DIGBY WELLS
ENVIRONMENTAL

Environmental Impact Assessment for proposed Future Developments within the Sun City Complex

Specialist Fauna and Flora Report

Project Number:

SUN4642

Prepared for:

Sun International (Sun City Resort)

June 2018

This document has been prepared by Digby Wells Environmental.

Report Type:	Specialist Fauna and Flora Report
Project Name:	Environmental Impact Assessment for proposed Future Developments within the Sun City Complex
Project Code:	SUN4642

Name	Responsibility	Signature	Date
Rudi Greffrath	Report Writer		June 2018
Brett Coutts	Technical Review		June 2018

EXECUTIVE SUMMARY

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Sun City Resort to undertake a Strategic Environmental Impact Assessment (EIA) in relation to proposed future developments within the Sun City Resort Complex located near Rustenburg, North West Province.

The objectives of this report are to describe the current state of the flora and fauna within the proposed Expansion Areas and assess the impact of the proposed expansion projects. The report delivers various flora and fauna findings in compliance with existing provincial and national legislation.

An in-depth desktop study was undertaken as well as two field surveys. The first visit took place in the wet season (March 2018) and assessed expansion areas A, B, and C. The second visit took place in May 2018 for focused on the Vacation club expansion area. The flora component included a total of 54 sample plots throughout the project area as well as general species listing. Faunal sampling was concurrently undertaken. Visual sightings were conducted with binoculars and identification enabled with recognised South African literature. The presence of species was evaluated using tracks, dung, ecological indicators and non-fatal traps such as Pit-fall traps and Sherman traps. Motion-sensitive cameras were also placed strategically throughout the site. The invertebrate assessment included butterflies and active searching for scorpions and spiders.

The affected environment is typical of the region, which lies within the Savanna Biome (Mucina and Rutherford, 2012) which is located in the northern part of South Africa.

Four vegetation communities were identified within the project area: Riparian Bushveld, Mountain Bushveld, Plains Bushveld and Riverine Forest.

A total of 144 plant species were recorded during the vegetation assessment. Species of Special Concern included: *Boophane disticha (Poison bulb),* declining under SA Red Data List and *Sclerocarya birrea (*Maroela) protected according to the list of Protected Tree Species under the National Forest Act, 1998 (Act No. 84 of 1998) and *Spirostachys africana* (*Tambotie)* protected under Schedule 11 of the Nature Conservation Ordinance of Transvaal, 1983 (Act No. 12 of 1983) were encountered.

A total of 59 mammal species could occur within the study area (Appendix 1), with a total of 27 mammal species recorded during field work. Of the 27 mammal species twelve were recorded within the Mcregor Nature Reserve, with four of these being SSC. Two provincially protected bird species were recorded. No reptile SSC or Amphibian SSC were recorded from the study area.

Sensitivity of the area

Owing to the ecological function of the savannah habitat on the Sun City site and the presence or likelihood of occurrence of floral and faunal Species of Special Concern (SSC), the overall Sensitivity of the site was regarded as Medium High to High.

The following areas were regarded as highly sensitive:

- Wetlands, and

- Riparian Woodland

The following areas were regarded medium to highly sensitive:

- Mountain Bushveld;

- Plains Bushveld;

- Riverine Forest.

Impacts

Consideration of the impacts of the proposed expansion projects and associated activities on the terrestrial ecology forms a large component of this study. The primary anticipated impacts include a loss of vegetation communities, invasion of alien invasive plants and disturbance to fauna due to noise and increased vehicular movement on site. These impacts are particularly significant in sensitive areas.

Mitigation and management

Methods of mitigation and better management of the negative impacts have been recommended following the hierarchy of; avoidance, mitigation and offsetting. Major recommendations include;

- Avoidance of sensitive habitats;

- Rescue and Translocation of Flora and Fauna where clearing is unavoidable (especially Species of Special Concern);

- Alien Invasive Plant Management Plan, and;

- Compilation and implementation of a monitoring programme.

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1   Introduction

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Sun City Resort to undertake a Strategic Environmental Impact Assessment (EIA) in relation to proposed future developments within the Sun City Resort Complex located near Rustenburg, North West Province. The proposed Projects involve the following:

Table 1-1: Summary of Projects

Category	No.	Project Name	Project Summary
Resort Expansion Projects (REP)	REP1	Eco-Lodge	Development of a Bush Lodge / Eco-Lodge at Gary Player Golf Course Workshop.
	REP2	Driving Range Road	Construct a Road to connect the Driving Range at Lost City Golf Course (LCGC) to the Gary Player Golf Course (GPGC) via the Palace garden road and Valley of Waves road.
	REP3	Kwena Gardens Expansion	Construct 20 additional Rustic Chalets at Kwena Gardens.
	REP4.1	Vacation Club (VC) Phase 3	Construct an additional 150 simplex units, 2- 3 bed units and associated infrastructure to expand capacity at the VC. The site identified for the expansion currently houses the Helipad and Nursery.
	REP4.2	Vacation Club (VC) Phase 4	Construct an additional 150 simplex units, 2- 3 bed units and associated infrastructure to expand capacity at the VC. The VC Phase 4 area occupies a total footprint of 82 ha and is located between the decommissioned landfill site and Bakubung Gate.
	REP5	Recreational Lake Beach Expansion	Expand the existing artificial beach at the Lake and construct an additional shallow swimming pool at Waterworld Beach
	REP6	Helipad relocation and expansion	Decommission the existing helipad, to make space for VC Phase 3, and construct a new helipad with increased bays closer to the Palace.
	REP7	Additional Parking Garage, Convention Centre and Hotel	Construct an additional parking garage, Convention Centre and Hotel (250 rooms) including a bridge link from Sun Central to the new Hotel.
	REP8	Soccer Fields	Develop 2 soccer fields at the Warehouse

Utilities and Services Projects (USP)	USP1	Stormwater culverts at Golf Course Roads	Install Stormwater pipes / culverts at Golf Course Roads to allow water to flow under the roads and maintain the road surface for fence inspections by security (prevent floods washing away the road).
	USP2	Additional Reservoirs to Supplement existing water storage capacity	Construct 2 x 10Ml reservoirs or alternatively 1x 20Ml Reservoir on Telkom Hill next to existing Upper Reservoir.
	USP3	Effluent transfer line replacement	Currently there is an effluent transfer line (old asbestos line) through Sunset Drive to Hole 2. This line will be decommissioned (shut down) but remain in place. A new line will then be installed against the fence of Letsatsing.
	USP4	Sunset-Sky-train Fresh Water Line	Construct a main water line from the Welcome Centre to Sky-train (pipe will be attached to sky-train route)
	USP5	Ledig Sewer Line decommissioning, New WWTW for VC and Palace	Currently the sewer line running through Ledig (old asbestos line). The line will be decommissioned (shut down but remain in place). A new wastewater treatment works (WWTW) will be established to manage sewage from VC and The Palace. A new pipeline will be required to the Lost City hole 3 dam to return the treated water for irrigation.
	USP6	South Village Pipeline	Construct an additional pipeline for water supply to South Village
	USP7	Generator Park	Consolidate the generators throughout the site into one area for effective monitoring and control, or establish a generator park to service the east side business units.
Maintenance Projects (MP)	MP1	Clearance of Fence Roads	Vegetation Clearance at perimeter fences to serve as maintenance roads and Fire Breaks (25 km)
	MP2	Sun Park Culverts	Clear the Culverts under the road at Sun Park from debris and siltation. Construct maintenance road to facilitate future maintenance.

Activities that are listed in terms of the Environmental Impact Assessment (EIA) Regulations[1] require environmental authorisation prior to commencing. The proposed Projects at Sun City constitutes Listed Activities in terms of GN R 983 (Listing Notice 1); GN R 984 (Listing Notice 2) and GN R 985 (Listing Notice 3) as amended.

This specialist Fauna and Flora Specialist Report has been compiled in terms of Appendix 6 of the NEMA EIA Regulations, 2014, (as amended) in terms of the Scoping and EIA process which is being followed in applying for Environmental Authorisation.

The requirements of Appendix 6 are presented in Table 1-2 and cross-referenced to the relevant sections of this Report.

Table 1-2: Structure of this report in accordance with the EIA Regulations

Regulatory Requirement for EIA Reports	Relevant Section of this report
1. (1) A specialist report prepared in terms of these Regulations must contain -	

(a) details of—
   (i)   the specialist who prepared the report; and
   (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;
	Please refer to Section 2 and Appendix A of this Report

(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Please refer to Section 2 of this report: Details of the Specialist
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Please see Section 4: Terms of Reference
(cA) an indication of the quality and age of base data used for the specialist report;	Please see Section 5: Data used in this report
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Please see Section 7: Existing Environment
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Please see Section 5: Data used in this report
(e) a description of the methodology adopted in preparing the report inclusive of equipment and modelling used;	Please see Section 6: Methodology

[1] As published in Government Notices R982; 983; 984 and 985 on 4 December 2014, as Amended 7 April 2017.

(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Please see Section 8: Sensitivity of the Site
(g)	an identification of any areas to be avoided, including buffers;	Please see Section 8: Sensitivity of the Site
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Please see Section 8: Sensitivity of the Site
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Please see Section 9: Assumptions, Limitations and Gaps in knowledge
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Please see Section 10: Impact Assessment
(k)	any mitigation measures for inclusion in the EMPr;	Please see Section 12: Mitigation and Management Measures
(l)	any conditions for inclusion in the environmental authorisation;	
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Please see Section 13: Monitoring Requirements
(n)	a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised; (i) (A) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Please see Section 14: Reasoned opinion of the specialist
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Please see Section 15: Public Consultation
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	No additional information was requested.

2   Details of the Specialist

This Specialist Report has been compiled by the following specialists (CVs of the Project Team are included in Appendix A):

Table 2-1: Details of the Specialist(s) who prepared this Report

Responsibility	Fauna and Flora field work and report compilation
Full Name of Specialist	Rudi Greffrath
Highest Qualification	B-Tech Conservation Management
Years of experience in specialist field	11

2.1   Declaration of the Specialist

I Rudi Greffrath, as the appointed specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

■ in terms of the general requirement to be independent:

- other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or

- am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);

■ in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;

■ have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;

■ have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;

- ■ have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;

- ■ have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;

- ■ have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and

- ■ am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Signature of the specialist:

Rudolph Greffrath

Full Name and Surname of the specialist:

Digby Wells Environmental

Name of company:

2018/06/18

Date:

3   Aims and Objectives

Information generated from this survey was used to identify the potential impacts that the proposed Sun City expansion project construction activities will have on the environment. In order to achieve this aim the following objectives were considered for this specialist study:

■ To delineate the various vegetation/habitat types and describe their sensitivity, present within the study area;

■ To determine if any flora and fauna species or assemblages will be directly impacted upon by the proposed mining activities and its associated infrastructure, this includes flora and fauna communities present, the ecological state of these communities, identification of possible Red Data Listed species (according to the International Union for the Conservation of Nature (IUCN)) as well as considering National and Provincial criteria, and;

■ To determine mitigation measures for the identified impacts in order to reduce the severity of these impacts. In cases where impacts cannot be mitigated, areas may be regarded as 'no-go' owing to the presence of Species of Special Concern (SSC) or critical habitat.

4   Terms of Reference

The agreed terms of reference include the following deliverables for this Flora and Fauna Impact Assessment Report:

■ Record the plant species that occur within the study area based on the results of the infield vegetation/flora assessment;

■ Record the animal species (mammals, reptiles, amphibians, birds and invertebrates (butterflies and spiders) that occur within the study area based on the results of the infield fauna assessments;

■ Identify which of the species recorded are Species of Special Concern (SSC) based on the following lists:

▪ International Union for the Conservation of Nature (IUCN) Red Data List (2017);

▪ The South African National Biodiversity Institute (SANBI) Red Data List (2016);

▪ SIBIS: SABIF (South African Biodiversity Information Facility) established by the Department of Science and Technology (DST); and

▪ The Threatened Species Programme (TSP) listing in collaboration with the National Botanical Institute (NBI) was consulted to identify any SSC and/ or any Red Data Fauna and Flora Listed Species that may be present within the proposed Sun City Project areas earmarked for development;

- ▪ The National Environmental Biodiversity Act, 2004 (Act No. 10 of 2004)
  (NEMBA): Threatened or Protected Species List (ToPS).

- ■ Determine if any of the recorded species are alien invasive species or problem
  species in terms of NEMBA alien invasive species;

- ■ Using the results of the vegetation infield assessment and conduct a vegetation
  classification to identified the different plant communities within the study area;

- ■ Compile a vegetation distribution map of the identified plant communities recorded;

- ■ Map important faunal habitats identified within the study area;

- ■ Determine the biodiversity value of the study area using information gathered on both
  flora and fauna;

- ■ Compile a Biodiversity sensitivity map based on the identified biodiversity values; and

- ■ Assess the identified impacts of the proposed project and recommend mitigation
  measures.

5   Data used in this report

A study on available literature was conducted and includes the following:

- ■ Relevant and available previous studies that have been conducted within or
  surrounding the project area;

- ■ South African National Biodiversity Institute (SANBI), BGIS website, the National
  Spatial Biodiversity Assessment;

- ■ Governmental reports such the State of the environment Report for North West and
  legislation;

- ■ Conservation plan for North West;

- ■ Vegetation types of South Africa (Mucina and Rutherford, 2006); and

- ■ Fauna distribution and identification books of South Africa (Friedman and Daily
  2004), (Skinner and Chimimba 2005).

5.1   Database review

The review of Ecological databases included the following:

- ■ SANBI Plants of South Africa (POSA) – For the proposed plant species that might
  occur on site. This is site specific (as far as QDSG) and according to the quarter
  degree square in which the project is located. It also indicates Red Date species
  within the project area.

- ■ SANBI SIBIS (SANBI's Integrated Biodiversity Information System) – For the
  proposed fauna that might occur on site. It is also site specific based on the quarter
  degree square, but does not indicate Red Data species.

■ SANBI BGIS - National Spatial Biodiversity Assessment.

5.2 Maps and aerial photography review

Aerial photography, Google Earth and topographical maps have been studied to establish the habitat types that occur on the proposed project area. This is due to the fact that the probability of Red Data species occurring on site is based largely on the habitat requirements. This will also assist in the identification of sensitive or protected areas. Areas are protected or classified as sensitive if they support a unique ecological system, contain keystone species or contains protected/Red Data species.

5.3 Legislation

Various pieces of legislation was considered and consulted during the compilation of this report and the primary data collection field work. The legislation covers International, National and Provincial bets practices, and are listed below (Table 5-1).

Table 5-1: Legislation

Legislation	Relevance
Convention on Biological Diversity, 1992 (United Nations, 1992)	*The treaty aims to effect international cooperation in the conservation of biological diversity and to promote the sustainable use of living natural resources worldwide.*
The International Plant Protection Convention (IPPC), adopted in 1951 and revised twice, in 1979 and in 1997 (FAO,1997)	*The International Plant Protection Convention (IPPC), with 111 governments as Contracting Parties, aims "to secure common and effective action to prevent the spread and introduction of pets of plants and plant products, and to promote appropriate measures for their control. Defining pest as "any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products," the Convention has been applied mainly to crops, but it also extends to the protection of natural flora (McNeely, 2005). Thus the scope of the IPPC covers any invasive alien species that may be considered to be a plant pest.*
The Constitution of the Republic of South Africa, 1996 (As adopted on 8 May 1996 and amended on 11 October 1996 by the Constitutional Assembly) (Constitution) Section 24	*The Bill of Rights (Chapter 2) is central to this Constitution as it enshrines the 17 rights of all people in the country. Section 24 of the Bill of Rights guarantees the right an 18 environment that is not harmful to people's health or wellbeing, and provides for environmental 19 protection for the benefit of future generations through reasonable legislative and other measures 20 that prevent "ecological degradation, promote conservation, and secure ecologically sustainable 21 development". This imparts a responsibility to protect endangered species and control invasive alien species so as to reduce their 22 negative impacts, but also requires a balance between biological and economic imperatives where they are in tension.*

Legislation	Relevance
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) NEMA Principles and EIA Regulations	*Environmental Management must place people and their needs at the forefront of its concern. Development must be socially, environmentally, and economically sustainable. Sustainable development requires the consideration of all relevant factors.* *The NEMA is a framework Act which sets out the general principles (set out in section 2 of this Act) regarding the protection of the environment in South Africa within the context of the so-called 'sustainable development'. These principles must be borne in mind at all times by any person or organisation whose operations or activities have the potential to generate waste, cause pollution or lead to adverse environmental impacts.* *Section 2(4)(a) of the NEMA requires and envisages that development must take place in a manner that ensures that (inter alia):* ■ *The disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;* ■ *Pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;* ■ *Waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner; and* ■ *Negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.* *These principles create a duty on a landowner to take all reasonable measures to ensure that that negative environmental impacts are prevented, including impacts on SSC, and that the impact of alien and invasive species on land is minimised, all in line with the provisions of all applicable laws. These duties are made even clearer by section 28 of the NEMA which states that: "every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment". Failure to comply with section 28 of any directives issued in terms of this section is a prosecutable offence in terms of the NEMA.* *The Environmental Impact Assessment (EIA) regulations (GN R. 982) dictate that any development that could result in significant environmental pollution or degradation is required to undertake an EIA process. The EIA regulations also provide for the formulation of Environmental Management Frameworks for designated geographic areas to promote pro-active decision-making with regards to the choice of development alternatives.*

Legislation	Relevance
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) Chapter 3 and 4	*"To provide for the management and Conservation of South Africa's Biodiversity within the framework of the National Environmental Management Act, 1998;* *The protection of species and ecosystems that warrant national protection;* *The sustainable use of indigenous biological resources, the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment of functions of a South African Biodiversity Institute, and for matters herewith."* *The NEMBA is the main Act that regulates protected and alien and invasive species. The NEMBA contains provisions which are specifically aimed at the prevention, eradication, and management of alien and invasive species, and the protection of SSC in South Africa. The NEMBA provides the framework, norms, and standards for the conservation, sustainable use, and equitable benefit-sharing of South Africa's biological resources. Amongst other provisions, the NEMBA makes also provision for the declaration by the Minister of the DEA of the so-called "threatened or protected ecosystems" as well as "threatened or protected species." Chapter 5 of the NEMBA makes provision for "species and organisms posing threat to biodiversity" – these being "alien species" and "invasive species."*
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA)	*To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith. The CARA was originally enacted to regulate IAPs that may have an impact on agricultural resources, but in the absent of alternate relevant legislation, CARA regulations have been applied to regulate IAPs that impacted on biodiversity, water resource management and fire management.*
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	*Ensures sustainable use of water through the protection of quality of water resources for the benefit of all water users. Aquatic and wetland ecosystems are protected by legislation in order to secure ecologically sustainable development and use of the relevant water resources.*

Legislation	Relevance
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Alien and Invasive Species Regulations 2014	*Specific Regulations dealing with alien species and invasive species have been promulgated by the Department of Environmental Affairs ("DEA") under the NEM:BA in terms of GNR 598 in Government Gazette 37882 dated 1 August 2014 – effective from 1 October 2014) ("A&I Species Regulations"). The A&I Species Regulations list the organisms which the Minister of the DEA deems to be alien and/or invasive species and thereby prescribing the permitted and prohibited conduct with regard to the management of alien and invasive species.*

5.3.1 Conservation of Species of Special Concern

Red Data Books or RDBs, are lists of threatened plants and animals specific to a certain region. They are a vital source of information in guiding conservation decisions. South Africa has produced 5 RDBs dealing with each of the following: birds, land mammals, fish (fresh water and estuarine only), reptiles and amphibians, and butterflies.

