Terrestrial Ecological Assessment
Bloemsmond Grid Connection Infrastructure
Between Keimoes and Upington
Northern Cape Province

June 2019

APPLICANT

Bloemsmond Grid (Pty) Ltd

ENVIRONMENTAL ASSESSMENT PRACTITIONER

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1 INTRODUCTION

1.1 PROJECT DETAILS AND BACKGROUND

Enviro-Insight CC was commissioned by Atlantic Energy Partners to perform a Terrestrial Ecological Assessment for the proposed powerline infrastructure supporting the Bloemsmond 1, 2, 3, 4 and 5 projects located between Keimoes and Upington in the Northern Cape Province, South Africa. This report was developed to conform to the requirements of Appendix 6 of the NEMA EIA Regulations (2014, as amended). The primary purpose of the study is to adequately assess the alternatives as well as the impacts of the proposed Bloemsmond Grid Connection Infrastructure.

In all cases above, Bloemsmond 1, 2, 3, 4 & 5 will connect at 132kV to the Upington Main Transmission Substation (MTS) via the 132kV Bloemsmond Collector Substation (either of, or a combination of, the approved Bloemsmond 1 and 2 Substations). The projects intend connecting to the National Grid via the Upington MTS.

1.2 PROJECT AREA OF INFLUENCE

The Project Area of Influence (PAOI) is located on Portion 5 and Portion 14 of the Farm Bloemsmond 455 in the Northern Cape Province. The proposed development is located south west of Upington and north east of Keimoes in the Kai !Garib Municipality in the ZF Mgcawu District Municipality in the Northern Cape (Figure 1-1; Figure 2-1).

1.3 STUDY LIMITATIONS

- It is assumed that all third party information acquired is correct (e.g. GIS data and scope of work);
- Due to the nature of most biophysical studies, it is not always possible to cover every square metre of a given PAOI. The main focus for this study was on protected tree species and provincially protected species;
- Even though the site visit occurred at the end of the wet season (end of April), site conditions were dry as the region has experienced a drought since 2017 (pers. comm. from landowner).
- The late-wet season timing had significant limitations regarding avifaunal migrants, many of which have left the region.
- The study period (length thereof) was considered to be rapid, in accordance with budget and Basic Assessment requirements. Therefore, more detailed surveys may render results reflecting greater detail, especially the number of protected species as well as their localities.
- The exact position of the powerlines, including pylons, will be finalised after the field investigation and subsequent reporting is complete. Multiple alternatives have been presented and were rapidly surveyed simultaneously during the study period. Therefore, the study is subject to some data extrapolation and interpretation from accompanying surveys.
- It is felt that the Impact Analysis is not representative (in their Scale, Magnitude and overall Severity) of the Cumulative Impact Assessment that may be applied to the PAOI which will show increased development of solar facilities and especially, supporting powerline infrastructure.

- During the site visit it was unknown where exactly supporting infrastructure (such as supporting roads and fences) will be placed. This information only became available after the review of the draft report, and was taken into account in the final report.

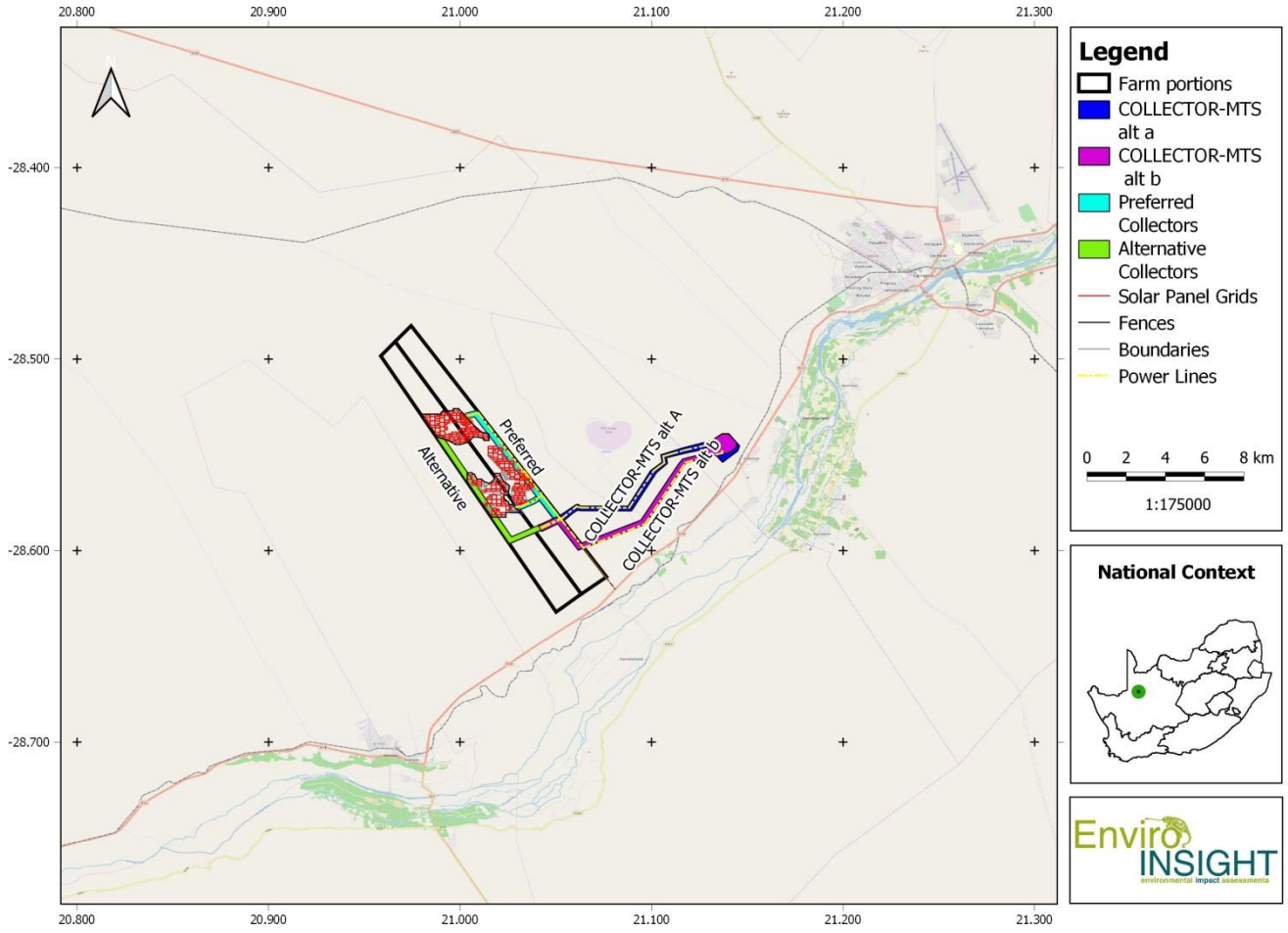

Figure 1-1: Locality of the PAOI of the proposed project.

2 METHODS

2.1 DESKTOP SURVEY

2.1.1 GIS

Existing data layers were incorporated into a GIS to establish how the proposed PAOI and associated activities interact with important terrestrial entities. Emphasis was placed on the following spatial datasets:

- Vegetation Map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2018);
- Northern Cape Critical Biodiversity Areas (Northern Cape Department of Environment and Nature Conservation, 2016);
- Important Bird Areas (BirdLife South Africa, 2015);

- Protected and Conservation areas of South Africa (South Africa Conservation Areas Database-SACAD)[1]; and
- National List of Threatened Ecosystems (SANBI, 2011).

All mapping was performed using open source GIS software (QGIS[2]).

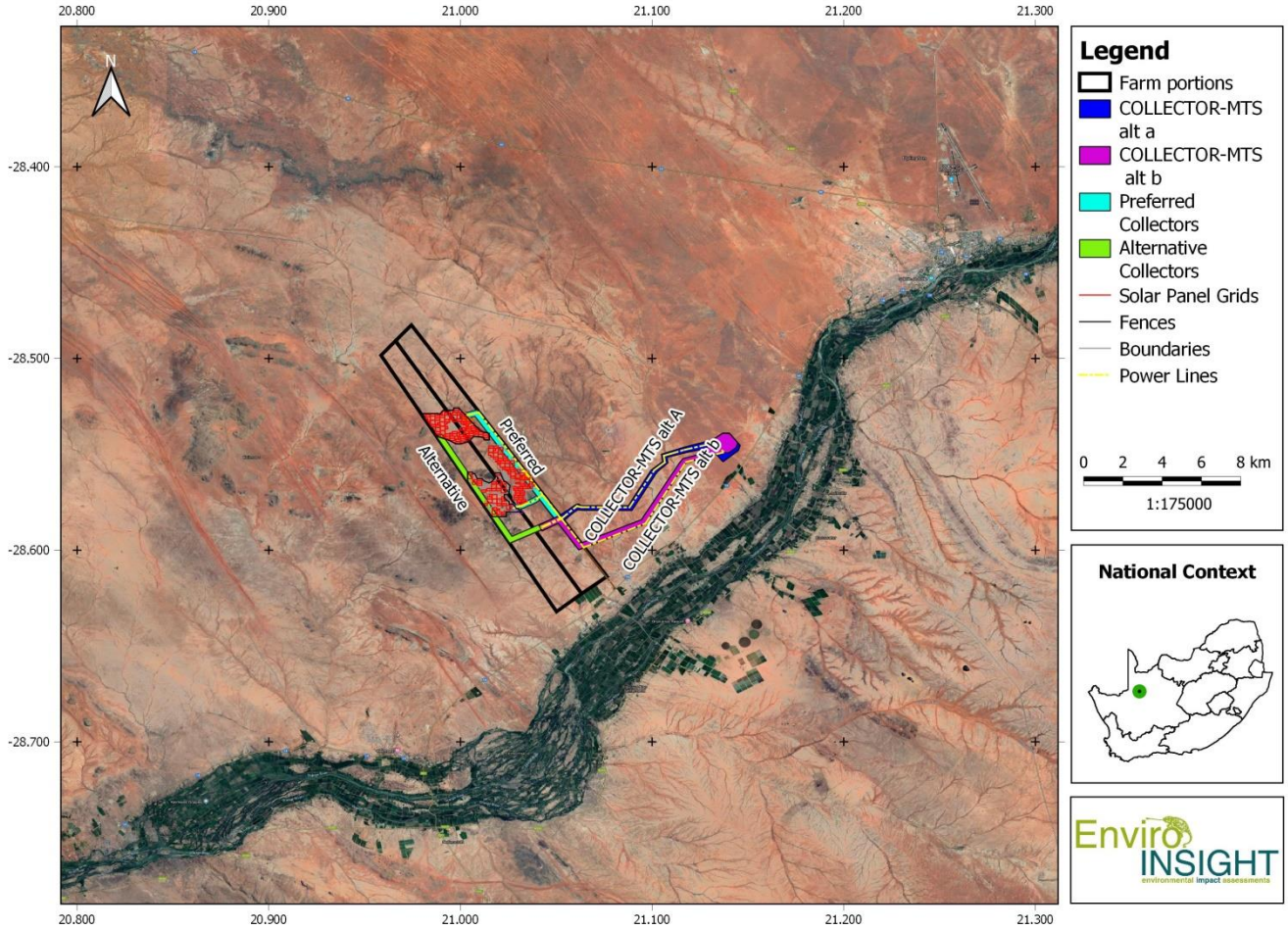

Figure 2-1: Satellite map of the PAOI.

2.1.2 Flora Assessment

A literature review was conducted as part of the desktop study to identify the potential habitats and flora species of conservation concern (SCC) present within the PAOI. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA) (SANBI, 2016[3]), to access

[1] http://dea.maps.arcgis.com/apps/MapTools/index.html?appid=2367540dd75148e8b6eaeab178a19d3a
2 http://qgis.osgeo.org/en/site/
3 http://newposa.sanbi.org/

distribution records on southern African plants[4]. This is a new database which replaces the old Plants of Southern Africa (POSA) database. The POSA database provided distribution data of flora at the quarter degree grid cell (QDGC) resolution; however, the BODATSA database provides distribution data as point coordinates. The literature study therefore, focussed on querying the database to generate species lists for the xMin, yMin 20.20°,-29.20° : xMax, yMax 21.4°,-28.20° extent (WGS84 datum) in order to increase the likelihood of obtaining a representative species list for the proposed PAOI. A total of 86 species were recorded for the mentioned location.

The Red List of South African Plants website (SANBI, 2019)[5] was utilized to provide the most current account of the national status of flora. Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- Guide to grasses of southern Africa (Van Oudtshoorn, 2014);
- Field guide to trees of southern Africa (Van Wyk & Van Wyk, 2013);
- Field guide to succulents of southern Africa (Smith *et al*. 2017);
- Field guide to wild flowers of South Africa (Manning, 2019);
- Problem plants and alien weeds of South Africa (Bromilow, 2019); and
- Identification guide to southern African grasses. An identification manual with keys, descriptions and distributions (Fish, Mashau, Moeaha, & Nembudani, 2015) and

Additional information regarding ecosystems, vegetation types, and SCC included the following sources:

- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2010); and
- Red List of South African Plants (Raimondo *et al*., 2009; SANBI, 2019).

2.1.3 Avifauna Assessment

A desktop study was undertaken in which bird species that could potentially occur in the vicinity of the PAOI were identified using data from the second South African Bird Atlas Project (SABAP 2; [SABAP2, 2019]). SABAP 2 records were developed based on records per pentad (i.e., 5' X 5'). To account for the high mobility of birds (inherent to linked habitats such as linear drainage lines), and the fact that atlas efforts are generally lower in remote areas, particularly away from public roads, a list of species potentially occurring within the PAOI was developed from SABAP 2 data for the pentads within the quarter degree grid cells (QDGCs) 280DB and 2821CA within which the study are falls, as well as all adjacent QDGCs pentads. This species list is therefore based on an area much larger than the actual PAOI. This approach was adopted to ensure that all species potentially occurring within the PAOI, whether resident, nomadic, or migratory, are identified.

4 Data are obtained from the National Herbarium in Pretoria (PRE), the Compton Herbarium in Cape Town (NBG & SAM) and the KwaZulu-Natal Herbarium in Durban (NH)
5 http://redlist.sanbi.org/

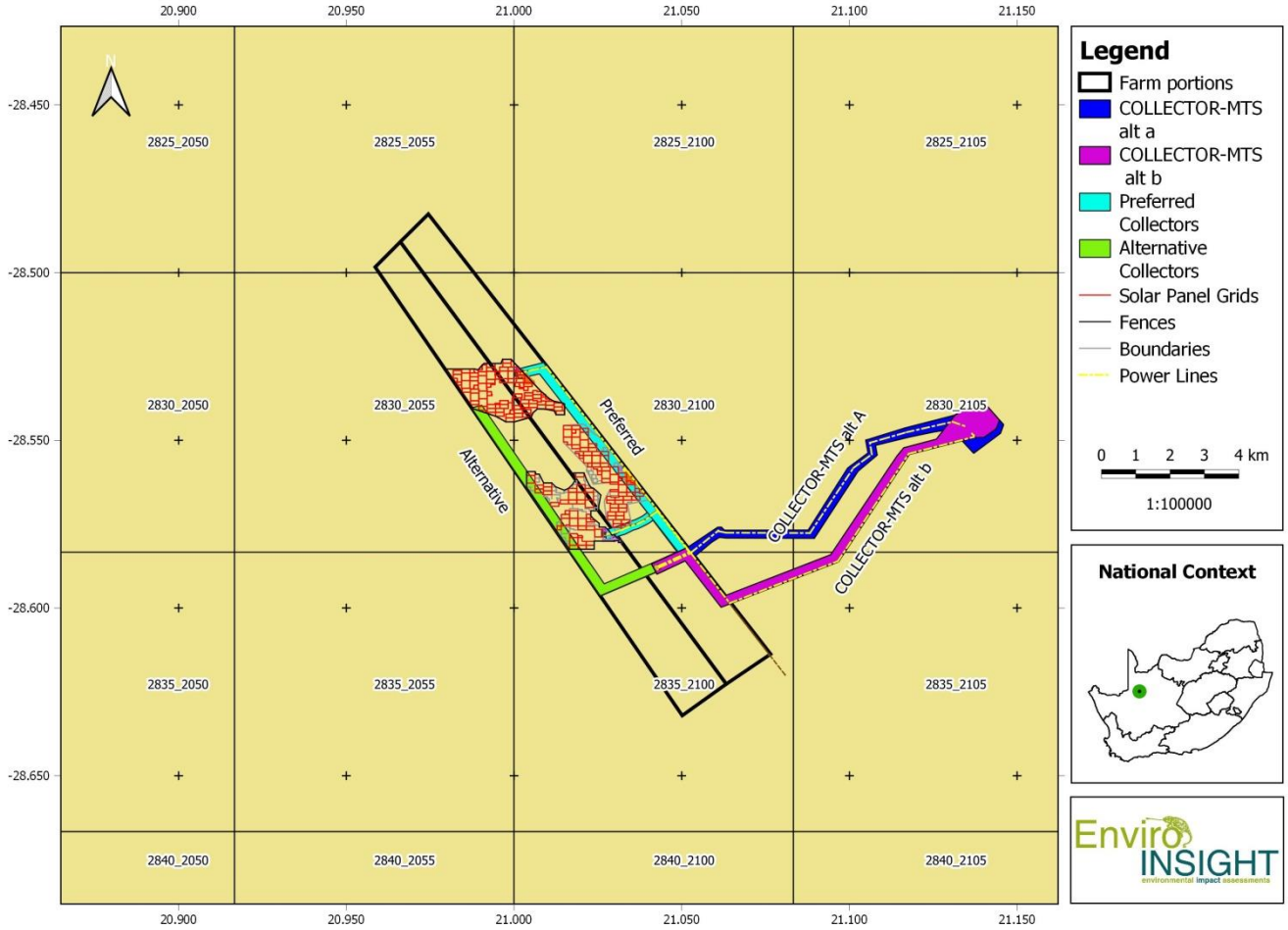

Figure 2-2: The PAOI in relation to the SABAP2 pentads.

The following main literature sources have been consulted for the avifauna study:

- Information relating to avifauna species of conservation concern (SCC) was obtained from the Southern Africa Bird Atlas Project (SABAP 2, 2019), Hockey *et al.* (2005) and Taylor *et al.* (2015);
- Hockey *et al.* (2005) were consulted for general information on the life history attributes of relevant bird species; and
- The conservation status of bird species is categorised according to Taylor *et al.* (2015) the IUCN Red List of threatened species (IUCN, 2019).

2.1.4 Mammal Assessment

The list of mammal species predicted to occur in the region and their respective likelihood of occurrence within the PAOI was generated based on known distributions and habitat suitability, sourced from online and literature sources such as MammalMap (2019), Skinner & Chimimba (2005) and Stuart & Stuart (1998). The literature study focussed on querying the MammalMap database to generate species lists for the 2820DB and 2821CA QDGCs. The predicted list is heavily influenced

by factors other than just distribution or biome type. Factors such as habitat suitability, current land use, current levels of disturbance and structural integrity of the habitats all influence the potential for a species to occur in the vicinity of PAOI. The key literature sources used during the mammal literature review included:

- MammalMAP (2019) - The online Virtual Museum (VM) facility of the Animal Demography Unit (ADU) of the University of Cape Town (http://vmus.adu.org.za);
- Mammal SCC information was obtained from Child *et al.* (2017);
- Lists of nationally protected species according to NEMBA (2004, as amended);
- Liebenberg (2005) and Stuart & Stuart (1998) were consulted to aid with identification of tracks and signs;
- Geographic distribution and general data were acquired from MammalMap (2019) and from Skinner & Chimimba (2007); and
- Minimum standards regarding the sampling of mammals were acquired from (Sutherland, 2006).

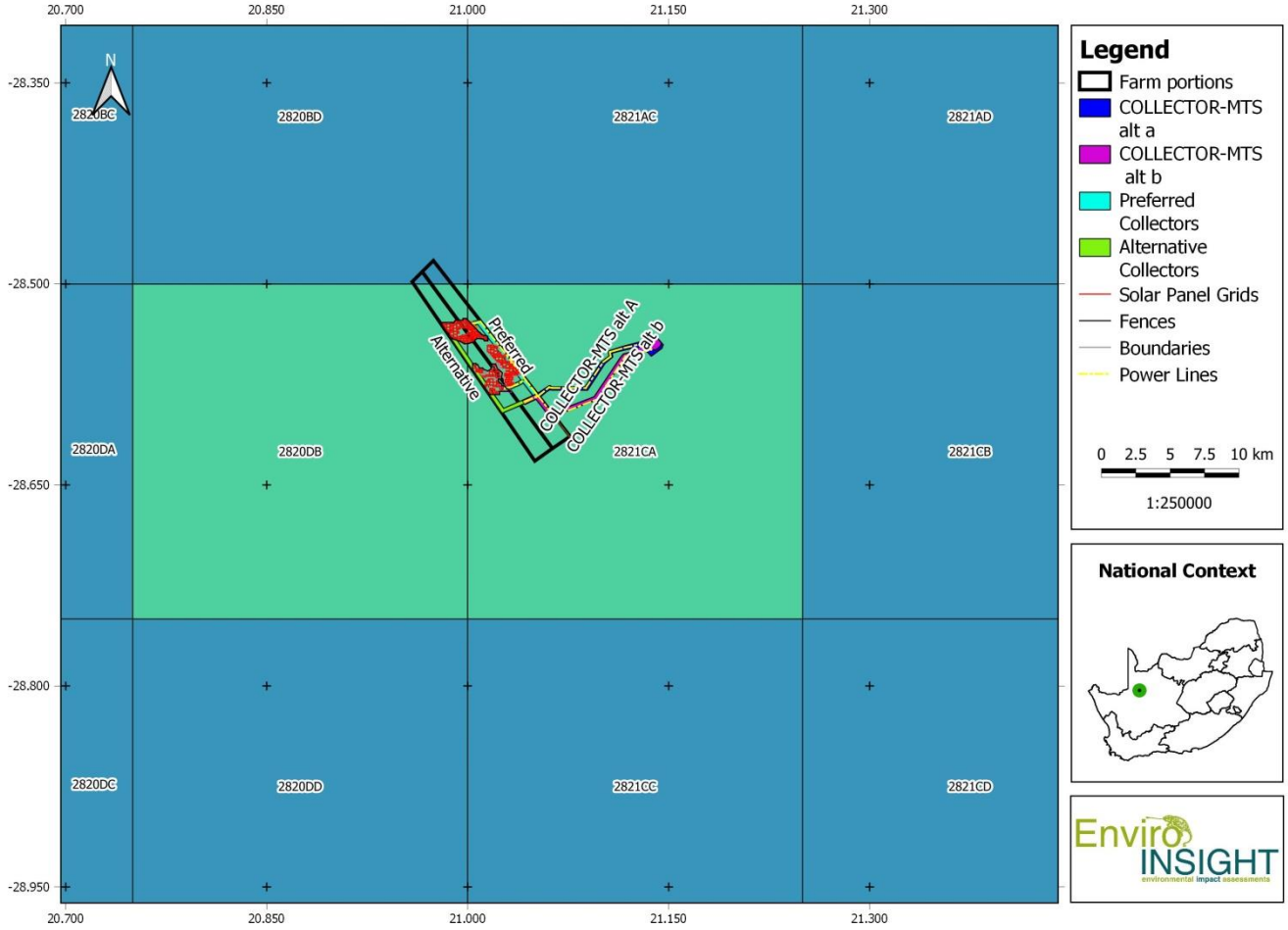

Figure 2-3: Quarter degree grid cell relevant to the PAOI.

Finally, the very nature of mammals is that they occupy several different niches and are represented by a vast diversity of body size/ types that perhaps exceed other vertebrate types (birds, reptiles etc). For example, rodents will occupy entirely different niches to apex predators (leopard/ caracals) and must therefore be evaluated in different ways. In addition, there is a high likelihood that not all mammal species known to occur within the PAOI and surrounding areas will be located during a particular survey. The relevant species of special consideration were addressed separately based on the data collected during the wet season fieldwork studies, in context with the proposed development and the potential effects on the species.

