SPECIALIST AVIFAUNAL ASSESSMENT FOR THE PROPOSED POFADDER SOLAR THERMAL PLANT, NORTHERN CAPE

COMPILED FOR:

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ON BEHALF OF

KAXU CSP SOUTH AFRICA (PTY) LTD
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1. INTRODUCTION AND TERMS OF REFERENCE

BirdLife South Africa was appointed by Savannah Environmental (Pty) Ltd to undertake an avifaunal specialist study for the proposed establishment of the Pofadder Solar Thermal Plant, to be located on Portion 4 of the Farm Scuit-Klip 92, which falls within the Khai-Ma Local Municipality, Northern Cape.

2. THE PROPOSED ACTIVITY

2.1 Location of the activity

The Pofadder Solar Thermal Plant is proposed on a portion of Portion 4 of the Farm Scuit-Klip 92, approximately 36 km north-east of Pofadder, 180 km west of Upington and 100 km west of Kakamas, Northern Cape. The larger site covers an area of approximately 22 km^2

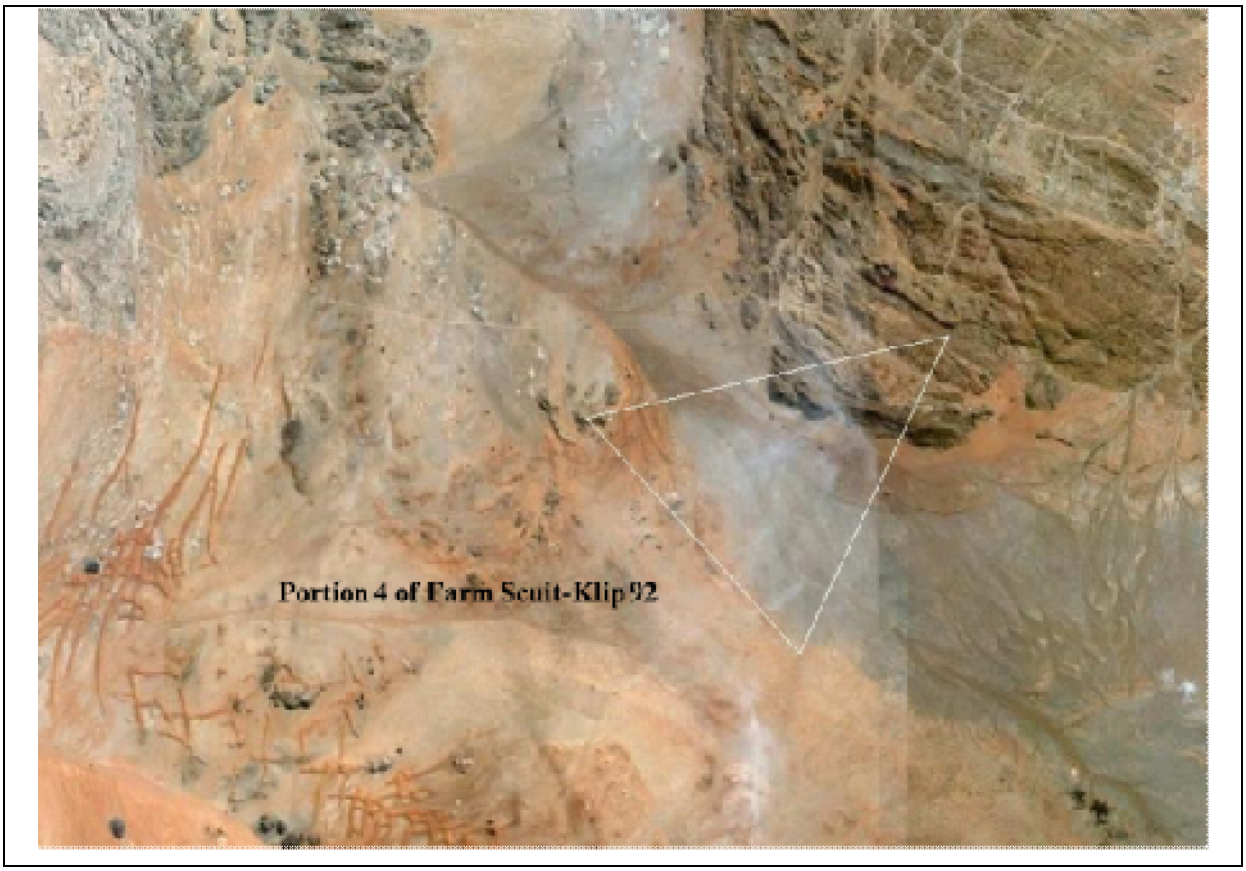

Figure 2-1: Portion 4 of Farm Scuit-Klip 92, Northern Cape

2.2 Proposed project and infrastructure requirements

The facility is proposed to accommodate up to 310 MW which will be comprised of a combination of the following technologies (in any combination):

- Parabolic troughs (i.e. concentrating solar thermal power)
- Power tower and heliostat field (i.e. concentrating solar thermal power)
- Photovoltaic array

The first two technology options will also include the associated infrastructural requirements:

- A steam turbine and generator housed within a 2-storey building
- A generator transformer and a small substation outside the building
- An auxiliary steam boiler and associated vessels
- A 2km long 132kV overhead power line feeding into the existing Paulputs Eskom transmission substation
- Water supply pipeline/s to the facility and extraction point on the Orange/Gariep River
- Water treatment plant and water storage facilities
- Access roads to the site from the R64, as well as access roads within the site
- Workshop and storage areas

3. METHODS

A two day site visit was conducted by Martin Taylor on the 15-16th September 2010. The purpose of the site visit was to complete an on-site avifaunal assessment site in order to identify Species of Special Concern (SSC) and assess the likely impacts of the construction and operational phases on the resident avifaunal communities present on site. Additional data was compiled by means of a desktop study utilising several sources including feasibility reports, literature and past environmental reports.

3.1 On site avifaunal assessment

The MacKinnon List Method, a rapid avifaunal assessment technique, was used to collect bird community data on site. All species seen or heard were grouped into consecutive lists of equal length (n=10) and a species accumulation curve was generated from adding those species not recorded on any previous list to the total species number (Colwell, Nao and Chang 2004). Saturation was defined as the point where the rate of species accumulation over five sample intervals fell below 0.10 (O' Dea, Watson and Whittaker 2004). At this point the study area was deemed to have been adequately surveyed with the likelihood of further species being detected being negligible to the amount of survey effort required. For the purposes of this study, aerial species such as Martins, Swallows, and Swifts were excluded from the data set. These species forage over an extremely wide area and in site specific surveys they are excluded unless known to be roosting on site. The number of species detected over two days was extremely low in terms of diversity as well as density (n=9). This can be attributed to the low rainfall in the area as well as the degraded nature of the habitat on site (overgrazed). It was not possible to saturate a species accumulation curve given the low number of species detected on site but after two different sampling sessions (15th and 16th) on site it was felt that an adequate snapshot of the avifaunal community on site had been obtained.

3.2 Desktop data compilation

Data was compiled by means of a desktop study utilising several sources including feasibility reports, literature and past environmental reports. The purpose of the literature review was to identify:

- A baseline bird community as well as Species of Special Concern
- Previous means of predicting bird mortality (and other impacts) of solar energy facilities affecting birds in groups similar to those in the study area.
- Accounts of avian mortality at solar facilities and associated infrastructure
- Information on the status in Pofadder, Northern Cape and globally, of bird groups most likely to be affected

3.3 Methods for determining the significance of impacts and assumptions

The consultant was provided with a document setting out the standardised method for evaluating impacts identified during the EIA phase of the study. A copy of this document is included in Appendix B.

4. BASELINE DESCRIPTION OF RECEIVING ENVIRONMENT

4.1 Vegetation

According to Hoare (2010), there are two major vegetation types that the study site falls within namely Bushmanland Grasslands (plains) and lower Gariep Broken Veld (Hilly/mountainous areas). Both vegetation types are listed as Least Concern.

Figure 4-1: Typical habitat occurring on site

The habitat type and extent required by a bird species depends on a species food preferences, foraging strategies, and nest site requirements. A key factor in the composition of a bird community is also the quality of habitat. Stock farming (mainly sheep) is a primary activity in this area and overstocking has degraded vegetation on the property.

4.2 Regional overview of bird species occurring in the Northern Cape

Approximately 445 bird species occur within the Northern Cape across a wide range of different biomes and habitat types. This includes ocean and coastal dwelling species such as albatrosses, petrels and so forth found on the western borders of the Province

and which do not occur in the interior. Fifty six of these species are endemic to South Africa meaning that they do not occur outside of South Africa's borders with a further forty two being classified as near endemics i.e. their distribution reaches just outside of our borders into neighbouring countries. Of the 445 bird species occurring in the Northern Cape, fifty two (or 11.5%) are listed in *The Eskom Red Data Book of Birds of South Africa, Lesotho, and Swaziland,* meaning that to a certain degree their existence as a species is threatened.

