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DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

The proposed hydropower station and associated infrastructure at Boegoeberg Dam on the Orange River, near Groblershoop, Northern Cape

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The specialist appointed in terms of the Regulations

I, Andrew Jenkins, declare that

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

AVISENSE Consulting cc

Name of company (if applicable):

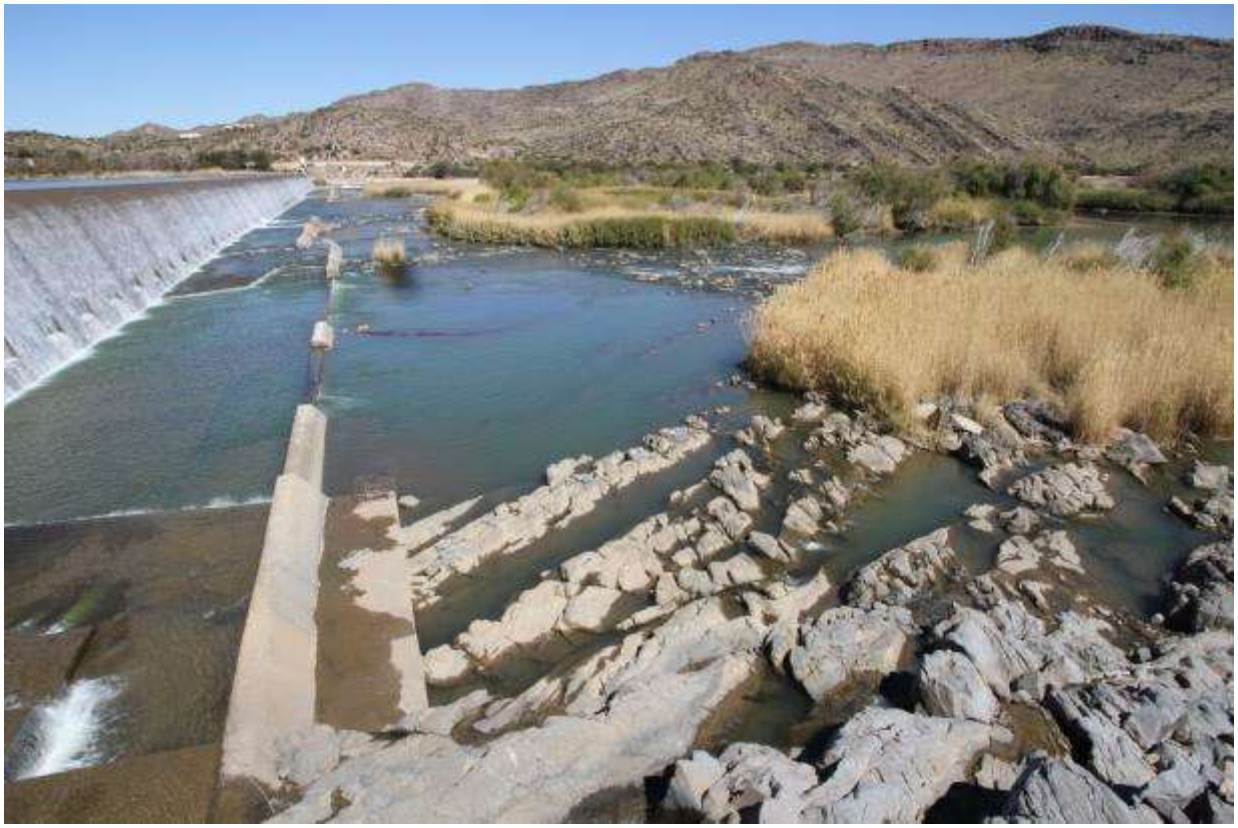
15 November 2013

Date:

PROPOSED HYDROPOWER STATION AND ASSOCIATED INFRASTRUCTURE AT BOEGOEBERG DAM ON THE ORANGE RIVER, NORTHERN CAPE

Avian impact assessment

Andrew Jenkins & Johan du Plessis, October 2013



AVISENSE CONSULTING

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1. EXECUTIVE SUMMARY

This study assesses the possible impacts on birds of the Boegoeberg 15 MW run-of-river Hydropower project, proposed for the vicinity of the Boegoeberg Dam, on the Orange River, Northern Cape. The expected avian impacts are: habitat destruction or degradation resulting from the construction of the facility and its associated power and road infrastructure, disturbance by construction and maintenance activities and possibly habitat degradation resulting from the operation of the plant, and mortality caused by collision with or electrocution on the associated power line network.

The broader impact zone of the proposed hydropower station is contained within an extensive tract of undulating, remote, arid Bushmanland Karoo, while the immediate vicinity features the rocky hills of the Boegeoberg, bisected by a stretch of the Orange River – a nationally significant waterway – attended by a heavily cultivated and wooded riparian strip. The area potentially supports over 200 bird species, including up to 10 red-listed species, 65 endemics, and three red-listed endemics. The birds of greatest potential relevance and importance in terms of the possible impacts of the hydropower plant are likely to be wetland birds foraging, roosting and/or nesting in the immediate area, cliff-nesting birds resident on the rock faces overlooking the site, and endemic passerines and large terrestrial species and raptors located in the area affected by the power line routing.

Overall, the proposed hydropower development is likely to have relatively little significant, long-term impact on the avifauna of the area. Careful and responsible implementation of the required mitigation measures – including minimizing the size of the construction footprint and the severity of disturbance arising from construction, maintenance and operational activities, and ensuring that the attendant power line is engineered to minimize avian mortality risk - should easily reduce impacts to tolerable and sustainable levels throughout the life of the development. Ideally, the project should be subject to a control modulated before:after avian monitoring programme to further inform effective impact mitigation on this and future hydropower projects in the region.

2. INTRODUCTION

Boegoeberg Hydro (Pty) Ltd is planning to construct a 15 MW hydropower plant at Boegoeberg Dam on the Orange River, near Groblershoop, Northern Cape. Aurecon South Africa (Pty) Ltd were appointed to do the Environmental Impact Assessment (EIA) study for this development, and subsequently appointed *AVISENSE* Consulting cc to conduct the specialist avifaunal assessment. The present report was compiled by Dr Andrew Jenkins and Johan du Plessis. Dr Jenkins is an established ornithologist, with over 20 years of experience in ornithology and impact assessment work. He has been involved in many power line, and wind and solar farm EIA and EMP studies in South Africa, and also does academic research on raptors, bustards and cranes in various parts of the country. Johan du Plessis holds an MSc degree in Zoology from the University of Stellenbosch. He has over six years of experience as a field biologist, and has assisted with field data collection in support of various zoological surveys and EIA studies, including avifaunal monitoring at various renewable energy facilities throughout South Africa.

3. DECLARATION OF INDEPENDENCE

Andrew Jenkins and Johan du Plessis (*AVISENSE* Consulting cc) are independent consultants to Aurecon South Africa (Pty) Ltd and Boegoeberg Hydro (Pty) Ltd. They have 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. There are no circumstances that compromise the objectivity of these specialists in performing such work.

4. TERMS OF REFERENCE

The terms of reference for the full EIA, as supplied by Aurecon, were to:

(i) Undertake additional field work required to verify desktop assessment or address gaps in available data.

(ii) Provide a focussed and relevant description of all baseline characteristics and conditions of the sites being considered, based on all relevant available data, reports and maps and the field work.

(iii) Liaise and consult with the relevant authorities, as required, to access additional information applicable to the investigation.

(iv) Identify relevant legislation and policies to be complied with.

(v) Determine thresholds of acceptable change and relevant standards to be complied with.

(vi) Identify sensitive elements that may potentially be impacted on by the proposed development (based on the site visit).

(vii) Identify any potential additional alternatives (site, process, technology or design) that should be considered in the process.

(viii) Make recommendations for additional study required.

(ix) Identify and evaluate predicted impacts of the proposed development using the criteria of extent, temporal scale and magnitude, in order to determine the significance of the potential impact, as per the methodology provided.

(x) Include assessment of the local, regional, national or international importance of each impact, the probability of each impact occurring, the reversibility of each impact and the level of confidence in each potential impact.

(xi) Allow for assessment of impacts during the construction, operation and decommissioning phases, as well as direct and indirect impacts.

(xii) Assess the alternatives to the same level of detail (including the no-go option) as the preferred alternative to support the motivation for the preferred alternative(s).

(xiii) Propose measures to mitigate the negative impacts and optimise the positive ones.

(xiv) Assess significance of each impact before and after mitigation and identify residual impacts that will remain after implementation of design and planning mitigation.

(xv) Determine the cumulative impact in terms of the current and proposed activities in the area.

(xvi) Identify additional measures to ensure that the project contributes towards sustainability goals or provides a positive contribution to the environment.

