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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

Caledon Wind Farm EIA

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4.2 The specialist appointed in terms of the Regulations_

I, **Chris van Rooyen** , declare that --

General declaration:

- 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:

Chris van Rooyen Consulting
Name of company (if applicable):

27 October 2011
Date:

Chris van Rooyen Consulting

Arcus GIBB (PTY) LTD

Environmental Impact Assessment for the Establishment of the Caledon Wind Farm, Western Cape Province

Environmental Impact Report

Bird Impact Assessment Study

Date: November 2011

EXECUTIVE SUMMARY

Caledon Wind plans to construct a wind facility in Caledon in the Theewaterskloof Municipality in the Western Cape Province. The size of the Caledon Wind Farm is expected to be 256 MW and will comprise of approximately 74 wind turbines. It is anticipated that the turbines will have a hub height of 80 - 105 m and a turbine blade length 40 – 58.5 m, with a generating capacity of between 2 MW and 3.6 MW each.

The study site is located in the Overberg wheatbelt. The mosaic of wheat, barley and canola fields interspersed with pastures that comprises the area known as the Overberg Wheatbelt, is classified as an Important Bird Area (IBA) (Barnes 1998) – the study area falls marginally outside the formal IBA borders, but in similar habitat. The topography consists of low-lying coastal plains and consists primarily of cereal croplands. The following main habitat types have been identified in the study area:

- Natural vegetation (fynbos and Renosterveld)
- Cereal crops and pastures
- Wetlands and drainage lines
- Dams
- Exotic trees

The following criteria were applied to identify priority bird taxa that potentially might be affected by the proposed wind facility:

- Nationally threatened species, i.e. species listed in The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Barnes 2000).
- Taxa listed under provisions of relevant legislation that provide protection for particular categories of taxa whether nationally threatened or not. This includes international treaties.
- Taxa naturally occurring at low densities because of their ecological function high in the trophic order. This relates primarily to taxa like raptors that are top-order predators.
- Taxa that are of special cultural significance, for example the Blue Crane which is South Africa's national bird.
- Any other taxa that require to be considered for a particular site, such as species not included in the categories above but for which the site is especially significant e.g. range restricted species.

The principal areas of concern with regard to the potential impacts on birds are listed below:

- Collision mortality on the wind turbines
- Collision with the proposed power line
- Displacement due to disturbance
- Displacement caused by habitat transformation.

It is important to note that the assessment is made on the status quo as it is currently on site.

Collisions
Of the 54 priority species that could potentially occur at the Caledon Wind Farm site, 34 (63%) are associated with aquatic habitats. Wetlands and dams therefore constitute high risk habitat as far as potential collisions are concerned. **Determination of the actual use of these dams will require further surveys during the pre-construction period.**

The next largest group are soaring species, which constitute 20 (37%) out of the 54 priority species. The biggest collision risk for soaring species would be where turbines are situated against slopes, particularly southerly slopes. None of the turbines are currently situated on a south facing slope, but turbines 1-13 are situated on a ridge approximately 160m behind a southerly slope with natural vegetation, which places them in a marginal position. **Determination of the actual use of these slopes by soaring species will require further surveys during the pre-construction period.**

It is important to note that all the agricultural lands in the study area may be used for foraging purposes by Blue Cranes and Denham's Bustards. Short flights between foraging areas or foraging areas and roost sites will happen continuously, and specific flight paths cannot be predicted without on site surveys. **Due to the high priority ranking of these species, on site, pre-construction surveys are required from strategically placed observation points.**

Displacement due to disturbance and habitat destruction

There is a dearth of literature on the displacement effect of wind farm developments on key species assemblages in the study area, particularly cranes and bustards. Indications are that Great Bustard *Otis tarda* is displaced by wind farms within one kilometre of the facility. If this happens with Denham's Bustard (and Blue Cranes) in the current study area, it may have longer term habitat fragmentation impacts if the number of wind farms in the Overberg increases significantly. **The only reliable way of establishing whether the wind farm will lead to the displacement of priority species will be through the implementation of a monitoring programme, by comparing pre- and post construction densities of key species in the wind farm area.**

Turbine lighting

The consensus among researchers is to avoid lighting the turbines if possible, but that is against civil aviation regulations (Civil Aviation Regulations 1997). Furthermore, the potential for collisions with the wind turbines due to presence of lights is not envisaged to be significant, primarily because the phenomenon of mass nocturnal passerine migrations is not a feature of the study area. Post – construction monitoring (carcass searches) will be required to assess the extent (if any) of nocturnal fatalities that may be linked to the lighting on the turbines

Electricity transmission

A proposed 33 kV power line that will link the wind facility to the grid could pose a collision risk, irrespective of which alignment is used. In addition, the turbines will be linked to each other with underground reticulation cables.

Mitigation

Despite the fact that wind power has been a feature of the energy industry in the developed world for more than a decade, best practices with regard to bird mitigation are still far from clear and universally accepted. It must be accepted that appropriate best practices and mitigation measures with regard to impacts on birds in a South African context will take a number of years to crystallise, and a measure of trial and error will inevitably be part of the process.

The following site-specific mitigation measures are proposed for the turbines **at the Caledon Wind Farm**

- Ensuring that key areas of conservation importance and sensitivity are avoided: See Figure 2 for a map of the area, indicating the most sensitive areas from a priority species perspective. The current proposed lay-out of the wind turbines avoids most of the highly sensitive avifaunal habitat. However, the following turbines are situated in high risk areas: 10, 11, 19, 32, 34, 42, 44, 45, 46, 51, 63, 69, 71, and 72. It is recommended that they are relocated outside potential high risk areas.

- Implementing appropriate working practices to protect sensitive habitats: Habitat destruction should be limited to what is absolutely necessary for the construction of the infrastructure, including the construction of new roads.
- Providing adequate briefing for site personnel and in particularly sensitive locations. Personnel should be adequately briefed on the need to restrict habitat destruction, and must be restricted to the actual building sites.
- Implementing a pre- and post construction monitoring programme to establish potential and actual collision and displacement impacts on priority species. An appropriate monitoring programme should be designed and implemented under the guidance of a suitably qualified and experienced ornithological consultant, starting at least one year prior to the construction of the infrastructure.
- Based on the results of the monitoring, a policy of adaptive management should be implemented, which could include the halting of turbines during peak flight periods, or the relocation of problem turbines.
- It is recommended that red intermittent lights are used for the lighting of the turbines.
- Electricity cables between turbines should be placed underground.
- The 33kV transmission line should be marked with Bird Flight Diverters on the earthwire.

Environmental Impact Assessment for the Establishment of the Caledon Wind Farm, Western Cape Province

TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 Background

Caledon Wind plans to construct a wind facility in Caledon in the Theewaterskloof Municipality in the Western Cape Province. The size of the Caledon Wind Farm is expected to be 256 MW and will comprise of approximately 74 wind turbines. It is anticipated that the turbines will have a hub height of 80 - 100 m and a turbine blade length 40 – 58.5 m, with a generating capacity of between 2 MW and 3.6 MW each. Associated infrastructure includes the following:

- Internal access roads from the R43 to the operations area.
- Transmission line from a point on the proposed wind farm connecting to the national grid through the nearest existing transmission lines within the proposed study area.
- Underground cables to carry electricity from the turbines to the project sub-station, then to the existing overhead transmission lines within the project boundaries.
- Substation at the connection point to the existing transmission lines.
- Control center compound in an existing building in Caledon.

The wind farm will be integrated with the national transmission system via new transmission lines and a substation will be constructed at the point where the transmission lines will connect with the existing transmission lines.

The wind facility will span several properties, which are adjacent or connected to each other. Chapter 3 of the Environmental Impact Report provides a detailed description of the project infrastructure.

