6 IDENTIFICATION OF IMPACTS, IMPACT ASSESSMENT AND MITIGATION MEASURES

The possible impacts arising from the construction, operation and decommissioning of the WEF site and the grid connection have been identified and rated separately and are described in the following sections. A significance rating and impact assessment was done for each impact and mitigation measures for each of the identified impacts are also provided.

6.1 Background to Interactions between Wind Energy Facilities, Power Lines and Birds

South Africa has experienced an increase in the number of wind energy developments (both in terms of applications and those that have been built) in the past six years, but still lacks some information about the effects that these developments have on certain aspects of the environment. In South Africa, while post-construction monitoring is being conducted on the majority of operational sites, publically available data and information of operational results is limited and restricted to information supplied to BirdLife SA and made available by them to the public in the form of a report (Ralston Paton *et al*. 2017), and a public presentation (BLSA 2017a). More site specific information for the Chaba Wind Farm, which is relevant to Haga Haga due to its location, was obtained and considered as discussed in section 5.6 above.

International experience, and results from South Africa have shown that birds can be impacted negatively by wind farms, and that the severity of these impacts can differ drastically from site to site. Overall, it appears that severe impacts, such as the high mortality numbers of Golden Eagle observed at Altamont Pass in California (Orloff & Flannery 1992; Hunt *et al.* 1998) seem to be the exception rather than the rule, with the majority of facilities recording relatively low mortalities (Erickson *et al.* 2001; de Lucas *et al.* 2008; Strickland *et al.* 2011). The effects of one poorly placed facility, or some poorly sited turbines within a facility, can however affect the population of certain species at a regional, national or even global level (Bellebaum *et al*. 2013; Carrete 2009; Dahl *et al.* 2012). Hence, it is important to assess the impacts of wind energy facilities, and to base this assessment on a thorough investigation of the local avifauna prior to construction, which is being done for the proposed development.

The main impacts of wind energy facilities and their associated infrastructure have been identified as (a) displacement through disturbance and habitat destruction and (b) mortality through collisions with turbines and/or powerlines and (c) electrocution on live power infrastructure (Rydell *et al*., 2017; Drewitt & Langston 2006; Hotker *et al.* 2006; Percival 2005; van Rooyen 2004).

6.2 Haga Haga WEF Impacts

6.2.1 Construction Phase Impacts

6.2.1.1 Habitat Loss

During the construction of the WEF, some habitat destruction and alteration will take place. This happens with the construction of access roads, the clearing of servitudes and areas for turbine placements, and the levelling of substation yards, development of laydown areas and

turbine bases. The removal of vegetation which provides habitat for avifauna and food sources may have an impact on birds breeding, foraging and roosting. 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 (Drewitt & Langston 2006). At the nearby operational Chaba WEF, it was calculated that the development resulted in 2.4% of the total site being lost ((Smallie & MacEwan, 2017).

The significance of the impact is rated as **Medium (-72)** prior to the application of mitigation measures, and as **Low (-32)** following mitigation (Table 7)

Table 7: Impact Rating Table for Habitat Loss- Construction Phase

IMPACT NATURE	**Avifaunal Impacts - Habitat Loss**		**STATUS**	**NEGATIVE**
Impact Description	Loss of habitat used by avifauna, particularly for feeding, foraging and breeding.			
Impact Source(s)	Construction of the WEF site and associated infrastructure on the WEF site			
Impact Receptor(s)	Priority bird species and Red Data species			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	4
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-72	Preferred Alternative	-32
	No-Go Alternative:	0	No-Go Alternative:	0

CUMULATIVE IMPACTS	The cumulative impact of habitat loss caused by the construction of the WEF site will be **medium** after mitigation when considering the habitat loss impacts of the adjacent grid connection and other relevant projects constructed or proposed within 50 km of the WEF site.
CONFIDENCE	Medium
MITIGATION MEASURES	• High traffic areas and buildings such as offices, batching plants, storage areas etc. should where possible be situated in areas that are already disturbed; • Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • Sensitive zones and no-go areas (e.g. nesting areas) are to be avoided; • No off-road driving; • Environmental Control Officer (ECO) to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final road and power line routes as well as the final turbine positions, to identify any nests/breeding activity of sensitive species, as well as any additional sensitive habitats within which construction activities may need to be excluded; Should priority species nest be located, a protective buffer may be applied, within which construction activities may need to be restricted during the breeding season for that species; • The construction Phase ECO, the onsite Environmental Manager, and the client's representative on site (e.g. the resident engineer) are to be trained to identify Red Data and priority bird species, as well as their nests. If any nests or breeding locations for this species are located, an avifaunal specialist is to be contacted for further instruction; and • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the CEMP.

6.2.1.2 Disturbance and Displacement

Disturbances and noise from staff and construction activities can impact on certain sensitive species particularly whilst feeding and breeding, resulting in effective habitat loss through a perceived increase in predation risk (Frid & Dill 2002; Percival 2005). There are various potentially sensitive species occurring on the WEF site including Grey-crowned Crane, Southern Ground Hornbill, Denham's Bustard, Lanner Falcon, Martial Eagle, Crowned Eagle and African Fish-eagle. Disturbance can cause these species to be displaced, either temporarily (i.e. for some

period during the construction activity) or permanently (i.e. they do not return), into less suitable habitat which may reduce their ability to survive and reproduce.