2.1.5 Herpetofauna Assessment

Relevant databases, field guides and texts were consulted for the desktop and literature study included the following:

- The online Virtual Museum (VM) facility of the Animal Demography Unit (ADU) of the University of Cape Town (http://vmus.adu.org.za) and iNaturalist (https://inaturalist.org) were queried for the presence of reptile (ReptileMAP, 2019) and amphibian (FrogMAP, 2019) species within the QDGC in which the proposed development is situated (2821CA), the nearby QDGC (2820DB), as well as the ten surrounding QDGC's (2820BC, 2820BD, 2821AC, 2821AD, 2821CB, 2821CD, 2821CC, 2820DD, 2820DB; due to the low sampling effort in the area, these additional QDGC's are justified);
- Reptile SCC information was obtained from Bates *et al.* (2014); and
- Amphibian SCC information was obtained from Du Preez & Carruthers (2017). Minter *et al.* (2004) has been the official reference used to provide the local conservation status of amphibians but because this reference is outdated, Du Preez & Carruthers (2017) was preferentially referenced.

Reptile species nomenclature follows ReptileMAP (2019) as new distribution data and taxonomic changes have already occurred since publication of Bates *et al.* (2014). Similarly, the Frog Atlas of Southern Africa (FrogMAP, 2019) provides information on the geographic distributions of amphibians and keeps current with the latest taxonomic changes. The use of these online facilities is justified as it not only includes the latest verified publicly contributed data but also a complete record of the museum material in South Africa. Drawing expected species lists for the surrounding QDGC's decreases the likelihood of underestimating the number of species present within the focal QDGC but also artificially inflates the total number of species likely to occur within the focal QDGC (some habitats may be present in adjacent QDGC's that are not present in the focal QDGC). Therefore, the resulting species list drawn from the twelve QDGC's was heavily refined to exclude those species unlikely to occur within the PAOI, based on habitat availability and knowledge of habitat selection by particular species. As a precautionary measure, species with a low probability of occurrence within the PAOI were included in the predicted list.

2.2 FIELD SURVEYS

A site visit was performed in April 2019 (representing the late wet season) by an ecologist where the floral and the faunal aspects of the survey area were rapidly evaluated, mainly through a "walkdown" analysis where the majority of the line was ground-truthed and relevant ecological sensitivities applied. The timing of the surveys represented late wet season conditions which were suboptimal. It should be noted that due to poor raining seasons in the last couple of years made conditions less

optimal for botanical work. Accordingly, many species were not in flower and have lost their vegetative parts which made species identification difficult.

During the field surveys performed, the habitats were evaluated on foot and a series of georeferenced photographs were taken of the habitat attributes. The field surveys focused on a classification of the observed fauna and flora, habitats as well as the actual and potential presence of species of conservation concern (either classified as Threatened by the IUCN (2019), protected by NEMBA (2014) or indeed other legislations applicable provincially or nationally). An analysis of the diversity and ecological integrity of the habitats present on site was also performed.

2.3 SPECIES OF CONSERVATION CONCERN

The Red List of threatened species generated by the IUCN (http://www.iucnredlist.org/) provided the global conservation status of terrestrial fauna and flora. However, regional conservation status assessments performed following the IUCN criteria were considered to be the most relevant and sourced for each group as follows:

- Plants: Red List of South African plants version 2017.16 and Raimondo *et al*. (2009);
- Reptiles: Bates *et al.* (2014);
- Amphibians: Du Preez & Carruthers (2017);
- Mammals: Child *et al.* (2016); and
- Avifauna: Taylor *et al*. (2015).

The conservation status categories defined by the IUCN, which are considered here to represent species of conservation concern, are the "threatened" categories defined as follows:

- **Critically Endangered (CR)** - Critically Endangered refers to species facing immediate threat of extinction in the wild.
- **Endangered (EN)** - Endangered species are those facing a very high risk of extinction in the wild within the foreseeable future.
- **Vulnerable (VU)** - Vulnerable species are those facing a high risk of extinction in the wild in the medium-term.

Other measures of conservation status include species listed under the following:

- Trade in Protected Species (TOPS; National)
- Convention on International Trade in Endangered Species (CITES; International).

6 http://redlist.sanbi.org/index.php

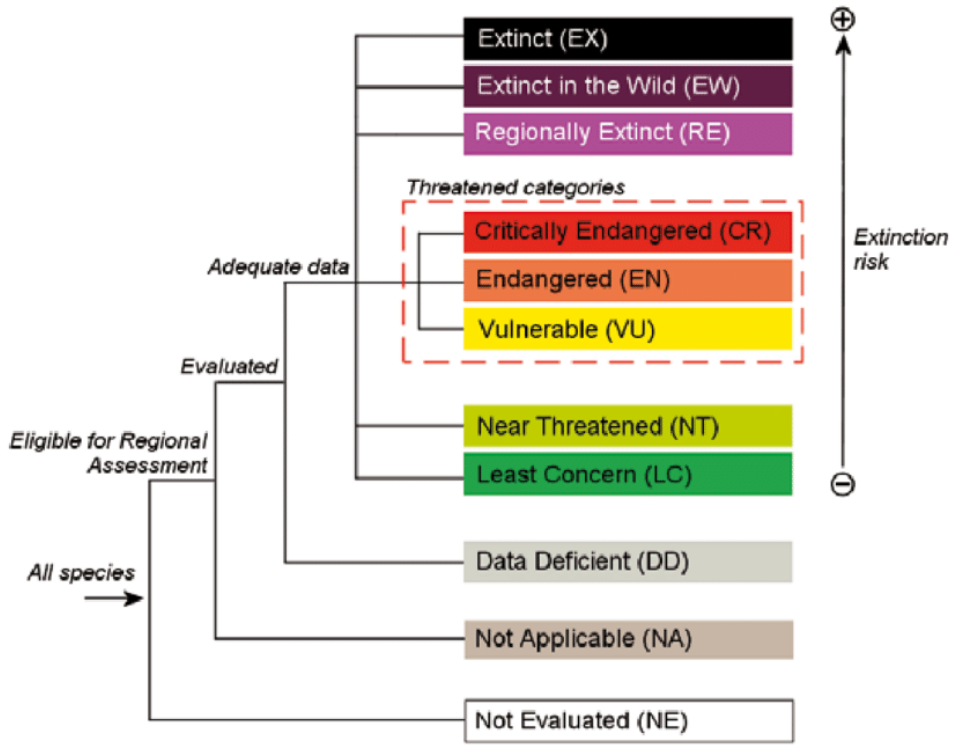

Figure 2-4: Schematic representation of the structure of the IUCN Red List Categories (IUCN 2012).

2.4 IMPACT ASSESSMENT

The following lists of impacts were evaluated against the data captured during the fieldwork to identify relevance to the PAOI. The relevant impacts were then subjected to a prescribed Impact Analysis methodology which is also described below. Mitigation measures were only developed for impacts deemed relevant on the basis of the Impact Analysis.

2.4.1 Potential Flora Impacts

1. Loss, destruction and/or eradication of critically endangered/endangered plant species;
2. Impact on plant communities of particular scientific, conservation or education value;
3. Impact on sensitive plant ecological systems;
4. Decrease in diversity of natural plant communities;
5. Possibility to enhance the spread of invasive and/or alien plants and declared weeds;
6. Threat to the ecological functioning of natural plant communities due to:
   - Isolation of plant communities by destruction of habitat;
   - Reduction in the effective size of habitat/community; and
   - Physical destruction of the habitat.
7. Degradation of plant habitat through:

- Compaction of the topsoil through trampling, vehicles, machinery etc.;
- Introduction and/or spread of invasive alien species - creation of dispersal sites; and
- Potential for bush encroachment through disturbance of topsoil.

2.4.2 Potential Fauna Impacts

1. Loss and/or displacement of critically endangered/endangered animal species;
2. Impact on natural communities of particular scientific, conservation or education value;
3. Impact on natural movement of species (flight pathways etc.);
4. Disturbance of non-resident or migrant species (birds over-wintering, breeding);
5. Decrease in diversity of natural animal communities;
6. Decrease in availability and reliability of food sources for animal communities;
7. Possibility to introduce and/or enhance the spread of alien animal species;
8. Threat to the ecological functioning of natural terrestrial communities due to:
   - Isolation of animal communities by destruction of habitat; and
   - Physical destruction of the habitat.
   - Construction of barriers to animal movement or migration.

2.4.3 Impact Analysis

Direct, indirect and cumulative impacts of the issues identified during the specialist investigations were assessed in terms of these six standard rating scales to determine their significance. The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on five criteria, namely:

- **Status of impacts** (Table 2-1) – determines whether the potential impact is positive (positive gain to the environment), negative (negative impact on the environment), or neutral (i.e. no perceived cost or benefit to the environment). Take note that a positive impact will have a low score value as the impact is considered favourable to the environment;
- **Extent of impacts** (Table 2-2) – determines the spatial scale of the impact on a scale of localised to global effect. Potential impact is expressed numerically on a scale of 1 (site-specific) to 5 (global);

Duration of impacts (

- Table 2-3) – determines the extent of the impact in terms of timescale and longevity. Potential impact is expressed numerically on a scale of 1 (project duration) to 5 (permanent);
- **Magnitude of impacts** (Table 2-4) – quantifies the impact in terms of the magnitude of effect on environment (receptor) and is derived by consideration of points 1, 2 and 3 above. For this particular study, a conservative approach is adopted for severity (e.g. where spatial impact was considered to be 2 and temporal impact was considered to be 3, a value of 3 would be adopted as a conservative estimate for severity of impact); and
- **Probability of impacts** (Table 2-5) – quantifies the impact in terms of the likelihood of the impact occurring on a percentage scale of <5% (improbable) to >95% (definite).

Table 2-1: Status of Impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment (positive impact)	+
Neutral	No determined cost or benefit to the receiving environment	N
Negative	At cost to the receiving environment (negative impact)	-

Table 2-2: Extent of Impacts

Rating	Description	Quantitative Rating
Very Low	**Site Specific** – impacts confined within the project site boundary	1
Low	**Proximal** – impacts extend to within 1 km of the project site boundary	2
Medium	**Local** – impacts extend beyond to within 5 km of the project site boundary	3
High	**Regional** – impacts extend beyond the site boundary and have a widespread effect - i.e. > 5 km from project site boundary	4
Very High	**Global** – impacts extend beyond the site boundary and have a national or global effect	5

Table 2-3: Duration of Impacts

Rating	Description	Quantitative Rating
Very Low	**Project duration** – impacts expected only for the duration of the project or not greater than 1 year	1
Low	**Short term** – impacts expected on a duration timescale of 1 to 2 years	2
Medium	**Medium term** – impacts expected on a duration timescale of 2-5 years	3
High	**Long term** – impacts expected on a duration timescale of 5-15 years	4
Very High	**Permanent** – impacts expected on a duration timescale exceeding 15 years	5

Table 2-4: Severity of Impacts

Rating	Description	Quantitative Rating
Very Low	Negligible – zero or very low impact	1
Low	Site specific and short term impacts	2
Medium	Local scale and / or short term impacts	3
High	Regional and / or long term impacts	4
Very High	Global scale and / or permanent environmental change	5

Table 2-5: Probability of Impacts

Rating	Description	Quantitative Rating
Highly Improbable	Likelihood of the impact arising is estimated to be negligible; <5%.	1
Improbable	Likelihood of the impact arising is estimated to be 5-35%.	2
Possible	Likelihood of the impact arising is estimated to be 35-65%	3
Probable	Likelihood of the impact arising is estimated to be 65-95%.	4

Highly Probable	Likelihood of the impact arising is estimated to be > 95%.	5

These five criteria are combined to describe the overall significance rating (Table 2-6). Calculated significance of impact – determines the overall impact on (or risk to) a specified receptor and is calculated as: the product of the probability (P) of the impact occurring and the severity (S) of the impact if it were to occur (Impact = P × S). This is a widely accepted methodology for calculating risk and results in an overall impact rating of Low (L), Low/Medium (LM), Medium (M), Medium/High (MH) or High (H). The significance of a particular impact is depicted in Table 2-7 and assigned a particular colour code in relation to its severity.

Table 2-6: Significance of Impacts

Rating	Description		Quantitative Rating
Low	P x S = 1-3	(low impact significance)	**L**
Low/Medium	P x S = 4-5	(low/medium impact significance)	**LM**
Medium	P x S = 6-9	(medium impact significance)	**M**
Medium/High	P x S = 10-14	(medium/high impact significance)	**MH**
High	P x S = 15-25	(High impact significance)	**H**

Table 2-7: Perceived Significance of Impacts

Probability (P)	Severity (S)				
	1	2	3	4	5
1	L	L	L	LM	LM
2	L	LM	M	M	MH
3	L	M	M	MH	H
4	LM	M	MH	H	H
5	LM	MH	H	H	H

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **Insignificant**: the potential impact is negligible and will not have an influence on the decision regarding the proposed development;
- **Low**: the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed development;
- **Low/Medium**: the potential impact may not have any meaningful influence on the decision regarding the proposed activity/development;
- **Medium**: the potential impact should influence the decision regarding the proposed activity/development;
- **Medium/High**: the potential impact will affect the decision regarding the proposed activity/development; and
- **High**: the proposed activity should only be approved under special circumstances.

Practicable mitigation and optimisation measures are recommended and impacts are rated in the prescribed way both without and with the assumed effective implementation of the recommended mitigation (and/or optimisation) measures. Mitigation and optimisation measures are either:

- Essential: measures that must be implemented and are non-negotiable; or
- Best Practice: recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented.

3 RESULTS

3.1 REGIONAL VEGETATION

The PAOI is located in the Kalahari Karroid Shrubland (Least threatened) and Bushmanland Arid Grassland (Least threatened) vegetation types (Figure 3-1). The PAOI is not located in a threatened ecosystem (Figure 3-2). The Lower Gariep Alluvial Vegetation threatened ecosystem is located south of the PAOI.

Kalahari Karroid Shrubland vegetation type is endemic to the Northern Cape Province (Table 3-1). The vegetation type is characteristic of forming belts alternating with belts of Gordonia Duneveld on plains northwest of Upington through Lutzputs and Noenieput to the Rietfontein/Mier area in the north. Other patches occur around Kakamas and north of Groblershoop. The unit is also found in the neighbouring Namibia. The vegetation can be described as low karroid shrubland on flat, gravel plains. Karoo-related and northern floristic elements such as shrubs meet here, indicating a transition to the Kalahari region and sandy soils. Altitude varies mostly from 700 - 1100 m.

The conservation target is set at 21% with very little statutorily conserved in the Augrabies Falls National Park. Although only a small area has been transformed many of the belts of this type were preferred routes for early roads, thus promoting the introduction of alien plants (about a quarter of the unit has scattered *Prosopis* species). Erosion is very low at 94% (Mucina & Rutherford 2010).

Table 3-1: Attributes of the Kalahari Karroid Shrubland vegetation type.

Name of vegetation type	Kalahari Karroid Shrubland
Code as used in the Book - contains space	NKb5
Conservation Target (percent of area) from NSBA	21%
Protected (percent of area) from NSBA	0.1%
Remaining (percent of area) from NSBA	99.2%
Description of conservation status from NSBA	Least threatened
Description of the Protection Status from NSBA	Hardly protected
Area (km^2) of the full extent of the Vegetation Type	8283.90
Name of the Biome	Nama-Karoo

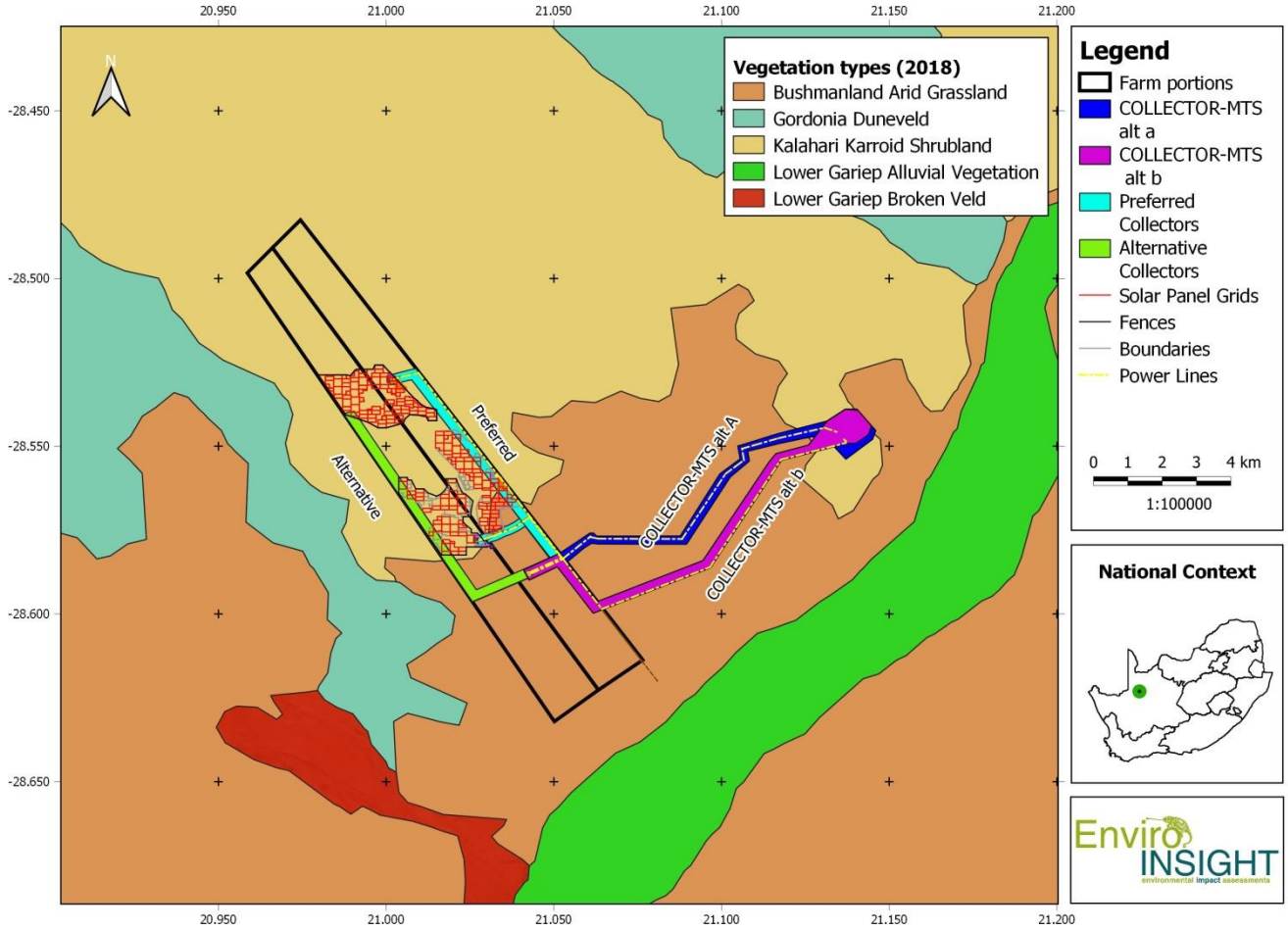

Figure 3-1: Regional vegetation types in relation to the PAOI (Mucina & Rutherford, 2018).

The Bushmanland Arid Grassland vegetation type occurs only in the Northern Cape Province (

Table 3-2). It spans about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the northwest this vegetation unit borders on desert vegetation (northwest of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies mostly from 600 – 1 200 m. The conservation target is set at 21% with only small patches statutorily conserved in Augrabies Falls National Park and Goegab Nature Reserve. Very little of the area has been transformed. Erosion is very low (60%) to low (33%) (Mucina & Rutherford, 2010).

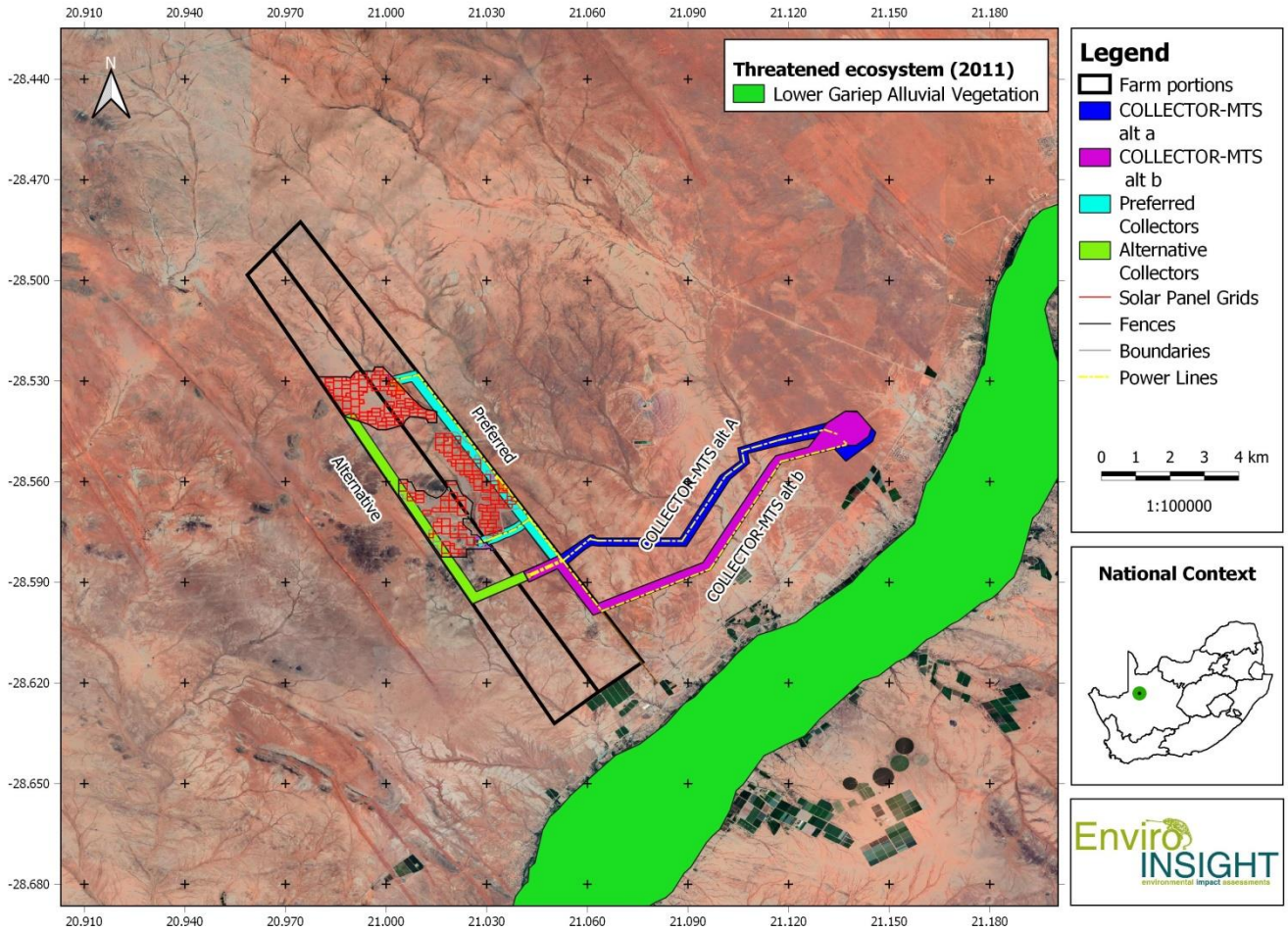

Figure 3-2: The PAOI in relation to threatened ecosystems.

Table 3-2: Attributes of the Bushmanland Arid Grassland vegetation type.

