AUGUST 2022

TSHEDZA 3 INVESTMENTS (PTY) LTD
40MW PHOTOVOLTAIC SOLAR ENERGY FACILITY (PHASE 2)
AVIFAUNAL IMPACT ASSESSMENT REPORT

DRAFTED BY:
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PREPARED FOR:
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PROFESSIONAL EXPERIENCE

Ms. Megan Diamond Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in conservation for 20 years. She has 16 years' worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for over 140 projects. During her tenure at the Endangered Wildlife Trust's Wildlife & Energy Programme and the Programme's primary project (i.e. the Eskom-EWT Strategic Partnership) from 2006 to 2013, Megan was responsible for assisting the energy industry and the national utility in minimising the negative impacts, associated with the construction and operation of electrical infrastructure, on wildlife through the provision of strategic guidance, risk and impact assessments, training and research. Megan (SACNASP Environmental Science Registration number 300022/14) currently owns and manages *Feathers Environmental Services* and is tasked with providing guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments including renewable energy facilities, power lines, power stations and substation infrastructure in addition to railway infrastructure and residential properties within South Africa and elsewhere within Africa. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored several academic papers, research reports and energy industry related guidelines, including the *BirdLife South Africa/ Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* and the *Avian Wind Farm Sensitivity Map for South Africa* (2015), and played an instrumental role in facilitating the endorsement of these two products by the South African Wind Energy Association (SAWEA), IAIAsa (International Association for Impact Assessment South Africa) and Eskom. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Power line Network (2013-2015), a working group comprised of subject matter experts from across the world, working in partnership to share lessons, develop capacity, pool resources, and accelerate collective learning towards finding innovative solutions to mitigate this impact on threatened crane populations. She is currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group.

DECLARATION OF INDEPENDENCE

I, Megan Diamond, in my capacity as a specialist consultant, hereby declare that I:

- Act as an independent specialist to *Environmental Management Assistance (Pty) Ltd* for this project.
- Do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Amendment to Environmental Impact Assessment Regulations, 2017.
- Will not be affected by the outcome of the environmental process, of which this report forms part of.
- Do not have any influence over the decisions made by the governing authorities.
- Do not object to or endorse the proposed development, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- Undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Amendment to Environmental Impact Assessment Regulations, 2017.

INDEMNITY

- This avifaunal impact assessment report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken.
- This report is based on a desktop investigation using the available information and data related to the site to be affected and site visits to the project area conducted on 8 and 9 February 2021 and 23 May 2022. No long-term investigation or monitoring has been conducted.
- The Precautionary Principle has been applied throughout this assessment.
- The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator reserves the right to modify this report, recommendations and conclusions at any stage should additional information become available.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

10 August 2022

EXECUTIVE SUMMARY

In order to demonstrate commitment to sustainable development and a pledge to move towards a cleaner energy future *Tshedza 1 Pre Project Development (Pty) Ltd and Tshedza 3 Investments (Pty) Ltd* (hereinafter referred to as *Tshedza*) proposes to construct a Photovoltaic (PV) Solar Energy Facility (SEF) up to 59.9MW, split across two phases of 19.9MW (granted an Environmental Authorisation (EA) by the national Department of Mineral Resources and Energy (DMRE) on 15 March 2022 Ref GP 30/5/1/2/2(58) MR) and 40MW (Phase 2 - as assessed in this impact assessment report) respectively, to supply power to the existing Ergo Mining (Pty) Ltd Brakpan Plant, a wholly owned subsidiary of DRD Gold Ltd. The two mining facilities i.e., Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Dam facility, are currently supplied with electricity by Eskom via the existing grid infrastructure. The proposed PV SEF will generate electricity with battery storage (EA 15 March 2022 Ref: GP 30/5/1/2/2(58) MR) to integrate with the existing Eskom grid to supply the Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Facility. The generated electricity will be utilised when there is an interruption to Eskom's supply in energy. The Phase 2 development envelope is situated on Ergo Mining owned land adjacent to the Withok Estates Agricultural Holdings and Witpoort Estates Agricultural Holdings areas of Brakpan within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province.

The proposed Project Area of Influence (PAOI) is considered to have a HIGH Animal Species sensitivity, based on the screening report for the proposed 40MW SEF development area and PAOI which was generated on 5 February 2021. The proposed PAOI occurs within the Gauteng Environmental Management Framework and within an Air Quality Priority Area. Parts of the proposed study area are considered to have a MEDIUM Animal Species Theme Sensitivity based on the possible occurrence of African Grass Owl *Tyto capensis* and a HIGH Avian Theme Sensitivity, as a result of the presence of wetland areas. It is important to note that the delineation of wetlands actually pertains to the Bat Theme Sensitivity, but does still have relevance to avifauna within the PAOI. Although African Grass Owl was not observed during the site verification surveys, it has been regularly recorded within the POAI (pers. comms Ms. Jeanne-Michele White, 23 May 2022). These records include breeding events, north west of land portion Withok 131 IR Portion 9 (Alternate Site Layout). In addition, the observation of African Marsh Harrier *Circus ranivorus* during the site verification survey conducted on 23 May 2022 further demonstrates the utilisation of the PAOI by Species of Conservation Concern (SCC). While parts of the PAOI are subject to fairly significant levels of disturbance, suitable avifaunal habitats are present that are capable of supporting SCC. The desktop analysis, I&AP observations & photographic records, in addition to the observations emanating from the on-site inspections, confirms the MEDIUM sensitivity assigned to the PAOI .

A total of 308 bird species have been recorded within the relevant pentads during the SABAP2 atlassing period to date. The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur within the areas earmarked for the proposed 40MW SEF, particularly where pockets

of natural vegetation/habitats persist. Of the 309 species, 19 of these are considered to be regional SCC. The White Stork *Ciconia ciconia*, which is not listed, but is protected internationally under the *Bonn Convention on Migratory Species* and Lesser Kestrel *Falco naumanni*, a GDARD priority species has also been recorded in the study area. It is important to note that with the exception of Maccoa Duck *Oxyura maccoa* (n=129), Lesser Flamingo (n=174) and Greater Flamingo (n=415) the remaining SCC species have been recorded in low numbers, with less than 20 individual birds being recorded over the fourteen-year survey period. The significant individual numbers of Maccoa Duck, Lesser and Greater Flamingo can be attributed to the number of observations/surveys conducted within the three pentads to the north of the study area, which contain a series of wetlands and waterbodies - habitat that is capable of supporting these species in abundance. Lanner Falcon *Falco biarmicus* is the only SCC species recorded in the single pentad within which the proposed 40MW SEF development sites are located. The low report rates can be attributed to fairly high levels of disturbance and habitat loss associated with the surrounding mining and industrial practices which has undoubtedly displaced many of the naturally occurring species, that under optimum conditions, would inhabit these areas. Although this report focuses on SCC, since the impacts associated with the construction and operation of the proposed 40MW SEF is likely to be more biologically significant for these species, the impact on non-SCC SEF sensitive avifauna (totalling 107 species) is also assessed, albeit in less detail. Furthermore, SCC can often be used as surrogate species for the others in terms of impacts and the necessary mitigation. The non-SCC priority species that have been considered for this assessment include korhaan, buzzards, kestrels, falcons, herons, geese, ibis and various water dependent species.

A summer survey was conducted on 8-9 February 2021 (encompassing the Phase 1 20MW SEF development area and PAOI). In order to describe the avifaunal community present, a concerted effort was made to sample the avifauna in all of the primary habitats that were available at the proposed solar site and within the larger study area by applying the fixed point count surveys, a vehicle transect survey and a focal site survey. The summer site survey produced a combined list of 40 species, covering both the 20MW SEF development area and PAOI. No SCC were observed during this site survey. Most observations were of small passerine species that are common to this area. An identical methodology was followed for the autumn site survey, conducted on 23 May 2022. This visit produced a similar suite of observations with a combined list of 66 species, covering both the 40MW SEF development area and PAOI. African Marsh Harrier was the most notable species recorded during this survey.

The proposed 40MW SEF development area and PAOI are located within a single primary vegetation division namely the Grassland Biome, specifically Tsakane Clay Grassland and Soweto Highveld Grassland. Of South Africa's 841 bird species, 350 occur in the Grassland Biome. This includes 29 species of conservation concern (i.e. those species declining in numbers), ten endemics, and as many as 40 specialist species that are exclusively dependent on grassland habitat. Grasslands represent a significant feeding area for many bird species in densely populated areas and will typically attract Lanner Falcon, African Marsh-harrier, Black-winged Pratincole,

Abdim's Stork and White Stork observed during the SABAP2 survey period. Grassland patches are also a favourite foraging area for game birds such as francolins, spurfowl and Helmeted Guineafowl. This in turn could attract large raptors i.e. Martial Eagle because of both the presence and accessibility of prey.

It is important to note that the area that has been earmarked for the proposed 40MW SEF development has experienced significant transformation in the form of mining and urbanisation which dominate the landscape. Although parts of the development area have been largely rehabilitated and the grassland habitat has recovered, fairly significant levels of disturbance persist in the form of vehicle and pedestrian traffic, pastoral activities and mining operations in the immediate surrounds. SABAP2 reporting rates for SCC potentially occurring in grassland habitat in the study area are very low and the absence of these grassland dependent SCC at the proposed 40MW SEF development area is an indication of the significant levels of human activity and disturbance. Therefore, the potential displacement impacts as a result of habitat loss and disturbance associated with the construction and operation of the proposed 40MW SEF are likely to be low for the aforementioned grassland dependent species.

The effects of any development 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 diversity of species present. With so many variables involved, the impacts of each development must be assessed individually. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss and disturbance causes a reduction in birds using an area which may then reduce the risk of collision). The principal areas of concern for SCC and non-SCC SEF sensitive species related to the proposed 40MW SEF development are:

* Displacement due to habitat loss in the physical SEF infrastructure footprint;
* Displacement due to disturbance associated with construction and operation/maintenance of the proposed 40MW SEF development;
* Mortality due to collision with the PV panels; and
* Displacement due to habitat loss as a result of altered run-off and the use of chemical pollutants.

Sensitive features present within the PAOI include the river systems, waterbodies, wetland areas and breeding locations to the north-west, west and south of the proposed SEF layout boundaries (FIGURE 7). The river and wetlands have been buffered by 100m and assigned a HIGH sensitivity rating, owing to the degree of connectivity with other ecosystems and their suitability to support African Grass Owl and African Marsh Harrier. The African Marsh Harrier breeding and foraging habitat is buffered by 100m and assigned a HIGH sensitivity rating. Similarly, the African Grass Owl breeding location has been buffered by 100m and assigned a HIGH sensitivity rating in accordance with GDARD requirements. Suitable foraging habitat occurs on the neighbouring properties for those priority SCC whose distribution overlaps with the proposed development

areas – this habitat has been assigned a MEDIUM sensitivity rating (FIGURE 8). The remaining areas earmarked for the proposed development are heavily transformed and considered to be of LOW sensitivity.

One of the objectives of this study is to determine the preferred PV SEF development layout that poses the least impact to the avifaunal community, particularly the sensitive SCC present within the study area. The two alternatives that have been proposed for the 40MW SEF i.e. Preferred Layout and Alternative Layout occur within the same pentad. They are comprised of identical vegetation units and subjected to similar existing disturbances associated with the land use practices in the area and are therefore likely to be identical in terms of species diversity and density too. With this in mind, the selection of a preferred Site Layout has been determined using observations of available micro habitat, species occurrence and the location of the Site Layouts in relation to existing infrastructure. The Preferred Layout avoids the areas of HIGH sensitivity within the PAOI, particularly the African Grass Owl and African Marsh Harrier breeding locations. This layout also contains areas that are heavily transformed and subject to significant levels of existing habitat degradation and disturbance. It is on this basis that the Preferred Layout is considered to pose the least impact to the resident avifaunal community.

In conclusion, the habitat within which the proposed development area is located MODERATELY to HIGHLY sensitive from a potential bird impact perspective. In recent years, anthropogenic impacts, mostly in the form of mining and urbanisation have largely transformed the landscape resulting in a negative impact on avifaunal diversity and abundance with the study area. This is reflected in the low reporting rates for priority species, which may also indicate that levels of disturbance are high. The construction of the proposed 40MW SEF will result in impacts of MODERATE to LOW significance to birds occurring in the vicinity of the new infrastructure, which can be reduced to negligible levels through the application of mitigation measures. Given the presence of existing habitat degradation and disturbance, it is anticipated that the proposed 40MW SEF can be constructed within the Preferred Layout with acceptable levels of impact on the resident avifauna subject to the following recommendations:

* Conduct a pre-construction inspection (avifaunal walk-through) of the final SEF layout, to identify any species that may be breeding on the authorised development site or within the immediate surrounds to ensure that any impacts likely to affect breeding species (if any) are adequately managed.
* Construction activities (i.e. all staff, vehicle and machinery) should be restricted to the immediate footprint of the infrastructure.
* Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifaunal species.
* Care should be taken not to introduce or propagate alien plant species/weeds during construction.
* Mitigation is complex at electrical structures since there are many factors that contribute to collisions with the PV panels. It is therefore recommended that mitigation be applied reactively once the SEF, if a

significant problem is detected. Monitoring of this infrastructure for bird fatalities must be built into the operational environmental management programme for the facility.

- A carefully considered surface water/drainage management plan must be developed for the site including attention to the use of environmentally friendly cleaning chemicals.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

In accordance with the outcomes of the impact assessment detailed in Section 11 and 12, in conjunction with the baseline conditions as presented in Section 7 and the impact management measures in Section 13, the proposed 40MW SEF is not deemed to present unmitigable negative environmental issues or impacts. It is this specialist's opinion that the construction of the 40MW SEF will result in acceptable levels of impact on the resident avifauna subject to the selection of the preferred layout alternative and the aforementioned mitigation and management measures.

TABLE OF CONTENTS

1. INTRODUCTION

Energy infrastructure plays an important role in fortifying economic activity and growth across the country and therefore the development of this infrastructure needs to be robust and extensive enough to meet industrial, commercial and household needs. South Africa's Renewable Energy potential is significant and together with a national commitment to transition to a low carbon economy, 26 030MW of the 2019 Integrated Resources Plan target of newly generated power are expected to be from renewable energy sources (https://ipp-projects.co.za). In order to demonstrate commitment to sustainable development and a pledge to move towards a cleaner energy future *Tshedza 1 Pre Project Development (Pty) Ltd and Tshedza 3 Investments (Pty) Ltd* (hereinafter referred to as *Tshedza*) proposes to construct a Photovoltaic (PV) Solar Energy Facility (SEF) up to 59.9MW, split across two phases of 19.9MW (granted an Environmental Authorisation (EA) by the national Department of Mineral Resources and Energy (DMRE)on 15 March 2022 Ref GP 30/5/1/2/2(58) MR) and 40MW (Phase 2 - as assessed in this impact assessment report) respectively, to supply power to the existing Ergo Mining (Pty) Ltd Brakpan Plant, a wholly owned subsidiary of DRD Gold Ltd, and the Withok Tailings Dam facility. The two mining facilities i.e., Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Dam facility, are currently supplied with electricity by Eskom via the existing grid infrastructure. The proposed PV SEF will generate electricity with battery storage (EA 15 March 2022 Ref: GP 30/5/1/2/2(58) MR) to integrate with the existing Eskom grid to supply the Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Facility. The generated electricity will be utilised when there is an interruption to Eskom's supply in energy.

The National Environmental Management Act (NEMA) (Act 107 of 1998) requires that an impact assessment be conducted for any development which could have a significant effect on the environment, with the objective to identify, predict and evaluate the actual and potential impacts of these activities on ecological systems; identify alternatives; and provide recommendations for mitigation to minimize the negative impacts. In order to meet the Scoping and Environmental Impact Reporting (S&EIR) requirements as outlined in the 2014 National Environmental Management Act (No 107 of 1998) Regulations GNR 983, GNR 984 and GNR 985, as amended in 2017, *Tshedza* require detailed specialist studies that will document any potential fatal flaws, the impacts of the project and recommend measures to manage (maximise positive and minimise negative) and monitor those impacts.

2. PROJECT LOCATION

The Phase 2 development envelope is situated on Ergo Mining owned land adjacent to the Withok Estates Agricultural Holdings and Witpoort Estates Agricultural Holdings areas of Brakpan within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province (FIGURE 1).

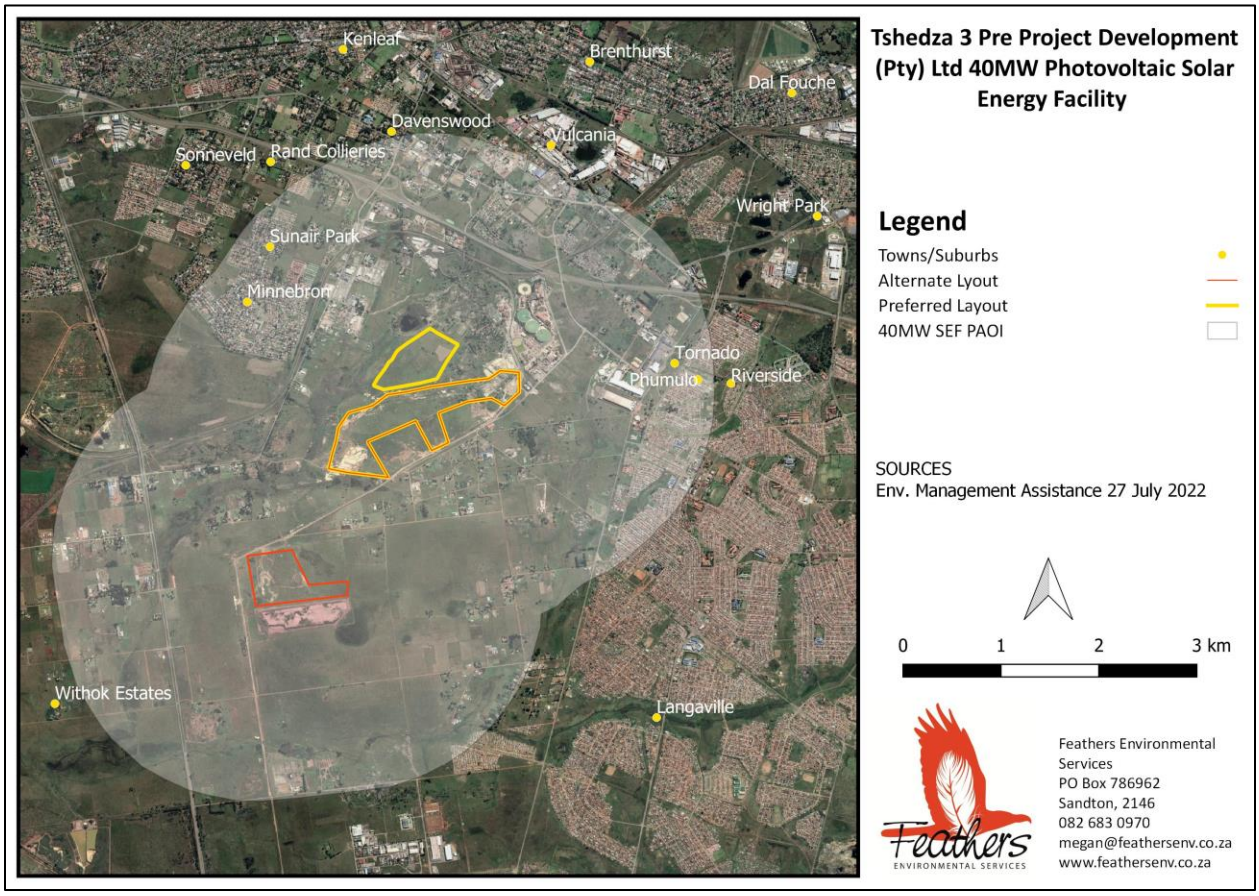

FIGURE 1: Regional map detailing the location of the 40MW PV Solar Energy Facility (Phase 2) located within the Ekurhuleni Metropolitan Municipality, Gauteng Province.