The conservation status of a plant or animal species is described by the following terms:

- EXTINCT: a species for which there is a historical record, but which no longer exists in the area under review.

- ENDANGERED a species in danger of extinction, and whose survival is unlikely if the factors causing its decline continue.

- VULNERABLE a species which it is believed will move into the endangered category if the factors causing its decline continue.

- RARE a species with small populations, which are not yet vulnerable or endangered, but which are at risk.

The term **THREATENED** is commonly used as a collective description for species which are endangered vulnerable or rare.

Some species are **ENDEMIC,** i.e. they are restricted to one region and occur nowhere else. A threatened endemic is a conservation priority.

Of special concern were protected plant and animal species. Listed species of flora and fauna are regarded as species whose representation in the wild has declined to such an extent that drastic action is needed to ensure their survival. Under anthropogenic pressure the number of these species has reached levels where preservation management is needed, and conservation management will no longer be effective. The listing of these species under either International Union for the Conservation of Nature (IUCN) or CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), is regarded as a valuable starting point to initiate legally sanctioned management practices to bring the numbers of these species back to within acceptable numbers.

5.3.1.1 IUCN

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The IUCN Red List also includes information on plants and animals that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e., are Data Deficient); and on plants and animals that are either close to meeting the threatened thresholds or that

would be threatened were it not for an on-going taxon-specific conservation programme (i.e., are Near Threatened).

Plants and animals that have been evaluated to have a low risk of extinction are classified as Least Concern (IUCN.org) (Figure 5-1).
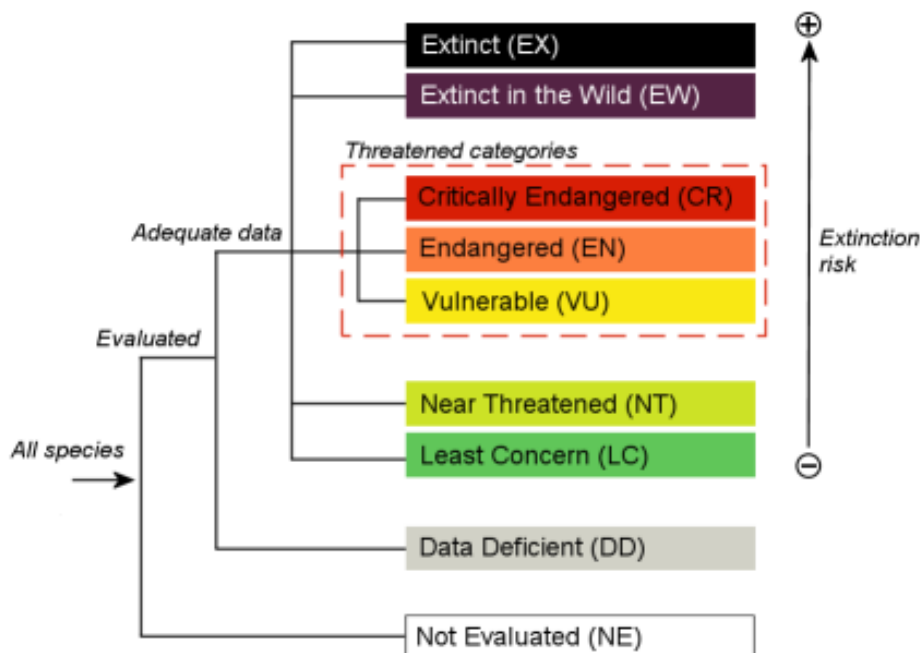
Figure 5-1: IUCN categories (IUCN.com)

5.3.1.2   CITES

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES.org).

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species (CITES.org). Specimens are divided into the following appendices according to the restriction on trade.

Appendices I, II and III

- Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.

- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

Appendix III contains species that are protected in at least one country, which has asked
other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a
distinct procedure from changes to Appendices I and II, as each Party is entitled to make
unilateral amendments to it.

5.4   Details of the site visit

Two wet season floristic surveys were conducted during the growing season (the rainy
season when most plants are in flower or seeding, October to March) to determine/confirm
the species composition of the project area. This gave an indication of the actual species
present on site and these are discussed in context of plant communities within the
ecosystem of the area.

6   Methodology

This section of the report first describes the methodology adopted in determining the status
quo of the present environment on the various project sites from a desktop and a
subsequent Impact assessment perspective. A description is then provided on the impact
assessment methodology, the results of which are presented in Section 10.

6.1   Determining the Baseline Environment

6.1.1   Literature Review and Desktop Study

A desktop study was undertaken, aiming to identify:

- Potential species in the proposed development area/site area according to the (
  South African National Botanical Institute (SANBI), Pretoria Computerised
  Information System) PRECIS List's;

- South African Bird Atlasing Project (SABAP2);

- Potential Red Data Listed species and their current status according to Provincial
  legislation;

- Expected vegetation type and community structure, (Mucina and Rutherford 2012);
  and

- Current biodiversity and ecosystem status.

6.1.2   Field Investigations and Seasonal Influence

The site visits and detailed infield flora and fauna assessments took place in March and May
2018. Flora sampling points are indicated in Figure 6-1, certain sampling points contained
protected tree species and these are also indicated on the map, this is however not an
indication of all the protected species on site.

Map Reference	Project Name
REP1	Eco-Lodge
REP2	Driving Range Road
REP3	Kwena Gardens Expansion
REP4.1	Vacation Club (VC) Phase 3
REP4.2	Vacation Club (VC) Phase 4
REP5	Recreational Lake Beach Expansion
REP6	Helipad Relocation and Expansion
REP7	Additional Parking Garage, Convention Centre and Hotel
REP8	Soccer Fields
USP1	Stormwater Culverts at Golf Course Roads
USP2	Additional Reservoirs to Supplement Existing Water Storage Capacity
USP3	Effluent Transfer Line Replacement
USP4	Sunset-Sky-Train Fresh Water Line
USP5	Ledig Sewer Line Replacement
USP6	South Village Pipeline
USP7	Generator Park
MP1	Clearance of Fence Roads
MP2	Sun Park Culverts

Figure 6-1: Location of the Fauna and Flora Sampling Points

6.1.2.1   Flora

As the sampling of the entire study area is not possible, representative samples of the vegetation were assessed. Aerial imagery was utilized to identify and stratefy homogenous vegetation units. Sampling points were then randomly selected within representative areas of this homogenous vegetation units and then ground truthed by means of detailed infield assessment. The number of sample sites visited was determined by the time available for the study as well as the accessibility of each of the sample sites. This methodology allows for more efficient sampling than overall random sampling.

At each sample site, a plot size of 50 m^2 was sampled. In each plot; the species were identified in the field and recorded. The Braun-Blanquet method was used for the listing of species and their associated cover. The Braun-Blanquet method incorporates seven cover-abundance categories as listed in Table 6-1. A general species list was also compiled from random traversing through the site.

Table 6-1: Braun-Blanquet Analysis Cover Abundance

Cover Abundance	Category
One or few individuals.	r
Occasional and less than 5% of total plot area.	+
Abundant and with very low cover, or less abundant but higher cover; in any case less than 5% cover of total plot area.	1
Very abundant and less than 5%, or 5-25% cover, of a total plot area: ▪ 2m – Very abundant ▪ 2a – 5-12.5 % cover, irrespective of number of individuals ▪ 2b – 12.5-25% cover, irrespective of number of individuals	2
25-50% cover of total plot area, irrespective of number of individuals.	3
50-75% cover of total plot area, irrespective of number of individuals	4
75-100% cover of total plot area, irrespective of number of individuals	5

Vegetation was classified and the broad plant communities identified during the classification was then mapped to show their distribution. Species lists were compiled for each broad habitat type.

6.1.2.2   *Species of Special Concern (SSC)*

From the overall species list, a list of SSC was compiled. A comprehensive SSC species list was compiled taking the following Red Data Lists into consideration:

- International Union for the Conservation of Nature (IUCN) Red Data List (2015);

- The South African National Biodiversity Institute (SANBI) Red Data list version 2015.1;

- The South African Red Data lists for mammals (2004), birds (2016), butterflies and Herpetafauna;

- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Threatened or Protected Species Regulations, and

- The Convention on International Trade in Endangered Species of Flora and Fauna (CITES) list (2016).

The South African Red Data List uses the same criteria as that defined by the IUCN. According to the IUCN all species are classified in nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (IUCN, 2016). The categories are described in Table 6-2 below.

Table 6-2: Red Data Categories (taken from SANBI 2012)

CATEGORY		DESCRIPTION
Extinct	(EX)	No known individuals remaining.
Extinct in the Wild	(EW)	Known only to survive in captivity.
Critically Endangered	(CR)	Extremely high risk of extinction in the wild.
Endangered	(EN)	High risk of extinction in the wild..
Vulnerable	(VU)	High risk of endangerment in the wild.
Near Threatened	(NT)	Likely to become endangered in the near future.
Least Concern	(LC)	Lowest risk. Does not qualify for a more at risk category. Widespread and abundant taxa are included in this category.

CATEGORY		DESCRIPTION
Data Deficient	(DD)	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	(NE)	Has not yet been evaluated against the criteria.
	Extinct	Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories CR, EN or VU is a threatened species. Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories, **NT, LC** and **DD**
	Threatened	
	Other categories of conservation concern	
	Other categories	

The online IUCN database was referenced in order to identify Red Data Listed species and
their various threat status categorisations.

6.1.3 Fauna

Two wet season surveys, were conducted for this project. In support of this, a detailed
desktop study was also conducted for mammals, birds, reptiles and frogs, this information
can be found in the relevant scoping report. All fauna species encountered on site were
identified and recorded. The following methods described below were used during the
survey and the location of the sampling areas are shown in Figure 6-1.

6.1.3.1 *Mammals*

Small mammals were sampled through opportunistic sightings, as well as the use of
Sherman traps. The 20 traps were baited with small mammal bait and left for the duration of
the field work time, two nights and three days. If no small mammals were captured after a
day, the traps were moved to a different location and re-baited. If small mammals were
captured, the traps were rebaited and re-set in the same position. All Sherman traps were
checked once a day, in the early morning. Large mammals were recorded using scats,
tracks and nesting or breeding sites such as burrows and dens. Scats and tracks found,
during active searches, were photographed with a scale and identified. For identification
purposes the following field guides were used, Mammals of Southern Africa (Smithers,
1983), The Mammals of the Southern African Sub-region (Skinner & Chimimba, 2005), Red
Data Book of the Mammals of South Africa (Friedman & Daly 2004) and camera traps
placed throughout the sites, mainly at water points within the different vegetation units.

6.1.3.2   *Avifauna*

The principal ornithological field survey technique used was transect surveys and random point surveys. Transect surveys were planned based on representative sites of different avifauna habitat, such as pans, dams, wetlands, open grassland and road reserves by simply following available roads and paths that transect over these habitat types. Transect procedures involve slow attentive walks along transects during which any bird seen or heard is identified and recorded; this was completed during diurnal surveys only. Species observed during the vegetation surveys and other field trips were also recorded.

The following was recorded:

- All birds encountered or noted during the survey;

- All birds observed by people residing in the study area; and

- A list of rare and endangered species encountered.

Visual identification of birds was used to confirm bird calls where possible. Bird species were confirmed using Robert's birds (2009).

6.1.3.3   *Herpetofauna (Reptiles and Amphibians)*

Herpetofauna include reptile and amphibian species. Direct/opportunistic observations were conducted along trails or paths within the project area. Any herpetofauna species seen or heard along such paths or trails within the project area were identified and recorded. Another method used was refuge examinations using visual scanning of terrains to record smaller herpetofaunal species which often conceal themselves under rocks and in fallen logs, rotten tree stumps, under rocks, in leaf litter, rodent burrows, ponds, old termite mounds, etc. Amphibians and reptiles observed by people residing in the study area were also recorded. Branch (2001), Du Preez and Caruthers (2009) and Carruthers (2009) was used to confirm identification where necessary.

6.1.3.4   *Macro-Invertebrates*

A sweep net (750 mm diameter) was used to sample the grass dominated areas within the Bushveld vegetation types. Day flying butterflies (Lepidoptera) and other flying insects were caught using a 750 mm butterfly net. Identification was done by using Picker *et al.* (2002).

During the first wet season survey insects were caught using a 750 mm butterfly net, in addition butterflies were photographed and identified where and when they were seen. In the second wet season site visit, transects were walked within identified vegetation/habitat types in order to identify any invertebrate activity or individuals, sweep netting was performed.

6.1.3.5   *Red Data Faunal Assessment*

The following parameters were used to assess the Probability of Occurrence of each Red Data species:

■ Habitat requirements (HR) – Most Red Data Listed animals have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated;

■ Habitat status (HS) – The status or ecological condition of available habitat in the area is assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data Listed species (this is especially evident in wetland habitats); and

■ Habitat linkage (HL) (corridors) – Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species habitat within the study area.

Probability of occurrence is presented in four categories, namely:

■ Low (unlikely to occur);

■ Medium (could possibly occur);

■ High (most likely could occur); or

■ Recorded (does occur on site).

The IUCN Red Data categories (2017) are used for the status identification of mammals, birds, reptiles and amphibians globally.

6.2   Impact Assessment Methodology

Impacts and risks have been identified based on a description of the activities to be undertaken. Once impacts have been identified, a numerical environmental significance rating process will be undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental impact.

The severity of an impact is determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact is then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures will be incorporated into the EMP.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

$$\text{Significance} = \text{CONSEQUENCE} \times \text{PROBABILITY} \times \text{NATURE}$$

Where

$$\text{Consequence} = \text{intensity} + \text{extent} + \text{duration}$$

And

$$\text{Probability} = \text{likelihood of an impact occurring}$$

And

$$\text{Nature} = \text{positive } (+1) \text{ or negative } (-1) \text{ impact}$$

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 6-4. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation has been applied; post-mitigation is referred to as the residual impact. The significance of an impact is determined and categorised into one of seven categories (The descriptions of the significance ratings are presented in Table 6-5).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 6-3: Impact assessment parameter ratings

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur.>65 but <80% probability.

