# BAT IMPACT ASSESMENT BASED ON 12 MONTH PRE-CONSTRUCTION MONITORING TO INFORM THE BASIC ASSESSMENT REPORT:

## Basic Assessment for the Proposed Development of the 325MW Kudusberg Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces: BA REPORT

*Report prepared for:*

CSIR – Environmental Management Services

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South Africa


*Report prepared by:*

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Unit 306, Warwick Place

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South Africa


26th October 2018

# SPECIALIST EXPERTISE

The Bat Specialist, Miguel Mascarenhas (Pri.Sci.Nat), serves as an independent specialist and is professionally registered with the South African Council for Natural Scientific Professions (Registration: Professional in Ecological Sciences, 400168/14). His short CV detailing a portion of his recent work and publications in 2018 is presented below. A full CV can be provided upon request.

## —— MIGUEL MASCARENHAS ——

### Profile

Miguel Mascarenhas is a Manager and an Ecological Environmental specialist that likes challenges, innovation and be a solution designer. As a consequence, at Bioinsight, Miguel assumes the role of business developer focused on leading a highly motivated team that also loves to be challenged, whether by complex project or the development of disruptive solutions.

Experience:

16 years | 648 proj.

Worked in countries:
- Portugal
- Mozambique

Projects for countries:
- South Africa
- Cape Verde
- Mexico
- Mozambique
- Poland
- Portugal

### Skills

Corporate management ●●●●●

Environmental Impact ●●●●○

Ecology ●●●●○

### + Employment

CHAIRMAN OF THE BOARD | BIODINÂMICA, MOZAMBIQUE
Since 2017

SENIOR CONSULTANT | BIO3 LDA., PORTUGAL
2012 - 2016

CEO AND BUSINESS DEVELOPMENT DIRECTOR | BIO3 LDA., PORTUGAL
2011 - 2012

CEO | BIOINSIGHT (BIO3), PORTUGAL
Since 2011

CEO | BIO3 LDA., PORTUGAL
2005 - 2011

CEO | BIO3 LDA., PORTUGAL
2005 - 2013

FREELANCER | SEVERAL COMPANIES SUCH AS DHVFBO, ENERPRO, PROCESL E PGG, PORTUGAL
2003 - 2005

RESEARCHER | LABORATÓRIO DE BIOLOGIA CELULAR - INSTITUTO DE BIOLOGIA EXPERIMENTAL E TECNOLÓGICA, PORTUGAL
2002 - 2003

### + Education

MSC IN BUSINESS MANAGEMENT (EQF LEVEL 7)
INDEG Business School, Portugal
2011 - 2013

POS-GRADUATION IN GEOGRAPHIC INFORMATION SYSTEMS
Higher Institute of Agronomy, Portugal
2006 - 2006

MSC IN ENVIRONMENTAL IMPACT ASSESSMENT (EQF LEVEL 7)
Institute of Ecology Investigation of Málaga, Spain
2003 - 2004

GRADUATION IN APPLIED PLANTS BIOLOGY (EQF LEVEL 6)
Sciences Faculty of the University of Lisbon, Portugal
1995 - 2001

## + Projects

**Bioinsight projects**

| | | |
|---|---|---|
| 2018 | Nature Conservation | Ecological Component of the Environmental Incidence Assessmen of na Aviary in Évora, Portugal. Portugal. |
| 2018 | Tourism&Urban Areas | Ecological Component of the Environmental Incidence Assessmen of an Execution Project for the Eletrification of the section Marco de Canaveses - Régua da Linha do Douro, Portugal. Portugal. |
| 2018 | Nature Conservation | Characterization of Flora and Vegetation of a Rural Hotel in Herdade da Comporta, Portugal. Portugal. |
| 2018 | Wind Energy | Ecological Component of the Environmental Impact Assessmen of Arrimal's Wind Farm, Portugal. Portugal. |
| 2018 | Wind Energy | Annual Monitoring Study of Birds and Bats (daytime and nightime) in 2018 in the Park and in the Eletric Line of Bii Stinu Wind Farm (EDI), Oaxaca, Mexico. Mexico. |
| 2018 | Oil & Gas | Ecological Monitoring of the Construction of the Replacement Village (RV) Ecological Monitoring of a Replacement Village Project associated to the development of a Liquefied Natural Gas Project of Anadarko Moçambique Area 1 Limitada (AMA 1) in Palma. Mozambique. |
| 2018 | Mines | Ecological Component of the Environmental Impact Assessmen of an Mining Instalation enlargement in Aljustrel, Portugal. Portugal. |
| 2018 | Hidric Energy | Ecological and climate componente of a Special Program for Ribeiradio-Ermida Dam, Portugal. Portugal. |
| 2018 | Electric Sector | Ecological Component of the Environmental Impact Assessmen of a substation of an Electric Energy Transformation - Tabaqueira, Portugal. Portugal. |
| 2018 | Wind Energy | Environmental Report for legal framework apllication to APA on the Overcapacity Equipment in Archeira Wind Farm, Portugal. Portugal. |

## + Publications

| | | |
|---|---|---|
| 2018 | Book Chapter \| Wind energy Impacts | Santos, J., Marques, J., Neves, T., Marques, A.T., Ramalho, R., Mascarenhas, M. (2018). Environmental Impact Assessment Methods: An Overview of the Process for Wind Farm's Different Phases – From Pre-Construction to Operation. In: Mascarenhas, M., Marques, A.T., Ramalho, R., Santos, D., Bernardino, J., Fonseca, C. (Eds). Biodiversity and Wind Farms in Portugal: Current Knowledge and Insights for an Integrated Impact Assessment Process, pp. 35-86. Springer International Publishing. |
| 2018 | Book Chapter \| Wind energy impacts | Rodrigues, S. , Rosa, L., Mascarenhas, M. (2018). An Overview on Methods to Assess Bird and Bat Collision Risk in Wind Farms. In: Mascarenhas, M., Marques, A.T., Ramalho, R., Santos, D., Bernardino, J., Fonseca, C. (Eds). Biodiversity and Wind Farms in Portugal, pp. 87-110. Springer International Publishing. |
| 2018 | Book Chapter \| Wind energy impacts | Marques, J., Rodrigues, S., Ferreira, R., Mascarenhas, M. (2018). Wind Industry in Portugal and Its Impacts on Wildlife: Special Focus on Spatial and Temporal Distribution on Bird and Bat Fatalities. In: Mascarenhas, M., Marques, A.T., Ramalho, R., Santos, D., Bernardino, J., Fonseca, C. (Eds). Biodiversity and Wind Farms in Portugal, pp. 1-22. Springer International Publishing. |
| 2018 | Book Chapter \| Wind energy Impacts | Paula, J., Augusto, M., Neves, T., Bispo, R., Cardoso, P., Mascarenhas, M. (2018). Comparing Field Methods Used to Determine Bird and Bat Fatalities. In: Mascarenhas, M., Marques, A.T., Ramalho, R., Santos, D., Bernardino, J., Fonseca, C. (Eds). Biodiversity and Wind Farms in Portugal. Springer International Publishing. |
| 2018 | Book chapter \| Wind energy impacts | Coelho, H., Mesquita, S., Mascarenhas, M. (2018). How to Design an Adaptive Management Approach? In: Biodiversity and Wind Farms in Portugal - Current knowledge and insights for an integrated impact assessment process. Editors: Mascarenhas, M., Marques, A.T., Ramalho, R., Santos, D., Bernardino, J., Fonseca, C. (Eds.). Chapter 8 - Pages 205-224. Springer Book. |
| 2017 | Oral Presentation \| Statistics & Ecology | Cláudio, N., Rodrigues, S., Mascarenhas, M., Mouriño, H., Marques, T.A. (2017). Classificação automática de sons de morcegos [Automatic identification of bat sounds]. Congresso da Sociedade Portuguesa de Estatística. 18 to 21 de October 2017. Lisbon, Portugal.[in Portuguese] |
| 2017 | Oral presentation \| Wind energy impacts | Coelho, H., McLean, N., Mascarenhas, M., Pendlebury, C. (2017). Experiences gained from delivery of offshore wind energy in the UK that could inform the environmental assessment of Portuguese projects. 4th Conference on Wind energy and Wildlife impacts (CWW). 6 to 8 September 2017. Estoril, Portugal. |
| 2017 | Poster \| Wind energy Environ. Assessment | Mascarenhas, M., Coelho, H., Sá da Costa, A. (2017). Wind farms aren't the same concept to all of us? So what are they? 4th Conference on Wind energy and Wildlife impacts (CWW). 6 to 8 september 2017. Estoril, Portugal. |
| 2017 | Poster \| Wind energy Environ. Assessment | Tidhar, D., Mascarenhas, M., Coelho, H., McLean, N. (2017). How to reduce uncertainty using a question based approach for universal wind energy assessment. 4th Conference on Wind energy and Wildlife impacts (CWW). 6 to 8 september 2017. Estoril, Portugal. |
| 2017 | Poster \| Wind energy impacts | Mesquita, S., Coelho, H., Mascarenhas, M. (2017). Adding value to wind farm projects by integrating ecosystem services in the environmental impact assessment process. 4th Conference on Wind energy and Wildlife impacts (CWW). 6 to 8 september 2017. Estoril, Portugal. |

# SPECIALIST DECLARATION

I, **Miguel Rodolfo Teixeira de Mascarenhas**, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: Miguel Rodolfo Teixeira de Mascarenhas

Name of Specialist: Miguel Rodolfo Teixeira de Mascarenhas

Date: 26th October 2018

# EXECUTIVE SUMMARY

The Kudusberg Wind Farm (hereafter referred to as “Kudusberg Wind Energy Facility” or “Kudusberg WEF”) is a proposed 325 MW wind farm development by Kudusberg Wind Farm (Pty) Ltd. The project is located on the border between the Western and Northern Cape, south of the R356 and west of the R354, at approximately 50km southwest of Sutherland. Bioinsight (Pty) Ltd. was appointed to conduct the bat pre-construction monitoring programme and compile the final bat pre-construction monitoring report in accordance with the best practice pre-construction monitoring guidelines.

