negative public opinion. This could of course potentially impact on the DGR's image as tourist destination. It is therefore most important that the DGRMA should consider this sensitivity whenever the removal of a leopard by means of hunting is planned. Trophy hunting is a financially lucrative activity and should therefore be a consideration whenever animals are to be removed from DGR. The sale of live animals is another possibility.

DGR Game Enterprises Ltd is the legal owner of game on the DGR and would therefore be involved in any decision with regards to the utilisation of leopard on the DGR.

Management Intent:

1. The possible live sale of leopard will be a first consideration when a leopard has to be removed from the DGR.
2. "Problem" leopard are considered to be a threat to human life or property, or which is a habitual fence breaker will be considered for trophy hunting.
3. In the event of a break out the DGRMA management will adhere to the break out policy (Anderson, 2009c) and exterminate the animal if necessary to protect humans and property.
4. All hunts will be done strictly in accordance to the accepted Hunting Rules and Regulations of the DGR (Annual General Meeting; Appendix 2: Hunting Rules and Regulations of the DGR).
5. Ethical standards of hunting as prescribed by the SA Hunters Association, the Professional Hunters Association of South Africa (PHASA) and Safari Club International (SCI) should be adhered to.

E.11) VETERINARY IMPLICATIONS

Game capture is a specialised activity and therefore any leopard capture will only be undertaken under the supervision of an experienced wildlife veterinarian. The responsibility of veterinary care during transportation and delivery of leopard will depend on the conditions agreed to between the various parties involved.

No leopard should be sourced from known BTB (bovine tuberculosis) infected areas. Any leopard for release into the DGR should receive standardised treatment for external and internal parasites. An experienced veterinarian should be consulted in this regard. Detailed guidelines for treatment and vaccinations are described by du Toit (2009).

F. MANAGEMENT OF CHEETAH (*Acinonyx jubatus*)

F.1) MOTIVATION FOR INTRODUCTION OF CHEETAH

F.1.1) Objectives

This single species management plan is an integral component of the overall management plan for Dinokeng, and has been drafted specifically for the procurement of a Threatened or Protected Species permit from GDACE. The specific objectives of this plan are:

(i) To provide guidelines for the procurement cheetah *(Acynonyx jubatus)* from a reputable source within South Africa
(ii) To provide guidelines for the management of cheetah in the DGR.
(iii) To ensure that the introduction of cheetah into the DGR conforms to acceptable, ethical and recommended practices as advised by recognised authorities including; DEAT and GDACE.

The National Principles, Norms and Standards for the Sustainable Use of Large Predators in South Africa will also be applied in the reintroduction and management process.

F.1.2) Goals

The introduction of cheetah into the DGR will fulfil the following goals and objectives of the DGR:

(i) Tourism – Although not one of the "Big Five" the cheetah is a large diurnal spotted cat, with significant appeal to tourists. Because they are diurnal hunters and favour more open habitats, cheetah are an extremely popular game viewing and photographic subjects. It will also be some time (if ever) before leopard sightings in the DGR will become a feature of the tourist menu, and until this happens cheetah will be a very worthy substitute.
(ii) Conservation – specifically the promotion of good conservation ethics and the conservation of biological diversity.
(iii) Meta-population management– As with lion, the DGR will promote a meta-population management approach to the conservation of the cheetah. The population will of necessity be small and the DGR management approach will be to remove and replace male coalitions at appropriate intervals and to remove young adult females for relocation should the cheetah density be considered to be too high.
(iv) Hunting - will not be used be used as a management tool for cheetah. When male coalitions and individual females have to be removed, they will be captured and returned to the gene pool of animals being conserved at De Wildt. Hopefully, these will be used to restock other suitable areas.
(v) The introduction of cheetah to the DGR conforms to the objectives of the DGR and is supported by the Gauteng Provincial Government.

F.2) HABITAT REQUIREMENTS

Cheetah are confined to open habitats where they are able to hunt by sight in daytime and catch their prey with a short burst of speed. The preferred size range of their prey species falls between 23 to 56kg. (Hayward et al., 2006), with a pivotal body weight of 40kg (Owen-Smith & Mills, 2007). In South Africa, the preferred species being impala, blesbok and springbok. The National Principles, Norms and Standards for the Sustainable Use of Large Predators in South Africa, Section 2, stipulates that:

(i) Enough suitable habitat must be available to accommodate a viable group;
(ii) Sufficient suitable prey must be available to sustain the predators through natural hunting
(iii) The standard of the fence to contain lion is adequate to contain cheetah.
(iv) Wild caught cheetah that are already experienced hunters and are familiar with lion are preferred. It should be noted that captive bred cheetah (Van Dyk, Cilliers, Marnewick pers. comm.) are capable of hunting without any training or " Re-wildling" process.

The DGR will initially release the cheetah into the south-eastern section of the DGR so as to minimise the risk of them encountering and being killed by lion. The area is fairly open and well stocked with suitable size ungulate species.

The DGR meets the habitat requirements for cheetah in the following respects:

F.2.1) Vegetation

Skosana and Westfall (2005) indicate that a grassy layer dominates the DGR area and therefore the vegetation of the DGR is regarded as suitable for a wide range of ungulate populations, particularly impala which are a favoured prey species.

Management Intent:

1. The overall EMP will provide a comprehensive vegetation survey of the current DGR area in order to refine the vegetation synopsis provided above.
2. The DGRMA will undertake to monitor the vegetation of the DGR as per the original vegetation assessment on an annual basis.

F.2.2) Water Provision

The provision of water in the DGR is facilitated through artificial watering points, dams along rivers and streams and perennial rivers. Water provision in the DGR is not a constraining factor for cheetah given the extent of these natural and artificial watering points.

The presence of the Pienaars River, Boekenhoutspruit, Kaallaagtespruit and Elands River could distribute game across a greater surface area. The cheetah would therefore establish territories in the best areas in terms of habitat structure (open country) and prey densities.

F.2.3) Fire

The impact of fire on cheetah will be slight, though there is always the risk of small cubs being caught in a fire. Where fire will be important to cheetah is where, in the aftermath of a fire, a green flush has developed and grazers are attracted in large numbers. This will have an impact on hunting success.

Management Intent:

1. A detailed and comprehensive fire plan will take cognisance of the management and safeguarding of the ungulate populations and a comprehensive fire management plan will form part of the overall EMP.
2. The fire management of the DGR will be used specifically to provide grazing by removing moribund and accumulated material.
3. Fire breaks will be made to safeguard areas prone to run away fires, especially in areas near the busier roads. Fire breaks have a vital role in providing suitable barriers from which to back-burn.
4. The DGRMA will form a FPA for the DGR area. This forum will establish the size, management requirement and time of fires in the DGR in accordance with the EMP. All areas burned will be recorded on maps. Initial surveys will be undertaken to assess fuel load of the plant communities in which a burn is intended.
5. Whenever fire is used as a management tool, care will be taken to ensure that cheetah are not trapped by fires.

F.2.4) Drought

Cheetah numbers are not expected to be impacted much by drought. Hunting will be impacted as prey numbers will become concentrated around water points and cover will be reduced. Some animals, particularly the old and the very young will become weaker and more vulnerable.

Management Intent:

1. The DGRMA will maintain ungulate numbers at the determined ecological carrying capacity to avoid excessive stocking rates that would lead to fatalities during periods of drought.

F.3) CARRYING CAPACITY

The area will not carry a high number of cheetah, simply because the species lives at low densities. The population will not reach 25, the number regarded as being viable and it is accepted that, with such a small gene pool, regular exchange of unrelated males into the population must take place so as to simulate a natural exchange of genetic material.

The initial introduction will be of one adult female and an unrelated coalition of two males. The female will be introduced first and the males will only be introduced after the female has had at least three months to settle down in the DGR.

The suggested carrying capacity for the current DGR situation where the total consolidated size of the area is approximately 18,500ha is two adult females and a coalition of two adult males. The second adult female will be established by retaining a female cub produced by the founder female and allowing her to become independent. As the DGR expands, males will be managed for genetic diversity and selected female cubs left to remain on the property. If an area of 5,000ha or more is to be added to the DGR, and intervening fences are still in place, this opportunity should be used to introduce another unrelated female and another coalition of two males to the DGR before the fence is removed.

F.4) BEHAVIOURAL ECOLOGY

Coalitions of two or three males, generally always siblings, jointly defend cores of shared territory (40-80 sq km). Females, at least in some studies, were found to hold territories and defend them against intruding females but not males. Female cheetah in Serengeti and on Namibian ranches have been shown to have much larger ranges than males; in Namibia a rages averages 1,500 sq km and in Serengeti 800 sq km. Nomadic males in Namibia have been recorded as covering some 800 sq km but groups of males have also been found to have territories of only 40 sq km in Serengeti. In Kruger National Park with its non-migratory prey, both sexes have been found to have similar ranges, on average 175 sq km.

Females are mated by males that live within their own range or by wanderers. Cheetah have a long, drawn-out and complex courtship, leading after seven to 14 days to the female coming into oestrus. The female remains receptive to males for up to 15 days. After a three-month gestation, the blind, helpless cubs are born in long grass, in thickets or in a temporary "borrowed" burrow. The young open their eyes at 4-14 days and are frequently carried to fresh hiding places by the mother. The cubs' first meat is eaten before they are 1 month old. Cheetah cub mortality is very high, particularly where there are other large predators. This mortality ranges from a recorded 43% in Nairobi National Park to 90-98% in Serengeti National Park, where mortality of adult male cheetah is also as high as 50% as a result of competition for territories. Cubs vary a great deal in the length of time they remain dependent on the mother; some stay with her for 2 years, others are on their own at just over 1 year.

Territories and preferred routes are marked with sprays of urine, faeces and, occasionally, by claw-raking. These markings are most often made near regularly used observation points (termitaria, rocks, leaning trees) or at path junctions. Animals mature sexually and can have cubs of their own at around 2 years. Captive specimens have lived for up to 16 years.

Management intent:

1. The DGRMA will promote natural interactions and behaviour as the DGR expands in size as well as to promote the behavioural ecology of the species through the maintenance of typical prides and coalitions.

2. In preference to introducing more than one adult female, when appropriate, the DGRMA will allow selected female cubs, born to the first female, to mature and remain in the DGR and then introduce a new unrelated coalition of males, after having removed the resident male coalition responsible for siring cubs in the DGR.

F.5) GENETIC MANAGEMENT

Cheetah populations throughout Africa show a remarkably low level of heterozygosity, indicating that at some stage cheetah went through a bottle-neck in numbers. Although this low level does not seem to affect cheetah populations, the DGR will implement active management of the cheetah population as part of a larger meta-population, which should reduce inbreeding depression and loss of heterozygosity (Jolley, 2005). The introduction of one to four animals per decade should decrease the risk of inbreeding depression, as has been shown with cougar (Beier, 1993).

Management Intent:

1. The DGRMA will adopt the meta-population management approach for cheetah and integrate with the De Wildt Cheetah programme and the EWT.
2. The DGRMA will exchange cheetah through the De Wildt programme or the EWT. This will simulate the natural transition of unrelated males through the population and will maintain the genetic viability of the DGR's small population.
3. The DGRMA will carefully maintain a detailed stud book of the cheetah population.
4. The male coalition will be replaced at intervals that will ensure that they will not have the opportunity to mate with their own offspring. Young males born in the DGR will be left with their mother for a few months, after which they would normally disperse. These will be captured and relocated elsewhere as part of the Meta-population management strategy. All founder individuals will be unrelated and will be obtained through De Wildt or the EWT.

F.6) INTRODUCTION OF CHEETAH

Cheetah are classified as a "Threatened or Protected Species". The introduction, transfer, conveyance, holding and movement of a threatened or protected species require specialised permits. All required permits acquisitions and stipulations will be adhered to, and followed according to the laws of South Africa.

F.6.1) Source Population

The cheetah to be introduced into the DGR will be chosen by De Wildt or the EWT. These are likely to be from the population found on farms in Limpopo or Northwest Provinces and will be accustomed to fences and of the appropriate suitable genetic origin.

Management Intent:

1. Cheetah will be acquired from De Wildt or through the EWT as part of the cheetah conservation effort. The origin of the animals will be as diverse as their programme will allow. Either wild or captive bred cheetah will be introduced. De Wildt has found that captive bred cheetah are able to hunt successfully with minimal training or acclimatisation.
2. Preference will be given to cheetah from areas where there are lion, as these will be more "aware" of lion and less likely to be killed.

F.6.2) Founder Population

The success of the introduction will depend on the experience of the founder population. The most successful will be animals that already have experience in hunting and a familiarity with lion. It will be essential that the males are unrelated to the female.

Management Intent:

1. The founding population will initially be 3 individuals, one females and two males, however the DGRMA will initially allow female cubs born in the DGR to remain and will replace male coalitions at appropriate intervals.

2. The origin of the animals will be decided by De Wildt or the EWT, to ensure as diverse bloodline as possible.
3. The animals must be checked and approved by an experienced veterinarian before being transported to the DGR. If it is advisable, the cheetah should be vaccinated for parvo-virus before loading and transport to the DGR, then this will be done.
4. As mentioned above, when appropriate female cubs born in the DGR will be left to form their own home ranges a new coalition of males – unrelated- will be introduced.

F.6.3) Temporary Holding Enclosure

In most instances, there will be no need for a period of habituation in a boma as the animals will only be held for a matter of days to ensure that they are in good health and to give them a large meal before their release. For this reason, an enclosure of 25mx25m with shade and suitable provision of clean water will be sufficient.

The period of holding a cheetah in the boma will, however, vary depending on the animal, its condition and how it reacts to people. As the emphasis will be to obtain wild caught animals, the period of holding the animals is primarily so that they will tame down somewhat and be more relaxed in the presence of vehicle and people. Animals obtained from De Wildt have generally gone through this process, so the holding period can be very short. Animals that have not been tamed down should be held for between 6 weeks and two months (Van Dyk pers comm.). The programme should be done in conjunction with the De Wildt project or the EWT.

Management Intent:

1. The DGRMA will hold the cheetah in the enclosure for as short a time as possible prior to release into the DGR. This will be primarily to allow them to recover from the journey to the DGR and to let them have a full stomach before they are released.
2. The DGRMA will feed the cheetah once while in the enclosure prior to release, if holding of cheetah will be only for a short time in order to tame down before release into the DGR. Animals held for longer periods will be fed three to four times a week (not daily) and will be fed half or quartered carcasses. A whole carcase will be given to the held cheetah every now and then so that they can open it and get used to feeding on the prey that they would normally kill.

F.7) INTRODUCTION AND RELEASE TIMING

The female cheetah will be released first and be given a period of at least three months to become established and familiar with the area, before the males are introduced.

The timing of the releases are that the female should released in December, when there are large numbers of impala and blesbok young available and hunting success will be relatively easy. The males should be released three months later.

Management Intent

1. The interval between the release of the female and the male coalition will permit her to establish her territory first and thereby reduce the risk of her being threatened or even killed by the males if they had first established a territory.
2. The release shortly after the impala and blesbok calf crops have arrived will give the cheetah a better chance of hunting success in an unfamiliar area.

F.8) CONTAINMENT

F.8.1) Perimeter Fence Specifications

A Big 5 compliant fence was erected in 2007/2008. The fence conforms to the following specifications:

(xii) An electrified perimeter game proof fence of 2.4 m height with a minimum of 24 strands (non-electrified);

(xiii) Electrified on the inside of the game fence with at least five strands of electrical wires, with a minimum diameter of 2.24 mm.
(xiv) Trip line 0.6 m from fence base and electrified.
(xv) Bottom strand: at ground level with 225 mm double offset brackets.
(xvi) Second strand: at 500mm above ground level with 225mm double offset brackets.
(xvii) Third strand: 1m above ground level with 225mm double offset brackets.
(xviii) Fourth strand: 1.5 m with 225 mm or 450 mm double offset brackets
(xix) Top strand: on top of fence (2.4m above ground level) with 450 mm double offset brackets
(xx) Earth strand: (double offset) 10 cm on the inside of each live wire strand
(xxi) Minimum voltage of 6000 V should be maintained on the whole peripheral electrified fence.
(xxii) Energisers large enough to maintain at least 6000 V over a distance of 8 km and do not release less than 6 Joules.

The approved Terms of Reference as accepted by the Gauteng Department Agriculture, Conservation & Environment (GDACE) for the awarded fencing tender can be consulted for further specifications.

F.8.2) Release Boma Specifications

The boma fence should simulate the perimeter fence but the electric wires need not be installed. The boma itself can be small at 23mx25m. If a suitable existing structure can be adapted to serve the purpose, this should be done as a practical cost-cutting option.

F.9) RISK ASSESSMENT OF INTRODUCTIONS

The risks and threats posed by cheetah introductions are lower than those for an introduction of any of the other large predators. The DGRMA will assess these risks and threats and mitigation measures will be followed.

F.9.1) Population Growth and Regulation

The cheetah population can be expected to increase rapidly in the absence of spotted hyena and an insignificant number of leopard. The regulation of cheetah numbers in the DGRMA will be by live removal of animals to be used in the meta-population management programme.

Management intent:

1. The DGRMA will collaborate with De Wildt or the EWT in the exchange of cheetah with other reserves to facilitate the meta-population management approach.
2. The adult females and one male in the male coalition will be collared. This will ensure that they can all be located should they disperse.

F.9.2) Genetics and Inbreeding

Inbreeding is one of the fundamental issues faced by small isolated populations and influences fitness determinants such as fecundity, survival, growth and susceptibility to environmental stress (Bjorklund, 2003). Inbreeding can be curbed through a meta-population management approach, which facilitates the introduction of new genes and removal of old genes thus maintaining a healthy population.

Management intent:

1. The DGRMA will establish close cooperation with the De Wildt Cheetah Centre and the EWT to participate in their meta-population management network.
2. Genetic integrity of the cheetah population should be managed through the population control and regulation management as well as through the meta-population management approach.

F.9.3) Predator-Prey Relationship

The DGRMA recognise that the reproduction rates of the cheetah will be higher than normal due to easy access to naïve prey and that the cheetah will be introduced at below carrying capacity and that competition from other predators will be low. This may result in selective reductions in blesbok numbers as occurred at Suikerbosrand Nature Reserve.

Management intent:

1. The cheetah population and numbers will be carefully managed according to the above-mentioned principles.
2. The prey species numbers will be carefully monitored and an annual count will be undertaken.
3. The DGRMA recognise that the prey species in lower population numbers MIGHT decline.
4. The DGRMA will maintain populations preferred by cheetah, such as impala, at close to ecological carrying capacity.

F.9.4) Inter-Species Conflict

Only cheetah from other areas where lion are present will be introduced.

F.9.5) Disease Management

The animals will be examined by a qualified veterinarian before they are released into the DGR to ensure that they do not carry any disease or parasite that does not already occur in the DGR. Whether they will be vaccinated for rabies or parvovirus will depend on the advice of De Wildt and EWT staff.

F.9.6) Shortage of Suitable Habitat

Given the current size of the DGR and the on-going plans to expand its area, it is only when the DGR reaches its greatest potential area that less intensive management of the cheetah population will be possible.

Management Intent:

1. The DGRMA will, with the assistance of the Gauteng Province, continue to extend the DGR to a maximum size of 120,000ha which will enable other unrelated adult females and additional male coalitions to be introduced. When new large blocks are added, it is suggested that new cheetah introductions are made into these blocks three months before intervening fences are removed. The number to be introduced would be decided in relation to the size of the area to be incorporated. An area of 5,000ha or larger should permit the introduction of an adult female and a coalition of two males. This process should minimise inter-territorial conflict and any related mortality.

F.10) COST OF CONSERVATION

Management Intent:

1. The DGRMA will secure as far as possible, the necessary financial inputs and manpower from DGR tourism incomes with supporting donor organisations to undertake an intensive monitoring and management regime.
2. The DGRMA will facilitate as far as possible, with the assistance from the Gauteng Provincial Government, to integrate local communities into the large predator introductions and DGR support structures.
3. The DGRMA will ensure a flow of benefits from the DGR to the neighbouring communities that will contribute to the social and economic development thereof.

F.11) BREAKOUTS

As the DGR borders on a densely populated semi-urban area, prevention of breakouts and the implementation of standard operating procedures in alignment with the break out action plan will be considered a high priority and will be undertaken.

Management Intent:

The prevention of cheetah break outs will be assisted through the following management interventions and actions by the DGRMA:

1. Regular daily GPS coordinates forwarded to a full time cheetah monitor via cell phone for the first two months.
2. Adequate water distribution and prey densities to be maintained.
3. Monitoring and management of predator and prey numbers.
4. Daily maintenance and monitoring of all fences to ensure constant electrical charge.

A dangerous game break out policy has been compiled for the DGR, which indicates exact procedures to follow in the event of a break out.

F.12) UTILISATION

Given their conservation status and high public profile in South Africa today, the hunting of cheetah will not be considered for the DGR. All utilisation will be in the form of live removals for the animals to become part of the meta-population strategy.

G. MANAGEMENT OF BROWN HYENA (*Hyena brunnea*)

G.1) MOTIVATION FOR INTRODUCTION OF BROWN HYENA

Brown hyena have been reported in the DGR during the past couple of years (Stevens *pers. comm.*) but there is no information on the number present in the area.

Although brown hyenas are not easily observed, any sighting would greatly contribute to the visitor's experience. An immediate introduction of brown hyenas is not recommended.

G.1.1) Objectives

The specific objectives of this species management plan are to:

(i) Provide guidelines for the management of brown hyena in the DGR;
(ii) Ensure that any possible introduction of additional brown hyena into the DGR conforms to acceptable and recommended practices.

G.1.2) Goals

(i) The DGRMA would potentially ensure that a self-sustained, small brown hyena population would be protected and managed in the DGR.
(ii) The brown hyena population will be managed as part of the overall DGR objectives.

These recommendations are specifically aimed at the identified DGR area (±18,500 ha).

G.2) HABITAT REQUIREMENTS

The brown hyena has a relatively wide habitat tolerance in the arid, semi-arid and dryer parts of the southern savanna areas. Stands of dense lower bush or scrub with overhanging branches are usually used for cover. Subterranean holes are also utilised. Brown hyena can exist in the absence of surface water but will drink water if available.

G.2.1) Vegetation

The vegetation of the DGR is suitable to support a wide range of ungulate species (estimated ungulate carrying capacity ±5 858 kg/km^2 (Anderson, 2009)).

Management intent:

1. No specific vegetation management strategies will be required for managing the DGR brown hyena population.

G.2.2) Water Provision

A number of both natural and artificial water points such as rivers, streams and dams are present in the DGR. Water provision for brown hyenas is not required as the present number and distribution of water points in DGR will provide sufficient water to support a range of wildlife. Brown hyenas are able to exist in semi-arid areas and without the presence of perennial water.

Management intent:

1. No specific water management strategies will be required for managing the DGR brown hyena population. Brown hyenas are mostly independent of surface water.

G.2.3) Fire

Fire could influence the movement and distribution of ungulates and some potential prey species of the brown hyena. Brown hyenas mostly scavenge and therefore it is not expected that fires will significantly affect brown hyena. The species could, however, potentially scavenge on animals killed during fires.

Management intent:

1. No specific fire management strategies will be required for managing the DGR brown hyena population.

G.2.4) Drought

Brown hyenas are well adapted to arid areas and even severe droughts should therefore not impact directly on brown hyena. Drought conditions could well benefit the species.

Management intent:

1. No specific management strategies will be required for managing the DGR brown hyena population during periods of drought.

G.3) BEHAVIOURAL ECOLOGY

The brown hyena is considered to have an advanced and elaborate social system. Home ranges, which are extensive (average ±330 km^2) in arid areas and smaller (±100 km^2) in less arid areas, are occupied by a clan consisting of a small number of closely related adults, sub-adults and young (often up to 10 individuals). The clan females are served by nomadic adult males, which make up roughly a third of the population.

Other larger carnivores such as spotted hyena and lion can possibly harass brown hyenas.

Brown hyena are almost entirely nocturnal.

Management Intent:

1. The DGRMA recognises the fact that the number of brown hyena in the DGR would be limited by typical range requirements.

G.3.1) Reproduction

Mating is opportunistic, and gestation is three months. Breeding is synchronised and perennial. Litter sizes can be up to three offspring and the female secludes herself for the birth and first couple of

months. Communal dens can remain in use for years. The young are suckled for 9-12 months and start to forage alone after approximately 15 months. Inter-litter interval is ±21 months.

Management intent:

1. No specific management strategies will be required for managing the DGR brown hyena population with regards to reproduction.

G.3.2) Foraging

The brown hyena is an opportunistic forager and can feed on a wide range of food items, including insects and small vertebrates. Fruit is often utilised in arid areas. The brown hyena kills only about 6% of the food it consumes. It is almost a pure scavenger of large mammals, utilising the remains of kills made by other large carnivores. Adults usually forage alone. Brown hyenas cache food items, usually in thickets, or carry food back to the den.

Incidents of brown hyena predation on sheep, goats and calves have been reported in certain rural areas. However, it appears that the brown hyena mostly scavenges for food in rural parts.

Management Intent:

1. The DGRMA recognises that predation by brown hyenas is not expected to impact on the populations of any potential prey species in the DGR.
2. The DGRMA also recognises the fact that food competition is likely to occur between the larger carnivores in the DGR, and that mortalities are possible as a result of interspecific aggression.
3. The DGRMA recognises that the brown hyenas in the DGR are likely to obtain most of their food from scavenging.

G.3.3) Age and Sex Ratios

The brown hyena's sex ratio is close to a 1:1 ratio. The sex and age classes of brown hyenas already present in the DGR are unknown and can therefore not be taken into account at this stage.

Management intent:

1. No specific management strategies will be required for managing the DGR brown hyena population with regards to age and sex ratio.

G.4) GENETIC MANAGEMENT

Inbreeding (a lack of genetic variety) is a problem frequently encountered by small, isolated populations and would potentially affect susceptibility to environmental stress as well as survival and growth. Inbreeding can be addressed through a meta-population management approach by the removal (and possible exchange) of some individuals and introducing replacement individuals from an area other than the original population's source.

It is unlikely that the brown hyenas in the DGR would face an inbreeding challenge in the short- to medium-term as the individuals currently in the DGR have probably not been isolated prior to the fencing of the DGR. However, it would be important to consider the introduction of some individual brown hyenas in the future. Such animals should be sourced from regions other than the immediate surroundings and should consist of three adults or young adults (one male and two females).

Management Intent:

1. Introduced brown hyenas should be sourced from different geographical areas, ideally separated geographically as far as possible.
2. Brown hyenas should preferably not be sourced from areas close to the DGR.
3. Consideration should be given to a possible meta-population management strategy whenever feasible. For this purpose individual brown hyenas may be captured and relocated to other protected areas in exchange for other brown hyenas.

4. At least one of the three adult or young adult brown hyenas (one male and two females) to be introduced will be from a different area than the other two brown hyenas, to ensure genetic heterogeneity.
5. Detailed records should be kept of all brown hyena relocations, including the exact localities from where brown hyenas were sourced, and the exact destinations when brown hyenas are moved out.

G.5) BROWN HYENA CARRYING CAPACITY

It is not certain what the potential brown hyena carrying capacity for the DGR is. It can be assumed that the current density of this species will be relatively low in the DGR but possibly higher than typical population densities in more arid regions. It can also be assumed that competition from other large carnivores in the DGR area has probably been minimal to date. Apart from leopard no other large carnivore has been recorded in the DGR area in recent years (Stevens *pers com*.).

G.6) INTRODUCTION OF BROWN HYENA

A brown hyena introduction will only be considered once the DGR's current surface area is expanded to between 22,000 and 25,000ha.

All provincial and other permit requirements would be adhered to for a brown hyena introduction. Brown hyenas are classified as a Schedule SB1: Protected Species – "Indigenous species of high conservation value or national importance that require national protection" under the South African Biodiversity Act (Act 10 of 2004).

The DGRMA plans to introduce lion during 2009 (Funston, 2009). Other planned future introductions will involve cheetah (Anderson, 2009b) and spotted hyenas at a later stage (Viljoen, 2009a) and possibly additional leopard (Viljoen, 2009b).

It is possible that the DGR brown hyena's numbers will be somewhat reduced due to competition with spotted hyenas, but this is not considered to be a problem as long as the spotted hyena population is kept at a low density (< 5 animals/100 km^2).

Management intent (eventual introduction once the DGR surface area expands):

1. No brown hyena will be introduced immediately into the DGR. Introduction of suitable individuals will only be considered once the DGR has expanded sufficiently (beyond its current surface area of ± 18,500 ha).
2. Known "problem" brown hyenas, such as individuals known to prey on domestic animals, will not be considered for introduction into the DGR.
3. Only "wild" brown hyenas will be considered for introduction. No captive-bred hyenas will be introduced.
4. Brown hyena eventually chosen to be introduced into the DGR, once the total area has been further expanded, should not be from areas immediately surrounding the DGR.
5. Consideration will be given to genetic aspects (see 2.2.2.1.2 (G.4) - Genetic Management).
6. Spotted hyenas should not be sourced from known BTB (bovine tuberculosis) areas.

G.6.1) Founder Population

Brown hyenas are already present within the boundaries of the DGR (Stevens *pers com*.). It is assumed that the resident brown hyena population is relatively small as most of the DGR properties were not fully protected areas prior to the establishment of the DGR.

Management Intent (eventual introduction once the DGR surface area expands):

1. The introduced number of brown hyenas will be three adults or young adults (one male and two females).

G.7) CONTAINMENT

The DGR perimeter fence has been constructed according to GDACE is a "Big 5 compliant" fence. This fence includes five electrified strands with a minimum of 9000V and a trip wire.

The river gates spanning the river crossings in the DGR will not necessarily stop movement of brown hyena entirely in or out of the protected area.

It is suggested that any introduced brown hyena should be free-released into the DGR. A boma or specific facility for release purposes will therefore not be required.

Management Intent:

1. Brown hyenas will be free-released into the DGR without the need of a containment boma.
2. Releases will not be done close to any of the perimeter fences or internal fences.
3. Human activities and any possible disturbance should be avoided at the release site during the release and for the immediate period after the release (first 1-2 days).

G.8) RISK ASSESSMENT OF INTRODUCTIONS

The presence of any large carnivore in a game reserve will always have some risk. Some brown hyenas are already present in the DGR, but as far as it is known no specific hyena-related problems have been reported in recent years.

Hyenas are often difficult to contain fully even with electrified "game-proof" fences, particularly where fences cross rivers and streams. It is therefore very possible that some of the brown hyenas currently present in the DGR have been moving in and out of the DGR area at times.

Any brown hyena break out events will be addressed according to the prescribed break out policy for the DGR (Anderson, 2009c).

Potential problems and estimated risk (low risk = 1/10; high risk = 10/10):

(i) Occasional fence breaks and movement into neighbouring areas (1/10);
(ii) Killing/injuring of livestock and domestic animals in neighbouring areas following a fence break (1/10);
(iii) Killing/injuring of livestock and domestic animals within DGR's "island properties" following a fence break (1/10).

Management Intent:

1. All brown hyenas to be released into the DGR at a later stage will be radio collared to allow tracking of movements, both inside the DGR and outside in case of a fence break.
2. Escaped brown hyenas will be immobilised and returned to the DGR, if possible.
3. Individual brown hyena identified as habitual fence breakers should be anaesthetised, or removed/relocated to other suitable areas.

G.9) POPULATION GROWTH AND REGULATION

Limited information is available on the brown hyena's population growth in habitat similar to the DGR area, but it is assumed that a population is unlikely to increase rapidly, particularly with the presence other large carnivores. Potentially there will also be a greater pressure on individual brown hyenas, particularly sub-adults, to disperse when the population increases. This could increase the probability of fence breaks and conflict with humans and property, both outside the DGR and in the excluded "island properties" within the DGR area.

Management Intent:

1. The DGRMA will attempt to manage the brown hyena population by removing individuals whenever there are indications of increased dispersal pressure. This could possibly be done as part of a meta-population management strategy, if feasible.

G.10) UTILISATION

A brown hyena is currently (2009) worth some R5,600. There is generally limited demand for both brown and spotted hyenas, but the sale of live animals remains a possibility. There is also limited demand of the brown hyena as a trophy animal.

DGR Game Enterprises Ltd is the legal owner of game on the DGR and would therefore be involved in any decision with regards to the utilisation of brown hyena in the DGR.

Management Intent:

1. The possible capture and live sale of brown hyenas will be a first consideration when an individual has to be removed from the DGR.
2. In the event of a known break out, the DGRMA management will adhere to the break-out policy (Anderson, 2009c) and exterminate the animal if necessary to protect humans and property.

G.11) VETERINARY IMPLICATIONS

Game capture is a specialised activity and therefore any brown hyena capture will only be undertaken under the supervision of an experienced wildlife veterinarian. The responsibility of veterinary care during transportation and delivery of any brown hyenas will depend on the conditions agreed to between the various parties involved.

Detailed guidelines for general treatment and vaccinations are described by du Toit (2009) in the Disease Management Plan for the DGR.

H. MANAGEMENT OF SPOTTED HYENA (*Crocuta crocuta*)

H.1) MOTIVATION FOR INTRODUCTION OF SPOTTED HYENA

Spotted hyenas do not currently occur in the DGR or surrounding areas.

The species would greatly contribute to the visitor's experience in the DGR but an immediate introduction is not recommended, at least not until the current DGR boundaries are extended to include an area of at least 25,000 ha or more.

H.1.1) Objectives

The specific objectives of this species management plan are to:

(i) Provide guidelines for the management of spotted hyena in the DGR;
(ii) Ensure that any possible introduction of spotted hyena into the DGR conforms to acceptable and recommended practices.

H.1.2) Goals

(i) The DGRMA would potentially ensure that a self-sustained, small spotted hyena population would be protected and managed in the DGR.
(ii) The spotted hyena population will be managed as part of the overall DGR objectives.

These recommendations are specifically aimed at the identified DGR area (±18,500 ha).

H.2) HABITAT REQUIREMENTS

The spotted hyena is primarily a savanna species but has a relatively wide habitat tolerance. It is, however, mostly absent from very arid areas or dense forested regions. Spotted hyenas are water dependent and therefore are never far from water.

H.2.1) Vegetation

The vegetation of the DGR is suitable to support a wide range of ungulate species (estimated ungulate carrying capacity ±5 858 kg/km^2; Anderson, 2009a).

Management intent:

1. No specific vegetation management strategies will be required for managing the DGR spotted hyena population once introduced.

H.2.2) Water Provision

A number of both natural and artificial water points such as rivers, streams and dams are present in the DGR which is sufficient to support a range of wildlife species, including spotted hyenas.

Management intent:

1. No specific water management strategies will be required for managing the DGR spotted hyena population. Spotted hyenas are mostly independent of surface water.

H.2.3) Fire

Fire could influence the movement and distribution of ungulates and some potential prey species of the spotted hyena. It is not expected that fire will significantly affect spotted hyenas. The species could, however, potentially scavenge on animals killed during fires.

Management intent:

1. No specific fire management strategies will be required for managing the DGR spotted hyena population.

H.2.4) Drought

Drought conditions could well benefit spotted hyenas. The spotted hyenas could have increased hunting success in the vicinity of water and would also be able to scavenge on carcasses.

Management intent:

1. No specific management strategies will be required for managing the DGR spotted hyena population during periods of drought.

H.3) BEHAVIOURAL ECOLOGY

The social system is unlike other social carnivores, including the two other hyena species. Female spotted hyenas have in many respects adopted the orthodox male role. Spotted hyena clans are structured by linear dominance hierarchies in which an individual's position, in the hierarchy determines its priority of access to resources such as food. The spotted hyena is polygynous, highly gregarious and territorial. Communal dens are used and females dominate and lead clans. The social organisation is variable but the communal den remains the clan’s focal point. Aggressive encounters between neighbouring clans are more marked when spotted hyenas occur in higher densities on open grasslands. Elsewhere buffer zones often exist with much less contact between clans. The movements and social organisation of hyenas vary seasonally in areas where prey animals are migratory.

Spotted hyenas are mostly nocturnal.

Management Intent:

1. The DGRMA recognises the fact that the number of spotted hyena in the DGR would be limited by typical range requirements.

H.3.1) Reproduction

Breeding is non-seasonal and the gestation period is 98-132 days. The average litter size is two. Spotted hyena males and females reach maturity at three years and 12 years respectively. The cubs initially remain at a separate borrow but usually moved to the communal den after approximately 10 days. Spotted hyena cubs can start eating meat at 2.5 months. The young are suckled for up to 12 months.

Management intent:

1. No specific management strategies will be required for managing a spotted hyena population in the DGR with regards to reproduction.

H.3.2) Foraging

The spotted hyena is an opportunistic forager which will scavenge whenever possible while it will hunt most easily captured prey. Foraging is usually alone or in pairs. Kills, or even hunting attempts, will attract other clan members which will join in.

Daily average food intake is ± 2-3 kg/animal. Individuals often go 1-2 days without food and sometimes even up to five days without eating. A spotted hyena can consume large amounts of meat during a single meal, sometimes to just over 30% of its body weight.

Management Intent:

1. The DGRMA recognises that predation by spotted hyenas could impact on the populations of certain potential prey species in the DGR.
2. The DGRMA recognises that the spotted hyenas in the DGR are likely to obtain their food from both scavenging and by hunting prey on their own.
3. The DGRMA also recognises the fact that food competition is likely to occur between the larger carnivores in the DGR, and that mortalities are possible as a result of interspecific aggression although it is not expected to be significant.

H.3.3) Age and Sex Ratios

The spotted hyena appears to adjust the ***sex ratio*** of their young after birth during the initial denning period. This is possibly achieved when the mother intervenes in siblicidal battles and thereby controls the sex ratio after birth.

Management intent:

1. No specific management strategies will be required for managing the DGR spotted hyena population with regards to age and sex ratio.

H.4) GENETIC MANAGEMENT

Female spotted hyenas tend to mate with males from other clans, thereby preventing inbreeding in large natural systems. Inbreeding (a lack of genetic variety) is a problem frequently encountered by small, isolated populations and would potentially affect susceptibility to environmental stress as well as survival and growth. Inbreeding can be addressed through a meta-population management approach by the removal (and possible exchange) of some individuals and introducing replacement individuals from an area other than the original population's source.

It is possible that introduced spotted hyenas in the DGR would potentially face an inbreeding challenge. Therefore it would be important that introduced animals should be sourced from different regions, consisting of three adults or young adults (one male and two females). A possible exchange of some individual spotted hyenas should also be considered after 5-10 years following the initial introduction.

Management Intent:

1. Spotted hyenas for an introduction should be sourced from different geographical areas. At least one of the three spotted hyenas (one male and two females) to be introduced will be from a different area than the others to ensure genetic heterogeneity.
2. Consideration should be given to a possible meta-population management strategy whenever feasible. For this purpose individual spotted hyenas may be captured and relocated to other protected areas in exchange for other individuals.
3. Detailed records should be kept of all spotted hyena relocations, including the exact localities from where spotted hyenas were sourced, and the exact destinations when spotted hyenas are moved out.

H.5) SPOTTED HYENA CARRYING CAPACITY

Large carnivore biomass has a positive correlation with rainfall in arid/eutrophic savannas and with total prey biomass. It is estimated that the maximum spotted hyena density in the DGR should not exceed approximately 5 animals/100 km^2 at a game stocking rate close to the one proposed by Anderson (2009a), and considering the presence of other large carnivores in the DGR. A high spotted hyena density would potentially encourage dispersal. This could also result in increased attempts to move out of the DGR.

Management intent (eventual introduction once the DGR surface area expands):

1. A spotted hyena population should be managed at below 5 animals/100 km^2.

H.6) INTRODUCTION OF SPOTTED HYENA

A spotted hyena introduction will only be considered once the DGR's current surface area is expanded.

All provincial and other permit requirements would be adhered to for a spotted hyena introduction.

The DGRMA plans to introduce lion during 2009 (Funston, 2009). Other planned future introductions will involve cheetah (Anderson, 2009b), brown hyena at a later stage (Viljoen, 2009a) and possibly additional leopard (Viljoen, 2009b).

It is possible that the DGR brown hyena's numbers will be somewhat reduced due to competition with spotted hyenas but this is not considered to be a problem as long as the spotted hyena population is kept at a low density (< 5 animals/100 km^2).