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediat surrounding area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 6-4: Probability/consequence matrix

Significance

-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 6-5: Significance rating description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

7 Existing Environment

7.1 Locality

The study area is located in the Sun International's Sun City Holiday Resort, within the Pilanesberg National Park Alkaline Ring Complex in the North-West Province (Figure 7-1).
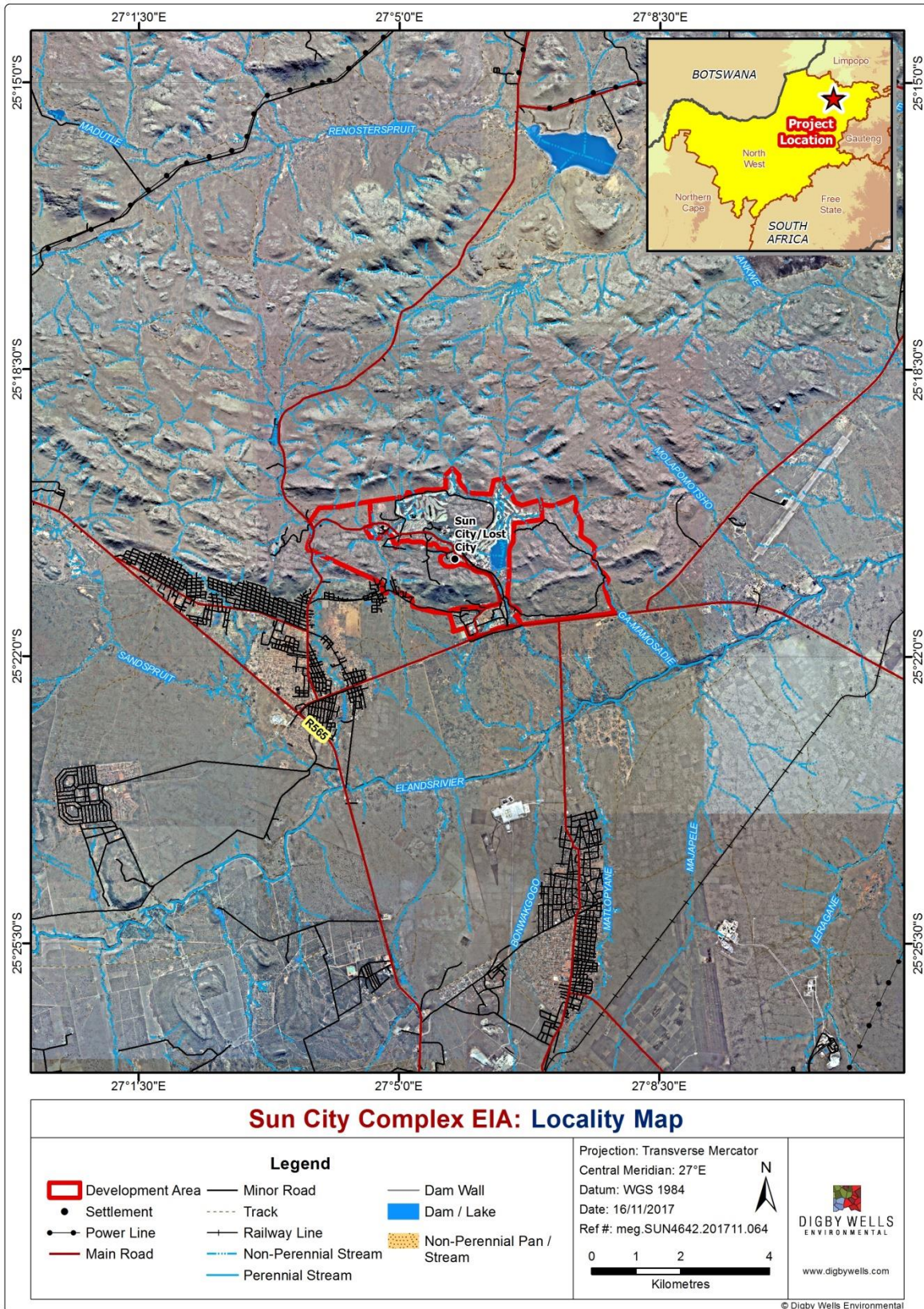
Figure 7-1: Locality Map

7.2   Regional Vegetation

According to the Vegetation map of South Africa, Lesotho and Swaziland (Mucina and Rutherford, 2006), the study area falls within the Zeerust Thornveld vegetation type. This vegetation type extends from the plains of Lobatsi River in the west via Zeerust, Groot Marico and Mabaalstad to the flats between the Pilanesberg and the western end of the Magaliesberg in the east, and is an Endemic Vegetation type. The ecosystems threat status according to the NWBSP (2015) is Vulnerable.

Vegetation consists of deciduous, open to dense short thorny woodland, dominated by *Senegalia* and *Vachellia* species (previous known as *Acacia*). The herbaceous layer is comprised predominantly of grasses on deep, high-base and some clay soils on plains and lowlands. Common and characteristic plant species for the Zeerust Thornveld vegetation type are listed in Table 7-1 and the distribution of this vegetation type is shown in Figure 7-2.

Table 7-1: Common and characteristic plant species of the Zeerust Thornveld vegetation type (Mucina and Rutherford, 2006)

Plant form	Species
Tall trees:	*Senegalia burkei* (d), *Vachellia erioloba* (d).
Small trees:	*Senegalia mellifera (d), Vachellia nilotica (d), Vachellia tortilis (d), Searsia lancea (d), Senegalia cinerea (d), Peltephorum africanum, Terminalia sericea.*
Tall shrubs:	*Diospyros lycioides, Grewia flava, Mystroxylon aethiopicum.*
Low shrubs:	*Agathisanthemum bojeri, Chaetecanthus costatus, Clerodendrum ternatum, Indigofera filipes, Searsia grandidens, Sida chrysantha, Stylosanthes fruticose.*
Graminoids (grasses and sedges):	*Eragrostis lehmanniana (d), Panicum maximum (d), Aristida congesta, Cymbopogon pospichilii.*
Herbs:	*Blepharis integrifolia, Chamaecristua absus, C. mimosoides, Cleome maculate, Dicoma anomal, Kyphocarpa angustifolia, Limeum viscosum, Lophiocarpus tenuissimus.*
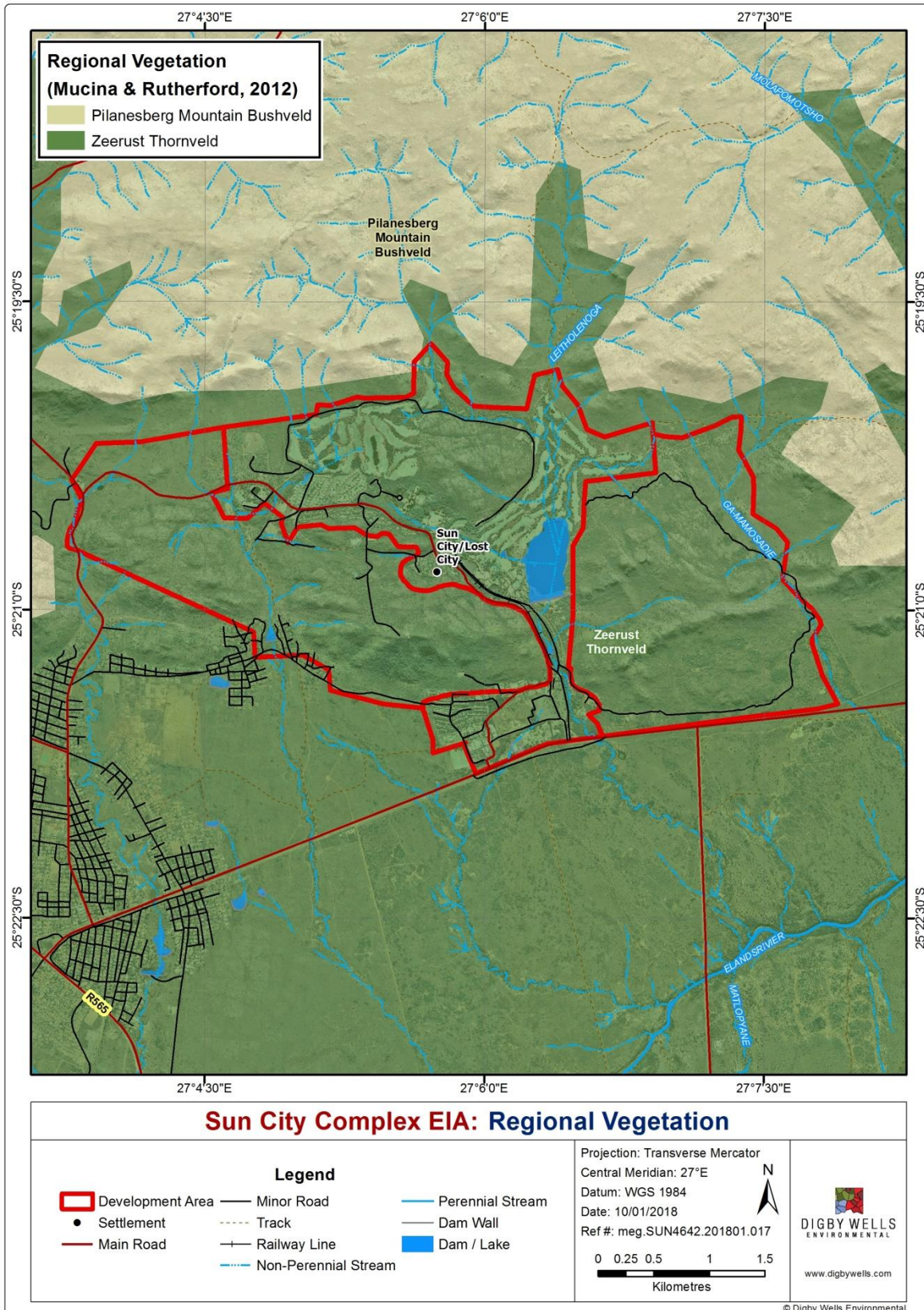
Figure 7-2: Regional Vegetation Types

7.2.1 Species of special concern

According to POSA (2016) no Red Data listed species have been recorded previously in the QDS 2527AC. However, following species were recorded on site, *Boophane disticha (Poison bulb),* declining under SA Red Data List and *Sclerocarya birrea (*Maroela) protected according to the list of Protected Tree Species under the National Forest Act, 1998 (Act No. 84 of 1998) and *Spirostachys africana* (*Tambotie)* protected under Schedule 11 of the Nature Conservation Ordinance of Transvaal, 1983 (Act No. 12 of 1983) were encountered.

7.3   Flora

The study area was divided into three distinct development zones as far as the expansion, maintenance and Services projects are concerned, collectively referred to as the development areas, in order to indicate where each of the project activities will take place.

The central part of the study area (596 ha or 39% of the total project area) known as development area B is where the majority of the current land use and resulting impacts are concentrated and expected to occur. This area contains all the roads, housing facilities (staff and guests), recreational facilities and administrative areas and associated infrastructure. There are however natural vegetation still present here, mostly for aesthetic reasons, but areas such as these are most often isolated and fragmented between the resort infrastructures.

The Western and Eastern parts of the study area (development area A (492 ha) and C (468 ha) respectively)) are mostly natural and consists of savanna woodland which has representative elements of the Zeerust Thornveld and Pilanesberg Mountain Bushveld (Table 7-2). The floristic composition is dominated by woody species with a relatively high richness that correlates with the Pilanesberg Mountain Bushveld in the foothills and Zeerust Thornveld on relatively flat areas where certain areas of development area B is suffering from grazing pressure.

Table 7-2: Vegetation delineations per Development Area

Vegetation Type	A	B	C
Mountain Bushveld	357.77	126.76	330.77
Plains	90.24	61.00	118.90
Riparian	0	65.46	0.83
Wetland	37.65	87.42	17.72
Riverine Forest	0	41.21	0
Disturbed	6.41	214.07	0
Total	**492.07**	**595.92**	**468.21**

Sun City Complex EIA: **Vegetation Delineation**
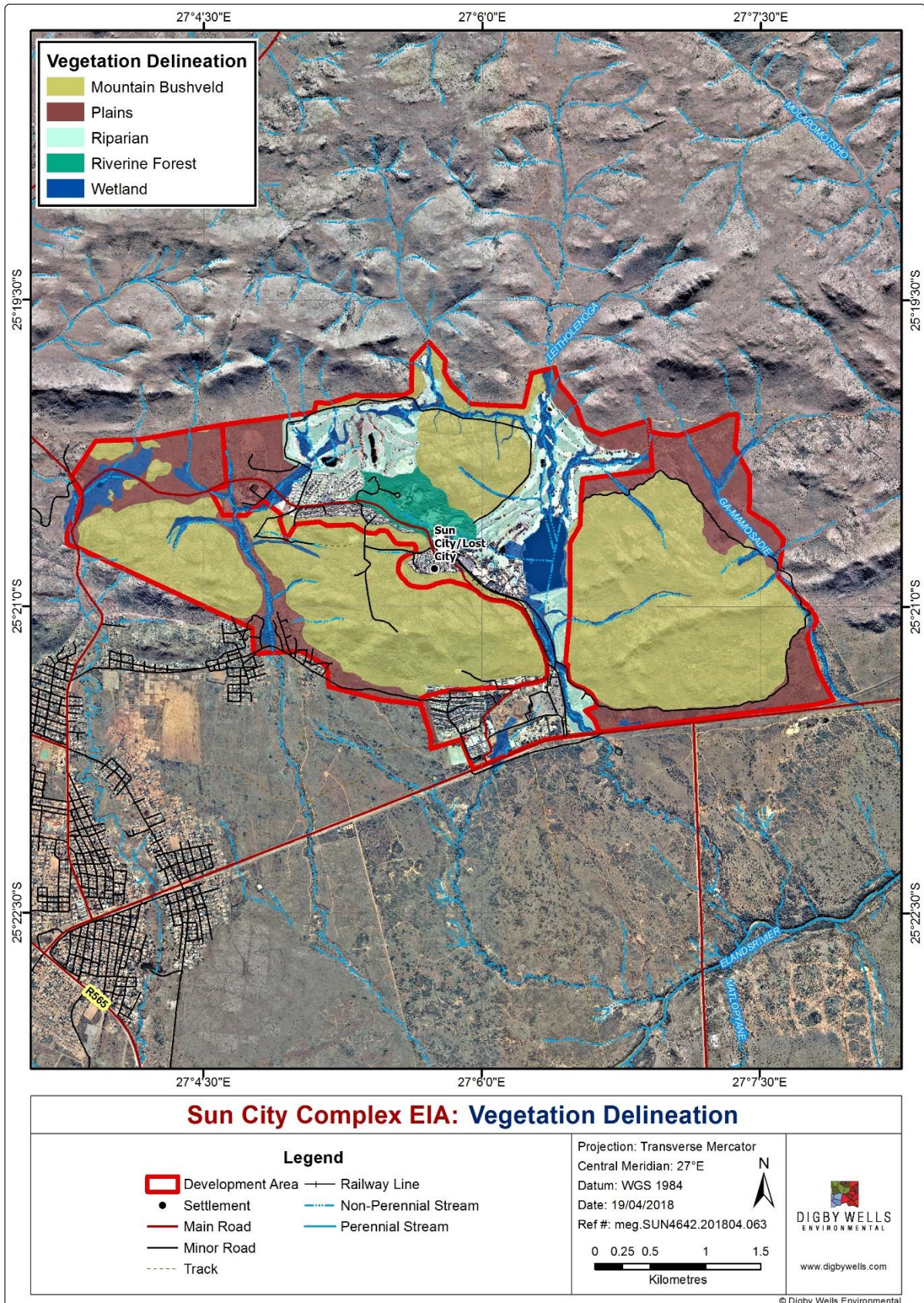
Figure 7-3: Vegetation Delineations

A total of 141 plant species were recorded on site during field work (Appendix C), of 266 listed (recorded by SANBI in the relevant grid 2527AC in the past) in the regional list (Appendix B), however more may occur that was not recorded and identified by SANBI and therefore not on the PRECIS List. The natural areas associated with the project area are discussed in more detail in the sections to follow. The disturbed areas refer to infrastructure areas that had been colonised by alien plants and pioneer species.

> **Acacia Name Change**
>
> The International Code of Botanical Nomenclature, the official botanical names authority, made a decision in July 2005 to reserve the name *Acacia* for Australian species only. Both Africa and Australia had been sharing the genus name for two distinctly different groups of species and a final call had become a necessity. The *Acacia* name change has been a matter of dispute for over a decade but it is important to note that the change is now official. The reasons for voting *Acacia* as an Australian type were numerous, primarily owing to the fact that over 1000 *Acacia*'s (many that are endemic) are to be found in Australia, making up the largest genus in the country. In addition, the *Acacia* has significant cultural and traditional value as a symbol in the Australian coat of arms. A taxonomic revision of African *Acacia*'s is underway and all species will be renamed into either *Vachellia* or *Senegalia*.

7.3.1 Historical Imagery

During 1948, the site-specific study area included a large faming component on the less rocky and steep areas. The Sun City project area was un-impacted by any type of developments or impacts, as is evident today. The presumed vegetation present in this photograph appears to be Plains Bushveld on the lower flat elevations, Mountain Bushveld on the higher elevations and Riverine Bushveld in the drainage line areas (Figure 7-4). The current delineations for vegetation types are relatively similar except the centrally located plains bushveld which has been completely transformed into a type of riverine forest.
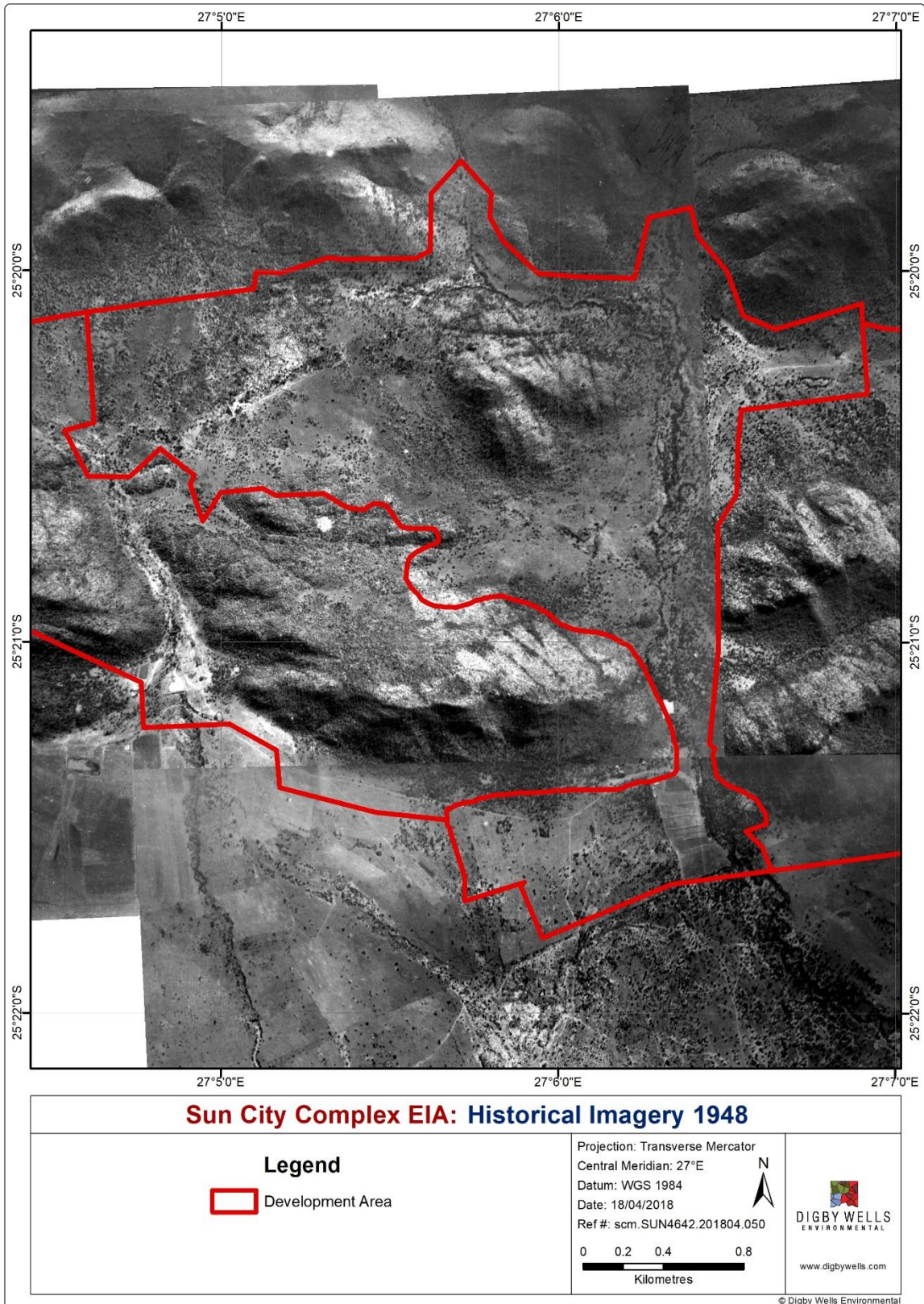
Figure 7-4: Historical Imagery of 1948

7.3.2 Riparian Bushveld

Riparian Bushveld was found predominantly in lower lying areas in close proximity to water courses. The nature of this vegetation type means it is often close to valley bottom wetland systems.

