ECOLOGICAL SCAN

FOR THE PROPOSED MAKADIMA LEISURE & CULTURAL VILLAGE IN NORTH WEST PROVINCE

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NSS Ref No: 2391
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ECOSCAN REPORT

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EXECUTIVE SUMMARY

Natural Scientific Services CC was appointed by the Council for Scientific and Industrial Research to perform a floral, faunal and wetland ecoscan assessment (with in situ water testing) for the proposed Makadima Leisure and Cultural Village on the Farm Moiloa 412-JO in Dinokana, North West Province.

Desktop research and findings from our site visit in October 2017 confirmed that the Dinokana Eye, which is a sacred cultural feature, a local important water source, and a national Freshwater Ecosystem Priority Area (FEPA), has Very High sensitivity and conservation importance. By law wetland systems are deemed sensitive and should be protected by a minimum 100m buffer, measured from the edge of the riparian zone. Surrounding hills and ridges, which intrude into the study area, and which may support conservation important species, were rated with High conservation importance. Some large indigenous trees that remain in the study area, and which are targeted for medicinal or other purposes, are at high risk of extirpation and deserve improved protection.

Summarized in the **Table** below are potential impacts of the proposed development on biodiversity, without and with mitigation. Without mitigation, the most significant potential impacts include:

- Destruction of the in situ wetland system (which represents a national FEPA) during construction of the development.
- Contamination of surface and groundwater from poor management of construction, operation and decommissioning activities (e.g. cement mixing), poor sanitation, and waste.
- Increased dust, erosion and sedimentation from development activities and livestock over-grazing.
- Clearing of (especially riparian) vegetation and faunal habitats during construction.
- Introduction and proliferation of invasive alien flora from the influx of vehicles, people and materials, soil disturbance, and uncontrolled livestock activity.
- Increased harvesting and hunting of flora and fauna resulting in possible extirpation of targeted taxa such as remaining large indigenous trees.
- Increased noise, light and other forms of sensory disturbance of fauna from development activities.

Table Summary of impact significance, without and with mitigation

POTENTIAL IMPACTS	SIGNIFICANCE	
CONSTRUCTION	**Without mitigation**	**With mitigation**
Direct loss of wetlands	**Fatally flawed**	**Medium**
Contamination of surface and groundwater resources	**High**	**Low**
Increased dust and erosion	**High**	**Low**
Increased sediment loads	**Medium**	**Low**
Increased flood peaks	**Medium**	**Low**

POTENTIAL IMPACTS	SIGNIFICANCE	
Decreased water inputs	Medium	Low
Clearing of (especially riparian) vegetation and faunal habitats	High	Medium
Introduction and establishment of alien species	High	Low
Loss of CI or medicinal flora	High	Low
Sensory disturbance of fauna	Medium	Low
Loss of CI fauna	Medium	Low
Altered burning	Medium	Low
OPERATION		
Further loss / degradation of wetlands	High	Medium
Contamination of surface and groundwater resources	High	Low
Decreased water inputs	Medium	Low
Continued introduction and proliferation of alien species	High	Low
Loss of CI or medicinal flora	High	Low
Sensory disturbance of fauna	High	Medium
Loss of CI fauna	Medium	Low
Erosion	High	Low
Altered burning	Medium	Low
DECOMMISSIONING		
Further loss / degradation of wetlands	High	Medium
Contamination of surface and groundwater resources	High	Low
Increased dust and erosion	High	Low
Increased sediment loads	Medium	Low
Continued proliferation of alien species	High	Low
Loss of CI or medicinal flora	High	Low
Sensory disturbance of fauna	Medium	Low
Loss of CI fauna	Medium	Low
Altered burning	Medium	Low

With the implementation of the mitigation measures suggested in this report, the significance of impacts on site can be reduced to **Medium** or **Low**. Based on the information obtained in the site visit and the information that was available to date, it is NSS's opinion that the project should only go ahead provided that the recommended mitigation measures are diligently implemented. *Most importantly, the Dinokana Eye wetland system must be protected from all forms of disturbance, and the various recommended wetland buffers must be strictly adhered to.*

DECLARATION

I, Susan Abell, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability; and
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field.

Susan Abell *Pr.Nat.Sci.*
SACNASP Reg. No. 400116/05
(Ecological & Environmental Science)

November 2017
Date

LIST OF ACRONYMS & ABBREVIATIONS

ACRONYM	DESCRIPTION
ADU	Animal Demography Unit – a research unit of the Department of Zoology at the University of Cape Town
AGIS	Agricultural Geo-referenced Information System
CARA	Conservation of Agricultural Resources Act (Act 43 of 1983)
CBA	Critical Biodiversity Area
CI	Conservation Important
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
C-Plan	Conservation Plan
CR	Critically Endangered
CRSA	Constitution of the Republic of South Africa (Act 108 of 1996).
CSIR	Council for Scientific and Industrial Research
D	Declining population trend
d	Dominant
DACE	Department of Agriculture, Conservation and Environment
DD	Data Deficient
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DREAD	Department of Rural, Environment and Agricultural Development
DWA	Department of Water Affairs (previously known as DWAF)
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation (previously known as DWAF and DWA)
ECA	Environmental Conservation Act (Act 73 of 1989)
EIS	Ecological Importance & Sensitivity
EMC	Ecological Management Class
EN	Endangered
End	Endemic
ES	Ecological Sensitivity
ESA	Ecological Support Area
EW	Extinct in the Wild
EWT	Endangered Wildlife Trust
EX	Extinct
FEPA	Freshwater Ecosystem Priority Area
GG	Government Gazette
GIS	Geographic Information System
GN	Government Notice
GN	Government Notice
HGM	Hydro-geomorphic
I	Increasing
IA	Impact Assessment
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature and Natural Resources, based in

ACRONYM	DESCRIPTION
	Gland, Switzerland
LC	Least Concern
LoO	Likelihood of Occurrence of a taxon in an area
NBI	National Botanical Institute
NE	Not Evaluated
NEM:AQA	National Environmental Management: Air Quality Act (Act 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEM:PAA	National Environmental Management: Protected Areas Act (Act 57 of 2003)
NEM:WA	National Environmental Management: Waste Act (Act 59 of 2008)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEPAD	New Partnership for Africa's Development
NFAPTS	National Forests Act (Act 84 of 1998) and Protected Tree Species
NFEPA	National Freshwater Ecosystem Priority Areas project
NHRA	National Heritage Resources Act (Act 25 of 1999)
NMPRDA	National Mineral and Petroleum Resources Development Act (Act 28 of 2002)
NSS	Natural Scientific Services CC
NT	Near Threatened
NVFFA	National Veld and Forest Fire Act (Act 101 of 1998)
NWA	National Water Act (Act 36 of 1998)
OG	Ordinary Game
PES	Present Ecological State
PG	Protected Game
POSA	Plants of Southern Africa (website)
Pr.Nat.Sci.	Professional Natural Scientist
PRECIS	Pretoria (PRE) Computerised Information System
PS	Protected Species
PWA	Protected Wild Animal
QDS	Quarter Degree Square – the basic unit used by the Surveyor General for creation of 1:50 000 topographical maps
S	Stable population trend
SABAP 1 & 2	First and second Southern African Bird Atlas Projects, managed by the ADU
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SCH	Schedule Species
ToPS	Threatened or Protected Species
U	Unknown population trend
UJ	University of Johannesburg
UP	University of Pretoria
VU	Vulnerable
WA	Wild Animal
WITS	University of the Witwatersrand
WSA	Water Services Act (Act 108 of 1997)

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1. Introduction

South African legislation affirms the national commitment to conservation. The National Environmental Management Act (NEMA; Act 107 of 1998) provides for "the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations." The National Environmental Management: Biodiversity Act (NEM:BA; Act 10 of 2004) affords *inter alia*: the management and conservation of South Africa's biodiversity within the framework of NEMA; the protection of species and ecosystems that warrant national protection; and the sustainable use of indigenous biological resources. The National Water Act (NWA; Act 36 of 1998) is the principle legal instrument relating to water resource management in South Africa. All wetlands are protected under the NWA, wherein numerous measures are stipulated "which are together intended to ensure the comprehensive protection of all water resources."

The Council for Scientific and Industrial Research's (CSIR's) "Special Needs Skills and Development Programme" is currently undertaking the necessary environmental authorisations under NEMA, NEM:BA and the NWA for the proposed Makadima Leisure and Cultural Village on the Farm Moiloa 412-JO in Dinokana, North West Province. To this end the CSIR appointed Natural Scientific Services CC (NSS) to perform a floral, faunal and wetland ecoscan assessment (with in situ water testing) for the proposed project.

Biodiversity is defined as "…***the variability among living organisms from all sources including…terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems***" (The Convention of Biological Diversity, 1992). In other words, plants, animals and micro-organisms, their genes, and the ecosystems that living organisms inhabit, are all facets of biodiversity.

2. Terms of Reference

The ecoscan was performed according to the methodology agreed between the CSIR and NSS and in accordance with current requirements under NEM:BA (Appendix 6 – GN R982) - as indicated in the appended table under **section 13.10** - this report includes:

- A broad description of (relevant) biophysical attributes of the study area;
- A list of applicable legislation, guidelines, standards and criteria to be considered in project planning;
- A broad determination of the (national and provincial) conservation importance of local biodiversity;
- A description of *in situ* vegetation and floral communities, including their structure, dominant plant species composition and condition;

- Discussion about observed and potentially occurring conservation important (e.g. Protected, Red List and medicinal) species;
- An assessment of potential impacts of the proposed project on biodiversity, and recommended measures to mitigate these.

3. Project Team

All aspects of the ecoscan were performed by NSS (**Table 3-1**). The NSS team has extensive experience in completing biodiversity assessments involving floral, faunal, wetland and aquatic work, as well as Environmental Impact Assessments, Environmental Management Programme Reports, Strategic Management Plans and Environmental Management Plans for the conservation, mining, waste, commercial and industrial sectors. In terms of accreditation and professional registrations the following is applicable to NSS:

- Senior team members are registered Professional Natural Scientists in the ecological, environmental and zoological fields. The CVs of Senior NSS personnel who were involved in the present assessment have been appended under section **13.9**.
- The senior wetland team member is acknowledged by the Department of Water and Sanitation (DWS) as a competent wetland delineator.

Table 3-1 NSS project team

ROLE	NAME	QUALIFICATIONS
Flora	Susan Abell	M.Sc. Resource Conservation Biology (WITS). Pr.Sci.Nat. registered (400116/05) – Ecology & Environmental Science
Fauna	Dr Caroline Lötter	Ph.D. – Zoology (UP). Pr.Sci.Nat. registered (400182/09) – Zoology.
Wetlands	Tyron Clark	M.Sc. – Zoology (WITS) – in progress.
GIS Mapping	Tim Blignaut	B.Sc. Honours - Geography (UJ).

4. Applicable Legislation, Policies & Guidelines

Legislation, policies and guidelines, which could apply to impacts of the proposed project on biodiversity, are listed below. Although the list is comprehensive, additional legislation, policies and guidelines that have not been mentioned may apply.

4.1. International Agreements

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- (Bonn) Convention on the Conservation of Migratory Species of Wild Animals.
- Convention on Biological Diversity including eco-systems and genetic resources.

- Agenda 21 regarding the sustainable development at global and national levels.
- Johannesburg Declaration and Plan of Implementation for sustainable development.

4.2. Regional Agreements

- Action Plan of the Environmental Initiative of NEPAD for sustainable development in Africa.

4.3. National Legislation

- Conservation of Agricultural Resources Act (Act 43 of 1983).
- Environmental Conservation Act (Act 73 of 1989).
- Constitution of the Republic of South Africa (Act 108 of 1996).
- Water Services Act (Act 108 of 1997).
- National Water Act (Act 36 of 1998).
- National Forests Act (Act 84 of 1998) and Protected Tree Species.
- National Veld and Forest Fire Act (Act 101 of 1998).
- National Environmental Management Act (NEMA; Act 107 of 1998).
- National Heritage Resources Act (Act 25 of 1999).
- National Mineral and Petroleum Resources Development Act (Act 28 of 2002).
- Draft Sustainable Utilization of Agricultural Resources Bill (2003).
- National Environmental Management: Protected Areas Act (Act 57 of 2003).
- National Environmental Management: Biodiversity Act (NEM:BA; Act 10 of 2004):
    - National list of Ecosystems Threatened and in need of Protection (Government Gazette [GG] 34809, Government Notice [GN] 1002, 9 December 2011).
    - Alien and Invasive Species Regulations (GG 37885, 1 August 2014).
    - Threatened or Protected Species Regulations (GG 587, GN 38600, 31 March 2015).
- National Environmental Management: Air Quality Act (Act 39 of 2004).
- National Environmental Management: Waste Act (Act 59 of 2008).

4.4. National Policies, Guidelines & Programmes

- National Aquatic Ecosystem Health Monitoring Program including the River Health Programme (initiated by the DWAF, now the DWA), which has recently been replaced with the River Eco-status Monitoring Programme.
- South African Water Quality Guidelines (DWAF 1996).
- White Paper on Environmental Management Policy for South Africa (1998).
- National Spatial Biodiversity Assessment (Driver *et al*. 2004) including Priority Areas and Threatened Ecosystems.
- National Biodiversity Strategy and Action Plan (DEAT 2005).
- National Freshwater Ecosystem Priority Areas project (Driver *et al*. 2011).
- Mining and Biodiversity Guideline (DEA *et al.* 2013).
- National Water Resource Strategy (DWAF 2013).
- Draft national guidelines on biodiversity offsets (DEA 2012 and 2015).

4.5. Provincial Legislation, Policies & Guidelines

- **North West Biodiversity Conservation Act (Act 4 of 2016).**
- Transvaal Nature Conservation Ordinance (1983).
- North West State of the Environment Report (Walmsley & Walmsley 2002).
- North West Environmental Outlook Report (DACE 2008).
- North West Conservation Plan (C-Plan; DREAD 2012).

5. Project Description

The Makadima Leisure and Cultural Village will be based on the Farm Moiloa 412-JO in Dinokana, outside of Zeerust, in Ngaka Modiri District, North West Province. The purpose of the Village is to showcase the culture of different tribes in the province. “The project team identified an increasing interest and curiosity by tourists in cultural villages within the region, and found that there is a high need in the area and surrounding towns of Mafikeng, Zeerust, Rustenburg and Lichtenburg.” The project will generate 20 permanent and 50 temporary employment opportunities for people from Dinokana, and will hopefully also create business opportunities for villagers (CSIR 2017).

The farm portion is 85ha but the total development footprint will be approximately 10ha. The Village will comprise various developments, which will be built in phases over three years. “Accommodation and leisure facilities will be constructed first, followed by the cultural village, recreational facilities, and an adventure park. The 2.5ha accommodation facilities will include 16 hotel rooms, 5 couple chalets, and 6 family chalets. The 1.5ha leisure facilities will consist of picnic gardens and a swimming pool. The 1ha Cultural Village will consist of a boma, craft market, and arts and culture museum. The 2ha recreational facilities will include an outdoor gym, braai area and park benches. The 3ha adventure park will comprise a race track for go-karts and quad bikes (CSIR 2017).

The entire development should receive 150 visitors per day, and accommodate a maximum of 48 people at a time. The conference facility will take up to 40 team members, and 55 guests will be allowed in the Village at a time (CSIR 2017).

6. Study Region

6.1. Land-use

The project site is surrounded by the rural Dinokana settlement to the north and east, and mostly natural bush to the south and west, and is situated near the Dinokana Eye (25°27’22.74”S; 25°51’07.40”E) – “a feature considered to be a sacred site by the local community and one of the main attractions in Dinokana” (CSIR 2017). The Eye is presently

protected by security guards inside a small (~1.5ha) area enclosed by palisade and electrified fencing. The security measures have been put in place by the national Department of Water and Sanitation to safeguard the Eye from degradation by people and livestock. North of the Eye is an old reservoir or "dam," and south-east of the Eye is an informal soccer field. Photographs of the site are provided in **Figure 6-1**.

Centre of study area: Dinokana Eye

North: downstream from the Eye
(proposed recreational park)

North-centre: dam

Centre: rocky hill
(proposed accommodation and restaurant)

South-centre: valley plain
(proposed cultural village and picnic area)

South-east: soccer field
(proposed race track and adventure facilities)

Figure 6-1 Photographs of the site

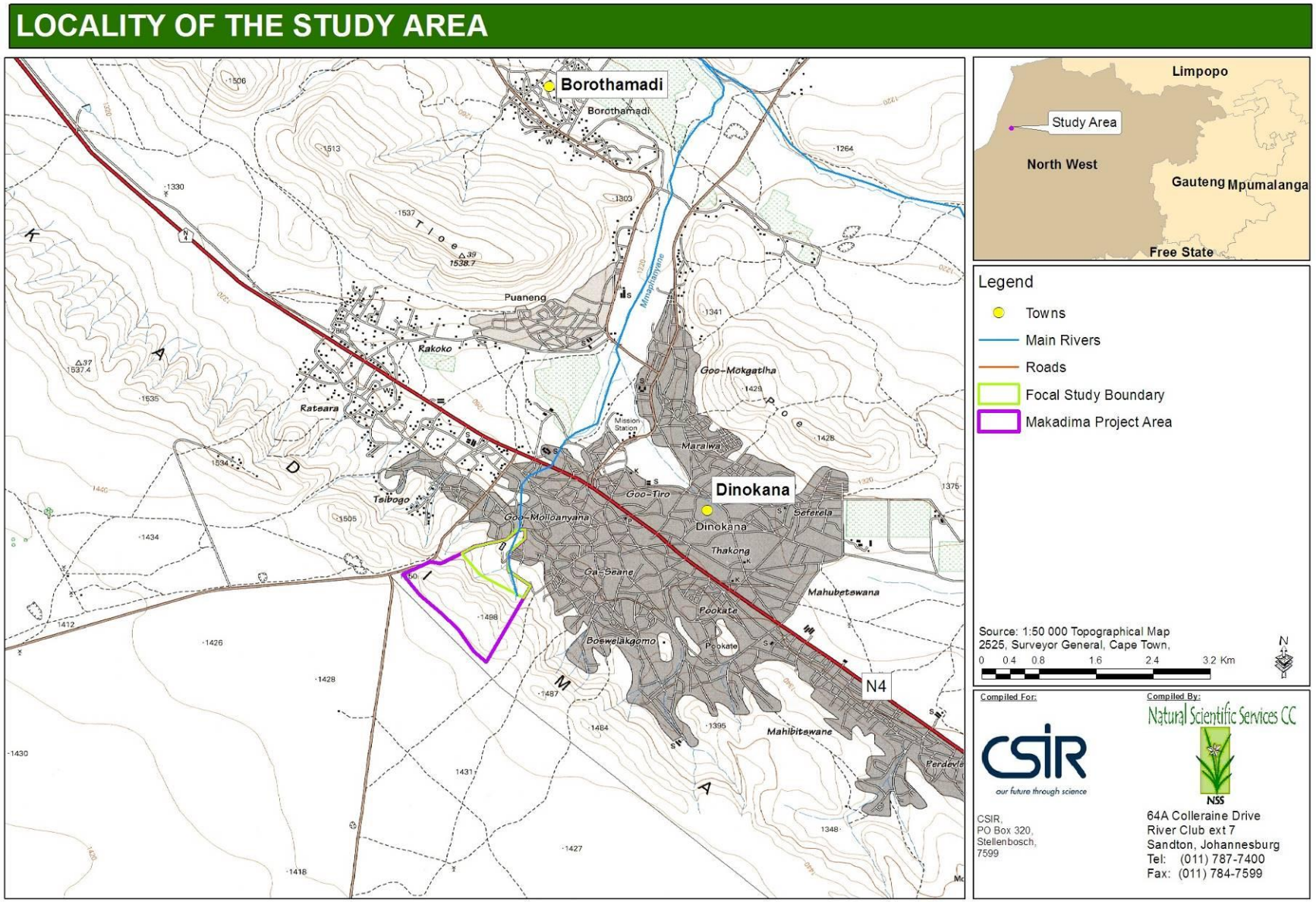


Figure 6-2 Site location

6.2. Climate

The regional climate features summer rainfall with very dry winters. Mean annual precipitation is about 550–650mm. Frost is fairly frequent in winter in lower-lying areas, but less so on the hills. Mean monthly maximum and minimum temperatures for Lindleyspoort-Irr weather station are 35.2°C and –0.4°C for January and June, respectively. Corresponding values for the Marico-Irr weather station are 36.7°C and -0.4°C (Mucina & Rutherford 2006).

Shown in **Figure 6-3** is monthly rainfall and atmospheric temperatures measured at Zeerust between January 2016 and November 2017 (data obtained from www.weatherunderground.com). This approximate rainfall data indicate that during the 12-month period preceding our site visit on 19 October 2017, the region had received an average annual amount of ~567mm rain. The approximate temperature data in **Figure 6-3** indicate that temperatures were generally cooler during October 2017 than during the October 2016. On the day that we visited the site, the weather was hot, and our observation of fresh sheet and gully erosion in places, indicated that the area had recently received rain. Conditions were, therefore, favourable for our floral, faunal and wetland survey work.

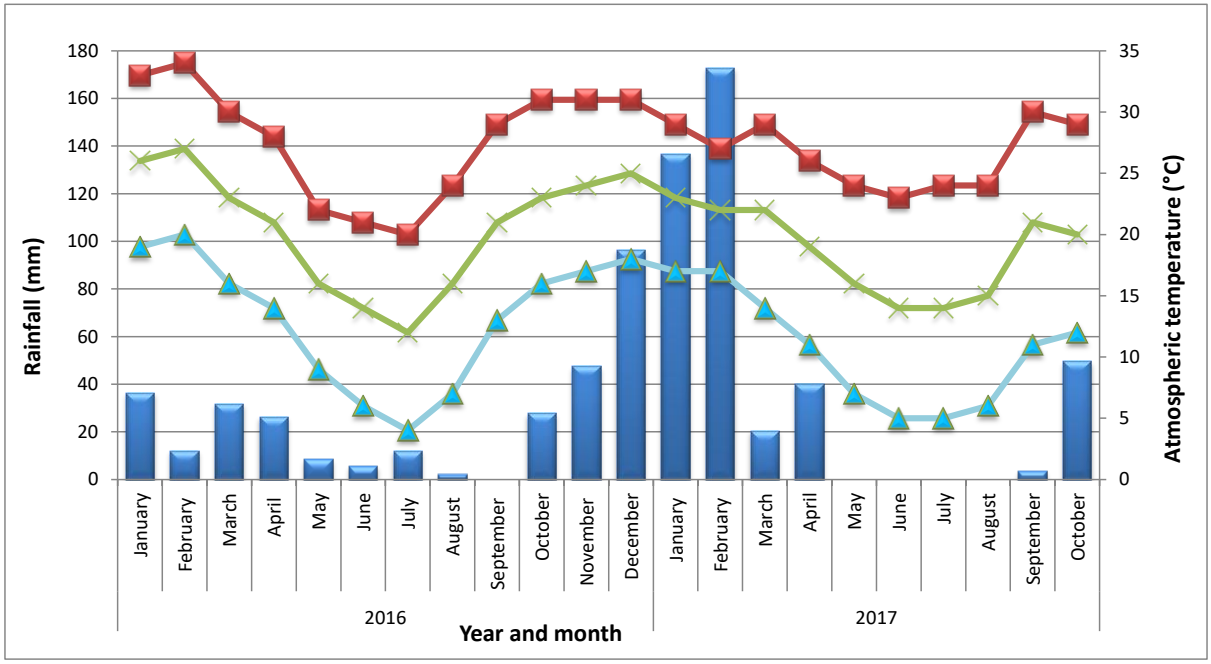


Figure 6-3 Measurements of monthly rainfall at Zeerust (www.weatherunderground.com)

6.3. Hydrology

The northern extremity of the site straddles the 7.04 ecoregion (to the north-east) and 11.09 ecoregion (to the south-west), and the southern section of the farm straddles quaternary catchment A10A (to the north-east) and D41A (to the south-west; **Figure 6-4**).

Both catchments have been rated with HIGH (Low Confidence) Ecological Sensitivity (ES), (DWAF 2011). The Dinokana Eye drains into the Ngotwane River, which enters the Limpopo River at Pala Camp, north-east of Gaborone. The Limpopo eventually flows through the

Kruger National Park before entering Mozambique. In contrast, quaternary catchment D41A feeds the Ramatlabama River, which enters the Molopo River, and which eventually drains into the Orange River.

6.4. Land Types

"Land types," which have been identified by the ARC's Institute for Soil, Climate and Water, represent areas that are uniform with respect to climate, terrain form, geology and soil. The data, obtained through the Agricultural Geo-referenced Information System (AGIS 2010), provide useful baseline information on land capability (especially agricultural potential). According to this data, most of the project footprint is situated in land type Ib40. The northern extremity of the site enters land type Ae33, and the southern section of the farm is situated in land type Fa9 (**Figure 6-5**).

Land type Ib40 features shales, quartzites and andesites of the Pretoria Group (Transvaal Supergroup) with stony shallow soils of the Glenrosa and Mispah soil forms, with some deep, freely drained soils. Within land type Ae33, sediments of the Pretoria Group (Transvaal Supergroup) - particularly the Silverton and Rayton Formations - are mostly shale with less quartzite and conglomerate. Carbonates, volcanic rocks, breccias and diamictites also occur in the Pretoria Group. Bronzite, harzburgite, gabbro and norite of the Rustenburg Layered Suite (Bushveld Igneous Complex) are also found. Soils are mostly deep, red-yellow, apedal, freely drained with high base status also with some vertic or melanic clays. Land type Fa9, in contrast, features dolomite and chert of the Malmani Subgroup (Transvaal SuperGroup) supporting mostly shallow Mispah and Glenrosa soil forms.

6.5. Vegetation

The project footprint is situated in the Savanna Biome, mainly within the SVcb 4 Dwarsberg-Swartruggens Mountain Bushveld regional vegetation type, but with the north-eastern extremity of the study area situated in the Svcb 3 Zeerust Thornveld vegetation type - as defined by Mucina & Rutherford (2006). To the south-west, the remainder of the farm portion straddles the Dwarsberg-Swartruggens Mountain Bushveld and the Gh 15 Carletonville Dolomitic Grassland vegetation types (**Figure 6-5**).

Dwarsberg-Swartruggens Mountain Bushveld features rocky, low to medium-high hills and ridges with steep faces in places (reaching about 300m in height above the surrounding plains). The structure of the vegetation is variable depending on slope, exposure, aspect and local habitat. Various combinations of tree and shrub layers occur, often with a dense grass layer. Bush clumps also occur. Dominant floral species within the Dwarsberg-Swartruggens Mountain Bushveld vegetation type are listed in **Table 6-1**. Although this vegetation type is not threatened, less than 2% is statutorily conserved (mainly in the Marico Bushveld Nature Reserve). Approximately 7% of the vegetation type has been transformed, mainly by cultivation, and scattered alien flora (e.g. *Cereus jamacaru* and *Acacia mearnsii*) occur in places. Erosion is mostly very low to low (Mucina & Rutherford 2006).

Zeerust Thornveld represents deciduous, open to dense, short, thorny woodland dominated by *Acacia* species with a herbaceous layer of mainly grasses. It is found on deep, high-base status and some clay soils on plains and lowlands, and also between rocky ridges of Dwarsberg-Swartruggens Mountain Bushveld. Zeerust Thornveld is also Least Threatened, but less than 4% is statutorily conserved between four reserves including the Pienaar and Marico Bushveld Nature Reserves. About 16% of the vegetation type has been transformed, mainly by cultivation, but also urban development. Alien flora (e.g. *Cereus jamacaru*) occur in a few very scattered areas. Erosion is also very low to low (Mucina & Rutherford 2006).

Carletonville Dolomitic Grassland is found on slightly undulating plains, dissected by prominent rocky chert ridges. This species-rich grassland type forms a complex mosaic pattern dominated by many species. It is listed as **Vulnerable**, with only a small extent of this vegetation type privately and statutorily conserved (in the Cradle of Humankind World Heritage, Oog van Malmanie, Abe Bailey, Boskop Dam, Schoonspruit, Krugersdorp, Olifantsvlei and Groenkloof protected areas). Almost a quarter of the Carletonville Dolomitic Grassland vegetation type has been transformed by cultivation, mining, urban development and damming. Erosion is very low to low (Mucina & Rutherford 2006).

Table 6-1 Dominant flora comprising the Dwarsberg-Swartruggens Mountain Bushveld vegetation type

GROWTH FORM	DOMINANT SPECIES
Tall Tree:	*Acacia robusta (d)*
Small Trees:	*Acacia caffra (d), A. erubescens (d), Burkea africana (d), Combretum apiculatum (d), Faurea saligna (d), Protea caffra (d), Combretum imberbe, C. molle, Cussonia paniculata, C. transvaalensis, Dombeya rotundifolia, Ozoroa paniculosa, Pappea capensis, Peltophorum africanum, Spirostachys africana, Vangueria infausta, Ziziphus mucronata.*
Succulent Tree:	*Aloe marlothii subsp. marlothii (d).*
Tall Shrubs:	*Dichrostachys cinerea (d), Croton pseudopulchellus, Ehretia rigida subsp. rigida, Grewia flava, Mundulea sericea, Tarchonanthus camphoratus, Vitex zeyheri.*
Low Shrubs:	*Athrixia elata, Pavonia burchellii, Searsia magalismontana subsp. magalismontana, S. rigida var. rigida.*
Woody Climber:	*Asparagus africanus.*
Graminoids:	*Aristida canescens (d), Cenchrus ciliaris (d), Chrysopogon serrulatus (d), Digitaria eriantha subsp. eriantha (d), Enneapogon scoparius (d), Loudetia simplex (d), Schizachyrium sanguineum (d), Setaria lindenbergiana (d), Bewsia biflora, Bothriochloa insculpta, Cymbopogon caesius, C. pospischilii, Elionurus muticus, Eragrostis rigidior, Fingerhuthia africana, Heteropogon contortus, Melinis nerviglumis, Panicum maximum, Setaria sphacelata, Themeda triandra, Trachypogon spicatus, Tristachya biseriata.*
Herbs:	*Barleria macrostegia, Commelina africana, Hermannia depressa, Senecio venosus.*
Geophytic Herbs:	*Hypoxis hemerocallidea, Pellaea calomelanos, Tritonia nelsonii.*

*The genus *Acacia* has been split internationally into *Vachellia* and *Senegalia*. For this report, these species will remain in the *Acacia* genus.

* d = Dominant

Table 6-2 Dominant flora comprising the Zeerust Thornveld vegetation type

GROWTH FORM	DOMINANT SPECIES
Tall Trees:	*Acacia burkei* (d), *Acacia erioloba* (d).
Small Trees:	*Acacia mellifera* subsp. *detinens* (d), *Acacia nilotica* (d), *Acacia tortilis* subsp. *heteracantha* (d), *Searsia lancea* (d), *Acacia fleckii, Peltophorum africanum, Terminalia sericea.*
Tall Shrubs:	*Diospyros lycioides* subsp. *lycioides, Grewia flava, Mystroxylon aethiopicum* subsp. *burkeanum.*
Low Shrubs:	*Agathisanthemum bojeri, Chaetacanthus costatus, Clerodendrum ternatum, Indigofera filipes, Searsia grandidens, Sida chrysantha, Stylsanthes fruticosa.*
Graminoids:	*Eragrostis lehmanniana* (d), *Panicum maximum* (d), *Aristida congesta, Cymbopogon pospischilii.*
Herbs:	*Blepharis integrifolia, Chamaecrista absus, C. mimosoides, Cleome maculata, Dicoma anomala, Kyphocarpa angustifolia, Limeum viscosum, Lophiocarpus tenuissimus.*

*The genus *Acacia* has been split internationally into *Vachellia* and *Senegalia*. For this report, these species will remain in the *Acacia* genus.

* d = Dominant

Table 6-3 Dominant flora comprising the Zeerust Thornveld vegetation type

GROWTH FORM	DOMINANT SPECIES
Low shrubs	*Anthospermum rigidum* subsp. *pumilum, Indigofera comosa, Pygmaethamnus zeyheri* var. *rogersii, Rhus magaliesmontana, Tylosema esculentum, Ziziphus zeyheriana,*
Geoxylic suffrutex	*Elephantorrhiza elephantina, Parinari capensis* subsp. *capensis*
Graminoids	*Aristida congesta, Brachiaria serrata, Cynodon dactylon, digitaria tricholaenoides, Hiheteropogon ampletens, Eragrostis chloromelas, E. racemosa, Heteropogn contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Alloteropsis semilata* subsp. *eckloniana, Andropogon schirensis, Aristida canescens, A. diffusa, Bewsia bifola, Bulbostylis burchellii, Cymbopogan caesius, C. pospibiflora, Elinonurus muticus, Eragrostis curvula, E. gummiflua, E. plantana, Eustachys paspaloides, Hyparrhenia hirta, Melinis nerviglumis, M. repens* subsp. *repens, Monocymbium ceresiiforme, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides, Tristachya leucothrix, T. rehmannii*
Herbs	*Aclypha angustata, Barleria macthrix, Chamaecrista mimosoides, Chamaesyce inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. Miconiifolium, H. nudifolium* var. *nudifolium, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Ophrestia oblongifolia, Pollichia campestris, Sencio coronatus, Vernonia oligocephala.*
Geophytic herbs	*Boophane disticha, Habenaria mossii*

*The genus *Acacia* has been split internationally into *Vachellia* and *Senegalia*. For this report, these species will remain in the *Acacia* genus.

* d = Dominant

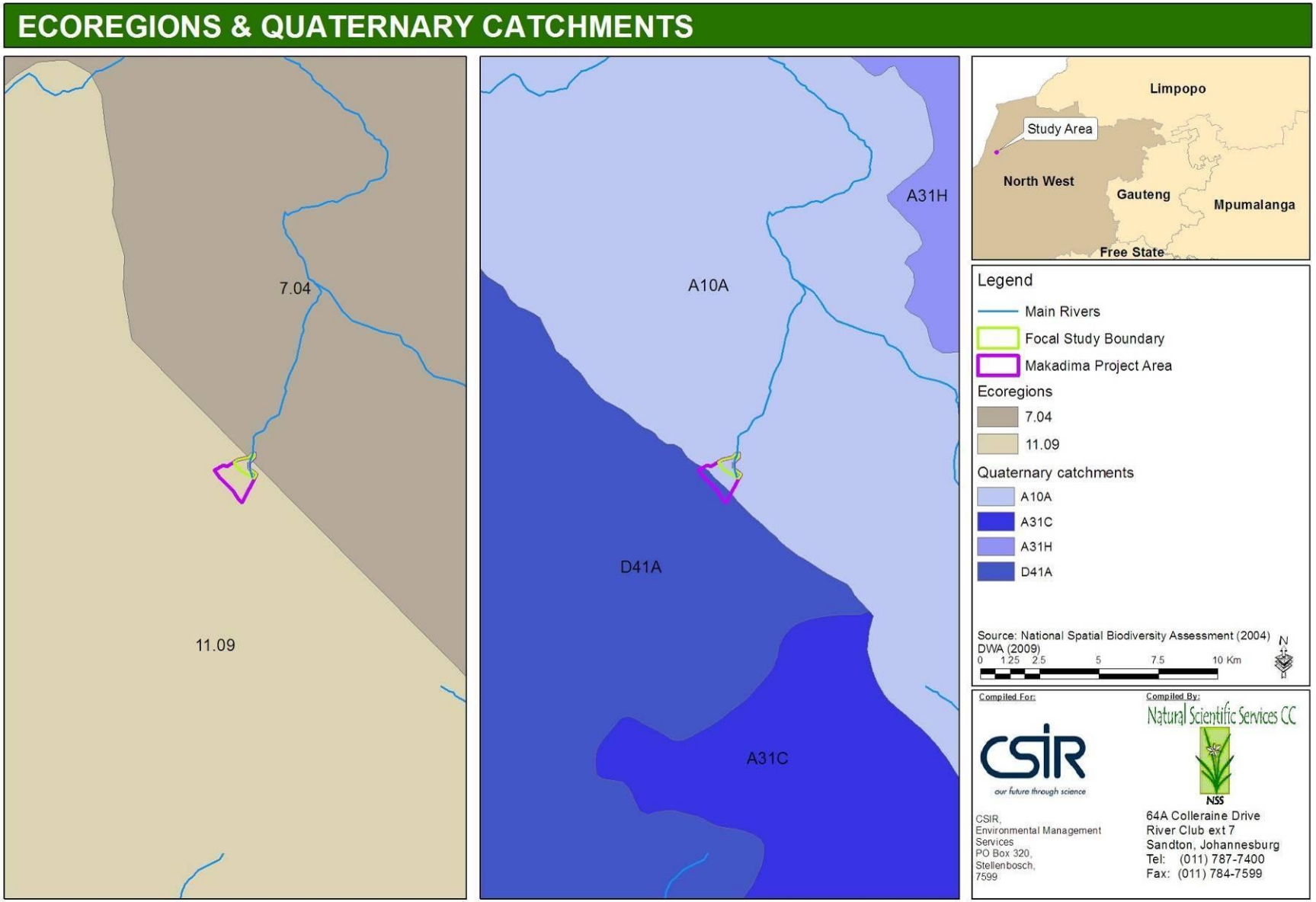


Figure 6-4 Ecoregion and quaternary catchment wherein the development site is situated

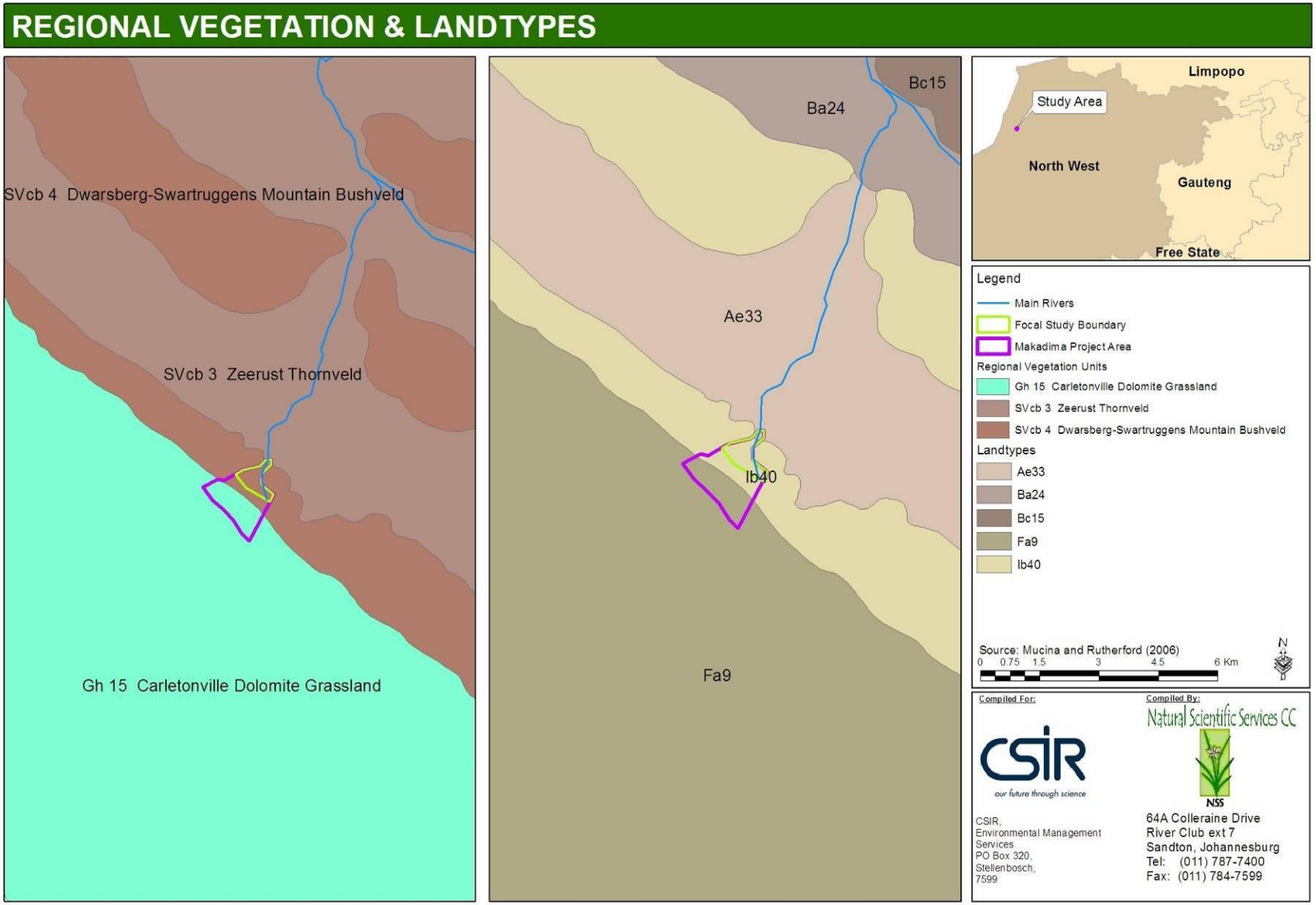


Figure 6-5 Regional vegetation and land type wherein the development site is situated

7. Methodology

The ecological scan involved desktop research and fieldwork, which was performed during a site visit on 19 October 2017.