Chapter 5 of the National Environmental Management Act (NEMA) (Act 107 of 1998) requires that an Environmental Impact Assessment (EIA) is conducted for the proposed development. Arcus Gibb was appointed by the proponent as independent impact assessment consultants to manage the EIA process. They in turn appointed Chris van Rooyen Consulting to investigate the potential impacts that the proposed facility could have on birds. This impact assessment report follows on from a bird impact scoping report which was completed in November 2009.

1.2 Scope and Limitations

The terms of reference for this bird impact assessment report are as follows:

- description of existing environment, bird communities and micro habitats;
- description of potential impacts;
- indication of confidence levels and gaps in baseline data;
- assessment of the potential impacts;
- recommendations for mitigation of potential impacts.

The following limitations need to be pointed out:

This study made the basic assumption that the sources of information used are reliable. However, it must be noted that there are factors may potentially detract from the accuracy of the predicted results.

- The Southern African Bird Atlas (SABAP1) data covers the period 1986 -1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting substrate. There are sources of error in the SABAP1 database, particularly inadequate coverage of some quarter degree grid cells (QDGCs). This means that the reporting rates of species may not be an accurate reflection of the true densities in QDGCs that were sparsely covered during the data collecting period (for a full discussion of potential inaccuracies in SABAP1 data, see Harrison *et al*. 1997). In this instance, the relevant QDGCs were not equally well covered with 316 checklists completed for 3419AA and 174 for 3419AB.
- The SABAP data was supplemented with SABAP2 data for the relevant QDGCs, although these QDGCs were also not equally well covered. In the case of 3419AA, 116 checklists have been completed to date, and 46 checklists have been completed for 3419AB.
- Little detailed, verified information on micro-habitat level was available of bird occurrence, densities and movements, therefore most conclusions are based on secondary sources, as systematic data capturing of flight patterns has not yet taken place at the site. With certain classes of birds, particularly cranes and bustards, very little research has been conducted on potential impacts with wind facilities worldwide. The only primary observations were those conducted during the site visits, and these observations were not detailed enough to establish actual flight patterns, which should happen as part of dedicated pre-construction site specific avifaunal survey. The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and among other international treaties and declarations is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the Rio Declaration 1992 states that: “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, **lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.”**
- Few peer-reviewed scientific papers are available on the impacts wind farms have on birds. Many studies lack before and after comparisons, or wind farm area and reference area comparisons, or do not offer any assessment whatsoever of relevant factors such as collision risk and differences in bird behaviour between night and day, or are of inadequate duration to provide conclusive results (Langston & Pullen 2003). It is therefore inevitable that given the inconclusive and sometimes contradictory scientific evidence on the nature and extent of the impacts caused by wind farms, and the lack of any research on this topic in South Africa, an element of speculation will enter the conclusions in this report. It is strongly recommended that the predictions made in this study should therefore be verified through a dedicated post-construction monitoring programme to establish actual collision and displacement risk.

1.3 Methodology

The following data sources were consulted for purposes of the study:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP1) was obtained from the Animal Demography Unit of the University of Cape Town. A data set was obtained for each of the two quarter degree grid cells (QDGCs) within which the development will take place, namely 3419AA and 3419AB. A QDGC corresponds to the area shown on a 1:50 000 map (15' x 15') and is approximately 27 km long (north-south) and 23 km wide (east-west).
- The SABAP data was supplemented with SABAP2 data for the relevant QDGCs. This data is much more recent, as SABAP2 was only launched in May 2007, and should therefore be more accurate. For SABAP, QDGCs were the geographical sampling units. For SABAP2 the sampling unit has been reduced to pentad grid cells (or pentads); these cover 5 minutes of latitude by 5 minutes of longitude (5. × 5.). Each pentad is approximately 8 × 7.6 km. This finer scale has been selected for SABAP2 to obtain more detailed information on the occurrence of species and to give a clearer and better understanding of bird distributions. There are nine pentads in a QDGC.
- Information on large terrestrial avifauna and habitat use was obtained from the Coordinated Avifaunal Roadcounts (CAR) project of the Animal Demographic Unit (ADU) of the University of Cape Town.
- The national conservation status of all bird species occurring in the aforementioned QDGCs was determined with the use of Eskom Priority Book of Birds of South Africa, Lesotho and Swaziland (Barnes 2000).
- A classification of the vegetation types from an avifaunal perspective in the QDGCs was obtained from SABAP1.
- Detailed satellite imagery from Google Earth (imagery date 2009) was used in order to view the study area on a landscape level and to help identify bird habitat on the ground.
- An extensive review of relevant international literature on birds and wind farm impacts was conducted, which is referenced in Section 6 of this report.
- Information on the micro habitat level was obtained through a reconnaissance site visit in November 2009. An attempt was made investigate the total study area as far as was practically possible, and to visit potential sensitive areas identified from Google Earth imagery.
- Interviews were conducted with Hennie Lötter, one of the landowners at the proposed wind facility, with regard to the birds that breed and forage on his property.
- Telephonic interviews with regard to Blue Crane flight and foraging patterns in the Overberg were conducted with Kevin Shaw (ornithologist, Cape Nature), Kevin McCann (ex-chairman of the South African Crane Working Group), and Bronwyn Botha (ex-field worker of the Overberg Crane Working Group).
- A telephonic interview was conducted with Dr. Anton Odendal of BirdLife Overberg.
- An interview was conducted with Mick D'Alton, chairman of the Overberg Crane Group (OCG).
- Technical details of the planned wind facility infrastructure were obtained from Arcus Gibb.

1.3.1 Study Area Sensitivity Analysis

In the tables below, the habitat in the study area was categorized in terms of the potential for an impact to occur. Emphasis was placed on priority species (see Table 1.5).

Table 1.1: Impact: Displacement due to disturbance and habitat transformation

	Description
Lower Sensitivity	Exotic trees, homesteads, roads
Medium Sensitivity	Natural vegetation
Higher Sensitivity	Agricultural areas, wetlands, drainage lines and dams

Table 1.2: Impact: Collisions with the turbines

	Description
Lower Sensitivity	Exotic trees, homesteads, roads
Medium Sensitivity	Agricultural areas
Higher Sensitivity	Natural vegetation on steeper south facing slopes, wetlands, drainage lines and dams

Table 1.3: Impact: Collisions with the power line

	Description
Lower Sensitivity	Exotic trees, homesteads, roads
Medium Sensitivity	Natural vegetation
Higher Sensitivity	Agricultural areas, wetlands, drainage lines and dams

Table 1.4: Combined Sensitivity analysis: All impacts

	Description
Lower Sensitivity	Exotic trees, homesteads, roads
Medium Sensitivity	Agricultural areas, natural vegetation
Higher Sensitivity	Wetlands, drainage lines, dams and steeper south facing slopes with natural vegetation

2 DESCRIPTION OF THE RECEIVING ENVIRONMENT

2.1 General Study Area

2.1.1 Bird habitat in the study area

The study area is located near the town of Caledon in the Theewaterskloof Municipality in the Western Cape. It comprises an area which overlaps with two QDGCs (i.e. 1:50 000 maps), and comprises 15 farm portions, with an overall surface area of about 3750 hectares..

The study site is located in the Overberg wheatbelt. The mosaic of wheat, barley and canola fields interspersed with pastures that comprises the area known as the Overberg Wheatbelt, is classified as an Important Bird Area (IBA) (Barnes 1998) – the study area falls marginally outside the formal IBA borders, but in similar habitat. This large agricultural district stretches from Caledon to Riversdale and encompasses the area south of these two towns, running between the coastal towns of Hermanus and Stilbaai (see Figure 1). The topography consists of low-lying coastal plains and consists primarily of cereal croplands.

Figure 1: Location of the study area relative to the Overberg Wheatbelt IBA.