The site is characterised by accentuated mountainous areas with very difficult human access and therefore in almost pristine natural conditions. Vegetation is adapted to the semi-arid conditions and harsh rocky conditions. Currently the area where Kudusberg WEF is proposed shows no signs of intense disturbance apart from the severe impacts on the veld caused by the three-year period of drought. Signs of human disturbance are characterised by the presence of a few farm dwellings and extensive sheep farming, mostly during the winter season.

Various techniques were implemented to study the local bat community and inform the assessment of potential risks from the construction and operation of the proposed project. The following techniques were applied at the proposed area for the wind energy development and its immediate surroundings: a desktop and bibliographic review, active acoustic detection surveys by means of vehicle-based transects, passive surveys by means of installation of five automatic acoustic detectors (rotor height and ground level in various habitats) and roost searches/inspection and monitoring.

The main results of the bat community pre-construction monitoring programme of the Kudusberg WEF are presented in the final bat pre-construction monitoring report[1] resulting from the analysis of the surveys conducted between December 2015 and December 2016. These methodologies resulted in confirming the occurrence of four bat species and the identification of them. The confirmed species are the Egyptian free-tailed bat (*Tadarida aegyptiaca*), the Cape serotine (*Neoromicia capensis*), the Natal long-fingered bat (*Miniopterus natalensis*) and the Egyptian slit-faced bat (*Nycteris thebaica*). These are all “Near Threatened”, or “Least Concern” species, according to the South African Red List (Friedmann & Daly, 2004b) and are considered sensitive species to the WEF development since three of them are considered to have medium to high risk of collision with wind turbines.

Results of the pre-construction bat monitoring indicate that the bat activity at the proposed Kudusberg WEF area is in general low considering the bat guidelines (Sowler *et al*., 2016).

According to pre-construction phase results, Kudusberg WEF is classified has having low sensitivity, but with some areas in particular with high and very high sensitivity due to the presence of specific features and habitat that may have an increased bat activity. These include the presence of potential roosts, as well as water lines which are important for bats, since they are likely to act as commuting routes, providing food resources likely to be associated to a higher bat activity.
It is recommended that the very high (no-go) areas identified for the bat community should be excluded from turbine placement and the areas considered as high sensitivity avoided as much as possible.

The potential occurrence of the following impacts on the general bat community was identified: direct mortality caused by collisions and barotrauma; Displacement effects by habitat alteration; Disturbance due to noise, machinery movements and maintenance operations.

[1] BioInsight, 2018. 2015/2016 Final bat pre-construction monitoring report for the proposed Kudusberg wind farm.

The overall significance of impacts expected to occur during the construction, operation, and decommissioning phases, is expected to be low before mitigation, and very low after mitigation.

Impacts may also be magnified due to cumulative impacts caused by other wind energy developments proposed in the area.

Cumulative impacts were assessed by adding expected impacts from the Kudusberg WEF to existing and proposed developments with similar impacts, within a 50 km radius. It is however important to note that the quantification or even evaluation of cumulative impacts is uncertain as there is not a generalised knowledge of large-scale movements or connection between bat populations within the region. The main direct cumulative impacts identified to potentially occur are: increased habitat loss, increased fatalities due to collision with various project infrastructures, and increased disturbance/displacement effects. The overall significance of cumulative impacts expected to occur is estimated to be moderate before mitigation, and low after mitigation.

No-go Alternative

Should the Kudusberg Wind Farm not be constructed, then all impacts (whether it be negative or positive) identified within the impact analysis will not take place. As a result, it is expected that the present environmental characteristics relevant for the bat community on site will remain unchanged, relative to that which is being observed at present, under current land-use practices.

Consequently, no fatal flaws were identified for the project, only very high (no-go) areas were identified which should be excluded from development due to the high sensitivity of the environmental features located within these areas.

From the perspective of the impact on bats, the proposed Kudusberg WEF may be authorised subject to the implementation of the recommendations proposed.

It is also recommended that a construction and operational phase bat monitoring programme is implemented in line with the best practice monitoring guidelines to confirm and determine the extent of the impacts predicted as well as to validate the success of the mitigation strategies proposed.

# LIST OF ABBREVIATIONS

| | |
|---|---|
| BA | Basic Assessment |
| CITES | The Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| DEA | Department of Environmental Affairs |
| ECO | Environmental Control Officer |
| EMPr | Environmental Management Programme |
| GIS | Geographical Information System |
| IUCN | International Union for Conservation of Nature (Global conservation status) |
| PVSEF | Photovoltaic Solar Energy Facility |
| SA | South Africa |
| WEF | Wind Energy Facility |

# GLOSSARY

| ***Definitions*** | |
|---|---|
| *Acoustic bat survey* | Bat sampling conducted through recording and analysing echolocation calls. |
| *Active detection* | A method of recording echolocation calls whereby the researcher actively orients the bat detector to follow bats as long as possible in real time; this method generally results in higher quality pulses and longer call sequences than passive recording. |
| *Bat activity index* | A way of normalising data by dividing the number of bat calls by time. |
| *Bat detector* | Electronic device that converts the ultrasonic echolocation calls of bats into an audible or readable signal. |
| *Bat pass* | For the purpose of this study, a bat pass was considered as a sequence of more than 1 echolocation calls where the duration of each pulse is equal or greater than 2ms. |
| *Barotrauma* | Tissue damage to the lungs caused by rapid or excessive changes in pressure. |
| *Biotope* | A region that has a characteristic set of environmental conditions and consequently a particular type of fauna and flora (biota). |
| *Call sequence* | A series of bat echolocation call pulses. |
| *Conspecific* | An organism of the same species as another. |
| *Cut-in wind speed* | The lowest wind speed at hub height at which the wind turbine starts to produce power. |
| *Echolocation* | The ability of bats and some other animals to orient themselves and locate obstacles and their prey using echoes from sound emitted, typically from the mouth or nostrils. |
| *Endemic species* | Species that are restricted to southern Africa. |
| *Fatal Flaw* | A major defect or deficiency in a project proposal that should result in an Environmental Authorisation being refused. |
| *Frequency* | The "pitch" of a sound (high or low), determined by the number of wavelengths per second, measured in Hertz (1 Hz=1cycle per second). |
| *Insectivorous* | Species that feed exclusively from insects. |
| *Passive detection* | A method of recording echolocation calls whereby the researcher is absent and a bat acoustic detector is placed at fixed position and left operational for long periods of time (usually over 1-month period); this method provides great amounts of data and allows to understand bat activity at a certain location over a full night for long periods of time, covering various environmental characteristics (good weather, bad weather, etc). |
| *Red data species* | A list of international (IUCN) as well as southern African threatened species. |
| *Sensitive species* | Species that aggregate a set of characteristics (higher risk of collision with wind turbines, specific habitat or ecological requirements, etc) and that are prone to be most affected by the project development. |

# COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Addressed in the Specialist Report |
|---|---|
| 1. (1) A specialist report prepared in terms of these Regulations must contain-<br>a) details of-<br>i. the specialist who prepared the report; and<br>ii. the expertise of that specialist to compile a specialist report including a curriculum vitae; | Yes<br>Pages 1-2 |
| b) a declaration that the specialist is independent in a form as may be specified by the competent authority; | Yes<br>Page 3 |
| c) an indication of the scope of, and the purpose for which, the report was prepared; | Yes<br>Section 1.1.1 |
| (cA) an indication of the quality and age of base data used for the specialist report; | Yes<br>Section 1.1.5 |
| (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | Yes<br>Section 1.6 |
| d) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment; | Yes<br>Section 1.1.3 |
| e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used; | Yes<br>Section 1.1.3 |
| 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; | Yes<br>Section 1.3 |
| g) an identification of any areas to be avoided, including buffers; | Yes<br>Section 1.3 |
| 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; | Yes<br>Section 1.3 |
| i) a description of any assumptions made and any uncertainties or gaps in knowledge; | Yes<br>Section 1.1.4 |
| j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities; | Yes<br>Section 1.6 |
| k) any mitigation measures for inclusion in the EMPr; | Yes<br>Section 1.8 |
| l) any conditions for inclusion in the environmental authorisation; | Yes<br>Section 1.9 |
| m) any monitoring requirements for inclusion in the EMPr or environmental authorisation; | Yes<br>Section 1.8 |
| n) a reasoned opinion-<br>i. as to whether the proposed activity, activities or portions thereof should be authorised;<br>(iA) regarding the acceptability of the proposed activity or activities; and<br>ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; | Yes<br>Section 1.9 |
| o) a description of any consultation process that was undertaken during the course of preparing the specialist report; | N/A |
| p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | N/A |
| q) any other information requested by the competent authority. | N/A |
| 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. | N/A |

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# TABLES



# FIGURES

# 1 BAT IMPACT ASSESSMENT REPORT

## 1.1 INTRODUCTION AND METHODOLOGY

As a basis to the impact assessment, this report refers to the findings of the bat pre-construction monitoring surveys conducted at the proposed Kudusberg Wind Energy Facility (hereafter referred as Kudusberg WEF), between December 2015 and December 2016. The project is being developed by Kudusberg Wind Farm (Pty) Ltd. and is located in the border between the Western and Northern Cape, south of the R356 and west of the R354, at approximately 50 km southwest of Sutherland.