3. PROJECT OVERVIEW

3.1 Layout Alternatives

Two layout areas are proposed, with their respective locations detailed below:

* Preferred Layout Area
  - Farm Witpoortje 117 IR Portion 183
  - Farm Witpoortje 117 IR Portion 272

* Alternate Layout Area
  - Farm Witpoortje 117 IR Portion 183 (this area is the same for both the preferred and alternate layout areas)
  - Farm Withok 131 IR Portion 9

3.2 Project Description

The proposed 40MW SEF development envelope is approximately 238ha (Preferred Layout Area totaling 116ha and the Alternate Layout Area totaling 122ha) in extent. The key infrastructure components associated with the proposed project will consist of the following:

- PV solar panels with an export capacity of up to 40MW;
- Mounting structures to support the PV panels. The PV panels will be mounted at an appropriate height so as to receive the maximum amount of solar radiation without the buffeting effects of the wind. The angle of the panel moves and tracks the sun (single axis tracking) so that the maximum amount of solar radiation can be collected through the day;
- Cabling between project components;
- An onsite substation with central inverter/transformer stations to collect the energy generated from the PV panels and convert the electricity from direct to alternating current which can be evacuated into the electricity distribution grid;
- A new road access point is proposed via Denne Road, north west of the preferred layout. A portion of the existing road will be upgraded - the upgrade length was not confirmed at the time of the assessment;
- Internal access roads (3m in width); and
- Associated buildings including a workshop area for maintenance, storage, and control facility with basic services such as water, sewage and electricity.

4. THIS REPORT

4.1 Scope of Work

Tshedza has appointed *Environmental Management Assistance (Pty) Ltd* (hereafter referred to as *EMA*) as independent environmental assessment practitioners to manage the Environmental Impact Assessment (EIA) process for the proposed Phase 2 40MW SEF development. *Feathers Environmental Services CC* (hereafter referred to as *Feathers*) was appointed to compile the avifaunal component using a set methodology and various data sets to determine which avian species regularly occur within the study area, the availability of bird micro habitats (i.e. avifaunal sensitive areas), the possible impacts of the proposed development and their significance in addition to the provision of recommendations for the mitigation of the anticipated impacts.

Feathers has conducted this avifaunal impact assessment according to the following terms of reference, in accordance with the minimum report requirements listed in the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species (Government Gazette No 43855, 30 October 2020):

- Conduct a site sensitivity verification through the use of a desk top analysis, using satellite imagery and other available and relevant information, in addition to an on-site inspection;
- Assess various avifaunal datasets, including but not limited to Important Bird Areas (IBAs) and describe the avifaunal communities (particularly with reference to Species of Conservation Concern (SCC) most likely to impacted on by the 40MW SEF;
- Identify and confirm avifaunal microhabitats within the proposed SEF layouts and assess these for their suitability to support SCC and non-SCC priority (SEF-sensitive) species, in terms of breeding, roosting and foraging;
- Describe the avifaunal communities (both SCC and non-SCC priority species) most likely to be impacted, based on primary occurrence data collected during the site surveys;
- Provide a detailed description of the impacts associated with the construction and operation of the 40MW SEF;
- Assess the significance (rated according to a pre-determined set of criteria of the identified direct, indirect and cumulative impacts, during the construction and operation phases of the SEF, based on data collected in-field;
- Consider the layout alternatives and the proposed PV solar panel layout and advise possible changes to the layout (if necessary);
- Recommend practical mitigation measures for the management of the identified impacts, at each stage of the development process, for inclusion in the draft Environmental Management Programme (EMPr);
- Propose a monitoring programme for the sensitive areas, species or receptors (if necessary); and
- Describe the gaps in baseline data and an indication of the confidence levels. The best available data sources will be used to predict the impacts.

4.2 Structure of this report

In terms of the NEMA 2014 EIA Regulations contained in GN R982 of 04 December 2014 (as amended) all specialist studies must comply with Appendix 6 of the NEMA 2014 EIA Regulations GN R982 of 04 December 2014 (TABLE 1) and in accordance with the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species (Government Gazette No 43855, 30 October 2020) (TABLE 2).

TABLE 1: Information to be included in specialist reports

Legal Requirement		Relevant Section in Specialist study
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	Professional Experience and Appendix 5

Legal Requirement		Relevant Section in Specialist study
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Professional Experience and Appendix 4
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Declaration of Independence
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 5
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 5
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5, 7 and 16
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5
(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 9
(g)	an identification of any areas to be avoided, including buffers;	Section 9 & 10
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 9 & 10
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 16
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
(k)	any mitigation measures for inclusion in the EMPr;	Section 13
(l)	any conditions for inclusion in the environmental authorisation;	Section 13, 14, and 15
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 14
(n)	a reasoned opinion	Section 15
	whether the proposed activity, activities or portions thereof should be authorised;	Section 15
	regarding the acceptability of the proposed activity or activities; and	Section 15
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation	Section 15

Legal Requirement		Relevant Section in Specialist study
	measures that should be included in the EMPr, and where applicable, the closure plan;	
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 7
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 7
(q)	any other information requested by the competent authority.	Not Applicable
(2)	Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 5, TABLE 2, Section 5 and Section 7

TABLE 2: Minimum report requirements listed in the protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020)

HIGH SENSITIVITY RATING FOR TERRESTRIAL ANIMAL SPECIES	
SITE SENSITIVITY VERIFICATION	
The site sensitivity verification must be undertaken by an environmental assessment practitioner or specialist.	Professional Experience and Appendix 4
The site sensitivity verification must be undertaken through the use of: (a) a desk top analysis, using satellite imagery; (b) a preliminary on-site inspection; and (c) any other available and relevant information.	Section 5 & 7
The outcome of the site sensitivity verification must be recorded in the form of a report that: (a) confirms or disputes the current use of the land and environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.; (b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and (c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations	Section 7
SPECIALIST ASSESSMENT & MINIMUM REPORT CONTENT REQUIREMENTS	
Contact details and relevant experience as well as the SACNASP Registration number of the specialist preparing the assessment including a curriculum vitae;	Professional Experience and Appendix 4
A signed statement of independence by the specialist;	Declaration of Independence

A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 5 & 16
A description of the methodology used to undertake the site sensitivity verification, impact assessment and site inspection, including equipment and modelling used where relevant;	Section 5
A description of the mean density of observations/number of sample sites per unit area and the site inspection observations;	Section 7
A description of the assumptions made and any uncertainties or gaps in knowledge or data;	Section 16
details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;	Section 7
the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the PAOI;	N/A
The location of areas not suitable for development and to be avoided during construction where relevant;	Section 9 and 10
a discussion on the cumulative impacts;	Section 12
Impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Section 13
A reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and	Section 15
A motivation must be provided if there were any development footprints identified as per paragraph 2.2.12 above that were identified as having "low" or "medium" terrestrial animal species sensitivity and were not considered. appropriate.	N/A

5. APPROACH AND METHODOLOGY

5.1 Methodology

The following methods were employed to compile this avifaunal impact assessment report:

* The focus of this assessment is primarily on the potential impacts of the 40MW SEF on priority species. Priority species are defined as those species which could potentially be impacted by displacement through habitat transformation and/or disturbance as well as collision with the PV panels based on specific behavioural characteristics. These include both Species of Conservation Concern (SCC) as defined by the *Species Environmental Assessment Guideline: Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa (2020)* i.e. those species listed on the International Union for Conservation of Nature (IUCN) Red List of Threatened

Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near Threatened and Data Deficient, as well as certain other impact susceptible species.

- By virtue of their mobility, the identification of bird presence and abundance cannot be confined to the 40MW SEF development area, therefore the Project Area of Influence (PAOI) is defined as a 2km zone around the proposed development area. Avifaunal sensitivity has been defined for this PAOI.
- The proposed 40MW SEF is located within a single South African Bird Atlas Project 2 (SABAP2) pentad grid cell (i.e. 2615_2820), however a larger area is necessary to obtain a dataset that is large enough (encompassing nine pentad grid cells) to ensure that reasonable conclusions about species diversity and densities, in a particular habitat type, can be drawn. A total of 1321 full protocol lists and 1115 ad hoc protocol lists have been completed. The SABAP2 data is regarded as a reliable reflection of the avifauna which could potentially occur in the PAOI. The relevant pentads within the study area include: 2610_2815; 2610_2820; 2610_2825; 2615_2815; 2615_2820; 2615_2825; 2620_2815; 2620_2820 and 2620_2825 (FIGURE 2)
- Collected and examined various avifaunal data sets (detailed in section 5.2) at a desktop level to determine the presence of species, that may be vulnerable to the impacts associated with the construction and operation of the 40MW SEF;
- Suitable avifaunal habitats and potential sensitive areas within the development area, where impacts are likely to occur, were identified using various Geographic Information System (GIS) layers and Google Earth imagery and confirmed based on personal observations made during the site visits on 8 & 9 February 2021 and 23 May 2022;
- Primary avifaunal diversity and abundance data collected during two site visits (austral summer and austral autumn respectively) to the 40MW SEF development area , conducted 8 & 9 February 2021 and 23 May 2022. Data was collected by means of incidental counts to ground truth the information gleaned from secondary data sources and to collect primary bird occurrence data within the proposed development area and the immediate surrounds;
- The potential impacts, associated with the construction and operation of the 40MW SEF on the avifaunal community and their significance were predicted and assessed according to quantitative criteria (APPENDIX 3); and
- Practical recommendations for the management and mitigation of impacts, related to the construction and operation of the 40MW SEF are provided in Section 9 for inclusion in the draft EMPr.

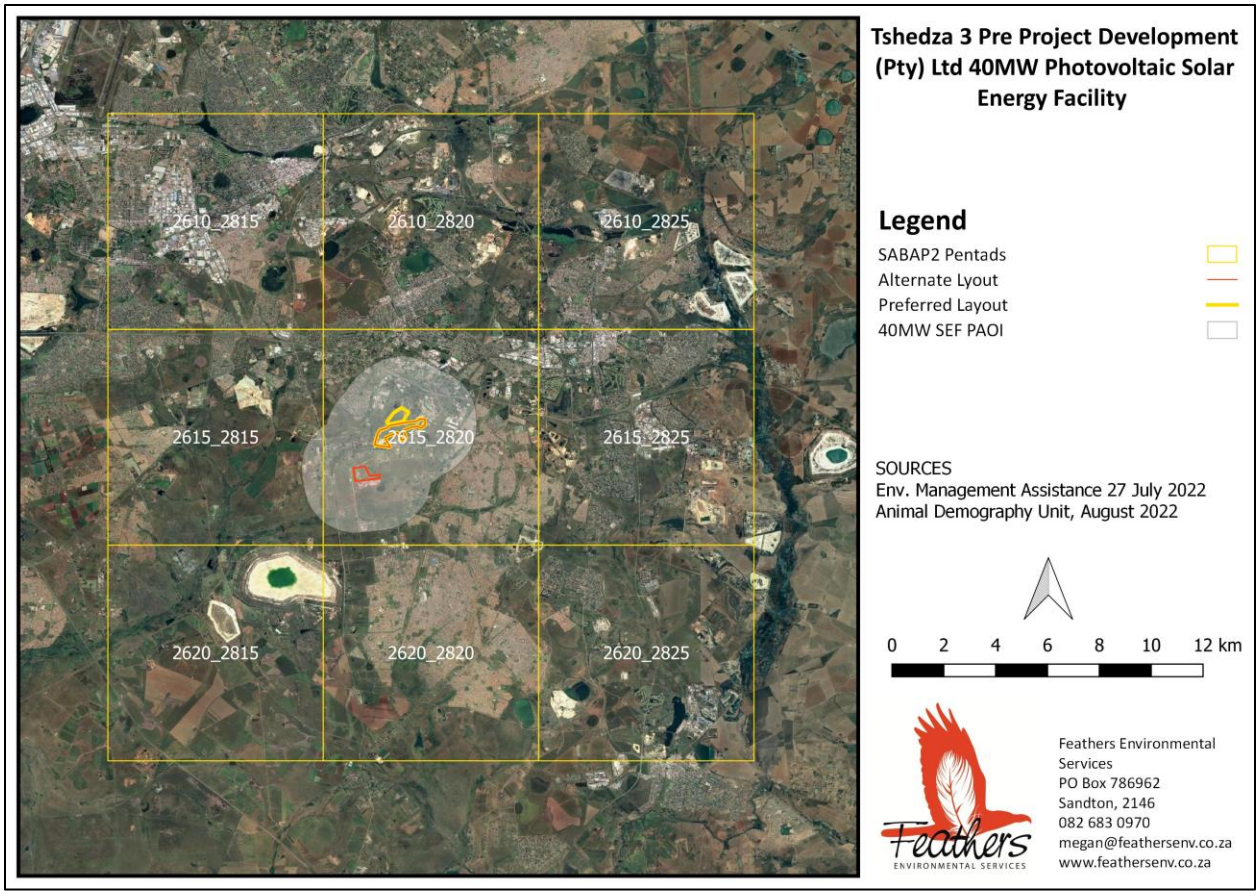

FIGURE 2: Location of the four South African Bird Atlas Project 2 (SABAP2) pentad grid cells that were considered for the 40ME SEF project

5.2 Data sources used

The following data sources and reports were used in varying levels of detail for this study:

* Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020);
* Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020) were consulted to determine the applicable protocol to be used;
* Screening Reports for an Environmental Authorisation as required by the 2014 EIA Regulations - Proposed Site Environmental Sensitivity: DRD Gold PV Facility, compiled by *Feathers* on 5 February 2021;
* The avifaunal impact assessment study completed by *Feathers* in May 2021, titled *Tshedza 1 Pre Project Development (Pty) Ltd Photovoltaic Solar Energy Facility: Avifaunal Impact Assessment Report*;
* The avifaunal scoping assessment study completed by *Feathers* in August 2021, titled *Tshedza 3 Pre Project Development (Pty) Ltd 40MW Photovoltaic Solar Energy Facility (Phase 2): Avifaunal Scoping Report*;
* Bird distribution data of the South African Bird Atlas 2 (SABAP 2) (Animal Demography Unit, 5 August 2022);

- The Important Bird Areas (IBAs) report (Marnewick et al. 2015). The Blesbokspruit IBA (SA017) may have relevance to this assessment;
- Co-ordinated Waterbird Count Database (CWAC – Taylor et al. 1999). Cowles Dam, Grootvaly Wetland Reserve, Grootvaly on Blesbok, the Anglo Reserve, Marievale (Areas A & B), Leeupan and Apex Pan CWAC sites are located within 20km of the study area and may have relevance to this study;
- Coordinated Avifaunal Roadcount project database (CAR – Young et al, 2003) - was consulted to obtain relevant data on large terrestrial bird report rates in the area. a single route (GD02) occurs within 20km of the study area and may have relevance to this study;
- The global and regional conservation status and endemism information of all bird species (Taylor et al. 2015) and the latest (2022-1) IUCN Red List of Threatened Species (http://www.iucnredlist.org);
- The latest vegetation classification described in the Vegetation Map of South Africa (South African National Biodiversity Institute, 2012 and Mucina & Rutherford, 2006);
- High-resolution Google Earth ©2022 imagery was used to examine the microhabitats within the PAOI;
- KMZ. shapefiles detailing the location and layout alternatives of the 40MW SEF, provided by *EMA* on 27 July 2022;
- A two-day austral summer survey and one-day austral autumn survey to the proposed 40MW SEF development area conducted on 8 & 9 February 2021 and 23 May 2022 respectively, to form a first-hand impression of avifaunal species presence and micro-habitat occurring within the larger PAOI surrounding the 40MW SEF (FIGURE 3). This information, together with the SABAP2 data was used to compile a comprehensive list of species that could occur in the PAOI;
- Comments received from Interested and Affected Party (I&AP) Ms. Jeanne-Michele White and Mrs. Santjie White on 17 and 25 March 2021 respectively during the public participation process conducted for Phase 1, regarding the presence and breeding activities of African Grass Owl, Marsh Owl *Asio Capensis and* African Marsh Harrier, in addition to the occasional presence of Blue Crane *Anthropoides paradeus,* Verreaux's Eagle *Aquilla verreauxii and* Secretarybird according to observations carried out in the area over a 15-year period;
- Comments emanating from a meeting held with I&AP Ms. Jeanne-Michele White and Mrs. Santjie White on 23 May 2022;
- The BirdLife South Africa position statement on solar energy and birds (BirdLife South Africa, 2012) and the *Birds and Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern* (Jenkins et al, 2017) was used for evaluating the potential impacts and to inform the site visit requirements for this assessment.

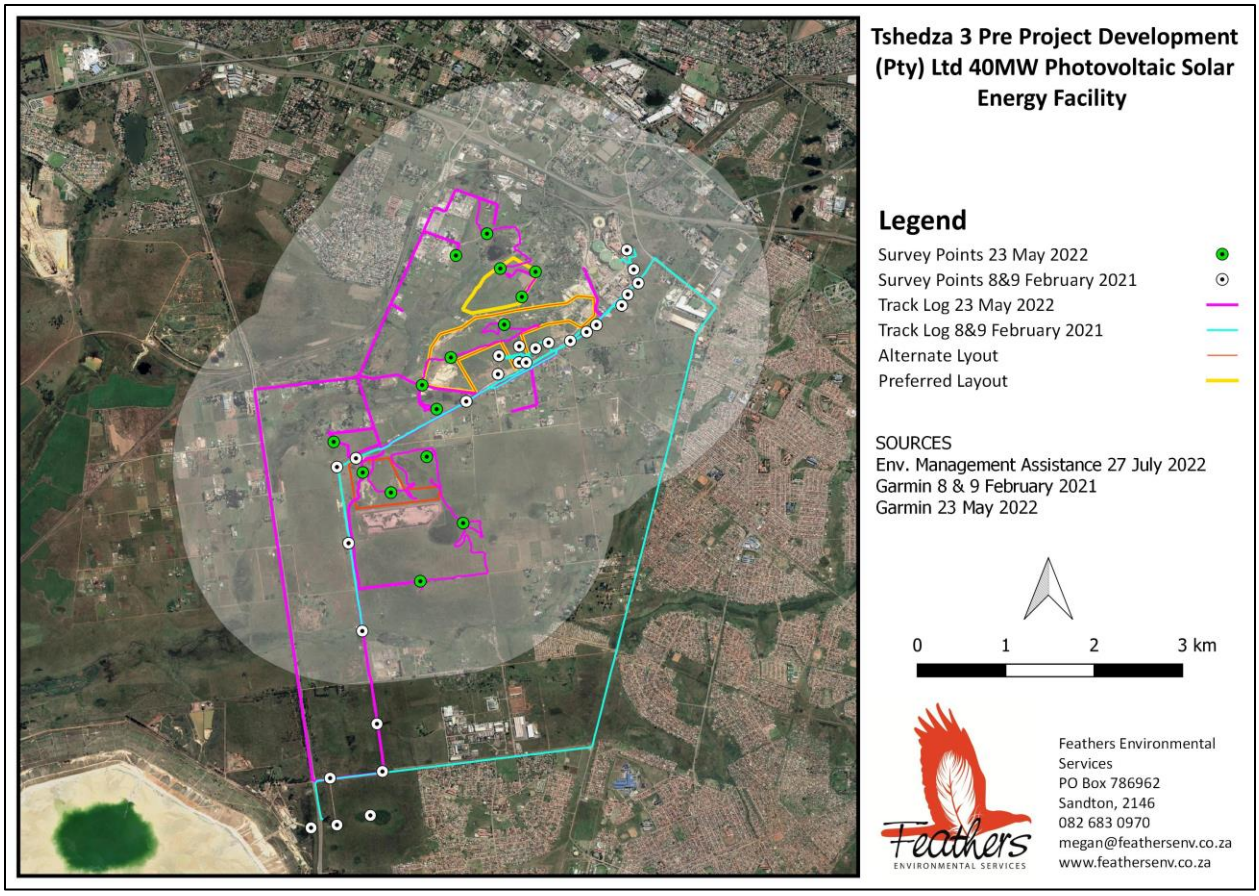

FIGURE 3: Regional map detailing the location of the survey points and transects surveyed during the site surveys of the PAOI, conducted on 8 & 9 February 2021 and 23 May 2022

6. APPLICABLE LEGISLATION, POLICIES AND GUIDELINES

The following pieces of legislation are applicable to this assessment:

6.1 The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) is an international convention (to which South Africa is a signatory) and represents a commitment to sustainable development. The Convention has three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (http://www.cbd.int/convention/guide/). The convention makes provision (in a general policy guideline) for keeping and restoring biodiversity. In addition to this the CBD is an ardent supporter of thorough assessment procedures (Strategic Environmental Assessments (SEAs) and Environmental Impact Assessments (EIAs)) and requires that Parties apply these processes when planning activities that will have a biodiversity impact. An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used as a reason for delaying management of these risks.