It is widely accepted that vegetation structure is more critical in determining bird habitat, than the actual plant species composition (Harrison *et al* 1997). The description of vegetation presented in this report therefore concentrates on factors relevant to the bird species present, and is not an exhaustive list of plant species present. The description of the vegetation types occurring in the study area makes extensive use of information presented SABAP1 (Harrison *et al* 1997). The criteria used by the SABAP1 authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. The natural vegetation in the QDGCs where the proposed wind facility is located is classified as **fynbos** vegetation (Harrison *et al* 1997).

Fynbos is dominated by low shrubs and can be divided into two categories, fynbos proper and Renosterveld. Despite having a high diversity of plant species, fynbos and Renosterveld has a relatively low diversity of bird species. The only priority species that are closely associated with natural vegetation in this study area, is the Black Harrier *Circus maurus* (Harrison *et al* 1997) and the Denham's Bustard *Neotis denhami*, (Harrison *et al* 1997, H. Lötter pers.com). Other priority species that sometimes use this habitat are Secretarybirds *Sagittarius serpentarius* which are sometimes found in fynbos and Renosterveld (pers. obs.), while Martial Eagles *Polemaetus bellicosus* on occasion forage in this habitat. **The proposed Caledon Wind Farm is primarily situated in an area of primarily agricultural activity (approximately 64% of the study area), but there are large areas of natural vegetation remaining, particularly against steeper slopes, ridges and in drainage lines.**

Much of the fynbos and Renosterveld in the Overberg Wheatbelt have been transformed for agriculture. Whilst this obviously resulted in substantial natural habitat being destroyed, several species have in fact adapted well to this transformation. One such species, which is highly relevant to this study, is the Blue Crane *Anthropoides paradiseus*. This species has thrived on the grain lands and pastures in the southern and western Cape. This will be further discussed when the micro-habitats are discussed below.

In addition to natural vegetation, the following bird micro-habitats are present on the site of the proposed development site:

2.1.2 Cereal crops and pastures

The natural vegetation at the study area at Caledon Wind Farm is surrounded by a typical mosaic of grain fields interspersed with pastures. It is of specific importance to the endemic, Blue Crane, as well as the Denham's Bustard (*Ardeotis denhamii*).

The Overberg holds the largest population of Blue Cranes in the world. At times the Overberg can hold nearly 20% of this species' global population, as well as containing large numbers of Denham's Bustard and White Stork *Ciconia ciconia* during the summer (Barnes 1998). The Blue Crane has relatively recently expanded its range into the Overberg, where it feeds on *inter alia* fallen grain and recently germinated crops. They also feed on supplementary food put out for small stock, and can congregate in huge numbers around these feed lots. The Blue Cranes favour agricultural areas above natural vegetation. During the reconnaissance site visits at Caledon Wind Farm, several small groups of Blue Cranes were recorded in cereal crops and pastures on and immediately adjacent to the proposed outer perimeter of the Caledon Wind Farm site.

The Black Harrier is also found frequently in the modified agricultural matrix of the Overberg region, where several pairs breed (Barnes 1998), although it prefers the natural vegetation in between the cereal crops. Secretarybirds are also present as well as (possibly) some karroid birds such as the endemic Karoo Korhaan *Eupodotis vigorsii* (Barnes 1998, Young 2003).

2.1.3 Drainage lines and wetlands

The Overberg Wheatbelt contains many drainage lines and associated wetlands, some of which are sometimes used as roosting areas for Blue Cranes (and White Storks *Ciconia ciconia*), as well as for foraging and breeding African Marsh-Harrier *Circus ranivorus*. wetlands are also important for several other priority species such as Egyptian Goose *Alopochen aegyptiacus*, White Stork and Spur-winged Goose *Plectropterus gambensis*. The Black Stork *Ciconia nigra* could also visit some wetlands. The proposed development site contains several drainage lines and associated wetlands. The short trees that line some of the drainage lines are also important for Secretarybird *Sagittarius serpentarius,* which use these trees for roosting and breeding purposes (pers. obs.).

2.1.4 Dams

The study area contains many dams, some of which could be important roosting areas for Blue Cranes. Blue Cranes tend to roost in dams at night, probably as a protective measure against predators. Cranes also require water for drinking and typically take nestlings to water within 24 hours of hatching (Bidwell 2004), and prefer nest sites close to dams. Apart from cranes, agricultural dams are also important for several other priority species such as Egyptian Goose *Alopochen aegyptiacus*, White Stork and Spur-winged Goose *Plectropterus gambensis*. The Black Stork could also visit dams in the study area.

2.1.5 Other habitats

Other micro-habitats within and immediately adjacent to the proposed site, which are important for a number of priority raptor species, are stands of Eucalyptus. Stands of exotic Eucalyptus do create attractive habitat for priority species such as Black Sparrowhawk *Accipiter melanoleucus*, Rufous-chested Sparrowhawk *Accipiter rufiventris* and Jackal Buzzard *Buteo rufofuscus*.

2.1.6 Avifauna in the study area

The following criteria were applied to identify priority bird taxa that potentially might be affected by the proposed wind facility:

- Nationally threatened species, i.e. species listed in The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Barnes 2000).
- Taxa listed under provisions of relevant legislation that provide protection for particular categories of taxa whether nationally threatened or not. This includes international treaties. From an international perspective, the Convention on Biological Diversity (CBD) (1992) to which South Africa is a signatory, is applicable. The overall objective of the Convention is the "…conservation of biological diversity, [and] the sustainable use of its components and the fair and equitable sharing of the benefits …". Another international convention which is applicable in this case is the Convention on the Conservation of Migratory Species of Wild Animals (http://www.unep-aewa.org). This Convention, commonly referred to as the Bonn Convention, (after the German city where it was concluded in 1979), came into force in 1983. This Convention's goal is to provide conservation for migratory terrestrial, marine and avian species throughout their entire range. This is very important, because failure to conserve these species at any particular stage of their life cycle could adversely affect any conservation efforts elsewhere. The fundamental principle of the Bonn Convention, therefore, is that the Parties to the Bonn Convention acknowledge the importance of migratory species being conserved and of Range

States agreeing to take action to this end whenever possible and appropriate, paying special attention to those migratory species whose conservation status is unfavourable, and individually, or in co-operation taking appropriate and necessary steps to conserve such species and their habitat. Parties acknowledge the need to take action to avoid any migratory species becoming endangered. Agreements are the primary tools for the implementation of the main goal of the Bonn Convention. Moreover, they are more specific than the Convention itself, more deliberately involve the Range States of the species to be conserved, and are easier to implement than the Bonn Convention itself. One such agreement is the African-Eurasian Waterbird Agreement (AEWA), which is an international agreement aimed at the conservation of migratory waterbirds.

- Taxa naturally occurring at low densities because of their ecological function high in the trophic order. This relates primarily to taxa like raptors that are top-order predators.
- Taxa that are of special cultural significance, for example the Blue Crane which is South Africa's national bird (http://www.info.gov.za/aboutgovt/symbols/bird.htm).
- Any other taxa that require to be considered for a particular site, such as species not included in the categories above but for which the site is especially significant e.g. range restricted species.

Table 1.5 below shows the list of priority species that have been recorded in the QDGCs overlapping with the study area, namely 3419AA and 3419AB. The criteria listed above have been used in establishing the list of priority species. **Only species that are likely to occur on site (to be confirmed by pre-construction surveys) based on the identification of habitat during the reconnaissance site visit have been included.**

The following abbreviations and acronyms are used to indicate conservation significance:
VU = Nationally vulnerable (Barnes 2000)
NT = Nationally near threatened (Barnes 2000)
AEWA = Listed in Annexure 2 of the African-Eurasian Waterbird Agreement
Ra = Raptor
SS = Special regional significance
CS = Cultural significance

Table 1.5: Priority species recorded in 3419AA and 3419AB QDGCs (Harrison *et al* 1997; http://sabap2.adu.org.za, Young et.al. 2003, Young 2008, Young 2009a, Young 2009b, Young 2010; pers. obs).