The significance of the impact is rated as **Medium (-56)** prior to the application of mitigation measures, and as **Low (-15)** following mitigation (Table 8).

Table 8: Impact Rating Table for Disturbance and Displacement- Construction Phase

IMPACT NATURE	**Avifaunal Impacts - Disturbance and/or Displacement**		**STATUS**	**NEGATIVE**
Impact Description	Disturbances and noise from staff and construction activities can impact on certain sensitive species particularly whilst feeding and breeding, potentially leading to temporary or permanent displacement.			
Impact Source(s)	Construction of the WEF site and associated infrastructure on the WEF site			
Impact Receptor(s)	Priority bird species and Red Data species, particularly those using the WEF site for breeding.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-56	Preferred Alternative	-15
	No-Go Alternative:	0	No-Go Alternative:	0

CUMULATIVE IMPACTS	The cumulative impact of disturbance and/or displacement caused by the construction of the WEF site will be **medium** after mitigation when considering the impacts of the adjacent grid connection and other relevant projects constructed or proposed within 50 km of the WEF site.
CONFIDENCE	Medium
MITIGATION MEASURES	• A CEMP must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMP and should apply good environmental practice during construction; • Prior to construction, the avifaunal specialist should conduct a site walkthrough, covering the final infrastructure (e.g. road, substation, offices, turbine positions etc.) to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise; • Sensitive zones and no-go areas are to be designated by the specialist (e.g. nesting sites) and must be avoided; • The construction Phase ECO, the onsite Environmental Manager, and the client's representative on site (e.g. the resident engineer) are to be trained to identify Red Data and priority bird species, as well as their nests. The ECO and Environmental Manager must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any nests or breeding locations for these species are located, the avifaunal specialist is to be contacted for further instruction; and • ECOs to oversee activities and ensure that the CEMP is implemented and enforced.

6.2.2 Operational Phase

6.2.2.1 Collisions with Wind Turbines

WEFs can cause bird mortalities through the collision of birds with moving turbine blades. A number of factors influence the number of birds impacted by collision, including:

- Number of birds in the vicinity of the WEF;
- The species of birds present and their flying patterns and behaviour; and
- The design of the development including the turbine layout, height and size of the rotor swept area.

It is important to understand that not all birds that fly through the WEF at heights swept by rotors automatically collide with blades. In fact avoidance rates for certain species have proven to be extremely high internationally, while avoidance rates have not been determined for South African species. In a radar study of the movement of ducks and geese in the vicinity of an off-shore wind facility in Denmark, less than

1% of bird flights were close enough to the turbines to be at risk, and it was clear that the birds avoided the turbines effectively (Desholm and Kahlert 2005). Whilst avoidance rates for SA species are currently unknown due to the lack of data, comparisons can be drawn between functionally similar species, for example Verreaux's' Eagle with Golden Eagle, in order to inform an assessment. Whitfield (2009) reviewed the avoidance rates for Golden Eagle and reported estimates varying between 98.64 % and 99.89 %.

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 carcasses, with no correction for carcasses that were overlooked or removed by scavengers (Drewitt & Langston 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 IBAs), especially among migrating birds, large raptors or other large soaring species, e.g. in the Altamont Pass in California, USA (Thelander *et. al* 2003), and in Tarifa and Navarra in Spain (Barrios and Rodrigues 2004).

In northern Germany one study estimated an annual mortality of 8,500 common Buzzards, 11300 Wood Pigeons and 13000 Mallards from wind turbine collisions (Grunkorn *et al.* 2017). They also concluded that for the majority of wind farms studied, the numbers of collision victims predicted by collision risk modelling (CRM) using the BAND model, were clearly below the number of collision victims estimated from carcass searches and that the suitability of the BAND-Model for the evaluation of an anticipated collision risk at an 'average' onshore site is limited. Although large birds with poor manoeuvrability (such as cranes, korhaans, and bustards) are generally at greater risk of collision with structures (Jenkins *et al*. 2015), 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, resulting in lower collision risks, or that they are not distracted and focussed on hunting and searching the ground while flying, as is the case for raptors.

A minimum of 636 birds have been killed by turbines in South Africa to date (BLSA, 2017a). Ralston Paton *et al.* (2017) found that mortality estimates for eight studied wind farms in South Africa ranged from 2.1 to 8.6 birds per turbine per year, which is within range of average estimates from Europe (6.5) and North America (1.6) (Rydell *et al.* 2012). Raptors and passerines are the groups most affected by collisions in South Africa to date.

Eleven Red Data species (Taylor *et al.* 2015) have been affected, including fatalities of six Blue Crane (Near Threatened), six Verreaux's' Eagle (Vulnerable), six Cape Vulture (Endangered), five Black Harrier (Endangered), four Lanner Falcon (Vulnerable), three Southern Black Korhaan (Vulnerable) and two Martial Eagle (Endangered). Notably, a large number of the not red listed but endemic Jackal Buzzard (63) have been killed (Ralston Paton *et al.* 2017), as well as a number of Rock Kestrel (33) and passerines such as Bokmakierie (21), White-rumped Swift (21) and Red-capped Lark (24). There have been no recorded turbine collision mortalities of Southern Ground Hornbill in South Africa, and none in the world that the specialist (and the SHG specialist) is aware of. Due to its general preference for walking and low flying, its potential to collide with turbine blades is likely to be low.