Multiple wetland systems totalling 136.5 ha fall within the proposed development areas (A, B and C). Seven freshwater features were identified on site and are broadly defined as follows:

■ An un-channelled valley bottom wetland situated on the western border of development area A;

■ An un-channelled valley bottom wetland on the eastern portion of development area A and originating in the western portion of development area B;

■ A large channelled and un-channelled valley bottom wetland drains the eastern portion of development area B from the north of the project area to the southern border of the Sun City Complex and consists of both channelled valley bottom and un-channelled valley bottom HGM units;

■ A seep, situated on the southern border of development area B;

■ Two artificial wetlands on the southern border of development area C, likely formed as a result of ponding as a result of the compaction of soils in the road resulting in the inhibition of surface water runoff in the catchment; and

■ A channelled valley bottom system to the east of development area C.

As alluded to previously this vegetation unit was encountered in the lower elevations of the study area where permanent or semi-permanent water is available and in certain areas throughout the dry season. As indicated by the coexistence of this vegetation type and the delineated wetlands (Figure 7-5).

The savannah vegetation type that dominates the project area is maintained by a fire regime that when allowed to occur naturally will balance the grass and woody layers to form a savannah landscape. This fire regime has been altered within the fence line of the golf courses and residential areas where fire has been excluded. This has resulted in the woody layer dominating the vegetation type and the grass layer being suppressed in certain areas.

The altered water regime in which water availability is artificially increased in and around the golf courses, Lost City and Gary Player, has resulted in the vegetation types present in these areas to be altered as well. Historical imagery has shown that the vegetation types present in the golf course/irrigated areas were historically more aligned with the plains savannah in species composition and physical features.

The woody component was characterised by *Syzigium cordatum* (Umdoni Waterberry), *Dombeya rotundifolia* (Wild Pear), *Ziziphus mucronata* (Buffalo thorn), *Faidherbia albida* (Ana Tree) and *Oleo europaea subs. Africana* (African Olive).

Gymnosporea senegalensis (Red Spike Thorn), *Cyperus denudatus* (Winged Sedge), *Carissa bispinosa* (Num Num).

Cynodon dactylon (Couch Grass), *Melinis repens* (Natal Red Top), *Eragrostis superba* (Saw tooth Love grass), *Digitaria eriantha* (Common Finger Grass).

Figure 7-5: Riparian Bushveld, A: Valley Bottom, B: *Spirostachys africana* **Woodland on North facing slope, C and D: Mountain Bushveld Footslopes and Riverine Bushveld.**

7.3.3 Mountain Bushveld

This vegetation type was predominantly found on the mountainous areas within the study areas, which in nature excluded certain anthropogenic disturbances that altered the vegetation types on more accessible areas (grazing and fires).

The north facing slopes were found to be a savannah/woodland which has a strong resemblance to the Zeerust Thornveld vegetation type. It consists of a floristic composition that is dominated by woody species with a fairly high richness that is similar to the Zeerust Thornveld vegetation type across the site. The vegetation type consists of mesophyllous woodland consisting of *Combretum molle, C. zeyheri, Croton gratissimus* and *Searsia (Rhus) leptodictya*, including various microphyllous species such as *Acacia nilotica* and *A. tortilis.* (Figure 7-6).

South facing slopes appears to be on steep slopes occur near the top of the koppies, here the topography is very steep and rocky with a few large boulders present. The tree canopy was closed in areas where taller trees persisted, grass species present were sparse but contained *Panicum maximum* (Guinea grass), *Enneapogon cenchroides* (Nine awned grass), *Trichoneura grandiglumis* (Small Rolling Grass).

The woody component was characterised by *Berchemia zeyheri* (Red Ivory Wood), *Combretum molle* (Velvet Bushwillow), *Mystroxylon aethiopicum* (Bald Kooboo Berry), *Searsia lancea* (Karee), *Vachellia karoo* (Sweet Thorn), *Ficus abutilifolia* (Large Leaved Rock Fig), *Cussonia spicata* (Common Cabbage tree), *Dombeya rotundifolia* (Wild Pear).

From the species richness it is evident that the occurrence of trees that prefer a rocky substrate are common in this vegetation type, however it must be noted that the plains bushveld was characterised by isolated rocky hills on the foot slopes of the mountainous areas. These areas were similar in substrate and species composition to the Mountain bushveld vegetation type due to fire and grazing being excluded from them.

Figure 7-6: Mountain Bushveld, A: Footslopes, B: South Facing Slopes, C and D: Close to South facing Reservoir

7.3.4 Plains Bushveld

This vegetation type was confined to the few locations in the development areas that are relatively flat, with less rocky substrate and sandier soils being present. This vegetation type was present in various successional stages, from pioneer to sub –climax, dependant on the degree to which it is being utilised and the presence or absence of main environmental drivers that maintains a savanna bushveld vegetation type structure and composition (Figure 7-7).

Development area 3 was found to be managed for the purpose of conserving the habitat and species composition in order to mimic the vegetation type's characteristics that was present prior to anthropogenic disturbances. The success of this management style was evident in the health and abundance of game species held in this area for game viewing purposes.

From historical imagery, that pre dates the Sun City development, plains bushveld appears to have been the vegetation type originally present on the locations of the two golf courses, this area coincided with development area 2. In these locations, specifically between golf course fairways the altered water regime has created microhabitats that resemble riparian woodland areas in species composition and structure.

As discussed previously, defoliation (browsing and fire) and water availability are factors that can change the composition and richness of an area. In development area 1 this vegetation type was not fenced or managed in any way, with the subsequent result that uncontrolled fires and grazing was occurring on a regular basis. This had a negative effect on the grass layer and the tree/shrub layer, as neither was able to recover sufficiently after disturbance events. The impact was the loss of certain species and the change in species occurrence.

The woody component was characterised by *Dichrostachys cinerea* (Sickle bush), *Vachellia karoo* (Sweet Thorn), *Vachellia nilotica* (Scented thorn), *Searsia pyroides* (Common wild current) and *Grewia flava* (Velvet Raisin).

The herbaceous component was dominated by *Hyparrhenia filipendula* (Fine Thatching Grass), *Heteropogon contortus* (Spear Grass), *Eragrostis cilianensis* (Stink love Grass) and *Cymbopogon caesius* (Broad-leaved Turpentine Grass).
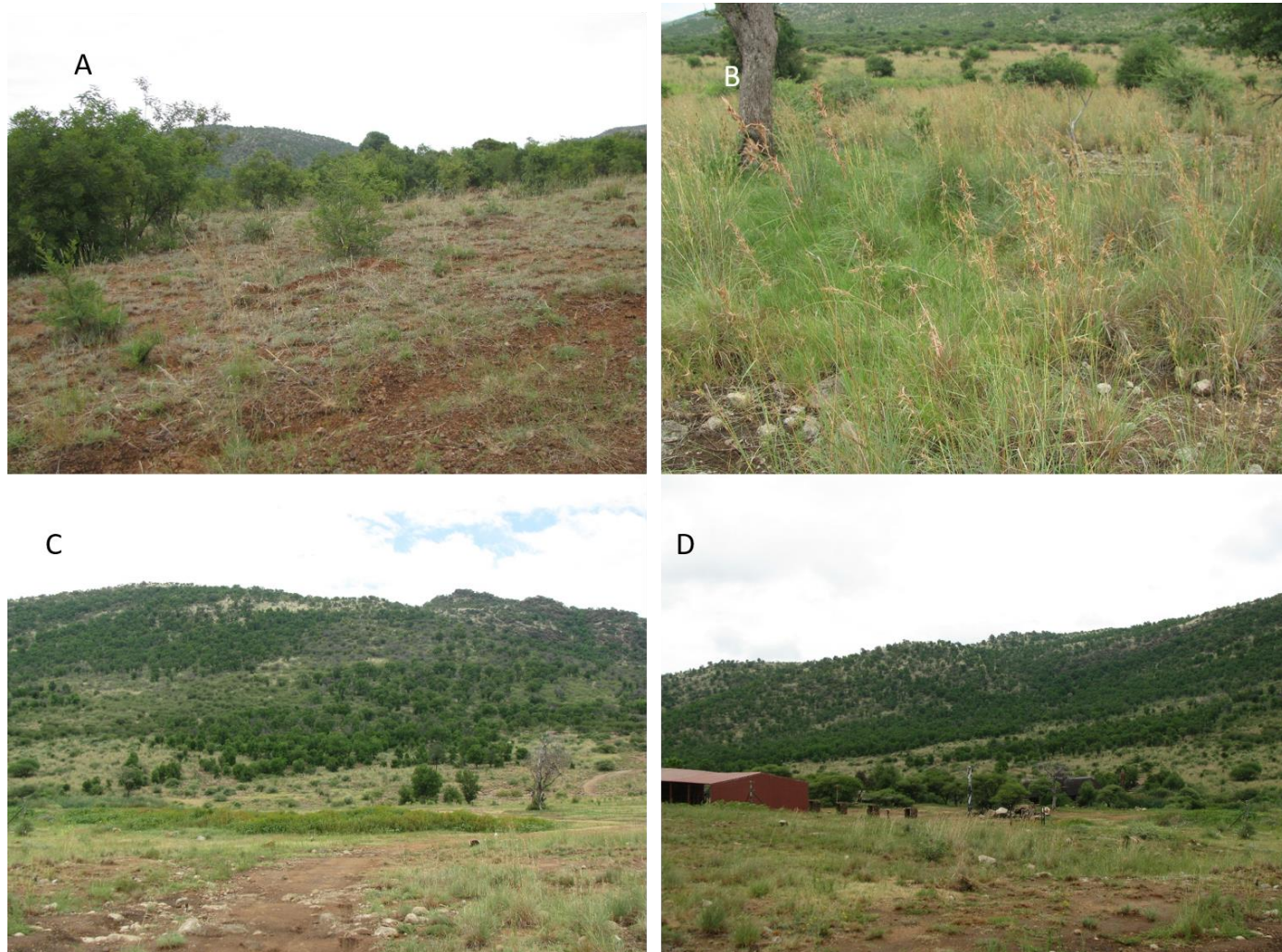
Figure 7-7: Plains Bushveld, A: Open Area, B: *Hypparhenia* and *Combretum imberbe* spp.C: and D: Development Area C plains.

7.3.5 Riverine Forest

This vegetation type is similar in composition to the Riverine Bushveld but contains more species that form a closed canopy. Furthermore, the occurrence of ornamental plant species was evident where this vegetation type was occurred close to the guest accommodation or entertainment areas. This vegetation type dominates in an area that previously would have resembled plains bushveld, as seen on historical imagery. The diagnostic species recorded were *Zanthoxylum capense* (Small Knobwood), *Faidherbia albida* (Ana Tree).

7.3.6 Alien Invasive Plant species

Alien plant species have been classified according to National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), as published in August 2014 (GN R599 in GG 37886 of 1 August 2014) into the following categories:

- Category 1a: Species requiring compulsory control;

- Category 1b: Invasive species controlled by an invasive species management programme;

- Category 2: Invasive species controlled by area, and;

- Category 3: Invasive species controlled by activity.

A total of 10 alien invader plant species (AIP) were recorded on site (Bromilow, 2010) eight of these have been assigned alien invader plant categories according to CARA and NEMBA (Table 7-3).

Table 7-3: Alien Invasive and Weed species recorded

Scientific Name	Common Name	NEMBA Status
Cereus jamacaru	Queen of the Night	Category 1b
Cirsium vulgare	Scotch thistle	Category 1b
Datura stramonium	Common Thorn Apple	Category 1b
Flaveria bidentis	Smelter's Bush	Category 1b
Melia azedarach	Syringa	Category 1b
Ocimum americanum v. americanum	Hoary Basil	Weed
Opuntia ficus-indica	Sweet Prickly Pear	Category 1b
Persicaria lapathifolia	Spotted Knotweed	Alien Invasive
Ricinus communis	Caster-oil Plant	Category 2
Verbena bonariensis	Tall Verbena	Category 1b

7.3.7 Plant Species with Ethnobotanical Value

Historically plants were once a primary source of all the medicines in the world and they still continue to provide mankind with new remedies. (Van Wyk, Van Outdshoorn and Gericke, 2013). Natural products and their derivatives represent more than 50% of all medicines in clinical use today. From a cultural perspective, many cultures have developed solutions to preventive, curative and promotive aspects of healthcare that is their own. The active ingredients, or compounds that are used can be found in different parts of the plant, and

include the roots, bulbs, rhizomes, tubers, bark, leaves stem or flowers, fruits and seeds, gums and nectars. The various vegetation types present in the Sun City project area contained 41 plant species which are known to be have medicinal properties (Table 7-4).

Table 7-4: Plant Species with Ethnobotanical Value

Scientific Name	Common Name	Ecological Status	Form
Adansonia digitata	Baobab	Medicinal	Tree
Asparagus laricinus	Cluster leaved asparagus	Charm	Herb
Berchemia zeyheri	Red Ivory Wood	Medicinal	Tree
Berkheya setifera	Buffalo-tongue Berkheya	Medicinal	Herb
Blepharis integrifolia var. integrifolia		Medicinal	Herb
Carissa bispinosa	Num Num	Edible fruit	Shrub
Combretum imberbe	Leadwood	**Medicinal SA National tree list**	Tree
Combretum molle	Velvet Bushwillow	Medicinal	Tree
Combretum zeyheri	Large fruited Bushwillow	Medicinal	Tree
Cucumis zeyheri	Wild cucumber	Medicinal	Herb
Cussonia spicata	Common Cabbage tree	Medicinal	Tree
Dichrostachys cinerea	Sickle bush	Medicinal	Tree
Dicoma anomala		Medicinal	Herb
Dombeya rotundifolia	Wild Pear	Medicinal	Tree
Elephantorrhiza elephantina	Elephant's Root	Medicinal	Shrublet
Erythrina lysistemon	Coraltree	Medicinal	Tree
Euclea undulata	Common guarrie	Medicinal	Tree
Faidherbia albida	Ana Tree	Medicinal	Tree
Ficus abutilifolia	Large Leaved Rock Fig	Medicinal	Tree
Grewia flava	Velvet Raisin	Medicinal	Tree
Gymnosporea senegalensis	Red Spike Thorn	Medicinal	Shrub
Lannea discolor	Live long	Medicinal	Tree
Morus alba	White Mulberry	Edible/Medicinal	Tree
Pappea capensis	Jacket plum	Medicinal	Tree
Pellaea calomelanos		Medicinal	Fern
Peltophorum africanum	Weeping wattle	Medicinal	Tree
Schoenoplectus corymbosus		Cultural-weaving	Reed
Sclerocarya birrea	Marula	**Medicinal SA National tree list**	Tree
Searsia lancea	Karee	Edible fruit	Tree
Solanum panduriforme	Yellow Bitter-apple	Medicinal	Shrub
Syzigium guineense	Bushveld Waterberry	Medicinal	Tree
Tarchonanthus camphoratus	Wild camphor bush	Medicinal	Tree
Terminalia sericea	Silver cluster leaf	Medicinal	Tree
Vachellia robusta	Horned thorn	Medicinal	Tree
Vachellia tortillis	Umbrella thorn	Medicinal	Tree
Vachellia xanthophloea	Fever Tree	Medicinal	Tree
Vachellia nilotica	Scented thorn	Medicinal	Tree
Vepris lanceolata	White ironwood	Medicinal	Tree
Ximenia caffra	Sourplum	Edible, traditional	Tree

| *Zanthoxylum capense* | Small Knobwood | Medicinal | Tree |
| *Ziziphus mucronata* | Buffalo thorn | Medicinal | Tree |

7.4 Fauna

7.4.1 Mammals

A total of 59 mammal species could occur within the study area (Appendix 1), with a total of 27 mammal species recorded during field work. Of the 27 mammal species twelve were recorded within the Mcregor Nature Reserve (Table 7-5).

The study area (apart from area C) is not particularly rich in mammal taxa, even though it is spatially located in close proximity to the Pilanesberg National Park which is an area specifically managed for conservation. The lack of richness can be attributed to the human activity that dominates the study area particularly development area A, and the lack of conservation focused management here. Development Area B, which forms the main Sun City infrastructure area, and is access controlled displayed more species richness that area A, but less that Area C.