(xvii) Identify any assumptions and limitations that have informed the study or gaps in knowledge that have become apparent.

4. LIMITATIONS AND ASSUMPTIONS

Any inaccuracies or deficiencies in the primary sources of information used in the compilation of this report could limit its value. The SABAP1 data (see below) for the Boegoeberg Dam area are now >15 years old (Harrison *et al.* 1997), and comprise only eight bird atlas cards for the relevant quarter-degree square, while there is presently only five SABAP 2 atlas cards in total for the four affected pentads. No more reliable and/or more recent formal data on bird species presence and abundance in the study area currently exist. The site visit (conducted on August 23-24 2013) goes some way towards remedying this knowledge deficiency. However, with limited time in the field, and no seasonal spread, it is possible, but not likely, that important components of the local avifauna – nest sites, localized areas of key habitat for rare or threatened species – were missed.

6. STUDY METHODOLOGY

6.1 Approach

The study included the following steps:

- A review was done of available published and unpublished literature pertaining to bird interactions with hydropower facilities and associated power infrastructure, summarizing the issues involved and the current level of knowledge in this field.
- A short visit to the development area to determine first-hand the avian habitats present.
- Compilation of an inclusive, annotated list of the avifauna likely to occur within the impact zone of the proposed hydropower facility was compiled using a combination of the existing distributional data, species seen during the site visit, and previous experience of the avifauna of the general area.
- Compilation of a short-list of priority bird species (defined in terms of conservation status and endemism) which could be impacted by the proposed hydropower facility was extracted from the total bird list. These species were subsequently considered as adequate surrogates for the local avifauna in general, and

mitigation of impacts on these species was considered likely to accommodate any less important bird populations that may also potentially be affected.

- A matrix of possible impacts on the local avifauna was drawn up for the various components of the proposed hydropower facility, and the significance of these impacts was assessed in terms of the available suite of mitigation options.

6.2 Data sources used

The following data sources and reports were used in the compilation of this report:

- Bird distribution data of the SABAP (Harrison *et al.* 1997) were obtained from the Animal Demography Unit website (http://sabap2.adu.org.za/index.php) for the SABAP 1 quarter-degree square covering the proposed hydropower project and its associated infrastructure (2922AA Boegoebergdam), and for the relevant SABAP 2 pentads (2900_2210, 2905_2210, 2910_2210 and 2915_2210). A composite list of species likely to occur in the impact zone of theproject was drawn up as a combination of these data, refined by a more specific assessment of the actual habitats affected, based on general knowledge of the birds of the region (Appendix 1).
- The conservation status and endemism of all species considered likely to occur in the area was determined from the national Red-list for birds (Barnes 2000), and the most recent and comprehensive summary of southern African bird biology (Hockey *et al.* 2005).

7. OVERVIEW OF THE PROPOSAL

The proposed Boegoeberg Hydro Electric Power Station will be located on the farm Zeekoebaart (portions of Farm no. 306 and Portion 1 of Farm no. 306) near Groblershoop (Figs 1 & 2). The proposed facility is a run-of-river hydropower scheme capable of producing approximately 15 MW of electricity through two or three Francis turbines, each having equal capacity. Run-of-the-river facilities use conventional hydropower technology to produce electricity by using the natural flow and drop in elevation of a river and diverting the flow and passing it through turbines that spin generators. There would be no storage of water off-stream and the power station would thus be subject to seasonal river flows, and would not operate during low flow periods.

The proposed hydropower station would consist of the following components:

- An off-take structure above the existing Boegoeberg weir to facilitate the abstraction of water (Figs 2 & 3).
- Water conveyance infrastructure comprising a combination of an open canal, a pipeline and/or culverts to convey the water to the head pond, and the head pond itself.
- Steel (or other suitable pipeline material) penstocks to transfer the water to the power chamber.
- A power chamber to house the turbines and generation equipment, and an outlet channel (tailrace) to return the abstracted water back into the river; downstream of the power chamber.
- A switchroom and transformer yard, attended by a high voltage (HV – 132 kV) distribution line to evacuate the power to the nearby Fibre Substation, and a network of access roads to the site (Figs 1 & 2). The power line would either be routed further to the east of the Orange River on its approach to the power station (preferred Alternative 1) or closely follow the bank of the river (Alternative 2).

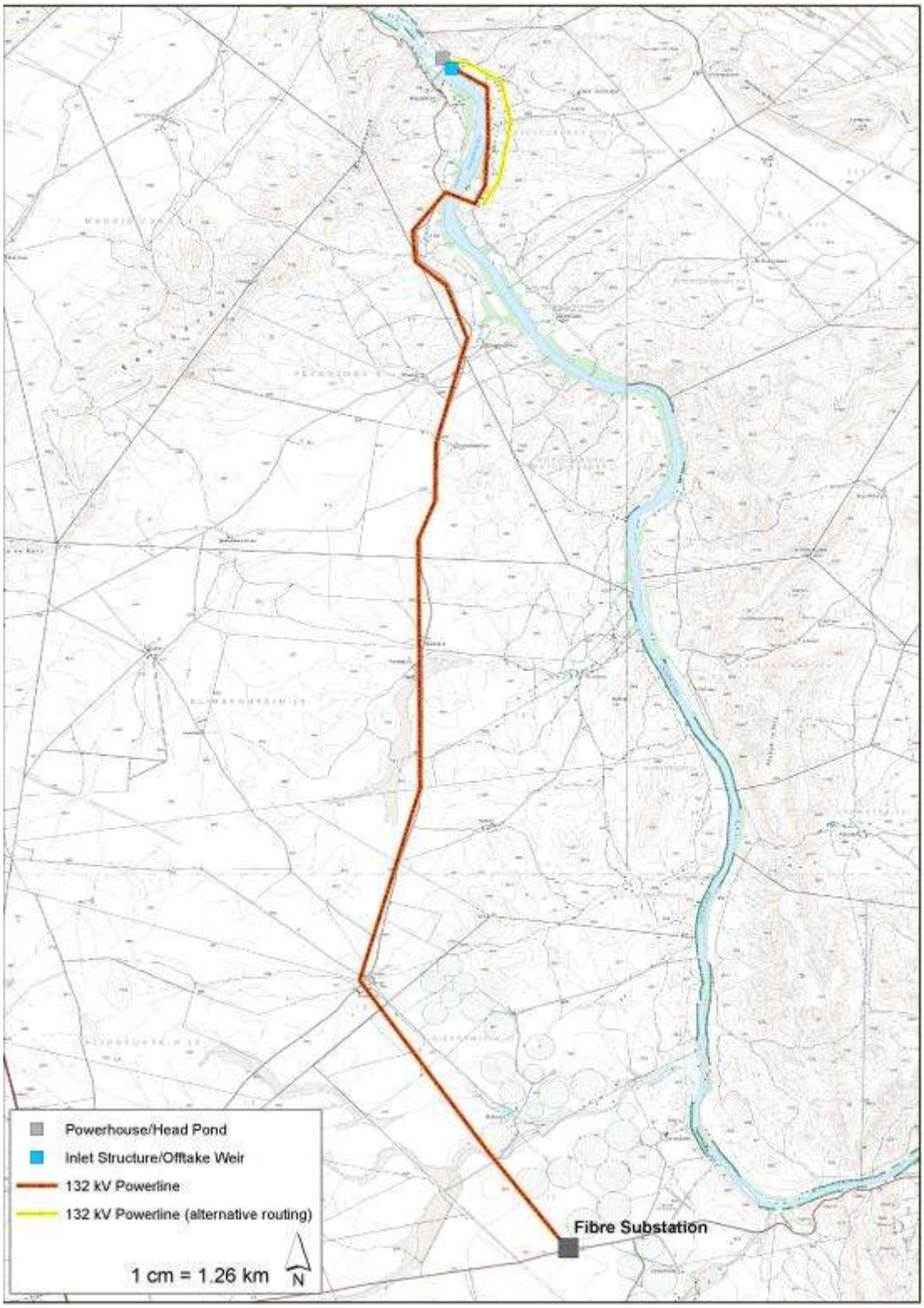

Figure1. General location of the Boegoeberg Hydropower Facility and the power line evacuating power from the plant to the national grid, including a proposed alternative routing for this power line.

8. DESCRIPTION OF THE AFFECTED ENVIRONMENT

8.1 Vegetation of the study area

The study area is located in the Bushmanland Bioregion of the Nama Karoo Biome (Mucina & Rutherford 2006). The natural vegetation of the study area is dominated by Bushmanland Arid Grassland – semi-desert steppe, characterized by dry, white grasses, with Upper Gariep Alluvial vegetation – riparian thicket, flooded grasslands and reedbeds – along the banks of the Orange River (Mucina & Rutherford 2006). Altitude on the site varies from about 1100 m above sea level on the tops of the Boegoeberge, to about 900 m a.s.l. on the plains next to the river. The area receives about 100 mm of rain per annum, most of which falls in autumn (February-March). Temperatures range from a mean winter minimum of about 2ºC overnight, to a mean summer maximum of about 33ºC at midday.