Eagle mortalities at wind farms are not unexpected. Fatalities at wind farms have been reported for Golden Eagle (e.g. Smallwood 2013), White-tailed Sea Eagle (e.g. Hötker *et al.* 2006), Bald Eagle (Pagel *et al.* 2013) and White-bellied Sea Eagle (Smales & Muir, 2005). Verreaux's Eagle has recently been up-listed to Vulnerable and rough estimates of the population size are between 3 500 and 3 750 mature individuals (Taylor *et al.,* 2015).

Bird mortality is a direct, negative effect that can occur for the duration of the project's lifespan (long-term). It can affect regional populations if for example dispersing eagles continue to collide with turbines as they attempt to populate an available territory (sinkhole effect). The consequence of this impact is potentially severe and recent data from wind farms in South Africa (Ralston Paton *et al.* 2017; BLSA, 2017a) demonstrates that mortalities are very likely to occur, and irreversible in terms of the deceased individual and potentially also irreversible at a population level.

The significance of the impact is rated as **High (-116)** prior to the application of mitigation measures, and as **Medium (-60)** following mitigation.

The most effective mitigation for collision impacts currently available is wind farm placement, as well as specific turbine placement within a WEF to avoid high use areas. Such recommendations have been made. While not yet tested in South Africa, deterrent devices and shut-down on demand strategies have been implemented internationally. Foss *et al.* (2017) found monochromatic LEDs that specifically target avian photoreceptors could provide a useful tool to divert raptors from hazardous situations, while in Scotland trials are underway by Scottish Natural Heritage (SNH) using laser beams to deter Sea Eagles from feeding on lambs[11]. Tome *et al.* (2017) found that a Radar Assisted Shutdown on Demand (RASOD) system at the Barão de São João wind farm in Portugal's Sagres region resulted in zero mortality of soaring birds over five consecutive autumn migratory seasons. While such strategy should not be relied upon completely (also considering that they are used internationally during migration events), they should not be discounted and may well hold valuable application in South Africa.

Table 9: Impact Rating Table for Collisions with Wind Turbines- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Mortality from collision with wind turbines**		**STATUS**	**NEGATIVE**
Impact Description	Bird mortality through collision with operational wind turbine blades			
Impact Source(s)	Operational wind turbines			
Impact Receptor(s)	Priority bird species and Red Data species			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	3	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0

[11] http://www.bbc.com/news/uk-scotland-highlands-islands-42578354

PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-116	Preferred Alternative	-60
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of turbine collisions after mitigation will be **medium to high** when considering other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	Medium			
MITIGATION MEASURES	The project size should be reduced in terms of number of turbine locations to be constructed. It is preferable to have smaller number of turbines with larger rotor, compared with more turbines with smaller rotor. Turbines must not be constructed within any designated No-Go Areas. The turbine blade should not protrude into these areas, and therefore the bases should be constructed suitably far from these areas to prevent this. Based on the outcomes of the sensitivity mapping, seven turbine positions should be dropped/relocated so that the turbine base is no less than 50 m from the boundary of No-Go Area; Turbines should be set back 300 m from rivers and 280 m from drainage lines and large alien stands of trees (possible roost sites), and wherever possible turbines should avoid wide open grass plains (preferred foraging areas). Placement may also be at least 300m within patches of denser ground cover unattractive to SGH, as an alternative to use of open <50cm ground cover that they prefer; The hierarchy of sensitivity zones to be identified should be considered where possible with preferential placement of turbines in areas with no sensitivity score, followed by low sensitivity, medium sensitivity and medium-high sensitivity; Develop and implement a carcass search programme for birds as a minimum during the first three years of operation followed by year 5, 10, 15, 20 and 25, in line with the applicable South African monitoring guidelines; Develop and implement a 24 month post-construction bird activity monitoring program that mirrors the pre-construction monitoring surveys completed by Arcus and is in line with the applicable South African post-construction monitoring guidelines. This program must include thorough and ongoing nest searches and nest monitoring;			

	Conduct frequent and regular review of operational phase monitoring data (activity and carcass) and results by an avifaunal specialist. This review should also establish the requirement for continued monitoring studies (activity and carcass) throughout the operational and decommissioning phases of the development; The above reviews should strive to identify sensitive locations at the development including turbines and areas of increased collisions with power lines that may require additional mitigation. If unacceptable impacts are observed (in the opinion of the bird specialist after consultation with BLSA, relevant stakeholders and an independent review), the specialist should conduct a literature review specific to the impact (e.g. collision and/or electrocution) and provide updated and relevant mitigation options to be implemented. Mitigations that may need to be implemented (and should be considered in the project's financial planning) include: • Onsite and off-site habitat management. A habitat management plan which aims to prevent an influx/increase in preferred prey items in the turbine area due to the construction and operation activities, while improving raptor habitat and promoting prey availability away from the site. Using deterrent devices (e.g. visual and noise deterrents) Deterrent and/or shutdown systems e.g. Automatic bird detectors (e.g. automated camera based monitoring systems – McClure et. al. 2018) if commercially available; or Radar Assisted Shutdown on Demand (RASOD) to reduce collision risk. Identify options to modify turbine operation (e.g. temporary curtailment or shut-down on demand) to reduce collision risk if absolutely necessary and other methods have not had the desired results. • Implementing a carcass management plan on the WEF site, to remove any dead livestock as soon as possible, to reduce the likelihood of attracting vultures to the WEF site.