7.1. Vegetation and Floral Communities

7.1.1. Desktop Research

A desktop assessment of the regional vegetation and potential local floral communities was performed using Mucina and Rutherford's (2006) vegetation map of southern Africa, the current biodiversity Sector or Conservation Plan (C-Plan) for North West Province, and SANBI's[1] Plants of South Africa (POSA) data for quarter degree square (QDS) 2525BD.

Conservation Important (CI) plant species records from the study region were sourced mainly from POSA, and the local Likelihood of Occurrence (LO) of each species was rated, based on in situ environmental conditions, as: present, high, possible, low or unlikely due to e.g. a lack of suitable habitat.

7.1.2. Fieldwork

In situ vegetation was sampled at multiple points (mapped in **Figure 7-1**) using the Braun-Blanquet approach. Floral community structure, condition and species composition and cover abundance was noted at each sampling point. Observed flora were identified to species level except when features for specimen identification were limited, in which case the epithet "cf" (meaning 'confer' or 'looks like') has been used. Plant scientific names follow those of POSA (accessed in October 2017).

Observed alien and invasive plant species were also recorded, as listed under both the Conservation of Agricultural Resources Act (Act 43 of 1983) and the National Environmental Management: Biodiversity Act (Act 10 of 2004) Alien and Invasive Species Regulations published on 1 August 2014 in Government Gazette 37885.

7.1.3. Limitations

- The short duration of fieldwork.
- Plant species with short flowering times, or which are small, rare or otherwise difficult to detect may not have been detected even though they are potentially present.
- Delineation of the identified floral communities might not be exact due to variable in-field GPS accuracy, potential georeferencing errors and outdated imagery from Google Earth.

[1] The South African National Biodiversity Institute

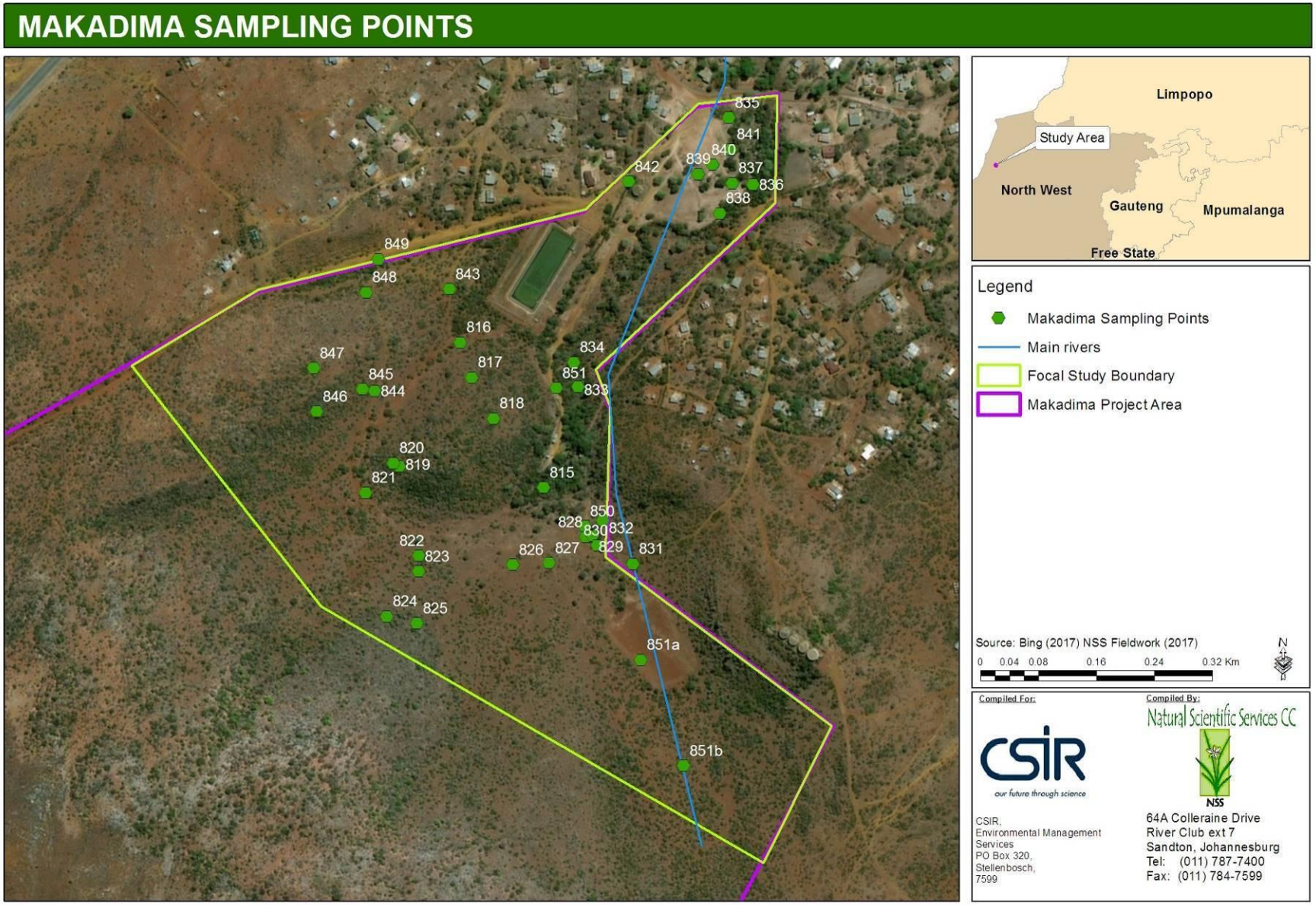


Figure 7-1 Vegetation sampling points

7.2. Fauna

7.2.1. Desktop Research

A list of species potentially occurring in the study area was compiled for:

- Mammals, including bats, using the published species distribution maps in Friedmann & Daly (2004) and Stuart & Stuart (2007), and Monadjem *et al*. (2010), respectively, and online species distribution data from MammalMAP (2017) for quarter degree square (QDS) 2525BD.
- Birds, using the list of bird species for QDS 2525BD from the Roberts VII (2013) mobile phone app., and the latest online list of bird species for pentad 2525_2550 from the second Southern African Bird Atlas Project (SABAP 2), which included records of bird species that were observed in QDS 2525BD during the first SABAP (SABAP 1).
- Reptiles, using the published species distribution maps in Bates *et al*. (2014), and online species distribution data from ReptileMAP (2017) for the relevant QDS.
- Frogs, using the published species distribution maps in Minter *et al*. (2004), and online species distribution data from FrogMAP (2017) for the relevant QDS.
- Butterflies, using the published species distribution maps in Mecenero *et al.* (2013). LepiMAP (2017) had only one species record for QDS 2525BD.
- Odonata, using the published distribution maps in Samways (2008). OdonataMAP (2017) did not have any species records for QDS 2525BD.
- Scorpions, using the published species distribution maps in Leeming (2003). ScorpionMAP (2017) did not have any species records for QDS 2525BD.

The lists were refined based on faunal records for the Dwarsberg-Swartruggens Mountain Bushveld, Zeerust Thornveld and Carletonville Dolomitic Grassland regional vegetation types in North West Province, which were received from DREAD (pers. comm. 2016), and our field observations, where the Likelihood of Occurrence (LO) of each species was rated using the following scale:

1 Present: the species, or signs of its presence, was recorded.
2 High: the species is highly likely to occur.
3 Moderate: the species may occur.
4 Low: the species is unlikely to occur.

7.2.2. Fieldwork

Faunal observations were made while driving, walking, and inspecting different habitats in the study area. Taxa were identified based on observations of dead or live specimens, spoor, droppings, burrows and other evidence. Rocks and logs were turned to find reptiles, scorpions, frogs and invertebrates. A sweep net was used to catch butterflies and odonata.

7.2.3. Conservation Status of Species

The appended faunal lists indicate the status of relevant species according to:

- The latest (2015) list of Threatened or Protected Species (ToPS) under the National Environmental Management: Biodiversity Act (NEM:BA 2004).
- The latest list of Threatened or Protected Species under the relevant provincial legislation, in this case, the Transvaal Nature Conservation Ordinance of 1983.
- The latest national or regional Red List assessment for:
  - Mammals by the SANBI & EWT (2016).
  - Birds by Taylor *et al*. (2015).
  - Reptiles by Bates *et al.* (2014).
  - Frogs by Minter *et al.* (2004).
  - Butterflies by Mecenero *et al.* (2013).
  - Dragonflies and damselflies (odonata) by Samways (2006).
- The IUCN Red List, where the global Red List status of a taxon has not been assessed during the relevant afore-mentioned national or regional Red List assessment.

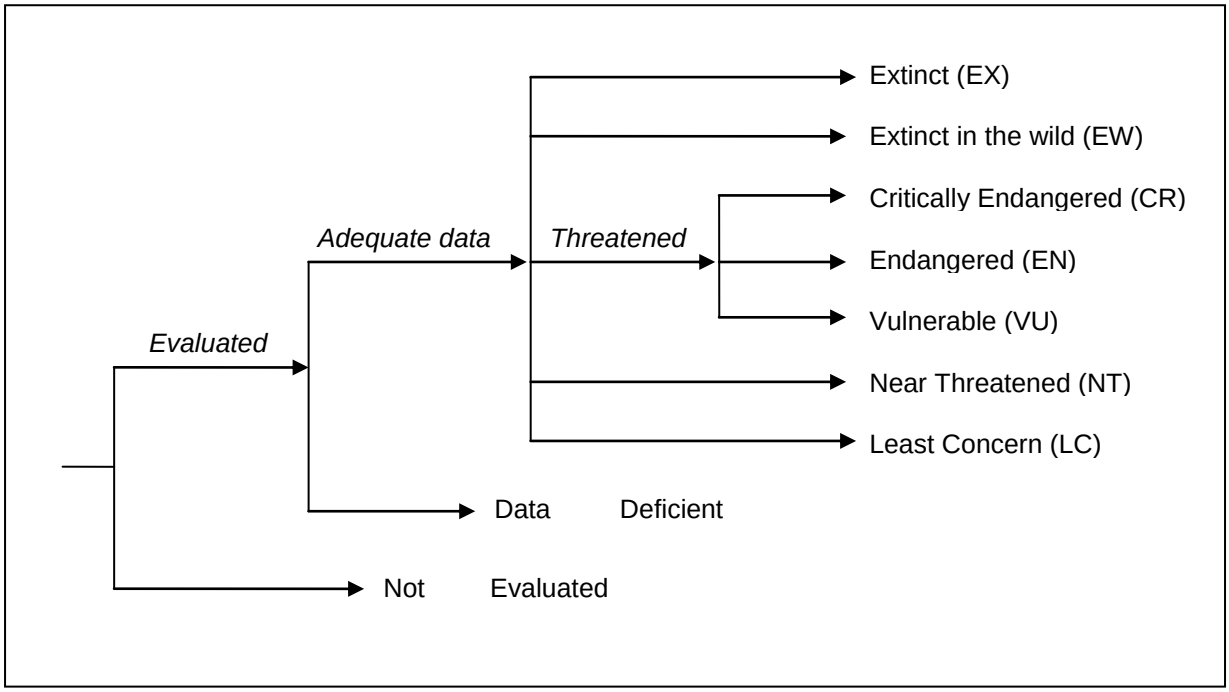


Figure 7-2 IUCN Red List categories

An atlas and Red List assessment for South African scorpion species has not yet been published. Due to spatio-temporal variation in human disturbances, the conservation status of some species differs between the NEM:BA, provincial legislation and the relevant regional or national Red List assessment publication. Unless otherwise stated, the *most* threatened status of a species is provided in text, whether this is at a global or other spatial scale.

Shown in **Figure 7-2** are the IUCN's Red List categories, which have been adopted to a large extent in regional / national /provincial assessments of animal taxa.

7.2.4. Limitations

- The site visit was limited to a few day time hours and, therefore, not all potentially occurring (especially nocturnal) species were likely to be detected.
- Some species, which are uncommon, small, migratory, secretive or otherwise difficult to detect may not have been detected even though they were potentially present.

7.3. Wetlands

7.3.1. Desktop Research

Prior to visiting the site, the area was surveyed at a desktop level using 1:50 000 topographical maps, Google Earth™ Imagery, contour data, provincial and national databases, as reference material to determine the layout of the in situ wetland system.

7.3.2. Wetland Classification

The wetland system was classified using the recently-published "Classification system for Wetlands and other Aquatic Ecosystems in South Africa" by Ollis *et al*. (2013), hereafter referred to as "the Classification System." Ecosystems included by the Classification System encompass all those that are listed under the Ramsar Convention as "wetlands[2]," and include all freshwater (non-marine) systems. The Classification System recognizes three broad inland systems: rivers, wetlands and open water bodies. Like Kotze ***et al's*** (2008) classification of wetlands based on hydro-geomorphic (HGM) units, the Ollis *et al*. (2013) Classification System asserts that the functioning of an inland aquatic ecosystem is determined fundamentally by hydrology and geomorphology. The Classification System has a six-tiered structure where under the determination of a system's HGM unit (Level 4):

Level 1 – Type of system (marine, estuarine or inland).
Level 2 – Regional setting (Level 1 Ecoregions; NFEPA WetVeg units; etc.).
Level 3 – Landscape unit (valley floor, slope, plain, and bench).
Level 4 – Hydro-geomorphic (HGM) unit.
Level 5 – Hydrological regime.
Level 6 – Descriptors (natural vs. artificial; salinity; pH; etc.).

7.3.3. Wetland Extent

The wetland delineation method used in the field is the same as that outlined in the DWS field procedure for the identification and delineation of wetlands and riparian areas (DWAF 2005).

[2] Under the Convention on Wetlands (Ramsar, Iran, 1971) "wetlands" are defined by Articles 1.1 and 2.1 as: Article 1.1: "*For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*." Article 2.1 provides that wetlands: "*may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands*".

The following three indicators described by DWAF (2005) were used:

- Terrain Unit Indicator: The topography of the area was used to determine where in the landscape wetlands were likely to occur. McVicar *et al*. (1977) defines five terrain units (**Figure 7-3**). Most wetlands will be found in valley bottoms (unit 5), but can occur on crests, mid slopes and foot slopes (units 1, 3 and 4).

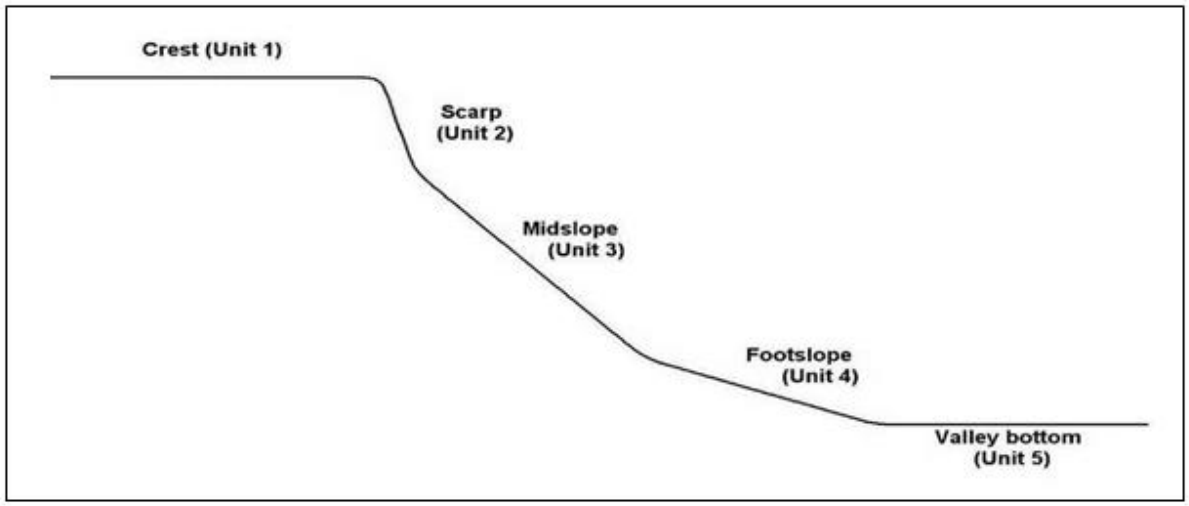


Figure 7-3 Simple depiction of terrain units (adapted from DWAF 2005)

- *Soil Wetness Indicator*: The soil wetness and duration of wetness are indicated by the colour of the soil. A grey soil matrix such as a G-horizon is an indication of wetness for prolonged periods of time and mottles indicate a fluctuating water table. In terms of the DWS guidelines (DWAF 2005), signs of soil wetness must be found within the top 50cm of the soil surface to classify as a wetland. The permanent zone of a wetland is therefore characterised by grey soil, the seasonal zone has a high frequency of low chroma mottles and the temporary zone has less, high chroma, mottles. These mottles are normally most prominent just below the A-horizon. Mottles may occur in non-wetland soils that have a high chroma matrix, and the colour of the matrix must always be considered in conjunction with the presence of mottles.
- *Vegetation Indicator*: Vegetation is a key component of the wetland definition in the National Water Act (Act 36 of 1998), and vegetation can be used as an indicator of wetland conditions. The presence / absence of hydrophytes provide a useful additional criterion in determining the boundaries of wetlands.

7.3.4. Wetland Present Ecological State (PES)

The PES of the in situ wetland system was assessed using the Level 1 WET-HEALTH tool of Macfarlane *et al.* (2008). The WET-HEALTH tool is designed to assess the health or integrity of a wetland. To assess wetland health, the tool uses indicators based on the main wetland drivers: geomorphology, hydrology and vegetation.

Macfarlane *et al.* (2008) explain that the application and methodology of WET-HEALTH uses:

- An impact-based approach, for those activities that do not produce clearly visible responses in wetland structure and function. The impact of irrigation or afforestation in the catchment, for example, produces invisible impacts on water inputs. This is the main approach used in the hydrological assessment.
- An indicator-based approach, for activities that produce clearly visible responses in wetland structure and function, e.g. erosion or alien plants. This approach is mainly used in the assessment of geomorphology and vegetation health.

With WET-HEALTH a wetland is first classified into HGM units (Level 4 – Ollis *et al.* 2013), and each HGM unit is separately assessed in terms of the extent, intensity and magnitude of impacts on the hydrology, geomorphology and vegetation of the unit, which is translated into a health score as follows:

- The *extent* of impact is measured as the proportion (percentage) of a wetland and/or its catchment that is affected by an activity.
- The *intensity* of impact is estimated by evaluating the degree of alteration that results from a given activity.
- The *magnitude* of impact for individual activities is the product of extent and intensity.
- The magnitudes of all activities in each HGM unit are then combined in a structured and transparent way to calculate the overall impact of all activities that affect a unit's hydrology, geomorphology and vegetation, and wetland PES is expressed on a scale of A-F (**Table 7.1**).

In addition, the threat and/or vulnerability of a wetland must be assessed to determine its likely "trajectory of change" (**Table 7-2**). Overall wetland health is then jointly represented by the wetland's PES and trajectory of change. This approach not only provides an indication of hydrological, geomorphological and vegetation health, but also highlights the key causes of wetland degradation.

7.3.5. Wetland Functionality

The WET-EcoServices tool of Kotze *et al.* (2008) provides a means for rapidly assessing ecosystem services supplied by wetlands. More specifically, the tool was designed to help assess the goods and services that individual palustrine wetlands (i.e. marshes, floodplains, vleis and seeps) provide in terms of support planning and decision-making.

The wetland benefits included in the WET-EcoServices model are selected based on their importance for South African wetlands, and how readily these can be assessed. Benefits such as groundwater recharge or discharge and biomass export may be important but are

difficult to characterise at a rapid assessment level, and have thus been excluded. Detailed in **Table 7-3** are the ecosystem services that are assessed during a rapid field assessment.

Table 7-1 Impact scores and Present Ecological State categories

ECOLOGICAL CATEGORY	DESCRIPTION	COMBINED IMPACT SCORE
A	**Unmodified, natural**	0-0.9
B	**Largely natural with few modifications**. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9
C	**Moderately modified**. A moderate change in ecosystem processes and loss of natural habitat has taken place but the natural habitat remains predominantly intact.	2-3.9
D	**Largely modified**. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9
E	**Seriously modified**. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9
F	**Critically modified**. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10
Source:	Modified from Macfarlane *et al.* (2008)	

Table 7-2 Trajectory of change classes, scores and symbols

TRAJECTORY CLASS	DESCRIPTION	CHANGE SCORE	CLASS RANGE	SYMBOL
Improve markedly	Condition is likely to improve substantially over the next five years	2	1.1 to 2	↑↑
Improve	Condition is likely to improve over the next five years	1	.3 to 1	↑
Remains stable	Condition is likely to remain stable over the next five years	0	-0.2 to +0.2	→
Deterioration slight	Condition is likely to deteriorate slightly over the next five years	-1	-0.3 to -1	↓
Deterioration substantial	Condition is likely to deteriorate substantially over the next five years	-2	-1.1 to 2	↓↓
Source:	Modified from Macfarlane *et al.* (2008)			

7.3.6. Wetland Ecological Importance & Sensitivity (EIS)

The assessment of wetland EIS was based on the DWAF (1999) guidelines. According to these guidelines, the "ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to a system's ability to resist disturbance and its capability to recover from disturbance once this has occurred. A wetland's EIS was then used to determine its Ecological Management Class (EMC). For this, a series of 10 determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance, and Level 4 indicates very high importance (**Table 7-4**). The median of the determinants is then used to assign a wetland's EMC (**Table 7-5**).

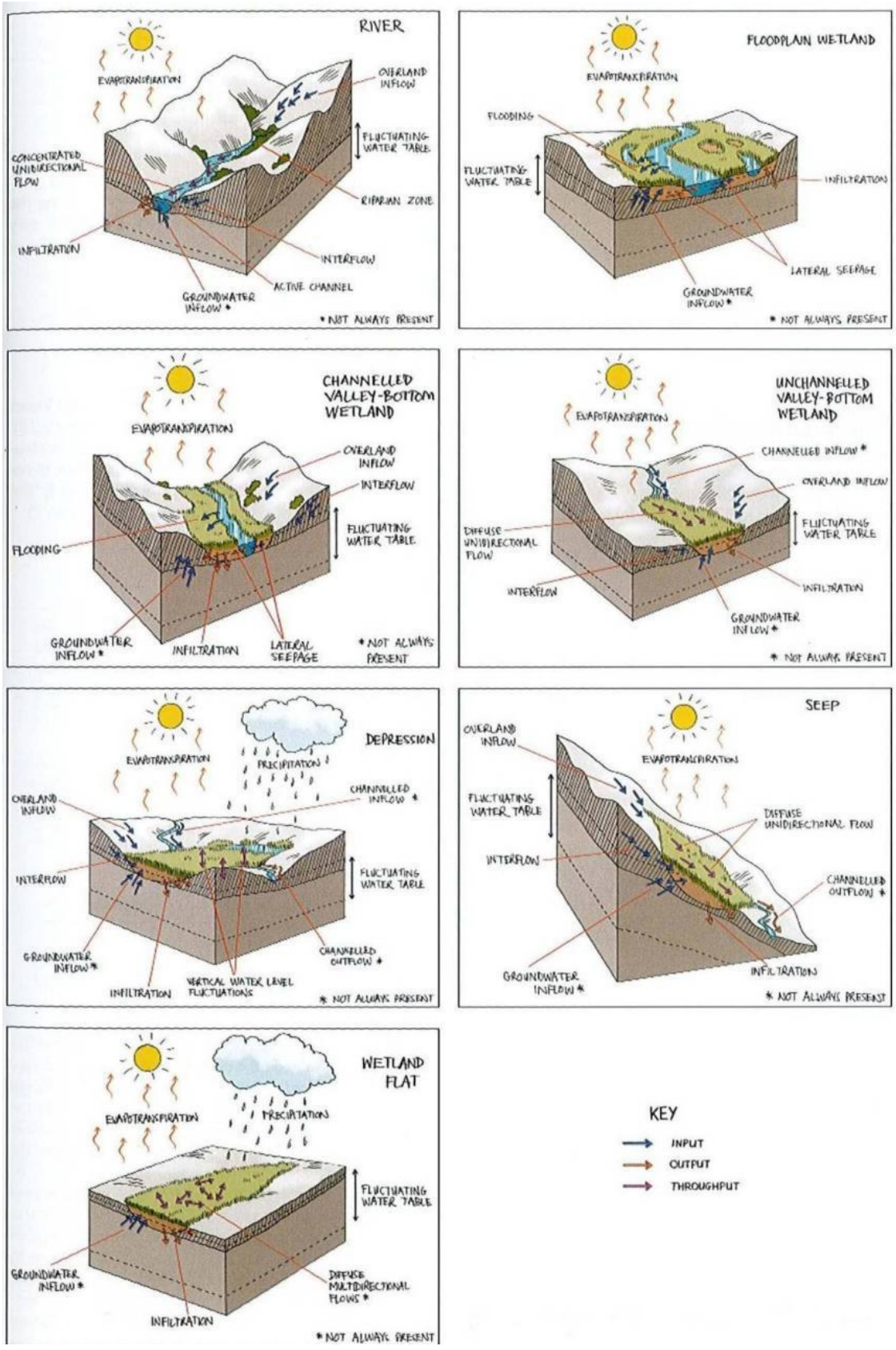


Figure 7-4 Primary wetland HGM types, highlighting dominant water inputs throughputs & outputs (Ollis *et al.* 2013)

The determinants assessed include:

PRIMARY DETERMINANTS

- Rare and endangered species - interpreted as Red Data and other Conservation Important (CI) species.
- Populations of unique species.
- Species / Taxon richness.
- Diversity of habitat types or features.
- Migration route/breeding and feeding site for wetland species.
- Sensitivity to changes in the natural hydrological regime.
- Sensitivity to water quality changes.
- Flood storage, energy dissipation and particulate/element removal.

MODIFYING DETERMINANTS

- Protected status.
- Ecological integrity.

Table 7-3 WET-EcoServices model of wetland ecosystem services (Kotze *et al.* 2000)

Ecosystem Services supplied by Wetlands	**Indirect Benefits**	**Regulating & supporting benefits**	Flood attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation	Sustaining streamflow during low flow periods
			Water quality enhancements: Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
			Water quality enhancements: Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
			Water quality enhancements: Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
			Water quality enhancements: Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff water
			Water quality enhancements: Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation
			Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter
	Direct Benefits	**Biodiversity maintenance**		Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Biodiversity maintenance is not an ecosystem service as such, but encompasses attributes widely acknowledged as having potentially high value to society		
		Provisioning benefits	Provision of water for human use	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods	The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
			Tourism and recreation	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research	Sites of value in the wetland for education or research

Table 7-4 Scoring guideline

SCORE GUIDELINE	CONFIDENCE RATING
Very high = 4	Very high confidence = 4
High = 3	High confidence = 3
Moderate = 2	Moderate confidence = 2
Marginal/Low = 1	Marginal/Low confidence = 1
None = 0	

Table 7-5 Ecological importance and sensitivity categories – Interpretation of median scores for biotic and habitat determinants

RANGE OF MEDIAN	ECOLOGICAL IMPORTANCE & SENSITIVITY (EIS)	RECOMMENDED EMC
>3 and <=4	**Very high** Wetlands that are considered ecologically important and sensitive on a national / international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	**A**
>2 and <=3	**High** Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	**B**
>1 and <=2	**Moderate** Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	**C**
>0 and <=1	**Low/Marginal** Wetlands which are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	**D**

7.3.7. Wetland buffers

A wetland buffer is a strip of land surrounding a wetland in which activities are controlled or restricted. Wetland buffers serve to: reduce the impact of adjacent land uses; slow potentially erosive run-off; capture sediments; absorb nutrients; and provide habitats for wetland-dependant organisms. The reach of the Mmaphanyane on site is registered as a FEPA river and as such 100 m applies to HGM unit 1 for general developments as well as a 250 m buffer on boreholes and a 500 m buffer on herbicide application. A 50 m buffer was

assigned to HGM Unit 2 based on the GDARD minimum requirement for biodiversity assessment protocol for wetlands outside the urban edge.

7.3.8. Limitations

The use of conventional redoximorphic soil indicators of wetland presence (mottles) is severely limited in the type of dolomitic derived soils present on site. This is due to the high manganese and iron content of soil (see wetland section for greater detail). The implication was that soil could not be used as a reliable wetland indicator.

The riparian vegetation zone has undergone considerable clearing and thinning from the reference state. This further hampers the use of vegetation indicators to reliably delineate the wetland boundary.

7.4. Impact Assessment

The Impact Assessment (IA) was performed according to the CSIR's IA methodology, which takes into account:

- Impact nature (direct, indirect and cumulative);
- Impact status (positive, negative or neutral);
- Impact spatial extent (**Table 7-6**);
- Impact duration (**Table 7-7**);
- Potential impact intensity (**Table 7-8**);
- Impact reversibility (high, moderate, low or irreversible);
- Irreplaceability of the impacted resource (high, moderate, low or replaceable);
- Impact probability (**Table 7-9**);
- Our confidence in the ratings (high, moderate or low);

Overall impact significance (**Table 7-10**) is calculated as:

Impact significance = Impact magnitude x Impact probability

where

Impact magnitude = Potential impact intensity + Impact duration + Impact extent

Table 7-6 Rating of impact spatial extent

EXTENT DESCRIPTION	SCORE
Site specific	1
Local (<2km from site)	2
Regional (within 30km of site)	3
National	4
International/Global	5

Table 7-7 Rating of impact duration

DURATION DESCRIPTION	SCORE
Temporary (less than 2 years) or duration of the construction period. This impact is fully reversible. *E.g. the construction noise temporary impact that is highly reversible as it will*	1

DURATION DESCRIPTION	SCORE
stop at the end of the construction period	
Short term (2 to 5 years). This impact is reversible.	2
Medium term (5 to 15 years). The impact is reversible with the implementation of appropriate mitigation and management actions.	3
Long term (>15 years but where the impact will cease after the operational life of the activity). The impact is reversible with the implementation of appropriate mitigation and management actions. *E.g. the noise impact caused by the desalination plant is a long term impact but can be considered to be highly reversible at the end of the project life, when the project is decommissioned*	4
Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient). This impact is irreversible. *E.g. The loss of a paleontological resource on site caused by construction activities is permanent and would be irreversible.*	5

Table 7-8 Rating of potential impact intensity

NEGATIVE POTENTIAL INTENSITY DESCRIPTION	RATING	SCORE
Potential to severely impact human health (morbidity/mortality); or to lead to loss of species[3] (fauna and/or flora)	Very High/Fatal Flaw	16
Potential to reduce faunal/flora population or to lead to severe reduction/alteration of natural process, loss of livelihoods / sever impact on quality of life[4], individual economic loss	High	8
Potential to reduce environmental quality – air, soil, water. Potential Loss of habitat, loss of heritage, reduced amenity	Medium	4
Nuisance	Medium-Low	2
Negative change – with no other consequence	Low	1
POSITIVE POTENTIAL INTENSITY DESCRIPTION	**RATING**	**SCORE**
Potential Net improvement in human welfare	High	8
Potential to improve environmental quality – air, soil, water. Improved individual livelihoods	Medium	4
Potential to lead to Economic Development	Medium-Low	2
Potential positive change – with no other consequence	Low	1

"Irreplaceable loss of a resource" must be factored into the potential intensity rating of an impact

Table 7-9 Rating of impact probability

PROBABILITY DESCRIPTION	SCORE
Improbable (little or no chance of occurring <10%)	0.1
Low probability(10 - 25% chance of occurring)	0.25
Probable (25 - 50% chance of occurring)	0.5
Highly probable (50 – 90% chance of occurring)	0.75
Definite (>90% chance of occurring).	1

[3]*Note that a loss of species is a global issue and is differentiated from a loss of "floral/faunal" populations.*
[4]*Note that a visual impact or air emissions for example could be considered as severely impacting on quality of life should it constitute more than a nuisance but not being life threatening.*

Table 7-10 Rating of overall impact significance

SCORE	RATING	SIGNIFICANCE DESCRIPTION
18-26	Fatally flawed	The project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating.
10-17	High	The impacts will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making.
5-9	Medium	The impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated.
<5	Low	The impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making.

8. Results

8.1. Vegetation and Floral Communities

8.1.1. Comparative Regional Vegetation

SANBI frequently collect/collate floral data within Southern Africa and update their PRECIS database system (National Herbarium Pretoria (PRE) Computerised Information System) which is captured according to quarter degree squares (QDSs). This is referred to the POSA database. For this study, the Site falls within 2525BD, which yielded 225 species. In order to obtain a more representative sample, the QDS 2525DB and 2526AC was incorporated, which yielded 342 species from 79 families. The dominant families being POACEAE, FABACEAE and ASTERACEAE (**Table 8-1**), with the Shrubs representing 29.5%, Herbs representing 18%, and graminiods representing just under 15% of the total species listed for the area (**Table 8-1**). Wooded species in total constitute over 45% of the species within the larger study region. In terms of the site, structural representation was following the trend presented within the larger region, with wooded vegetation being dominant (over 50%). The presence of Graminoids and Geophytic species was limited possibly due to the grazing impacts in the region **(Table 8-1**).

Table 8-1 Top 12 dominant families and most dominant growth forms obtained from the POSA website for the QDS 2525BD, DB, 2526AC and on site

IMPORTANT FAMILIES	No. OF SPP	GROWTH FORMS	% TOTAL SPP	ON SITE
POACEAE	49	Shrub	29.53	9.72
FABACEAE	33	Herb	18.42	13.89
ASTERACEAE	29	Graminoid	14.33	8.33
MALVACEAE	25	Dwarf shrub	10.23	5.56
CYPERACEAE	16	Tree	5.85	36.11

IMPORTANT FAMILIES	No. OF SPP	GROWTH FORMS	% TOTAL SPP	ON SITE
ANACARDIACEAE	11	Climber	4.97	1.39
LAMIACEAE	9	Geophyte	4.97	8.33
RUBIACEAE	9	Cyperoid	4.68	2.78
APOCYNACEAE	7	Succulent	3.22	9.72
COMBRETACEAE	7	Parasite	1.46	-
EUPHORBIACEAE	7	Bryophyte	0.88	2.78
EBENACEAE	6	Hydrophyte	0.29	1.39

8.1.2. On Site - Vegetation Communities

From the field investigations the study area is still in a relatively natural state. The site falls within two geological zones, the Shales of the Pretoria group and the Dolomites of the Malmani Supergroup. To the northwest of Zeerust, bands of chert make up the upper part of the Dolomite beds which gradually go over to ferruginous and cherty quartzites and finally turn into brown and black banded ironstones (Du Toit, 1954). Due to their hardness they have formed a series of low hills (Dinokana Hills) capping the dolomite and extending further northwest towards the Botswana border (Du Toit, 1954; Van der Meulen, 1979). Analyses performed in the Western Central Basin (WCB) where the study site occurs, confirmed that even though the WCB contains only 3% of the savanna biome core area, it harbours 41% of its species richness and has a species/area ratio of 0.07. This high gamma[5] diversity in such a small area can be explained by a low beta diversity between the species rich communities of the savanna and consequently of the WCB. The species richness in the WCB is not equally distributed, some areas are clearly more species rich than others with species richness increasing along an N–S and NW–SE gradient with the highest mean species richness in areas with high variation in relief: 1) hills and lowlands 2) slightly undulating plains 3) lowlands with parallel hills (Kurzweg, 2012).

The vegetation on site is distributed in a complex mosaic pattern, and is not dominated by a single or a few species. This can be seen in the vegetation structure on site, with more diversity occurring within the dolomitic outcrop areas (*C molle - Dombeya* North Facing Slopes). Shale mountainous communities include the *Pappea capensis - Euclea* South Facing Slope Thicket and the similar *Searsia leptodictya- Aloe marlothi - Helichrysum* North Slope Thicket (**Figure 8-1**). Within the valley bottom, on deeper red soils, the community is dominated by species such as *Euclea* and *Dodonaea* (*Euclea-Dodonaea* Lower slope-valley thicket). Along the river (from the Eye of the spring towards downstream) there is a well

[5] Whittaker (1972) defines beta diversity as the extent of differentiation between communities along an environmental gradient. The total diversity of a landscape, the gamma diversity, results from the alpha diversity of its communities and the amount of beta differentiation (beta diversity) among them.

defined Riparian Zone (*Combretum erythrophyllum - Halleria lucida* Riparian Zone) and along the immediate streambank more hydrophytic species are found (*Cyperus-Imperata-Kniphofia* Active River Channel community).

Approximately 4% of the immediate study area has been transformed through the construction of infrastructure, reservoirs, dams and a football field (refer to **Table 8-2**).

Species recorded during the Ecoscan and their associated habitats are within **Table 8-2**.