Management intent (eventual introduction once the DGR surface area expands):

1. No spotted hyenas will be introduced immediately into the DGR. Introduction of suitable individuals will only be considered once the DGR has expanded sufficiently (beyond its current surface area of ±18,500 ha).
2. Known "problem" spotted hyenas, such as individuals known to prey on domestic animals, will not be considered for introduction into the DGR.
3. Only "wild" spotted hyenas will be considered for introduction. No captive-bred hyenas will be introduced.
4. Consideration will be given to genetic aspects (see 2.2.2.1.2 (H.4) - Genetic Management).
5. Spotted hyenas should not be sourced from known BTB (bovine tuberculosis) areas.

H.6.1) Founder Population

No spotted hyenas are currently present within the boundaries of the DGR or surrounding areas.

Management Intent (eventual introduction once the DGR surface area expands):

1. The introduced number of spotted hyenas will be three adults or young adults (one male and two females).

H.7) CONTAINMENT

The DGR perimeter fence has been constructed according to GDACE standards as a "Big 5 compliant" fence. This fence includes five electrified strands with a minimum of 9000V and a trip wire.

The river gates spanning the river crossings in the DGR should also be effective in stopping any released spotted hyena from moving out along the river areas.

It is suggested that introduced spotted hyenas should be free-released into the DGR. A boma or another similar facility for release purposes will therefore not be required.

Management Intent:

1. Spotted hyenas will be free-released into the DGR without the need of a containment boma.
2. Releases will not be done close to any of the perimeter fences or internal fences.
3. Human activities and any possible disturbance should be avoided at the release site during the release and for the immediate period after the release (first 1-2 days).

H.8) RISK ASSESSMENT OF INTRODUCTIONS

The presence of any large carnivore in a game reserve will always have some risk.

Electrified game-proof fences are generally effective in confining spotted hyenas. It is therefore unlikely that any spotted hyenas will be able to move out of the DGR. Any spotted hyena break out event will be addressed according to the prescribed break-out policy for the DGR (Anderson, 2009c).

Spotted hyenas are often responsible for significant predation on livestock in agricultural areas.

Potential problems and estimated risk (low risk = 1/10; high risk = 10/10):

(i) Occasional fence breaks and movement into neighbouring areas (1/10);
(ii) Killing/injuring of livestock and domestic animals in neighbouring areas following a fence break (6/10);
(iii) Killing/injuring of livestock and domestic animals within DGR's "island properties" following a fence break (6/10).

Management Intent:

1. All spotted hyenas to be released into the DGR at a later stage will be radio collared to allow tracking of movements, both inside the DGR and outside in case of a fence break.
2. Escaped spotted hyenas will be immobilised and returned to the DGR, if possible.
3. Individual spotted hyena identified as habitual fence breakers should be destroyed or removed/relocated to other suitable areas.

H.9) POPULATION GROWTH AND REGULATION

It has been suggested that spotted hyena populations in large ecosystems are primarily regulated by social factors when prey animals are abundant. It is likely that the spotted hyena numbers in the DGR will be limited by a combination of factors.

Management Intent:

1. The DGRMA will attempt to manage the spotted hyena population by removing individuals whenever there are indications of increased dispersal pressure. This could possibly be done as part of a meta-population management strategy, if feasible.

H.10) UTILISATION

A spotted hyena is currently (2009) worth approximately R5 600. There is generally limited demand for both brown and spotted hyenas, but the sale of live animals remains a possibility. There is also limited demand of spotted hyena as a trophy animal.

DGR Game Enterprises Ltd is the legal owner of game on the DGR and would therefore be involved in any decision with regards to the utilisation of spotted hyena in the DGR.

Management Intent:

1. The possible capture and live sale of spotted hyena will be a first consideration when an individual has to be removed from the DGR.
2. In the event of a known breakout, the DGRMA management will adhere to the break-out policy (Anderson, 2009c) and exterminate the animal if necessary to protect humans and property.

H.11) VETERINARY IMPLICATIONS

Game capture is a specialised activity and therefore any spotted hyena capture will only be undertaken under the supervision of an experienced wildlife veterinarian. The responsibility of veterinary care during transportation and delivery of spotted hyenas will depend on the conditions agreed to between the various parties involved.

Detailed guidelines for treatment and vaccinations are described by du Toit (2009) in the Disease Management Plan for the DGR.

I. MANAGEMENT OF ROAN ANTELOPE (*Hippotragus equinus*)

I.1) MOTIVATION FOR INTRODUCTION OF ROAN ANTELOPE

There are currently no roan antelope in the DGR and there are also no historic records of roan antelope for the area.

The DGRMA plans to release lion (initially three individuals) into the DGR during 2009 (Funston, 2009). Considering this lion introduction and the historic distribution range the release of roan antelope into the DGR is not recommended at this time. Instead, a captive breeding programme of roan antelope in the DGR is recommended.

There remains a great demand for roan antelope on South African game reserves and game ranches. Surplus roan antelope would be sold and relocated to other protected areas, or to other roan antelope captive-breeding facilities.

I.1.1) Objectives

The specific objectives of this species management plan are to:

(i) Provide guidelines for the management of roan antelope in a captive breeding programme;
(ii) Ensure that the introduction and management of roan antelope in the DGR conforms to acceptable and recommended practices.

I.1.2) Goals

(i) The DGRMA would manage roan antelope within an enclosure primarily for breeding purposes.
(ii) The DGRMA will adhere to current guidelines with regards to roan antelope subspecies' separation.

The release of roan antelope into the DGR itself is not recommended. The intention is to stock the DGR at higher (upper) carrying capacity levels. It is well known that roan antelope avoid concentrations and high densities of other ungulates and therefore roan antelope could face a less-than-ideal situation. Furthermore, lion are to be introduced, which could also result in predation on roan antelope – a valuable species which fetches high prices and is a valuable asset.

The DGRMA may consider releasing roan antelope into the DGR from the captive-breeding programme at a later stage, but preference will be given to the release of roan antelope sourced from an area where the animals are accustomed to predation.

I.2) HABITAT REQUIREMENTS

Roan antelope is typically associated with wooded savanna regions but prefers grassland and sparse tree savanna areas. The species is also able to tolerate taller grass. Roan antelope is a selective grazer, often on perennial grasses on soils with poor nutrient status where there is also a relatively low large herbivore biomass. The roan antelope's diet sometimes includes as much as 10-20% browse. It is a water-dependent species and is therefore typically found in the vicinity of waterholes during the dry season.

Management intent:
The DGRMA does not plan to release roan antelope into the DGR at this stage, so no specific habitat management activities are planned.

I.3) BEHAVIOURAL ECOLOGY

The roan antelope is territorial and mostly dispersed in small herds in Southern and East Africa. Varying range sizes, average group sizes and social organisation have been reported in various parts of its distribution range. The home range, which is exclusive, varies between 60 and 120 km^2. Sometimes rainy and dry season ranges are completely separated. The typical group size of females with young is 6-20 animals. This antelope maintains a typical individual distance of ± 7 m when resting, which is greater than for most other African antelopes. Herds have a female dominance hierarchy, and males are tolerated until almost two years. Young males live in small bachelor herds until sexual maturity at around six years.

Roan antelope are slower than most other antelope species and it has been reported that lion commonly prey on the species (Estes, 1991). Predation by lion has also been identified as one of the factors limiting roan antelope in the Kruger National Park (Harrington *et al.,* 1999).

In favourable habitat roan antelope can occur in densities up to 1 animal/25 ha.

Management Intent:

1. Social behaviour and basic ecological requirements of roan antelope will be considered as part of the captive-breeding programme strategy.

I.3.1) Reproduction

Roan antelope can reproduce every 10 months under favourable conditions. Gestation is approximately 276-287 days. Calves are born throughout the year.

Management Intent:

1. Reproductive behaviour and associated requirements of roan antelope will be considered as part of the captive-breeding programme strategy.

I.4) INTRODUCTION OF ROAN ANTELOPE

I.4.1) Source Population

Roan antelope for the captive-breeding programme should only be obtained from recognised roan antelope breeders where the genetic history of the animals is known and well documented.

Management Intent:

1. Roan antelope will be sourced from a recognised, established roan antelope captive-breeding establishment, preferably from a facility with a relatively large group of captive-bred roan antelope.

2. The genetic history of the source roan population must be known and also be well documented.

I.5) INTRODUCTION AND CONTAINMENT

All provincial and other permit requirements would be adhered to for introducing roan antelope to a captive-breeding programme. Legislation which may affect the captive breeding of wildlife includes the Animal Health Act No. 7 of 2002, Animals Protection Act No. 71 of 1962 and National Environmental Management Biodiversity Act No. 10 of 2004.

Detailed information on a wide range of general aspects for the management of wildlife in captivity is given by Ebedes (2002). While no specific guidelines for roan antelope are available, Kriek (2005) gives more detailed guidelines for captive and semi-captive breeding of sable antelope. It is strongly recommended that wildlife experts familiar with captive-breeding programmes be contracted, prior to the establishment of such a captive breeding facility, to guide the DGRMA with regards to the various steps. This includes the site selection, which is a most important aspect.

Considerations for a roan antelope captive-breeding facility:

(i) Founder roan antelope group: ± eight individuals (1 adult ♂, 2 sub-adult ♂♂, 3 adult ♀♀, 2 sub-adult ♀♀).

(ii) Camp site and construction
   a. Sandy soils area (not clay);
   b. Vegetation: needs to include some stands of dense, shady tree clusters;
   c. Camp size: ±50-100 ha; ideally more than one camp.
   d. Camp could be subdivided into three camps, two of which should be smaller;
   e. Perimeter fence: same specifications as the DGR electrified boundary fence;
   f. Internal fences of smaller camp sections: ±1.8m high;
   g. Gates: 2 sliding gates (electrified);
   h. Loading ramp: ±3m x 12m;
   i. Cleared areas: ±2 m wide area cleared on both sides of the perimeter fence; ±1.5m along both sides of the internal fences;
   j. Cleared zone/track ±2 wide through the middle of the camp;

(iii) Food and water provision
   a. Water troughs: 2 troughs with ball valves. Should always be kept full with clean water;
   b. Feeding platforms: 4 wooden feeding platforms ±5m x 5m, 0.5-1.0 m above ground;
   c. Lucerne & hay: only the best quality lucerne and hay should be provided (wilted lucerne should never be provided);
   d. Buckets for antelope cubes (± one for each individual) could be placed ±1.5 m apart along central cleared zone/track. Approximately 0.5-1 kg cubes/animal/day should be provided in the buckets;
   e. Salt lick and block should be provided.

(iv) General roan antelope management
   a. Adult roan antelope males should always be kept separate.
   b. A 50-100ha camp can, with correct management practices, keep up to 40 roan antelope. The density of roan antelope should never exceed 1 roan antelope/ha (du Toit *pers com.*). Kriek (2005) recommends a minimum camp area of 500ha, but roan antelope can be kept at higher densities when carefully managed.
   c. To prevent inbreeding, females born in one camp should be moved to another camp with an unrelated male.

(v) Facility management and control
   a. The camp should be inspected on a regular basis, ideally twice a day;
   b. Staff must be familiar with all emergency procedures and the contact details of key personnel as well as appointed wildlife veterinarians;

c. Visitors to the breeding facility may be allowed, but it should be done under strict supervision only and with minimum disturbance to the animals.

(vi) Animal health

a. Roan antelope should be monitored on a regular basis for early signs of external parasites, loss of condition, injuries, unusual behaviour, etc.
b. Self-medicating ***applicators (such as a "Duncan Applicator")*** for the control of ***ticks should be installed at the feeding platforms. Effective control of ticks is essential with captive and semi-captive roan antelope, as tick-related diseases could result in mortalities if not addressed. Whether antelope that has received tick treatment from time to time is less fit to survive, should they be released into the open veld is debatable and it is not considered that such treatment would limit the potential for live sales to game ranches and reserves.***
c. An experienced wildlife veterinarian should immediately be consulted at the first signs of any health-related problem.

(vii) Additional management considerations

a. Caracal *Felis caracal* occur in the DGR area (Stevens *pers com.*). Caracal is known to prey on roan antelope calves in enclosures or bomas (du Toit *pers com.*) and steps should be taken to minimise this threat. A trap cage for caracal could be set against the perimeter fence. Trapped caracal could be released elsewhere in the DGR.

These are general guidelines based on camp designs and management of roan antelope by various captive breeders.

A detailed management plan should be compiled for the captive-breeding programme.

Island properties are already fenced out of the DGR and may possibly provide potential future breeding pens for roan antelope, although the use of currently unfenced properties in the DGR may provide greater advantages in the long term. Individual island properties currently average approximately 20ha and may, therefore, prove to be too small. The largest island property groupings measure approximately 80ha, which could be large enough to house breeding pens. However, such island properties may prove not be suitable for the keeping of roan antelope in terms of a variety of practical reasons. In any event, further detailed investigation on a case-by-case basis will have to be conducted to determine the suitability of island properties for these purposes.

I.6) UTILISATION

A roan antelope is currently worth R70,000 – R80,000 (based on the average 2008 game auction prices). Roan antelope are in great demand for captive-breeding programmes as well as for release onto game ranches and nature reserves.

Management Intent:

1. Surplus roan antelope from the captive-breeding programme will be sold to game ranches or game reserves with suitable roan antelope habitat. The sale of roan antelope could be both via game auctions or direct sales.
2. It is not the intent of the DGR roan antelope captive-breeding programme to release captive-bred individuals into the DGR as these animals will not be accustomed to predation. Any such release will only be based on specific requirements or merit.

I.7) VETERINARY IMPLICATIONS

The captive breeding of animals is a specialised activity. Veterinary care during all phases of such a project, including the transportation and delivery of animals, will be required. The responsibility of veterinary care during transportation and delivery of roan antelope will depend on the conditions agreed to between the various parties involved.

Detailed guidelines for treatment and vaccinations are described by du Toit (2009) in the Disease Management Plan for the DGR.

J. MANAGEMENT OF SABLE ANTELOPE (*Hippotragus niger*)

J.1) MOTIVATION FOR INTRODUCTION OF SABLE ANTELOPE

There are currently no sable antelope in the DGR.

The DGRMA plans to release lion (initially three individuals) into the DGR during 2009 (Funston, 2009). Considering this lion introduction and the possible release of leopard (Viljoen, 2009), the free release of sable antelope into the DGR is not recommended at this time. Instead, a captive breeding programme of sable antelope in the DGR is recommended.

There is generally a great demand for sable antelope on South African game reserves and game ranches. Surplus sable antelope would be sold and relocated to other protected areas, or to other sable antelope captive-breeding facilities.

J.1.1) Objectives

The specific objectives of this species management plan are to:

(i) Provide guidelines for the management of sable antelope in a captive-breeding programme;
(ii) Ensure that the introduction and management of sable antelope in the DGR conforms to acceptable and recommended practices.

J.1.2) Goals

(i) The DGRMA would manage sable antelope within an enclosure primarily for breeding purposes.
(ii) The DGRMA will adhere to current guidelines with regards to sable antelope subspecies' separation.

The release of sable antelope into the DGR itself is not recommended. The intention is to stock the DGR at higher (upper) carrying capacity levels. It is well known that sable antelope avoid concentrations and high densities of other ungulates and therefore sable antelope could face a less-than-ideal situation. Furthermore, lion are to be introduced, which could also result in predation on sable antelope – a valuable species which fetches high prices.

The DGRMA may consider releasing sable antelope into the DGR from the captive-breeding programme at a later stage, but preference will be given to the release of sable antelope sourced from an area where the animals are accustomed to predation.

J.2) HABITAT REQUIREMENTS

Sable antelope is mostly associated with a mosaic of open woodland and grassland. Open grassland areas are typically utilised in the dry season and the woodlands in the rainy season or at the end of the dry season. Sable antelope is a selective grazer, often on grasses of medium height, or new grass growth on burnt areas. Their diet includes a small amount of browse (±10-15%). A high crude protein and low fibre diet is typical.

It is a water-dependent species and is therefore typically found in the vicinity of waterholes during the dry season.

Management intent:

1. The DGRMA does not plan to release sable antelope into the DGR at this stage, so no specific habitat management activities are planned.

J.3) BEHAVIOURAL ECOLOGY

Sable antelope are gregarious animals and groups typically consist of one dominant male, several adult females and their offspring while bachelor herds and solitary males also typically occur. A dominant female leads the herd. Sable antelope occur in herds of 6-40 animals with a mean herd size of roughly 14 animals. Males start to compete with the dominant male at around six years.

Herds have a range of approximately 200 to 400ha each and ranges very rarely overlap. Dominant sable antelope males are seasonally territorial when they defend their areas of some 400ha each.

The natural population growth of sable antelope is approximately 20% per annum.

In favourable habitat sable antelope can occur in densities up to 1 antelope/25 ha.

Management Intent:

1. Social behaviour and basic ecological requirements of sable antelope will be considered as part of the captive-breeding programme strategy.

J.3.1) Reproduction

Sable antelope males and females are sexually mature at 32 and 24 months respectively but males only become socially able to mate at around six years. The species can reproduce approximately every 12 months under favourable conditions. Gestation is around 240-280 days. Females leave the herd to give birth and the calf is usually concealed for approximately two weeks. Sable antelope are seasonal breeders, with a peak in mating May-July, and calves are usually born towards the end of the rainy season. Females can breed until the age of around 10-12 years.

Management Intent:

1. Reproductive behaviour and associated requirements of sable antelope will be considered as part of the captive-breeding programme strategy.

J.4) INTRODUCTION OF SABLE ANTELOPE

J.4.1) Source Population

Sable antelope for the captive-breeding programme should only be obtained from established sable antelope breeders where the genetic history of the animals is known and well documented.

Management Intent:

1. Sable antelope will be sourced from a recognised, established antelope captive-breeding establishment, preferably from a facility with a relatively large group of captive-bred sable antelope.
2. The genetic history of the source sable population must be known and also be well documented.

J.5) INTRODUCTION AND CONTAINMENT

Sable antelope are considered to be an ideal species for intensive production as they tend to adapt well to captive conditions.

All provincial and other permit requirements would be adhered to for introducing sable antelope to a captive-breeding programme. Legislation which may affect the captive breeding of wildlife includes the Animal Health Act No. 7 of 2002, Animals Protection Act No. 71 of 1962 and National Environmental Management Biodiversity Act No. 10 of 2004.

Detailed information on a wide range of general aspects for the management of wildlife in captivity is given by Ebedes (2002) and more specifically for sable antelope by Kriek (2005). It is strongly recommended that wildlife experts familiar with captive-breeding programmes be contracted, prior to

the establishment of such a captive breeding facility, to guide the DGRMA with regards to the various steps. This includes the site selection for the camp facility.

Considerations for a sable antelope captive-breeding facility:

(i) Founder sable antelope group: ± eight individuals (1 adult ♂, 2 sub-adult ♂♂, 3 adult ♀♀, 2 sub-adult ♀♀).

(ii) Camp site and construction
   a. Sandy soils area (not clay);
   b. Vegetation: needs to include some stands of dense, shady tree clusters;
   c. Camp size: ±50-100 ha; ideally more than one camp.
   d. Perimeter fence: same specifications as the DGR electrified boundary fence;
   e. Gates: 2 sliding gates (electrified);
   f. Loading ramp: ±3m x 12m;
   g. Shelters for shade should be constructed.
   h. Cleared areas: ±2 m wide area cleared on both sides of the perimeter fence;
   i. Cleared zone/track ±2 wide through the middle of the camp;

(iii) Food and water provision
   a. Water troughs: 2 troughs with ball valves. Should always be kept full with clean water;
   b. Feeding platforms: 4 wooden feeding platforms ±5m x 5m, 0.5-1.0 m above ground;
   c. Lucerne & hay: only the best quality lucerne and hay should be provided (wilted lucerne should never be provided);
   d. Buckets for antelope cubes (± one for each individual) could be placed ±1.5 m apart along central cleared zone/track. Approximately 0.5-1 kg cubes/animal/day should be provided in the buckets;
   e. Salt lick and block should be provided.

(iv) General sable antelope management
   a. A 100ha camp can, with correct management practices, keep up to 40 sable antelope. The density of sable antelope should never exceed 1 animal/ha.
   b. Adult sable males should always be kept separate.
   c. Young males should be removed at the age of 12 months, or sooner.
   d. To prevent inbreeding, females born in one camp should be moved to another camp with an unrelated male.

(v) Facility management and control
   a. The camp should be inspected on a regular basis, ideally twice a day;
      i. Staff must be familiar with all emergency procedures and the contact details of key personnel as well as appointed wildlife veterinarians;
   b. Visitors to the breeding facility may be allowed, but it should be done under strict supervision only and with minimum disturbance to the animals.

(vi) Animal health
   a. Sable antelope should be monitored on a regular basis for early signs of external parasites, loss of condition, injuries, unusual behaviour, etc.
   b. Internal parasites can pose a real problem, such as wireworms. Animals could be immobilised for de-worming purposes, or by adding a suitable anthelmintic in the food.
   c. Self-medicating ***applicators (such as a "Duncan Applicator")*** for the control of ***ticks should be installed at the feeding platforms.***
   d. An experienced wildlife veterinarian should immediately be consulted at the first signs of any health-related problem.

These are general guidelines based on camp designs and management of sable antelope by various captive breeders.

A detailed management plan should be compiled for the captive-breeding programme.

Island properties are already fenced out of the DGR and may possibly provide potential future breeding pens for sable antelope, although the use of currently unfenced properties in the DGR may provide greater advantages in the long term. Individual island properties currently average approximately 20ha and may, therefore, prove to be too small. The largest island property groupings measure approximately 80ha, which could be large enough to house breeding pens. However, such island properties may prove not be suitable for the keeping of sable antelope in terms of a variety of practical reasons. In any event, further detailed investigation on a case-by-case basis will have to be conducted to determine the suitability of island properties for these purposes.

J.6) UTILISATION

Mostly because of the conservation status of sable antelope, this species have a very high commercial value and therefore the demand for sable antelope is high in the private sector. A sable antelope is currently worth an estimated R71,460 (based on the average 2008 game auction prices). Two sable antelope reached prices of more than a R1 million each at a 2008 game auction. Sable antelope are in great demand for captive-breeding programmes as well as for release onto game ranches and nature reserves.

Management Intent:

1. Surplus sable antelope from the captive-breeding programme will be sold to game ranches or game reserves with suitable sable antelope habitat. The sale of sable antelope could be both via game auctions or direct sales.
2. It is not the intent of the DGR sable antelope captive-breeding programme to release captive-bred individuals into the DGR as these animals will not be accustomed to predation. Any such release will only be based on specific requirements or merit.

J.7) VETERINARY IMPLICATIONS

The captive breeding of animals is a specialised activity. Veterinary care during all phases of such a project, including the transportation and delivery of animals, will be required. The responsibility of veterinary care during transportation and delivery of sable antelope will depend on the conditions agreed to between the various parties involved.

Detailed guidelines for treatment and vaccinations are described by du Toit (2009) in the Disease Management Plan for the DGR.

2.2.2.1.3 DISASTER MANAGEMENT

This section describes the risk rating of the identified hazards for the DGR and sets out specific risk management measures for addressing those hazards in Table 2.5 to 2.12.

Table 2.5 Geological and Topographical Hazards

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Earthquake	Very low	Due to very low risk rating, no specific management measures are required. Measures to mitigate risks associated with general structural collapse (discussed below), will be sufficient
Landslides (rock falls, slides & mud flows)	Very low	Due to very low risk rating, no specific management measures are required. Measures to mitigate risks associated with soil erosion and stream bank stability (discussed below), will be sufficient
Soil erosion and stream bank stability	Very low	No construction of buildings should be allowed within the 1:100 year flood line, and riparian vegetation should be conserved
Land subsidence and sinkhole formation	Very low	Due to very low risk rating, no specific management measures are required

Table 2.6 Meteorological Hazards

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Floods	Moderate	The following measures should be adopted to minimise flood hazard within the Dinokeng area: No development should be allowed within the 1:100 year flood line. Riparian vegetation should be conserved. Storm water management measures should not simply aim at efficient removal of storm water. Storm water Best Management Practices should be adopted by all participating landowners to retain storm water and encourage groundwater recharge. Storm water Best Management Practices that may be appropriate considering site-specific conditions include: Sedimentation/settlement tanks (particularly during construction activities); Filter strips, especially along Pienaarsriver and along the western boundary of the Dinokeng area; Permeable/porous paving for new developments; Porous asphalt for new street infrastructure, if any; Swales (along new road verges); Infiltration trenches; Small infiltration basins; Small detention basins; Soakaways will only be suitable at certain locations.
High winds	Moderate	Measures to mitigate risks associated with soil erosion and stream bank stability (discussed below), will be sufficient
Major inversions	Low	Due to low risk rating, no specific management measures are required
Droughts	High	Water saving measures should be incorporated, including: General water conservation: Install water-flow restricting valves to guest units to reduce water pressure which will result in water saving. Any leaks/faults in the water system should immediately be addressed. Pipes, taps, bathtubs, showers and toilets should be checked for leaks on a regular basis. Leakages in sanitary devices lead to wastage of water, and energy when there is leakage of hot water. It should be considered to install water-meters in major water consuming sections (larger guest units, kitchens, laundry units, etc.) for monitoring purposes. Water conservation in guest rooms and housekeeping: Housekeepers should be informed and regularly reminded to pay attention to check and close running taps when guests leave the room. Water saving sanitary devices (tap, toilet, showerhead), rather than the conventional types, should be installed. Float level in toilet water tanks should be retrofitted/adjusted to save

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
		water. Water saving tips/notices (with more pictures and less text) should be placed in the bathrooms and toilets of all guest rooms. Water conservation in the kitchen: Only water efficient kitchen appliances should be procured. Kitchen staff should only turn taps on when needed. Running water should never be used as a method to defrost food. Water conservation measures for gardens: Gardens design and choice of plant species should be aimed to reduce irrigation needs to a minimum. Xeromorphic plants (plants with low water requirements which are able to conserve or retain water) and/or plants indigenous to the area, should be used in landscaping. Less water consuming plants and pots should be used for decoration instead of fresh flowers. It should be considered to use recycled wastewater (especially grey water) for gardening purposes. To avoid excessive water evaporation, gardens should only be watered during early mornings or late afternoons.
Heat waves	Moderate	Heat stress and associated health risk could be managed as follows: Interventions should focus on older people, who are more vulnerable to heat stress. Landscaping should be designed to control microclimate by shading, and channelling of wind to facilitate ventilation so that heat accumulation during summer afternoons is limited. Building design and building materials should be such that excessive heat accumulation should not occur during the summer. Swimming pools are often used by tourists to escape from heat during midsummer afternoons. However, if the entire pool is exposed to full sun, people are exposed to sunburn. Swimming pools or landscaping around pools should be designed such that part of the pool receives mid afternoon shade. People should be encouraged to drink large quantities of water during heat waves.
Cold waves	Low	Cold stress and associated health risk could be managed by the adoption of green building techniques (especially sun orientation, choice of materials, and proper isolation) and landscaping techniques that allow sun rays to reach buildings in winter. Relative steep south facing slopes should be avoided
Hail	Moderate	The risk posed by hail could be mitigated by the following measures: Because the hail season generally coincides with the growing season, the full leave cover of trees could be utilised to protect windows and parking areas. Although hail does penetrate through tree canopies, the speed of hail may be sufficiently reduced by the tree canopy to cause less damage.
Lightning	High	The risk posed by lightning should be minimised by adopting the following measures: Workers (during health and safety awareness programmes) and tourists (possibly by pamphlets, notices etc) should be informed on how protect themselves from lightning. Tourists coming from areas where lightning rarely occurs, may be frightened by thunderstorms and may not know what safety precautions to take. Awareness messages should include the following as a minimum: Avoid pools and other water bodies during lightning storms; Avoid large trees and other tall objects; To seek refuge in buildings, cars, busses etc; In buildings, stay away from windows and doors or other openings; Avoid electrical appliances, land line telephones and contact with plumbing e.g. bath tubs, wash basins etc;

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
		Electrical appliances should be unplugged before and not during lightning storms; All thatch roofed buildings or structures should be fitted with lightning protectors to prevent fire

Table 2.7 Ecological Hazards

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Desertification	Low	The following risk management measures should be implemented to prevent desertification from occurring: The conservation area should not be overgrazed. Animal density should be strictly controlled. Alien invasive plants should be controlled. Wind and water erosion should be controlled. Veld condition and vegetation species composition should be monitored to allow for early detection of major shifts in grazing potential.
Alien plant infestation	Moderate	The following risk management measures should be implemented to control the introduction, establishment and spread of alien invasive species: Alien plants should be controlled according to the provisions of the Conservation of Agricultural Resources Act. Only indigenous plants should be introduced or utilised for landscaping or gardening purposes.
Pests and vermin	Low	The following risk management measures should be implemented to control the introduction, establishment and spread of pests/vermin: Waste storage bins should be inaccessible to vermin, and waste disposal sites should be covered. Vermin should be controlled at all food storage, handling and preparation facilities. Owls should be established and their habitat protected to ensure their survival. Owls are known for their ability to keep mice and rat numbers under control. The integrity of natural ecological processes should be conserved to the maximum extent possible. This will reduce the risk of pest species to experience uncontrolled population growth.
Animal disease outbreaks	Low	All relevant legislation regarding the transportation of wildlife and wildlife products, placement in quarantine when needed, and prevention of further spread of disease, should be adhered to
Negative animal-human interactions	High	The following risk minimisation measures should be implemented: All measures regarding big game management, should be adhered to. All tourism establishments and operators should be prepared to handle emergencies associated with incidents with dangerous wildlife, including large animals, aggressive animals, snakes, spiders, scorpions, and poisonous plants or animals. Tourists should be made aware regarding the seriousness and nature of threats posed by wildlife, how to avoid risk and how to react in case of negative interactions. Measures to control interaction should be implemented, e.g. rules, fencing and control of activities such as hiking, sleeping outdoors, touching and feeding of wildlife etc.

Table 2.8 Environmental Health Hazards

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Cholera and hepatitis	Low	The following measures should be implemented to prevent the spread of cholera and hepatitis: All sanitation and food preparation facilities should be regularly cleaned and kept hygienic. Personal hygiene should be promoted amongst workers, tenants, the local community (especially the communities to the west, possibly by means of Corporate Social Investment initiatives), and even tourists, especially during periods of major outbreaks. Sewage should be properly treated. The functioning of all sanitation systems should be monitored regularly, and sanitation systems should never be overloaded. Efforts should be made, possibly by means of Corporate Social Investment initiatives or assistance to the municipality, to improve the quality of sanitation provision in the high density residential areas to the west of the Dinokeng conservation area. Potable water should be well treated or sourced from safe sources. The quality of potable water should be monitored regularly, especially in the western and north-western parts of the conservation area. Milk and food should be sourced from safe sources to prevent the introduction of cholera or hepatitis viruses.
TB	Low	The following measures should be considered to prevent the spread of TB: Workers should be tested when it is suspected that they may be infected by tuberculosis, and should be treated if they are found to be infected. Workers should be encouraged to receive vaccination against TB.
HIV/Aids	Very high	The following measures should be considered to prevent the spread of HIV/Aids: Aids awareness programmes should be implemented to reach workers and adjacent communities, including sex workers active in the broader area. Tourists should be made aware regarding the prevalence of HIV/Aids.

Table 2.9 Failing Utilities and Logistics

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Failing food delivery	Very low	Due to low risk rating, no special measures aimed at risk minimisation are necessary.
Failing potable water supply	Very low	The Dinokeng area is not dependant on external water service providers, therefore tailing potable water supply at a scale larger than single properties, will not occur.
Failing electricity supply	Moderate	The following measures should be implemented to reduce risk associated with failing electricity supplies: Energy efficiency should be practiced as a matter of priority. This will not only reduce dependence of electricity, but will reduce the degree to which landowners are cumulatively contributing to the problem of demand beyond capacity. Alternative energy sources should be utilised to the maximum extent possible. Although the Dinokeng area has virtually no potential to harvest hydro-electricity and only very limited capacity to harvest wind energy, the area does have high potential to utilise solar energy. In fact, the Dinokeng area receives 17 (during mid winter) to 30 (mid summer) MJ/m^2 of solar radiation per day. All land owners should make an effort to optimally utilise solar energy by means of photovoltaic panels or at least solar thermal heating of water, and should investigate opportunities to make use of solar cookers. Building design, orientation and choice of materials should aim at

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
		reducing need for heating in winter and cooling in summer. The adoption of sustainable building techniques should be compulsory for all new buildings.
Isolation due to impassable road network	Moderate	Apart from the main gates to be developed, secondary entrance/exit points should be maintained, even if used only during emergency situations

Table 2.10 Transport Accidents

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Road accidents	Moderate	Speed limits should be communicated (at least by means of signage) and strictly enforced. All tourism establishments and operators should maintain their vehicles properly, and drivers should be properly qualified. Vehicle overload should be strictly prevented
Railway or aircraft accidents	Very low	N.A.

Table 2.11 Technological Hazards

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
Accidental explosions or explosion accidents	Moderate	Accidental explosions may result where gas, petrol or explosives occurs while explosion accidents may result where blasting is conducted
Dam wall failure	Very low	Risk minimisation measures discussed under flood risk, will be sufficient to address flooding associated with upstream dam wall failure

Table 2.12 Other Hazards

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
War	Very low	Management measures will fall outside the jurisdiction of landowners. Strict cooperation with the relevant authorities will be necessary
Tourism demand fluctuations	High	The following measures should be adopted to manage tourist demand fluctuations: Workers should be provided with portable skills training. Tourism managers should engage in continuing professional development to enhance the competitiveness of tourism establishments within the Dinokeng area
Drowning	Moderate	The following measures should be adopted to minimise drowning risk: All management measures to address flood risk, as described elsewhere in this document, should be adopted. All stream crossings that are not save for a small car, bicycle or pedestrian to cross without the risk of being swept into the stream, should be closed down during and after floods or significant rain events. All swimming pools or deep fishponds or water features should be fenced or otherwise enclosed to prevent children from entering on their own. Fences and gate opening latches should be of sufficient height to keep small children out. All children should be accompanied by their parents or another responsible adult when access is gained to any pool or water feature that poses a drowning risk. All tourism establishments should provide first aid training to at least some of their employees, which should include training on first aid during drowning incidents. Pool location and landscape design should find a compromise between privacy on the one hand and intervisibility (to aid in supervision or spotting of those in danger) on the other.

HAZARD TYPE	RISK RATING	RISK MANAGEMENT
		Tourists should be discouraged from swimming or being near a pool or water feature after using alcohol. If unavoidable, efforts aimed at supervision should be made
Fire	Moderate	The following measures should be adopted to manage fire risk within the Dinokeng area: Fire breaks should be maintained in accordance with the National Veld and Forest Fire Act (Act 101 of 1998). Electrical installations should be made by qualified electricians. Electricity sockets should never be overloaded. Electrical systems and appliances should regularly be inspected for short circuiting. Faulty wires or appliances should not be used until it has been repaired by a competent person. Fire fighting equipment and skills to handle it correctly, should be readily accessible. Water hydrants should be established where fire hazard may be prominent. Fire emergency response teams should be able to gain access to all areas of the Dinokeng area, including all properties and especially access roads, should the need arise.
Collapse of buildings and other structures	Low	Appropriate building standards should be adhered to. This should not exclude the use of sustainable construction methods such as adobe, rammed earth or even hay bale construction. If properly constructed, these structures will be just as stable compared to conventional brick structures. Structures should occasionally be inspected for signs of instability.

2.2.2.2 COMMUNITY-BASED NATURAL RESOURCE MANAGEMENT

2.2.2.2.1 SOCIO-ECONOMIC ASPECTS

A. EXTERNAL COMMUNITIES

A.1) DESIRED STATE

The DGR will establish and maintain positive and mutually enforcing relationships with surrounding communities and land owners. This relationship will strive to extend the positive socio-economic and other benefits from the DGR to these external communities, and limit potential negative externalities upon the DGR. This positive relationship will be established and maintained through regular interaction and communication between the DGR Management Association (DGRMA) and representatives of the adjoining communities and land owners.

A.2) OBJECTIVES

The specific objectives that will be pursued to achieve the desired state include the following:

(i) Establish a wide spread community awareness programme of the DGR through appropriate forms of interaction and communication.

(ii) Utilise schools and other community facilities as an important medium for transfer of information and capacitation of adjacent communities.

(iii) Methods for communication and information sharing with the adjacent communities will be sensitive to the literacy levels and language medium in these settlements.

(iv) Potential employment creation, skills development, income earning, and entrepreneurship development opportunities resulting from the implementation of the DGR will be identified for potential beneficiaries from adjacent communities.

(v) Positively influence the behaviour and attitude of adjacent communities and land owners towards the DGR through ongoing communication and consultation.

(vi) Limit potential negative externalities that may arise from behaviour of external communities such as littering, poaching, unlawful use of natural resources, and negative impacts on the DGR fence.
(vii) Encourage surrounding land owners to engage in land use activities and environmental management practices that will ensure positive interaction with the DGR.

A.3) POLICY AND OPERATIONAL GUIDELINES

A.3.1) Neighbouring Settlements along Western Boundary

The operation of the DGR will be influenced by the behaviour of residents of settlements to the west of the conservation area. Community incentives and programmes by means of community participation, community awareness raising, and cooperation with the municipality and other government institutions, should be encouraged as follows:

(i) Encourage the community to keep stands and streets neat, and free from litter and waste.
(ii) Discourage illegal waste dumping, especially along the border of the protected area and enforce appropriate by-laws.
(iii) Encourage the community to adopt cleaner alternatives to coal and wood burning for heating and cooking, e.g. solar cookers for cooking, and installation of insulation to reduce the need for heating.
(iv) Residential areas within the primary zone of influence should act as a buffer between the protected area and the core residential areas further to the west. The community should be encouraged to plant indigenous species to enable the creation of habitat to some of the more mobile species. However, care should be taken to prevent the residential areas from acting as sink habitat.
(v) The community should be discouraged from poaching. Measures to prevent poaching by snaring and hunting with dogs should be adopted.
(vi) The community should be encouraged to collect resources such as medicinal plants and honey only as part of approved programmes in the DGR.
(vii) The community should be discouraged from damaging the fence, and be made aware of the implications of damage to the fence.
(viii) Encourage the local community to respect tourists and visitors and be friendly towards them.

The following policy guidelines for participating landowners towards the community should be adapted:

(i) Opportunities for members of the community within the primary sphere of influence to participate in the sustainable harvesting of resources within the protected area should be investigated and implemented. Examples may include harvesting of honey and medicinal plants. Some useful indigenous species may even be introduced for low intensity sustainable harvesting purposes.
(ii) Candidates for employment opportunities living within the primary zone of influence should enjoy preference over potential candidates from other areas.
(iii) Lack of specialist eco-tourism skills in the local community should not encourage employers to recruit workers from outside. Rather, training and skills development should be provided to local candidates.
(iv) To maximise employment benefit to the local community, participating land owners and tourism businesses operating within the DGR should focus on service excellence as a marketing strategy, supporting a high tourism worker to tourist ratio, rather than self-catering accommodation.
(v) Promote the products/services of local entrepreneurs amongst visitors of the protected area.
(vi) Local ownership or shareholding of tourism businesses operating within the protected area, should be encouraged.
(vii) Conduct township tours into the residential areas to the west of the protected area. The community should be presented in a respectful manner, and visitors should be made aware

of the challenges faced by the local people. Tourists should be presented with spending opportunities within these communities.

(viii) Where possible, products/services should be procured from suppliers from the surrounding community. As part of BEE commitments, strengthen potential suppliers from the local community to meet often stringent quality criteria required by upmarket tourist establishments.

(ix) Devise mechanisms to protect the local community from the seasonal nature of the tourism industry to ensure that the community may benefit throughout the year from tourism.

(x) Initiate environmental education programmes targeting local schools and the broader community to inform them on the importance of conservation and the benefits of tourism.

(xi) Enable a significant number of residents from the local community to enjoy some of the intrinsic benefits offered by the DGR, e.g. sponsor occasional tours into the DGR.

A.3.2) Recommendations regarding surrounding farms

The main concerns regarding surrounding farms along the northern, eastern and southern boundary, are fire risk, encroachment of alien plants and animals, visual pollution, noise pollution, erosion, spread of disease, creation of sink habitat and unsustainable abstraction from and pollution of the local aquifer. The following policy guidelines should be applied:

(i) Encourage surrounding farmers to maintain fire breaks.

(ii) Encourage surrounding farmers to control the spread of alien invasive plants and domestic animals such as cats and dogs.

(iii) Surrounding farmers should adhere to recommendations by the authorities (Department of Agriculture) regarding animal disease control during disease outbreaks.

(iv) Encourage surrounding farmers to maintain a buffer zone of at least 100 meter from the DGR where no animal concentration areas such as kraals, feedlots, piggeries, broilers, slaughtering activities, or disposal of carcasses or slaughtering waste or manure, is allowed.