6.2.2.2 Collisions with Power Lines

Collisions with power lines are a well-documented threat to birds in southern Africa (van Rooyen 2004), and smaller lines pose a higher threat of electrocution but can still be responsible for collisions. Wind energy facilities may have overhead lines between turbine strings and substations that pose a collision threat, although this is not often the case as internal power is usually transferred between turbines and the onsite substation via underground cabling. Collisions with overhead power lines occur when a flying bird does not see the cables, or is unable to take effective evasive action, and is killed by the impact or impact with the ground. Especially heavy-bodied birds such as bustards, cranes and waterbirds, with limited manoeuvrability are susceptible to this impact (van Rooyen 2004). Many of the collision and electrocution sensitive species are also considered threatened in southern Africa. The Red Data (Taylor *et al.* 2015) species vulnerable to power line collisions are generally long living, slow reproducing species. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

Species that may be affected on the WEF site include Grey-crowned Crane, Denham's Bustard, White Stork and possibly Southern Ground Hornbill.

The significance of the impact is rated as **Medium (-60)** prior to the application of mitigation measures, and as **Low (-22)** following mitigation (Table 10)

Table 10: Impact Rating Table for Collisions with Power Lines- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Mortality from collision with powerlines on the WEF site**		**STATUS**	**NEGATIVE**
Impact Description	Bird mortality through collision with new overhead power lines.			
Impact Source(s)	Overhead powerline sections on the WEF site.			
Impact Receptor(s)	Priority bird species and Red Data species			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	3	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-60	Preferred Alternative	-22
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of powerline collisions after mitigation may be **medium to high** when considering other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	Medium			

MITIGATION MEASURES	• Construction of electrical infrastructure must consider avifaunal sensitivity zones and avoid areas of higher sensitivities where possible; • Place new power lines on the WEF site underground where possible; • Place new overhead power lines adjacent to existing power lines or linear infrastructure (e.g. roads and fence lines). Where new lines are placed next to existing lines, the pylons of the new line should be 'staggered' so that they do not line up with the pylons of the existing line as far as possible; • Attach appropriate marking devices [Bird Flight Diverters (BFDs)] on all spans of all new overhead power lines to increase visibility; and • Develop and implement a carcass search programme for birds during the first two years of operation, in line with the South African monitoring guidelines (Jenkins et al. 2015). This program must include monitoring of overhead power lines, including the new grid connection line.

6.2.2.3 Electrocution

Electrocution of birds from electrical infrastructure including overhead lines and substation components is an important and well documented cause of bird mortality, especially for raptors and storks (APLIC 1994; van Rooyen and Ledger 1999). Electrocution may also occur within newly constructed substations. Electrocution refers to the scenario where a bird is perched or attempts to perch on the 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 2004). Electrocutions are generally more likely for larger species whose wingspan is able to bridge the gap such as eagles or storks. A few large birds (such as Southern Ground Hornbill, White Stork, African Fish-eagle and Martial Eagle), susceptible to electrocution (particularly in the absence of safe and mitigated structures) occur in the area. Electrocution is also possible on electrical infrastructure within the substation particularly for species such as crows and owls.

The significance of the impact is rated as **Low (-22)** prior to the application of mitigation measures, and as L**ow (-11)** following mitigation.

Table 11: Impact Rating Table for Electrocution- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Mortality from collision with powerlines on the WEF site**		**STATUS**	**NEGATIVE**
Impact Description	Bird mortality through collision with new overhead power lines.			
Impact Source(s)	Overhead powerline sections on the WEF site.			
Impact Receptor(s)	Priority bird species and Red Data species			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	1	Preferred Alternative	1

	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-22	Preferred Alternative	-11
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of electrocution after mitigation may be **low to medium** when considering other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	High			
MITIGATION MEASURES	• Construction of electrical infrastructure must consider avifaunal sensitivity zones and avoid areas of higher sensitivities where possible; • Place new power lines on the WEF underground where possible; • Any new overhead power lines must be of a design that minimizes electrocution risk by using adequately insulated 'bird friendly' structures, with clearances between live components of 1.8 m or greater and which provides a safe bird perch.			

6.2.2.4 Disturbance and Displacement

Disturbance and displacement by operational activities such as power line and turbine maintenance, fencing, and noise can lead to birds avoiding the area for feeding or breeding, and effectively leading to habitat loss and a potential reduction in breeding success (Larsen & Madsen 2000; Percival 2005). Turbines can also be disruptive to bird flight paths, with some species altering their routes to avoid them (Dirksen *et al.* 1998, Tulp *et al.* 1999, Pettersson & Stalin 2003). While this reduces the chance of collisions it can also create a displacement or barrier effect, for example between roosting and feeding grounds and result in an increased energy expenditure and lower breeding success (Percival 2005). Small songbirds have been known to have been displaced from operational turbines which cause disturbance through noise, vibrations and shadow-flicker (Rydell *et al.* 2017). Disturbance distances (the distance from wind farms up to which birds are absent or less abundant than expected) can vary between species and also within species with alternative habitat availability (Drewitt & Langston 2006). Some international studies of various species have recorded disturbance distances of 80 m, 100 m, 200 m and 300 m (Larsen & Madsen 2000,

Shaffer & Buhl 2015) from turbine positions, but distances of 600 m (Kruckenberg & Jaehne 2006) and up to 800 m have been recorded (Drewitt & Langston 2006).