4.3 Bird community assemblage within the study area

The plains in the vicinity of the demarcated site footprint were fairly unproductive and low in bird density and diversity. This habitat type was dominated by Spikeheeled Lark, Fawncoloured Lark, and Anteating Chats. No Species of Special Concern were detected during the site visit. In addition to the site visit, a number of the pentads (SABAP2 database) in the immediate vicinity of the study site were analysed and a composite list of what species might occur on site has been compiled. This list, as well as a list of the species detected in the site visit, is contained in Appendix G.

4.4 Avifaunal Species of Special Concern

As mentioned above, of the 445 bird species occurring in the Northern Cape, fifty two (or 11.5%) are listed in *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* meaning, that to a certain degree, their existence as a species is threatened. A data set of the total number of species that occurred within the Northern Cape was compiled and is contained in Appendix H. Species that would not occur within the area or for which the habitat would be unsuitable, i.e. pelagic species such as albatrosses which are oceanic, were removed. The remaining species which may possibly occur on site are recorded in **Error! Reference source not found.**Table 4-1 below.

Table 4-1: Threatened species possibly occurring within the study area

Common name	Scientific name	Biome	Red Data Book status	Habitat
Secretarybird	*Sagittarius serpentarius*	S, G	Near-threatened	Grassland
Ludwig's Bustard	*Neotis ludwigii*	NK	Vulnerable	Savannah
Red Lark	*Calendulauda burra*	S	Vulnerable	Dunes
Lanner Falcon	*Falco biarmicus*	NK, S	Near-threatened	Varied
Martial Eagle	*Polemaetus bellicosus*	NK, S	Vulnerable	Varied
Sclater's Lark	*Spizocorys sclateri*	Uncommon	Near-threatened	Stony desert scrub

The above table represents species whose distribution range overlaps with the study area. Whilst these species may not always be observed on site is not inconceivable for these species to occur within the study area at some stage – after all birds respond to the sporadic availability of resources such as food and move accordingly. Larger bodied species such as Martial Eagle (*Polemaetus bellicosus)* and Secretarybird (*Sagittarius serpentarius*) have extremely large home ranges and could very well be found on occasion within the study area. Given this, we have included the possibility that interactions between these Red Data species and the proposed development may occur. Smaller bodies species such as Red Lark (*Calendulauda burra*) tend to have smaller home ranges and it would be easier to determine if they are present on site following a site visit.

4.4.1 Secretarybird *(Sagittarius serpentarius)*

In 2000, the Secretarybird was classified as Near-threatened (Barnes 2000). Secretary Birds are endemic to Sub-Saharan Africa and are non-migratory, though they may follow food sources. Secretary Birds prefer open grasslands and savannahs which assist their foraging habits. It is sensitive to habitat degradation due to overgrazing, bush encroachment, disturbance and loss of habitat to afforestation and crop cultivation. Recent data has seen a constriction of its range and lower reporting rates which is cause for concern.

4.4.2 Ludwig's Bustard *(Neotis ludwigii)*

Ludwig's Bustard has a large range centred on the dry biomes of the Karoo and Namib in southern Africa, being found in the extreme south-west of Angola, western Namibia and in much of South Africa. The global population has been previously estimated at 56,000 to 81,000 individuals. However, this estimate is now approximately 20 years old and is unreliable. This species has been listed as Vulnerable as recent research has suggested that the population has undergone a very rapid population decline due to collisions with power lines, a trend which is set to continue into the future as successful mitigation measures are yet to be implemented. Collision rates on high voltage transmission lines in the De Aar area of the Karoo may exceed one Ludwig's Bustard per kilometre per year (Anderson 2002). Given that the extent of power lines in the Karoo is vast and expanding, with already over 25,000 km of lines in place, it is estimated that such collisions alone are already enough to cause a rapid decline in the population and may increase in the future. This threat may be exacerbated as males are more prone to power line collisions than females, which may lead to a reduced effective population size.

4.4.3 *Red Lark (*Calendulauda burra*)*

The Red Lark is listed as Vulnerable in South Africa. It is range restricted with its distribution being defined to the Northern Cape Province, where it occurs from east of Steinkopf, east to Aggenys and south to the Kliprand area. From there, it occurs south to Klein Soutpan, where it is found on sand-dunes from east of Verneukpan and Fortuinkolksepan south and east to Brandvlei and isolated dunes in the Brospan area. It mostly follows the distribution of red sand-dunes south of the Orange/Gariep River, with the majority of the population found in the fossil Koa river valley (BirdLife International Factsheet 2010).

Figure 4-2: Typical habitat type for Red lark to the south west of the site

Only 5% of its range contains suitable habitat, and most (75%) has been overgrazed and degraded, leaving an area of occupancy of c.1,000 km^2. Although there is no evidence to suggest that the limits of its range have contracted, there is evidence for local population declines. This species is classified as Vulnerable due to a small population size which is continuing to decline owing to ongoing habitat loss and degradation, primarily through overgrazing. Extensive livestock farming may have resulted in trampling and grazing which has changed vegetation structure and reduced plant cover, causing erosion and shifting of dunes. There was no suitable habitat for this species on site and it is unlikely that it will occur there.

4.4.4 Lanner Falcon *(Falco biarmicus)*

The Lanner Falcon is listed as Near Threatened in South Africa. It is fairly catholic in its habitat requirements being found across Southern Africa in just about most habitat types excluding forest. The Lanner Falcon is generally a cliff nester and its distribution can be closely associated with mountainous areas. However, and especially in the Karoo, the increasing number of pylon towers has offered alternative nesting opportunities for this species (Kemp 1993).

Figure 4-3: Habitat to the north east of the site suitable for Lanner Falcon

The site has a number of steep slopes and seemingly mountainous areas in the north eastern portions of the property which may offer suitable breeding localities for Lanner Falcons. The slopes were examined for whitewash and evidence of breeding but no signs of any activity were found. Two individuals, an adult and a juvenile, were seen in the vicinity of the N14 approximately 25km to the south east of the site. Given the suitable habitat on site it is likely that this species may occur on site sporadically.

4.4.5 Martial Eagle (*Polemaetus bellicosus)*

The Martial Eagle is listed as Vulnerable in South Africa (Barnes 2000). The SABAP2 provisional distribution map shows records in two pentads the vicinity of the study site. As mentioned above the area is extremely lacking in terms of atlas records and this may not reflect accurately the distribution of the species. We can however conclude that the species does occur in the vicinity of Scuit-Klip. It inhabits open woodland, wooded savanna, bushy grassland, thornbush and, in southern Africa, more open country and even sub desert, from sea level to 3,000 m but mainly below 1,500 m (Ferguson-Lees & Christie 2001). The availability of nests sites is often a limiting factor with regards to this species. The species suffers from direct persecution (shooting and trapping) by farmers, indirect poisoning (these two threats by far the most important causes of losses), drowning in sheer-walled reservoirs, electrocution on power poles, and habitat alteration and degradation (BirdLife International Factsheet 2010). Poisoning is largely carried out by a few large-scale commercial farmers, but is also a problem in tribal small-stock farming communities. Reduction in natural prey may lead to an increase in predation on domestic animals which may in turn lead to increased persecution by farmers.

4.4.6 Sclater's Lark *(Spizocorys sclateri)*

Sclater's Lark is listed as Near Threatened (Barnes 2000). This species is endemic to South Africa and Southern Namibia, its distribution being confined to the Nama Karoo where it is concentrated in the Northern Cape slightly to the south of the study area (Barnes 2000). Although this species has been reported to move substantially it appears to move within in its core Bushmanland distribution. Sclater's Lark preferred habitat is arid to semi-arid gravely and stony plains with scattered shrubs and grasses on shale soils, and sparse dwarf shrublands on clays. This species was not detected during the site visit but is notoriously nomadic, responding to rainfall events. Three individuals were seen in similar habitat near to the town of Pofadder during the trip and it is not inconceivable that they may occur on site sporadically.

5. ISSUES IDENTIFIED DURING THE SCOPING PROCESS

Very little research has been conducted on the impacts of solar energy facilities on birds as opposed to the well documented impacts that wind energy facilities and power lines have. The primary impact on bird species and communities is mainly due to the large ecological footprint required for commercial-scale energy production. This would refer to the habitat loss and disturbance created during the construction phase of the facility. The second group of impacts relate to the operation of the facility. In terms of avian

mortality due to direct interaction with the facilities, it seems as if these are low with the exception of interactions with power lines. The degree of the impact is also related to the length of power lines that would need to be installed. Based upon the information that was gathered in the scoping phase several impacts were identified that needed to be further quantified during the EIA Phase namely:

- Impact on local bird communities due to habitat loss
- Impact on local bird community due to disturbance
- Collision of birds with facilities associated with the development
- Electrocution of birds on the power line tower structures
- Impacts of bird species upon the facilities
    - Bird pollution (Streamers and faeces build up) and power lines
    - Bird nests on tower structures

These impacts were quantified using the data collected during the site visit and according to criteria set out by Savannah Environmental (Appendix B).

