SOVENTIX SOLAR POWER PLANT:

AVIFAUNAL MANAGEMENT AND MONITORING PLAN

PRODUCED FOR ECOLEGES

BY

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INTRODUCTION

The Soventix solar facility will result in a number of impacts on the local avifauna, including habitat loss and disturbance during the construction and operational phases, and potentially direct mortality of priority species colliding with solar panels and associated power line structures during the operational phase. There is also a high probability that the facility will attract a number of species during the operational phase, as a result of foraging and nesting opportunities present within the facilities. Although the solar development is considered a low risk project according to the Birdlife South Africa (BLSA) guidelines (Jenkins et al., 2016), an avifaunal management plan which ensures that the development will have the least amount of impact on sensitive avifauna and their habitats is required, while also ensuring that birds do not impact the facility's operational productivity.

The required management actions and associated monitoring requirements to minimise and reduce impacts on Avifauna are detailed below, first for the Construction Phase and then for the Operational Phase.

1. CONSTRUCTION PHASE MANAGEMENT ACTIONS

1.1 Actions to reduce habitat loss

Habitat loss and fragmentation will be the most significant impact during the construction phase of the development, resulting in immediate and permanent displacement of most bird species from the development footprint. Although it is generally recommended that existing degraded urban/industrial areas and transformed/sterile agricultural areas with no natural habitat remaining are used for the construction of new solar facilities (Jenkins et al., 2016), this is not always feasible. Sensitive microhabitats identified during the EIA should be avoided at all costs, such as dolerite ridges, water bodies (even when dry), and raptor nests (with a 1 km buffer zone). The following management actions during the construction phase are recommended:

1. The destruction of habitat during construction should be limited as far as possible, and should be strictly contained within the direct footprint of the development.
2. The use of designated lay-down areas within the footprint of the development should be employed where feasible, to avoid habitat loss and disturbance to adjoining areas.
3. All building waste produced during construction from the development site must be removed and disposed of at a designated waste management facility.

4. All liquid wastes must be contained in appropriately sealed vessels/ponds within the footprint of the development area, and be disposed of at a designated waste management facility after use.
5. Any liquid and chemical spills should be dealt with accordingly to avoid contamination of the environment and bird habitats.
6. Only existing roads should be used as far as possible to avoid the unnecessary construction of new roads, which will result in further habitat loss.
7. Similarly, the construction of any new power lines associated with the development should follow the shortest route possible and along existing power line routes or roads where feasible. The footprint beneath new power lines should also be kept to an absolute minimum to avoid further habitat loss.
8. Where any additional knowledge regarding sensitive avifaunal habitats is gained, this should be used to guide the final siting and layout of solar arrays so as to avoid potential loss of such habitat.

1.2 Actions to reduce disturbance

Although disturbances will not have a permanent impact as opposed to habitat loss, it may cause the displacement of sensitive birds from preferred habitats with a possible reduction in their survival and reproduction potential. The following management actions during the construction phase are recommended:

1. The movement of vehicles and personnel involved with the construction should be restricted to within the footprint of the development and designated access roads.
2. The number of vehicles using access and maintenance roads should be minimised, in an attempt to keep disturbances to a minimum.
3. Sensitive microhabitats (e.g. dolerite ridges) in the vicinity of the development footprint should be avoided, particularly during the breeding season of large terrestrial birds (generally during summer; Hockey *et al*., 2005).
4. The construction of any new roads or power lines within 1 km of raptor nest sites should be avoided, so as to limit disturbance to breeding birds.
5. Existing roads within 1 km of nest sites of priority species should be decommissioned prior to the onset of construction, so as to avoid any disturbance to breeding birds.
6. Where any additional knowledge regarding sensitive avifaunal habitats or movements patterns is gained, this should be used to guide the final siting and layout of solar arrays so as to avoid potential disturbance of priority species as well as their flight paths between focal points such as water bodies, foraging and roosting sites.