Table 7-5: Mammal Species recorded in areas A and B

Scientific Name	English Name	Observed Indicator	Observed Habitat
Aepyceros melampus	Impala	Camera Trap	Mountain Bushveld
Aethomys chrysophilus	Red Veld Rat	Burrows	Widespread
Atilax paludinosus	Marsh Mongoose	Spoor	Riverine Bushveld
Canis mesomelas	Black-backed Jackal	Spoor & scats	Widespread
Cercopithecus pygerythrus	Vervet Monkey	Spoor	Widespread
Cryptomys hottentotus	African Mole-rat.	Soil heaps	Widespread
Galerella sanguinea	Slender Mongoose	Scats	Widespread
Hystrix africaeaustralis	Cape Porcupine	Diggings & quills	Widespread
Lepus saxatilis	Scrub Hare	Droppings	Widespread
Papio cynocephalus ursinus	Savanna Baboon	Camera Trap	Widespread
Paraxerus cepapi	Tree Squirrel	Visual	Widespread
Phacochoerus africanus	Common Warthog	Spoor	Widespread
Sylvicapra grimmia	Common Duiker	Droppings & spoor	Widespread
Tatera leucogaster/brantsii	Highveld/Bushveld Gerbil	Burrows	Disturbed areas on sandy soils
Tragelaphus Scriptus	Bushbuck	Visual	Riverine Bushveld

Refer to development area C. This area is managed as a nature conservancy and is stocked with wildlife for the entertainment of visitors. The fauna diversity in this protected area is markedly higher than the two other development areas due to this. Two species were recorded in this area were assessed in the South African Red list of Species as Vulnerable

(Sable Antelope) and Endangered (Roan). A further two species' populations were measured against IUCN criteria and were found to be Vulnerable (Leopard) and Near Threatened (Brown Hyena) (Table 7-6).

Table 7-6: Mammal Species recorded in areas C

Scientific Name	English Name	Observed Indicator	Observed Habitat
Tragelaphus angasii	Nyala	Pers. Comm	Riverine Bushveld
Panthera pardus (VU SA and IUCN) Cites App1	Leopard	Pers. Comm	Widespread
Aepyceros melampus	Impala	Observed	Widespread
Equus quagga	Burchell's zebra	Observed	Plains
Hippotragus niger (VU SA)	Sable antelope	Pers. Comm	Mountain Bushveld
Hippotragus equinus (EN SA)	Roan	Observed	Mountain Bushveld
Connochaetes taurinus	Blue Wildebeest	Observed	Plains
Giraffa		Pers. Comm	Plains
Antidorcas marsupialis	Springbuck	Pers. Comm	Widespread
Damaliscus pygargus phillipsi	Blesbuck	Observed	Widespread
Hyaena brunnea (NT)	Brown Heyena	Pers. Comm	Widespread
Canis mesomelas	Black-backed Jackal	Pers. Comm	Widespread

7.4.1.1 Bats

One bat species, the Natal Long-fingered Bat (*Miniopterus natalensis)* regarded by the IUCN as Least Concerned, and not listed according to NEMBA 2007, could utilize the study area during nocturnal foraging bouts. However, this species roost and breed in caves or mine adits which are absent on the proposed study site area. During field work no Bat species were however recorded.

7.4.1.2 Data Deficient" species"

According to distribution records all shrew species that could occur in the project area (specifically the genera *Crocidura* and *Suncus*), the Single-striped Mouse (*Lemniscomys rosalia*), the Bushveld Gerbil (*Tatera leucogaster*) and the Short-snouted Elephant-shrew (*Elephantulus brachyrhynchus*) are "Data Deficient" and likely to occur on the study area (Development Areas A, B and C).

7.4.2 Avifauna

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007).

Land cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species. The bird species observed during the transect counts are listed in Table 7-7. The SABAP2 list for the QDS can be found in

Two provincially protected bird species, Cape Turtle Dove, and the Laughing Dove were recorded during field work.

Table 7-7: Avifauna species recorded in areas A and B

Birds	Scientific Name	Protection Status (IUCN 2016-2)/ NWBSP 2015
Black Shouldered kite	*Elanus axillaris*	Not protected
Blacksmith Lapwing	*Vanellus armatus*	Not protected
Cape Turtle Dove	*Streptopelia capicola*	Provincially protected
Cape Glossy Starling	*Lamprotornis nitens*	Not protected
Fiscal Flycatcher	*Sigelus silens*	Not protected
Hadeda Ibis	*Bostrychia hagedash*	Not protected
Helmeted Guineafowl	*Numida meleagris*	Not protected
Laughing Dove	*Spilopelia senegalensis*	Provincially protected
Southern Grey-headed Sparrow	*Passer diffusus*	Not protected
Masked Weaver	*Ploceus velatus*	Not protected
Speckled Pigeon	*Columba guinea*	Not protected
Crested Barbet	*Trachyphonus vaillantii*	Not protected
Crimson-breasted Shrike	*Laniarius atrococcineus*	Not protected
Groundscraper Thrush	*Turdus litsitsirupa*	Not protected
Pied Babbler	*Turdoides bicolor*	Not protected
Greater Honeyguide	*Indicator indicator*	Not protected
Lilacbreasted Roller	*Coracias caudata*	Not protected
Carmine Bee-eater	*Merops nubicoides*	Not protected

Avifauna diversity was found to be very low, primarily due to the limited amount and diversity of habitat types available in the study area. As is discussed previously the habitat varied between mountain bushveld on steep slopes and plains bushveld on the moderate slopes. No species of special concern were encountered, however the species indicated in Table 7-8, can possibly occur on site.

7.4.2.1 Important Bird Area

The Pilansberg National Park IBA occurs north of the project site, and is managed by North West Parks and Tourism Board. Pilanesberg National Park covers a wide range of habitats, including vleis, lakes, streams, thick bush, broad-leaved and acacia woodland, koppies, open grasslands and former farmlands. The proximity of the park to the Sun City Study area must be noted and taken into consideration, as the probability of the below mentioned species occurring in the project site is high.

More than 300 species occur in the park, thanks to its extensive range of habitats and the fact that it lies in the overlap between the dry western and wet eastern parts of the country. The site lies midway between the Cape Vulture (*Gyps coprotheres*) colonies in the Magaliesberg and the Waterberg and Cape Vultures periodically forage in it. Small numbers of White-backed Vulture (*G. africanus*) and Lappet-faced Vulture (*Torgos tracheliotus*) also occasionally visit it. Pilanesberg supports several breeding pairs of Verreauxs' Eagle (*Aquila verreauxii*), and other raptors, such as Wahlberg's Eagle (*Hieraaetus wahlbergi*), African

Hawk Eagle (*Aquila spilogaster*), Brown Snake Eagle (*Circaetus cinereus*), Black-chested Snake Eagle (*C. pectoralis*) and Lanner Falcon (*Falco biarmicus*), occur in small numbers. Individual Martial Eagles (*Polemaetus bellicosus*), Bateleurs (*Terathopius ecaudatus*) and Tawny Eagles (*Aquila rapax*) occasionally visit. Mankwe River holds small populations of African Finfoot (*Podica* senegalensis). White-backed Night Heron (*Gorsachius leuconotus*) is an occasional visitor. A large vlei with mixed grassland at the eastern end of Mankwe Dam provides habitat for African Grass Owl (*Tyto capensis*).

The surrounding woodland–grassland mosaic is known to hold Secretarybird (*Sagittarius serpentarius*) and Kori Bustard (*Ardeotis kori*). Other threatened species occasionally seen are European Roller (*Coracias garrulous)* and Yellow-throated Sandgrouse (*Pterocles gutturalis)*. Black Stork (*Ciconia nigra*), Marabou Stork (*Leptoptilos crumeniferus)* and Yellow-billed Stork (*Mycteria ibis)* occur as occasional visitors. Other woodland specials include Monotonous Lark (*Mirafra passerine)*, Southern Pied Babbler (*Turdoides bicolor*) White-throated Robin-chat (*Cossypha humeralis)*, Kalahari Scrub Robin (*Erythropygia paean)*, Burnt-necked Eremomela (*Eremomela usticollis)*, Striped Pipit (*Anthus lineiventris)*, Barred Wren-Warbler (*Calamonastes fasciolatus)*, Marico Flycatcher (*Bradornis mariquensis)*, Crimson-breasted Shrike (*Laniarius atrococcineus)*, Great Sparrow (*Passer motitensis)*, Scaly-feathered Finch (*Sporopipes squamifrons)*, Violet-eared Waxbill (*Uraeginthus granatinus)*, Black-faced Waxbill (*Estrilda erythronotos)* and Shaft-tailed Whydah (*Vidua regia)*.

Table 7-8: Red Data Protected Bird Species that could occur in the area of concern

Species	Global Conservation Status (IUCN 2016)	National Conservation Status (SA Red Data 2016)	Preferred Habitat	Potential Likelihood of Occurrence
Anthropoides paradiseus (Blue Crane)	Vulnerable	Near- threatened	Prefers open grassland, open karroid veld, as well as wetland habitats.	Unlikely to occur
Alcedo semitorquata (Half-collared Kingfisher)	Least Concern	Near- threatened	Clear, fast-flowing streams with dense overhanging vegetation.	Unlikely to occur
Aquila rapax (Tawny Eagle)	Least Concern	Endangered	Lowveld and Kalahari savanna, especially game farming areas and reserves.	Regarded as an irregular foraging visitor on the study area.
Ciconia nigra (Black	Least Concern	Vulnerable	Breeds on steep cliffs	Vagrant on

Species	Global Conservation Status (IUCN 2016)	National Conservation Status (SA Red Data 2016)	Preferred Habitat	Potential Likelihood of Occurrence
Stork)			within mountain ranges; forages on ephemeral wetlands.	study area.
Circus ranivorus (African Marsh Harrier)	Least Concern	Endangered	Wetlands and vleis, breeds in extensive wetland systems with	Unlikely to occur.
Coracias garrulus (European Roller)	Least Concern	Near- threatened	Open woodland and bushveld.	Common summer visitor
Falco biarmicus (Lanner Falcon)	Least Concern	Vulnerable	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor.
*Gorsachius leuconotus (*White-backed Night Heron*)*	Least Concern	Vulnerable	Clear well- vegetated perennial rivers. Prefers lowland rivers to Highveld rivers.	Unlikely to occur
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas	Irregular and opportunistic foraging visitor.
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	Varied but breeds on steep south or east facing cliffs.	Irregular and opportunistic foraging visitor.
Leptoptilos crumeniferus (Marabou Stork)	Least Concern	Near- threatened	Varied, often near surface water or feeding on carcasses.	A vagrant to the study area.

Species	Global Conservation Status (IUCN 2016)	National Conservation Status (SA Red Data 2016)	Preferred Habitat	Potential Likelihood of Occurrence
Mirafra cheniana (Melodious Lark)	Near-threatened	Least Concern	A species with a preference for open dry "climax" *Themeda triandra* grassland or open primary grassland dominated by sour wiry grasses on well drained sandy substrates.	A rare resident, probably absent.
*Mycteria ibis (*Yellow-billed Stork*)*	Least Concern	Endangered	Prefers shoreline habitat bordering large impoundments and extensive wetland systems.	Vagrant to the study area.
Oxyura maccoa (Maccoa Duck)	Near-threatened	Near- threatened	Large saline pans and shallow impoundments.	Unlikely to occur
Phoenicopterus minor (Lesser Flamingo)	Near-threatened	Near- threatened	Restricted to large saline pans and other inland water bodies.	Unlikely to occur
Phoenicopterus ruber Greater Flamingo)	Least Concern	Near- threatened	Restricted to large shallow pans and other inland water bodies.	Unlikely to occur
Polemaetus bellicosus (Martial Eagle)	Vulnerable	Endangered	Varied, from open karroid shrub to lowland savanna.	Vagrant to the study area.
Sagittarius serpentarius (Secretarybird)	Vulnerable	Vulnerable	Prefers open grassland or lightly wooded habitat.	Uncommon and irregular foraging visitor.

Species	Global Conservation Status (IUCN 2016)	National Conservation Status (SA Red Data 2016)	Preferred Habitat	Potential Likelihood of Occurrence
Pterocles gutturalis (Yellow-throated Sandgrouse)	Least Concern	Near- threatened	Prefers open grassland or agricultural land on vertic soils	Unlikely to utilise study area, although known to fly overhead.
Torgos tracheliotus (Lappet-faced Vulture*)*	Endangered	Endangered	Lowveld and Kalahari savanna; mainly on game farms and reserves	Vagrant to the study area.
Tyto capensis (African Grass- owl)	Least Concern	Vulnerable	Prefers rank moist grassland that borders drainage lines or wetlands.	Unlikely to occur

Species indicated in the table above all have historic records in the general area, species such as storks and birds of prey whom were recorded opportunistically. These depend on food items that must be available most often in areas such as reserves or game farms and will travel long distances to find these food items. These species are common in the nearby Pilansberg National Park and could frequent the proposed Sun City Project area.

7.4.3 Herpetofauna

According to Du Preez and Carruthers (2009), frogs occur throughout every habitat within Southern Africa. A number of factors influence their distribution, and they are generally restricted to the habitat type they prefer, especially in their choice of breeding site. The choices available of these habitats coincide with different biomes, these biomes in turn, are distinguished by means of biotic and abiotic features prevalent within them. Therefore a collection of amphibians associated with the Savanna Biome will all choose to breed under the prevailing biotic and abiotic features present. Further niche differentiation is encountered by means of geographic location within the biome, this differentiation includes, banks of pans, open water, inundated grasses, reed beds, trees, rivers and open ground, all of which are present within the area of interest.

7.4.3.1   Amphibians

A total of 18 taxa are known to occur in the study area (QDS 2527AC; Minter *et al.*, 2004) of which 12 could occur on the study site (please refer to the fauna and flora scoping report) based on the presence of suitable habitat. In addition, five of these are believed to be irregular visitors on passage during exceptionally high precipitation events. Those species with a high probability of occurrence include dispersing individuals of *Amietophrynus*

gutturalis (Gutteral Toad), *Schismaderma carens* (Red Toad), *Kassina senegalensis* (Bubbling Kassina), *Tomopterna cryptotis* (Tremolo Sand Frog) and *Cacosternum boettgeri* (Boettger"s Caco).

Currently, none of the frog species likely to occur is of any conservation significance according to criteria listed in this document (Measey, 2010).

7.4.3.2   *Reptiles*

Forty-nine (49) reptile taxa (comprising of two chelonians, 28 snakes, 15 lizards, three gecko species and one chameleon; Appendix E) could occur on the study area. Twenty- six (26) species have been recorded from QDG 2527AC that overlaps with the study site (information obtained from the South African Reptile Conservation Assessment (SARCA) (Appendix E).

The outcrops associated with the mountain bushveld provide the highest reptile richness when compared to the other floristic units. None of the species likely to occur is threatened or near-threatened.

7.4.4 Invertebrates

During the field survey, selected invertebrates were recorded using a butterfly net and opportunistic observation and photographed where possible. In support of this, transects were walked along the roads, vegetation types, and bushveld areas in order to identify any scorpion or spider nests.

The diversity and density of the invertebrates was relatively low for the proposed Sun City Project footprint area and surroundings, however this in general could assist in providing an indication of the health of the regional ecology. Although livestock have modified the general area, there is sufficient habitat that still remains to sustain moderate populations of the typical bushveld/savanna species of fauna. The study area is not known to overlap with the known distribution range of any threatened or near-threatened butterfly species as assessed by Mecenero *et al.* (2013). According to Mecenero *et al.* (2013), approximately 70 species could be present on the study area consisting of six skippers (Hesperiidae), 28 blues (Lycaenidae), 22 "brush- footed" butterflies (Nymphalidae), two swallowtails (Papiionidae) and 12 whites (Pieridae). Recorded species are listed below in Table 7-9.

Table 7-9: Invertebrates Recorded

Scientific Name	English Name	Status
Urothemis assignata	Red Basker	LC
Lasiocnemis lugens	*Picture-Winged Robber fly*	LC
Zonocerus elegans	Elegant Grasshopper	LC
Sisyphus spp.	Spider Dung beetle	LC
Mylabris oculata	CMR Beetle	Not Evaluated
Cladophorus marshalli	Slender Net Winged Beatle	Not Evaluated
Colotis evagore	Desert Orange Tip	Not Listed
Eurema brigitta	Small Grass Yellow	LC
Junonia hierta	Yellow Pansy	LC

The rocky soils and outcrops associated with the mountain bushveld provide habitat for the stenotopic (habitat specialist) rock scorpion *Hadogenes troglodytes* and burrowing scorpion *Opistophthalmus glabrifrons*. Both species are currently protected by Schedule B1 of the list of threatened and protected species issued in terms of Section 56(1) of the NEM: BA.

8   Sensitivity of the Site

In terms of ecological sensitivity, the following features are assessed to determine how sensitive the habitat identified within the site is:

■   Presence or absence of Red Data Listed or protected plant and animal species;

■   Presence or absence of exceptional species diversity;

■   Extent of intact habitat in good ecological condition in the absence of disturbance; and

■   Presence or absence of important ecosystems such as Important Bird Areas (IBA's), Protected Areas, areas demarcated for future protected area status (NPAES) and wetlands.