6. ASSESSMENTS OF IMPACTS ON AVIFAUNA DUE TO THE PROPOSED DEVELOPMENT

6.1 Impact on local bird community due to habitat loss

Nature: To produce clean power cost-effectively, solar energy facilities often cover a sizeable land area, in this case 11km^2. A certain amount of habitat will be lost during the establishment of the solar farm and the associated infrastructure (including the clearing of land for access roads and the power line). In the simplest terms, when habitat is destroyed, the plants, animals, and other organisms that occupied the habitat have a reduced carrying capacity so that populations decline and extinction becomes more likely. Whilst impacting greatly on endangered bird species, habitat loss can also have an impact on existing bird communities within the study area i.e. the problem of common birds becoming less common. Habitat loss can impact on local as well as, to a lesser degree, migratory species. Habitat on site is of an extremely low quality having been overgrazed by livestock.

Extent: The south eastern portion of the site would be the area within the broader site that would be disturbed by the proposed facility. Habitat loss would be limited to the development footprint and the extent of the impact would therefore be **local**.

Duration: The loss of habitat will have a permanent impact for the life of the project. For this reason the loss of habitat and subsequent impact on local bird communities will be **long term.**

Magnitude: The magnitude of this type of impact could be low to high, depending on the species concerned, the proportion of the study site affected and the current status of the habitat currently on site (i.e. degraded or intact). Habitat on site was severely degraded with a corresponding low diversity and density of bird species. The amount of habitat that would be lost (11km^2) would also be insignificant in the context of availability of similar habitat in the area that the study site is found. For this reason the magnitude is **minor**.

Probability: Habitat will be lost if the construction of the facility takes place. In light of this the impact will occur regardless of any prevention or mitigation measures that are put in place. The impact will be **definite**.

Mitigation measures: The following mitigation measures are recommended:

- Development in the north eastern area of the site should be minimal.
- The minimum amount of vegetation on site will be cleared.
- The diversity and abundance of bird species was far greater in the drainage channels as opposed to the open plains. Where possible as much of this habitat should be kept intact.
- If possible the servitude of the power line exiting the site should follow existing roads where possible and should not cut across habitat.
- With regards to the four alternative access roads and the amount of habitat loss. There is a minimal amount of difference in terms of impact on bird communities and therefore it is recommended that alternative A, the shorter route, be preferred.
- All construction and maintenance activities must be undertaken in accordance with Eskom Transmission's Environmental Best Practise Standards. All construction activities and access roads should be restricted as much as possible.

Table 6-1: Summary impact significance table for habitat loss

Nature: Impact on local bird community due to habitat loss		
	Without mitigation	**With mitigation**
Extent	1 – local	1 – local
Duration	4 – long term>15 years	4 – long term>15 years

Magnitude	2 – minor	0 - small
Probability	4 – highly probable	4 – highly probable
Significance	28 – Low	20 – Low
Status	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	Yes
Mitigation measures:	Included above	
Cumulative impacts:	The quality (degraded) as well as the amount of habitat (11km^2) that would be lost in the context of the amount of similar habitat in the region means that the cumulative habitat would be negligible.	
Residual impacts:	None	

6.2 Impact on local bird communities due to disturbance

Nature: The Pofadder Solar Thermal Plant will consist of the solar components as well as associated infrastructure. At an individual level, disturbance from human activity may modify bird foraging behaviour (Burger and Gochfield 1998) and even more seriously reproduction (Giese 1996). For shy and sensitive species this may result in negative impacts especially during the breeding season.

Extent: It is presumed that construction, and subsequently, operational activities will be limited mainly to the 11km^2 area in the south eastern portion of the property, to the access roads in between the Paulputs Substation and the access road leading to the R64 and the R358 and that no other disturbance will take place on the property. Based upon this the extent of the impact will be **local**.

Duration: Disturbance would occur mainly during the construction period and then, to a lesser extent, through ongoing maintenance. Over time bird species are able to adapt and co-exist with certain disturbances. The duration of the impact will be of a **short duration**.

Magnitude: The magnitude of the impact is measured as to what would be the conservation outcome should certain individuals in the present bird community be unduly disturbed and affected by the construction and operation of the facility. No Species of

Special Concern were detected during the site visit. None of the species detected during the on site assessment are unduly shy or secretive species or be sensitive to disturbance. Given this the magnitude of the impact will be **minor**.

Probability: There is a **distinct possibility** of this impact occurring.

Mitigation: The additional disturbance created through the construction and ongoing maintenance will be minimal and should not have any significant impact upon the local bird community.

- Development in the north eastern area of the site should be minimal given the possibility of Lanner Falcons utilising these mountainous areas as possible breeding sites.

- Contractors need to minimise the amount of disturbance during the construction phase by staying within the boundaries of the 11km^2 construction area

- If the nest of a large species is detected within the vicinity of the area then the Northern Cape Department needs to be notified and all attempts made to minimise the amount of disturbance of traffic near it. Given the lack of tall trees on site it is unlikely that this will occur.

Table 6-2: Impact significance table for disturbance

Nature: Impact on local bird community due to disturbance		
	Without mitigation	**With mitigation**
Extent	1 - local	1 - local
Duration	2 – short duration	2 – short duration
Magnitude	2 - minor	2 - minor
Probability	3 – distinct possibility	2 – distinct possibility
Significance	15 - Low	15 - Low
Status	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	Yes
Mitigation measures:	Provided above	
Cumulative impacts:	N/A	

Residual impacts:	N/A

6.3 Collision of birds with infrastructure associated with the development

Nature: There are two types of collision events that may occur with regards to the proposed facility, namely collisions with the PV panels, heliostats, parabolic troughs and power tower and collisions with the overhead power line. There is a scarcity of information relating to bird collisions with solar panels. At a study site in Nevada (McCrary, et al. 1986) the estimated mortality rate was 1.9-2.2 birds per week of which 57 birds (81%) of 20 species died due to collisions with structures, mainly the mirrored surfaces of heliostats whilst 13 birds (19%) of 7 species died from burns received by flying through "standby points". The conclusion was that the impact of this mortality on the local bird population was minimal. However, the same cannot be said of power lines. In South Africa, bird collisions with power lines are a major form of unnatural mortality amongst several threatened species as well as other species (Jenkins, Smallie and Diamond 2010). Unfortunately, the majority of species that are susceptible to collision tend to be long lived, slow reproducing species such as bustards, cranes, korhaaans, and different species of waterbird. All of these species utilise waterways as flyways and the proximity of the Orange River exacerbates the likelihood of interaction with power lines. Due to the slow reproductive nature of the species most likely to be collision suspects, long-term mortalities caused by collisions with power lines could have a high likelihood on future population's abilities to be able to sustain themselves. It is generally accepted that birds can usually avoid the highly visible bundled conductors but often fail to see the thin ground wires. Typical injuries that result from collisions are impact injuries such as broken necks and legs. Research indicates that there is a correlation between the size of the power line and the collision risk potential with mortality increasing with voltage size. The size of the power lines associated with this project will be 132kV. Species that may possibly occur in the area and that may be involved in collision events are included in Table 6-3.

Table 6-3: Endangered species within the study area that may be collision suspects

Common name	Scientific name	Biome	Red Data Book status	Habitat
Secretarybird	*Sagittarius serpentarius*	S, G	Near-threatened	Grassland
Kori Bustard	*Ardeotis kori*	NK	Vulnerable	Grassland/Thornveld
Ludwig's Bustard	*Neotis ludwigii*	NK	Vulnerable	Savannah

Whilst the above table lists only endangered species, all korhaan and bustard populations are currently under pressure. According to Anderson (2001), the collision of large terrestrial birds with the wires of utility structures and especially power lines, has been determined to be one of the highest mortality factors for this group of birds in South Africa. It is possible that the populations of two southern Africa endemic species namely Ludwig's Bustard (*Neotis ludwigi*) and the Blue Crane (*Anthropoides paradiseus*) may be in decline due to this single mortality factor (Anderson 2001). For species such as Northern Black Korhaan (*Eupoditis afraoides*) which occur on site, collision mortalities would probably not have a hugely significant impact on their regional populations. Ongoing mortalities on a large scale could however have long term effects on Northern Black Korhaan and as such an effort should be made to minimise the impacts upon these populations.

Duration: The impact would cover the lifespan of the facility and will be **long term**.

Extent: The impact will be confined to the study area (i.e. area that the facility and the power lines cover). The extent is therefore **local**.

Magnitude: The magnitude of this impact will be **low** given the amount of power line (2km) that will be erected.