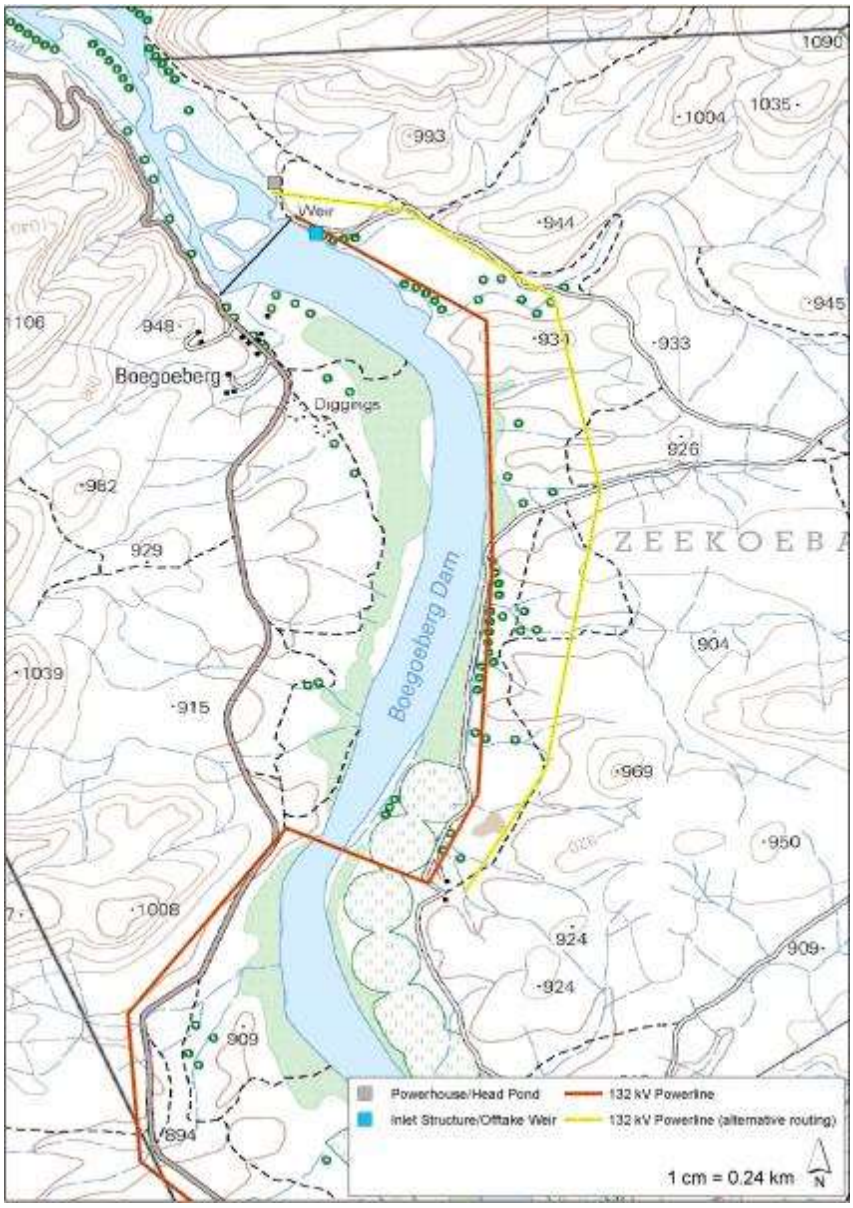

Figure 2. More detailed map of the proposed project layout in relation to the Boegoeberg Weir on the Orange River.

8.2 Avian microhabitats

These largely comprise areas of dry, grassy Karoo veld around the broader periphery of the development area, overlaid on the hilly, rocky terrain of the Boegoeberge (Figs 1 & 2), with small areas of exposed, vertical rock presenting habitat for cliff-nesting birds (Fig. 4). The riparian strip along both banks of the river features taller vegetation, including a tallish tree component comprising both indigenous acacias and a variety of alien trees. The river itself presents both deeper, slow-flowing sections above the weir, and shallow, fast-flowing sections below (Fig. 4), with a number of side-streams adding further variety to the conditions available to wetland birds, including stands of reeds and pools of standing water. Land-use is dominated by small-stock farming away from the river, and irrigation agriculture within the immediate floodplain, featuring a variety of cash-crops sustained by canals tapping water directly from the river into the fields. The power line evacuating power from the hydro plant follows the roadway south from the Boegoeberg settlement to its intersection with the R383, passing through flat, dry ranchland, centre-pivot agriculture and, in the south, the course of the Marydale River which flows into the Orange. Existing infrastructure in the general area is sparse, with a scattering of farmsteads, dams, gravel roads and distribution and reticulation power lines.

Figure3. Sketch of the layout of the Boegoeberg Hydropower Facility, with the off-take weir and inlet structure situated just upstream of the weir (bottom right in picture), and the head-pond, power-house and tail race just downstream (top left).

Figure 4. Avian habitats available within the impact area of the proposed Boegoeberg Hydropower Station: cliff-lines on the ridges overlooking the development site (above), open water of the Boegoeberg Dam and a fringe of riparian woodland (centre), the narrower, faster-flowing channel of the Orange River below the weir (below).

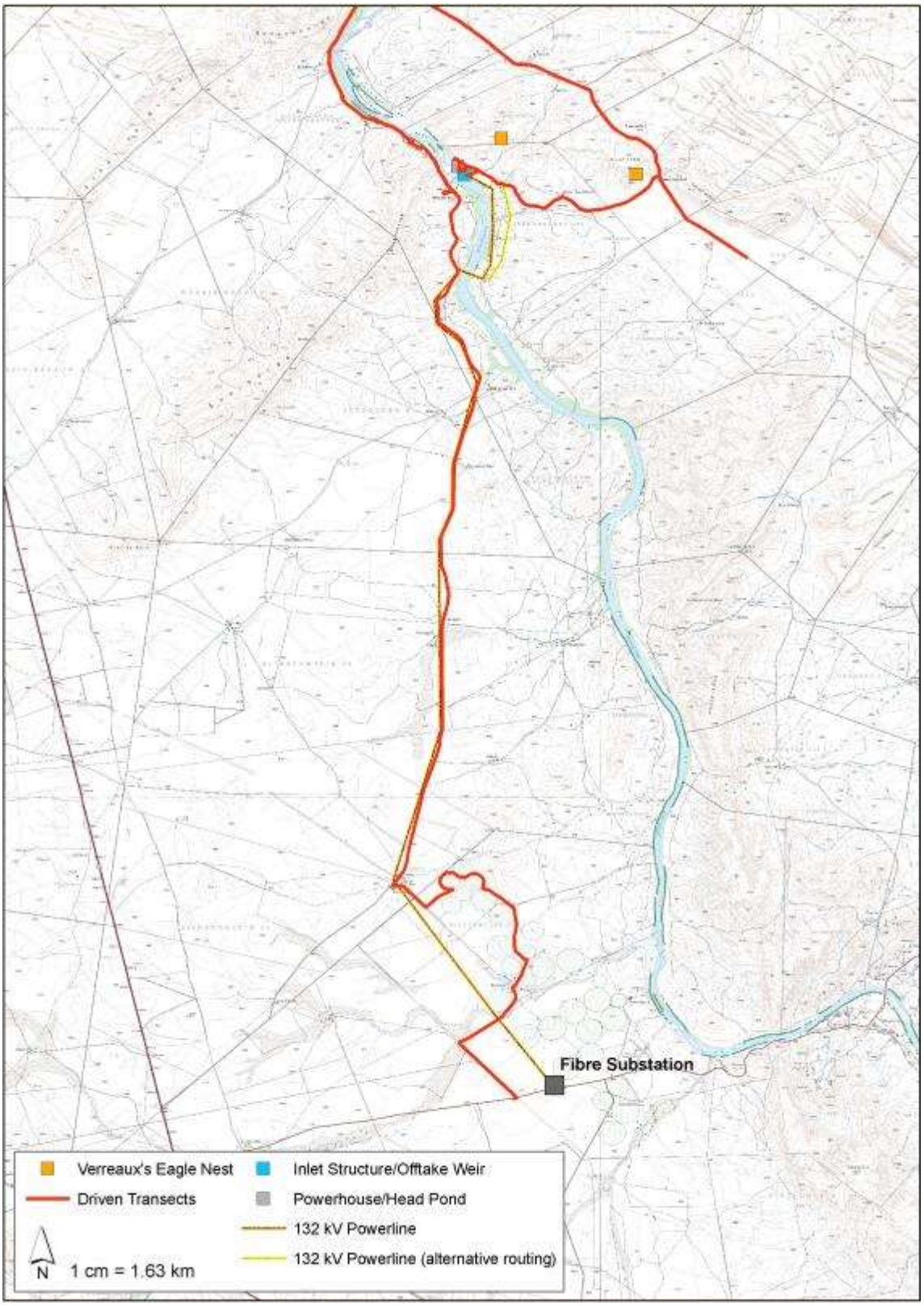

Figure5. GPS track of our August site visit, showing the affected areas that were visited, and the two Verreaux's Eagle nest sites located just north-east of the planned power station.