8.1   Protected Areas

Officially protected areas, either provincially or nationally, that occur within proximity to the project site could have consequences as far as impact on these areas are concerned. For the Sun City project area, the Pilansberg National Park surrounds the project boundary from the north east and west. The protected areas within proximity to the project site are represented in Figure 8-1.
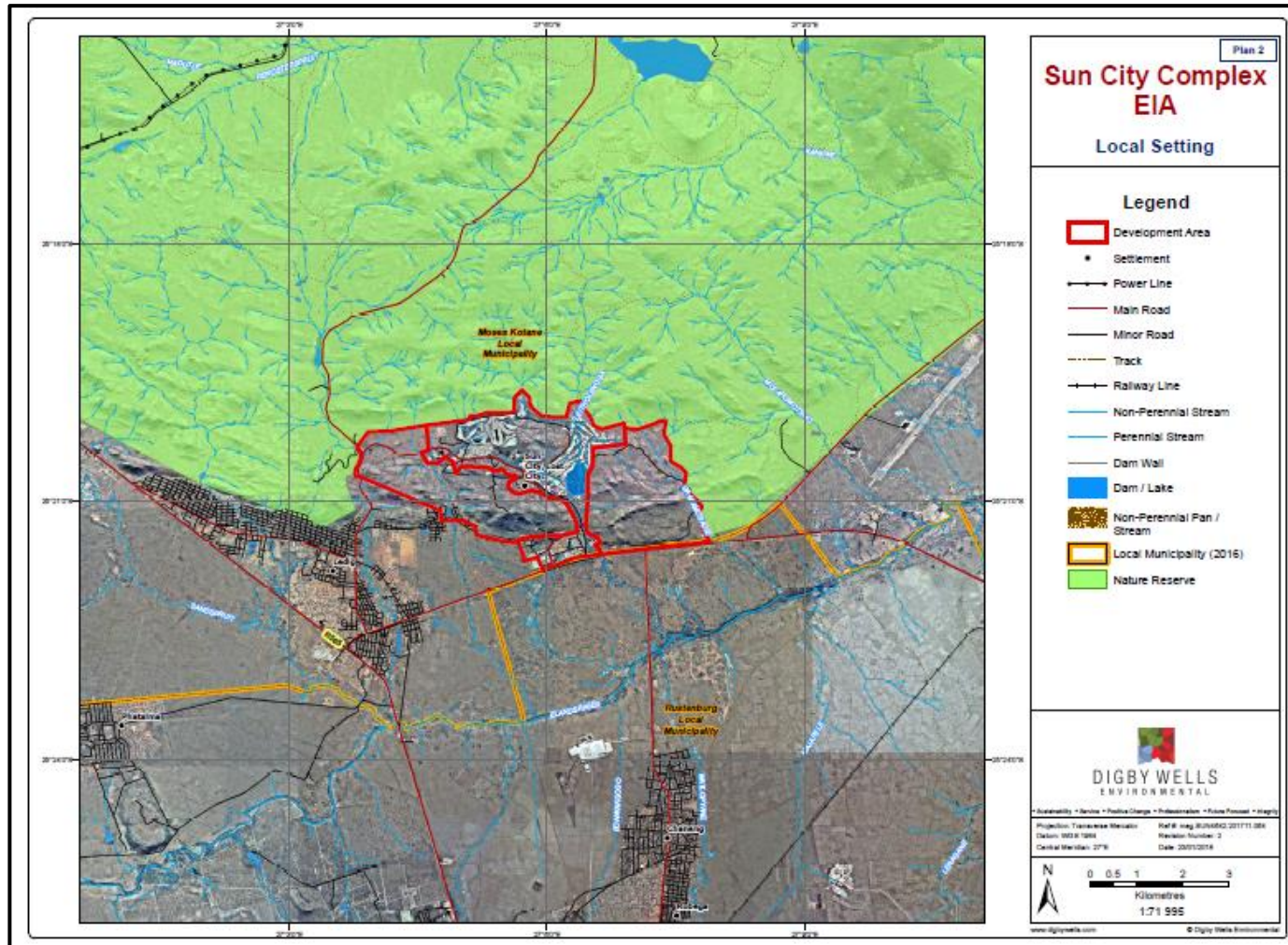
Figure 8-1: Protected Areas

8.2   North West Biodiversity Sector Plan

The proposed Sun City Project area has undergone a small degree of disturbance due to livestock grazing, resulting in the establishment of bush encroachment. The proposed Sun City Project site falls within a Critical Biodiversity Area 1, Critical Biodiversity Areas 2 and Ecological Support Areas 1 (Figure 8-2) according to the regional ecological importance (North West Biodiversity Sector Plan; 2015).

8.2.1   Land management objectives of areas classified as CBA 1

Maintain in a natural or near-natural state that maximises the retention of biodiversity pattern and ecological process:

- ■   Ecosystems and species fully or largely intact and undisturbed.

- ■   These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met.

- ■   These are biodiversity features that are at, or beyond, their limits of acceptable change.

8.2.2   Land management objectives of areas classified as CBA 2

Maintain in a natural or near-natural state that maximises the retention of biodiversity pattern and ecological process:

- ■   Ecosystems and species fully or largely intact and undisturbed;

- ■   Areas with intermediate irreplaceability or some flexibility in terms of meeting biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve biodiversity targets, although loss of these sites would require alternative sites to be added to the portfolio of CBAs; and

- ■   These are biodiversity features that are approaching but have not passed their limits of acceptable change.

The matrix of recommended land use zones and associated activities in relation to the CBA Map categories (adopted from MPTA, 2014), indicates that Environmental Conservation, Environmental Management Overlay Zones, Game Farming and Livestock production, are the only acceptable land use zoning activities permitted in CBA 1 and 2. Ecological support areas 1, fall in the same category but adds that Low Impact Tourism/Recreational and Accommodation is also permitted.
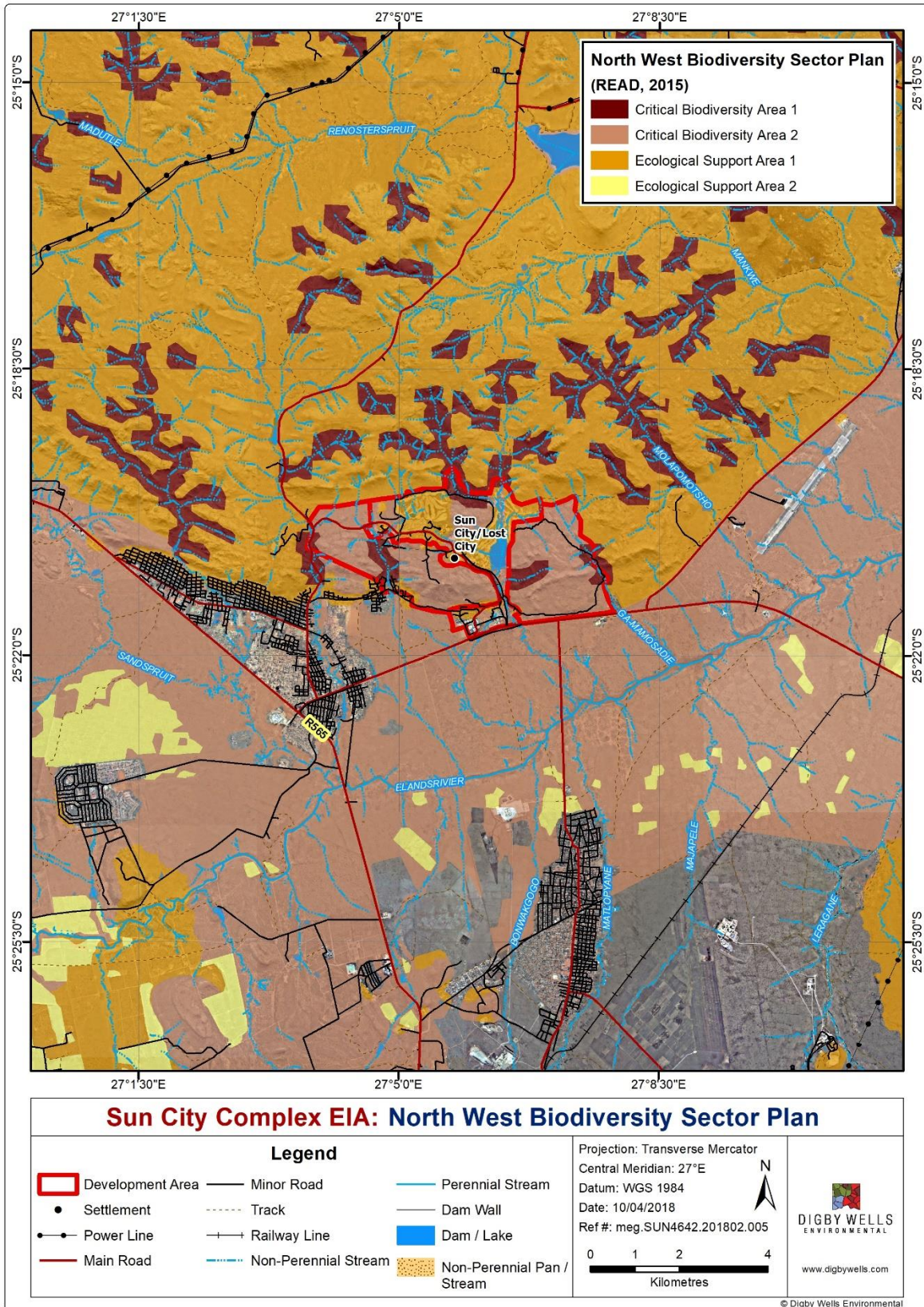
Figure 8-2: Critical Biodiversity Areas. (North West Biodiversity Sector Plan, 2015)

8.3 Important Bird Areas

An IBA is an area recognised as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only a million hectares of the total land surface covered by our IBA's is legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013). The Pilansberg National Park IBA occurs north of the project site (Figure 8-3).
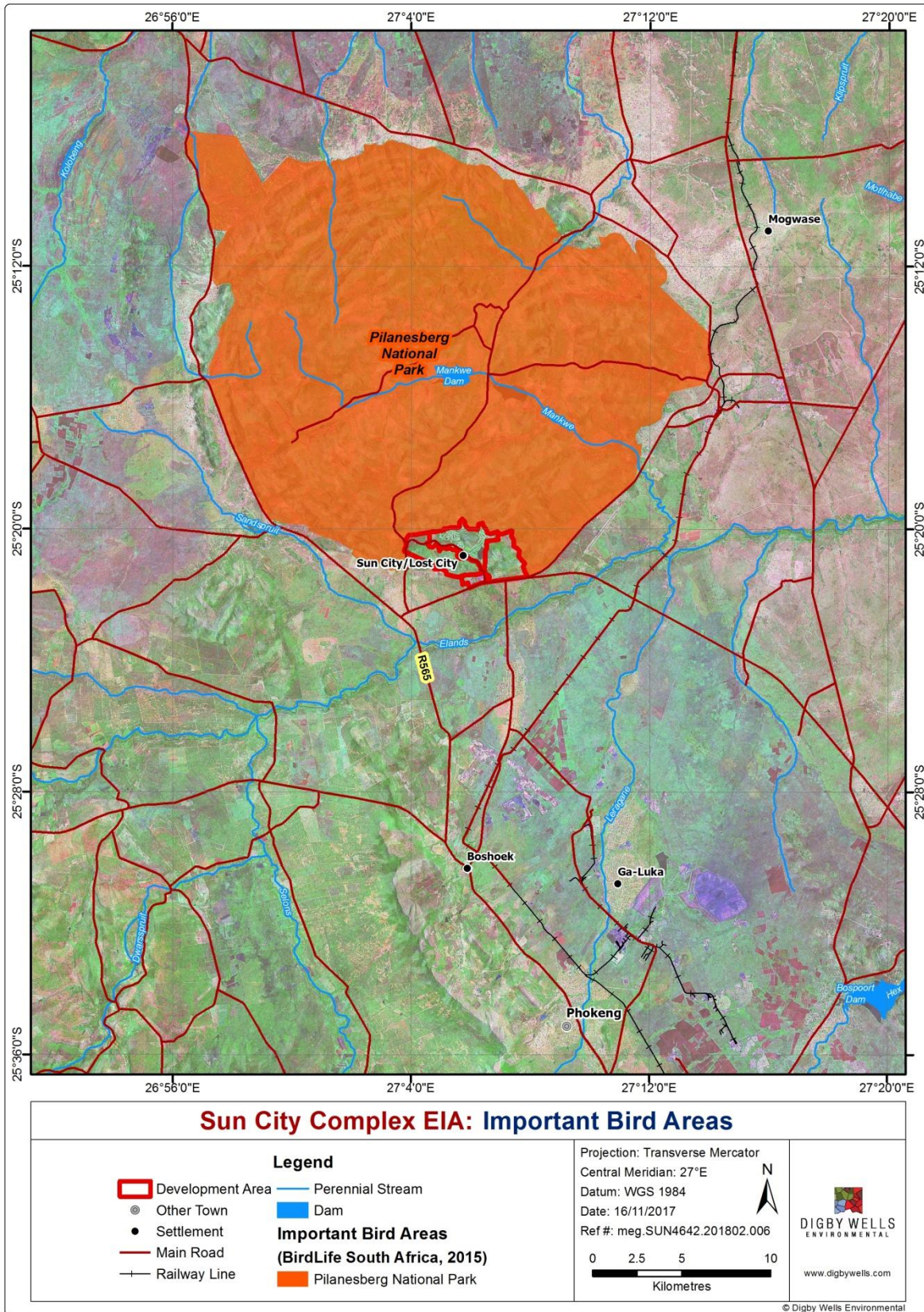
Figure 8-3: Important Bird Areas. (Birdlife South Africa 2015)

8.4   Site Specific Sensitivity

The ecological sensitivity map for the site is represented in Figure 8-4. The Wetland and
Riverine Bushveld vegetation units were allocated a medium-high sensitivity since wetlands
are regarded as important habitats that should be conserved due to the presence of plant
SSC and habitat diversity. Further to this the Mountain Bushveld were assigned medium
high ecological sensitivity and the Plains Bushveld medium sensitivity, due to the confirmed
presence of plant SSC and current high species diversity and ecosystems function.
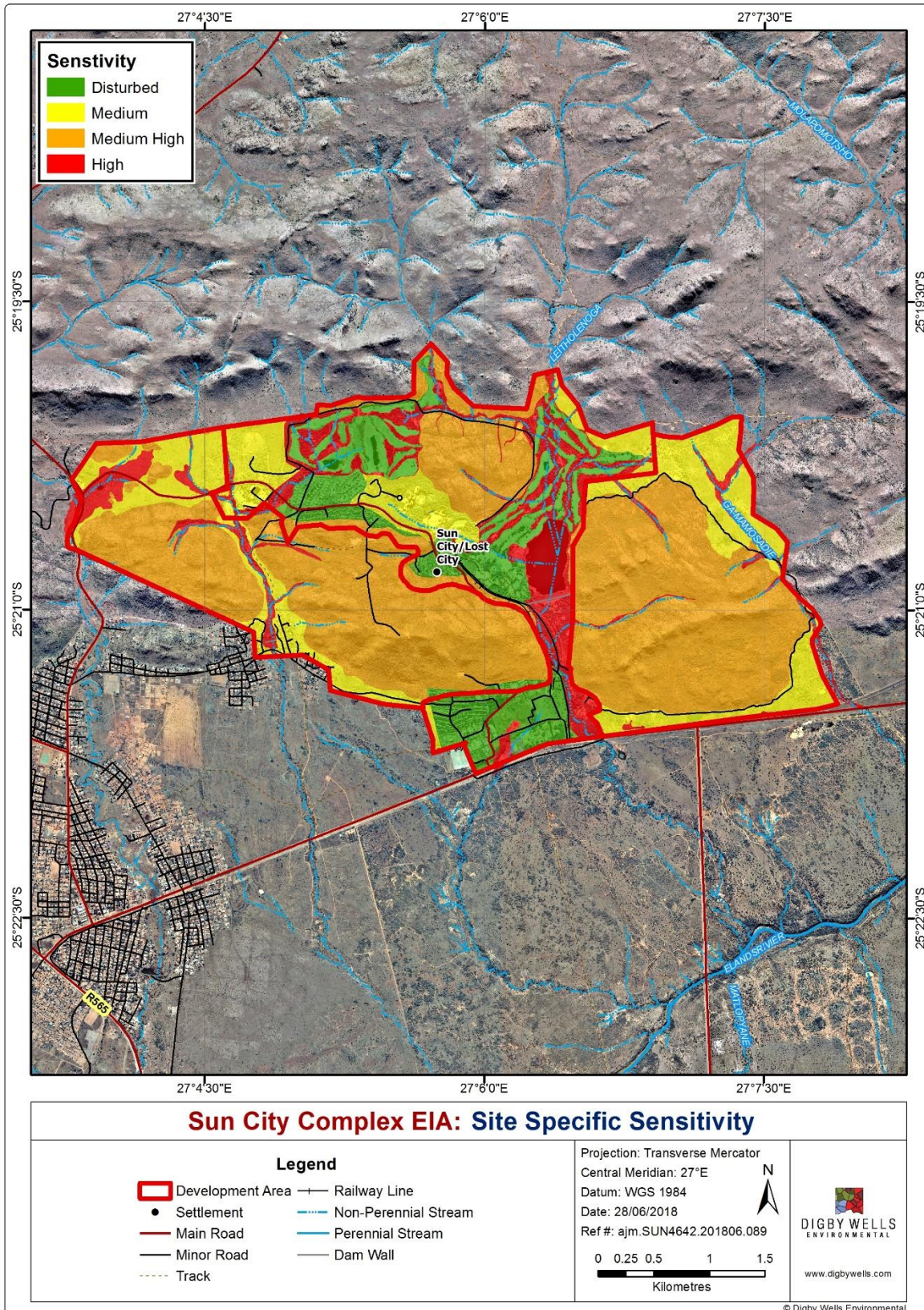
Figure 8-4: Site specific Sensitivity

9 Assumptions, Limitations and Gaps in knowledge

The following limitations were encountered during this study:

- Whilst every effort is made to cover as much of the site as possible, representative sampling is done and it is possible that some plant and animal species that are present on site were not recorded during the field investigations, due to seasonality.

10 Impact Assessment

10.1 Construction Phase

10.1.1 Project Activities: Site Clearing

During the construction phase (construction of various infrastructure during the Resort Expansion Project), the identified vegetation types will be affected, these are listed in Table 10-1. As described in the heading North West Biodiversity Sector Plan, the project area coincides with CBA 1 and 2 as well as ESA1. These designations further coincide with delineated vegetation types recorded and delineated on site, these were, Mountain Bushveld – CBA 2, Plains Bushveld – CBA 2, Riparian areas (Wetlands) – CBA 1, and Riparian Bushveld – ESA 1. Please refer to North West Biodiversity Sector Plan heading for specifics restrictions and requirements in these areas. The three REP areas A, B and C all coincide with vegetation types, CBA and ESA, however the actual impacts will only occur in REP A and B, with no infrastructure planned in Area C.