Probability: There is a **low possibility** of collision events and subsequent impacts on local bird populations. The probability of events can be minimised through the implementation of mitigation measures.

Significance: The significance of this impact will be **low to moderate**. The significance of this impact can be mitigated for which will reduce the significance to **low** i.e. this impact would not have a direct influence on the decision to develop in the area.

Mitigation: The incidences of birds interacting with the solar facility itself and subsequent mortalities are minimal. It is however recommended that an appropriate bird deterrent device is placed at locations around the facility to lessen this impact. Additional mitigation options considered included reviewing the placement of proposed new lines, removing the earth-wire, or else fitting the wire with a type of marker where necessary.

- With regards to the different alternatives proposed by the project proponent there is no significant difference (in terms of impact on birds). It would therefore be recommended to go with the shorter line.
- The line should be kept as low as possible taking into account engineering and legal requirements
- The span lengths should be kept as short as possible taking into account engineering and legal requirements
- Placement of a sufficiently large form of marker which will increase the visibility of the wire where necessary. There remains considerable uncertainty about the best performing marking device. Bird marking devices have proved to be extremely effective in preventing bird collisions by making the line more visible to birds.
- The marker should be placed with sufficient regularity where deemed necessarry
- The markers should preferably be placed on the earth wires as opposed to the conductors.

Table 6-4: Impact significance table for the collision of birds with the facility and infrastructure

Nature: Impact on local bird community due to collision with the facility		
	Without mitigation	**With mitigation**
Extent	1 - Low	1 - Low
Duration	4 - Low	4 - Low
Magnitude	4 - Low	4 - Low
Probability	4 – Improbable	2 - Improbable
Significance	36 – Medium	10 - Low
Status	Negative	Negative
Reversibility	Possible	
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	N/A
Mitigation measures:	Included above	
Cumulative impacts:	There are existing power lines in the area as well as on the site. The length of the proposed power line is 2km and it is unlikely that this will add significantly to the cumulative impact of power lines collisions in the region.	
Residual impacts:	None	

6.4 Electrocution of birds on the power line tower structures

Nature: The design has allowed for a 132kV overhead power line feeding into the existing Eskom Paulputs Substation, which lies immediately to the west of the site. Four alternatives have been identified, the routes of which, are shown in the map included in Appendix C. Power lines have a range of bird related impacts, one of which is electrocution events. Electrocution events refer to scenarios whereby a bird perches on an electrical structure and causes an electrical short circuit by bridging the gap between live components and or live and earthed components. The larger transmission lines from 220kV to 765kV upwards are not a threat to large raptors and other birds which are vulnerable to electrocution and in a number of cases have proved to be beneficial by providing roosting and nesting sites.

Table 6-5: Endangered species possibly occurring within the study area capable of electrocution events

Common name	Scientific name	Biome	Red Data Book status	Habitat
Secretarybird	*Sagittarius serpentarius*	S, G	Near-threatened	Grassland
Martial Eagle	*Polemaetus bellicosus*	NK, S	Vulnerable	Varied
Ludwig's Bustard	*Neotis ludwigii*	NK	Vulnerable	Savannah

However, the smaller lines, such as a 132kV line (older designs) and depending on the tower design, can be dangerous to birds. Birds that are typically the cause of this are the larger species with corresponding large wingspans which can bridge the gaps, such as raptors and storks. Endangered species which could occur within the area is included in Table 6-5.

Extent: The impact will be confined to the 2km power line. The impact is therefore **Local**.

Duration: The impact will cover the lifespan of the facility and will be **long term**.

Magnitude: The magnitude of this impact will be **moderate** due to the conservation status of the species which may be involved in electrocution events.

Probability: There is a **distinct possibility** of electrocution events and subsequent impacts on local bird communities as well as endangered species. The probability of events can be minimised through mitigation measures.

Mitigation: Discussions with the representative from !KaXu CSP indicated that it is planned to utilise the mono pole bird friendly structure which will significantly minimise the number of electrocutions on the power lines. An example of the existing monopole structures on site can be found in Appendix D.

Table 6-6: Impact significance table for the electrocution of birds

Nature: Impact on local bird communities due to electrocution events		
	Without mitigation	**With mitigation**
Extent	1 - Local	1 - Local
Duration	4 – Long term	4 – Long term
Magnitude	6 - Moderate	2 - Minor
Probability	4 – Distinct possibility	2 - Improbable
Significance	44 - Medium	14 - Low
Status	Negative	Negative
Reversibility	Possible	
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	
Mitigation measures:	Included above	
Cumulative impacts:	There are a number of power lines in the vicinity of Pofadder as well as throughout the Northern Cape. The length of the proposed power line is 2km. It is unlikely that this will add significantly to the cumulative impact of electrocution events in the region.	
Residual impacts:	N/A	

6.5 Impacts of bird species upon the Pofadder Solar Plant

6.5.1 ***Bird pollution (Streamers and faeces build up) and power lines***

Nature: A streamer is when a bird defecates and releases a stream of faeces which creates an air gap intrusion between the conductor and the earthed structure. The fault appears to flash across the air gap (i.e. between the live conductor and the tower steelwork which is earthed) and does not follow an insulator creepage as observed on pollution faults. Species which create streamers large enough to create this type of situation are typically large species such as vultures, raptors, and herons.

Table 6-7: Species that may impact on the power line through pollution events

Common name	Scientific name	Biome	Red Data Book status	Habitat
Ludwig's Bustard	*Neotis ludwigii*	NK	Vulnerable	Savannah
Secretarybird	*Sagittarius serpentarius*	S, G	Near-threatened	Grassland
Martial Eagle	*Polemaetus bellicosus*	NK, S	Vulnerable	Varied

A flashover occurs when an insulator string becomes coated with pollutant which then causes the insulator to function incorrectly. When the pollutant is wet, the coating becomes conductive, insulation breaks down, and a flashover occurs. This is created by a build-up of bird faeces over a period on a line. Species in the region that could possibly impact upon the power line are included in

Table 6-7.

Extent: The extent of the impact that a flashover event could be **regional** depending on the configuration of the power line grid.

Duration: The impact will cover the lifespan of the facility and will be **long term**.

Magnitude: The magnitude is **moderate** and will result in the process continuing albeit in a modified manner. With the implementation of different measures, such as selecting the correct tower structure design, the impacts that these events can have can be mitigated.

Probability: There is a **high probability** that these types of events may occur. With the correct mitigation measures it is possible to eliminate the chances of these events occurring.

Mitigation: KaXu CSP has indicated that it intends to utilise the Eskom mono pole bird-friendly structure similar to the design already found on site. The design of the tower needs to incorporate perch deterrents in the area directly above the insulator strings to ensure that bird species are not given the opportunity to defecate on the string.

Table 6-8: Impact significance table for the impact of bird pollution (Streamers and faeces build up) and power lines

Nature: Impact of bird pollution (streamers and faces build up) an power lines		
	Without mitigation	**With mitigation**
Extent	1 - Low	1 - Low
Duration	4 – Long term	4 – Long term
Magnitude	6 - Moderate	4 - Moderate
Probability	4 - Highly probable	2 - Improbable
Significance	44 - Medium	18 - Low
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	
Mitigation measures:	Included above	
Cumulative impacts:	N/A	

Residual impacts:	N/A

6.5.2 *Birds nesting on the tower structures*

Nature: As mentioned above, certain structures have proven to be beneficial to certain raptors by providing roosting and nesting sites in areas where natural alternatives are scarce. In the case of the proposed facility, there are two area of concern namely of species nesting on transmission tower structures and then nesting on the solar infrastructure itself. This is especially true in the Northern Cape where there is a lack of suitable sites. Species, such as Martial Eagle, are known to be restricted by suitable nesting opportunities and are known to utilise tower structures.

Table 6-9: Species capable of nesting on the tower power line structure

Common name	Scientific name	Biome
Secretarybird	*Sagittarius serpentarius*	S, G
Martial Eagle	*Polemaetus bellicosus*	NK, S
Sociable Weaver	*Philetairus socius*	NK
Pied Crow	*Corvus albus*	NK
White-browed Sparrow-Weaver	*Plocepasser mahali*	S, NK

[1]

Whilst the larger towers can be beneficial, the smaller power lines can pose a problem. The construction of bird nests on the smaller power lines has the potential to cause faults by creating an air gap intrusion. Species such as crows are famous for the different materials (such as pieces of wire) they collect which in turn can cause flashovers. The faults created by nests can also result in veld fires due to the nesting material igniting as well as surrounding veld. Of even more concern is the possibility of species such as Sociable Weavers and White Browed Sparrow Weavers nesting on the infrastructure making up the solar facility.

Extent: The impact will be limited to the immediate area i.e. the site to be developed. The impact will therefore be **local**.

Duration: The lifetime of the impact will be for **long term**.