Common Name	**Scientific Name**	**Conservation Status (Barnes 2000)**	**Likelihood of occurrence at the wind farm site**	**Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)**
Black Stork	*Ciconia nigra*	NT, AEWA	Medium	Cliffs for roosting and breeding, and rivers and dams for foraging.
Secretarybird	*Sagittarius serpentarius*	NT, Ra	High	Grassland, old lands, open woodland. Most likely to be

				encountered in fynbos, pastures and old agricultural areas.
African Marsh-Harrier	*Circus ranivorus*	VU, Ra	Medium	Large permanent wetlands with dense reed beds. Sometimes forages over smaller wetlands and grassland. Could be foraging at wetlands associated with dams in the study area.
Black Harrier	*Circus maurus*	NT, Ra	High	Highest expected densities in remnant patches of fynbos.
Peregrine Falcon	*Falco peregrinus*	NT, Ra	Low	A wide range of habitats, but cliffs (or tall buildings) are a prerequisite for breeding. May hunt over old agricultural areas. Immature birds are most likely to be encountered foraging over farm land.
Lanner Falcon	*Falco biarmicus*	NT, Ra	High	Generally prefers open habitat, but exploits a wide range of habitats. May hunt over old agricultural areas.
Lesser Kestrel	*Falco naumanni*	VU, Ra	High	Summer migrant most likely to be encountered hunting over agricultural areas.
Blue Crane	*Anthropoides paradiseus*	VU, CS	High	Cereal crops, old lands, pastures, wetlands, dams and pans for roosting. Recorded in pastures and wheat fields in the study area during the site visit.
Denham's Bustard	*Neotis denhami*	VU	High	Cereal crops, fynbos and pastures.
Aghulhas Long-billed Lark	*Certhilauda brevirostris*	NT, SS	Medium	Fallow and recently ploughed fields, sparse shrubland

				dominated by Renosterveld.
Little Grebe	*Tachybaptus ruficollis*	AEWA	High	Any of the larger water bodies.
Little Egret	*Egretta garzetta*	AEWA	High	Any of the water bodies and drainage lines.
Grey Heron	*Ardea cinerea*	AEWA	High	Any of the larger water bodies and drainage lines.
Purple Heron	*Ardea purpurea*	AEWA	Low	Mostly in thick vegetation along drainage lines.
Black-headed Heron	*Ardea melanocephala*	AEWA	High	Lands, edges of fynbos, drainage lines and water bodies.
Great Egret	*Egretta alba*	AEWA	Low	Any of the larger water bodies and drainage lines.
Cattle Egret	*Bubulcus ibis*	AEWA	High	Lands, drainage lines and water bodies.
Black-crowned Night-Heron	*Nycticorax nycticorax*	AEWA	Low	Mostly in thick vegetation along drainage lines.
Little Bittern	*Ixobrychus minutus*	AEWA	Low	Mostly in thick vegetation along drainage lines.
White Stork	*Ciconia ciconia*	AEWA	High	Agricultural lands and water bodies.
African Sacred Ibis	*Threskiornis aethiopicus*	AEWA	High	Margins of wetlands, dams, cultivated fields.
African Spoonbill	*Platalea alba*	AEWA	High	Any of the larger water bodies and drainage lines.
Egyptian Goose	*Alopochen aegyptiacus*	AEWA	High	Lands, drainage lines and water bodies.
South African Shelduck	*Tadorna cana*	AEWA	Medium	Any of the water bodies
Yellow-billed Duck	*Anas undulata*	AEWA	High	Any of the water bodies
Cape Teal	*Anas capensis*	AEWA	Medium	Drainage lines and water bodies.
Spur-winged Goose	*Plectropterus gambensis*	AEWA	High	Lands, drainage lines and water bodies.
Red-billed Teal	*Anas erythrorhyncha*	AEWA	Medium	Drainage lines and water bodies.
Southern Pochard	*Netta erythrophthalma*	AEWA	Low	Any of the water bodies
Cape Shoveler	*Anas smithii*	AEWA	Medium	Drainage lines and water bodies.
Red-knobbed Coot	*Fulica cristata*	AEWA	High	Any of the water bodies.
Common	*Gallinula*	AEWA	High	Any of the water

Moorhen	*chloropus*			bodies.
African Rail	*Rallus caerulescens*	AEWA	Low	Mostly in thick vegetation along drainage lines.
Black Crake	*Amaurornis flavirostris*	AEWA	Low	Mostly in thick vegetation along drainage lines.
Black-winged Stilt	*Himantopus himantopus*	AEWA	Low	Any of the water bodies.
Kittlitz's Plover	*Charadrius pecuarius*	AEWA	Low	Margins of water bodies.
Crowned Lapwing	*Vanellus coronatus*	AEWA	High	Bare lands
Three-banded Plover	*Charadrius tricollaris*	AEWA	High	Open shorelines at a wide range of water bodies.
Common Sandpiper	*Actitis hypoleucos*	AEWA	Medium	Drainage lines and water bodies.
Common Greenshank	*Tringa nebularia*	AEWA	Medium	Drainage lines and water bodies.
Black-shouldered Kite	*Elanus caeruleus*	Ra	High	Fynbos and agricultural areas.
Booted Eagle	*Aquila pennatus*	Ra	Medium	Wide variety of habitats. Ridges important for slope soaring.
African Fish-Eagle	*Haliaeetus vocifer*	Ra	Medium	Any of the water bodies
Steppe Buzzard	*Buteo vulpinus*	Ra	High	Agricultural areas. Ridges important for slope soaring.
Jackal Buzzard	*Buteo rufofuscus*	Ra	High	Wide variety of habitats, mostly near rocky outcrops. Ridges important for slope soaring.
Black Sparrowhawk	*Accipiter melanoleucus*	Ra	Medium	Alien plantations.
African Goshawk	*Accipiter tachiro*	Ra	Low.	Alien plantations.
African Harrier-Hawk	*Polyboroides typus*	Ra	Low	Alien plantations and in natural vegetation along drainage lines.
Osprey	*Pandion haliaetus*	Ra	Low	Any of the water bodies
Rock Kestrel	*Falco rupicolus*	Ra	High	Wide variety of habitats, mostly near rocky outcrops. Ridges important for slope

				soaring.
Rufous-chested Sparrowhawk	*Accipiter rufiventris*	Ra	Low	Alien plantations.
Spotted Eagle-Owl	*Bubo africanus*	Ra	High	Wide range of habitats, but mostly in fynbos and in alien stands of trees.
Marsh Sandpiper	*Tringa stagnatilis*	AEWA	Medium	Mostly freshwater bodies, also along the coast.
Wood Sandpiper	*Tringa glareola*	AEWA	Medium	Wide range of inland freshwater habitats.

3 IMPACTS AND ISSUES IDENTIFICATION

To be effective, wind farms must be sited in open, exposed areas experiencing high average wind speeds. This means that they are often proposed in higher lying, coastal and offshore areas, thus potentially affecting important habitats for breeding, wintering and migrating birds. The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact with each other, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision).

- Collision mortality on the wind turbines
- Collision with the proposed power line
- Displacement due to disturbance
- Displacement caused by habitat transformation.

It is important to note that the assessment is made on the status quo as it is currently on site. The possible change in land use in the area where the wind farm is situated is not taken into account because the extent and nature of future developments are unknown at this stage. It is however highly unlikely that the land use will change in the foreseeable future.