(v) Encourage surrounding farmers to conserve natural vegetation that provides a visual screening function along their borders and vegetation that may screen visual disturbances such as buildings, roads, excavations and other structures and disturbed areas on their properties.

(vi) Encourage surrounding farmers not to contribute to light pollution (over-illumination and light trespass).

(vii) Surrounding property owners may not in any way tamper with the DGR fence.

(viii) Surrounding property owners and their tenants or guests may not disturb or cause any harm to wildlife of the DGR, e.g. poisoning of, or shooting at wildlife across the fence.

(ix) Surrounding property owners and their tenants may not dispose of any effluent or waste into the DGR and should prevent litter or pollutants from being transported by wind, storm water or groundwater from their properties into the conservation area.

(x) Storm water outfalls should be designed not to cause erosion along the border of the DGR.

(xi) Surrounding property owners should take measures to prevent wind and soil erosion on their properties.

(xii) Surrounding property owners and their tenants may not cause excessive noise pollution.

B. INTERNAL COMMUNITIES

B.1) DESIRED STATE

The DGR will establish and maintain positive and supporting relationships with internal land owners and their labourers. The participating land owners will maximise its contribution towards the development of eco-tourism facilities and activities in the DGR, and the non-participating land owners will strive to minimise potential negative impacts on the functioning of the DGR. Labourers of land owners will be capacitated on their responsibilities and potential risks associated with residing in the DGR. Appropriate forms of transportation between places of residence and employment will be provided to all labourers.

B.2) OBJECTIVES

This desired state will be pursued through the following objectives:

(i) Ensure the optimal participation and contribution of participating land owners to eco-tourism activities and facilities in the DGR.
(ii) Establish and maintain positive relationships with non-participating land owners and develop an agreed set of operational guidelines for non-participating land owners in the DGR.
(iii) Ensure participation and communication with labourers who is residing within the DGR regarding responsibilities and risks associated with residing in the DGR.
(iv) Encourage non-participating land owners to engage in land use activities compatible to the ongoing operation and contributing to sustainability of the DGR.
(v) Provide training, skills development, and entrepreneurship development opportunities for labourers residing within the DGR.
(vi) Provide measures and guidelines to limit the potential visual impact that could be associated with residential and non-residential structures.
(vii) Provide guidelines to land owners and labourers regarding the provision of appropriate types of basic services such as storm water, sanitation and other forms of infrastructure.
(viii) Ensure that all internal communities and land owners are aware of and participate in the fire management plan for the DGR.

B.3) POLICY AND OPERATIONAL GUIDELINES

B.3.1) Island properties (non-participating landowners and their tenants)

(i) Encourage non-participating land owners to control the spread of alien invasive plants and domestic animals such as cats and dogs.
(ii) Non-participating land owners should adhere to recommendations by the authorities (Department of Agriculture) regarding animal disease control during disease outbreaks.
(iii) Encourage non-participating land owners to conserve natural vegetation that provides a visual screening function along their borders and vegetation that may screen visual disturbances such as buildings, roads, excavations and other structures and disturbed areas on their properties.
(iv) Encourage non-participating land owners not to contribute to light pollution (over-illumination and light trespass).
(v) Non-participating land owners may not in any way tamper with the DGR fence.
(vi) Non-participating land owners and their tenants or guests may not disturb or cause any harm to wildlife of the DGR, e.g. poisoning of, or shooting at wildlife across the fence.
(vii) Non-participating land owners and their tenants may not dispose of any effluent or waste into the DGR and should prevent litter or pollutants from being transported by wind, storm water or groundwater from their properties into the conservation area.
(viii) Non-participating land owners should take measures to prevent wind and soil erosion on their properties.
(ix) Non-participating land owners and their tenants may not cause excessive noise pollution.

B.3.2) Participating land-owners, tenants and workers

The following policy guidelines should be applicable to participating landowners and tourism establishments within the DGR:

(i) Over-dependency on tourism as a source of employment and income should be prevented. Workers should be provided with portable skills training to enable them to find alternative employment in case the local tourism industry experience a significant downturn.
(ii) Sufficient training, ranging from Adult Basic Education and Training to more general training and specialised training in specific skills areas should be provided to labourers. All workers should be encouraged to receive training.

(iii) Basic conditions of employment as prescribed by the Basic Conditions of Employment Act, should be adhered to.

(iv) Measures should be developed to retain workers during seasons of the year characterised by low tourism demand.

(v) All participating land owners, tenants and workers should refrain from the following activities:

- Hunting or trapping of wildlife, except where agreed with fellow participating landowners and authorities, e.g. for sustainable utilisation or wildlife population control to remain within carrying capacity limits of the land;
- General disturbance to wildlife;
- Unsustainable utilisation of medicinal plants;
- Noise pollution;
- Uncontrolled fires in non-designated areas;
- Littering;
- Illegal waste dumping;
- Causing any damage to the fence or other common assets such as roads, signage etc.
- No disturbance or development should be allowed within the riparian corridor or wetland boundary. In addition, a further 32meter buffer zone beyond the wetland boundary should also be excluded from any development or disturbance, especially from vehicles. Road crossings across riparian corridors should be carefully designed to minimise disturbance.

(vi) Visual pollution should be strictly controlled. The following guidelines should apply:

- Develop a policy on building appearance and outdoor signage, including architectural design, choice of colours and materials, etc.
- Over illumination should be prevented. Lighting should be limited to the maximum extent possible, and no unnecessary lighting should be allowed. Where possible, lighting should be switched off during periods of low or no usage, e.g. late evenings and early morning hours, as well as during periods of low/no occupancy.
- Light trespass should be avoided. The direction of lighting should be limited to the area where absolutely needed and not allowed to spread onto the surrounding veld or neighbouring properties.
- Lights should be pointed downwards to limit contribution to sky glow (which will be significant in the Dinokeng area due to high levels of suspended particles in the area).
- Screening vegetation (indigenous trees and shrubs) should be planted and maintained by all land owners to reduce the visual impact of buildings, roads and other infrastructure, disturbed areas, excavations and other features that may reduce the visual appearance of the landscape, on their properties.

(vii) Land owners should ensure that sanitation systems on their properties are appropriate for the site specific geotechnical conditions, and are well maintained.

(viii) Waste material should be properly disposed of according to legal requirements and as specified in the waste management guidelines specified in this document.

(ix) Every effort should be made by land owners to control/limit soil and wind erosion.

(x) Storm water outfalls should be designed not to cause erosion.

(xi) No surface storm water generated as a result of the development of the area should be directed directly into the riparian or wetland system.

(xii) All new fuel storage, if any, should be aboveground and properly bunded. In case of existing underground tanks, groundwater quality monitoring should be regularly conducted to detect possible leakages. In case of spills or leakages, the relevant authorities should be contacted. A spill response strategy should be in place, including the on-site availability of a spill response kit. All relevant legislation and SANS standards regarding the construction, operation, maintenance and decommissioning of tanks should be adhered to.

(xiii) Fire breaks should be maintained.

(xiv) The spread of alien invasive plants and domestic animals should be controlled.

(xv) Participating landowners should adhere to recommendations by the authorities regarding animal disease control during disease outbreaks.
(xvi) Use of insecticides should be minimised and eliminated where possible, and alternatives (e.g. mosquito nets and window netting) should rather be utilised.
(xvii) Strict water conservation measures should be adopted.
(xviii) Xeriscape gardening, i.e. the use of xeromorphic or climate appropriate plants (all indigenous) that are adapted to the local climate, should be practiced. Apart from habitat provision, these plants require less water, and are more likely to survive drought conditions. Use of high-maintenance lawns and annual plants should be minimised.
(xix) Should any artefacts or other forms of heritage resources be discovered during the operational phase, SAHRA should immediately be notified, and a professional archaeologist should be called in to investigate.
(xx) All applicable Occupational Health and Safety Law of the Republic of South Africa and municipal by-laws related to Environmental Health and Safety should be adhered to.

C. TRANSPORTATION

C.1) DESIRED STATE

The road network and transport system will consist of a logical hierarchy of roads making provision for both thoroughfare and tourism traffic in and through the DGR. A functional public transport system which makes provision for the transportation of employees and labourers within the DGR will be established. The tourism road network will be informed by the location of existing and potential future tourism attractions in the area. The specific objectives for the road and transport network include:

(i) The impact of road maintenance and upgrading activities should be managed to limit potential negative impacts on the natural environment;
(ii) No new borrow pits will be established within the DGR, and the potential use of the existing borrow pits for maintenance purposes will be followed by appropriate rehabilitation procedures;
(iii) No hazardous substances will be transported along public roads within the DGR, and the possibility of introducing weight restrictions on traffic in the DGR will be investigated;
(iv) An efficient and functioning public transport system and facilities for the transportation of the employees, labourers and pupils within the DGR will be maintained;
(v) Road safety and speeding control measures will be strictly enforced on all roads within the DGR; and
(vi) Access to and from the DGR will be regulated.

C.2) POLICY AND OPERATIONAL GUIDELINES

The transportation recommendations are contained in Table 2.13.

Table 2.13 Transportation recommendations

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
1. Potential impact of road maintenance, upgrading and construction activities on the natural environment.	1.1 Construction site impacts	a) If possible, no contractor site camps should be established within the DGR for future road upgrading and maintenance projects.		
		b) When the establishment of a site camp within the DGR is unavoidable, the contractor must provide a detailed layout plan of construction site camps to the engineer. This plan must include site office facilities, such as chemical toilets, areas for stockpiling of materials, storage of hazardous materials and provision of containers.	Contractor (C)/ Environmental Control Officers (ECO)	Prior to commencement of any road construction
		c) The site offices will require rehabilitation at the end of the contract. All construction materials are to be removed from the site on completion of the contract.	C/ECO	At completion of construction
		d) Adequate toilet facilities must be provided. The contractor shall be entirely responsible for enforcing their mandatory use and for maintaining such facilities in a clean, orderly and sanitary condition to the satisfaction of the engineer.	C/ECO	Monthly ECO report
		f) The contractor should ensure that the access roads are maintained in good condition by attending to potholes, storm water damage and other aspects as soon as these develop.	C/ Site Engineer (E) /ECO	Weekly and after heavy rains; Monthly ECO report
		g) Construction vehicle drivers should be licensed, well trained and always alert.	C/E	Ongoing monitoring during construction
	1.2 Impact of maintenance and storage areas on natural environment	a) Storage areas must be designated, demarcated and fenced.	C/ECO	Monthly reports from ECO during construction
		b) Location of storage areas must take into account prevailing winds, distance to water bodies, boreholes	C/ECO	Monthly reports from ECO during construction

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
		and on-site topography.		
		c) Storage areas should be secure and be safe from access by animals.	C/ECO	Monthly reports from ECO during construction
		d) Fire prevention facilities must be present at all storage facilities.	C/ECO	Monthly reports from ECO during construction
		e) Contractors/Developer must ensure that storage facilities are cleaned and maintained regularly and that leaking containers are disposed of without spillage onto the soil.	C/ECO	Monthly reports from ECO during construction
	1.3 Insufficient sanitation facilities at construction sites	a) A sufficient number of chemical toilets should be provided to construction workers.	C/ECO	During site setup; Monthly ECO reports during construction
		b) Construction worker's toilet facilities should be cleaned at least once a day.	C/ECO	Daily during construction; Monthly ECO reports
		c) Construction worker's toilet facilities should be regularly inspected to ensure proper cleaning took place, and to detect maintenance problems	C/ECO	Daily during construction; Monthly ECO reports
	1.4 Soil erosion and impacts on topsoil resulting from road construction or maintenance activities	a) The stripping of vegetation during preliminary activities on site greatly increases the risk of erosion and permanent loss of topsoil. The removal of vegetation must be limited to demarcated areas under strict supervision of the ECO.	C/ECO	Start of construction and ongoing monitoring during construction
		b) Building material such as rock and sand should not be collected from the site and should be imported from areas that have already been altered for the supply of such material.	C/E/ECO	Monthly ECO report during construction

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
		c) Topsoil and subsoil should not be mixed during excavations.	C/E/ECO	Start of construction; Monthly ECO report
		d) Application of topsoil and re-vegetation must commence immediately after the completion of construction activities. Re-vegetation should only commence in the rainy season.	C/E/ECO	On completion of construction; Quarterly ECO reports for one year after completion of construction
		e) Soil stockpiles must be kept free of any contaminants, including paints, building rubble, cement, chemicals, oil, etc.	C/ECO	Monthly ECO report during construction
		f) Prevent any concentrated water flow over exposed soil into drainage lines using berms, silt traps, detention ponds and temporary measures to spread flow over the soil surface into vegetation.	C/E/ECO	Monthly ECO report
	1.5 Soil contamination resulting from road construction activities	a) Potential soil contaminants, e.g., fuel, oil and cement, must be managed carefully with adequate containment measures.	C/E/ECO	Ongoing monitoring during construction; Monthly ECO report
		b) If it is suspected that top- and/or sub-soils have become contaminated due to site operations, top-/subsoil tests must be conducted.	C/ECO	After spillage
		c) If tests are positive the contractor must remove the polluted soil to the full depth of pollution from the site and provide an equal replacement of approved topsoil in terms of quality and quantity.	C/ECO	After spillage
		d) Contaminated soil must be transported to a DWAF-approved facility. Waybills for all such disposals are to be kept by contractors/developer for review by the engineer and the ECO.	C/E/ECO	After spillage

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
2. Impact of the potential use of existing or new borrow pits along public roads in the DGR for road maintenance or construction purposes	2.1 Impacts of borrow pits on surrounding areas	a) The areas at the identified borrow pits must be clearly marked and fenced.	C/ECO	During construction; Monthly ECO report during construction
		b) Clear warning signage must be erected at the borrow pits.	C/ECO	During construction; Monthly ECO report during construction
		c) Speed limits of construction vehicle must be strictly enforced at the identified borrow pits.	C/ECO	During construction; Monthly ECO report during construction
		d) Dust suppression programme at the borrow pits must be implemented	C/ECO	During construction; Monthly ECO report during construction
		e) Borrow pits should be rehabilitated according to each borrow pit's Environmental Management Plan, as approved by the Department of Minerals and Energy.	C/ECO	At completion of construction
3. The transportation of hazardous substances along public roads within the DGR	3.1 Potential spillage of hazardous substance or materials during transportation or at storage areas	a) Hazardous storage and refuelling areas must be underlain with an impermeable liner to protect groundwater quality.	C/E/ECO	Monthly ECO report
		b) If applicable, fuel tanks must meet relevant specifications and must be elevated so that leaks may be detected easily. Storage areas containing hazardous substances and materials must be clearly signed.	C/E/ECO	Monthly ECO report
		c) The transport and handling of potential hazardous materials must be in accordance with DWAF's requirements and specifications.	C/E/ECO	When required

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
		d) No vehicles transporting, placing or compacting asphalt or any other bituminous product may be washed on site.	C/ECO	When required
		e) No vehicles transporting concrete to construction sites may be washed on site.	C/ECO	When required
		f) Hazardous substances and materials are to be transported in sealed containers or bags.	C/ECO	When required
4. The need for an efficient public transport system and facilities for transportation of employees and labourers within DGR.	4.1 Possible dangers to labourers and employees if efficient and well planned public transport facilities to and from places of work are not available in the DGR.	a) The DGRMA should liaise with relevant public transport operators (e.g. bus companies, taxi operators) to identify important pick-up points, transport routes and drop off points at main tourism facilities and sources of employment.	DGRMA	
		b) All labourers and employees must be fully informed of the responsibilities of using public transport once the Big Five Game fence have been completed and the game introduced in the area.	DGRMA	
5. Potential sources of pollution originating from road construction activities or traffic along public roads in DGR.	5.1 Insufficient waste management at construction sites and littering along roads	a) The excavation and use of rubbish pits on site or the burning of waste at construction sites are forbidden.	C/ECO	Monthly ECO report during construction
		b) Littering at construction sites and surrounding areas is forbidden and the site must be cleared of litter at the end of each working day.	C/ECO	Ongoing monitoring; Monthly ECO report during construction
		c) Skips and bins must be emptied regularly, removed from the construction sites and transported to a DWAF-registered recycling and waste facility.	C/E/ECO	Ongoing monitoring; Monthly ECO report during construction
		d) Excess concrete, building rubble or other material must be disposed of in areas designated specifically for this purpose or at a registered facility.	C/E/ECO	Monthly ECO report during construction

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
		e) Notice boards along roads creating increased awareness to keep the environment clean and penalties for littering from vehicles, and illegal dumping along the roads.	Roads Authorities	During DGR implementation
6. Management of storm water originating from road network in DGR	6.1 Ineffective maintenance of road and storm water infrastructure and impact of storm water run-off	a) Storm water infrastructure should be designed to reduce flow velocity and avoid stream bank and soil erosion.	C/E/ECO	When necessary during construction
		b) Disturbed surfaces must be re-vegetated immediately after completion of construction activities in each area.	C/ECO	After completion of construction activities
		c) Regular inspection and maintenance of road storm water management measures, as well as erosion control measures on road surface and along road verges, is important. Apart from regular routine inspections, inspections should also be conducted after every significant storm events.	Roads Authorities	Quarterly inspections
7. Access control to DGR and road safety on public roads within DGR.	7.1 Road safety and personal security risks resulting from through traffic	a) Strict traffic speed control measures should be introduced in the DGR, including the use of ticket dispensers and readers, and the erection of traffic speed limit signs	Roads Authorities	
		b) Random speed trapping could be undertaken on public roads within the DGR	Roads Authorities	
		c) Random checks of baggage of vehicles should be conducted at the entrance and exit gates to avoid poaching of game along public roads	DGRMA	
		d) Other traffic calming measures along public roads should be investigated and implemented in consultation with the relevant roads authority	Roads Authorities	

Issues	Potential Impacts	Management/ Recommendations	Responsibility	Frequency/ Timeframe
8. Potential ecological impacts of road construction / maintenance activities and through traffic in the DGR.	8.1 Potential impacts on ecological characteristics	a) Disturbance of indigenous fauna and flora, and the natural ecology along road reserves must be avoided and must only be cleared to provide essential access for construction purposes.	C/ECO	Bi-annual reports by roads authority
		b) Gathering of firewood, fruit, medicinal plants, crops or any other natural material or the poaching of small animals adjacent to roads are strictly forbidden.	C/ECO	Random checks along roads
		c) Snakes and other reptiles that may be encountered along roads must not be killed unless the animal endangers the life of a commuter.	C/ECO	When necessary
		d) Avoid the introduction of exotic plant species along road verges and surrounding areas through the use of imported material.	C/ECO	Ongoing monitoring
		e) Plant invader species favour disturbed soil (i.e. areas with low competition) and pose the biggest threat to indigenous vegetation in and adjacent to road reserves. These species must be eradicated before they can spread.	C/ECO	Ongoing monitoring by DGRMA

D. WASTE MANAGEMENT

D.1) DESIRED STATE

The DGR will adopt best practice waste management guidelines which is suitable to the low density and rural character of the area. Waste prevention and minimisation measures will be prioritised as far as possible, and re-use and recycling of waste material will be considered before the last option of disposal is implemented. All land owners within the DGR will support the waste management guidelines for the DGR and contribute towards its practical implementation. The implementation of waste management practices within the DGR will ensure a positive perception and visitor experience for tourists to the area.

D.2) OBJECTIVES

This desired state will be pursued through the following objectives:

(i) Provide practical guidelines for waste management on residential properties within the DGR.
(ii) Provide clear guidelines for management of commercial and tourism related waste within the DGR.
(iii) Limit the visual impact and other negative perceptions associated with waste disposal and uncontrolled littering.
(iv) Provide sufficient and appropriate forms of containers along visitor routes and at eco-tourism facilities.
(v) Maximise the impact of waste minimisation, re-use and recycling.
(vi) Introduce penalties for illegal littering and waste disposal in the DGR.
(vii) Maximise the economic and entrepreneurial opportunities that may arise from waste management activities.

D.3) POLICY AND OPERATIONAL GUIDELINES

D.3.1) General Principles

The following general waste management principles should be adhered to:

(i) Any worker that will handle waste will be equipped with the necessary personal protective equipment.
(ii) Litter should be regularly collected. Litterbins should be provided at strategic locations along tourist routes. Litterbins should be regularly emptied, from where it will enter the waste stream for litter as described in Table 2.14.
(iii) Illegal dumping by the public, tourists, and residents should not be tolerated, and should be cleaned up within a week.
(iv) All provisions in the relevant municipal Solid Waste By-laws and the Gauteng Waste Information Regulations (2004) should be adhered to.
(v) Waste may only be transported by a person licensed to do so.
(vi) Custody of waste may not be transferred to a transporter or a receiver who is not licensed to do so.

D.3.2) General Management Recommendations for various waste types

Table 2.14 provides general guidelines for waste management applicable to participating landowners, including residents, tourists, tourism establishments, farmers and operators of businesses within the DGR. As far as practical and viable, waste prevention and minimisation measures should be adopted, followed by re-use or re-cycling, before the option of disposal is considered.

D.3.3) Management Recommendations according to source of waste

The management recommendations in relations to the sources of waste are provided in Table 2.15.

Table 2.14 General Management of Specific Waste Types

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Garden waste	Xeriscape gardening, i.e. the use of xeromorphic or climate appropriate plants (preferably indigenous) that are adapted to the local climate, should be practiced. Apart from water saving and draught resistance, it also produce less biomass therefore less garden waste. Use of high-maintenance lawns and annual plants should be minimised.	Vermin control and control of alien invasive plant species should be practiced at places where garden waste is stored.	Plant residue should preferably be composted onsite.	All plant residue should be composted.	Non-compostable garden waste should be landfilled at a disposal site registered for general landfill. Small quantities of garden waste may be deposited at private non-commercial farm waste disposal sites on the individual farms.
Litter and general "household" or personal waste. Hazardous domestic waste such as batteries, paints, solvents, engine oils, old refrigerators, asbestos sheeting/lagging, fluorescent tubes, etc. should be separated and handled as described further below.	-	Storage in bins for no longer than a week.	-	Collected by waste contractor, where it may be subjected to general waste recycling activities.	Collected by waste contractor, and disposed of at a waste disposal site registered for general landfill. Small quantities of general household waste may be deposited at private non-commercial farm waste disposal sites on the individual farms.
Organic kitchen waste	-	Storage in bins for no longer than a week.	Use in animal feed, otherwise composted, thereafter used as compost in gardens or cultivated land, either on-site or sold to the public.	Use as animal feed, otherwise composted and applied to soil.	If not composted, it will be collected by municipality or waste contractor, and disposed of at a waste disposal site registered for general landfill. Small quantities of organic kitchen waste may be deposited at private non-commercial waste disposal sites on the individual farms.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Edible / Vegetable Oil.	The following measures will reduce health and environmental toxicity of cooking oil: a) Only good quality oil should be used. b) Frying container should always be cleaned before use, and should be comprised of stainless steel. c) Raw chips should be soaked in water before frying (to remove excess starch and sugars). d) Raw chips should be well drained before frying to prevent foaming, which makes the oil combine with oxygen in the air, and may cause unhealthy compounds to form. Oil should be filtered afterwards to remove food particles and sediment. e) The oil should be stored in a sealed container in a cool dark place, as oxygen and light speeds the process of oil degradation. f) Oil temperature should be monitored to not exceed 190˚C. g) Oil should be discarded when it becomes too dark, stringy and has a bitter, harsh taste and unpleasant odour. h) New oil should not be added to old deteriorated oil. i) Oil should be drained and filtered daily, and the equipment should be cleaned. j) Burnt residues in oil should be removed before frying. *(University of Orange Free State, as reported by Brice et al, 2006)*	Collect used oil in separate container for recycling or safe disposal.	Re-use should never commence beyond the point where the oil can be classified as "abused oil" or "over-used oil".	Recycle – for the material value; recycle into a usable product for other applications, but not for human consumption. It may also be Incinerated – to utilise its energy value.	Collected by a waste contractor and landfilled in sealed containers at a suitably registered landfill site (only if recycling or incineration is not possible).

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Waste tyres	-	-	With permission from relevant authorities, may be used for erosion control purposes or other innovative uses.	With permission from relevant authorities, may be used for erosion control purposes or other innovative uses.	Collected and disposed of at a suitable registered waste disposal site.
Construction waste: demolition waste or building rubble from old, demolished structures or current building rubble on the site	-	May not be stored for longer than 3 months on-site. After removal, alien and invasive plant species that may have been established should be removed, and if the footprint will not be covered by infrastructure, it should be rehabilitated (ripping of soil and addition of organic matter).	On site re-use is desirable, e.g. for construction, drainage control, land reclamation, erosion control, to construct temporary access roads, fill for road embankments, etc. Before re-use, potentially hazardous components should be removed, e.g. asbestos, surfaces covered with lead-containing paint, and radio-active smoke detectors.	May be used for construction, drainage control, land reclamation, erosion control, to construct temporary access roads, fill for road embankments, etc. Before re-use, potentially hazardous components should be removed, e.g. asbestos, surfaces covered with lead-containing paint, and radio-active smoke detectors.	Valuable landfill space should not be wasted with building rubble. Potentially hazardous waste should be separated from inert building rubble, and only the remaining hazardous material should be landfilled if not re-cycled. However, building waste may be used at landfill sites as a daily or final cover, or liner.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Construction waste: broken, wasted or excessive cement, aggregate, sand, soil, and ceramics, e.g. brick, tiles, rooftiles, porcelain	Principles of sustainable or green building should be adopted in design and construction of all new buildings or renovation of existing buildings where possible.	Cement powder may not be exposed.	-	Inert waste cement, sand, aggregate and ceramics can be sold as fill material to local building civil engineering contractors. Materials discarded because of aesthetics, e.g. scratched tiles or broken but still usable bricks, should be sold or donated to the poor, or builders or building material dealers in poor areas, who undertakes to use it within 3 months. The same applies to materials left over in small quantities e.g. 5 tiles or half bag cement or leftover pieces of timber or pipe.	If not re-usable or needed as a fill material in construction, it may be used as a cover or liner medium at waste disposal sites.
Waste wood (e.g. pallets, crates, timber, boards, shelves, furniture, frames, doors)	Create awareness amongst suppliers that overpackaging should be eliminated. Purchase of tropical hardwood from non-sustainable sources should be avoided. All wood for construction or wooden furniture should originally been sourced from certified sustainable forests e.g. certified by Forest Stewardship Council.	Storage in skips. Steps should be taken to reduce fire risk.	Wooden crates and pallets should be re-used when possible.	In case of local manufacturers, wooden crates and pallets should be sent back for re-use if possible. All non re-usable wood-waste will be chipped and used in chipboard or medium density fibreboard manufacturing, or other applications e.g. manufacturing of mulch, composting agents, and animal bedding.	Waste wood that cannot be re-used or recycled, should be incinerated for energy recovery, but landfill should be the last resort. Small quantities of waste wood may be deposited at private non-commercial waste disposal sites on the individual farms, provided that the waste is not contaminated or painted with lead containing paint.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Paper, carton, glass, metal, textiles and plastic	Create awareness amongst suppliers that overpackaging should be eliminated. Documentation should increasingly be handled in electronic format only. Unnecessary printing should be avoided.	Provide separate bins for paper/carton, glass, plastic, and other materials. This will also raise awareness regarding the importance of separation and recycling.	Carton boxes and plastic crates should be re-used on-site.	All paper, glass, metal and plastic not needed or suitable for re-use will be recycled. Plastic crates should be sent back for re-use in case of local manufacturers if possible.	Paper, carton, textiles and plastic may be incinerated to recover its energy value. All paper, glass, metal, textiles and plastic not suitable for re-use, recycling or incineration should be landfilled at a waste disposal site registered for general landfill. Small quantities of paper, glass, plastic and textile waste may be deposited at private non-commercial farm waste disposal sites on the individual farms.
Used oil and other petroleum products	-	Stored in drums or containers that will prevent leakage or exposure during handling and storage. The storage area should be bunded, provided with a sump, roofed, and well ventilated.		Sold to waste contractor for re-refining or reclamation. Oil that cannot be reclaimed or re-refined, will be used as a fuel in cement/limekilns or similar processes to recover its energy value (the oil will, thus, replace virgin non-renewable fuel oil)	Only oil that is too contaminated for re-refining, reclamation, or to be used as fuel oil, should be landfilled at a registered hazardous waste disposal site.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Hydrocarbon Contaminated Waste (soil, rags, gloves, wood, sawdust, paper, plastic and cardboard packaging that are contaminated with oil)	Methods to prevent oil spills and leaks will be followed, including: • Maintaining machinery; • Placing machinery and oil drums on drip trays; • Storing oil in bunded storage facilities; • Ensuring container and drums are kept closed; • Maintaining a stocked emergency spill kit.	Stored in drums or containers that will prevent leakage or exposure during handling and storage. The storage area should be bunded, provided with a sump, roofed, and well ventilated.	-	Collected by waste contractor to be bioremediated with permission from DWAF and DEAT.	Should be disposed of at a site that is registered to accept hazardous waste.
Polychlorinated Biphenyls (PCBs) and PCB contaminated waste (used in e.g. hydraulic fluid, casting wax, pigments, carbonless copy paper, plasticizer, vacuum pumps, compressors, heat transfer systems and especially as a dielectric fluid in electrical equipment)	-	Should be stored in a storage area that is bunded, provided with a sump, roofed, and well ventilated.	-	-	Collected by a waste contractor and disposed of at a registered H:H landfill site. With permission from DEAT, other options may be considered e.g. incineration (high temperature, controlled incineration, which might actually be the best option) or encapsulation.
Solvents (paints, varnishes, and lacquers, used in industrial cleaners, metal and electronic cleaners, adhesives, and printing inks)	Just-in-time stock management policy will reduce chances of solvents or paint being stored or kept in inventory beyond their lifetime without being sold (in case of stock) or used (in case of own use).	Stored in drums or containers that will prevent leakage or exposure during handling and storage. The storage area will be bunded, provided with a sump, roofed, and well ventilated.	Solvents may be re-used on site.	Solvents that can be re-used or recycled including certain hydrocarbons, certain chlorinated and other Halogenated Hydrocarbons, certain ketones, methylated spirits, tetrahydrofuran, iso-propyl alcohol, paint thinners, and solvent degreasers	Collected by a waste contractor to be landfilled at a registered H:H Landfill site. Certain solvents may also be thermally destructed at very high temperatures by registered thermal treatment companies. Bioremediation may also be considered after consultation with relevant authorities.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Used and contaminated chemical containers	If possible, use bulk re-usable containers (especially if supplier is not able to take back empty containers for re-use).	All vehicles, re-usable containers and covers that have been in contact with HCS (hazard chemical substances) waste should be cleaned and decontaminated after use. Where chemicals are decanted into containers, ensure that the containers are labelled correctly. When there is a risk of staff taking containers for their personal use (risk of poisoning), containers should be crushed, or perforated by drilling and punching holes into container.	Re-use on site where possible.	Re-condition: send drums to registered re-conditioners (steel) or re-processors (steel & plastic). Returning containers to supplier for reuse/recycling. Send containers to registered waste recycling enterprises for recycling. Incinerate at temperatures high enough to facilitate decontamination or thermal destruction.	Hazardous landfill (at suitably registered hazardous landfill waste disposal site) only if recycling, re-use, re-conditioning or incineration is not possible.
Paint waste (residual paint) and empty paint containers	-	The storage area should be bunded, provided with a sump, roofed, and well ventilated. Flammable paint waste must be stored separately from other wastes.	Excess paint will be re-used on site.	Empty paint metal containers should be recycled. Excess paint should be re-used if possible.	General Landfill at registered waste disposal sites is acceptable for small quantities of dried and solidified water-based paint, but for larger quantities, H:H landfill is necessary. For solvent/oil-based paints, H:H landfill is required.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Waste ash (e.g. boiler ash)	All ash must be tested for hazardous material before disposal or reuse in terms of applicable legislation.	Any handling and treatment options of boiler ash should be in line with the DWAF Guideline on Handling and Disposal of Boiler Ash.	-	If approved, alternative uses are generally preferred to landfilling. The use of ash in cement as an extender has several benefits (e.g. increased strength, decreased permeability and increased chemical resistance).	Boiler ash must be approved for land disposal or other uses. A classification report must be submitted to DWAF, confirming whether it is considered hazardous or non-hazardous. Can be used as cover for landfill at landfill sites.
Wood ash from fire places or braai areas	Unnecessary camp fires or cooking fires should be prevented. Fires for non-cooking purposes that does not significantly contribute to sense of place or visitor experience or recreational value, should be avoided. Solar cookers should be considered.	Dust formation should be prevented while handling and storing ash.	Ash could be added to compost, used in organic soap production, used as a natural pest deterrent (snails), or used as a cleaning agent.	Ash could be added to compost, used in organic soap production, used as a natural pest deterrent (snails), or used as a cleaning agent.	Landfilling of pure wood ash should be avoided at all times. If ash were contaminated with non-hazardous waste e.g. household waste, it should be disposed of at a site registered for general landfill. If ash were contaminated with hazardous substances, it should be landfilled at a registered H:H Landfill site.
Spent antifreeze	-	-	-	Recycling will probably not be feasible since very small quantities will be produced.	Hazardous Landfill H:H or H:h (depending on levels of contaminants, such as heavy metals).Incineration under controlled conditions may also be considered.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Lighting waste (Fluorescent lamps, Compact fluorescent lamps, Incandescent bulbs, High Intensity Discharge lamps)	Maximum use should be made of natural light in architectural design.	Storage should take place in a secure place where breakage risk is reduced.	-	Recycling is not currently practised in South Africa, but as soon it becomes a viable option, it should strongly be considered, especially in the case of fluorescent tubes.	Collected by a waste contractor. Fluorescent tube lamps, Compact fluorescent tube lamps, High pressure sodium vapour lamps, Low pressure Sodium vapour lamps, Metal Halide lamps and Mercury Vapour lamps should be landfilled at registered H:H landfill sites. All Incandescent bulbs may be landfilled at a general registered landfill site.
Electronic waste	-	-	-	Collected by a waste contractor to be dismantled and valuable material removed for re-use or recycling, e.g. cathode ray tubes, circuit boards, metals such as gold, copper, aluminium, and other valuable components.	After re-usable or recyclable materials and components have been removed, the remaining waste will be disposed of at a suitably registered waste disposal site.
Ink and toner cartridges	Documentation should increasingly be handled in electronic format only. Unnecessary printing should be avoided.	-	-	Where such arrangements exist, the cartridges should be returned to the supplier. Otherwise, where possible, valuable materials e.g. plastic and metals should be recovered from ink and toner cartridges for recycling.	To recover energy value of the material, the cartridges may be incinerated in a controlled environment, otherwise landfilled at a registered hazardous landfill site.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Wet cell batteries (Lead-acid batteries e.g. for vehicles)	-	-	-	Where such arrangements exist, wet cell batteries should be returned to the supplier who will recycle the lead and plastic.	If not returned to the supplier, wet cell batteries should, after treatment, be landfilled at a hazardous landfill site.
Dry cell batteries	Use of mains electricity or rechargeable batteries should receive preference above the use of non-rechargeable batteries.	-	-	-	Disposal at a H:H waste site.
Asbestos and asbestos containing waste (asbestos cement sheets or pipes, building material, insulation, asbestos rope, and friction products, such as gaskets, brake pads and clutch plates, as well as bags, containers, equipment, and clothing that have been in contact with asbestos)	-	Should be covered, and possibly wetted if needed, to prevent fibres from becoming airborne.	-	-	Dispose at a waste disposal site registered to accept asbestos waste, and pre-treat if needed. Where demolition is involved, it should be carried out by a Department of Labour registered asbestos contractor. Provisions in the Asbestos Regulations and in the Guide: Demolition Work (Regulation 21 Asbestos Regulations), March 2003, Chief Directorate: Occupational Health and Safety, South African Department of Labour, should be adhered to.

Type of waste	Waste prevention and minimisation measures	On-site storage and/or treatment	Re-use or re-cycling: on-site	Re-use or re-cycling: off-site	Disposal
Redundant pesticides	Just-in-time stock management policy will reduce chances of pesticides being stored or kept in inventory beyond their lifetime without being sold (in case of stock) or used (in case of own use).	The SANS 10206:2005 Standard should be followed during the handling, storage and disposal of pesticides	The SANS 10206:2005 Standard should be followed during the handling, storage and disposal of pesticides	The SANS 10206:2005 Standard should be followed during the handling, storage and disposal of pesticides	Disposal options is limited to high-temperature incineration, encapsulation, H:H landfill, or chemical treatment. Empty pesticide containers may be recycled after triple-rinsing, otherwise incinerated for energy recovery. Un-destroyed containers should be cut or punctured to prevent re-use. The SANS 10206:2005 Standard should be followed during the handling, storage and disposal of pesticides.

Table 2.15 Management of Waste per Source

Parameter/ Activity / Source:	Expected waste characteristics:	Weekly generation rates:	Vehicle access and transport distance:	Selected options for containers:	Selected options for treatment:	Selected options for transfer:	Selected options for disposal:
Domestic – high income	▪ Large amounts of low density packaging material; ▪ Organic kitchen waste; ▪ Organic garden waste; ▪ Occasional building rubble.	Estimated on average to be in the order of 250-litre per week, i.e. 1 x 240-litre wheelie bin or 3 x 85 plastic bags.	▪ Generally no access limitations	▪ 85-litre bins with plastic liners. ▪ 240-litre wheelie bins. ▪ Possibility for dry-wet separation at source.	▪ Removal of recyclable packaging ▪ Removal of compostable organics	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.
Domestic – low income	▪ Limited low-density packaging. ▪ Limited organic foodstuffs or garden waste. ▪ Substantial ash and sand.	Estimated on average to be in the order of 175-litre per week, i.e. 2 x 85-litre bags.	▪ Access often limited due to narrow access routes and poor road conditions.	▪ 85-litre bins with plastic liners. ▪ Limited opportunity for dry-wet separation at source.	▪ Limited opportunity for treatment.	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment.	▪ Transfer of all waste to regional site. ▪ Disposal of all waste on new local site.
Businesses	▪ Large amounts of low density packaging material.	Varying according to the size of the business, which could be between 240-l and 10- m^3	▪ Generally no access limitations.	▪ 240-litre wheelie bins, 5- m^3 or 10- m^3 skips. ▪ Opportunity for dry-wet separation.	▪ Removal of recyclable packaging.	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.
Light Industries	▪ Some bulky material from manufacturing / repairs; ▪ Some high-density waste.	Varying according to the size of the industry, which could be between 240-l and 5- m^3	▪ Generally no access limitations	▪ 240-litre wheelie bins, 5- m^3 or 10- m^3 skips. ▪ Opportunity for dry-wet separation.	▪ Removal of recyclable bulky waste.	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.

Parameter/ Activity / Source:	Expected waste characteristics:	Weekly generation rates:	Vehicle access and transport distance:	Selected options for containers:	Selected options for treatment:	Selected options for transfer:	Selected options for disposal:
Hospitality industry	▪ Large amounts of cans, bottles & packaging; ▪ Organic foodstuffs.	Varying according to the size of the business, which could be between 240-l and 1- m³ **per day**	▪ Generally no access limitations	▪ 240-litre wheelie bins, 1- m³ or 5- m³ skips. ▪ Opportunity for dry-wet separation.	▪ Removal of recyclable packaging ▪ Removal of compostable organics	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.
Hospitals HCGW only	▪ Large amounts of low density packaging material.	Varying according to the size of the business, which could be between 240-l and 10- m³	▪ Generally no access limitations.	▪ 240-litre wheelie bins, 5- m³ or 10- m³ skips. ▪ Opportunity for dry-wet separation.	▪ Removal of recyclable packaging ▪ Removal of compostable organics	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.
Holiday Resort	▪ Large amounts of low density packaging material; ▪ Organic kitchen waste; ▪ Organic garden waste; ▪ Occasional building rubble	Estimated on average to be in the order of 85-litre per weekend of 300-litre per week in season, i.e. 4 X 85-litre bags or 1 wheelie. Generation seasonal.	▪ Access often limited due to narrow access routes and small turning circles.	▪ 85-litre bins with plastic liners. ▪ Possibility for dry-wet separation at source.	▪ Removal of recyclable packaging ▪ Removal of compostable organics	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.