Magnitude: The magnitude of this impact will be **minor**. Should there be any incidents of Species of Special Concern nesting on the facilities then the magnitude of the impact would be greater.

[1] Species highlighted in red indicate a high likelihood of nesting on infrastructure associated with the development

Probability: Both species which will have the highest likelihood of nesting on the structures (Sociable Weavers and White browed Sparrow Weavers) are fairly abundant species and there are numerous examples of these species taking advantage of man-made structures to construct their nests upon. There is a **definite possibility** that these species will attempt to construct nests on either the solar panels or associated infrastructure. Mitigation measures will need to be applied to prevent these species from impacting on the facility.

Mitigation measures: A procedure for the removal of nests must be written into the operating manual for the facility. The project proponent will be required to apply to the Northern Cape Provincial Department for a permit in order to relocate the nests of Sociable Weavers and White Browed Sparrow Weavers.

Table 6-10: Impact significance table for species nesting on infrastructure

Nature: Species capable of nesting on the infrastructure		
	Without mitigation	**With mitigation**
Extent	1 - Low	1 - Low
Duration	4 – Long term	4 – Long term
Magnitude	2 - Minor	0 - Small
Probability	5 - Definite	3 - Probable
Significance	35 - Medium	15 - Low
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	Yes
Mitigation measures:	Included above	
Cumulative impacts:	N/A	
Residual impacts:	N/A	

7. A DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

Due to the low density and diversity of bird species it was not possible to saturate a species accumulation curve for the study area. An alternative survey method would have been to utilise either a point transect or line transect method and substitute sampling units in the place of ten species lists as in the MacKinnon List method. However, it is felt

that sufficient time was spent on site surveying and that the species occurring on site are representative.

8. ENVIRONMENTAL IMPACT STATEMENT

A rapid avifaunal assessment of the Scuit-Klip site was completed, the results of which are in Section 4.3 of the report. In addition to this, a full desktop study was undertaken in which the likelihood of Species of Special Concern occurring within the study area was identified. This has been completed in Section 4.3 of the report. Based upon this baseline data the possible impacts that the development would have on local bird communities and Species of Special Concern was assessed. This has been completed in section 6 of the report. The most significant threat to bird communities would be from collisions with the overhead power line. However, it should be noted that only 2km of power line are to be installed and this impact will be minimal. The site is also not located in an area of high bird traffic i.e. near riverbeds, wetlands or valleys etc. It is not believed that the loss of habitat, disturbance, or any interaction with the facility will have any negative impact on bird communities in the area.

In this document, recommendations have been made regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan (EMP). Provided the recommended mitigation measures are employed, BirdLife South Africa does not consider that the construction and operation of the Pofadder solar plant will have a negative impact upon local bird communities or Species of Special Concern occurring in the region.

9. INPUT FOR THE EMP

OBJECTIVE: Minimise the impact on habitat on site during the construction phase of the project

Project component/s	Clearing of the site for placement of the solar plant components, location of office infrastructure, steam turbine and generator, energy storage plant and vessels, power line and pipeline servitudes and access roads
Potential Impact	Impact on local bird community due to habitat loss
Activity/risk source	Habitat will be lost during the establishment of the solar facility and the associated infrastructure (including the clearing of land for access roads and the power line). When habitat is destroyed the birds that that occupied the habitat are compromised.
Mitigation: Target/Objective	All construction and maintenance activities should be carried out in a manner so as to minimise the amount of habitat loss on site

Mitigation: Action/control	Responsibility	Timeframe
All construction activities should be carried out according to generally accepted environmental best practices. No additional habitat destruction should take place beyond the site boundaries or power line and/or road servitudes Existing roads should be used during construction and maintenance	EPC contractor Environmental Control Officer	Construction

Performance Indicator	A minimum amount of habitat clearance
Monitoring	ECO to monitor the extent of the disturbance and habitat clearance on a weekly basis during construction and a monthly basis during operation

OBJECTIVE: Minimise the amount of disturbance to birds on site during the construction and operational phases of the project

Project component/s	Activities during construction such as the placement of the solar plant components, location of office infrastructure, steam turbine and generator, energy storage plant and vessels, power line and pipeline servitudes and access roads as well as ongoing operational activities on

	site
Potential Impact	Impact on local bird community due to disturbance
Activity/risk source	Undue disturbance by construction and operational staff can impact on bird species. Disturbance from human activity may modify bird foraging behaviour and, even more seriously, reproduction. For shy and sensitive species this may result in negative impacts especially during the breeding season.
Mitigation: Target/Objective	All construction and operational activities should be carried out in a manner so as to minimise the amount of disturbance to bird species on site

Mitigation: Action/control	Responsibility	Timeframe
All construction and maintenance should be carried out according to generally accepted environmental best practices. Contractors need to minimise the amount of disturbance during the construction phase by staying within the boundaries of the 11 km^2 construction area If the nest of a large species is detected within the vicinity of facility then the Northern Cape Department needs to be notified and all attempts made to minimise the amount of disturbance of traffic or activity near it.	EPC contractor Environmental Control Officer	Construction and operation

Performance Indicator	A minimal amount of disturbance to bird species beyond the extent of the site, power line or road servitudes boundaries
Monitoring	ECO to monitor the extent of the disturbance

OBJECTIVE: Minimise the impact of the power lines on resident bird communities

Project component/s	Operation of power line exiting the facility
Potential Impact	Collision of birds with facilities associated with the development
Activity/risk source	Two types of collision events may occur with regards to the proposed facility, namely collisions with the PV panels, heliostats, parabolic troughs and power tower and collisions with the overhead power line.
Mitigation: Target/Objective	To minimise the number of collisions by birds with the power lines

Mitigation: Action/control	Responsibility	Timeframe
Mitigation options considered included reviewing the placement of proposed new lines, removing the earth-wire, or else fitting the wire with a type of marker where deemed necessary. With regards to the four different alternatives proposed by the project proponent there is no significant difference (in terms of impact on birds) between them. It would therefore be recommended to go with the shorter line if practical. The line should be kept as low as possible taking into account engineering and legal requirements The span lengths should be kept as short as possible taking into account engineering and legal requirements Placement of a sufficiently large form of marker which will increase the visibility of the wire. The marker should be placed with sufficient regularity (i.e. at least every 5 - 10m) The markers should preferably be placed on the earth wires as opposed to the conductors.	EPC contractor Environmental Control Officer	Operation

Performance Indicator	Ideally there should be zero collisions.
Monitoring	ECO to monitor the number of collisions on a monthly basis

OBJECTIVE: Minimise the number of electrocution events

Project component/s	Operation of power line exiting the facility
Potential Impact	Electrocution of birds on the power line structures
Activity/risk source	Electrocution events occur when bird perches on an electrical structure and causes an electrical short circuit by bridging the gap between live

	components and or live and earthed components
Mitigation: Target/Objective	To minimise the number of electrocution events on the power lines exiting the site

Mitigation: Action/control	Responsibility	Timeframe
Utilise the Eskom mono pole bird friendly structure which will significantly minimise the number of electrocutions on the power line	EPC contractor Environmental Control Officer	Construction (design) and operation

Performance Indicator	Ideally there should be zero electrocution events
Monitoring	ECO to monitor the number of electrocution on a monthly basis

OBJECTIVE: Minimise the amount of bird pollution on the facilities

Project component/s	Operation of the facility
Potential Impact	The build-up of bird pollution, in the forms of streamers and faeces build up, will impact on the functioning of the power line
Activity/risk source	A streamer is when a bird defecates and releases a stream of faeces which creates an air gap intrusion between the conductor and the earthed structure. A flashover occurs when an insulator string becomes coated with pollutant which then causes the insulator to function incorrectly. When the pollutant is wet, the coating becomes conductive, insulation breaks down, and a flashover occurs. This is created by a build-up of bird faeces over a period on a line.
Mitigation: Target/Objective	To minimise the number of bird pollution related events on the power lines exiting the site

Mitigation: Action/control	Responsibility	Timeframe
Utilise the Eskom mono pole bird friendly structure which will significantly minimise the number of electrocutions on the power line. The design of the tower needs to incorporate perch deterrents in the area directly above the insulator strings to ensure that bird species are not given the opportunity to defecate on the string.	EPC Contractor Environmental Control Officer	Operation

Performance	Zero incidents caused by the build up of bird faeces or flashovers

Indicator	
Monitoring	ECO to monitor the amount of pollution on the lines on a monthly basis

OBJECTIVE: Minimise the number of bird nests on infrastructure

Project component/s	Operation of the facility
Potential Impact	Impact of bird nests on infrastructure
Activity/risk source	Structures similar to those on site have proven to be beneficial to certain bird species by providing roosting and nesting sites in areas where natural alternatives are scarce. There are two area of concern namely of species nesting on transmission tower structures and then nesting on the solar infrastructure itself.
Mitigation: Target/Objective	To minimise the number of bird nests on infrastructure