8.3 Avifauna of the impact area

At least 217 bird species are considered likely to occur with some regularity within the anticipated impact zone of the proposed hydropower development (Appendix 1), including 65 endemic or near-endemic species, 10 red-listed species, and three species – Ludwig's Bustard *Neotis ludwigii*, Blue Crane *Anthropoides paradiseus* and Sclater's Lark *Spizocorys sclateri* – which are both endemic and red-listed (Barnes 1998, 2000, Table 1). The site is not situated close to any presently recognised national Important Bird Areas (Barnes 1998), but it does straddle and interact directly with the Lower Orange River, a nationally significant wetland system, and a significant resource area, flyway and dispersal and range expansion medium for the region's avifauna (Barnes 1998, Allan & Jenkins 1993, Simmons & Allan 2002).

The birds of greatest potential relevance and importance in terms of the possible impacts of the hydropower station are likely to be wetland and water-associated birds using the Orange River in the vicinity of the power station as a foraging, roosting and/or nesting area, or as a thoroughfare between such resource areas, cliff-nesting birds resident on the rock faces located close to the proposed development area, and endemic passerines and large terrestrial species and raptors located in the area affected by the power line routing. In addition, a number of species are likely to associate with and even benefit from aspects of the installed infrastructure, in particular the larger outbuildings and the power line. These include Speckled Pigeon *Columba guinea*, Rock Kestrel *Falco rupicolus*, Greater Kestrel *Falco rupicoloides*, Southern Pale Chanting Goshawk, Cape Crow *Corvus capensis*, Pied Crow *Corvus albus*, Cape Sparrow *Passer melanurus*, House Sparrow *Passer domesticus* and Sociable Weaver *Philetairus socius*, and possibly a variety of other perch-hunting and insectivorous passerines.

Eighty-one species were seen during the August site visit (Appendix 1) over two days spent visiting as much of the affected area as possible (Fig. 5). Very little of significance or concern was encountered along the transmission line routing, although clearly areas of flat, open Karoo are likely to support numbers of collision prone, large terrestrial birds (in particular Ludwig's Bustard and Kori Bustard *Ardeotis kori* – Jenkins *et al.* 2012 – and Secretarybird *Sagittarius serpentarius*), and may also support large, pylon-nesting raptors (in particular Martial Eagle *Polemaetus bellicosus* – Jenkins *et al.* 2013). Collision risk for birds on this line is likely to be greatest where it crosses the Orange River proximal to the power station, and also where it traverses an area of centre-pivot irrigation agriculture and crosses the Marydale River and its attendant farm dams and ephemeral wetlands, just north of the Fibre Substation (Fig. 5).

The Boegoeberg area itself supports a reasonable diversity of birds, substantially inflated by the habitat diversity (in the form of woodlands and cultivated lands) introduced by the riparian strip along both banks of the Orange River. While this diversity includes some locally abundant regional endemics (such as Orange River White-eye *Zosterops pallidus*, Namaqua Warbler *Phragmacia substriata*, Appendix 1), and some species with westerly range extensions entirely dependent on the Orange River (e.g. Crested Barbet *Trachyphonus vaillantii*, Red-eyed Dove *Streptopelia semitorquata*), none of these populations are considered particularly susceptible to the impacts likely to arise from the proposed development, and none are irreplaceable in a broader context.

The waterbirds of the Boegoeberg Dam, and the downstream section of the Orange River and its tributaries are clearly central to this report. This avifauna is dominated by large piscivores – African Fish-Eagle *Haliaetus vocifer*, Goliath Heron *Ardea goliath*, Grey Heron *Ardea cinerea*, Little Egret *Egretta garzetta*, White-breasted Cormorant *Phalacrocorax lucidus*, African Darter *Anhinga rufa*, and Reed Cormorant *Phalacrocorax africanus* (e.g. Fig. 6), all of which are relatively common and probably occur

as resident breeders in the area, and possibly including the increasingly rare and red-listed Black Stork *Ciconia nigra* (Simmons & Allan 2002).

The rocky ridges and crags of the Boegoeberg itself are likely to support populations of cliff-nesting species, possibly including Cape Eagle-Owl *Bubo capensis*, Booted Eagle *Hieraetus pennatus*, Peregrine Falcon *Falco peregrinus*, Lanner Falcon *Falcon biarmicus* and Black Stork, and definitely including Verreaux's Eagle *Aquila verreauxii*. Two nest sites of the latter species were located on the cliff-line immediately north-east of the proposed location for the power station during the site visit (Fig. 5). The closest of these is situated about 1.5 km from the development area, and contained a half-grown nestling at the time. The other territory was almost certainly occupied by a pair of eagles, but was not obviously active in August 2013.

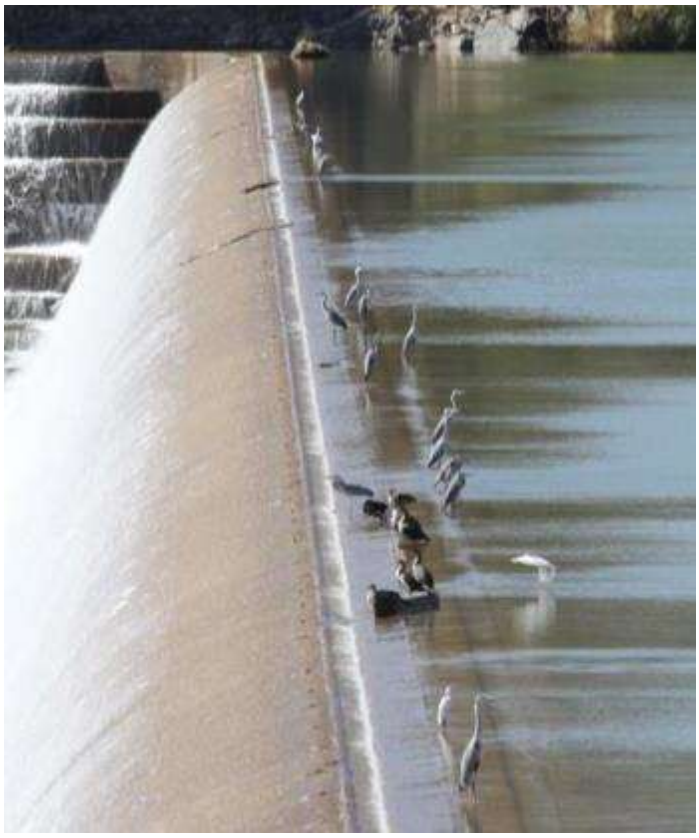

Figure 5. Large piscivorous birds (herons, egrets and cormorants) resting on and hunting from the inner edge of the Boegoeberg weir.

On the basis of these observations, and in combination with already documented information on the avifauna of the general area, 11 priority species are recognized as key in the assessment of avian impacts of the proposed Boegoeberg Hydropower Station (Table 1). These are mostly nationally and/or globally threatened species which are known to occur, or could occur, in relatively high numbers in the development area and which are likely to be, or could be, negatively affected by the proposed development. Seven species were included despite the fact that they were not recorded in either SABAP 1 or SABAP 2 data for the area because the site is located within their respective distributions, the available habitat is suitable, and these species have been recorded in the general area in other studies (e.g. Allan & Jenkins 1993, Simmons & Allan 2002). Cape Eagle-Owl, African Fish-Eagle, Verreaux's Eagle, and Goliath Heron, were included despite not being red-listed or endemic because they are all relatively large, scarce predatory species that probably play a significant role in maintaining the ecological integrity of the area.

Table 1. Priority bird species considered central to the avian impact assessment process for the proposed Boegoeberg Hydropower Station, selected mainly on the basis of South African (Barnes 2000) or global conservation status (www.iucnredlist.org or http://www.birdlife.org/datazone/species/), level of endemism, relative abundance on site (SABAP reporting rates, direct observation), and estimated conservation or ecological significance of the local population. Red-listed endemic species are shaded in grey.