Parameter/ Activity / Source:	Expected waste characteristics:	Weekly generation rates:	Vehicle access and transport distance:	Selected options for containers:	Selected options for treatment:	Selected options for transfer:	Selected options for disposal:
Street or parking litter	▪ Low density packaging material as litter; ▪ Occasional illegal dumped building rubble; ▪ Occasionally illegally dumped organic garden waste; ▪ Occasional illegally dumped mixed waste.	Dependant of size of community, as well as level of awareness to initiate anti-litter campaigns.	▪ Generally no access limitations	▪ 50-litre pole mounted bin ▪ 85-litre freestanding bins. ▪ Limited opportunity for dry-wet separation.	▪ Limited opportunity for treatment, as collection of such waste does not allow for separation.	▪ Transfer directly from collection for long haul; ▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.
Public Disposal	▪ Low density packaging material; ▪ Building rubble; ▪ Organic garden waste; ▪ Mixed waste.	Dependant of size of community, as well as accessibility of facilities for members of the public.	▪ Generally no access limitations	▪ 5- m^3 or 10- m^3 skips. ▪ 20 or 30- m^3 skips if facility allows for that; ▪ Opportunity for full separation.	▪ Removal of recyclable packaging ▪ Removal of compostable organics ▪ Removal of clean building rubble.	▪ Transfer from transfer station without treatment; ▪ Transfer residues from transfer station after treatment.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.
Bulk building rubble (BR) / garden waste (GW) collection.	▪ High Density material (BR); ▪ Abrasive when compacted (BR); ▪ Bulky with low density (GW)	Dependant on generator and source; On call service	▪ Generally no access problems; ▪ Transport distance varies according to generator.	▪ 5- m^3 tractor trailer bulk containers ▪ 6- m^3 loadlugger bulk containers.	▪ Removal of compostable organics ▪ Removal of clean building rubble.	▪ Transfer of residues to regional site. ▪ Disposal of residues on new local site; ▪ Disposal on dedicated BR disposal site.	▪ Transfer of residues to regional site ▪ Disposal of residues on new local site.

E. POLLUTION

E.1) DESIRED STATE

The DGR will seek to identify and eventually eliminate all potential sources of pollution within its boundaries. An action plan will be put in place to deal with potential off-site pollution sources which may impact on the operation of the DGR through its flow in different environmental medium.

E.2) OBJECTIVES

The desired state will be pursued through the following objectives:

(i) Develop guidelines for the provision of appropriate household sanitation systems which will limit the impact on surface and ground water resources.
(ii) Limit the development of gravesites within the DGR.
(iii) Discourage any significant live stock concentration areas on island properties within the DGR.
(iv) Rehabilitate recently or currently cultivated areas.
(v) Avoid where possible, fuel, oil and chemical storage on properties within the DGR.
(vi) Ensure that the demolition of any structures which may contain asbestos or lead containing paint are undertaken according to the necessary Occupational Health and Safety regulations.
(vii) Introduce measures to prevent erosion and silt pollution within the DGR.

E.3) POLICY AND OPERATIONAL GUIDELINES

The potential impacts associated with these potential pollution sources, and policy and management recommendations are described in Table 2.16.

Table 2.16 The impact of Potential Pollution Sources within the DGR and Management Recommendations

Potential Source	Impacts	Management Recommendations
Household sanitation or sewer Systems	Improper household sanitation systems may lead to a variety of impacts, including: • Health impacts related to the spread of endopathogens, especially cholera and *E.coli*. • Eutrophication of surface water and groundwater. In case of surface water, eutrophication may cause algal blooms which on turn may lead to turbidity and anoxic conditions in downstream water bodies. • Localised odour problems, which could become a nuisance at affected sites, reducing quality of life to residents, and reduce visitor experience amongst tourists. This is not expected to become a significant problem because property size is sufficiently large and population density is sufficiently low to prevent conflict between neighbouring landowners on this issue.	• All households should be served by a proper functioning sanitation system, suitable to site specific conditions. • All larger developments in proximity to bulk sewer lines of Tshwane Metropolitan Municipality should link with those lines. • Remote large developments should consider the installation of small package sewage treatment plants. • Isolated households and small developments should consider proper septic tank systems where local geotechnical conditions permit. • Urine diversion systems should be considered for households which will not be able to afford the installation, operation and maintenance of abovementioned systems. • All sanitation infrastructure should be properly installed/constructed, operated and maintained. • Waste from chemical toilets or temporary on site sanitation system for construction workers should be regularly cleaned and disposed of regularly at a suitably certified waste facility by a registered waste contractor. Care must be taken to avoid soil and water contamination. • All sanitation system infrastructure and facilities should be properly maintained, and regularly inspected and monitored for leakages. If leakages are detected, it should receive immediate attention. In case of leakages or spillages, DWAF and the municipality should be notified. • All temporary, seasonal and permanent workers should be provided with proper sanitation facilities, and use thereof enforced. Worker sanitation facilities should be kept neat and hygienic on a daily basis.
Gravesites	The risk of pollution posed by smaller private cemeteries to the quality of the water resource, especially the quality of drinking water, is regarded as limited due to the following reasons: • Grave density within the study area is low. • The process of decay of human bodies is relatively slow, therefore the rate of potential pollutant release is slow. • Although seepage from gravesites is high in nutrients, it is small in volume.	The following measures regarding the siting and management of gravesites should be practiced: • Indigenous trees should be planted adjacent to gravesites to absorb seepage. • New graves should not be established below the 1 in 50 year flood line of a river; • New graves should not be established in close proximity to water bodies such as wetlands, vleis, pans, estuaries and floodplains; • New graves should not be established on unstable areas, like fault zones, seismic zones, dolomitic or karst areas where sinkholes and subsidence are likely; • New graves should not be established in or near sensitive ecological areas; • New graves should not be established in or on areas characterised by flat gradients, shallow or emergent groundwater;

Potential Source	Impacts	Management Recommendations
		• New graves should not be established in areas characterised by steep gradients, or shallow bedrock with little soil cover, where stability of slopes could be a problem; • New graves should not be established in areas of ground water recharge on account of topography and/or highly permeable soils; • New graves should not be established on areas overlaying or adjacent to important or potentially important aquifers (Parsons aquifer classification), where such aquifers are to be use for water supply purposes.
Livestock concentration areas	Impacts related to livestock concentration areas are directly related to the number of animals kept, sanitary practices and distance to sensitive receivers (e.g. water courses or residences). The following impacts could be associated with livestock concentration areas: • Production of high strength wastewater (high in Biological Oxygen Demand or BOD), which could pose a significant water pollution and eutrophication risk. • Odour problems, which could significantly reduce quality of life to residents/neighbours and reduce visitor experience amongst tourists. • Ammonia emission from manure. • Acidification (NH_3, SO_2, NO_x) and Eutrophication (N, P). • Pathogens. • Diffuse spreading of heavy metals and pesticides. • Health risk associated with groundwater and surface water pollution. A number of abandoned livestock concentration areas occur within the study area. No significant residual impacts related to these abandoned livestock concentration areas are however expected. There are a number of non-participating farms in and around the DGR area with significant livestock concentrations, specifically one or two areas with high concentrations of sheep and goat, and the potential impacts of these activities on the DGR will have to be carefully monitored.	No livestock concentrations will be allowed in the DGR. Existing livestock concentration areas on non-participating properties should be required to have an operation-specific Environmental Management Plan. Any livestock areas on surrounding farms or non-participating properties which fall within the ambit of listed activities under Government Notice R386 of 2006, should obtain the necessary environmental authorisation and management plan. These listed activities include: • Activity 1(h): The concentration of animals for the purpose of commercial production in densities that exceed – o 20 square meters per head of cattle and more than 500 head of cattle per facility per year; o eight square meters per sheep and more than 1000 sheep per facility per year; o eight square meters per pig and more than 250 pigs per facility per year excluding piglets that are not yet weaned; o 30 square meters per crocodile at any level of production, excluding crocodiles younger than 6 months; o three square meters per head of poultry per facility at any time, excluding chicks younger than 20 days; o three square meter per rabbit at and more than 250 rabbits per facility at any time, or o 100 square meters per ostrich and more than 50 ostriches per facility per year or 2500 square meters per breeding pair Activity 1 (i): aquaculture production, including mariculture and algae farms, with a product throughput of 10 000kg or more per year. • Activity 1 (j): agri-industrial purposes, outside areas with and existing land use zoning for industrial purposes, that cover an area of 1000 square meters or more.

Potential Source	Impacts	Management Recommendations
Previously, recently or currently cultivated areas as sources of pesticides and other biocides and nutrients	Previously, recently or currently cultivated areas may act as pollution sources of pesticides (DDT, dioxins and chlordane) and other biocides, as well as nitrates, phosphates and other plant nutrients. Herbicides or pesticides were probably applied to most previously cultivated areas during the period of cultivation. No significant residual impacts (e.g. residual agro-chemical pollution) related to historical or more recent land cultivation is however expected. Although pioneer species are still dominant in old lands, vegetation succession is taking place to establish a relative stable vegetation cover because interconnectivity between old lands and patches of relative intact vegetation are strong. No signs of extensive vegetation regression or impaired vegetation growth, as an indication of large scale historic or recent herbicide contamination, were observed. The potential continued intensive cultivation on certain of the non participating island properties within the DGR may however present some continuing challenges as far as the use of pesticides and nutrient application are concerned.	No new clearing of vegetation for cultivation which has not been transformed before, should be allowed. Crop production should only be allowed in case of sustainable, organic farming on existing or previously cultivated land
Fuel and oil storage and handling	Possible pollutants resulting from fuel/oil/hydrocarbon spills or leakages may include: • nitrates; • sulphides; • cadmium; • chromium; • copper; • iron; • nickel; • mercury; • zinc; • cyanide; • phenols, benzene, mercaptans and other toxic organics.	The following management measures should be implemented: • All participating landowners should register current, recent or known historic fuel storage sites, even if the tank(s) were decommissioned and rehabilitated. • A pollution risk index should be developed and risks of each tank assessed. Tanks which pose a significant pollution risk should be identified. • A hydrocensus should be conducted around tanks which pose a significant pollution risk. A management strategy be developed to minimise pollution risks posed by high risk tanks and to protect or manage boreholes which are vulnerable to pollution from these high risk tanks. • Refuelling areas must be underlain with an impermeable liner to protect groundwater quality. • New fuel tanks must meet relevant SANS and other specifications and must be elevated so that leaks may be detected easily.

Potential Source	Impacts	Management Recommendations
	Affected environmental media in case of spillages include, in order of decreasing importance: • Groundwater (only affected medium in case of underground fuel storage); • Soil (first contact front); • Surface water (in case of surface spillage); • Air (short term medium of transmission for Volatile Organic Compounds only). The impact of potential hydrocarbon spillages or leakages is not expected to be significant in the study area, and the impact is mostly of a localised nature.	
Other chemical storage and handling	Impacts associated with chemical storage and handling depends on the type of chemical, environmental media affected, characteristics of environmental media, time and volume of exposure, handling procedures adopted, and conditions of storage and disposal. The impact on conservation and ecotourism development is not expected to be significant.	The following management measures should be implemented to minimise risks associated with the transportation, storage, handling, use and disposal of chemicals and other potentially hazardous substances: • All hazardous substances should be transported, stored, handled, used and disposed of according to the legal provisions stipulated in the Occupational Health and Safety Act and other applicable legislation. • Storage areas that contain chemicals and hazardous substances must be bunded with an approved impermeable lining. The containment capacity must equal the capacity of the storage containers. • Material Safety Data Sheets should be kept on-site for each potentially hazardous substance transported, stored or handled on the site. • The landowner and workers dealing with materials and substances must be aware of their potential impacts and follow the appropriate safety measures. • Scheduled hazardous waste and its containers must be disposed of at DWAF- or DEAT- approved facilities. • If applicable, hazardous substances and materials are to be transported in sealed containers or bags. • Hazardous substance storage areas must be designated, demarcated, fenced and roofed if necessary. • Location of hazardous substance storage areas must take into account prevailing winds, distance to water bodies, boreholes and residences in the surrounding area, and on-site topography.

Potential Source	Impacts	Management Recommendations
		• Storage areas should be secure and be safe from access by children and animals. • Hazardous substance storage facilities should be cleaned and maintained regularly and leaking containers should be disposed of without spillage. • Hazardous storage and refuelling areas must be underlain with an impermeable liner to protect groundwater quality. • Storage areas containing hazardous substances and materials must be clearly signed
Historic or recent spills	No Evidence or information on significant historic spills is available. However, the impacts associated with spills could include the following: • Contamination of topsoil and/or subsoils; • Potential impacts on surface and groundwater; • Impact on vegetation and wildlife.	The following management measures should be implemented to minimise risks for pollution posed by past or future spills: • If it is suspected by the landowner or management of the DGR, that top- and/or sub-soils are contaminated due to current, recent or historic spills, top-/subsoil tests must be conducted. • In-situ remediation should be conducted in case of spills. In case of more significant spills, the polluted soil must be removed to the full depth of pollution from the site and replaced with an equal (in terms of quality and quantity) replacement of approved topsoil and subsoil. • In case of more serious spills, spillage residues must be treated or removed from the area by specialist contractors to DWAF- or DEAT- approved waste disposal facilities. • Spills in bunded areas must be cleaned up, removed and disposed of safely from the bunded area as soon after detection as possible to minimise pollution risk and reduced bunding capacity. • Emergency contact telephone numbers should be on hand in order to deal with new spillages and contamination of soil or groundwater. • Adequate spillage containment measures must be implemented, such as cut-off drains, berms, etc.
Polychlorinated biphenyls (PCB's)	Polychlorinated biphenyls cause a variety of health impacts, including skin, liver and reproductive disorders, and possibly cancer. Bioaccumulation and biomagnification may occur.	Polychlorinated biphenyls should not be burned for energy recovery or any other purposes because by-products of burning (dioxins and dibenzofurans) are highly toxic to humans and animals. Other common uses such as candle making, use as cattle dip, mixing with other oils, use as base oil or fuel oil, should not be allowed under any circumstances. Measures as described in the Waste Management Plan elsewhere in the document, should be adopted. Because polychlorinated biphenyls occur only in small, isolated quantities in the study area, specific remediation measures or a collection campaign are not needed.

Potential Source	Impacts	Management Recommendations
Asbestos	Asbestos is linked to lung cancer and associated diseases and has therefore been designated as a known human carcinogen. The potential occurrence of asbestos waste material in the study area is likely to be associated with old buildings within the study area. Any buildings to be demolished and which contain any asbestos material these will have to be appropriately managed in terms of the relevant legalisation.	If asbestos buildings or other asbestos containing structures need to be demolished, special measures needs to be taken, as prescribed by the Asbestos Regulations. Due to relative low building density across the area, only relative small quantities of asbestos will need to be managed and disposed of, therefore cost of management will be relatively low, and no significant residual asbestos pollution is expected. When asbestos containing structures or buildings are to be demolished, procedures described in the following guide should be adopted: Demolition Work (Regulation 21 Asbestos Regulations). March 2003. Chief Directorate: Occupational Health and Safety, South African Department of Labour.
Lead	Lead paint can result in hazardous paint chips and dust when disturbed, e.g. during demolition or restoration of houses, or with normal paint surface deterioration. Lead-containing paint chips or dust are particularly hazardous to children.	Special measures (but not necessary expensive or disruptive measures) will need to be taken if paint surfaces are to be disturbed. Dust control is essential during demolition or renovation work. All workers should wear masks of sufficient filtration grade to prevent lead containing paint dust from inhalation.
Low frequency electromagnetic fields	The potential health impact of an electromagnetic field depends on the frequency and intensity of the field. Radiation from normal electrical wiring e.g. in houses does not pose a health hazard. High voltage power lines may pose some health threats to humans. These impacts are not considered to be significant in the context of the DGR. In fact, the more significant impacts associated with the power lines will rather be the visual impact, and threat to large birds and hazard to low flying airplanes.	• As a precautionary measure, it may be considered to lay new power lines underground where possible or to preserve a 60 m buffer between residential units and power lines. Low frequency electromagnetic fields do not currently have a significant impact on wildlife or human health, and will not have an influence on the site's suitability for proposed conservation and ecotourism development. • The DGRMA should engage and maintain working relations with ESKOM to negotiate all new electricity infrastructure to be provided as underground lines where possible.
Radon	Radon pollution may cause illnesses such as lung cancer. Radon pollution is not expected to be a significant issue in the DGR.	Because environmental factors that increase radon pollution are not present within the study area, it is not necessary to address building-specific factors as described above, and there will be no need to introduce special measures to manage radon pollution.
Other sources of ionizing radiation	Radioactive radiation has severe health effects, including carcinogenesis and mutagenesis. Exposure levels within the study area will however probably be too low to have a significant impact.	Potentially radioactive material such as smoke detectors should be disposed of as described in the Waste Management Plan elsewhere in this document.
Suspended solids (due to on-site erosion)	Suspended solid pollution may be problematic during construction activities, particularly if vegetation is cleared during the rainy season. Erosion is expected to increase initially, but will still be within acceptable limits. Overgrazing may also contribute to silt pollution	The following measures should be adopted to prevent erosion and silt pollution: • Soil erosion should be prevented throughout the study area. Special attention should be given to erosion control along the road network, driveways and parking areas, mining areas, disturbed areas where soil are exposed, and along storm water control measures, especially where storm water are released. • Storm water Best Management Practices that allow for settlement of suspended solids, should be applied. • Erosion control measures, including structural Storm water Best Management

Potential Source	Impacts	Management Recommendations
		Practices (BMP's) should be well maintained. Storm water damage should be regularly monitored, especially after storm events. Structural integrity of storm water infrastructure along the road network, driveways and parking areas, along storm water control measures, and at the point(s) where storm water are released from the site, should be regularly inspected and repaired if needed. • Storm water control and wind screening should be undertaken to prevent soil loss from exposed surfaces, including construction sites and old mining areas or borrow pits. • Storm-water outfalls should be designed to reduce flow velocity and avoid soil erosion. • Remedial action must be taken in areas where erosion is occurring. Effectiveness of such anti-erosion measures must be monitored. • At construction sites, if stockpiles are exposed to windy conditions or heavy rain, they should be covered by suitable material. Stockpiles may further be protected by the construction of berms or low brick walls around their bases. • Overgrazing should be prevented. Old mining areas, including sand mines and borrowpit areas, should be rehabilitated to a reasonable extent. Highest priority should be to make high walls save by grading high walls to a slope of less than 18 degrees. Alien invasive plants should be controlled, and anti-erosion measures implemented.

F. DEVELOPMENT IMPACTS

This section sets out a summary conclusion of the development impacts of the various components described in section 2.2.2.2.1. It provides a clear indication of the levels of significance of these impacts in terms of the management of the DGR, and management recommendations for areas where mitigation management will be required.

F.1) SURROUNDING COMMUNITIES

Table 2.17 Management Recommendations for Surrounding Communities

Nature	Significance	Management Recommendations
High percentage of the population in the 5 – 19 year age category	High	• The high proportion of the population in the school going age implies that schools could be used as an important medium for transfer of information and capacitation of adjacent communities regarding the function and benefits of the DGR • Social Responsibility investments associated with the benefits of the DGR should be strongly focused on the education sector
Transport and commuting of pupils to schools located within boundaries of DGR	Medium	• The location of schools within the boundaries of the study area would imply an ongoing commuter stream, specifically in the case of the Fan Jan School. Appropriate alternative locations will thus have to be investigated in the medium to longer term
As much as 12.5% of the adult population not having received any form of education and can thus be regarded as completely illiterate. A further 20.2% have only completed some primary education and can thus be classified as functionally illiterate	High	• The methods of communicating relevant information regarding the DGR to adjacent communities should take cognisance of the high levels of illiteracy and functional illiteracy in settlements such as Mandela Village and Steve Bikoville. Appropriate forms of communication should thus be identified and established • Social responsibility investments resulting from the operation of the DGR should strongly consider support for Adult Basic Education and Training programmes for the population of the adjacent settlements • Skills development programmes which specifically provides beneficiaries with skills associated with the eco-tourism sector should be supported • Lack of specialist eco-tourism skills in the local community should not encourage employers to recruit workers from outside. Rather, training and skills development should be provided to local candidates • Enable a significant number of residents from the local community to enjoy some of the intrinsic benefits offered by the DGR, e.g. sponsor occasional tours into the DGR

Nature	Significance	Management Recommendations
As much as 87.4% of all households in the adjacent communities earn less than R3 200 per month	High	• Potential employment and income earning opportunities to be created within the DGR should be strongly focused on potential beneficiaries from the immediately adjacent communities • The products/services of local entrepreneurs amongst visitors • Conduct township tours into the residential areas to the west of the protected area. The community should be presented in a respectful manner, and visitors should be made aware of the challenges faced by the local people. Tourists should be presented with spending opportunities within these communities • Where possible, products/services should be procured from suppliers from the surrounding community. As part of BEE commitments, strengthen potential suppliers from the local community to meet often stringent quality criteria required by upmarket tourist establishments
The unemployment rate (proportion of the economically active population classified as unemployed) range between 40% and 60%	High	• It is important that the financial and economic benefits of the DGR be clearly communicated to adjacent communities on a ongoing base • Candidates for employment opportunities living within the primary zone of influence should enjoy preference over potential candidates from other areas
Littering and uncontrolled waste disposal	Medium	• Encourage the community to keep stands and streets neat, and free from litter and waste • Discourage illegal waste dumping, especially along the border of the protected area and enforce appropriate by-laws • Surrounding property owners and their tenants may not dispose of any effluent or waste into the DGR and should prevent litter or pollutants from being transported by wind, storm water or groundwater from their properties into the conservation area
Impact on ambient air quality due to coal and wood burning for heating and cooking	Medium	• Encourage the community to adopt cleaner alternatives , e.g. solar cookers for cooking, and installation of insulation to reduce the need for heating
Uncontrolled use and harvesting of natural resources such as medicinal plants	Low	• Opportunities for members of the community within the primary sphere of influence to participate in the sustainable harvesting of resources within the protected area should be investigated and implemented. Examples may include harvesting of honey and medicinal plants. Some useful indigenous species may even be introduced for low intensity sustainable harvesting purposes.
Damaging of fence by communities or surrounding land owners	High	• The community should be discouraged from damaging the fence, and be made aware of the implications of damage to the fence • Surrounding property owners may not in any way tamper with the DGR fence
Visual and noise impacts	Medium	• Encourage surrounding farmers not to contribute to light pollution (over-illumination and light trespass) • Surrounding property owners and their tenants may not cause excessive noise pollution • Encourage surrounding farmers to conserve natural vegetation that provides a visual screening function along their borders and vegetation that may screen visual disturbances such as buildings, roads, excavations and other structures and disturbed areas on their properties

Nature	Significance	Management Recommendations
Starting and spreading of fires from surrounding communities/properties	Medium	• Encourage surrounding farmers to maintain fire breaks
Impact on natural environment and spread of alien invasive species from surrounding communities/farms	Medium	• Encourage surrounding farmers to control the spread of alien invasive plants and domestic animals such as cats and dogs • Encourage surrounding farmers to maintain a buffer zone of at least 100 meter from the DGR where no animal concentration areas such as kraals, feedlots, piggeries, broilers, slaughtering activities, or disposal of carcasses or slaughtering waste or manure, is allowed • Surrounding property owners and their tenants or guests may not disturb or cause any harm to wildlife of the DGR, e.g. poisoning of, or shooting at wildlife across the fence • Surrounding property owners and their tenants may not dispose of any effluent or waste into the DGR and should prevent litter or pollutants from being transported by wind, storm water or groundwater from their properties into the conservation area. Surrounding property owners should take measures to prevent wind and soil erosion on their properties

F.2) INTERNAL COMMUNITIES

Table 2.18 Management Recommendations for Internal Communities

Nature	Significance	Management Recommendations
Spread of alien invasive plants and domestic animals such as cats and dogs from internal properties	Low	• Encourage non-participating land owners to control the spread of alien invasive plants and domestic animals such as cats and dogs
Visual impacts resulting from activities on internal properties	Medium	• Encourage non-participating land owners to conserve natural vegetation that provides a visual screening function along their borders and vegetation that may screen visual disturbances such as buildings, roads, excavations and other structures and disturbed areas on their properties • Encourage non-participating land owners not to contribute to light pollution (over-illumination and light trespass • Develop a policy on building appearance and outdoor signage, including architectural design, choice of colours and materials, etc • Over illumination should be prevented. Lighting should be limited to the maximum extent possible, and no unnecessary lighting should be allowed. Where possible, lighting should be switched off during periods of low or no usage, e.g. late evenings and early morning hours, as well as during periods of low/no occupancy • Light trespass should be avoided. The direction of lighting should be limited to the area where absolutely needed and not allowed to spread onto the surrounding veld or neighbouring properties • Lights should be pointed downwards to limit contribution to sky glow (which will be significant in the Dinokeng area due to high levels of suspended particles in the area). • Screening vegetation (indigenous trees and shrubs) should be planted and maintained by all land owners to reduce the visual impact of buildings, roads and other infrastructure, disturbed areas, excavations and other features that may reduce the visual appearance of the landscape, on their properties
Damaging of fence by internal communities/non-participating land owners	Medium	• Non-participating land owners may not in any way tamper with the DGR fence
Impact on natural environment resulting from activities on internal properties	Low	• Non-participating land owners and their tenants or guests may not disturb or cause any harm to wildlife of the DGR, e.g. poisoning of, or shooting at wildlife across the fence • Non-participating land owners should take measures to prevent wind and soil erosion on their properties • No disturbance or development should be allowed within the riparian corridor or wetland boundary. In addition, a further 32meter buffer zone beyond the wetland boundary should also be excluded from any development or disturbance, especially from vehicles. Road crossings across riparian corridors should be carefully designed to minimise disturbance • No surface storm water generated as a result of the development of the area should be directed directly

Nature	Significance	Management Recommendations
		into the riparian or wetland system • Use of insecticides should be minimised and eliminated where possible, and alternatives (e.g. mosquito nets and window netting) should rather be utilised • Strict water conservation measures should be adopted • Xeriscape gardening, i.e. the use of xeromorphic or climate appropriate plants (all indigenous) that are adapted to the local climate, should be practiced. Apart from habitat provision, these plants require less water, and are more likely to survive drought conditions. Use of high-maintenance lawns and annual plants should be minimised • Should any artefacts or other forms of heritage resources be discovered during the operational phase, SAHRA should immediately be notified, and a professional archaeologist should be called in to investigate
Littering and uncontrolled waste disposal originating from internal communities/non-participating land owners	Low	• Non-participating land owners and their tenants may not dispose of any effluent or waste into the DGR and should prevent litter or pollutants from being transported by wind, storm water or groundwater from their properties into the conservation area • Land owners should ensure that sanitation systems on their properties are appropriate for the site specific geotechnical conditions, and are well maintained • Waste material should be properly disposed of according to legal requirements and as specified in the waste management guidelines specified in this document • All new fuel storage, if any, should be aboveground and properly bunded. In case of existing underground tanks, groundwater quality monitoring should be regularly conducted to detect possible leakages. In case of spills or leakages, the relevant authorities should be contacted. A spill response strategy should be in place, including the on-site availability of a spill response kit. All relevant legislation and SANS standards regarding the construction, operation, maintenance and decommissioning of tanks should be adhered to
Low skills levels of labourers	Medium	• Over-dependency on tourism as a source of employment and income should be prevented. Workers should be provided with portable skills training to enable them to find alternative employment in case the local tourism industry experience a significant downturn • Sufficient training, ranging from Adult Basic Education and Training to more general training and specialised training in specific skills areas should be provided to labourers. All workers should be encouraged to receive training
Noise pollution resulting from activities on internal properties	Medium	• Participating land owners and their tenants may not cause excessive noise pollution.

F.3) WASTE MANAGEMENT

Table 2.19 Management Recommendations for Waste Management

Nature	Significance	Management recommendations
Exposed household refuse dumps and illegal dumping and littering act as source habitat for vermin	Medium	• Refer to detailed management recommendations in Table 2.14
Direct infection (without vermin as a vector) with diseases may occur in case of direct contact between household waste and humans	Low	• Refer to detailed management recommendations in Table 2.14
Leachate from isolated household refuse dumps originates from rainwater percolating through the dump	Low	• Refer to detailed management recommendations in Table 2.14
Odours released from decomposing waste may have a negative impact on the quality of life to residents/neighbours, and reduce the visitor experience of tourists	Low	• Refer to detailed management recommendations in Table 2.14

F.4) POLLUTION

Table 2.20 Management recommendations for Pollution

Nature	Significance	Management recommendations
1. Improper household sanitation systems may lead to a variety of impacts, including: Health impacts related to the spread of endopathogens, especially cholera and *E.coli*. Eutrophication of surface water and groundwater. In case of surface water, eutrophication may cause algal blooms which on turn may lead to turbidity and anoxic conditions in downstream water bodies. Localised odour problems, which could become a nuisance at affected sites, reducing quality of life to residents, and reduce visitor experience amongst tourists.	Medium	• All households should be served by a proper functioning sanitation system, suitable to site specific conditions. • All larger developments in proximity to bulk sewer lines of Tshwane Metropolitan Municipality, should link with those lines. • Remote large developments should consider the installation of small package sewage treatment plants. • Isolated households and small developments should consider proper septic tank systems where local geotechnical conditions permit. • Urine diversion systems should be considered for households which will not be able to afford the installation, operation and maintenance of abovementioned systems. • All sanitation infrastructure should be properly installed/constructed, operated and maintained. • Waste from chemical toilets or temporary on site sanitation system for construction workers should be regularly cleaned and disposed of regularly at a suitably certified waste facility by a registered waste contractor. Care must be taken to avoid soil and water contamination. • All sanitation system infrastructure and facilities should be properly maintained, and regularly inspected and monitored for leakages. If leakages are detected, it should receive immediate attention. In case of leakages or spillages, DWAF and the municipality should be notified. • All temporary, seasonal and permanent workers should be provided with proper sanitation facilities, and use thereof enforced. Worker sanitation facilities should be kept neat and hygienic on a daily basis.
2. The risk of pollution posed by smaller private cemeteries to the quality of the water resource	Low	The following measures regarding the siting and management of gravesites should be practiced: • Indigenous trees should be planted adjacent to gravesites to absorb seepage. • New graves should not be established below the 1 in 50 year flood line of a river; • New graves should not be established in close proximity to water bodies such as wetlands, vleis, pans, estuaries and floodplains; • New graves should not be established on unstable areas, like fault zones, seismic zones, dolomitic or karst areas where sinkholes and subsidence are likely; • New graves should not be established in or near sensitive ecological areas; • New graves should not be established in or on areas characterised by flat gradients, shallow or emergent groundwater; • New graves should not be established in areas characterised by steep gradients, or shallow bedrock with little soil cover, where stability of slopes could be a problem;

Nature	Significance	Management recommendations
		• New graves should not be established in areas of ground water recharge on account of topography and/or highly permeable soils; • New graves should not be established on areas overlaying or adjacent to important or potentially important aquifers (Parsons aquifer classification), where such aquifers are to be use for water supply purposes.
Impacts related to livestock concentration areas are directly related to the number of animals kept, sanitary practices and distance to sensitive receivers (e.g. water courses or residences).	Low	• No livestock concentrations will be allowed in the DGR. Existing livestock concentration areas on non-participating properties should be required to have an operation specific Environmental Management Plan. • Any livestock areas on surrounding farms or non-participating properties which fall within the ambit of listed activities under Government Notice R386 of 2006, should obtain the necessary environmental authorisation and management plan
Previously, recently or currently cultivated areas may act as pollution sources of pesticides (DDT, dioxins and chlordane) and other biocides, as well as nitrates, phosphates and other plant nutrients	Low	• No new clearing of vegetation for cultivation which has not been transformed before, should be allowed. Crop production should only be allowed in case of sustainable, organic farming on existing or previously cultivated land
Possible pollutants resulting from fuel/oil/hydrocarbon spills or leakages	Low	The following management measures should be implemented: • All participating landowners should register current, recent or known historic fuel storage sites, even if the tank(s) were decommissioned and rehabilitated. • A pollution risk index should be developed and risks of each tank assessed. Tanks which pose a significant pollution risk should be identified. • A hydrocensus should be conducted around tanks which pose a significant pollution risk. A management strategy be developed to minimise pollution risks posed by high risk tanks and to protect or manage boreholes which are vulnerable to pollution from these high risk tanks. • Refuelling areas must be underlain with an impermeable liner to protect groundwater quality. • New fuel tanks must meet relevant SANS and other specifications and must be elevated so that leaks may be detected easily

Nature	Significance	Management recommendations
Impacts associated with chemical storage and handling depends on the type of chemical, environmental media affected, characteristics of environmental media, time and volume of exposure, handling procedures adopted, and conditions of storage and disposal	Low	The following management measures should be implemented to minimise risks associated with the transportation, storage, handling, use and disposal of chemicals and other potentially hazardous substances: • All hazardous substances should be transported, stored, handled, used and disposed of according to the legal provisions stipulated in the Occupational Health and Safety Act and other applicable legislation. • Storage areas that contain chemicals and hazardous substances must be bunded with an approved impermeable lining. The containment capacity must equal the capacity of the storage containers. • Material Safety Data Sheets should be kept on-site for each potentially hazardous substance transported, stored or handled on the site. • The landowner and workers dealing with materials and substances must be aware of their potential impacts and follow the appropriate safety measures. • Scheduled hazardous waste and its containers must be disposed of at DWAF- or DEAT- approved facilities. • If applicable, hazardous substances and materials are to be transported in sealed containers or bags. • Hazardous substance storage areas must be designated, demarcated, fenced and roofed if necessary. • Location of hazardous substance storage areas must take into account prevailing winds, distance to water bodies, boreholes and residences in the surrounding area, and on-site topography. • Storage areas should be secure and be safe from access by children and animals. • Hazardous substance storage facilities should be cleaned and maintained regularly and leaking containers should be disposed of without spillage. • Hazardous storage and refuelling areas must be underlain with an impermeable liner to protect groundwater quality. • Storage areas containing hazardous substances and materials must be clearly signed
Asbestos is linked to lung cancer and associated diseases and has therefore been designated as a known human carcinogen. The potential occurrence of asbestos waste material in the study area is likely to be associated with old buildings within the study area	Low	• If asbestos buildings or other asbestos containing structures need to be demolished, special measures needs to be taken, as prescribed by the Asbestos Regulations. Due to relative low building density across the area, only relative small quantities of asbestos will need to be managed and disposed of, therefore cost of management will be relatively low, and no significant residual asbestos pollution is expected. When asbestos containing structures or buildings are to be demolished, procedures described in the following guide should be adopted: Demolition Work (Regulation 21 Asbestos Regulations). March 2003. Chief Directorate: Occupational Health and Safety, South African Department of Labour.
Lead paint can result in hazardous paint chips and dust when disturbed, e.g. during demolition or restoration of houses, or with normal paint surface deterioration. Lead-containing paint chips or dust are particularly hazardous to children	Low	• Special measures (but not necessary expensive or disruptive measures) will need to be taken if paint surfaces are to be disturbed. Dust control is essential during demolition or renovation work. All workers should wear masks of sufficient filtration grade to prevent lead containing paint dust from inhalation

Nature	Significance	Management recommendations
The potential health impact of an electromagnetic field depends on the frequency and intensity of the field. These impacts are not considered to be significant in the context of the DGR. In fact, the more significant impacts associated with the power lines will rather be the visual impact, and threat to large birds and hazard to low flying airplanes	Low	• As a precautionary measure, it may be considered to lay new power lines underground where possible or to preserve a 60 m buffer between residential units and power lines. Low frequency electromagnetic fields do not currently have a significant impact on wildlife or human health, and will not have an influence on the site's suitability for proposed conservation and ecotourism development. • The DGRMA should engage and maintain working relations with ESKOM to negotiate all new electricity infrastructure to be provided as underground lines where possible
Suspended solid pollution may be problematic during construction activities, particularly if vegetation is cleared during the rainy season. Erosion is expected to increase initially, but will still be within acceptable limits. Overgrazing may also contribute to silt pollution	Low	The following measures should be adopted to prevent erosion and silt pollution: • Soil erosion should be prevented throughout the study area. Special attention should be given to erosion control along the road network, driveways and parking areas, mining areas, disturbed areas where soil are exposed, and along storm water control measures, especially where storm water are released. • Storm water Best Management Practices that allow for settlement of suspended solids, should be applied. • Erosion control measures, including structural Storm water Best Management Practices (BMP's) should be well maintained. Storm water damage should be regularly monitored, especially after storm events. Structural integrity of storm water infrastructure along the road network, driveways and parking areas, along storm water control measures, and at the point(s) where storm water are released from the site, should be regularly inspected and repaired if needed. • Storm water control and wind screening should be undertaken to prevent soil loss from exposed surfaces, including construction sites and old mining areas or borrow pits. • Storm-water outfalls should be designed to reduce flow velocity and avoid soil erosion. • Remedial action must be taken in areas where erosion is occurring. Effectiveness of such anti-erosion measures must be monitored. • At construction sites, if stockpiles are exposed to windy conditions or heavy rain, they should be covered by suitable material. Stockpiles may further be protected by the construction of berms or low brick walls around their bases. • Overgrazing should be prevented.

F.5) TRANSPORTATION

Table 2.21 Management recommendations for Transportation

Nature	Significance	Management recommendations
Potential impact of road maintenance, upgrading and construction activities on the natural environment.	High	• See detailed management recommendations in section 2.2.2.2.1 (C)
Impact of the potential use of existing or new borrow pits along public roads in the DGR for road maintenance or construction purposes	Low	• The areas at the identified borrow pits must be clearly marked and fenced. • Clear warning signage must be erected at the borrow pits. • Speed limits of construction vehicle must be strictly enforced at the identified borrow pits. • Dust suppression programme at the borrow pits must be implemented • Borrow pits should be rehabilitated according to each borrow pit's Environmental Management Plan, as approved by the Department of Minerals and Energy.
Potential spillage of hazardous substance or materials during transportation or at storage areas	Low	• Hazardous storage and refuelling areas must be underlain with an impermeable liner to protect groundwater quality. • If applicable, fuel tanks must meet relevant specifications and must be elevated so that leaks may be detected easily. Storage areas containing hazardous substances and materials must be clearly signed. • The transport and handling of potential hazardous materials, must be in accordance with DWAF's requirements and specifications. • No vehicles transporting, placing or compacting asphalt or any other bituminous product may be washed on site. • No vehicles transporting concrete to construction sites may be washed on site. • Hazardous substances and materials are to be transported in sealed containers or bags.
Possible dangers to labourers and employees if efficient and well planned public transport facilities to and from places of work are not available in the DGR	Medium	• The DGRMA should liaise with relevant public transport operators (e.g. bus companies, taxi operators) to identify important pick-up points, transport routes and drop off points at main tourism facilities and sources of employment. • All labourers and employees must be fully informed of the responsibilities of using public transport once the Big Five Game fence have been completed and the game introduced in the area.

Nature	Significance	Management recommendations
Insufficient waste management at construction sites and littering along roads	Low	• The excavation and use of rubbish pits on site or the burning of waste at construction sites are forbidden. • Littering at construction sites and surrounding areas is forbidden and the site must be cleared of litter at the end of each working day. • Skips and bins must be emptied regularly, removed from the construction sites and transported to a DWAF-registered recycling and waste facility. • Excess concrete, building rubble or other material must be disposed of in areas designated specifically for this purpose or at a registered facility. • Notice boards along roads creating increased awareness to keep the environment clean and penalties for littering from vehicles, and illegal dumping along the roads
Ineffective maintenance of road and storm water infrastructure and impact of storm water run-off	Low	• Storm-water infrastructure should be designed to reduce flow velocity and avoid stream bank and soil erosion. • Disturbed surfaces must be re-vegetated immediately after completion of construction activities in each area. • Regular inspection and maintenance of road storm water management measures, as well as erosion control measures on road surface and along road verges, is important. Apart from regular routine inspections, inspections should also be conducted after every significant storm events.
Road safety and personal security risks resulting from through traffic	Medium	• Strict traffic speed control measures should be introduced in the DGR, including the use of ticket dispensers and readers, and the erection of traffic speed limit signs • Random speed trapping could be undertaken on public roads within the DGR • Random checks of baggage of vehicles should be conducted at the entrance and exit gates to avoid poaching of game along public roads • Other traffic calming measures along public roads should be investigated and implemented in consultation with the relevant roads authority
Potential ecological impacts of road construction / maintenance activities and through traffic in the DGR	Medium	• Disturbance of indigenous fauna and flora, and the natural ecology along road reserves must be avoided and must only be cleared to provide essential access for construction purposes. • Gathering of firewood, fruit, medicinal plants, crops or any other natural material or the poaching of small animals adjacent to roads are strictly forbidden. • Snakes and other reptiles that may be encountered along roads must not be killed unless the animal endangers the life of a commuter. • Avoid the introduction of exotic plant species along road verges and surrounding areas through the use of imported material. • Plant invader species favour disturbed soil (i.e. areas with low competition) and pose the biggest threat to indigenous vegetation in and adjacent to road reserves. These species must be eradicated before they can spread.