To assess the potential impact of the project, a complete monitoring programme was developed including one year of surveys to establish a baseline scenario for the future project phases (construction and operation).

Bioinsight (Pty) Ltd. was appointed to produce the Bat Specialist Impact Assessment report for the Kudusberg WEF to inform the Basic Assessment process currently undertaken by the CSIR.

The final results of the pre-construction monitoring phase of the project have contributed to the characterisation of the bat community present in the location defined for development and its immediate surroundings; as well as informed the prediction of potential impacts in future phases of the project and defined sensitive areas in terms of bat communities and adjustments to the project layout and measures required to avoid or mitigate identified impacts.

### *1.1.1 Scope and Objectives*

The main objective of this report is to use the baseline information collected over 12-months to assess bat habitat use in a pre-impact scenario and evaluate the potential impact of the Kudusberg WEF on bats (such as bat direct mortality caused by collisions and barotrauma, displacement due to disturbance, barrier effects and habitat loss) (Drewitt & Langston, 2006) and consider suitable mitigation measures. The pre-construction bat monitoring programme data, which characterised the bat community present in the area was used as a basis for this report. The specific objectives in the Impact Assessment are to:

a) Inform the authorities and key stakeholders of the proposed project;
b) Inform the authorities and key stakeholders regarding the alternatives that have been considered;
c) Assist authorities in the decision-making;
d) Outline the baseline receiving environment;
e) Identify potential impacts on the environment from the proposed activity, and their significance, as well as describe mitigation measures to minimise such impacts;
f) Compile mitigation measures to be included in the proposed Environmental Management Programme (EMPr) to mitigate the expected impacts.

To achieve the objectives of the Impact Assessment Report, the results of the pre-construction bat monitoring programme, as well of the Final Scoping report of the proposed Kudusberg WEF (Bioinsight, 2016) were considered. By referring to the baseline scenario established (on the scope of the present report) it will be possible to ground-truth the potential impacts identified, to determine if other impacts are occurring and adequately adjust any mitigation measures prosed at this stage (or propose new and more appropriate ones if necessary).

### *1.1.2 Terms of Reference*

The following assessment was conducted according to the specialist terms of reference:

- A key task for the specialists is to review the existing sensitivity mapping from the SEA for the project area and provide an updated sensitivity map for the Kudusberg WEF project site;
- Adhere to the requirements of specialist studies in terms of Appendix 6 of the NEMA EIA Regulations (2014), as amended;
- Assess the potential impacts of the proposed Kudusberg WEF project and its associated infrastructure by assessing the impacts during the construction, operational and decommissioning phases;
- Assess Cumulative impacts from other Wind and Solar PV projects located within a 50 km radius from the Kudusberg WEF that already have received Environmental Authorisation (EA), are preferred bidders and/or may still be identified as having received a positive Environmental Authorisation at the start of this BA process;
- Propose mitigation measures to address possible negative effects and to enhance positive impacts to increase the benefits derived from the project;
- Use the Impact Assessment Methodology as provided by the CSIR;
- Assess the project alternatives and the no-go alternative; and
- Provide a recommendation as to whether the project must receive Environmental Authorisation of not and identify any aspects which are conditional to the findings of the assessment which are to be included as conditions of the Environmental Authorisation.

Specific ToR:

- Describe the affected environment from a bat perspective, including consideration of the surrounding habitats and bat habitat/foraging features (e.g. caves, ridges, crevices, migration routes, feeding, roosting & nesting areas, etc.);
- Describe and map bat habitats on the site, based on on-site monitoring, desk-top review, collation of available information, studies in the local area, previous experience, and the Wind and Solar SEA (CSIR, 2015);
- Compile a detailed list of bat species present on site, including SCC;
- Map the sensitivity of the site in terms of bat features such as habitat use, roosting, feeding and nesting/breeding.
- Identify and assess the potential impacts of the proposed project on bats, including impacts that may be seasonal or diurnal, or linked to specific species and their feeding, roosting or nesting habitats and habits. Provide sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
- ▪ Conduct a review of national and international specialised literature and experiences regarding bats and wind farms;
- ▪ Conduct a field investigation to determine the bat community present in the study area, describe the affected environment and identify species of special concern for the proposed wind farm (12-month pre-construction monitoring). Although the general community is considered, this study has special focus on the species considered to be more sensitive to wind energy development related impacts;

### *1.1.3 Approach and Methodology*

Surveys undertaken during the pre-construction bat monitoring programme included the use of several field techniques, adjusted to the specific characteristics of the study area. The pre-construction bat monitoring programme, implemented across a 12-month period, from December 2015 to December 2016, included the following:

- Active acoustic bat surveys, by means of vehicle-based transects and point-based monitoring with an ultrasound automatic bat detector;
- Passive acoustic surveys at ground level and rotor height with ultrasound automatic bat detectors; and
- Roost searches and inspections - any structure thought to be used as a roosting location by bats was inspected, following the “South African Best Practice Guidelines for Surveying Bats in Wind Farm Developments” that were available at the time that the pre-construction monitoring programme initiated (Sowler & Stoffberg, 2014).

*Sampling period*

The bat community monitoring programme started in December 2015 at the Kudusberg proposed WEF development area. The area was surveyed for a total of 12 months, covering all seasons (Table 1) in order to comply with the requirements of the “South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments” (Sowler *et al.*, 2016).

Passive detection was conducted continually during a 12-month period and active detection surveys were conducted twice per season, starting in January 2016, covering all seasons.

For passive monitoring, five automated detection recorded continuously in order to achieve a total of 100% and a minimum of 75% of the total nights of the year, as recommended on the guidelines (Sowler *et al.*, 2016).

The detectors coverage during the year is presented in Table 2. Three passive detectors were installed in the first reconnaissance survey and have been running since the 17th December 2015 (PQKDA01-10m, PQKDA01-90m, PQKDA02-10m, PQKDA02-90m, PQKDA03-10m and PQKDA03-90m) and the other two (PQKDA04-10m, PQKDA04-90m, PQKDA05-10m, PQKDA05-90m) were installed on 4th February 2016. Overall, 77,13% of the nights were surveyed by automated detection, which therefore meet the requirements of the bat guidelines as indicated above.

**Table 1 - Schedule of bat monitoring fieldwork at the Kudusberg proposed WEF site (* - not undertaken).**

| Year | Season | Survey | Bat Monitoring method | |
|---|---|---|---|---|
| | | | Active ultrasound detection & Roost search and monitor | Passive ultrasound detection |
| 2015 | Summer | December | * | Continuous |
| 2016 | | January | $13^{rd}$ to $22^{nd}$ January | Continuous |
| | | February | $3^{rd}$ to $13^{rd}$ February | Continuous |
| | Autumn | March | * | Continuous |
| | | April | $1^{st}$ to $11^{st}$ April | Continuous |
| | | May | $17^{th}$ to $27^{th}$ May | Continuous |

| Year | Season | Survey | Bat Monitoring method | |
|---|---|---|---|---|
| | | | Active ultrasound detection & Roost search and monitor | Passive ultrasound detection |
| | Winter | June | 21st to 28th June | Continuous |
| | | July | * | Continuous |
| | | August | 15th to 26th August | Continuous |
| | Autumn | September | 6th to 15th September | Continuous |
| | | October | 26th September to 5th October | Continuous |
| | | November | * | Continuous |

**Table 2 - Percentage of the total nights covered by automated bat detection per detector. *- Incomplete month**

| Detector | Dec 2015* | Jan 2016 | Feb 2016 | Mar 2016 | Apr 2016 | May 2016 | June 2016 | July 2016 | Aug 2016 | Sep 2016 | Oct 2016 | Nov 2016 | Dec 2016* | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PQKDA01 | 48% | 100% | 100% | 100% | 100% | 100% | 27% | 16% | 100% | 100% | 100% | 57% | 10% | 79,83% |
| PQKDA02 | 45% | 100% | 100% | 100% | 37% | 45% | 100% | 100% | 100% | 100% | 100% | 57% | 39% | 85,25% |
| PQKDA03 | 42% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 81% | 0% | 48% | 89,25% |
| PQKDA04 | 0% | 0% | 90% | 13% | 67% | 45% | 87% | 68% | 100% | 100% | 100% | 57% | 13% | 61,66% |
| PQKDA05 | 0% | 0% | 90% | 23% | 73% | 100% | 100% | 100% | 100% | 100% | 100% | 40% | 10% | 69,66% |
| | | | | | | | | | | | | | | **77,13%** |

*Evaluated Parameters*

To characterise the bat community present in the study area, the following parameters were evaluated for the Kudusberg WEF site:

- Species Richness;
- Activity Index;
- Location and use of roosts within and around the site; and
- Type of utilisation of the study area by bats.