Mitigation: Action/control	Responsibility	Timeframe
All possible attempts should be made to prevent nests from being established on infrastructure. All removal of bird nests should be carried out according to generally accepted environmental best practices. The ECO will be required to apply to the Northern Cape Provincial Department for a permit in order to relocate the nests of Sociable Weavers and White Browed Sparrow Weavers once established.	Environmental Control Officer	Operation

Performance Indicator	Zero nests established on infrastructure
Monitoring	ECO to monitor nesting events on a weekly basis

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Appendix A – Control sheet for Specialist Study

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Control Sheet in line with Regulation 33 of Government Notice No. R385 of 1996 EIA Regulations

Activity	**Yes**	**No**	**Comment**
Details of: I: the person who prepared the report; and Ii: the expertise of that person to carry out the specialist study	√		Appendix D
A declaration that the person is independent in a form as may be specified by the competent authority	√		Appendix E
An indication of the scope of, and the purpose for which the report was prepared	√		
A description of the methodology adopted in preparing the report or carrying out the specialised process	√		
A description of any assumptions made and any uncertainties or gaps in knowledge	√		
A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives, on the environment	√		
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	√		
A description of any consultation process that was undertaken during the course of carrying out the study	√		
A summary and copies of any comments that were received during the consultation process		√	
Any other information requested by the competent authority			None requested as of yet

Appendix B – Criteria for Evaluating Impacts

ASSESSMENT OF IMPACTS
Direct, indirect, and cumulative impacts of the issues identified through the Scoping Study, as well as other issues identified in the EIA Phase must be assessed in terms of the following criteria.

» The **nature**, which shall include a description of what causes the effect, what will be affected, and how it will be affected.

» The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:

- local extending only as far as the development site area – assigned a score of 1;
- limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
- will have an impact on the region – assigned a score of 3;
- will have an impact on a national scale – assigned a score of 4; or
- will have an impact across international borders – assigned a score of 5.
-

» The **duration**, wherein it will be indicated whether:

- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5.

» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:

- 0 is small and will have no effect on the environment;
- 2 is minor and will not result in an impact on processes;
- 4 is low and will cause a slight impact on processes;
- 6 is moderate and will result in processes continuing but in a modified way;
- 8 is high (processes are altered to the extent that they temporarily cease); and
- 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:

- Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
- Assigned a score of 2 is improbable (some possibility, but low likelihood);
- Assigned a score of 3 is probable (distinct possibility);
- Assigned a score of 4 is highly probable (most likely); and
- Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).

» the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.

» the **status**, which will be described as either positive, negative or neutral.

» the degree to which the impact can be reversed.

» the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

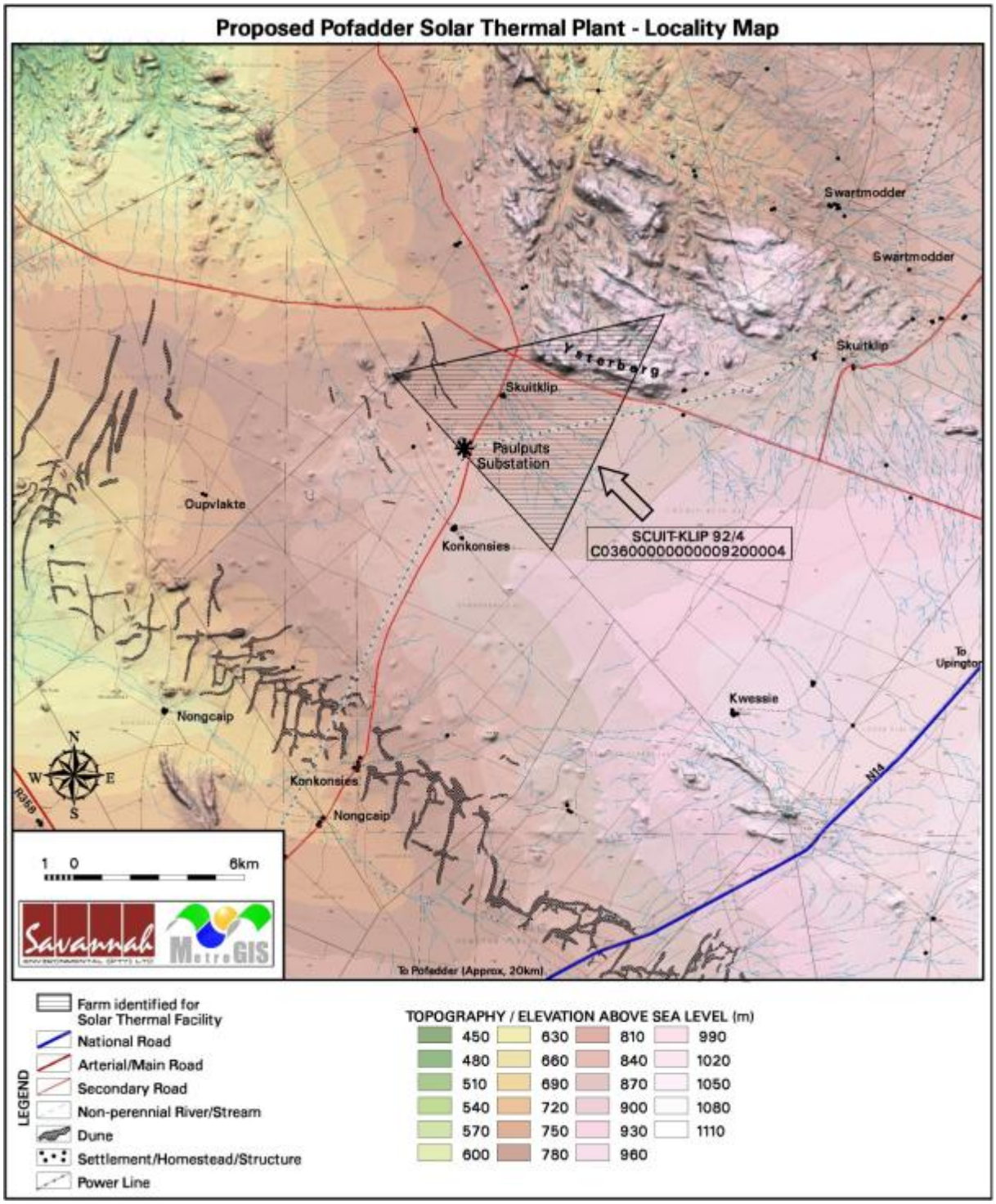
The **significance** is determined by combining the criteria in the following formula:
S= (E+D+M) P; where
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:
» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),

» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),

» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Appendix C – Map of the Study Area


Proposed Pofadder Solar Thermal Plant - Locality Map
Swartmodder
Swartmodder
Skuitklip
Skuitklip
Paulputs Substation
Oupvlakte
Konkonsies
SCUIT-KLIP 92/4
C0360000000009200004
To Upington
Kwessie
Nongcaip
Konkonsies
Nongcaip
N
W
E
S
R359
N14
1 0 6km
To Pofadder (Approx. 20km)
LEGEND
Farm identified for Solar Thermal Facility
National Road
Arterial/Main Road
Secondary Road
Non-perennial River/Stream
Dune
Settlement/Homestead/Structure
Power Line
TOPOGRAPHY / ELEVATION ABOVE SEA LEVEL (m)
450 630 810 990
480 660 840 1020
510 690 870 1050
540 720 900 1080
570 750 930 1110
600 780 960

Appendix D – Photograph illustrating the existing 132kV Mono Pole Design on site

Appendix E – Declaration of Independence

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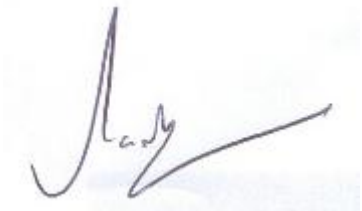
Nonprofit Registration Number 001-298 NPO • Public Benefit Organisation Exemption No 930 004 518

To whom it may concern, 26 May 2010

Declaration of Independence

BirdLife South Africa is an independent entity and has no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. BirdLife South Africa is not a subsidiary, legally or financially of !KaXu CSP South Africa (Pty) Ltd. Remuneration for services by the proponent in relation to this project is not linked to approval by decision making authorities responsible for authorising this proposed project. BirdLife South Africa has no interest in secondary or downstream developments as a result of the authorisation of this project. There are no circumstances that compromise the objectivity of the specialist performing such work. The percentage work received directly or indirectly from the proponent in the last 12 months is approximately 0% of BirdLife South Africa's turnover.