Common name	Scientific name	SA conservation status/ (Global conservation status)	Regional endemism	Average reporting rate[1] (*n* = 13 cards)	Estimated importance of local population	Preferred habitat	Risk posed by		
							Collision	Electro-cution	Disturbance / habitat loss
Cape Eagle-Owl	*Bubo capensis*	-	-	0.0	Moderate	Cliffs & ridges	Moderate	High	Moderate
Ludwig's Bustard	*Neotis ludwigii*	Vulnerable (Endangered)	Near-endemic	0.0	Low	Open Karoo	High	-	Moderate
Kori Bustard	*Ardeotis kori*	Vulnerable	-	0.0	Low	Open Karoo	High	-	Moderate
African Fish-Eagle	*Haliaetus vocifer*	-	-	38.5	Moderate	Open river and riparian strip	High	High	Moderate
Martial Eagle	*Polemaetus bellicosus*	Vulnerable (Near-threatened)	-	7.7	Moderate	Open Karoo, power pylons	High	High	Moderate
Verreaux's Eagle	*Aquila verreauxii*	-	-	7.7	Moderate	Cliffs & ridges	High	High	Moderate
Secretarybird	*Sagittarius serpentarius*	Near-threatened (Vulnerable)	-	0.0	Moderate	Open Karoo	High	-	Moderate
Peregrine Falcon	*Falco peregrinus*	Near-threatened	-	0.0	Moderate	Cliffs & ridges, riparian strip	High	Moderate	-
Lanner Falcon	*Falco biarmicus*	Near-threatened	-	0.0	Moderate	Cliffs & ridges, riparian strip	High	Moderate	-
Goliath Heron	*Ardea goliath*	-	-	15.4	High	Open river and riparian strip	High	Moderate	Moderate
Black Stork	*Ciconia nigra*	Near-threatened	-	0.0	High	Open river and riparian strip	High	Moderate	Moderate

[1] Reporting rate calculated as the % of bird lists submitted for a given area which include each species.

9. ASSESSMENT OF IMPACTS

9.1 General assessment of impacts & mitigation

9.1.1 Impacts of run-of-river hydropower facilities

Habitat loss – destruction, disturbance and displacement

Direct effects of hydropower developments on birds include levels of disturbance associated with construction and maintenance of new plants, and the loss of habitat and the displacement of birds from the immediate development footprint. Such impacts are no different from those associated with any relatively small scale industrial development, and provided that (i) these activities are carried out responsibly and with due consideration of the surrounding environment, and (ii) allowances are made for the cumulative impacts of multiple projects, they are not likely to have a significant, lasting effect.

Other effects

The more systemic impacts of small, run-of-river hydropower installations on birds are not well researched or understood. In the absence of any substantial impoundment of the river or interruption of water flow, the likelihood of such impacts reaching significant levels seems low, but probably should be monitored. Certainly, in a relatively pristine river system, the intake and small-scale storage of water might affect avian community structure by introducing more foraging opportunities for still-water predators or affecting siltation and water turbidity, while the risk of downstream pollution stemming from the plant machinery cannot be discounted.

9.1.2 Impacts of associated infrastructure

Infrastructure commonly associated with solar energy facilities may also have detrimental effects on birds. The construction and maintenance of substations, power lines, servitudes and roadways causes both temporary and permanent habitat destruction and disturbance, and overhead power lines pose a collision and possibly an electrocution threat to certain species (Van Rooyen 2004a, Lehman *et al.* 2007, Jenkins *et al.* 2010).

Construction and maintenance of power lines and substations

Some habitat destruction and alteration inevitably takes place during the construction of power lines, substations and associated roadways. Also, power line service roads or servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, and to prevent vegetation from intruding into the legally prescribed clearance gaps between the ground and the conductors. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, and retention of cleared servitudes can have the effect of altering bird community structure along the length of any given power line (e.g. King & Byers 2002).

Collision with power lines

Power lines pose a significant collision risk to birds, affecting a particular suite of collision prone species (Bevanger 1994, 1995, 1998, Janss 2000b, Anderson 2001, van Rooyen 2004a, Drewitt & Langston 2008, Jenkins *et al.* 2010). Mitigation of this risk involves the informed selection of low impact alignments for new power lines relative to movements and concentrations of high risk species, and the use of either static or

dynamic marking devices to make the lines, and in particular the earthwires, more conspicuous. While various marking devices have been used globally, many remain largely untested in terms of their efficacy in reducing collision incidence, and those that have been fully assessed have all been found to be only partially effective (Drewitt & Langston 2008, Jenkins *et al.* 2010).

Electrocution on power infrastructure

Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004b, Lehman *et al.* 2007). Electrocution risk is strongly influenced by the voltage and design of the power lines erected (generally occurring on lower voltage infrastructure where air gaps are relatively small), and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energised components. Mitigation of electrocution risk involves the use of bird-safe structures (ideally with critical air gaps >2 m), the physical exclusion of birds from high risk areas of live infrastructure, and comprehensive insulation of such areas (van Rooyen 2004b, Lehman *et al.* 2007).

9.2 Specific impacts of this development

The project is likely to negatively affect the local avifauna in three principal ways (also see Tables 2 & 3):

1. Habitat loss/change/degradation and disturbance impacts on the waterbird (e.g. herons, cormorants, egrets, storks and African Fish-Eagle) and cliff-nesting communities (e.g. Verreaux's Eagle, other montane raptors, storks), and to a lesser extent on populations of woodland and regionally endemic Karoo passerines, associated with construction and decommissioning activities on the development site, as well as with maintenance and operation of the plant itself.
2. Habitat loss/degradation and disturbance impacts on large terrestrial birds (e.g. bustards, korhaans, Secretarybird) and savannah raptors (e.g. Martial Eagle), and to a lesser extent on populations of woodland and regionally endemic Karoo passerines, associated with construction and maintenance of the power line servicing the power station.
3. Mortality of waterbirds, raptors and large terrestrials in collisions with and/or electrocution on the power line servicing the power station.

In addition, some waterbird species may benefit from the imposed changes on river flow or water quality, and species such as Martial Eagle, a suite of smaller raptors, corvids and Sociable Weaver may colonise and roost and/or breed in the various utility structures making up the development.

Table 2. Impact characteristics: Boegoeberg Hydropower Station– Birds.

Summary	Construction	Operation	Decommissioning
Project Aspect/ activity	(i) Disturbance/displacement associated with noise and movement of construction equipment and personnel. (ii) Loss or degradation of avian habitat through site clearance, road upgrade and establishment of the camp, lay-down and assembly areas.	(i) Loss of habitat to space occupied by hydropower station and associated infrastructure, and disturbance / displacement associated with routine maintenance work. (ii) Interruption of regular water flow, changes in water turbidity and/or downstream pollution of river. (iii) Mortality in collisions with power lines, or by electrocution on new power infrastructure.	(i) Disturbance/displacement associated with noise and movement of decommissioning equipment and personnel.
Impact Type	Direct	Direct	Direct
Receptors Affected	(i) All birds on site; key species – wetland bird community (herons, cormorants, African Fish-Eagle), cliff-nesting raptors (Verreaux's Eagle), endemic passerines. (ii) All birds on site; key species – wetland bird community (herons, cormorants, African Fish-Eagle), cliff-nesting raptors (Verreaux's Eagle), endemic passerines.	(iii) All birds on site; key species – wetland bird community (herons, cormorants, African Fish-Eagle), cliff-nesting raptors (Verreaux's Eagle), endemic passerines. (i) Wetland bird community. (ii) Wetland bird community, cliff-nesting raptors, large terrestrial species.	(iii) All birds on site; key species – wetland bird community (herons, cormorants, African Fish-Eagle), cliff-nesting raptors (Verreaux's Eagle), endemic passerines.

Table 3. Avian impact assessment matrix for the proposed Boegoeberg Hydropower Station. See Table 2 for a more complete explanation of impacts.