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. A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Raptors are generally fairly tolerant of wind farms, and continue to use the area for foraging (Thelander *et al.* 2003, Madders & Whitfield 2006, Ralston Paton *et al.* 2017), and may not be affected by displacement, however this increases their collision risk.

In South Africa the results available thus far have shown little evidence that displacement and disturbance of priority species has occurred. However, due to the limited number of operational wind farms in South Africa and short monitoring efforts, the precautionary principle should be applied, and disturbance and displacement must still be regarded as a potential impact.

The significance of the impact is rated as **Medium (-42)** prior to the application of mitigation measures, and as **Low (-16)** following mitigation (Table 12).

Table 12: Impact Rating Table for Disturbance and Displacement- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Disturbance and/or Displacement**		**STATUS**	**NEGATIVE**
Impact Description	Disturbance and displacement by operational activities such as power line and turbine maintenance and turbine noise can lead to birds avoiding the area for feeding or breeding.			
Impact Source(s)	Operational turbines and various O&M activities.			
Impact Receptor(s)	Priority bird species and Red Data species, particularly those using the WEF site for breeding.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	3	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0

INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-42	Preferred Alternative	-16
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of disturbance and/or displacement caused by the operational WEF site may be **medium** after mitigation when considering the disturbance/displacement impacts of the adjacent grid connection and other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	Low			
MITIGATION MEASURES	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce unnecessary disturbance. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • The on-site WEF manager (or a suitably appointed Environmental Manager) must be trained by an avifaunal specialist to identify the potential priority species and Red Data species as well as the signs that indicate possibly breeding by these species. If a priority species or Red Data species is found to be breeding (e.g. a nest site is located) on the operational Wind Farm, the nest/breeding site must not be disturbed and an avifaunal specialist must be contacted for further instruction; • Operational phase bird monitoring, in line with applicable guidelines, must be implemented and must include monitoring of all raptor nest sites for breeding success; • No turbines should be placed in no-go areas to be identified through pre-construction monitoring, while associated infrastructure should be avoided where possible in these areas. Turbines should be set back 300 m from rivers and 280 m from drainage lines and large alien stands of trees (possible roost sites), and wherever possible turbines should avoid wide open grass plains (preferred foraging areas). Placement may be within the 300 m in patches of denser ground cover unattractive to SGH, as an alternative to use of open <50cm ground cover that they prefer.			

6.2.2.5 Disruption of Local Bird Movement Patterns

Wind energy facilities may form a physical barrier to movement of birds across the landscape, this may alter migration routes and increase distances travelled and energy expenditure or block movement to important areas such as ephemeral wetlands or prey sources altogether. This potential impact is not yet well understood, is likely to be more significant as a cumulative impact with surrounding developments, is difficult to measure and assess, and therefore mitigation measures are difficult to identify. Some mitigation may be possible by avoiding turbine placement in obvious flyways and making turbines more visible through lighting, but this will not change the significance of this impact.

The significance of the impact is rated as **Low (-28)** prior to the application of mitigation measures, and as **Low (-28)** following mitigation.

Table 13: Impact Rating Table for Disruption of Local Bird Movement Patterns- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Disruption of local bird movement patters**		**STATUS**	**NEGATIVE**
Impact Description	Wind energy facilities may form a physical barrier to movement of birds across the landscape, this may alter migration routes and increase distances travelled and energy expenditure or block movement to important areas such as ephemeral wetlands or prey sources altogether.			
Impact Source(s)	Operational turbines			
Impact Receptor(s)	Priority bird species and Red Data species, particularly those that fly long distances from roost sites to areas of use and/or to and from breeding and foraging areas.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	2	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
	Preferred Alternative	-28	Preferred Alternative	-28

SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of disruption to bird movements caused by the operational WEF site may be **low to medium** after mitigation when considering other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	Low			
MITIGATION MEASURES	• The lowest feasible number of turbines should be constructed for the required MW output. Therefore, fewer larger (i.e with a higher MW output) turbine models should be favoured where possible; and • Lighting on turbines to be of an intermittent and coloured nature rather than constant white light to reduce the possible impact on the movement patterns of nocturnal migratory species.			

6.2.3 Decommissioning Phase

6.2.3.1 Disturbance and Displacement

Activities such as, noise and traffic associated with the decommissioning of the facility can impact species in the same way as construction activities. In addition, any nesting birds utilising the electrical infrastructure are vulnerable to disturbance impacts, especially if nests are disturbed or removed during the removal/take down of structures (e.g. pylons).

The significance of the impact is rated as **Low (-32)** prior to the application of mitigation measures, and as **Low (-15)** following mitigation.