*Data collection techniques and methods*

Bats are usually divided into two main groups: echolocating and non-echolocating bats, the former usually use highly evolved ultrasound echolocation to navigate, forage and communicate (Schnitzler & Kalko, 2001) and the latter uses vision for orientation, to navigate and search for food sources (Monadjem *et al*., 2010). Non-echolocating bats are commonly known as fruit bats (feeds mainly on fruits); whereas echolocating bats are known as insectivorous bats (insects are their main food source). The different flight and echolocation inter-specific characteristics are directly related to differences in species' foraging habitats (Schnitzler & Kalko, 2001).

Tracking the conservation status of bat populations through the abundance and distribution of echolocation calls has the potential to offer a more efficient alternative to trapping or visual sampling methods for bat survey and monitoring programmes (Walters *et al*., 2012). The detection, recording and analysis of ultrasounds is very useful in the detection and identification of different bat species, since these mammals are nocturnal and, in the majority of species, emit ultrasound calls to guide them, and to detect prey, as well as to communicate. Details pertaining to the collection techniques are provided below.

Active detection

The active detection of ultrasounds was conducted with a portable ultrasound detector (Wildlife Acoustics® EM3+ automatic ultrasound detector with an attached GPS) along vehicle-based transects (Figure 1). The active detection surveys were conducted twice per season for a full year, and the established transects were intended to be representatives of the biotopes present at the study area. Therefore, four transects were established crossing all the main biotopes present within the development area and extending to the surrounding area. Characterization points were established for each transect, at approximately every 2 kms, where environmental variables were collected during each active survey.

Sampling commenced at evening civil twilight (hereafter referred to as sunset) and continued for a minimum of 1.5 hours and a maximum 4 hours after sunset - ensuring that bat species that emerge early in the evening can be included in the surveys (according to Sowler & Stoffberg, 2014). At each survey the order by which the sampling points established along transects was conducted was altered so that each transect would not be conducted at the same time of the night. Each characterisation point was characterised in terms of lunar phase, cloudiness, temperature, precipitation and wind speed and direction at the time it was conducted. The manual surveys were not performed in adverse weather conditions (rain, very strong wind, fog, thunderstorms).

After conducting transect sampling surveys, the recorded data was analysed in order to determine spatial use by bat community, as well as to acoustically confirm the presence of bat species that may occur in the area.

Passive detection

Passive detection for this monitoring programme was conducted by making use of automatic ultrasound detectors (Wildlife Acoustics® SM2BAT+) with automatic triggering (starting an ultrasound recording when a bat echolocation is detected). The equipment was scheduled to automatically record calls every night starting 30 min before sunset and ending 30 min after morning civil twilight (hereafter referred to as sunrise).

Five different locations and five detectors were used: all the detectors were placed on meteorological masts (PQKDA01, PQKDA02, PQKDA03, PQKDA04 and PQKDA05) (Figure 1). These locations cover the different combinations of vegetation types and topography and were determined following the recommendations included in the 4th Edition of the “South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments” (Sowler *et al.*, 2016). The detectors had a microphone installed at 90m and at 10 m (ground level). Bat activity was measured continuously, aiming to cover a minimum of 75% of at least 365 nights (12-month period) (and aiming to cover 100% during the bat migration months – April, May and September). The placement of microphones at two different heights on the met mast will allow for comparisons of bat activity and diversity, both at approximate rotor height and ground level.

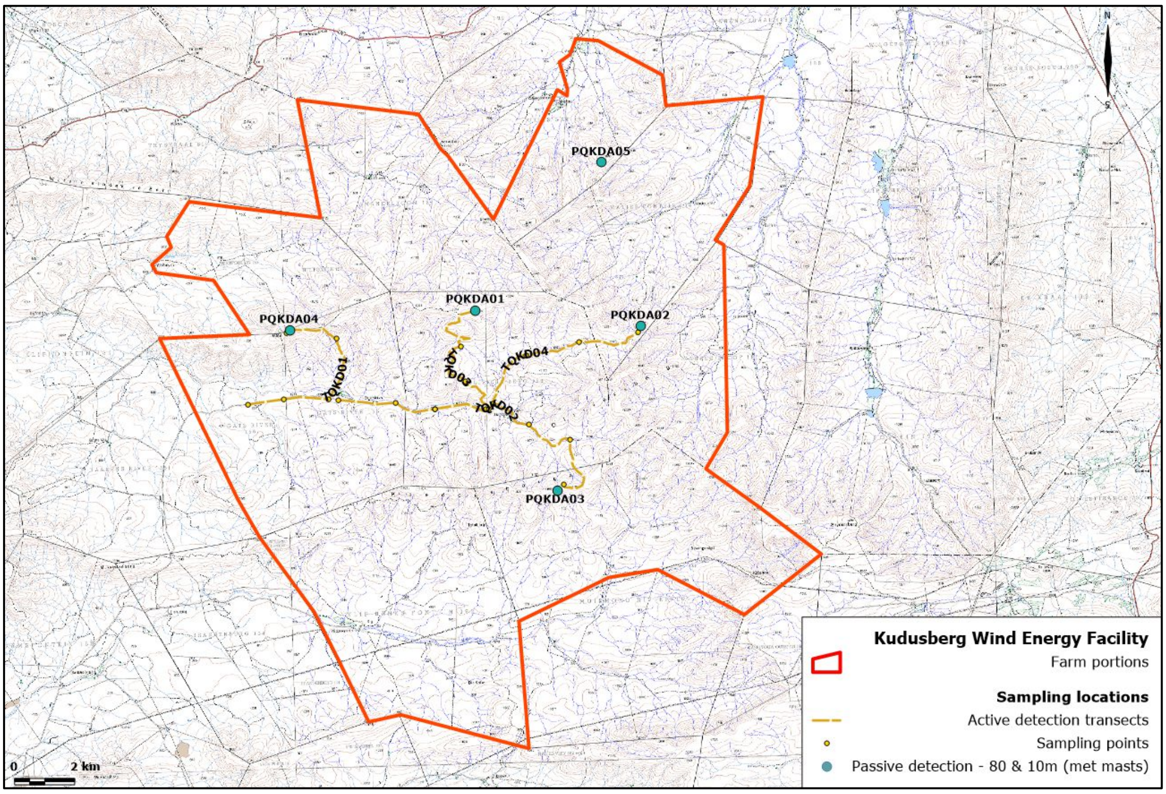


**Figure 1 - Bat sampling locations at Kudusberg WEF site.**

<u>Non-echolocating bats</u>

The South African fruit bats feed on the fruits, flowers and nectar of a wide range of indigenous trees as well on domestic or commercial fruit trees (Monadjem *et al*., 2010). To determine the occurrence of fruit-eating bat species on the study area, searches were directed to potential roosting sites suitable to these species during daytime.

<u>Roost searches, inspection and monitoring</u>

All structures considered to have potential for bat species roosting (e.g. caves, mines, abandoned buildings, bridges, etc.) were identified in the study area and its surroundings by means of a GIS based desktop study and during the fieldwork visits to the area. The potential roosting locations identified were then inspected in the subsequent surveys in order to record evidence of bats presence and occupation (such as live bats roosting, bat droppings accumulation, bat corpses or insect remains). During the fieldwork, the location of each prospected roost was recorded with a handheld GPS (Garmin® ETREX 10 or ETREX 20), and photographs were taken for documentation (Figure 3).

When a roost was considered to have potential to be occupied by bats (determined either by means of interviews to the local inhabitants or direct observation of traces of bat occupation), an active survey was conducted outside of the potential roost during sunset (to determine number of bats leaving the roost) using the same equipment described above (Wildlife Acoustics® EM3+ automatic ultrasound detector). Additionally, static Wildlife Acoustics® SM2+ automatic ultrasound detector was left overnight inside the roost (when possible) in order to confirm bat usage and determine roosting activity, such as, time of usage/time of arrival/time of exit). Determining time of arrival also aids to determine when is the best time to inspect roosts in order to determine the species and number of individuals inhabiting the roost.

*Data analysis and criteria*

<u>Ultra-sounds analysis</u>

Automatic acoustic monitoring produces a large amount of data recorded by the SM2BAT+ as *.WAV format, automatic identification is needed to process data and determine bat activity analysis. In order to eliminate all non-bat ultrasounds detections and process data to determine bat activity, AnalookW4.1d© Software was used to identify and filter out non-biological noise such as rain, wind, birds and insect sounds. In this first step, files were converted to *.ZC format using Kaleidoscope© 2.1.0 and then a filter for bat pulses was applied with AnalookW©.