Name of vegetation type	Bushmanland Arid Grassland
Code as used in the Book - contains space	NKb3
Conservation Target (percent of area) from NSBA	21%
Protected (percent of area) from NSBA	0.4%
Remaining (percent of area) from NSBA	99.4%
Description of conservation status from NSBA	Least threatened
Description of the Protection Status from NSBA	Hardly protected
Area (km^2) of the full extent of the Vegetation Type	45478.96
Name of the Biome	Nama-Karoo

3.2 NORTHERN CAPE CRITICAL BIODIVERSITY AREAS

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of e landscape as a whole.

The Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province.

According to the CBA Map, the PAOI is located in the categories "Critical Biodiversity Area 2", "Ecological Support Area" and "Other Natural Areas" (Figure 3-3).

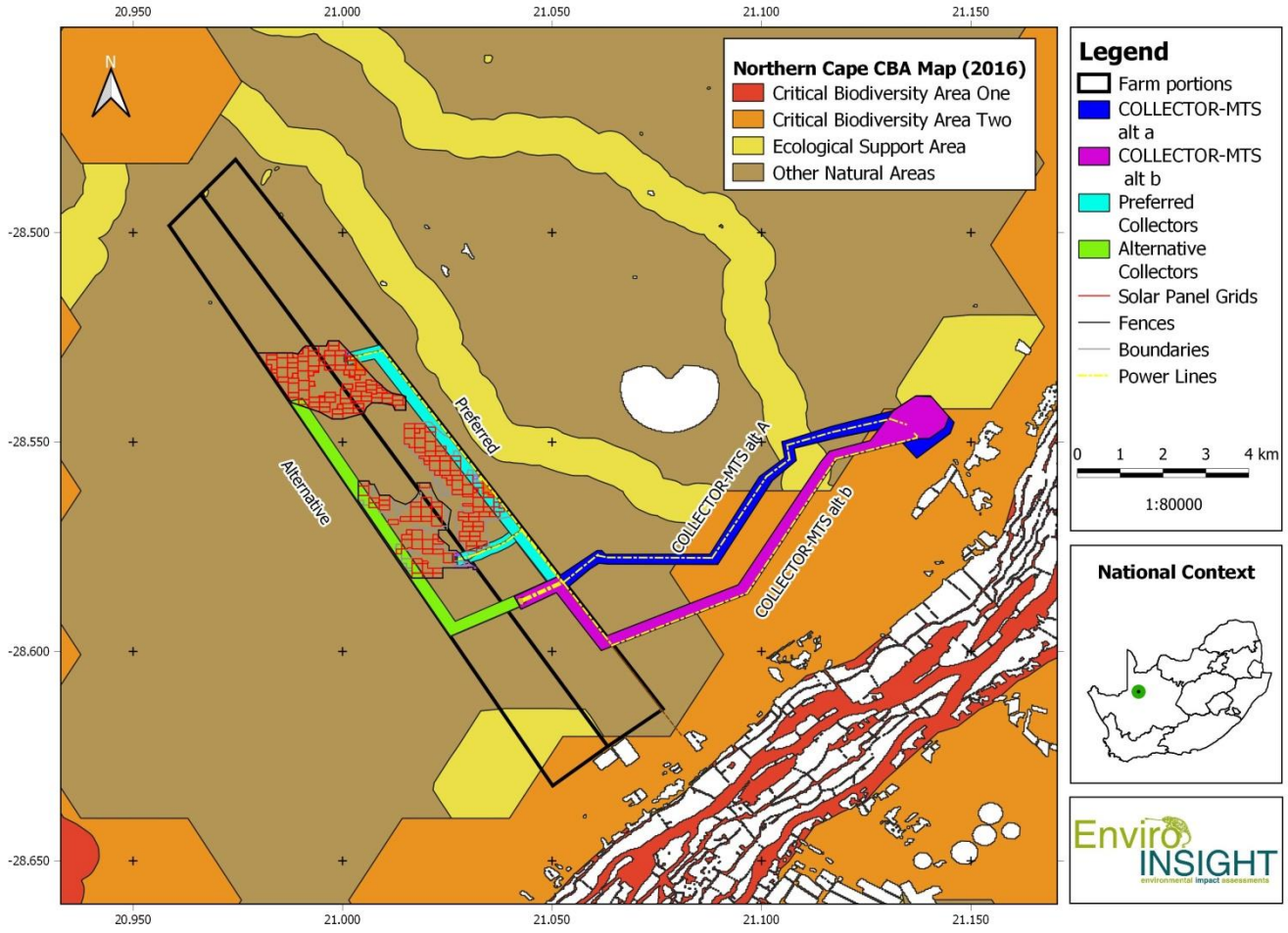

Figure 3-3: The PAOI in relation to the Northern Cape Critical Biodiversity Areas (2016).

3.3 OVERVIEW

The specialist GPS tracks as well as the location of the georeferenced photos taken during the field survey are shown in Figure 3-4. The georeferenced photographs (Appendix 1) serve to assist in both the site characterisation as well as the sensitivity analysis and provide lasting evidence for future queries. The specialist coverage was considered to be semi-optimal considering the large PAOI. Furthermore, all areas of the PAOI were clearly visible and accessible.

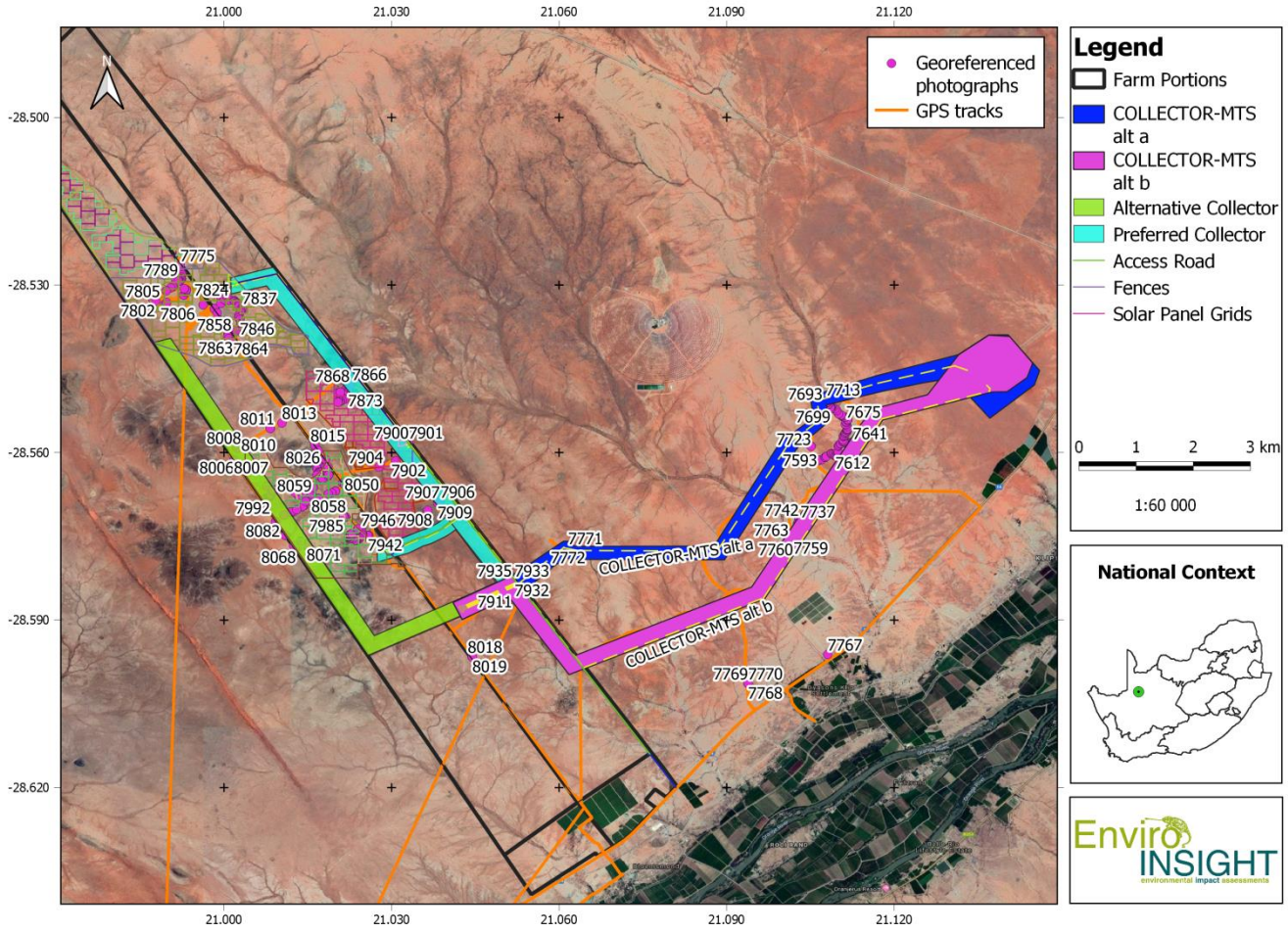

Figure 3-4: Specialist coverage (GPS tracks) and location of georeferenced photographs taken during the field surveys.

3.4 OBSERVED AND EXPECTED FAUNA

The previous biodiversity impact assessments for the proposed Bloemsmond 2 (Todd 2015; Widdows 2015) were consulted. Both reports contained significant errors in regards to SCC status, for example, Honey Badger being listed as Endangered when in actual fact it was listed as NT at the time [(it is now listed as LC as significant changes have been made to South African assessments of SCC e.g. Child *et al*., (2016); Taylor *et al*., (2015) which is reflected in the current report]. These status classifications have both legal and management ramifications within the current report.

3.4.1 Mammals

The PAOI resides in the 2820DB and 2821CA quarter degree grid cells (QDGCs). These QDGCs along with adjacent cells were considered to represent similar habitats and therefore the predicted species list was derived from observation records from these QDGCs.

The level of time and terms of reference for the survey did not allow for highly intensive mammal surveying. However, accurate results are shown in Table 3-3 and allowed for the survey which records the mammalian species inventory as 42 species in total. Of these species, many, including Endangered Roan Antelope and Vulnerable Sable Antelope are classified as ranched and other ungulates such as springbok and blesbok may be classified as being semi-ranched. Therefore, the status of ranched species, or the relatively inflated mammal diversity provided by other semi-ranched species cannot impact the results of the Environmental Impact Assessment/ Analysis. Overall, the PAOI shows a medium/ high rich mammal diversity (in comparison with other national studies carried out by the author [SL]) which is expected given the varied karroid, drainage line/ ridge and arid environment. The detailed field survey provided invaluable information regarding mammals within the PAOI and the mammal inventory within the PAOI shows all the relevant mammal species, likelihood of occurrence, EWT status, IUCN status and NEMBA status (Table 3-3). Due to the inherently large variations in the mammalian taxa, each group must be assessed separately in the context of the PAOI. Mammalian groups are defined and discussed below. The mammal species list derived from records collected for the QDGCs is presented in Appendix 3: Mammal species list. Three species of conservation concern could be expected to occur within the PAOI and are discussed in detail in section 3.6: Faunal Species of Conservation Concern.

3.4.1.1 Small herbivores

Small herbivores are located throughout the PAOI and were sighted frequently during the survey period. Steenbok (*Raphicerus campestris*) were sighted on numerous occasions with frequent records of spoor and scat recorded from all habitats. Rock hyrax (*Procavia* capensis) and porcupines (*Hystrix africaeaustralis*) were recorded frequently via spoor/signs and direct sightings. As a taxonomic group, small herbivores are far more resilient than their larger counterparts, primarily due to their ability to take refuge in a wider range of habitats. In addition, springhares (*Pedetes capensis*), Smith's red rock rabbits and Cape hares (*Lepus capensis*) were very common throughout the PAOI and surrounding habitats, albeit showing some habitat specific requirements. Small herbivores are often amongst the last of the mammalian taxonomic groups to be eliminated in heavily disturbed or heavily utilised areas.

3.4.1.2 Large and medium herbivores

Larger herbivores that are found within the PAOI must be divided into naturally occurring or free-roaming and "game farmed" or ranched. There may be some overlap for a given species which may be farmed on one property within the PAOI, yet free roaming on another. Species that fall into this category include Sable antelope (*Hippotragus niger*), Roan antelope (*Hippotragus equinus*), blesbok (*Damaliscus pygargus phillipsi*), kudu (*Tragelaphus strepsiceros*) and springbok (*Antidorcas marsupialis*). Overall, the PAOI show only a moderate large herbivore habitat potential which is why the PAOI is heavily subsidised through supplementary feeding. All of the above mentioned herbivores were sighted frequently during the survey

period and appeared to be in excellent condition. Although the densities of this mammalian group were high, the diversity of the group is moderate. Overall, the PAOI show evidence of a functional herbivore system which indicates that the trophic level of the food chain is being adequately represented. However, it is clear from the veld condition that some areas are overstocked, possibly due to the localised high densities of sheep and to a lesser extent, cattle.

3.4.1.3 Meso-carnivores

It appears that larger carnivores exhibit an insignificant presence throughout the PAOI and are considered to be largely absent. Meso-carnivores however were significantly represented within the PAOI. Relevant species include honey badger (*Mellivora capensis*), black-backed jackal (*Canis mesomelas*), water mongoose (*Atilax* paludinosus), bat-eared fox (*Otocyon megalotis*), African wild-cat (*Felis silvestris lybica*), Caracal (*Caracal* caracal) and Cape fox (*Vulpes chama*). The significant presence of the species could be explained by a number of factors. Firstly, and most importantly, the food supply (especially within the feeding spectrum of meso-predators) is still highly functional with small mammals, birds, insects, reptiles and amphibians available in high densities and high diversity. The wetland areas may exhibit a sporadic high density of amphibians, whilst the vegetated areas, ridges and even human residential areas showed large densities of small mammals, nesting birds and reptiles, all of which are utilised (albeit in different ratios) by the above mentioned species. Insectivorous species such as aardwolf and bat-eared fox (and to a lesser extent Cape fox and black-backed jackal) have access to a large resource base which is typical of such arid environments. Aardwolf and bat-eared fox however is addressed in a separate category, despite its status as member of the Order Carnivora. Finally, meso-predators often react positively to the presence of humans (in the absence of large densities of African dogs and intensive persecution) and will readily forage on anthropogenic food sources. The primary reason for the low observed densities of caracals and black-backed jackal however is due to the significant influence of predator extermination programs taking place within the PAOI.

3.4.1.4 Small carnivores

This group includes smaller carnivores below 5 kg in mass. Relevant species include smaller species of mongoose, suricates (*Suricata suricata*) small-spotted cat (*Felis nigripes* is addressed in the Red-List section below), genets and polecats (*Ictonyx striatus*). Of these listed species, slender mongooses (*Galerella sanguinea*), yellow mongooses (*Cynictis penicillata)*, small-grey mongoose (*Galerella pulverulenta)*, and spotted genets (*Genetta genetta)* were recorded frequently throughout the PAOI and region. These species are usually highly resilient and respond positively to human presence, as they readily utilise anthropogenic food sources or the rodents that are attracted to human settlements. They are also highly catholic in their habitat requirements, meaning that most habitat types are suitable to meet the ecological requirements of the species. Dietary requirements are equally broad, which increases the adaptability of the group and therefore their overall resilience. These species may be considered to be essential in controlling the spread of synanthropic[7] or alien rodents.

[7] Associated with humans and their infrastructure

Table 3-3: Mammal list of sightings and from previous data which covers the larger project area of influence.

Scientific name	Common name	Mammal Type (Free Roaming=FR, Ranched=R)	Red List	Likelihood	Method of Acquisition	Notes
Antidorcas marsupialis	Springbok	Medium Ungulate (R)	LC	Confirmed	Sighting	Common resident/ ranched
Alcelaphus buselaphus	Red Hartebeest	Large Ungulate (R)	LC	Confirmed	Sighting	Ranched resident
Aonyx capensis	African Clawless	Meso Carnivore (FR)	NT	Confirmed	Previous Survey in area	Uncommon visitor
Atilax paludinosus	Marsh mongoose	Meso Carnivore (FR)	LC	Confirmed	Previous Survey in area	Uncommon visitor
Canis mesomelas	Black-backed Jackal	Meso Carnivore (FR)	LC	Confirmed	Sighting	Common resident
Caracal caracal	Caracal	Meso Carnivore (FR)	LC	Confirmed	Spoor	Common resident
Cynictis penicillata	Yellow Mongoose	Small Carnivore (FR)	LC	Confirmed	Sighting	Common resident
Elephantulus intufi	Bushveld Elephant-shrew	Small Mammal (FR)	LC	Confirmed	Sighting	Common resident
Equus burchellii	Plains Zebra	Large Ungulate (R)	LC	Confirmed	Sighting	Common resident
Felis silvestris lybica	African Wild Cat	Small Carnivore (FR)	LC	Confirmed	Dead specimen	Common resident
Galerella sanguinea	Slender Mongoose	Small Carnivore (FR)	LC	Confirmed	Sighting	Common resident
Genetta genetta	Small-spotted Genet	Small Carnivore (FR)	LC	Confirmed	Spoor	Common resident
Genetta tigrina	Large-spotted Genet	Small Carnivore (FR)	LC	Confirmed	Spoor	Common resident
Helogale parvula	Dwarf Mongoose	Small Carnivore (FR)	LC	Confirmed	Spoor	Common resident
Hippotragus equinus	Roan Antelope	Large Ungulate (R)	EN	Confirmed	Sighting	Ranched resident
Hippotragus niger	Sable Antelope	Large Ungulate (R)	VU	Confirmed	Sighting	Ranched resident
Hystrix africaeaustralis	Porcupine	Small Herbivore (FR)	LC	Confirmed	Quills/ spoor	Common resident
Ichneumia albicauda	White-tailed Mongoose	Small Carnivore (FR)	LC	High	Spoor	Common resident
Ictonyx striatus	Striped Polecat	Small Carnivore (FR)	LC	Confirmed	Spoor	Common resident
Lepus capensis	Cape Hare	Small Herbivore (FR)	LC	Confirmed	Sighting	Common resident
Lepus saxatilis	Scrub Hare	Small Herbivore (FR)	LC	Confirmed	Sighting	Common resident
Manis temmincki	Pangolin	Large Insectivore (FR)	VU	Confirmed	Previous survey in area	Low density resident
Mellivora capensis	Honey Badger	Meso Carnivore (FR)	LC	Confirmed	Spoor	Low density resident
Mungos mungo	Banded Mongoose	Small Carnivore (FR)	LC	Confirmed	Sighting	Common resident
Orycteropus afer	Aardvark	Large Insectivore (FR)	LC	Confirmed	Dead specimen	Common resident
Oryx gazella	Gemsbok	Large Ungulate (R)	LC	Confirmed	Sighting	Common resident
Otocyon megalotis	Bat-eared Fox	Meso Carnivore (FR)	LC	Confirmed	Camera trap	Common resident
Parahyaena brunnea	Brown Hyaena	Large Carnivore (FR)	NT	Confirmed	Camera trap	Common resident

Paraxerus cepapi	Tree Squirrel	Small Mammal (FR)	LC	Confirmed	Sighting	Common resident
Pedetes capensis	Springhare	Small Mammal (FR)	LC	Confirmed	Spoor	Common resident
Procavia capensis	Rock Hyrax	Small Herbivore (FR)	LC	Confirmed	Droppings/ prey remains	Habitat specific resident
Pronolagus rupestris	Smith's Red Rock Rabbit	Small Herbivore (FR)	LC	Confirmed	Droppings	Habitat specific resident
Proteles cristatus	Aardwolf	Meso Carnivore (FR)	LC	Confirmed	Roadkill	Habitat specific resident
Raphicerus campestris	Steenbok	Small Herbivore (FR)	LC	Confirmed	Sighting	Common resident
Suricata suricata	Meerkat	Small Carnivore (FR)	LC	Confirmed	Sighting/ camera trap	Common resident
Sylvicapra grimmia	Common Duiker	Small Herbivore (FR)	LC	Confirmed	Sighting	Common resident
Tatera leucogaster	Bushveld Gerbil	Small Mammal (FR)	DD	Confirmed	Sighting	Common resident
Thallomys paedulcus	Tree Rat	Small Mammal (FR)	LC	Confirmed	Droppings	Common resident
Tragelaphus oryx	Eland	Large Ungulate (R)	LC	Confirmed	Sighting	Common ranched resident
Tragelaphus strepsiceros	Kudu	Large Ungulate (FR)	LC	Confirmed	Sighting	Common resident
Vulpes chama	Cape Fox	Meso Carnivore (FR)	LC	Confirmed	Camera trap	Common resident

3.4.1.5 Primates

Relevant species from this taxonomic group are limited to vervet monkeys (*Cercopithecus pygerythrus*) (baboons were not observed during the current study) which were frequently sighted, both within the riverine portions adjacent to the PAOI and the region as a whole. They are primarily limited to areas linked to available surface water and/or trees (drainage).

3.4.1.6 Large insectivores

Aardvarks (*Orycteropus afer*) are specialist insectivores that are very common within the PAOI. They are a "keystone" species whose burrows are utilised as refugia by numerous other animals. Although regionally common, areas showing high aardvark density (similar to that observed for the PAOI) should show due consideration and earthworks may seriously impact on local populations. Aardwolf (*Proteles cristatus*) and bat-eared fox (*Otocyon megalotis*) can be counted as specialist insectivore species for the purposes of ecology, despite their status as carnivores. Aardwolf was particularly common throughout the PAOI, with numerous individuals observed per night drive. The species is also particularly prone to collisions with vehicles and many individuals were observed along the roads between the PAOI. A dead specimen was recorded during the survey.

Photographic evidence of the some of the mammals recorded within the PAOI is shown in Figure 3-5.

3.4.2 Herpetofauna

The PAOI resides on the 2821CA and 2820DB QDGC's. These QDGC's along with ten adjacent cells (2820BC, 2820BD, 2821AC, 2821AD, 2821CB, 2821CD, 2821CC, 2820DD, 2820DB) were considered to represent similar habitats and therefore the predicted species list was derived from observation records from these QDGCs. Expected species lists derived in this manner may therefore represent an overestimation of the diversity expected as very specific habitat types may be required by a species which may be present in a QDGC but not necessarily on the PAOI within the QDGC. Conversely, many large areas in South Africa are poorly sampled for herpetofauna and expected species lists derived from a single QDGC may therefore underestimate the species diversity. Drawing expected species from surrounding QDGCs therefore increases the likelihood of obtaining a species list that suffers less from poor sampling in the area but it also artificially inflates the expected number of species because many different habitats in the surrounding QDGCs may not be present on the PAOI. To counteract this, all possible attempts were made to refine the expected species list based on species-specific habitat requirements and a good understanding of the habitat types and quality of the PAOI. Species that are unlikely to occur on the PAOI but that do occur in the surrounding QDGCs were kept in the expected species list (precautionary principle) and species with a high probability of occurrence on the PAOI were added to the list even if ReptileMAP (2019) and FrogMAP (2019) did not have a record for the selected QDGCs.