Table 14: Impact Rating Table for Disturbance and Displacement- Decommissioning Phase

IMPACT NATURE	**Avifaunal Impacts - Disturbance and/or Displacement**		**STATUS**	**NEGATIVE**
Impact Description	Activities such as, noise and traffic associated with the decommissioning of the facility can impact species in the same way as construction activities. In addition, any nesting birds utilising the electrical infrastructure are vulnerable to disturbance impacts, especially if nests are disturbed or removed during the removal/take down of structures (e.g. pylons).			
Impact Source(s)	Decommissioning activities on the WEF site.			
Impact Receptor(s)	Priority bird species and Red Data species, particularly those using the WEF site for breeding.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**

EXTENT (A)	Preferred Alternative	1	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-32	Preferred Alternative	-15
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of disturbance and/or displacement caused by the decommissioning of the WEF site may be **low to medium** after mitigation when considering other relevant projects within 50 km of the WEF site.			
CONFIDENCE	Low			

MITIGATION MEASURES	• An EMP for decommissioning must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted. All contractors are to adhere to the EMP and should apply good environmental practice during decommissioning; • ECOs to oversee activities and ensure that the EMP is implemented and enforced; • The appointed ECO must be trained by an avifaunal specialist to identify the potential priority species and Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), decommissioning activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed; • Prior to decommissioning, an avifaunal specialist should conduct a site walkthrough, to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final decommissioning schedule in close proximity to that specific area, including abbreviating activity times, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.

6.3 Grid Connection Impacts

6.3.1 Construction Phase Impacts

6.3.1.1 Habitat Loss

During the construction of the grid connection infrastructure, some habitat destruction and alteration will take place. This happens with the construction of access roads, the clearing of servitudes and areas for pylon placements, and the development of laydown areas. The removal of vegetation which provides habitat for avifauna and food sources may have an impact on birds breeding, foraging and roosting.

The significance of the impact is rated as **Low (-32)** prior to the application of mitigation measures, and as **Low (-20)** following mitigation (Table 15).

Table 15: Grid Connection Impact Rating Table for Habitat Loss- Construction Phase

IMPACT NATURE	**Avifaunal Impacts - Habitat Loss**	**STATUS**	**NEGATIVE**
Impact Description	Loss of habitat used by avifauna, particularly for feeding, foraging and breeding.		

Impact Source(s)	Construction of the Grid Connection overhead power line			
Impact Receptor(s)	Priority bird species and Red Data species			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	1	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	4
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-2	Preferred Alternative	-1
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-32	Preferred Alternative	-20
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of habitat loss caused by the construction of the Grid Connection will be **low to medium** after mitigation when considering the habitat loss impacts of the adjacent Haga Haga WEF and other relevant projects constructed or proposed within 50 km.			
CONFIDENCE	Medium			

MITIGATION MEASURES	• Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including access road widths and lengths; • Sensitive zones and no-go areas (e.g. nesting areas) are to be avoided; • No off-road driving; • ECOs to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • Prior to construction, the avifaunal specialist should conduct a site walkthrough, covering the final power line routes to identify any nests/breeding activity of sensitive species, as well as any additional sensitive habitats within which construction activities may need to be excluded; and • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the CEMP.

6.3.1.2 Disturbance and Displacement

Disturbances and noise from staff and construction activities can impact on certain sensitive species particularly whilst feeding and breeding, resulting in effective habitat loss through a perceived increase in predation risk (Frid & Dill 2002; Percival 2005). There are various potentially sensitive species occurring on the Grid Connection route and disturbance can cause these species to be displaced, either temporarily (i.e. for some period during the construction activity) or permanently (i.e. they do not return), into less suitable habitat which may reduce their ability to survive and reproduce.

The significance of the impact is rated as **Medium (-56)** prior to the application of mitigation measures, and as **Low (-15)** following mitigation (Table 16).

Table 16: Grid Connection Impact Rating Table for Disturbance and Displacement- Construction Phase

IMPACT NATURE	**Avifaunal Impacts - Disturbance and/or Displacement**	**STATUS**	**NEGATIVE**
Impact Description	Disturbances and noise from staff and construction activities can impact on certain sensitive species particularly whilst feeding and breeding, potentially leading to temporary or permanent displacement.		
Impact Source(s)	Construction of the Grid Connection overhead power line		

Impact Receptor(s)	Priority bird species and Red Data species, particularly those using the Grid Connection site for breeding.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-56	Preferred Alternative	-15
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of disturbance and/or displacement caused by the construction of the Grid Connection may be **medium** after mitigation when considering the disturbance/displacement impacts of the adjacent Haga Haga WEF and other relevant projects constructed or proposed within 50 km of the site.			
CONFIDENCE	Medium			

MITIGATION MEASURES	• A CEMP must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMP and should apply good environmental practice during construction; • Prior to construction, the avifaunal specialist should conduct a site walkthrough, covering the final power line route to identify any nests/breeding/roosting activity of sensitive species as well as any additional sensitive habitats. The results of which may inform the final construction schedule, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise; • Sensitive zones and no-go areas are to be designated by the specialist (e.g. nesting sites) and must be avoided; and • ECOs to oversee activities and ensure that the site specific CEMP is implemented and enforced.

6.3.2 Operational Phase

6.3.2.1 Collisions with Power Lines

Collisions with large (132 kV or above) power lines is a well-documented threat to birds in southern Africa (van Rooyen 2004). Collisions with overhead power lines occur when a flying bird does not see the cables, or is unable to take effective evasive action, and is killed by the impact or impact with the ground. Especially heavy-bodied birds such as bustards, cranes and waterbirds, with limited manoeuvrability are susceptible to this impact (van Rooyen 2004). Many of the collision sensitive species are also considered threatened in southern Africa. The Red Data (Taylor *et al.* 2015) species vulnerable to power line collisions are generally long living, slow reproducing species. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term. Species that may be affected on the Grid Connection route include Denham's Bustard, Cape Vulture, Secretarybird, Denham's Bustard, White Stork and Southern Ground Hornbill.