	Project component	Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE (Without mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction	Layout (preferred)	Disturbance	Local	Low - Medium	Short	Low-Medium	Low	Definite	Certain	Reversible
		Habitat loss / degradation	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
	Roads and water pipeline	Disturbance	Local	Low - Medium	Short	Low-Medium	Low	Definite	Certain	Reversible
		Habitat loss / degradation	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
	Transmission Route 1	Disturbance	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
		Habitat loss / degradation	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
	Transmission Route 2	Disturbance	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
		Habitat loss / degradation	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
Operation	Layout (preferred)	Habitat loss & disturbance	Local	Low - Medium	Long	Low-Medium	Low	Definite	Certain	Irreversible
		Changes in river quality	Local	Low - Medium	Long	Low-Medium	Low	Probable	Sure	Reversible
	Roads and water pipeline	Habitat loss & disturbance	Local	Low	Long	Low-Medium	Low	Definite	Certain	Irreversible
	Transmission Route 1	Habitat loss & disturbance	Local	Low	Long	Low	Very Low	Definite	Certain	Irreversible
		Mortality	Regional	Medium	Long	High	Low-Medium	Probable	Sure	Irreversible
	Transmission Route 2	Habitat loss & disturbance	Local	Low	Long	Low-Medium	Low	Definite	Certain	Irreversible
		Mortality	Regional	Medium	Long	High	Low-Medium	Probable	Sure	Irreversible
Decommissioning	Layout (preferred)	Disturbance	Local	Low	Short	Low-Medium	Low	Definite	Certain	Reversible
	Roads and water pipeline	Disturbance	Local	Low	Short	Low-Medium	Low	Definite	Certain	Reversible
	Transmission Route 1	Disturbance	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible
	Transmission Route 2	Disturbance	Local	Low	Short	Low	Very Low	Definite	Certain	Reversible

10. MITIGATION

Should the proposed Boegoeberg Hydropower Station be approved, mitigation of negative impacts on birds should focus on:

(i) Minimizing the inclusive construction footprint of the inclusive development area, abbreviating construction time to a reasonable minimum, and minimizing noise and disturbance associated with construction activities. Ideally, the bulk of the construction work should be done outside of the Verreaux's Eagle breeding season (approximately April/May to September/October).

(ii) Minimizing noise and disturbance associated with maintenance activities at the plant once it becomes operational.

(iii) Selecting power line route Alternative 1, which takes the line away from the immediate vicinity of the Orange River as it evacuates power from the plant, rather than running it through the riparian vegetation along the bank of the river.

(iv) Minimising the length of any new power lines installed and burying lines wherever possible. If lines cannot be buried, ensure that all new lines are marked with bird flight diverters (Jenkins *et al.* 2010) along their entire length, and that all new power line infrastructure is adequately insulated and bird friendly in configuration (Lehman *et al.* 2007). Note that current understanding of power line collision risk in birds precludes any guarantee of successfully distinguishing high risk from medium or low risk sections of a new line (Jenkins *et al.* 2010). The relatively low cost of marking the entire length of a new line during construction, especially quite a short length of line in an area frequented by collision prone birds, more than offsets the risk of not marking the correct sections, causing unnecessary mortality of birds, and then incurring the much greater cost of retro-fitting the line post-construction. In situations where new lines run in parallel with existing, unmarked power lines, this approach has the added benefit of reducing the collision risk posed by the older line.

(v) Preferably using industry standard aviation balls to mark the power line where it crosses the Orange River, in addition to bird flight diverters, to ensure that the line is maximally visible to birds using the river course as a flyway.

(vi) In the interests of understanding the longer-term and cumulative impacts of run-of-river hydro developments in South Africa, and with a view guiding impact assessment for future developments of this kind, it would be ideal to institute a control modulated before:after monitoring programme, particularly aimed at quantifying and comparing waterbird numbers on the affected length of river. The results of such a programme could also inform any additional impact mitigation that might be required.

11. CONCLUSION

The proposed hydropower development is likely to have relatively little significant, long-term impact on the avifauna of the area, after mitigation. Careful and responsible implementation of the required mitigation measures should easily reduce construction and operational phase impacts to tolerable and sustainable levels.

Note that the negative impacts resulting from all phases of this proposed development would certainly be amplified by the construction and operation of multiple such hydropower projects along this stretch of the Orange River the area.

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Appendix 1. Inclusive, annotated list of the bird species considered likely to occur within the broader impact zone of the proposed locations for the Boegoeberg Hydropower project. Species seen on site during the August site visit appear in **bold**.

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Common Ostrich	*Struthio camelus*	-	-	X					-	-	High
Cape Spurfowl	*Pternistis capensis*	-	Endemic		X				Moderate	-	High
Common Quail	*Coturnix coturnix*	-	-	X					-	-	High
Helmeted Guineafowl	***Numida meleagris***	**-**	**-**		**X**				**Moderate**	**-**	**High**
Spur-winged Goose	***Plectopterus gambensis***	**-**	**-**				**X**		**High**	**Moderate**	**-**
Egyptian Goose	*Alopochen aegyptiaca*	-	-				X		High	High	-
South African Shelduck	***Tadorna cana***	**-**	**Endemic**				**X**		**High**	**-**	**-**
Yellow-billed Duck	***Anas undulata***	**-**	**-**				**X**		**Moderate**	**-**	**-**
African Black Duck	***Anas parsa***	**-**	**-**				**X**		**Moderate**	**-**	**-**
Cape Shoveler	*Anas smithii*	-	Endemic				X		Moderate	-	-
Southern Pochard	*Netta erythropthalma*	-	-				X		Moderate	-	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Red-billed Teal	*Anas erythrorhyncha*	-	-				X		Moderate	-	-
Common Buttonquail	*Turnix sylvaticus*	-	-	X	X				-	-	High
Lesser Honeyguide	*Indicator minor*	-	-		X				-	-	Moderate
Golden-tailed Woodpecker	***Campethera abingoni***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Cardinal Woodpecker	***Dendropicos fuscescens***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Crested Barbet	***Trachyphonus vaillantii***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Acacia Pied Barbet	***Tricholaema leucomelas***	**-**	**Near-endemic**		**X**				**-**	**-**	**Moderate**
African Grey Hornbill	*Tockus nasutus*	-	-		X				-	-	Moderate
African Hoopoe	*Upupa africana*	-	-		X				-	-	Moderate
Common Scimitarbill	*Rhinopomastus cyanomelas*	-	-		X				-	-	Moderate
European Roller	*Coracias garrulus*	-	-	X	X				-	-	-
Giant Kingfisher	***Megaceryle maximus***	**-**	**-**				**X**		**Moderate**	**-**	**Moderate**
Malachite Kingfisher	*Alcedo cristata*	-	-				X		-	-	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Pied Kingfisher	***Ceryle rudis***	**-**	**-**				**X**		**-**	**-**	**-**
Brown-hooded Kingfisher	***Halcyon albiventris***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Swallow-tailed Bee-eater	***Merops hirundineus***	**-**	**-**	**X**	**X**	**X**	**X**		**-**	**-**	**Moderate**
White-fronted Bee-eater	*Merops bullockoides*	-	-	X	X		X				
European Bee-eater	*Merops apiaster*	-	-						-	-	-
White-backed Mousebird	***Colius colius***	**-**	**Endemic**		**X**				**-**	**-**	**Moderate**
Red-faced Mousebird	*Urocolius indicus*	-	-		X				-	-	Moderate
Jacobin Cuckoo	*Clamator jacobinus*	-	-		X				-	-	Moderate
Diderick Cuckoo	*Chrysococcyx caprius*	-	-		X				-	-	Moderate
Rosy-faced Lovebird	*Agapornis roseicollis*	-	Near-endemic		X				-	-	Moderate
African Palm-Swift	*Cypsiurus parvus*	-	-		X				-	-	-
Alpine Swift	*Tachymarptis melba*	-	-					X	-	-	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Common Swift	*Apus apus*	-	-					X	-	-	-
Bradfield's Swift	*Apus bradfieldi*	-	Near-endemic			X		X	-	-	-
Little Swift	***Apus affinis***	**-**	**-**			**X**			**-**	**-**	**-**
White-rumped Swift	*Apus caffer*	-	-					X	-	-	-
Barn Owl	*Tyto alba*	-	-	X	X	X			-	Moderate	Moderate
Southern White-faced Scops-Owl	*Ptilopsis granti*	-	-		X				-	-	Moderate
Cape Eagle-Owl	*Bubo capensis*	-	-			X			-	High	Moderate
Spotted Eagle-Owl	*Bubo africanus*	-	-	X	X	X			-	High	Moderate
Verreaux's Eagle-Owl	*Bubo lacteus*	-	-		X				-	High	Moderate
Pearl-spotted Owlet	***Glaucidium perlatum***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Freckled Nightjar	*Caprimulgus tristigma*	-	-			X			-	-	Moderate
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	-	-	X					-	-	Moderate
Rock Dove	*Columba livia*	-	-			X		X	-	-	Moderate
Speckled Pigeon	***Columba guinea***	**-**	**-**			**X**		**X**	**-**	**-**	**Moderate**