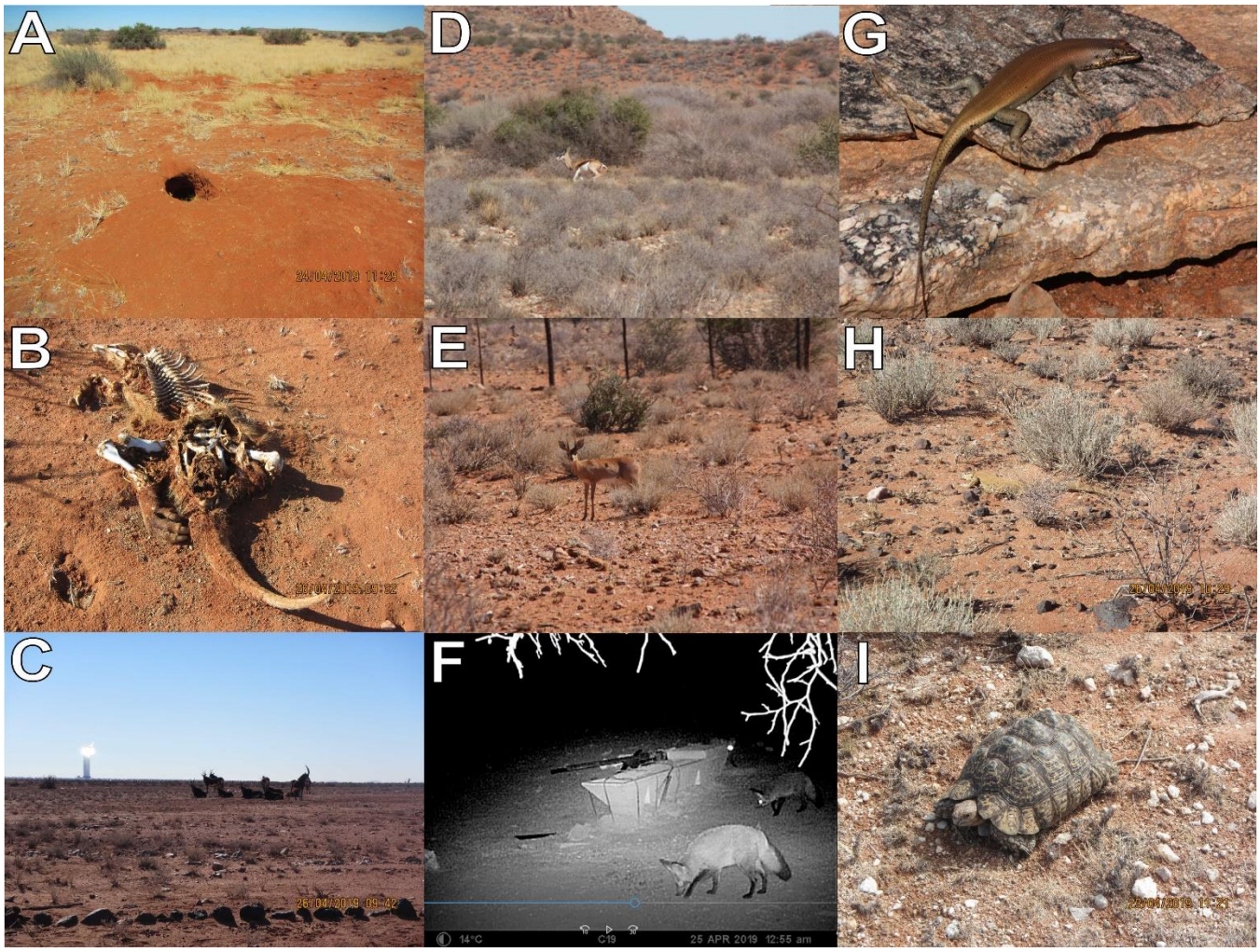

Figure 3-5: Photographic evidence of the some of the fauna recorded within the PAOI. [8]

The QDGC's near the PAOI are poorly sampled, and are characterised by moderate diversity and low endemicity for reptiles and low diversity and endemicity for amphibians (FrogMAP, 2019; ReptileMAP, 2019). The herpetofauna species list derived from records collected for the QDGCs is presented in Appendix 4: Herpetofauna species list. Five amphibian species have previously been recorded within and surrounding the PAOI. A total of 59 reptile species could potentially occur within and surrounding the PAOI although only twelve have previously been recorded from within 2821CA QDGC.

The PAOI intersects multiple habitat features, such as boulders, gravel plains and dry river beds and arid living rupicolous and some arenicolous reptile species are therefore expected to be present in the PAOI. However, the PAOI is situated adjacent to

[8] (A) Burrow of an Aardvark; (B) *Orycteropus afer* carcass; (C) Sable antelope (*Hippotragus niger*); (D) Springbok (*Antidorcas marsupialis*); (E) Steenbok (*Raphicerus campestris*); (F) Foraging Cape fox (*Vulpes chama*); (G) Western Rock Skink (*Trachylepis sulcata sulcata*); (H) Rock Monitor (*Varanus albigularis*); (I) Leopard tortoise (*Stigmochelys pardalis*).

the Orange River, which is suitable habitat for mesic herpetofauna assemblages, but the habitat is unsuitable for such species, which may temporarily persist or pass through the PAOI.

No threatened (CR, EN or VU) herpetofauna are expected to occur within the PAOI and no other SCC are expected to be resident or breeding within the PAOI. However, there are two NT species that may occur within and surrounding the PAOI. These species are discussed in detail in section 3.6: Faunal Species of Conservation Concern.

3.4.3 Avifauna

The PAOI is located in the 2830_2055, 2830_2100, 2830_2105 and 2835_2100 pentads (Figure 2-2).

From Widdows (2015), 40 bird species were observed. The current study recorded 75 species in relatively suboptimal conditions. Many of the bird species expected and observed in the PAOI (most of them non passerines) are dependent upon local availability of suitable habitat or food and their presence is not directly determined by the surrounding indigenous vegetation. In addition, many of the recorded birds were represented by highly mobile species, able to move around to areas where rain has fallen. These include several of the lark species, finchlarks, canaries and buntings. Several of these mobile species form flocks. This is another key conclusion that has shown that the avifaunal assemblages are dictated by optimal conditions, rather than prevailing habitat types. However, distinct groupings of bird species were observed in some more "unique" habitat types such as the rocky ridges and large drainage lines. For the purposes of this study, the discussion will focus on SCC.

As mentioned a total of 75 avifauna species were recorded in the current study. As mentioned previously, the study period was relatively short and the data gathered was not powerful enough in order to formulate guild profiles. The most important change from the previous study was the very frequent sightings of IUCN Endangered Ludwig's Bustard (*Neotis ludwigii*). Species of Conservation Concern are discussed in section 3.6: 33Faunal Species of Conservation Concern.

The avifauna species list derived from SABAP2 records is presented in Appendix 5: Avifauna Expected species list.

3.5 FLORAL SPECIES OF CONSERVATION CONCERN

According to the Botanical Database of Southern Africa (BODATSA)[9] for the xMin, yMin 20.20°,-29.20°: xMax, yMax 21.4°, -28.20° extent (WGS84 datum) four Red List species are present. In addition, six species are protected under the Northern Cape Nature Conservation Act (Act No 9 of 2009) of which two species are protected under the National Forest Act (Act No 84 of 1998). All potential Red and Orange Listed plant species are indicated in Table 3-4.

The SANBI Red Listed species *Aloidendron dichotomum* was recorded in the PAOI. Please take note that individuals were not counted or marked with a GPS as this was not part of the scope of work. Where the proposed Grid Connection impacts on this species, a relocation plan should be drafted and submitted to the competent authority for review. Each individual affected by

[9] http://posa.sanbi.org/sanbi/Explore

the proposed development need to be recorded and marked with a GPS. For affected individuals, a permit application for their removal / relocation needs to be applied for with the competent authority.

Climate change models for *A. dichotomum* project a 36% decline in range in 100 years, assuming dispersal into newly suitable areas (Foden, 2005). Patterns of modelled declines have been supported by field and repeat photo studies. However, no colonization of newly suitable areas has yet happened. Without dispersal, the models predict a 73% decline in 100 years, qualifying the species as Endangered. This is a vital flagship species for climate change impacts on biodiversity. It is also likely to be a keystone and umbrella species. This species is not likely to be more sensitive to climate change than others. Foden's study has shown that this species is a useful indicator of climate change and that, because modelled and actual mortality are shown to be relatively similar, the modelled future range shifts need to be seriously considered (Foden 2002, Foden *et al*. 2007). Main threats include climate change, harvesting and trampling by livestock. Damage by baboons, scale insects and fungus has been observed, but none of these seem to cause mortality. Genetic studies show that there is much genetic variation between populations. Degree of interbreeding between populations is unknown, but large dispersal distance and bird pollinators make genetic exchange seem likely. The population is declining due to mortality of individuals in northern subpopulations.

Acanthopsis hoffmannseggiana is taxonomically problematic and is classified as data deficient. As per SANBI Red List of South African Plants: "A widespread and variable species that possibly contains several taxa, some of which may be of conservation concern. More study is needed to find reliable distinguishing characters to separate individual taxa." This species occur in sandy plains, stony hillsides and ridges, usually associated with weathered quartzite and granite, but also occur on mudstone (in Prince Albert area) and limestone (Asbestos Mountains), usually at an elevation between 650 and 1000 m (Von Staden & Steyn 2015).

Felicia deserti: Known from two highly disjunct areas, last collected in 1925. The population status, distribution and habitat of this species is too poorly known to determine its status.

Boscia albitrunca and *Vachellia erioloba* were recorded within the footprint of the Connection Grid and are protected under the National Forest Act (Act No 84 of 1998). Should any of these species be harmed or damaged by the proposed powerline development or removal is required a permit application should be submitted to the competent authority prior to construction activities taking place. In order to do this, all trees need to be marked with a GPS and individuals of each species counted (this was not part of the current scope of work).

All specially protected plant or a protected plant species listed in the Northern Cape Nature Conservation Act (Act No 9 of 2009) requires permit applications for ther removal should the proposed powerline development destroy or damage any of these species, including *Aloidendron dichotomum, Hoodia gordonii, Boscia albitrunca, Boscia foetida, Aloe claviflora, Avonia albissima, Euphorbia gariepina subsp. gariepina* and all *Mesembryanthemum* spp.

Table 3-4: Potential plant species of conservation concern.

Species	Common Name	SANBI National Red List[10]	Northern Cape Protected[11]	National Forest Act (1998)[12]	Habitat Description	Present within PAOI
Acanthopsis hoffmannseggiana		Data deficient - Taxonomically Problematic			Sandy plains, stony hillsides and ridges, usually associated with weathered quartzite and granite, but also occurs on mudstone (in Prince Albert area) and limestone (Asbestos Mountains), usually at an elevation between 650 and 1000 m.	Yes
Aloe claviflora	Aanteelaalwyn	Least Concern	Yes		Well drained areas on rocky slopes or flat stony areas at the margins of Kalahari Thornveld. Usually, but not always, on calcrete	Yes
Aloidendron dichotomum	Quiver tree	Vulnerable			On north-facing rocky slopes (particularly dolomite) in the south of its range. Any slopes and sandy flats in the central and northern parts of range.	Yes
Anacampseros albissima		Least Concern	Yes		Rock outcrops and quartz flats. Southern Angola through Namibia to the Richtersveld, and eastwards through Bushmanland to Griqualand West.	Yes

[10] http://redlist.sanbi.org/
[11] Northern Cape Nature Conservation Act (Act No 9 of 2009)
[12] Notice of the list of protected tree species under the National Forests Act 84 of 1998 published in GN 182 in GG 41100 of 8 September 2017

Boscia albitrunca	Shepherd's tree	Least Concern	Yes	Yes	Terrestrial – including seven provinces excluding Western and Eastern Cape	Yes
Boscia foetida		Least Concern	Yes		Terrestrial – Northern Cape	Yes
Dinteranthus wilmotianus		Near Threatened			Alluvial gravel soils – desert, Nama Karoo	Yes
Felicia deserti		Data deficient			Terrestrial – Nama Karoo, Succulent Karoo	Possible
Hoodia gordonii	Bitterghaap, Bobbejaanghaap	Least Concern	Yes		Occurs in a wide variety of arid habitats from coastal to mountainous, also on gentle to steep shale ridges, found from dry, rocky places to sandy spots in riverbeds – Desert, Nama Karoo, Savanna, Succulent Karoo.	Within farm portion. High likelihood to occur in corridor
Vachellia erioloba	Camel thorn	Least Concern	Yes	Yes	Widespread in the arid northern provinces of South Africa, also Namibia, Botswana, Zimbabwe, southern Angola and south-western Zambia	Yes

3.6 FAUNAL SPECIES OF CONSERVATION CONCERN

3.6.1 Mammals

Of the observed and expected mammal species, the black-footed cat *Felis nigripes* (expected) is listed as Vulnerable while the honey badger *Mellivora capensis* (observed in the current study) was listed as Near Threatened (IUCN 2015) but as of 2016, has been downgraded to Least Concern; it is however still NEMBA protected. The Cape fox (*Vulpes chama*) (observed during the current survey) is also protected by the NEMBA.

Three of the observed mammal species within the PAOI are Red-Listed in South Africa and two species are protected by NEMBA. These species are discussed below and the probability of occurrence for selected threatened and near threatened mammal species on the respective PAOI is shown in Table 3-5.

Table 3-5: The probability of occurrence[13] for selected threatened and near threatened mammal taxa by PAOI.

Species	Bloemsmond 3	Bloemsmond 4	Bloemsmond 5	Grid Connection
Felis nigripes (Small-spotted/black footed cat)	Low	Low	Low	Low
Vulpes chama (Cape fox)	Confirmed	Confirmed	Confirmed	Confirmed
Mellivora capensis (Honey Badger)	Low	Low	Low	Moderate

3.6.1.1 Honey Badger (*Mellivora capensis*)

Honey badgers were recorded once through spoor tracking within the drainage line habitat of the PAOI. Their presence is unusual even though the PAOI does not represent a stronghold for the species. This species is often associated with more savanna type habitats encountered in the Kalahari and Bushveld which is represented in the drainage line habitat (and not the more karroid habitats to the north). It is often subject to snaring and persecution due to its penchant for raiding commercial honey farms and chicken breeding facilities. The presence of honey badgers on the PAOI should be considered as a healthy ecological indicator and the NEMBA protection warrants due consideration.

3.6.1.2 Small-spotted cat (*Felis nigripes*)

This cat species is a relatively uncommon resident that is nationally protected. It was not observed during the survey period but is predicted to be resident within suitable habitats within the surrounding PAOI, mostly associated with termitaria. Termitaria represent one of the most important micro habitat types within the greater PAOI and should form the cornerstone of the mitigation measures to ensure protection for this species.

3.6.1.3 Cape fox (*Vulpes chama*)

[13]High: regular, expected to be present daily/weekly, Moderate: uncommon but expected to be present at least once a month Low: irregular or occasional to very rare

This canid species is a relatively uncommon resident that is nationally protected. The stronghold of this species is centered around more arid savanna systems and the Mpumalanga grassland habitats. It was not sighted during the survey period although road kill was seen within the greater PAOI. Despite widespread and intensive persecution by farmers, it is a relatively common species throughout its range and can be considered to be relatively resilient to impacts.

3.6.2 Mammalian Importance

Mammalian importance relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain mammal species of conservation importance. It is clear that throughout the PAOI most of the habitats are generic in their ability to support the prevailing mammal population, including species of conservation concern. With the exception of inselberg ridges and drainage lines, no unique geographical or topographical features exist which would cause the areas targeted for the proposed development to be classified as a "No Go" area. Therefore, the region as a whole is considered to be an area of medium mammalian importance although the PAOI should still be managed in a holistic manner at a policy level, prioritising general best practice (not fatal flaw or high sensitivity related) mitigation and monitoring of mammal species, both general and of conservation concern.

Areas with elevated mammal sensitivities include inselberg ridges, seasonal drainage lines, artificial impoundments and windmills. The seasonal drainage lines act as linear dispersal corridors for mammal species. Greater species diversity (as well as a unique composition) was observed in this habitat and therefore, these systems are earmarked as being of high mammal importance. It must be noted that this elevated diversity could also be attributed to the highly trackable substrate within the drainage line making the detection of mammal species through spoor tracking easier. However, the probability is high that the corridor potential of the habitat type acts as a factor increasing the presence of mammal species. Intermittent impoundments and water sources throughout a region that is inherently arid is an obvious cause for increased mammal diversity, density and therefore sensitivity within these habitat types, due to the inherent water dependence of the taxonomic group as well as the increased foraging potential of the ecosystem. The presence of impenetrable fences also limits migration and dispersal making enclosed populations totally dependent on these water points. Finally, the ridge systems (connected or otherwise) may not provide habitat for mammal SCC but are a crucial source of food for avifaunal SCC which rely on small to medium mammals as the cornerstone of their prey base. Therefore, these systems are unique in the landscape and must be subject to appropriate buffering.

3.6.3 Herpetofauna

Giant Bullfrog (*Pyxicephalus adspersus*)

The Giant Bullfrog is listed by Minter *et al*. (2004) as Near Threatened. However, the IUCN (2019) considers this species to be of Least Concern across its global distribution. This species may undergo an escalation in conservation status soon and must pre-emptively be considered to be of conservation importance. This species has not been recorded in 2821CA in which the PAOI is situated, but has been observed in adjacent QDGCs (FrogMAP, 2019). In arid regions Giant Bullfrogs utilise small pans that are difficult to detect without heavy rainfall, it is likely that suitable breeding habitat occurs within the PAOI.

Verrox's Tent Tortoise (*Psammobates tentorius veroxii*)

Although Verrox's Tent Tortoise is listed by Bates *et al*. (2014) as Least Concern, the IUCN (2019) considers the species to be Near Threatened. This small, scarce tortoise species is rarely seen. It is active in early mornings and evenings during the wet season when it feeds on succulents and perennial plants, but burrow beneath the base of shrubs during dry spells. This tortoise species has been recorded in the 2821CA QDGC on which the PAOI is situated (ReptileMAP, 2019). It is likely to be a permanent resident within the PAOI.

3.6.4 Avifauna

The Widdows (2015) study recorded a number of SCC that were not recognised and/ or discussed in detail in accordance to Taylor *et al.* (2015) and the regulations. Therefore, the entire SCC and mitigation application has been reviewed and updated in the current study.

According to the literature, 12 Red-Listed species are known to occur in the region with 6 species confirmed during the respective surveys, representing a very high success rate given the short study period. Of the nine highly likely or confirmed species and according to Taylor *et al.* (2015), two of the species are Endangered, four of the species are Vulnerable species and three are Near-Threatened. These species are discussed below and the probability of occurrence for selected threatened and near threatened avifauna on the respective PAOI is shown in Table 3-6. According to this, 8 species can be expected regularly in the PAOI. *A. paradisaea* and *N. ludwigii* are particularly widespread in the surrounding area.

Table 3-6: The probability of occurrence[14] for selected threatened and near threatened avifauna by PAOI.

Species	Bloemsmond 3	Bloemsmond 4	Bloemsmond 5	Connection Grid
Aquila verreauxii (Verreaux's Eagle)	Confirmed	High	High	High
Polemaetus bellicosus (Martial Eagle)	High	High	High	High
Circus maurus (Black Harrier)	Low	Low	Low	Low
Ciconia nigra (Black Stork)	Low	Low	Low	Low
Ardeotis kori (Kori Bustard)	High	High	High	Confirmed
Eupodotis vigorsii (Karoo Korhaan)	Confirmed	Confirmed	Confirmed	Confirmed
Neotis ludwigii (Ludwig's Bustard)	Confirmed	High	High	High
Falco biarmicus (Lanner Falcon)	Confirmed	High	High	High
Circus macrourus (Pallid Harrier)	Medium	Medium	Medium	Medium
Sagittarius serpentarius (Secretary Bird)	High	High	High	High
Rhinoptilus africanus (Double banded courser)	Confirmed	Confirmed	High	Confirmed
Spizocorys sclateri (Sclater's Lark)	High	High	High	Confirmed
Total (High-Confirmed)	**9**	**9**	**9**	**9**

[14]High: regular, expected to be present daily/weekly, Moderate: uncommon but expected to be present at least once a month Low: irregular or occasional to very rare. Confirmed species per PAOI not indicated

Table 3-7 represents a summary explanation of the Red-Listed species identified by SABAP 1 and SABAP 2 within the AOI and relates to the detailed discussion provided below. The table illustrates the long term habitat suitability for the observed and high likelihood Red-Listed species. The remaining taxa are either (1) irregular to rare foraging visitors or (2) unlikely to be present on the PAOI due to the poor availability (surface cover) of suitable habitat on the PAOI. According to Table 3-6 (which describes the likelihood of occurrence of Red-Listed species per PAOI) it is evident that the connected projects (therefore cumulative) exhibit similar likelihoods of occurrence. However, the areas showing large associations with ridges and/ drainage lines are characterised by some moderately unique habitat attributes and thus likely to provide refuge and foraging habitat for large terrestrial bird species (e.g. cranes, bustards, secretary bird and storks) and/ or wetland associates/ foraging migratory raptors, therefore, elevating the sensitivity.

In regards to the current study, it was deemed unnecessary that all species should be discussed in detail. Species such as lanner falcon as migrants incur pressures outside of the borders of South Africa and do not warrant intensive discussion. Therefore, the selected relevant species that are possibly susceptible to the proposed development have been discussed in detail below. Photographic evidence of SCC observed during the current study is provided in Figure 3-6.

Table 3-7: Avifauna species of conservation concern previously recorded in the PAOI pentads.

Species	Global Conservation Status (IUCN 2019)	National Conservation Status (Taylor et al. 2015)	Preferred Habitat	Potential likelihood of occurrence in PAOI
Anthropoides paradiseus (Blue Crane)	Vulnerable	Near threatened	Prefers open grasslands. Also forages in wetlands, pastures and agricultural land.	Moderately Likely: An uncommon foraging visitor to most of the PAOI. Low densities expected with breeding pairs recorded in adjacent areas and potentially susceptible to development activities.
Aquila verreauxii (Verreaux's Eagle)	-	Vulnerable	Mountainous areas or areas with prominent outcrops with a high prey base (e.g. hyrax)	Confirmed: Moderately frequent foraging resident throughout the PAOI, susceptible to poisoning events. Confirmed from previous records and one sighting during the study. Low mortality risk from proposed activities, but high risk of permanent localised displacement in association with Bloemsmond 1 and 3.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	Open bushveld with adequate roosting and foraging potential.	Likely: A highly irregular to rare foraging visitor dependent on adequate food supply and roosts. Moderately vulnerable to the proposed development activities
Ciconia nigra (Black Stork)	-	Vulnerable	Breeds on steep cliffs within mountain ranges; forages on ephemeral wetlands.	Likely: A highly irregular to rare foraging visitor dependent on the wetland systems located throughout the PAOI and potentially very

Species	Global Conservation Status (IUCN 2019)	National Conservation Status (Taylor et al. 2015)	Preferred Habitat	Potential likelihood of occurrence in PAOI
				vulnerable to the proposed development activities.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	Confirmed: A fairly common foraging migrant not recorded in the current study but expected periodically to occur. Not vulnerable to the proposed activities.
Neotis ludwigii (Ludwig's Bustard)	Endangered	Endangered	Primary upland grassland, particularly on hilly terrain.	Confirmed in high densities throughout the PAOI. Large bodied species, highly susceptible to development activities.
Oxyura maccoa (Maccoa Duck)	Near threatened	Near threatened	Large saline pans and shallow impoundments.	Unlikely: Rare visitor occurring in inundated water impoundments. Individually susceptible to development activities but as a species, low risk.
Sagittarius serpentarius (Secretarybird)	Vulnerable	Vulnerable	Prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah.	Confirmed: Regular low density resident which is most likely of lower risk to the proposed development activities.
Eupodotis vigorsii (Karoo Korhaan)	Near threatened	Near threatened	Large saline pans and shallow impoundments.	Confirmed: Common resident occurring near areas with open water. Individually susceptible to development activities but as a species, low risk.
Afrotis afra (Southern Black Korhaan	Vulnerable	Vulnerable	Prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah.	Confirmed: Regular low density resident which is most likely of lower risk to the proposed development activities.
Red-footed falcon (Lesser Kestrel)	Near Threatened	Near Threatened	Prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah.	Highly Likely: Regular migrant of fluctuating seasonal density which is most likely of lower risk to the proposed development activities due to most pressures occurring with breeding grounds and migration routes.
Circus maurus (Black Harrier)	Vulnerable	Endangered	Prefers open wetland and moist grasslands. Uncommon in open karroid savannah.	Low probability: Low density uncommon migrant which is most likely of lower risk to the proposed development activities.