To determine bat activity, it was necessary to define a "bat pass". For this study, a bat pass was considered as a sequence of more than 1 echolocation call where the duration of each pulse is ≥ 2ms (Weller & Baldwin 2012). Single call fragments do not apply, and therefore only complete pulses were considered for the analysis. Where there is a gap between pulses of >500ms in one file, this then represents a new bat pass (Sowler & Stoffberg, 2014).

Considering the characteristics of a bat pass and the characteristics of echolocation pulses (e.g. characteristic frequency, slope, pulse duration, initial and final frequencies, bandwidth, interval between pulses) a set of filters were produced for the species/group of species identification. The reference values used were the ones presented in several published and unpublished sources of South Africa (Gauteng & Northern Regions Bat Interest Group; Taylor *et al.*, 2005; Hauge, 2010; Monadjem *et al*., 2010; Kopsinis *et al.,* 2010; ACR, 2013; Pierce, 2012). This acoustic echolocation parameters reference table was reviewed and adjusted in order to use the most accurate reference parameters as possible, considering the limitations of the current knowledge on South African bats echolocation. The filters were cross-validated by selecting a proportion of recordings in each survey and analysing them manually by a specialized technician. The analysis of the recorded calls was performed using *Audacity© 2.0.0 – Cross-Platform Digital Audio Editor*, from Dominic Mazzoni. The results of the manual identification analysis were used to cross validate the results from the automatic identification with AnalookW and the filters were adjusted to the best extent possible.

As bats have extremely flexible call structures which may depend on various factors including habitat structure, foraging strategy, age, gender, morphology, and the presence of other conspecifics (Thomas, Bell & Fenton, 1987; Obrist, 1995; Murray, Britzke & Robbins, 2001), call convergence has led to overlap in frequencies and call shapes, making it difficult to distinguish between some calls (Preatoni *et al*., 2005). For that reason, and to optimize the identification process, the filters produced in AnalookW aimed to identify groups of species, which shared similar acoustic characteristics, instead of individual species. These groups were assembled based on the list of species considered as potential for the area, collision risk and characteristics of their echolocation calls, i.e., species with the same collision risk and echolocation parameters were grouped together. Whenever species with different conservation status and relevant ecological behaviour (such as migration) were present, attempts to separate them in different groups were made. If the filter cross-validation results were not satisfactory (over 80% capacity to correctly detect bat passes of the species), the filter would not be used for activity analysis purposes. These filters will, however, be used to aid in species confirmation at the site. Recordings selected by these filters were subject to manual identification by specialists.

<u>Spatial-temporal analysis</u>

The results obtained from the surveys undertaken between December 2015 and December 2016 were analysed according to the number of bat passes at each sampling point and allowed the determination of the following parameters for active and passive detection:

- Average number of bat passes per hour (e.g. activity index) (data from passive detection);
- Average number of bat passes per sampling location (e.g. activity index) (data from active detection); and
- Frequency of occurrence of each species/group of species identified (number of contacts of a species or group of species / total number of records identified).

Notice however that the activity index does not provide an absolute number of individuals, indicating solely a relative index of abundance (Hayes, 2000). An analysis of the activity index for each hour of the recording period was also performed in order to evaluate the variation of activity through time, indicating periods of higher bat activity.

These parameters were also analysed in terms of environmental factors, such as temperature, wind speed and biotope. The same parameters were analysed in terms of space, according to the point locations (WEF site and control area).

#### *1.1.4 Assumptions and Limitations*

- The pre-construction bat monitoring is based on both primary (data collection) and secondary data sources, such as those indicated in section 1.1.5.
- In South Africa, data on migratory paths of bats is still largely unknown, this limiting the ability to determine if the wind farm might have impact on migratory species.
- Any inaccuracies or lack of information in the bibliographic sources consulted could limit this study. In particular, 8 years have passed since the leading literature that is available for bat distribution in South Africa has been updated (Monadjem *et al*., 2010).
- Bat detectors were installed and used according to the manufacturer's indications. However, data gaps still occurred due to technical limitations of the detector and/or unavoidable malfunctions. Nevertheless, a sampling effort of more than 75% of the year was obtained as per the requirements of the 4th Edition of the "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments" (Sowler *et al*., 2016).
- At this stage, no inter-annual variations are taken into consideration as only one year of data has been collected. Nevertheless, the basis for comparisons with subsequent years has been established.
- The very high sensitivity areas (no-go areas) identified for the bat community are to be excluded from development (excluding the use/upgrading of existing roads).
- The quantification or even evaluation of cumulative impacts is uncertain as there is not a generalised knowledge of the large-scale movements or connection between bat populations within the greater area. If present, cumulative impacts will be reflected on a very rapid decline of bat populations far from the impacts expected from a single wind energy facility operation. As such, further monitoring during the operational phase will be beneficial in helping to determine the presence of this type of impact.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Appendix 1.

#### *1.1.5 Source of Information*

A desktop survey was conducted to compile the best information possible, in order to provide a better evaluation of all conditions present within the study area. Therefore, the available data sources (Table 3) were consulted to assess which species could occur in the different habitat occurring at the Kudusberg WEF study area. The following steps were taken:

- Based on a desktop review and considering all literature references available (Table 3), a list of all bat species with potential to occur within or in close proximity to the site was compiled.
- Literature references and local farmers were consulted concerning any available information regarding presence of known roosts in the vicinities of the proposed site. Literature review was conducted as well regarding wind developments in South Africa or similar environments.
- All listed species were assessed at a national level in terms of endemism, population trend, habitat preferences and conservation status.

- All listed species were classified in terms of probability of occurrence within the site, considering several criteria evaluated in conjunction with one another, such as historical confirmation of species in the area, presence of known roosts and presence of suitable habitats, etc.
- The vulnerability of these species to potential impacts caused by wind energy developments (in terms of potential collision risks with wind turbines) was evaluated according to the most recent "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments", the 4th Edition" (Sowler *et al.,* 2016).
- A short list of sensitive species was identified to which the assessment and monitoring programme should pay special attention to. Sensitive species were identified by means of a specific structured decision process based each species' conservation status, vulnerability to collision and ecological characteristics such as migratory behaviour.
- A desktop study, based on all the available information such as topographical maps of South Africa, Google™ Earth imagery, and Geographical Information System software was conducted for a preliminary evaluation of the area. A reconnaissance field visit was conducted in February 2016 to achieve an initial understanding of its characteristics.
- It is important to characterise the study area in terms of the vegetation and habitat present on site. The method used for vegetation classification is that developed by Mucina & Rutherford (2006). At a micro level, more important than the biomes, is the presence of specific structures which shaped the local occurrence and bat distribution within the site. Bat abundance and movement are related to vegetation features such as tree-lined avenues, hedges and other relevant features which could potentially be used as roosts (open water bodies, cliff faces, buildings with accessible roofs or attics etc.). It is therefore essential to characterise the study area in these terms. Google™ Earth imagery and most importantly, field work, was used to identify the available micro-habitats on site.

Table 3 includes, but is not limited to, the list of data sources and reports consulted and taken into consideration, for the compilation of this report, in varying levels of detail. Other references were consulted for particular issues (these are detailed in section 1.10).

**Table 3 - Main data sources consulted for the evaluation of bat species present in the study area (international references and guidelines used to support the methodological approach and resulting analysis are also presented).**

| Type | Name | Reference | Detail of information |
|---|---|---|---|
| Data sources | Bats of Southern and Central Africa | (Monadjem *et al.,* 2010) | National level |
| | African Chiroptera Report 2013 | (ACR, 2013) | National level |
| | Caves and Caving in the Cape | http://www.darklife.co.za/Caves/ | Regional level |
| | Endangered Wildlife Trust | www.ewt.org.za | Regional level |
| | Bat fatality at a wind energy facility in the Western cape, South Africa | (Aronson, Thomas & Jordaan 2013; Doty & Martin, 2013) | Regional level |
| | The Vegetation of South Africa, Lesotho and Swaziland | (Mucina & Rutherford, 2006) | National level |
| | Global List of Threatened Species | (IUCN, 2018) | International level |
| | Renewable Energy Application Mapping – Report version I | (CSIR, 2013) | National level |
| | Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa | (CSIR, 2015) | National level |
| | Renewable Energy Application Mapping. Third Quarter 2016 | (DEA, 2016) | National level |
| Guidelines and Other international references | Wind energy development and Natura 2000 | (European Commission, 2011) | International level Methodological approach and analysis |
| | Directrices para la evaluación del impacto de los parques eólicos en aves y murciélagos | (Atienza *et al.,* 2011) | International level Methodological approach and analysis |
| | Comprehensive Guide to Studying Wind Energy/Wildlife Interaction | (Strickland *et al.,* 2011) | International level Methodological approach and analysis |
| | U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines | (USFWS, 2012) | International level Methodological approach and analysis |
| | South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments | (Sowler & Stoffberg, 2012) | Methodological approach |
| | South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments – 3rd Edition | (Sowler & Stoffberg, 2014) | South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments – 3rd Edition |
| | South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments (4th Edition) | (Sowler *et al.*, 2016) | Methodological approach |
| | Bat surveys: Good practice guidelines, 2nd edition | (Hundt, 2012) | Methodological approach |
| | Guidelines for consideration of bats in wind farm projects | (Rodrigues *et al.,* 2008) | International level Methodological approach and analysis |
| | Good Practice Wind Project | www.project-gpwind.eu/ | International level Methodological approach and analysis |

## 1.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO BAT IMPACTS

The project aspects relevant to bats include:

Presence of Wind Turbines

The presence of wind turbines, in general, can result in certain bat impacts such as fatalities due to collision, and/or barotrauma as well as disturbance / displacement effects. It is very important that turbines are sited correctly, to avoid and/or minimise these potential impacts. Careful planning and avoidance measures are therefore crucial to achieve this.