2.2.2.2.2 LAND OWNERS

A. MANAGEMENT OF ISLAND FARMS AND PROPERTIES

A.1) VISION AND OBJECTIVES

A.1.1) Vision

It is the Vision of DGR that Island Farms and Properties could eventually be phased out whilst ensuring that current and future developments and activities that impact negatively on DGR would be minimised.

A.1.2) Objectives

The Objective regarding Island Farms and Properties is to develop Policies and Guidelines that will militate against the negative impacts on DGR until they can be incorporated into DGR.

A.1.3) Desired State

The desired state for DGR regarding Island Farms and Properties in the long term is to have them fully integrated as part of a Nature Reserve proclaimed by government under the NEMA Protected Areas Act.

Understanding that proclamation has not yet been achieved, that all land owners may not yet be willing to incorporate their land and that the existence of Island Farms and Properties are likely to cause negative impacts between DGR and these properties, policies and operational guidelines will be in place to address these areas of possible impact. The operational guidelines required for island properties in the interim need to deal with collaborative management in terms of:

(i) Development Control, Impacts and Impact Mitigating Measures;
(ii) Fire Break Management;
(iii) Fence Management; and
(iv) Traversing.

These operational guidelines as a first option will be implemented by the DGR through collaboration with property owners, failing which legal action will be used to enforce compliance in terms of the powers granted to the DGRMA through the NEMA Act, once DGR is registered as a Nature Reserve.

These operational guidelines as a first option will be implemented by DGR through collaboration with property owners, failing which legal action will be used to enforce compliance.

A.2) POLICY AND OPERATIONAL GUIDELINES

A.2.1) Development Control, Impacts and Impact Mitigation Measures

A.2.1.1) POLICIES

It will be policy to control developments and manage island properties in such a manner that the negative environmental impacts will be minimised and the eventual potential for incorporation optimised, until Island Properties could be fully incorporated with and integrated into DGR.

A.2.1.2) STRATEGIES

The overall control over developments and the management of environmental impacts will be achieved by:

(i) Registering DGR as a formally proclaimed Nature Reserve under the Protected Areas Act, 2003 with clearly indicated expansion areas;
(ii) Pro-actively striving towards integrating DGR's vision, aims and objectives and the desired state of land use for the DGR, island properties and expansion areas into land use plans of government at all levels to limit negative environmental impacts and further development of undesirable land use practices;

(iii) Striving to create mutually beneficial relationships and collaborative solutions to negative environmental impacts between DGR and owners of island properties; and
(iv) Utilising available legislation to enforce compliance where it cannot be achieved through collaboration.

A.2.1.3) OPERATIONAL GUIDELINES

Registering DGR as a Nature Reserve with indicated expansion areas

DGR will be registered as a Nature Reserve under the NEMA: Protected Areas Act, 2003. Expansion areas including the Island farms and Properties as at time of registration will be reflected in the application for registration.

Land use management

DGR should use available land use legislation to manage the developments and activities on island properties as follows:

(i) Pro-actively use every opportunity to integrate the DGR land use aims and objectives with that of government. Available land use management tools of government include EMFs, SDFs and IDPs. The aim of this is to ensure that the desired state of land use as well as that of island properties, other neighbouring land and targeted expansion areas (as reflected in the application for registration as a Nature Reserve) are reflected in government land use plans and can be enforced by government. These land use tools should be used as the most appropriate legal tool outside the DGR with which to minimise negative environmental impact and undesirable land use on island properties.
(ii) DGR should regularly monitor land use on island properties so that developments and activities with negative environmental impacts resulting from inappropriate land use or land management practises could be timely identified and addressed.
(iii) Such impacts should be brought to the attention of the land owner and the first attempt should be to obtain a joint solution through collaboration, for which appropriate operational guidelines should be developed and implemented.
(iv) Where land use or land management practises on island properties negatively impact on DGR and do not comply with social, environmental or land use laws and/or guidelines of government and/or those rights registered against title of the relevant property and for which willing cooperation with land owners cannot be obtained, the most appropriate legal action should be taken.

A.2.2) Fire Break Management

A.2.2.1) POLICIES

It will be policy to collaborate with island property land owners for the establishment and management of firebreaks in line with appropriate legislation.

A.2.2.2) DESIRED STATE

The desired state regarding fire break management in the DGR by owners, employees and visitors of and to island properties is that fire breaks will be planned and executed in a coordinated and collaborative manner so that the threat of unplanned fires and damage to the environment and property; or injury to man and animals and the costs to all parties involved will be minimised.

A.2.2.3) OPERATIONAL GUIDELINES

Under the National Veld and Forests Fire Management Act, 101 of 1998, Landowners are required to prepare firebreaks on their side of the boundary where there is a reasonable risk of veldfire (section 12(1)).

The Act

According to the Act, the operational guidelines are as follows:

(i) Firebreaks can be prepared in a number of ways, for example, by grading, ploughing, disking, hoeing or burning.

(ii) S16 allows the owner to damage, destroy or remove any protected plants in making a firebreak, despite what the National Forest Act or any other law says. But the owner must transplant protected plants if possible or position the firebreak to avoid protected plants.
(iii) The National Environment Management Act requires biodiversity to be protected, so remind landowners of this when advising them about firebreaks.
(iv) The Act sets out a procedure for burning firebreaks.
(v) Neighbours can agree to reposition a firebreak on a common boundary.

Procedures as prescribed by DWAF:
DGRMA will establish a local Fire Protection Association (FPA) and through liaison with island property land owners and participating land owners, strictly follow the guidelines provided by DWAF for developing firebreaks and where appropriate they will engage affected island property land owners and/or other affected neighbouring land owners in undertaking fire breaks as prescribed by law, in the best interest of DGR. Where neighbours do not agree to cooperate, available legislation will be used to enforce the law.

Requirements for firebreaks

(i) The Act doesn't specify clear requirements for firebreaks. This is because requirements will vary from one situation to the next. Local practice and local issues must determine what the requirements are.
(ii) The Act states that the owner must pay attention to weather, climate, terrain and vegetation in deciding on how to prepare the break.
(iii) The break must:
- be wide enough and long enough to have a reasonable chance of stopping the veldfire
- not cause soil erosion
- be reasonably free of inflammable material (s13).

DWAF provides specific guidelines on how to prepare a firebreak where there is no problem with burning:

Procedure for burning firebreaks when there is no problem with burning
Discuss with neighbours and reach agreement
(i) Determine mutually acceptable dates.
(ii) Inform the (FPA) in the area.
(iii) Burn firebreaks on same day as each other OR be present or have agent present.
(iv) Have enough people present to prevent it from spreading.
(v) If the neighbour is not present on the agreed day, you can burn in his/her absence.

Discuss with neighbours and do not reach agreement
(i) Give 14 days' written notice to neighbours and FPA of day/s on which you intend burning.
(ii) Neighbour must burn firebreaks on same day/s as each other OR be present or have agent present.
(iii) Have enough people present to prevent it from spreading.
(iv) If the neighbour is not present on the notified day, you can burn in his/her absence.

Procedure for burning firebreaks: neighbours agree but on the day, burning can't go ahead
Discuss with neighbours and reach agreement
(i) Determine mutually acceptable dates.
(ii) Inform FPA.

But burning cannot go ahead
(i) Possible reasons:
- FPA objects.
- High fire danger rating.

- Conditions not conducive.

(ii) Inform neighbours and FPA, if there is one:
- that burning cannot be done
- of additional day/s you intend to burn.

(iii) You do not have to give 14 days' notice of these additional days.
(iv) Burn firebreaks on same day as each other OR be present or have agent present.
(v) Have enough people present to prevent it from spreading.
(vi) If the neighbour is not present on the agreed day, you can burn in his/her absence

Procedure for burning firebreaks: neighbours do not agree and on the day, burning cannot go ahead

Discuss with neighbours and do not reach agreement

(i) Give 14 days' written notice to neighbours and FPA of day/s on which you intend burning.
(ii) Neighbour must burn firebreaks on same day/s as each other OR be present or have agent present.

But burning cannot go ahead

(i) Possible reasons:
- FPA objects.
- High fire danger rating.
- Conditions not conducive.

(ii) Inform neighbours & FPA, if there is one:
- that burning cannot be done
- of additional day/s you intend to burn

(iii) You do not have to give 14 days' notice of these additional days.
(iv) Burn firebreaks on same day as each other OR be present or have agent present.
(v) Have enough people present to prevent it from spreading.
(vi) If the neighbour is not present on the agreed day, you can burn in his/her absence.

Procedure for burning firebreaks

(i) If an owner will be absent for longer than 14 days during the period in which firebreaks are usually burnt, s/he must give neighbours an address and phone number where s/he can be contacted.
(ii) An FPA may make rules different to what is in the Act if the Minister approves them. The new rules will apply to members of the FPA.
(iii) But the FPA can always object to the burning of firebreaks by anyone within its area, whether the person is a member or not. In that way, the FPA enforces its own rules on members and non-members.

Exemption from preparing firebreaks

(i) An owner can apply to the Minister to be exempted from preparing firebreaks. The Minister can grant an exemption "for good reason" (s15).
(ii) The FPA in the area (if one exists) must be consulted before granting the exemption.
(iii) Many land owners are requesting an exemption. Most requests are blanket exemption requests e.g. Spoornet.

Co-ordination with other legislation

(i) Burning of firebreaks must co-ordinate with other legislation and regulations.
(ii) Conservation of Agricultural Resources Act (CARA):
- Regulation 12 contains provisions dealing with prevention and control of veldfires, preventing land users from burning or grazing burnt veld without written permission from the executive officer
- Rules of an FPA for burning veld (firebreaks and controlled burns) must not contradict the procedure set out in CARA.

(iii) Atmospheric Pollution Prevention Act:

- Although the Act does not apply to smoke caused by veld fires, it may apply to smoke caused by management practices such as burning firebreaks and controlled burns.
- If occupiers of premises make representation to the local authority regarding smoke that is causing a nuisance, the authority is obliged to serve an abatement notice.
- Failure to comply with the notice (i.e. failure to abate or stop) constitutes an offence.
- FPA rules must take this Act into consideration when dealing with controlled burns.

A.2.3) Fence Management

A.2.3.1) POLICIES

DGR will be fenced in accordance with the ruling GDACE criteria for a Big Five Fence that can at least contain lion and elephant.

A.2.3.2) OPERATIONAL GUIDELINES

Placement

The Big Five Game Fence is developed and belongs to DGR and will generally be placed between three to five metres inside the DGR property parallel with the common boundary with the island properties.

Big Five Fence monitoring and maintenance

The DGRMA, in terms of its legal mandate, will be responsible for the monitoring and maintenance of any Big Five Game Fence on DGR property, or such fence which is erected inside the boundary on the land of participating land owners. This responsibility cannot be that of individual land owners.

Common Boundary Fence Maintenance

A land owner does not relinquish part ownership and joint responsibility for the upkeep of other fences (excluding Big Five fences placed inside the property of participating land owners, as referred to above) along the common boundary with the island properties and therefore has to monitor and maintain such fence in partnership with the island property owner.

Use of corridor between Big Five Fence and common boundary

The corridor created between the Big Five Fence and the common boundary remains the property of the participating land owner and therefore any usage right or responsibility of such corridor remains with the participating land owner. These corridors are useful as potential firebreaks. It is important that the land owner monitors the area to ensure that animals are not trapped in this corridor.

A.2.4) Traversing

A.2.4.1) POLICIES

DGR will honour all servitude and related traversing rights of island properties over the DGR and will seek to find the best solutions to mitigate against negative impacts that may emanate from such traversing rights and activities on DGR and on island properties.

A.2.4.2) DESIRED STATE

The desired state regarding traversing over DGR by owners, employees and visitors of and to island properties is that traversing will be conducted in such a manner that the negative impacts on DGR and those traversing DGR are minimised.

A.2.4.3) OPERATIONAL GUIDELINES

To achieve the desired state, it will be necessary to implement the following operational guidelines:

Traversing rights recognised

All formal traversing rights related to island properties that exist over DGR will be recognised.

Rules, regulations and indemnification

Where these traversing rights are in potential conflict with DGR or are of a potential threat to those traversing DGR, appropriate rules and regulations will be developed by management. The rules and regulations should cover the following aspects:

(i) All servitudes, traversing rights and accesses must be formally registered with DGR, whether they are registered against title or otherwise.

(ii) No land owner, employee, visitor or school child visiting an island property should be allowed in DGR unless they are in a properly enclosed vehicle on a registered or DGR approved road or alternatively under the direct supervision and/or control of DGR or under someone's control to whom DGR has formally delegated such right.

(iii) DGR should provide specifications regarding the type or types of vehicles that are acceptable for carrying passengers through the DGR, considering the dangers posed by Big Five and other animal species.

(iv) Each land owner, employee, visitor or school child entering the DGR for purposes of visiting island farms should be informed of the dangers entering and traversing through DGR, should receive relevant rules and regulations and should sign appropriate documentation to indemnify DGR and its participating land owners from any claim against damage, loss or injury caused whilst traversing through DGR or staying on island properties.

B. DOMESTIC ANIMALS

B.1) VISION AND OBJECTIVES

B.1.1) Desired State

It is DGR's intension that no domestic animals will be allowed to enter into or traverse through DGR unless properly contained in an appropriate vehicle and that all necessary measures will be in place to minimise potential threats from domestic stock traversing through DGR or being kept on Island Farms and Properties.

B.1.2) Objectives

The Primary Objective regarding the threat of Domestic Animals on Island Farms and Properties is to monitor and manage the existence of Domestic Animals and their potential negative impacts and to have mitigating measures in place to deal with such impacts.

B.1.3) Policy And Operational Guidelines

B.1.3.1) POLICY AND STRATEGY

It is DGR's policy to proactively minimise the potential threats arising from passive and active interactions between DGR wildlife and domestic stock on Island Farms and Properties through the introduction of preventative measures, ongoing monitoring and management interventions.

B.1.3.2) OPERATIONAL GUIDELINES

The following strategies will be employed:

a. Disease prevention measures

The presence of current domestic stock on island properties should be determined and monitored on an ongoing basis. Any new animal introductions to island properties should be recorded at entry control points into DGR. With the cooperation of the local veterinary services, any threatening diseases from domestic stock and possible carriers of such disease should be identified and entry points to GDS should have such information at hand. No domestic stock that has a risk of carrying threatening diseases should be allowed into DGR unless proof of appropriate vaccination can be provided.

DGR will formally and in advance inform island property owners of any planned introductions into DGR of animals that could carry a disease potentially harmful to domestic stock on island farms.

b. Disease control

DGR will proactively seek to obtain the cooperation of the state veterinarian services and island property owners in implementing appropriate animal and animal product movements and the implementation of vaccination programmes throughout the year to reduce the risk of disease outbreaks and the potential spread thereof.

Where any disease caused by domestic animals on island properties have been identified, the assistance of the state veterinary services will be called in and the DGR in collaboration with the owners of island properties and the state veterinarian the necessary programmes will be introduced to bring the disease under control.

c. Stray domestic animals

Any stray domestic animals found inside DGR that in the opinion of the DGR may cause a potential threat to the wildlife and ecology of DGR or which animal is regarded to be under threat from predators inside the DGR, will be eradicated, removed or returned to the land owner by the DGR, by whichever method is regarded to be the most expedient, humane and cost-effective at the discretion of DGR.

Although any domestic animal found in DGR will be treated in this manner, special effort will be made to eradicate those domestic animals that are regarded to be dangerous to wildlife and/or human beings inside the DGR are capable of cross-breeding with wild animals or are potential carriers of disease.

d. Transporting animals through DGR

Domestic animals will only be allowed to be transported through the DGR or between one island property and another if contained in a secure vehicle. Where domestic animals are transported through the DGR on a public road, special effort will be made by the DGR to ensure that the animals entering the DGR also leave the DGR. The DGR will enforce appropriate control measurements to ensure that the risk of animals being released into the DGR are minimised.

2.2.2.3 RISK MANAGEMENT

2.2.2.3.1 FENCE MONITORING AND MANAGEMENT

A. DESIRED STATE

It is the Vision of DGR the Big Five fence should be appropriately monitored and maintained through a strict fence monitoring and management plan that will ensure that all valuable species, dangerous animals and large mammals do not escape from the DGR and that the safety of neighbouring communities, land owners and tenants and their property are not threatened by dangerous animals as a result of bad fence monitoring and management; and if animals should escape for whatever reason, that such occurrence will be detected within 24 hours and that appropriate response could be initiated without any delay.

B. OBJECTIVES

The Primary Objective regarding Fence Monitoring and Management is to have appropriate procedures and capacities in place to ensure cost-effective and efficient surveillance and maintenance of the DGR Big 5 Fence on a daily basis.

C. STRATEGIES

The Main Strategies used to achieve the desired state are:

(i) To have the entire perimeter and all private properties fenced with a suitable Big Five fence as specified in the Infrastructure Plan (see section 2.2.3.2)
(ii) To contract an appropriately experienced, skilled and equipped unit or service provider to monitor and maintain the fence on a daily basis.
(iii) To have all incidents of damage or breakage reported as it is detected.
(iv) To have appropriate policies and procedures in place to ensure prompt repairs, response and/or reaction to incidents observed and reported.

D. FENCE MONITORING AND MANAGEMENT GUIDELINES

D.1) FENCE MONITORING AND MANAGEMENT OF PERIMETER FENCE

D.1.1) Policy

The DGRMA will appoint a suitably experienced, skilled and equipped fence monitoring and management service provider to monitor and maintain the perimeter fence between the DGR and neighbours as well as island properties.

All minor incidents will be repaired and recorded on discovery of such incident and will be reported to the DGRMA within 24 hours.

All breakages and serious incidents will be recorded and reported to the DGRMA without any delay, so that appropriate response to such incidents could be initiated without any delay.

D.1.2) Operational Guidelines

The monitoring and management of the Big Five fence is a fairly simple task despite the fact that it requires diligent application and control to ensure appropriate safety and security. The relative simplicity of the task makes it a function that can be outsourced with reasonable ease, provided the service provider is adequately skilled and equipped and the necessary controls are in place on the part of management. Direct 24 hour communication with management is essential, so that incidents can be recorded immediately as and when required.
In broad terms, the typical functions that will be contracted to a fence monitoring and management service provider will include the following elements:

(i) Inspection of the entire fence each day
(ii) Immediate reporting of any signs of breakout or escape by any animals or signs of illegal entry of domestic animals or people
(iii) Effecting minor repairs and maintenance during daily inspections each day
(iv) Recording and reporting status of fence, floodgates, fence road and incidences each day
(v) Reporting completion of inspections and incidences to management on a daily and monthly basis.

Minor maintenance that could be carried out on a daily basis during inspections by the service provider as part of the monitoring and management contract includes the following:

(i) Fence maintenance (poles, wire, apron, wire ties, floodgates, etc)
(ii) Clearing grass, branches and debris from the electric fencing up to 1 metre either side of the fence
(iii) Seasonally and as often as required spray herbicide 1 metre either side of the fence to keep fence clear of grass and shrubs.

Maintenance work that falls outside the normal minor maintenance as defined in the contract will require immediate reporting, especially if security or safety is at risk, to allow management to rectify.

Typical equipment required will include the following:

(i) Vehicle that provides all-weather access;
(ii) 24 Hour communication (either radio or cell-phone);

(iii) Basic maintenance equipment as required; and
(iv) Logbook for recording inspections and incidents.

All of the above fence monitoring and maintenance functions can also be undertaken internally by DGRMA staff.

D.2) FENCE MONITORING AND MANAGEMENT OF PRIVATE PROPERTIES

D.2.1) Policy

Private land owners within the DGR are responsible for securing their own homesteads and infrastructure and the DGR is not responsible for the maintenance of electric Big Five game fencing erected for this purpose.

All minor incidents will be repaired and recorded on discovery of such incident by the land owner and will be reported to the DGRMA within 24 hours, so as to allow management to be aware of and monitor any such incidents.

All breakages and serious incidents will be recorded and reported to the DGRMA without any delay, so that appropriate response to such incidents could be initiated immediately, in collaboration with the relevant land owner.

2.2.2.3.2 SECURITY MANAGEMENT

A. DESIRED STATE

The vision is that the DGR has a security system in place that is able to ensure that any illegal killing of animals is at a low level and does not compromise the status of any species in the DGR. By its presence, the security system will also deter illegal trespassers, house-breaking and thefts

B. POLICY AND OPERATIONAL GUIDELINES

B.1) POLICY

It will be DGR Policy that it will have a cost-effective, well trained and equipped and well managed field ranger (guard) force in place in 2009. This force will be a strong deterrent to poaching and illegal trespass. This force will report to the DGRMA chain of command, whether it is an “In house” force or one that is outsourced to an appropriate service provider.

B.2) OPERATIONAL GUIDELINES

B.2.1) The guiding principles

The guiding principles with regard to the staff component on the DGR are as follows:

(i) The conservation staff employed by the DGRMA will become a cost-effective core of skilled and experienced staff capable of dealing with all routine tasks and the occasional unforeseen situation that may arise;
(ii) Because of the high level of responsibility that will rest with the senior positions, the appointments to these positions will be on the basis of merit. At all other levels, the goal will be to achieve employment equity without compromising on standards of service delivery;
(iii) The DGR will make every effort to recruit and train junior and middle management staff from the local community.
(iv) The security staff employed by the DGR will necessitate the provision of housing and other benefits yet it is desirable to keep infrastructure on the DGR to a minimum. Therefore, where it is cost-effective to do so, DGR will outsource work in order to keep its own staff levels within realistic bounds.

B.2.2) Staff positions and deployment

The staff structure in the DGR has to be addressed as a matter of urgency. It is not direct and appears to be cumbersome and certainly not suited to the development and management of a large Big 5 Game Reserve. The internal relationships and available budget are not known but it is strongly recommended that the DGR appoints a full time champion to manage the development and management of the DGR and this person, whether this is a CEO, Director or General Manager, the person must undertake the following:

B.2.2.1) THE DGR MANAGER

With respect to security on the DGR, the responsibilities of the DGR Manager must be the following:

(i) To manage all security staff on the DGR, including ensuring that their skills and knowledge are of an acceptable standard;
(ii) To assist the DGRMA with the establishment and management of an intelligence network;
(iii) To establish and maintain constructive relations with neighbours, particularly those in the high density townships nearby;
(iv) To manage the re-introduction of potentially dangerous species to the DGR;
(v) To plan and implement specialised anti-poaching training programmes and field exercises;
(vi) To liaise with landowners regarding their absence from the DGR and security problems.

The following key competencies are required for this position:

(i) The ability to work without supervision and to assume the estate management responsibilities of the DGRMA;
(ii) A demonstrated capacity for leadership and the guidance of junior staff;
(iii) At least ten years experience in a position of responsibility in protected area management;
(iv) The ability to represent the DGR and its interests at various provincial and regional gatherings;
(v) Excellent interpersonal skills;
(vi) The ability to handle a potentially dangerous situation with elephant, lion and buffalo;
(vii) The ability to train and mentor field rangers and guides and other DGR employees in bushcraft and safety in the presence of dangerous animals; and
(viii) The ability to produce clear, punctual monthly reports on his work.

B.2.2.2) SECURITY STAFF COMPLEMENT

There needs to be a significant increase in the number of staff that focuses on security and a minimum complement is given in Table 2.22.

Table 2.22 Current and proposed protection staff levels at the DGR

Position	Current	Proposed
DGR General Manager	0	1
Assistant manager	0	1
Senior field ranger	0	1
Field rangers	0	16
Community guards	0	2
Fence patrol guards	4	6
Informers	?	6
Contract gate guards	10	10

B.2.2.3) STAFF DEPLOYMENT AND SURVEILLANCE

Field rangers must be deployed in three-man teams. These teams should do strategic surveillance patrols focussed on high risk areas. These patrols should not follow a fixed routine or pattern. The selection of these high risk areas needs to be done on the ground in conjunction with landowners and the present management team. This will facilitate frequent and rapid access of the high-risk areas of

the DGR on foot. In addition to the surveillance teams, there must be one mobile team that covers the entire DGR. The mobile team would react to information, check on the operation of surveillance patrols and also undertake high profile activities along the roads.

Surveillance teams must have access to suitable ablution facilities and amenities.

B.2.3) Staff capacity

With respect to the future field rangers (guards) to be recruited and trained, it is recommended that:

(i) The minimum level of training for field rangers must be equivalent to NQF (National Qualifications Framework) level 2. This accommodates a person with no formal education but with appropriate experience and skills. This level of training is provided in courses presented by the African Field Ranger Training Services (Tel. 013 741-1554 & 082-905-3271), this is the same company that provides the training at the Southern African Wildlife College and the possibility of presenting this training on the DGR should be investigated;

(ii) All levels of leadership staff must receive appropriate training. It is also imperative that re-training exercises are run several times a year. These should vary from tracking and follow-up exercises to participating in road blocks with the SAPS;

(iii) All staff will need to be taught how to react to potentially dangerous situations with elephant, lion, buffalo and black rhino (if they are introduced).

(iv) One member of each patrol operating in an area frequented by elephant and lion will have to carry a rifle and training in the use of firearms will have to be given to those staff members selected for this role.

(v) At least one specialist tracker should be recruited – this person may not be available locally.

B.2.4) Access control

The greatest poaching threat has come from the fact that the district roads traversing the DGR are legally a public right of way. Control in the form of speed-limits and a no-stopping zone in the DGR needs to be established. This can only be done by establishing a permanent presence on the road.

Irregular patrols along this road must be undertaken to create an awareness with regular users that the road is not a soft option for poaching. Exercises to “test” the security firm should be carried out.

B.2.5) Equipment & Communications

Security staff must have an appropriate uniform and an adequate issue of equipment. It is essential that at least one member of each patrol carries and is able to use a rifle. This rifle should be of a suitable calibre to offer a measure of protection against armed poachers and dangerous game (7.62 or .303).

A VHF high band duplex radio system must be deployed. The repeater for this will require a good elevation and if no suitable mast exists on the property, the possibility of using the nearest cell phone tower should be examined.

One GPS with Cybertracker system should be procured. It will be useful for recording data, but the use of a GPS in any tracking follow-up is a great advantage in placing stop groups to intercept offenders.

B.2.6) Rations

In addition to their wages, field rangers must be provided with a basic ration. The reason for this is that theirs is a 24/7 responsibility and they cannot leave the station to buy food at the end of the day.

B.2.7) Protection monitoring

The effectiveness of any patrolling system can only be evaluated if the degree of measurable effort is compared against measurable results. There needs to be a detailed briefing before any patrol, OP

(Observation Post) or roadblock is conducted. There must then be a detailed debrief on its completion. Junior leader field rangers need to be competent in the use of a GPS and Cybertracker.

The protection staff in each patrol must have a note book and record at least the following:

(i) Number of persons on the patrol or OP;
(ii) Date, time start and finish of patrol or OP;
(iii) Area patrolled and routes taken;
(iv) Wind conditions and weather;
(v) Game seen - location, species, numbers, sex, age and comments;
(vi) Signs of human activity - tracks, snares, other signs etc;
(vii) Actions taken and results.

These data must be collated and safely filed and analysed annually for trends in incidents and observations.

B.2.8) Intelligence gathering

Combating poaching involves pre-emptive action as much as reaction to incidents. The establishment of an information and intelligence system beyond the boundaries of the DGR is important and this needs to be integrated with the Stock Theft Unit of the SAP and other landowners in the area that have significant numbers of game, especially rhino.

If it does not already take place, the person in charge of security must hold regular meetings with the SAPS and other members of the DGRMA for security briefings.

2.2.2.3.3 MINING RIGHTS IN THE DGR

A. DESIRED STATE

No prospecting rights or mining operations will be allowed in the DGR. All new applications for prospecting rights or mining operations in the larger Dinokeng Tourism destination (outside the existing DGR boundaries) will be critically evaluated by all relevant decision makers (including DME, GDACE, DTE, and relevant municipalities) to determine possible indirect or cumulative impacts on the DGR, and potential areas earmarked for future expansion of the DGR. All disused quarries and borrow pits in the DGR will be fully rehabilitated.

B. OBJECTIVES

The vision outlined above will be pursued through the following objectives:

(i) All applications for prospecting rights or mining operations in the DGR will be opposed by the DGRMA
(ii) Applications for prospecting rights and mining operations at locations outside the current DGR boundary, within the larger Dinokeng tourism destination, will be carefully evaluated by the relevant decision making authorities to determine any possible indirect or cumulative impacts on the DGR
(iii) Any application for prospecting right or mining operation in the functional area of influence of the DGR will be subject to the implementation of all best practice management and rehabilitation guidelines, and the DGRMA will be recognised as a key partner in the monitoring of the implementation of these guidelines
(iv) The future expansion areas of the DGR will be considered by DME and GDACE in the processing of any applications for prospecting rights in these areas. In order to enforce this, it is required that protected area status be obtained for the DGR.
(v) All disused small quarrying areas and borrow pits in the DGR will be rehabilitated

Although no mining operations will be allowed in the DGR, in the unlikely event that mining does

take place in the DGR, best practice generic management guidelines should be applicable to all prospecting or mining operations in the functional area of influence of the DGR. These guidelines can also be applied (where relevant) to the rehabilitation of small scale quarrying areas and disused borrow pits in the DGR. The relevant management guidelines, as described in the "M*ining in Metsweding (Best Practice Guidelines)*" report prepared for GDACE (Mining directorate) (Umhlaba Environmental Consulting cc & Prime Resources (Pty) Ltd, 2007), is summarised and the entire report provided in **Annexure 15**.

2.2.3 DEVELOPMENT AND ZONATION

2.2.3.1 DEVELOPMENT POLICY

A. DESIRED STATE

It is the Vision of the DGR that it will be developed and its infrastructure managed in line with accepted industry norms and standards.

Recognising that the DGR was already a high-use game reserve at the time of incorporation as a result of historic private and tourism developments, the DGR desires to limit current and guide future development through this development policy, so that:

(i) the impact on the environment will be limited;
(ii) the visitor experience will be enhanced;
(iii) and the tourism potential optimised for the benefit of the DGR, the adjoining communities and the region.

B. OBJECTIVES

The primary objective regarding developments is that development densities and the development and management of all infrastructure will be guided by norms and guidelines that will ensure optimum use, maximum visitor satisfaction and cost-effective management of the DGR for the benefit of its stake holders. In line with the vision of the DGR to be developed as a fully integrated Big Five Game Reserve recognised as an ecotourism destination, the following objectives will be pursued:

(i) To limit the number and footprint of developments and infrastructure within the DGR;
(ii) To limit the impact of developments on the tourism experience of the DGR;
(iii) To optimise benefits; and
(iv) To seek to continually reduce the development densities in the DGR in an attempt to enhance visitor experience.

C. POLICY AND OPERATIONAL GUIDELINES

C.1) DEVELOPMENT DENSITIES

C.1.1) Policy

It is DGR's policy to acknowledge developments existing on incorporated properties and the resulting high levels of development; whilst simultaneously encouraging land owners to reduce densities without necessarily reducing income and benefit potentials and limiting new developments through the establishment of development guidelines and restrictions.

These guidelines will be based on industry norms and standards and will seek to find means of reducing environmental impact not only through implementing restrictive rules and regulations, but also through finding clever ways in which visitor experiences can be enhanced and benefits can be maintained or improved whilst reducing development impacts.

Due to the historic rights that have been recognised by DGRMA at the time of negotiation the incorporation of land, it is difficult to find an equitable distribution of developments and therefore introducing a logical Zonation policy based upon environmental factors, It is therefore policy that developments on State land will be minimised to reduce the overall development densities and resulting impact.

It will further be policy to consider the ecology, visibility, neighbouring developments and other site specific impacts when new developments are considered.

C.1.2) Operational Guidelines

C.1.2.1) DEVELOPMENT DENSITIES FOR PRIVATE RESIDENCES

The existence of private residences in the DGR and the continued right to a residential unit, associated structures and uses on land owners' land is recognised.

The existing footprints and densities of private residences and structures at the date of signing of agreements will be recognised in future density calculations.

The combined density of private and commercial developments on both private and State land should be limited to a development footprint of 1% of the area of the DGR.

Where the development densities in approved or declared private residences existing at the execution date of agreements exceed the 1% development footprint, the existing footprints are accepted as the upper limit for those residences.

All private residential developments will remain subject to compliance with the legislation and regulations of the competent local, regional and national authorities in terms of land use rights, building regulations, etc.

All other guidelines contained in the existing DGR Development Policy (2005), or any other subsequent density guidelines approved by the DGRMA, will be adhered to.

C.1.2.2) DEVELOPMENT DENSITIES FOR COMMERCIAL DEVELOPMENT ON PRIVATE LAND

The presence of existing commercial tourism developments in the DGR on private land is recognised.

The existing footprints and densities at the date of signing of agreements will be recognised in future density calculations.

Development densities for existing commercial developments should be capped in accordance with the following:

(i) Where the development densities in approved or declared commercial developments on private land existing at the execution date of agreements exceed the 1% footprint limits, the existing footprints are accepted as the upper limits for those developments;

(ii) Excess densities accepted for such existing developments will accrue only to the land owner that signed the agreement and may not be transferred to any other land owner, nominee, land portion or erf within the DGR.

Density guidelines may be adjusted in accordance with changes in market demand and other determining factors, as contained in any other subsequent density guidelines approved by the DGRMA.

The densities for commercial tourism developments will be calculated over the area of the each property in the DGR and in recognition of existing rights.

Rezoning, subdivisions and changes in land use towards compliance with the tourism objectives of the DGR will generally be supported, in accordance with the existing DGR Development Policy (2005), or any other subsequent development policy approved by the DGRMA, provided that potential impacts on the DGR are satisfactorily addressed.

Applications for subdivision of private land to portions no smaller than 100ha for purposes aimed at compliance with the tourism objectives of the DGR will generally be supported provided that potential impacts on the DGR are satisfactorily addressed.

All other guidelines contained in the existing DGR Development Policy (2005), or any other subsequent density guidelines approved by the DGRMA, will be adhered to.

C.1.2.3) DEVELOPMENT DENSITIES FOR COMMERCIAL DEVELOPMENT ON STATE LAND

In order to maintain acceptable density norms for the DGR as a whole, developments on State land will be determined in accordance with the 1% development footprint density guideline and will attempt to stay within acceptable benchmarked density norms as presented above.

C.1.2.4) DEVELOPMENT IN SENSITIVE AREAS

No development will be allowed in sensitive areas such as wetlands (refer to Map 9 - Hydrology).

C.1.2.5) EXPANSION OF THE DGR

In order to maintain acceptable density norms, the incorporation of additional land into the DGR will be sought. Land incorporated into the DGR in the future may be subject to greater limitations to assist the greater DGR in conforming to benchmarked density norms as presented above.

C.2) INFRASTRUCTURE DEVELOPMENT

C.2.1) Policy

The development of infrastructure will be carefully monitored and controlled with the overall and long-term objective being to reduce the high levels of development within DGR. Where developments are in need of substantial renovation or replacement, an effort will be made to reduce the footprint and/or the impact of developments through the adoption of development and operational guidelines provided below.

C.2.2) Operational Guidelines

C.2.2.1) PERIPHERAL DEVELOPMENT OF MANAGEMENT INFRASTRUCTURE

The unique ownership structure of the DGR where multiple private land owners and the State have incorporated land into a single reserve will be recognised. It is acknowledged that these arrangements, the associated private residential rights and the historic development patterns on individual land parcels are inherited by the DGR. Limited control over the removal of such infrastructure is, therefore, accepted.

A peripheral development strategy and the clustering of management infrastructure around gateways will be adopted for the development of management infrastructure as far as is practically possible in an effort to reduce the fragmentation and impact of infrastructure development on the DGR.

The facilitation of new developments outside the DGR that can divert internal pressures, stimulate the creation of new regional products and generate new benefits and opportunities for local communities will also be encouraged and partnerships with existing products such as the Carousel will be sought.

C.2.2.2) OTHER REQUIREMENTS

All infrastructure development will take place in accordance with the Physical Infrastructure Development Plan (see section 2.2.3.2).

All other guidelines pertaining to infrastructure development contained in the existing DGR Development Policy (2005), or any other subsequent development guidelines approved by the DGRMA, will be adhered to.

For any development, an EIA must be undertaken should it be required as per national legislation and regulations.

C.3) MANAGEMENT OF TOURISM ACTIVITIES AND VISITOR DENSITIES

C.3.1) Policy

A flexible approach to visitor carrying capacities will be followed, rather than setting fixed limits on visitor numbers, in accordance with market demand, levels of utilisation and the eco-tourism vision of the DGR. Through adaptive management, the impact of tourism will be measured over time and the DGRMA in collaboration with land owners and tourism developers and operators will annually evaluate and consider means of improving visitor experiences and tourism benefits whilst reducing the impact of tourism developments and activities.

C.3.2) Operational Guidelines

C.3.2.1) TOURISM ACTIVITIES

All tourism activities conducted in the DGR will be classified and approved by the DGRMA into high and low impact activities, in accordance with the DGR Development Policy (2005), or any other subsequent development guidelines approved by the DGRMA.

C.3.2.2) VISITOR DENSITIES

Visitor densities will be determined as a density over the DGR as a whole, as there is no geographic or spatial logic in terms of high and low density nodes inherited from historic densities on private land. The decision to not have any developments of substance on State land contributes in countering the high densities on private land, thereby reducing the overall densities. Development on State land has not been finalised, but visitor densities and numbers will be affected by the eventual tourism options implemented on the State land.

Day visitor levels will be restricted through limits on vehicle permits and other operator activities. High impact day visitor levels will be monitored and visitor densities of 1 high impact day visitor per 55ha will be allowed, as determined by the DGR Development Policy (2005).

Visitor densities will be monitored and controls on day visitor numbers annually reviewed and adjusted in line with utilisation and impact levels of visitors, in accordance with the DGR Development Policy (2005), or any other subsequent development guidelines approved by the DGRMA.

C.3.2.3) ACCESS CONTROL & USER FEES

Road access control measures will be put in place in order to allow for the control of traffic as a monitoring and management measure to ensure the safety of road users and the security of animals in the DGR.

Self-drive visitors will be subject to the issue of an appropriate permit. The size of the DGR does, however, not currently allow for self drive tourism. Only once the DGR has significantly expanded will self-drive visitation be introduced.

Visitors to the DGR (including concessionaire guests) will pay an exit fee proportionate to their length of stay and/or in accordance with the season of their visit, as determined and approved by the DGRMA. This may also include a differential rate for “in-season”, “off-season”, “mid-week”, “weekend” or “peak season” visitors as well as affordable rates for certain target markets such as local communities, pensioners, etc.

C.3.2.4) VEHICLES & TRAVERSING

Both self-drive as well as guided game viewing activities will be allowed in the DGR. However, the size of the DGR does not currently allow for self-drive tourism.

Self-drive game viewing, when implemented, will be restricted to specified Green and Yellow roads as determined by the DGRMA and in accordance with the road classifications set out in the in the DGR Development Policy (2005), or any other subsequent development guidelines approved by the DGRMA.

Registration with the DGRMA of all vehicles to be utilised for game drive or other commercial activities will be required, together with confirmation that appropriate licences, operator's permits, insurances, etc. have been obtained.

Game drive and other special vehicle permits given to concessionaires will be limited to 1 permit per 100ha of land in the DGR, as set out in the DGR Development Policy (2005).

Vehicle permit limits may be adjusted as agreed with the DGRMA or in accordance with any other subsequent density guidelines approved by the DGRMA.

Vehicles utilising public or private rights of way to access accommodation facilities, activity bases or private residences will not be controlled.

A variety of visitor management techniques that are aimed at increasing visitor carrying capacities whilst reducing impacts will be employed. A range of non-driving amenities will be provided to keep visitors occupied off the roads and will include the following:

(i) Interpretation at sites of interest
(ii) Hides and picnic sites
(iii) Restaurants, tea gardens, cafeterias
(iv) Man-made attractions such as predator parks, breeding camps, rehabilitation centres, etc.

Scheduled conducted game drives with maximum passengers per trip will be encouraged to reduce the number of vehicles on the roads.

Rules to minimise vehicles at animal sightings will be negotiated and agreed with concessionaires in order to enhance the visitor experience. Other measures such as route reservation procedures, radio communication, precedence management and minimum separation on routes may be negotiated and implemented by the DGRMA.

All non-vehicular activities will have to be guided, due to the presence of dangerous game.