2. RECOMMENDED MONITORING – CONSTRUCTION PHASE

2.1 Monitoring nests of priority species

The monitoring of nests of priority species is essential in order to determine whether the facility has any negative impact on these. The nests of priority species, such as Verreaux's Eagle *Aquila verreauxii* and Secretarybird *Sagittarius serpentarius*, that are in close proximity to the facility, must be monitored on a regular basis at the onset of construction and continue throughout the operational phase of the project. The following monitoring recommendations are suggested:

1. All nests of priority species identified during the EIA phase must be included in the monitoring programme.
2. Monitoring of nests of priority species must be initiated at the onset of the construction phase of the project, and be continued into the operational phase.
3. Any new nests of priority species that are detected during the construction phase of the project must also be included in the monitoring programme.
4. Monitoring of nests of priority species should be undertaken at least weekly during the construction phase.
5. All observations made of the nests of priority species must be recorded in writing, and ultimately in electronic format, to facilitate distribution of the data to the relevant persons responsible for collating and analysing the data.
6. Data to be recorded should include at least the following: the date, time, nest identification, bird species, nest status (active or inactive), nesting stage if known (e.g. nest building, incubation, nestling rearing, fledging), and the presence of adult birds.

3. OPERATIONAL PHASE MANAGEMENT ACTIONS

3.1 Actions to reduce habitat loss

Although habitat impacts during the operational phase may be less severe than during the construction phase, the following management recommendations should be adhered to during the operational phase:

1. Avoid clearing any natural undisturbed areas during routine or ad hoc maintenance procedures, especially beyond the existing footprint of the development.
2. Use lay-down areas within the footprint of the development where feasible during any maintenance procedures, to avoid habitat loss and disturbance to adjoining areas

3. Remove all building waste produced during maintenance procedures from the solar facility site and dispose of these at a designated waste management facility.
4. Contain any liquid wastes kept at the facility for maintenance purposes in appropriately sealed vessels/ponds within the footprint of the development, and dispose of these at a designated waste management facility after use.
5. Any liquid and chemical spills should be dealt with accordingly to avoid contamination of the environment.

3.2 Actions to reduce disturbance

1. Limit activities and movement of vehicles and personnel to within the footprint of the development area to avoid disturbance of sensitive species and their habitats.
2. Limit any movements by vehicle and personnel to within the footprint of power lines and other associated infrastructure, especially during routine maintenance procedures.
3. Avoid disturbance of large raptors nesting on power line structures at all costs by keeping a suitable distance from such nests.
4. Minimise the use of outdoor lighting at night so as not to unnecessarily attract invertebrates to the solar facility and possibly their avian predators, and to minimise disturbance to birds flying over the facility at night, which can be attracted and confused by lights (Gehring et al., 2009).

3.3 Actions to reduce collisions with PV panels

Various groups of birds are known to collide with PV solar panels, primarily due to the reflective properties of the panels (Kagan *et al*., 2014). In the absence of a complete understanding of the factors that cause birds to collide with PV panels, it is suggested that the recommendations be incorporated into new solar facilities until further research into panel design and layout suggests otherwise. The following recommendations are suggested:

1. Use 28 cm-spaced contrasting bands or 10 cm spatial gaps between solar panels, as suggested by Visser (2016), as this may reduce collision mortality. This enables birds, particularly waterbirds, to differentiate the expansive layout of panels as a solid structure, reducing the likelihood that they may try to land and collide with the panels.
2. All incidents of collision with panels should be recorded as meticulously as possible in writing, including data related to the species involved, the exact location of collisions within the facility, and suspected cause of death (e.g. direct impact with PV panel, or other associated structures).

3. Any incidents of bird injury or mortality observed during the operational phase due to collision with PV panels must also be reported to the relevant official responsible for implementing the avifaunal management plan on a regular basis.
4. Post-construction monitoring with the aid of video surveillance should be considered, as suggested by Visser (2016), as this will contribute towards understanding bird interactions with solar panels.

3.4 Actions to reduce collisions with power lines

Collisions with power lines is a major cause of mortality amongst large terrestrial birds, flamingos and waterfowl (Jenkins *et al.*, 2010) and particularly the Endangered Ludwig's Bustard (Jenkins *et al*., 2011; Shaw, 2013). It is therefore essential that any power lines erected within the study area should be located and marked in such a way as to minimise bird collisions as far as possible. Prior to construction, the design and layout of any proposed power lines must be endorsed by members of the Eskom-EWT Strategic Partnership, taking into account the mitigation guidelines recommended by Birdlife South Africa (Smit, 2012; Jenkins *et al.*, 2016). The proposed routes that the new connecting power lines between the solar facility and the existing lines will follow must also be assessed for any areas that may pose a threat to birds. Any new power line erected should also follow the shortest distance possible across an area where collisions are expected to be minimal, or follow existing power lines. The following recommendations are suggested:

1. New power lines must be marked with bird diverters to make the lines as visible as possible to collision-susceptible species. Recommended bird diverters such as brightly coloured 'aviation' balls, thickened wire spirals, or flapping devices that increase the visibility of the lines should be fitted.
2. Any incidents of bird injury or mortality observed during the operational phase due to collision with power lines must be recorded in writing and reported to the relevant official responsible for implementing the avifaunal management plan. Information pertaining to collisions with power lines must include at least the following: the date, the species and number of individuals involved, the exact geographical location, and the possible reasons for the collision.
3. Regular monitoring (weekly) of power lines should be undertaken to detect bird carcasses to enable the identification of any areas of high impact to be marked with bird diverters.

3.5 Actions to reduce electrocutions on power lines

Electrocution is an additional threat faced by the large raptors when perched or attempting to perch on power line structures (Lehman *et al*., 2007). Prior to construction of the facility, only power lines structures that are deemed safe for birds should be considered for construction. The following recommendations are suggested:

1. Where necessary, deterrent devices such as bird guards should be mounted on relevant parts of the pylons to reduce the possibility of electrocutions.
2. Any incidents of bird injury or mortality observed during the operational phase due to electrocution caused by power lines must be recorded in writing and reported to the relevant official responsible for implementing the avifaunal management plan. Information pertaining to electrocutions should include at least the following: the date, species and number of individuals involved, the exact geographical location, and the possible reasons for the electrocution.
3. Regular monitoring (weekly) of power lines should be undertaken to detect bird carcasses to enable the identification of any areas where mitigation measures must be applied.

3.6 Actions to reduce impact of fences

If the perimeter of the solar facility is to be fenced, due consideration should be given to erecting only a single fence. Double fences are known to cause terrestrial birds such as bustards and francolin to get caught between the fences, resulting in potential fatalities (Visser, 2016). The following recommendations are suggested to ensure minimal impact of fences on the local avifauna:

1. The perimeter fence should be monitored at least weekly to determine whether any bird fatalities have occurred as a result of the fencing.
2. All bird fatalities along the perimeter fence must be recorded in writing, with respect to the following: the date, the species and number of individuals involved, the exact geographical location along the perimeter, and the possible reason for the collision with the fence (e.g. was the bird startled while walking beside fence, was the bird flying when it collided with the fence).
3. If the fence or portions of the fence are considered to be a significant threat to local bird populations, especially sensitive or priority species, then systematic marking of the fence to reduce avian collisions with the fence must be implemented. Markings should be at an appropriate height to be visible to birds colliding with the fence.

3.7 Actions to reduce nesting on infrastructure

Birds are known to breed at solar facilities, and are reported to construct nests on the mountings directly underneath the solar panels where there is shade (Lovich and Ennen, 2011; Hernandez et al., 2014; Visser, 2016), but also on communication masts and buildings. It is therefore highly probable that certain avifaunal species, primarily non-priority species, will be attracted to the facility and use the associated infrastructure for nesting. Increased water runoff from PV panels may also contribute to a denser growth of vegetation, which may also serve to attract certain species. The presence of avifauna within the facility should therefore be managed to minimise negative interactions between these and the facility. The following management actions are recommended:

1. The identity of species that have built nests on structures should be identified and recorded in writing, while the position of nests on structures should also be noted so as to contribute towards a better understanding of how birds use the structures for nesting.
2. Nests can be removed from the infrastructure if they pose a threat to the safe operation of the facility, but preferably only after the completion of the breeding season when the nests are no longer in use.
3. Should the construction of nests on infrastructure become a significant problem, then birds should rather be prevented from accessing these areas by covering susceptible structures with fine mesh or similar material to exclude birds.
4. Where any bird nests of sensitive or priority species occur within the facility that might be affected by management activities (e.g. vegetation mowing), these should be marked or cordoned off to prevent these from being destroyed during the breeding season.
5. Resident birds should not be habituated by providing them with food in any way, as it is not necessary to provide such species with food or water. Feeding birds may only exacerbate the incidence of birds nesting on structures in the vicinity.