Turbine machine specifications

In terms of turbine specifications, the most relevant aspect to consider is the machine size, in terms of rotor diameter and lower tip height. The turbines proposed for the Kudusberg project have a hub height of up to 140 m, with a rotor diameter of up to 180 m, making it a relatively large machine. Larger machines with bigger rotor diameters are generally considered better for bats, as they would restrict the project to have fewer wind turbines – due to their increased generating capacity. As a result of a larger machine, the total affected airspace would be less, and the lower tip height is also higher than that of smaller machines. This is considered relatively safer for the clutter & clutter-edge foragers species (due to a higher ‘lowest rotor swept height’) – subsequently reducing the risk of collision with turbine blades.

However, in terms of migratory species, it is not uncommon for bat activity to be higher at increased heights during the autumn and spring migration months (namely March, April and October). It is therefore possible that higher mortality rates may be associated with the use of larger machines during migratory periods (Barclays *et al.,* 2007; Kunz *et al*., 2007). However, studies also suggest that nocturnal migrants have the tendency to fly at heights ranging from <100 m to 1 km in height.

Wind measurement masts

The presence of wind measurement masts usually poses no risk to bat species. Four monitoring masts have been erected on the project site.

Underground 33kV cabling and Overhead 33kV Power Lines

The use of underground cabling is preferred over overhead power lines. However, it is important to note that underground cabling may also result in habitat destruction. Regardless, this impact is only considered to be short-term and is likely to only occur during the installation process. More relevant to the Kudusberg Project is the proposed use of a 33kV overhead power line that will be used to group turbines to crossing valleys and ridges outside of the road footprints, to reach the 33/132kV onsite substation. According to the bat guidelines (Sowler *et al.*, 2016), no powerline infrastructure should be constructed within 2km of any large known confirmed roosts and 500m from smaller confirmed roosts. There are no large confirmed roosts within the Kudusberg wind farm project site. As discussed in section 1.3, there are four confirmed buildings that serve as roosts and therefore no turbines, 33kV or 132kV powerlines may be placed within 500 m thereof.

Other associated Infrastructure

Other sources of disturbance and habitat destruction can be the presence of other associated infrastructures, such as electrical transformers, access roads, a substation, temporary construction camp, fencing around the batching plant and construction camp, and temporary infrastructure to obtain water from available sources. These infrastructures are however not expected to have a significant impact on the bat community due to some of the structures only being temporary, and also due to the fact that the area required for construction only represents a small percentage of the total area available with the same habitat characteristics.

## 1.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

At a macro level, there are no known features considered to have relevant importance for bats in the broader area of the proposed Kudusberg WEF development area. As referred to in Figure 2, the closest known roost is located at approximately 100 km from the site (Montagu Guano Cave). Additionally, there are no nature conservancy areas, to our present knowledge, within a 30km radius of the proposed development area. The proposed Kudusberg WEF site is located approximately 55km south-east of the Tankwa Karoo National Park (Figure 2). Considering that this area is located at a considerable distance from the proposed WEF area it is not expected that the species using the National Park will be affected in any way by the implementation of this project. Nonetheless the analysis of the bat species present in the area, which are of similar nature to the Kudusberg WEF proposed area, may provide an indication of the suite of species likely to be present in the study area.

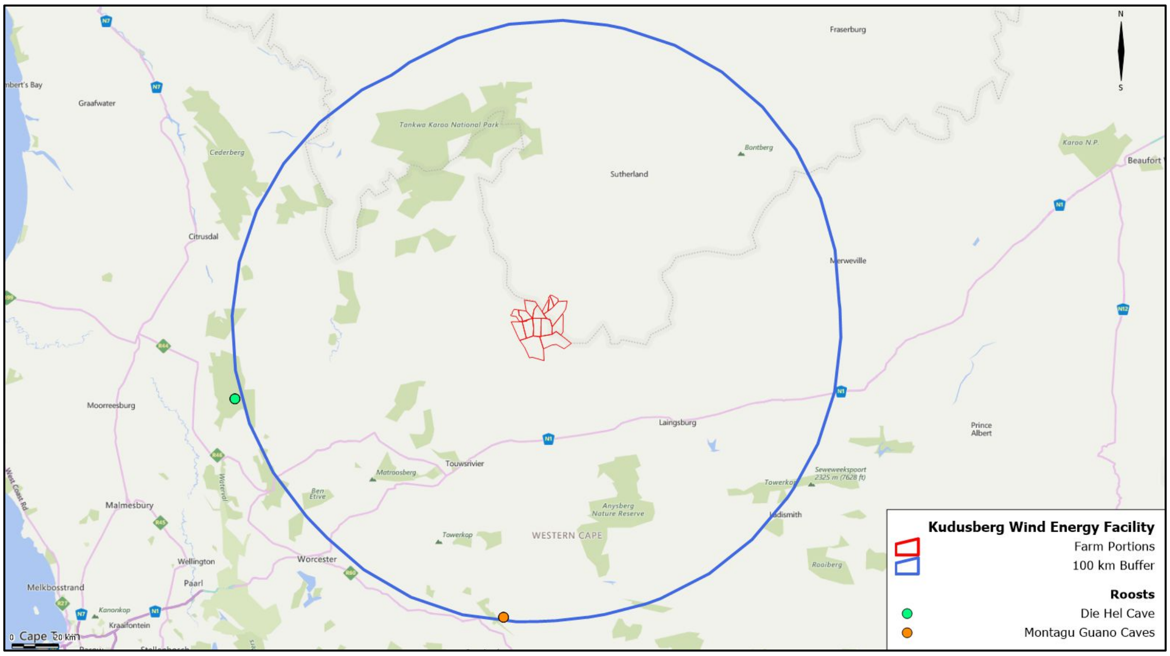


**Figure 2 - Confirmed roosts located in the vicinity of the proposed WEF site (background image source: Virtual Earth Street Image).**

At the WEF site level, the site falls within the Succulent Karoo and the Fynbos biome, with the occurrence of two main vegetation types (Mucina & Rutherford, 2006 updated to version 2012) (Figure 3):

- Central Mountain Shale Renosterveld (Fynbos biome): associated with areas of slopes and broad ridges where the vegetation is predominantly tall shrubland and renosterveld composed by non-succulent karoo shrubs and a rich flora in rockier areas.
- Koedoesberge-Moordenaars Karoo (Succulent Karoo biome): this type of vegetation is found in slightly undulating to hilly landscape and is characterised by low succulent scrub with interspersed taller shrubs. Rain may occur through the year though it is more likely during the winter season – two rainfall peaks during the year: one in March and the other in May – August.

Vegetation structure is a key determining factor in bat distribution. The proposed Kudusberg WEF site is characterised by accentuated mountainous areas which is located between two vegetation types and major biotopes: the Fynbos biome and the Succulent Karoo biome (Figure 3). Both are characteristic of higher altitudes and are present both in the bottom and top of the mountains. Within the proposed Kudusberg WEF site the area is mostly comprised of natural vegetation that is adapted to the hot and seasonal climate. This type of habitat is generally associated with the presence of several bat species that occur in these arid and semi-arid habitats. Such species include the Egyptian slit-faced bat (*Nycteris thebaica*), the Lesueur's wing gland bat (*Cistugo lesueuri*), the Cape horseshoe bat (*Rhinolophus capensis*), or the Egyptian free-tailed bat (*Tadarida aegyptiaca*). Other species may be present in the area, not due to the vegetation structure but due to the terrain features, which include mountains, cliffs and ridges. The Long-tailed serotine (*Eptesicus hottentotus*), the Natal long-fingered bat (*Miniopterus natalensis*) and the Temminck's myotis (*Myotis tricolor*) are examples of species which can be present in these areas due to their preference for roosting in caves and cracks in rocks (Monadjem *et al*., 2010).

The study area is not abundant in water sources at present, and therefore it is expected that the few water features present will have a high attraction factor for bats, especially during the wet season. Their importance is not restricted only to water availability but also to insect abundance due to the associated vegetation present.

The proposed development area is occupied mainly by natural vegetation. The vegetation provides a very sparse coverage of the soil and does not provide much refugee to any bat species. It is however a good hunting ground for open-air foragers such as the Egyptian free-tailed bat. Natural shrubby vegetation is present both at the top of the mountain ridges and in the slope and flatter plain areas.

Vegetation taller than shrubs is very scarce in the study area and is generally associated with watercourse lines. These locations may have two different utilisations by the different bat species potentially present in the area: they may be used as roosts by tree-dwelling or be used as feeding roosts during the night by other bat species, such as the Geoffroy's horseshoe bat, which then roost during the day at separate locations (usually caves or mines).