All other guidelines pertaining to the control of vehicles and traversing rights contained in the existing DGR Development Policy (2005), or any other subsequent development guidelines approved by the DGRMA, will be adhered to.

C.3.2.5) LIMITS OF DEVELOPMENT AND USE

All concessionaire agreements will have explicit limits placed on sizes and levels of development, type and level of activities and on the nature and capacities of traversing rights, as determined by the DGR Development Policy (2005), or any other subsequent development guidelines approved by the DGRMA.

2.2.3.2 INFRASTRUCTURE

A. DESIRED STATE

It is the Vision of DGR that appropriate infrastructure should be in place that will enable the professional management of DGR in line with its stated objectives and strategies. The composition, locality and design of this infrastructure will be aimed at provision of cost-effective and efficient support to the operational management and optimum utilisation of DGR.

B. OBJECTIVES

The Primary Objective regarding Physical Infrastructure is to have appropriate facilities and support services cost-effectively developed in appropriate localities that will enable efficient management of DGR and its assets in line with management policies and strategies.

C. STRATEGIES

The Main Strategies used to achieve the Desired State are:

(i) To direct and control the development of infrastructure in line with a Development Plan
(ii) To optimise cost-efficiency by utilising available infrastructure in existence on private land before investing in new infrastructure
(iii) To encourage the phasing out and eventual demolition of redundant infrastructure
(iv) To develop infrastructure essential to the management and utilisation of the DGR that is not yet in place.

D. POLICY AND OPERATIONAL GUIDELINES

D.1) OVERALL INFRASTRUCTURE POLICIES

D.1.1) Policy Guidelines

All infrastructure development must take place in accordance with integrated environmental management principles and procedures within which the following needs to be considered:

(i) Full compliance with the policies and guidelines as provided in this document
(ii) Compliance with registered land rights, Environmental Impact Assessment (EIA) processes and any other relevant legislation
(iii) Potential visual impacts
(iv) Applicable building and safety standards
(v) Saving of energy and waste management
(vi) Rehabilitation of construction sites.

The DGRMA, once appointed as the management authority by the MEC or the Minister under the Protected Areas Act, has the right to monitor and enforce compliance with policies through normal legal action, and any costs associated therewith may pass to the land owner/developer.

D.1.2) Responsibility for Infrastructure

The DGRMA will be responsible for the development and/or procurement as well as the maintenance of appropriate game reserve and conservation infrastructure and will decide on standards and quality required and the final placement of developments. This will be done in collaboration and with the assistance of land owners, within budgetary constraints and in accordance with specified needs.

Physical game reserve and conservation infrastructure will only be developed as required and will not be duplicated if such infrastructure already exists in appropriate location/s on private land where the land owner is willing and able to make such infrastructure available to the DGR.

D.1.3) Existing Infrastructure and Control over Developments

Land owners can retain the infrastructure present on properties at the time of agreeing to incorporation of their land. No new infrastructure will be developed and existing infrastructure will not be replaced or expanded without the approval of DGRMA. As a guiding principle, no replacement or expansion

will be allowed unless it is essential for the management of the DGR in line with stated objectives, strategies and policy guidelines. Control over development will be made possible through the rights afforded to the DGRMA, once appointed as the management authority of the proclaimed Protected Area, or in accordance with existing municipal development policies.

D.1.4) Responsibility for New Infrastructure

Where the necessary game reserve and conservation infrastructure is not in place, DGRMA will determine the need, procure appropriate funding and develop the necessary infrastructure.

Where bulk services are required by DGR management, land owners and/or tourism developers and operators, procurement and/or development of such bulk services will be the responsibility of the beneficiaries thereof, although the DGRMA will control standards and determine the location of such infrastructure.

Development of new infrastructure will not be permitted unless it is deemed essential for the management of the DGR in line with stated objectives, strategies and policy guidelines of the DGR. All those additional services required for park management will be supplied and maintained from the reserves capital and operational budgets respectively.

For any new developments, an EIA must be undertaken according to DGR guidelines.

D.1.5) Redundant Infrastructure

Land owners will be encouraged to identify and remove redundant infrastructure in an effort to reduce the footprint of inherited infrastructure that does not materially contribute towards the cost-effective and efficient management of DGR.

D.2) ADMINISTRATIVE INFRASTRUCTURE

D.2.1) Policies

Administrative infrastructure required for the proper management of DGR will be provided at regional service centres.

Minimum infrastructure that should be contained at regional centres includes:

(i) Offices;
(ii) Workshops; and
(iii) Gateways.

At present, the management of DGR will be serviced by three regional centres, each providing basic support infrastructure servicing the relevant region. The most logical regional dispensation is to have a Northern Region, Southern Region and Eastern Region, as depicted in the administrative infrastructure map, Map 25.

Where possible, management infrastructure (other than gateways) is centralised at regional centres to avoid the unnecessary spread of infrastructure. The use of existing facilities that can be used as service centres will be negotiated with and procured from participating land owners before any investment is made in infrastructure by DGRMA.

The placement of gateways is determined by the main roads that form the major routes into and through DGR as depicted by the administrative infrastructure map, Map 25. Gateways will have minimum infrastructure developed to control access and thoroughfare into and through the DGR in accordance with standards set by the DGRMA.

D.2.2) Guidelines

The following minimum facilities and equipment are required at each of the regional centres:

(i) Workshop with basic equipment, ideally comprising:

a. Work benches
b. Service pit
c. Full set of standard mechanical tools
d. Back-up generator

(ii) Stores and management supplies for:
a. Road maintenance materials
b. Emergency fence maintenance materials
c. Storage for vehicles and equipment
d. Sheds or shaded parking
e. Safe for firearms, confiscated items, valuables, etc.

(iii) Office with basic furniture and equipment per regional centre, ideally comprising the following items:
a. Printer (large), copier and fax machine;
b. Working table, ringbinder, shredder and guillotine;
c. Boardroom table and chairs;
d. White board, projector, projector screen and flip-chart stand;
e. Stationary cupboard, filing cabinets and book cases;
f. Kitchen equipment including kettle, fridge, microwave oven and general cutlery and crockery.

(iv) Offices for field and administrative staff; ideally comprising the following per work station:
a. Desktop computer;
b. Small printer;
c. Desk, chair & visitors' chairs;
d. Desktop organiser;
e. Filing cabinet & book case;
f. Telephone;
g. Waste paper bin.

(v) Staff Housing:
a. Staff housing for staff that are required on site for 24 hours

(vi) Vehicles and Equipment:
a. Vehicles for field staff
b. Vehicles for maintenance staff
c. Transport vehicles for staff
d. Tractor and trailer
e. TLB
f. Grader
g. Bowser
h. Fire fighter

All gateways into the DGR will be under the control of the DGRMA. Should land owners or developers wish to have additional gates other than those already present; the implementation, maintenance and staff costs will be borne by such land owners or developers. This includes requirements for additional DGRMA staff accommodation and salaries and any other costs, if deemed necessary by the DGRMA.

D.3) CONSERVATION INFRASTRUCTURE

D.3.1) Policies

Conservation infrastructure required for the proper management of DGR will be provided at appropriate localities throughout the DGR.

Minimum conservation infrastructure includes:

(i) Fencing;
(ii) Game Release Bomas and Ramps;

(iii) Breeding Camps; and
(iv) Water points.

The DGR is fenced with a Big 5 standard game fence in accordance with the specifications laid down by the DGRMA (see section 2.2.3.2 (D.3.2)) that is regarded as a minimum requirement for containing animals and the protection of residential properties of land owners, tourism accommodation facilities, island properties and neighbouring properties.

The DGRMA will ensure adequate fencing is provided to contain the animals that occur in the DGR. DGRMA will ensure that this is maintained in good condition. All DGRMA staff accommodation and facilities will be protected from wild animals where relevant. The land owners and the tourism developers and operators are responsible for ensuring the safety of their own staff and guests and should fence their residential-, staff-, guest- and associated facilities adequately. Should they not be fenced, then the DGRMA will not be liable for any claims that may arise from damage to property, injury or loss of life. Erection and maintenance of fencing of private property will be in accordance with the specifications laid down by the DGRMA (see section 2.2.3.2 (D.3.2)).

The use of existing game release bomas and ramps, breeding camps and water points that can be used by DGR will be negotiated with and procured from participating land owners before any investment is made into such infrastructure by the DGRMA. It is however essential to consider and comply with other DGR policies and guidelines, when deciding to develop or use existing conservation infrastructure.

D.3.2) Guidelines

D.3.2.1) FENCING

The fencing should be compliant with Big 5 standards as approved by the Provincial body GDACE, currently with the following specifications:

(i) An electrified perimeter game proof fence of 2.4m height with a minimum of 24 strands (non-electrified);
(ii) Electrified on the inside of the game fence with at least five strands of electrical wires, with a minimum diameter of 2.24mm;
(iii) Trip line 0.6 m from fence base and electrified;
(iv) Bottom strand: at ground level with 225mm double offset brackets;
(v) Second strand: at 500mm above ground level with 225mm double offset brackets;
(vi) Third strand: 1m above ground level with 225mm double offset brackets;
(vii) Fourth strand: 1.5m with 225mm or 450mm double offset brackets;
(viii) Top strand: on top of fence (2.4m above ground level) with 450mm double offset brackets;
(ix) Earth strand: (double offset) 10cm on the inside of each live wire strand;
(x) Minimum voltage of 6000V should be maintained on the whole peripheral electrified fence; and
(xi) Energisers large enough to maintain at least 6000V over a distance of 8 km and do not release less than 6 Joules.

The specifications may be amended by the DGRMA as new knowledge and/or technology is developed.

The perimeter fence and fences around island properties will be monitored and managed by the DGRMA in accordance with the policies and guidelines set out in section 2.2.3.2 of this report.

All land owners and tourism developers and operators will maintain their own fences around their homesteads, staff accommodation and tourism facilities in order to ensure the safety of their staff and guests.

D.3.2.2) GAME RELEASE RAMPS AND BOMAS, BREEDING CAMPS AND WATER POINTS

Recognising that the need for game release bomas and ramps, breeding camps and water points will change over time, the DGRMA will regularly map and keep a register of all approved game release ramps and bomas to ensure that it complies with minimum standards and requirements and is aligned with the conservation policies and needs at that time. The DGRMA may insist that redundant conservation infrastructure be demolished and/or removed.

D.4) RESERVE INFRASTRUCTURE

D.4.1) Policies

Reserve infrastructure required for the proper management of DGR will be provided at appropriate localities throughout the DGR.

Minimum reserve infrastructure includes:

(i) Staff Housing;
(ii) Management Roads;
(iii) Quarries;
(iv) Service Gates; and
(v) Communications.

The DGR relies on basic reserve infrastructure developed by individual land owners and the DGRMA will make use of this infrastructure before adding any additional infrastructure. The use of existing staff housing, management roads, quarries, service gates and communications that can be used will be negotiated with and procured from participating land owners before any investment is made in infrastructure by DGRMA. Compliance with natural resource policies and guidelines when deciding to develop or use existing reserve infrastructure, is however essential.

D.4.2) Development Guidelines

D.4.2.1) STAFF HOUSING

The DGRMA will as far as possible not provide housing for staff inside the DGR but will have staff find their own housing outside the DGR. Land owners and tourism operators will also be encouraged to have staff housed in neighbouring towns and transported into DGR on a daily basis. Only personnel that are required to be on standby on the property should be housed inside DGR. This will require a pro-active effort by all land owners to have staff housing phased out from the DGR over time.

D.4.2.2) MANAGEMENT ROADS

The DGR has adequate tourist and land owner management roads in place and do not foresee the need for any new management roads. DGR management has the right of way on all roads inside the DGR for management purposes and will use these accordingly.

The policy guidelines in the existing DGR Development Policy (2005) regarding the construction of Roads and Paths, or any other subsequent construction guidelines approved by the DGRMA, will be adhered to.

D.4.2.3) QUARRIES

Gravel for road construction and maintenance can only be collected from outside the DGR and no quarrying of road material will be allowed inside DGR.

D.4.2.4) SERVICE GATES

A number of service gates have been developed along the periphery of DGR (see Map 25). These service gates are developed and are maintained by the DGRMA in accordance with set standards.

D.4.2.5) SECURITY OUTPOSTS

DGR will not have any security staff stationed along the perimeter fence or elsewhere inside DGR and therefore do not require security outposts, as security patrols will be operated on a random basis.

D.4.2.6) COMMUNICATIONS

DGR will make use of cell-phone and two-way radio communication for reserve management functions and do not require new infrastructure in the foreseeable future. Should the need however arise, the DGRMA will decide on the best locality/ies and standards for the development of a central radio base and for the erection of a repeater station/s. It is foreseen that this requirement will most likely be identified for purposes of dealing with emergencies and security.

D.5) TOURISM AND TOURISM SUPPORT INFRASTRUCTURE

D.5.1) Policies

Tourism support infrastructure in operation and required by private tourism developers, operators and their guests will be provided at appropriate localities throughout the DGR. No new developments will be allowed on private land post incorporation, unless specific approval is granted by the DGRMA in accordance with the development policies of the DGR. The provision and control of such support infrastructure by the DGRMA is subject to the appointment of the DGRMA as the management authority under the Protected Areas Act. In the interim, the DGRMA will promote and make recommendations on the provision of such infrastructure by private tourism operators.

Minimum tourism support infrastructure includes:

(i) Tourism Lodges, Resorts, Facilities, Amenities and Bulk Services;
(ii) Tourism Roads and Tracks;
(iii) Signage; and
(iv) Air Strips.

D.5.2) Development Guidelines

D.5.2.1) TOURISM LODGES, RESORTS, FACILITIES, AMENITIES

Tourism lodges, resorts, facilities and amenities cannot be expanded without the approval of the DGRMA. The guidelines set in section 2.2.3.1 will be used as an upper limit regarding development densities.

Facilities, such as tourism lodges, resorts, facilities and amenities, hides, picnic areas and game viewing waterholes on private land must be built and maintained by the land owner and/or the respective tourism developer/operator and should be registered with the DGRMA. Should operators wish to construct facilities on State land, this must be concessioned in consultation between the State and DGRMA and in compliance with normal tendering or bidding procedures as prescribed by the State. Such tendering or bidding must be agreed to in writing by the DGRMA. If necessary, it should also be negotiated and agreed to in writing with other operators in the DGR on the principle that it is a communal facility and therefore available and accessible to all. Maintenance of those facilities, however, will be to the cost of the lodges. The DGRMA must seek to ensure that waterholes and/or dams are developed according to the water plan for game, by negotiating with, advising and encouraging private land owners to cooperate in this respect. The DGRMA will ensure that these facilities are maintained by the appropriate land owner, or the DGRMA, as may be agreed between the parties.

Telephones, radios, electricity, water and other bulk services for use by tourism developers and operators must be supplied, maintained and paid for by the tourism developers and operators and they must ensure they have sufficient capacity to supply their needs. The DGRMA will provide advice and, where necessary, will endeavour to facilitate negotiations with the relevant government departments in order to get these services into the area.

D.5.2.2) TOURISM ROADS AND TRACKS

Existing roads and trails will be registered by land owners and will be maintained to an agreed format and standard, as described in the DGR Development Policy (2005) or any other subsequent development guidelines approved by the DGRMA. Tourism roads and trails will be classified as follows:

(i) Grade A roads will be public roads and other roads classified as such by the DGRMA, to be used for general game drive activities and self-drive permit holders.
(ii) Grade B roads will be private roads within the DGR open only for registered game drive vehicles and for use by members themselves or other game drive operators with traversing agreements registered with the DGRMA.
(iii) Grade C roads will be private roads reserved for registered game drive vehicles only or 4x4 vehicles with special trail permits.
(iv) Trails are classified as thoroughfares accessible on foot, trail bike or on horseback.

Road densities, sight distances, intersection intervals, construction standards and signage will all be controlled by the DGRMA.

The development of additional roads and trails will be subject to approval of a development plan submitted to the DGRMA and will meet all Local Authority and other statutory requirements, as well as the road development guidelines set out in the DGR Development Policy (2005) or any other subsequent development guidelines approved by the DGRMA.

Road densities of 3km per 100ha with a 50:50 split between roads and trails will be maintained, subject to local variation, as determined by the DGR Development Policy (2005).

Road and trail density guidelines may be adjusted in accordance as required for improved visitor experiences and other determining factors, as contained in any other subsequent density guidelines approved by the DGRMA.

All other guidelines contained pertaining to roads and trails in the existing DGR Development Policy (2005), or any other subsequent density guidelines approved by the DGRMA, will be adhered to.

The policy guidelines in the existing DGR Development Policy (2005) regarding the construction of Roads and Paths, or any other subsequent construction guidelines approved by the DGRMA, will be adhered to.

D.6) PRIVATE DWELLINGS AND RELATED INFRASTRUCTURE

D.6.1) Policies

Private dwellings and related infrastructure belonging to land owners exist on their property. Although the DGR has no say over the existence or use of such infrastructure, no new infrastructure or expansion of existing infrastructure will be allowed.

D.6.2) Development Guidelines

To facilitate the necessary control and to minimise the footprint of private dwellings and associated infrastructure, the DGRMA should encourage land owners to demolish all infrastructure that is redundant or unsightly or that threatens the well-being of animals inside the DGR.

2.2.3.3 LAND USE & HOUSING

This section makes recommendations for the management of land uses and includes management recommendations related to housing issues.

A. DESIRED STATE

Existing and future use of land in the DGR will be consistent with and supportive of the overall goal of eco-tourism development. No changes to land use rights which is inconsistent with this goal will be allowed. Clear guidelines will be developed to ensure compatibility of type and architectural style of tourism and residential structures in the DGR. The management of land uses in the buffer area around the DGR boundary will also be sensitive to the goal of eco-tourism development.

B. POLICY OBJECTIVES AND MANAGEMENT RECOMMENDATIONS

Table 2.23 sets out the policy objectives and management recommendations with respect to land use and housing aspects, as it pertains to the DGR.

Table 2.23 Policy Objectives and Management Recommendations: Land Use and Housing

Land Use	DGR context	Impacts	Policy guidelines/recommendations
Formal Residential/ Tourism Development	The distribution and extent of residential and tourism facilities within the DGR has been analysed in detail in section 1.2.5.1 of the report. This information indicated that the residential component accounts for 33.5% of the total development footprint in the DGR, and tourism facilities for 26.5%. It can also realistically be expected that the spatial distribution of tourism facilities will increase in the foreseeable future.	• Loss in biodiversity quantity and habitat fragmentation as result of development footprint • Visual impacts of development, e.g., different styles, densities, etc. • Changes in river flow regimes as result of hardening of catchment areas • Decline in surface water quality due to polluted run-off • Decline in ground water quality as result of household sewerage systems • Lower infiltration to supplement groundwater reserves • Withdrawal of groundwater reserves by boreholes • Increased waste volumes • Increasing possibility of various forms of pollution	• The following guidelines should apply to limit the visual impacts of residential structures and tourism facilities: o Develop a policy on building appearance and outdoor signage, including architectural design, choice of colours and materials, etc. o Over illumination should be prevented. Lighting should be limited to the maximum extent possible, and no unnecessary lighting should be allowed. Where possible, lighting should be switched off during periods of low or no usage, e.g. late evenings and early morning hours, as well as during periods of low/no occupancy. o Light trespass should be avoided. The direction of lighting should be limited to the area where absolutely needed and not allowed to spread onto the surrounding veld or neighbouring properties. o Lights should be pointed downwards to limit contribution to sky glow (which will be significant in the Dinokeng area due to high levels of suspended particles in the area). o Screening vegetation (indigenous trees and shrubs) should be planted and maintained by all land owners to reduce the visual impact of buildings, roads and other infrastructure, disturbed areas, excavations and other features that may reduce the visual appearance of the landscape, on their properties. • Land owners should ensure that sanitation systems on their properties are appropriate for the site specific geotechnical conditions, and are well maintained. • All households should be served by a proper functioning sanitation system, suitable to site specific conditions. • All larger developments in proximity to bulk sewer lines of Tshwane Metropolitan Municipality, should link with those lines. • Waste material should be properly disposed of according to legal

Land Use	DGR context	Impacts	Policy guidelines/recommendations
			requirements and as specified in the waste management guidelines specified in section 2.2.2.2..1 (D) • Every effort should be made by land owners to control/limit soil and wind erosion • Storm water outfalls should be designed not to cause erosion. No surface storm water generated as a result of the development of the area should be directed directly into the riparian or wetland system. • All new fuel storage, if any, should be aboveground and properly bunded. In case of existing underground tanks, groundwater quality monitoring should be regularly conducted to detect possible leakages. In case of spills or leakages, the relevant authorities should be contacted. A spill response strategy should be in place, including the on-site availability of a spill response kit. All relevant legislation and SANS standards regarding the construction, operation, maintenance and decommissioning of tanks should be adhered to • Use of insecticides should be minimised and eliminated where possible, and alternatives (e.g. mosquito nets and window netting) should rather be utilised. • Strict water conservation measures should be adopted • Xeriscape gardening, i.e. the use of xeromorphic or climate appropriate plants (all indigenous) that are adapted to the local climate, should be practiced. Apart from habitat provision, these plants require less water, and are more likely to survive drought conditions. Use of high-maintenance lawns and annual plants should be minimised. • Should any artefacts or other forms of heritage resources be discovered during the operational phase, SAHRA should immediately be notified, and a professional archaeologist should be called in to investigate.

Land Use	DGR context	Impacts	Policy guidelines/recommendations
Informal Housing	The location of informal and semi-formal housing areas is limited to the areas immediately adjacent to the western boundary of the DGR, with specific reference to the Steve Bikoville settlement. As indicated in section 1.2.5.1 of the report, a number of housing provision and services upgrading initiatives are currently underway in this settlement which is likely to lessen the negative impacts on the DGR.	• Air pollution due to the lack of electricity • Loss in biodiversity quantity and habitat fragmentation as result of growth of settlements • Decline in ground water quality as result of pollution, mostly due to lack of service provision • Decline in surface water quality due to pollution • Impacts of littering and illegal waste disposal	• Discourage illegal waste dumping, especially along the border of the DGR and enforce appropriate by-laws. • The DGRMA will support initiatives to upgrade the standards of housing and services provided in the Steve Bikoville settlement • The DGRMA will work closely with relevant authorities to prevent any growth of the existing informal settlement, or the establishment of new informal settlements • Encourage the community to adopt cleaner alternatives to coal and wood burning for heating and cooking, e.g. solar cookers for cooking, and installation of insulation to reduce the need for heating. • Residential areas within the primary zone of influence should act as a buffer between the protected area and the core residential areas further to the west. The community should be encouraged to plant indigenous species to enable the creation of habitat to some of the more mobile species. However, care should be taken to prevent the residential areas from acting as sink habitat. • The community should be encouraged to collect resources such as medicinal plants and honey only as part of approved programmes in the DGR. • The community should be discouraged from damaging the fence, and be made aware of the implications of damage to the fence.
Industrial/ Commercial	The occurrence of industrial/commercial types of development within the DGR is limited to a number of non-participating properties. These include a Brick making factory, a grain mill, a detonator factory, and a retail complex (Safari	• Loss in biodiversity quantity and habitat fragmentation as result of industrial and commercial development • Non-sustainable use of ground water resources • Decline in ground water quality as result of industrial pollution and effluent • Decline in surface water quality due to	• No new commercial or industrial land uses will be allowed in the DGR. The DGRMA should liaise with the NTTLM and other decision making bodies such as the Gauteng Development Tribunal to be recognised as an Interested and Affected party for any such applications on adjacent properties or non-participating properties. • All existing commercial or industrial uses should be operated in terms of the specifications and conditions of approved land use rights. The DGRMA should liaise with the NTTLM to ensure enforcement thereof on surrounding properties and non-participating properties. • The DGRMA should liaise with GDACE to ensure that existing

Land Use	DGR context	Impacts	Policy guidelines/recommendations
	Mall). Although these components are mostly located on island properties, they will have a continued impact on the future operation of the DGR.	industrial/commercial effluent • Loss in biodiversity quality (ecosystem health) as result of soil contamination • Impacts and ambient air quality	commercial/industrial uses are strictly managed in accordance with the conditions and EMP of the environmental authorisation. If applicable, an application for rectification for unlawful activities should be undertaken. • The following management measures should be implemented to minimise risks associated with the transportation, storage, handling, use and disposal of materials, chemicals and other potentially hazardous substances that may be used at industrial/commercial activities on island properties: o All hazardous substances should be transported, stored, handled, used and disposed of according to the legal provisions stipulated in the Occupational Health and Safety Act and other applicable legislation. o Storage areas that contain chemicals and hazardous substances must be bunded with an approved impermeable lining. The containment capacity must equal the capacity of the storage containers. o Material Safety Data Sheets should be kept on-site for each potentially hazardous substance transported, stored or handled on the site. o The landowner and workers dealing with materials and substances must be aware of their potential impacts and follow the appropriate safety measures. o Scheduled hazardous waste and its containers must be disposed of at DWAF- or DEAT- approved facilities. o If applicable, hazardous substances and materials are to be transported in sealed containers or bags. o Hazardous substance storage areas must be designated, demarcated, fenced and roofed if necessary. o Location of hazardous substance storage areas must take into account prevailing winds, distance to water bodies, boreholes and residences in the surrounding area, and on-site topography. o Storage areas should be secure and be safe from access by

Land Use	DGR context	Impacts	Policy guidelines/recommendations
			children and animals. o Hazardous substance storage facilities should be cleaned and maintained regularly and leaking containers should be disposed of without spillage. o Hazardous storage and refuelling areas must be underlain with an impermeable liner to protect groundwater quality. o Storage areas containing hazardous substances and materials must be clearly signed.
Agriculture	Agricultural activities are mostly in the takes the form of extensive cattle farming. With the exception of a limited number of more intensively utilised areas for sheep farming, these activities are generally of a low density and impact. It can also be expected that the occurrence of cattle farming will decrease with the implementation of the DGR. The extent of cultivated areas on participating properties is limited	• Non-sustainable agricultural practices on marginal land • Soil contamination and decline in surface water quality due to agricultural pollution (e.g. pesticides) • Reduced river flows and water quality • Non-sustainable use of ground water resources as result of agricultural activities • Loss in biodiversity quantity and habitat fragmentation as result of agricultural activities • Decline in ground water quality as result of agricultural pollution • Overgrazing and loss in vegetation cover resulting in an increase in soil erosion	• No new clearing of vegetation for cultivation which has not been transformed before, should be allowed in the DGR. • No livestock concentrations will be allowed in the DGR. The DGRMA should liaise with GDACE to ensure that existing livestock concentration areas on non-participating properties have an operation specific Environmental Management Plan. • The DGRMA should liaise with GDACE for the latter to ensure that any livestock areas on surrounding farms or non-participating properties which fall within the ambit of listed activities under Government Notice R386 of 2006, should obtain the necessary environmental authorisation and management plan. These listed activities include: o Activity 1(h): The concentration of animals for the purpose of commercial production in densities that exceed – (i) 20 square meters per head of cattle and more than 500 head of cattle per facility per year; (ii) eight square meters per sheep and more than 1000 sheep per facility per year; (iii) eight square meters per pig and more than 250 pigs per facility per year excluding piglets that are not yet weaned; (iv) 30 square meters per crocodile at any level of production, excluding crocodiles younger than 6 months; (v) three square meters per head of poultry per

Land Use	DGR context	Impacts	Policy guidelines/recommendations
			facility at any time, excluding chicks younger than 20 days; (vi) three square meter per rabbit at and more than 250 rabbits per facility at any time, or (vii) 100 square meters per ostrich and more than 50 ostriches per facility per year or 2500 square meters per breeding pair. o Activity 1 (i): aquaculture production, including mariculture and algae farms, with a product throughput of 10,000kg or more per year. o Activity 1 (j): agri-industrial purposes, outside areas with and existing land use zoning for industrial purposes, that cover an area of 1000 square meters or more.
Mining	See detailed mining information in section 2.2.2.3.3	See detailed recommendations in section 2.2.2.3.3	See detailed recommendations in section 2.2.2.3.3
Planning and management of housing and land use	There are a number of existing spatial and other planning frameworks applicable to the DGR, with some inconsistencies regarding planning guidelines and standards. The capacity of the relevant authority to manage land use rights is also limited	• Inconsistent guidelines for evaluation of applications for changes to land use rights • Land use practices and uses inconsistent with provisions of existing land use rights	• Use the results of the current Environmental Management Framework (EMF) process and the DGR Management Plan to inform the Spatial Development Framework of the municipality, and to inform decisions regarding applications for changes to land use rights and environmental authorisations • Revise the SDF of the local and district municipalities to clearly reflect the long term vision and implementation of the DGR • Prepare a consolidated Land Use Management System for the NTTLM to ensure coordinated and consistent management of land use rights • Inform relevant decision making authorities such as the municipalities, GDACE, DME and others of the proposed future extension of the DGR boundaries to ensure that current decision making processes do not compromise the longer term vision and viability of the DGR

2.3 COSTING PLAN

2.3.1 BUSINESS PLAN

2.3.1.1 ORGANISATIONAL STRUCTURING

2.3.1.1.1 MANAGEMENT AUTHORITY

Each of the participating land owners has to join the LOA which is governed by the LOA constitution. The LOA members elect the DGRMA to represent their interests. Refer Section 1.2.2 and in particular Figures 1.1 and 1.2 for more detail.

2.3.1.1.2 MANAGEMENT AND ORGANISATIONAL STRUCTURE

A. PRINCIPLES

The following principles are applied in determining the operational management structure for the DGR:

(i) Where possible current infrastructure and resources are used to achieve operational capacities, thus attempting not to duplicate any infrastructure that already exists on the land.

(ii) Land owners will assume as much responsibility for the maintenance of their own properties and the infrastructure thereon as practically possible.

(iii) The DGR will only staff and fund the management and maintenance of infrastructure and resources that are collectively owned by the DGR and its members, i.e. the gateways, the Big Five fence and the game.

(iv) As much of the management and maintenance work not carried out by land owners will be outsourced instead of contracting own staff.

(v) Commercial operations are run by the various tourism operators and controlled by the land owners. DGR Management will only play an oversight role.

(vi) Posts are identified according to the type of work and level of responsibility as per the work done in Asia by the ASEAN Regional Centre for Biodiversity Conservation (2003) *Appleton, M.R., Texon, G.I. & Uriarte, M T. (2003) Competence Standards for Protected Area Jobs in South East Asia. ASEAN Regional Centre for Biodiversity Conservation, Los Baños, Philippines* (see **Annexure 16**).

(vii) Costs are determined according to the current norm for other similar sized reserves in South Africa.

B. ORGANISATIONAL STRUCTURE FOR FUNCTIONAL DEPARTMENTALISATION

To achieve business plans and goals and to utilise resources optimally, businesses usually group activities or products together to form functional departments. In order to gain competitive advantage an organisation requires well-defined skills and areas of specialisation. Dividing tasks into specific areas also enables personnel to focus on their area of expertise only. Proposed functional departmentalisation of the DGR is given in Figure 2.8.

The challenge of such an organisational design is the coordination of the different functions. Each department may view the organisation solely from its own perspective. The DGR Manager/Coordinator must ensure that proper coordination mechanisms are in place.

The management structure proposed comprises four components, namely:

(i) Reserve Management;
(ii) Maintenance Management;
(iii) Administration; and
(iv) Security.

The proposed management structure, with the responsibilities of each component, is illustrated in Figure 2.8.

C. POST LEVELS

Five post levels are proposed, from Reserve Manager to labourer, based on job responsibilities and equivalent educational attainment. These levels form the basis for defining the skills requirements for the protected area jobs. It is also foreseen that community members with little formal education will play an important role in the DGR's management. The assessment of job levels should be based primarily on the type of work, level of responsibility and on experience, and not on educational attainment alone. The underlying assumption is that each level should report to the next so that the control span becomes bigger as the level of responsibility increases.

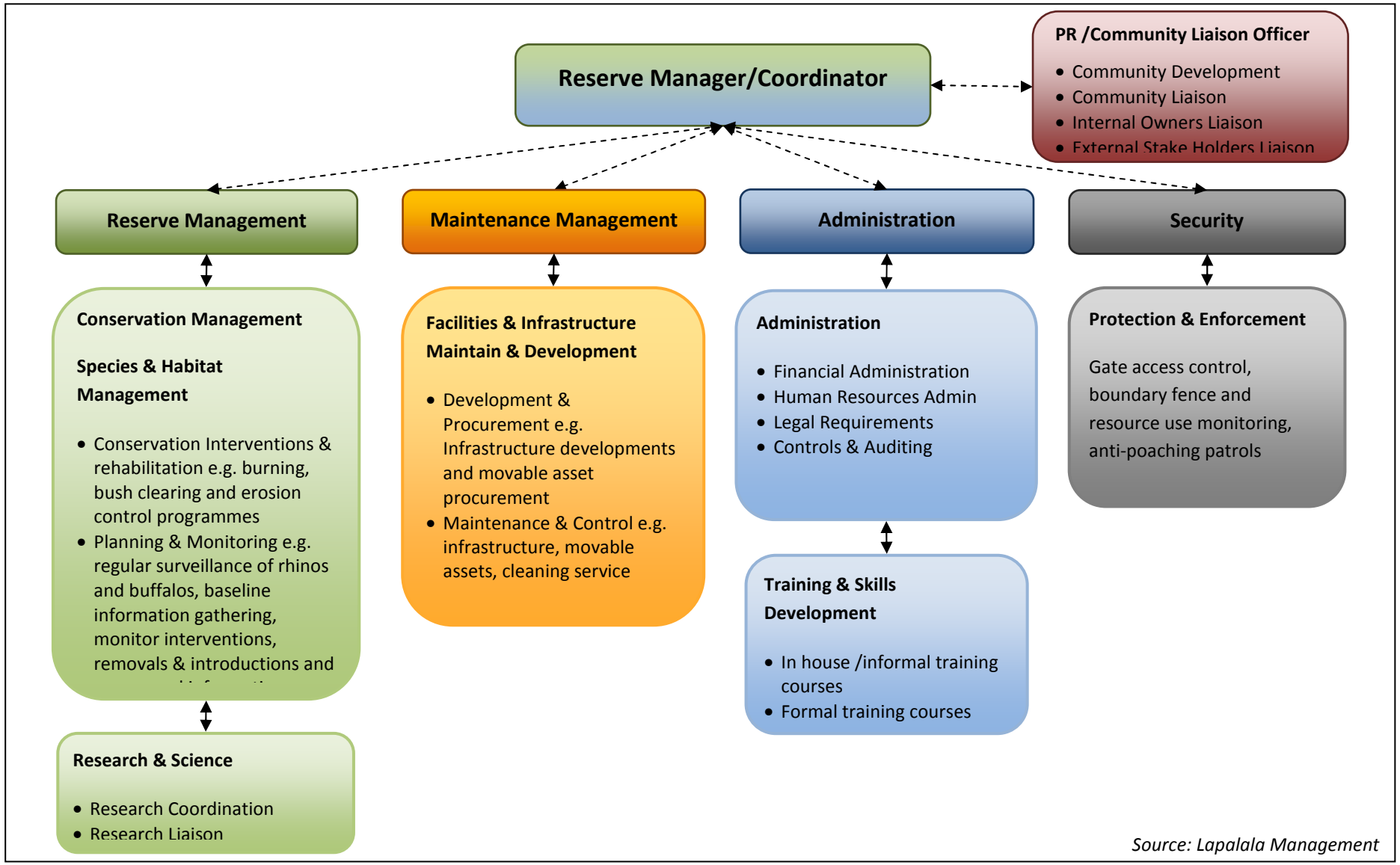
Although not all of these posts may be filled by the DGR due to these functions being provided by the land owners, it is essential that the types and levels of skills required are understood. Therefore the comprehensive list of typical posts is provided.

The following post levels are generally accepted for Game Reserve management:

(i) Non-technical whereby the work is predominantly routine, prescribed and predictable;
(ii) Technical whereby the work is specific but not always predictable and mostly requires certain technical and analytical skills;
(iii) Supervisory whereby the work is managing the flow of specific activities that can be often complex, technical and made up of non-routine tasks;
(iv) Managerial whereby the work is integrating the flow of activities in a complex and technical environment with wide and unpredictable range of contexts.
(v) Senior Management whereby the work is outward looking dealing with the business in its institutional, financial and policy environments.

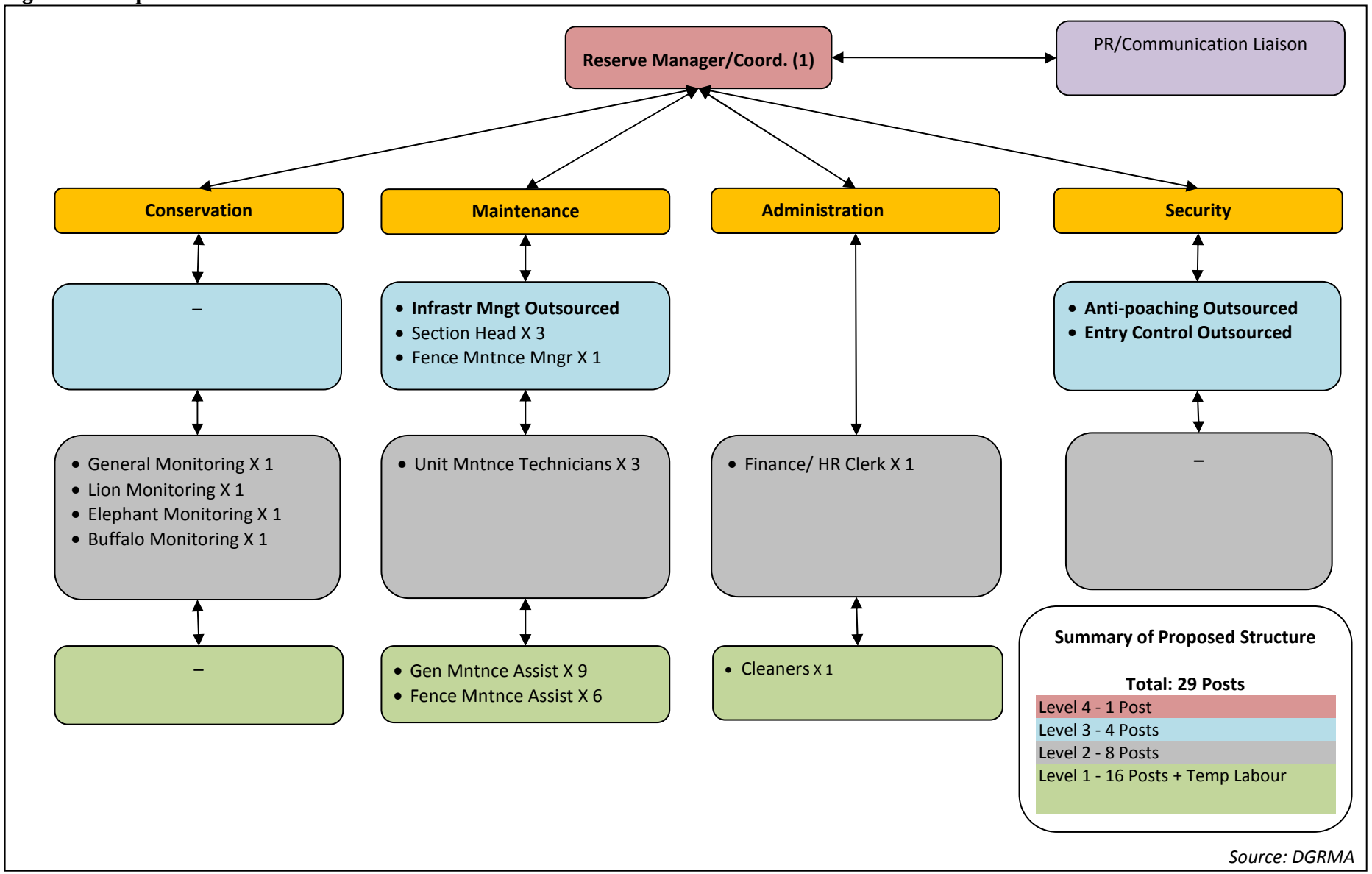
The post levels and staff numbers, as per the organisational structure and in line with the set principles, are provided in the personnel structure in Figure 2.9. The post levels with their respective post descriptions and tasks, as well as the minimum required education levels are provided in Table 2.24.