C erythrophyllum - H lucida Riparian Vegetation

S leptodictya- A marlothi - Helichrysum Slope Habitat

Euclea-Dodonaea Lower slope-valley thicket

Cleared Areas (Transformed habitat)

Figure 8-1 Photographs of the different habitats within and surrounding the site

Table 8-2 Broad Habitat/Vegetation communities

Vegetation Community	Area (hectares)	Conservation Significance
Woodland Habitats		
P capensis - Euclea South Facing Slope Thicket	*6.743*	**Moderate-High**
C molle - Dombeya North Facing Slopes	*1.756*	**Moderate-High**
S leptodictya- A marlothi - Helichrysum North-Northwest Slope	*5.297*	**Moderate-High**
Euclea-Dodonaea Lower slope-valley thicket	*14.592*	**Moderate**
Wetland Habitats		
Cyperus-Imperata-Kniphofia Active River Channel	*0.686*	**Very - High**

C erythrophyllum - H lucida Riparian Vegetation	*2.065*	**Very - High**
Completely Transformed		
Disturbed - Grassed Open Areas	*2.035*	**Low**
Cleared Areas	*0.786*	**Low**
Current Infrastructure	*1.008*	**Low-None**

Dodonaea viscosa

Combretum molle

Aloe marlothi

Dombeya rotundifolia

Figure 8-2 Examples of species found on site

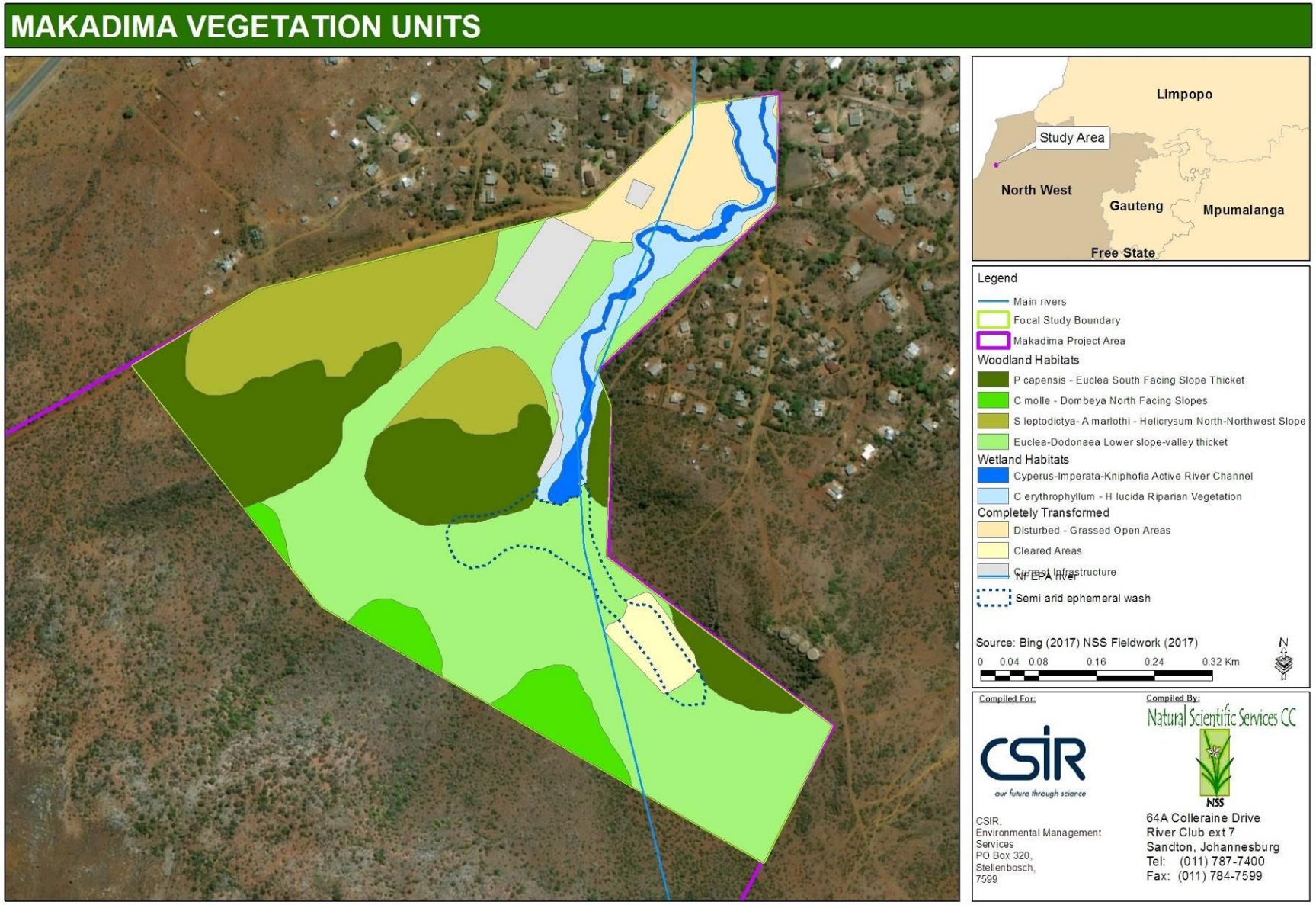


Figure 8-3 Vegetation communities within the study area

Table 8-3 Floral species located during the EcoScan and associated Vegetation Communities

FAMILY	SCIENTIFIC NAME	COMMON NAME	GROWTH	HABITAT					
				Pap- Euc	Com-Dom	Sea-Alo	Euc-Dod	Cyp-Imp	Com-Hal
ACANTHACEAE	*Barleria macrostegia*		Herb			√	√		
ANACARDIACEAE	*Ozoroa paniculosa (Sond.) R.& A.Fern*		Shrub	√		√			
ANACARDIACEAE	*Rhus spp*		Shrub	√					
ANACARDIACEAE	*Searsia lancea (L.f.) F.A.Barkley*	Karee	Tree	√	√	√	√		√
ANACARDIACEAE	*Searsia leptodictya (Diels) T.S.Yi, A.J.Mill. & J.Wen forma leptodictya*		Tree	√	√	√			
ANACARDIACEAE	*Searsia pyroides (Burch.) Moffett var. pyroides*	Common Wild Currant	Tree	√	√	√			√
APOCYNACEAE	*Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus*	Milkweed	Dwarf Shrub				√	√	
APOCYNACEAE	*Sarcostemma viminale (L.) R.Br.*	Caustic Vine	Succulent	√	√	√			
APOCYNACEAE	*Tavaresia barklyi*	Bergghaap	Succulent		√				
ASPHODELACEAE	*Aloe cryptopoda Baker*	Geelaalwyn	Succulent			√			
ASPHODELACEAE	*Aloe greatheadii var. davyana (Schonland) Glen & D.S.Hardy*	Spotted Aloe	Succulent			√	√		
ASPHODELACEAE	*Aloe marlothii A.Berger subsp. marlothii*	Mountain Aloe	Succulent	√	√	√			
ASPHODELACEAE	*Bulbine abyssinica A.Rich.*		Geophyte	√	√	√	√		
ASPHODELACEAE	*Kniphofia ensifolia Baker subsp. Ensifolia*		Geophyte					√	
ASTERACEAE	*Felicia muricata (Thunb.) Nees subsp. muricata*	White Felicia	Herb	√	√	√	√		
ASTERACEAE	*Geigeria burkei Harv. subsp. burkei var. burkei*	Vermeersiektebossie	Herb	√	√	√	√		
ASTERACEAE	*Helichrysum spp*		Dwarf Shrub		√		√		
ASTERACEAE	*Helichrysum aureonitens Sch.Bip.*	Golden Everlasting	Herb					√	
ASTERACEAE	*Senecio spp (possibly S pleistocephalus)*		Herb	√		√	√		

FAMILY	SCIENTIFIC NAME	COMMON NAME	GROWTH	HABITAT					
				Pap- Euc	Com-Dom	Sea-Alo	Euc-Dod	Cyp-Imp	Com-Hal
ASTERACEAE	*Helichrysum kraussii Sch.Bip*		Dwarf Shrub			√			
BUDDLEJACEAE	*Buddleja salviifolia*	Weeping Sage	Shrub	√	√	√	√		
CAPPARACEAE	*Boscia albitrunca (Burch.) Gilg & Gilg-Ben*	Sheperd Tree	Tree		√	√			
CELASTRACEAE	*Gymnosporia buxifolia (L.) Szyszyl.*	Common Spike - Thorn	Shrub	√	√	√	√		
CELTIDACEAE	*Celtis africana Burm.f.*	White Stinkwood	Tree						√
COMBRETACEAE	*Combretum erythrophyllum (Burch.) Sond.*	River Bushwillow	Tree				√		√
COMBRETACEAE	*Combretum molle R.Br. ex G.Don*	Velvet Bushwillow	Tree	√	√	√			
COMBRETACEAE	*Combretum zeyheri Sond.*	Large-fruited Bushwillow	Tree		√	√	√		
CRASSULACEAE	*Kalanchoe paniculata Harv.*		Succulent	√	√	√			
CYPERACEAE	*Carex spp*	Wood Sedge	Sedge					√	√
CYPERACEAE	*Isolepis cf. costata Hochst. ex A.Rich*		Sedge					√	√
EBENACEAE	*Diospyros lycioides Desf. subsp. lycioides*	Bluebush	Shrub	√	√	√	√		√
EBENACEAE	*Euclea undulata Thunb.*	Small - leaved Guarri	Shrub	√		√	√		
EUPHORBIACEAE	*Croton gratissimus Burch.*	Fever Berry	Tree		√	√			
FABACEAE	*Acacia caffra (Thunb.) Willd.*	Common Hook Thorn	Tree		√	√	√		
FABACEAE	*Acacia karroo Hayne*	Sweet - thorn	Tree	√		√	√		√
FABACEAE	*Acacia nilotica (L.) Willd. ex Delile var. kraussiana (Benth.) A.F.Hill*	Scented-pod Acacia	Tree	√		√	√		
FABACEAE	*Acacia tortilis (Forssk.) Hayne subsp. heteracantha (Burch.) Brenan*	Umbrella Thorn	Tree	√	√	√	√		
HYACINTHACEAE	*Albuca spp*	Albuca	Geophyte				√		
HYACINTHACEAE	*Ledebouria spp*		Geophyte		√		√		
IRIDACEAE	*Moraea pallida (Baker) Goldblatt*		Geophyte					√	√

FAMILY	SCIENTIFIC NAME	COMMON NAME	GROWTH	HABITAT					
				Pap- Euc	Com-Dom	Sea-Alo	Euc-Dod	Cyp-Imp	Com-Hal
LAMIACEAE	*Leucas capensis (Benth.) Engl.*	African Pitocine	Herb		√		√		√
MALVACEAE	*Dombeya rotundifolia (Hochst.) Planch. var. rotundifolia*	Wild Pear	Tree	√	√				
MALVACEAE	*Grewia flava DC.*	Grey Raisin	Shrub	√	√	√	√		
MORACEAE	*Ficus ingens (Miq.) Miq.*	Red - Leaved Rock Fig	Tree		√				
OLEACEAE	*Olea europaea L. subsp. africana (Mill.) P.S.Green*	African Olive	Tree						√
POACEAE	*Aristida canescens Henrard subsp. canescens*		Graminoid	√	√	√	√		
POACEAE	*Aristida congesta Roem. & Schult. subsp. congesta*	Cat's-tail Three-awned Grass	Graminoid	√	√	√	√		
POACEAE	*Cynodon dactylon (L.) Pers.*	Couch Grass	Graminoid	√	√	√	√	√	√
POACEAE	*Elionurus muticus (Spreng.) Kunth*	Lemon-scented Grass	Graminoid	√	√	√	√		
POACEAE	*Imperata cylindrica (L.) Raeusch.*	Cottonwool Grass	Graminoid					√	√
POACEAE	*Schizachyrium sanguineum (Retz.) Alston*		Graminoid	√	√	√	√		
PTERIDACEAE	*Adiantum capillus-veneris*	Maidenhair Fern	Bryophyte					√	√
RHAMNACEAE	*Ziziphus mucronata Willd. subsp. mucronata*	Buffalo Thorn	Tree	√	√		√		√
RUBIACEAE	*Vangueria infausta Burch. subsp. infausta*	Wild Medlar	Tree	√	√	√			
SAPINDACEAE	*Dodonaea viscosa Jacq. var. angustifolia (L.f.) Benth.*	Cape Sand Olive	Shrub	√	√	√	√		
SAPINDACEAE	*Pappea capensis Eckl. & Zeyh.*	Jacket Plum	Tree	√	√	√			
SCROPHULARIACEAE	*Halleria lucida L.*	Tree Fuschia	Tree						√
SCROPHULARIACEAE	*Jamesbrittenia aurantiaca (Burch.) Hilliard*		Herb				√		
SINOPTERIDACEAE	*Pellaea calomelanos (Sw.) Link var. calomelanos*	Hard Fern	Bryophyte	√	√	√			

FAMILY	SCIENTIFIC NAME	COMMON NAME	GROWTH	HABITAT					
				Pap- Euc	Com-Dom	Sea-Alo	Euc-Dod	Cyp-Imp	Com-Hal
TYPHACEAE	*Typha capensis (Rohrb.) N.E.Br.*	Bulrush	Hydrophyte					√	
VITACEAE	*Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. tridentata*	Bushman's Grape	Climber	√					√
KEY:	Pap- Euc Com-Dom Sea-Alo Euc-Dod Cyp-Imp Com-Hal	*P capensis - Euclea* South Facing Slope Thicket *C molle - Dombeya* North Facing Slopes *S leptodictya- A marlothi - Helichrysum* North-Northwest Slope *Euclea-Dodonaea* Lower slope-valley thicket *Cyperus-Imperata-Kniphofia* Active River Channel *C erythrophyllum - H lucida* Riparian Vegetation							

8.1.3. Conservation Important Species

It is well documented that heterogeneous landscapes, diverse geology and a range of environmental conditions, provide a diverse number of habitats for plant species (Pickett, *et.al*. 1997; O'Farrell, 2006; KNNCS, 1999). These areas are normally associated with high levels of species endemism and richness. For example, at least 74% of the 23 threatened Highveld plant taxa occur on the crests and slopes of ridges and hills (Pfab & Victor 2002). However, homogenous landscapes, either natural or that have been transformed through historical farming practices and infrastructural development contain minimal diversity and endemism.

With reference to the WCB, a total of 21 (0.9%) endemic species have been recorded for the WCB, (half of the predicted species thought to occur – 43 species). Compared to the Succulent Karoo, which is comparable in size and climate, the degree of endemism in the WCB flora is comparatively low (Cowling & Hilton-Taylor, 1994). However, most of the WCB endemic species are rare (e.g. *Gladiolus filiformis*) or threatened with extinction. In terms of Dolomitic hills, studies have shown that there is a positive trend between species diversity and high dolomite percentage areas (Touré & Ge, 2014). The current site is within relatively natural habitat and situated on moderate sloped hills. These hills are either shale or dolomite based. From the field visit, the dolomitic hills showed (as per studies such as Touré & Ge, 2014) more species diversity than the surrounding habitats.

Although considered a brief Vegetation Scan report, NSS has included a section on Conservation Important (CI) species that were detected or could possibly be detected on site. Within this section the CI species are discussed. These include the National Threatened Plant Species Programme (TSP) lists, any Protected species according to the North West Biodiversity Management (NWBMA) Act 4 of 2016 and any specific Endemic or Rare species.

The Threatened Plant Species Programme (TSP) is an ongoing assessment that revises all threatened plant species assessments made by Craig Hilton-Taylor (1996), using IUCN Red Listing Criteria modified from Davis *et al.* (1986). According to the TSP Red Data list of South African plant taxa (accessed December 2016), there are 46 Red Data listed species (**Table 8-4**) out of a possible 2416 species within North West Province (including Data Deficient species) of which 2 species are Critically Endangered (CR), 4 Endangered (EN), 8 are Vulnerable (VU) and 8 are Near Threatened.

Table 8-4 Numbers of conservation important plant species per Red Data category within South Africa and North West (date accessed: October 2017)

Threat Status	South Africa	NORTH WEST	2525BD /DB
EX (Extinct)	28	0	0
EW (Extinct in the wild)	7	0	0

Threat Status	South Africa	NORTH WEST	2525BD /DB
CR PE (Critically Endangered, Possibly Extinct)	57	0	0
CR (Critically Endangered)	332	2	0
EN (Endangered)	716	4	0
VU (Vulnerable)	1217	8	1
NT (Near Threatened)	402	8	0
Critically Rare (known to occur only at a single site)	153	1	1
Rare (Limited population but not exposed to any direct or potential threat)	1212	4	0
Declining (not threatened but processes are causing a continuing decline in the population)	47	7	2
LC (Least Concern)	13 856	1935	336
DDD (Data Deficient - Insufficient Information)	348	0	0
DDT (Data Deficient - Taxonomically Problematic)	904	12	2
Total spp (including those not evaluated)	**23 399**	**2416**	**342**

**Date accessed – October 2017 (Data on POSA last updated in March 2012)

From the POSA website (2525BD /DB and 2526AC) 6 listed CI species have been recorded in the greater region (**Table 8-5**). Please not that this list is not exhaustive and there is still the potential for other listed species to occur in the region. In addition, the Dwarsberg-Swartruggens Mountain Bushveld is listed as containing the Central Bushveld endemic *Erythrophysa transvaalensis* and the South African endemic *Euphorbia perangusta* (DDT and protected under the NWBMA, Act 4 of 2016). However, *Euphorbia perangusta* likes southern or south-eastern slopes of quartzite ridges (not typical of the study area).

Table 8-5 Potential CI species based on information obtained from 2527BB & 2527BD QDG

FAMILY	SPECIES	STATUS	FLOWERING TIME	HABITAT	LoO
FABACEAE	*Acacia erioloba* E.Mey.	Declining	Late winter to summer	Deep dry sandy soils	Possible
AMARYLLIDACEAE	*Boophone disticha* (L.f.) Herb.	Declining	July - October	Dry grassland and rocky areas.	Possible
EUPHORBIACEAE	*Euphorbia knobelii* Letty	DDT		Woodland / thornveld, wedged among large rocks on the slopes of quartzitic ridges, 1000-1200 m.	Possible (shales and Quartzites of the Pretoria Group)
IRIDACEAE	*Gladiolus filiformis* Goldblatt & J.C.Manning	Critically Rare	Mainly December, but can extend from October to February	Grassland and scrubland on hill slopes and plateaus.	Possible
MYROTHAMN-	*Myrothamnus*	DDT	Spring-	In shallow soil	Possible

FAMILY	SPECIES	STATUS	FLOWERING TIME	HABITAT	LoO
ACEAE	*flabellifolius Welw.*		Summer	over sheets of rock	
ANACARDIACEAE	*Searsia maricoana* (Baker f.) Moffett	VU	Summer	Grassland, at the transition from bushveld, in dark soil among igneous rocks.	Unlikely

* Vulnerable – VU; Data Deficient Taxonomically – DDT

Although no Red Listed species were recorded, unique plants included species such as *Kniphofia ensifolia* and the succulent *Tavaresia barklyi* (Bergghaap) (**Figure 8-4)**. Although *Tavaresia barklyi* has a wide distribution range, it is rarely abundant. According to the latest assessment, the Bergghaap is listed as of Least Concern in South Africa (2009). It is, however, protected under the neighbouring Limpopo Environmental Management Act 2003 in the Limpopo Province (South Africa). The Bergghaap is mainly grown by plant collectors and enthusiasts. Except for its horticultural use, not much is known about other uses. It has been reported that the plant is crushed and externally applied to painful and aching parts of the body as a kind of dressing to alleviate pain.

Tavaresia barklyi

Kniphofia ensifolia subsp. *ensifolia*

Figure 8-4 Photographs of Conservation Important or unique plant species on Site

8.1.4. Alien and Invasives Species

Alien, especially invasive[6] plant species are a major threat to the ecological functioning of natural systems and to the productive use of land. The trend within areas with such high past disturbances and transformation, is considered to be infested with a number of alien species.

A survey conducted in 2007 investigated the indigenous knowledge of the local community towards weeds and alien invasive plants in the Dinokana area (Itholeng, 2007). As part of this study a vegetation survey was conducted. The vegetation survey indicated that there were more *Populus canescens* than other plant species within the region. Approximately 9.4 ha of the land in Maramage Village were invaded by *Populus canescens*. The predominant height classes in terms of Tree Equivalent per hectare (TE/ha) was 2 to 3 meters with a density of 34073 TE/ha, followed by trees of more than 4 meters with a density of 61687 TE/ha (Itholeng, 2007). Directly in the Dinokana Village, the most prominent species identified were mainly *Opuntia imbricata*, *Melia azedarach* and *Lantana camara*. During the NSS surveys, the areas containing the most alien records were along the channel and within the areas where human movements and development was present. According to Smith & Panetta (2002), riparian ecosystems are important for maintaining biodiversity and ecosystem functioning within landscapes. They are prone to alien invasions due to their dynamic nature and high nutrient level. Some of the invasive species, called "transformer species", are capable of markedly changing ecosystem structure and functioning. When the functional values of a riparian system are compromised, downstream ecosystems may be negatively affected. This may occur via reduced water quality and increased nutrient and sediment flows. Once invaded, the riparian vegetation can act as a source of weed propagules for downstream and upstream habitats. It is therefore imperative that these areas obtain priority for alien species removal.

Alien Invasive Categories according to NEM:BA; Act 10 of 2004:

Category 1a
Species requiring compulsory control.
Category 1b
Invasive species controlled by an invasive species management programme
Category 2
Invasive species controlled by area
Category 3

From the ecoscan that was conducted, most of the species recorded were NEMBA Category 1b listed species (**Table 8.5** and **Figure 8-5**) with two Category 2 species present.

[6] Two main pieces of national legislation are applicable to alien, invasive plants, namely the:

- Conservation of Agriculture Resources Act (CARA; Act 43 of 1983); and
- National Environmental Management: Biodiversity Act (NEM:BA; Act 10 of 2004):

Table 8-6 Alien and Invasive Species detected during the survey

Family	Species	Growth forms	NEMBA
ASTERACEAE	*Cirsium vulgare (Savi) Ten.*	Herb	1b
OLEACEAE	*Ligustrum spp*	Tree	1b
MELIACEAE	*Melia azedarach L.*	Tree	1b, (3 urban)
CACTACEAE	*Opuntia ficus-indica (L.) Mill.*	Succulent	1b
ARECACEAE	*Phoenix spp*	Tree	Weed
SALICACEAE	*Populus × canescens (Populus alba hybrid)*	Tree	2
RANUNCULACEAE	*Ranunculus multifidus Forssk.*	Herb	Weed
EUPHORBIACEAE	*Ricinus communis L. var. communis*	Herb	2
CACTACEAE	*Cereus jamacaru DC.*	Succulent	1b
BIGNONIACEAE	*Jacaranda mimosifolia*	Tree	1b

Populus x canesens
(Grey Poplar)

Cirsium vulgare
(Scottish Thistle)

Ligustrum sp.

Jacaranda mimosifolia
(Jacaranda)

Cereus jamacaru
(Queen of the Night)

Figure 8-5 Photographic representation of alien species found in the study area

8.2. Fauna

Provided in the appended lists under **13.2-13.8** is the name and conservation status of each mammal, bird, reptile, frog, butterfly, odonata (dragonfly and damselfly) and scorpion species that was recorded, or was rated with a high, moderate or low Likelihood of Occurrence (LO) in the study area.

8.2.1. Mammals

Approximately 57 mammal species are considered highly likely or likely to occur at least sporadically in the study area (**Appendix 13.2**). This represents 64-67% of the total number of 85 and 89 mammal species recorded, respectively, in the Dwarsberg-Swartruggens and Zeerust Thornveld vegetation types (DREAD unpubl. data). Most of the 33-36% of mammal species, which are known to occur in the regional vegetation types, but which have not been listed for the study area, represent species that are typically vulnerable to anthropogenic disturbance.

Local project team members and other community members indicated that mongeese and tree squirrels are seen regularly in the study area. Kudu, jackals, porcupines, baboons and Brown Hyenas are reportedly encountered on occasion in the surrounding region. A number of Southern African / Common Mole-rat mounds were found in the proposed picnic area, and Scrub Hare and/or Jameson's Red Rock Hare / Rabbit droppings were found amidst the rocky hill slopes on site (**Figure 8-6**).

Other regionally-occurring rupiculous mammal species, which were rated with a high or moderate LO in the study area include e.g. Eastern Rock Elephant Shrew, Namaqua Rock Mouse and Rock Hyrax. Large, regionally-occurring wetland-associated mammal species e.g. African / Cape Clawless Otter, Greater Cane Rat, and Marsh / Water Mongoose, were rated with a low LO due to the small size of the in situ wetland system and local high levels of anthropogenic disturbance. Poor grass cover caused by livestock over-grazing potentially precludes mammal taxa such as climbing mice, the Near Threatened (NT) Southern African Hedgehog and Serval.

Common regionally-occurring fauna such as Bush / Common Duiker, Steenbok, Vervet Monkey and Warthogs were rated with a low LO on site due to local high levels of anthropogenic disturbance and lacking anecdotal accounts of these taxa. The widely exploited Ground Pangolin probably no longer occurs. An estimated 14 bat species were rated with a high or moderate LO in the study area. While some of these bat species are expected to roost in trees and buildings in the study area, others are expected to roost in nearby caves (such as the Derdepoort limestone and Marico Eye caves), which have formed in the dolomitic terrain that extends south-westwards from the site. Alien mammals, which were detected in the study area, included cattle, horses, donkeys, goats and dogs (**Figure 8-6**). Domestic cats presumably also occur.

Common Mole-rat (*Cryptomys hottentotus*) mounds

Scrub Hare (*Lepus saxatilis*) and/or Jameson's Red Rock Rabbit (*Pronolagus randensis*) droppings

Cattle (*Bos taurus*)

Horses (*Equus caballus*)

Donkeys (*Equus asinus*)

Probable goat (*Capra aegagrus hircus*) droppings

Figure 8-6 Evidence of mammal species in the study area

At least four mammal species with a known threatened or Protected status may occur or least visit the study area on occasion (**Table 8-7**).

- The regionally Endangered (EN) Percival's Short-eared Trident Bat (SANBI & EWT unpubl. data) is sparsely distributed mainly in north-eastern South Africa. “The entire southern African population may well be restricted to less than 20 caves”; although the species could be more common given that it is difficult to catch with conventional bat-catching mist-nets (Monadjem *et al.* 2010). According to DREAD (unpubl. data), Percival's Short-eared Trident Bat has been recorded in each of the three regional vegetation types. “The habitat preferences of this species is not well known, but it appears to be associated with woodland” (Monadjem *et al.* 2010. Percival's Short-eared Trident Bat was, therefore, rated with a moderate LO in the study area.
- The Brown Hyena is a national Protected Species (PS) and is listed as globally and regionally Near Threatened (NT; SANBI & EWT unpubl. data). In North West Province (and elsewhere) this species favours areas with rugged terrain (Power 2011) and, as previously mentioned, community members indicated that this species is known to occur in the surrounding region. Given the local high level of anthropogenic disturbances, however, this species was rated with a moderate LO within the study area.
- The regionally NT Blasius’s Horseshoe Bat (SANBI & EWT unpubl. data) is widely but sparsely distributed in savanna woodland in eastern southern Africa, where it roosts in small groups of up to four individuals in caves and mine adits. Considering that the study region may provide suitable foraging and roosting habitat for this species, given its typical rarity, it was rated with a moderate LO in the study area.
- The Swamp Musk Shrew is regionally NT (SANBI & EWT unpubl. data). Little is known about this small, inconspicuous insectivore except that it typically inhabits dense, matted vegetation near wetlands (Stuart & Stuart 2000). According to DREAD (unpubl. data), the Swamp Musk Shrew has been recorded in each of the three regional vegetation types. As NSS has found that Swamp Musk Shrews are common at wetlands, which remain in good condition within this species’ distribution range, it was rated with a high LO along (especially the protected headwaters) of the in situ wetland system.

8.2.2. Birds

Approximately 396 bird species are listed for QDS 2525BD (Roberts VII 2013), of which 300 were rated with a high or moderate LoO in the study area. Approximately 196 bird species have been recorded in pentad 2525_2550 (SABAP 2 2017), and 55 bird species were detected during our brief site visit (**Appendix 13.3**). Bird species that were recorded during the site visit mostly represent common, widespread species that are tolerant to a large extent of anthropogenic disturbance (e.g. bulbuls, doves, mousebirds, prinias, robins, shrikes, swallows, weavers). Along the in situ wetland system, Dark-capped and Red-eyed bulbuls, Cape Weavers, Robin-chats, Wagtails and White-eyes, Speckled Mousebirds,

Southern Boubou, Neddicky, and Black-chested and Tawny-flanked prinias were frequently heard. In the surrounding bushveld Black-throated Canaries, Laughing Doves, Kalahari and White-browed Scrub robins, Cape Glossy and Red-winged Starlings, Chestnut-vented Tit-babblers, and Blue Waxbills were repeatedly detected. Observed aerial-feeding birds included European Bee-eaters, Common and Little swifts, Greater and Lesser striped swallows, Red-breasted Swallows and Rock Martins.The most note-worthy bird observation was that of a single **Critically Endangered (CR) White-backed Vulture** soaring overhead.

Apart from many regionally-occurring bird species that are classified as provincial Protected Game, at least 12 bird species, which are nationally Protected and/or globally or regionally threatened, were rated with a high or moderate LO in the study area (**Table 8-8**).

- The White-backed Vulture, which is globally and regionally CR, and nationally EN under NEM:BA, typically inhabits lowland savanna with *Acacia* trees. It is a gregarious species congregating at carcasses, in thermals, and at roost sites. Breeding birds nest in loose colonies, and require tall trees for nesting. Although this species was seen soaring overhead during our visit, it is unlikely to nest on site due to the paucity of large trees and local high levels of disturbance. If, however, carrion becomes available, White-backed Vultures *might* forage on site depending on prevailing disturbances.
- The Cape Vulture, which is EN globally, regionally and under NEM:BA, is usually found near mountains where it breeds and roosts on cliffs. However, individuals can travel large distances to search for carrion in open country. As with the White-backed Vulture, if carrion becomes available, Cape Vultures *might* forage on site depending on their risk of disturbance. This species was, therefore, rated with an optimistic moderate LO.
- The Lappet-faced Vulture, which is EN globally, regionally and under NEM:BA, typically inhabits dry savanna where it constructs solitary nests mainly in *Acacia*, but also *Terminalia* and *Balanites* trees. Individual Lappet-faced Vultures can travel large distances in search of carrion, although this vulture species is also known to hunt prey. As with the afore-mentioned vulture species, Lappet-faced Vultures *might* forage on site and, therefore, this species was also rated with an optimistic moderate LO.
- The Steppe Eagle, which does not have a national threatened or Protected status, has been listed as globally EN. This is because within its European range, the Steppe Eagle has undergone extremely rapid population declines as a result of the conversion of steppes to agricultural land, combined with their direct persecution and mortality on power lines and wind turbines (BirdLife International 2016). Steppe Eagles preferably inhabit open savanna woodland where they prey primarily on termites but also Red-billed Quelea nestlings. Considering that there is no SABAP 2 record of this species from pentad 2525_2550 and no SABAP 1 record of this species from QDS 2525BD (SABAP 2 2017), the LO of this species in the study area was rated as moderate.

Table 8-7 Potentially occurring conservation important mammal species

SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	RSA RED LIST STATUS	QDS (MammalMAP 2017)	LO ON SITE
Cloeotis percivali	Percival's Short-eared Trident Bat			LC (U)	EN	3	3
Hyaena brunnea	Brown Hyena	PS	PG	NT (D)	NT	2	3
Rhinolophus blasii	Blasius's Horseshoe Bat			LC (D)	NT	3	3
Crocidura mariquensis	Swamp Musk Shrew			LC (U)	NT	2	2

Status: D = Declining; EN = Endangered; LC = Least Concern; NT = Near Threatened; PG = Protected Game; PS = Protected Species; U = Unknown population trend

Likelihood of Occurrence (LO): 2 = High; 3 = Moderate

Sources: Transvaal Nature Conservation Ordinance (1983); Stuart & Stuart (2007); Monadjem *et al.* (2010); NEM:BA ToPS (2015); IUCN (2016); MammalMAP (2017); DREAD (unpubl. data)

Table 8-8 Potentially occurring conservation important bird species

SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (ROBERTS VII)	QDS (SABAP 1)	PENTAD (SABAP 2)	LO ON SITE
Gyps africanus	White-backed Vulture	EN	PG	CR	CR	1			1
Gyps coprotheres	Cape Vulture	EN	PG	EN	EN	1	1		3
Torgos tracheliotos	Lappet-faced Vulture	EN	PG	EN	EN	1	1		3
Aquila nipalensis	Steppe Eagle		PG	EN	LC	1			3
Sagittarius serpentarius	Secretarybird		PG	VU	VU	1	1		3
Falco biarmicus	Lanner Falcon		PG	LC	VU	1	1		3
Gorsachius leuconotus	White-backed Night Heron		PG	LC	VU	1			3
Falco vespertinus	Red-footed Falcon		PG	NT	NT	1			3
Certhilauda chuana	Short-clawed Lark		PG	LC	NT	1			3
Ciconia abdimii	Abdim's Stork		PG	LC	NT	1			3
Coracias garrulus	European Roller		PG	LC	NT	1		1	2
Leptoptilos crumeniferus	Marabou Stork		PG	LC	NT	1			3

Status: CR = Critically Endangered; EN = Endangered; LC = Least Concern; NT = Near Threatened; PG = Protected Game; VU = Vulnerable

Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate

Sources: Transvaal Nature Conservation Ordinance (1983); Roberts VII (2013); NEM:BA ToPS (2015); Taylor *et al.* (2015); SABAP 2 (2017)

- The globally and regionally VU Secretarybird inhabits a diversity of grasslands and savanna where breeding birds typically nest on flat-topped *Acacia* trees. Although this species was recorded in QDS 2525BD during the SABAP 1 (SABAP 2 2017), and although Secretarybirds could potentially forage in the study area, there are few trees that seem suitable for nesting, and local levels of disturbance are potentially too high for this sensitive species. This species was, therefore, rated with a moderate LO in the study area.
- The regionally VU Lanner Falcon favours open grassland or woodland in the vicinity of cliff or electricity pylon breeding sites (Roberts VII 2013). Although there appears to be no nearby cliffs and pylons, there are small birds and other suitable prey for Lanner Falcons in the study area. Given this, and that the species was recorded in QDS 2525BD during the SABAP 1, it was rated with a moderate LO in the study area.
- The regionally VU White-backed Night Heron is regarded as an uncommon species - although this nocturnal bird is often overlooked. It occurs singly or in pairs in overhanging vegetation along the quiet backwaters of clear, slow-flowing perennial rivers and streams (Roberts VII 2013). Considering that these habitat conditions are available around the protected headwaters of the Dinokana Eye, this species was rated with a moderate LO although there is no record of this species from pentad 2525_2550 (SABAP 2 2017).
- The globally and nationally NT Red-footed Falcon favours open semi-arid and arid savannas, and preys mainly on insects, especially termites and grasshoppers (Roberts VII 2013). However, as there is no SABAP 2 record of this species from pentad 2525_2550, and no SABAP 1 record of this species from QDS 2525BD (SABAP 2 2017), it was only rated with a moderate LO in the study area.
- The regionally NT Abdim's Stork, which is a non-breeding visitor in South Africa, generally occurs in large flocks in savanna, grassland, cultivated lands and even suburban areas, feeding on termite alates, grasshoppers, crickets, locusts and other large insects (Roberts VII 2013). As there is no SABAP 2 record of this species from pentad 2525_2550, and no SABAP 1 record of this species from QDS 2525BD (SABAP 2 2017), and as flocks of this species would be vulnerable to disturbance in the study area, it was rated with a moderate LO at best.
- The regionally NT European Roller overwinters in South Africa primarily in dry wooded savanna and bushy plains, and is known to forage in agricultural habitats including fallow lands. Habitat conditions appear to be suitable on site for the European Roller, and considering that there is a 2013 record of this species from pentad 2525_2550 (SABAP 2, 2017), it was rated with a high LO.
- The regionally NT Marabou Stork favours semi-arid areas where populations are concentrated in game reserves where carrion is readily available. Marabou Storks are primarily scavengers, which may frequent rubbish dumps, but also catch small vertebrate and insect prey. Nests are constructed in tall trees often near water, and birds roost communally at traditional sites (Roberts VII 2013). Although Marabous are unlikely to roost or nest on site, like vultures, they *might* feed on available carrion and have, therefore, been rated with an optimistic moderate LO.

- The regionally NT Short-clawed Lark has a small, fragmented distribution in central and north-western South Africa and south-eastern Botswana, where it favours sparsely vegetated semi-arid *Acacia* savanna (Roberts VII 2013). As the arid bushveld on site is not dominated by *Acacia*s, and as there is also no SABAP record of this species from pentad 2525_2550 (SABAP 2 2017), this species was also rated with an optimistic moderate LO on site.

An additional 24 regionally-occurring bird species with a threatened and/or Protected status were rated with a low LO (**Appendix 13.3**) due to unsuitable conditions (e.g. high levels of disturbance, unsuitable habitat, limited suitable prey, etc.) in the study area. Examples include the African Finfoot, Grass-owl and Marsh Harrier, both flamingo and pelican species, Black and Yellow-billed Storks, Blue Crane, the White-bellied Korhaan and Kori Bustard.

8.2.3. Reptiles

Approximately 47 reptile species are considered highly likely or likely to occur at least occasionally in the study area (**Appendix 13.4**). This represents 75% of the total number of 63 reptile species recorded in both the Dwarsberg-Swartruggens and Zeerust Thornveld vegetation types (DREAD unpubl. data). Most of the 25% of reptile species, which are known to occur in the regional vegetation types, but which have not been listed for the study area, represent species that are typically vulnerable to anthropogenic disturbance.

During our site visit Southern Rock Agama (**Figure 8-7**) was detected on a rocky hill slope, and Speckled Rock Skink was found on built infrastructure near the Eye. Variable Skink, Cape Skink, Spotted Sand Lizard, Yellow-throated Plated Lizard, Common Dwarf Gecko, Cape/Transvaal Gecko and Southern Tree Agama are likely also common in the study area. Local project team members and other community members indicated that the Rock Monitor, Common Flap-neck Chameleon, Boomslang, Mozambique Spitting Cobra and Python are known to occur in the greater study region.

Southern Rock Agama
(*Agama atra*)

Red Toad
(*Schismaderma carens*)

Figure 8-7 Evidence of reptile and frog species on site

Table 8-9 Potentially occurring conservation important reptile and frog species

SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL OR REGIONAL RED LIST STATUS	QDS (Community pers. comm.)	LO ON SITE
Python natalensis	Southern African Python	**PS**	**WA**	2LC	1*	3
Pyxicephalus adspersus	Giant Bullfrog		**PG**	**1NT**	1*	4

Status: 1 = Global; 2 = Regional; D = Declining; LC = Least Concern; NT = Near Threatened; PG = Protected Game; PS = Protected Species; WA = Wild Animal

Likelihood of Occurrence (LO): 1* = Present (based on anecdoctal accounts of community members); 3 = Moderate; 4 = Low

Sources: Transvaal Nature Conservation Ordinance (1983); Minter *et al.* (2004); Bates *et al.* (2014); NEM:BA ToPS (2015); IUCN (2016); FrogMAP (2017); ReptileMAP (2017)

Red-lipped and Brown Water snakes likely occur in association with the in situ wetland system. The Common and Jone's girdled lizards were rated with a moderate LO on site as they are most likely to occur south-westwards of the site, where large rocks over appropriate sized cracks and crevices for these lizards.

The South African Marsh Terrapin, Lobatse Hinged Tortoise, Speke's Hinged Tortoise, Serrated Tent Tortoise and Leopard Tortoise were rated with a low LO on site considering the high local level of anthropogenic disturbances. Local project team members and other community members indicated that although tortoises are found in the surrounding region, they are no longer seen in the study area. The only potentially occurring CI reptile species is the python (**Table 8-9**).

- The Southern African Python is listed as a Protected Species under NEM:BA. It typically inhabits savanna where it favours rocky areas and water. Suitable habitat for this species is, therefore, present in the area and, as previously mentioned, community members indicated that Python is known to occur in the region. Given, however, the high levels of anthropogenic disturbance in the vicinity of the Eye, the Python was only rated with a moderate LO on site.

8.2.4. Frogs

Approximately 19 frog species are considered highly likely or likely to occur at least occasionally in the study area (**Appendix 13.5**). This matches the total number of 19 and 20 frog species recorded, respectively, in the Zeerust Thornveld and Dwarsberg-Swartruggens vegetation types (DREAD unpubl. data). In other words, all frog species which are known to occur in the regional vegetation types are also expected to occur on site.

During our site visit a Red Toad was found in close proximity to the in situ wetland (**Figure 8-7**), and Plain Grass Frogs were heard calling in the stream channel. The Common Platanna and Queckett's River Frog were rated with a high LO in the in situ wetland system. Bubbling Kassina, Common Caco, Guttural and Olive toads likely also occur.

The terrestrial-breeding Bushveld Rain Frog was rated with a high LO. Common, regionally-occurring frog species, which favour shallow, still-standing temporary or ephemeral water for breeding, such as the Banded Rubber Frog, Tremolo Sand Frog and Southern Pygmy Toad, were rated with a moderate LO given the apparent limited availability of such habitat on site. Community members indicated that bullfrogs occur in the surrounding region. The only potentially occurring conservation important frog species is the Giant Bullfrog (**Table 8-9**).

- The Giant Bullfrog is listed as regionally NT by Minter *et al.* (2004). For most of the year bullfrogs are buried in a state of torpor, and are typically active aboveground for a night or two after heavy rain in November-January. Bullfrog breeding is limited to a few days in the year and occurs in shallow, standing, seasonal water with emergent grassy

vegetation. Bullfrog foraging appears to be concentrated around their burrows, which may be situated up to 1km from their breeding site (Yetman & Ferguson 2011). Therefore, although the perennial, flowing in situ wetland is unlikely to support bullfrog breeding, Giant Bullfrogs could occasionally disperse and migrate through the study area. The Giant Bullfrog was, therefore, rated with a moderate LO on site.

8.2.5. Butterflies

Based on the published butterfly distribution maps in Mecenero *et al.* (2013), approximately 87 butterfly species were rated with a high or moderate LO in the study area (**Appendix 13.6**). Sixteen butterfly species were detected during our site visit, which included the common and widespread African Monarch, Broad-bordered Grass Yellow, Brown-veined White, Citrus Swallowtail and Yellow Pansy. A number of common and widespread Lycaenid butterfly species were seen throughout the site, which were concentrated at mud puddles on the dirt road near the Eye (**Figure 8-8**). No potentially occurring butterfly species has a known threatened or Protected status.

8.2.6. Odonata

Based on the published odonatan distribution maps in Samways (2006), approximately 28 dragonfly and damselfly species were rated with a high or moderate LO in the study area (**Appendix 13.6**). Four species were detected at or near the Eye during our site visit. These included the Broad Scarlet, Powder-faced / Kersten's Sprite, Dancing Jewel and Guinea Skimmer (**Figure 8-8**), which have Biotic Index scores of 0, 1, 2 and 4, respectively. Samways' (2008) Biotic Index is "based on three criteria: geographical distribution, conservation status and sensitivity to change in habitat. It ranges from a minimum of 0 to a maximum of 9. A very common, widespread species which is highly tolerant of human disturbance scores 0. In contrast, a range-restricted, threatened and sensitive endemic species scores 9." The presence of Guinea Skimmers at the Eye indicates that at this point, the system remains in fair (or better) condition. The VU Makabusi Sprite, which has a localised distribution in Limpopo Province, was rated with a low LO, but cannot be discounted. No other potentially occurring odonatan species has a known threatened or Protected status.