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Laughing Dove	***Streptopelia senegalensis***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Cape Turtle-Dove	***Streptopelia capicola***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Red-eyed Dove	***Streptopelia semitorquata***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Namaqua Dove	*Oena capensis*	-	-	X	X				-	-	Moderate
Ludwig's Bustard	*Neotis ludwigii*	Vulnerable	Near-endemic	X					High	-	Moderate
Kori Bustard	*Ardeotis kori*	Vulnerable	-	X					High	-	Moderate
Red-crested Korhaan	*Eupodotis ruficrista*	-	Near-endemic	X					Moderate	-	Moderate
Northern Black Korhaan	***Afrotis afraoides***	**-**	**Endemic**	**X**					**Moderate**	**-**	**Moderate**
Karoo Korhaan	*Eupodotis vigorsii*	-	Endemic	X					Moderate	-	Moderate
Blue Crane	*Anthropoides paradiseus*	Vulnerable	Endemic	X			X		High	-	Moderate
Common Moorhen	*Gallinula chloropus*	-	-				X		-	-	-
Red-knobbed Coot	***Fulica cristata***	**-**	**-**				**X**		**-**	**-**	**-**
Namaqua Sandgrouse	*Pterocles namaqua*	-	Near-endemic	X			X		-	-	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Double-banded Sandgrouse	*Pterocles bicinctus*	-	-	X			X		-	-	-
Burchell's Sandgrouse	*Pterocles burchelli*	-	Near-endemic	X			X		-	-	-
Marsh Sandpiper	*Tringa stagnatilis*	-	-				X		-	-	-
Common Greenshank	*Tringa nebularia*	-	-				X		-	-	-
Wood Sandpiper	*Tringa glareola*	-	-				X		-	-	-
Common Sandpiper	*Actitis hypoleucos*	-	-				X		-	-	-
Little Stint	*Calidris minuta*	-	-				X		-	-	-
Curlew Sandpiper	*Calidris ferruginea*	-	-				X		-	-	-
Ruff	*Philomachus pugnax*	-	-				X		-	-	-
Spotted Thick-knee	*Burhinus capensis*	-	-	X	X				-	-	-
Black-winged Stilt	*Himantopus himantopus*	-	-				X		-	-	-
Pied Avocet	*Recurvirostra avosetta*	-	-				X		-	-	-
Kittlitz's Plover	*Charadrius pecuarius*	-	-				X		-	-	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Three-banded Plover	***Charadrius tricollaris***	**-**	**-**				**X**		**-**	**-**	**-**
Blacksmith Lapwing	***Vanellus armatus***	**-**	**-**				**X**		**-**	**-**	**-**
Crowned Lapwing	*Vanellus coronatus*	-	-	X					-	-	-
Double-banded Courser	*Rhinoptilus africanus*	-	-	X					-	-	-
Burchell's Courser	*Cursorius rufus*	-	Near-endemic	X					-	-	-
White-winged Tern	*Chlidonias leucopterus*	-	-				X		-	-	-
Black-shouldered Kite	***Elanus caeruleus***	**-**	**-**	**X**	**X**				**-**	**-**	**Moderate**
Black Kite	*Milvus migrans*	-	-	X				X	-	-	-
African Fish-Eagle	***Haliaeetus vocifer***	**-**	**-**					**X**	**-**	**High**	**-**
Black-chested Snake-Eagle	*Circaetus pectoralis*	-	-					X	-	Moderate	Moderate
African Harrier-Hawk	*Polyboroides typus*	-	-		X			X	-	-	Moderate
Southern Pale Chanting Goshawk	***Melierax canorus***	**-**	**Near-endemic**	**X**	**X**				**-**	**Moderate**	**Moderate**

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Gabar Goshawk	*Melierax gabar*	-	-		X				-	-	Moderate
Steppe Buzzard	*Buteo vulpinus*	-	-	X				X	-	Moderate	Moderate
Jackal Buzzard	*Buteo rufofuscus*	-	Endemic	X				X	-	Moderate	Moderate
Tawny Eagle	*Aquila rapax*	Vulnerable	-		X			X	-	High	Moderate
Verreauxs' Eagle	***Aquila verreauxii***	**-**	**-**			**X**		**X**	**Moderate**	**High**	**Moderate**
Booted Eagle	*Aquila pennatus*	-	-			X		X	-	-	Moderate
Martial Eagle	*Polemaetus bellicosus*	Vulnerable	-	X	X			X	Moderate	High	Moderate
Secretarybird	*Sagittarius serpentarius*	Near-threatened	-	X				X	High	-	Moderate
Pygmy Falcon	***Polihierax semitorquatus***	**-**	**-**	**X**	**X**				**-**	**-**	**Moderate**
Rock Kestrel	***Falco rupicolus***	**-**	**-**	**X**		**X**			**-**	**-**	**Moderate**
Greater Kestrel	*Falco rupicoloides*	-	-	X					-	-	Moderate
Red-necked Falcon	*Falco chicquera*	-	-		X			X		-	Moderate
Lanner Falcon	*Falco biarmicus*	Near-threatened	-	X				X	High	Moderate	-
Peregrine Falcon	*Falco peregrinus*	Near-threatened	-	X				X	High	Moderate	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Little Grebe	*Tachybaptus ruficollis*	-	-				X		-	-	-
White-breasted Cormorant	***Phalacrocorax lucidus***	**-**	**-**				**X**		**Moderate**	**-**	**-**
African Darter	***Anhinga rufa***	**-**	**-**				**X**		**-**	**-**	**-**
Reed Cormorant	***Phalacrocorax africanus***	**-**	**-**				**X**		**-**	**-**	**-**
Little Egret	***Egretta garzetta***	**-**	**-**				**X**		**-**	**-**	**-**
Goliath Heron	***Ardea goliath***	**-**	**-**		**X**		**X**		**High**	**Moderate**	**-**
Grey Heron	***Ardea cinerea***	**-**	**-**		**X**		**X**		**Moderate**	**Moderate**	**-**
Black-headed Heron	***Ardea melanocephala***	**-**	**-**	**X**	**X**		**X**		**Moderate**	**Moderate**	**-**
Cattle Egret	*Bubulcus ibis*	-	-				X		-	-	-
Green-backed Heron	***Butorides striata***	**-**	**-**				**X**		**-**	**-**	**-**
Hadeda Ibis	***Bostrychia hagedash***	**-**	**-**		**X**			**X**	**Moderate**	**-**	**-**
African Sacred Ibis	*Threskiornis aethiopicus*	-	-				X	X	Moderate	-	-
African Spoonbill	*Platalea alba*	-	-				X	X	Moderate	-	-

Common name	Scientific name	Conservation status	Regional endemism	Habitat					Susceptibility to		
				Karoo veld and cultivate lands	Riparian strip woodland	Rocky slopes and cliffs	River and associated wetlands	Fly over	Collision	Electro-cution	Disturbance / habitat loss
Black Stork	*Ciconia nigra*	Near-threatened	-				X	X	High	Moderate	-
Abdim's Stork	*Ciconia abdimii*	-	-	X			X	X	Moderate	Moderate	-
White Stork	*Ciconia ciconia*	-	-				X	X	High	High	-
Hamerkop	***Scopus umbretta***	**-**	**-**		**X**	**X**	**X**		**Moderate**	**-**	**-**
Fork-tailed Drongo	***Dicrurus adsimilis***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Brubru	*Nilaus afer*	-	-		X				-	-	Moderate
Crimson-breasted Shrike	*Laniarius atrococcineus*	-	Near-endemic		X				-	-	Moderate
Bokmakierie	***Telophorus zeylonus***	**-**	**Near-endemic**		**X**				**-**	**-**	**Moderate**
Pririt Batis	***Batis pririt***	**-**	**Near-endemic**		**X**				**-**	**-**	**Moderate**
Cape Crow	*Corvus capensis*	-	-	X	X				-	-	Moderate
Pied Crow	***Corvus albus***	**-**	**-**	**X**	**X**	**X**			**-**	**-**	**Moderate**
White-necked Raven	*Corvus albicollis*	-	-	X		X			-	-	Moderate
Red-backed Shrike	*Lanius collurio*	-	-	X					-	-	Moderate
Lesser Grey Shrike	*Lanius minor*	-	-	X					-	-	Moderate

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Common Fiscal	***Lanius collaris***	**-**	**-**	**X**	**X**				**-**	**-**	**Moderate**
Cape Penduline-Tit	*Anthoscopus minutus*	-	Near-endemic	X					-	-	Moderate
Ashy Tit	*Parus cinerascens*	-	Near-endemic	X					-	-	Moderate
Brown-throated Martin	***Riparia paludicola***	**-**	**-**				**X**	**X**	**-**	**-**	**Moderate**
Barn Swallow	*Hirundo rustica*	-	-				X	X	-	-	Moderate
White-throated Swallow	***Hirundo albigularis***	**-**	**-**				**X**		**-**	**-**	**Moderate**
Greater Striped Swallow	***Hirundo cucullata***	**-**	**-**				**X**	**X**	**-**	**-**	**Moderate**
Rock Martin	***Hirundo fuligula***	**-**	**-**			**X**	**X**	**X**	**-**	**-**	**Moderate**
African Red-eyed Bulbul	***Pycnonotus nigricans***	**-**	**Near-endemic**		**X**				**-**	**-**	**Moderate**
Fairy Flycatcher	*Stenostira scita*	-	Endemic		X				-	-	Moderate
Long-billed Crombec	***Sylvietta rufescens***	**-**	**-**	**X**	**X**				**-**	**-**	**Moderate**
Yellow-bellied Eremomela	*Eremomela icteropygialis*	-	-	X	X				-	-	Moderate