The vegetation types assigned medium-high sensitivity are displayed below in Table 10-1, apart from the disturbed delineation all other vegetation types are sensitive and any loss of them are seen as negative for biodiversity. It is not anticipated that any plant SSC will be lost, though they will be encountered. Should any plant SSC be recorded within the infrastructure development footprint area, it should be reported to the relevant authorities and a relocation strategy must be compiled. Once all permits are in place, such species must be relocated.

Table 10-1: Present and Predicted Loss of Habitat due to site clearance

Vegetation/Habitat Type	Area A Disturbed/Total (ha)	Area B Disturbed/Total (ha)	Area C Disturbed/Total (ha)
Mountain Bushveld	13/358	9/127	0/331
Mountain Bushveld	13/358	9/127	0/331
Plains Bushveld	43/90	9/61	0/119
Riparian Bushveld	0/0	1.2/144	0/1

Vegetation/Habitat Type	Area A Disturbed/Total (ha)	Area B Disturbed/Total (ha)	Area C Disturbed/Total (ha)
Wetlands	19/38	8/94	0/18
Riverine Forest	0/0	1/41	0/0
Disturbed	0/6	4/129	0/0
Totals	**75/492**	**32/596**	**0/468**

10.1.1.1 Impact Description

During site clearing, the vegetation/habitats that were delineated in the project area will be affected by the construction and clearance of various size footprints. The loss of these vegetation types are quantified in Table 10-1 above.

- ■ Mountain Bushveld;
- ■ Plains Bushveld;
- ■ Riparian Bushveld; and
- ■ Riverine Forest.

10.1.1.1.1 Alien plant species invasion

As detailed in section 7.3.6, the alien plant species present, degrade the natural state of habitat. Species that may establish are listed in Table 7-3, as they have already been recorded on site. The risk of spread of alien plant species can be managed through regular monitoring and removal of alien plants as seedlings/juveniles before they reach seed-bearing maturity.

10.1.1.1.2 Disturbance to fauna due to noise and increased vehicular movement on site

Fauna on site may be disturbed and scared away due to increase activity associated with construction activities. In addition, breeding species within proximity of the activities may be disturbed.

Ecosystem function is the measure of the combined functioning of the vegetation and associated species, faunal habitats and wetlands, all of which result in the ecosystem health. Clearing for the infrastructure will affect the ecosystem functioning in two main ways. The first is the fragmentation of the ecosystem, which will occur with land surface changes. Fragmentation occurs in conjunction with edge-effects, which change the composition of the ecosystem on the edge of structures such as buildings and roads. The consequence of this

is a loss of cohesiveness between larger fragments of habitat which limits the exchange of genes and resources across them. An additional contributor to loss of ecosystem function is the introduction of alien and invasive species (discussed above). Disturbance to the soil after vegetation clearing results in the establishment of alien species, that may form dense monospecific stands.

10.1.1.2 Management Objectives

The objective of management measures is to ensure that no plant or animal SSC are harmed or disturbed without authorisation, furthermore, the impact to habitat is restricted only to the footprint area and that alien plant invasion does not take place as a result of development.

10.1.1.3 Management Actions and Targets

In addition, the following mitigation and management measures have been prescribed:

- Perform a site walkthrough prior to construction commencing, to identify and mark all SSC present, as part of a SSC management plan;

- The footprint area should be kept as small as possible, and well delineated;

- Existing access roads should be used to reach the site for clearing and vehicles should not be allowed to traverse natural areas or leave the demarcated road;

- An Alien Invader Plant species (AIPs) management plan should be implemented, whereby the disturbed site is monitored quarterly for at least two years to ensure that alien invasion does not take place.

10.1.1.4 Impact Ratings

The impacts of the construction phase are rated in the table below.

Table 10-2: Potential Impacts of the Construction Phase – Loss of Habitat/Vegetation Types, Mountain Bushveld

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Loss of 22ha of *Mountain Bushveld*			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	Sensitive native vegetation/ fauna habitat will be removed (22ha) for surface infrastructure and the impact will be permanent. Fauna species will move away with no permanent impact on them. Occasional and accidental moralities may occur.	Moderate (negative) 84
Extent	Very limited (2)	The area to be cleared is minor in comparison to the extent of the vegetation unit, as well as the extent of the total study area. Flora SSC was encountered. No faunal SSC was encountered in the area of disturbance; therefore no direct impact is expected.	
Intensity x type of impact	Moderate (-3)	Since the vegetation unit has been assigned moderate ecological sensitivity, is widespread, and as CBA 1 and 2 areas are present, but only 22 ha will be impacted on, the impact is not regarded as particularly significant for terrestrial biodiversity.	
Probability	Certain (7)	Clearing of vegetation will definitely take place for the establishment of infrastructure. SSC plant species do occur, and is expected to be impacted on.	
Nature	Negative	The impact will be negative.	
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
▪ Pre-disturbance survey to mark and identify all SSC. ▪ AIP management strategy must be in place. ▪ Rehabilitation of the disturbed area should take place after construction, whereby a mixture of native grass species harvested from climax *Themeda* grassland and native grass species (such as *Cynodon dactylon*) are planted immediately to prevent erosion; and ▪ The footprint area should be limited as far as possible.			
Post-Mitigation			
Duration	Beyond Project Life (6)	The areas that are disturbed cannot be returned to prior state, footprints have been kept to a minimum though.	Minor (negative) 36
Extent	Very limited (1)	The area to be cleared is minor in extent.	
Intensity x type of impact	Minor Loss (2)	Loss of limited areas of medium high sensitivity areas has a moderate impact on flora and fauna.	
Probability	Probable (4)	This impact could happen.	
Nature	negative	The impact will be negative.	

Table 10-3: Potential Impacts of the Construction Phase – Loss of Habitat/Vegetation Types, Plains Bushveld

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Loss of 52ha of Plains Bushveld			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	Native vegetation/ fauna habitat will be removed for surface infrastructure and the impact will be permanent. Fauna species will move away with no permanent impact on them. Occasional and accidental moralities may occur.	**Moderate (negative) 98**
Extent	Limited (2)	The area to be cleared is minor in comparison to the extent of the vegetation unit, as well as the extent of the total study area. No faunal SSC was encountered in this project area it is still regarded as CBA 2; impacts are regarded as negative to biodiversity.	
Intensity x type of impact	Moderate (-5)	Since the vegetation unit has been assigned moderate ecological sensitivity, and CBA 2 category, and is earmarked for destruction, the impact is regarded as negative for biodiversity.	
Probability	Certain (7)	Clearing of vegetation in this vegetation type will definitely take place for the establishment of infrastructure.	
Nature	Negative	The impact will be negative.	
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
- Pre-disturbance survey to mark and identify all SSC. - AIP management strategy must be in place. - Rehabilitation of the disturbed area should take place after construction, whereby a mixture of native grass species harvested from climax *Themeda* grassland and native grass species (such as *Cynodon dactylon*) are planted immediately to prevent erosion; and - The footprint area should be limited as far as possible.			
Post-Mitigation			
Duration	Project Life (5)	Loss of 52ha is permanent, but with limited footprint after mitigation.	Minor (negative) 49
Extent	Very limited (1)	The area to be cleared is 52 ha in extent. The vegetation type is not limited to the project area.	
Intensity x type of impact	Minimal (1)	Loss of this vegetation type has a neglible impact on flora and fauna.	
Probability	Likely (7)	This is impact will probably	
Nature	negative	The impact will be negative.	

Table 10-4: Potential Impacts of the Construction Phase – Loss of Habitat/Vegetation Types, Riparian Bushveld

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Loss of 22 ha of Riparian Bushveld and Wetlands			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	Sensitive native vegetation/ fauna habitat will be removed for surface infrastructure and the impact will be permanent. Fauna species will move away with no permanent impact on them. Occasional and accidental moralities may occur.	Moderate (negative) 98
Extent	Very limited (2)	The area to be cleared is minor in comparison to the extent of the vegetation unit, as well as the extent of the total study area. Flora SSC was encountered in the area of disturbance; therefore direct impacts is expected.	
Intensity x type of impact	Moderate (-5)	Since the vegetation unit has been assigned CBA1 ecological sensitivity, and is earmarked for destruction, the impact is regarded as particularly significant for riparian and wetlands biodiversity.	
Probability	Certain (7)	Clearing of vegetation these vegetation types will definitely take place for the establishment of infrastructure.	
Nature	Negative	The impact will be negative.	

Mitigation/Management Actions

- Pre-disturbance survey to mark and identify all SSC.

- AIP management strategy must be in place.

- Rehabilitation of the disturbed area should take place after construction, whereby a mixture of native grass species harvested from climax *Themeda* grassland and native grass species (such as *Cynodon dactylon*) are planted immediately to prevent erosion; and

- The footprint area should be limited as far as possible.

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	Beyond Project Life (6)	The areas that are disturbed cannot be returned to prior state, footprints have been kept to a minimum though.	Minor (negative) 49
Extent	Very limited (1)	The area to be cleared is minor in extent.	
Intensity x type of impact	Minor Loss (2)	Loss of limited areas of medium high sensitivity areas has a moderate impact on flora and fauna.	
Probability	Probable (4)	This impact could happen.	
Nature	Negative	The impact will be negative.	

Table 10-5: Potential Impacts of the Construction Phase – Loss of Habitat/Vegetation Types: Riverine Forest

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Loss of Riverine Forest 0.5 ha			
Prior to Mitigation/Management			
Duration	Permanent (7)	Non-Native vegetation/ fauna habitat will be removed for surface infrastructure and the impact will be permanent. Fauna species will move away with no permanent impact on them. Occasional and accidental moralities may occur.	Moderate (negative) 91

Dimension	Rating	Motivation	Significance
Extent	Very limited (2)	The area to be cleared is minor in comparison to the extent of the vegetation unit, as well as the extent of the total study area. No faunal SSC was encountered in the area of disturbance; therefore no direct impact is expected.	
Intensity x type of impact	Moderate (-4)	Since the vegetation unit has been assigned moderate ecological sensitivity, and ESA 1, and is earmarked for destruction, the impact is regarded as not significant for the biodiversity of this vegetation type.	
Probability	Certain (7)	Clearing of vegetation will definitely take place for the establishment of infrastructure.	
Nature	Negative	The impact will be negative.	

Mitigation/Management Actions
▪ Pre-disturbance survey to mark and identify all SSC. ▪ AIP management strategy must be in place. ▪ Rehabilitation of the disturbed area should take place after construction, whereby a mixture of native grass species harvested from climax *Themeda* grassland and native grass species (such as *Cynodon dactylon*) are planted immediately to prevent erosion; and ▪ The footprint area should be limited as far as possible.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Beyond Project Life (6)	The areas that are disturbed cannot be returned to prior state, footprints have been kept to a minimum though.	Minor (negative) 49
Extent	Very limited (1)	The area to be cleared is minor in extent.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Minor Loss (2)	Loss of limited areas of medium high sensitivity areas has a moderate impact on flora and fauna.	
Probability	Probable (4)	This impact could happen.	
Nature	Negative	The impact will be negative.	

Table 10-6: Potential Impacts of the Construction Phase – Habitat Fragmentation facilitating Alien plant Invasion

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Habitat fragmentation and edge effects resulting in alien plant invasion			
Prior to Mitigation/Management			
Duration	Medium-term (3)	Habitat fragmentation and alien plant invasion will take place for a period of 2 – 5 years.	
Extent	Limited (2)	Alien plants will establish around disturbed areas associated with the construction phase.	Minor (negative) 54
Intensity x type of impact	Serious (4)	Alien plant invasion is a serious problem with significant ecological consequences; hence its reference in the NEMBA and CARA legislation.	
Probability	Highly probable (6)	Since alien plants have already been recorded on site, the spread of these species due to disturbance will invariably take place. The seedbank in the soil will contain alien species.	

Dimension	Rating	Motivation	Significance
Nature	negative	The impact will be negative	
Mitigation/Management Actions			
▪ An alien plant species management plan should be compiled and implemented.			
Post-Mitigation			
Duration	Medium-term (3)	As seedlings emerge, they will be removed bi-annually as part of an alien management plan.	Minor (negative) 42
Extent	Limited (2)	Alien plants will establish around disturbed areas associated with the construction phase.	
Intensity x type of impact	Minimal (1)	Alien plant invasion is serious for terrestrial biodiversity; however, if these species are controlled timeously, the impact will be reduced.	
Probability	Likely (7)	Since alien plants have already been recorded on site, the spread of these species due to disturbance will invariably take place. The seedbank in the soil will contain alien species.	
Nature	Negative	The impact will be negative	

10.1.1.4.1 Table 10-7: Potential Impacts of the Construction Phase: Disturbance to fauna due to increased vehicular movement on site

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Disturbance to fauna due to increased vehicular movement on site			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Medium-term (3)	Construction vehicles will be active on site, thereafter guests will be using roads.	Minor (negative) 54
Extent	Limited (2)	This impact will be limited to areas lose to natural vegetation and habitat.	
Intensity x type of impact	Serious (4)	Most animals would have moved away however SSC is present on site and could be affected.	
Probability	Highly probable (6)	This impact has occurred in other locations and is likely to occur here.	
Nature	negative	The impact will be negative	

Mitigation/Management Actions

- ▪ Sensitising road users.
- ▪ Signage to advise on sensitive areas where animals could cross the road.
- ▪ Strict speed limits during construction.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Medium-term (3)	Construction vehicles will still be active on site, however road users such as guests will be cautioned.	Minor (negative) 42
Extent	Limited (2)	This impact will be limited to areas lose to natural vegetation and habitat.	
Intensity x type of impact	Minimal (1)	Most animals would have moved away however SSC is present on site and could be affected.	
Probability	Likely (7)	This impact has occurred in other locations and could occur here.	
Nature	Negative	The impact will be negative	

10.2 Operational Phase

10.2.1 Project Activities Assessed: Habitat Fragmentation, Alien Invasive Plant Establishment and Vehicular Activity on Site.

During the operational phase of the development, no further site clearance will take place. Expected impacts include alien invasive plant species recruitment, and vehicular activity.

10.2.1.1 Impact Description

Open areas around newly established infrastructure will create a favourable environment for the establishment of alien invasive plant species. Due to increased vehicular movement on site, fauna may be disturbed due to noise and dust. Further to this, roadkill of smaller fauna and birds may take place.

10.2.1.2 Management Objectives

The objective of management measures is to ensure that no alien invasive plant species are recruited and established, or spread on site.

From a vehicular activity perspective, the objective will be for no roadkill's to take place and faunal disturbance is kept to a minimum.

10.2.1.3 Management Actions and Targets

An alien invasive plant management strategy must be developed for the new infrastructure areas.

Signage should be erected to indicate a minimum speed limit of 30 km/hr on access roads on site. Signage should also warn drivers of the risk of animal kills on the road. Further to this, driving of vehicles should be restricted to daylight hours.

10.2.1.4 Impact Ratings

The impacts of the operational phase are rated in the table below.

Table 10-8: Potential Risks of the Operational Phase – Increased Vehicular Movement on Site

Dimension	Rating	Motivation	Significance
Increased vehicular movement and noise on site			
Impact Description: Disturbance to fauna on site (noise, roadkills)			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Project life (5)	The impact will last for the project life.	Minor (negative) 40
Extent	Very limited (2)	The extent is limited since surface infrastructure is minimal.	
Intensity x type of impact	Moderate (3)	No Red Data fauna species are expected to be at risk and the impact will not be frequent.	
Probability	Probable (4)	This is a commonly observed impact but it is not definite.	
Nature	negative	The impact will be negative.	

Mitigation/Management Actions

- Erect signage on site;
- Adhere to speed limits;
- Make use of internal fencing; and
- Avoid vehicle movement at night.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	The impact will last for the project life.	Negligible(negative) 14
Extent	Very limited (1)	The extent is limited since surface infrastructure is minimal.	
Intensity x type of impact	Minimal (1)	No Red Data fauna species are expected to be at risk and the impact will not be frequent.	
Probability	Rare (2)	Roadkills will be minimal if the speed limit is adhered to and activity is restricted to daylight hours.	
Nature	negative	The impact will be negative.	

Table 10-9: Potential Risks of the Operational Phase: Habitat Fragmentation and edge effects resulting in alien plant invasion

Dimension	Rating	Motivation	Significance
Site Clearing			
Impact Description: Habitat fragmentation and edge effects resulting in alien plant invasion			
Prior to Mitigation/Management			
Duration	Medium-term (3)	Habitat fragmentation and alien plant invasion will take place for a period of 2 – 5 years.	Minor (negative) 54
Extent	Limited (2)	Alien plants will establish around disturbed areas associated with the construction phase.	
Intensity x type of impact	Serious (4)	Alien plant invasion is a serious problem with significant ecological consequences; hence its reference in the NEMBA and CARA legislation.	
Probability	Highly probable (6)	Since alien plants have already been recorded on site, the spread of these species due to disturbance will invariably take place. The seedbank in the soil will contain alien species.	
Nature	negative	The impact will be negative	
Mitigation/Management Actions			
▪ An alien plant species management plan should be compiled and implemented.			
Post-Mitigation			
Duration	Medium-term (3)	As seedlings emerge, they will be removed bi-annually as part of an alien management plan.	Minor (negative) 42

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	Alien plants will establish around disturbed areas associated with the construction phase.	
Intensity x type of impact	Minimal (1)	Alien plant invasion is serious for terrestrial biodiversity; however, if these species are controlled timeously, the impact will be reduced.	
Probability	Likely (7)	Since alien plants have already been recorded on site, the spread of these species due to disturbance will invariably take place. The seedbank in the soil will contain alien species.	
Nature	Negative	The impact will be negative	

11 Cumulative Impacts

It is necessary to consider the impacts that the development will have from a broad area perspective, by considering land-use and transformation of natural habitat in areas surrounding the site. Cumulative impacts are assessed by considering past, present and anticipated changes to biodiversity.