8.2.7. Scorpions

Approximately eight scorpion species are considered highly likely or likely to occur in the study area (**Appendix 13.8**). Although no specimens were found during our visit, rock-turning revealed that the presence of millipede carcasses, suggesting that scorpions are indeed present on site. Scorpion species most likely to occur based on their published distributions (Leeming 2003) and observed habitat conditions (especially substrates and shelter) on site, include the highly venomous *Parabuthus mossambicensis* and *P. transvaalicus*, and *Uroplectes carinatus* and *Opistophthalmus glabifrons*, which are found in scrapes under rocks and surface debris in areas of hard substrate. None of the potentially occurring scorpion species has a threatened or Protected status.

Topaz Babul Blue
(*Azanus jesous*)

Citrus Swallowtail
(*Papilio demodocus demodocus*)

Pea Blue
(*Lampides boeticus*)

Peppered Hopper
(*Platylesches ayresii*)

Guinea-fowl Butterfly
(*Hamanumida daedalus*)

Dusky Line Blue
(*Pseudonacaduba sichela sichela*)

Dotted Blue
(*Tarucus sybaris sybaris*)

Veined Tip
(*Colotis vesta argillaceus*)

Brown-veined White
(*Belenois aurota*)

Tiny / Gaika Grass Blue
(*Zizula hylax*)

Cupreous Blue
(*Eicochrysops messapus mahallakoaena*)

Twin-spot Blue
(*Lepidochrysops plebeia plebeia*)

Figure 8-8 Evidence of butterfly species on site

Dancing Jewel
(*Platycypha caligata*)

Broad Scarlet
(*Crocothemis erythraea*)

Guinea Skimmer
(*Orthetrum guineense*) male

Guinea Skimmer
(*Orthetrum guineense*) female

Powder-faced / Kersten's Sprite
(*Pseudagrion kersteni*) male

Powder-faced / Kersten's Sprite
(*Pseudagrion kersteni*) female

Figure 8-9 Evidence of odonata species on site

8.3. Wetlands

In spite of the semi-arid setting, the study area supports wetland systems fed predominantly by groundwater inputs from the Dinokana Eye as well as surface water runoff from the clearly defined catchment basin immediately upstream. Karstic springs such as these are important resources, not least in terms of their strategic value in supplying large volumes of clean water for human use but also their ecological value in supporting unique species assemblages and a diversity of life in an otherwise dry environment. The source of this groundwater is the Dinokana-Lobatse Aquifer which forms part of a much larger karstic landscape known as the north-west dolomites.

Unlike the wetlands on site (for which there is very limited information) the active channel of the Mmaphanyane has been well studied. The Department of Water Affairs and Sanitation (DWS) monitors flow rate (since 1960) and water quality (since 1971) from the gauging station at Dinokana Upper (WMS 101764, A1H001; co-ordinates: 25° 27' 25.2"S and 25° 51' 11.9"E). Monitoring data (2005-2014) on the fish and aquatic macro-invertebrate assemblages exists for the reaches below the Eye (DWS, 2015). Results of these studies suggest that the water quality is of a good standard and that these near oligotrophic conditions support a variety of unique and sensitive aquatic biota. The data from DWS (2017) are depicted in **Figure 8-11**.

Since 1971, the 17 measured water quality parameters have all remained within “very good” limits. Water flow has fluctuated around a median value of 0.1m^3/s from a high of 0.263m^3/s in the late 1970s, to a low of 0.054m^3/s in the late 1990s and again from 2016 until February 2017 (**Figure 8-11**). As DWS biomonitoring data are not available post-February 2017, during the October 2017 site visit NSS also performed an in situ water quality test at co-ordinates 25°27'24.12"S and 25°51'12.07"E, close to the DWS WMS 101764. Our water sampling revealed a pH of 7.51(neutral tending to alkaline), electrical conductivity (EC) of 0.1, and TDS of 201mg/L (all within the TWQR for aquatic ecosystems). These values correspond with the latest available (February 2017) data from the DWS (2017). Evidently, in the upper reaches of the Dinokana wetland system, water quality remains very good and is, therefore, of high economic and conservation importance, and disturbances that could impact the system’s water quality and flow should be strictly prohibited.

The average flow rate of 3.56 Mm^3/a far exceeds those recorded at all three of the other major eyes within the Dinokana / Lobatse Aquifer. Water flow has fluctuated around a median value of 0.1m^3/s from a high of 0.263m^3/s in the late 1970s, to a low of 0.054m^3/s in the late 1990s and again from 2016 until February 2017. However, the data also show that the overall trend in flow is negative (**Figure 8-10**). Current impacts to the various wetland HGM units identified on site are detailed in **Section 8.1.2** and summarised together with other important information in **Table 8-10** and **Table 8-11.**

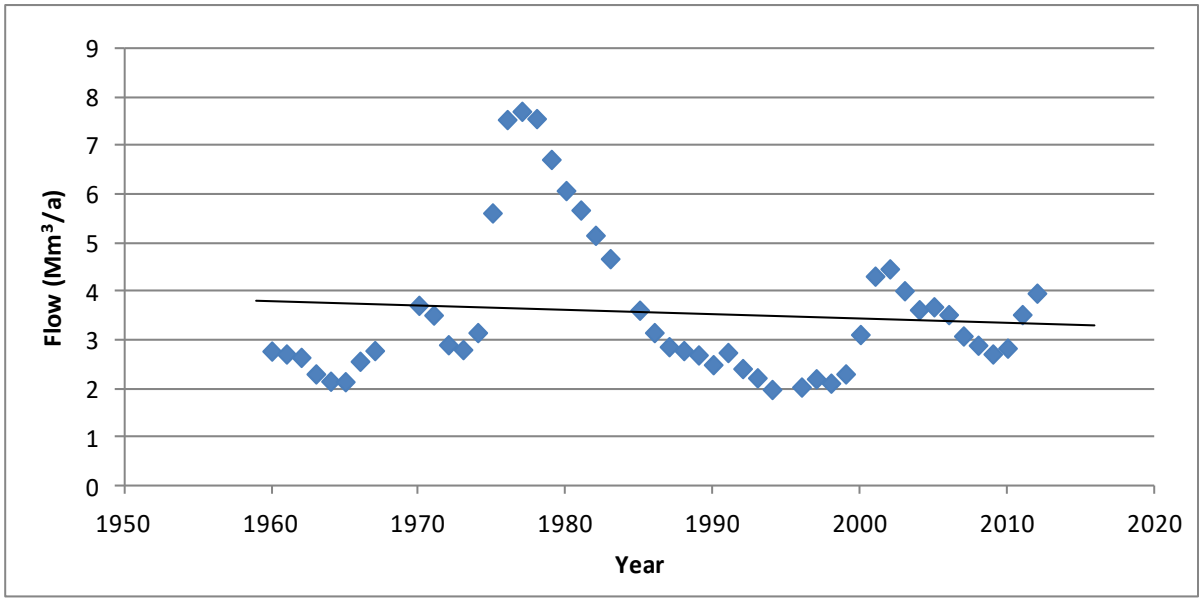


Figure 8-10 Flow volumes recorded at the upper Dinokana Eye (data courtesy of DWS)

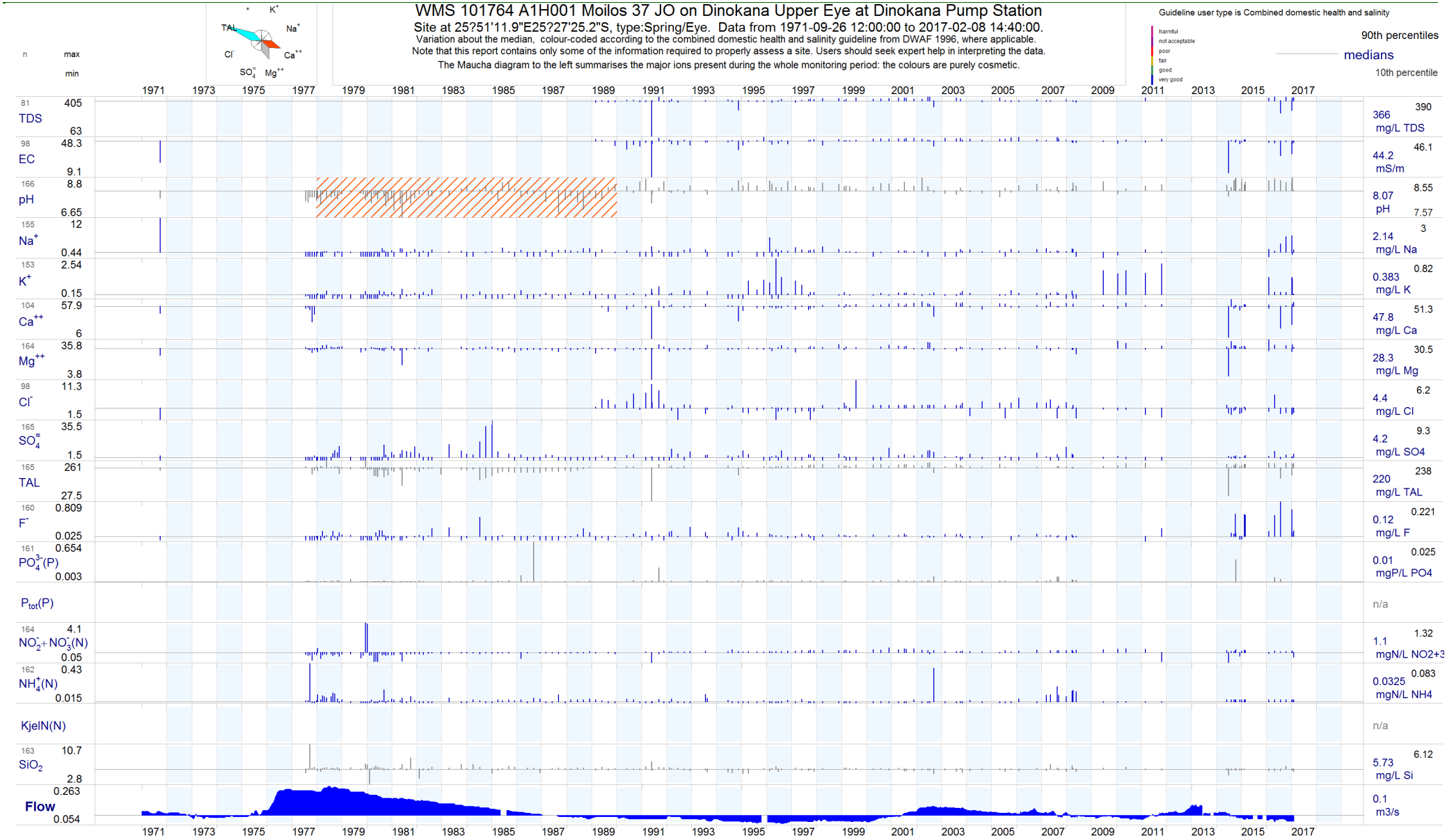


Figure 8-11 Water quality and flow data from the upper Dinokana wetland (data courtesy of DWS)

Table 8-10 Wetland summary HGM Units 1 & 3

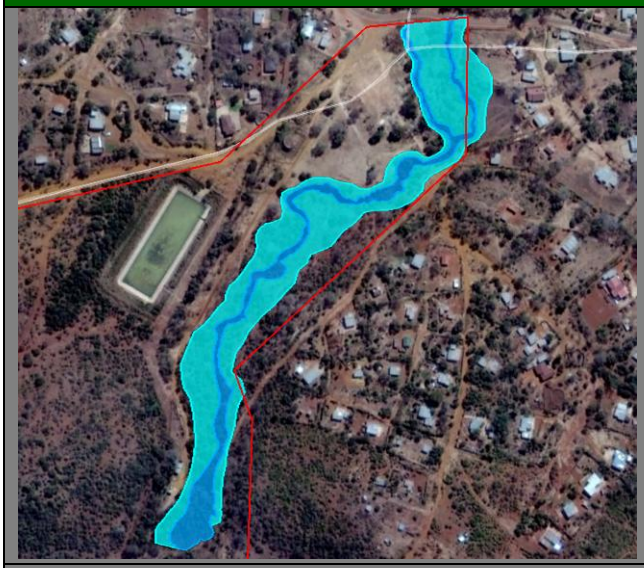
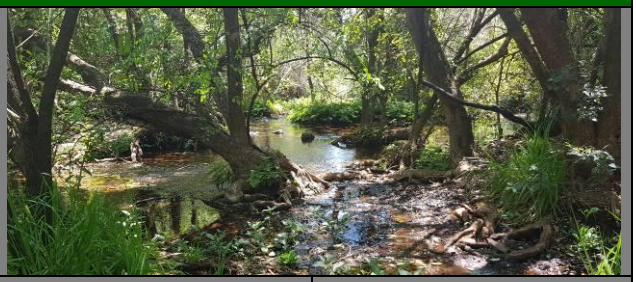
HGM Units 1 & 3 – Channelled Valley-bottom with Active Channel			
			
		Seep	Seep
			
HGM Unit 1 (light blue) & 3 (dark blue)		Mottling in Dundee soils	*Cyperus* cf. *congestus*
SETTING			
Coordinates (Centroid)	25°27'26.52"S; 25°51'11.85"E	Level 1: System	Inland
Altitude (m.a.s.l)	1350	Level 2a: Ecoregion	11.09 / 7.04
Aspect	NNE	Level 2b: NFEPA WetVeg	Central Bushveld Group 1
Regional vegetation	SVcb4	Level 3: Landscape unit	Valley floor
Quaternary catchment	A10A	Level 4a:	Channelled valley-bottom
CPLAN V3.3	CBA 1	Level 4b:	NA
Area (ha)	2.85	FEPA Wet Veg Status	CR / NP
SITE DESCRIPTION			
Overview	A narrow channelled valley-bottom system fed by a karstic spring (Dinokana Eye) in semi arid bushveld. A DWA pump, gauging and purification station occurs at the Eye. Water quality good.		
Wetland indicators	Vegetation and topographic indicators present. Redoxymorphic features (mottles) absent. Use of mottles as a reliable wetland indicator in dolomitic soils is limited.		
Impacts	Moderate to high levels of abstraction of both groundwater (boreholes for regional water provision) and surface water (partial diversion through furrow to dams for local water provision), clearing of riparian vegetation, settlements, human activity, livestock trampling and poaching of wetland vegetation, sedimentation, downstream litter, cultural practices and minor encroachment by alien and invasive vegetation.		
Vegetation	Riparian zone dominated by large trees such as *Searsia lancea, Celtis africana, Combretum erythrophyllum, Halleria lucida, Rhamnus prunoides, Ziziphus mucronata*		
Soil characteristics	Ubiquitous red iron and manganese rich sandy soils, no mottles present.		
Present Ecological State (PES)			
Hydrology	Geomorphology	Vegetation	
D	**C**	**C**	
Wetland Ecosystem Services			
Mostly direct provisional (clean water and crops) and cultural (tourism and spiritual value) benefits but also biodiversity maintenance (supports various sensitive aquatic macro-invertebrate and unique / conservation important plant taxa).			
Wetland Importance and Sensitivity			
Hydrological	Ecological	Cultural	
Very High (3.6)	**High (2.4)**	**Very High (3.3)**	

Table 8-11 Wetland summary HGM Unit 2

HGM Unit 2 – Semi-arid Ephemeral Wash			
 HGM Unit 2	 Channelled outflow	 Soccer pitch in HGM unit	 Deep red soils
HGM Unit 2	Mottling in Dundee soils		*Cyperus* cf. *congestus*
SETTING			
Coordinates (Centroid)	25°27'28.82"S; 25°51'12.86"E	Level 1: System	Inland
Altitude (m.a.s.l)	1351	Level 2a: Ecoregion	11.09
Aspect	N	Level 2b: NFEPA WetVeg	Central Bushveld Group 1
Regional vegetation	SVcb4	Level 3: Landscape unit	Slope
Quaternary catchment	A10A	Level 4a:	Seep
CPLAN V3.3	CBA 1	Level 4b:	With channelled outflow
Area (ha)	1.94	FEPA Wet Veg Status	EN / NP
SITE DESCRIPTION			
Overview	Indistinct, ephemeral wash system.		
Wetland indicators	Topographical. Signs of sheet flow obvious. Vegetation indicators indistinct apart from slight difference in structure. Use of mottles as a reliable wetland indicator in dolomitic soils is limited.		
Impacts	Head cut erosion upstream of Eye, clearing for soccer field and increased bare and exposed surfaces due to overgrazing		
Vegetation	*Searcia lancea*, *Dodonaea viscosa*, *Acacia tortillis* , *Grewia flava*		
Soil characteristics	Deep red iron and manganese rich sandy Hutton soils, no mottles present		
Present Ecological State (PES)			
Hydrology	Geomorphology	Vegetation	
B	**C**	**C**	
Wetland Ecosystem Services			
Mostly catchment of water, sediment trapping, provision of clean water, and tourism / cultural benefits.			
Wetland Importance and Sensitivity			
Hydrological	Ecological	Cultural	
Very High (3.2)	**High (2)**	**High (2.2)**	

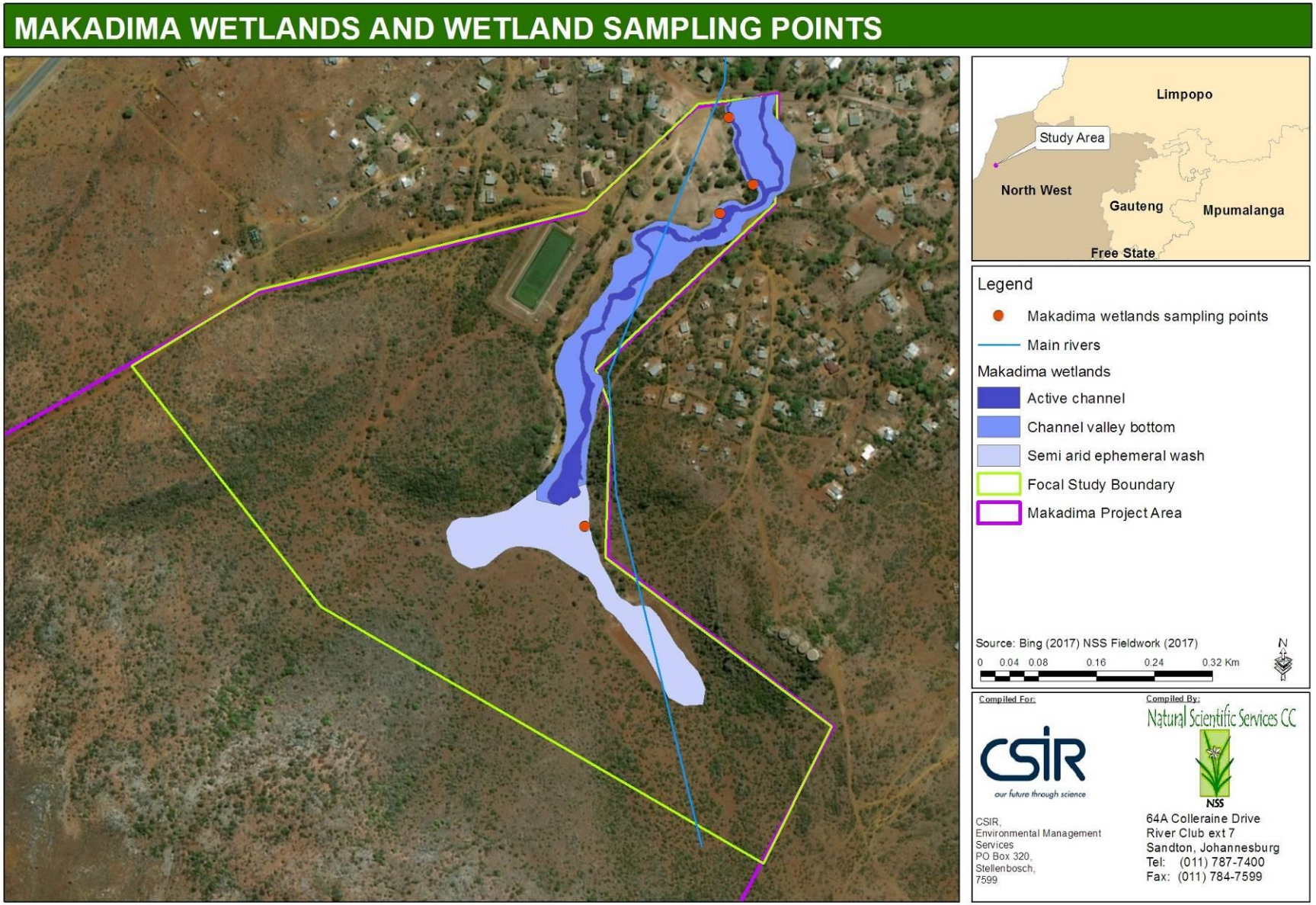


Figure 8-12 Current wetland extent

8.3.1. Wetland Classification and Extent

Three HGM units were identified on site. These include the Mmaphanyane Channelled Valley-bottom wetland (HGM Unit 1) and associated active channel (HGM Unit 3) as well as the semi-arid ephemeral wash immediately upstream of the Dinokana Eye (HGM Unit 2). The active channel (HGM Unit 3) was distinguished as its own HGM Unit following the recommendations made in Ollis *et al.* 2013 but was not assessed individually but rather grouped under the HGM Unit 1 following the broader RAMSAR definition of a wetland which includes the active channel as part of the wetland. The Level 1-4 wetland classification (Ollis *et al.* 2013) for both wetland HGM units is given in **Table 8-10** and **Table** 8-11**.** The current wetland extent is depicted in **Figure 8-12**.

It is important to note that the site was located on dolomitic ground and consequently the lack of redoximorphic features (mottles) in the soil samples meant that the wetland boundaries had to be delimited primarily using terrain (contour data) and vegetation indicators (partly based on species composition and partly on vegetation structure). A study by Mudaly (2015) showed that the use of mottles as a reliable wetland indicator on dolomitic ground is limited due to the high manganese content of the soil resulting in a high oxidative and electron demand capacity which acts to inhibit the reduction of iron to its more mobile ferrous (Fe^{2+}) state and consequently mottle formation, even in areas of high soil moisture. Additionally the use of vegetation indicators was, itself, limited due to the extensive clearing of the riparian zone, semi-arid conditions, overgrazing and ephemeral nature of HGM Unit 3. Together these factors limit the accuracy of the delineated wetland boundaries.

8.3.2. Wetland Present Ecological State

Overall HGM Unit 1 score C (Moderately Modified) in line with recent river health programme aquatic assessments. HGM Unit 2 was also rated as C (Moderately Modified). A summary of the PES of the wetland HGM unit identified on site is provided in **Table 8-12** and discussed in greater detail per wetland driver (hydrology, geomorphology and vegetation) below. Examples of the main existing wetland impacts are given in **Figure 8-13**.

Table 8-12 Wetland present ecological state

NAME	Ha	EXTENT (%)	HYDROLOGY		GEOMORPHOLOGY		VEGETATION		OVERALL
			IMPACT	CHANGE	IMPACT	CHANGE	IMPACT	CHANGE	
HGM Unit 1	2.85	59	**D (4)**	-1	**C (2.9)**	-1	**C (3.1)**	-1	**C (3.4)**
HGM Unit 2	1.94		**B (1)**	-1	**C (3.4)**	-1	**C (2.3)**	-1	**C (2)**

Hydrology : Overall HGM Unit 1 and 2 scored D (Largely Modified) and B (Largely natural) respectively for hydrology. The score for HGM Unit 1 was based on the considerable water pressure due to both high levels of catchment (exceeding sustainable levels based on calculated recharge rates) and on site water use (surface water diversion and domestic use). The largely Natural rating for HGM Unit 2 was based on the mostly intact and relatively undisturbed nature of the catchment.

Changes to water input characteristics from the catchment centre on relatively high levels of groundwater abstraction from the dolomitic compartments that feed the Dinokana Eye and in turn HGM units 1 and 3. This takes the form of several high yielding boreholes, installed to meet the water needs of both the regional and local community. For HGM Unit 2 minor decreases in water inputs likely occur as a result of increased evaporation from decreased from livestock grazing and the resultant decreased grass cover and increased hardened surfaces. Both these factors together with vegetation clearing (soccer field) are likely to decrease infiltration and retention of water within the soil with the effect of increasing the flood peaks during high rainfall events in all HGM the units. Within system impacts include a small furrow near the source which partially diverts flow into a dam that supplies the local community and a DWS pump, gauging and water purification station with a small weir. However, this small gauging weir does not appear to cause any adverse backlogging impacts. Some additional domestic use does take place but not as intensively as the reach downstream of the study area. Additionally there has been an overall decrease in vegetative roughness from the reference state due to clearing, trampling and poaching by livestock and human traffic.

Geomorphology: Both HGM Units 2 and 3 scored C (Moderately Modified) for geomorphology based on the moderate signs of sedimentation and erosion respectively. Increased runoff and erosion within HGM Unit 2 following high rainfall events is likely the cause of the increased sediment loads evident within the active channel (HGM Unit 3). Although little erosion is present within HGM Units 1 and 3 (likely due to the incidence of a shallow bedrock layer) the deeper and highly erosive Hutton soils together with steep catchment slopes and decreased vegetation roughness from overgrazing make HGM Unit 2 particularly prone to erosion. Indeed signs of early but significant head cut erosion where evident within this system, immediately upstream of the Eye (**Figure 8-13**).

Vegetation: In terms of vegetation, the majority of the upper catchment remains in a relatively natural state and is a good representation of the region's dolomitic grassland and mountain bushveld, perhaps spared to some degree by high slope gradients and rugged dolomitic outcrops which make cultivation and settlement difficult. However, much of the vegetation within HGM Unit 2 has been cleared for a soccer pitch and has been heavily impacted by livestock grazing. Hence, the rating of C (Moderately Modified). The riparian zone fringing HGM Units 1 and 3 has been considerably altered; such that it is far narrower and less dense than would be expected in its reference state hence it's rating of C (Moderately Modified). Although some large riparian trees remain they are scattered often at quite some distance from the channel suggesting the riparian zone was once considerably more extensive than current. Stumps and remaining buttress roots testament to the presence of many more large indigenous along the system which have since been cut down. Further downstream vegetation disturbance intensifies with increased soil disturbance, infilling, clearing, grazing, trampling and poaching by livestock and settlement. In spite of this alien and invasive species encroachment is negligible limited to small scattered patches

(e.g. *Populus* and *Jacaranda mimosifolia*) with a low prevalence of herbaceous / annual alien species.


Trampling and sedimentation


Channel modification


Head cut erosion


Clearing of riparian zone


Populus deltoides


Gauging weir

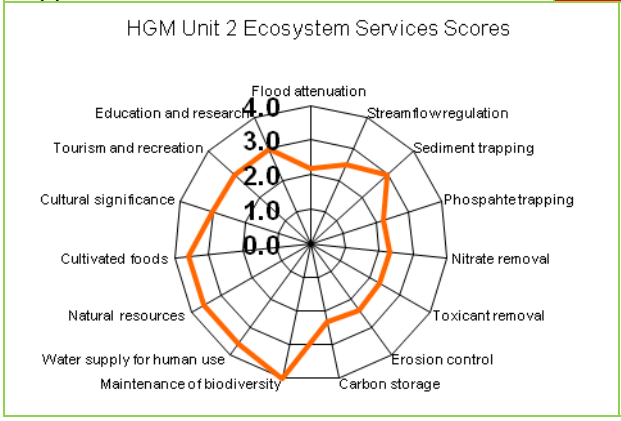
Figure 8-13 Examples of existing wetland impacts

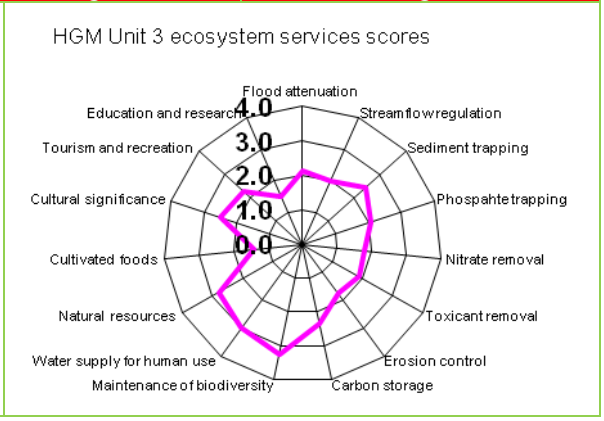
8.3.3. Wetland Ecosystem Services

Overall HGM Unit 1 (together with the active channel HGM Unit 3) provides mostly direct services that include the provision of good quality water for human use and the provision of water for subsistence farming (original channel has been highly dissected into a network of drainage canals for crop irrigation as well as a strong cultural value in terms of spiritual beliefs and mythologies. These centre on the reverence of a large water serpent referred to as “Watermuys” which, according to local inhabitants, has powers that extend into the super natural (e.g. ability to control weather or ones fortune). Additionally HGM Unit 1 is important in terms of biodiversity maintenance in that it supports various sensitive aquatic macro-invertebrate taxa and unique and / or conservation important plant species. HGM Unit 2 in contrast is important in terms of the catchment of water, sediment trapping, provision of clean water, and tourism / cultural value. The results of the eco-system services assessment for the HGM unit are summarised in **Table 8-13**.

Table 8-13 Ecosystem services supplied by the identified wetland HGM units

			HYDRO-GEOMORPHIC SETTING	RATING	
				HGM UNIT 2	HGM UNIT 3
Ecosystem Services	Indirect benefits	Regulating/supporting	Flood attenuation	Moderately High	Moderately High
			Streamflow regulation	Moderately High	Intermediate
			Sediment trapping	High	Moderately High
			Phosphate trapping	Moderately High	Moderately High
			Nitrate removal	Moderately High	Intermediate
			Toxicant removal	Moderately High	Intermediate
			Erosion control	Moderately High	Intermediate
			Carbon storage	Moderately High	Moderately High
	Direct benefits		Maintenance of biodiversity	High	High
		Provisional	Water supply for human use	High	High
			Natural resources	High	Moderately High
			Cultivated foods	High	Moderately Low
		Cultural	Cultural significance	High	Moderately High
			Tourism and recreation	High	Moderately High
			Education and research	High	Intermediate
Threats				High	High
Opportunities				High	High





8.3.4. Wetland Importance and Sensitivity

Both identified wetland HGM units (1 and 2) are considered have of High to Very High importance from an Ecological, Hydrological and Human perspective (**Table 8-14**). Of particular significance is the high importance of the clean water provided by this near oligotrotrophic karstic spring system which is, of the three major springs in the Dinokana / Lobatse Aquifer, by far the highest yielding. Aside from providing clean water for human use and feeding the downstream Ngotwane dam these conditions support a unique assemblage of diatoms and other aquatic biota dependant on good water quality.

In terms of biodiversity, the longstanding presence of the high density rural settlement of Dinokana (high livestock grazing pressure and disturbance levels) limits the number of regionally occurring CI species on site, particularly with regards to terrestrial fauna.

However, HGM Units 1 & 3 provide ideal habitat for a high diversity of aquatic macro-invertebrates including taxa that are highly sensitive and / or indicative of good water quality (DWS, 2015). The overall Present Ecological State of aquatic conditions monitored at some distance below the Eye between 2005 and 2014 by DWS has been rated as A = natural or B = largely natural. DWS (2015) obtained a high rating of roughly 291 using the aquatic macro-invertebrate South African Scoring System (SASS; Dickens & Graham 2002), and recorded a total of 48 aquatic macro-invertebrate taxa. This yielded an Average Score Per Taxon (ASPT) of 6.06. Recorded sensitive taxa included species belonging to e.g. the stonefly family Perlidae, the mayfly family Baetidae, the net-spinning caddisfly family Hydropsychidae, and the jewel damselfly family Chlorocyphidae. Although our scope of work did not include an assessment of aquatic biota, and as mentioned in the preceding faunal results **section 8.2**, during our site visit the moderately-sensitive Dancing Jewel (*Platycypha caligata*) was recorded at the Eye. *Pyxicephalus* bullfrogs reportedly occur in the region, and might occur if/where downstream conditions provide suitable habitat for these frogs. The presence of the VU Makabusi Sprite (*Pseudagrion makabusiense*) was rated with a low likelihood, but cannot be discounted. Additionally the potential for Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*) occurring on site is possible given its occurrence further downstream in the Ngotwane River (O'brein, 2009). The lack of large natural open water bodies and mudflats suggests that significant congregations of migratory waterfowl are unlikely. Nonetheless, the Dinokana wetland system may still serve as an important movement corridor and foraging habitat for wildlife albeit highly degraded, fragmented and densely populated downstream. In terms of flora some unique and / or CI floral species were observed within HGM Unit 1 (*Kniphofia* sp.) and others may occur.

Although none of the identified HGM units occur within a statutorily protected area, wetlands are nevertheless protected under the national water act. HGM Unit 1 and 2 fall within the Central Bushveld Group 1 wetlands. According to the NFEPA Wet Veg database channelled valley-bottom wetlands (HGM unit 1) within this zone are recognised as Critically Endangered and Not Protected whereas Seeps (HGM unit 2) are listed as Endangered and Not Protected. Additionally the area within which the wetlands are located has been zoned as a Critical Biodiversity Area (CBA) 1. Furthermore the entire Mmaphanyane extending well up into the catchment is recognised as a FEPA river.

Table 8-14 Wetland importance and sensitivity

WETLAND IMPORTANCE AND SENSITIVITY			
NAME	**ECOLOGICAL**	**HYDROLOGICAL**	**HUMAN**
HGM Unit 1	Very High (3.6)	High (2.4)	Very high (3.3)
HGM Unit 2	Very High (3.2)	High (2)	High (2.2)

9. Areas of Significance

The site significance assessment, which includes a significance map for flora, fauna and the in situ wetland system, was based on the findings from the ecological scan, as well as relevant international, national and provincial planning and other biodiversity conservation initiatives as described below.

9.1. International Areas of Conservation Significance

The site does not fall into any proclaimed:

- *Ramsar Site.*
- *World Heritage Site.*
- *Important Bird Area (IBA)* – see **Figure 9-1**.

9.2. National and Regional Areas of Conservation Significance

The site does not fall into any national:

- *Protected Area* - see **Figure 9-1.**
- *Priority Area or Threatened Ecosystem* – see **Figure 9-2**.

However, the following biodiversity features with recognised national or provincial conservation importance do require consideration.

9.2.1. Water Resources

A broad spectrum of international, regional and national legislation and guidelines applies to the protection of wetlands and their biodiversity. The National Water Act (NWA; Act 36 of 1998) is the principle legal instrument relating to water resource management in South Africa. Under the NWA, all wetlands and their buffer zones are protected.

The NWA points out that it is:

> "*the National Government's overall responsibility for and authority over the nation's water resources and their use, including the equitable allocation of water for beneficial use, the redistribution of water, and international water matters."*

According to Chapter 3 of the NWA on the protection of water resources:

> *"The protection of water resources is fundamentally related to their use, development, conservation, management and control. Parts 1, 2 and 3 of this Chapter lay down a series of measures which are together intended to ensure the comprehensive protection of all water resources."*

9.2.2. Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas project (NFEPA; Driver *et al.* 2011) provides strategic spatial priorities for conserving freshwater ecosystems and supporting sustainable use of water resources in South Africa. Freshwater Ecosystem Priority Areas (FEPAs) were identified using a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries. **The NFEPA spatial data indicate that the in situ Dinokana Eye and downstream wetland system is a recognized national FEPA** (**Figure 9-3**).

9.2.3. North West C-Plan

The North West Conservation or C-Plan is the outcome of systematic conservation planning by the North West Department of Rural, Environment and Agricultural Development (DREAD 2012), for improved conservation of biodiversity in the province.

According to the latest available C-Plan, the entire site and farm are situated within an Irreplaceable or Critical Biodiversity Area 1 (CBA1; Figure 9-4). The CBA was presumably assigned because of the sensitive dolomitic terrain and associated caves, springs, and **Vulnerable** Carletonville Dolomitic Grassland vegetation type.

9.3. Local Areas of Conservation Significance

The conservation significance of local biodiversity was rated and mapped based on:

- Ecological sensitivity (including renewability/success for rehabilitation);
- Level/Extent of disturbance.
- Presence of CI species (identified at the vegetation unit/habitat level); and
- Conservation value (at a regional, national, provincial and local scale).

Identified habitat units within the study site were ranked into ***Very High, High, Moderate-High***, ***Moderate*** or ***Low*** classes in terms of significance. This was undertaken according to a sensitivity-value analysis and included input based on knowledge of the area, on-the-ground investigations and experience when dealing with ecological systems and processes. A summary overview of the Areas of Local Conservation Significance is presented in **Figure 9-5**. Based on our findings and relevant national and provincial biodiversity conservation planning initiatives, the following is applicable (**Figure 9-5**):

- **Very High** rated areas include:
  - The *Cyperus-Imperata-Kniphofia* Active River Channel; and
  - The *C. erythrophyllum-H. lucida* Riparian Vegetation.

    In addition to being protected by law under the NWA, the local wetland system is also classified as a national FEPA. The system currently provides good quality water, and its upper reach remains in a good state. Here it supports a high abundance of unique species such as *Kniphofia*, and might also support threatened fauna such as the NT Swamp Musk Shrew and VU White-backed Night Heron.

- **High** rated areas include:
  - A minimum 100m protective buffer around the afore-mentioned wetland system,
  - The *C. molle–Dombeya* North Facing Slopes, which are based on dolomites and contain a higher diversity of species (based on the Ecoscan observations and literature). These areas also contain more unique species to the lower lying deeper red clays.
- **Moderate-High** rated areas include:
  - The *P. capensis–Euclea* South Facing Slope Thicket;
  - The *S. leptodictya–A. marlothi– Helicrysum* North-North-West Slope.

  Both these habitat are on slopes which are genuinely more heterogeneous.
- **Moderate** rated areas include:
  - The *Euclea-Dodonaea* Lower Slope-Valley Thicket.
- **Low** rated areas include:
  - Roads, buildings and other infrastructure.

In recognition of the status of the local wetland as a national FEPA, the following additional buffers also apply around the system:

- A minimum 500m buffer wherein the use of any herbicide must be strictly prohibited, to avoid adversely impacting wetland water quality, integrity and biodiversity.
- A minimum 250m buffer wherein boreholes must be strictly prohibited to avoid adversely impacting wetland hydrology, integrity and biodiversity.

The Areas of Significance map should guide the proposed development where:

- Disturbances should preferentially occur in Moderate – Low and Low sensitive areas.
- **Very High** sensitive areas should be avoided AND protected.
- **High** sensitive areas should be avoided.
- **Moderate-High** sensitive areas should be subject to very limited disturbance and rigorous mitigation.
- **Moderate** sensitive areas may be disturbed with effective mitigation.
- **Low** sensitive areas should be rehabilitated if not developed.