At a WEF site level, activity in the area is considered to be low at ground and rotor level. The general area of the site is being used by sensitive species, with a medium to high risk of collision with wind turbines (e.g. Natal long-fingered bat, Cape serotine and the Egyptian free-tailed bat). The mountains and ridges present throughout the site supply many rock crevices suitable for bat roosts, however the roosts identified within the proposed WEF area are all buildings identified to have potential to be used as roosts. It has been confirmed that the four roosts located within the proposed Kudusberg WEF area have bat occupation (Figure 3).

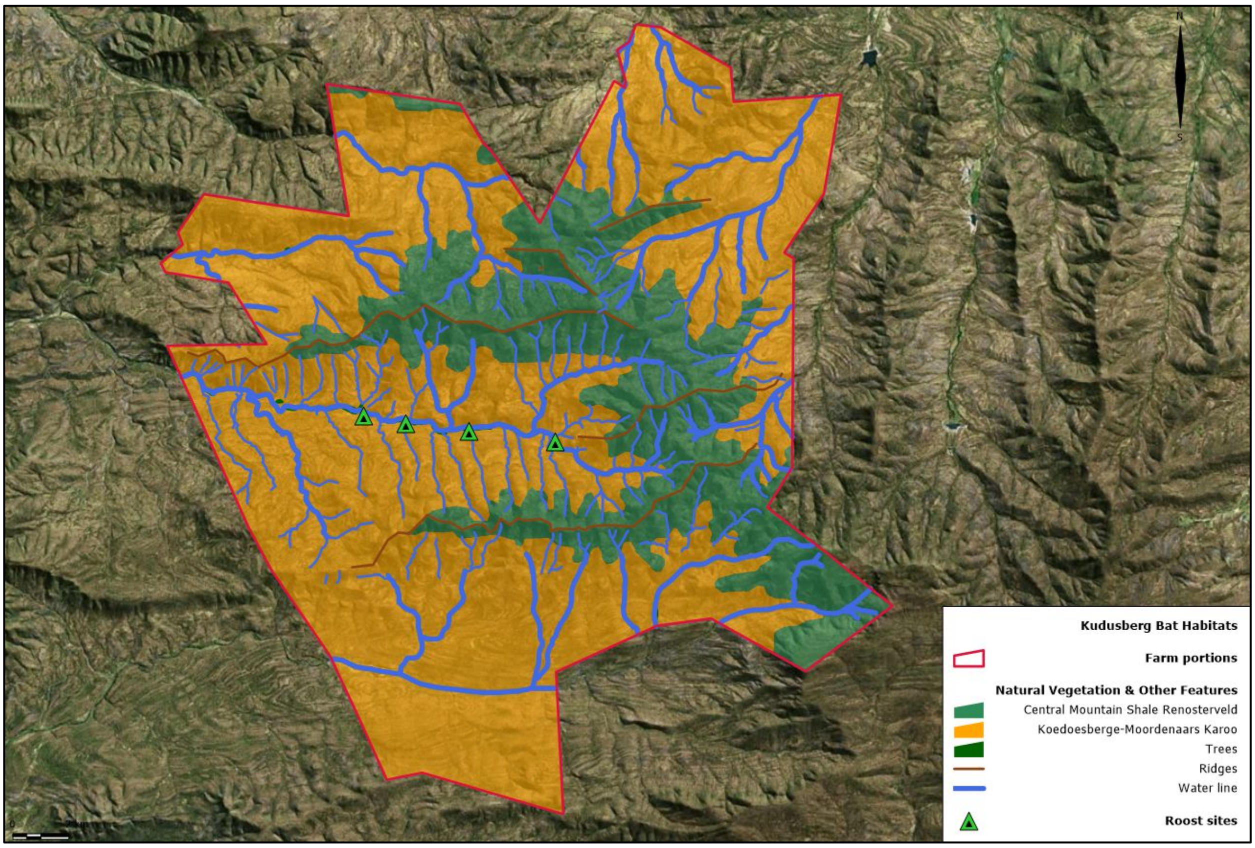


**Figure 3 - Bat habitats occurring within the Kudusberg WEF. *watercourses mapped using open source data and not confirmed through a hydrology assessment.**

The general area of the proposed WEF is classified as having a low bat sensitivity due to the very low bat activity observed during the 12-month monitoring. However, considering the presence of medium-high and high collision risk species, some precautionary measures are needed.

Therefore, very high (no-go) areas and other sensitive areas for bats are outlined in Figure 4 and follow the recommendation from the South African Bat Assessment Advisory Panel (SABAAP; in Sowler *et al*., 2016). The very high sensitivity areas (no-go areas) should exclude all new WEF-associated structures (wind turbines, roads, powerlines, substation infrastructures or other associated structures).

Considering the Best practice recommendations, the sensitivity areas were delineated according to the buffer areas indicated in the "Bat Sensitivity Buffer Zone Recommendations" of the South African Bat Assessment Advisory Panel (SABAAP) (SABAAP, 2013) and the fourth edition of the South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction:

- High sensitivity - 200m around all potentially bat important features:
  - *Along water lines and associated riverine vegetation*. Such features are important for bats, since they are likely to act as commuting routes, providing food resources, likely to be associated with higher bat activity, and likely to favour the occurrence of dispersion routes, besides local commuting routes. A 200m buffer was considered around those features. It is recommended that should new infrastructures (including roads and electrical infrastructures) cross these features (including buffers), then they should not be routed to run parallel with them, but rather cross them perpendicularly, as far as possible. Additionally, this avoidance recommendation will not include the use of existing roads, as long as they are not upgraded in such a manner that will re-route them (to be more parallel with the feature) within those

buffered areas. However, no wind turbines or substations may be permanently placed within any of these buffered areas.

- Very High sensitivity (No-Go):
  - *Confirmed Roosts*. There are four confirmed roosts within the proposed Kudusberg WEF. During ultrasound monitoring and inspection of the roosts, it was confirmed that bats are using the identified buildings as roosts. While the number of individuals using the roosts remain relatively uncertain, we estimate that there are at least about 1-50 individuals, resulting in a 500m buffer, considering the known occurrence species with medium-high and high risk of collision with wind turbines. As such, no wind turbines, electrical infrastructure, substations or new roads may be permanently placed within the buffered areas. However, the use of existing roads may be used, as long as they are not upgraded in such a manner that will cause them to be re-routed and subsequently run more perpendicular to the roosts (and their buffered areas).