The burden of proof that the impact will *not* occur lies with the proponent of the activity posing the threat. In addition, the Aichi Biodiversity Targets (CBD 2011) address several priority issues i.e. the loss of biodiversity and its causes; reducing direct pressure on biodiversity; safeguarding ecosystems, species and genetic diversity and participatory planning to enhance implementation of biodiversity conservation. Each of these is relevant in the case of energy infrastructure and bird conservation through all project phases from planning to the implementation of mitigation measures for existing developments.

6.2 The Convention on the Conservation of Migratory Species of Wild Animals

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) is an intergovernmental treaty and is the most appropriate instrument to deal with the conservation of terrestrial, aquatic and avian migratory species. The convention includes policy and guidelines with regards to the impacts associated with man-made infrastructure. CMS requires that Parties (South Africa is a signatory) take measures to avoid migratory species from becoming endangered (Art II, par. 1 and 2) and to make every effort to prevent the adverse effects of activities and obstacles that seriously impede or prevent the migration of migratory species (Art III, par. 4b and 4c). At CMS/CoP7 (2002) Res. 7.2 on Impact Assessment and Migratory Species was accepted, requesting Parties to apply appropriate SEA and EIA procedures for all proposed developments. An agreement developed in the framework of CMS, in force since November 1999, brings the 119 Range States of the Africa Eurasian Waterbird Agreement (AEWA) region together in a common policy to protect migratory waterbirds that use the flyway from the Arctic to southern Africa. The agreement contains a number of obligations that are relevant to migratory waterbirds and energy infrastructure. AEWA has also published a series of practical guidelines that enable Parties to effectively address conservation issues influencing the status of migratory waterbirds. The most relevant guideline for migratory birds and energy infrastructure is the *Guideline on how to avoid, minimise or mitigate impact of infrastructural developments and related disturbance affecting waterbirds* (Tucker & Treweek, 2008).

6.3 The Agreement on the Conservation of African-Eurasian Migratory Water Birds

The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The core activities carried out under AEWA are described in its Action Plan, which is legally binding for all countries that have joined the Agreement. The AEWA Action Plan details the various measures to be undertaken by Contracting Parties (South Africa included) to guarantee the conservation of migratory waterbirds within their national boundaries. These include species and habitat protection, and the management of human activities, as well as legal and emergency measures.

6.4 The National Environmental Management Act 107 of 1998 (NEMA)

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

6.5 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) regulations on Threatened and Protected Species (TOPS) provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. The national Act provides for among other things, the management and conservation of South Africa's biodiversity; protection of species and ecosystems that necessitate national protection and the sustainable use of indigenous biological resources.

6.6 The National Environmental Management: Protected Areas Act 57 of 2003

The National Environmental Management: Protected Areas Act (No. 57 of 2003), as amended in 2014, provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also provides for the establishment of a national register of all national, provincial and local protected areas that are managed in accordance with national norms and standards; and to endure intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are declared in order to regulate the area as a buffer zone for protection of a special nature reserve, world heritage site or nature reserve; to enable owners of land to take collective action to conserve biodiversity on their land and to seek legal recognition therefor; to protect the area if the area is sensitive to development due to its- (i) biological diversity; (ii) natural characteristics; (iii) scientific, cultural, historical, archaeological or geological value; (iv) scenic and landscape value; or (v) provision of environmental goods and services; to protect a specific ecosystem outside of a special nature reserve, world heritage site or nature reserve; to ensure that the use of natural resources in the area is sustainable. This Act

explicitly states that no development, construction or farming may be permitted in a nature reserve or world heritage site without the prior written approval of the management authority.

6.7 The National Environmental Management Act 107 of 1998 (NEMA) Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal and or Avifaunal Species

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on terrestrial animal and/or avifaunal species for activities requiring environmental authorisation. This protocol replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations. The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) for terrestrial animal species. The relevant terrestrial animal species data in the screening tool has been provided by the South African National Biodiversity Institute (SANBI).

6.8 Gauteng Biodiversity Conservation Plan, Version 3.3

Gauteng Nature Conservation, a component of the Gauteng Department of Agriculture and Rural Development (GDARD) produced the Gauteng Conservation Plan to 1) serve as the primary decision support tool for the biodiversity component of the Environmental Impact Assessment (EIA) process; 2) inform protected area expansion and biodiversity stewardship programmes in the province; and 3) serve as a basis for development of Bioregional Plans in municipalities within the province.

6.9 Gauteng Department of Agriculture and Rural Development (GDARD) Requirements for Biodiversity Assessments Version 3, March 2014

The Gauteng Department of Agriculture and Rural Development (GDARD) Requirements for Biodiversity Assessments is an important set of provincial conservation legislation that details the minimum requirements and accepted format for biodiversity assessments to be undertaken for proposed developments within the Gauteng province. The document provides specific avifaunal assessment requirements to ensure effective conservation of most bird species and their habitat. The appointed Specialist Ornithological Consultant must 1) determine whether the proposed development site falls within the known or expected distribution of any of the following SCC prioritized by GDARD i.e. Cape Vulture *Gyps coprotheres*, Blue Crane *Anthropoides paradiseus*, Lesser Kestrel *Falco naumanni*, African Grass-Owl *Tyto capensis*, African Marsh-Harrier *Circus ranivorus*, White-backed Night-Heron *Calherodius leuconotus*, White-bellied Korhaan *Eupodotis senegalensis*, Martial Eagle *Polemaetus bellicosus*, African Finfoot *Podica senegalensis*, Lesser Flamingo *Phoenicopterus minor*, Secretarybird *Sagittarius serpentarius*, Black Stork *Ciconia nigra*, Half-collared Kingfisher *Alcedo semitorquata* and Greater Flamingo *Phoenicopterus ruber*; 2) determine whether suitable habitat occurs on the proposed development site or neighbouring properties for those priority SCC whose distribution overlaps with the proposed development site; 3) map suitable habitat according to the *Sensitivity Mapping rules for Biodiversity Assessments* (spatial rules for birds) and indicate the number of individuals/pairs that could potentially be

supported in each habitat; and 4) where mitigation measures are appropriate, these must be detailed together with the relevant problem statement.

6.10 Best Practice Guidelines: Birds and Solar Energy

The most important guidance document from an avifaunal impact perspective that is currently applicable (but not legally binding) to solar energy development in South Africa is the *Birds and Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa* (Jenkins et al, 2017). A gradient of survey and monitoring requirements for avian studies is recommended in the guidelines and is dependent on the proposed technology, size of footprint, the amount of available data, and the estimated sensitivity of the receiving environment. Based on these criteria, the proposed PV SEF has been assessed based on Regime 1, where structured and repeated baseline data collection is not required due to the lower-risk nature of the proposed development. Such projects require that the consulting specialist visit the site at least once, during peak period of avian abundance and activity. Sufficient time must be spent on site in order to obtain first-hand knowledge of the avian habitats present, and to predict the affected avifauna, the nature and scale of impacts and the best mitigation options available.

6.11 International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability

The International Finance Corporation's (IFC) Sustainability Framework details the Corporation's strategic commitment to sustainable development, and is an integral part of IFC's approach to risk management. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. The Performance Standards are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way. Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project (http://www.ifc.org).

7. DESCRIPTION OF THE BASELINE CONDITIONS

7.1 Site Sensitivity Verification

A screening report for the proposed 40MW SEF development area and PAOI was generated on 5 February 2021. The proposed PAOI occurs within the Gauteng Environmental Management Framework and within an Air Quality Priority Area. Parts of the proposed study area are considered to have a MEDIUM Animal Species Theme Sensitivity based on the possible occurrence of African Grass Owl *Tyto capensis* and a HIGH Avian Theme Sensitivity, as a result of the presence of wetland areas. It is important to note that the delineation of

wetlands actually pertains to the Bat Theme Sensitivity, but does still have relevance to avifauna within the PAOI. Although African Grass Owl was not observed during the site verification surveys, it has been regularly recorded within the POAI (pers. comms Ms. Jeanne-Michele White, 23 May 2022). These records include breeding events, north west of land portion Withok 131 IR Portion 9 (Alternate Site Layout). In addition, the observation of African Marsh Harrier *Circus ranivorus* during the site verification survey conducted on 23 May 2022 further demonstrates the utilisation of the PAOI by SCC. While parts of the PAOI are subject to fairly significant levels of disturbance, suitable avifaunal habitats are present that are capable of supporting SCC. The desktop analysis, I&AP observations & photographic records, in addition to the observations emanating from the on-site inspections, confirms the MEDIUM sensitivity assigned to the PAOI .

7.2 Relevant Bird Populations

7.2.1. Important Bird Areas

Some sites are exceptionally important for maintaining the taxa dependent upon the habitats and ecosystems in which they occur. Vigorous protection of the most critical sites is one important approach to conservation. Many species may be effectively conserved by this means. Patterns of bird distribution are such that, in most cases, it is possible to select sites that support many species. These sites, carefully identified on the basis of the bird numbers and species complements they hold (i.e. globally threatened, range restricted and or migratory or congregatory species) are termed Important Bird Areas (IBAs). IBAs are selected such that, taken together, they form a network throughout the species' biogeographic distributions. IBAs are key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network.

The proposed SEF is not located within the confines of an Important Bird Area (IBA). The closest IBA to the proposed study area is the Blesbokspruit IBA (SA021) with its most western boundary located approximately 10km to the east of the proposed solar site (FIGURE 4). The Blesbokspruit IBA is a large, highly modified wetland which extends along the Blesbokspruit, one of the Vaal River's larger tributaries, from the Grootvaly Wetland Reserve in the north to the Marievale Bird Sanctuary in the south. More than 220 species have been recorded for the IBA in SABAP2. The highly productive water which is artificially maintained by the inflow of mining, industrial and municipal effluents, provides food for Lesser Flamingo *Phoeniconaias minor* and Greater Flamingo *Phoenicopterus roseus*. The system also supports a diversity of waterbird species, including Goliath Heron *Ardea goliath*, Purple Heron *Ardea purpurea*, African Spoonbill *Platalea alba*, Glossy Ibis *Plegadis falcinellus*, Pied Avocet *Recurvirostra avosetta*, Red-knobbed Coot *Fulica cristata* and White-winged Tern *Chlidonias leucopterus* (Marnewick et al. 2015). African Marsh Harrier *and* Grass-Owl have been displaced from much of the surrounding area as a result of intense industrialisation, urbanisation and habitat modification.

Although this wetland is thought to hold 20,000 individual waterbirds, there is insufficient data to indicate that any species meet the IBA criteria (Marnewick et al. 2015). It is important to note that no distinct waterbird flight paths were observed across the proposed solar site in relation to the network of wetland areas to the

east of the study area during the site surveys. Despite the close proximity (in bird terms) of the Blesbokspruit IBA to the study area, the construction and operation activities of the proposed SEF will not have a negative impact on the IBA and the species it supports. Of the species mentioned above African Marsh Harrier and Red-knobbed Coot *Fulica cristata* were recorded in the waterbody areas within the study area during the respective site surveys.

7.2.2. Protected Areas

Four protected areas are located within a 20km radius of the PAOI (FIGURE 4). These areas are protected by law and managed for biodiversity conservation, providing much needed habitat that can potentially support a diversity and abundance of avifaunal species. Similarly, to IBAs these areas may provide an indication of the avifaunal species that are likely to occur in similar habitats found within the PAOI. It is unlikely that the disturbance associated with the construction of the 40MW SEF will have a significant negative impact on the surrounding protected areas and the species they support.

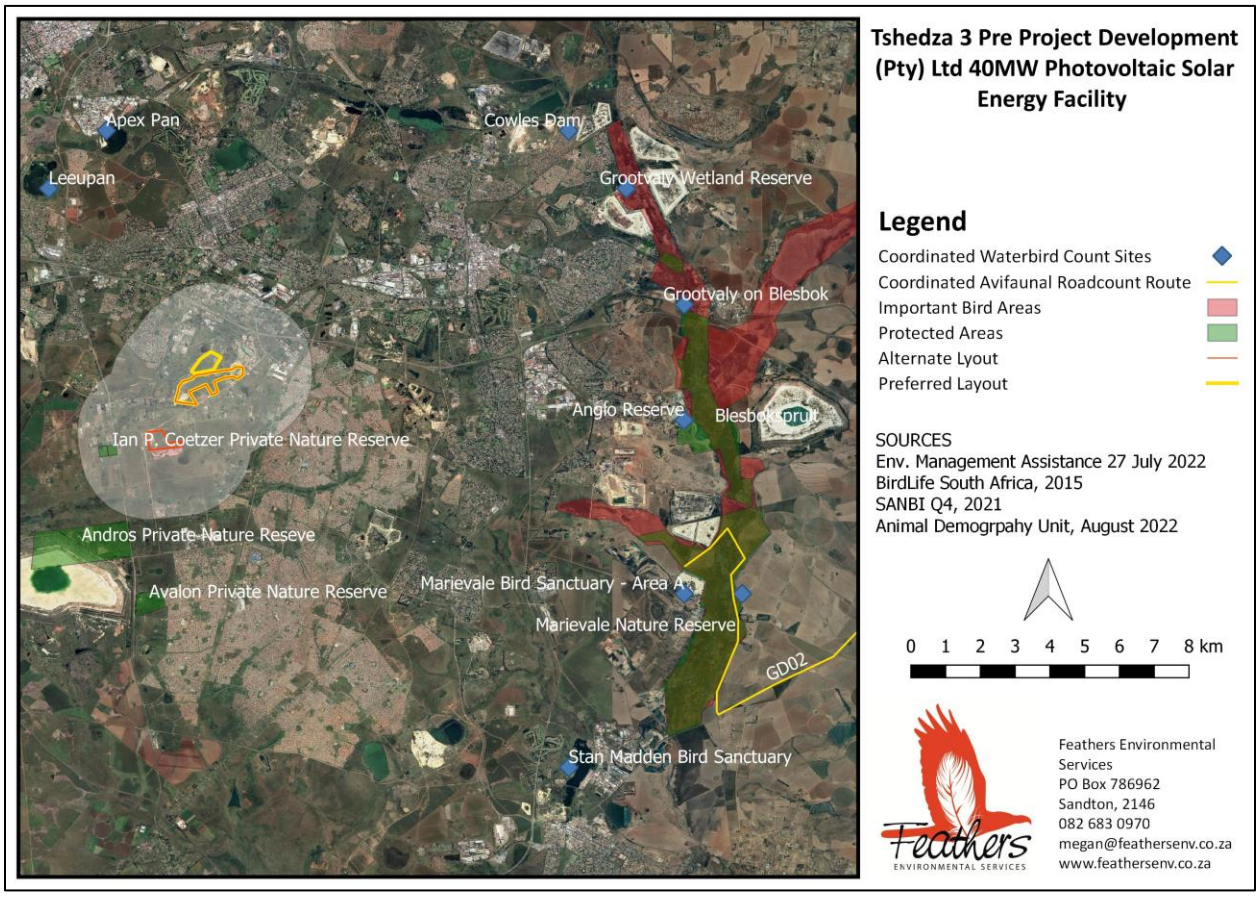

FIGURE 4: Regional map detailing the location of the proposed 40MW SEF development area in relation to Protected Areas, IBAs, CWAC sites and CAR routes.

7.2.3. Coordinated Avifaunal Roadcount (CAR) Routes

Cranes, bustards, storks and other large birds that spend most of their time on the ground, need wide, open spaces and are certainly not restricted to protected areas. Agricultural habitats are used extensively for feeding, roosting and breeding, often because no natural, pristine habitats are available, and sometimes because the agricultural habitats are especially attractive to birds. The Coordinated Avifaunal Roadcounts (CAR) project monitors the populations of 36 species of large terrestrial birds in agricultural habitats, in addition to gamebirds, raptors and corvids along 350 fixed routes covering over 19 000km (http://car.adu.org.za/). Although CAR road counts do not give an absolute count of all the individuals in a population, they do provide a measure of relative abundance in a particular area. Given the built-up nature of the study area, there are no CAR routes within the proposed development area. Route GD02 occurs within a 20km of the study area and is associated with the Blesbokspruit IBA (FIGURE 4). This route has recorded White Stork *Ciconia ciconia*, Secretarybird *Sagittarius serpentarius*, Common Buzzard *Buteo buteo* and Back-winged Kite *Elanus caeruleus*. Helmeted Guineafowl *Numida meleagris* and Black-shouldered Kite were the only species, monitored by the CAR project, that were recorded during the two site visits to the study area. Neither of these are SCC and are common inhabitants of urbanized environments.

7.2.4. Coordinated Waterbird Count (CWAC) Sites

Although there are no CWAC sites within the immediate study area, there are eight CWAC sites within 20km of the proposed solar site. These include Cowles Dam, Grootvaly Wetland Reserve, Grootvaly on Blesbok, the Anglo Reserve, Marievale (Areas A & B), Leeupan and Apex Pan (FIGURE 4). Seven of the eight sites are comprised of open water, reedbeds and marshes that support a wide variety of waterbirds including Greater Flamingo, Southern Pochard *Netta erythrophthalma*, Fulvous Duck *Dendrocygna bicolor*, Yellow-billed Duck *Anas undulata*, Red-billed Teal *Anas erythrorhyncha*, Cape Shoveller *Anas smithii*, Ruff *Philomachus pugnax*, Common Moorhen *Gallinula chloropus*, African Purple Swamphen *Porphyrio madagascariensis,* Little Grebe *Tachybaptus ruficollis*, Squacco Heron *Ardeola ralloides*, Black-crowned Night Heron *Nycticorax nycticorax*, Egyptian Goose *Alopochen aegyptiacus*, Spur-winged Goose *Plectropterus gambensis*, Glossy Ibis, African Sacred Ibis *Threskiornis aethiopicus*, White- winged Tern, Grey-headed Gull *Larus cirrocephalus* and egret sp. Apex Pan is an open-water pan with a shoreline of grass/sedge, and an island of *Phragmites*. White-breasted Cormorant, African Spoonbill and Black-headed Heron breed at the pan. Also an important site for Great Crested Grebe White-backed Duck, Greater and Lesser Flamingo, Red-knobbed Coot, Grey-headed Gull and Cape Wagtail. Sewage overflow and squatter encroachment has resulted in a dramatic decline in bird numbers at this site.