Species	Global Conservation Status (IUCN 2019)	National Conservation Status (Taylor et al. 2015)	Preferred Habitat	Potential likelihood of occurrence in PAOI
Circus ranivorus (Marsh Harrier)	Least Concern	Endangered	Prefers open wetland and moist grasslands. Uncommon in open karroid savannah.	Likely: Regular albeit low density uncommon migrant which is most likely of lower risk to the proposed development activities.

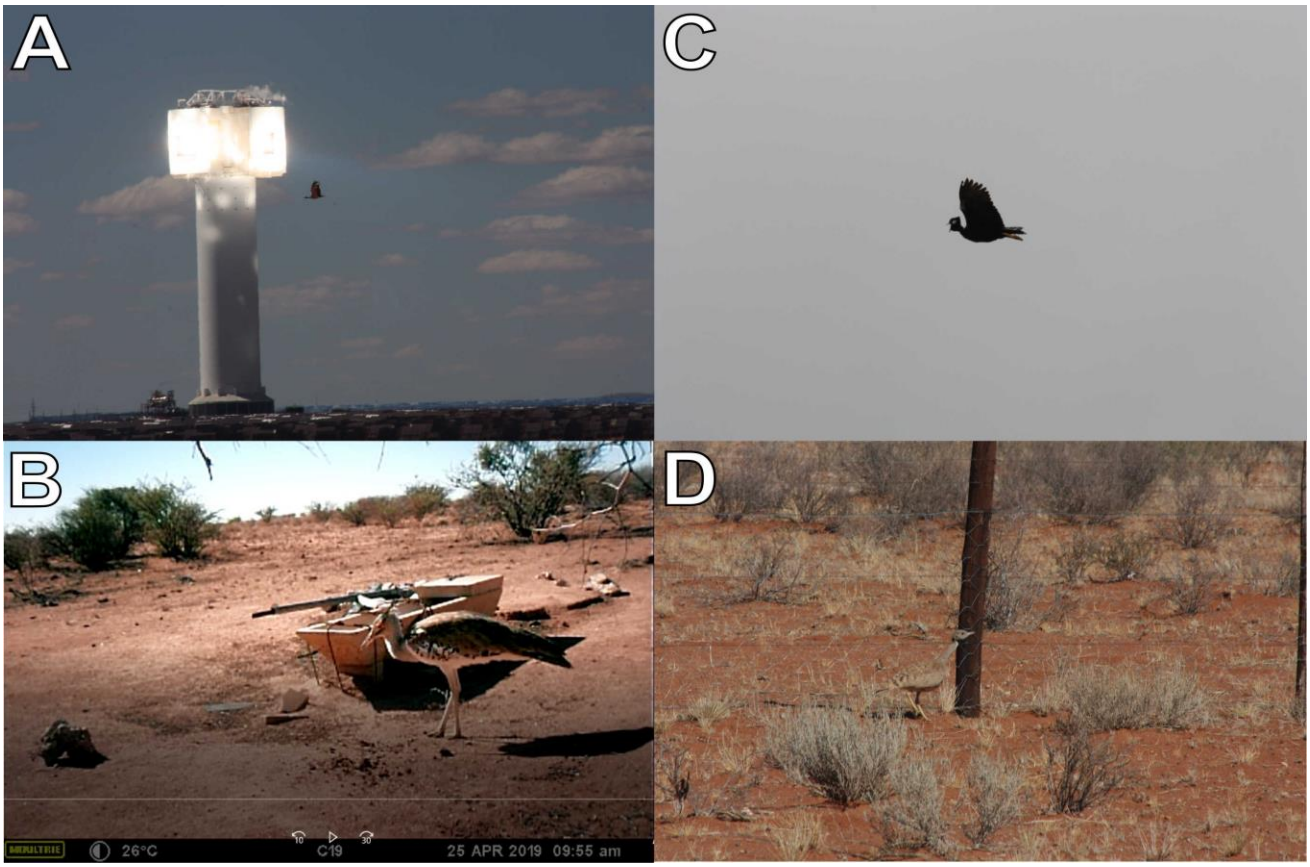

Figure 3-6: Photographic evidence of avifauna SCC observed during the current study.[15]

[15] (A) *Neotis ludwigii* (Ludwig's Bustard); (B) *Ardeotis kori* (Kori Bustard); (C) *Afrotis afra* (Southern Black Korhaan); (D) *Eupodotis vigorsii* (Karoo Korhaan).

3.6.4.1 Kori Bustard (*Ardeotis kori*)

Kori Bustards are globally and regionally listed as Near-Threatened (Taylor *et al.*, 2015). This large terrestrial bird exhibits a preference for lightly wooded savanna as well as arid open systems, which are very abundant within the PAOI. Camera trapping and anecdotal community interview information suggest that breeding pairs may persist on site and young sub-adults were encountered within the PAOI. The species is resident and at risk to the creation of large, non-marked powerlines which may cause collision of birds. In addition, large-scale increases in fencing (entanglement) combined with a high volume of large maintenance trucks may cause localised drastic declines in bustard numbers.

3.6.4.2 Ludwig's Bustard (*Neotis ludwigii*)

Ludwig's Bustards are globally and regionally listed as Endangered (Taylor *et al.* 2015) which is cause for a significant evaluation of the species in relation to the proposed development. Actual counts were not carried out (time limitations) although community interview data suggest that breeding pairs persist for prolonged periods within the PAOI and two separate sightings (total number five individuals including a sub-adult) were recorded. The species is highly migratory and localised development may not represent a fatal flaw. However, the fact that sub-adults and juveniles are encountered in the PAOI, there is strong anecdotal evidence of residential breeding behaviour which may have significance ramifications for the Cumulative Impact Assessment. The species was not recorded at any time from the previous study (Widdows 2015) and it is a significant oversight that no landowner interviews were carried out given the intricate long-term knowledge shown by interview subjects, including diagnostic distinctions between bustard species. The landowner stated that Ludwig's bustards have increased in density over the last five years. There are a number of possible explanations for the observed increase in density over time:

- It is possible that predator poisoning programs designed to eliminate jackals and black eagles (both of which prey on Ludwig's bustard and both of which are heavily targeted by sheep farmers) have allowed for a local population recovery/ increase;
- The lack of powerlines within much of the PAOI allowing for localised lower mortality rates; and
- This species, as a nomad, may show localised and temporal increases as part of natural population dynamics.

This species is almost certainly resident and at risk to the creation of large, non-marked powerlines which may cause collision of birds. In addition, large-scale increases in fencing combined with a high volume of large maintenance trucks may cause drastic declines in bustard numbers due to displacement, collisions and entanglements. The presence of this species must form a significant focal point of the mitigation measures of the project which is addressed below.

On a final note concerning monitoring of the species (and possible mitigations), it is vital to highlight that fact that as an Endangered species, Ludwig's bustard demands higher degrees of auditing and monitoring attention than other Red-Listed birds (a fact supported by multiple publications including Visser *et. al.* 2018 and Scott *et. al.* 2012). It is also vital to highlight that presence or absence over time for a nomadic species is difficult to predict and spatial/ temporal population reductions may or may not be development-induced. For example, the cessation of predator poisoning activities within the PAOI may in fact cause a localised increase in jackal populations, thereby reducing the population of Bustards through good practice. Although it is highly feasible that the development may be directly responsible for local population reductions, comprehensive

and continuous data collection is required to monitor the situation on site and apply appropriate mitigation measures and far more significant weighting and value should be applied to the Cumulative Impact Assessment.

3.6.4.3 Black Stork (*Ciconia nigra*)

The IUCN Vulnerable Black Stork (*Ciconia nigra*) is not expected to occur within the PAOI in significant densities. Due to lack of standing water and sub-optimal time of year, this species was not sighted during the current survey. The species is an uncommon albeit regular migrant and is seasonally associated with water bodies and pans throughout the region.

3.6.4.4 Verreaux's Eagle (*Aquila verreauxii*) and Martial Eagle (*Polemaetus bellicosus*)

As a rule, all nesting raptors should be protected within the PAOI. Although seen infrequently, Verreaux's eagle is most likely classified as a regular foraging visitor on the PAOI. The IUCN Vulnerable Verreaux's Eagles provide a typical scenario where the foraging population (and possible breeding pairs) of a Red List species are under constant pressure from development due to modifications and alterations of their preferred foraging habitat and dispersal networks. Generally, Verreaux's eagles occupy a home range size of approximately 20-35 km^2 (Van der Lecq 2012) or 35 - 65 km^2 in the Magaliesberg (Allan 1988; Anderson 2002) in areas where their preferred prey, the Rock Hyrax (*Procavia capensis*) is abundant (Gargett & Mundy 1990; Simmons 2005). Within the Keimoes PAOI, not only were rock hyrax and Smith's red rock rabbit observed in high densities, but a Verreaux's eagle was observed actively foraging. In areas of high disturbance, the species can increase their home range to an area of 150 - 200 km^2. This observed expansion of their home range size is probably explained by the lack of sufficient densities of prey and subsequent habitat loss within the landscape.

These data reveal a number of risks in regard to the current study. Increased stress to obtain food in the area has almost certainly modified the eagles' behaviour within the national population. Breeding adults have become more aggressive towards each other leading to increased post-hatchling mortalities (Anon 2012). This is especially relevant in regards to the loss of habitat for the Cumulative effects due to much reduced available prey as well as the increased disturbance levels.

It is an undisputed fact that the fitness of Verreaux's eagle (e.g. breeding success) is closely tied with the availability of its preferred prey. If prospecting and proposed future development is threatening the long-term viability of suitable prey populations, the Verreaux's Eagle can be expected to suffer equivalent population declines (Allan 1988).

Impacts

Disturbance applies to the disruption of a foraging, breeding or roosting bird caused by human-induced activities. Since development and construction go hand in hand with high ambient and stochastic noise levels (machinery) and habitat loss, it is possible for bird species and bird individuals to be displaced from the surrounding environment. It is essentially true for large species that require extensive home ranges, and those species that are inherently shy or unobtrusive by nature (e.g. raptors).

Displacement will be the response of eagles to the disturbance activity, for example when a bird changes its behaviour or takes flight by aborting its activity prior to the disturbance, or being unsuccessful in completing its current activity (Ruddock & Whitfield 2007). Reactions are likely to differ between species and between individuals of the same species (Rogers & Smith 1995; Rogers & Schwikert 2002). Reactions are also positively correlated to the magnitude and frequency of a particular

disturbance event. For the proposed Connection Grid application as well as the cumulative solar farm applications, it is currently unknown to what degree these activities will affect the eagles and their prey (due to absence of approvals, long-term studies and detailed list of activities), but reactions can be estimated to be similar due to the surrounding development activities. It must be stated that many bird species will become accustomed, or have the ability to learn and adapt, to constant occurring disturbance events of low magnitude (e.g. vehicle noise), unless they are not directly affected (e.g. their physical habitat is left intact). However, reduced poisoning of large SCC raptors may in fact have a positive effect on the population.

Reaction to disturbance events causes behavioural disruption which is likely to result in an increased energy expenditure (e.g. if a disturbed bird takes flight) and physical stress. In the case of breeding birds, disturbances could lead to the loss of eggs or nestlings, thereby affecting the breeding success of the population (Stillman *et al*. 2007). In addition, sustained disturbances could eventually result in less time for individuals to invest in breeding activities due to high energy demands compromising their survival. Displacement and disturbances are further aggravated by an increased loss of suitable foraging, breeding and roosting habitat.

Mitigation measures

Set-back areas or buffer zones are allocated to sensitive or important habitat features to alleviate the effect of foraging habitat in particular. The choice of an appropriate set-back distance is complex since different species and even different taxon groups demand different habitat types or home ranges to maintain a viable population in the long term.

The distance from an individual when it ceases normal behaviour (so-called alert distance) or before an individual engages in flight (so-called flight initiation distance) when approached by a potential disturbance entity (e.g. human intrusion) varies between individuals and species (Ruddock & Whitfield 2007). GDARD Biodiversity Guidelines is used in this case due to the higher proportion of studies conducted in Gauteng but can be applied to all populations. This is a dated policy document (GDARD 2014) which specifies buffer areas for certain Red List avifauna species. The Guidelines proposed a buffer of 800 m around the breeding colony or vulture restaurant for the Cape Vulture (*Gyps coprotheres*). Other buffers of 650 metres or more have been recommended for large bodied raptors of a similar niche to Verreaux's Eagle.

Given that the PAOI has been confirmed as a foraging site and not (as of yet) a breeding site, the following recommendation is proposed in order to preserve the ecological function of the ridge habitats, and to maintain foraging corridors for large SCC raptor species in the form of a set-back area of natural vegetation. The PAOI is therefore best zoned as a wildlife support area, where development should take into account foraging habitat without compromising the National economic value of sustainable energy generation. For the proposed development activities, the presence of Verreaux's and Martial Eagles and their preferred prey does not represent a fatal flaw, as the temporary nature and relatively small ecological impact footprint of the activities are unlikely to translate into permanent negative impacts on the regional populations. It is recommended that the entire ridge habitat areas should be interpreted as ecologically sensitive and declared as "no-go" areas for future development activities and their associated impacts.

3.6.4.5 All small Bustard, Korhaan species and especially Karoo Korhaan (*Eupodotis vigorsii*)

Due to the similar life histories and susceptibility to impacts, all Korhaan species are to be dealt with together. Karoo Korhaans are listed as Near-Threatened and were also observed with great frequency, totalling more than 15 sightings across the study period. All species are highly susceptible to entanglement in jackal fences and as an endemic species, range reductions (possibly between 30 to 50% loss between SABAP 1 and SABAP 2) are considered to be of significant concern. Therefore, and like many medium to large-bodied species, large-scale increases in fencing combined with a high volume of maintenance vehicles may cause drastic declines in Korhaan numbers.

3.6.4.6 Secretarybird (Sagittarius serpentarius)

This species was recently upgraded from regionally Near-Threatened to Vulnerable (Taylor *et al.*, 2015) as evidence suggests large-scale rapid population declines across its entire range. The species was not observed during the study but local landowners have testified that significant populations exist within the region. The cause of the declines is mainly due to habitat loss through intensive agricultural practices as well as accidental persecution and poisoning. Within the PAOI, they appeared to be a species of unknown density. The species prefers open areas, in particular open savanna and grassland and it is considered as a regular foraging visitor in the region owing to its preference for snakes and reptiles. It is predicted to share habitats in common with the Kori Bustards. Due to the nomadic habits of this bird as well as the observed low densities, the potential impacts on the species are considered to be Moderate to unknown.

3.7 CURRENT IMPACT DESCRIPTION

Several current ecological impacts were identified for the PAOI. It is vital to adequately describe these current impacts as they serve to illustrate the *status quo* of the PAOI and provide context to the impacts and mitigations section. The most obvious current impacts observed were:

- Fences causing direct mortalities of fauna;
- Powerline infrastructure causing avifauna mortality;
- Fencing inhibiting free movement of fauna;
- Livestock grazing;
- Wildlife-vehicle collisions (WVC's);
- Hunting (both legal and illegal);
- Dust effects and the contamination; and
- Rock collection to pack against fence bottoms.

Photographic evidence of a selection of current impacts is shown in Figure 3-7.

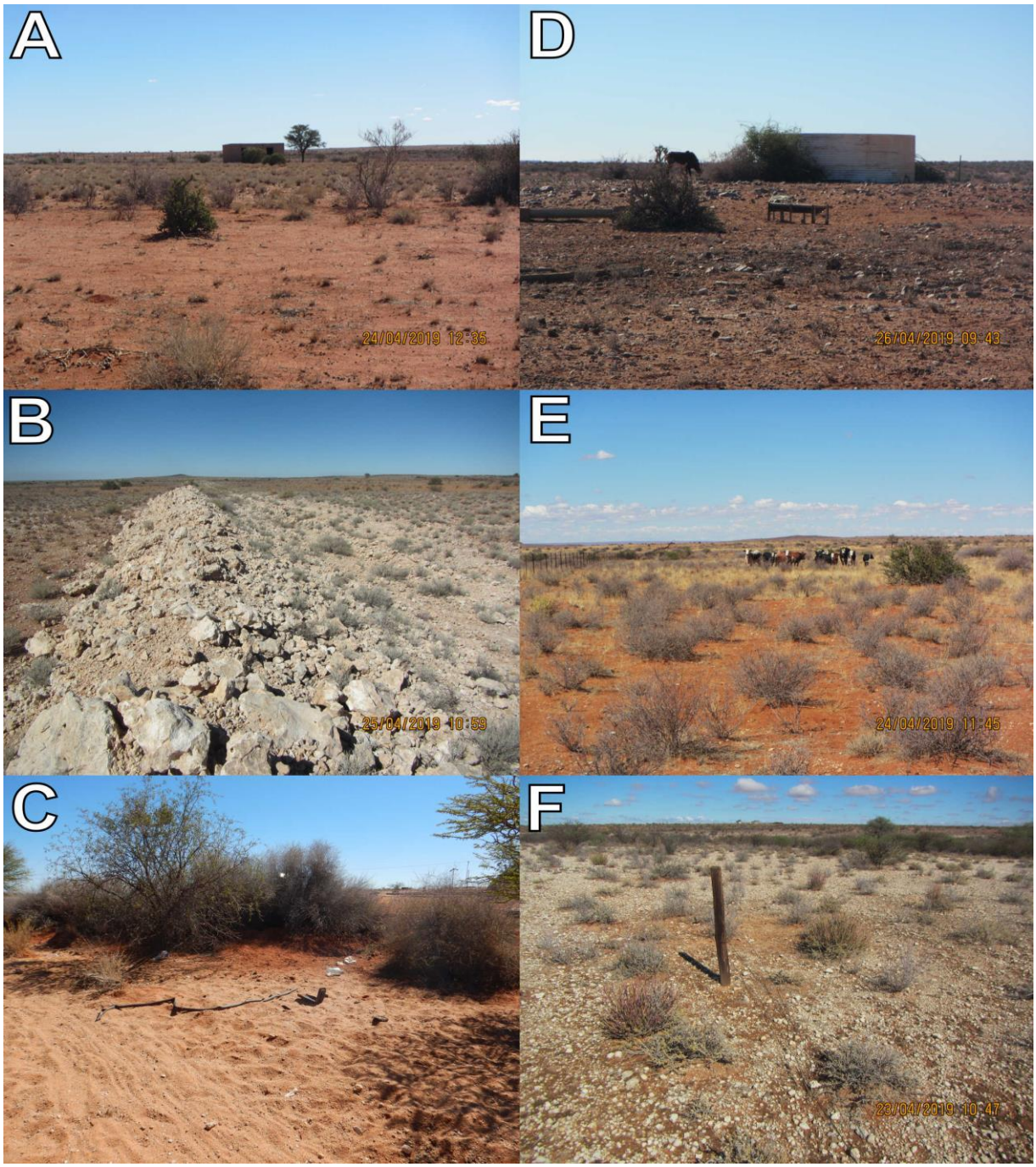

Figure 3-7: A selection of current impacts recorded within the PAOI and surroundings[16].

[16] Top to bottom, left to right: Farm buildings; Historical dam wall; Rubbish pollution within riverbeds; Reservoirs; Cattle grazing; Fences.

3.7.1 The influence of fences on direct mortalities for faunal species

Fencing is very prevalent in the Karoo due to the livestock farming practices that persist throughout the region. Fencing varies between simple properties boundaries to "jackal proof" fences which are used to control access by these potential sheep predators. This infrastructure causes the direct mortality of fauna through collision entanglement, especially for large and medium bodied birds, small ungulates and tortoises, the mortalities of which were observed on several occasions during the field surveys.

3.7.2 Powerline infrastructure causing avifaunal mortality

Existing and future distribution and electrical powerline infrastructure is present throughout some of the PAOIs but increases significantly in the areas adjacent to the exiting Khi One Solar facility and will increase cumulatively with the establishment of significant powerline infrastructure. Large bodied birds such as bustards, cranes and korhaans are particularly susceptible to mortalities arising from collisions with these electrical lines, which has caused large population declines for these species.

3.7.3 Fencing inhibiting free movement of fauna

As discussed above, large-scale fencing is prevalent throughout the Karoo landscape which prevents of free movement of many fauna. Species unable to jump high enough or burrow (e.g. tortoises, smaller antelope) are particularly susceptible to such fencing which effectively results and habitat fragmentation. In areas with intensely managed fencing, this habitat fragmentation can result in populations of certain species that are completely isolated from one another (e.g. Aardwolf) leading to inbreeding and population decline. Furthermore, during unfavourable environmental conditions such as drought, these animals cannot disperse to seek more suitable conditions and face localised extinctions. This is however somewhat offset by the fact that most of these intensely managed fenced camps have water sources in the forms of windmills which raises the ecological importance of these man-made structures considerably.

3.7.4 Extensive livestock and ranched antelope grazing

Livestock farming is the primary land use observed within the PAOI. The intensity of grazing by ranched wildlife species, livestock, particularly sheep and cattle, varies both seasonally (rotational grazing) and in density throughout each of the PAOIs. Livestock presence causes numerous impacts in the landscape including selective eradication of vegetation through grazing, displacement of native species, large scale erosion through the clearing of vegetation, spread of disease and alien invasive species. Poor husbandry and grazing practices have caused damage to several areas that may not be able to recover without active rehabilitation.

3.7.5 Wildlife-vehicle collisions (WVC's)

The direct mortality of fauna through collisions with vehicles represents one of the most significant and detectible impacts throughout the Karoo. Susceptible species include slow moving reptiles such as tortoises, large lizards and snakes, ungulates of all sizes and predators trapped on the roads between impenetrable fences and large bodied birds. Despite the fact that the current traffic volumes on these roads are relatively low, numerous road mortalities were encountered during the field surveys

(especially on highways servicing the area). The anticipated increased traffic volume from the proposed development is expected to significantly exacerbate this impact if direct mitigation is not implemented.

3.7.6 Hunting (both legal and illegal)

Livestock agriculture represents one of the most important commercial and subsistence income/ food streams for the Karoo region. As a result, large predator eradication campaigns (poisoning, trapping and shooting) have been implemented throughout the PAOIs in order to limit livestock losses. Targeted species include all predators, regardless of their actual impact on livestock (examples being black-backed jackal, caracal, bat-eared fox, cape fox and aardwolf) as well as large raptors such as Verreaux's eagle. In addition, several farmers regularly kill large leopard tortoises as they often interfere with the infrastructure at sheep watering points and windmills and compete with sheep for grazing. The presence of controlled concession areas by the proposed development (and subsequent control of such activities) may in fact show positive results in regards to reducing the significance of this impact.

4 IMPACT ASSESSMENT

Birds are impacted in three ways by means of power lines. It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with powerlines. These include the following:

4.1 ELECTROCUTION

Impact

Electrocution occurs when a bird creates a circuit between the live components or a combination of a live and earth component of a power line, thereby creating a fatal electrical shorting. The most common incidences occur when a species with a large wingspan attempts to perch on a pylon or flies off, creating unwanted contact. High-risk species include vultures (of the genera *Gyps, Torgos* and *Trigonoceps*) as well as other large birds of prey such as the Martial Eagle (*Polemaetus bellicosus*) (Ledger & Annegarn, 1981; Kruger, 1999; Van Rooyen, 2000). Vultures are non-pertinent to this particular PAOI. In addition, some species will attempt to roost and even breed on the tower structures if available nesting platforms are a scarce commodity, e.g. in the Karoo region where large trees are confined to riverine areas, thus increasing the relative importance and sensitivity of these habitat types. Other types of electrocutions happen by means of so-called "bird-streamers", where larger birds excrete on take-off and thereby create a short-circuit electrocution through the highly conductive uric acid (Van Rooyen & Taylor, 1999). Other species also likely to be affected include those prone towards roosting on pylons such as larger Storks, Herons and large Ducks and Geese. It is vital to confirm and ascertain that cross-rope suspension towers will be used, thereby reducing the inherent risk of electrocution to large birds due to the large gap between the energised components.