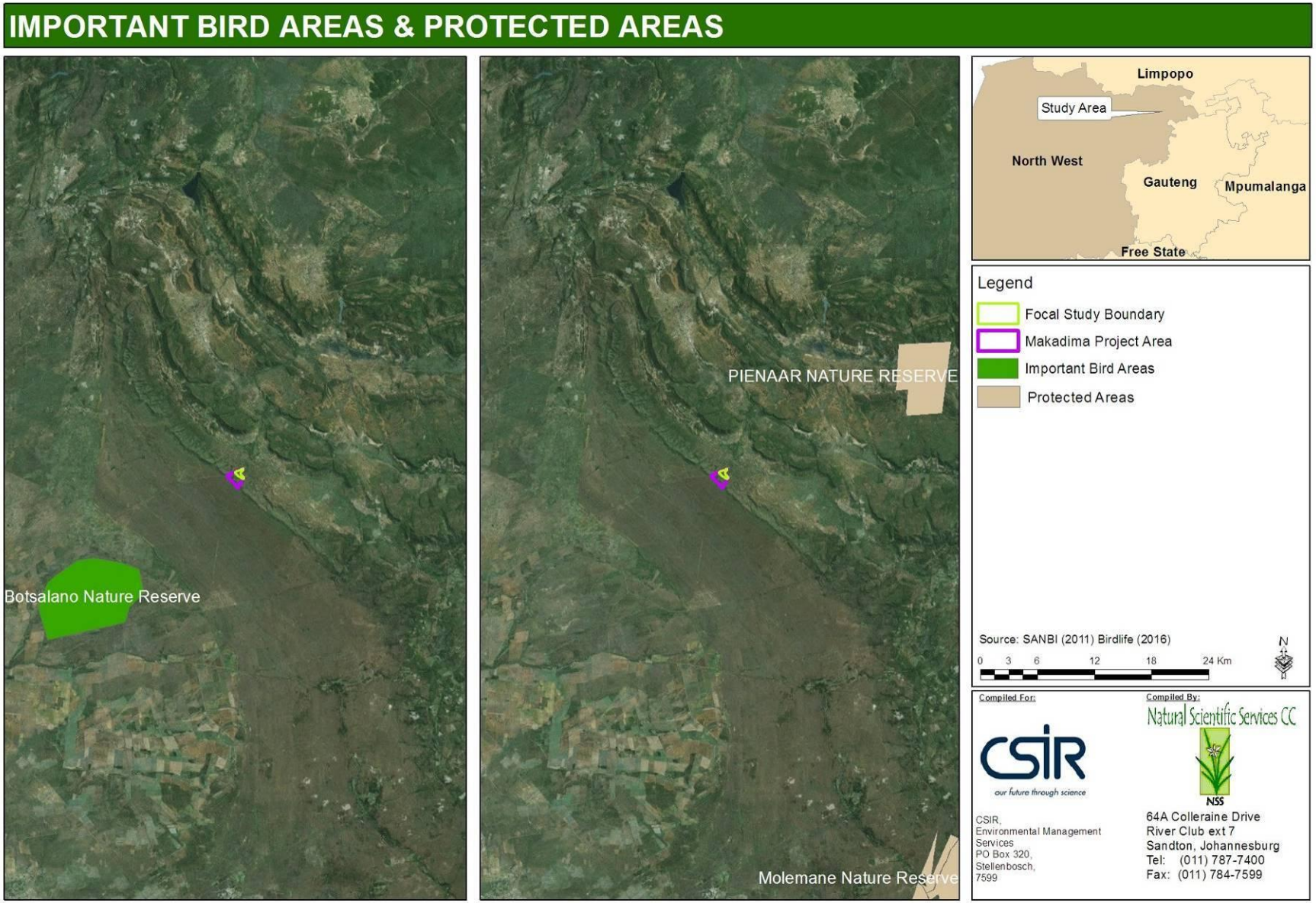


Figure 9-1 Location of the site in relation to Important Bird Areas, and Protected Areas

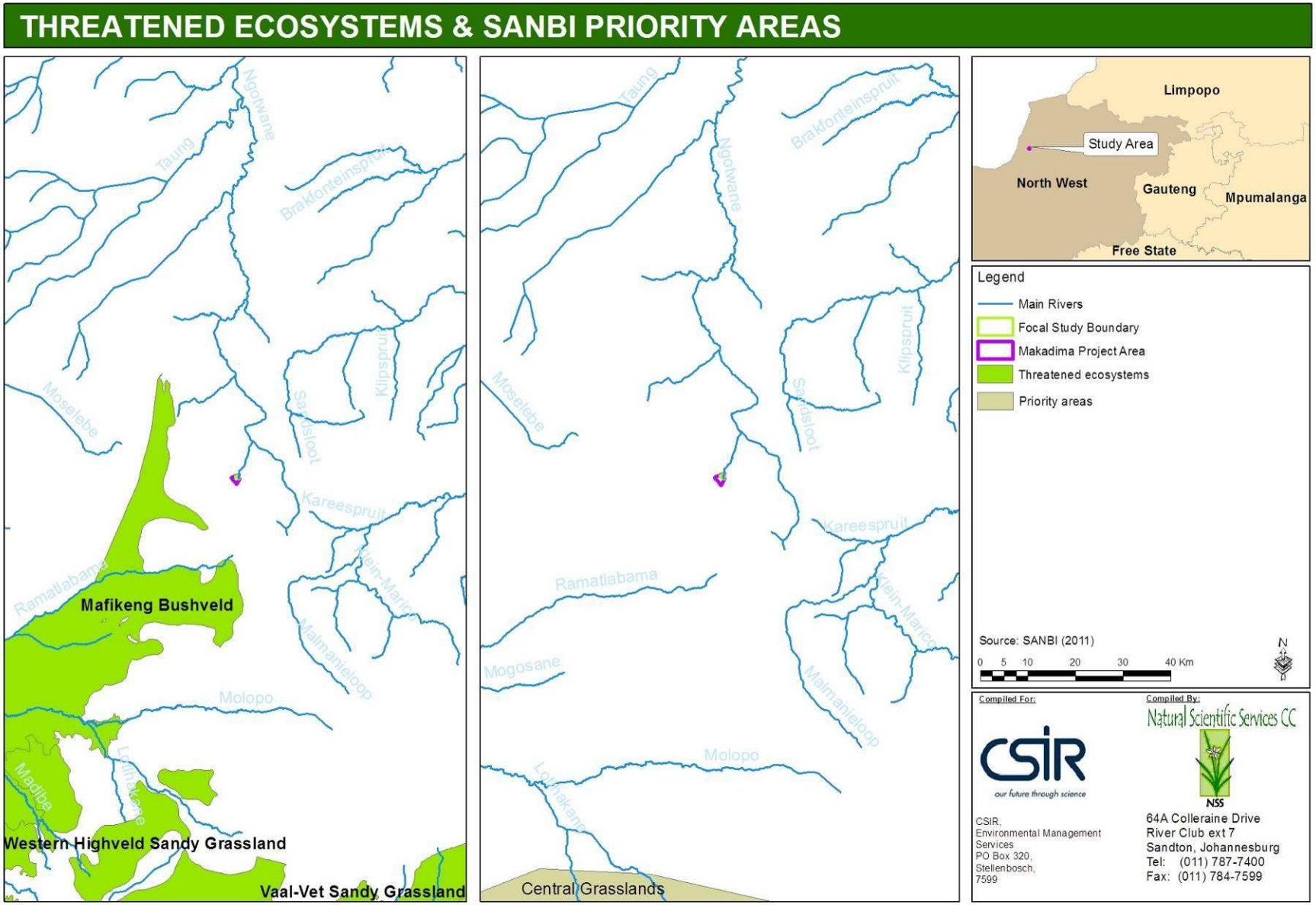


Figure 9-2 Location of the site relative to regional terrestrial Priority Areas and Threatened Ecosystems

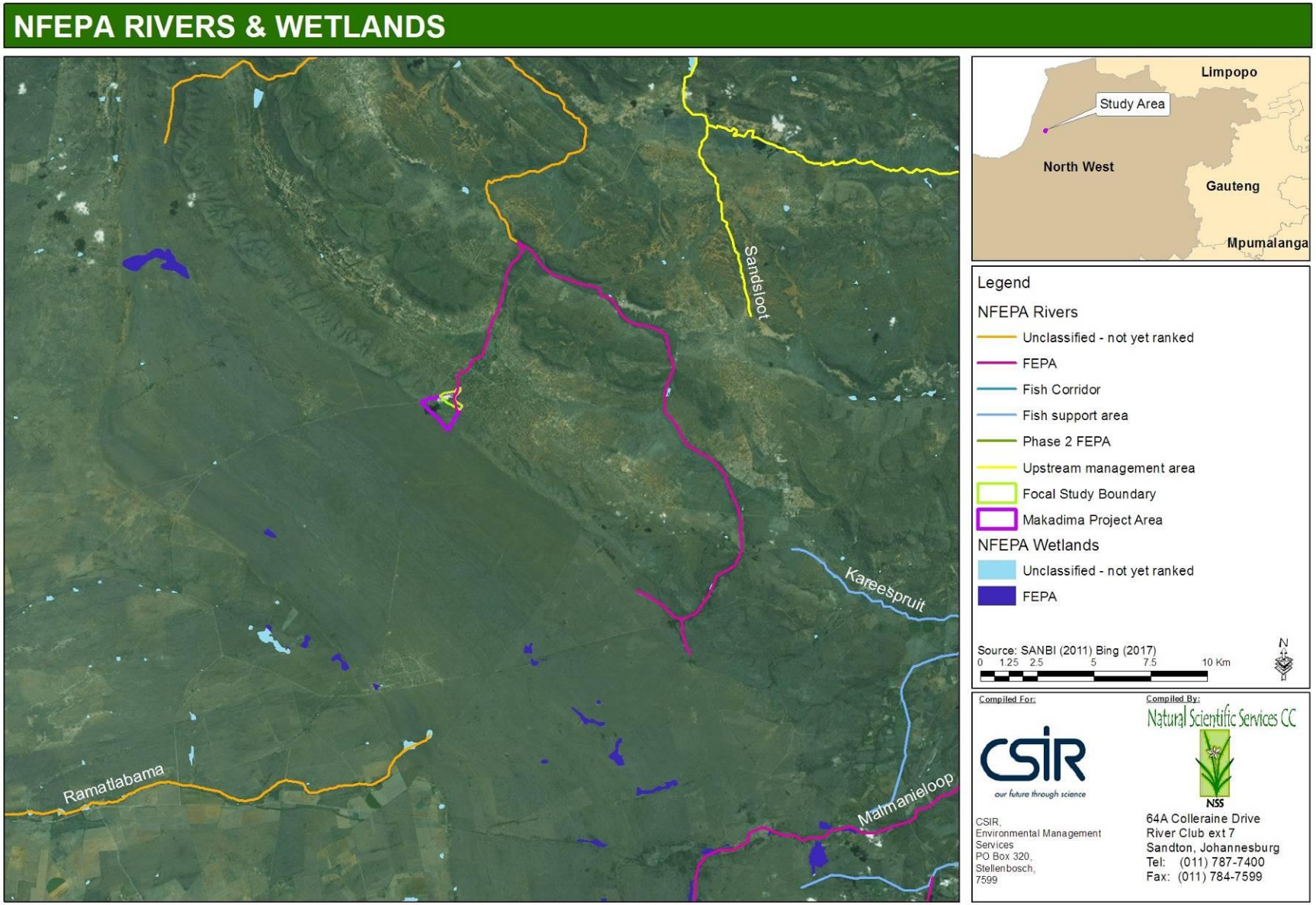


Figure 9-3 Location of the site in relation to regional Freshwater Ecosystem Priority Areas

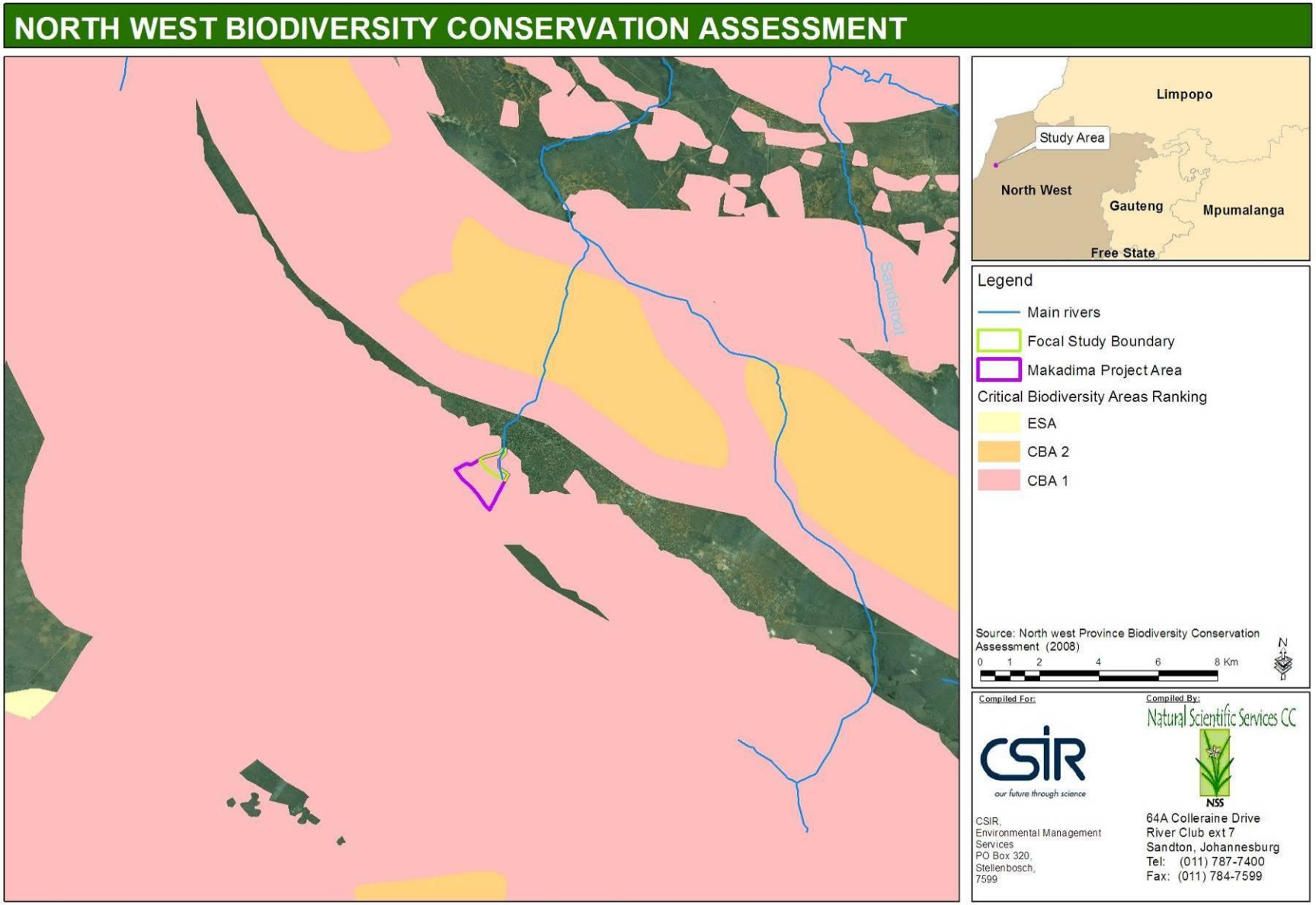


Figure 9-4 Location of the site in relation to North West CBAs and ESAs

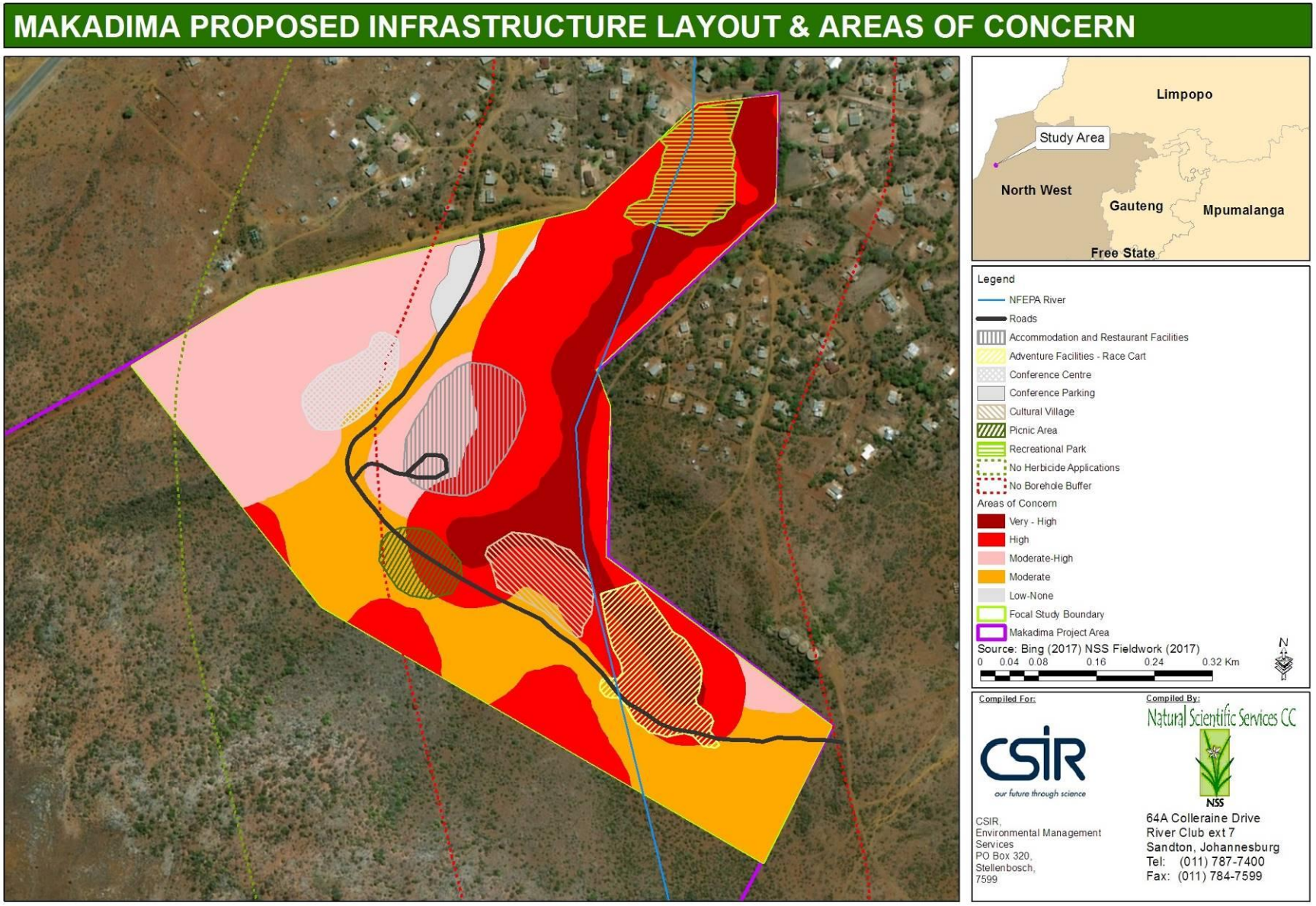


Figure 9-5 **Areas of biodiversity conservation concern, superimposed with Makadima's proposed infrastructure layout**

10. Impacts & Mitigation

Potential impacts of the proposed project on biodiversity are summarized in **Table 11-1** and briefly discussed below, followed by recommended measures to mitigate these during relevant phases of the development.

10.1. Impacts

10.1.1. Direct loss of wetlands

The current proposed infrastructure footprint will result in the loss of a large portion of the semi-arid ephemeral wash system (HGM Unit 2), and encroaches upon the buffer of HGM Unit 1 along its downstream reaches. A revised infrastructure layout as recommended by NSS has been provided in **Figure 11-1**.

10.1.2. Contamination of surface and groundwater resources

The groundwater resource from the Eye is of a good quality, and is heavily relied upon for water provision at both local and regional scales. However, the site for the proposed infrastructure development is situated within a dolomitic landscape with strong surface - groundwater linkages. Here the potential for contamination of pristine groundwater by surface water (or visa-versa) is high, and particular caution should be practiced with regards to water management in and around the development. One potential impact may be the eutrophication of groundwater through inappropriate sewerage and grey water management. Another pertinent impact may be the potential contamination of the groundwater resource through sinkhole formation, which could arise as a result of leaking water pipes or prolonged discharge of water in one location, such as a French drain. Any increases in nutrient levels entering this near oligotrophic system are of high significance, not least from a water security perspective, but also because of the unique and sensitive aquatic biota which rely on clean, clear water.

10.1.3. Increased sediment loads

Clearing of vegetation and levelling for construction will increase the opportunity for sediment loads to enter HGM Units 1 and 3 following rainfall events. During aquatic biomonitoring conducted during from 2005 to 2014, there were reported visual observations of a distinct increase in the levels of sediment within the channel immediately below the Eye (HGM Unit 3). Water clarity is high within the channel, and any increase in sediment will have implications for water purification and biota (particularly benthic organisms).

10.1.4. Increased flood peaks

Clearing and landscaping during the construction phase, and subsequent establishment of impervious surfaces (e.g. roofs, paving, pathways and roads), will concentrate storm flows

and decrease rainfall infiltration. This could exacerbate existing head cut erosion within HGM Unit 2.

10.1.5. Decreased water inputs

Water use to supply the proposed development has the potential to impact the local groundwater balance, especially if boreholes are sunk upstream of the Eye. This has implications for water security, aquatic biota, and the integrity (thinning) of the riparian zone.

10.1.6. Clearing of (especially riparian) vegetation and faunal habitats

Although most of the proposed infrastructure is situated away from HGM Unit 1, the proposed recreational area is positioned within the wetland buffer. The construction of buildings and associated infrastructure for the recreational area, if poorly designed, could result in some loss of remaining riparian vegetation. This could impact the availability of suitable habitat for wetland-associated fauna including potentially occurring CI species such as the **NT** Swamp Musk Shrew and **VU** White-backed Night Heron. Fauna will also be impacted where terrestrial vegetation and habitats are cleared. Taxa that will likely be impacted most include those with poor mobility e.g. scorpions and baboon spiders.

10.1.7. Introduction and proliferation of alien plant species

Increased vehicle, human and material traffic, clearing of vegetation and soil disturbance will further increase the prevalence of invasive alien flora in the study area. If left to proliferate without control, invasive alien could eventually threaten the hydrology, integrity and biodiversity of the local wetland system because it is small and largely fed by groundwater.

10.1.8. Loss of CI or medicinal flora

Observed and potentially occurring Protected, Red Listed and/or medicinal plant species could be lost as a result of vegetation clearing during construction, and increased traffic and harvesting during all phases of the development.

10.1.9. Sensory disturbance of fauna

Sensory disturbance of fauna from noise and light pollution could cause remaining sensitive taxa to vacate the area, at least temporarily during construction and decommissioning. Animals that would be most adversely affected include calling and/or secretive nocturnal species.

10.1.10. Loss of CI fauna

With potential habitat destruction and/or degradation, increased sensory disturbance, and possibly increased persecution (hunting, poisoning, etc), certain fauna including potential CI species could be lost from the area. Possible examples include visiting scavengers such as the various threatened vultures and Brown Hyena (**NT**), wetland-dependent species such as the Swamp Musk Shrew (**NT**) and secretive, nocturnal White-backed Night Heron (**VU**), and the feared and traded Southern African Rock Python (**PS**).

10.1.11. Increased dust and erosion

Clearing of vegetation and earth-moving activities during construction are likely to increase bare ground, dust and the land's susceptibility to erosion.

10.1.12. Altered burning

The development could result in an increase or decrease in wild fires in the study area. Although fires might on the one hand be accidentally ignited, it is more likely that burning will be prohibited for human and infrastructural safety. Lack of fire will eventually cause local vegetation to become more woody / bush-encroached.

10.2. Management and Mitigation Recommendations

Recommended management and mitigation measures are detailed in **Table 11-2**. With successful implementation of the recommended measures, the significance of most impacts can be reduced to **Low,** as highlighted in **Table 10-1**.

Table 10-1 Summary of impact significance, without and with mitigation

POTENTIAL IMPACTS	SIGNIFICANCE	
CONSTRUCTION	**Without mitigation**	**With mitigation**
Direct loss of wetlands	**Fatally flawed**	**Medium**
Contamination of surface and groundwater resources	**High**	**Low**
Increased dust and erosion	**High**	**Low**
Increased sediment loads	**Medium**	**Low**
Increased flood peaks	**Medium**	**Low**
Decreased water inputs	**Medium**	**Low**
Clearing of (especially riparian) vegetation and faunal habitats	**High**	**Medium**
Introduction and establishment of alien species	**High**	**Low**
Loss of CI or medicinal flora	**High**	**Low**
Sensory disturbance of fauna	**Medium**	**Low**
Loss of CI fauna	**Medium**	**Low**
Altered burning	**Medium**	**Low**
OPERATION		
Further loss / degradation of wetlands	**High**	**Medium**
Contamination of surface and groundwater resources	**High**	**Low**
Decreased water inputs	**Medium**	**Low**
Continued introduction and proliferation of alien species	**High**	**Low**
Loss of CI or medicinal flora	**High**	**Low**
Sensory disturbance of fauna	**High**	**Medium**
Loss of CI fauna	**Medium**	**Low**
Erosion	**High**	**Low**
Altered burning	**Medium**	**Low**
DECOMMISSIONING		
Further loss / degradation of wetlands	**High**	**Medium**
Contamination of surface and groundwater resources	**High**	**Low**
Increased dust and erosion	**High**	**Low**
Increased sediment loads	**Medium**	**Low**

POTENTIAL IMPACTS	SIGNIFICANCE	
Continued proliferation of alien species	**High**	**Low**
Loss of CI or medicinal flora	**High**	**Low**
Sensory disturbance of fauna	**Medium**	**Low**
Loss of CI fauna	**Medium**	**Low**
Altered burning	**Medium**	**Low**

Figure 10-1 Examples of potential picnic spot designs (from existing sites around the Savanna biome) – blending into the surrounding environment

11. Concluding Remarks

With the implementation of the mitigation measures suggested in this report, the significance of impacts on site can be reduced to **Medium** / **Low**. Based on the information obtained in the site visit and the information that was available to date, it is NSS's opinion that the project should only go ahead provided that the recommended mitigation measures are diligently implemented. *Most importantly, the Dinokana Eye wetland system must be protected from all forms of disturbance, and the various recommended wetland buffers must be strictly adhered to.*

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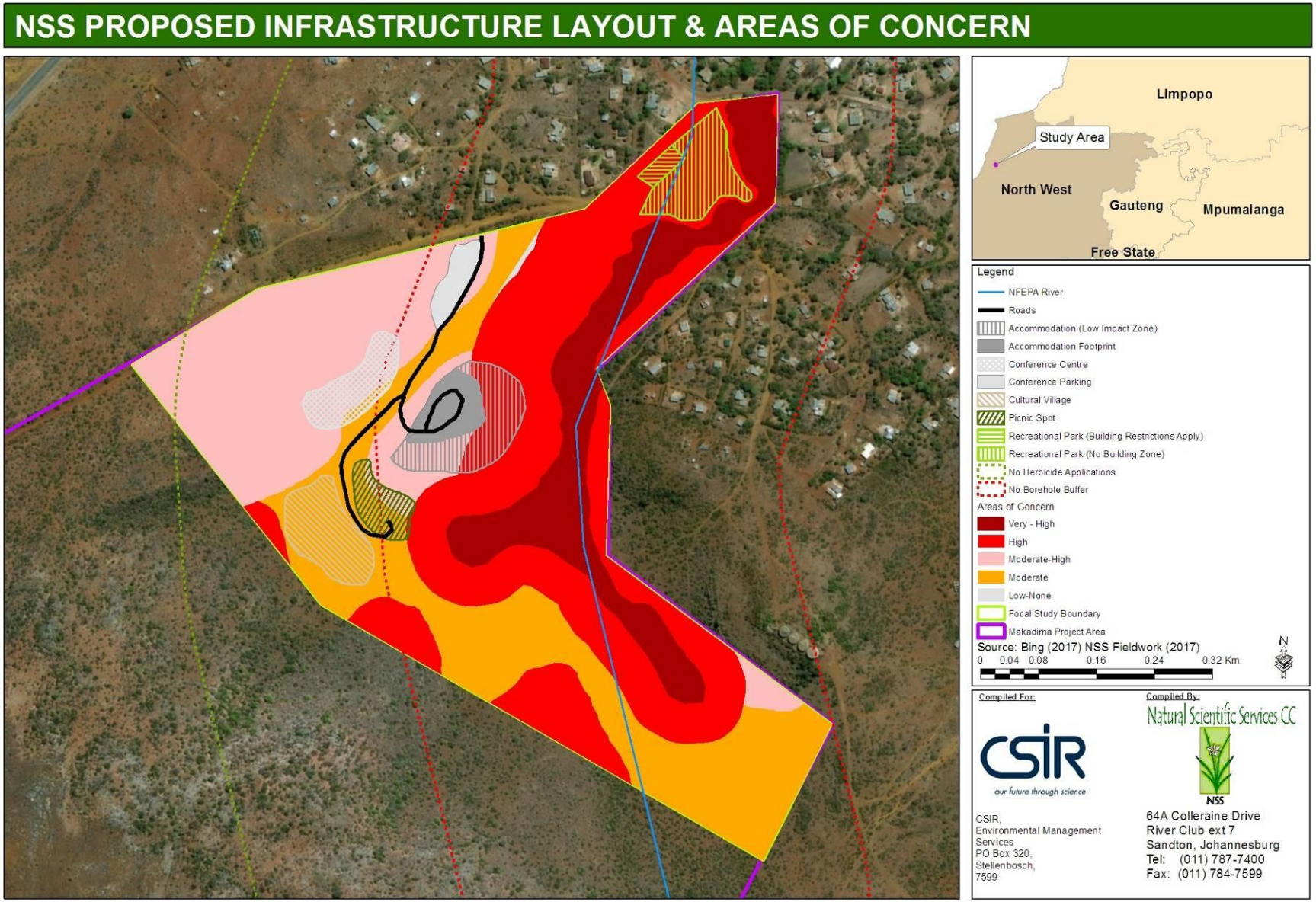

Figure 11-1 Areas of biodiversity conservation concern, superimposed with NSS's proposed infrastructure layout

Table 11-1 Impact Assessment

POTENTIAL IMPACTS	MITIGATION	STATUS	EXTENT		DURATION		INTENSITY		REVERSIBILITY	IRREPLACEABILITY	PROBABILITY		SIGNIFICANCE		CONFIDENCE	
			RATING	SCORE	RATING	SCORE	RATING	SCORE	RATING	RATING	RATING	SCORE	RATING	SCORE	RATING	SCORE
CONSTRUCTION																
Direct loss of wetlands																
Potential loss of a large portion of the semi-arid ephemeral wash system (HGM Unit 2) and encroachment on the buffer of HGM Unit 1	Without	Negative	Regional (within 30km of site)	3	Permanent	5	Very high / Fatal flaw	16	Low reversibility	High irreplaceability	Definite (>90% chance)	1	**Fatally flawed**	**24.00**	High	3
	With	Negative	Site specific	1	Permanent	5	Medium	4	Low reversibility	High irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**5.00**	High	3
Contamination of surface and groundwater resources																
Potential contamination / nutrient loading of clean ground and surface water resources through construction activities (e.g. concrete mixing, poor site sanitation)	Without	Negative	Local (<2km from site)	2	Permanent	5	Very high / Fatal flaw	16	Low reversibility	High irreplaceability	Probable (25-50% chance)	0.5	**High**	**11.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	High reversibility	Low irreplaceability	Low probability (10-25% chance)	0.25	**Low**	**1.00**	High	3
Increased dust and erosion																
from clearing of vegetation, earth-moving activities, increased vehicle traffic, and uncontrolled livestock activity	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	High	8	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**10.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	High reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Increased sediment loads																
Potential increase in sediment loads entering HGM Unit 1 from exposed soil and building materials stored within the prescribed wetland buffers or upstream of the Eye	Without	Negative	Regional (within 30km of site)	3	Short term (2-5 years)	2	Medium	4	Low reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**6.75**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Low reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Increased flood peaks																
Clearing and levelling resulting in increased hardened surface will increase runoff and potentially exacerbate the existing head cut erosion in HGM Unit 2.	Without	Negative	Regional (within 30km of site)	3	Long term (>15 years)	4	Medium	4	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**8.25**	High	3
	With	Negative	Local (<2km from site)	2	Temporary (<2 years)	1	Low	1	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Decreased water inputs																
Water use to supply the proposed development has the potential to impact upon the local groundwater balance especially if boreholes are sunk upstream of the Eye	Without	Negative	Regional (within 30km of site)	3	Short term (2-5 years)	2	High	8	Moderate reversibility	High irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**9.75**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Clearing of (especially riparian) vegetation and faunal habitats																
Construction of buildings and associated infrastructure may result in the loss of some of the remaining riparian vegetation	Without	Negative	Site specific	1	Permanent	5	High	8	Low reversibility	Moderate irreplaceability	Definite (>90% chance)	1	**High**	**14.00**	High	3
	With	Negative	Site specific	1	Long term (>15 years)	4	Medium-low	2	Low reversibility	Low irreplaceability	Definite (>90% chance)	1	**Medium**	**7.00**	High	3
Introduction and establishment of alien species																
from influx of vehicles, people and materials, site disturbance, uncontrolled livestock activity, and lack of alien species control	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Moderate reversibility	High irreplaceability	Definite (>90% chance)	1	**High**	**15.00**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Low	1	High reversibility	Low irreplaceability	Probable (25-50% chance)	0.5	**Low**	**1.50**	High	3
Loss of CI or medicinal flora																
from clearing of vegetation, and increased vehicle and human activity including harvesting, and uncontrolled livestock activity	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Low reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**11.25**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Low reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Sensory disturbance of fauna																
from increased vehicle and human activity, noise, dust and light	Without	Negative	Local (<2km from site)	2	Short term (2-5 years)	2	Medium	4	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**6.00**	High	3
	With	Negative	Local (<2km from site)	2	Short term (2-5 years)	2	Low	1	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.50**	High	3
Loss of CI fauna																
from clearing of vegetation, earth-moving activities, habitat degradation and uncontrolled vehicle, livestock and human activity including harvesting	Without	Negative	Local (<2km from site)	2	Medium term (5-15 years)	3	High	8	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**6.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Altered burning																
from clearing of vegetation, built infrastructure, increased vehicle and human activity, and uncontrolled livestock activity	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium	4	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**7.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Low	1	High reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**1.50**	High	3
OPERATION																

POTENTIAL IMPACTS	MITIGATION	STATUS	EXTENT		DURATION		INTENSITY		REVERSIBILITY	IRREPLACEABILITY	PROBABILITY		SIGNIFICANCE		CONFIDENCE	
			RATING	SCORE	RATING	SCORE	RATING	SCORE	RATING	RATING	RATING	SCORE	RATING	SCORE	RATING	SCORE
Further loss / degradation of wetlands																
Further loss/ degradation to wetlands from continued erosion and poor water and veld management practices	Without	Negative	Regional (within 30km of site)	3	Permanent	5	High	8	Moderate reversibility	High irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**12.00**	High	3
	With	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium	4	Low reversibility	Low irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**5.00**	High	3
Contamination of surface and groundwater resources																
Potential contamination / nutrient loading of clean ground and surface water resources from inappropriate plumbing, sanitation and waste water management practices or the creation of sinkholes from leaking water pipes.	Without	Negative	Regional (within 30km of site)	3	Permanent	5	High	8	Low reversibility	High irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**12.00**	High	3
	With	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium-low	2	Low reversibility	Moderate irreplaceability	Low probability (10-25% chance)	0.25	**Low**	**2.00**	High	3
Decreased water inputs																
Inappropriate water use during operation	Without	Negative	Regional (within 30km of site)	3	Long term (>15 years)	4	Medium	4	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**5.50**	High	3
	With	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium-low	2	Moderate reversibility	Moderate irreplaceability	Low probability (10-25% chance)	0.25	**Low**	**2.00**	High	3
Continued introduction and proliferation of alien species																
from continued influx of vehicles, people and materials, uncontrolled livestock activity, and lack of alien species control	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Moderate reversibility	High irreplaceability	Definite (>90% chance)	1	**High**	**15.00**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Low	1	High reversibility	Low irreplaceability	Probable (25-50% chance)	0.5	**Low**	**1.50**	High	3
Loss of CI or medicinal flora																
from uncontrolled vehicle, livestock and human activity including harvesting	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Low reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**11.25**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Low reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Sensory disturbance of fauna																
from continuous vehicle and human activity, noise and light	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	High	8	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**10.50**	High	3
	With	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium	4	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**5.00**	High	3
Loss of CI fauna																
from habitat degradation and uncontrolled vehicle, livestock and human activity including harvesting	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**7.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Erosion																
from uncontrolled livestock activity, and lack of alien species control	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	High	8	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**10.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	High reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Altered burning																
from built infrastructure, vehicle and human activity, and uncontrolled livestock activity	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium	4	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**7.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Low	1	High reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**1.50**	High	3
DECOMMISSIONING																
Further loss / degradation of wetlands																
Further loss/ degradation to wetlands from continued erosion and poor water and veld management practices	Without	Negative	Regional (within 30km of site)	3	Permanent	5	High	8	Moderate reversibility	High irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**12.00**	High	3
	With	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium	4	Low reversibility	Low irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**5.00**	High	3
Contamination of surface and groundwater resources																
Potential contamination / nutrient loading of clean ground and surface water resources from destruction of infrastructure, poor waste management or the creation of sinkholes from pipes that are left underground without maintenance.	Without	Negative	Regional (within 30km of site)	3	Permanent	5	High	8	Low reversibility	High irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**12.00**	High	3
	With	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium-low	2	Low reversibility	Moderate irreplaceability	Low probability (10-25% chance)	0.25	**Low**	**2.00**	High	3
Increased dust and erosion																
from traffic, demolition and possible earth-moving activities, and uncontrolled livestock activity	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	High	8	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**10.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	High reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Increased sediment loads																

POTENTIAL IMPACTS	MITIGATION	STATUS	EXTENT		DURATION		INTENSITY		REVERSIBILITY	IRREPLACEABILITY	PROBABILITY		SIGNIFICANCE		CONFIDENCE	
			RATING	SCORE	RATING	SCORE	RATING	SCORE	RATING	RATING	RATING	SCORE	RATING	SCORE	RATING	SCORE
Potential increase in sediment loads entering HGM Unit 1 from exposed soil and building materials stored within the prescribed wetland buffers or upstream of the Eye	Without	Negative	Regional (within 30km of site)	3	Short term (2-5 years)	2	Medium	4	Low reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**6.75**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Low reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Continued proliferation of alien species																
from uncontrolled livestock activity, and lack of alien species control	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Moderate reversibility	High irreplaceability	Definite (>90% chance)	1	**High**	**15.00**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Low	1	High reversibility	Low irreplaceability	Probable (25-50% chance)	0.5	**Low**	**1.50**	High	3
Loss of CI or medicinal flora																
from uncontrolled vehicle, livestock and human activity including harvesting	Without	Negative	Local (<2km from site)	2	Permanent	5	High	8	Low reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**High**	**11.25**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Low reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Sensory disturbance of fauna																
from vehicle and human activity, noise, dust and light	Without	Negative	Local (<2km from site)	2	Short term (2-5 years)	2	Medium	4	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**6.00**	High	3
	With	Negative	Local (<2km from site)	2	Short term (2-5 years)	2	Low	1	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.50**	High	3
Loss of CI fauna																
from habitat degradation and uncontrolled vehicle, livestock and human activity including harvesting	Without	Negative	Local (<2km from site)	2	Medium term (5-15 years)	3	High	8	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Medium**	**6.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Medium-low	2	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**2.00**	High	3
Altered burning																
from demolished and remaining infrastructure, vehicle and human activity, and uncontrolled livestock activity	Without	Negative	Local (<2km from site)	2	Long term (>15 years)	4	Medium	4	Moderate reversibility	Moderate irreplaceability	Highly probable (50-90% chance)	0.75	**Medium**	**7.50**	High	3
	With	Negative	Site specific	1	Temporary (<2 years)	1	Low	1	High reversibility	Moderate irreplaceability	Probable (25-50% chance)	0.5	**Low**	**1.50**	High	3