Figure 2.8 Typical Game Reserve Management Structure



Source: Lapalala Management

Figure 2.9 Proposed Personnel Structure



Source: DGRMA

Table 2.24 Proposed Post Levels and Descriptions

Level of General Responsibility	Type of Work	Management responsibility (Direction, management, supervision, decision making allocation of resources).	Equivalent (but not required) educational level.	Typical Job Title
Level 1 **General Worker** Non-technical responsibilities.	Predominantly routine, prescribed and predictable.	• No supervisory responsibilities. • Limited decision making and accountability.	Intermediate or Elementary School	Cleaner, Clerk, Fence Guard, Field or Maintenance Assistant, Field Monitor or a member of a labour intensive work team
Level 2 **Skilled Worker** Technical responsibilities with some leadership requirements.	Specific but not always predictable tasks that sometimes require technical and analytical skills.	• Completing specific tasks and assignments. • Decision making is limited to ensure completion of specified technical tasks. • Monitoring and reporting related to resource utilisation.	High school or Intermediate School	Gate Attendant, Plant Operators, Law Enforcement Ranger, Store Man, Mechanic, Administrative Officer, Maintenance Technician, Personal Assistant, Field Monitor Cpl
Level 3 **Technical / Supervisory** Supervisory / Mid-level technical responsibilities.	• Managing the flow of specific activities. • Complex, often technical and non-routine performed in a variety of contexts and requiring detailed technical skills.	• Supervision and leadership of staff and work teams. • Planning and supervision of tasks and assignments. • Accountable for resources within clearly defined operational plans.	College Diploma or Technical Certificate or High School	Section Ranger, Section Head, Sergeant
Level 4 Managerial / Higher Technical Project, divisional management and/or high level technical responsibilities.	• Integrating flows of activities into projects and programmes. • Complex and technical work in a wide and unpredictable range of contexts.	• Management of divisions, teams and work groups. • Development and management of projects. • Decision-making within plan frameworks. • Developing and monitoring project or departmental budgets and resources.	Bachelors Degree or College Diploma.	Conservation Manager, Maintenance Manager, Admin & Security Officers
Level 5 Senior Management Strategic and programmatic responsibilities.	• Outward looking, dealing with the organisation in its institutional, financial and policy environments. • Strategic application of complex techniques and approaches across a wide, unpredictable range of contexts.	• Strategic planning, direction, management, and evaluation of complex programmes and plans. • Working with policy and decision makers. • Extensive authority for decision-making and direction. • Overall responsibility for budgets and resources.	Masters or Bachelors Degree	Reserve Manager – Head of Protected Area

Source: Lapalala Management

2.3.1.2 COSTING OF OPERATIONS

2.3.1.2.1 PERSONNEL COSTS

According to the proposed Personnel Structure (see Figure 2.9), it is proposed that the staff complement for the management of the DGR will amount to 29 members of staff, with additional temporary labour being employed on an ad-hoc basis as and when required.

This staff complement will be employed at 4 post levels. It is expected that the following number of staff will be employed in each of the post levels:
Level 4: 1 post;
Level 3: 4 posts;
Level 2: 8 posts; and
Level 1: 16 posts.

The proposed Patterson grading and estimated salaries of each post are provided in Table 2.25.

Table 2.25 Personnel Structure with Paterson Grading and Cost

Department	Job Name	Number	Post Level	Patterson Grade	Basic Monthly Salary			Monthly Salary
					Min	Max	Average	
Conservation Management	Conservation Manager	1	4	D2/D3	19 518	33 823	26 670	26 670
	Field Monitoring - General	1	2	A4	2 281	3 041	2 661	2 661
	Field Monitoring - Lion	1	2	A4	2 281	3 041	2 661	6 945
	Field Monitoring - Elephant	1	2	A4	2 281	3 041	2 661	2 661
	Field Monitoring - Buffalo	1	2	A4	2 281	3 041	2 661	2 661
Maintenance Management	Section Head - North	1	3	C3/C4	9 239	15 400	12 320	12 320
	Maintenance Technician	1	2	B3	3 945	9 255	6 600	6 600
	Maintenance Assistant	3	1	A2	1 730	2 300	2 015	6 045
	Section Head - East	1	3	C3/C4	9 239	15 400	12 320	12 320
	Maintenance Technician	1	2	B3	3 945	9 255	6 600	6 600
	Maintenance Assistant	3	1	A2	1 730	2 300	2 015	6 045
	Section Head - South	1	3	C3/C4	9 239	15 400	12 320	12 320
	Maintenance Technician	1	2	B3	3 945	9 255	6 600	6 600
	Maintenance Assistant	3	1	A2	1 730	2 300	2 015	6 045
	Fence Maintenance Supervisor	1	3	C3/C4	9 239	15 400	12 320	12 320
	Maintenance Assistant - North	2	1	A2	1 730	2 300	2 015	4 030
	Maintenance Assistant - East	2	1	A2	1 730	2 300	2 015	4 030
	Maintenance Assistant - South	2	1	A2	1 730	2 300	2 015	4 030
Administration	Finance/HR Clerk	1	2	B3	3 945	9 255	6 600	6 600
	Cleaners	1	1	A1	1 500	2 000	1 750	1 750
Security	Outsourced							
Total for 29 Staff Members		**29**						**149 253**
Total Annual Salaries								**1 940 289**
Total Annual Salaries (incl. benefits)		**5%**						**2 037 303**

The annual direct staff cost can be calculated by multiplying the monthly staff cost of R149,253 by 13 to make provision for an annual 13th cheque bonus. This results in an annual direct salary cost of 1,940,289. In addition, employer contributions towards pension, medical aid, UIF and uniforms can be assumed at 5% of basic salary costs. This results in an annual salary cost of R2,037,303.

2.3.1.2.2 TYPICAL RESERVE MANAGEMENT COSTS

Based on experience elsewhere, the acceptable cost per hectare for a game reserve of between 20,000ha and 50,000ha in size could be anything between R60 and R350 per hectare per annum depending on the intensity of management (Pilanesberg National Park budget for 2008/09 was R316 per hectare and that of Molopo Game Reserve was R63 per hectare – see Table 2.27). According to the Grant Thornton study, the expected cost (inflation excluded) by year five should be in the order of R6,64m. This equals a cost of R341 per hectare which should be seen as an upper limit for this project.

A reasonable split of costs for a 20,000 – 50,000ha reserve is indicated in Table 2.26.

Table 2.26 Proportionate Costs for a Typical 20,000 – 50,000 ha Reserve

Category	Portion
Administration and Operations	9%
Maintenance	21%
Manpower	60%
Subsistence and Travelling	10%
Internal Operational Costs	**100%**

Source: CONTOUR

2.3.1.2.3 ESTIMATED DGR MANAGEMENT COSTS

A. COSTING METHODOLOGY

The cost of managing a game reserve can be calculated by using the staff cost and its proportionate contribution to total operating costs as a basis. Provided enough thought went into the determination of the staff compliment and the level of experience required, the staff structure and the cost of staff should be a direct reflection of the expected complexity of management for a specific game reserve.

Overall game reserve management costs in turn are also directly influenced by the staff compliment. Every staff member makes demands on other resources such as office backup, uniforms, transport and equipment. There is thus a direct correlation between staff costs and other operating costs. Staff cost can therefore be used as a reasonably accurate method of calculating overall operating costs. Once operational, however, it is essential that a policy of zero-based budgeting be implemented for refining budgets. Although this will eventually be the real acid test for realistic budgeting, it is not possible at this stage, as zero-based budgeting can only be done once the new staff structure is in place and the relevant managers are allocated clear key performance areas and expected deliverables. For the sake of this broad budgeting exercise, the staff cost will be used as a basis for calculating the expected operating costs for DGR.

Staff cost, expressed as a percentage of total operating costs (excluding depreciation), will be based on norms currently experienced in the industry. As a final test, total operating costs between different game reserves will be used as a comparison.

Costs per game reserve and the proportionate contribution of staff to the total costs can vary significantly, depending on a number of factors. Factors that most notably can contribute towards high costs as well as increased staff contribution to costs are:

(i) The size of the property (economies of scale considerations);
(ii) The topography (higher maintenance for mountainous and erodible areas);
(iii) The complexity of fauna and flora populations (intensive management of valuable species, bush encroachment, alien plants, etc);
(iv) The shape of the property (long and thin or many turns and twists in the boundary);
(v) The level of outsourcing; and
(vi) High levels of game and tourism utilisation demanding higher levels of expertise and more intensive management.

B. BENCHMARKING OF OPERATING COSTS AND STAFF COSTS

To develop a comparative yardstick, the following examples of game reserve costs and staff contribution to costs have been used:

(i) Pilanesberg National Park;
(ii) Molopo Game Reserve; and
(iii) Simple game farms.

The comparative data used for Pilanesberg National Park and Molopo Game Reserve were provided by North West Parks and Tourism Board (NWPTB) and that for private game farms by ABSA (http://www.absa.co.za). Previous benchmarking exercises proved that NWPTB parks provide good representative samples with a full range of protected areas from low intensity management to high intensity management.

In Table 2.27, the expected cost contribution of each factor is rated as Extreme, High, Moderate or Low for each game reserve, to obtain some sense of comparison and to assess where the DGR should be pitched.

Table 2.27 Comparative Assessment of Contributors to Cost and Actual Cost per Hectare

Component	Pilanesberg (45,000 ha)	Molopo (24,000 ha)	Game Farms (1,500 – 10,000 ha)	Lapalala/ Motse (42,687 ha)	DGR (18,500 ha)
Size	Moderate	High	High	Moderate	High
Topography	Extreme	Low	Moderate	Extreme	Moderate
Complexity	Extreme	Low	Low	Extreme	Extreme
Shape	High	Low	Moderate	High	High/Extreme
Levels of Utilisation	Extreme	Low	Low	High	High/Extreme
OVERALL	**Extreme**	**Low**	**Moderate**	**High/Extreme**	**High/ Extreme**
COST PER HA	**R316**	**R63**	**R84 – R96**	**R277**	**R359**

Sources: NWPTB, ABSA & GT
Note: The ABSA costs for private game reserves are based on LSUs, rather than hectares. To enable the above comparison of costs, it was assumed that the game farms had a stocking rate of 1 LSU per 7 ha.

Based on the above simple comparison, it is apparent that the DGR can expect its costs per hectare to fall within the high to extreme category, when compared with other game reserves.

The second benchmark after overall cost comparisons is the contribution of staff costs to the total

operating costs. The staff cost contribution for the same comparative properties are listed below:

(i) Lapalala/Motse Game Reserve	65%
(ii) Pilanesberg National Park	62%
(iii) Molopo Game Reserve	66%
(iv) Private Game Farms (1,000 – 7,000ha)	35 - 24%

The private game farms indicated above cannot be used as an appropriate benchmark for the DGR, as they are usually managed by the owners themselves, with costs not reflected against the property, but usually hidden within the owner's accounts or that of his company. These properties are usually not commercialised and without endangered species and therefore do not require skilled staff on site. Mostly, only one or a few labourers stay on the property, with the owner bringing in skills as and when required from his other business ventures.

C. OPERATING COST CALCULATIONS FOR DGR

Considering all of the above, the manpower costs for the DGR are taken at 60% of the total operational costs, from which the other operational categories will be calculated.

Table 2.28 sets out the estimated management costs for the proposed DGR.

Table 2.28 Estimated Operational costs

Category	Portion	Budget
Administration and Operations	9%	305 595
Maintenance	21%	713 056
Manpower	60%	2 037 303
Subsistence and Travelling	10%	339 551
Internal Operational Costs	**100%**	**3 395 505**
Marketing *		0
Anti-poaching contract **		2 640 000
Gateway entry control contract **		960 000
TOTAL OPERATIONAL COSTS		**6 995 505**

*Notes: * Tourism operators in the DGR will club together for marketing of the destination, under a separate budget*

*** As per DGRMA quotes received*

No provision is made for marketing cost

Source: CONTOUR calculations based on DGR staff structure and other DGR assumptions

It is estimated that the total annual operational costs will amount to between R6,64m as per the Grant Thornton study and R6,99m as calculated in Table 2.28, excluding marketing costs.

The management costs provided in the Table 2.28 are based on the following assumptions:

(i) Manpower costs represent 60% of internal operational costs (excluding depreciation);
(ii) Manpower costs equal R2,037,303 (as per salary costs provided in Table 2.25);
(iii) Based on the above, the internal operational budget at present cost should be R6,995,505 (calculated as R2,037,303/ 60%);
(iv) Further provision should be made for specialist services at R2,640,000 for anti-poaching security and R960,000 for entry control and security.

Based on the estimated management costs indicated in Table 2.28, the resulting total operational budget of R6,995,505 equates to a management cost of R378 per ha (R6,995,505/18,500ha). In the case of the NWPTB comparative examples above, the specialist services and marketing costs are provided by their head office and in the case of the private game reserves, these services are not required. Therefore, these costs are not reflected in the cost per hectare figures provided above. In

addition, the management costs for Pilanesberg National Park do not make provision for major road upgrades. The management cost falls within the higher end of the industry norm, as indicated above.

D. SIX YEAR FORECAST OF DGR MANAGEMENT COSTS

The phasing in of a full management capacity over a six year period is shown in Table 2.29.

For the purposes of forecasting the DGR management costs, the current year's budget for DGR is used as the benchmark/ starting point and is then grown at a fixed rate over a period of five years to reach the proposed operational costs once all the tourism products (also those on state land) are fully operational. The proportionate contribution of each management component (i.e. administration and operations, maintenance, etc.) to DGR's total management cost is used throughout. Year six reflects the full complement of staff and costs, when income and expenditures are expected to stabilise.

The outsourced costs are introduced in year two at 75% of the full capacity and increased up to year six when the full capacity will be required. The figures used do not reflect inflation adjustments and are therefore reflected at current values. The cost of equipment is included in the above figures.

No marketing costs are provided, assuming that the tourism operators will make a contribution towards marketing, proportionate to their tourism interests and operations.

Table 2.29 Six Year Forecast of DGR Management Costs

Category	Y1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6
Administration and Operations						305 595
Maintenance						713 056
Manpower						2 037 303
Subsistence and Travelling						339 551
Internal Operational Costs	**2 000 000**	**2 280 000**	**2 560 000**	**2 840 000**	**3 120 000**	**3 395 505**
Marketing	0	0	0	0	0	2 000 000
Anti-poaching contract	-	1 980 000	1 650 000	1 980 000	2 310 000	2 640 000
Gateway entry control contract	-	720 000	600 000	720 000	840 000	960 000
TOTAL OPERATIONAL COSTS	**2 000 000**	**4 980 000**	**5 810 000**	**5 540 000**	**6 270 000**	**8 995 505**

As is evident from the Table 2.29 above, the management costs are grown from the current operational expenditure of DGR up to the level of maturity (from Year 6 onwards) where the DGR will become fully operational with all tourism infrastructure in place.

2.3.1.2.4 INCOME PROJECTIONS

A. CALCULATED VISITOR NUMBERS

Table 2.30 reflects the estimated number of bed nights presently sold at DGR

Table 2.30 Estimated Number of Bed nights presently sold at DGR

Phase	Number of Existing Beds	Number of Existing Bed nights	Number of Beds Sold pa at 44% Occupancy	Number of Beds Sold pa at 49% Occupancy
A1	328	119 720	52 677	58 663
A2 (2009)	84	30 660	13 490	15 023
A2 (2009+)	156	56 940	25 054	27 901
Total	**568**	**207 320**	**91 221**	**101 587**

If the average length of stay used by Grant Thornton of 2.7 nights is applied to the Table 2.30, by dividing the beds sold at each occupancy level by the average length of stay, then it is estimated that the DGR presently attracts between 33,786 and 37,625 overnight visitors per year. For Phase A1, this would equate to between 19,510 and 21,727 overnight visitors per year. Therefore, on this basis, it appears that the projections provided by Grant Thornton for DGR are consistent with the findings of HSSA and these will form the basis of future visitor projections for DGR during Phase 2 of the tourism plan development for state land.

In terms of day visitor levels for DGR, the estimates provided by Grant Thornton cannot be verified due to the absence of accurate visitor records for the DGR but it is suggested that their estimate of 13,000 visitors to Phase A1 could be reliable.

If the ratio between overnight and day visitor demand at DGR for Phase A1 is 60:40, then it could be assumed that the same ratio could apply to the remaining phases, thus bring day visitor levels for Phase A2 to between 9,517 and 10,599. The total estimated visitor levels to DGR for all phases could therefore range between 56,503 and 61,424 annually. An adult/child ratio of 70:30 could be applied.

These figures do not include the projections for the State land options and the Predator Park projections are excluded as they are not relevant to the A1 and A2 start up portions.

The potential of each of the state land options is calculated in Tables 2.31 and 2.32.

Table 2.31 Option Bundu Boma Network

Item	Number
Total sellable nights (4 bomas)	14 600
Sellable nights based on single/double take up	11 680
Actual Take up:	
Y1 35%	4 088
Y2 40%	4 672
Y3 45%	5 256
Y4 50%	5 840
Y5 55%	6 424

Table 2.32 Option Ditholo Bush Stop

Item	Description	Number
Total hospitality sessions	Breakfast/am tea/ lunch/ pm tea	4
Max allowed per session		30
Max covers per day		120
Max covers p.a.	120 x 365	43 800
Max B'Fast	20%	8 760
Max Am Tea	20%	8 760
Max Lunch	2 sessions - 40%	17 520
Max Pm Tea	20%	8 760
Actual Take Up of p.a. figures		
Y1 (30%)	% of max covers p.a.	13 140
Y2 (40%)		17 520
Y3 (50%		21 900
Y4 (60%)		26 280
Y5 (70%)		30 660

Table 2.33 Combined Tourist Numbers

Year	Bundu Boma Network (assume average 2 nights per guest= no of pax)	Ditholo Bush Stop (assume 1.5 covers to get a pax figure (assuming that many will have more than one session at the site)	Total Pax (assume 30% children)
Y1	4 088/2 = 2 044	13 140/1.5 = 8 760	10 804
Y2	4 672/2 = 2 336	17 520/1.5 = 11 680	14 016
Y3	5 256/2 = 2 628	21 900/1.5 = 14 600	17 228
Y4	5 840/2 = 2 920	26 280/1.5 = 17 520	20 440
Y5	6 424/2 = 3 212	30 660/1.5 = 20 440	23 652

B. INDUSTRY NORMS

Table 2.34 reflects the entry fee norms for comparative protected areas.

Table 2.34 Comparative Entry Fees

National Park	Per Overnight Visitor		Per Day Visitor		
	Adults	*Children*	*Adults*	*Children*	*Vehicles*
Addo Elephant National Park	25.00	25.00	25.00	25.00	-
Hluhluwe- Umfolozi Park	45.00	22.50	45.00	22.50	-
Kruger National Park	35.00	35.00	35.00	35.00	-
Mkuze National Park	Included in Accommodation Price	Included in Accommodation Price	35.00	18.00	35.00
Pilanesberg National Park	45.00 (Once off payment)	20.00 (Once off payment)	45.00	20.00	20.00

Based on the above industry norms, it is recommended that Adults pay R40 per visit and children R30 per visit in 2009 and that this is increased to R50 per adult and R35 per child as from 2010 when the

last of the Big Five animals are introduced, capitalising on the proximity of DGR to the main source markets.

No income is expected from game sales (refer section 1.2.4.3.7).

C. CALCULATED INCOME

Based on the above and on an assumption that each adult pays a R40 fee per visit and a child R30 per visit, the income potential for the DGR is projected in Table 2.35.

Table 2.35 Combined Tourist Numbers and Calculated Income

Visitor Numbers		2009	2010	2011	2012	2013	2014
Overnight Visitors (present)	*	33 786	37 625	37 625	37 625	37 625	37 625
Day visitors (present)	**	22 524	25 083	25 083	25 083	25 083	25 083
Overnight visitors (State Land)	***		10 804	14 016	17 228	20 440	23 652
Day visitors (State Land)	**		7 203	9 344	11 485	13 627	15 768
		56 310	**80 715**	**86 068**	**91 422**	**96 775**	**102 128**
Split between children & adults							
Children	30%	16 893	24 215	25 821	27 427	29 033	30 639
Adults	70%	39 417	56 501	60 248	63 995	67 743	71 490
Entry/exit fees							
Entry/exit fees (children) *****	R 30/R35	R 506 790	R 847 525	R 903 735	R 959 945	R 1 016 155	R 1 072 365
Entry/exit fees (adults) ****	R 40/R50	R 1 576 680	R 2 825 050	R 3 012 400	R 3 199 750	R 3 387 150	R 3 574 500
Total Entry/exit fees		**R 2 083 470**	**R 3 672 525**	**R 3 916 135**	**R 4 159 695**	**R 4 403 305**	**R 4 646 865**

An additional security contribution of R60 per hectare is proposed by Grant Thornton in their financial calculations. This amounts to R1 110 000 p.a. (R60 x 18,500 ha), payable as from Year 2. It is proposed that this is the starting fee in year two and that this be increased by R15 per year up to R120 by year six to cover the increased cost of security. The deficit predicted in Table 2.36 could be financed through limited game utilisation programmes.

Table 2.36 Expected Deficit

Category	Y1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6
Tourism Income Projections	2 083 470	3 672 525	3 916 135	4 159 695	4 403 305	4 646 865
Security Levy Income	0	1 110 000	1 387 500	1 665 000	1 942 500	2 220 000
Expenditure Projections	-2 000 000	-4 980 000	-5 810 000	-5 540 000	-6 270 000	-6 995 505
NET OPERATIONAL DEFICIT	**83 470**	**-197 475**	**-506 365**	**284 695**	**75 805**	**-128 640**
ACCUMULATED INCOME/DEFICIT	**83 470**	**- 114 005**	**-620 370**	**-335 675**	**-259 870**	**-388 510**

2.3.2 DEVELOPMENT OF ECONOMIC BENEFITS

The development of economic activities on private land is already present and the development densities are expressed in section 1.2.4.2.3. The proposed tourism developments on State land are discussed in great detail in the DGR Tourism Development on State land report (2009).

2.3.2.1 JOB CREATION

The total visitor beds estimated for the DGR in 2014 is 1,030 beds, based on the projected growth in overnight visitor numbers (see projections in Table 2.35 in section 2.3.1.2.4) and the existing beds in the DGR of 568 (see Table 2.30 in section 2.3.1.2.4). The day visitor projections indicate that a combined total of 40,851 day visitors on private and State land in the DGR can be expected in 2014 (see Table 2.35 in section 2.3.1.2.4), which equates to 112 day visitors per day. This calculates to a maximum of 1,142 visitors at peak.

At an estimated 2 visitors per staff member in the tourism sector, this equates to roughly 571 permanent jobs within the tourism sector by 2014. It is further estimated that the staff involved in management of DGR, made up of the 29 staff to be self-employed by the DGRMA (refer section 2.3.1.2.1), the contracted services (refer section 2.3.1.2.3) and the employees working on management and maintenance jobs on the private properties, could conservatively be totalling at least 50 permanent jobs. Therefore, it is estimated that a total of at least 621 jobs could be created by the DGR when fully operational.

It is an accepted fact that for each direct job created within the tourism sector, another 2 indirect jobs are created. It is therefore estimated that a total of 621 direct and 1,242 indirect jobs can be sustained by the DGR.

The typical jobs that are provided in a game reserve are reflected as follows:

Construction

- Road building
- Building industry (brick layers, builders, painters, etc)
- Labourers

Park Operations

- Game rangers
- Ecologists
- Game guards
- Road maintenance
- Building maintenance
- Administration
- Receptionists
- Telephonists
- Accounting
- Drivers
- Labourers

Tourism Operations

- Resort managers

- Front office staff
- Administration
- Accounting
- Chefs
- Field guides
- Tour Guides
- Transit Tour Operators
- Receptionists
- Telephonists
- Interpretation officers
- Adventure Operators (trails, quad-biking, abseiling, cycling, 4x4 operators, etc.)
- Gardeners
- Road maintenance
- Building maintenance
- Food & beverage managers
- Chefs
- Cooks
- Waiters
- Till operators
- Labourers

2.3.2.2 EMPOWERMENT OPPORTUNITIES

It is recommended that an "Empowerment Code of Conduct" should be developed that will strive to improve empowerment of previously disadvantaged communities, with a specific focus on the neighbouring communities. The following opportunities exist:

2.3.2.2.1 EQUITY

Opportunity for equity participation by local businessmen should be pursued and can include the following:

Land

- Negotiate with Department of Lands align with Land Redistribution policy to incorporate claimed land.
- Pro-active promotion to existing and potential previously disadvantaged individual (PDI) land owners
- Motivate BEE shareholding with existing non-PDI land owners

Lodge Developments

- Communities to incorporate land and use land value to leverage funding for lodge developments / JV's with private sector
- Consider contractual obligation to be negotiated with Lodge Developers and Operators to take on PDI partners

Concessions

- Communities to incorporate land and use land value to leverage Concession JV's with private sector
- Contractual obligation on Lodge Operators and Concessionaires to take on PDI partners to operate concessions

Service Providers

- Contractual obligation on Lodge Operators and Concessionaires to outsource services to entities with PDI status and/or partners

2.3.2.2.2 TRAINING

Opportunities for training and development include the following:

Concessions

- Training plan for concessionaires
- Set training targets for concessionaires (% of operational budgets, number of courses, etc)
- Set advancement targets (% PDIs in snr. Positions at certain intervals, etc)

2.3.2.2.3 SMME OPPORTUNITIES

Opportunity for Small, Medium, Micro Enterprises (SMME's) are available in the following fields and should be pro-actively pursued:

Construction

- Fencing
- Roads
- Buildings
- Dams

Park Operations

Entry Control

- Fence patrols
- De-bushing contracts
- Soil reclamation works
- Road maintenance

Tourism Operations

- Lodge and Resort Operators
- Game Drive Concessions
- Heritage Tour Operators
- Transit Tour Operators
- Information Centres
- Cultural Products
- Adventure Operators (trails, quad-biking, abseiling, cycling, 4x4 operators, etc)
- B&Bs & Guest Houses
- Tour Guides
- Game viewing by boat
- Campsite & caravan park operators

Support Services

- Security
- De-bushing contracts
- Soil reclamation works

- Maintenance of Vehicles and Equipment
- Road maintenance
- Building maintenance
- Garden maintenance
- Transport
- Laundry

Manufacturing & Trading

- Curios (baskets, pots, branded artefacts, jewellery, etc)
- Arts & crafts (carvings, ornaments, beadwork)
- Uniforms
- Refreshments (kiosks, shops, snack-bars, etc)
- Restaurants
- Bars & taverns

3. MONITORING AND AUDITING

3.1 CONTROLS AND PERFORMANCE CRITERIA

The DGRMA is in the process of developing a DGR Management Plan which will be used as an operational guideline document. Based on this document, key performance areas and performance standards will be set. The DGRMA will on an annual basis evaluate actual performance against these performance standards and make the necessary amendments.

3.2 AUDIT PROCEDURE AND ANNUAL REPORTING

The accounts of the DGRMA and the LOA will be audited by a registered firm of chartered accountants on an annual basis and submitted to the LOA Annual General Meeting and to the board of directors of the DGRMA as prescribed by the constitution of the LOA.

3.3 FIVE-YEAR REVIEW

The DGR Management Plan will be reviewed and updated every five years. This review will assess the latest situation regarding all external (biophysical, social, economic, political) and internal (institutional, infrastructural, financial) factors and will evaluate management against most recent best practices in the industry. Based on the finding from this review, the Management Plan will be amended accordingly.

The revised Management Plan will be submitted to the LOA members and the DGRMA board of directors for adoption and implementation.

3.4 BIODIVERSITY MONITORING

3.4.1 VEGETATION MONITORING

The plant communities should form the basis for a broad based monitoring plan for the natural vegetation of the DGR. Representative monitoring plots should be established in each of the 15 identified and described plant communities and surveyed on an annual basis (refer section 1.2.4.1.1).

3.4.1.1 MONITORING TECHNIQUE

The two structural components of the vegetation should be monitored at the same location, but different techniques for assessing the herbaceous layer and the woody vegetation should be adopted.

3.4.1.1.1 HERBACEOUS LAYER

The herbaceous layer consists of a grass layer, which is important as food for grazers, but also a layer that consist mainly of forbs. Grasses and forbs are not only important grazing plants, but also serve as sensitive indicators of change in veld condition and as fuel for a potential veld fire. These plant species as well as their frequency, density and production, should therefore be assessed during a monitoring programme.

It is proposed that an adapted version of the Ecological Index Method (EIM) as described by Vorster (1982), be used as method in the monitoring programme for the herbaceous layer. This method provides a sample of veld with an ecological index that can be compared with that of a benchmark for a particular veld type, in order to gauge the veld condition of the sample site. This index is a reflection of the ecological status of a sample of veld and can also be used to calculate grazing capacity.

The EIM should be used in combination with a Disc Pasture Meter (Bransby & Tainton, 1977), which is a rapid technique for estimating the standing crop or production of grass fuel in an area.

A 20m x 25m (500m²) sample plot should be permanently marked. Once a site has been selected, an inventory of all herbaceous species is made by walking over the demarcated site and classifying each species present into an ecological group (i.e. Decreasers, Increasers and Others). Each species should then be written under the appropriate heading on a data sheet or site inventory form. The grass and forb species that are listed for each plant community in the vegetation description should be used to facilitate the survey.

The IEM consists of the collection of 200 points on the plot where the nearest plant to the point is recorded and classified. When there are no herbaceous plants closer than 25cm from the point, the point is marked as “bare ground”. The points are distributed over the plot by taking a reading every 1m on a line along the length of the plot. Eight parallel lines area located every 2m apart, which end up with a total of 200 points (25 x 8 points).

By using the disc pasture meter to establish each “point”, the nearest plant is first recorded and thereafter the disc is released and the reading on the disc recorded. By combining the two methods, both the frequency of species and the standing crop can be calculated.

The advantages of the combined the methods are:

i) The survey can be used to determine the Ecological Index of the plot, which can be compared to the same plot every successive year, or to other plots in the same plant community in the same year.
ii) When compared with a suitable benchmark, the inventory of all the herbaceous species on the plot could be used to indicate loss or gain of certain species. Depending on the status of the species, the succession trends on the plot can be determined every year.
iii) After calibrating the Disc Pasture Meter, results of this survey can be used to calculate the standing crop or fuel production of the herbaceous layer, which could also be compared with the same plot every successive year or with other plots in the same plant community. This data can be used for calculating carrying capacity or give an indication of the build-up of fuel for a potential veld fire.

3.4.1.1.2 WOODY PLANTS

Experience with the use of the Variable Quadrant Plot (VQP) in the savannah woodland of South Africa as described by Coetzee & Gertenbach (1977), indicates that a plot of 400m² will be adequate to monitor the woody vegetation composition and structure of the vegetation of the DGR. For that purpose, the same fixed plot of 500m² (25m x 20m) identified for the monitoring of the herbaceous vegetation, could also be used for monitoring the woody vegetation.

To do the survey on the 500m² plot, all the woody plants occurring on the plot should be grouped into three height classes:

(i) Below 0,5 meters
(ii) Between 0,5 and 1,5 meters
(iii) Higher than 1,5 meters

The number of each woody species per height class should then be recorded for the plot. The woody plant species that are listed for each plant community in the vegetation description should be used to facilitate the survey (refer section 1.2.4.1.1).

To assist in the evaluation of the changes that took place on a specific plot, photos from the central point to the four corners of the plot could also be taken. These photographs could be compared from year to year to highlight possible changes.

Comparing the woody plant survey of a plot with the same plot the next year and with other plots in the same plant community, it can be determined:

i) What the difference in biodiversity between plots in the same plant community is and what changes in biodiversity take place from one year to another.
ii) What woody plant species have been introduced and which species increased or decreased.
iii) What the changes in vegetation structure is.

3.4.1.2 NUMBER OF SAMPLE SITES

To be able to successfully monitor the special differences between plots in the same plant community and the changes in the vegetation over a period, it is necessary to have at least three monitoring plots of 25m x 20m for each plant community. For the 15 plant communities in the DGR, it will result in 45 plots.

An experienced ecologist will be able to survey a plot in 2 hours and then use another 24 hours to calculate the results for the entire DGR.

3.4.1.3 LOCATION OF SAMPLE SITES

The sample sites, each measuring 20m x 25m, must be located in areas that are representative of that plant community. The plots should be marked permanently to ensure that the same area is surveyed in the following years.

NOTES:

i) Once the management plan of the DGR is in place or when management is ready to start the monitoring programme, the Consultant will indicate the exact location of the 45 plots.
ii) If required a demonstration of the monitoring technique could be arranged.

iii) The proposed monitoring technique requires that the surveyor must have a sound knowledge of the vegetation of the area. If such staff is not available, it is highly recommended that the monitoring programme should be outsourced to professional ecologists.

3.4.2 MONITORING OF LARGE MAMMALS

3.4.2.1 MONITORING OF ELEPHANT

The DGRMA will initiate and undertake a monitoring programme of the elephant population, with immediate effect. Monitoring of individuals will be required in order to ensure the success of the programme and each individual will be identifiable via a photograph identity file. (The perimeter fence will retain the animals and the experience gained from the monitoring of the release of adults into other reserves such as Madikwe and Pilanesberg, suggests that radio-tracking is not essential).

Although the elephant EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. The DGRMA will record all the elephant sightings on a daily basis for the first year.
2. The implementation manager or another representative of the DGRMA will supervise the record keeping of elephant movements and any other issue of concern. Once the DGRMA has appointed an ecologist, this person will undertake the data collection function.

Management intent - long term monitoring commitments:

1. The DGRMA will record all the elephant sightings on a daily basis for the first year.
2. The implementation manager or another representative of the DGRMA will supervise the record keeping of elephant movements and any other issue of concern. Once the DGRMA has appointed an ecologist, this person will undertake the data collection function.
3. The DGRMA will promote research and monitoring programmes in the DGR especially those undertaken and facilitated by recognised Tertiary Institutions.
4. Adult bulls will be monitored for the first year, as they are the most likely sex/age class to break out.
5. Land Owners and registered game drive vehicle drivers will be involved in recording sightings.
6. Elephant sightings will be reported by all DGRMA staff and guides. All potential observers will be encouraged to report sightings and to record sex, age, location and activity of the animals.
7. No annual elephant census will be necessary as the population number will be well known from individual recognition.

Identification technique

Each animal will be photographed annually from the front and each side and a photo identikit established. With so few animals, individual identification will be relatively easy and the identikit information will be provided to DGRMA staff, lodge managers, guides and interested landowners.

3.4.2.2 MONITORING OF BLACK RHINO

The DGRMA will initiate and undertake a comprehensive monitoring programme of the black rhino population with immediate effect. Monitoring of individuals will be required in order to ensure the success of the programme and each individual will be identifiable.

Once the introduced individuals have settled in the area they will establish home ranges (cows) and territories (bulls). As rhino are very territorial they will remain within their established ranges and territories and will therefore be easier to monitor.

Identification technique
Black rhino are easily identifiable by using horn shape and ear tears and all animals will be photographed and a photographic identikit kept on file. Animals in the founder population will also be ear-notched on capture.

The widely accepted ear notch technique used by the Rhino Management Group will be used in the DGR when animals do not have natural notches. Ear notching as a method of identification is permanent and does not affect tourist enjoyment.

Although the black rhino EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. The DGRMA will track and record all the rhinos at least on a weekly basis.
2. The implementation manager or another representative of the DGRMA will undertake the monitoring of the population. Once the DGRMA has appointed staff, the ecologist will collate the monitoring functions.
3. Land owners and registered game drive vehicle drivers will be involved in recording sightings. The DGRMA will keep a record of these sightings.

Management intent - long term monitoring commitments:

1. The DGRMA will track and record all the rhinos at least on a weekly basis.
2. The implementation manager or another representative of the DGRMA will undertake the monitoring of the population. Once the DGRMA has appointed staff, the ecologist will collate the monitoring functions.
3. The DGRMA will promote research and monitoring programmes in the DGR especially those undertaken and facilitated by recognised University or University of Technology.
4. Land owners and registered game drive vehicle drivers will be involved in recording sightings. The DGRMA will keep a record of these sightings.
5. The black rhino population will be monitored using a vehicle or quad bike, but primarily on foot.

3.4.2.3 MONITORING OF BUFFALO

The DGRMA will initiate and undertake a monitoring programme of the buffalo population, after they are released. This monitoring of the herd will be required in order to ensure the success of the programme. Sex and age classification criteria will follow Bothma & van Rooyen (2006).

Although the buffalo EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. In the first two years, the DGRMA will record all the buffalo sightings when they are reported. Once it is accepted that the buffalo have settled down well, the status of the population will be recorded on a monthly basis.
2. The implementation manager or another representative of the DGRMA will supervise the record keeping of buffalo movements and any other issue of concern, such as predation by lion. Once the DGRMA has appointed an ecologist, this person will undertake the data collection function.
3. The sex and age composition data is essential to determine the calving rate and calve survival in the population.

Management intent - long term monitoring commitments:

1. In the first two years, the DGRMA will record all the buffalo sightings when they are reported. Once it is accepted that the buffalo have settled down well, the status of the population will be recorded on a monthly basis.
2. The implementation manager or another representative of the DGRMA will supervise the record keeping of buffalo movements and any other issue of concern, such as predation by lion. Once the DGRMA has appointed an ecologist, this person will undertake the data collection function.
3. The DGRMA will promote research and monitoring programmes in the DGR especially those undertaken and facilitated by recognised Tertiary Institutions.
4. Land Owners and registered game drive vehicle drivers will be instructed to be involved in recording buffalo sightings.
5. Buffalo sightings will be reported by all DGRMA staff and guides. All potential observers will be encouraged to report sightings and to record the number in the group, sex and age composition, activity, location and the condition of the animals.
6. No annual dedicated buffalo census will be necessary as the population number will be well known from individual recognition and from regular monitoring of herds.
7. The sex and age composition data is essential to determine the calving rate and calve survival in the population.
8. As the population also has an aesthetic and tourist role in the DGR, no ear tags or collars will be fitted. Implanting animals with microchips is not considered necessary.
9. As the animals will come from a "Disease-free" population and certified as being disease free, blood sample will not be necessary.

Sex Age classification

Staff, lodge staff and guides will be instructed to use the common sex and age criteria (Bothma & van Rooyen, 2006).

3.4.2.4 MONITORING OF LEOPARD

It is important that the DGRMA undertake a monitoring programme of leopard starting immediately after release into the DGR. This will help to determine potential problems with regards to possible fence break attempts.

Although the leopard EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. Introduced leopard should be microchipped.
2. Monitoring should also include the recording of all other leopard in the DGR, not only the introduced individuals. This monitoring component includes sightings, spoor, kills and any other identified leopard activity. An attempt should be made to estimate the total number of leopard present in the DGR.

Management intent - long term monitoring commitments:

1. Ideally all introduced leopard should be collared for tracking purposes. The recommended transmitter type is GSM/GPS. The system could be programmed to transmit a SMS alert whenever the boundary fence is approached.
2. Introduced leopard should also be microchipped.
3. The movements of collared leopard should be monitored on a regular basis, either by the DGRMA or a student (as part of a tertiary education programme). The monitoring should also include movements, predation (age and sex classes of species killed), observed inter and intraspecific behaviour and reproductive aspects. It is possible that the student assigned to monitor lion (Funston, 2009) and other large carnivores could also be responsible for leopard monitoring.
4. Collars should be replaced before the predicted expiry date or when there are indications that collars could become too tight. For this the leopard will have to be immobilised or caught by means of other acceptable methods such as a safe, purpose built predator trap cage ("box cage").
5. Leopard monitoring should be done, as far as possible, from a vehicle.
6. Monitoring should also include the recording of all other leopard in the DGR, not only the introduced individuals. This monitoring component includes sightings, spoor, kills and any other identified leopard activity. An attempt should be made to estimate the total number of leopard present in the DGR.

3.4.2.5 MONITORING OF CHEETAH

The DGRMA will initiate and undertake a comprehensive and intensive monitoring programme of the cheetah introduction as soon as they arrive in the DGR. Monitoring of individuals will be required in order to ensure the success of the programme and each individual will be identifiable. The location of the cheetah should be known at least twice weekly and these locations will be recorded. They will be observed to ensure that they are hunting successfully. (Obviously very few actual hunts will be observed, but the animals will be observed to see if their stomachs are full or empty). The animals will be checked visually to see whether there are any outward signs of injury. If, over the first two months, animals are having difficulty in feeding themselves, DGR management may provide the animals with a meal. This must not be overdone and should be regarded as an emergency procedure rather than a matter of course.

A detailed documentation of individual's age, sexual status, bloodline and genetic makeup, etc. will be maintained.

The monitoring will be done daily for a period of six months, either by volunteers or the game drive staff.