Mitigation

The cross rope suspension tower (

- Figure 4-1) design should be used for the current powerline since it poses no significant risk for electrocution in relation to highly sensitive bird species. This design is preferred to other tower designs based on the following aspects:
    - The clearances between the live components exceed the wingspan of any susceptible bird species (plus/ minus 7 m);
    - The structure is tall (up to 42.06 m high with an average of 37.9 m depending on topography and pylon position) with an average span of approximately 490 m between pylons (up to 642.7 m). Therefore, the height of the tower will not restrict the movement of terrestrial birds between successive pylons;
    - The live components are aligned in bundles or in close proximity to each other and are therefore very visible to approaching birds (although the earth wire remains invisible and requires additional measures such as flappers);
    - "Bird streamers" are unlikely to happen since the design discourage birds from perching above the insulator strings.
- Self-supporting (strain) towers will be used at bend or diversion points. This design allows for perching, roosting and nesting of bird species which could lead to electrical faults due to streamers. All self-supporting pylons should be fitted with *metal* (not rubber) *bird guards* as shown in Figure 4-2 to discourage birds from perching above the insulator strings.

Figure 4-1: Examples of the bird friendly "cross-rope suspension" tower design

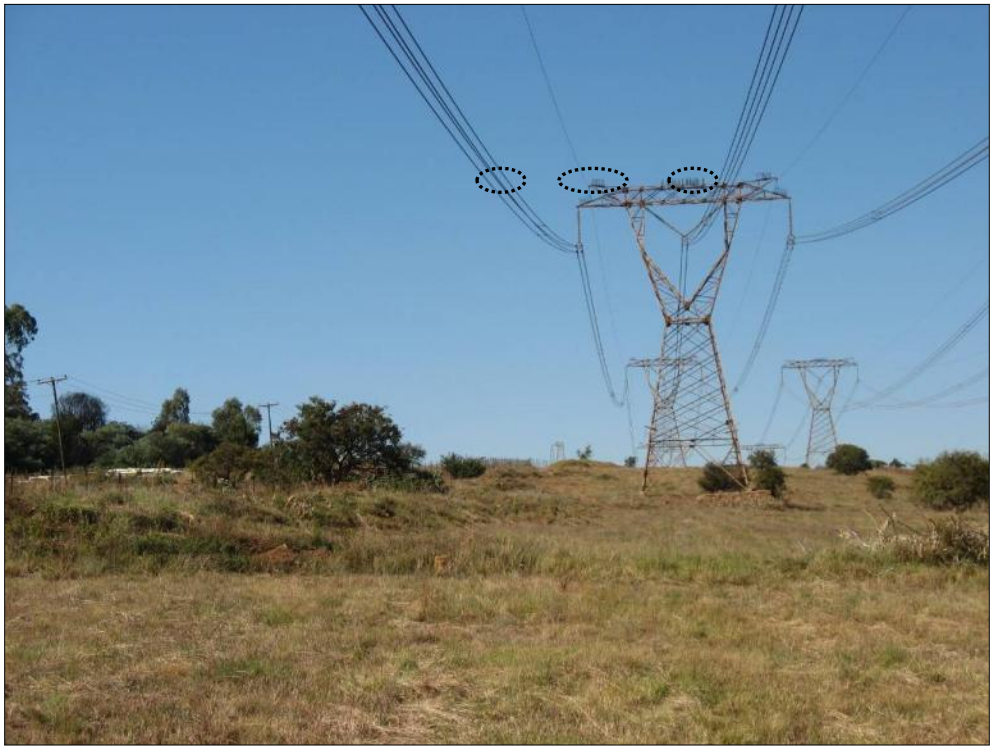

Figure 4-2: Bird guards ('spikes') fitted to a self-supporting tower.

4.2 COLLISION

Impact

Collisions with earth wires account for most negative bird interactions with powerlines in South Africa/ African context. Earth wires are much thinner in diameter when compared to the live components, and therefore invisible to approaching birds. Many of the species likely to be affected include heavy, large-bodied, less manoeuvrable terrestrial species such as Cranes, Storks, Flamingos, larger waterbirds, Bustards and Korhaans. These species, especially nocturnal fliers or those species with extended neck flight patterns (e.g. storks) find it difficult to make a sudden change in direction while flying – resulting in collisions. No matter the alignment chosen, the current powerline options poses a potential threat to the local avifaunal community due to possible collisions with the earth wire, especially for Endangered Ludwig's Bustards.

Mitigations

All of the following habitats are considered highest risk for collision.

- Drainage lines of the systems and ephemeral depressions – irrespective of their non-perennial status as birds will seasonally feed on fairy shrimp and utilise standing fresh water;
- Drainage lines, livestock troughs and depressions in close proximity to the alignment (usually within 100 m from the alignment);
- Farm and livestock water points.

Areas where bird collisions are likely to be high could be mitigated by increasing the visibility of the lines through applications of bird diverters and flappers (Ferrar & Janns 1999). However, the entire PAOI is considered as high-risk due to the presence of multiple susceptible species, suitable foraging habitat and breeding habitat, especially for the Endangered Ludwig's Bustard (*Neotis ludwigii*). Therefore, it is recommended that the entire alignment be marked with appropriate bird diverters in accordance to the prescribed specification. The placement of the proposed corridor alongside any existing infrastructure existing will greatly increase the visibility of the earth wires and many bird species have already become accustomed to the existing lines which will reduce collisions;

The specifications of the diverters are as follows:

- The "Double Loop Bird Flight Diverter" (BFD) is recommended as a marking device on the earth wires Figure 4-3 and Figure 4-4. The installation should meet the following criteria:
  - Diverters should make use of the largest available spirals, preferably using the model with a diameter range of at least 300 mm and at least 1 m in length (see http://www.preformedsa.co.za);
  - Diverters should be performed PVC that are UV resistant in order to maximise time between maintenance or replacement;
  - Diverters should be applied to all earth wires in a staggered fashion, alternating between black and white diverters for maximum contrast and visibility;
  - Diverters should be fitted to the entire span as Ludwig's Bustards often perceive the Diverters during their approach, while so they deviate their course only to collide with unmarked spans near their edges (see Shaw, 2013; Figure 4-5); and

- All diverters should be spaced at 10 m intervals from each other.

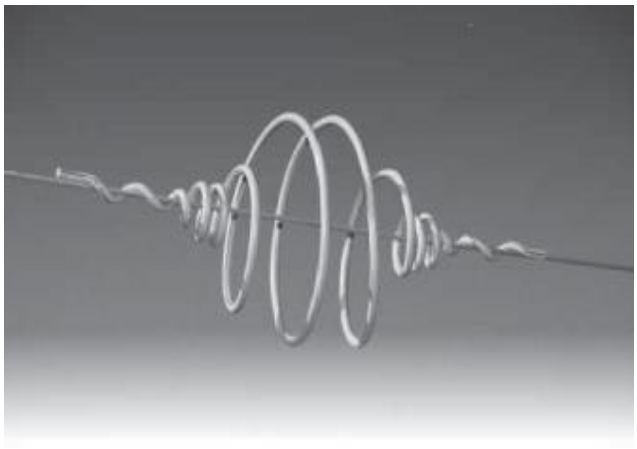

Figure 4-3: An example of the Double Loop Bird Flight Diverter fitted to the earth wires of a 400 kV powerline which is considered small and ineffective for the current project (Image copyright Niemand and Laurence 2014).

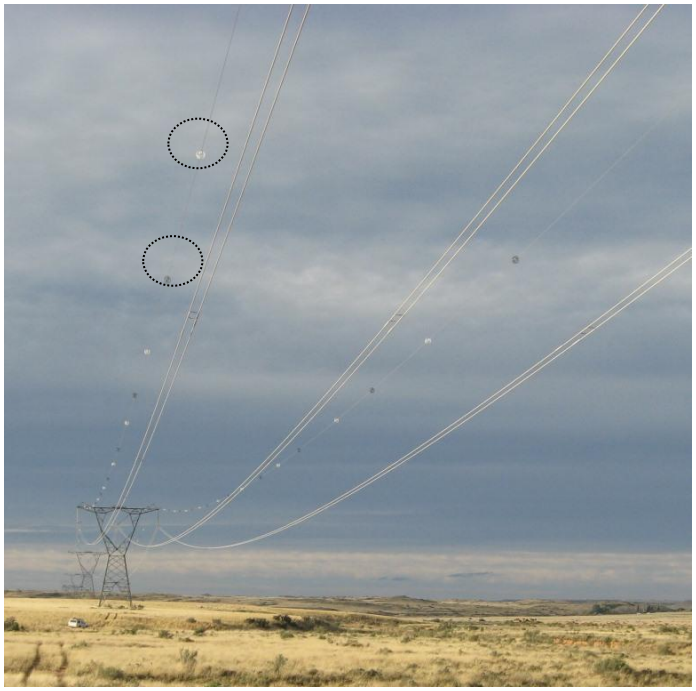

Figure 4-4: An example of the Double Loop Bird Flight Diverter fitted to the earth wires of a 400 kV power line in similar open habitat which is considered to be of sufficient size to be used for the current power line (image courtesy and copyright of Niemand, 2014).

Figure 4-5: Regional example of IUCN Endangered Ludwig's Bustard recorded in the PAOI.

4.3 GENERAL IMPACTS AND MITIGATIONS

1. Impact on vegetation and loss of flora species of conservation concern

a. Physical disturbance of vegetation

i. Vegetation loss [Construction & Operation] – *Where pylons* are *placed vegetation will be lost, especially shrubs and trees will be removed. Some earthworks and removal of topsoil might take place. Smaller species such as forbs and graminoids will initially be disturbed during the construction phase, but maintenance taking place during the operational phase will severely harm, damage or destroy vegetation that has regrown underneath the powerline. Available habitat for terrestrial fauna species will be reduced if continuously maintained;*

ii. Direct loss of flora species of conservation concern and flora species endemic to the region [Construction & Operation] - *The vegetation type has a unique floral species composition and the potential destruction of natural vegetation could lead to a significant loss of biodiversity. Removal of species of conservation concern is possible, especially protected trees and provincially protected plant species. Where necessary permits have to be submitted to the competent authority for their removal, destruction or damaged caused to them.*

iii. *Aloidendron dichotomum* physical disturbance and habitat destruction [Construction] - *Only one individual were recorded in Bloemsmond 4, but numerous individuals occur on the surrounding*

ridges and even possibly within the powerline corridor. This species should be protected in situ where possible. If the layout cannot be amended to accommodate this species, a permit application for its removal is required.

iv. Site camps and laydown areas [Construction] - *The proposed activities require temporary erection of machinery and site camps, and consequently increase the impact on the vegetation. Available habitat for terrestrial fauna species will also be reduced.*

v. Stochastic events such as fire (e.g. cooking fires or cigarettes of workers) [Construction & Operation] - *careless discarding of lit cigarette butts and/or glowing embers from cooking fires being blown into surrounding vegetation may cause runaway fires to remove habitat for terrestrial fauna species that would otherwise have been available. Also a human risk if out of control.*

b. Secondary impacts associated with the loss of habitat and removal of vegetation

i. Displacement/loss of flora & fauna (including rare or endangered species and important habitats) - *the removal of habitat, in particular vegetation, will directly result in the loss of flora species, and indirectly affect fauna reliant on this vegetation for foraging and/or refugia;*

ii. Habitat fragmentation & disruption of habitat corridors – *removal of vegetation leading to fauna habitat loss and fragmentation preventing migration and dispersal.*

iii. Establishment of alien and invasive vegetation – *alien and invasive flora are usually pioneer species capable of establishing and spreading across the sites where the natural vegetation has been disturbed. This further reduces available natural habitat and habitat quality for flora and fauna.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 4-1.

d. Mitigation and Enhancement Measures

i. Clearings associated with construction and movement of equipment across the site should occur in as small a footprint as possible. The layout design needs to specify the areas where disturbances will take place, including roads that will be utilised and the location of the site camp. The surrounding natural area that is not part of the layout design may not be disturbed or damaged;

ii. The site camps and laydown areas should be located in low sensitivity areas and should be demarcated. No unauthorised activities may take place outside of the demarcated fenced areas. Alternatively, existing storerooms and landowners yards can be utilised for storing of equipment and machinery. This can be organised with landowners directly;

iii. Alternatives should be planned in order to avoid loss of or damage to SCC as well as primary habitat such as ridges. Appropriate buffers should be maintained in order to prohibit loss of habitat for SCC and breeding and foraging sites for fauna SCC;

iv. No vehicles may drive off existing roads and create new roads in natural vegetation unless authorised;

v. Buffer zones are allocated to sensitive or important habitat features to alleviate the effect of habitat loss, habitat fragmentation, disturbances, increased isolation and edge effects;

vi. Temporary erosion control measures during the construction phase should be implemented to limit erosion where applicable, especially close to drainage lines;
vii. Re-vegetation where required after clearance should commence immediately after removal of camp site;
viii. Alien vegetation control should take place during all phases of the proposed development to limit the likelihood of dispersal and establishment of new areas;
ix. A maintenance plan should be developed which stipulates clearing of natural vegetation, management of alien vegetation, rehabilitation where required and removal of SCC including permit applications;
x. An environmental induction for all staff members must be mandatory in which all matters regarding SCC and specific issues related to the potential of fire are addressed e.g. only smoking in designated areas, no open cooking fires etc.

e. Impact Assessment (Post-mitigation) – Refer to Table 4-2.
f. Residual impacts –
   i. The spread of alien species is likely to occur and should be continuously controlled.
   ii. Habitat loss will result from the development, equivalent to the operational footprint of the facility
g. Uncertainty
   – The location of the site camp and pylons has not been determined as yet.
   – A detailed survey of the site has not taken place, accordingly the exact location and number of protected trees and SCC are not known.

2. Direct mortality of fauna

a. Project components that can cause direct mortality of fauna

   i. Staff or construction workers poaching and hunting [Construction & Operation] - *Several fauna species could be hunted and consumed by staff during the prospecting activities*;
   ii. Direct mortality due to collisions with vehicles and machinery (roadkill) [Construction & Operational phase] - *Vehicles are defined as support vehicles (e.g. bakkies / pickups), staff vehicles (light passenger vehicles), large and slow moving construction vehicles (such as earth moving equipment/trucks, drill) that will be either self-propelled or towed (construction phase). As this is a restricted area with low traffic volumes vehicle presence throughout the project is expected to be low and consequently collisions would be minimal. Reptiles, amphibians, small mammals and avifauna are particularly prone to collisions with fast moving vehicles as they do not move out of the way upon approach by a vehicle. Furthermore, vehicle drivers rarely see small fauna on the road surface or avifauna flying across, and cannot avoid collisions with these animals while travelling at high speed;*
   iii. Intentional killing of fauna [Construction & Operation] - *In general people are either superstitious or extremely fearful of snakes which usually results in the death of the snake when it is encountered.*

Despite the beneficial ecological functions of snakes such as rodent control, snakes are usually considered to be dangerous (despite the many non-venomous species) and are therefore killed;

iv. Loss of Species of Conservation Concern [Construction & Operation] – *Several avifauna SCC are present on site. Destruction of their foraging and/or breeding habitat is possible. For this reason flappers need to be installed*;

v. Direct mortality due to ground preparation for construction [Construction] - *The machinery used and the method of installation can result in the direct mortality of fauna, especially for burrowing fauna.*

b. Secondary impacts associated with direct mortality of fauna

i. Changes in fauna population dynamics (e.g. rodent population explosion) – *for example, prolonged mortality of predacious species such as snakes could significantly reduce the population density of these predators and allow prey species to undergo localised population explosions. This in turn can have major negative impacts on the surrounding ecology*.

c. Impact Assessment (Pre-mitigation) – Refer to Table 4-1.

d. Mitigation and Enhancement Measures

i. All vehicle speeds associated with the project should be monitored and should be limited to 40 km/h (maximum) during the construction and operation phases;

ii. Road mortalities should be monitored by vehicle operators via a logbook system where staff takes note of the date, time and location of the sighting/incident. This will allow determination of the locations where the greatest likelihood exists of causing road mortality and allow mitigation against it (e.g. additional speed reductions). Finally, mitigation should be adaptable to the onsite situation which may vary over time;

iii. All staff operating motor vehicles must undergo an environmental induction training course that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Drivers not complying with speed limits should be subject to penalties;

iv. An environmental induction for all staff members must be mandatory in which specific issues related to the killing and/or disturbance of faunal species should be avoided. Several staff members should complete a snake handling course in order to safely remove snakes from drill rigs and other operational areas. Snakes should only be handled after inductions have taken place due to the risks of envenomation;

v. Should large holes or burrows be located at the sites, and where avoidance of these areas is not possible, a zoological specialist should be contacted to investigate and possibly remove any species located within them.

e. Impact Assessment (Post-mitigation) – Refer to Table 4-2.

f. Residual impacts

- It is not possible to avoid all faunal deaths but proper mitigation will reduce the residual impacts to acceptable levels.

g. Uncertainty – The location of the site camp and pylons has not been determined as yet.

3. Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting [Construction & Operation]

a. Project components that can result in increased noise, dust and lighting
   i. Access roads and construction works [Construction & Operation] – *Noise, dust and lighting generated from moving vehicles operating on access roads and from machinery on site can disrupt fauna populations by interfering with their movements and/or breeding activities. In particular, lighting at night is expected to attract insects which will attract geckos and amphibians which in turn can attract snakes (which might be venomous). Lighting at night may also disrupt flight paths of migrating birds and bats foraging at night which could cause collisions.*
   ii. Construction activities – *Noise and dust generated from construction machinery can disrupt fauna populations by interfering with their movements and/or breeding activities.*

b. Secondary impacts associated with disruption/alteration of ecological lifecycles
   i. Increased probability of interaction with reptiles – *As described above, snakes may be attracted to potential prey due to lights and represent a potential health and safety threat. In addition, reptiles attracted to site such as snakes could be killed by staff on site.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 4-1.

d. Mitigation and Enhancement Measures
   i. Equipment with low noise emissions must be used or silencers should be fitted on all engines;
   ii. A dust monitoring system should be implemented during the construction and operational phase;
   iii. Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light. Use down-lighting from non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators at night;
   iv. Keep noise levels suppressed as per the local municipality or national standards. Do not unnecessarily disturb faunal species, especially during the breeding season and those with juveniles;
   v. All staff should be subjected to an induction training program where appropriate conservation principles, safety procedures, snake bite avoidance and first aid treatment are taught. Several staff members should complete a snake handling course in order to safely remove snakes from construction areas.

e. Impact Assessment (Post-mitigation) – Refer to Table 4-2

f. Residual impacts – None

g. Uncertainty – Location of site camp.

4. Introduction of alien and/or invasive flora affecting native flora and faunal assemblages

a. Project components that can result in increased densities of alien flora
   i. Vehicles and machinery [Construction & Operation] – *Vehicles and machinery can spread alien plant seeds throughout the PAOI which could potentially spread into the adjacent natural and agricultural areas. Alien plants can cause alterations to the environment which could affect local flora and fauna, especially since the PAOI is located within a threatened ecosystem and vegetation type;*
   ii. Soil Disturbance [Construction & Operation] – *Seeds lying dormant for years could germinate when the soil is disturbed, especially Category 1 and 2 alien invasive species;*

b. Secondary impacts associated with increased alien flora and fauna species
   i. Displacement of native species due to competition and/or unfavourable habitats due to alien establishment.

c. Impact Assessment (Pre-mitigation) – Refer to Table 4-1.

d. Mitigation and Enhancement Measures
   i. Disturbance of natural areas should be avoided and the spread of alien flora into natural areas should be controlled.
   ii. Continuous monitoring of the growth and spread of alien flora coupled with an adaptive management approach to identify suitable control mechanisms, preferably mechanical for such a small area. No chemical control should take place in close proximity of wetlands unless authorised;

e. Impact Assessment (Post-mitigation) – Refer to Table 4-2.

f. Residual impacts
   - The management of alien flora remains a global issue with the success of control measures highly dependent on the management strategy as well as resources available (e.g. financial and intellectual).
   - Numerous alien invasive species exist due to current impacts such as agricultural practices.

g. Uncertainty – The types of alien species that might be dormant within the soils.

5. Increase in erosion reduces habitat quality

a. Project components that can cause increase in erosion
   i. Vegetation clearing and earthworks [Construction and Operation] –*Vegetation clearing (pylon sites, camp sites and roads) throughout the site will lead to erosion caused by wind and rain. Such erosion undermines the stability of the habitat and reduces overall habitat quality for fauna and flora.*

b. Secondary impacts associated with increased erosion
   i. Establishment of alien and invasive vegetation – *as alien and invasive flora establish and spread across the site it reduces available natural habitat and habitat quality for fauna*

c. Impact Assessment (Pre-mitigation) – Refer to Table 4-1
d. Mitigation and Enhancement Measures
    i. Construction activities and vegetation clearing should be left open for as short a time as possible. Erosion control methods during the construction phase should be implemented to limit erosion where applicable.
    ii. Revegetation in natural areas after clearance should commence directly after construction activities.
    iii. Heavy vehicles should preferably not operate in the wet season as gravel roads can be disturbed and lead to erosion if not managed.
e. Impact Assessment (Post-mitigation) – Refer to Table 4-2
f. Residual impacts – None.
g. Uncertainty – The location of the site camp and pylons has not been determined as yet.

Table 4-1: The proposed development impacts on fauna and flora pre-mitigation.

Impact	Impacts Status	Spatial scale	Temporal scale	Probability (P)	Severity (S)	Significance value (P × S)	Significance rating
Loss of existing habitat due to loss of vegetation							
Vegetation loss	Negative	1	3	5	3	15	High
Site camps and laydown areas	Negative	1	4	5	3	15	High
Direct loss of flora species of conservation concern and flora species endemic to the region	Negative	1	4	5	4	20	High
Stochastic events such as fire	Negative	4	3	4	4	16	High
Direct mortality of fauna							
Staff or construction workers poaching and hunting	Negative	1	2	4	3	12	Medium/High
Collisions with vehicles	Negative	1	4	5	4	20	High
Intentional killing of fauna	Negative	1	4	4	4	16	High
Loss of species of conservation concern	Negative	2	4	5	4	20	High
Vegetation clearing/ construction preparation	Negative	1	2	4	3	12	Medium/ High
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting							
Access roads and construction	Negative	2	4	4	3	12	Medium/High

works							
Construction activities	Negative	2	5	5	4	20	High
Introduction of alien flora affecting native floral and faunal assemblages							
Vehicles and machinery	Negative	3	4	4	4	16	High
Soil Disturbance	Negative	2	3	4	4	16	High
Increase in erosion reduces habitat quality							
Vegetation clearing	Negative	1	3	4	3	12	Medium/High
Roads and hardened surfaces	Negative	1	4	4	3	12	Medium/High

Table 4-2: The proposed development impacts on fauna and flora post-mitigation.

Impact	Impacts Status	Spatial scale	Temporal scale	Probability (P)	Severity (S)	Significance value (P × S)	Significance rating
Loss of existing habitat due to loss of vegetation							
Vegetation loss	Negative	1	3	3	2	6	Medium
Site camps and laydown areas	Negative	1	4	3	2	6	Medium
Direct loss of flora species of conservation concern and flora species endemic to the region	Negative	1	4	3	3	9	Medium
Stochastic events such as fire	Negative	4	3	2	2	4	Low/Medium
Direct mortality of fauna							
Staff or construction workers poaching and hunting	Negative	1	2	1	2	2	Low
Collisions with vehicles	Negative	1	4	2	2	4	Low/Medium
Intentional killing of fauna	Negative	1	4	1	2	2	Low
Loss of species of conservation concern	Negative	2	4	3	3	9	Medium
Vegetation clearing/ construction preparation	Negative	1	2	2	2	4	Low/Medium
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting							
Access roads and construction works	Negative	1	1	2	2	4	Low/Medium

Construction activities	Negative	1	1	2	2	4	Low/Medium
Introduction of alien flora affecting native faunal assemblages							
Vehicles and machinery	Negative	2	4	3	2	6	Medium
Soil disturbance	Negative	2	3	2	2	4	Low/Medium
Increase in erosion reduces habitat quality							
Vegetation clearing	Negative	1	3	2	2	4	Low/Medium
Roads and hardened surfaces	Negative	1	4	3	2	6	Medium

5 CONCLUSION AND SENSITIVITY

The primary function of this document is to guide the selection of the alignment based on the sensitivity map generated from Confluent (2019) indicated in Figure 5-1 and the sensitivity map based on the solar grids indicted in Figure 5-2. Based upon the ground-truthing, Impact Analysis and Sensitivity analysis, it is the conclusion of the terrestrial ecologist and avifaunal zoologist that The Northern Collector-MTS Alternative A and the Preferred Eastern Connector be chosen as the preferred alignments for the power line from the Bloemsmond Collector Substation to the Upington MTS.