While these CWAC sites may provide an indication of the waterbird species that could be supported by natural and artificial impoundments within the study area, these sites will not have a significant impact on the sensitivity rating for the proposed SEF. Of the species mentioned above, Yellow-billed Duck, Red-billed Teal, Common Moorhen, Egyptian Goose, African Sacred Ibis, Little Grebe and Western Cattle Egret *Bubulcus ibis* were

recorded in various waterbody areas within the study area during the site visits. Similarly, none of these species are of conservation concern and are commonly found in *wetland* habitats.

7.2.5. South African Bird Atlas Project 2 Data (SABAP2)

A total of 308 bird species have been recorded within the relevant pentads during the SABAP2 atlassing period to date (APPENDIX 1). The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur within the areas earmarked for the proposed 40MW SEF, particularly where pockets of natural vegetation/habitats persist. Of the 308 species, 19 of these are considered to be regional SCC (Taylor et al, 2015). The White Stork *Ciconia ciconia*, which is not listed, but is protected internationally under the *Bonn Convention on Migratory Species* and Lesser Kestrel *Falco naumanni*, a GDARD priority species has also been recorded in the study area. It is important to note that with the exception of Maccoa Duck *Oxyura maccoa* (n=129), Lesser Flamingo (n=174) and Greater Flamingo (n=415) the remaining SCC species have been recorded in low numbers, with less than 20 individual birds being recorded over the fourteen-year survey period. The significant individual numbers of Maccoa Duck, Lesser and Greater Flamingo can be attributed to the number of observations/surveys conducted within the three pentads to the north of the study area, which contain a series of wetlands and waterbodies - habitat that is capable of supporting these species in abundance. Lanner Falcon *Falco biarmicus* is the only SCC species recorded in the single pentad within which the proposed 40MW SEF development sites are located. The low report rates can be attributed to fairly high levels of disturbance and habitat loss associated with the surrounding mining and industrial practices which has undoubtedly displaced many of the naturally occurring species, that under optimum conditions, would inhabit these areas. Although this report focuses on SCC, since the impacts associated with the construction and operation of the proposed 40MW SEF is likely to be more biologically significant for these species, the impact on non-SCC SEF sensitive avifauna (totalling 107 species) is also assessed, albeit in less detail. Furthermore, SCC can often be used as surrogate species for the others in terms of impacts and the necessary mitigation. The non-SCC priority species that have been considered for this assessment include korhaan, buzzards, kestrels, falcons, herons, geese, ibis and various water dependent species. Each SCC's potential for occurring in a specific habitat class is indicated in TABLE 3.

7.2.6. Primary Data Collection

A summer survey was conducted on 8-9 February 2021 (encompassing the Phase 1 20MW SEF development area and PAOI). In order to describe the avifaunal community present, a concerted effort was made to sample the avifauna in all of the primary habitats that were available at the proposed solar site and within the larger study area by applying the fixed point count surveys, a vehicle transect survey and a focal site survey. The summer site survey produced a combined list of 40 species (APPENDIX 1 - highlighted in grey), covering both the 20MW SEF development area and PAOI. No SCC were observed during this site survey. Most observations were of small passerine species that are common to this area.

An identical methodology was followed for the autumn site survey, conducted on 23 May 2022. This visit produced a similar suite of observations with a combined list of 66 species (APPENDIX 1 - highlighted in grey), covering both the 40MW SEF development area and PAOI. African Marsh Harrier was the most notable species recorded during this survey.

All of the observed species have the potential to be displaced by the proposed 40MW SEF as a result of habitat transformation and disturbance. However, these species have persisted despite existing disturbance within the study area. This resilience, coupled with the fact that similar habitat is available throughout the broader area, means that the displacement impact will not be of regional or national significance. While no active breeding locations were observed, historical African Grass Owl and African Marsh Harrier breeding locations do occur within close proximity to the proposed development area, particularly the Alternative Layout.

7.2.7. Interested and Affected Party Comments and Local Knowledge

Comments were received from Ms. Jeanne-Michele White and Mrs. Santjie White on 17 and 25 March 2021 respectively, regarding the presence and breeding activities of African Grass Owl, Marsh Owl *Asio Capensis and* African Marsh Harrier, in addition to the occasional presence of Blue Crane *Anthropoides paradeus*, Verreaux's Eagle *Aquilla verreauxii and* Secretarybird according to observations carried out in the area over a 15-year period.

The following detailed account is provided in response to the I&AP comments:

- In accordance with the most current legislation, a site sensitivity report was generated for the combined 60MW SEF PAOI on 5 February 2021, using the DEA Online Screening Tool. The report concluded that the proposed SEF development site and the broader POAI is considered to have a MEDIUM Animal Species Theme Sensitivity, based on the possible occurrence of African Grass Owl *Tyto capensis* and a HIGH Avian Theme Sensitivity based on the presence of wetland areas within the study area. It is important to note that the delineation of wetlands within the broader study area, pertains to the Bat Theme Sensitivity. However, the sensitivity of this habitat type was still considered as it may have relevance to priority avifauna occurring within the proposed study area. An analysis of the South Africa Bird Atlas Project 2 and CAR datasets do not contain records of African Grass Owl observations in the study area or within the much broader area of 68,000ha. A site sensitivity verification was conducted through the use of both a desktop analysis and on-site inspections, conducted on 8-9 February 2021 and again on 23 May 2022.
- The *BirdLife South Africa Best Practice Guidelines: Birds and Solar Energy* require that a Regime 1 assessment (comprised of 1-5 days) occur at proposed SEF development sites that are less than 30ha in size and are of medium sensitivity. A two-day site visit was conducted on 8-9 February 2021. The survey

completed on 8 February 2021 was conducted mid-morning to midday and the surveys completed on 9 February 2021 were conducted in the early to mid-morning hours and again in the late afternoon hours, to accommodate possible temporal variances and avoid the warmer period in the middle of the day when birds are less active and vocal, and hence less conspicuous. An additional one-day survey was conducted on 23 May 2022, from early morning to early evening.

- A total of 40 fixed-point count survey points were established across the proposed 60MW SEF development area, sampling the dominant grassland habitat and associated microhabitats within the PAOI. The survey also included a vehicle (driven) transect to collect bird occurrence data for the broader study area and as well observation made at a focal site (a large waterbody) within the study area.
- The South African Bird Atlas Project 2 (SABAP2), Important Bird Areas, Coordinated Waterbird Count and Coordinated Avifaunal Roadcount datasets were consulted to support the findings of the primary in-field surveys. These datasets do not replace or supersede in-field observations, professional judgement and extensive experience of the avifaunal specialist. These comprehensive datasets do however provide a valuable baseline against which any changes in species presence, abundance, and distribution can be monitored.
- The site investigations comprised of peak (austral summer) season and autumn season surveys, in accordance with the *BirdLife South Africa Best Practice Guidelines: Birds and Solar Energy*.
- By virtue of avian mobility, the assessment of bird occurrence cannot be confined to the proposed SEF site alone, therefore the PAOI was defined as a 2km zone around the proposed development area. Avifaunal sensitivity was defined for this study area.
- Although the proposed 40MW SEF is located largely within a single SABAP 2 pentad grid cell (2615_2820), a larger area is necessary to obtain a dataset that is large enough (encompassing nine pentad grid cells – approx. 68,000ha) to ensure that reasonable conclusions about species diversity and densities can be drawn. Coverage by SABAP2 is extensive with a total of 1321 full protocol lists, lasting a minimum of two hours, in addition to 1115 ad hoc protocol lists each being completed across the nine pentads. These surveys provide an accurate snapshot of the avifauna in the study area, but again do not replace or supersede site survey observations.
- Recognising that these databases might not have a record of every species occurrence within an area (despite the number of surveys conducted over a minimum of 14 years), avifaunal specialists welcome comments and encourage collaboration with I&APs who may have details of key species occurring within their respective areas. Having compiled and curated species lists for over 15 years, Ms. White has access to valuable avifaunal data that has been incorporated into the findings of this report.

TABLE 3: Annotated list of regional SCC that have been recorded in the relevant SABAP2 pentads surrounding the 40MW SEF PAOI

Name		SABAP2 Reporting Rate				Habitat				Impacts		
Species Name	Scientific Name	Full protocol	Ad hoc protocol	Red Lis: Regional	Solar Priority	Grassland	Rivers	Waterbodies/Wetlands	Exotic Tree Stands	Collisions with solar panels	Displacement: Disturbance	Displacement: Habitat transformation
Abdim's Stork	Ciconia abdimii	0,23	0,00	NT	x	x				x	x	x
African Grass Owl	Tyto capensis	0,00	0,00	VU	x	x		x		x	x	x
African Marsh Harrier	Circus ranivorus	1,44	0,00	EN	x	x		x			x	x
Black-winged Pratincole	Glareola nordmanni	0,45	0,00	NT	x	x					x	x
Blue Crane	Grus paradisea	0,00	0,00	NT	x	x		x		x	x	x
Caspian Tern	Hydroprogne caspia	0,08	0,00	VU	x			x				
European Roller	Coracias garrulus	0,00	0,00	NT	x	x					x	x
Great White Pelican	Pelecanus onocrotalus	0,08	2,04	VU	x			x		x		
Greater Flamingo	Phoenicopterus roseus	31,42	3,06	NT	x			x		x		
Greater Painted-snipe	Rostratula benghalensis	0,15	0,00	NT	x			x		x	x	
Half-collared Kingfisher	Alcedo semitorquata	0,08	0,00	NT	x		x	x			x	
Lanner Falcon	Falco biarmicus	0,38	1,02	VU	x	x			x	x	x	x
Lesser Flamingo	Phoeniconaias minor	13,17	0,00	NT	x			x		x		
Maccoa Duck	Oxyura maccoa	9,77	5,10	NT	x		x	x		x	x	
Marabou Stork	Leptoptilos crumenifer	0,00	0,00	NT	x	x		x	x		x	x
Martial Eagle	Polemaetus bellicosus	0,08	0,00	EN	x	x			x		x	x
Red-footed Falcon	Falco vespertinus	0,00	1,02	NT	x	x				x	x	x
Secretarybird	Sagittarius serpentarius	0,00	0,00	VU	x	x					x	x
Yellow-billed Stork	Mycteria ibis	0,98	0,00	EN	x		x	x		x	x	

7.3 Avifaunal Habitats

Vegetation is one of the primary factors determining bird species distribution and abundance in an area. It is widely accepted within ornithological circles that vegetation structure is more important in determining which bird species will occur there. The classification of vegetation types is from Mucina & Rutherford (2006 and 2012), while from an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison et al. 1997). Whilst much of the distribution and abundance of bird species can be attributed to the broad vegetation types present in an area, it is the smaller spatial scale habitats (micro habitats) that support the requirements of a particular bird species that need to be examined in greater detail. Micro habitats are shaped by factors other than vegetation, such as topography, land use, food availability, and various anthropogenic factors all of which will either attract or deter birds and are critically important in mapping the site in terms of avifaunal sensitivity and ultimately informing mitigation requirements. Assessment of the PAOI revealed five broadly described avifaunal micro habitats i.e. grassland, rivers, waterbodies, exotic/alien tree stands and built-up areas (FIGURE 6). APPENDIX 2 provides a photographic record of the bird habitats.

7.3.1. Grassland

The proposed 40MW SEF development area and PAOI are located within a single primary vegetation division namely the Grassland Biome, specifically Tsakane Clay Grassland and Soweto Highveld Grassland (South African National Biodiversity Institute, 2012 and Mucina & Rutherford, 2006) see FIGURE 5.

Tsakane Clay Grassland occurs within the Gauteng and Mpumalanga Provinces, extending in a narrow band from Soweto to Springs, broadening southwards to Nigel and from there towards Vereeniging, as well as north of the Vaal Dam and between Balfour and Standerton. This vegetation type occurs predominantly on flat to slightly undulating plains and low hills and is short and dense in structure. Tsakane Clay Grassland is dominated by a mixture of common Highveld grasses such as *Themeda triandra*, *Heteropogon contortus* and *Elionurus muticus* (Mucina & Rutherford, 2012). More than 60% of the vegetation type is transformed by cultivation, urbanisation, mining, dam-building and roads. Increasing urbanisation and infrastructure development bring further pressure on the remaining vegetation (Mucina & Rutherford 2006). Soweto Highveld Grassland occurs on gently to moderately undulating landscape on the Highveld plateau, supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra*. In areas where the grassland is intact, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover. Similarly, almost half of this vegetation type is already transformed by cultivation, urban sprawl, mining and building of road infrastructure (Mucina & Rutherford 2006).

Of South Africa's 841 bird species, 350 occur in the Grassland Biome. This includes 29 species of conservation concern (i.e. those species declining in numbers), ten endemics, and as many as 40 specialist species that are

exclusively dependent on grassland habitat. Grasslands represent a significant feeding area for many bird species in densely populated areas and will typically attract Lanner Falcon, African Marsh-harrier, Black-winged Pratincole, Abdim's Stork and White Stork observed during the SABAP2 survey period. Grassland patches are also a favourite foraging area for game birds such as francolins, spurfowl and Helmeted Guineafowl. This in turn could attract large raptors i.e. Martial Eagle because of both the presence and accessibility of prey.

It is important to note that the area that has been earmarked for the proposed 40MW SEF development has experienced significant transformation in the form of mining and urbanisation which dominate the landscape. Although parts of the development area have been largely rehabilitated and the grassland habitat has recovered (APPENDIX 2: FIGURE 1), fairly significant levels of disturbance persist in the form of vehicle and pedestrian traffic, pastoral activities and mining operations in the immediate surrounds. SABAP2 reporting rates for SCC potentially occurring in grassland habitat in the study area are very low (TABLE 3) and the absence of these grassland dependent SCC at the proposed 40MW SEF development area is an indication of the significant levels of human activity and disturbance (APPENDIX 2: FIGURE 5). Therefore, the potential displacement impacts as a result of habitat loss and disturbance associated with the construction and operation of the proposed 40MW SEF are likely to be low for the aforementioned grassland dependent species.

7.3.2. Rivers, Wetlands and Surface Waterbodies

Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. These freshwater resources provide important corridors of microhabitat for waterbirds (13 of which are mostly restricted to riverine habitat in southern Africa) that will regularly utilise rivers not only as a source of drinking water and food, but also for bathing and cover for skulking species. In addition, the thick riverine woodland with large shady riparian trees, offers important breeding substrate for a variety of birds (e.g. Half-collared Kingfisher), including raptors (Hockey et al 2005).

The Rietpsruit and Withokspruit river system feature within the study area (FIGURE 5). Given the current level of disturbance and utilisation Withokspruit, it is unlikely that the SCC that have been recorded in the study area will frequent the watercourse. Therefore, potential collision and displacement impacts as a result of habitat loss, disturbance and collision associated with the construction and operation of the proposed 40MW SEF are likely to be low.

Wetlands are characterized by slow flowing seasonal water (or permanently wet) and tall emergent vegetation (rooted or floating) and provide habitat for many water birds. The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetlands worldwide, with many having already been destroyed. There are examples of localized wetlands within the study area (APPENDIX 2: FIGURE 3), which may represent attractive foraging habitat for sensitive species such as Greater Painted-snipe, Bar-tailed Godwit, Curlew Sandpiper and White Stork (Young 2003). It is also the preferred roosting and foraging

habitat for the African Marsh Harrier (Hockey et al 2005). Various common species i.e. ibis, herons and geese will also utilise wetlands for their foraging needs (APPENDIX 2: FIGURE 2 and 3).

Many thousands of earthen and other dams exist in the southern African landscape. Whilst dams have altered flow patterns of streams and rivers, and affected many bird species detrimentally, a number of species have benefited from their construction. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall. Man-made impoundments, although artificial in nature, can be very important for a variety of birds, particularly water birds. Apart from the water quality, the structure of the dam, and specifically the margins and the associated shoreline and vegetation, plays a big role in determining the species that will be attracted to the dam. The broader study area contains several dams and the species of conservation concern recorded in the study area by SABAP2 that are likely to be attracted to these dams (APPENDIX 2: FIGURE 3) include Greater Flamingo, Lesser Flamingo, Maccoa Duck, Yellow-billed Stork and White Stork. Common species in the study area that could use dams and dam edges include African Darter *Anhinga rufa*, Red-knobbed Coot *Fulica cristata,* Reed Cormorant *Phalacrocorax africanus,* White-breasted Cormorant *Phalacrocorax carbo*, various heron and duck species, Common Moorhen, Black-winged Stilt, African Sacred Ibis *Threskiornis aethiopicus*, Egyptian Goose *Alopochen aegyptiacus and* Blacksmith Lapwing *Vanellus armatus.*

Given the location of the wetlands and dams outside of the proposed solar site boundary and the fact that the area is already subject to considerable existing disturbance, coupled with the low reporting rates for the majority of the SCC supported by these habitats, construction and operational activities associated with the proposed SEF are unlikely to have a permanent negative impact on the wetlands and the bird communities that these may support. Similarly, for the more common species that are fairly resilient to disturbance, the potential displacement impacts are unlikely to be permanent and of regional or national significance.

7.3.3. Exotic Tress Stands

Although stands of *Eucalyptus* are strictly speaking invader species, they have become important refuges for certain species of raptors, particularly Amur Falcon *Falco amurensis*, a Palearctic migrant, which will commonly roost in small stands of *Eucalyptus* in suburbs of small towns. Black Sparrowhawk *Accipiter melanoleucus* and Ovambo Sparrowhawk *Accipiter ovampensis* are another two species that use these trees for roosting and breeding purposes (APPENDIX 2: FIGURE 6).

7.3.4. Built-up Areas and Infrastructure

These areas includes mine, industry, residential areas and surface infrastructure such as roads (APPENDIX 2: FIGURE 4 and 7). Built-up areas generally are of little value to SCC due to their degraded nature and the associated disturbance factor, with the possible exception of Lanner Falcon which hunt feral pigeons and (possibly) free-ranging poultry. The impact of the dense human population also spills over in the adjacent

habitat classes through the constant movement of pedestrians, cattle and dogs into those areas. This has implications for the avifauna, particularly the larger species, in that it acts as sources of potential disturbance. These areas play an important role in providing safe refuge and foraging opportunities for small passerine species that have become common in urban, peri-urban and rural environments. Again, these species are relatively tolerant of disturbance and are therefore likely to be temporarily displaced from the area during the construction phase of the project.

TABLE 3 details the micro habitats that each of the SEF-sensitive bird species (recorded by SABAP2) will typically frequent in the PAOI. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis in TABLE 3 represents each species' most preferred habitats. These locations are where most of the birds of that species will spend most of their time which in turn provides an indication of where impacts on those species will be most significant.