3.1 256 MW Wind facility

3.1.1 Collision mortality on wind turbines

Internationally, it is widely accepted that bird mortalities from collisions with wind turbines contribute a relatively small proportion of the total mortality from all causes.
The US National Wind Coordinating Committee (NWCC) conducted a comparison of wind farm bird mortality with that caused by other man-made structures in the USA (Anon. (b) 2000). The NWCC did not conduct its own study, but analyzed all of the research done to date on various causes of avian mortality, including commercial wind farm turbines. It reports that "data collected outside California indicate an average of 1.83 avian fatalities per turbine (for all species combined), and 0.006 raptor fatalities per turbine per year. Based on current projections of 3,500 operational wind turbines in the US by the end of 2001, excluding California, the total annual mortality was estimated at approximately 6,400 bird fatalities per year for all species combined". The NWCC report states that its intent is to "put avian mortality associated with windpower development into perspective with other significant sources of avian collision mortality across the United States". It further reports that: "Based on current estimates, windplant related avian collision fatalities probably represent from 0.01% to 0.02% (i.e. 1 out of every 5,000 to 10,000) of the annual avian collision fatalities in the United States". That is, commercial wind turbines cause the direct deaths of only 0.01% to 0.02% of all of the birds killed by collisions with man-made structures and activities in the USA.

Also in the USA, a Western EcoSystems Technology Inc. study found a range of between 100 million to 1 billion bird fatalities due to collisions with artificial structures such as vehicles, buildings and windows, power lines and communication towers, in comparison to 33,000 fatalities attributed to wind turbines. The study (see Anon. (a) 2003) reports that "windplant-related avian collision fatalities probably represent from 0.01% to 0.02% (i.e. one out of every 5,000 to 10,000 avian fatalities) of the annual avian collision fatalities in the United States, while some may perceive this level of mortality as small, all efforts to reduce avian mortality are important". A Finnish study reported 10 bird fatalities from turbines, and 820,000 birds killed annually from colliding with other structures such as buildings, electricity pylons and lines, telephone and television masts, lighthouses and floodlights (Anon. (a) 2003).

The majority of studies on collisions caused by wind turbines have recorded relatively low mortality levels (Madders & Whitfield 2006). This is perhaps largely a reflection of the fact that many of the studied wind farms are located away from large concentrations of birds. It is also important to note that many records are based only on finding corpses, with no correction for corpses that are overlooked or removed by scavengers (Drewitt & Langston in *Ibis* 2006).

Relatively high collision mortality rates have been recorded at several large, poorly sited wind farms in areas where large concentrations of birds are present (including Important Bird Areas (IBAs)), especially among migrating birds, large raptors or other large soaring species, e.g. in the Altamont Pass in California, USA, and in Tarifa and Navarra in Spain. In these cases actual deaths resulting from collision are high, notably of Golden Eagle *Aquila chrysaetos* and Eurasian Griffon *Gyps fulvus*, respectively.

In a study in Spain, it was found that the distribution of collisions with wind turbines was clearly associated with the frequencies at which soaring birds flew close to rotating blades (Barrios & Rodriguez 2004). Patterns of risky flights and mortality included a temporal component (deaths concentrated in some seasons), a spatial component (deaths aggregated in space), a taxonomic component (a few species suffered most losses), and a migration component (resident populations were more vulnerable). Clearly, the risk is likely to be greater on or near areas regularly used by large numbers of feeding or roosting birds, or on migratory flyways or local flight paths, especially where these are intercepted by the turbines. Risk also changes with weather conditions, with evidence from some studies showing that more birds collide with structures when visibility is poor due to fog or rain, although this effect may to some extent be offset by lower levels of flight activity in such conditions (Madders & Whitfield 2005). Strong headwinds also affect collision rates and migrating birds in particular tend to fly lower when flying into the wind (Drewitt & Langston 2006). The same applies for Blue Cranes flying between roosting and foraging areas (pers. obs.).

Accepting that many wind farms may only cause low levels of mortality, even these levels of additional mortality may be significant for long-lived species with low productivity and slow maturation rates (e.g. Blue Crane, Denham's Bustard, Martial Eagle and Secretarybird), especially when rarer species of conservation concern are affected. In such cases there could be significant effects at the population level (locally, regionally or, in the case of rare and restricted species, nationally), particularly in situations where cumulative mortality takes place as a result of multiple installations (Carette *et. al.* 2009).

Large birds with poor manoeuvrability (such as cranes, bustards and secretarybirds) are generally at greater risk of collision with structures, and species that habitually fly at dawn and dusk or at night are perhaps less likely to detect and avoid turbines (e.g. cranes arriving at a roost site after sunset, or flamingos flying at night). Collision risk may also vary for a particular species, depending on age, behaviour and stage of annual cycle (Drewitt & Langston 2006). While the flight characteristics of cranes, flamingos and bustards make them obvious candidates for collisions with power lines, it is noted that these classes of birds (unlike raptors) do not feature prominently in literature as wind turbine collision victims. It may be that they avoid wind farms entirely, resulting in lower collision risks (see the discussion on Displacement in section 3.1.2 below). However, this can only be verified through on-site post-construction monitoring.

The precise location of a wind farm site can be critical. Soaring species may use particular topographic features for lift (Barrios & Rodriguez 2004; De Lucas *et. al.* 2008) or such features can result in large numbers of birds being funnelled through an area of turbines (Drewitt & Langston 2006). For example, absence of thermals on cold, overcast days may force larger, soaring species (e.g. Martial Eagle and Secretarybird) to use slopes for lift, which may increase their exposure to turbines. Birds also lower their flight height in some locations, for example when following the coastline or crossing a ridge, which might place them at greater risk of collision with rotors.

The size and alignment of turbines and rotor speed are likely to influence collision risk; however, physical structure is probably only significant in combination with other factors, especially wind speed, with gentle winds resulting in the highest risk (Barrios & Rodriguez 2004; Stewart *et. al.* 2007). Lattice towers are generally regarded as more dangerous than tubular towers because many raptors use them for perching and occasionally for nesting; however Barrios & Rodriguez (2004) found tower structure to have no effect on mortality, and that mortality may be directly related to abundance for certain species (e.g. Common Kestrel *Falco tinnunculus*). De Lucas *et. al.* (2008) found that turbine height and higher elevations may heighten the risk (taller/higher = higher risk), but that abundance was not directly related to collision risk, at least for Eurasian Griffon Vulture *Gyps fulvus*.

A review of the available literature indicates that, where collisions have been recorded, the rates per turbine are highly variable with averages ranging from 0.01 to 23 bird collisions annually (the highest figure is the value, following correction for scavenger removal, for a coastal site in Belgium and relates to gulls, terns and ducks among other species) (Drewitt & Langston 2006). Although providing a helpful and standardised indication of collision rates, average rates per turbine must be viewed with some caution as they are often cited without variance and can mask significantly higher rates for individual turbines or groups of turbines (Everaert *et. al.* 2001 as cited by Drewitt & Langston 2006).