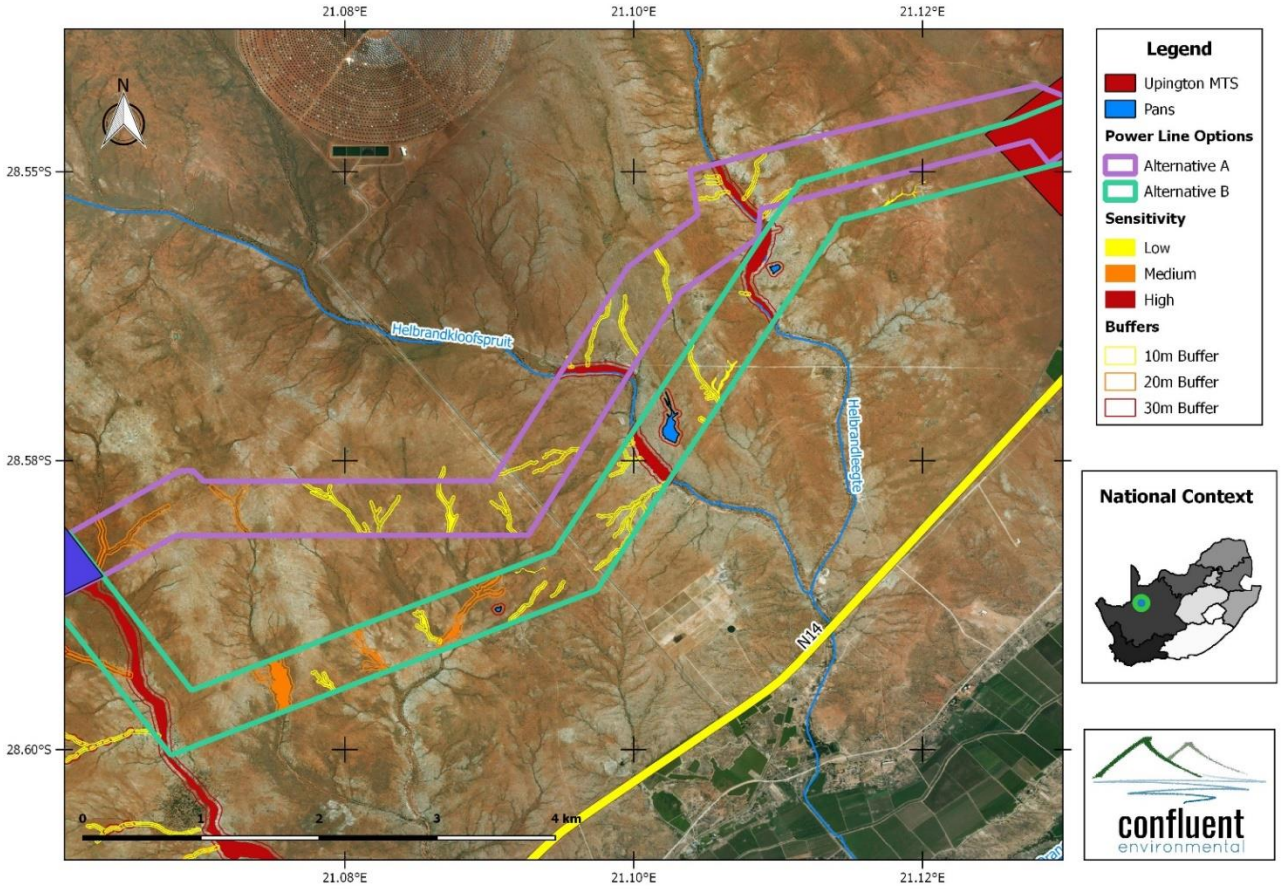

Figure 5-1: Sensitivity map in relation to proposed alignment alternatives (Confluent 2019).

Specifically, the conclusions are based on the following key points.

- It is anticipated that a number of access roads and laydown camps need to be constructed, including the clearing of vegetation during the construction and stringing of the pylons. Although intensive clearing is unlikely to take place underneath the powerlines, it is anticipated that sensitive succulent vegetation will be destroyed during the construction of access roads. In addition, the placement of access roads and laydown camps next to habitat features with a high probability of sustaining breeding Ludwig's Bustards and other birds of prey species is likely to displace individuals or it could result in the total abandoning of these areas. Therefore, the increased presence of drainage lines, ephemeral depressions (when inundated) and the intact vegetation show a preference for Alternative A.
- Permit applications for the removal of species listed in terms of the National Forest Act (Act No 84 of 1998) and the Northern Cape Nature Conservation Act (Act No 9 of 2009) which will be harmed or destroyed by the proposed development will be required from the competent authority. Protected tree species were not marked with a GPS or the number of individuals counted. This will be required prior to submitting permit applications with the competent authority.

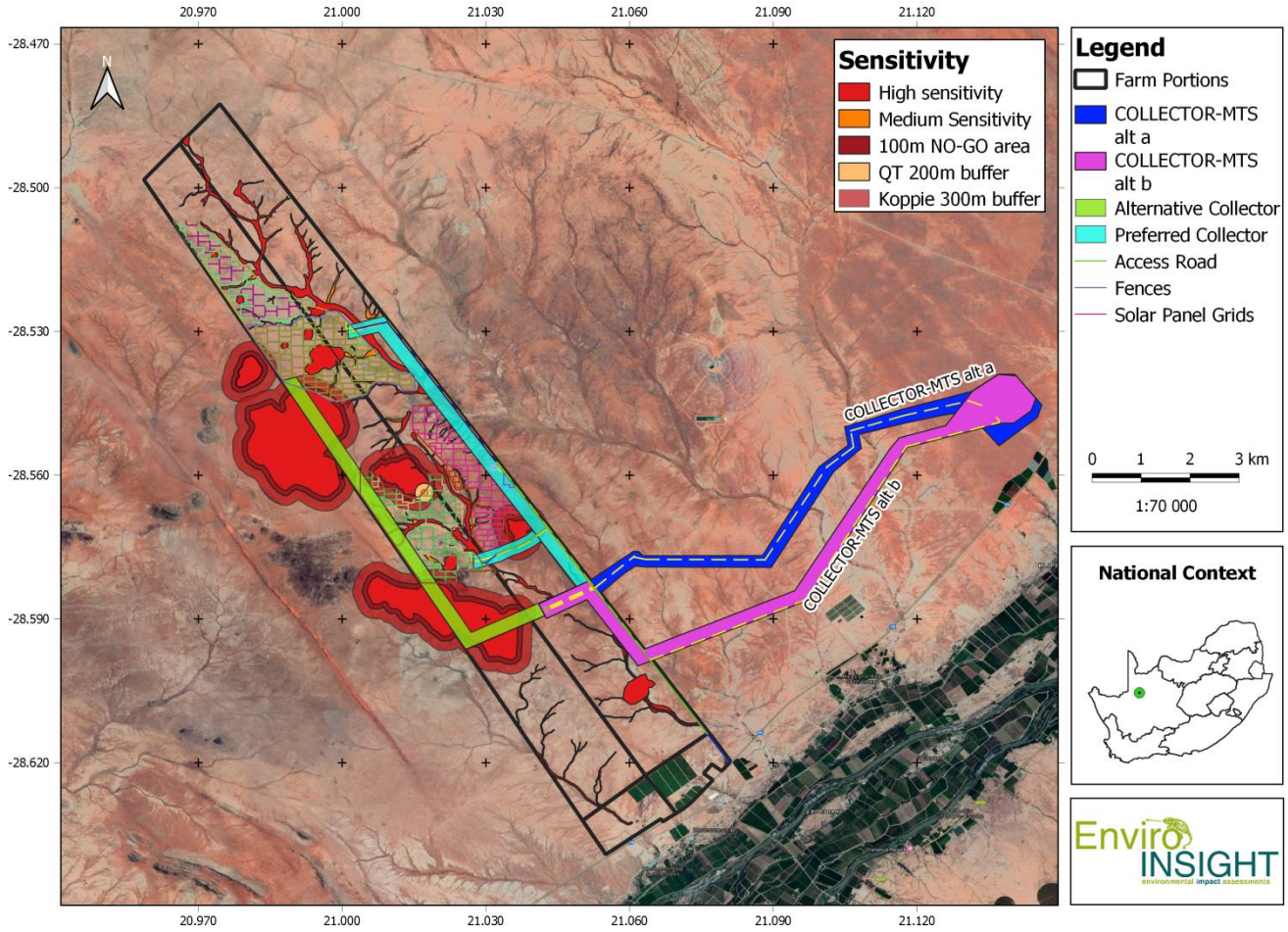

Figure 5-2: Sensitivity map of the connectors to the substation connectors.

6 PROFESSIONAL OPINION

The allocation of a positive outcome depends primarily on the following key conclusions.

- All the above mitigation measures should be followed accordingly.
- That Alternative A and the Preferred Eastern Connector are the preferred options (Figure 5-1; Figure 5-2) for the powerline infrastructure from the Bloemsmond Collector Substation to the Upington MTS from an ecological perspective.
- All drainage lines, depressions, inselbergs and ridges and quartz plains (as defined in this document) are regarded as sensitive habitat units. Therefore, these areas should be buffered accordingly where no construction personnel or vehicles may enter such areas. Those areas surrounding the laydown sites that are not part of the proposed corridor/servitude should be considered as “no-go” areas for employees, machinery or even visitors;

- Loss of any ridge habitat should be avoided where possible since they are often utilised by foraging bustards and act as suitable habitat for flora SCC. These should be indicated to the contractor by the Environmental Control Officer and an EMPr must be developed in order to monitor regional Cumulative Impacts;
- Prior to construction, the company must screen the alignment for any nesting birds of prey (with reference to nest-building activities, incubating and brooding individuals) prior to the construction phase. If active nests are identified or nest-building activities are noticed, the particular pylon should be barricaded and construction should cease in the nearby vicinity until the fledglings have left the nest. Under no circumstances should an inactive nest be removed or destroyed during the construction phase;
- If breeding Ludwig's Bustards are encountered, construction activities should cease until the nestlings have successfully fledged and left the area. In general, construction activities should not take place during the peak breeding months of:
    - Ludwig's Bustards (and to a lesser degree Kori Bustards): July – September;
    - Martial Eagle: April to June (the likelihood of martial eagles breeding on site is almost nil);
- It is strongly advised that the alignment be monitored bimonthly for at least two years after commencement of the operational phase to quantify the mortality of Ludwig's Bustards involved in collisions (counting of carcasses or signs of carcasses). The data should be made available to the infrastructure mortality incident register of the EWT. If after the first year no significant incidents have taken place, the monitoring frequency can be readjusted; and
- All labour or staff should be advised (induction) by means of environmental awareness training on the ecological and conservation importance of the avifaunal community in the area.

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8 APPENDIX

8.1 APPENDIX 1: GEOREFERENCED PHOTOGRAPHS TAKEN DURING THE FIELDWORK SURVEY.

					
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7772					

8.2 APPENDIX 2: EXPECTED FLORA SPECIES LIST

Plant species recorded on the BODATSA database for the xMin, yMin 20.20°,-29.20°: xMax, yMax 21.4°,-28.20° extent (WGS84 datum). Species of Conservation Concern are indicated in Red.

Scientific names	IUCN Category[17]	Ecology
Geigeria pectidea	LC	Indigenous; Endemic
Indigastrum argyroides	LC	Indigenous; Endemic
Heliophila sp.		
Peliostomum leucorrhizum	LC	Indigenous; Endemic
Ruschia sp.		
Arctotis leiocarpa	LC	Indigenous; Endemic
Suaeda merxmuelleri	LC	Indigenous
Solanum burchellii	LC	Indigenous; Endemic
Zygophyllum dregeanum	LC	Indigenous
Mesembryanthemum coriarium		Indigenous; Endemic
Tetraena microcarpa		Indigenous; Endemic
Selago paniculata	LC	Indigenous; Endemic
Kohautia cynanchica	LC	Indigenous
Rhigozum trichotomum	LC	Indigenous
Tribulus zeyheri	LC	Indigenous
Searsia pendulina		Indigenous; Endemic
Pteronia mucronata	LC	Indigenous; Endemic
Phalaris canariensis	NE	Not indigenous; Naturalised
Ferraria variabilis	LC	Indigenous; Endemic
Wahlenbergia denticulata	LC	Indigenous
Dimorphotheca pluvialis	LC	Indigenous; Endemic
Felicia muricata	LC	Indigenous
Anacampseros albissima		Indigenous; Endemic
Dyerophytum africanum	LC	Indigenous; Endemic
Tylecodon rubrovenosus		Indigenous; Endemic
Eragrostis procumbens	LC	Indigenous
Tephrosia dregeana	LC	Indigenous
Heliophila minima	LC	Indigenous; Endemic
Eragrostis brizantha	LC	Indigenous; Endemic
Aptosimum lineare		Indigenous
Felicia deserti	DD	Indigenous; Endemic
Pentzia sp.		

[17] VU = Vulnerable; NT = Near Threatened; DD = Data Deficient; LC = Least Concern; NE = Not Evaluated;

Ficus cordata	LC	Indigenous
Cenchrus ciliaris	LC	Indigenous
Melolobium macrocalyx		Indigenous
Cyperus longus	NE	Indigenous
Mesembryanthemum crystallinum	LC	Indigenous
Vachellia erioloba	LC	Indigenous
Ornithoglossum vulgare		Indigenous
Kleinia longiflora	LC	Indigenous
Setaria italica	NE	Not indigenous; Naturalised
Trachyandra sp.		
Cleome angustifolia	LC	Indigenous
Dinteranthus wilmotianus	NT	Indigenous; Endemic
Senecio sisymbriifolius	LC	Indigenous; Endemic
Melinis sp.		
Laggera decurrens	LC	Indigenous
Mesembryanthemum articulatum		Indigenous; Endemic
Setaria pumila	LC	Indigenous
Prosopis velutina	NE	Not indigenous; Naturalised; Invasive
Brachiaria glomerata	LC	Indigenous; Endemic
Crotalaria virgultalis	LC	Indigenous; Endemic
Kedrostis capensis	LC	Indigenous; Endemic
Barleria lichtensteiniana		Indigenous; Endemic
Forsskaolea candida		Indigenous; Endemic
Montinia caryophyllacea	LC	Indigenous
Prosopis chilensis	NE	Not indigenous; Naturalised
Dimorphotheca polyptera	LC	Indigenous; Endemic
Lotononis rabenaviana	LC	Indigenous; Endemic
Eriochloa fatmensis	LC	Indigenous
Bidens bipinnata		Not indigenous; Naturalised
Triraphis ramosissima	LC	Indigenous
Nymania capensis	LC	Indigenous; Endemic
Nerine laticoma	LC	Indigenous
Babiana flabellifolia	LC	Indigenous; Endemic
Tetragonia calycina	LC	Indigenous; Endemic
Crinum sp.		
Aloe claviflora	LC	Indigenous; Endemic
Eriospermum roseum	LC	Indigenous; Endemic
Aristida congesta	LC	Indigenous
Sebaea pentandra	LC	Indigenous; Endemic
Hermannia sp.		

Anthephora pubescens	LC	Indigenous
Azolla filiculoides	NE	Not indigenous; Naturalised; Invasive
Helianthus annuus		Not indigenous; Naturalised; Invasive
Phaeoptilum spinosum	LC	Indigenous; Endemic
Moraea polystachya	LC	Indigenous; Endemic
Echinochloa holubii	LC	Indigenous
Lapeirousia littoralis		Indigenous
Ruschia canonotata	LC	Indigenous; Endemic
Tragus berteronianus	LC	Indigenous
Heliophila trifurca	LC	Indigenous; Endemic
Dipcadi papillatum		Indigenous
Adromischus sp.		
Albuca suaveolens		Indigenous; Endemic
Cyanella lutea		Indigenous; Endemic
Eragrostis biflora	LC	Indigenous
Nolletia annetjieae	LC	Indigenous; Endemic
Monsonia parvifolia	LC	Indigenous; Endemic
Anacampseros baeseckei		Indigenous; Endemic
Echinochloa stagnina	LC	Indigenous
Senegalia mellifera	LC	Indigenous
Lasiosiphon polycephalus	LC	Indigenous; Endemic
Geigeria filifolia	LC	Indigenous
Berkheya spinosissima	LC	Indigenous; Endemic
Prosopis sp.		
Vachellia haematoxylon	LC	Indigenous; Endemic
Ledebouria sp.		
Eragrostis porosa	LC	Indigenous
Stipagrostis amabilis	LC	Indigenous; Endemic
Larryleachia marlothii		Indigenous; Endemic
Eriospermum bakerianum	LC	Indigenous; Endemic
Requienia sphaerosperma	LC	Indigenous
Aptosimum spinescens	LC	Indigenous; Endemic
Salsola tuberculata	LC	Indigenous; Endemic
Justicia spartioides		Indigenous; Endemic
Oxalis lawsonii	LC	Indigenous; Endemic
Salix mucronata	LC	Indigenous
Gorteria corymbosa	LC	Indigenous; Endemic
Geigeria ornativa	LC	Indigenous
Hermannia bicolor	LC	Indigenous; Endemic
Adenolobus garipensis	LC	Indigenous

Hermannia stricta	LC	Indigenous; Endemic
Acanthopsis hoffmannseggiana	DD	Indigenous; Endemic
Berkheya annectens	LC	Indigenous; Endemic
Mesembryanthemum guerichianum	LC	Indigenous; Endemic
Gladiolus saccatus	LC	Indigenous; Endemic
Cyperus marginatus	LC	Indigenous
Mesembryanthemum sp.		
Tetragonia reduplicata	LC	Indigenous
Tetraena simplex		Indigenous
Selago divaricata	LC	Indigenous; Endemic
Oxygonum alatum	LC	Indigenous
Polygala seminuda	LC	Indigenous
Haemanthus humilis	LC	Indigenous; Endemic
Suaeda caespitosa	LC	Indigenous; Endemic
Aristida engleri	LC	Indigenous; Endemic
Anacampseros filamentosa		Indigenous; Endemic
Rogeria longiflora	LC	Indigenous; Endemic
Urochloa panicoides	LC	Indigenous
Centropodia glauca	LC	Indigenous
Orbea sp.		
Lapeirousia plicata	LC	Indigenous; Endemic
Monsonia crassicaulis	LC	Indigenous; Endemic
Portulaca hereroensis		Indigenous
Codon royenii	LC	Indigenous; Endemic
Amellus tridactylus	LC	Indigenous; Endemic
Searsia lancea		Indigenous
Heliophila carnosa	LC	Indigenous
Eragrostis aspera	LC	Indigenous
Ifloga molluginoides	LC	Indigenous; Endemic
Aptosimum sp.		
Spergularia media		Not indigenous; Naturalised
Gymnosporia linearis	LC	Indigenous; Endemic
Parkinsonia africana	LC	Indigenous; Endemic
Crassula muscosa		Indigenous; Endemic
Manulea schaeferi	LC	Indigenous; Endemic
Thesium hystricoides	LC	Indigenous; Endemic
Lithops bromfieldii	LC	Indigenous; Endemic
Salsola kali		Not indigenous; Naturalised; Invasive
Hermannia spinosa	LC	Indigenous; Endemic
Digitaria sp.		

Tribulus pterophorus	LC	Indigenous; Endemic
Diplosoma sp.		
Aloidendron dichotomum	VU	Indigenous; Endemic
Leptochloa fusca	LC	Indigenous
Adenium oleifolium	LC	Indigenous; Endemic
Blepharis mitrata		Indigenous; Endemic
Cenchrus incertus	NE	Not indigenous; Naturalised
Justicia australis		Indigenous; Endemic
Enneapogon scaber	LC	Indigenous
Dipcadi gracillimum		Indigenous
Hermannia minutiflora	LC	Indigenous; Endemic
Prosopis glandulosa	NE	Not indigenous; Naturalised; Invasive
Monsonia luederitziana	LC	Indigenous; Endemic
Senna italica	LC	Indigenous
Anacampseros filamentosa		Indigenous; Endemic
Eragrostis rotifer	LC	Indigenous
Sericocoma avolans	LC	Indigenous; Endemic
Jamesbrittenia integerrima	LC	Indigenous; Endemic
Kissenia capensis	LC	Indigenous
Stipagrostis uniplumis	LC	Indigenous
Indigofera pungens	LC	Indigenous; Endemic
Anacampseros filamentosa		Indigenous; Endemic
Jamesbrittenia aridicola	LC	Indigenous; Endemic
Colchicum melanthoides		Indigenous; Endemic
Helichrysum gariepinum	LC	Indigenous; Endemic
Hirpicium echinus	LC	Indigenous; Endemic
Stipagrostis obtusa	LC	Indigenous
Aristida vestita	LC	Indigenous
Aptosimum procumbens	LC	Indigenous; Endemic
Tapinanthus oleifolius	LC	Indigenous
Commiphora gracilifrondosa	LC	Indigenous; Endemic
Pellaea calomelanos	LC	Indigenous
Prosopis glandulosa	NE	Not indigenous; Naturalised
Asparagus pearsonii	LC	Indigenous; Endemic
Persicaria lapathifolia		Not indigenous; Naturalised
Hermannia abrotanoides	LC	Indigenous; Endemic
Gisekia africana	LC	Indigenous
Osteospermum microcarpum	LC	Indigenous
Heliophila deserticola	LC	Indigenous; Endemic
Cyperus usitatus	LC	Indigenous

Digitaria sanguinalis	NE	Not indigenous; Naturalised
Sida rhombifolia	LC	Indigenous
Gazania lichtensteinii	LC	Indigenous; Endemic
Zygophyllum sp.		
Eragrostis annulata	LC	Indigenous
Stipagrostis ciliata	LC	Indigenous
Hermannia tomentosa	LC	Indigenous
Grielum humifusum	LC	Indigenous; Endemic
Setaria sp.		
Albuca virens		Indigenous; Endemic
Crinum bulbispermum	LC	Indigenous; Endemic
Schmidtia kalahariensis	LC	Indigenous
Felicia namaquana	LC	Indigenous; Endemic
Cotyledon orbiculata		Indigenous; Endemic
Lycium pumilum	LC	Indigenous; Endemic
Melinis repens	LC	Indigenous
Foveolina dichotoma	LC	Indigenous; Endemic
Aizoon canariense	LC	Indigenous
Barleria rigida	LC	Indigenous; Endemic
Dinebra retroflexa		Indigenous
Aloe gariepensis	LC	Indigenous; Endemic
Litogyne gariepina	LC	Indigenous
Setaria verticillata	LC	Indigenous
Rhigozum obovatum	LC	Indigenous
Dicoma capensis	LC	Indigenous
Helichrysum micropoides	LC	Indigenous; Endemic
Enneapogon desvauxii	LC	Indigenous

8.3 APPENDIX 3: MAMMAL SPECIES LIST

Mammals predicted to potentially occur within the PAOI. Species of conservation concern are highlighted in red.