Yours faithfully



Mark Anderson
Executive Director
BirdLife South Africa

Appendix F – Curriculum Vitae of the Consultant

CURRICULUM VITAE– MARTIN TAYLOR

Name	**Martin Russell Taylor**
Year of Birth	1979
Nationality	South African (British passport holder)
Languages	English and Afrikaans
Residence	1a Tudor Road, Gillitts, KZN
Key areas	Project development and management, strategic environmental assessment , environmental assessments, ecological assessment and planning, community development, ecotourism development, proposal writing, institutional fundraising
Professional experience in	South Africa, Central African Republic, Lesotho, Egypt, Kenya, Malawi and Mozambique
Qualifications	BSc Biology with University Honours (4yr degree), Francis Marion University, USA. MSc Zoology (Masters in Conservation Ecology), University of Pretoria, South Africa Currently completing a PhD Zoology, University of Cape Town
Additional courses	WSP Environmental Internal Environmental Management Systems Auditor Course
Professional Associations	Member of the South African Wildlife Management Association Pri Sci Nat (in progress)
Awards and honours	2005 – Recipient – Second place in the Graduate Research Award, South African Wildlife Management Association Conference, Magoebeskloof. 2004-2005 – Awarded a National Research Foundation Bursary to conduct research on coastal dune forest bird communities 2001 and 2003 – Recipient – Presidents Undergraduate Research

Award, Francis Marion University. (Work done on a project initiated in 2001)

2001– Recipient – Second place in the Frank C. Brooks Undergraduate Research Award at Association of South-Eastern Biologists meeting – New Orleans.

2001 – Recipient – Biology Research Award, Francis Marion University.

1998-2000 – Deans List for Academic Achievement, Francis Marion University.

1998-1999 – Academic Honours Roll for the Peach Belt Athletics Conference

Career History

2010 until present – Editor: Red Data Book for Birds of South Africa, Swaziland and Lesotho

Responsible for managing the revision of the Eskom Red data Book for Birds of South Africa, Swaziland and Lesotho. This includes project management and text revision.

2009 until 2010 – Division manager for BirdLife South Africa

Avitourism division manager responsible for avitourism development within South Africa, project and financial management, proposal writing, route development, marketing, human resource management and managing various community and conservation projects.

2007 to 2009 –Project manager for BirdLife South Africa

Project manager of the Kruger to Canyons Birding Route project, a community and conservation orientated avitourism development project. Responsible for all aspects of project and financial management of the project.

2005 to 2007 –Senior environmental consultant for Coastal and Environmental Services

Held the position of Senior Environmental Consultant dealing with various projects involving scoping reports, environmental impact assessments, risk assessments, ecological assessments, environmental impact assessment guideline documents and environmental monitoring projects.

2003 to 2005 – Martin Taylor and Associates

Formed Martin Taylor and Associates providing freelancing consulting services ranging from strategic environmental overviews, scoping reports, ecological assessments, vegetation assessments, and environmental management plans. Company was formed in order to supplement income whilst studying for my Masters degree.

2001 to 2003 – Environmental scientist for WSP Walmsley (Pty) Ltd

Held the position of Environmental Scientist and was involved in various projects involving scoping reports and environmental impact assessments, risk assessments, ecological assessments, environmental impact assessment, guideline documents and environmental monitoring projects.

1998-2004 – Conservation Ecology Unit, University of Pretoria

Held position of Research Assistant at Richards Bay Minerals Field Station. Involved in restoration ecology, various graduate research projects and the processing of collected data (vacational work)

Environmental Project Experience

Avifaunal Assessment of Transnet Capital Projects Nsezi Property, Richards Bay, KwaZulu Natal: Project management, field work and report writing

Avifaunal Assessment of the Black Rock 132kV Power line, Northern Cape:
Project management, field work and report writing

Avifaunal Assessment of the inundation of 200ha by the Nacala Dam, Northern Mozambique: Project management, field work and report writing.

SAPP EIA Thermal Guidelines for Nexant (plc), Sub Saharan Africa. Data
Collection on EIA Practice in Sub-Saharan Africa and report writing.

Environmental Assessment for Additional Water Supply Options for the Kwale Mineral Sands Project, Kenya: Project management, data collection and report writing.

Environmental Risk Report for the Dimbi Diamond Concession,

Central
African Republic: Project management and report writing.

Environmental Assessment for El Burrullus Heavy Minerals Mine, Egypt: Project management, data collection and report writing.

Strategic Environmental Overview of a Heavy Mineral Deposit, Malawi.
(Client and location confidential) Project management, data collection and report writing.

Construction Environmental Action Plans for various components of the
Kwale Mineral Sands Project, Kenya: Compilation of environmental action plans and document management

EIA Guidelines for the Sectors of Roads, Transmission Lines, Telecom Masts, Filling Stations and Housing for the Department of Environmental Affairs and Tourism , South Africa. Data collection and report writing.

Limpopo State of the Environment Report, South Africa: Biodiversity and Terrestrial Resource Use Sections: Data collection and report writing

Environmental Assessment for the Knysna N2 Upgrade, South Africa: Project management and report writing

Rehabilitation and Closure Plan for the Coega Kop Quarry, South Africa: Project management and report writing

Zandrivierspoort Pre-Feasibility Study for Kumba Resources (plc), South Africa. Data collection, risk assessment, identification of alternatives and report writing.

Environmental Assessment for RBC Distributors (Pty) Ltd Bulk Material Handling and Storage Facility, South Africa. Data collection, impact assessment and report writing.

Environmental Assessment for Kingsburgh 132/11/32kV substation for Durban Metro Electricity. Project management and report writing.

Baseline Study for Platreef Resources. Synthesis of specialist reports and final report compilation.

Environmental Assessment of Ferro Furnaces (Pty) Ltd. Project management and report writing.

Professional review of the Van Ryn Mine EMPR. Data review and report writing.

Various Environmental Management Plans for road upgrade applications in the Limpopo Province
Various smaller EMPR's for borrow pits in the Limpopo province.
Various Environmental Due Diligence Assessments on various properties throughout South Africa.
Various Ecological Assessments for a variety of different projects and clients.

Ecological research experience

Small mammal trapping - Richards Bay Minerals Ecological Monitoring Program. Field work, grid maintenance, trap maintenance and data
entry
Vegetation surveys - Richards Bay Minerals Ecological Monitoring
Program. Field work and data entry
Herpetological surveys at Francis Marion University and surrounding
areas, Florence, USA. Field work and data entry.
Small mammal museum specimen preparation at Francis Marion University, Florence, USA. Specimen collection and preparation.
Bird surveys - Richards Bay Minerals Ecological Monitoring Program. Field work, data entry, data analysis and reporting
Acacia kosiensis seed bank trials – Richards Bay Minerals Ecological
Monitoring Program. Field work, data entry and reporting
***Mastomys* competition trials – University of Pretoria.** Field work.
Assistance in African Buffalo TB Research Program at Kruger National Park: Field assistant

Publications, Technical Reports and

Wassenaar, T.D and Taylor, M.R. (2004). Seed germination rates of *Acacia kosiensis*- CERU 22. Internal technical report. Conservation Ecology Research Unit. University of Pretoria.

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"The Role of Visual and Auditory Senses in Prey Detection by *Bufo terrestris*." Association of Southeastern Biologists. New Orleans, Louisiana. April 6, 2001

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Appendix G - Species List for the Study Site

Skuit- Klip Avifaunal Assessment – Bird species Possibly Occurring on Site

August 2010

Common Name	*Scientific Name*	*Site survey*
Acacia Pied Barbet	*Tricholaema leucomelas*	
African Black Duck	*Anas sparsa*	
African Darter	*Anhinga rufa*	
African Fish-Eagle	*Haliaeetus vocifer*	
African Hoopoe	*Upupa africana*	
African Palm-Swift	*Cypsiurus parvus*	
African Pied Wagtail	*Motacilla aguimp*	
African Pipit	*Anthus cinnamomeus*	*Yes*
African Red-eyed Bulbul	*Pycnonotus nigricans*	
African Reed-Warbler	*Acrocephalus baeticatus*	
African Sacred Ibis	*Threskiornis aethiopicus*	
Anteating Chat	*Myrmecocichla formicivora*	*Yes*
Ashy Tit	*Parus cinerascens*	
Barn Swallow	*Hirundo rustica*	
Black-chested Prinia	*Prinia flavicans*	
Black-eared Sparrowlark	*Eremopterix australis*	
Black-headed Heron	*Ardea melanocephala*	
Black-shouldered Kite	*Elanus caeruleus*	
Blacksmith Lapwing	*Vanellus armatus*	
Black-throated Canary	*Crithagra atrogularis*	
Black-winged Stilt	*Himantopus himantopus*	
Bokmakierie	*Telophorus zeylonus*	
Brown-throated Martin	*Riparia paludicola*	
Brubru	*Nilaus afer*	
Burchell's Coucal	*Centropus burchellii*	
Cape Glossy Starling	*Lamprotornis nitens*	
Cape Robin-Chat	*Cossypha caffra*	
Cape Sparrow	*Passer melanurus*	
Cape Turtle-Dove	*Streptopelia capicola*	*Yes*
Cape Wagtail	*Motacilla capensis*	
Capped Wheatear	*Oenanthe pileata*	
Cattle Egret	*Bubulcus ibis*	
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	
Common Fiscal	*Lanius collaris*	
Common Waxbill	*Estrilda astrild*	
Crested Barbet	*Trachyphonus vaillantii*	
Crowned Lapwing	*Vanellus coronatus*	
Diderick Cuckoo	*Chrysococcyx caprius*	
Dusky Sunbird	*Cinnyris fuscus*	
Eastern Clapper Lark	*Mirafra fasciolata*	
Egyptian Goose	*Alopochen aegyptiacus*	