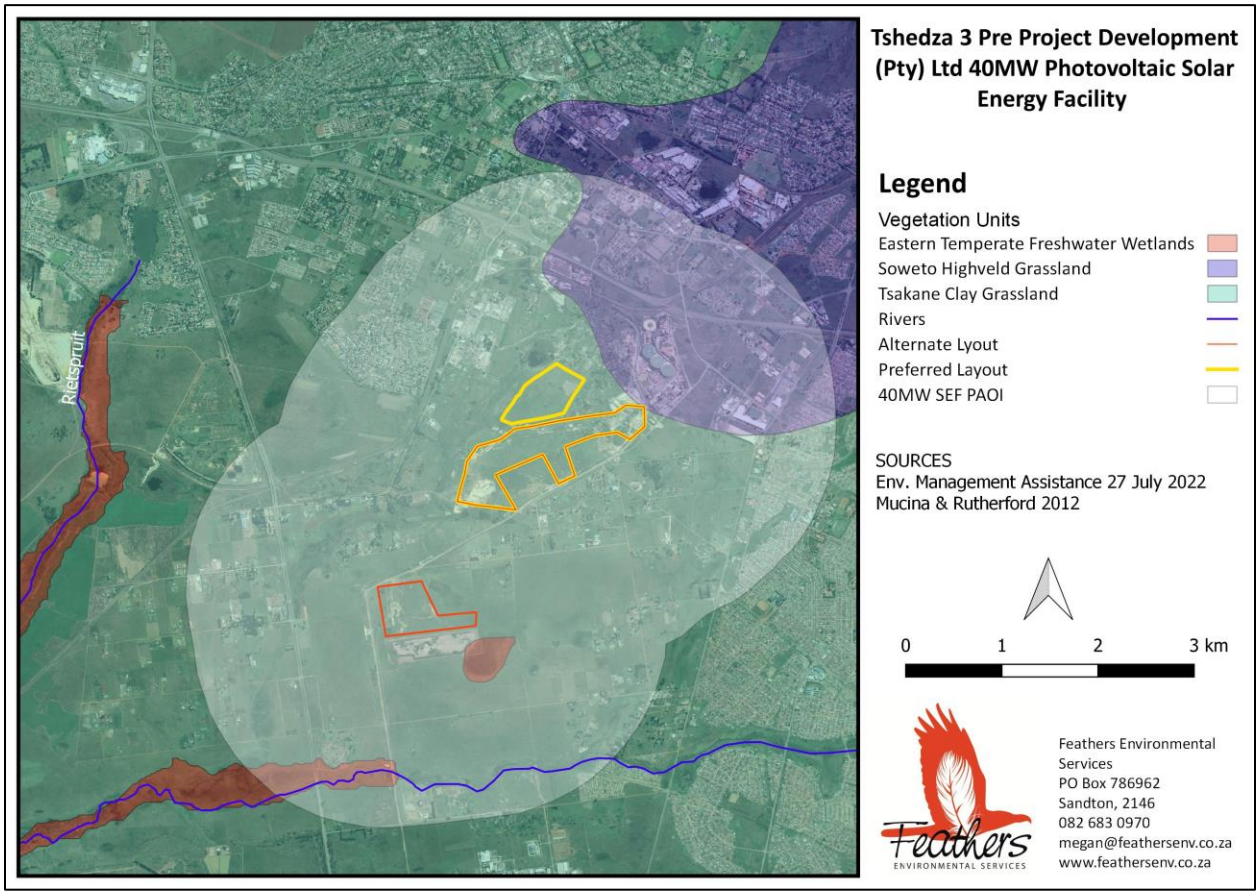

FIGURE 5: Regional map detailing the various vegetation types and river systems occurring within the 40MW SEF development area and PAOI.

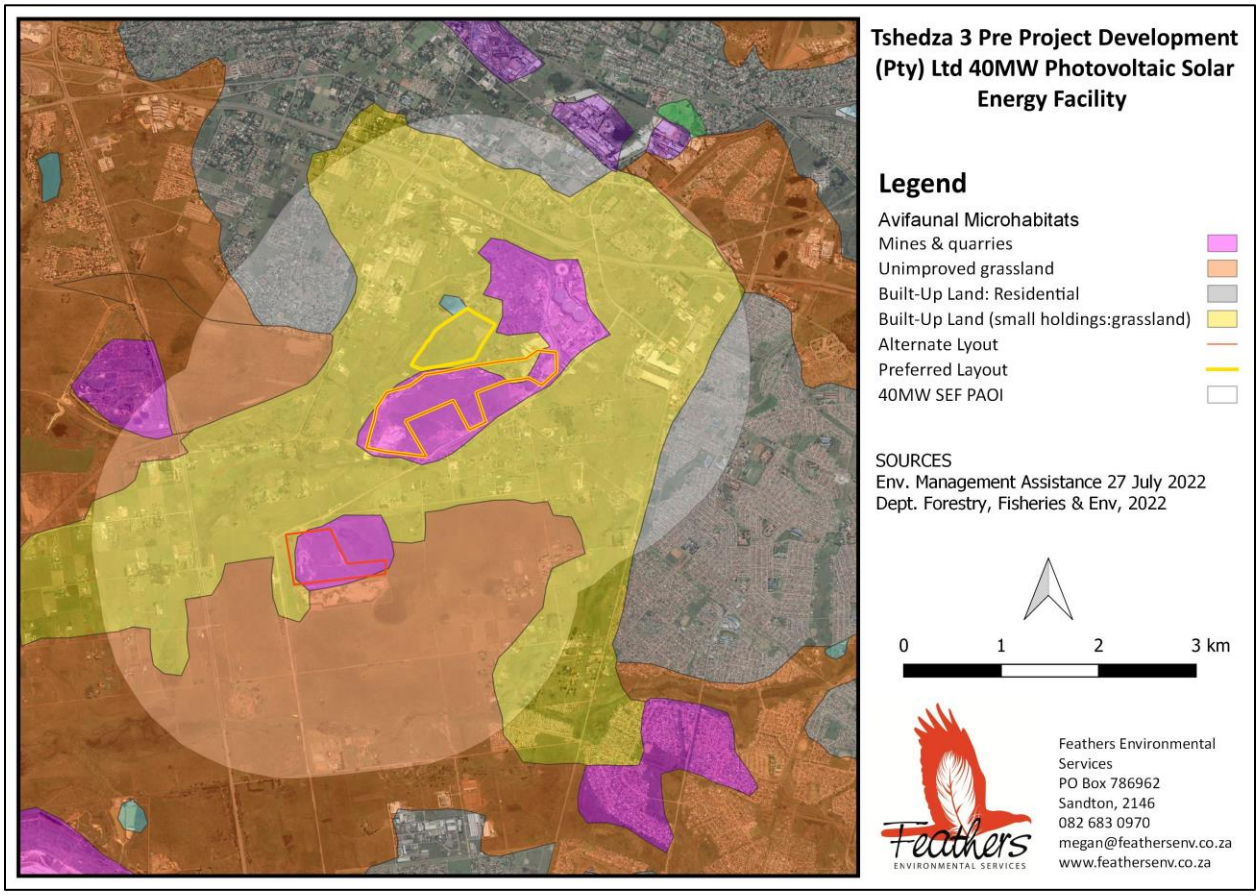

FIGURE 6: Regional map detailing the land use types occurring within the 40MW SEF development area and PAOI.

8. GENERAL DESCRIPTION OF BIRD INTERACTIONS WITH ELECTRICITY GENERATION INFRASTRUCTURE

The effects of any development 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 diversity of species present. With so many variables involved, the impacts of each development must be assessed individually. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss and disturbance causes a reduction in birds using an area which may then reduce the risk of collision). The principal areas of concern for SCC and non-SCC SEF sensitive species related to the proposed 40MW SEF development are:

* Displacement due to habitat loss in the physical SEF infrastructure footprint;
* Displacement due to disturbance associated with construction and operation/maintenance of the proposed 40MW SEF development;
* Mortality due to collision with the PV panels; and

* Displacement due to habitat loss as a result of altered run-off and the use of chemical pollutants.

8.1 Construction Phase

8.1.1. Displacement as a result of habitat loss or transformation

This impact is dependent on various factors i.e., the location and the scale of the facility, the amount of habitat affected; the uniqueness of the habitat; and the sensitivity and conservation status of the bird species utilizing that habitat. Areas of habitat will be cleared to accommodate the considerable amount of infrastructure required, reducing the amount of habitat available to birds for foraging, roosting and breeding (Smallie, 2013). Typically, PV panels occupy a surface area of approximately 2-5ha per MW according to Ong *et al*, 2013 and Hernandez *et al,* 2014 or approximately 1.4 to 6.2ha per MW according to US Department of Energy 2012 and together with the associated roads, substations, offices and its ancillary grid connection, SEFs occupy a relatively large amount of land and represent a significant anthropogenic land use in any environment (Walston *et al*, 2015). This impact is likely to have dire consequences for the smaller bird species with small home ranges as entire territories could be removed during construction activities.

In a study comparing the avifaunal habitat use within PV arrays versus the adjoining managed grassland at airports in the USA, DeVault et al. (2014) found that species diversity within the PV arrays was reduced (37) compared to the grasslands (46), supporting the view that solar development is generally detrimental to wildlife on a local scale. A local case study aimed at identifying the functional and structural changes in bird communities in and around the development footprint of the 180ha Jasper PV solar facility in the Northern Cape (Visser, 2016), revealed that bird density and diversity per unit area was higher in the boundary and untransformed landscape. However, the extent was not considered to be statistically significant and therefore suggests that the PV facility matrix is pervious to most species. A key finding of this study was that the distribution of birds in the landscape changed, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability were detrimental to shrubland specialists, but in contrast, open country, grassland and generalist species, were favoured by the changes brought about by the development (Visser 2016).

The grassland vegetation present within the proposed SEF layouts is subject to significant existing disturbance and is already heavily transformed. It is therefore unlikely to support the more sensitive grassland species listed in TABLE 3, compared to the grassland areas to the south and west of the proposed development areas. Despite the levels of existing disturbance, the wetlands within the PAOI remain critical habitat that needs to be avoided. Unfortunately, due to the nature of this impact, it would be extremely difficult to mitigate to negligible levels, but it can be significantly reduced with the selection of the layout that poses the least risk to SCC and non-SCC SEF sensitive species (discussed in section 10 below) and avoidance of wetland and waterbody habitats.

8.1.2. Displacement as a result of disturbance

Construction of energy generation facilities requires a significant amount of machinery and labour to be present on site for a period of time. For most bird species, construction activities are likely to be a cause of temporary disturbance and will impact on foraging, breeding and roosting behaviors. However, for shy, sensitive species or ground nesting birds, construction activities in close proximity to breeding locations, could be a source of disturbance resulting in temporary breeding failure or even permanent abandonment of nests and displacement from the site entirely. In addition, species commuting around the area may become disorientated, avoid the site and fly longer distances than usual as a result, and for some species this may have critical energy implications (Smallie, 2013). Similarly, but to a lesser extent, ongoing maintenance activities at the operational facility, are likely to cause some degree of disturbance to birds in the general vicinity.

The broader study area is already subjected to a fairly significant degree of disturbance associated with mining and urbanisation in the immediate vicinity of the proposed development. However, African Grass Owl and African Marsh Harrier have bred historically in the grassland areas to the north and northwest of land portion Withok 131 IR Portion 9. Development in this area will undoubtedly displace the avifaunal community that reside within the proposed development areas. The significance of this impact can be reduced with the selection of the layout that poses the least risk to SCC and non-SCC SEF sensitive species (discussed in section 10 below) in addition to strict adherence to the recommendations that will stem from the pre-construction avifaunal walk-through, which may include delaying construction to accommodate breeding SCC.

8.1.3. Direct mortality as a result of construction activities

Bird mortality as a result of construction activities is improbable because birds are incredibly mobile and able to move out of harm's way. If mortality does occur, it is likely to be confined to a localised area and restricted to immobile species e.g. nestlings. No terrestrial bird species (ground) nest locations were observed during the site surveys.

8.2 Operational Phase

8.2.1. Mortality due to collisions with the PV panels

This impact refers to collision-related fatality i.e. fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al*. 1986; Hernandez *et al*. 2014; Kagan *et al*. 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injuries.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space. Although very few cases have been reported it is possible that the

reflective surfaces of solar panels could constitute a similar risk to avifauna. An extremely rare but potentially related problem is the so-called "lake effect" where reflections from solar facilities' infrastructure, particularly large sheets of dark blue PV panels, may attract birds in flight, who mistake the broad reflective surfaces for water (Kagan et al. 2014).

The results of mortality searches at various solar facilities in the USA (all technology types), suggest that impact trauma ranks as the highest identifiable cause of avian mortality (Harvey & Associates 2014a and 2014b, Kagan et al. 2014 and Walston *et al*. 2015). The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the "lake effect" hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al*. 2015). However, until such time as enough scientific evidence has been collected to discount the "lake effect" hypothesis, it must be considered as a potential source of impact.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was conducted at the Jasper PV solar facility in the Northern Cape Province (Visser 2016). The Jasper PV facility contains 325 360 solar panels over a footprint of 180ha. Mortality surveys were conducted over a three-month period, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site (Visser 2016).

It is important to understand that bird abundance and flight activity levels differ according to habitat availability, and other natural features. Therefore the impact on birds through direct fatality is very site specific. The priority species that may occur in the study area which could potentially be exposed to collision risk are listed in TABLE 3. In addition, the so-called "lake effect" could act as a potential attraction to numerous waterbird species recorded in the broader study area. It is also important to note, that in order to increase solar panel efficiency and power output, most solar panels are treated with an anti-reflective coating which may mitigate this impact. It is not possible to determine whether this impact will occur until operational monitoring reveals actual mortalities at the proposed 40MW SEF.

8.2.2. Displacement due to habitat loss associated with altered run-off and chemical pollutants

The transformation of the site surface from natural vegetation to infrastructure alters the manner in which water moves on the site after rainfall and cleaning of infrastructure. If this is not carefully managed this could cause soil erosion reducing the remaining bird habitat further by affecting off site areas. Increased runoff could also create moister conditions on or near the site thereby attracting more birds to the area and increasing the likelihood of other interactions with the facility. Jenkins *et al,* 2017 suggests that pollution could occur if hazardous chemicals are used to clean PV panels once operational. This could have secondary effects on vegetation, invertebrate populations and in turn food availability and habitat for birds.

8.2.3. Nesting

Various bird species are quick to seize a new opportunity for perching, roosting or nesting, including on man-made structures (van Rooyen & Ledger 1999, de Goede 2011 and de Goede & Jenkins 2001). Relevant to the proposed 40MW SEF, passerine and corvid species are likely to use certain parts of the proposed facility once commissioned. Whilst nesting could be viewed as a positive impact for birds, it can result in operational problems for the facility. An increase in the number of birds roosting, nesting and feeding at the facility could lead to increased defecation on the solar infrastructure causing panel obstruction requiring management actions such as nest management in order to ensure that the nests don't interfere with operations or increase fire risk. Nest relocation or removal should be done under permit from the provincial authority. It is also likely that some small species will use the PV panels for shade and this will create a new microhabitat on the site. This should not adversely affect the operation of the equipment however and should also not lead to direct mortalities by these small species.

8.3 Decommissioning & Closure Phases

8.3.1. Displacement as a result of disturbance

The PAOI is already subjected to a degree of disturbance. While the decommissioning of the 40MW SEF will undoubtedly displace some species, the bird species likely to occupy this area, and the fact that similar habitat is available within the broader PAOI, displacement as a result of disturbance is unlikely to be permanent and of national significance.

9. SENSITIVITY MAPPING

Sensitive features present within the PAOI include the river systems, waterbodies, wetland areas and breeding locations to the north-west, west and south of the proposed SEF layout boundaries (FIGURE 7). The river and wetlands have been buffered by 100m and assigned a HIGH sensitivity rating, owing to the degree of connectivity with other ecosystems and their suitability to support African Grass Owl and African Marsh Harrier. The African Marsh Harrier breeding and foraging habitat is buffered by 100m and assigned a HIGH sensitivity

rating. Similarly, the African Grass Owl breeding location has been buffered by 100m and assigned a HIGH sensitivity rating in accordance with GDARD requirements. Suitable foraging habitat occurs on the neighbouring properties for those priority SCC whose distribution overlaps with the proposed development areas – this habitat has been assigned a MEDIUM sensitivity rating (FIGURE 8). The remaining areas earmarked for the proposed development are heavily transformed and considered to be of LOW sensitivity.

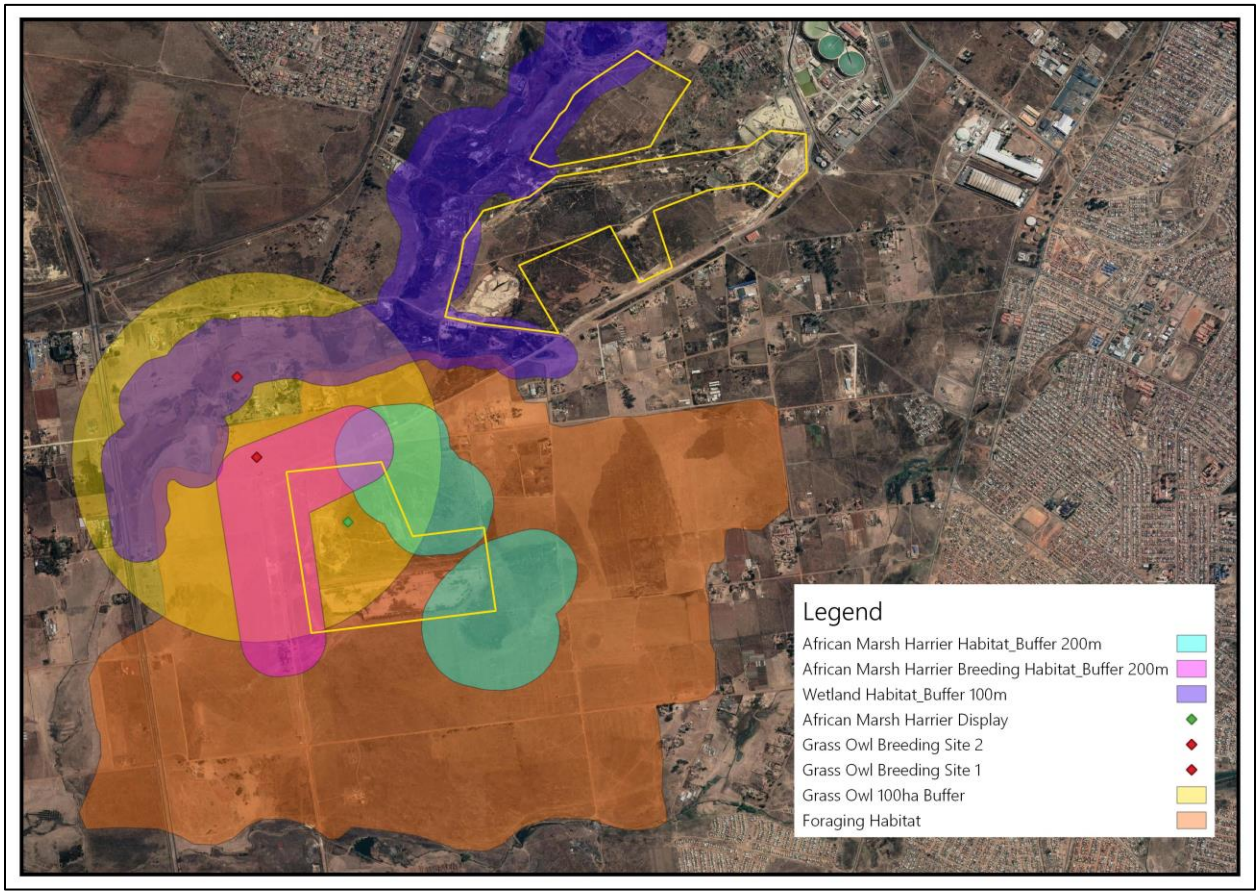

FIGURE 7: Key avifaunal sites and habitat requirements within the 40MW SEF development area and PAOI.