Some of the highest mortality levels have been for raptors in the Altamont Pass in California (Howell & DiDonato 1991, Orloff & Flannery 1992 as cited by Drewitt & Langston 2006) and at Tarifa and Navarre in Spain (Barrios & Rodriguez unpublished data as cited by Drewitt & Langston 2006). These cases are of particular concern because they affect relatively rare and long-lived species such as Griffon Vulture *Gyps fulvus* and Golden Eagle *Aquila chrysaetos* that have low reproductive rates and are vulnerable to additive mortality. Golden Eagles congregate in Altamont Pass to feed on super-abundant prey which supports very high densities of breeding birds. In the Spanish cases, extensive wind farms were built in topographical bottlenecks where large numbers of migrating and local birds fly through a relatively confined area due to the nature of the surrounding landscape, for example through mountain passes, or use rising winds to gain lift over ridges (Barrios & Rodriguez 2004). Although the average numbers of annual fatalities per turbine (ranging from 0.02 to 0.15 collisions/turbine) were generally low in the Altamont Pass and at Tarifa, overall collision rates were high because of the large numbers of turbines involved (over 7 000 in the case of Altamont). At Navarre, corrected annual estimates ranging from 3.6 to 64.3 mortalities/turbine were obtained for birds and bats (unpublished data). Thus, a minimum of 75 Golden Eagles are killed annually in Altamont and over 400 Griffon Vultures are estimated (following the application of correction factors) to have collided with turbines at Navarre. Work on Golden Eagles in the Altamont Pass indicated that the population was declining in this area thought to be due, at least in part, to collision mortality (Hunt *et. al.* 1999, Hunt 2001 as cited by Drewitt & Langston 2006).

Of the 54 priority species that could potentially occur at the Caledon Wind Farm site, 34 (63%) are associated with aquatic habitats. Dams therefore constitute high risk habitat as far as potential collisions are concerned. **Determination of the actual use of these dams will require further surveys during the pre-construction period.**

The next largest group are soaring species, which constitute 20 (37%) out of the 54 priority species. The biggest collision risk for soaring species would be where turbines are situated against slopes, particularly southerly slopes. Several of the priority species identified as potentially occurring at the sites fall in this category, especially raptors, but also storks and occasionally Blue Cranes. These species could use wind currents on slopes for lift. The dominant wind directions in the Overberg are south-east in summer and south-west in winter (Mintoff pers. comm.). It follows therefore that turbines situated against the southern facing slopes are likely to hold the biggest risk of collision for soaring species, as the majority of usable slope associated wind currents should be on the southerly slopes. None of the turbines are currently situated on a south facing slope, but turbines 1-13 are situated on a ridge approximately 160m behind a southerly slope with natural vegetation, which places them in a marginal position. **Determination of the actual use of these slopes by soaring species will require further surveys during the pre-construction period.**

It is important to note that all the agricultural lands in the study area may be used for foraging purposes by Blue Cranes and Denham's Bustards. Short flights between foraging areas or foraging areas and roost sites will happen continuously, and specific flight paths cannot be predicted without on site surveys. **Due to the high priority ranking of these species, on site, pre-construction surveys are required from strategically placed observation points.**

3.1.2 Displacement due to disturbance

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance effectively can amount to habitat loss. Displacement may occur during both the construction and operational phases of wind farms, and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before-and-after and control-impact (BACI) assessments. Onshore, disturbance distances (in other words the distance from wind farms up to which birds are absent or less abundant than expected) up to 800 m (including zero) have been recorded for wintering waterfowl (Pedersen & Poulsen 1991 as cited by Drewitt & Langston 2006), **though 600 m is widely accepted as the maximum reliably recorded distance (Drewitt & Langston 2006).** The variability of displacement distances is illustrated by one study which found lower post-construction densities of feeding European White-fronted Geese *Anser albifrons* within 600 m of the turbines at a wind farm in Rheiderland, Germany (Kruckenberg & Jaene 1999 as cited by Drewitt & Langston 2006), while another showed displacement of Pink-footed Geese *Anser brachyrhynchus* up to only 100–200 m from turbines at a wind farm in Denmark (Larsen & Madsen 2000 as cited by Drewitt & Langston 2006). Indications are that Great Bustard *Otis tarda* (a species related to the Denham's Bustard) are displaced by wind farms within one kilometre of the facility (Langgemach 2008).

Studies of breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80 m of the turbines, indicating that displacement did occur at least in this case. The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. In the absence of any reliable information on the effects of displacement on birds, it is precautionary to assume that significant displacement will lead to a population reduction (Drewitt & Langston 2006).

Studies show that the scale of disturbance caused by wind farms varies greatly. This variation is likely to depend on a wide range of factors including seasonal and diurnal patterns of use by birds, location with respect to important habitats, availability of alternative habitats and perhaps also turbine and wind farm specifications. Behavioural responses vary not only between different species, but between individuals of the same species, depending on such factors as stage of life cycle (wintering, moulting, breeding), flock size and degree of habituation. The possibility that wintering birds in particular might habituate to the presence of turbines has been raised (Langston & Pullin 2003), though it is acknowledged that there is little evidence and few studies of long enough duration to show this, and at least one study has found that habituation may not happen (Altamont Pass Avian Monitoring Team 2008) . A recent systematic review of the effects of wind turbines on bird abundance has shown that increasing time since operation resulted in greater declines in bird abundance (Stewart *et al*. 2004 as cited by Drewitt & Langston 2006). This evidence that impacts are likely to persist or worsen with time suggests that habituation is unlikely, at least in some cases (Drewitt & Langston 2006, Altamont Pass Avian Monitoring Team 2008).

The effect of birds altering their migration flyways or local flight paths to avoid a wind farm is also a form of displacement. This effect is of concern because of the possibility of increased energy expenditure when birds have to fly further, as a result of avoiding a large array of turbines, and the potential disruption of linkages between distant feeding, roosting, moulting and breeding areas otherwise unaffected by the wind farm. The effect depends on species, type of bird movement, flight height, distance to turbines, the layout and operational status of turbines, time of day and wind force and direction, and can be highly variable, ranging from a slight 'check' in flight direction, height or speed, through to significant diversions which may reduce the numbers of birds using areas beyond the wind farm (Drewitt & Langston 2006).

A review of the literature suggests that none of the barrier effects identified so far have significant impacts on populations (Drewitt & Langston 2006). However, there are circumstances where the barrier effect might lead indirectly to population level impacts; for example where a wind farm effectively blocks a regularly used flight line between nesting and foraging areas, or where several wind farms interact cumulatively to create an extensive barrier which could lead to diversions of many tens of kilometres, thereby incurring increased energy costs.

There is a dearth of literature on the displacement effect of wind farm developments on key species assemblages in the study area, particularly cranes and bustards. As mentioned above, indications are that Great Bustard *Otis tarda* is displaced by wind farms within one kilometre of the facility (Langgemach 2008). If this happens with Denham's Bustard (and Blue Cranes) in the current study area, it may have longer term habitat fragmentation impacts if the number of wind farms in the Overberg increases significantly. **The only reliable way of establishing whether the wind farm will lead to the displacement of priority species will be through the implementation of a monitoring programme, by comparing pre- and post construction densities of key species in the wind farm area.**

3.1.3 Habitat change and loss

The scale of direct habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, generally speaking, is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development area (Fox *et al*. 2006 as cited by Drewitt & Langston 2006), though effects could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

3.2 Associated Infrastructure for the wind facility

3.2.1 Turbine lighting

The effects of night-time illumination has not been adequately tested, and the results of studies are contradictory (Gregory *et al* 2007).

Studies involving lighted objects or towers indicate that lights may attract birds, rather than disorient or repel them, resulting in collision mortality (Johnson *et al* 2007). This is mostly a problem for nocturnal migrants (primarily passerines) during poor visibility conditions. Different colour lights vary in their attractiveness to birds and their effect on orientation. Several studies have shown that intermittent lights have less than an effect on birds than constant lights, with reduced rates of mortality. In addition, some studies suggest that replacing white lights with red coloured lights may reduce mortality by up to 80%. This may be due to the change in light intensity rather than the change in wavelength (Johnson *et al* 2007). However, Ugoretz (2001) suggest that birds are more sensitive to red lights and may be attracted to them. Quickly flashing white strobe lights appear to be less attractive. The issue is however far from settled - a study at Buffalo Ridge, Minnesota, where most of the collision fatalities were classified as nocturnal migrants, found little difference between lighted and unlighted turbines (Johnson *et al* 2000).