European Bee-eater	*Merops apiaster*	
Familiar Chat	*Cercomela familiaris*	*Yes*
Fawn-coloured Lark	*Calendulauda africanoides*	*Yes*
Fiscal Flycatcher	*Sigelus silens*	
Giant Kingfisher	*Megaceryle maximus*	
Goliath Heron	*Ardea goliath*	
Greater Striped Swallow	*Hirundo cucullata*	
Grey-backed Sparrowlark	*Eremopterix verticalis*	
Hadeda Ibis	*Bostrychia hagedash*	
Hamerkop Hamerkop	*Scopus umbretta*	
House Sparrow	*Passer domesticus*	
Icterine Warbler	*Hippolais icterina*	
Karoo Korhaan	*Eupodotis vigorsii*	
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	
Karoo Thrush	*Turdus smithi*	
Laughing Dove	*Streptopelia senegalensis*	
Layard's Tit-Babbler	*Parisoma layardi*	
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	
Little Bittern	*Ixobrychus minutus*	
Little Egret	*Egretta garzetta*	
Little Swift	*Apus affinis*	
Long-billed Crombec	*Sylvietta rufescens*	
Mountain Wheatear	*Oenanthe monticola*	
Namaqua Dove	*Oena capensis*	
Namaqua Sandgrouse	*Pterocles namaqua*	*Yes*
Namaqua Warbler	*Phragmacia substriata*	
Northern Black Korhaan	*Afrotis afraoides*	
Orange River White-eye	*Zosterops pallidus*	
Pied Kingfisher	*Ceryle rudis*	
Pied Starling	*Spreo bicolor*	
Pririt Batis	*Batis pririt*	
Purple Heron	*Ardea purpurea*	
Red-billed Quelea	*Quelea quelea*	
Red-billed Teal	*Anas erythrorhyncha*	
Red-eyed Dove	*Streptopelia semitorquata*	
Reed Cormorant	*Phalacrocorax africanus*	
Rock Martin	*Hirundo fuligula*	
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	
Rufous-eared Warbler	*Malcorus pectoralis*	
Sabota Lark	*Calendulauda sabota*	*Yes*
Scaly-feathered Finch	*Sporopipes squamifrons*	
Short-toed Rock-Thrush	*Monticola brevipes*	
Sociable Weaver	*Philetairus socius*	
South African Shelduck	*Tadorna cana*	
Southern Grey-headed Sparrow	*Passer diffusus*	
Southern Masked-Weaver	*Ploceus velatus*	
Southern Pale Chanting Goshawk	*Melierax canorus*	
Southern Red Bishop	*Euplectes orix*	

Speckled Pigeon	*Columba guinea*	
Spike-heeled Lark	*Chersomanes albofasciata*	*Yes*
Spotted Flycatcher	*Muscicapa striata*	
Spur-winged Goose	*Plectropterus gambensis*	
Swallow-tailed Bee-eater	*Merops hirundineus*	
Three-banded Plover	*Charadrius tricollaris*	
Wattled Starling	*Creatophora cinerea*	
White-backed Mousebird	*Colius colius*	
White-breasted Cormorant	*Phalacrocorax carbo*	
White-browed Sparrow-Weaver	*Plocepasser mahali*	
White-faced Duck	*Dendrocygna viduata*	
White-throated Swallow	*Hirundo albigularis*	
Wood Sandpiper	*Tringa glareola*	
Yellow Canary	*Crithagra flaviventris*	

*Data derived from Southern African Bird Atlas Project 2

Appendix H - Red Data Species Occurring within the Northern Cape

Red Data Bird Species List for the Northern Cape

Common name	Scientific name	Status	Red Data Book status	Habitat
Saddle-billed Stork	*Ephippiorhynchus senegalensis*	Uncommon	Endangered	Water
Damara Tern	*Sterna balaenarum*	Rare	Endangered	Ocean
Southern Giant-Petrel	*Macronectes giganteus*	Common	Near-threatened	Ocean
Northern Giant-Petrel	*Macronectes halli*	Common	Near-threatened	Ocean
White-chinned Petrel	*Procellaria aequinoctialis*	Common	Near-threatened	Ocean
Great White Pelican	*Pelecanus onocrotalus*	Common	Near-threatened	Water
Cape Cormorant	*Phalacrocorax capensis*	Common	Near-threatened	Ocean
Crowned Cormorant	*Phalacrocorax coronatus*	Uncommon	Near-threatened	Ocean
Black Stork	*Ciconia nigra*	Rare	Near-threatened	Water
Marabou Stork	*Leptoptilos crumeniferus*	Uncommon	Near-threatened	Game Reserves
Yellow-billed Stork	*Mycteria ibis*	Uncommon	Near-threatened	Water
Greater Flamingo	*Phoenicopterus ruber*	Common	Near-threatened	Water
Lesser Flamingo	*Phoenicopterus minor*	Common	Near-threatened	Water
Secretarybird	*Sagittarius serpentarius*	Uncommon	Near-threatened	Grassland
Pallid Harrier	*Circus macrourus*	Uncommon	Near-threatened	Grassland
Black Harrier	*Circus maurus*	Uncommon	Near-threatened	Grassland
Peregrine Falcon	*Falco peregrinus*	Rare	Near-threatened	Cliffs
Lanner Falcon	*Falco biarmicus*	Uncommon	Near-threatened	Varied
Blue Korhaan	*Eupodotis caerulescens*	Common	Near-threatened	Grassland
African Black Oystercatcher	*Haematopus moquini*	Common	Near-threatened	Ocean
Chestnut-banded Plover	*Charadrius pallidus*	Uncommon	Near-threatened	Wetlands, Pans
Caspian Tern	*Sterna caspia*	Common	Near-threatened	Water
Eastern Long-billed Lark	*Certhilauda [c.] semitorquata*	Common	Near-threatened	Farmlands
Short-clawed Lark	*Certhilauda chuana*	Uncommon	Near-threatened	Thornveld
Sclater's Lark	*Spizocorys sclateri*	Uncommon	Near-threatened	Stony desert scrub
Red-billed Oxpecker	*Buphagus erythrorhynchus*	Rare	Near-threatened	Savanna
Eastern Long-billed Lark	*Certhilauda [c.] semitorquata*	Common	Near-threatened	Farmlands
Egyptian Vulture	*Neophron percnopterus*	Rare	Regionally extinct	Grassland
Lappet-faced Vulture	*Torgos tracheliotus*	Rare	Vuln. / Threat	Grassland
African Penguin	*Spheniscus demersus*	Common	Vulnerable	Ocean
Indian Yellow-nosed Albatross	*Thalassarche carteri*	Uncommon	Vulnerable	Ocean
Pink-backed Pelican	*Pelecanus rufescens*	Uncommon	Vulnerable	Water
Cape Gannet	*Morus capensis*	Common	Vulnerable	Ocean
Bank Cormorant	*Phalacrocorax neglectus*	Common	Vulnerable	Ocean
White-backed Night-Heron	*Gorsachius leuconotus*	Uncommon	Vulnerable	Water
Hooded Vulture	*Necrosyrtes monachus*	Uncommon	Vulnerable	Grassland
White-backed Vulture	*Gyps africanus*	Uncommon?	Vulnerable	Grassland
White-headed Vulture	*Trigonoceps occipitalis*	Uncommon	Vulnerable	Grassland
Tawny Eagle	*Aquila rapax*	Uncommon	Vulnerable	Thornveld
Martial Eagle	*Polemaetus bellicosus*	Uncommon	Vulnerable	Varied
Bateleur	*Terathopius ecaudatus*	Uncommon	Vulnerable	Savanna
African Marsh-Harrier	*Circus ranivorus*	Uncommon	Vulnerable	Marshlands
Blue Crane	*Anthropoides paradisea*	Common	Vulnerable	Grassland
Corn Crake	*Crex crex*	Uncommon	Vulnerable	Grassland
Ludwig's Bustard	*Neotis ludwigii*	Uncommon	Vulnerable	Savanna
Red Lark	*Certhilauda burra*	Common	Vulnerable	Shrubland, dunes
Cape Vulture	*Gyps coprotheres*	Uncommon	Vulnerable / Threat	Grassland