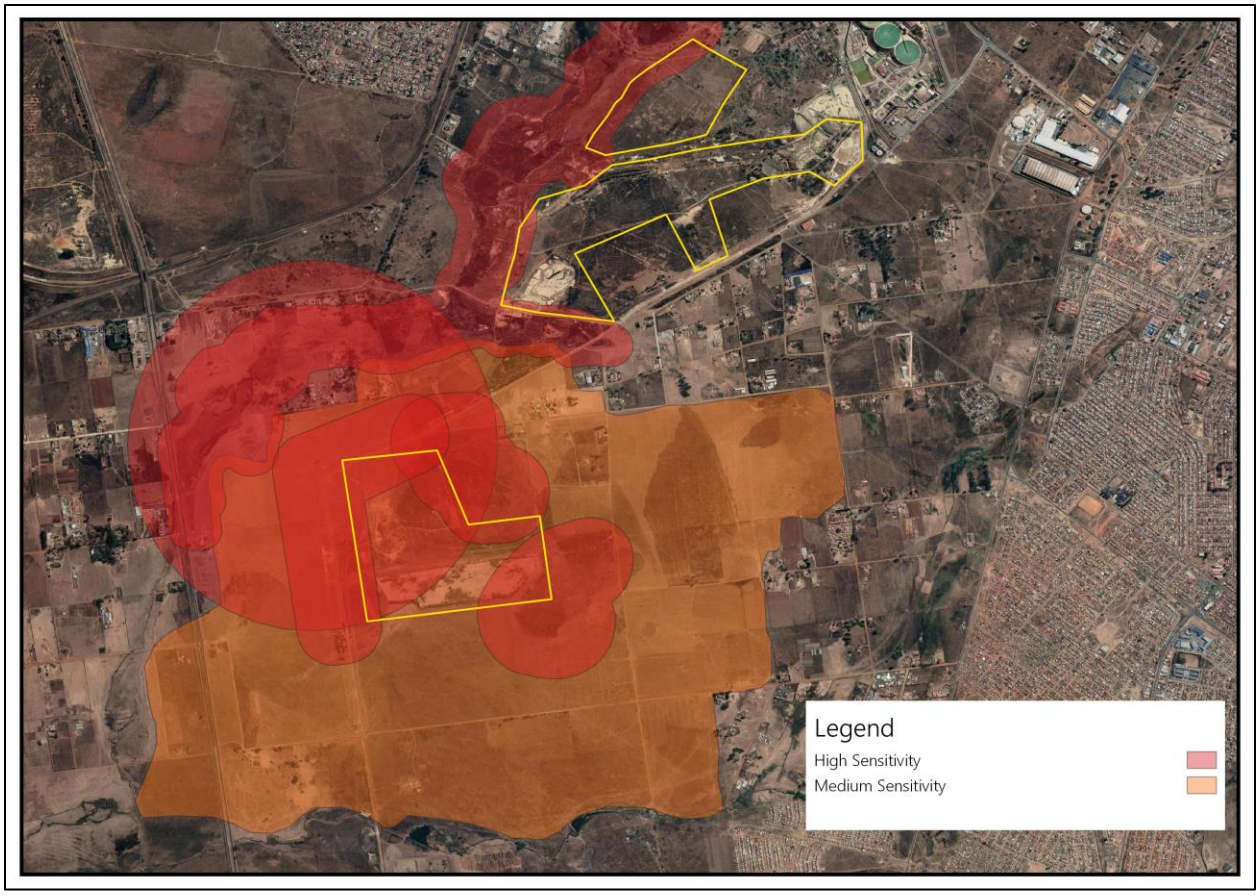

FIGURE 8: Avifaunal sensitivity within the 40MW SEF development area and PAOI.

10. IDENTIFICATION OF A PREFERRED LAYOUT ALTERNATIVE

One of the objectives of this study is to determine the preferred PV SEF development layout that poses the least impact to the avifaunal community, particularly the sensitive SCC present within the study area. The two alternatives that have been proposed for the 40MW SEF i.e. Preferred Layout and Alternative Layout occur within the same pentad. They are comprised of identical vegetation units and subjected to similar existing disturbances associated with the land use practices in the area and are therefore likely to be identical in terms of species diversity and density too. With this in mind, the selection of a preferred Site Layout has been determined using observations of available micro habitat, species occurrence and the location of the Site Layouts in relation to existing infrastructure.

The Preferred Layout avoids the areas of HIGH sensitivity within the PAOI, particularly the African Grass Owl and African Marsh Harrier breeding locations. This layout also contains areas that are heavily transformed and subject to significant levels of existing habitat degradation and disturbance. It is on this basis that the Preferred Layout is considered to pose the least impact to the resident avifaunal community.

11. ASSESSMENT OF EXPECTED IMPACTS

A qualitative methodology was used to describe, evaluate and rate the significance of the aforementioned impacts associated with the construction and operation of the 40MW SEF. This assessment is presented in tabular format below (TABLES 4-7) for both pre- and post-mitigation according to set criteria described in APPENDIX 3.

TABLE 4 Assessment of the habitat loss and/or transformation caused by the construction of the 40MW SEF

Activity:		Construction of the 40MW SEF				
Impact:		Displacement of SCC as a result of habitat loss and/or transformation				
Significance rating:		Duration	Extent	Magnitude	Probability	Significance
Preferred Layout	Pre-Mitigation	4	1	4	3	27
	Post-Mitigation	4	1	2	2	14
Alternative Layout	Pre-Mitigation	4	1	4	3	27
	Post-Mitigation	4	1	2	2	14
Is the Impact Reversible?		• Medium reversibility – The removal of vegetation will be limited to the PV foundations.				
Mitigation Measures:		• Given the disturbed nature of the habitat and the absence of unique habitat features within the Preferred Layout, there is no specific mitigation required. • Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species • All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. • All temporary disturbed areas should be rehabilitated according to the site's rehabilitation plan, following construction.				
Cumulative impacts:		• Despite existing habitat transformation and disturbance, the PAOI does contain grassland and wetland habitats that are important to African Grass Owl, African Marsh Harrier and a variety of waterbird and passerine species and therefore the cumulative impact is deemed to be of moderate significance.				
Residual impacts:		• SCC and non-SCC passerine species may return once the construction activity is completed and the site rehabilitated, but it is unlikely that the numbers will recover to those recorded prior to the development due to the significant habitat transformation that will take place.				
Climate Change:		• N/A				

TABLE 5 Assessment of the disturbance impact caused by the construction of the 40MW SEF

Activity:		Construction of the 40MW SEF				
Impact:		Displacement of SCC as a result of disturbance				
Significance rating:		Duration	Extent	Magnitude	Probability	Significance
Preferred Layout	Pre-Mitigation	1	2	6	3	27
	Post-Mitigation	1	2	4	2	14
Alternative Layout	Pre-Mitigation	2	2	8	4	48
	Post-Mitigation	1	2	6	3	27
Is the Impact Reversible?		• Medium reversibility - After the construction activities, have ceased, the source of displacement will largely dissipate.				
Mitigation Measures:		• All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. • Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species. • Measures to control noise should be applied according to current best practice in the industry.				
Cumulative impacts:		In addition to the proposed PV SEF arrays, there are several activities (i.e. mining, light industrial and urbanisation) that feature prominently both within the development area and the broader PAOI - a significant source of existing disturbance. These activities, coupled with the limited habitat diversity and degradation within the proposed development site, are a likely cause of the absence of SCC within the development area and the immediate area. Therefore the cumulative impact is deemed to be of high significance.				
Residual impacts:		• The majority of species observed in the study area may return once the construction activity is completed.				
Climate Change:		• N/A				

TABLE 6 Assessment of mortality due to collision with the PV panels

Activity:	Operation of the SEF				
Impact:	Mortality at PV facility (impact trauma on PV panels)				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	4	2	6	3	42
Post-Mitigation	4	2	2	2	16
Is the Impact Reversible?	• High reversibility - If the PV SEF is de-commissioned the collision risk will disappear				
Mitigation Measures:	• The PV panels should spend as little time as possible in a vertical position as this presents a greater collision hazard. • An operational monitoring programme, that includes carcass searches to provide an indication of fatality rates as a result of collisions, and if there are any spatial, temporal or conditional patterns to the frequency of collisions. • Most importantly, operational monitoring should highlight if mitigation (i.e. modifications to the panel design to reduce the illusionary characteristics of the panels) is required to reduce impacts to acceptable levels.				

Cumulative impacts:	• An extensive power line network features prominently within the immediate vicinity of the proposed study area. The addition of reflective PV panels will potentially increase the collision risk. Collisions with the proposed PV panels will have a medium cumulative impact.
Residual impacts:	• It is envisaged that mitigation, if required, will reduce but not eliminate collision mortality.
Climate Change:	• N/A

TABLE 7 Assessment of habitat impacts associated with altered run-off and chemical pollution

Activity:	Operation of the 40MW SEF - particularly cleaning of the solar panels				
Impact:	Habitat loss associated with altered run-off and chemical pollution				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	4	2	4	2	20
Post-Mitigation	4	2	2	1	8
Is the Impact Reversible?	• High reversibility - a robust water management plan will eliminate habitat loss				
Mitigation Measures:	• This will need to be managed through the development of a carefully considered surface water/drainage management plan for the site. • The surface water management plan should stipulate the use of environmentally friendly and acceptable cleaning products.				
Cumulative impacts:	• The surrounding area is already heavily transformed as a result of industrial and urban activities. Although relatively small in size, any additional loss of habitat as a result of altered runoff and the use of chemical pollutants is deemed to have a medium cumulative impact.				
Residual impacts:	• Smaller passerine species may return once the construction activity is completed and the site rehabilitated.				
Climate Change:	• N/A				

12. CUMULATIVE IMPACT

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The cumulative impacts have been assessed below, according to the guidance offered by the DEA (DEAT (2004) Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism (DEAT), Pretoria) and IFC guidelines (Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets"(International Finance Corporation)) on this matter.

Specifically, the steps undertaken in the cumulative impact assessment section of the study were as follows:

- Define and assess the impacts of the PV SEF project. *See Section 8.*
- Identify and obtain details for all operational and authorised SEFs (within a 30km radius of 40MW SEF activities). *Three solar projects are approved within a 30km radius of the 40MW SEF (DEA online screening tool).*
- Identify impacts of the proposed PV SEF project which are also likely or already exist at the other projects. *All of the impacts described in Section 8 will occur on the other solar PV facilities. However the most important one of these impacts and the one which we know will definitely occur (i.e. some of the others are slightly speculative) is that of habitat destruction. The area of habitat which is altered or destroyed is also a good indicator of some of the other impacts. We have therefore used habitat destruction as the focus impact for the cumulative impact assessment. Habitat destruction is likely to be most significant for a suite of small passerine species.*
- Where possible obtain reports and data for other projects. *In most cases specialist avifaunal studies were not done. Ecological reports considered avifauna but not comprehensively.*
- As far as possible quantify the effect of all projects on key bird species local populations (defined and estimated). *Where the amount of habitat to be altered or destroyed has been specified in other project reports this has been used. See Table 8 for these figures.*
- Express the likely impacts associated with the PV SEF project as a proportion of the overall impacts on key species. *This analysis is presented in Table 8. PV SEF will represent 68% of the total habitat destruction across all solar projects. We have to assume that the importance of the habitat for the relevant bird species is uniform across all this habitat. In which case the PV SEF will contribute approximately 68% of the total impact of habitat destruction on birds. It is however important to note that our estimate is that all three projects will only take up 0.0087% of the total area within the 30km radius of the PV SEF site. Of this 0.0087% the PV SEF contributes 0.006%. In our view this is a small proportion of the broader landscape.*
- A reasoned overall opinion will be expressed on the suitability of the proposed development against the above background. This will include a cumulative impact assessment statement. *This has been presented below Table 8.*
- The decision making process with respect to the above will be clearly documented in the report. *This section.*
- Identified cumulative impacts must be clearly defined and where possible the size of the identified impact quantified and indicated. *See above and Table 8*
- Detailed process flow and proof must be provided to indicate how the specialists' recommendations, mitigation measures and conclusions from the various similar developments in the area were taken into consideration in the assessment of cumulative impacts and when the conclusion and mitigation measures were drafted for this project. *This section.*
- The cumulative impacts significance rating must also inform the need and desirability of the proposed development. *This has been addressed with the Cumulative Impacts Statement.*

* A cumulative impact environmental statement on whether the proposed development must proceed. *See below Table 8.*

TABLE 8. Summary information for the proposed solar facilities within 30km of the PV SEF.

Project	Capacity (MW)	Footprint (ha)	Proportion of total footprint of all projects	Proportion of 30km radius circle (282 743 hectares)
14/12/16/3/3/1/569	3MW	2	0.98%	0.0007%
14/12/16/3/3/2/706	Unknown	6	2.96%	0.002%
GP 30/5/1/2/2(58)MR	up to 20MW	80	39.41%	0.028%
40MW PV SEF (Preferred Layout)	up to 40MW	115	56.65%	0.041%
Total	-	203	100%	0.0717%

10.1 Cumulative Impact Statement

Relevant to the proposed 40MW SEF, the removal of vegetation will be limited to the PV foundations and will be maintained under the paneling, during the operational lifespan of the facility. While the smaller passerines are unlikely to be displaced permanently from the development area as a result of habitat transformation, the paneling will alter movement, breeding and foraging patterns for the SCC recorded in the PAOI i.e. African Grass Owl and African Marsh Harrier, particularly at the Alternate Layout Area. It stands to reason that the more land is altered in this manner, the greater the impact on birds. The cumulative impact of multiple SEFs on birds is therefore negative. The construction of multiple additional facilities will result in the overall cumulative impact being MODERATE.

13. PROPOSED IMPACT MITIGATION ACTIONS

Based on the anticipated impacts described above, the following recommendations are provided regarding practical mitigation measures for potentially significant impacts to be included in the Environmental Management Programme (EMPr) detailed in TABLE 9 below.

TABLE 9: Recommendations for the anticipated impacts associated with the construction and operation of the 40MW SEF

OBJECTIVE: Mitigate the displacement and direct mortality impacts caused by the construction and operation of the 40MW PV Solar Energy Facility	
Project component/s	PV SEF including PV panels, cabling between project components and access road

Potential Impact	Permanent displacement and mortality of local populations of SCC and non-SCC caused by habitat loss, disturbance and collisions with the PV panels		
Activity/risk source	* Construction of the 40MW SEF within sensitive avifaunal habitat. * Unmitigated construction, operational and decommissioning activities.		
Mitigation: Target/Objective	No avifaunal mortality and displacement as far as practically possible for the duration of the operational life span of the 40MW SEF		
Mitigation: Action/control		Responsibility	Timeframe
CONSTRUCTION PHASE			
Displacement as a result of habitat loss: * Avoid removal of sensitive vegetation types. The recommendations of the botanical study must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned. * Construction activity should be restricted to the immediate footprint of the infrastructure. * All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. * All temporary disturbed areas should be rehabilitated according to the site's rehabilitation plan, following construction. * Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.		Solar PV Developer, Construction Manager, Environmental Control Officer and Avifaunal Specialist.	From the commencement of construction (inclusive of all project components to the completion of construction.
Displacement as a result of disturbance: * Conduct a pre-construction inspection (avifaunal walk-through) of the final SEF layout, to identify any species that may be breeding on the authorised development site or within the immediate surrounds to ensure that any impacts likely to affect breeding species (if any) are adequately managed. * Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. * Measures to control noise should be applied according to current best practice in the industry.		Solar PV Developer, Construction Manager, Environmental Control Officer and Avifaunal Specialist.	From the commencement of construction (inclusive of all project components to the completion of construction.
OPERATIONAL PHASE			
Collision Mortality (PV arrays): * The PV panels should spend as little time as possible time in a vertical position as this presents a greater collision hazard. Single axis tracking will be utilized..		PV Solar Facility Developer, PV Solar Facility Environmental Manager, Environmental Control	Post construction monitoring should be conducted for a minimum three years of operation. Additional monitoring requirements will be determined

* An operational monitoring programme, that includes carcass searches to provide an indication of fatality rates as a result of collisions, and if there are any spatial, temporal or conditional patterns to the frequency of collisions. * Immediate mitigatory action to be taken upon record of first SCC collision mortality. * If repeated (<5) collision impacts of non-SCC are recorded once the SEF is operational, it is recommended that an avifaunal specialist investigate the mortalities and provide recommendations for site-specific mitigation to be applied reactively. * Most importantly, operational monitoring should highlight if mitigation (i.e. modifications to the panel design to reduce the illusionary characteristics of the panels) is required to reduce impacts to acceptable levels.	Officer and Avifaunal Specialist	following an assessment of the data collected over the three-year period.
Habitat loss associated with altered run-off and chemical pollution * A carefully considered surface water/drainage management plan for the site must be developed. * The surface water management plan must stipulate the use of environmentally friendly and acceptable cleaning products.	PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Water management strategies to be developed prior to commissioning and implemented during the operational life span of the SEF.
Nest building on PV infrastructure: * If repeated quality of supply impacts are recorded once the 40MW SEF is operational, it is recommended that these impacts be assessed by a suitably qualified avifaunal specialist and site-specific mitigation be applied reactively.	PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Nest management strategies to be identified and implemented reactively, if required.
DECOMMISSIONING PHASE		
Displacement as a result of disturbance: * Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. * Measures to control noise should be applied according to current best practice in the industry.	Solar PV Developer, Construction Manager, Environmental Control Officer and Avifaunal Specialist.	From the commencement of construction (inclusive of all project components to the completion of construction.
Performance Indicator	* Habitat loss is confined to the 40MW SEF footprint and rehabilitation results in the size and extent of habitat present at the start of construction remains intact at end of construction phase.	

	* Sustainable levels of mortalities are reported on a monthly basis and the necessary mitigation measures are implemented.
Monitoring	* Environmental Control Officer to ensure that construction activities are confined to the site footprint to avoid any additional impacts on bird species residing in the broader area. * Environmental manager and/or maintenance staff to conduct regular (preferably weekly) inspections of the PV arrays to record the number of mortalities, nesting activity and faecal matter fouling on solar PV panels and determine the effectiveness of the mitigation actions taken.

14. PROPOSED MONITORING ACTIONS

Environmental Control Officer to ensure that construction activities are confined to the site footprint to avoid any additional impacts on bird species residing in the broader area.

Environmental manager and/or maintenance staff to conduct regular (preferably weekly) inspections of the PV arrays to record the number of mortalities, nesting activity and faecal matter fouling on solar PV panels and determine the effectiveness of the mitigation actions taken.

15. ENVIRONMENTAL IMPACT STATEMENT

15.1 Conditions to be included in the Environmental Authorisation

In conclusion, the habitat within which the proposed development area is located MODERATELY to HIGHLY sensitive from a potential bird impact perspective. In recent years, anthropogenic impacts, mostly in the form of mining and urbanisation have largely transformed the landscape resulting in a negative impact on avifaunal diversity and abundance with the study area. This is reflected in the low reporting rates for priority species, which may also indicate that levels of disturbance are high. The construction of the proposed 40MW SEF will result in impacts of MODERATE to LOW significance to birds occurring in the vicinity of the new infrastructure, which can be reduced to negligible levels through the application of mitigation measures. Given the presence of existing habitat degradation and disturbance, it is anticipated that the proposed 40MW SEF can be constructed within the Preferred Layout with acceptable levels of impact on the resident avifauna subject to the following recommendations:

* Conduct a pre-construction inspection (avifaunal walk-through) of the final SEF layout, to identify any species that may be breeding on the authorised development site or within the immediate surrounds to ensure that any impacts likely to affect breeding species (if any) are adequately managed.
* Construction activities (i.e. all staff, vehicle and machinery) should be restricted to the immediate footprint of the infrastructure.

* Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifaunal species.
* Care should be taken not to introduce or propagate alien plant species/weeds during construction.
* Mitigation is complex at electrical structures since there are many factors that contribute to collisions with the PV panels. It is therefore recommended that mitigation be applied reactively once the SEF, if a significant problem is detected. Monitoring of this infrastructure for bird fatalities must be built into the operational environmental management programme for the facility.
* A carefully considered surface water/drainage management plan must be developed for the site including attention to the use of environmentally friendly cleaning chemicals.
* Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
* In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

15.2 Specialist Opinion

In accordance with the outcomes of the impact assessment detailed in Section 11 and 12, in conjunction with the baseline conditions as presented in Section 7 and the impact management measures in Section 13, the proposed 40MW SEF is not deemed to present unmitigable negative environmental issues or impacts. It is this specialist's opinion that the construction of the 40MW SEF will result in acceptable levels of impact on the resident avifauna subject to the selection of the preferred layout alternative and the aforementioned mitigation and management measures.

16. ASSUMPTIONS, UNCERTAINTIES & GAPS IN KNOWLEDGE

The avifaunal specialist assumed that the sources of information used for this assessment are reliable. However, it must be noted that there are limiting factors and these may potentially detract from the accuracy of the predicted results.

* The report is the result of a short-term study and is based on a two site surveys of the PAOI. No long-term, seasonal monitoring was conducted by the avifaunal specialist. This assessment relies upon secondary data sources with regards to bird occurrence and abundance such as the SABAP2 and IBA projects. These comprehensive datasets provide a valuable baseline against which any changes in species presence, abundance, and distribution can be monitored. However, primary information on bird habitat and avifaunal species occurrence collected during the site visit and together with professional judgement, based on extensive field experience since 2006, was used directly in

determining which species of conservation importance are likely to occur within suitable avifaunal habitat types within the PAOI. Based on these findings, the specialist was able to identify and assess the anticipated impacts and provide recommendations for mitigation;

* The site survey of the proposed 40MW SEF and the resultant observations were made in the austral summer and austral autumn seasons respectively, during which time various species may not have been present in the PAOI and therefore may not be a true indication of all bird species potentially present in the area;
* The focus of this assessment is primarily on the potential impacts on regional SCC and non-SCC SEF sensitive species i.e., species that are vulnerable to the displacement and collision impacts associated with the construction and operation of the 40MW SEF; and
* Predictions in this study are based on experience of these and similar species in different parts of South Africa, through the authors' experience working in the avifaunal specialist field since 2006. However, bird behaviour can't be reduced to formulas that will hold true under all circumstances. It must also be noted that, it is often not possible to entirely eliminate the risk of the disturbance and displacement impacts associated with the construction and operational activities. Our best possible efforts can probably not ensure zero impact on birds. Assessments such as this attempt to minimise the risk as far as possible, and although the displacement impacts, associated with the construction and operation of the 40MW SEF, will be unavoidable, they are likely to be temporary and of low significance.

The above limitations need to be stated as part of this assessment so that the reader fully understands the complexities. However, they do not detract from the confidence that this author has in the findings of this impact assessment report and subsequent recommendations for this project.

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APPENDIX 1: SOUTH AFRICAN BIRD ATLAS PROJECT DATA (SABAP2) FOR THE 40MW SOLAR ENERGY FACILITY

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Abdim's Stork	Ciconia abdimii	0,23	0,00	-	NT		
Acacia Pied Barbet	Tricholaema leucomelas	0,30	0,00	-	-		
African Black Duck	Anas sparsa	3,71	3,06	-	-		
African Black Swift	Apus barbatus	0,23	0,00	-	-		
African Crake	Crecopsis egregia	0,08	10,20	-	-		
African Darter	Anhinga rufa	56,93	7,14	-	-		
African Firefinch	Lagonosticta rubricata	0,00	0,00	-	-		
African Fish Eagle	Haliaeetus vocifer	0,53	0,00	-	-		
African Grass Owl	Tyto capensis	0,00	0,00	-	VU		
African Green Pigeon	Treron calvus	0,61	0,00	-	-		
African Grey Hornbill	Lophoceros nasutus	0,15	1,02	-	-		
African Harrier-Hawk	Polyboroides typus	2,57	2,04	-	-		
African Hoopoe	Upupa africana	31,64	0,00	-	-		
African Jacana	Actophilornis africanus	2,88	0,00	-	-		
African Marsh Harrier	Circus ranivorus	1,44	0,00	-	EN		
African Olive Pigeon	Columba arquatrix	48,15	0,00	-	-		
African Palm Swift	Cypsiurus parvus	47,54	0,00	-	-		
African Paradise Flycatcher	Terpsiphone viridis	1,74	0,00	-	-		
African Pied Wagtail	Motacilla aguimp	0,23	0,00	-	-		
African Pipit	Anthus cinnamomeus	14,69	0,00	-	-		
African Rail	Rallus caerulescens	2,50	0,00	-	-		
African Red-eyed Bulbul	Pycnonotus nigricans	0,91	0,00	-	-		
African Reed Warbler	Acrocephalus baeticatus	19,98	0,00	-	-		
African Sacred Ibis	Threskiornis aethiopicus	87,89	0,00	-	-		
African Snipe	Gallinago nigripennis	6,96	0,00	-	-		
African Spoonbill	Platalea alba	15,90	0,00	-	-		
African Stonechat	Saxicola torquatus	37,47	0,00	-	-		
African Swamphen	Porphyrio madagascariensis	38,23	0,00	-	-		
African Wattled Lapwing	Vanellus senegallus	55,26	3,06	-	-		
Alpine Swift	Tachymarptis melba	0,08	0,00	-	-		
Amethyst Sunbird	Chalcomitra amethystina	11,36	0,00	-	-		
Amur Falcon	Falco amurensis	6,36	9,18	-	-		
Ant-eating Chat	Myrmecocichla formicivora	1,67	3,06	-	-		
Arrow-marked Babbler	Turdoides jardineii	0,45	1,02	-	-		
Banded Martin	Riparia cincta	0,76	4,08	-	-		
Barn Swallow	Hirundo rustica	28,31	0,00	-	-		
Bar-tailed Godwit	Limosa lapponica	2,57	0,00	NT	LC		
Bar-throated Apalis	Apalis thoracica	0,08	12,24	-	-		
Black Crake	Zapornia flavirostra	9,16	0,00	-	-		
Black Heron	Egretta ardesiaca	9,31	0,00	-	-		
Black Sparrowhawk	Accipiter melanoleucus	0,38	0,00	-	-		
Black Swan	Cygnus atratus	13,17	0,00	-	-		
Black-backed Puffback	Dryoscopus cubla	0,30	0,00	-	-		
Black-chested Prinia	Prinia flavicans	10,30	0,00	-	-		
Black-chested Snake Eagle	Circaetus pectoralis	0,30	4,08	-	-		
Black-collared Barbet	Lybius torquatus	43,60	0,00	-	-		
Black-crowned Night Heron	Nycticorax nycticorax	12,19	0,00	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Black-crowned Tchagra	Tchagra senegalus	0,08	0,00	-	-		
Black-headed Heron	Ardea melanocephala	56,09	0,00	-	-		
Black-headed Oriole	Oriolus larvatus	0,45	8,16	-	-		
Black-necked Grebe	Podiceps nigricollis	1,29	8,16	-	-		
Blacksmith Lapwing	Vanellus armatus	91,67	3,06	-	-		
Black-throated Canary	Crithagra atrogularis	29,37	9,18	-	-		
Black-winged Kite	Elanus caeruleus	39,97	2,04	-	-		
Black-winged Pratincole	Glareola nordmanni	0,45	0,00	NT	NT		
Black-winged Stilt	Himantopus himantopus	12,34	0,00	-	-		
Blue Crane	Grus paradisea	0,00	0,00	VU	NT		
Blue Korhaan	Eupodotis caerulescens	0,00	0,00	NT	LC	x	Endemic
Blue Waxbill	Uraeginthus angolensis	0,15	0,00	-	-		
Blue-billed Teal	Spatula hottentota	23,09	0,00	-	-		
Bokmakierie	Telophorus zeylonus	0,98	0,00	-	-		
Booted Eagle	Hieraaetus pennatus	0,08	3,06	-	-		
Bronze Mannikin	Spermestes cucullata	0,83	2,04	-	-		
Bronze-winged Courser	Rhinoptilus chalcopterus	0,00	0,00	-	-		
Brown-crowned Tchagra	Tchagra australis	0,00	0,00	-	-		
Brown-hooded Kingfisher	Halcyon albiventris	0,23	1,02	-	-		
Brown-throated Martin	Riparia paludicola	21,65	7,14	-	-		
Brubru	Nilaus afer	0,08	0,00	-	-		
Buffy Pipit	Anthus vaalensis	0,15	0,00	-	-		
Burchell's Coucal	Centropus burchellii	5,90	4,08	-	-		
Cape Bunting	Emberiza capensis	0,08	0,00	-	-		
Cape Canary	Serinus canicollis	0,08	0,00	-	-		
Cape Crow	Corvus capensis	0,08	1,02	-	-		
Cape Grassbird	Sphenoeacus afer	0,23	0,00	-	-	x	Near endemic
Cape Longclaw	Macronyx capensis	17,41	3,06	-	-		
Cape Robin-Chat	Cossypha caffra	68,96	0,00	-	-		
Cape Rock Thrush	Monticola rupestris	0,08	0,00	-	-	x	Endemic
Cape Shoveler	Spatula smithii	54,58	0,00	-	-		
Cape Sparrow	Passer melanurus	94,32	0,00	-	-		
Cape Starling	Lamprotornis nitens	74,87	0,00	-	-		
Cape Teal	Anas capensis	5,15	0,00	-	-		
Cape Turtle Dove	Streptopelia capicola	95,69	1,02	-	-		
Cape Wagtail	Motacilla capensis	81,68	0,00	-	-		
Cape Weaver	Ploceus capensis	0,30	0,00	-	-	x	Near endemic
Cape White-eye	Zosterops virens	56,55	0,00	-	-	x	Near endemic
Capped Wheatear	Oenanthe pileata	9,01	0,00	-	-		
Cardinal Woodpecker	Dendropicos fuscescens	2,20	0,00	-	-		
Caspian Tern	Hydroprogne caspia	0,08	0,00	-	VU		
Chestnut-vented Warbler	Curruca subcoerulea	0,08	0,00	-	-		
Chinspot Batis	Batis molitor	0,15	7,14	-	-		
Cinnamon-breasted Bunting	Emberiza tahapisi	0,15	0,00	-	-		
Cloud Cisticola	Cisticola textrix	6,51	2,04	-	-	x	Near endemic
Common Buttonquail	Turnix sylvaticus	0,15	0,00	-	-		
Common Buzzard	Buteo buteo	0,61	2,04	-	-		
Common Greenshank	Tringa nebularia	2,12	0,00	-	-		
Common House Martin	Delichon urbicum	0,61	2,04	-	-		
Common Moorhen	Gallinula chloropus	75,17	5,10	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Common Myna	Acridotheres tristis	94,10	1,02	-	-		
Common Ostrich	Struthio camelus	0,61	0,00	-	-		
Common Quail	Coturnix coturnix	0,45	0,00	-	-		
Common Ringed Plover	Charadrius hiaticula	0,15	0,00	-	-		
Common Sandpiper	Actitis hypoleucos	1,21	0,00	-	-		
Common Scimitarbill	Rhinopomastus cyanomelas	0,08	0,00	-	-		
Common Starling	Sturnus vulgaris	0,15	0,00	-	-		
Common Swift	Apus apus	0,38	0,00	-	-		
Common Waxbill	Estrilda astrild	13,47	0,00	-	-		
Corn Crake	Crex crex	0,08	2,04	-	-		
Crested Barbet	Trachyphonus vaillantii	75,47	0,00	-	-		
Crimson-breasted Shrike	Laniarius atrococcineus	0,08	0,00	-	-		
Crowned Lapwing	Vanellus coronatus	65,25	3,06	-	-		
Curlew Sandpiper	Calidris ferruginea	1,29	0,00	NT	LC		
Dark-capped Bulbul	Pycnonotus tricolor	82,59	3,06	-	-		
Desert Cisticola	Cisticola aridulus	1,36	1,02	-	-		
Diederik Cuckoo	Chrysococcyx caprius	16,12	11,22	-	-		
Domestic Duck	Anas platyrhynchos domestica	2,73	8,16	-	-		
Domestic Goose	Anser anser domesticus	13,47	5,10	-	-		
Eastern Long-billed Lark	Certhilauda semitorquata	0,08	3,06	-	-	x	Endemic
Egyptian Goose	Alopochen aegyptiaca	90,01	0,00	-	-		
European Bee-eater	Merops apiaster	1,14	1,02	-	-		
European Honey-buzzard	Pernis apivorus	0,08	0,00	-	-		
European Roller	Coracias garrulus	0,00	0,00	-	NT		
Fairy Flycatcher	Stenostira scita	0,08	0,00	-	-	x	Near endemic
Familiar Chat	Oenanthe familiaris	0,38	0,00	-	-		
Fan-tailed Widowbird	Euplectes axillaris	5,22	0,00	-	-		
Fiery-necked Nightjar	Caprimulgus pectoralis	0,00	0,00	-	-		
Fiscal Flycatcher	Melaenornis silens	10,07	0,00	-	-	x	Near endemic
Fork-tailed Drongo	Dicrurus adsimilis	0,30	4,08	-	-		
Freckled Nightjar	Caprimulgus tristigma	0,15	0,00	-	-		
Fulvous Whistling Duck	Dendrocygna bicolor	5,22	1,02	-	-		
Gabar Goshawk	Micronisus gabar	0,23	4,08	-	-		
Giant Kingfisher	Megaceryle maxima	1,59	16,33	-	-		
Glossy Ibis	Plegadis falcinellus	61,09	2,04	-	-		
Goliath Heron	Ardea goliath	39,67	2,04	-	-		
Great Crested Grebe	Podiceps cristatus	23,47	1,02	-	-		
Great Egret	Ardea alba	2,04	2,04	-	-		
Great Reed Warbler	Acrocephalus arundinaceus	1,44	0,00	-	-		
Great White Pelican	Pelecanus onocrotalus	0,08	2,04	-	VU		
Greater Flamingo	Phoenicopterus roseus	31,42	3,06	-	NT		
Greater Honeyguide	Indicator indicator	4,01	0,00	-	-		
Greater Kestrel	Falco rupicoloides	0,08	0,00	-	-		
Greater Painted-snipe	Rostratula benghalensis	0,15	0,00	-	NT		
Greater Striped Swallow	Cecropis cucullata	43,38	0,00	-	-		
Green Wood Hoopoe	Phoeniculus purpureus	51,63	0,00	-	-		
Grey Go-away-bird	Crinifer concolor	69,42	5,10	-	-		
Grey Heron	Ardea cinerea	35,28	0,00	-	-		
Grey-headed Gull	Chroicocephalus cirrocephalus	85,84	0,00	-	-		
Groundscraper Thrush	Turdus litsitsirupa	0,08	0,00	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Hadada Ibis	Bostrychia hagedash	94,40	3,06	-	-		
Half-collared Kingfisher	Alcedo semitorquata	0,08	0,00	-	NT		
Hamerkop	Scopus umbretta	0,91	1,02	-	-		
Helmeted Guineafowl	Numida meleagris	70,70	3,06	-	-		
Horus Swift	Apus horus	0,68	0,00	-	-		
House Sparrow	Passer domesticus	70,70	0,00	-	-		
Hybrid Mallard	Anas hybrid	0,68	0,00	-	-		
Indian Peafowl	Pavo cristatus	0,83	15,31	-	-		
Intermediate Egret	Ardea intermedia	4,39	5,10	-	-		
Jackal Buzzard	Buteo rufofuscus	0,23	17,35	-	-	x	Near endemic
Jacobin Cuckoo	Clamator jacobinus	0,08	2,04	-	-		
Karoo Thrush	Turdus smithi	77,37	0,00	-	-	x	Near endemic
Kittlitz's Plover	Charadrius pecuarius	1,82	0,00	-	-		
Klaas's Cuckoo	Chrysococcyx klaas	0,08	0,00	-	-		
Knob-billed Duck	Sarkidiornis melanotos	0,45	0,00	-	-		
Kurrichane Thrush	Turdus libonyana	0,00	0,00	-	-		
Lanner Falcon	Falco biarmicus	0,38	1,02	-	VU		
Laughing Dove	Spilopelia senegalensis	95,23	1,02	-	-		
Lazy Cisticola	Cisticola aberrans	0,08	2,04	-	-		
Lesser Black-backed Gull	Larus fuscus	0,91	0,00	-	-		
Lesser Flamingo	Phoeniconaias minor	13,17	0,00	NT	NT		
Lesser Grey Shrike	Lanius minor	0,38	0,00	-	-		
Lesser Honeyguide	Indicator minor	0,83	3,06	-	-		
Lesser Kestrel	Falco naumanni	0,15	3,06	-	-		
Lesser Masked-weaver	Ploceus intermedius	0,00	0,00	-	-		
Lesser Striped Swallow	Cecropis abyssinica	0,98	0,00	-	-		
Lesser Swamp Warbler	Acrocephalus gracilirostris	43,00	0,00	-	-		
Levaillant's Cisticola	Cisticola tinniens	51,32	10,20	-	-		
Lilac-breasted Roller	Coracias caudatus	0,08	0,00	-	-		
Little Bittern	Ixobrychus minutus	3,86	11,22	-	-		
Little Egret	Egretta garzetta	11,28	5,10	-	-		
Little Grebe	Tachybaptus ruficollis	53,52	0,00	-	-		
Little Rush Warbler	Bradypterus baboecala	39,89	0,00	-	-		
Little Sparrowhawk	Accipiter minullus	0,38	0,00	-	-		
Little Stint	Calidris minuta	6,28	0,00	-	-		
Little Swift	Apus affinis	18,47	0,00	-	-		
Long-billed Crombec	Sylvietta rufescens	0,00	4,08	-	-		
Long-crested Eagle	Lophaetus occipitalis	0,23	1,02	-	-		
Long-tailed Paradise Whydah	Vidua paradisaea	0,00	0,00	-	-		
Long-tailed Widowbird	Euplectes progne	20,06	0,00	-	-		
Maccoa Duck	Oxyura maccoa	9,77	5,10	VU	NT		
Magpie Shrike	Urolestes melanoleucus	0,00	0,00	-	-		
Malachite Kingfisher	Corythornis cristatus	2,50	3,06	-	-		
Malachite Sunbird	Nectarinia famosa	0,08	0,00	-	-		
Mallard	Anas platyrhynchos	5,37	2,04	-	-		
Mandarin Duck	Aix galericulata	0,68	1,02	-	-		
Marabou Stork	Leptoptilos crumenifer	0,00	0,00	-	NT		
Marsh Owl	Asio capensis	1,44	2,04	-	-		
Marsh Sandpiper	Tringa stagnatilis	2,12	0,00	-	-		
Marsh Warbler	Acrocephalus palustris	0,68	0,00	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Martial Eagle	Polemaetus bellicosus	0,08	0,00	EN	EN		
Melodious Lark	Mirafra cheniana	0,08	0,00	-	-	x	Near endemic
Meyer's Parrot	Poicephalus meyeri	0,38	2,04	-	-		
Mocking Cliff Chat	Thamnolaea cinnamomeiventris	0,00	1,02	-	-		
Mountain Wheatear	Myrmecocichla monticola	21,50	0,00	-	-		
Namaqua Dove	Oena capensis	0,45	0,00	-	-		
Natal Spurfowl	Pternistis natalensis	0,08	0,00	-	-		
Neddicky	Cisticola fulvicapilla	3,56	3,06	-	-		
Northern Black Korhaan	Afrotis afraoides	0,53	3,06	-	-		
Orange River Francolin	Scleroptila gutturalis	0,61	1,02	-	-		
Orange-breasted Waxbill	Amandava subflava	5,00	0,00	-	-		
Ovambo Sparrowhawk	Accipiter ovampensis	1,29	0,00	-	-		
Pearl-breasted Swallow	Hirundo dimidiata	0,23	0,00	-	-		
Peregrine Falcon	Falco peregrinus	0,08	0,00	-	-		
Pied Avocet	Recurvirostra avosetta	8,02	0,00	-	-		
Pied Crow	Corvus albus	35,20	4,08	-	-		
Pied Kingfisher	Ceryle rudis	7,49	0,00	-	-		
Pied Starling	Lamprotornis bicolor	11,20	0,00	-	-	x	Endemic
Pin-tailed Whydah	Vidua macroura	25,28	0,00	-	-		
Plain-backed Pipit	Anthus leucophrys	0,61	0,00	-	-		
Purple Heron	Ardea purpurea	8,33	0,00	-	-		
Quailfinch	Ortygospiza atricollis	2,57	0,00	-	-		
Rattling Cisticola	Cisticola chiniana	0,15	3,06	-	-		
Red-backed Shrike	Lanius collurio	0,45	0,00	-	-		
Red-billed Firefinch	Lagonosticta senegala	0,08	0,00	-	-		
Red-billed Quelea	Quelea quelea	8,02	0,00	-	-		
Red-billed Teal	Anas erythrorhyncha	22,03	0,00	-	-		
Red-breasted Swallow	Cecropis semirufa	0,00	0,00	-	-		
Red-capped Lark	Calandrella cinerea	5,45	0,00	-	-		
Red-chested Cuckoo	Cuculus solitarius	7,12	15,31	-	-		
Red-chested Flufftail	Sarothrura rufa	0,45	0,00	-	-		
Red-collared Widowbird	Euplectes ardens	1,74	0,00	-	-		
Red-eyed Dove	Streptopelia semitorquata	90,61	0,00	-	-		
Red-faced Mousebird	Urocolius indicus	69,57	0,00	-	-		
Red-footed Falcon	Falco vespertinus	0,00	1,02	NT	NT		
Red-headed Finch	Amadina erythrocephala	36,94	16,33	-	-		
Red-knobbed Coot	Fulica cristata	86,90	0,00	-	-		
Red-throated Wryneck	Jynx ruficollis	10,98	0,00	-	-		
Red-winged Starling	Onychognathus morio	1,74	0,00	-	-		
Reed Cormorant	Microcarbo africanus	67,68	0,00	-	-		
Ringed Teal	Callonetta leucophrys	0,45	0,00	-	-		
Rock Dove	Columba livia	71,08	9,18	-	-		
Rock Kestrel	Falco rupicolus	0,23	0,00	-	-		
Rock Martin	Ptyonoprogne fuligula	7,19	0,00	-	-		
Rose-ringed Parakeet	Psittacula krameri	4,92	1,02	-	-		
Ruff	Calidris pugnax	8,40	1,02	-	-		
Rufous-naped Lark	Mirafra africana	3,33	1,02	-	-		
Sand Martin	Riparia riparia	1,14	0,00	-	-		
Sanderling	Calidris alba	0,08	0,00	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Secretarybird	Sagittarius serpentarius	0,00	0,00	EN	VU		
Sedge Warbler	Acrocephalus schoenobaenus	1,36	0,00	-	-		
Sentinel Rock Thrush	Monticola explorator	0,08	0,00	NT	LC	x	Endemic
Shikra	Accipiter badius	0,08	13,27	-	-		
South African Cliff Swallow	Petrochelidon spilodera	1,67	0,00	-	-	x	Endemic Breeding
South African Shelduck	Tadorna cana	3,26	0,00	-	-		
Southern Boubou	Laniarius ferrugineus	6,74	0,00	-	-		
Southern Fiscal	Lanius collaris	79,64	8,16	-	-		
Southern Grey-headed Sparrow	Passer diffusus	10,52	0,00	-	-		
Southern Masked Weaver	Ploceus velatus	95,08	0,00	-	-		
Southern Pochard	Netta erythrophthalma	26,12	0,00	-	-		
Southern Red Bishop	Euplectes orix	80,47	3,06	-	-		
Southern Yellow-billed Hornbill	Tockus leucomelas	0,00	6,12	-	-		
Speckled Mousebird	Colius striatus	70,40	0,00	-	-		
Speckled Pigeon	Columba guinea	69,49	0,00	-	-		
Spike-heeled Lark	Chersomanes albofasciata	2,50	2,04	-	-		
Spotted Eagle-Owl	Bubo africanus	1,59	0,00	-	-		
Spotted Flycatcher	Muscicapa striata	0,68	8,16	-	-		
Spotted Thick-knee	Burhinus capensis	54,88	0,00	-	-		
Spur-winged Goose	Plectropterus gambensis	41,64	0,00	-	-		
Squacco Heron	Ardeola ralloides	15,29	1,02	-	-		
Streaky-headed Seedeater	Crithagra gularis	12,19	0,00	-	-		
Striated Heron	Butorides striata	0,83	0,00	-	-		
Swainson's Spurfowl	Pternistis swainsonii	16,96	0,00	-	-		
Tawny-flanked Prinia	Prinia subflava	42,54	0,00	-	-		
Thick-billed Weaver	Amblyospiza albifrons	48,75	0,00	-	-		
Three-banded Plover	Charadrius tricollaris	28,92	0,00	-	-		
Unidentified Duck	N/A N/A	0,08	0,00	-	-		
Village Weaver	Ploceus cucullatus	0,38	0,00	-	-		
Wattled Starling	Creatophora cinerea	30,13	0,00	-	-		
Western Barn Owl	Tyto alba	0,45	0,00	-	-		
Western Cattle Egret	Bubulcus ibis	45,34	4,08	-	-		
Western Marsh Harrier	Circus aeruginosus	0,08	2,04	-	-		
Western Yellow Wagtail	Motacilla flava	0,15	0,00	-	-		
Whiskered Tern	Chlidonias hybrida	12,94	0,00	-	-		
White Stork	Ciconia ciconia	1,29	0,00	-	-		
White-backed Duck	Thalassornis leuconotus	2,95	1,02	-	-		
White-backed Mousebird	Colius colius	0,08	1,02	-	-		
White-bellied Sunbird	Cinnyris talatala	32,70	0,00	-	-		
White-breasted Cormorant	Phalacrocorax lucidus	56,70	1,02	-	-		
White-browed Scrub Robin	Cercotrichas leucophrys	0,00	0,00	-	-		
White-browed Sparrow-Weaver	Plocepasser mahali	3,86	0,00	-	-		
White-crested Helmetshrike	Prionops plumatus	0,00	0,00	-	-		
White-faced Whistling Duck	Dendrocygna viduata	43,00	0,00	-	-		
White-fronted Bee-eater	Merops bullockoides	0,30	2,04	-	-		
White-rumped Swift	Apus caffer	33,69	0,00	-	-		
White-throated Swallow	Hirundo albigularis	31,11	0,00	-	-		
White-winged Tern	Chlidonias leucopterus	5,07	0,00	-	-		
White-winged Widowbird	Euplectes albonotatus	1,59	0,00	-	-		