Although the cheetah EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. The adult female and one of the males will be fitted with a radio collar (cell phone type).
2. The positions of the cheetah will be sent via cell phone to the designated lion monitor on at least a 2 hourly basis. (This will make use of the system set up for the lion introduction and should incur minimal extra costs).
3. All cheetah introduced to the DGR will be photographed before their release so that they can be individually identified.

Management intent - long term monitoring commitments:

1. The adult female and one of the males will be fitted with a radio collar (cell phone type).
2. The positions of the cheetah will be sent via cell phone to the designated lion monitor on at least a 2 hourly basis. (This will make use of the system set up for the lion introduction and should incur minimal extra costs).
3. After a year, the collars will be removed. When new cheetah are introduced, they will have collars fitted and will be closely monitored for a year.
4. All cheetah introduced to the DGR will be photographed before their release so that they can be individually identified.
5. The location of the animals and habitat selection, condition of the animals, hunting, prey selection, breeding will be recorded.
6. The DGRMA will promote research and monitoring programmes in the DGR especially those undertaken and facilitated by recognised Tertiary Institutions.
7. The cheetah population will be monitored, as far as possible, using a vehicle only.

Identification technique

Each individual will be photographed from both sides to record their spot pattern before it is released. This photographic record will be kept on file and used to identify animals when necessary. Once cubs are born and then permitted to mature and remain in the DGR, these will also be photographed, while they are free ranging and the data kept on record.

In addition to monitoring, the following will also be undertaken by the DGRMA:

(i) Daily fence patrols will be conducted to ensure the integrity of the fence and to ensure no fence breaches have occurred.
(ii) Armed security guards will man all access/exit gates to the DGR on a 24 hour basis.
(iii) The DGRMA will employ field rangers who will be trained and equipped to deal with all fence break outs, poaching or illegal entry situations on a game reserve.
(iv) Community involvement and education programmes will be undertaken with the assistance of the DTE and the local authority.

3.4.2.6 MONITORING OF BROWN HYENA

Short-Term

It is important that the DGRMA undertakes a brown hyena population survey to determine the number of brown hyena in the DGR, as well as to collect basic data on population structure. A population survey can be done using basic large carnivore calling station methodology. An additional camera trap survey is strongly recommended, as it would also provide additional data on the DGR's leopard and other smaller mammal populations. Such a project could be done in collaboration with one of the universities as part of a post-graduate project.

Medium to Long-Term

It is proposed that consideration should be given to the introduction of selected brown hyena individuals once the DGR has expanded. The movement and foraging behaviour of introduced brown hyena should then also be monitored.

Although the brown hyena EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. Introduced brown hyenas should be microchipped.

Management intent - long term monitoring commitments:

1. Ideally all introduced brown hyenas should be collared for tracking purposes. The recommended transmitter type is GSM/GPS. The system could also be programmed to transmit sms-alert messages whenever certain key areas are approached.
2. Introduced brown hyenas should be microchipped.
3. The movements of collared individuals should be monitored on a regular basis, either by the DGRMA or a student (as part of a tertiary education programme). The monitoring should also include any recorded foraging (scavenging, kills made) observed, inter- and intra-specific behaviour and reproductive aspects.
4. Collars should be replaced before the predicted expiry date or when there are indications that collars could become too tight. For this the collared individuals will have to be immobilised or caught by means of other acceptable methods such as a safe, purpose-built predator trap cage ("box cage").
5. Monitoring should be done, as far as possible, from a vehicle.

3.4.2.7 MONITORING OF SPOTTED HYENA

All introduced spotted hyenas should preferably be radio collared. This will ensure that the DGRMA would be able to monitor of movements, foraging behaviour and interaction with other large carnivores. It is possible that the student assigned to monitor lion (Funston, 2009) and other large carnivores could also be responsible for hyena monitoring.

Periodic calling station surveys could be considered at a later stage to collect additional population data.

Although the spotted hyena EMP recommends the ideal monitoring regime based on best practice, it is not feasible to achieve the desired state immediately. Therefore, a basic monitoring regime will also be established for elephant, which will be the regarded as the minimum requirement and further monitoring activities will gradually be phased in as the DGRMA's management capacity expands:

Management intent - minimum monitoring requirements:

1. All introduced spotted hyenas will be collared for tracking purposes if possible. The recommended transmitter type is GSM/GPS. The system could also be programmed to transmit sms-alert messages whenever certain key areas are approached.
2. Introduced spotted hyenas should be microchipped.
3. The movements of collared individuals should be monitored on a regular basis, either by the DGRMA or a student (as part of a tertiary education programme). The monitoring should also include any recorded foraging (scavenging, kills made) observed, inter- and intra-specific behaviour and reproductive aspects.
4. Collars should be replaced before the predicted expiry date or when there are indications that collars could become too tight. For this the collared individuals will have to be immobilised or caught by means of other acceptable methods such as a safe, purpose-built predator trap cage ("box cage").

Management intent - long term monitoring commitments:

1. All introduced spotted hyenas will be collared for tracking purposes if possible. The recommended transmitter type is GSM/GPS. The system could also be programmed to transmit sms-alert messages whenever certain key areas are approached.
2. Introduced spotted hyenas should be microchipped.
3. The movements of collared individuals should be monitored on a regular basis, either by the DGRMA or a student (as part of a tertiary education programme). The monitoring should also include any recorded foraging (scavenging, kills made) observed, inter- and intra-specific behaviour and reproductive aspects.
4. Collars should be replaced before the predicted expiry date or when there are indications that collars could become too tight. For this the collared individuals will have to be immobilised or caught by means of other acceptable methods such as a safe, purpose-built predator trap cage ("box cage").
5. Monitoring should be done, as far as possible, from a vehicle.

REFERENCES

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. *Memoirs of the Botanical Survey of South Africa.* 57: 1–146.

Alpers, D.L. & Robinson, T.J. 2001. Roan antelope population genetic survey 2000-2001. Summary of results and management recommendations. Roun Action Group (RAG) meeting. Unpublished report.

Alpers, D.L., van Vuuren, B.J., Arctander, P. & Robinson, T.J. 2004. Population genetics of the roan antelope (*Hippotragus equinus*) with suggestions for conservation. *Molecular Ecology* 13: 1771-1784.

Anderson J.L. 1976. ASPECTS OF THE ECOLOGY OF THE NYALA (*Tragelaphus angasi*, Gray 1849) IN ZULULAND. PhD thesis. London University.

Anderson,J.L. 1981. The re-establishment and management of a lion (*Panthera leo*) population in Zululand, South Africa. Biological Conservation 19(2): 107 - 118.

Anderson. J.L. 1993 . The introduction of elephants into medium-sized reserves. *Pachyderm.* 13. 14-19

Anderson, J.L. 2009a. Game carrying capacity in the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

Anderson, J.L. 2009b. Species management plan: cheetah (*Panthera pardus*). The introduction and management of cheetah in the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

Anderson, J.L. 2009c. Break-out policy of the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

Anderson. J.L. & F. Pariela. 2005. THE MITIGATION OF HUMAN-WILDLIFE CONFLICT IN MOçAMBIQUE. Report for FAO and the National Directorate of Forests & Wildlife.

Anon. 1997. CITES Discussion document on the proposal to remove the annotation on the Appendix II listing of southern white rhino. Care for the Wild Defence Fund, West Sussex.

Attwell, R.I.G. 1966. Oxpeckers and their associations with mammals in Zambia. *Puku*, 4: 17 – 48.

Baldus, R.D. 2004. Lion conservation in Tanzania leads to serious human-lion conflict. With case study of a man-eating lion killing 35 people. *Tanzanian Wildlife Discussion Paper* No. 41.

Beier, P. 1993. Determining minimum habitat areas and habitat corridors for cougars. *Conservation Biology* 7: 94-108.

Bell R.H.V. 1984 Bell, R.H.V. 1984. *Adaptive management in CONSRVATION AND WILDLIFE MANAGEMENT IN AFRICA.* The proceedings of a Peace Corps Workshop. Eds. Bell and McShane-Caluzi. Forestry & Natural Resources Sector U.S. Peace Corps: 1-6.

Bengis, R.G. Preparedness and contingency planning for significant infectious animal disease outbreaks in South African National Parks. *Unpublished Report.*

Berrisford S et al 2001. *Dinokeng integrated tourism development framework, Vol B- DGR development framework.* ICUN The World Conservation Union/International Organisation Development Consortium.

Bertram, B.C.R. 1975. Social factors influencing reproduction in wild lion. *Journal of Zoology* 177: 463-482.

Bjorklund, M. 2003. The risk of inbreeding due to habitat loss in lion (*Panthera leo*). *Conservation Genetics* 4: 515-523.

Blanc, J.J, R.F.W.Barnes,G.C.Craig,H.T.Dublin,C.R.Thouless,I.Douglas-Hamilton and J.A.Hart. 2007. Africa Eelephant Status Report 2007. IUCN Publications.

Boecklen, W.J. 1987. Optimal design of nature reserves: consequences of genetic drift. *Biological Conservation* 38: 323-338.

Boekenhoutskloof Landowners Association 2004. *Boekenhoutskloof Landowners Association Constitution.*

Bohlweki SSI 2008. *Environmental management framework & environmental management plan for the Dinokeng project area.* Gauteng Provincial Government: Department of Economic Development.

Bothma, J. du P. 1977. Leopard ecology in southern Africa. In: Lions and Leopards as Game Ranch Animals (ed van Heerden, J.). Pp 27-36. SA Veterinary Association: Pretoria.

Bothma, J. du P. (Ed.). 2002. *Game Ranch Management.* Van Schaik Publishers, Pretoria.

Bothma, J. du P. & Du Toit, J.G. (Eds.). 2009. Game Ranch Management. 5th Edition. *In Press.* J.L. van Schaik, Pretoria.

Bothma.J. du P. & van Rooyen. 2006. *Intensive wildlife production in southern Africa.* Van Schaik Publishers.

Bothma, J. du P., van Rooyen, N. & du Toit, J.G. 2002. Antelope and other smaller herbivores. In: *Game Ranch Management*. 4th Edition (ed Bothma, J. du P.). Pp. 149-175. Van Schaik Publishers: Pretoria.

Bransby, D.I. & N.M. Tainton. 1977. The disc pasture meter: possible application in grazing management. *Proceedings of the grassland Society of South Africa*. 12: 115 – 118.

Bredenkamp, G.J. & Brown, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. *Urban Greenfile* Nov-Dec 2001: 38-39.

Bredenkamp, G.J. & Van Rooyen, N. 1996. Mixed Bushveld. *In:* Low, A.B. & Rebelo, A.G. (eds) *Vegetation of South Africa, Lesotho and Swaziland*. Dept Environmental Affairs & Tourism, Pretoria.

Buechner, H.K., Stroman, H.R. & Xanten, W.A. 2007. Breeding behaviour of sable antelope *Hippotragus niger* in captivity. *Int. Zoo Yb.* 14: 133–136.

Buijs, D. 1999. Survey: White rhino on private land. African Rhino Owners Association, WWF-Netherlands.

Coe, M.J., Cumming D.H. & Phillipson J. 1976. Biomass and production of large African herbivores in relation to rainfall and primary production. *Oecologia* 22:341-354.

Coetzee, B.J. & Gertenbach, W.P.D. 1977. Technique for describing woody vegetation, composition and structure in inventory type classification, ordination and animal habitat surveys. *Koedoe* 20: 67 – 75.

Coetzee, B.J., Van der Meulen, F., Zwanziger, S., Gonsalves, P. & Weisser, P.J. 1976. A phytosociological classificationof the Nylsvley Nature Reserve. *Bothalia* 12: 137-160.

Coetzer, J.W.A., Thomson, G.R. & Tustin, R.C. (Eds.). 1994. *Infectious diseases of livestock with special reference to South African. 2 Volumes.* Cape Town, Oxford.

Collinson R et al 2001. *Dinokeng integrated tourism development framework, Vol B- Dinokeng Game Reserve development framework*. International Union for conservation of nature and natural resources(IUCN) The World Conservation Union/International Organisation Development Consortium.

Contour and Associates. 2009. Tourism Development on State Land in the Dinokeng Game Reserve. DGR/DTE.

Cotterill, A. 1997. The economic viability of lion (*Panthera leo*) on a commercial wildlife ranch: Examples and management implications from a Zimbabwean case study. In: *Proceedings of a Symposium on Lion and Leopards as Game Ranch Animals.* Wildlife Group of the South African Veterinary Association, Onderstepoort, South Africa. pp 189-207.

Davies, J.W., Karsted, L.H. & Tranier, D.O. (Eds). 1981. *Infectious diseases of wild mammals*. Ames: Iowa State University Press.

Dinokeng Game Reserve. 2005. Combined Landowners Association Integrated Business Plan. Preamble Executive Summary. Unpublished report.

Druce, D.D., Genis, H.H., Braak, J., Greatwood, S., Delsink, A., Kettles, R., Hunter, L. & Slotow, R. 2004. Population demography and spatial ecology of a reintroduced lion population in the Greater Makalali Conservancy, South Africa. *Kudu* 47: 113-118.

Du Plessis, S.F. 1969. The past and present distribution of the Perrisodactyla and Artiodactyla in Southern Africa. MSc Thesis, University of Pretoria: Pretoria.

Durant, S. 1998. A minimum intervention approach to conservation: The influence of social structure. In: *Behavioral Ecology and Conservation Biology* (ed Caro, T.). Pp. 105-129. Oxford University Press: New York.

Du Toit, J.G. 1991. An evaluation of “snotsiekte” in South Africa for insurance purposes. http://bigfive.jl/.co.za./snotsiekte.htm

Du Toit, J.G. 1992. The sable antelope as a game ranch animal. In: Penzhorn, B.L. (Ed). *Proceedings of a Symposium on the Sable Antelope as a Game Ranch Animal. Wildlife Group of the SAVA, Onderstepoort.*

Du Toit, J.G. 1996. The African buffalo as a game ranch animal. In: B.L. Penzhorn (Ed.), *Proceedings of a Symposium on the African Buffalo as a Game Ranch Animal.* Pretoria: Wildlife Group of the South African Veterinary Association.

Du Toit, J.G. 1998. Rhino-ranching - a manual for owners of white rhinos. South African Veterinary Foundation and African Rhino Owners Association. Onderstepoort: Wildlife Group.

Du Toit, J.G. 2001. The veterinary care of African elephants. Norvartis & South African Veterinary Foundation Publication.

Du Toit, J.G. 2005. Buffalo. In: Bothma, J. du P. & van Rooyen, N. (Eds.). Intensive wildlife production. *Van Schaiks, Pretoria*.

Du Toit, J.G. 2009. Disease management report for the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

du Toit, J.G., Van Marle-Köster, E. & Bothma, J. du P. 2002. Hybridazation and inbreeding. In: *Game Ranch Management*. 4th Edition (ed Bothma, J. du P.). Pp.287-292. Van Schaik Publishers: Pretoria.

East, R. 1981. Species-area curves and populations of large mammals in African savanna reserves. *Biological Conservation* 2: 111-126.

East, R. 1984. Rainfall, soil nutrient status and biomass of large African mammals. *Afr. J. Ecol*. 22: 245-270.

Ebedes, H., van Rooyen, J. 2002. Keeping and feeding wild animals in captivity. In: *Game Ranch Management*. 4th Edition (ed Bothma, J. du P.). Pp.441-454. Van Schaik Publishers: Pretoria.

Ebedes, H., van Rooyen, J. & du Toit, J.G. 2002. Bomas and holding pens. In: *Game Ranch Management*. 4th Edition (ed Bothma, J. du P.). Pp.132-146. Van Schaik Publishers: Pretoria.

Emslie, R.H. & Brooks, P.M. 1999. African Rhino Specialist Group, IUCN / SSC.

Estes, R.D. 1991. *The Behavior Guide to African Mammals*. Russel Friedman: Halfway House.
Frankham, R., Ballou, J.D. & Briscoe, D.A. 2002. *Introduction to Conservation Genetics*. Cambridge University Press: Cambridge.

Frank, L.G., Glickman, S.E. & Licht, P. 1991. Fatal sibling aggression, precocial development, and androgens in neonatal spotted hyenas. *Science* 252: 702.

Frankham, R., Ballou, J.D. & Briscoe, D.A. 2002. *Introduction to Conservation Genetics*. Cambridge University Press: Cambridge.

Franklin, I.R. 1980. Evolutionary change in small populations. In: M.E. Soule (ed.). *Conservation Biology: and evolutionary – ecological perspective.* Wilcox. Sunderland, M.A.

Friedmann, Y. & Daly, B. (eds) 2004. *Red Data Book of the Mammals of South Africa: A Conservation Assessment*. CBSG Southern Africa (SSC/IUCN). Endangered Wildlife Trust of South Africa: Johannesburg.

Fuerst, P.A. & Maruyama, T. 1986. Considerations on the conservation of alleles and genetic heterozygosity in small managed populations. *Zoological Biology* 5: 171-179.

Funston. C. 2008 SPECIES MANAGEMENT PLAN: LION (*Panthera leo*). THE INTRODUCTION AND MANAGEMENT OF LION IN THE DINOKENGGAME RESERVE. DTE.

Funston. C. 2008. SPECIES MANAGEMENT PLAN: WHITE RHINO (*Ceratotherium simum*) THE INTRODUCTION AND MANAGEMENT OF WHITE RHINO IN THE DINOKENG GAME RESERVE. DTE

Funston, P.J. 2004. Potential and problems of game ranching with large carnivores in South Africa. In: *Proceedings of a Symposium on Game Ranch Planning*. Wildlife Group of the South African Veterinary Association, Onderstepoort, South Africa. pp 49-63.

Funston, P.J. 2008. Conservation and management of lion in Southern Africa: Status, threats, utilization and the restoration option. In: *Status and Conservation of large carnivores in Africa.* Pp 109 – 131.

Funston, P.J., Mills, M.G.L., Biggs, H.C. & Richardson, P.R.K.1998. Hunting by male lion: ecological influences and sociological implications. *Animal Behaviour* 56:1333-1345.

Gertenbach, W.P.D. & Bredenkamp, G. 2009a. *Vegetation of the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE*. Unpublished report.

Gertenbach, W.P.D. & Bredenkamp, G. 2009b. *Water provision in the Dinokeng Game Reserve. Dinokeng Game Reserve/ DTE.* Unpublished report.

Gertenbach, W.P.D. & Bredenkamp, G. 2009c. *Geology and topography of the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE.* Unpublished report.

Grant, C.C. & van der Walt, J.L. 2000. Towards an adaptive management approach for the conservation of rare antelope in the Kruger National Park. Kruger National Park Workshop. *Koedoe* 43: 103-112.

Grossman.D. 2005. ECOLOGICAL MANAGEMENT AND GAME POLICY GUIDELINES in: DINOKENG GAME RESERVE: COMBINED LANDOWNERS ASSOCIATIONS INTEGRATED BUSINESS PLAN. E.C. HARRIS Pty (Ltd).

Grubbich, J.D. 2001. Genetic variation within and among fragmented populations of South African lion *Panther leo:* implications for management. MSc Thesis, University of Pretoria, Pretoria.

Hanski, I. 1999. *Metapopulation Ecology*. Oxford University Press: Oxford.

Harrington, R., Owen-Smith, N., Viljoen, P.C., Biggs, H.C., Mason, D.R. & Funston, P. 1999. Establishing the causes of the roan antelope decline in the Kruger National Park, South Africa. *Biological Conservation* 90: 69-78.

Hayward, M.W., Hofmeyer, M., O'Brien & Kerley, G. 2006. Prey Preferences of the Cheetah (*Acynonyx jubatus*) (Felidae: Carnivora): Morphological limitations or the need to capture readily consumable prey before kleptoparasites arrive. *J. Zool.* 270: 615-627.

Henderson, L. 2001. Alien weeds and invasive plants. ATC, Pretoria.

Hitchins. P.M. 1969. The influence of vegetation types on size of home ranges of black rhinoceros in Hluhluwe Game Reserve. *Lammergeyer* **10**: 81-86.

Hitchins.P.M. & J.L.Anderson. 1983. Population characteristics and management of the black rhinoceros in the Hluhluwe/Umfolozi Game Reserve Complex, Zululand. *S. Afr. J. Wildl. Res. 1983. Vol 13.*

Hofmeyr, M. 2001. Introduction of the African wild dog (*Lycaon pictus*) to game reserves. Proceedings of a Symposium on the Re-introduction of Larger Mammals to Game Reserves. Wildlife Group of the SA Veterinary Association, Onderstepoort.

Honiball, E.J. 2009. A review of malignant catarrhal fever in the Republic of South Africa. *M.Phil. Thesis, University Pretoria*.

Hunter, L.T.B. 1999. The socio-ecology of reintroduced lion in small reserves: comparisons with established populations and the implications for management in enclosed conservation areas. Preliminary Project Report, School of Life and Environmental Science, University of Natal, Durban, South Africa.

Hunter, L.T.B. & Skinner, J.D. 1998. Vigilance in African ungulates: The role of predation pressure. *Behaviour* 135: 195-211.

International Conservation Services. 2007. REVIEW AND UPDATE OF THE MADIKWE GAME RESERVE MANAGEMENT PLAN Part 2.: SPECIES MANAGEMENT PLANS-BLUE WILDEBEEST, BUFFALO, BLACK WILDEBEEST AND WHITE RHINO. 64pp.

Jolley, C.G. 2005. Best management protocols for lion (*Panthera leo*) in medium-sized reserves in South Africa. Masters Thesis, Tshwane University of Technology.

Keet, D.F., Hunter, P., Bengis, R.G., Bastos, A. & Thomson, G.R. 1996. The 1992 foot-and-mouth disease epizootic in the Kruger National Park. *J. S. Afr. Vet. Ass.*, 67: 83 – 87.

Keet, D.F., Kriek, N.P.J., Penrith, M. & Michel, A. 1997. Tuberculosis in lions and cheetahs. In: Van Heerden, J. (Ed.). *Proceedings of a Symposium on Lions and Leopards as Game Animals*. 24 & 25 October 1997. Onderstepoort, Republic of South Africa. pp. 151 – 156.

Kilian, P.J. & Bothma, J.Du. P. 2003. Notes on the social dynamics and behaviour of reintroduced lion in the Welgevonden Private Game Reserve. *South African Journal of Wildlife Research*. 33(2): 119-124.

Kingdon, J. 1997. *The Kingdon Field Guide to African Mammals*. Academic Press, San Diego.

Klingel, H. 1991. The social organization and behaviour of *Hippopotamus amphibious*. In: African Wildlife: Research and Management (Eds Kayanja, F.I.B. & Edroma, E.). Pp. 73-75. ICSU Publication: Kampala.

Kriek, J.C. 2005. The roan antelope. In: *Intensive Wildlife Production in Southern Africa* (eds Bothma, J. du P. & van Rooyen, N.). Pp.125-137. Van Schaik: Pretoria.

Kriek, J.C. 2005. The sable antelope. In: *Intensive Wildlife Production in Southern Africa* (eds Bothma, J. du P. & van Rooyen, N.). Pp.138-1467. Van Schaik: Pretoria.

Kruuk, H. 1966. *Clan-system and feeding habits of spotted hyaenas (Crocuta crocuta Erxleben). Nature* 209: 1257-1258.

Kruuk, H. 1974. *The Spotted Hyena. A Study of Predation and Social Behavior*. University of Chicago Press: Chicago.

Lamarque, F, J. L. Anderson, M. Le Grange. et al. " HUMAN-WILDLIFE CONFLICT IN AFRICA: AN OVERVIEW OF CAUSES, CONSEQUENCES & MANAGEMENT STRATEGIES". 2008 Keynote paper at FAO conference on Human-Wildlife Conflict held in Addis Ababa Feb 2008.

Lehmann, M.B., Funston, P.J., Owen, C.R. & Slottow, R. 2008. Feeding behaviour of lion (*Panther leo*) on a small reserve. *South African Journal of Wildlife Research* 38(1): 66-78.

Low, A.B. & Rebelo, A.G. (eds) 1996 *Vegetation of South Africa, Lesotho and Swaziland*. Dept Environmental Affairs & Tourism, Pretoria.

Manaka, B. 2009. *GUIDELINES: The deaclaration of a Nature Reserve and a Protected Environment in terms of the Protected Areas Act (Act No. 57 of 2003*. South African National Biodiversity Institute; National Grasslands Biodiversity Programme; and Gauteng Department of Agriculture, Conservation and Environment.

Maritz, T. 1993a. Accommodation of the hippopotamus *Hippopotamus amphibius*. In: *The Capture and Care Manual. Capture, Care, Accommodation and Transportation of Wild African Animals* (Ed McKenzie, A.). Pp. 580-581. Wildlife Decision Support Services & SA Veterinary Foundation, Lynwood Ridge & Menlo Park.

Maritz, T. 1993b. Transportation of the hippopotamus *Hippopotamus amphibius*. In: *The Capture and Care Manual. Capture, Care, Accommodation and Transportation of Wild African Animals* (Ed McKenzie, A.). Pp. 579-580. Wildlife Decision Support Services & SA Veterinary Foundation, Lynwood Ridge & Menlo Park.

Maritz, T. 1993c. Care of the hippopotamus *Hippopotamus amphibius*. In: *The Capture and Care Manual. Capture, Care, Accommodation and Transportation of Wild African Animals* (Ed McKenzie, A.). Pp. 581-582. Wildlife Decision Support Services & SA Veterinary Foundation: Lynwood Ridge.

Maritz, T. 1993d. Chemical capture of the hippopotamus *Hippopotamus amphibius*. In: *The Capture and Care Manual. Capture, Care, Accommodation and Transportation of Wild African Animals* (Ed McKenzie, A.). Pp. 571-575. Wildlife Decision Support Services & SA Veterinary Foundation: Lynwood Ridge.

Maritz, T. 1993e. Physical capture of the hippopotamus *Hippopotamus amphibius*. In: *The Capture and Care Manual. Capture, Care, Accommodation and Transportation of Wild African Animals* (Ed McKenzie, A.). Pp. 575-578. Wildlife Decision Support Services & SA Veterinary Foundation: Lynwood Ridge.

Martin, R. & S. Thomas. 1991. *QUOTAS FOR SUSTAINABLE WILDLIFE UTILIZATION IN COMMUNAL LANDS.* The Zimbabwe Trust, Harare, Zimbabwe

Mattee, C.A. & Robinson, T.J. 1999. Mitochondrial DNA population structure of roan and sable antelope: implications for the translocation and conservation of the species. *Molecular Ecology* 8: 227-238.

Metsweding District Municipality 2006. Metsweding District Municipality LED. [online] Available from: www.metsweding.com

Metsweding District Municipality. Metsweding District Municipality IDP, 2009/2010, [online] Available from: www.metsweding.com

Mills, M.G.L. 1978. The comparative socio-ecology of the Hyaenidae. *Carnivore* 1: 1-6.

Mills,M.G.L. 1982. Factors affecting group size and territory size of the brown hyaena, *Hyaena brunnea. J.Zool., Lond.* 198: 39-51.

Mills, M.G.L. 1983. Behavioural mechanisms in territory and group maintenance of the brown hyaena,*Hyaena brunnea, Animal Behaviour* 31: 503-510.

Mills, M.G.L. 1990. *Kalahari Hyaenas: Comparative Behavioral Ecology of Two Species*. Unwin Hyman: London.

Mills, M.G.L. 1991. Conservation management of large carnivores in Africa. *Koedoe* 34: 81-90.

Mills, M.G.L. 1992. A comparison of methods used to study food habits of large African carnivores. *Wildlife 2001: Populations* (eds McDullough, D.R. & Barrett, R.H.). Pp. 1112-1123. Elsevier Applied Science: London & New York.

Mills, M.G.L. 2007. About lion – Ecology and behaviour. *African Lion Working Group*.

Mills, M.G.L., Juritz, J.M. & Zucchini, W. 2001. Estimating the size of spotted hyaena *Crocuta crocuta* populations through playback recordings allowing for non-response. *Animal Conservation* 4: 335-343.

Mills, M.G.L. & Hofer, H. 1998. Hyaena Status Survey and Action Plan. IUCN/SSC Hyaena Specialist Group, IUCN: Gland.

Mucina, L., Bredenkamp, G.J., Hoare, D.B. & Mcdonald, D.J. 2000. A National vegetation database for South Africa. *South Africa Journal of Science* 96:497-498.

Mucina, L, & Rutherford, M.C. (Eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Mueller-Dombois, D. & Ellenberg, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

National Agricultural Marketing Council. 2006. Report on the investigation to identify problems for sustainable growth and development in South African Wildlife Ranching. Report No. 2006-03. NAMC: Pretoria.

National Environmental Management (NEMA): Protected Areas Act, Act 57 of 2003. South African Government.

Nokeng tsa Taemane Local Municipality. Nokeng TSA Taemane Local Municipality IDP 2006/2007. [online] Available from: www.nokengmun.co.za

Nokeng tsa Taemane Local Municipality. Nokeng TSA Taemane Local Municipality IDP 2008. [online] Available from: www.nokengmun.co.za

Noss, RF. 1990. Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology* 4(4);355-364.

Nowell, G & Bauer, H. 2004. *Panthera leo*. *2006 IUCN Red List of Threatened Species*. IUCN 2006.

O'Connor, T.G., P.S. Goodman & B. Clegg (in press) Predicting the impact of elephants on woody plants diversity.

Owen, C. 2006. Reproductive biology and population ecology of leopards (*Panthera pardus*) on Karongwe. MSc Thesis, University of KwaZulu-Natal: Pietermaritzburg.

Owen-Smith, R.N. & M.G.L.Mills 2007. Predator-prey size relations in an African large-mammal food web. *J. Anim. Ecol.* 77. 173-183.

Packer, C. & Pusey, A.E. 1983a. Male take-overs and female reproductive parameters: a simulation of oestrus synchrony in lion (*Panthera leo*). *Animal behaviour* 31: 334-340.

Packer, C. & Pusey, A.E. 1983b. Adaptations of female lion to infanticide by incoming males. *The American Naturalist* 121: 716-728.

Packer, C., Herbst, L., Pusey, A.E., Bygott, J.D., Hanby, J.P., Cairns, S.J., Borgerhoff-Mulder, M. 1988. Reproductive success in lion. In. T.H. Clutton-Brock (ed.) *Reproductive success*. University of Chicago Press, Chicago, Illinois. Pp 363-383.

Packer, C., Hilborn, R., Mosser, A., Kissui, B., Borner, M., Hopcraft, G., Wilmshurst, J., Mduma, S. & Sinclair, A.R.E. 2005. Ecological change, group territoriality and population dynamics in Serengeti lion. *Science* 307: 390-393.

Penzhorn. B.L. 1996. The African Buffalo as a Game Ranch Animal. Wildlife Group. South African Veterinary Association. 188pp.

Policy for the Declaration of a Nature reserve in Limpopo: 12/6/P – Policy 1 of 2008. Limpopo Provincial Government.

Poole. J. H. & C.J. Moss 1981. Musth in African elephant. *Nature.* 292: 830-931.

Price Waterhouse. 1996. The trophy hunting industry: an African Perspective. *In:* Tourist Hunting in Tanzania (eds Leader-Williams, Kayera, J.A. & Overton, G.L.). Pp.12-13. Occasional Paper No. 14, IUCN Species Survival Commission: Gland.

PWV Consortium 2003. *Dinokeng –Transportation solutions for a new tourism destination in Gauteng,* Vol 2: 4. Department of Public Transport, Roads & Works.

Rautenbach, I.L. 1982. Mammals of the Transvaal. Ecoplan Monograph No. 1: Pretoria.

Robinson, T.J. & Harley, E.H. 1995. Absence of geographical chromosomal variation in the roan and sable antelope and the cytogenetics of a naturally occurring hybrid. *Cytogenet.Cell Genet.* 71: 363-369.

Rodwell, T., Kriek, N., Bengis, R., Whyte, I., Viljoen, P., de Vos, V. & Boyce1, W. 2001. Prevelance of bovine tuberculosis in African buffalo at Kruger National Park. *Journal Wildlife Diseases*, 37(2): 258 – 264.

Rogers K. & Biggs H. 1999. Integrating indicators, endpoints and value systems in strategic management of the rivers of the Kruger National Park. Freshwater Biology 41: 439-451.

Schaller, G.B. 1972. *The Serengeti lion: a study of predator-prey relations.* Chicago University Press, Chicago.

Scholes, R.J. & Walker, B.H. 1993. An African savanna: A synthesis of the Nylsvley study. Cambridge University Press, Cambridge

Sekulic, R. 2008. Seasonality of reproduction in the sable antelope. *African Journal of Ecology* 16: 177–182.

Sinclair A.R.E. 1977. The African buffalo. Wildlife behavior and ecology series. The University of Chicago Press, Chicago.

Skinner.J.D & Chimimba, C.T. 2005. *The Mammals of the Southern African Subregion.* Third Edition. Cambridge University Press.

Skinner,J.D. & Smithers, R.H.N. 1990. *The Mammals of the Southern African Subregion*. University of Pretoria: Pretoria.

Skosana, E & Westfall, B. Unpublished. *The vegetation of Dinokeng Game Reserve.* 2005. Gauteng Provincial Government.

Slottow, R. & Van Dyk, G. 1999. Preliminary results of the Pilanesberg Elephant Project.

Slotow.R & van Dyk, G.. 1999. Role of delinquent young elephants in of high mortality of White rhinoceros in Pilanesberg National Park, South Africa. *Koedoe:* **44.** 85-94.

Slottow, R., Van Dyk, G., Poole, J., Page, B. & Klocke, A. 2000. Older bull elephants control young males. Brief Communication. **Nature**: 408.

Smuts, G.L. 1978. Inter-relations between predators, prey and their environment. *Biological Science* 28(5): 316-320.

Stalmans M., van Wyk A., Anderson J.L. & Starfield. A. 1994. Boosting a buffalo bull population. *Conserva*. 9(1):8-11.

Steyl, J. 2007. Veterinary Diagnostics – Diagnostic Sampling Manual. *Department Pathology, Onderstepoort, University Pretoria.*

Sung-Hoon, K. 1997. Brief introduction of Traditional Chinese Medicine (TCM) and possible measures to protect the endangered species of 1MC. **Korea Oriental Medicine Association**, Republic of Korea

Tello J.L.P.L 1975. The natural history of nyala *Tragelaphus angasi* (*Mammalia, Bovidae*) in Mozambique. Bull. Am.Mus. |Nat. Hist. 155(4): 321-386.

The Dinokeng Big 5 Game Reserve Land Owners Association Constitution 2006.

Theron, G.K. 1973. 'n Ekologiese studie van die plantegroei van die Loskopdan-natuurresrvaat. DSc thesis, University of Pretoria, Pretoria.

Thompson, K. 1993. Aggressive behavior and dominance hierarchies in female sable antelope, *Hippotragus niger*: Implications for captive management. *Zoo Biology* 12: 189-202.

Tirisano Consulting Engineers 2009. *Preliminary design report, Vol 1:1*. The South African National Roads Agency Limited: Consulting Services for the Establishment of Access Control & Associated Works for Dinokeng Big Five Game Reserve.

Unknown author 2001. Dinokeng integrated tourism development framework (DITDF).

Unknown author 2005. Dinokeng Game Reserve Infrastructure Guideline: Discussion document for approval.

Unknown Author 2005. Dinokeng Game Reserve marketing strategy.

Unknown author 2005. Dinokeng Game Reserve operational management plan.

Unknown author 2006. Cooperative government & stakeholder engagement framework.

Unknown Author 2007. Dinokeng Big 5 Game Reserve management plan.

Unknown author 2007. Dinokeng Game reserve infrastructure guidelines - discussion document for approval.

Unknown author 2007. Dinokeng Game Reserve operational management plan.

Unknown author 2009. Dinokeng Big 5 Game Reserve 2009/2010.

Van der Meulen, F., 1979. Plant sociology of western Transvaal bushveld, South Africa. A syntaxonomic and synecological study. A Gantner, Vaduz.

Van Dyk, G. 1997. Reintroduction techniques for lion (*Panthera leo*). In: *Proceedings of a Symposium on Lion and Leopards as Game Ranch Animals. Wildlife Study Group of the South African Veterinary Association, Onderstepoort,* pp 82-91.

Van Dyk, G. 2001. Large predator management strategy – North West Parks & Tourism Board, *Unpublished Report.*

Van Orsdol, K.G. 1984. Foraging behaviour and hunting success of lion in Queen Elizabeth National Park, Uganda. *African Journal of Ecology* 22: 79-99.

Van Rooyen, N. 1983. Die plantegroei van die Roodeplaatdam natuurreservaat. Ii. Die plantgemeenskappe. *S. Afr. J. Bot.* 2: 115-125.

Van Rooyen, N. 1984. ‘n Fenologiese studie van die plantegroei van die Roodeplaatdam natuurreservaat. DSc thesis, University of Pretoria, Pretoria.

Vartan, S. 2001. Overpopulation and inbreeding in small game reserves: the lion *Panthera leo* as a case study. M.Sc. Thesis, Percy Fitzpatrick Institute, University of Cape Town.

Viljoen, P.C. 2002. The Hippopotamus. In: *Game Ranch Management*. 4th Edition (Ed Bothma, J. du P.). Pp.194-200. Van Schaik Publishers: Pretoria.

Viljoen P.C. 2009a. Species management plan: spotted hyaena (*Crocuta crocuta*). The introduction and management of spotted hyena in the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

Viljoen P.C. 2009b. Species management plan: brown hyena (*Hyaena brunnea*). The management of brown hyena in the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

Viljoen P.C. 2009b. Species management plan: leopard (*Panthera pardus*). The management of brown hyena in the Dinokeng Game Reserve. Dinokeng Game Reserve/DTE. Unpublished report.

Viljoen, P.C. & Biggs,H.C. 1998. Population trends of hippopotami in the rivers of the Kruger National Park, South Africa. In: *Behaviour and Ecology of Riparian Mammals* (Eds Dunstone, N. & Gorman, M. L.). Pp. 251-279. Clarendon Press: Oxford.

Vorster, M. 1982. Development of the ecological index method for assessing veld condition in the Karoo. *Proceedings of the Grassland Society of South Africa*. 17: 84 – 89.

Waldram, M.S; Bond, W.J. AND Stock, W.D. 2007. Ecological Engineering by a Mega-grazer: White rhino impacts on a South African savanna. **Ecosystems.** Springer New York.

Walker B.H. 1998. The art and science of wildlife management. *Wildlife Research* **25:** 1-9.

Wessels, J. 2001. The roan antelope saga. *SA Game & Hunt* 7: 25-27.

Westhoff, V. & Van der Maarel, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.

White & Case 2008. Management agreement. DGR Management Association & DGR Game Enterprises Limited.

Whyte, I.J 2001. CONSERVATION MANAGEMENT OF THE KRUGER NATIONAL PARK ELEPHANT POPULATION. PhD. Thesis. University of Pretoria. 235pp.

Wilcox, B.A. 1980. Insular ecology and conservation. In: M.E. Soule & B.A. (eds). Wilcox. *Conservation Biology: an evolutionary-ecological perspective.* Sunderland, Massachusetts.

Wilson, D.E. & Hirst, S.M. 1977. Ecology and factors limiting roan and sable antelope populations in South Africa. Wildl. Monogr. 54: 1-111.

Winterbach, R. 1998. A phytosociological synthesis of *Acacia tortilis* communities in the north-western savanna of South Africa. MSc thesis, University of Pretoria, Pretoria.

Young, E. 1970. The diagnosis and control of game diseases. *Zool. Afr.*, 5: 167 – 177.

Young. E. 1970 Water as faktor in die ekologie van wild in die Nasionale Krugerwildtuin. D.Sc. theses. University of Pretoria.

Young, E. 1972. Considerations of large scale vaccination of free-living game.
J. S. Afr. Vet. Assoc., 43: 189 – 191.

DRAFT DOCUMENTS CONSULTED:

Dinokeng Game Reserve, Draft Environmental Management Plan. August 2008. Compiled by Lynn van Rooyen and Jenny Stevens.

The introduction and management of elephant in the Dinokeng Game Reserve. Compiled by Lynn Van Rooyen and Jenny Stevens.

The introduction and management of lion in the Dinokeng Game Reserve. Compiled by Jenny Stevens and Jan Du Preez.

Consumption calculation of lion and their impact on prey species in the Dinokeng Game Reserve. Compiled by Jenny Stevens

ACKNOWLEDGEMENTS

Dr. Dewald Keet for the use of some of his photos used in the text.

INTERNET SOURCES & WEBSITE LINKS:

http://www2.dwaf.gov.za/webapp/FireOverview.aspx
www.metsweding.com
www.nokengmun.co.za
www.rhino.org.za
www.speciesstatus.sanbi.org