The significance of the impact is rated as **High (-116)** prior to the application of mitigation measures, and as **Medium (-60)** following mitigation.

Table 17: Grid Connection Impact Rating Table for Collision with Power Lines- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Mortality from collision with the Overhead Power Line**	**STATUS**	**NEGATIVE**
Impact Description	Bird mortality through collision with new overhead power lines. Collisions with overhead power lines occur when a flying bird does not see the cables, or is unable to take effective evasive action, and is killed by the impact or impact with the ground		
Impact Source(s)	Grid Connection Overhead powerline.		

Impact Receptor(s)	Priority bird species and Red Data species, especially heavy-bodied birds such as bustards, cranes and waterbirds, with limited manoeuvrability			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	3	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-116	Preferred Alternative	-60
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of powerline collisions after mitigation may be **medium to high** when considering other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	Medium			

MITIGATION MEASURES	• Wherever possible, place new overhead power lines adjacent to existing power lines or linear infrastructure (e.g. roads and fence lines). Where the new power line is adjacent to an existing line, ensure that new pylons are staggered so that they are not in line with existing pylons wherever possible; • Prior to construction, the avifaunal specialist must conduct a site walkthrough determine the power line spans that will require marking devices [Bird Flight Diverters (BFDs)] to increase visibility. It is likely that the specialist may recommend all, or the vast majority of spans will need to be mitigated, and suitable financial allowance should be made for this. • Attach recommend BFD's to the required spans, in line with the instructions of the avifaunal specialist. In some instances, BFDs fitted with solar lights may be needed to mitigate for nocturnal/diurnal flying species e.g. flamingos; and • Develop and implement a carcass search programme for large terrestrial birds, covering the Grid Connection line (or strategic locations along the line selected by the specialist), to be implemented as a minimum over the course of the first two years of operations.

6.3.2.2 Electrocution

Electrocution of birds from electrical infrastructure including overhead lines is an important and well documented cause of bird mortality, especially for raptors and storks (APLIC 1994; van Rooyen and Ledger 1999). With regard to the grid connection infrastructure, overhead power line infrastructure with a capacity of 132 kV or more does not generally pose a risk of electrocution due to the large size of the clearances between the electrical infrastructure components. Electrocutions are therefore more likely for larger species whose wingspan is able to bridge the gap such as eagles or storks. A few large birds (such as Cape Vulture and Martial Eagle), susceptible to electrocution (particularly in the absence of safe and mitigated structures) occur in the area.

The significance of the impact is rated as **High (-87)** prior to the application of mitigation measures, and as **Low (-20)** following mitigation.

Table 18: Grid Connection Impact Rating Table for Electrocution- Operational Phase

IMPACT NATURE	Avifaunal Impacts - Mortality from electrocution with electrical infrastructure on the Grid Connection site.	STATUS	NEGATIVE
Impact Description	Bird mortality through electrocution with new overhead power line and/or in the substation.		
Impact Source(s)	Electrical infrastructure associated with the Grid Connection site.		
Impact Receptor(s)	Priority bird species and Red Data species, especially for larger species whose wingspan is able to bridge the gap such as vultures, eagles or storks.		

PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative	3	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	3	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-87	Preferred Alternative	-20
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of electrocution after mitigation may be **low to medium** when considering other relevant projects constructed or proposed within 50 km.			
CONFIDENCE	High			
MITIGATION MEASURES	• Any new overhead power lines must be of a design that minimizes electrocution risk by using adequately insulated 'bird friendly' structures (in line with standard Eskom guidelines), with clearances between live components of 1.8 m or greater and which provides a safe bird perch. • All electrical infrastructure, including transformers and substations, must be designed in line with Eskom's standards that ensure adequate insulation of all components to prevent electrocution of birds. • Develop and implement a carcass search programme for large terrestrial birds, covering the Grid Connection line (or strategic locations along the line selected by the specialist), to be implemented as a minimum over the course of the first two years of operations.			

6.3.2.3 Disturbance and Displacement

Disturbance and displacement by operational activities such as power line maintenance, can lead to birds avoiding the area for feeding or breeding, and effectively leading to habitat loss and a potential reduction in breeding success (Larsen & Madsen 2000; Percival 2005). During operation of the grid connection, servitudes for the power line will have to be cleared of excess vegetation at regular intervals. This is done to allow access to the power line for maintenance, to prevent vegetation from intruding into the prescribed clearance gap between the ground

and the conductors, and to minimize the risk of fire under the line which can result in electrical flashovers. These and other maintenance activities can disturb sensitive species occurring on site.

It is expected that some species potentially occurring on the Grid Connection route alternatives will be susceptible to disturbance and displacement, for example smaller passerines such as larks, warblers, flycatchers and chats, as well as large terrestrial Red Data species such as Grey-crowned Crane, Southern Ground Hornbill and Denham's Bustard. Priority species nesting on the project site (including on new infrastructure e.g. powerline pylons) may be disturbed during routine maintenance.

The significance of the impact is rated as **Medium (-60)** prior to the application of mitigation measures, and as **Low (-16)** following mitigation (Table 19).