Species name	Scientific name	Full protocol	Ad hoc protocol	Red List - Global	Red List -Regional	Endemic	Endemic Description
Willow Warbler	Phylloscopus trochilus	3,71	0,00	-	-		
Wing-snapping Cisticola	Cisticola ayresii	2,42	5,10	-	-		
Wood Sandpiper	Tringa glareola	4,24	0,00	-	-		
Woodland Kingfisher	Halcyon senegalensis	0,53	12,24	-	-		
Yellow Bishop	Euplectes capensis	0,15	0,00	-	-		
Yellow Canary	Crithagra flaviventris	10,83	0,00	-	-		
Yellow-billed Duck	Anas undulata	56,62	3,06	-	-		
Yellow-billed Kite	Milvus aegyptius	0,30	0,00	-	-		
Yellow-billed Stork	Mycteria ibis	0,98	0,00	-	EN		
Yellow-crowned Bishop	Euplectes afer	12,64	1,02	-	-		
Yellow-fronted Canary	Crithagra mozambica	1,06	0,00	-	-		
Yellow-fronted Tinkerbird	Pogoniulus chrysoconus	0,08	0,00	-	-		
Zitting Cisticola	Cisticola juncidis	21,12	4,08	-	-		

APPENDIX 2: AVIFAUNAL HABITAT OBSERVED WITHIN THE DEVELOPMENT AREA AND BROADER PAOI

FIGURE 1: Grassland habitat dominates the proposed PAOI

FIGURE 2: Wetland area – potential African Marsh Harrier habitat

FIGURE 3: Surface waterbody and associated wetland edges within the PAOI

FIGURE 4: Surface waterbody associated with the mine operations

FIGURE 5: Degraded grassland habitat within the Preferred Layout

FIGURE 6: Alien tree stands

FIGURE 7: Mine operations near the Alternate Layout

APPENDIX 3: METHOD OF ASSESSING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS

Characteristic	Definition	Terms	Scoring
Duration	The time period over which a resource / receptor is affected.	Temporary - (period of less than 1 year - negligible/ pre-construction/ construction) Short term - period of less than 5 years ie commissioning/operational period Medium term - period of less than 15 years ie operational period Long term - period of less than 20 years ie life of project Permanent - a period that exceeds the life of project– ie irreversible.	Temporary – 1 Short term – 2 Medium term – 3 Long term – 4 Permanent – 5
Extent	The reach of the impact (ie physical distance an impact will extend to)	On-site - impacts that are limited to the Project site. Local - impacts that are limited to the Project site and adjacent properties. Regional - impacts that are experienced at a regional scale, ie Gauteng. National - impacts that are experienced at a national scale. Trans-boundary/International - impacts that are experienced outside of South Africa.	On-site – 1 Local – 2 Regional – 3 National – 4 International – 5
Probability	Measure of the probability with which the impact is expected to occur	Unlikely - probably will not happen Improbable - some possibility, but low likelihood Probable - distinct possibility) Highly probable - most likely Definite - impact will occur regardless of any prevention measures	Unlikely – 1 Improbable – 2 Probable – 3 Highly probable – 4 Definite – 5
Magnitude	A measure of the damage that the impact will cause if it does occur	No effect - will have no effect on the environment Minor – minor and will not result in an impact on processes Low – low and will cause a slight impact on processes Moderate – moderate and will result in processes continuing but in a modified way High - processes are altered to the extent that they temporarily cease Very high - results in complete destruction of patterns and permanent cessation of processes	No effect – 0 Minor – 2 Low – 4 Moderate – 6 High – 8 Very high – 10

The significance (quantification) of potential environmental impacts identified during the Basic Assessment have been determined using a ranking scale, based on the following (terminology has been taken from the Guideline Documentation on EIA Regulations, of the Department of Environmental Affairs and Tourism, April 1998):

Occurrence

- Probability of occurrence (how likely is it that the impact may occur?)
- Duration of occurrence (how long may it last?)

Severity

- Magnitude (severity) of impact (will the impact be of high, moderate or low severity?)
- Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?)

The environmental significance of each potential impact is assessed using the following formula:

Significance Points (SP) = (Magnitude + Duration + Extent) x Probability

The maximum value is 100 Significance Points (SP). Potential environmental impacts were rated as high, moderate or low significance on the following basis:

- < 30 significance points = LOW environmental significance.
- 30- 60 significance points = MODERATE environmental significance
- >60 significance points = HIGH environmental significance

APPENDIX 4: CURRICULUM VITAE

MEGAN DIAMOND

PERSONAL DETAILS

Date of Birth | *7 December 1978*

Driver's License | *Code A and B*

Home Language | *English*

Other Languages | *Afrikaans*

EDUCATION

BSc Environmental Management | *University of South Africa (UNISA)* 2002 – 2009

ACCREDITATION

South African Council for Natural Scientific Professions | *Environmental Science*

Registration Number: 300022/14

EXPERIENCE

Owner & Avifaunal Specialist | *Feathers Environmental Services*

July 2013 – Present

- Perform specialist avifaunal assessment studies to minimise the impact of industrial infrastructure on birds and their habitats;
- Provide strategic guidance to industry through the development of best practice procedures and guidelines;
- Review and comment on methodologies, specialist studies and EIA reports for Renewable Energy projects;
- Provide input into renewable energy and power line developments elsewhere in Africa and across the globe;
- Manage the collection and collation of relevant and complete desktop and/or field datasets;
- Manage pre- and post-construction avifaunal monitoring data collected at wind and solar energy facilities;
- Site assessments, either as part of the project team or independently;
- Preparation of reports according to project deadlines, including the use of Geographic Information Systems (GIS) to portray data;
- Attendance of specialist integration meetings; and
- Liaison with stakeholders where necessary.

Wildlife & Energy Programme Manager | *Endangered Wildlife Trust*

October 2006 – June 2013

Programme management

- Annually review the programme's conservation and research strategic objectives and update in accordance with the EWT's and programme's vision and mission including work plans for staff etc.;
- Ensure timeous, professional delivery on all aspects of Wildlife & Energy Programme activities;
- Formulate, prioritise and approve relevant research and conservation projects;
- Ensure acceptable quality of all research projects and their outputs;
- Participate in international network liaison as and when required;
- Produce regular popular articles & media releases on the Wildlife & Energy Programme projects and outputs & contribute to the EWT publications;
- Establish & maintain a network with relevant national & international stakeholders;
- Deliver presentations at relevant meetings, functions, workshops & conferences on behalf of the programme;
- Assist with compilation of newsletters, updating of webpage, compilation of press articles, any advocacy issues;
- Identify & establish partnerships to achieve Wildlife & Energy Programme conservation goals.

Eskom –EWT Strategic Partnership

- Ensure that this partnership is managed effectively and sustainably against its goals. Manage staff in this division;
- Develop and maintain relationships with Eskom;
- Negotiate the terms of reference for the annual service level agreements between EWT and Eskom, to ensure the sustainability of the relationship;
- Compile annual report to Eskom Corporate Environment and Sustainability;
- Produce monthly reports to Eskom's regional grids on the status of incident follow-up;
- Attend applicable forums to interact with Eskom stakeholders;
- Participate in international network liaison as and when required;
- Maintain a network with all relevant local and regional level stakeholders (meetings, forums, workshops, etc.);
- Identify research needs relating to the management of wildlife interaction with power lines;
- Conduct research projects on wildlife and power line interaction and present the results at national and international conferences and workshops;
- Development and implementation of training for Eskom field services staff (at various levels) in the management of wildlife interactions; and
- Conduct special investigations on power lines relating to wildlife induced faulting.

Environmental Impact Assessment Division

- Ensure that this division operates effectively and efficiently at all times and manage staff in this division; and

- Conduct specialist avifaunal studies for new power lines developments including: tendering/quoting for the projects, conducting field work, preparing reports, presenting results & negotiating the acceptance of recommendations, final "walk through" as part of Environmental Management Plans; general project management, all liaison with clients, Eskom, authorities, Interested and Affected Parties etc.

Management and administration

- Ensure all programme staff have relevant terms of reference;
- Ensure that all programme staff are performance appraised against their terms of reference;
- Compile and manage programme budgets, monthly reports, work plans and strategy;
- Monitor expenditure and take corrective action if necessary; and
- Ensure timely delivery on all projects to all stakeholders.

CONFERENCE ATTENDANCE

- *Society for Conservation Biology 21st Annual Meeting (1-5 July 2007)*
- *The 6th TAWIRI Scientific Conference (3 – 6 December 2007) Presented a paper titled "*Co-operative management of wildlife and power line conflicts: an African solution"
- Pan-African Ornithological Congress (7-12 September 2008)
- International Conference on Overhead Lines, Design, Construction, Inspection & Maintenance, Fort Collins Colorado USA. (29 March – 1 April 2010) Presented a paper titled "Bird's eye view: how birds see is key to avoiding power line collision"
- Windaba 2011 – Implementing South African Wind Energy (27-29 September 2011)
- Pan African Vulture Summit (16-20 April 2012) Presented a paper titled "Electrification in Africa – Are our vultures being strung along"
- 4th Wind Power Africa Conference & Renewable Energy Exhibition (28-30 May 2012) Presented a paper titled "Wind Energy in Africa – what does this really mean for our continent's birds"
- 13th Pan-African Ornithological Congress (14-21 October 2012) Presented a paper titled "Stringing South Africa's Terrestrial Birds Along - Monitoring of Bird Interactions with Power Line and Experimental Testing of Bird Collision Mitigation at the Karoo Long Term Monitoring Site"
- AEWA Single Species Action-Planning Workshop for the Conservation of the Grey Crowned Crane (10-13 September 2013) Presented and participated in the workshop as a subject expert (energy and bird interactions)

AUTHORED & CO-AUTHORED PAPERS

Jenkins, A.R., Smallie, J. & Diamond, M. 2009. Balls, flashers, flappers and coils: South African perspectives on a global search for ways to prevent avian collisions with overhead lines. In: Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakatomonana, H. & Muchai, M. (eds). Proceedings of the 12th Pan-African Ornithological Congress, 2008. Cape Town, Animal Demography Unit.

Smallie, J., Diamond, M. & Jenkins, A. 2009. Lighting up the African continent – what does it mean for our birds? pp. 38–43. In: Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakotomanana, H. & Muchai. (eds). *Proceedings of the 12th Pan-African Ornithological Congress, 2008.* Cape Town, Animal Demography Unit.

Jenkins, A. R., Smallie, J.J and Diamond, M. 2010 Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International, page1 of16.

Retief, E.F., Diamond, M., Anderson, M.D., Smit, H.A., Jenkins, A.R., Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa.

Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Harrison, J.A., Diamond, M. And Smit, H.A. 2012. BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.

Jenkins, A.R., De Goede, K.H., Sebele, L. and Diamond, M. 2013. Brokering a settlement between eagles and industry: sustainable management of large raptors nesting on power infrastructure. Bird Conservation International (2013) 23:232 – 246.

Diamond, M., Harris, J., Mirande, C. and Austin, J. 2014. People of a feather flock together: A global initiative to address crane and power line interactions. 13th North American Crane Workshop Summary. Lafayette, Louisiana.

Page-Nicholson, S., Tate, G., Hoogstad, C., Murison, M., Diamond, M., Blofield, A., Pretorius, M., Michael, M.D. 2018. Mitigating the Impact of Large Mammals on Wooden Electrical Distribution Poles in the Kruger National Park, South Africa. African Journal of Wildlife Research.

Diamond, M. and Hoogstad, C. (in press) Collisions and habitat loss associated with utility lines and wind turbines. IUCN SSC Crane Specialist Group – Crane Conservation Strategy.