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African Reed-Warbler	*Acrocephalus baeticatus*	-	-				X		-	-	Moderate
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	-	-				X		-	-	Moderate
Willow Warbler	*Phylloscopus trochilus*	-	-		X				-	-	Moderate
Layard's Tit-Babbler	*Parisoma layardi*	-	Endemic	X	X				-	-	Moderate
Chestnut-vented Tit-Babbler	***Parisoma subcaeruleum***	**-**	**Near-endemic**		**X**				**-**	**-**	**Moderate**
Orange River White-eye	***Zosterops pallidus***	**-**	**Endemic**		**X**				**-**	**-**	**Moderate**
Grey-backed Cisticola	*Cisticola subruficapilla*	-	Near-endemic	X	X				-	-	Moderate
Levaillant's Cisticola	*Cisticola tinniens*	-	-				X		-	-	Moderate
Zitting Cisticola	*Cisticola juncidis*	-	-				X		-	-	Moderate
Desert Cisticola	*Cisticola aridulus*	-	-				X		-	-	Moderate
Black-chested Prinia	***Prinia flavicans***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Karoo Prinia	*Prinia maculosa*	-	Endemic	X	X				-	-	Moderate

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Namaqua Warbler	***Phragmacia substriata***	**-**	**Endemic**		**X**				**-**	**-**	**Moderate**
Rufous-eared Warbler	*Malcorus pectoralis*	-	Endemic	X					-	-	Moderate
Eastern Clapper Lark	*Mirafra fasciolata*	-	Near-endemic	X					-	-	Moderate
Sabota Lark	*Calendulauda sabota*	-	-	X					-	-	Moderate
Fawn-coloured Lark	***Calendulauda africanoides***	**-**	**Near-endemic**	**X**					**-**	**-**	**Moderate**
Spike-heeled Lark	*Chersomanes albofasciata*	-	-	X					-	-	Moderate
Karoo Long-billed Lark	*Certhilauda subcoronata*	-	Endemic	X					-	-	Moderate
Black-eared Sparrowlark	*Eremopterix australis*	-	Endemic	X					-	-	Moderate
Chestnut-backed Sparrowlark	*Eremopterix leucotis*	-	-	X							
Grey-backed Sparrowlark	*Eremopterix verticalis*	-	Near-endemic	X					-	-	Moderate
Red-capped Lark	*Calandrella cinerea*	-	-	X					-	-	Moderate
Stark's Lark	*Spizocorys starki*	-	Endemic	X					-	-	Moderate

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Pink-billed Lark	*Spizocorys conirostris*	-	Near-endemic	X					-	-	Moderate
Sclater's Lark	*Spizocorys sclateri*	Near-threatened	Endemic	X					-	-	Moderate
Large-billed Lark	***Galerida magnirostris***	**-**	**Endemic**	**X**					**-**	**-**	**Moderate**
Short-toed Rock-Thrush	*Monticola brevipes*	-	Near-endemic			X			-	-	Moderate
Karoo Thrush	***Turdus smithi***	**-**	**Endemic**		**X**				**-**	**-**	**Moderate**
Chat Flycatcher	***Bradornis infuscatus***	**-**	**Near-endemic**	**X**					**-**	**-**	**Moderate**
Marico Flycatcher	*Bradornis mariquensis*	-	Near-endemic	X	X				-	-	Moderate
Fiscal Flycatcher	***Sigelus silens***	**-**	**Endemic**		**X**				**-**	**-**	**Moderate**
Cape Robin-Chat	***Cossypha caffra***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	-	Endemic	X	X				-	-	Moderate
Kalahari Scrub-Robin	*Cercotrichas paena*	-	Near-endemic	X	X				-	-	Moderate
Mountain Wheatear	***Oenanthe monticola***	**-**	**Near-endemic**	**X**		**X**			**-**	**-**	**Moderate**
Capped Wheatear	*Oenanthe pileata*	-	-	X					-	-	Moderate

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Sickle-winged Chat	*Cercomela sinuata*	-	Endemic	X					-	-	Moderate
Karoo Chat	*Cercomela schlegelii*	-	Near-endemic	X					-	-	Moderate
Tractrac Chat	*Cercomela tractrac*	-	Near-endemic	X					-	-	Moderate
Familiar Chat	***Cercomela familiaris***	**-**	**-**	**X**					**-**	**-**	**Moderate**
Ant-eating Chat	***Myrmecocichla formicivora***	**-**	**Endemic**	**X**					**-**	**-**	**Moderate**
African Stonechat	***Saxicola torquatus***	**-**	**-**	**X**					**-**	**-**	**Moderate**
Pale-winged Starling	***Onychognathus nabouroup***	**-**	**Near-endemic**			**X**		**X**	**-**	**-**	**Moderate**
Cape Glossy Starling	***Lamprotornis nitens***	**-**	**-**		**X**				**-**	**-**	**Moderate**
Pied Starling	***Spreo bicolor***	**-**	**Endemic**			**X**		**X**	**-**	**-**	**Moderate**
Wattled Starling	*Creatophora cinerea*	-	-	X	X			X	-	-	Moderate
Common Starling	*Sturnus vulgaris*	-	-		X	X			-	-	Moderate
Malachite Sunbird	*Nectarinia famosa*	-	-		X				-	-	Moderate
Dusky Sunbird	***Cinnyris fuscus***	**-**	**Near-endemic**	**X**	**X**				**-**	**-**	**Moderate**

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Southern Double-collared Sunbird	*Cinnyris chalybeus*	-	Endemic	X					-	-	Moderate
Scaly-feathered Finch	*Sporopipes squamifrons*	-	Near-endemic	X					-	-	Moderate
White-browed Sparrow-Weaver	***Plocepasser mahali***	**-**	**-**	**X**	**X**				**-**	**-**	**Moderate**
Sociable Weaver	***Philetairus socius***	**-**	**Endemic**	**X**	**X**				**-**	**-**	**Moderate**
Southern Masked-Weaver	***Ploceus velatus***	**-**	**-**		**X**		**X**		**-**	**-**	**Moderate**
Red-billed Quelea	*Quelea quelea*	-	-	X	X		X	X	-	-	Moderate
Southern Red Bishop	*Euplectes orix*	-	-				X		-	-	Moderate
African Quailfinch	*Ortygospiza atricollis*	-	-	X					-	-	Moderate
Red-headed Finch	*Amadina erythrocephala*	-	Near-endemic	X	X				-	-	Moderate
Black-faced Waxbill	*Estrilda erythronotos*	-	-		X				-	-	Moderate
Common Waxbill	***Estrilda astrild***	**-**	**-**				**X**		**-**	**-**	**Moderate**

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Violet-eared Waxbill	*Granatina granatina*	-	-	X	X				-	-	Moderate
Pin-tailed Whydah	*Vidua macroura*	-	-		X				-	-	Moderate
House Sparrow	*Passer domesticus*	-	-		X				-	-	Moderate
Cape Sparrow	***Passer melanurus***	**-**	**Near-endemic**	**X**	**X**				**-**	**-**	**Moderate**
Southern Grey-headed Sparrow	***Passer diffusus***	**-**	**-**	**X**	**X**				**-**	**-**	**Moderate**
Cape Wagtail	***Motacilla capensis***	**-**	**-**				**X**		**-**	**-**	**Moderate**
African Pied Wagtail	***Motacilla aguimp***	**-**	**-**				**X**		**-**	**-**	**Moderate**
African Pipit	***Anthus cinnamomeus***	**-**	**-**			**X**			**-**	**-**	**Moderate**
Long-billed Pipit	***Anthus similis***	**-**	**-**	**X**					**-**	**-**	**Moderate**
Black-headed Canary	*Serinus alario*	-	Endemic	X					-	-	Moderate
Black-throated Canary	*Crithagra atrogularis*	-	-	X					-	-	Moderate
Yellow Canary	*Crithagra flaviventris*	-	Near-endemic	X					-	-	Moderate

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White-throated Canary	***Crithagra albogularis***	**-**	**Near-endemic**	**X**					**-**	**-**	**Moderate**
Lark-like Bunting	***Emberiza impetuani***	**-**	**Near-endemic**	**X**					**-**	**-**	**Moderate**
Cape Bunting	*Emberiza capensis*	-	Near-endemic	X					-	-	Moderate