Table 11-2 Mitigation measures

OBJECTIVE / TARGET	MITIGATION / MANAGEMENT ACTION	METHODOLOGY	FREQUENCY	RESPONSIBILITY
CONSTRUCTION				
Direct loss of wetlands				
To avoid loss and degradation of wetland resources.	Minimise loss of and disturbance to wetlands through planning and proactive management.	*Modify the original infrastructure layout based on the layout and recommendations made by NSS to as far as possible avoid wetland areas and their buffers.	Once-off during the planning phase prior to construction	CSIR, Makadima Management
		*Demarcate the construction site and ensure that all activities are carried out within that area. Additionally mark out the wetland on the ground to ensure activities stay out of it.	First phase of construction before any earth moving commences	Makadima Management
		*Do not build any infrastructure upstream of the Eye.	Project lifetime	Makadima Management
		*Avoid construction within the "no building zone" as indicated on the NSS proposed infrastructure map.	During construction	Makadima Management
Contamination of surface and groundwater resources				
To avoid the contamination of ground and surface water resources.	Minimise contamination of surface water from inappropriate water and waste management	*Highlight all prohibited activities (e.g. Mixing of concrete in wetland areas littering, cutting of large trees, using the wetland as an ablution development) to workers through training and sign notices.	Weekly toolbox talks with signs displayed throughout construction	Makadima Management
		*Do not make use of fertilisers, pesticides or herbicides on site especially upstream of the Eye.	Life of operation	Makadima Management
Increased dust and erosion				
Minimize dust and erosion.	Implement effective measures to control dust and erosion.	*Limit vehicles, people and materials to the construction site.	During construction	Makadima Management, Construction Crew
		*Commence (and preferably complete) construction during winter, when the risk of erosion should be least.	During construction	Makadima Management, Construction Crew
		*Revegetate denude areas with locally indigenous flora a.s.a.p.	During construction	Makadima Management, Construction Crew
		*Implement erosion protection measures on site. Measures could include bunding around soil stockpiles, and vegetation of areas not to be developed.	During construction	Makadima Management, Construction Crew
		*Implement effective and environmentally-friendly dust control measures, such as mulching or periodic wetting.	During construction	Makadima Management, Construction Crew
Increased sediment loads				
To avoid further sedimentation of the upper Mmaphanyane (HGM Unit 1).	Keep the extent of exposed soil and other sediment sources to a minimum.	*Commence (and preferably complete) construction activities during winter when the risk of erosion and wetland sedimentation is lowest.	Try to keep construction to within the winter seasons	Makadima Management
		*Keep all construction activities to within the demarcated footprint areas (keep out of wetland).	Throughout construction	Makadima Management
		*Keep cleared areas to a minimum by constructing one development at a time.	Throughout construction	Makadima Management
		*Revegetate remaining cleared areas by planting indigenous grasses and other vegetation as soon as possible.	Immediately revegetate as construction finishes in one area	Makadima Management
		*Do not stockpile soil in the catchment area above the Eye or within the delineated wetland areas.	Life of operation	Makadima Management
		*Design measures to effectively control vehicle access, vehicle speed, dust, stormwater run-off, erosion and sedimentation on the road.	Life of operation	Makadima Management
Increased flood peaks				
To decrease the incidence of flood peaks during high rainfall events.	Minimise the extent of hardened surfaces and stem the head cut erosion in HGM Unit 2.	*Rehabilitate the head cut erosion within HGM Unit 2 (just upstream of the Eye outside the DWS fence) by stabilising the channel banks. This may be achieved by filling and levelling the channel to remove the drop which creates the erosive vortex during rainfall events. Start with coarser material (e.g. rock) deeper down and progress to finer sands and topsoils towards the surface. Thereafter employ temporary flow attenuation structures such as branches and rows of small hessian bags across the channel filled with grass and sand held in place by thin logs pegged in place with wooden stakes.	Conduct before construction and complete during winter	DWS and Makadima Management in association with a Wetland Specialist
		Preferably prohibit or otherwise monitor the levels of livestock grazing to avoid the overutilisation of the grass sward.	Life of operation	Makadima Management
		Make sure that the access road is well cambered with enough drainage berms to prevent erosion.	Life of operation	Makadima Management
		Minimise the extent of cleared ground and hardened surfaces.	Life of operation	Makadima Management
Decreased water inputs				

OBJECTIVE / TARGET	MITIGATION / MANAGEMENT ACTION	METHODOLOGY	FREQUENCY	RESPONSIBILITY
To avoid negatively impacting on the flow rates from the Dinokana Eye.	Avoid impacting on the water levels directly from the Dinokana Lobatse aquifer immediately upstream of the Eye.	Do not sink boreholes for the development upstream of the Eye or within 100 m of the delineated wetlands.	Prior to and during construction	Makadima Management
Clearing of (especially riparian) vegetation and faunal habitats				
Minimize loss and degradation of (especially riparian) terrestrial vegetation and faunal habitat.	Avoid unnecessary loss of existing (especially riparian) indigenous vegetation and faunal habitats.	*Do not clear any riparian vegetation for the development. This is the vegetation occurring within the delineated wetland boundaries. Additionally wherever possible minimise the disturbance to vegetation within the prescribed wetland buffer zones.	Especially during construction but also during operation	Makadima Management and Construction Crew
		*Modify the layout of planned infrastructure to avoid important floral communities and large indigenous trees. Avoid construction of infrastructure within the NSS infrastructure map demarcated as "no building zone". Integrate the planned infrastructure into the surrounding environment (blending in). NSS has provided some picnic examples in **Figure 10-1**.	Pre-construction	CSIR, Makadima Management, with advice from a Botanist / Horticulturist
		*Identify and mark indigenous trees on the ground. Those that are small and cannot be avoided should be transplanted elsewhere on site.	Pre-construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
		*Demarcate or fence in the construction site.	Prior to and during construction	Makadima Management, Construction Crew
		*Highlight all prohibited activities to workers through training and notices.	Prior to and during construction	Makadima Management, Construction Crew
		*Commence (and preferably complete) construction activities during winter, when the risk of disturbing growing plants should be least.	Prior to and during construction	Makadima Management, Construction Crew
	Promote re-establishment of indigenous vegetation in disturbed areas.	*Briefly and effectively stockpile topsoil preferably 1-1.5m in height.	During construction	Makadima Management, Construction Crew
		*Use the topsoil to allow natural vegetation to establish in disturbed areas. If recovery is slow, then a seed mix for the area (using indigenous grass species listed within this report) should be sourced and planted.	During construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
		*Do not undertake any landscaping with alien flora.	During construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
Introduction and establishment of alien species				
Minimize the introduction and proliferation of invasive alien species during construction.	Limit / Regulate access by potential vectors of alien flora.	*Demarcate or fence in the construction site.	Prior to and during construction	Makadima Management, Construction Crew
		*Carefully limit / regulate access by vehicles and materials to the construction site.	Prior to and during construction	Makadima Management, Construction Crew
		*Prohibit further introduction of domestic animals such as cattle, goats, horses, donkeys, chickens, dogs and cats.	During construction	Makadima Management
	Maintain a tidy construction site.	*Keep construction activities neat and tidy.	During construction	Makadima Management, Construction Crew
		When complete, remove all sand piles, and landscape all uneven ground while re-establishing a good topsoil layer.	During construction	Makadima Management, Construction Crew
		*Plant only locally indigenous flora if landscaping needs to be done.	During construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
	By law, remove and dispose of Category 1b alien species on site. All Category 2 species that remain on site will require a permit.	*Remove Category species using mechanical methods, and minimize soil disturbance as far as possible. Alien wood could be donated to the surrounding community.	During construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
Loss of CI or medicinal flora				
Minimize loss of CI and medicinally important flora.	Adhere to law and best practice guidelines regarding CI and medicinally important flora.	*Obtain permits to remove CI species.	Pre-construction	CSIR, Makadima Management
		*Transplant CI and medicinally important floral specimens from the infrastructure footprint to suitable and safe locations elsewhere on site or nearby.	Pre-construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
		*Obtain guidance from a suitably qualified vegetation specialist or horticulturist regarding the collection, propagation/storage and transplantation of plants.	During construction	Makadima Management, Construction Crew, with advice from a Botanist / Horticulturist
	Prohibit harvesting of CI and medicinally important flora	*Highlight all prohibited activities to workers through training and notices.	Prior to and during construction	Makadima Management, Construction Crew
		*Prohibit harvesting of CI and medicinal flora on site by community members through notices and site access control (e.g. fencing).	During construction	Makadima Management

OBJECTIVE / TARGET	MITIGATION / MANAGEMENT ACTION	METHODOLOGY	FREQUENCY	RESPONSIBILITY
Sensory disturbance of fauna				
Minimize sensory disturbance of fauna.	Time construction activities to minimize sensory disturbance of fauna.	*Commence (and preferably complete) construction during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least.	Prior to and during construction	Makadima Management, Construction Crew
	Minimize noise pollution.	*Minimize noise to limit its impact on calling and other sensitive fauna (e.g. frogs).	During construction	Makadima Management, Construction Crew
	Minimize light pollution.	*Limit construction activities to day time hours.	During construction	Makadima Management, Construction Crew
		*Minimize or eliminate security and construction lighting, to reduce the disturbance of nocturnal fauna.	During construction	Construction Crew
Loss of CI fauna				
Minimize mortality and displacement of fauna, especially CI species such as the NT Giant Bullfrog.	Adhere to law and best practice guidelines regarding the displacement of CI faunal species.	*Appoint an appropriate specialist to relocate CI fauna from rocky areas, water, termitaria, trees and soil that will be disturbed.	Pre-construction	Makadima Management with advice from a Zoologist / Ecologist
		*Commence (and preferably complete) construction during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least.	Prior to and during construction	Makadima Management, Construction Crew
		*Check open trenches for trapped animals (e.g. reptiles, frogs and small terrestrial mammals), and relocate trapped animals with advice from an appropriate specialist.	Daily during construction	Makadima Management, Construction Crew, with advice from a Zoologist / Ecologist
	Prohibit disturbance and harvesting of CI and other indigenous fauna	*Educate workers about dangerous animals (e.g. snakes, scorpions, bees) and highlight all prohibited activities to workers through training and notices.	Prior to and during construction	Makadima Management
		*Prohibit harvesting of CI and other indigenous fauna on site by community members through notices and site access control (e.g. fencing).	During construction	Makadima Management
Altered burning				
Control fire	Avoid fire on site, without prohibiting wild fires in the surrounding natural environment.	*Create safe storage on the premises for flammable materials.	Pre-construction	Makadima Management, Construction Crew
		*If artificial burning is considered necessary, establish and implement a fire management plan with emergency fire procedures.	Pre-construction	CSIR, Makadima Management, with advice from a Botanist / Horticulturist
		*Maintain an effective fire break between the development and the surrounding natural environment.	Pre-construction	Makadima Management, Construction Crew
		*Ensure that there are appropriate control measures in place for any accidental fires.	Pre-construction	Makadima Management, Construction Crew
		*Educate workers about the fire plan and emergency procedures with regular training and notices.	Prior to and during construction	Makadima Management, Construction Crew
OPERATION				
Further loss / degradation of wetlands				
Minimize loss and degradation of wetland areas and their buffers.	Maintain measures on the access road to reduce dust, erosion and sedimentation.	Monitor the success of the rehabilitated erosion gully in HGM Unit 2	Annually	CSIR, DWS and Makadima Management in association with a Wetland Specialist
		Keep future developments outside of the delineated wetland areas and associated buffers.	Throughout operation	DWS, Makadima Management
Contamination of surface and groundwater resources				
To not degrade the ground or surface water quality	Minimise contamination of surface water from inappropriate water and waste management	*Ensure that all waste water (sewerage and grey water) is contained in properly lined septic tanks. Which are serviced regularly.	Once-off during construction, monitor for leaks on a regular basis throughout operation	Makadima Management
		*Do not make use of french drains or long drops.	Throughout operation	Makadima Management
		*Minimise sinkhole formation by regularly inspect all water pipelines and thoroughly mend any leaks as soon as they arise.	Throughout operation	Makadima Management
		*Ensure that the development is run in accordance with international best practice norms, and with advice from an appropriate specialist, to ensure that there is no environmental contamination from effluent, fodder, carcasses and other waste, and to ensure that there is also effective storm water management.	Throughout operation	Makadima Management
		Signpost the site especially the picnic area with all prohibited activities which should include (amongst others) no littering, no wood collecting, no abluting in the stream or bush, no making of fires except within the braai areas.	Throughout operation	Makadima Management
		*All hazardous waste should be disposed of at an appropriate licensed facility for this.	Throughout operation	Makadima Management
		*Waste recycling should be incorporated into the development's operations as far as possible.	Throughout operation	Makadima Management

OBJECTIVE / TARGET	MITIGATION / MANAGEMENT ACTION	METHODOLOGY	FREQUENCY	RESPONSIBILITY
		*Educate workers about the development's waste management and handling of hazardous substances with regular training and notices.	Quarterly notice board updates, Monthly meetings and a yearly AGM	Makadima Management
Decreased water inputs				
To avoid negatively impacting on the flow rates from the Dinokana Eye.	Avoid impacting on the water levels directly from the Dinokana Lobatse aquifer immediately upstream of the Eye.	Diligently monitor and measure water usage in measurable Units. Keep a spreadsheet and compare data to DWS flow rates for the Dinokana Eye on an annual basis.	Monthly for life of operation	DWS, Makadima Management
		Reduce water usage wherever possible. Put up signs in the accommodation encouraging visitors to spare water and re-use laundry during their stay if not too dirty. Investigate the possibility of capturing rainwater.	Start of operation	Makadima Management
Continued introduction and proliferation of alien species				
Minimize the introduction and proliferation of invasive alien species during operation.	Limit / Regulate access by potential vectors of alien flora.	*Carefully limit / regulate access by vehicles and materials to the site.	Throughout operation	Makadima Management
		*Prohibit further introduction of domestic animals such as cattle, goats, horses, donkeys, chickens, dogs and cats.	Throughout operation	Makadima Management
	Maintain a tidy development.	*Employ best practices regarding tilling of soil and weed management.	Throughout operation	Makadima Management
		*Plant only locally indigenous flora if landscaping needs to be done.	Throughout operation	Makadima Management, with advice from a Botanist / Horticulturist
	By law, remove and dispose of Category 1b alien species on site. All Category 2 species that remain on site will require a permit.	*Remove Category species using mechanical methods, and minimize soil disturbance as far as possible. Alien wood could be donated to the surrounding community.	Throughout operation	Makadima Management, with advice from a Botanist / Horticulturist
Loss of CI or medicinal flora				
Prohibit harvesting of CI and medicinally important flora.	Harvesting of indigenous flora for medicine, fire wood, building materials, and other purposes must be prohibited.	*Highlight all prohibited activities to workers through training and notices.	Prior to and during operation	Makadima Management
		*Prohibit harvesting of CI and medicinal flora on site by community members through notices and site access control (e.g. fencing).	Throughout operation	Makadima Management
Sensory disturbance of fauna				
Minimize sensory disturbance of fauna.	Minimize essential lighting	*Install motion-sensitive lights.	Construction and operation	Makadima Management
		*Ensure that all outdoor lights are angled downwards and/or fitted with hoods.	Construction and operation	Makadima Management
		*Use bulbs that emit warm, long wavelength (yellow-red) light, or use UV filters or glass housings on lamps to filter out UV.	Throughout operation	Makadima Management
		*Avoid using metal halide, mercury or other bulbs that emit high UV (blue-white) light that is highly and usually fatally attractive to insects.	Throughout operation	Makadima Management
	Minimize unavoidable noise	*Conduct regular maintenance of machinery, fans and other noisy equipment.	Throughout operation	Makadima Management
	Prevent unnecessary light and noise pollution	*Encourage workers to minimize light and noise pollution through training and notices.	Throughout operation	Makadima Management
Loss of CI fauna				
Prohibit harvesting of CI and other fauna.	Harvesting of indigenous fauna for food, sport, medicine, and other purposes must be prohibited.	*Educate workers about dangerous animals (e.g. snakes, scorpions, bees) and highlight all prohibited activities to workers through training and notices.	Prior to and during operation	Makadima Management
		*Prohibit harvesting of CI and other indigenous fauna on site by community members through notices and site access control (e.g. fencing).	Throughout operation	Makadima Management
Erosion				
Minimize erosion.	Implement effective measures to control erosion.	*Limit vehicles and people to the development footprint.	Throughout operation	Makadima Management
		*Revegetate denude areas with locally indigenous flora a.s.a.p.	Throughout operation	Makadima Management
		*Implement erosion protection measures on site. Measures could include bunding around soil stockpiles, and vegetation of areas not to be developed.	Throughout operation	Makadima Management
Altered burning				
Control fire	Avoid fire on site, without prohibiting wild fires in the surrounding natural environment.	*Create safe storage on the premises for flammable materials.	Construction and operation	Makadima Management
		*If artificial burning is considered necessary, establish and implement a fire management plan with emergency fire procedures.	Construction and operation	CSIR, Makadima Management, with advice from a Botanist / Horticulturist
		*Maintain an effective fire break between the development and the surrounding natural environment.	Construction and operation	Makadima Management
		*Ensure that there are appropriate control measures in place for any accidental fires.	Construction and operation	Makadima Management
		*Educate workers about the fire plan and emergency procedures with regular training and notices.	Throughout operation	Makadima Management
DECOMMISSIONING				
Further loss / degradation of wetlands				

OBJECTIVE / TARGET	MITIGATION / MANAGEMENT ACTION	METHODOLOGY	FREQUENCY	RESPONSIBILITY
Minimize loss and degradation of wetland areas and their buffers.	Minimise loss of and disturbance to wetlands through planning and proactive management.	*Keep decommissioning activities outside of the delineated wetland areas and associated buffers.	During decommissioning	DWS, Makadima Management, Decommissioning Crew
		*Demarcate the decommissioning site and ensure that all activities are carried out within that area. Additionally mark out the wetland on the ground to ensure activities stay out of it.	First phase of decommissioning before any demolition activities commence	Makadima Management, Decommissioning Crew
		*Avoid disturbing the "no building zone" as indicated on the NSS proposed infrastructure map.	During decommissioning	Makadima Management, Decommissioning Crew
Contamination of surface and groundwater resources				
To not degrade the ground or surface water quality	Minimise contamination of surface water from inappropriate water and waste management	*Do not make use of french drains or long drops.	During decommissioning	Makadima Management
		*Minimise sinkhole formation by sealing or otherwise inspecting water pipelines and thoroughly mend any leaks.	During decommissioning	Makadima Management
		*Ensure that storm water management remains effective during and following decommissioning.	During decommissioning	Makadima Management
		*All grey water, sewage and other hazardous waste should be disposed of at an appropriate licensed facility for this.	During decommissioning	Makadima Management, Decommissioning Crew
		*Waste recycling should be incorporated into decommissioning as far as possible.	During decommissioning	Makadima Management, Decommissioning Crew
		*Educate workers about the development's waste management and handling of hazardous substances with regular training and notices.	Quarterly notice board updates, Monthly meetings and a yearly AGM	Makadima Management, Decommissioning Crew
Increased dust and erosion				
Minimize dust and erosion.	Implement effective measures to control dust and erosion.	*Limit vehicles, people and materials to the decommissioning site.	During decommissioning	Makadima Management, Decommissioning Crew
		*Commence (and preferably complete) decommissioning during winter, when the risk of erosion should be least.	During decommissioning	Makadima Management, Decommissioning Crew
		*Revegetate denude areas with locally indigenous flora a.s.a.p.	During decommissioning	Makadima Management, Decommissioning Crew
		*Implement erosion protection measures on site. Measures could include bunding around soil stockpiles, and vegetation of areas not to be developed.	During decommissioning	Makadima Management, Decommissioning Crew
		*Implement effective and environmentally-friendly dust control measures, such as mulching or periodic wetting.	During decommissioning	Makadima Management, Decommissioning Crew
Increased sediment loads				
To avoid further sedimentation of the upper Mmaphanyane (HGM Unit 1).	Keep the extent of exposed soil and other sediment sources to a minimum.	*Commence (and preferably complete) decommissioning activities during winter when the risk of erosion and wetland sedimentation is lowest.	Try to keep decommissioning to within the winter seasons	Makadima Management
		*Keep all decommissioning activities to within the demarcated footprint areas (keep out of wetland).	Throughout decommissioning	Makadima Management, Decommissioning Crew
		*Keep cleared areas to a minimum by demolishing one development section at a time.	Throughout decommissioning	Makadima Management, Decommissioning Crew
		*Revegetate remaining cleared areas by planting indigenous grasses and other vegetation as soon as possible.	Throughout decommissioning	Makadima Management, Decommissioning Crew
		*Do not stockpile soil in the catchment area above the Eye or within the delineated wetland areas.	Throughout decommissioning	Makadima Management, Decommissioning Crew
		*Design measures to effectively control vehicle access, vehicle speed, dust, stormwater run-off, erosion and sedimentation on the road.	Throughout decommissioning	Makadima Management
Continued proliferation of alien species				
Minimize the continued proliferation of invasive alien species during decommissioning.	By law, remove and dispose of Category 1b alien species on site. All Category 2 species that remain on site will require a permit.	*Remove Category species using mechanical methods, and minimize soil disturbance as far as possible. Alien wood could be donated to the surrounding community.	Throughout decommissioning until all Category 1b and Category 2 alien species have been effectively removed from the site	Makadima Management
Loss of CI or medicinal flora				
Prohibit harvesting of CI and medicinally important flora.	Harvesting of indigenous flora for medicine, fire wood, building materials, and other purposes must be prohibited.	*Highlight all prohibited activities to workers through training and notices.	Prior to and during decommissioning	Makadima Management, Decommissioning Crew
		*Prohibit harvesting of CI and medicinal flora on site by community members through notices and site access control (e.g. fencing).	During decommissioning	Makadima Management
Loss of CI fauna				

OBJECTIVE / TARGET	MITIGATION / MANAGEMENT ACTION	METHODOLOGY	FREQUENCY	RESPONSIBILITY
Prohibit harvesting of CI and other fauna.	Harvesting of indigenous fauna for food, sport, medicine, and other purposes must be prohibited.	*Educate workers about dangerous animals (e.g. snakes, scorpions, bees) and highlight all prohibited activities to workers through training and notices.	Prior to and during decommissioning	Makadima Management
		*Prohibit harvesting of CI and other indigenous fauna on site by community members through notices and site access control (e.g. fencing).	During decommissioning	Makadima Management
Sensory disturbance of fauna				
Minimize sensory disturbance of fauna.	Minimize unavoidable noise	*Conduct regular maintenance of machinery, fans and other noisy equipment.	During decommissioning	Makadima Management, Decommissioning Crew
	Prevent unnecessary light and noise pollution	*Encourage workers to minimize light and noise pollution through training and notices.	During decommissioning	Makadima Management, Decommissioning Crew
Altered burning				
Control fire	Avoid fire on site, without prohibiting wild fires in the surrounding natural environment.	*Create safe storage on the premises for flammable materials.	Prior to and during decommissioning	Makadima Management, Decommissioning Crew
		*If artificial burning is considered necessary, establish and implement a fire management plan with emergency fire procedures.	Prior to and during decommissioning	CSIR, Makadima Management, with advice from a Botanist / Horticulturist
		*Maintain an effective fire break between the development and the surrounding natural environment.	Prior to and during decommissioning	Makadima Management, Decommissioning Crew
		*Ensure that there are appropriate control measures in place for any accidental fires.	Prior to and during decommissioning	Makadima Management, Decommissioning Crew
		*Educate workers about the fire plan and emergency procedures with regular training and notices.	Prior to and during decommissioning	Makadima Management, Decommissioning Crew

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13. Appendices

13.1. POSA list for QDS 2525BD

Family		Species	Growth forms
ACANTHACEAE		Barleria pretoriensis C.B.Clarke	Dwarf shrub
ACANTHACEAE		Crabbea angustifolia Nees	Herb
ACANTHACEAE		Dyschoriste transvaalensis C.B.Clarke	Dwarf shrub
ACANTHACEAE		Hypoestes forskaolii (Vahl) R.Br.	Herb
AMARANTHACEAE	*	Achyranthes aspera L. var. aspera	Herb
AMARANTHACEAE		Aerva leucura Moq.	Herb
AMARANTHACEAE		Guilleminea densa (Willd. ex Roem. & Schult.) Moq.	Herb
AMARANTHACEAE		Pupalia lappacea (L.) A.Juss. var. lappacea	Herb
AMARYLLIDACEAE		Boophone disticha (L.f.) Herb.	Geophyte
AMARYLLIDACEAE		Scadoxus puniceus (L.) Friis & Nordal	Geophyte
ANACARDIACEAE		Lannea discolor (Sond.) Engl.	Tree
ANACARDIACEAE		Ozoroa paniculosa (Sond.) R.& A.Fern. var. paniculosa	Shrub, tree
ANACARDIACEAE		Sclerocarya birrea (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro	Tree
ANACARDIACEAE		Searsia lancea (L.f.) F.A.Barkley	Shrub, tree
ANACARDIACEAE		Searsia leptodictya (Diels) T.S.Yi, A.J.Mill. & J.Wen forma leptodictya	Shrub, tree
ANACARDIACEAE		Searsia magalismontana (Sond.) Moffett subsp. magalismontana	Dwarf shrub
ANACARDIACEAE		Searsia pallens (Eckl. & Zeyh.) Moffett	Shrub, tree
ANACARDIACEAE		Searsia pyroides (Burch.) Moffett var. pyroides	Tree
APOCYNACEAE		Ancylobotrys capensis (Oliv.) Pichon	Climber
APOCYNACEAE		Carissa bispinosa (L.) Desf. ex Brenan	Shrub
APOCYNACEAE		Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus	Shrub
APOCYNACEAE		Marsdenia sylvestris (Retz.) P.I.Forst.	Climber
APOCYNACEAE		Orbea lutea (N.E.Br.) Bruyns subsp. lutea	Succulent
APOCYNACEAE		Sarcostemma viminale (L.) R.Br. subsp. viminale	Climber
ARALIACEAE		Cussonia paniculata Eckl. & Zeyh. subsp. sinuata (Reyneke & Kok) De Winter	Succulent
ASPARAGACEAE		Asparagus cooperi Baker	Dwarf shrub
ASPARAGACEAE		Asparagus suaveolens Burch.	Shrub
ASPHODELACEAE		Aloe cryptopoda Baker	Dwarf shrub
ASPHODELACEAE		Kniphofia ensifolia Baker subsp. ensifolia	Herb
ASPLENIACEAE		Asplenium cordatum (Thunb.) Sw.	Geophyte
ASTERACEAE		Berkheya radula (Harv.) De Wild.	Herb
ASTERACEAE	*	Bidens bipinnata L.	Herb
ASTERACEAE	*	Bidens pilosa L.	Herb
ASTERACEAE	*	Conyza bonariensis (L.) Cronquist	Herb
ASTERACEAE		Dicoma anomala Sond. subsp. gerrardii (Harv. ex F.C.Wilson) S.Ortíz & Rodr.Oubiña	Herb
ASTERACEAE		Emilia ambifaria (S.Moore) C.Jeffrey	Succulent
ASTERACEAE	*	Flaveria bidentis (L.) Kuntze	Herb

Family		Species	Growth forms
ASTERACEAE		Gazania krebsiana Less. subsp. serrulata (DC.) Roessler	Herb
ASTERACEAE		Geigeria burkei Harv. subsp. burkei var. zeyheri (Harv.) Merxm.	Herb
ASTERACEAE		Helichrysum paronychioides DC.	Dwarf shrub
ASTERACEAE		Helichrysum setosum Harv.	Shrub
ASTERACEAE		Kleinia longiflora DC.	Shrub
ASTERACEAE		Nidorella resedifolia DC. subsp. resedifolia	Herb
ASTERACEAE		Pseudognaphalium oligandrum (DC.) Hilliard & B.L.Burtt	Herb
ASTERACEAE		Psiadia punctulata (DC.) Vatke	Shrub
ASTERACEAE	*	Tagetes minuta L.	Herb
ASTERACEAE		Tarchonanthus camphoratus L.	Shrub, tree
ASTERACEAE	*	Xanthium spinosum L.	Herb
BORAGINACEAE		Ehretia rigida (Thunb.) Druce subsp. nervifolia Retief & A.E.van Wyk	Shrub
BUDDLEJACEAE		Buddleja saligna Willd.	Shrub, tree
BUDDLEJACEAE		Nuxia congesta R.Br. ex Fresen.	Shrub, tree
BURSERACEAE		Commiphora africana (A.Rich.) Engl. var. africana	Dwarf shrub
BURSERACEAE		Commiphora glandulosa Schinz	Shrub, tree
CAPPARACEAE		Boscia albitrunca (Burch.) Gilg & Gilg-Ben.	Shrub, tree
CAPPARACEAE		Maerua cafra (DC.) Pax	Shrub, tree
CELASTRACEAE		Gymnosporia buxifolia (L.) Szyszyl.	Shrub, tree
CELTIDACEAE		Celtis africana Burm.f.	Shrub, tree
CHRYSOBALANACEAE		Parinari capensis Harv. subsp. capensis	Dwarf shrub
COMBRETACEAE		Combretum apiculatum Sond. subsp. apiculatum	Shrub, tree
COMBRETACEAE		Combretum erythrophyllum (Burch.) Sond.	Shrub, tree
COMBRETACEAE		Combretum molle R.Br. ex G.Don	Tree
COMBRETACEAE		Combretum zeyheri Sond.	Shrub, tree
COMBRETACEAE		Terminalia sericea Burch. ex DC.	Tree
CONVOLVULACEAE		Ipomoea oblongata E.Mey. ex Choisy	Succulent
CRASSULACEAE		Kalanchoe paniculata Harv.	Shrub
CRASSULACEAE		Kalanchoe rotundifolia (Haw.) Haw.	Dwarf shrub
CUCURBITACEAE		Momordica balsamina L.	Climber
CYPERACEAE		Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke	Cyperoid
CYPERACEAE		Cladium mariscus (L.) Pohl subsp. jamaicense (Crantz) Kük.	Cyperoid
CYPERACEAE		Cyperus cyperoides (L.) Kuntze subsp. pseudoflavus (Kük.) Lye	Cyperoid
CYPERACEAE		Cyperus decurvatus (C.B.Clarke) C.Archer & Goetgh.	Cyperoid
CYPERACEAE		Cyperus digitatus Roxb. subsp. auricomus (Sieber ex Spreng.) Kük.	Cyperoid
CYPERACEAE		Cyperus indecorus Kunth var. inflatus (C.B.Clarke) Kük.	Cyperoid
CYPERACEAE		Cyperus longus L. var. tenuiflorus (Rottb.) Boeck.	Cyperoid
CYPERACEAE		Cyperus margaritaceus Vahl var. margaritaceus	Cyperoid
CYPERACEAE		Kyllinga alba Nees	Cyperoid
CYPERACEAE		Pycreus betschuanus (Boeckeler) C.B.Clarke	Cyperoid
CYPERACEAE		Schoenoplectus muricinux (C.B.Clarke) J.Raynal	Cyperoid

Family		Species	Growth forms
DRACAENACEAE		Sansevieria aethiopica Thunb.	Geophyte
EBENACEAE		Diospyros lycioides Desf. subsp. lycioides	Shrub
EBENACEAE		Euclea crispa (Thunb.) Gürke subsp. crispa	Shrub, tree
EBENACEAE		Euclea natalensis A.DC. subsp. angustifolia F.White	Shrub, tree
EBENACEAE		Euclea undulata Thunb.	Shrub, tree
EUPHORBIACEAE		Acalypha glabrata Thunb. var. pilosa Pax	Shrub, tree
EUPHORBIACEAE		Clutia pulchella L. var. pulchella	Dwarf shrub
EUPHORBIACEAE		Croton gratissimus Burch. var. subgratissimus (Prain) Burtt Davy	Shrub, tree
EUPHORBIACEAE		Spirostachys africana Sond.	Shrub, tree
EUPHORBIACEAE		Tragia rupestris Sond.	Climber
FABACEAE		Acacia caffra (Thunb.) Willd.	Shrub, tree
FABACEAE		Acacia erioloba E.Mey.	Shrub, tree
FABACEAE		Acacia fleckii Schinz	Shrub, tree
FABACEAE		Acacia hebeclada DC. subsp. hebeclada	Shrub, tree
FABACEAE		Acacia karroo Hayne	Shrub, tree
FABACEAE		Acacia mellifera (Vahl) Benth. subsp. detinens (Burch.) Brenan	Shrub, tree
FABACEAE		Acacia nigrescens Oliv.	Tree
FABACEAE		Acacia nilotica (L.) Willd. ex Delile subsp. kraussiana (Benth.) Brenan	Tree
FABACEAE		Acacia robusta Burch. subsp. robusta	Tree
FABACEAE		Acacia tortilis (Forssk.) Hayne subsp. heteracantha (Burch.) Brenan	Shrub, tree
FABACEAE		Burkea africana Hook.	Tree
FABACEAE		Chamaecrista biensis (Steyaert) Lock	Herb
FABACEAE		Crotalaria orientalis Burtt Davy ex I.Verd. subsp. orientalis	Dwarf shrub
FABACEAE		Crotalaria spartioides DC.	Shrub
FABACEAE		Dichrostachys cinerea (L.) Wight & Arn. subsp. africana Brenan & Brummitt var. africana	Shrub, tree
FABACEAE		Dolichos pratensis (E.Mey.) Taub.	Climber
FABACEAE		Elephantorrhiza burkei Benth.	Shrub, tree
FABACEAE		Elephantorrhiza elephantina (Burch.) Skeels	Dwarf shrub
FABACEAE		Indigofera bainesii Baker	Dwarf shrub
FABACEAE		Indigofera cryptantha Benth. ex Harv. var. cryptantha	Dwarf shrub
FABACEAE		Indigofera daleoides Benth. ex Harv. var. daleoides	Herb
FABACEAE		Indigofera hofmanniana Schinz	Dwarf shrub
FABACEAE		Indigofera vicioides Jaub. & Spach var. vicioides	Herb
FABACEAE		Mundulea sericea (Willd.) A.Chev. subsp. sericea	Shrub, tree
FABACEAE		Neonotonia wightii (Wight. ex Arn.) J.A.Lackey	Climber
FABACEAE		Otoptera burchellii DC.	Climber
FABACEAE		Peltophorum africanum Sond.	Tree
FABACEAE		Stylosanthes fruticosa (Retz.) Alston	Dwarf shrub
FABACEAE		Tephrosia burchellii Burtt Davy	Herb
FABACEAE		Zornia glochidiata Rchb. ex DC.	Herb
FLACOURTIACEAE		Flacourtia indica (Burm.f.) Merr.	Shrub, tree

Family		Species	Growth forms
GERANIACEAE		Monsonia burkeana Planch. ex Harv.	Herb
GISEKIACEAE		Gisekia africana (Lour.) Kuntze var. africana	Herb
HYACINTHACEAE		Ledebouria marginata (Baker) Jessop	Geophyte
HYACINTHACEAE		Schizocarphus nervosus (Burch.) Van der Merwe	Geophyte
IRIDACEAE		Gladiolus filiformis Goldblatt & J.C.Manning	Geophyte
IRIDACEAE		Moraea pallida (Baker) Goldblatt	Geophyte
LAMIACEAE		Salvia runcinata L.f.	Herb
LAMIACEAE		Stachys spathulata Burch. ex Benth.	Herb
LAMIACEAE		Tetradenia brevispicata (N.E.Br.) Codd	Shrub
LAMIACEAE		Teucrium trifidum Retz.	Herb
LAMIACEAE		Vitex zeyheri Sond.	Tree
LORANTHACEAE		Agelanthus natalitius (Meisn.) Polhill & Wiens subsp. zeyheri (Harv.) Polhill & Wiens	Parasite
LORANTHACEAE		Tapinanthus quequensis (Weim.) Polhill & Wiens	Parasite
MALPIGHIACEAE		Sphedamnocarpus pruriens (A.Juss.) Szyszyl. subsp. pruriens	Climber
MALVACEAE		Corchorus kirkii N.E.Br.	Shrub
MALVACEAE		Dombeya rotundifolia (Hochst.) Planch. var. rotundifolia	Shrub, tree
MALVACEAE		Grewia flava DC.	Shrub
MALVACEAE		Grewia flavescens Juss.	Shrub
MALVACEAE		Grewia monticola Sond.	Shrub, tree
MALVACEAE		Grewia subspathulata N.E.Br.	Shrub
MALVACEAE		Hermannia depressa N.E.Br.	Herb
MALVACEAE		Hibiscus engleri K.Schum.	Herb
MALVACEAE		Hibiscus micranthus L.f. var. micranthus	Shrub
MALVACEAE		Melhania prostrata DC.	Dwarf shrub
MALVACEAE		Sida dregei Burtt Davy	Dwarf shrub
MALVACEAE		Triumfetta rhomboidea Jacq. var. rhomboidea	Shrub
MALVACEAE		Waltheria indica L.	Herb
MELIACEAE		Turraea obtusifolia Hochst.	Climber
MOLLUGINACEAE		Limeum sulcatum (Klotzsch) Hutch. var. sulcatum	Herb
MOLLUGINACEAE		Limeum viscosum (J.Gay) Fenzl subsp. viscosum var. viscosum	Herb
MORACEAE		Ficus abutilifolia (Miq.) Miq.	Shrub, tree
MORACEAE		Ficus ingens (Miq.) Miq.	Tree
MORACEAE		Ficus salicifolia Vahl	Tree
MYROTHAMNACEAE		Myrothamnus flabellifolius Welw.	Dwarf shrub
NYCTAGINACEAE	*	Boerhavia diffusa L. var. diffusa	Herb
OCHNACEAE		Ochna inermis (Forssk.) Schweinf.	Shrub, tree
OCHNACEAE		Ochna pulchra Hook.f.	Shrub, tree
OLACACEAE		Ximenia americana L. var. microphylla Welw. ex Oliv.	Shrub, tree
OLACACEAE		Ximenia caffra Sond. var. caffra	Shrub, tree
OLEACEAE		Olea europaea L. subsp. africana (Mill.) P.S.Green	Shrub, tree
OXALIDACEAE	*	Oxalis corniculata L.	Herb

Family		Species	Growth forms
PEDALIACEAE		Dicerocaryum senecioides (Klotzsch) Abels	Herb
PHYLLANTHACEAE		Bridelia mollis Hutch.	Shrub, tree
PHYLLANTHACEAE		Flueggea virosa (Roxb. ex Willd.) Voigt subsp. virosa	Shrub, tree
PHYLLANTHACEAE		Phyllanthus maderaspatensis L.	Herb
PLUMBAGINACEAE		Plumbago zeylanica L.	Shrub
POACEAE		Aristida canescens Henrard subsp. canescens	Graminoid
POACEAE		Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter	Graminoid
POACEAE		Aristida junciformis Trin. & Rupr. subsp. junciformis	Graminoid
POACEAE		Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis	Graminoid
POACEAE		Cymbopogon prolixus (Stapf) E.Phillips	Graminoid
POACEAE		Dichanthium annulatum (Forssk.) Stapf var. papillosum (A.Rich.) de Wet & Harlan	Graminoid
POACEAE		Digitaria eriantha Steud.	Graminoid
POACEAE		Eleusine coracana (L.) Gaertn. subsp. africana (Kenn.-O'Byrne) Hilu & de Wet	Graminoid
POACEAE		Eragrostis barbinodis Hack.	Graminoid
POACEAE		Eragrostis chloromelas Steud.	Graminoid
POACEAE		Eragrostis heteromera Stapf	Graminoid
POACEAE		Eragrostis rigidior Pilg.	Graminoid
POACEAE		Hyparrhenia anamesa Clayton	Graminoid
POACEAE		Melinis repens (Willd.) Zizka subsp. repens	Graminoid
POACEAE		Panicum maximum Jacq.	Graminoid
POACEAE		Perotis patens Gand.	Graminoid
POACEAE		Pogonarthria squarrosa (Roem. & Schult.) Pilg.	Graminoid
POACEAE		Setaria verticillata (L.) P.Beauv.	Graminoid
POACEAE		Sorghum bicolor (L.) Moench subsp. arundinaceum (Desv.) de Wet & Harlan	Graminoid
POACEAE		Themeda triandra Forssk.	Graminoid
POACEAE		Trichoneura grandiglumis (Nees) Ekman	Graminoid
POACEAE		Urochloa mosambicensis (Hack.) Dandy	Graminoid
POLYGALACEAE		Securidaca longepedunculata Fresen. var. longepedunculata	Shrub, tree
PORTULACACEAE	*	Portulaca oleracea L.	Succulent
PROTEACEAE		Faurea saligna Harv.	Tree
PTERIDACEAE		Adiantum capillus-veneris L.	Geophyte
RANUNCULACEAE		Clematis brachiata Thunb.	Climber
RHAMNACEAE		Berchemia zeyheri (Sond.) Grubov	Tree
RHAMNACEAE		Ziziphus mucronata Willd. subsp. mucronata	Shrub, tree
RHAMNACEAE		Ziziphus zeyheriana Sond.	Dwarf shrub
RUBIACEAE		Pavetta zeyheri Sond. subsp. zeyheri	Shrub, tree
RUBIACEAE		Psydrax livida (Hiern) Bridson	Shrub, tree
RUBIACEAE		Pygmaeothamnus zeyheri (Sond.) Robyns var. zeyheri	Dwarf shrub
RUBIACEAE		Rothmannia capensis Thunb.	Tree
RUBIACEAE		Vangueria infausta Burch. subsp. infausta	Tree
SANTALACEAE		Osyris lanceolata Hochst. & Steud.	Shrub