4. RECOMMENDED MONITORING - OPERATIONAL PHASE

4.1 Monitoring of bird mortalities associated with infrastructure

Monitoring bird mortalities associated with infrastructure of the facility during the operational phase of project must be undertaken, as this will contribute to a better understanding of the nature and extent of the impact of solar facilities on avifaunal populations. It should be noted that monitoring during the operational phase (post-construction), as part of the management plan, does not negate the need to first avoid, minimise and mitigate the negative impacts

during the construction phase of the project. The following monitoring procedures for all types of infrastructure (PV panels, power lines, and fences) are recommended, based on the guidelines outlined by Jenkins et al. (2016):

1. Monitoring surveys to detect fatal collisions between birds (especially priority species) and all types of infrastructure must be undertaken at least weekly during the operational phase for at least two years after construction to generate a baseline of mortality patterns and identify problem areas where additional mitigation may be required.
2. The entire length of all power lines associated with the facility, and the entire length of perimeter fences, must be monitored with the aim of detecting potential fatalities are a result of collisions with such infrastructure.
3. For solar arrays, a minimum of 20- 30% of the solar hardware should be methodically searched for fatalities, with a search interval informed by carcass persistence trials and objective monitoring (Jenkin et al., 2016). Any evidence of mortalities or injuries within the remaining area should be carefully recorded as incidental findings. The search areas under power lines and solar arrays, and adjacent fences, should be clearly defined and consistently applied throughout the monitoring.
4. All monitoring of fatalities should be undertaken systematically with the aim of attempting to quantity the impact of the facility on local bird populations, and particularly on priority species.
5. Observed mortality rates must to be adjusted to account for searcher efficiency (which can change seasonally depending on vegetative condition of the site), scavenger removal and the proportion of the facility covered by the monitoring effort. It should be noted that some of these factors may change seasonally due to the changes in abundance of scavengers (e.g. breeding season) and visibility of the areas to be monitored due to seasonal changes in vegetation cover through the course of a year.
6. The duration and scope of monitoring should be informed by the outcomes of the previous year's monitoring, and should be reviewed annually.
7. Monitoring of bird fatalities should be undertaken for two to three years to take inter-annual variations into account.
8. The monitoring protocols employed during the operational phase should preferably be repeated periodically (perhaps every 3-5 years) over the lifetime of the project.
9. Where there is significant mortality or any impact on priority species as a result of the facility, the help of an avifaunal specialist should be sought to help mitigate and reduce these problems and additional monitoring initiated to check on the effectiveness of the implemented actions.

3.3 Monitoring nests of priority species

The monitoring of nests of priority species is essential in order to determine whether the facility has any negative impact on these. The nests of priority species such as Verreaux's Eagle and Secretarybird that are in close proximity to the facility must be monitored on a regular basis, and must commence at the onset of construction and throughout the operational phase. The following monitoring recommendations during the operational phase are recommended:

1. All nests of priority species identified during the EIA phase must be included in the monitoring programme.
2. Any new nests of priority species that are detected during the operational phase of the project must also be included in the monitoring programme.
3. Monitoring of nests should be undertaken on at least a monthly basis during the operational phase.
4. All observations made of the nests of priority species must be recorded in writing, and ultimately in electronic format, to facilitate distribution of the data to the relevant persons responsible for collating and analysing the data.
5. Data to be recorded should include at least the following: the date, time, nest identification, bird species, nest status (active or inactive), nesting stage if known (e.g. nest building, incubation, nestling rearing, fledging), and the presence of adult birds.

5. CONCLUSIONS

The Soventix solar development is considered a low risk project according to the guidelines stipulated by BLSA. However, it is advised that the precautionary principle is applied with regards to recommended management and monitoring actions, to ensure the conservation of priority species where uncertainty prevails. Adherence to strict monitoring protocols is therefore of utmost importance both during the construction and operational phase of the project.

Habitat loss and disturbance are the primary impacts expected during the construction phase, and hence should be kept to an absolute minimum where feasible. Although monitoring of habitat loss and disturbance are not considered as management actions, the monitoring of collisions between birds and infrastructure during the operational phased of the project is deemed very important.

Monitoring of all bird fatalities associated with infrastructure such as PV panels, power lines, fences, as well as electrocutions, must be undertaken on a regular basis. Regular monitoring of

these impacts should be undertaken to determine high risk areas where further mitigation can be implemented, and to contribute to a better understanding of the interactions between birds and solar facilities. This will also facilitate the development of a sustainable solar energy industry and reduce the risks and costs to both the environment and the industry in the long term.

6. REFERENCES

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