The consensus among researchers is to avoid lighting the turbines if possible, but that is against civil aviation regulations (Civil Aviation Regulations 1997). Furthermore, the potential for collisions with the wind turbines due to presence of lights is not envisaged to be significant, primarily because the phenomenon of mass nocturnal passerine migrations is not a feature of the study area. Post – construction monitoring (carcass searches) will be required to assess the extent (if any) of nocturnal fatalities that may be linked to the lighting on the turbines.

3.2.2 Electricity transmission lines

A proposed 33 kV power line that will link the wind facility to the grid could pose a collision risk, irrespective of which alignments is used. In addition, the turbines will be linked to each other with reticulation cables.

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Ledger *et.al.* 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Electrocutions are not envisaged to be a problem on the proposed electricity network. Collisions, on the other hand, could be a major potential problem.

Collisions kill far more birds annually in southern Africa than electrocutions (Van Rooyen 2007). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa -

of the 2369 avian mortalities on distribution lines recorded by the EWT since August 1996, 1512 (63.8%) were Red Data species (Van Rooyen 2007).

In the Overberg, power line collisions have long been recorded as a major source of avian mortality (Van Rooyen 2007). Most numerous amongst power line collision victims are Blue Crane and Ludwig's Bustard (Shaw 2009). It has been estimated that as many as 10% of the Blue Crane population in the Overberg are killed annually on power lines, and figure for Denham's Bustard might be as high as 30% of the Overberg population (Shaw 2009). These figures are extremely concerning, as it represents a possible unsustainable source of unnatural mortality. The study area supports a very high density of Blue Cranes (Young 2008, 2009, 2010).

Unfortunately, the dynamics of the collision problem is poorly understood. In the most recent study on this problem in the Overberg, Shaw (2009) identified cultivated land and region as the significant factors influencing power line collision risk. Lines that cross cultivated land pose a higher risk, as expected, as this is the preferred habitat of Blue Cranes in the Overberg. Interestingly, she also found that collision rates in the Bredasdorp region are much higher than those around Caledon, which might be a function of the higher proportion of flocks, and a greater number of large flocks (50+ birds) in Bredasdorp, as opposed to Caledon in the winter. Collision rates are higher for birds in flocks, as they may panic, or lack visibility and room for manoeuvre because of the close proximity of other birds (APLIC, 1994). Other factors, such as proximity to dams, wind direction and proximity to roads and dwellings did not emerge as significant factors, but she readily admits that her broad-scale analysis may have been too crude to demonstrate their effects. It is for example a well known fact that cranes are particularly vulnerable to power lines skirting water bodies used as roosts, as they often arrive there or leave again in low light conditions (pers. obs.).

4 ASSESSMENT OF POTENTIAL IMPACTS

The impact assessment methodology for the avifaunal impacts that has been adopted for the EIA phase of the project is detailed in Chapter 6 of the Environmental Impact Report. An assessment of the potential impacts is provided in table format below.

No assessment of impacts is provided for the No-Go alternative as that would preserve the status quo as it currently exists. For a description of the status quo, see Section 2: Description of the Receiving Environment.

Table 1.6: Impact assessment table for the construction phase

Impact	***Nature***	***Extent***	***Duration***	***Intensity***	***Probability***	***Non-reversibility***	***Impact on irreplaceable resource***	***Confidence level***
Displacement due to disturbance during construction activities	Negative	Local	Short term	High	Highly probable	Short term	Yes	High
With mitigation	*Negative*	*Local*	*Short term*	*High*	*Probable*	*Short term*	*Yes*	*High*

Impact	***Consequence***	***Probability***	***Significance***	***Confidence***
Displacement due to disturbance during construction activities	Low	Highly probable	Low	High
With mitigation	*Low*	*Probable*	*Low*	*High*

Table 1.7: Impact assessment table for the operational phase

Impact description	***Status***	***Extent***	***Duration***	***Intensity***	***Probability***	***Non-reversibility***	***Impact on irreplaceable resource***	***Confidence level***
Bird collisions, of priority species, with the wind turbines	Negative	Local	Long term	Low	Probable	Medium term	Yes	Low due to lack of South African precedents.
With mitigation	*Negative*	*Local*	*Long term*	*Low*	*Improbable*	*Medium term*	*Yes*	*Low due to lack of South African precedents.*
Bird collisions, of priority species, with the power lines	Negative	Local	Long term	High	Probable	Medium term	Yes	High
With mitigation	*Negative*	*Local*	*Long term*	*Medium*	*Probable*	*Medium term*	*Yes*	*High*

Displacement due to disturbance because of movement and activity associated with the wind turbines.	Negative	Local	Long term	Medium – the **cumulative impact** of several wind farms may affect the capacity of the environmental resources within the geographic area to respond to change and withstand further stress	Probable	Medium term	Yes	Low due to lack of South African precedents.
With mitigation: Very little practical mitigation is possible	*Negative*	*Local*	*Long term*	*Medium (see cumulative impacts above)*	*Probable*	*Medium term*	*Yes*	*Low due to lack of South African precedents.*
Habitat change and loss due to the footprint of the infrastructure	Negative	Local	Long term	Low	Probable	Medium term	Yes	Low due to lack of South African precedents.
With mitigation: Very little practical mitigation is possible	*Negative*	*Local*	*Long term*	*Low*	*Probable*	*Medium term*	*Yes*	*Low due to lack of South African precedents.*

Impact	***Consequence***	***Probability***	***Significance***	***Confidence***
Bird collisions, of priority species, with the wind turbines	Low	Probable	Low	Medium/low due to lack of South African precedents.
With mitigation	*Low*	*Improbable*	*Low*	*Medium/low due to lack of South African precedents.*
Bird collisions, of priority species, with the power lines	High	Highly Probable	Medium	High
With mitigation	*Medium*	*Probable (for the 33 kV line)*	*Low*	*High*
Displacement due to disturbance	Medium	Probable	Medium	Low due to lack

because of movement and activity associated with the wind turbines.				of South African precedents.
With mitigation: Very little practical mitigation is possible	*Medium*	*Probable*	*Medium*	*Low due to lack of South African precedents.*
Habitat change and loss due to the footprint of the infrastructure	Low	Probable	Low	Medium/low due to lack of South African precedents.
With mitigation: Very little practical mitigation is possible	*Low*	*Probable*	*Low*	*Medium/low due to lack of South African precedents.*

5 MITIGATION MEASURES

Despite the fact that wind power has been a feature of the energy industry in the developed world for more than a decade, best practices with regard to bird mitigation are still far from clear and universally accepted. In the USA, for example, best practices are sorely lacking (Smallwood 2008). Mitigation measures would be more effective if based on scientifically founded conclusions of factors affecting bird collisions with wind turbines. It is essential to perform scientifically rigorous pre- and post-construction monitoring of bird fatalities and flight behaviours in wind farms, as well as ecological investigations. These types of investigations have not been performed at most wind farms in the USA so the scientific basis for mitigation measures remains weak (Smallwood 2008). Avoidance and minimisation measures will be the most effective mitigation at wind farms, but these have yet to be implemented at USA wind farms. Adaptive management is often promised in environmental review documents, but in practice it seldom happens. Off-site compensation may be the only substantial means of mitigating impacts following wind farm development. A scientifically defensible nexus between project impacts and mitigation benefits still needs to be established for compensation ratios directed toward wind farms (Smallwood 2008).

It must be accepted that appropriate best practices and mitigation measures with regard to impacts on birds in a South African context will take a number of years to crystallise, and a measure of trial and error will inevitably be part of the process.

5.1 256 MW Wind facility

Mitigation measures fall into two broad categories: best-practice measures which could be adopted by any wind farm development and should be adopted as an industry standard, and additional measures which are aimed at reducing an impact specific to a particular development (Drewitt & Langston 2006).