Family		Species	Growth forms
SAPINDACEAE		Erythrophysa transvaalensis I.Verd.	Shrub, tree
SAPINDACEAE		Pappea capensis Eckl. & Zeyh.	Shrub, tree
SAPOTACEAE		Englerophytum magalismontanum (Sond.) T.D.Penn.	Shrub, tree
SAPOTACEAE		Mimusops zeyheri Sond.	Shrub, tree
SCROPHULARIACEAE		Chaenostoma leve (Hiern) Kornhall	Herb
SCROPHULARIACEAE		Halleria lucida L.	Shrub, tree
SINOPTERIDACEAE		Cheilanthes hirta Sw. var. brevipilosa W.& N.Jacobsen	Herb
SINOPTERIDACEAE		Pellaea calomelanos (Sw.) Link var. calomelanos	Geophyte
SOLANACEAE		Solanum lichtensteinii Willd.	Dwarf shrub
SOLANACEAE		Solanum supinum Dunal var. supinum	Dwarf shrub
STRYCHNACEAE		Strychnos madagascariensis Poir.	Shrub, tree
STRYCHNACEAE		Strychnos pungens Soler.	Shrub, tree
TYPHACEAE		Typha capensis (Rohrb.) N.E.Br.	Hydrophyte
URTICACEAE		Pouzolzia mixta Solms var. mixta	Shrub
VERBENACEAE		Lantana rugosa Thunb.	Shrub
VERBENACEAE		Lippia javanica (Burm.f.) Spreng.	Shrub
VERBENACEAE	*	Verbena aristigera S.Moore	Herb
VISCACEAE		Viscum combreticola Engl.	Parasite
VISCACEAE		Viscum rotundifolium L.f.	Parasite
VISCACEAE		Viscum verrucosum Harv.	Parasite
VITACEAE		Cissus cactiformis Gilg	Climber
VITACEAE		Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. cuneifolia (Eckl. & Zeyh.) Urton	Climber
VITACEAE		Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. tridentata	Shrub
ZYGOPHYLLACEAE		Tribulus terrestris L.	Herb

13.2. Mammal list for the study area

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	RSA RED LIST STATUS	QDS (MammalMAP 2017)	LO ON SITE
BATHYERGIDAE	**Mole-rats**						
Cryptomys hottentotus	Southern African Mole-rat			LC (S)	LC	1	1
BOVIDAE	**Even-toed antelope**						
Oreotragus oreotragus	Klipspringer		PG	LC (S)	LC	2	4
Raphicerus campestris	Steenbok		PG	LC (S)	LC	1	3
Redunca arundinum	Southern Reedbuck		PG	LC (S)	LC	1	4
Redunca fulvorufula	Mountain Reedbuck		PG	LC (S)	EN	1	4
Sylvicapra grimmia	Bush Duiker			LC (S)	LC	1	3
Tragelaphus scriptus	Bushbuck			LC (S)	LC	1	4
Tragelaphus strepsiceros	Greater Kudu			LC (S)	LC	1	4
CANIDAE	**Dogs, foxes, jackals & relatives**						
Canis mesomelas	Black-backed Jackal			LC (S)	LC	2	3
Otocyon megalotis	Bat-eared Fox	PS		LC (U)	LC	3	4
Vulpes chama	Cape Fox	PS		LC (S)	LC	3	4
CERCOPITHECIDAE	**Baboon & monkeys**						
Cercopithecus pygerythrus pygerythrus	Vervet Monkey			LC (S)	LC	1	4
Papio ursinus	Chacma Baboon			LC (S)	LC	2	4
ERINACEIDAE	**Hedgehog**						
Atelerix frontalis (frontalis)	Southern African Hedgehog		PG	LC (S)	NT	2	4
FELIDAE	**Cats**						
Caracal caracal	Caracal			LC (U)	LC	3	3
Felis nigripes	Black-footed Cat	PS		VU (D)	VU	3	4
Felis silvestris	Wildcat			LC (D)	LC	3	4
Leptailurus serval	Serval	PS		LC (S)	NT	2	4
Panthera pardus	Leopard	PS	PWA	NT (D)	VU	1	4
GALAGIDAE	**Bushbabies**						
Galago moholi	Moholi Bushbaby			LC (S)	LC	2	2
GLIRIDAE	**Dormice**						
Graphiurus murinus	Forest African Dormouse			LC (S)	LC	2	2
HERPESTIDAE	**Meerkat & mongooses**						
Atilax paludinosus	Marsh Mongoose			LC (D)	LC	2	4
Cynictis penicillata	Yellow Mongoose			LC (S)	LC	1	2
Helogale parvula	Common Dwarf Mongoose			LC (S)	LC	3	4
Herpestes sanguineus	Slender Mongoose			LC (S)	LC	2	2

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	RSA RED LIST STATUS	QDS (MammalMAP 2017)	LO ON SITE
Ichneumia albicauda	White-tailed Mongoose			LC (S)	LC	3	4
Mungos mungo	Banded Mongoose			LC (S)	LC	2	4
Suricata suricatta	Meerkat			LC (U)	LC	3	4
HIPPOSIDERIDAE	**Leaf-nosed & related bats**						
Cloeotis percivali	Percival's Short-eared Trident Bat			LC (U)	**EN**	3	3
Hipposideros caffer	Sundevall's Leaf-nosed Bat			LC (D)	LC	3	3
HYAENIDAE	**Aardwolf & hyenas**						
Hyaena brunnea	Brown Hyena	**PS**	**PG**	**NT (D)**	**NT**	2	3
Proteles cristata	Aardwolf		**PG**	LC (S)	LC	2	4
HYSTRICIDAE	**Porcupine**						
Hystrix africaeaustralis	Cape Porcupine			LC (S)	LC	2	4
LEPORIDAE	**Hares & rabbits**						
Lepus capensis	Cape Hare			LC (D)	LC	3	3
Lepus saxatilis	Scrub Hare			LC (D)	LC	2	1
Pronolagus randensis	Jameson's Red Rock Hare			LC (U)	LC	2	
MACROSCELIDIDAE	**Elephant shrews**						
Elephantulus brachyrhynchus	Short-snouted Elephant Shrew			LC (U)	LC	2	2
Elephantulus myurus	Eastern Rock Elephant Shrew			LC (S)	LC	2	2
MANIDAE	**Pangolin**						
Smutsia temminckii	Ground Pangolin	**VU**	**PG**	LC (D)	**VU**	3	4
MOLOSSIDAE	**Free-tailed & related bats**						
Sauromys petrophilus	Roberts's Flat-headed Bat			LC (S)	LC	3	3
Tadarida aegyptiaca	Egyptian Free-tailed Bat			LC (U)	LC	2	2
MURIDAE	**Gerbils, rock mice, vlei rats & relatives**						
Acomys spinosissimus	Southern African Spiny Mouse			LC (S)	LC	3	3
Aethomys chrysophilus	Red Veld Aethomys			LC (U)	LC	3	4
Aethomys ineptus	Tete Veld Aethomys			LC (U)	LC	2	2
Aethomys namaquensis	Namaqua Rock Mouse			LC (S)	LC	1	2
Gerbilliscus brantsii	Highveld Gerbil			LC (U)	LC	2	3
Gerbilliscus leucogaster	Bushveld Gerbil			LC (S)	LC	2	2
Gerbilliscus paeba	Paeba Hairy-footed Gerbil				LC	3	4
Lemniscomys rosalia	Single-Striped Lemniscomys			LC (S)	LC	1	2
Mastomys coucha	Southern African Mastomys			LC (S)	LC	1	2
Mus indutus	Desert Pygmy Mouse			LC (S)	LC	2	2
Mus minutoides	Southern African Pygmy Mouse			LC (S)	LC	2	2

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	RSA RED LIST STATUS	QDS (MammalMAP 2017)	LO ON SITE
Otomys angoniensis	Angoni Vlei Rat			LC (S)	LC	1	2
Otomys auratus / irroratus	Southern African Vlei Rat			LC (S)	LC	2	2
Rhabdomys pumilio	Xeric Four-striped Grass Rat			LC (S)	LC	2	2
Thallomys paedulcus	Acacia Thallomys			LC (U)	LC	2	3
MUSTELIDAE	**Badger, otters, polecat & weasel**						
Aonyx capensis	African Clawless Otter			LC (S)	**NT**	2	4
Ictonyx striatus	Striped Polecat			LC (S)	LC	2	4
Mellivora capensis	Honey Badger			LC (D)	LC	2	4
Poecilogale albinucha	African Striped Weasel			LC (U)	**NT**	2	4
NESOMYIDAE	**Climbing & fat mice & relatives**						
Dendromus melanotis	Gray African Climbing Mouse			LC (S)	LC	2	4
Saccostomus campestris	Southern African Pouched Mouse			LC (S)	LC	2	2
Steatomys krebsii	Kreb's African Fat Mouse			LC (S)	LC	3	4
NYCTERIDAE	**Slit-faced bats**						
Nycteris thebaica	Egyptian Slit-faced Bat			LC (U)	LC	2	2
ORYCTEROPODIDAE	**Aardvark**						
Orycteropus afer	Aardvark	**PS**	**PG**	LC (U)	LC	3	4
PEDETIDAE	**Spring Hare**						
Pedetes capensis	South African Spring Hare			LC (U)	LC	2	4
PETROMURIDAE	**Dassie Rat**						
PROCAVIIDAE	**Hyraxes**						
Procavia capensis	Rock Hyrax			LC (U)	LC	2	3
RHINOLOPHIDAE	**Horseshoe bats**						
Rhinolophus blasii	Blasius's Horseshoe Bat			LC (D)	**NT**	3	3
Rhinolophus clivosus	Geoffroy's Horseshoe Bat			LC (U)	LC	3	3
Rhinolophus darlingi	Darling's Horseshoe Bat			LC (U)	LC	2	2
Rhinolophus simulator	Bushveld Horseshoe Bat			LC (D)	LC	3	3
SCIURIDAE	**Squirrels**						
Paraxerus cepapi	Smith's Bush Squirrel			LC (S)	LC	2	1*
Xerus inauris	South African Ground Squirrel			LC (S)	LC	1	4
SORICIDAE	**Shrews**						
Crocidura cyanea	Reddish-gray Musk Shrew			LC (S)	LC	2	2
Crocidura fuscomurina	Bicolored Musk Shrew			LC (U)	LC	2	2
Crocidura hirta	Lesser Red Musk Shrew			LC (U)	LC	2	2
Crocidura mariquensis	Swamp Musk Shrew			LC (U)	**NT**	2	2

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	RSA RED LIST STATUS	QDS (MammalMAP 2017)	LO ON SITE
Crocidura silacea	Lesser Gray-brown Musk Shrew			LC (S)	LC	2	2
Suncus infinitesimus	Least Dwarf Shrew			LC (U)	LC	3	3
Suncus lixus	Greater Dwarf Shrew			LC (U)	LC	3	3
SUIDAE	**Hogs & pigs**						
Phacochoerus africanus	Common Warthog			LC (S)	LC	1	4
Potamochoerus larvatus (koiropotamus)	Bush-pig			LC (S)	LC	2	4
THRYONOMYIDAE	**Cane Rat**						
Thryonomys swinderianus	Greater Cane Rat			LC (U)	LC	3	4
VESPERTILIONIDAE	**House, pipistrelle, serotine & related bats**						
Eptesicus hottentotus	Long-tailed Serotine			LC (U)	LC	3	3
Miniopterus natalensis / shreibersii	Natal / Shreiber's Long-fingered Bat			LC (U)	LC	2	2
Myotis tricolor	Temminck's Myotis			LC (U)	LC	3	3
Neoromicia capensis	Cape Serotine			LC (S)	LC	2	2
Neoromicia zuluensis	Zulu Serotine			LC (U)	LC	2	2
Pipistrellus rusticus	Rusty Pipistrelle			LC (U)	LC	3	3
Scotophilus dinganii	Yellow-bellied House Bat			LC (U)	LC	2	2
VIVERRIDAE	**Civet & genets**						
Civettictis civetta	African Civet			LC (U)	LC	3	4
Genetta genetta	Common Genet			LC (S)	LC	2	3
Genetta maculata	Common Large- / Rusty-spotted Genet			LC(U)	LC	2	3
Genetta tigrina	Cape Genet			LC (U)	LC	2	3

Status: D = Declining; EN = Endangered; LC = Least Concern; NT = Near Threatened; PG = Protected Game; PS = Protected Species; PWA = Protected Wild Animal; S = Stable; VU = Vulnerable; U = Unknown population trend

Likelihood of Occurrence (LO): 1 = Present; 1* = Present according to anectodal account; 2 = High; 3 = Moderate; 4 = Low

Sources: Transvaal Nature Conservation Ordinance (1983); Stuart & Stuart (2007); NEM:BA ToPS (2015); IUCN (2016); MammalMAP (2017); DREAD (unpubl. data); SANBI & EWT (unpubl. data)

13.3. Bird list for the study area

SCIENTIFIC NAME	ALPHABETICAL COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (Roberts VII)	PENTAD (SABAP 2) OR QDS (SABAP 1)	LO ON SITE
Apalis thoracica	Apalis, Bar-throated		PG	LC	LC	1		2
Recurvirostra avosetta	Avocet, Pied		PG	LC	LC	1		4
Turdoides jardineii	Babbler, Arrow-marked		PG	LC	LC	1	1	1
Turdoides bicolor	Babbler, Southern Pied		PG	LC	LC	1	1	2
Tricholaema leucomelas	Barbet, Acacia Pied		PG	LC	LC	1	1	2
Lybius torquatus	Barbet, Black-collared		PG	LC	LC	1	1	1
Trachyphonus vaillantii	Barbet, Crested		PG	LC	LC	1	1	1
Batis molitor	Batis, Chinspot		PG	LC	LC	1	1	2
Merops persicus	Bee-eater, Blue-cheeked		PG	LC	LC	1		4
Merops apiaster	Bee-eater, European		PG	LC	LC	1	1	1
Merops pusillus	Bee-eater, Little		PG	LC	LC	1	1	2
Merops hirundineus	Bee-eater, Swallow-tailed		PG	LC	LC	1		3
Merops bullockoides	Bee-eater, White-fronted		PG	LC	LC	1	1	2
Euplectes orix	Bishop, Southern Red		WA	LC	LC	1	1	2
Euplectes afer	Bishop, Yellow-crowned		PG	LC	LC	1		3
Ixobrychus sturmii	Bittern, Dwarf		PG	LC	LC	1		4
Ixobrychus minutus	Bittern, Little		PG	LC	LC	1		4
Telophorus zeylonus	Bokmakierie		PG	LC	LC	1	1	2
Laniarius ferrugineus	Boubou, Southern		PG	LC	LC	1	1	1
Nilaus afer	Brubru		PG	LC	LC	1	1	2
Pycnonotus nigricans	Bulbul, African Red-eyed		WA	LC	LC	1	1	1
Pycnonotus tricolor	Bulbul, Dark-capped		WA	LC	LC	1	1	1
Emberiza capensis	Bunting, Cape		PG	LC	LC	1	1	2
Emberiza tahapisi	Bunting, Cinnamon-breasted		PG	LC	LC	1	1	2
Emberiza flaviventris	Bunting, Golden-breasted		PG	LC	LC	1	1	2
Emberiza impetuani	Bunting, Lark-like		PG	LC	LC	1		2
Malaconotus blanchoti	Bush-shrike, Grey-headed		PG	LC	LC	1		2
Ardeotis kori	Bustard, Kori	PS	PG	NT	NT	1		4
Turnix sylvaticus	Buttonquail, Common (Kurrichane)		PG	LC	LC	1		3
Buteo vulpinus	Buzzard, Common (Steppe)		PG	LC	LC	1	1	2
Pernis apivorus	Buzzard, European Honey		PG	LC	LC	1		4
Buteo rufofuscus	Buzzard, Jackal		PG	LC	LC	1		3
Kaupifalco monogrammicus	Buzzard, Lizard		PG	LC	LC	1		4
Camaroptera brevicaudata	Camaroptera, Grey-backed		PG	LC	LC	1	1	2

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Crithagra atrogularis	Canary, Black-throated		PG	LC	LC	1	1	1
Crithagra flaviventris	Canary, Yellow		PG	LC	LC	1	1	2
Crithagra mozambicus	Canary, Yellow-fronted		PG	LC	LC	1	1	2
Myrmecocichla formicivora	Chat, Ant-eating		PG	LC	LC	1	1	2
Cercomela familiaris	Chat, Familiar		PG	LC	LC	1	1	2
Thamnolaea cinnamomeiventris	Chat, Mocking Cliff		PG	LC	LC	1	1	2
Cisticola textrix	Cisticola, Cloud		PG	LC	LC	1	1	2
Cisticola aridulus	Cisticola, Desert		PG	LC	LC	1	1	2
Cisticola aberrans	Cisticola, Lazy		PG	LC	LC	1		2
Cisticola tinniens	Cisticola, Levaillant's		PG	LC	LC	1		2
Cisticola chiniana	Cisticola, Rattling		PG	LC	LC	1	1	3
Cisticola rufilatus	Cisticola, Tinkling		PG	LC	LC	1		3
Cisticola juncidis	Cisticola, Zitting		PG	LC	LC	1	1	3
Fulica cristata	Coot, Red-knobbed		PG	LC	LC	1	1	3
Phalacrocorax africanus	Cormorant, Reed		WA	LC	LC	1	1	2
Phalacrocorax carbo	Cormorant, White-breasted		WA	LC	LC	1	1	3
Centropus burchellii	Coucal, Burchell's		PG	LC	LC	1	1	2
Rhinoptilus chalcopterus	Courser, Bronze-winged		PG	LC	LC	1		2
Rhinoptilus africanus	Courser, Double-banded		PG	LC	LC	1		2
Cursorius temminckii	Courser, Temminck's		PG	LC	LC	1		3
Crecopsis egregia	Crake, African		PG	LC	LC	1		3
Porzana pusilla	Crake, Baillon's		PG	LC	LC	1		4
Amaurornis flavirostris	Crake, Black		PG	LC	LC	1		2
Porzana porzana	Crake, Spotted		PG	LC	LC	1		4
Anthropoides paradiseus	Crane, Blue	PS	PG	VU	NT	1		4
Sylvietta rufescens	Crombec, Long-billed		PG	LC	LC	1	1	2
Corvus capensis	Crow, Cape		WA	LC	LC	1	1	2
Corvus albus	Crow, Pied		WA	LC	LC	1	1	1
Cuculus gularis	Cuckoo, African		PG	LC	LC	1		2
Cuculus clamosus	Cuckoo, Black		PG	LC	LC	1	1	2
Cuculus canorus	Cuckoo, Common		PG	LC	LC	1		2
Chrysococcyx caprius	Cuckoo, Diederik		PG	LC	LC	1	1	2
Clamator glandarius	Cuckoo, Great Spotted		PG	LC	LC	1		2
Clamator jacobinus	Cuckoo, Jacobin		PG	LC	LC	1	1	2
Chrysococcyx klaas	Cuckoo, Klaas's		PG	LC	LC	1	1	1
Clamator levaillantii	Cuckoo, Levaillant's		PG	LC	LC	1		2

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Cuculus solitarius	Cuckoo, Red-chested		PG	LC	LC	1	1	2
Campephaga flava	Cuckooshrike, Black		PG	LC	LC	1	1	1
Anhinga rufa	Darter, African		PG	LC	LC	1		3
Streptopelia capicola	Dove, Cape Turtle		WA	LC	LC	1	1	1
Turtur chalcospilos	Dove, Emerald-spotted Wood		PG	LC	LC	1	1	3
Streptopelia senegalensis	Dove, Laughing		WA	LC	LC	1	1	1
Oena capensis	Dove, Namaqua		PG	LC	LC	1	1	2
Streptopelia semitorquata	Dove, Red-eyed		WA	LC	LC	1	1	2
Columba livia	Dove, Rock		PG	LC	LC	1		2
Dicrurus adsimilis	Drongo, Fork-tailed		PG	LC	LC	1	1	1
Anas sparsa	Duck, African Black		PG	LC	LC	1		3
Dendrocygna bicolor	Duck, Fulvous Whistling		PG	LC	LC	1		4
Sarkidiornis melanotos	Duck, Knob-billed		PG	LC	LC	1	1	4
Oxyura maccoa	Duck, Maccoa		PG	NT	NT	1		4
Thalassornis leuconotus	Duck, White-backed		PG	LC	LC	1		4
Dendrocygna viduata	Duck, White-facedWhistling		PG	LC	LC	1	1	3
Anas undulata	Duck, Yellow-billed		OG	LC	LC	1	1	2
Haliaeetus vocifer	Eagle, African Fish		PG	LC	LC	1		4
Aquila spilogaster	Eagle, African Hawk		PG	LC	LC	1		3
Hieraaetus ayresii	Eagle, Ayres's Hawk		PG	LC	LC	1		4
Circaetus pectoralis	Eagle, Black-chested Snake		PG	LC	LC	1	1	2
Hieraaetus pennatus	Eagle, Booted		PG	LC	LC	1		4
Circaetus cinereus	Eagle, Brown Snake		PG	LC	LC	1	1	2
Clanga pomarina	Eagle, Lesser Spotted		PG	LC	LC	1		3
Polemaetus bellicosus	Eagle, Martial	EN	PG	VU	EN	1		4
Aquila nipalensis	Eagle, Steppe		PG	EN	LC	1		4
Aquila rapax	Eagle, Tawny	EN	PG	LC	EN	1		4
Aquila verreauxii	Eagle, Verreauxs'		PG	LC	VU	1	1	4
Aquila wahlbergi	Eagle, Wahlberg's		PG	LC	LC	1	1	2
Egretta alba	Egret, Great		PG	LC	LC	1		4
Egretta garzetta	Egret, Little		PG	LC	LC	1		3
Bubulcus ibis	Egret, Western Cattle		PG	LC	LC	1	1	2
Egretta intermedia	Egret, Yellow-billed		PG	LC	LC	1		4
Eremomela usticollis	Eremomela, Burnt-necked		PG	LC	LC	1	1	2
Eremomela icteropygialis	Eremomela, Yellow-bellied		PG	LC	LC	1		2
Falco amurensis	Falcon, Amur		PG	LC	LC	1		2

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Falco biarmicus	Falcon, Lanner		PG	LC	VU	1	1	3
Falco vespertinus	Falcon, Red-footed		PG	NT	NT	1		3
Falco chicquera	Falcon, Red-necked		PG	LC	LC	1		3
Amadina fasciata	Finch, Cut-throat		PG	LC	LC	1	1	2
Amadina erythrocephala	Finch, Red-headed		PG	LC	LC	1	1	2
Sporopipes squamifrons	Finch, Scaly-feathered		PG	LC	LC	1	1	2
Podica senegalensis	Finfoot, African		PG	LC	VU	1		4
Lagonosticta rubricata	Firefinch, African		PG	LC	LC	1		2
Lagonosticta rhodopareia	Firefinch, Jameson's		PG	LC	LC	1		2
Lagonosticta senegala	Firefinch, Red-billed		PG	LC	LC	1	1	2
Lanius collaris	Fiscal, Southern (Common)		PG	LC	LC	1	1	1
Phoenicopterus roseus	Flamingo, Greater		PG	LC	NT	1		4
Phoeniconaias minor	Flamingo, Lesser		PG	NT	NT	1		4
Terpsiphone viridis	Flycatcher, African Paradise		PG	LC	LC	1	1	2
Bradornis infuscatus	Flycatcher, Chat		PG	LC	LC	1		2
Stenostira scita	Flycatcher, Fairy		PG	LC	LC	1		2
Sigelus silens	Flycatcher, Fiscal		PG	LC	LC	1	1	2
Myioparus plumbeus	Flycatcher, Grey Tit-		PG	LC	LC	1		2
Bradornis mariquensis	Flycatcher, Marico		PG	LC	LC	1	1	2
Melaenornis pammelaina	Flycatcher, Southern Black		PG	LC	LC	1	1	2
Muscicapa striata	Flycatcher, Spotted		PG	LC	LC	1		2
Peliperdix coqui	Francolin, Coqui		OG	LC	LC	1		4
Dendroperdix sephaena	Francolin, Crested		OG	LC	LC	1	1	2
Scleroptila levaillantoides	Francolin, Orange River		OG	LC	LC	1	1	3
Corythaixoides concolor	Go-away-bird, Grey		PG	LC	LC	1	1	1
Limosa limosa	Godwit, Black-tailed		PG	NT	NA	1		4
Alopochen aegyptiacus	Goose, Egyptian		OG	LC	LC	1	1	1
Plectropterus gambensis	Goose, Spur-winged		OG	LC	LC	1		4
Melierax gabar	Goshawk, Gabar		PG	LC	LC	1		3
Melierax canorus	Goshawk, Pale Chanting		PG	LC	LC	1	1	2
Podiceps nigricollis	Grebe, Black-necked		PG	LC	LC	1		4
Podiceps cristatus	Grebe, Great Crested		PG	LC	LC	1		3
Tachybaptus ruficollis	Grebe, Little		PG	LC	LC	1	1	3
Tringa nebularia	Greenshank, Common		PG	LC	LC	1		4
Numida meleagris	Guineafowl, Helmeted		PG	LC	LC	1	1	3
Chroicocephalus cirrocephalus	Gull, Grey-headed		PG	LC	LC	1		4

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Scopus umbretta	Hamerkop		PG	LC	LC	1	1	2
Circus ranivorus	Harrier, African Marsh		PG	LC	EN	1		4
Circus maurus	Harrier, Black		PG	VU	EN	1		4
Circus pygargus	Harrier, Montagu's		PG	LC	LC	1		4
Circus macrourus	Harrier, Pallid		PG	NT	NT	1		4
Aviceda cuculoides	Hawk, African Cuckoo		PG	LC	LC	1		2
Polyboroides typus	Hawk, African Harrier-		PG	LC	LC	1		2
Prionops plumatus	Helmet-shrike, White-crested		PG	LC	LC	1	1	3
Egretta ardesiaca	Heron, Black		PG	LC	LC	1		4
Nycticorax nycticorax	Heron, Black-crowned Night		PG	LC	LC	1		3
Ardea melanocephala	Heron, Black-headed		PG	LC	LC	1	1	2
Butorides striata	Heron, Green-backed		PG	LC	LC	1		3
Ardea cinerea	Heron, Grey		PG	LC	LC	1	1	2
Ardea purpurea	Heron, Purple		PG	LC	LC	1		4
Ardeola ralloides	Heron, Squacco		PG	LC	LC	1		4
Gorsachius leuconotus	Heron, White-backed Night		PG	LC	VU	1		3
Falco subbuteo	Hobby, Eurasian		PG	LC	LC	1		3
Prodotiscus regulus	Honeybird, Brown-backed		PG	LC	LC	1		2
Indicator indicator	Honeyguide, Greater		PG	LC	LC	1		2
Indicator minor	Honeyguide, Lesser		PG	LC	LC	1		3
Upupa africana	Hoopoe, African		PG	LC	LC	1	1	1
Tockus nasutus	Hornbill, African Grey		PG	LC	LC	1	1	1
Tockus erythrorhynchus	Hornbill, Southern Red-billed		PG	LC	LC	1	1	2
Tockus leucomelas	Hornbill, Southern Yellow-billed		PG	LC	LC	1	1	2
Threskiornis aethiopicus	Ibis, African Sacred		PG	LC	LC	1		2
Plegadis falcinellus	Ibis, Glossy		PG	LC	LC	1		2
Bostrychia hagedash	Ibis, Hadeda		PG	LC	LC	1	1	1
Vidua purpurascens	Indigobird, Purple		PG	LC	LC	1		4
Vidua chalybeata	Indigobird, Village		PG	LC	LC	1		3
Actophilornis africanus	Jacana, African		PG	LC	LC	1		4
Falco rupicoloides	Kestrel, Greater		PG	LC	LC	1	1	2
Falco rupicolus	Kestrel, Rock		PG	LC	LC	1		3
Halcyon albiventris	Kingfisher, Brown-hooded		PG	LC	LC	1	1	2
Megaceryle maximus	Kingfisher, Giant		PG	LC	LC	1		2
Halcyon leucocephala	Kingfisher, Grey-headed		PG	LC	LC	1		4
Alcedo cristata	Kingfisher, Malachite		PG	LC	LC	1	1	2

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Ceryle rudis	Kingfisher, Pied		PG	LC	LC	1		2
Halcyon chelicuti	Kingfisher, Striped		PG	LC	LC	1	1	4
Halcyon senegalensis	Kingfisher, Woodland		PG	LC	LC	1	1	2
Milvus migrans	Kite, Black		PG	LC	LC	1		3
Elanus caeruleus	Kite, Black-shouldered		PG	LC	LC	1	1	1
Milvus aegyptius	Kite, Yellow-billed		PG	LC	LC	1	1	2
Afrotis afraoides	Korhaan, Northern Black		PG	LC	LC	1	1	4
Lophotis ruficrista	Korhaan, Red-crested		PG	LC	LC	1	1	4
Eupodotis senegalensis	Korhaan, White-bellied		PG	LC	VU	1	1	4
Vanellus senegallus	Lapwing, African Wattled		PG	LC	LC	1	1	2
Vanellus armatus	Lapwing, Blacksmith		PG	LC	LC	1	1	2
Vanellus coronatus	Lapwing, Crowned		PG	LC	LC	1	1	2
Eremopterix leucotis	Lark, Chestnut-backed Sparrow-		PG	LC	LC	1	1	2
Mirafra fasciolata	Lark, Eastern Clapper		PG	LC	LC	1	1	3
Calendulauda africanoides	Lark, Fawn-coloured		PG	LC	LC	1		3
Eremopterix verticalis	Lark, Grey-backed Sparrow		PG	LC	LC	1	1	2
Mirafra cheniana	Lark, Melodious		PG	NT	LC	1	1	4
Mirafra passerina	Lark, Monotonous		PG	LC	LC	1		2
Spizocorys conirostris	Lark, Pink-billed		PG	LC	LC	1		3
Calandrella cinerea	Lark, Red-capped		PG	LC	LC	1	1	2
Mirafra africana	Lark, Rufous-naped		PG	LC	LC	1	1	2
Calendulauda sabota	Lark, Sabota		PG	LC	LC	1	1	1
Certhilauda chuana	Lark, Short-clawed		PG	LC	NT	1		3
Chersomanes albofasciata	Lark, Spike-heeled		PG	LC	LC	1	1	2
Macronyx capensis	Longclaw, Cape		PG	LC	LC	1	1	4
Spermestes cucullatus	Mannikin, Bronze		PG	LC	LC	1	1	2
Riparia cincta	Martin, Banded		PG	LC	LC	1	1	2
Riparia paludicola	Martin, Brown-throated		PG	LC	LC	1		2
Delichon urbicum	Martin, Common House		PG	LC	LC	1	1	2
Hirundo fuligula	Martin, Rock		PG	LC	LC	1	1	1
Riparia riparia	Martin, Sand		PG	LC	LC	1		4
Gallinula chloropus	Moorhen, Common		PG	LC	LC	1	1	3
Urocolius indicus	Mousebird, Red-faced		WA	LC	LC	1	1	1
Colius striatus	Mousebird, Speckled		WA	LC	LC	1	1	1
Colius colius	Mousebird, White-backed		WA	LC	LC	1	1	2
Acridotheres tristis	Myna, Common		PG			1	1	1

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Cisticola fulvicapilla	Neddicky		PG	LC	LC	1	1	1
Caprimulgus europaeus	Nightjar, European		PG	LC	LC	1		3
Caprimulgus pectoralis	Nightjar, Fiery-necked		PG	LC	LC	1	1	3
Caprimulgus tristigma	Nightjar, Freckled		PG	LC	LC	1		4
Caprimulgus rufigena	Nightjar, Rufous-cheeked		PG	LC	LC	1		2
Oriolus larvatus	Oriole, Black-headed		PG	LC	LC	1	1	1
Oriolus oriolus	Oriole, Eurasian Golden		PG	LC	LC	1		3
Pandion haliaetus	Osprey, Western		PG	LC	LC	1		4
Struthio camelus	Ostrich, Common			LC	LC	1		4
Tyto capensis	Owl, African Grass		PG	LC	VU	1		4
Otus senegalensis	Owl, African Scops		PG	LC	LC	1		2
Asio capensis	Owl, Marsh		PG	LC	LC	1		4
Ptilopsis granti	Owl, Southern White-faced		PG	LC	LC	1		2
Bubo africanus	Owl, Spotted Eagle-		PG	LC	LC	1		2
Bubo lacteus	Owl, Verreaux's Eagle-		PG	LC	LC	1		4
Tyto alba	Owl, Western Barn		PG	LC	LC	1		2
Glaucidium perlatum	Owlet, Pearl-spotted		PG	LC	LC	1	1	2
Buphagus erythrorhynchus	Oxpecker, Red-billed		PG	LC	LC	1	1	3
Poicephalus meyeri	Parrot, Meyer's		PG	LC	LC	1		3
Pelecanus onocrotalus	Pelican, Great White		PG	LC	VU	1		4
Pelecanus rufescens	Pelican, Pink-backed		PG	LC	VU	1		4
Anthoscopus minutus	Penduline-tit, Cape		PG	LC	LC	1	1	2
Anthoscopus caroli	Penduline-tit, Grey		PG	LC	LC	1		4
Petronia superciliaris	Petronia, Yellow-throated		PG	LC	LC	1		2
Treron calvus	Pigeon, African Green		PG	LC	LC	1		2
Columba arquatrix	Pigeon, African Olive		PG	LC	LC	1		3
Columba guinea	Pigeon, Speckled		PG	LC	LC	1	1	1
Anthus cinnamomeus	Pipit, African		PG	LC	LC	1	1	2
Anthus vaalensis	Pipit, Buffy		PG	LC	LC	1		2
Anthus caffer	Pipit, Bushveld		PG	LC	LC	1		2
Anthus similis	Pipit, Long-billed		PG	LC	LC	1	1	2
Anthus leucophrys	Pipit, Plain-backed		PG	LC	LC	1		2
Anthus lineiventris	Pipit, Striped		PG	LC	LC	1		4
Charadrius asiaticus	Plover, Caspian		PG	LC	LC	1		3
Charadrius pallidus	Plover, Chestnut-banded		PG	NT	NT	1		4
Charadrius hiaticula	Plover, Common Ringed		PG	LC	LC	1		4

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Charadrius pecuarius	Plover, Kittlitz's		PG	LC	LC	1		4
Charadrius tricollaris	Plover, Three-banded		PG	LC	LC	1		4
Charadrius marginatus	Plover, White-fronted		PG	LC	LC	1		4
Netta erythrophthalma	Pochard, Southern		PG	LC	LC	1		4
Glareola nordmanni	Pratincole, Black-winged		PG	NT	NT	1		4
Prinia flavicans	Prinia, Black-chested		PG	LC	LC	1	1	1
Prinia subflava	Prinia, Tawny-flanked		PG	LC	LC	1	1	1
Dryoscopus cubla	Puffback, Black-backed		PG	LC	LC	1	1	1
Pytilia melba	Pytilia, Green-winged		PG	LC	LC	1	1	1
Coturnix coturnix	Quail, Common		PG	LC	LC	1		3
Coturnix delegorguei	Quail, Harlequin		PG	LC	LC	1		4
Ortygospiza atricollis	Quail-finch, African		PG	LC	LC	1	1	2
Quelea quelea	Quelea, Red-billed		WA	LC	LC	1	1	2
Rallus caerulescens	Rail, African		PG	LC	LC	1		4
Cercotrichas paena	Robin, Kalahari Scrub		PG	LC	LC	1	1	1
Cercotrichas leucophrys	Robin, White-browed Scrub		PG	LC	LC	1	1	1
Cossypha caffra	Robin-chat, Cape		PG	LC	LC	1	1	1
Cossypha humeralis	Robin-chat, White-throated		PG	LC	LC	1		1
Coracias garrulus	Roller, European		PG	LC	NT	1	1	2
Coracias caudatus	Roller, Lilac-breasted		PG	LC	LC	1	1	2
Coracias naevius	Roller, Purple		PG	LC	LC	1		3
Philomachus pugnax	Ruff		PG	LC	LC	1		4
Pterocles burchelli	Sandgrouse, Burchell's		PG	LC	LC	1		2
Pterocles bicinctus	Sandgrouse, Double-banded		PG	LC	LC	1		3
Actitis hypoleucos	Sandpiper, Common		PG	LC	LC	1		4
Calidris ferruginea	Sandpiper, Curlew		PG	NT	LC	1		4
Tringa ochropus	Sandpiper, Green		PG			1		4
Tringa stagnatilis	Sandpiper, Marsh		PG	LC	LC	1		4
Tringa glareola	Sandpiper, Wood		PG	LC	LC	1		4
Rhinopomastus cyanomelas	Scimitarbill, Common		PG	LC	LC	1	1	2
Sagittarius serpentarius	Secretarybird		PG	VU	VU	1	1	3
Crithagra gularis	Seedeater, Streaky-headed		PG	LC	LC	1		3
Tadorna cana	Shelduck, South African		PG	LC	LC	1		3
Accipiter badius	Shikra		PG	LC	LC	1		3
Anas smithii	Shoveler, Cape		PG	LC	LC	1		3
Laniarius atrococcineus	Shrike, Crimson-breasted		PG	LC	LC	1	1	2

SCIENTIFIC NAME	ALPHABETICAL COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (Roberts VII)	PENTAD (SABAP 2) OR QDS (SABAP 1)	LO ON SITE
Lanius minor	Shrike, Lesser Grey		PG	LC	LC	1	1	2
Corvinella melanoleuca	Shrike, Magpie		PG	LC	LC	1	1	2
Lanius collurio	Shrike, Red-backed		PG	LC	LC	1	1	2
Eurocephalus anguitimens	Shrike, Southern White-crowned		PG	LC	LC	1		2
Gallinago nigripennis	Snipe, African		PG	LC	LC	1		2
Passer melanurus	Sparrow, Cape		WA	LC	LC	1	1	2
Passer motitensis	Sparrow, Great		PG	LC	LC	1	1	2
Passer domesticus	Sparrow, House		PG			1	1	2
Passer diffusus	Sparrow, Southern Grey-headed		PG	LC	LC	1	1	2
Accipiter melanoleucus	Sparrowhawk, Black		PG	LC	LC	1		4
Accipiter minullus	Sparrowhawk, Little		PG	LC	LC	1		4
Accipiter ovampensis	Sparrowhawk, Ovambo		PG	LC	LC	1		4
Plocepasser mahali	Sparrow-weaver, White-browed		PG	LC	LC	1	1	2
Platalea alba	Spoonbill, African		PG	LC	LC	1		4
Pternistis natalensis	Spurfowl, Natal		OG	LC	LC	1		3
Pternistis swainsonii	Spurfowl, Swainson's		PG	LC	LC	1	1	3
Lamprotornis australis	Starling, Burchell's		PG	LC	LC	1	1	2
Lamprotornis nitens	Starling, Cape Glossy		PG	LC	LC	1	1	1
Lamprotornis bicolor	Starling, Pied		PG	LC	LC	1		2
Onychognathus morio	Starling, Red-winged		WA	LC	LC	1	1	1
Cinnyricinclus leucogaster	Starling, Violet-backed		PG	LC	LC	1	1	1
Creatophora cinerea	Starling, Wattled		PG	LC	LC	1	1	2
Himantopus himantopus	Stilt, Black-winged		PG	LC	LC	1		4
Calidris minuta	Stint, Little		PG	LC	LC	1		4
Saxicola torquatus	Stonechat, African		PG	LC	LC	1		2
Ciconia abdimii	Stork, Abdim's		PG	LC	NT	1		4
Ciconia nigra	Stork, Black		PG	LC	VU	1		4
Leptoptilos crumeniferus	Stork, Marabou		PG	LC	NT	1		3
Ciconia ciconia	Stork, White		PG	LC	LC	1		4
Mycteria ibis	Stork, Yellow-billed		PG	LC	EN	1		4
Chalcomitra amethystina	Sunbird, Amethyst		PG	LC	LC	1	1	2
Cinnyris mariquensis	Sunbird, Marico		PG	LC	LC	1	1	2
Cinnyris talatala	Sunbird, White-bellied		PG	LC	LC	1	1	1
Hirundo rustica	Swallow, Barn		PG	LC	LC	1	1	2
Hirundo cucullata	Swallow, Greater Striped		PG	LC	LC	1	1	1
Hirundo abyssinica	Swallow, Lesser Striped		PG	LC	LC	1	1	1