Table 19: Grid Connection Impact Rating Table for Disturbance and Displacement- Operational Phase

IMPACT NATURE	**Avifaunal Impacts - Disturbance and/or Displacement**		**STATUS**	**NEGATIVE**
Impact Description	Disturbance and displacement by operational activities such as power line maintenance, can lead to birds avoiding the area for feeding or breeding, and effectively leading to habitat loss and a potential reduction in breeding success.			
Impact Source(s)	Operational and maintenance activities along the grid connection route			
Impact Receptor(s)	Priority bird species and Red Data species, particularly those using the Grid site for breeding.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	3	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	3	Preferred Alternative	2
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0

SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-60	Preferred Alternative	-16
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of disturbance and/or displacement caused by activities on the operational Grid Connection site may be **medium** after mitigation when considering the disturbance/displacement impacts of the adjacent Haga Haga WEF and other relevant projects constructed or proposed within 50 km of the WEF site.			
CONFIDENCE	Low			
MITIGATION MEASURES	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce unnecessary disturbance. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • No bird nests must be disturbed or removed from any pylon or substation infrastructure prior to consultation with and approval from the avifaunal specialist; • The Manager and field staff responsible for maintenance and repairs on the grid connection line (or a suitably appointed Environmental Manager) must be trained by an avifaunal specialist to identify the potential priority species and Red Data species as well as the signs that indicate possibly breeding by these species. If a priority species or Red Data species is found to be breeding (e.g. a nest site is located) on the operational Grid Connection site, the nest/breeding site must not be disturbed and an avifaunal specialist must be contacted for further instruction; and • Operational phase bird monitoring, in line with applicable guidelines, must be implemented to include monitoring of the Grid Connection route and must include monitoring of all raptor nest sites for breeding success.			

6.3.3 Decommissioning Phase

6.3.3.1 Disturbance and Displacement

Activities such as, noise and traffic associated with the decommissioning of the Grid Connection can impact species in the same way as construction activities. In addition, any nesting birds utilising the electrical infrastructure are vulnerable to disturbance impacts, especially if nests are disturbed or removed during the removal/take down of structures (e.g. pylons). Particularly Martial Eagle (Endangered) is known to utilise pylons for nesting and could be susceptible to disturbance, and experience a resulting reduced breeding success. Lanner Falcon and Verreaux's Eagle are other priority species that may nest on pylons.

The significance of the impact is rated as **Low (-32)** prior to the application of mitigation measures, and as **Low (-15)** following mitigation.

Table 20: Grid Connection Impact Rating Table for Disturbance and Displacement- Decommissioning Phase

IMPACT NATURE	**Avifaunal Impacts - Disturbance and/or Displacement**		**STATUS**	**NEGATIVE**
Impact Description	Activities such as, noise and traffic associated with the decommissioning of the Grid Connection can impact species in the same way as construction activities. In addition, any nesting birds utilising the electrical infrastructure are vulnerable to disturbance impacts, especially if nests are disturbed or removed during the removal/take down of structures (e.g. pylons).			
Impact Source(s)	Decommissioning activities on the Grid Connection site.			
Impact Receptor(s)	Priority bird species and Red Data species, particularly those using the Grid Connection site for breeding.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative	1	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
DURATION (B)	Preferred Alternative	2	Preferred Alternative	1
	No-Go Alternative:	0	No-Go Alternative:	0
PROBABILITY (C)	Preferred Alternative	4	Preferred Alternative	3
	No-Go Alternative:	0	No-Go Alternative:	0
INTENSITY OR MAGNITUDE (D)	Preferred Alternative	-3	Preferred Alternative	-3
	No-Go Alternative:	0	No-Go Alternative:	0
STAKEHOLDER INPUT (E)	Preferred Alternative	-2	Preferred Alternative	-2
	No-Go Alternative:	0	No-Go Alternative:	0
SIGNIFICANCE RATING (F) = ((A*B*D) + (E))*C	Preferred Alternative	-32	Preferred Alternative	-15
	No-Go Alternative:	0	No-Go Alternative:	0
CUMULATIVE IMPACTS	The cumulative impact of disturbance and/or displacement caused by the decommissioning of the Grid Connection may be **low to medium** after mitigation when considering other relevant projects within 50 km.			
CONFIDENCE	Low			

MITIGATION MEASURES	• An EMP must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted. All contractors are to adhere to the EMP and should apply good environmental practice during decommissioning; • ECOs to oversee activities and ensure that the CEMP for decommissioning is implemented and enforced; • The appointed ECO must be trained by an avifaunal specialist to identify the potential priority species and Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), decommissioning activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed; • Prior to decommissioning, an avifaunal specialist should conduct a site walkthrough, covering the entire power line route to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final decommissioning schedule in close proximity to that specific area, including abbreviating activity times, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.

6.4 Assessment of no-go alternative

Should the proposed WEF site and Grid Connection projects not be constructed (i.e. the no-go alternative is realised), the status quo with regards to the current land use is likely to persist in the medium to long term. The bird baseline as described in the report is unlikely to change significantly, apart from changes caused by natural environmental fluctuations (e.g. dry vs wet years). There will be no negative impact on the avifauna of the WEF site or the Grid Connection site if the no-go alternative is realised.

Literature cited

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