5.1.1 Generic best practice measures

Examples of **generic best practice** measures are listed below (Drewitt & Langston 2006). Some of these measures may have significant economic implications, and will need to be discussed on a per project basis with the developer:

- Ensuring that key areas of conservation importance and sensitivity are avoided;
- Implementing appropriate working practices to protect sensitive habitats;
- Providing adequate briefing for site personnel and, in particularly sensitive locations, employing an on-site ecologist during construction;

- Implementing an agreed post-development monitoring programme;
- Siting turbines close together to minimise the development footprint (subject to technical constraints such as the need for greater separation between larger turbines);
- Grouping turbines to avoid alignment perpendicular to main flight paths and to provide corridors between clusters, aligned with main flight trajectories, within large wind farms;
- Where possible, installing transmission cables underground (subject to habitat sensitivities and in accordance with existing best practice guidelines for underground cable installation);
- Marking overhead cables using Bird Flight Diverters and avoiding use over areas of high bird concentrations, especially for species vulnerable to collision;
- Timing construction to avoid sensitive periods e.g. during the breeding season if there is the chance of disturbing a priority species;
- Increasing the visibility of rotor blades. Research indicates that high contrast patterns might help reduce collision risk, although this may not always be acceptable on landscape grounds. Another suggested, but untested possibility is to paint blades with UV paint, which may enhance their visibility to birds. However, there is enough evidence that birds generally avoid the turbines, even if not painted in optimal patterns (Madders & Whitfield 2006), and it may be against South African aviation regulations (Civil Aviation Regulations 1997).
- Relocation of proposed or actual turbines responsible for particular collision mortality.
- Halting operation during peak flight periods, or reducing rotor speed, to reduce the risk of collision mortality.
- Post-construction monitoring in order to test the effectiveness of mitigation measures.
- Timing construction to avoid sensitive periods.
- Implementing habitat enhancement for species using the site.

5.1.2 Site specific mitigation measures or the Caledon Wind Farm

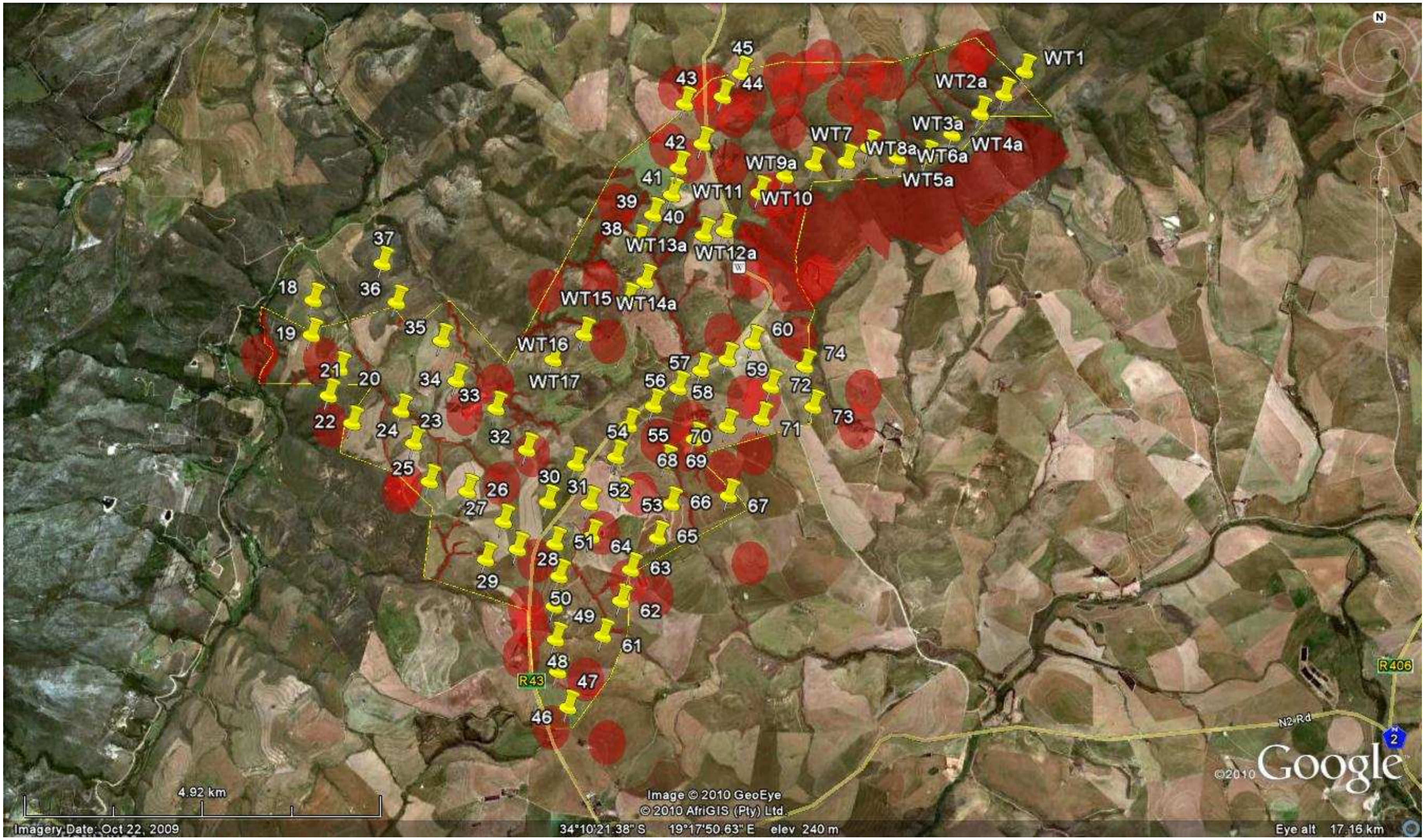
The following site-specific mitigation measures are proposed for the turbines **at the Caledon Wind Farm**

- Ensuring that key areas of conservation importance and sensitivity are avoided: See Figure 2 for a map of the area, indicating the most sensitive areas from a priority species perspective. The current proposed lay-out of the wind turbines avoids most of the highly sensitive avifaunal habitat. However, the following turbines are situated in high risk areas: 10, 11, 19, 32, 34, 42, 44, 45, 46, 51, 63, 69, 71, and 72. It is recommended that they are relocated outside potential high risk areas.
- Implementing appropriate working practices to protect sensitive habitats: Habitat destruction should be limited to what is absolutely necessary for the construction of the infrastructure, including the construction of new roads.

- Providing adequate briefing for site personnel and in particularly sensitive locations. Personnel should be adequately briefed on the need to restrict habitat destruction, and must be restricted to the actual building sites.
- Implementing a pre- and post construction monitoring programme to establish potential and actual collision and displacement impacts on priority species. An appropriate monitoring programme should be designed and implemented under the guidance of a suitably qualified and experienced ornithological consultant, starting at least one year prior to the construction of the infrastructure.

Based on the results of the monitoring, a policy of adaptive management should be implemented, which could include the halting of turbines during peak flight periods, or the relocation of problem turbines.

Figure 2: High risk areas from an avifaunal perspective



5.2 Associated Infrastructure for the wind facility

It is recommended that red intermittent lights are used for the lighting of the turbines.

5.3 Electricity transmission lines

The following mitigation measures are proposed as far as the electricity transmission lines are concerned:

- Electricity cables between turbines should be placed underground.
- The 132kV transmission line should be marked with Bird Flight Diverters on the earthwire. There are many studies that prove that marking a line with PVC spiral type Bird Flight Diverters (BFD's) can reduce the mortality rates by at least 60% (Alonso & Alonso 1999; Koops & De Jong 1982). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Koops and De Jong (1982) found that the spacing of the spirals were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%.

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