The cumulative loss of this vegetation types present as well as the SSC found within it should be considered proactively.

Surrounding land use has resulted in large-scale cumulative impacts with local implications due to the dependence of local people on ecosystems functioning.

The impacts on the ecology of the general area will not be significant. It is expected that there will be losses of vegetation and flora along with associated faunal habitat. The primary impacts will be loss of vegetation types and fragmentation with a reduction in movement of remaining naturally occurring wildlife and isolation of pockets of vegetation. Secondary cumulative impacts will include increased accessibility to the site and the resulting increase in development and resource dependence. Ideally, a strategic environmental plan for the area should be developed and adhered to. This should include the conservation of important areas as well as the provision of corridors for faunal movement.

12   Mitigation and Management Measures

Table 12-1 provides a description of the mitigation and management options for the environmental impacts anticipated during the construction, operational and decommissioning and closure phases. Information on the frequency of mitigation, relevant legal requirements, recommended management plans, timing of implementation, and roles / responsibilities of persons implementing the EMP.

Table 12-1: Mitigation and Management Measures

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			Sun City		
Construction of Infrastructure	Pre-construction and construction		Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose Illegal waste dumping should be prohibited Training should be given to onsite staff on which plants have Red Data Status and how to identify them Destruction of vegetation should be	South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1 National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species; National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; North West Province Biodiversity Sector Plan Sensitive Species.	Continually, specifically construction

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			limited to the areas essential for the development		
			All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly		
			Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats		
			Rehabilitation of disturbed areas should take place as soon as possible		

13   Monitoring Requirements

The fauna and flora monitoring program should be initiated pre-construction and continue through construction thereafter conducted annually during the growing season (December to March) as close to the same time of year as possible. Should the monitoring results indicate the additional presence of red data species, or threatened species, this may necessitate the need to undergo monitoring for that particular species more frequently, especially during the breeding season and birthing season for that species.

Monitoring will include sites in the undisturbed vegetation which will act as control plots, plots within the disturbed infrastructure areas which will have baseline data and then be monitored during the rehabilitation phase. The same plots will be monitored with each survey so as to ensure collected data is comparable and trends are identified.

Where rehabilitation is conducted, additional plots will be included to monitor the efficacy of the re-vegetation.

Aspects that will be monitored in the annual surveys will include, species richness, vegetation composition i.e. proportion grasses, forbs and woody species, canopy height, cover percentage, presence of Red Data or protected species, and presence of alien invasive species.

13.1   Flora

13.1.1 Vegetation Cover Monitoring

The vegetation cover established on the disturbed areas needs to be monitored annually for the first two years after rehabilitation has been carried out, to ensure that the rehabilitation work has been successful in terms of stabilising the newly formed surfaces (preventing air and water erosion from affecting those surfaces), and that the newly established vegetation cover is trending towards convergence with the original vegetation cover found on the areas prior to disturbance (and on adjacent undisturbed areas) (Dawson, 2007).

Various parameters need to be measured, both on the rehabilitation sites and in the adjacent undisturbed areas, to determine the success or otherwise of the establishment of the rehabilitation vegetation cover, and how this compares with the undisturbed vegetation in the Resort Expansion Areas (REP). The Resort Expansion Projects, specifically the Eco lodge, Vacation Club phase 3 and 4 and the Driving Range Road, will affect relatively large areas of previously undisturbed vegetation. Monitoring in these areas are of importance as one of the main mitigation measures are rehabilitation of these areas.

This assessment needs to be undertaken by a botanist / environmental scientist trained and experienced in vegetation assessments of this nature.

Vegetation cover of rehabilitated areas should be assessed during the summer growing season, at least a month after rain has fallen (so that there has been an opportunity for fresh plant growth to have occurred). It is recommended that this should be done annually for the

first two years. Thereafter, visual spot-checking with photographic recording by an experienced field botanist / rehabilitation practitioner every three years will suffice, depending on results found. Remote sensing information and aerial photos will also be used to determine impacts and management plans.

The environmental indicators which will demonstrate whether the rehabilitation in disturbed areas has been successful, or not include:

- Increasing similarity between rehabilitated and undisturbed areas in terms of species composition and vegetation structure;

- Increasing species diversity of desired (local) species in rehabilitation cover over time;

- Reduction in presence of weed species over time;

- Increase in woody plant growth, and achievement of reproductive status and production of reproductive propagules (seed);

- Ability of the rehabilitation species populations to reproduce, indicated by the presence of seedlings of the rehabilitation species once the original generation has reached sexual maturity ("population recruitment");

- Increase in vegetation basal cover and biomass; and

- Increase in soil organic matter.

In the event that the vegetation cover remains static, or should deteriorate; additional seeding, with locally harvested species, and possibly fertilisation would be required as a mitigation measure.

13.1.2 Alien Vegetation Monitoring

During vegetation monitoring, the presence of alien species should also be detected. An active programme of weed management, to control the presence and spread of invasive weeds, will need to be instituted so that any weeds encroaching because of the disturbed conditions are controlled by means appropriate to the species.

Species likely to be problematic include those identified during the fauna and flora study of the site, namely *Datura stramonium* and *D. ferox* and *Opuntia ficus-indica.*

The environmental indicator assessed in this instance is the reduction in presence of weed species over time, to the point where no invasive weed species are present and no further population recruitment occurs.

13.2 Fauna

The fauna monitoring will be closely linked to the flora monitoring to enable solid scientific conclusions and comparisons; also, the strong ecological link between vegetation and animals can only be measured if monitoring is similar (e.g. in terms of monitoring points) for both disciplines.

To successfully monitor faunal and floral biodiversity, a solid baseline (prior to construction) will be established through the first round of monitoring. This needs to be supplemented with regular repeats to compile a reasonable comparison between the pre-construction faunal communities present and faunal communities found in the same areas during various stages of construction and operation of the proposed project.

13.2.1 Mammals

Small mammals will be surveyed by using small mammal live traps – line transects will be used to gather repeatable quantitative data with regards to species richness and population dynamics. Tracks and ecological indicators will be used to assess the presence of larger free-roaming mammals – frequencies of such observations will be used for quantitative comparisons. The nesting sites, burrows and possible home ranges of these species will be recorded, marked, monitored and actively avoided.

13.2.2 Birds

Line transects will be used to compile quantitative lists of birds present in the areas surveyed; both sounds and visual observations will be used. Nesting sites of threatened birds, will be marked and the area preserved with an adequate buffer zone. The authorities will be informed of any sites found and the client will abide by their recommendations. It is recommended that the more detailed avifaunal monitoring is conducted in the breeding season between October and January.

Surveys for terrestrial birds must be conducted in summer, but only once the vegetation layer has recovered sufficiently from winter fires to allow for assessment of available habitat.

Surveys for aquatic birds must also be conducted in summer. For species associated with rivers, the assessment must coincide with average flow conditions (i.e. not dry and not in flood) and preferably within the breeding season. For species associated with wetlands, the assessment must follow good summer rains i.e. standing water must be present and the vegetation must have recovered sufficiently from winter fires to allow for assessment of available habitat.

13.2.3 Reptiles & Amphibians

Active searches for both reptiles and amphibians will be used to assess species richness of these groups in the area; due to the difficulty in recording occurrence of these groups data gathering will be limited to species counts.

13.2.4 Invertebrates

Invertebrate biodiversity will be measured by using pitfall trap lines. This method concentrates on ground-living invertebrates – the groups found in pitfall traps are good indicator groups for general biodiversity. Pitfall traps can be repeated exactly and works well in areas where vegetation cover at ground level is low (open habitat) as is found in the study

area. In addition sweep net sampling will be conducted to provide an indication of airborne and canopy dwelling species.

14 Reasoned opinion of the specialist

The impacts as descried rated and mitigated in this document does not pose a risk to large natural areas of Very High sensitivity, neither is SSC with restricted ranges being threatened with destruction. All vegetation, habitat and species present on site that could be affect by the activities proposed are of stable populations. With strict adherence to the mitigation measures prescribed in this document, the impacts have been rated as acceptable and the proposed development can go ahead.

15 Public Consultation

The consultation process affords Interested and Affected Parties (I&APs) opportunities to engage in the EIA process. The objectives of the Stakeholder Engagement Process (SEP) include the following:

- To ensure that the I&APs are informed of the Project;

- To provide the I&APs with an opportunity to engage and provide comment on the Project;

- To draw on local knowledge by identifying environmental and social concerns associated with the Project;

- To involve the I&APs in identifying methods in which concerns can be addressed;

- To verify stakeholder comments have been recorded accurately; and

- To comply with legal requirements.

No comments relating to fauna and flora were received during the SEP undertaken during the original EIA process.

16 Conclusion and Recommendations

The Sun City development areas offers a high Biodiversity Value owing to the presence of intact savanna woodland habitat as well as Riparian and wetland habitat. Loss of these components will result in loss of biodiversity for the area. The opportunity exists however, for the proposed Development Areas to contribute significantly to conservation of biodiversity within the area. Conservation of as much of the natural land in the area within the site as possible, and the creation of corridors linking other natural areas would aid in conservation of ecosystems, flora and fauna. If efforts are made to initiate conservation of this habitat, and conservation is maintained, the net impacts on biodiversity could be positive.

DIGBY WELLS
ENVIRONMENTAL

Appendix A: CVs of the Project Team

Mr. Rudolph Greffrath

Manager: Biodiversity

Senior Terrestrial Ecology specialist

Biophysical Department

Digby Wells Environmental

1 Tertiary Education

2005-2006: B-tech Degree in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

2001- 2004: National Diploma in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

2 Professional Registration

South African Council for Natural Scientific Professions, *Professional Natural Scientist* in the field of practice *Conservation Science,* registration number, *400018/17*;

IAIA, International Association for Impact assessments;

Botanical Society of South Africa;

The Land Rehabilitation Society of Southern Africa, LARSA (Membership No. 0085);

Birdlife International;

Grassland Society of Southern Africa.

3 Employment

2006 – Present: Digby Wells Environmental, Johannesburg, South Africa.

2002 - 2003: Shamwari Game Reserve, Eastern Cape, South Africa.

2001: Kop-Kop Geotechnical instrumentation specialists, Johannesburg, South Africa.

4 Experience

Rudolph's current role is that of a terrestrial ecologist, with specific reference to fauna and flora biodiversity. In this capacity he is responsible for the planning and completion of terrestrial ecological studies, in the context of standalone reports, EIA reports and ESIA reports used for environmental authorisations or are focused specialist studies which meet local and international standards.

Rudolph has extensive experience in the application and adherence to the International Finance Corporation Performance standards, specifically performance standard 6. In this field he has worked with mining companies across Africa to ensure their compliance to IFC PS6. In this regard he has gained experience in applying the No Net Loss and Net Positive

Impact approaches for Biodiversity in a mining business context. He has experience in applying the Equator Principles and World Bank criteria, specifically Criteria 7.

In support of this, Rudolph is responsible for off set design after a mitigation hierarchy is applied, in this regard he compiles Biodiversity Land Management Programs where various specialist studies are collated into a working document for clients in order to aid in pre or post mining management and achieving the No Net Loss and Net Positive Impacts.

Further to this he is also involved in rehabilitation design studies which entail the planning, implementation and monitoring of vegetative rehabilitation in designated areas on mines. He is responsible for the planning of post mine land use and the various methods utilised to achieve this.

Rudolph also fulfils the role of project manager here he manages national and international projects across Africa, specifically west, central and southern Africa, managing a multi-disciplinary team of specialists.

Rudolph is also involved in the acquisition of regulatory permits for clients, this includes the planning of relocation strategies for protected and endangered plant species in areas where mines are to be established. This involves the planning and execution of data gathering surveys, thereafter he manages the process involving relevant provincial and National authorities in order to obtain the specific permit that allows for a development to continue.

Information pertaining to the technical expertise of Rudolph includes the following:

- Environmental Impact Assessments (EIAs), Basic Assessments and Environmental Management Plans (EMPs) for environmental authorisations in terms of the South African National Environmental Management Act (NEMA), 1998 (Act 107 of 1998);

Environmental pre-feasibility studies for gold tailings reclamation and iron ore mining projects;

- International Finance Corporation (IFC) related projects across central and west Africa, applying performance standards and Equator Principles on the Environmental Health and Safety Guidelines set down by the IFC;

- Environmental and Social Impact Assessments (ESIA) for Environmental Authorisation;

- Environmental off-Set studies, determining off-set liability, applying the Mitigation hierarchy and best practice in the form of IFCPS6 and BBOP.

- Large Mammal Monitoring Projects;

- Biodiversity Assessments including Mammalia, Avifauna, Herpetofauna and Arthropoda;

- Environmental Impact Assessments (EIA) based Impacts to the terrestrial Ecological environment;

- Geographic Information Systems (GIS), frequent use of ArcGIS, QGIS.

■ Biodiversity Action Plan, design and Implementation;

■ Biodiversity and Land Management Programs;

■ Protected plant species management strategies planning and implementation;

■ Monitoring of rehabilitation success by means of vegetation establishment;

■ Rehabilitation planning;

■ Environmental auditing of rehabilitated areas;

■ Project management of ecological specialist studies;

Planning and design of Rehabilitation off-set strategies.

5   Training

Measurements of Biodiversity at the University of the Free State, led by Prof. M. T. Seaman. September 2008.

IFC performance standards implementation training, Lee-Ann Joubert, January 2013.

Bird Identification course led by Ettiene Marais November 2009.

Introduction to VEGRAI and Eco-classification led by Dr. James Mackenzie December 2009 and January 2018.

Dangerous snake handling and snake bite treatment with Mike Perry 2011, 2015.

Rehabilitation of Mine impacted areas, with Fritz van Oudshoorn, Dr Wayne Truter and Gustav le Roux 2011.

First aid Level 2, School of Emergency and Critical care, Netcare, 2013

First aid Level 2, National First Aid Academy, 2017.

6   Projects

The following project list is indicative of Rudolph's experience, providing insight into the various projects, roles and locations he has worked in.

Project	Location	Client	Main project features	Positions held	Activities performed
Tongon Off-set project	Ivory Coast	Randgold Resources Limited	Applying IFC, BBOP and other best practice guidelines in designing an Off-set project for the residual Impact of the Tongon Gold Mine	Project Lead Technical Specialist	
Annual Large Mammal Monitoring in the Niokola Koba National Park.	Senegal	DPN Direction des Parcs Nationaux du Sénégal	Applying Aerial, Ground and vehicle, monitoring techniques in the National Park.	Aerial game counter, project specialist.	Training of field staff, recording of data in the vehicle and aerial surveys, Report reviewes
Mmamabula Energy Project (MEP).	Botswana	CIC energy	Construction of a railway, opencast mine, wellfield, conveyors, addits, housing.	Technical Specialist Ecologist	IFC level specialist studies, Fauna and Flora surveys for the project features, including impact assessments, management plans. Alien eradication plans.
Orlight Solar PV Power Project	South Africa	Orlight SA	Environmental Impact Assessment (EIA) process for five proposed	Technical Specialist	EIA Terrestrial Biodiversity studies, IFC

			Solar Photovoltaic (PV) Power Plants	Ecologist	level specialist studies
Twenty Nine Capitol	South Africa	CSIR	Photovoltaic Power stations	Technical Specialist Ecologist	EIA Terrestrial Biodiversity studies, in support of the EIA report, IFC level specialist studies
Tongan Biodiversity Land Management Plan	Ivory Coast	Randgold Resources Limited	Design, compilation and implementation of the BLMP	Technical Specialist Ecologist, Project Manager	Fauna and Flora surveys for the BLMP, compilation of BLMP. Alien eradication plans. IFC level specialist studies
Kibali Gold mine	DRC Congo	Randgold Resources Limited	Gold mine infrastructure	Technical Specialist Ecologist	Technical specialist, fauna and flora, for the Kibali ESIA. IFC level specialist studies
Kibali Gold mine	DRC Congo	Randgold Resources Limited	ESIA Update	Technical Specialist Ecologist	Technical specialist, fauna and flora, for the Kibali ESIA. IFC level specialist

					studies
Nzoro Hydroelectric station	DRC Congo	Randgold Resources Limited	Hydroelectric plant	Technical Specialist Ecologist	Technical specialist, fauna and flora, for the Nzoro ESIA. IFC level specialist studies.
Loulo Biodiversity Land Management Plan	Mali	Randgold Resources Limited	Design, compilation and implementation of the BLMP	Technical Specialist Ecologist, Project Manager	Fauna and Flora surveys for the project features, compilation of BLMP.
Koidu Diamond Mine	Sierra Leone	Koidu Resources	Construction of new open pit	Technical Specialist Ecologist	Technical specialist, fauna and flora, for the Koidu ESIA. IFC level specialist studies, terrestrial ecology management plans
Resource Generation	South Africa	Temo Coal	Coal mine/Railway Line	Technical Specialist Ecologist	Fauna and Flora surveys, Protected plant species management plans, Permitting and Rehabilitation design.

| Impunzi Rehabilitation monitoring | South Africa | Glencore | Monitoring of rehabilitation success and suggested management measures | Technical Specialist

Flora specialist, Project manager | Vegetation surveys, rehabilitation monitoring. Alien eradication plan. |

7 Publications

- Biodiversity Action Plans for faunal habitat maintenance and expansion in mining. Poster presented at the 48th Annual Grassland Society of Southern Africa (GSSA) conference.

- Limpopo Province South Africa – the Biodiversity perspective Paper presentation, presented at the Limpopo Minerals Conference and Trade show, hosted by the fossil fuel foundation and LEDET, 2015/11/11.

- Sustainability and Biodiversity Strategic Planning, Randgold Resources, 2018.