Family	Scientific name	Common name	Conservation status Child *et al.*, (2016)
Bovidae	*Antidorcas marsupialis*	Springbok	Least Concern
Bovidae	*Connochaetes taurinus taurinus*	Blue wildebeest	Least Concern
Bovidae	*Oryx gazella*	Gemsbok	Least Concern
Canidae	*Otocyon megalotis*	Bat-eared Fox	Least Concern
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	Near Threatened
Felidae	*Felis nigripes*	Black-footed Cat	Vulnerable
Felidae	*Panthera pardus*	Leopard	Vulnerable
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	Least Concern
Leporidae	*Lepus capensis*	Cape Hare	Least Concern
Leporidae	*Lepus saxatilis*	Scrub Hare	Least Concern
Macroscelididae	*Macroscelides proboscideus*	Short-eared Elephant Shrew	Least Concern
Muridae	*Desmodillus auricularis*	Cape Short-tailed Gerbil	Least Concern
Muridae	*Otomys unisulcatus*	Karoo Bush Rat	Least Concern
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern
Mustelidae	*Mellivora capensis*	Honey Badger	Least Concern
Pedetidae	*Pedetes capensis*	South African Spring Hare	Least Concern
Procaviidae	*Procavia capensis*	Cape Rock Hyrax	Least Concern
Sciuridae	*Xerus inauris*	South African Ground Squirrel	Least Concern

8.4 APPENDIX 4: HERPETOFAUNA SPECIES LIST

Herpetofauna predicted to potentially occur within the PAOI. Species of conservation concern are highlighted in red.

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
AMPHIBIANS								
Bufonidae	Karoo Toad (subsp. gariepensis)	*Vandijkophrynus gariepensis gariepensis*	LC	LC	Habitat generalist across wide array of arid biomes	X	Moderate	Close to edge of range, but similar habitat
Pipidae	Common Platanna	*Xenopus laevis*	LC	LC	Habitat generalist but requires aquatic habitats that are at least semi-permanently inundated		Low	no water drainage areas in site, but individuals might migrate across it
Pyxicephalidae	Common Caco	*Cacosternum boettgeri*	LC	LC	Endorheic and palustrine systems in a wide variety of biomes		High	
Pyxicephalidae	Giant Bull Frog	*Pyxicephalus adspersus*	LC	LC	Seasonal endorheic and palustrine systems in a wide variety of biomes. Will not breed in permanent water.		High	
Pyxicephalidae	Tremelo Sand Frog	*Tomopterna cryptotis*	LC	LC	Endorheic and palustrine systems in a wide variety of biomes	X	High	
REPTILES								
Agamidae	Common Ground Agama	*Agama aculeata aculeata*	LC	LC	Habitat generalist across wide array of arid biomes, associated with sandy plains	X	High	

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
Agamidae	Anchieta's Agama	*Agama anchietae*	LC	LC	Habitat generalist across wide array of arid biomes, associated with rocky habitats		High	
Agamidae	Southern Rock Agama	*Agama atra*	LC	LC	Habitat generalist across wide array of biomes, associated with rocky habitats		High	
Amphisbaenidae	Dusky Worm Lizard	*Monopeltis infuscata*	LC	LC	Fossorial, associated with sandy habitats		High	
Amphisbaenidae	Maurice's Worm Lizard	*Monopeltis mauricei*	LC	LC	Fossorial, associated with sparsely vegetated Kalahari sands		Low	The dune systems are not present within the site, which lacks deep sand
Amphisbaenidae	Kalahari Dwarf Worm Lizard	*Zygaspis quadrifrons*	LC	Not Listed	Fossorial, associated with sandy habitats but recorded marginally in karroid habitat		Low	Patchy distribution, but recorded 2 QDGC away
Colubridae	Rhombic Egg-eater	*Dasypeltis scabra*	LC	LC	Habitat generalist across wide array of biomes		High	
Colubridae	Dwarf Beaked Snake	*Dipsina multimaculata*	LC	LC	Habitat generalist across wide array of arid biomes		High	
Colubridae	Beetz's Tiger Snake	*Telescopus beetzii*	LC	LC	Habitat generalist across wide array of arid biomes, associated with rocky habitats		High	
Cordylidae	Karoo Girdled	*Karusasaurus*	LC	LC	Habitat generalist across wide array	X	High	

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
	Lizard	*polyzonus*			of biomes, associated with rocky habitat			
Elapidae	Coral Shield Cobra	*Aspidelaps lubricus lubricus*	LC	LC	Habitat generalist across wide array of biomes	X	High	
Elapidae	Black Spitting Cobra	*Naja nigricincta woodi*	LC	LC	Associated with rocky arid habitats		High	
Elapidae	Cape Cobra	*Naja nivea*	LC	LC	Habitat generalist across wide array of biomes		High	
Gekkonidae	Common Giant Ground Gecko	*Chondrodactylus angulifer angulifer*	LC	LC	Habitat generalist across wide array of arid biomes, associated with sandy soils in which it burrows		Low	Site lacks deep sandy soils
Gekkonidae	Bibron's Gecko	*Chondrodactylus bibronii*	LC	LC	Habitat generalist across wide array of biomes, associated with rocky habitat		High	
Gekkonidae	Turner's Gecko	*Chondrodactylus turneri*	LC	LC	Habitat generalist across wide array of arid biomes, associated with rocky habitat	X	Moderate	Records at range margin, possibly misidentified C. bibronii
Gekkonidae	Bradfield's Dwarf Gecko	*Lygodactylus bradfieldi*	LC	LC	Habitat generalist preferring trees and rocks		High	
Gekkonidae	Augrabies Gecko	*Pachydactylus atorquatus*	LC	LC	Rocky specialist in arid habitats		Low	Recorded 2 QDGC away, but site may contain suitable habitat
Gekkonidae	Cape Gecko	*Pachydactylus*	LC	LC	Generalist in grassland and savanna		High	

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
		capensis						
Gekkonidae	Quartz Gecko	*Pachydactylus latirostris*	LC	LC	Arid sandy habitats, such as dry river beds and plains		High	
Gekkonidae	Namaqua Mountain Gecko	*Pachydactylus montanus*	LC	LC	Generalist in arid rocky habitats		High	
Gekkonidae	Speckled Gecko	*Pachydactylus punctatus*	LC	LC	Generalist in open habitats, such as dry river beds		High	
Gekkonidae	Purcell's Gecko	*Pachydactylus purcelli*	LC	LC	Generalist in arid rocky habitats	X	High	
Gekkonidae	Common Rough Gecko	*Pachydactylus rugosus*	LC	LC	Associated with dry river beds and woody debris		High	
Gekkonidae	Striped Ground Gecko	*Pachydactylus wahlbergii furcifer*	LC	LC	Sandy soils in dune habitats		Low	The dune systems are not present within the site, which lacks deep sand
Gekkonidae	Common Barking Gecko	*Ptenopus garrulus garrulus*	LC	LC	Associated mostly with dunes and sandy karroid habitat	X	Moderate	Site lacks deep sandy soils
Gekkonidae	Spotted Barking Gecko	*Ptenopus garrulus maculatus*	LC	LC	Associated mostly with dunes and sandy karroid habitat		Low	Unlikely to be sympatric with P. g. garrulus, and is more marginally distributed near the site
Gerrhosauridae	Dwarf Plated Lizard	*Cordylosaurus subtessellatus*	LC	LC	Generalist in arid rocky habitats		Moderate	Rocky habitat present but not extensive
Lacertidae	Bushveld Lizard	*Heliobolus lugubris*	LC	LC	Generalist in lowland savanna, often		Low	The dune systems are not

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
					associated with Kalahari sands			present within the site, which lacks deep sand
Lacertidae	Spotted Desert Lizard	*Meroles suborbitalis*	LC	LC	Habitat generalist across wide array of biomes		High	
Lacertidae	Western Sandveld Lizard	*Nucras tessellata*	LC	LC	Generalist associated with arid rocky areas, dry river beds and karroid habitat		Moderate	Sparse but scattered records in site vicinity, habitat suitable
Lacertidae	Plain Sand Lizard	*Pedioplanis inornata*	LC	LC	Generalist associated with open arid rocky areas		High	
Lacertidae	Karoo Sand Lizard	*Pedioplanis laticeps*	LC	LC	Prefers well vegetated karroid habitats and montane grassland		Low	Sparse but scattered records in site vicinity, lack of vegetative cover
Lacertidae	Spotted Sand Lizard	*Pedioplanis lineoocellata lineoocellata*	LC	LC	Habitat generalist across wide array of biomes, prefers open habitats		High	
Lacertidae	Namaqua Sand Lizard	*Pedioplanis namaquensis*	LC	LC	Habitat generalist across wide array of arid biomes, prefers open sandy habitats		High	
Lamprophiidae	Brown House Snake	*Boaedon capensis*	LC	LC	Habitat generalist across wide array of biomes		High	
Lamprophiidae	Cape Wolf Snake	*Lycophidion capense capense*	LC	LC	Habitat generalist across wide array of biomes		High	

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
Lamprophiidae	Two-striped Shovel-snout	*Prosymna bivittata*	LC	LC	sandveld, karoo scrub and savanah		Moderate	Sparse but scattered records in site vicinity, lack of vegetative cover
Lamprophiidae	Southwestern Shovel-snout	*Prosymna frontalis*	LC	LC	Rocky arid habitats		High	
Lamprophiidae	Karoo Sand Snake	*Psammophis notostictus*	LC	LC	Habitat generalist across wide array of biomes		High	
Lamprophiidae	Fork-marked Sand Snake	*Psammophis trinasalis*	LC	LC	Arid savanna and grassland		High	
Lamprophiidae	Mole Snake	*Pseudaspis cana*	LC	LC	Partly fossorial, generalist across wide array of biomes		Moderate	Sparse but scattered records in site vicinity
Lamprophiidae	Bicoloured Quill-snouted Snake	*Xenocalamus bicolor bicolor*	LC	LC	Fossorial, prefering habitats with Kalahari sands		Low	Site lacks deep sandy soils
Scincidae	Striped Blind Legless Skink	*Acontias kgalagadi kgalagadi*	LC	LC	Fossorial, prefering dunes and savanna with Kalahari sands		Low	The dune systems are not present within the site, which lacks deep sand
Scincidae	Striped Dwarf Legless Skink	*Acontias lineatus*	LC	LC	Fossorial generalist, associated with sandy habitats		High	
Scincidae	Cape Skink	*Trachylepis capensis*	LC	LC	Habitat generalist across wide array of biomes, but absent from Nama Karoo biome		Moderate	Marginal habitat with lack of vegetative cover
Scincidae	Western Three-	*Trachylepis*	LC	LC	Habitat generalist across wide array	X	High	

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
	striped Skink	*occidentalis*			of arid biomes			
Scincidae	Karasburg Tree Skink	*Trachylepis sparsa*	LC	LC	Arid savanna and karoo, associated with trees in dry river beds and rocky areas	X	High	
Scincidae	Kalahari Tree Skink	*Trachylepis spilogaster*	LC	LC	Arid savanna and karoo, associated with trees in dry river beds and rocky areas	X	High	
Scincidae	Western Rock Skink	*Trachylepis sulcata sulcata*	LC	LC	Habitat generalist across arid biomes, always associated with rocky habitats	X	High	
Scincidae	Variegated Skink	*Trachylepis variegata*	LC	LC	Habitat generalist across wide array of biomes		High	
Testudinidae	Serrated Tent Tortoise	*Psammobates oculifer*	LC	LC	Prefers high altitude arid habitats, but marginally distributed in Nama Karoo biome		Moderate	Marginally distributed near the site
Testudinidae	Verrox's Tent Tortoise	*Psammobates tentorius verroxii*	LC	NT	Habitat generalist across wide array of arid biomes, associated with some karroid vegetation cover	X	High	
Testudinidae	Leopard Tortoise	*Stigmochelys pardalis*	LC	LC	Habitat generalist across wide array of biomes, but absent in most karroid habitats		Moderate	Distribution extends along the Orange River and while the site habitat is unsuitable some individuals might utilise the area temporarily.

Family	Common name	Scientific name	National Conservation Status	IUCN	Habitat preference	Focal QDGC (2528CC)	Probability of Occurrence	Justification
Typhlopidae	Schinz's Beaked Blind Snake	*Rhinotyphlops schinzi*	LC	LC	Fossorial, arid habitats	X	High	
Varanidae	Rock Monitor	*Varanus albigularis albigularis*	LC	LC	Habitat generalist across wide array of biomes, associated with rocks or trees		High	
Viperidae	Puff Adder	*Bitis arietans arietans*	LC	LC	Habitat generalist across wide array of biomes		High	
Viperidae	Horned Adder	*Bitis caudalis*	LC	Not Listed	Habitat generalist across wide array of arid biomes		High	
Viperidae	Desert Mountain Adder	*Bitis xeropaga*	LC	Not Listed	Rocky specialist in arid habitats		Low	Edge of distribution, but rocky outcrop on site

8.5 APPENDIX 5: AVIFAUNA EXPECTED SPECIES LIST

Avifauna predicted to potentially occur within the PAOI according to SABAP1 and SABAP2. Species of conservation concern are highlighted in red.

Scientific name	Common name	Conservation status Taylor *et al*. (2015)
Acrocephalus baeticatus	Reed-warbler, African	Least concern
Acrocephalus gracilirostris	Swamp-warbler, Lesser	Least concern
Actitis hypoleucos	Sandpiper, Common	Least concern
Afrotis afraoides	Korhaan, Northern Black	Least concern
Alcedo cristata	Kingfisher, Malachite	Least concern
Alopochen aegyptiacus	Goose, Egyptian	Least concern
Amadina erythrocephala	Finch, Red-headed	Least concern
Amaurornis flavirostris	Crake, Black	Least concern
Anas erythrorhyncha	Teal, Red-billed	Least concern
Anas sparsa	Duck, African Black	Least concern
Anhinga rufa	Darter, African	Least concern
Anthoscopus minutus	Penduline-tit, Cape	Least concern
Anthus cinnamomeus	Pipit, African	Least concern
Apus affinis	Swift, Little	Least concern
Apus apus	Swift, Common	Least concern
Apus caffer	Swift, White-rumped	Least concern
Aquila pennatus	Eagle, Booted	Least concern
Ardea cinerea	Heron, Grey	Least concern
Ardea goliath	Heron, Goliath	Least concern
Ardea melanocephala	Heron, Black-headed	Least concern
Ardea purpurea	Heron, Purple	Least concern
Ardeotis kori	Bustard, Kori	Least concern
Batis pririt	Batis, Pririt	Least concern
Bostrychia hagedash	Ibis, Hadeda	Least concern
Bradornis infuscatus	Flycatcher, Chat	Least concern
Bubulcus ibis	Egret, Cattle	Least concern
Burhinus capensis	Thick-knee, Spotted	Least concern
Calendulauda africanoides	Lark, Fawn-coloured	Least concern
Calendulauda sabota	Lark, Sabota	Least concern
Campethera abingoni	Woodpecker, Golden-tailed	Least concern
Caprimulgus rufigena	Nightjar, Rufous-cheeked	Least concern

Centropus burchellii	Coucal, Burchell's	Least concern
Cercomela familiaris	Chat, Familiar	Least concern
Cercotrichas coryphoeus	Scrub-robin, Karoo	Least concern
Cercotrichas paena	Scrub-robin, Kalahari	Least concern
Certhilauda subcoronata	Lark, Karoo Long-billed	Least concern
Ceryle rudis	Kingfisher, Pied	Least concern
Charadrius tricollaris	Plover, Three-banded	Least concern
Chersomanes albofasciata	Lark, Spike-heeled	Least concern
Chrysococcyx caprius	Cuckoo, Diderick	Least concern
Cinnyris fuscus	Sunbird, Dusky	Least concern
Cinnyris mariquensis	Sunbird, Marico	Least concern
Circus pygargus	Harrier, Montagu's	Least concern
Cisticola aridulus	Cisticola, Desert	Least concern
Cisticola juncidis	Cisticola, Zitting	Least concern
Cisticola tinniens	Cisticola, Levaillant's	Least concern
Clamator jacobinus	Cuckoo, Jacobin	Least concern
Colius colius	Mousebird, White-backed	Least concern
Columba guinea	Pigeon, Speckled	Least concern
Corvus albus	Crow, Pied	Least concern
Cossypha caffra	Robin-chat, Cape	Least concern
Creatophora cinerea	Starling, Wattled	Least concern
Crithagra albogularis	Canary, White-throated	Least concern
Crithagra atrogularis	Canary, Black-throated	Least concern
Crithagra flaviventris	Canary, Yellow	Least concern
Cypsiurus parvus	Palm-swift, African	Least concern
Dendrocygna viduata	Duck, White-faced	Least concern
Dendropicos fuscescens	Woodpecker, Cardinal	Least concern
Egretta garzetta	Egret, Little	Least concern
Elanus caeruleus	Kite, Black-shouldered	Least concern
Emberiza impetuani	Bunting, Lark-like	Least concern
Eremomela icteropygialis	Eremomela, Yellow-bellied	Least concern
Eremopterix verticalis	Sparrowlark, Grey-backed	Least concern
Estrilda astrild	Waxbill, Common	Least concern
Euplectes orix	Bishop, Southern Red	Least concern
Eupodotis vigorsii	Korhaan, Karoo	Least concern
Falco biarmicus	Falcon, Lanner	Vulnerable
Fulica cristata	Coot, Red-knobbed	Least concern

Gallinula chloropus	Moorhen, Common	Least concern
Genus Species	Common_group, Common_species	Least concern
Glaucidium perlatum	Owlet, Pearl-spotted	Least concern
Halcyon albiventris	Kingfisher, Brown-hooded	Least concern
Haliaeetus vocifer	Fish-eagle, African	Least concern
Himantopus himantopus	Stilt, Black-winged	Least concern
Hippolais icterina	Warbler, Icterine	Least concern
Hirundo albigularis	Swallow, White-throated	Least concern
Hirundo cucullata	Swallow, Greater Striped	Least concern
Hirundo fuligula	Martin, Rock	Least concern
Hirundo rustica	Swallow, Barn	Least concern
Hirundo spilodera	Cliff-swallow, South African	Least concern
Indicator minor	Honeyguide, Lesser	Least concern
Ixobrychus minutus	Bittern, Little	Least concern
Lagonosticta senegala	Firefinch, Red-billed	Least concern
Lamprotornis nitens	Starling, Cape Glossy	Least concern
Lanius collaris	Fiscal, Common (Southern)	Least concern
Lanius minor	Shrike, Lesser Grey	Least concern
Malcorus pectoralis	Warbler, Rufous-eared	Least concern
Megaceryle maximus	Kingfisher, Giant	Least concern
Melierax canorus	Goshawk, Southern Pale Chanting	Least concern
Merops apiaster	Bee-eater, European	Least concern
Merops bullockoides	Bee-eater, White-fronted	Least concern
Merops hirundineus	Bee-eater, Swallow-tailed	Least concern
Mirafra fasciolata	Lark, Eastern Clapper	Least concern
Motacilla aguimp	Wagtail, African Pied	Least concern
Motacilla capensis	Wagtail, Cape	Least concern
Muscicapa striata	Flycatcher, Spotted	Least concern
Mycteria ibis	Stork, Yellow-billed	Endangered
Myrmecocichla formicivora	Chat, Anteating	Least concern
Nilaus afer	Brubru, Brubru	Least concern
Numida meleagris	Guineafowl, Helmeted	Least concern
Nycticorax nycticorax	Night-Heron, Black-crowned	Least concern
Oena capensis	Dove, Namaqua	Least concern
Oenanthe monticola	Wheatear, Mountain	Least concern
Oenanthe pileata	Wheatear, Capped	Least concern
Onychognathus nabouroup	Starling, Pale-winged	Least concern

Parisoma layardi	Tit-babbler, Layard's	Least concern
Parisoma subcaeruleum	Tit-babbler, Chestnut-vented	Least concern
Parus cinerascens	Tit, Ashy	Least concern
Passer diffusus	Sparrow, Southern Grey-headed	Least concern
Passer domesticus	Sparrow, House	Least concern
Passer melanurus	Sparrow, Cape	Least concern
Phalacrocorax africanus	Cormorant, Reed	Least concern
Phalacrocorax carbo	Cormorant, White-breasted	Least concern
Philetairus socius	Weaver, Sociable	Least concern
Phragmacia substriata	Warbler, Namaqua	Least concern
Phylloscopus trochilus	Warbler, Willow	Least concern
Plectropterus gambensis	Goose, Spur-winged	Least concern
Plegadis falcinellus	Ibis, Glossy	Least concern
Plocepasser mahali	Sparrow-weaver, White-browed	Least concern
Ploceus velatus	Masked-weaver, Southern	Least concern
Polihierax semitorquatus	Falcon, Pygmy	Least concern
Prinia flavicans	Prinia, Black-chested	Least concern
Pterocles namaqua	Sandgrouse, Namaqua	Least concern
Pycnonotus nigricans	Bulbul, African Red-eyed	Least concern
Quelea quelea	Quelea, Red-billed	Least concern
Rhinopomastus cyanomelas	Scimitarbill, Common	Least concern
Riparia paludicola	Martin, Brown-throated	Least concern
Scopus umbretta	Hamerkop, Hamerkop	Least concern
Sigelus silens	Flycatcher, Fiscal	Least concern
Spizocorys starki	Lark, Stark's	Least concern
Sporopipes squamifrons	Finch, Scaly-feathered	Least concern
Stenostira scita	Flycatcher, Fairy	Least concern
Streptopelia capicola	Turtle-dove, Cape	Least concern
Streptopelia semitorquata	Dove, Red-eyed	Least concern
Streptopelia senegalensis	Dove, Laughing	Least concern
Struthio camelus	Ostrich, Common	Least concern
Sylvietta rufescens	Crombec, Long-billed	Least concern
Tachybaptus ruficollis	Grebe, Little	Least concern
Tadorna cana	Shelduck, South African	Least concern
Telophorus zeylonus	Bokmakierie, Bokmakierie	Least concern
Threskiornis aethiopicus	Ibis, African Sacred	Least concern
Trachyphonus vaillantii	Barbet, Crested	Least concern

Tricholaema leucomelas	Barbet, Acacia Pied	Least concern
Tringa glareola	Sandpiper, Wood	Least concern
Tringa nebularia	Greenshank, Common	Least concern
Turdus smithi	Thrush, Karoo	Least concern
Tyto alba	Owl, Barn	Least concern
Upupa africana	Hoopoe, African	Least concern
Urocolius indicus	Mousebird, Red-faced	Least concern
Vanellus armatus	Lapwing, Blacksmith	Least concern
Vanellus coronatus	Lapwing, Crowned	Least concern
Vidua macroura	Whydah, Pin-tailed	Least concern
Zosterops pallidus	White-eye, Orange River	Least concern

8.6 APPENDIX 6: SPECIALISTS PROOF OF QUALIFICATION

Specialist: Samuel Laurence

SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Samuel David Laurence
Registration number: 400450/13

is registered as a

Professional Natural Scientist

In terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule I of the Act)

Zoological Science	**20 November 2013**
Ecological Science	**20 November 2013**

COPY

20 November 2013
Pretoria

President

Executive Director

Disclaimer

I Samuel Laurence *Pr. Sci. Nat. (Zoology and Ecological Science)* declare that the work presented above is my own and has not been influenced in any way by the client. At no point has the client asked me as a specialist to manipulate my results and the above methods has been carried out to the highest ecological standards.

Samuel Laurence (*Pr. Sci. Nat.*)

Specialist: Corné Niemandt

SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Corné Niemandt
Registration number: 116598

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Ecological Science

Effective 13 December 2018 Expires 31 March 2019

President Executive Director

Disclaimer

I Corné Niemandt *Pr. Sci. Nat. (Ecological Science)* declare that the work presented above is my own and has not been influenced in any way by the client. At no point has the client asked me as a specialist to manipulate my results and the above methods has been carried out to the highest ecological standards.

Corné Niemandt (*Pr. Sci. Nat.*)