SCIENTIFIC NAME	ALPHABETICAL COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (Roberts VII)	PENTAD (SABAP 2) OR QDS (SABAP 1)	LO ON SITE
Hirundo dimidiata	Swallow, Pearl-breasted		PG	LC	LC	1		3
Hirundo semirufa	Swallow, Red-breasted		PG	LC	LC	1	1	1
Hirundo spilodera	Swallow, South African Cliff		PG	LC	LC	1		4
Hirundo albigularis	Swallow, White-throated		PG	LC	LC	1		3
Porphyrio madagascariensis	Swamphen, African (Purple)		PG	LC	LC	1		4
Apus barbatus	Swift, African Black		PG	LC	LC	1		3
Cypsiurus parvus	Swift, African Palm		PG	LC	LC	1	1	3
Tachymarptis melba	Swift, Alpine		PG	LC	LC	1		3
Apus apus	Swift, Common		PG	LC	LC	1	1	1
Apus horus	Swift, Horus		PG	LC	LC	1		2
Apus affinis	Swift, Little		PG	LC	LC	1	1	1
Apus caffer	Swift, White-rumped		PG	LC	LC	1	1	2
Tchagra senegalus	Tchagra, Black-crowned		PG	LC	LC	1	1	2
Tchagra australis	Tchagra, Brown-crowned		PG	LC	LC	1	1	2
Anas capensis	Teal, Cape		PG	LC	LC	1		3
Anas hottentota	Teal, Hottentot		PG	LC	LC	1		3
Anas erythrorhyncha	Teal, Red-billed		OG	LC	LC	1		2
Sterna caspia	Tern, Caspian		PG	LC	VU	1		4
Chlidonias hybrida	Tern, Whiskered		PG	LC	LC	1		4
Chlidonias leucopterus	Tern, White-winged		PG	LC	LC	1		4
Burhinus capensis	Thick-knee, Spotted		PG	LC	LC	1		2
Psophocichla litsipsirupa	Thrush, Groundscraper		PG	LC	LC	1	1	1
Turdus smithi	Thrush, Karoo		PG	LC	LC	1	1	2
Turdus libonyanus	Thrush, Kurrichane		PG	LC	LC	1	1	2
Monticola brevipes	Thrush, Short-toedRock		PG	LC	LC	1	1	2
Pogoniulus chrysoconus	Tinkerbird, Yellow-fronted		PG	LC	LC	1	1	2
Parus cinerascens	Tit, Ashy		PG	LC	LC	1	1	2
Parus niger	Tit, Southern Black		PG	LC	LC	1	1	2
Parisoma subcaeruleum	Tit-Babbler, Chestnut-vented		PG	LC	LC	1	1	1
Gyps coprotheres	Vulture, Cape	EN	PG	EN	EN	1	1	3
Torgos tracheliotus	Vulture, Lappet-faced	EN	PG	EN	EN	1	1	3
Gyps africanus	Vulture, White-backed	EN	PG	CR	CR	1		1
Motacilla aguimp	Wagtail, African Pied		PG	LC	LC	1		2
Motacilla capensis	Wagtail, Cape		PG	LC	LC	1	1	1
Motacilla flava	Wagtail, Western Yellow		PG	LC	LC	1		4
Acrocephalus baeticatus	Warbler, African Reed		PG	LC	LC	1		3

SCIENTIFIC NAME	ALPHABETICAL COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (Roberts VII)	PENTAD (SABAP 2) OR QDS (SABAP 1)	LO ON SITE
Calamonastes fasciolatus	Warbler, Barred Wren-		**PG**	LC	LC	1	1	2
Sylvia borin	Warbler, Garden		**PG**	LC	LC	1		3
Acrocephalus arundinaceus	Warbler, Great Reed		**PG**	LC	LC	1		4
Hippolais icterina	Warbler, Icterine		**PG**	LC	LC	1		4
Acrocephalus gracilirostris	Warbler, Lesser Swamp		**PG**	LC	LC	1		3
Bradypterus baboecala	Warbler, Little Rush		**PG**	LC	LC	1		3
Acrocephalus palustris	Warbler, Marsh		**PG**	LC	LC	1		4
Hippolais olivetorum	Warbler, Olive-tree		**PG**	LC	LC	1		4
Malcorus pectoralis	Warbler, Rufous-eared		**PG**	LC	LC	1		2
Acrocephalus schoenobaenus	Warbler, Sedge		**PG**	LC	LC	1		3
Phylloscopus trochilus	Warbler, Willow		**PG**	LC	LC	1	1	3
Estrilda erythronotos	Waxbill, Black-faced		**PG**	LC	LC	1	1	2
Uraeginthus angolensis	Waxbill, Blue		**PG**	LC	LC	1	1	1
Estrilda astrild	Waxbill, Common		**PG**	LC	LC	1	1	2
Amandava subflava	Waxbill, Orange-breasted		**PG**	LC	LC	1		3
Granatina granatina	Waxbill, Violet-eared		**PG**	LC	LC	1	1	2
Ploceus capensis	Weaver, Cape		**WA**	LC	LC	1		1
Ploceus intermedius	Weaver, Lesser Masked		**PG**	LC	LC	1		2
Bubalornis niger	Weaver, Red-billed Buffalo		**PG**	LC	LC	1		4
Anaplectes rubriceps	Weaver, Red-headed		**PG**	LC	LC	1		3
Philetairus socius	Weaver, Sociable		**PG**	LC	LC	1	1	3
Ploceus velatus	Weaver, Southern Masked		**WA**	LC	LC	1	1	1
Ploceus cucullatus	Weaver, Village		**WA**	LC	LC	1		2
Oenanthe pileata	Wheatear, Capped		**PG**	LC	LC	1		2
Oenanthe monticola	Wheatear, Mountain		**PG**	LC	LC	1	1	2
Zosterops virens	White-eye, Cape		**PG**	LC	LC	1	1	1
Sylvia communis	Whitethroat, Common		**PG**	LC	LC	1	1	2
Vidua paradisaea	Whydah, Long-tailed Paradise		**PG**	LC	LC	1	1	2
Vidua macroura	Whydah, Pin-tailed		**PG**	LC	LC	1	1	2
Vidua regia	Whydah, Shaft-tailed		**PG**	LC	LC	1	1	2
Euplectes progne	Widowbird, Long-tailed		**PG**	LC	LC	1	1	4
Euplectes ardens	Widowbird, Red-collared		**PG**	LC	LC	1		4
Euplectes albonotatus	Widowbird, White-winged		**PG**	LC	LC	1	1	3
Phoeniculus purpureus	Wood-hoopoe, Green		**PG**	LC	LC	1	1	1
Dendropicos namaquus	Woodpecker, Bearded		**PG**	LC	LC	1	1	2
Campethera bennettii	Woodpecker, Bennett's		**PG**	LC	LC	1		2

SCIENTIFIC NAME	ALPHABETICAL COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (Roberts VII)	PENTAD (SABAP 2) OR QDS (SABAP 1)	LO ON SITE
Dendropicos fuscescens	Woodpecker, Cardinal		**PG**	LC	LC	1	1	2
Campethera abingoni	Woodpecker, Golden-tailed		**PG**	LC	LC	1	1	2

Status: CR = Critically Endangered; EN = Endangered; LC = Least Concern; NT = Near Threatened; OG = Ordinary Game; PG = Protected Game; PS = Protected Species; PWA = Protected Wild Animal; VU = Vulnerable; WA = Wild Animal
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low

Sources: Transvaal Nature Conservation Ordinance (1983); Roberts VII (2013); NEM:BA ToPS (2015); Taylor *et al.* (2015); BirdLife South Africa (2016); SABAP 2 (2017)

13.4. Reptile list for the study area

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	RED LIST STATUS	QDS (ReptileMAP 2017)	LO ON SITE
AGAMIDAE	**Agamas**					
Acanthocercus atricollis atricollis	Southern Tree Agama		**PG**	1LC	2	2
Agama aculeata distanti	Distant's Ground Agama		**PG**	1LC	1	2
Agama atra	Southern Rock Agama		**PG**	1LC	1	1
AMPHISBAENIDAE	**Worm lizards**					
Monopeltis capensis	Cape Worm Lizard		**PG**	1LC	4	4
CHAMAELEONIDAE	**Chameleons**					
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon		**PG**	2LC	2	1*
COLUBRIDAE	**Typical snakes**					
Crotaphopeltis hotamboeia	Red-lipped Snake		**WA**	2LC	2	2
Dasypeltis scabra	Rhombic Egg-eater		**WA**	2LC	2	2
Dispholidus typus typus	Boomslang		**WA**	2LC	1	2
Philothamnus semivariegatus	Spotted Bush Snake		**WA**	2LC	1	2
Telescopus semiannulatus semiannulatus	Eastern Tiger Snake		**WA**	2LC	3	3
CORDYLIDAE	**Crag, flat & girdled lizards**					
Cordylus jonesii	Jones' Girdled Lizard		**PG**	1LC	1	3
Cordylus vittifer	Common Girdled Lizard		**PG**	1LC	1	3
ELAPIDAE	**Cobras, mambas & relatives**					
Aspidelaps scutatus scutatus	Speckled Shield Cobra		**WA**	1LC	4	4
Dendroaspis polylepis	Black Mamba		**WA**	2LC	4	4
Elapsoidea sundevallii media	Highveld Garter Snake		**WA**	1LC	3	3
Naja annulifera	Snouted Cobra		**WA**	2LC	2	2
Naja mossambica	Mozambique Spitting Cobra		**WA**	2LC	1	2
GEKKONIDAE	**Geckos**					
Chondrodactylus turneri	Turner's Gecko		**PG**	1LC	2	2
Hemidactylus mabouia	Common Tropical House Gecko		**PG**	2LC	2	3
Homopholis wahlbergii	Wahlberg's Velvet Gecko		**PG**	1LC	4	4
Lygodactylus capensis capensis	Common Dwarf Gecko		**PG**	1LC	1	2
Pachydactylus capensis	Cape Gecko		**PG**	2LC	1	2
GERRHOSAURIDAE	**Plated lizards & seps**					
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard		**PG**	2LC	1	2
LACERTIDAE	**Typical lizards**					
Meroles squamulosus	Common Rough-scaled Lizard		**PG**	1LC	2	2
Nucras holubi	Holub's Sandveld Lizard		**PG**	2LC	2	2
Nucras intertexta	Spotted Sandveld Lizard		**PG**	2LC	3	3

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	RED LIST STATUS	QDS (ReptileMAP 2017)	LO ON SITE
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard		PG	2LC	1	1
LAMPROPHIIDAE	**Lamprophid snakes**					
Aparallactus capensis	Black-headed Centipede-eater		WA	2LC	2	2
Atractaspis bibronii	Bibron's Stiletto Snake		WA	2LC	4	4
Boaedon capensis	Brown House Snake		WA	2LC	2	2
Lycodonomorphus rufulus	Brown Water Snake		WA	1LC	1	2
Lycophidion capense capense	Cape Wolf Snake		WA	2LC	2	2
Prosymna bivittata	Two-striped Shovel-snout		WA	1LC	4	4
Psammophis brevirostris	Short-snouted Grass Snake		WA	1LC	1	2
Psammophis subtaeniatus	Western Yellow-bellied Sand Snake		WA	2LC	2	2
Psammophis trinasalis	Fork-marked Sand Snake		WA	2LC	1	2
Psammophylax tritaeniatus	Striped Grass Snake		WA	2LC	2	2
Pseudaspis cana	Mole Snake		WA	2LC	2	2
Xenocalamus bicolor bicolor	Bicoloured Quill-snouted Snake		WA	1LC	4	4
LEPTOTYPHLOPIDAE	**Thread snakes**					
Leptotyphlops scutifrons scutifrons	Peters' Thread Snake		WA	1LC	2	2
PELOMEDUSIDAE	**Terrapins**					
Pelomedusa galeata	South African Marsh Terrapin		PG		2	4
PYTHONIDAE	**Python**					
Python natalensis	Southern African Python	PS	WA	2LC	1*	3
SCINCIDAE	**Skinks**					
Acontias occidentalis	Western Legless Skink		PG	1LC	4	4
Mochlus (sundevallii) sundevallii	Sundevall's Writhing Skink		PG	2LC	1	2
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink		PG	1LC	2	2
Trachylepis capensis	Cape Skink		PG	2LC	1	2
Trachylepis punctatissima	Speckled Rock Skink		PG	2LC	1	1
Trachylepis punctulata	Speckled Sand Skink		PG	2LC	1	2
Trachylepis varia	Variable Skink		PG	2LC	1	2
TESTUDINIDAE	**Tortoises**				1*	
Kinixys lobatsiana	Lobatse Hinged Tortoise		PG	1LC	3	4
Kinixys spekii	Speke's Hinged Tortoise		PG	2LC	3	4
Psammobates oculifer	Serrated Tent Tortoise		PG	1LC	3	4
Stigmochelys pardalis	Leopard Tortoise		PG	1LC	3	4
TYPHLOPIDAE	**Blind snakes**					
Afrotyphlops bibronii	Bibron's Blind Snake		WA	1LC	2	2
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake		WA	2LC	1	2

FAMILY & SCIENTIFIC NAME	COMMON NAME	RSA LEGAL STATUS	NORTH WEST LEGAL STATUS	RED LIST STATUS	QDS (ReptileMAP 2017)	LO ON SITE
VARANIDAE	**Monitors**					
Varanus albigularis albigularis	Rock Monitor		**WA**	2LC	1*	4
Varanus niloticus	Water Monitor		**WA**	2LC	3	4
VIPERIDAE	**Adders**					
Bitis arietans arietans	Puff Adder		**WA**	2LC	1*	2

Status: 1 = Global status; 2 = Regional status; LC = Least Concern; PG = Protected Game; PS = Protected Species; WA = Wild Animal

Likelihood of Occurrence (LO): 1 = Present; 1* = Present according to anectodal account; 2 = High; 3 = Moderate; 4 = Low

Sources: Transvaal Nature Conservation Ordinance (1983); Bates *et al.* (2014); NEM:BA ToPS (2015); ReptileMAP (2017); DREAD (unpubl. data)

13.5. Frog list for the study area

FAMILY & SCIENTIFIC NAME	COMMON NAME	NORTH WEST LEGAL STATUS	GLOBAL RED LIST STATUS	REGIONAL RED LIST STATUS	QDS (FrogMAP 2017)	LO ON SITE
BREVICIPITIDAE	**Rain frogs**					
Breviceps adspersus adspersus	Bushveld Rain Frog		LC (U)	LC	2	2
BUFONIDAE	**True toads**					
Poyntonophrynus vertebralis	Southern Pygmy Toad		LC (U)	LC	2	3
Schismaderma carens	Red Toad		LC (U)	LC	1	1
Sclerophrys garmani	Olive Toad		LC (U)	LC	1	2
Sclerophrys gutturalis	Guttural Toad		LC (I)	LC	3	3
Sclerophrys poweri	Power's Toad		LC (U)	LC	3	3
HYPEROLIIDAE	**Leaf-folding & reed frogs**					
Kassina senegalensis	Bubbling Kassina		LC (U)	LC	1	3
MICROHYLIDAE	**Rubber frogs**					
Phrynomantis bifasciatus	Banded Rubber Frog		LC (U)	LC	1	3
PHRYNOBATRACHIDAE	**Puddle frogs**					
Phrynobatrachus natalensis	Snoring Puddle Frog		LC (S)	LC	2	3
PIPIDAE	**African clawed frogs**					
Xenopus laevis	Common Platanna		LC (I)	LC	2	2
PTYCHADENIDAE	**Grass frogs**					
Ptychadena anchietae	Plain Grass Frog		LC (U)	LC	1	1
Ptychadena mossambica	Broad-banded Grass Frog		LC (U)	LC	1	3
PYXICEPHALIDAE	**Moss, river, sand & stream frogs**					
Amietia quecketti	Queckett's River Frog		LC (S)	LC	2	2
Cacosternum boettgeri	Common Caco		LC (U)	LC	2	2
Pyxicephalus adspersus	Giant Bullfrog	**PG**	LC (D)	**NT**	1*	3
Pyxicephalus edulis	African Bullfrog		LC (U)	LC		3
Tomopterna cryptotis	Tremolo Sand Frog		LC (S)	LC	1	3
Tomopterna krugerensis	Knocking Sand Frog		LC (U)	LC	3	4
Tomopterna natalensis	Natal Sand Frog		LC (U)	LC	3	3
RHACOPHORIDAE	**Foam Nest Frog**					
Chiromantis xerampelina	Southern Foam Nest Frog		LC (U)	LC	2	3

Status: D = Declining; I = Increasing; LC = Least Concern; NT = Near Threatened; PG = Protected Game; S = Stable; U = Unknown population trend

Likelihood of Occurrence (LO): 1 = Present; 1* = Present according to anectodal account; 2 = High; 3 = Moderate; 4 = Low

Sources: Transvaal Nature Conservation Ordinance (1983); Minter *et al.* (2004); Du Preez & Carruthers (2009); IUCN (2013.1); NEM:BA ToPS (2015); FrogMap (2017); DREAD (unpubl. data)

13.6. Butterfly list for the study area

FAMILY & SCIENTIFIC NAME	COMMON NAME	NORTH WEST LEGAL STATUS	RED LIST STATUS	QDS (LepiMAP 2017)	LO ON SITE
HESPERIIDAE	**Sandmen, skippers, sylphs & relatives**				
Coeliades forestan forestan	Striped Policeman		1LC	3	3
Coeliades pisistratus	Two-pip Policeman		1LC	2	2
Gegenes niso niso	Common Hottentot		1LC	2	2
Gegenes pumilio gambica	Dark Hottentot		1LC	2	2
Leucochitonea levubu	White-cloaked Skipper		1LC	3	3
Platylesches ayresii	Peppered Hopper		1LC	4	1
Platylesches neba	Flower-girl Hopper		1LC	3	3
Spialia delagoae	Delagoa Sandman		1LC	3	3
Spialia diomus ferax	Common Sandman		1LC	2	2
Spialia mafa mafa	Mafa Sandman		1LC	2	2
Spialia paula	Mite Sandman		1LC	3	3
Spialia spio	Mountain Sandman		1LC	3	4
LYCAENIDAE	**Blues, coppers, opals & relatives**				
Aloeides taikosama	Dusky Copper		1LC	2	2
Anthene amarah amarah	Black Striped Hairtail		1LC	2	2
Anthene definita definita	Common Hairtail		1LC	3	3
Anthene talboti	Talbot's Hairtail		1LC	3	3
Axiocerses amanga amanga	Bush Scarlet		1LC	2	2
Axiocerses tjoane tjoane	Eastern Scarlet		1LC	2	2
Azanus jesous	Topaz Babul Blue		1LC	2	1
Azanus moriqua	Black-bordered Babul Blue		1LC	2	2
Azanus ubaldus	Velvet-spotted Babul Blue		1LC	2	2
Chilades trochylus	Grass Jewel		1LC	2	2
Cigaritis ella	Ella's Bar		1LC	2	2
Cigaritis natalensis	Natal Bar		1LC	3	3
Cigaritis phanes	Silvery Bar		1LC	3	3
Crudaria leroma	Silver Spotted Grey		1LC	3	3
Cupidopsis cissus cissus	Common Meadow Blue		1LC	3	3
Cupidopsis jobates jobates	Tailed Meadow Blue		1LC	2	2
Eicochrysops messapus mahallakoaena	Cupreous Blue		1LC	2	2
Lampides boeticus	Pea Blue		1LC	2	1

FAMILY & SCIENTIFIC NAME	COMMON NAME	NORTH WEST LEGAL STATUS	RED LIST STATUS	QDS (LepiMAP 2017)	LO ON SITE
Lepidochrysops glauca	Silvery Blue		1LC	3	3
Leptotes pirithous pirithous	Common Zebra Blue		1LC	2	2
Lepidochrysops plebeia plebeia	Twin-spot Blue		1LC	3	1
Pseudonacaduba sichela sichela	Dusky Line Blue		1LC	3	1
Tarucus sybaris sybaris	Dotted Blue		1LC	2	1
Tuxentius calice	White Pie		1LC	3	3
Tuxentius melaena melaena	Black Pie		1LC	2	2
Virachola antalus	Brown Playboy		1LC	3	3
Virachola dinochares	Apricot Playboy		1LC	2	2
Zintha hintza hintza	Hintza Pierrot		1LC	2	2
Zizeeria knysna knysna	African / Sooty Grass Blue		1LC	2	2
Zizula hylax	Tiny / Gaika Grass Blue		1LC	1	1
NYMPHALIDAE	**Acraeas, browns, charaxes & relatives**				
Acraea anemosa	Broad-bordered Acraea		1LC	2	2
Acraea axina	Little Acraea		1LC	3	3
Acraea caldarena caldarena	Black-tipped Acraea		1LC	3	3
Acraea horta	Garden Acraea		1LC	3	3
Acraea neobule neobule	Wandering Donkey Acraea		1LC	2	2
Acraea stenobea	Suffused Acraea		1LC	3	3
Byblia anvatara acheloia	Joker		1LC	3	3
Byblia ilithyia	Spotted Joker		1LC	2	1
Catacroptera cloanthe cloanthe	Pirate		1LC	3	3
Charaxes jasius saturnus	Foxy Charaxes	**SCH**	1LC	3	3
Coenyropsis natalii natalii	Natal Brown		1LC	3	3
Danaus chrysippus orientis	African Monarch, Plain Tiger		1LC	2	1
Hamanumida daedalus	Guinea-fowl Butterfly		1LC	2	1
Heteropsis perspicua perspicua	Eyed Bush Brown		1LC	3	3
Hypolimnas misippus	Common Diadem		1LC	2	2
Junonia hierta cebrene	Yellow Pansy		1LC	2	1
Junonia oenone oenone	Blue Pansy		1LC	3	3
Junonia orithya madagascariensis	Eyed Pansy		1LC	3	3
Phalanta phalantha aethiopica	African Leopard		1LC	2	2
Physcaeneura panda	Dark-webbed Ringlet		1LC	2	2

FAMILY & SCIENTIFIC NAME	COMMON NAME	NORTH WEST LEGAL STATUS	RED LIST STATUS	QDS (LepiMAP 2017)	LO ON SITE
Precis archesia archesia	Garden Commodore		1LC	2	2
Telchinia rahira rahira	Marsh Acraea		1LC	3	3
Telchinia serena	Dancing Acraea		1LC	2	2
Vanessa cardui	Painted Lady		1LC	2	2
PAPILIONIDAE	**Swallowtails, swordtails & relatives**				
Papilio demodocus demodocus	Citrus Swallowtail		1LC	2	1
Papilio nireus lyaeus	Green-banded Swallowtail		1LC	2	3
PIERIDAE	**Tips, whites & relatives**				
Belenois aurota	Brown-veined White		1LC	2	1
Catopsilia florella	African Migrant		1LC	2	2
Colias electo electo	African Clouded Yellow		1LC	2	2
Colotis annae annae	Scarlet Tip		1LC	2	2
Colotis antevippe gavisa	Red Tip		1LC	2	2
Colotis euippe omphale	Smoky Orange Tip		1LC	2	2
Colotis evagore antigone	Small Orange Tip		1LC	2	2
Colotis evenina evenina	Orange Tip		1LC	2	2
Colotis lais	Kalahari Orange Tip		1LC	2	2
Colotis pallene	Bushveld Orange Tip		1LC	3	3
Colotis regina	Queen Purple Tip		1LC	3	3
Colotis vesta argillaceus	Veined Tip		1LC	3	3
Eurema brigitta brigitta	Broad-bordered Grass Yellow		1LC	2	1
Mylothris agathina agathina	Common Dotted Border		1LC	2	1
Mylothris rueppellii haemus	Twin Dotted Border		1LC	3	3
Pinacopteryx eriphia eriphia	Zebra White		1LC	2	2
Pontia helice helice	Common Meadow White		1LC	2	2
Teracolus agoye agoye	Speckled Sulphur Tip		1LC	3	3
Teracolus agoye bowkeri	Speckled Sulphur Tip		1LC	3	3
Teracolus eris eris	Banded Gold Tip		1LC	2	2
Teracolus subfasciatus	Lemon Traveller		1LC	2	2

Status: 1 = Global; LC = Least Concern; SCH = Schedule species

Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low

Sources: Transvaal Nature Conservation Ordinance (1983); Mecenero *et al.* (2013); LepiMAP (2017)

13.7. Odonata list for the study area

FAMILY & SCIENTIFIC NAME	COMMON NAME	BIOTIC INDEX SCORE	RSA RED LIST STATUS	QDS (Samways 2008)	LO ON SITE
AESHNIDAE	**Hawkers**				
Anax ephippiger	Vagrant Emperor	2		3	3
Anax imperator	Blue Emperor	1		3	4
Pinheyschna subpupillata	Stream Hawker	4		3	3
Zosteraeschna minuscula	Friendly Hawker	5		3	3
CHLOROCYPHIDAE	**Jewels**				
Platycypha caligata	Dancing Jewel	2		2	1
COENAGRIONIDAE	**Pond damsels**				
Ceriagrion glabrum	Common Citril	0		2	3
Ischnura senegalensis	Tropical / Marsh Bluetail	0		2	2
Pseudagrion kersteni	Powder-faced / Kersten's Sprite	1		2	1
Pseudagrion makabusiense	Makabusi / Green-striped Sprite	4	**VU**	3	4
Pseudagrion salisburyense	Slate Sprite	1		3	3
LESTIDAE	**Spreadwings**				
Lestes pallidus	Pallid / Pale Spreadwing	2		2	3
Lestes plagiatus	Highland Spreadwing	2		2	3
LIBELLULIDAE	**Skimmers**				
Brachythemis leucosticta	Southern Banded Groundling	2		2	2
Crocothemis erythraea	Broad Scarlet	0		2	1
Crocothemis sanguinolenta	Little Scarlet	3		2	2
Diplacodes luminans	Barbet Percher	3		3	3
Orthetrum chrysostigma	Epaulet Skimmer	2		2	2
Orthetrum guineense	Guinea Skimmer	4		3	1
Palpopleura jucunda	Yellow-veined Widow	2		2	3
Palpopleura lucia	Lucia Widow	2		3	3
Pantala flavescens	Wandering Glider / Pantala	0		3	3
Sympetrum fonscolombii	Red-veined Darter / Nomad	0		2	2
Tramea basilaris	Keyhole Glider	0		3	4
Trithemis annulata	Violet Dropwing	1		3	3
Trithemis arteriosa	Red-veined Dropwing	0		2	2
Trithemis donaldsoni	Denim Dropwing	4		2	2
Trithemis dorsalis	Highland / Round-hook Dropwing	0		3	4

FAMILY & SCIENTIFIC NAME	COMMON NAME	BIOTIC INDEX SCORE	RSA RED LIST STATUS	QDS (Samways 2008)	LO ON SITE
Trithemis furva	Navy Dropwing	0		3	3
Trithemis kirbyi	Orange-winged / Kirby's Dropwing	0		2	2
Trithemis stictica	Jaunty Dropwing	1		3	3
PLATYCNEMIDIDAE	**Featherlegs**				
Elattoneura glauca	Common Threadtail	1		2	2
SYNLESTIDAE	**Malachites**				
Chlorolestes fasciatus	Mountain Malachite	4		3	3

Status: VU = Vulnerable

Likelihood of Occurrence (LoO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low

Sources: Samways (2006); Samways (2008); OdonataMAP (2017)

13.8. Scorpion list for the study area

FAMILY & SCIENTIFIC NAME	QDS (Leeming 2003)	LO ON SITE
BUTHIDAE (Fat-tailed scorpions)		
Parabuthus granulatus	3	3
Parabuthus mossambicensis	2	2
Parabuthus transvaalicus	2	2
Uroplectes carinatus	2	2
Uroplectes planimanus	3	3
Uroplectes vittatus	3	3
HORMURIDAE (Flat rock scorpions)		
Hadogenes troglodytes	3	3
SCORPIONIDAE (Burrowing scorpions)		
Opistophthalmus carinatus	3	3
Opistophthalmus fitzsimonsi	3	3
Opistophthalmus glabrifrons	2	2

Likelihood of Occurrence (LO): 2 = High; 3 = Moderate

Sources: Leeming (2003)

13.9. CVs of relevant Senior NSS personnel

CURRICULUM VITAE

Name: **SUSAN ABELL (neé BRADLEY)**
Position: Senior Ecologist and Co-Owner of Natural Scientific Services

Date of Birth: 29 March 1976
Nationality: South African
Languages: English (mother tongue), Afrikaans

EDUCATIONAL QUALIFICATIONS

- MSc Resource Conservation Biology (Ecology) (2000 – 2001)
- B Sc Hons University of the Witwatersrand, Johannesburg (1999)
- B Sc University of the Witwatersrand, Johannesburg (1998)

KEY QUALIFICATIONS

- **Environmental Impact Assessment**:

  Compiled numerous Environmental Impact Assessments, Scoping Reports and Environmental Management Programmes as required by the Environment Conservation Act (Act No. 73 of 1989) and the National Environmental Management Act (Act 107 of 1998).

- **Specialist Assessments:**

  Over 14 years performing ecological and vegetation surveys within Southern Africa. Expertises are strong in the Savanna and Grasslands within Gauteng, North West, Limpopo, Mpumalanga, KwaZulu Natal, Lesotho and Botswana. Further experience within the Karoid Shrub, Kalahari and Fynbos Areas.

  GIS Mapping, Database management, GIS Modelling undertaken within specialist projects

- **Strategic / Spatial Planning**:

  Co-ordinated and managed strategic spatial planning projects in Gauteng, North West Province and Mpumalanga including the:

  - State of Environment Reporting
  - Gauteng Agricultural Potential Atlas (GAPA)
  - North West Biodiversity Site Inventory and Database Development Atlas
  - Tshwane Macro Open Space Policy
  - Biodiversity Database for Optimum Collieries (BHP Billiton)

- **Conference Presentations:**

  Undertaken numerous presentations at conferences (SAAB; IAIA)

- **Educational Training:**

Education training for organisations such as Wits University and Induction Training in Biodiversity Conservation for Mining Operations

EMPLOYMENT EXPERIENCE

Member & Senior Ecologist: Natural Scientific Services. Johannesburg (November 2004-Present)

- Project management and administration
- Project management and compilation of biodiversity assessments within savanna, karoid, fynbos and grassland systems including:
    - Ecological assessments
    - Vegetation/Habitat assessments;
    - Red Data Scans;
    - Ecological Screening, Opinions & Statements;
    - Wetland Assessments.
- Ecological Sensitivity Mapping;
- Project management and compilation of Biodiversity Management & Action Plans (BMAPS);
- Reserve Management Plans (examples below):
    - Blyde River Reserve Strategic Management Plan
    - Monate Reserve Management Plan
- Alien Invasive Management Plans;
- Project Management for Rehabilitation and Land-Use Plans;
- Management and specialist input into Green Star Rating Projects (Ecological Component);
- Environmental Impact Assessments and Scoping Reports;
- Project management and compilation of a number of Environmental Impact Control Reports (EICR) for waste management projects;
- Compilation of Conceptual Closure Plans for a number of mining operations;
- Tender and proposal compilation;
- Marketing;
- Liaison with clients and government officials; and
- Involvement in Specific GIS-related projects (examples below):
    - Blyde Strategic Management Plan
    - Visual Assessment for Natalspruit Hospital
    - Biodiversity Database – Optimum Collieries

Project Manager: Strategic Environmental Focus (SEF) (November 2003-October 2004)

- Project management and administration
- Project Management of and input into Ecological Assessments
- Tender and proposal compilation
- Marketing
- Liaison with clients and government officials
- Involvement in GIS-related projects.
    - Tshwane Open Space Project
    - Numerous State of the Environment Reports

Environmental Manager: SEF, Pretoria (April 2001- November 2003)

- Project management and administration
- Compilation of environmental assessments and scoping reports including:
- Tourism & Recreational developments
- Residential developments
- Commercial and industrial developments
- Liaison with government officials
- Management and input into GIS-related projects:
    - Gauteng Agricultural Potential Atlas (GAPA)
    - Gauteng Open Space Plan (GOSP)
    - North West Biodiversity Database Development

- Ecological Assessments / vegetation surveys / opinions/ Red Data Scans for various industries – mining, industrial, business, residential and sampling
- Sensitivity mapping

University of the Witwatersrand (Wits) 1999 – 2001

- Teaching Assistant:
- Mammalian surveys within Wits Rural Facility, Mpumalanga
- Vegetation sampling for SAFARI 2000- Kruger National Park
    - Scientific Paper: Koedoe Journal 44/1 2001
- Vegetation sampling Nylsvley Nature Reserve (2000)
- Monitoring and growth experiments (1998-1999) Electron and Transmission microscopy

MEMBERSHIPS IN PROFESSIONAL SOCIETY

- South African Council for Natural Scientific Professions (*Pr.Sci.Nat*)
- Botanical Society of South Africa
- International Association for Impact Assessment (IAIA)

PAPERS PUBLISHED

- Koedoe Journal 44/1 2001
- Proceedings: Microscopy Society of South Africa, 1999

PAPERS PRESENTED

- Proceedings of the Microscopy Society of Southern Africa, 1999
- Population dynamics and regeneration ecology of *Acacia nilotica* and *Acacia tortilis* in Nylsvley Nature Reserve, SAAB Conference 2000
- Tools for Cooperative Governance: North West Biodiversity Site Inventory And Database Development, IAIA Conference 2003

CURRICULUM VITAE

Name:	**CAROLINE ANGELA LöTTER (YETMAN)**
Firm:	Natural Scientific Services CC
Position:	Terrestrial Ecologist
Date of Birth:	6 November 1979
Nationality:	South African, British
Language:	English, Afrikaans

KEY EDUCATIONAL QUALIFICATIONS

- PhD Zoology (2012). Conservation biology of the Giant Bullfrog, *Pyxicephalus adspersus*. (University of Pretoria).
- MSc African Mammalogy (2002). Effects of body size on the activity budgets of African browsing ruminants. (University of Pretoria).
- BSc Honours Zoology (2001). Terrain ruggedness and forage patch use by African browsing ungulates. (University of Pretoria).
- BSc Ecology (2000). (University of Pretoria).

KEY EXPERIENCE

Specialist Assessments

- International Experience
  - Terrestrial faunal assessments in Sierra Leone (2011 & 2012).
  - Terrestrial faunal assessment in Lesotho (2012).

- Local Experience
  - Biodiversity Management Plans in Gauteng Province (2014-present).
  - Terrestrial faunal assessments in the Free State, Gauteng, Kwa-Zulu Natal, Limpopo, Mpumalanga, Northern Cape and North-West provinces (2011-present).
  - Long-term bat monitoring for wind farm developments in the Western, Eastern, Northern Cape and Kwa-Zulu Natal provinces (2012-2013).
  - Giant Bullfrog assessments in Gauteng, Limpopo, Mpumalanga and North-West provinces (2004-2011).

Research

- Analysis of acoustic bat data using AnalookW (2013).
- Species distribution modelling in MaxEnt (2008-2013).
- Geographic Information Systems (in ArcView and ArcGIS) (2001-2013).
- DNA sequencing and analysis (2003-2011).
- Histology (2003-2011).
- Amphibian and mammal radio- and spool-tracking (2003-2010).
- Amphibian and mammal mark-recapture (2001-2010).
- Extensive data analysis in Statistica (2001-2013).
- Vegetation sampling (1999-2001).
- Cricket behavioural studies (1999-2001).

Applied Conservation

- Biodiversity Management Plans for large gold mines in Gauteng Province (2014-present).
- Monitoring and mitigating impacts on bats at wind farms in South Africa, NSS (2012-2013).
- Giant Bullfrog conservation in South Africa, Endangered Wildlife Trust (2004-2007).
- Captive animal care at the National Zoological Gardens (1993-1998).

Lecturing

- Third year Animal Physiology (2007).
- First year Amphibian Practicals (2007-2012).

- Giant Bullfrogs (2003-2012).

KEY EMPLOYMENT EXPERIENCE

Natural Scientific Services, Johannesburg (November 2011 – present)

- Project Management
  - Biodiversity Management Plans in Gauteng Province (2014-present).
  - Biodiversity Assessments in Gauteng and Mpumalanga provinces (2012-present).
  - Long-term bat monitoring studies in the Western and Northern Cape provinces (2012-2013).
- Field work, data analysis and report writing
  - Terrestrial faunal assessments in Sierra Leone, Lesotho, and South Africa (2011-present).
  - Long-term bat monitoring for wind farm developments in the Western, Eastern, Northern Cape and Kwa-Zulu Natal provinces (2012-2013).

Exclusive Books, Woodlands Boulevard, Pretoria (2008-2011)

- Night-staff management and book sales.

University of Pretoria, Pretoria (1999-2011)

- Government Environmental Inspectorate exam invigilation and marking (2009-2011).
- Lecturing (2007-2011).
- Academic Programme Organizer for Dartmouth College, U.S.A. (2003-2007).
- Editorial Assistant for The Kruger Experience (2005) by Du Toit.
- Research Assistant for behavioural and evolution studies on crickets (1999-2001).

Endangered Wildlife Trust, Johannesburg (2004-2008)

- Project Executant of the Giant Bullfrog Project.

Biodiversity Foundation of Africa, Zimbabwe (December 2001)

- Insect and amphibian collecting expedition on the Barotse Floodplain, Zambia.

National Zoological Gardens, Pretoria (1993-1998)

- Public Educator.
- Assistant Nature Conservator.
- Junior Nature Conservator.

MEMBERSHIP IN PROFESSIONAL SOCIETIES

- International Association for Impact Assessment: 2014-present.
- Gauteng and Northern Regions Bat Interest Group: 2014-present.
- South African Council for Natural Scientific Professions: 2008-present.
- Herpetological Association of Africa: 2004-present.
- Zoological Society of Southern Africa: 2003-present.

PUBLICATIONS

Yetman, C.A., Verburgt, L. & S.D. Laurence (2015). Geographical distributions Pyxicephalidae *Pyxicephalus adspersus* Tschudi, 1838 Giant Bullfrog. *African Herp News* 62: 50-53.

Scott, E., Visser, J.D., Yetman, C.A. & Oliver, L. (2013). Revalidation of Pyxicephalus angusticeps Parry, 1982 (Anura: Natatanura: Pyxicephalidae), a bullfrog endemic to the lowlands of eastern Africa. *Zootaxa* 3599: 201–228.

Verburgt, L. & Yetman, C.A. (2012). Geographical Distributions: Amphibia: Anura: Pyxicephalidae: *Pyxicephalus adspersus* Tchudi, 1838 Giant Bullfrog. *African Herp News* 57: 18-20.

Yetman, C.A., P. Mokonoto & J.W.H. Ferguson (2012). Conservation implications of the age/size distribution of Giant Bullfrogs (*Pyxicephalus adspersus*) at three peri-urban breeding sites. *Herpetological Journal* 22: 23-32.

Yetman, C.A., P. Mokonoto & J.W.H. Ferguson (2012). Conservation implications of the age/size distribution of Giant Bullfrogs (*Pyxicephalus adspersus*) at three peri-urban breeding sites. *Herpetological Journal* 22: 23-32.

Yetman, C.A. & J.W.H. Ferguson (2011). Conservation implications of spatial habitat use by adult Giant Bullfrogs (*Pyxicephalus adspersus*). *Journal of Herpetology* 45: 56-62.

Yetman, C.A. & J.W.H. Ferguson (2011). Spawning and non-breeding activity of adult Giant Bullfrogs (*Pyxicephalus adspersus*). *African Journal of Herpetology* 60: 13-29.

Bateman, P.W., J.W.H. Ferguson & C.A. Yetman (2006). Courtship and copulation, but not ejaculates, reduce the longevity of female field crickets (*Gryllus bimaculatus*). *Journal of Zoology, London* 268: 341-346.

Du Toit, J.T. & C.A. Yetman (2005). Effects of body size on the diurnal activity budgets of African browsing ruminants. *Oecologia* 143: 317-325.

AWARDS

2010-2013: Podium positions for various 10km, 21km, 42km and +50km road and trail-running races in Gauteng, Mpumalanga, Limpopo and North-West provinces.
2012: PhD, Academic Honorary Colours, University of Pretoria.
2009: Best PhD Student Presentation, AGM, Dept. of Zoology & Entomology, University of Pretoria.
2005: Nominated: Science & Technology Category, Shoprite Checkers SABC 2 Woman of the Year.
2003: Best Student Presentation, Conference, Zoological Society of Southern Africa.
2003: MSc, Academic Honorary Colours, University of Pretoria.

OTHER TRAINING

- Permaculture (2016).
- First Aid (2013).
- Comrades Marathon (2012 & 2013)
- Climbing and Fall Arrest at height (2012).
- Basic 4x4ing (2010).
- Snake handling (2008).

CONFERENCES

2014 & 2015: Annual Oppenheimer De Beers Group Diamond Route Research Conference, Johannesburg, Gauteng.
2013: Annual Symposium of the Zoological Society of Southern Africa, Tshipise, Limpopo

13.10. Requirements under NEM:BA which have / have not been met in this report

REQUIREMENTS LISTED IN APPENDIX 6 IN GN R982	ADDRESSED IN 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;	Yes
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Yes
c) an indication of the scope of, and the purpose for which, the report was prepared;	Yes
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Yes
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Yes
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Yes
g) an identification of any areas to be avoided, including buffers;	Yes
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to beavoided, including buffers;	Yes
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Yes
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Yes
k) any mitigation measures for inclusion in the EMPr;	Yes
l) any conditions for inclusion in the environmental authorisation;	Yes
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Yes
n) a reasoned opinion i.as to whether the proposed activity or portions thereof should be authorised; and ii. if the opinion is that the proposed activity 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;	Yes
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	No - consultation process conducted for a broad level Ecoscan
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	As above
q) any other information requested by the competent authority.	Yes