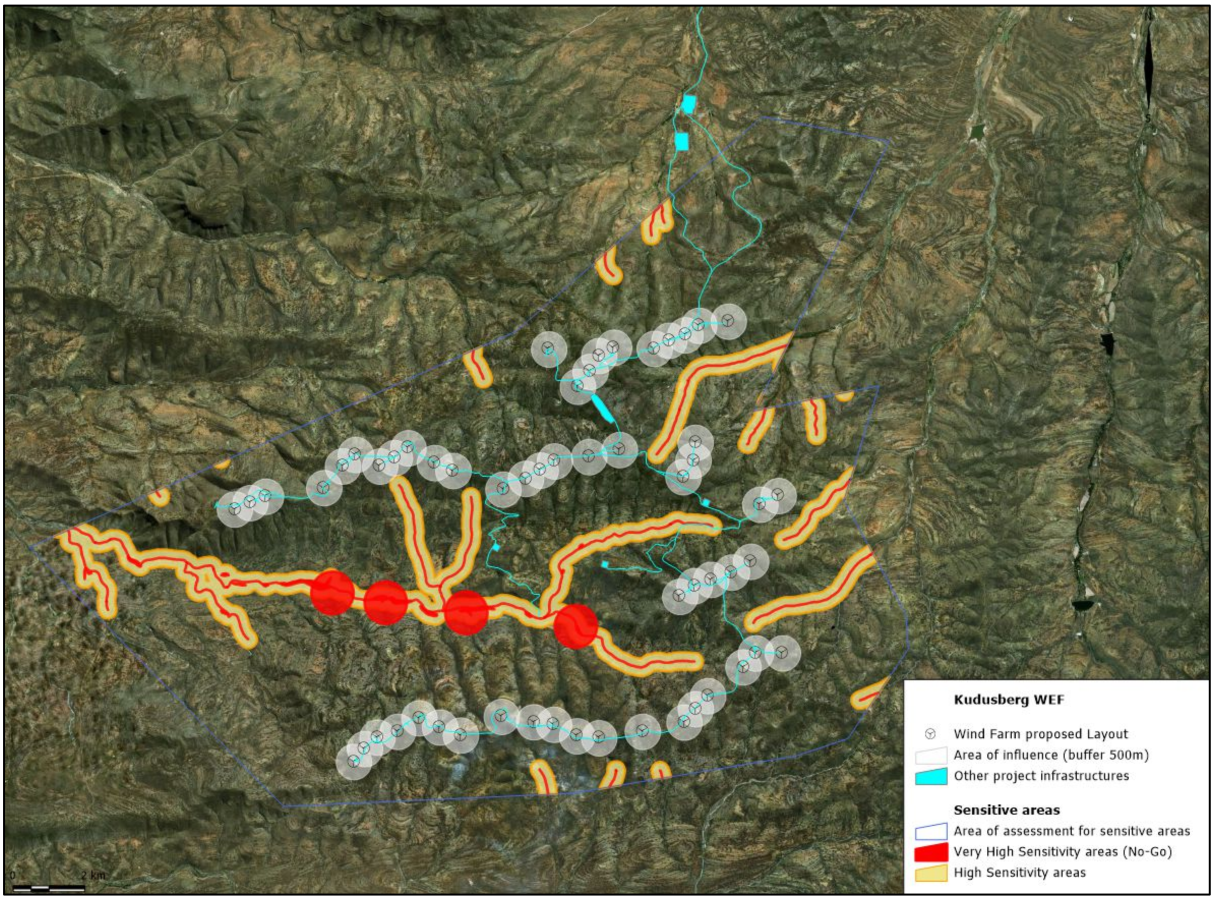


**Figure 4 - Sensitive areas for bats within the Kudusberg WEF.**

Approximately 67 bat species may occur within South Africa (Monadjem *et al*., 2010). Bat distribution areas are, however, strongly influenced by geographic and climatic variables, with only a few species occurring throughout the entire South African territory. Therefore, not all of these 67 bat species are likely to occur within Kudusberg WEF study area. Considering several criteria, it was possible to determine that at least four species had confirmed occurrence in the area and fifteen have the potential to occur in the immediate vicinity of the site (Table 2). From all these fifteen species, nine of them are considered to be sensitive to the project development.

The confirmed species on site are the Egyptian free-tailed bat (*Tadarida aegyptiaca*), the Cape serotine (*Neoromicia capensis*), the Natal long-fingered bat (*Miniopterus natalensis*) and the

Egyptian slit-faced bat (*Nycteris thebaica*). These are all “Near Threatened” or “Least Concern” species, according to the South African Red List (Friedmann & Daly, 2004b)

One species with confirmed occurrence is perceived as having a potential high risk of collision with wind turbines (according to Sowler *et al.*, 2016) due to their behaviour, i.e. Egyptian free-tailed bat (*Tadarida aegyptiaca*). Two other species with confirmed presence in the area raise concerns regarding their probability of fatalities, as they have a medium-high risk of collision with wind turbines: Cape serotine (*Neoromicia capensis*) and Natal long-fingered bat (*Miniopterus natalensis*). Additionally, *Miniopterus natalensis* is a migrant species that can use air space at rotor level during migration periods being prone to collision during these events.

According to pre-construction monitoring results, the bat activity at the proposed Kudusberg WEF area is **generally low** considering the bat guidelines (Sowler *et al.,* 2016). Although the Kudusberg WEF is considered to be classified as having **low bat sensitivity**, it is noteworthy that some areas in particular, have high and very high sensitivity due to the presence of specific features and habitat that may have an increased bat activity. These include the presence of potential roosts, as well as watercourse lines which are important for bats, since they are likely to act as commuting routes, providing food resources, and are therefore likely to be associated with higher bat activity.

## 1.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The Kudusberg WEF is subject to the requirements of the National Environmental Management Act (Act 104 of 1998). The EIA Regulations of December 2014 (as amended) require that an EIA process must be undertaken for the development of the proposed project with strict timeframes. Considering that Kudusberg WEF is located within the Komsberg renewable energy development zone, a Basic Assessment process instead of an EIA can be undertaken.

In line with the principles of NEMA, impacts on the environment (and in this case, bats specifically) must be determined and assessed, and recommendations made on how to avoid, as far as possible, mitigate and manage negative impacts on bat species caused by human-made infrastructures (e.g. wind turbines and associated infrastructures). In this context, the bat assessment considers all bat species that may occur within the site, provides an assessment of potential impacts as well as recommend mitigation measures for the avoidance of impacts (if possible).

It is considered best practice for bat monitoring to be undertaken on WEF sites, thereby striving for the reconciliation of wind energy facilities and bats, with the aim of evaluating and minimising any potential impacts. This can be achieved by fulfilling the requirements outlined by the most recent version of the “South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments” (Sowler *et al*., 2016).

There are no permit requirements dealing specifically with bats in South Africa. However, legislation which applies to bats includes the following:

**National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)**

Sections 2, 56 and 97 are of specific reference. Section 97 considers the Threatened or Protected Species Regulations: The Act calls for the management and conservation of all biological diversity within South Africa.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected.

NEMBA also deals with endangered, threatened and otherwise controlled species, under the Threatened or Protected Species (ToPS) Regulations. The Act provides for listing of species as threatened or protected, under one of the following categories:

- Critically Endangered: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- Vulnerable: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- Protected species: any species that is of such high conservation value or national importance that national protection is required. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

A ToPS permit is required for any activities involving any ToPS-listed species. Several bat species are listed as critically endangered, endangered, vulnerable and protected in terms of Regulations published under this Act.

**Nature and Environmental Conservation Ordinance No. 19 of 1974; Schedule 5:**

Although the primary purpose of this Act is to provide for the amendment of various laws on nature conservation, it also deals with a number of other issues. This Act lists protected wild animals, including all bats except Fruit Bats of the family PTEROPODIDAE. A permit is required for any activities which involve endangered or protected flora and fauna.

**IUCN Red List of Threatened Species**

The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species ranks plants and animals according to threat levels and risk of extinction, thus providing an indication of biodiversity loss. This has become a key tool used by scientists and conservationists to determine which species are most urgently in need of conservation attention. In South Africa, a number of bats are listed on the IUCN Red List.

**Convention on Biological Diversity**

This Convention aims to protect and maintain biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits from the use of genetic resources. The Convention intends to enforce the concept of sustainable use of resources among decision-makers and that these are not infinite. It also offers decision-makers guidance based on the precautionary principle. South Africa is a Party to this convention since 1993.

**Convention on the Conservation of Migratory Species of Wild Animals (CMS)**

CMS is a treaty of the United Nations Environment Programme (UNEP), which provides a global platform for the conservation and sustainable use of migratory animals and their habitats. South Africa is a Party State since 1991. CMS includes the States through which migratory animals pass (Range States) and establishes the legal foundation for internationally coordinated conservation measures throughout a migratory range. Besides establishing obligations for each

State joining the Convention, CMS promotes concerted action among the Range States of many of these species.

The CMS has two Appendices: Appendix I pertains to migratory species threatened with extinction and Appendix II that regards migratory species that need or would significantly benefit from international co-operation. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.

## 1.5 IDENTIFICATION OF KEY ISSUES

### *1.5.1 Key Issues Identified*

The potential bat issues identified include:

- Destruction of natural vegetated areas due to platforms construction, workstation and substation construction, internal access roads construction, and turbines, underground cabling and overhead power lines installation;
- Disturbance and/or Displacement effects of bat community due to noise and movement generated by turbines operation, an increase of people and vehicles in the area and destruction of roosts location; and
- Fatality of individuals due to collision with turbine blades or barotrauma caused by operating turbines.

To date, no consultation process has been undertaken for this project. However, CSIR will provide all stakeholders with the opportunity to comment on the proposed project.

### *1.5.2 Identification of Potential Impacts*

Considering the species that could potentially occur at the proposed Kudusberg WEF site, the main potential impacts identified during the BA assessment are:

### *1.5.3 Construction Phase*

- Direct Impacts
  - Habitat Loss.
  - Disturbance Effects.
- Indirect Impacts
  - Displacement to other areas which may or may not have the ability to support the influx of species.

### *1.5.4 Operational Phase*

- Direct Impacts
  - Fatalities due to collision with wind turbines or barotrauma.
  - Disturbance Effects.
- Indirect Impacts
  - Displacement to other areas which may or may not have the ability to support the influx of species.
  - Population decline over time.

### *1.5.5 Decommissioning Phase*

- Direct Impacts
  - Disturbance Effects
- Indirect Impacts

- Displacement to other areas which may or may not have the ability to support the influx of species

### *1.5.6 Cumulative impacts*

- Increased Habitat Loss
- Increased fatalities due to collision with various projects' infrastructures and/or barotrauma
- Increased disturbance/displacement effects

## 1.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

### *1.6.1 Results of the Field Study*

From the 67 bat species that may occur within South Africa (Monadjem *et al.*, 2010), according to several criteria, only 15 bat species are likely to occur within the Kudusberg WEF study area. From all these 15 species, at least four species had confirmed occurrence in the area. From all these fifteen species, nine of them are considered to be sensitive to the project development. (Table 4).

**Table 4 - List of species with possible occurrence at Kudusberg WEF (IUCN, 2018) and South Africa Red List (Friedmann & Daly, 2004b): VU – Vulnerable; NT – Near Threatened; LC – Least Concerned; NE – Not Evaluated; Collision risk according to Sowler *et al.*, 2016; Probability of occurrence: High; Low; Mod – Moderate**

| Species name | Common name | IUCN | SA Red List | Collision risk | Sensitive species | Probability of occurrence | Presence confirmed during campaign |
|---|---|---|---|---|---|---|---|
| *Nycteris thebaica* | Egyptian slit-faced bat | LC | LC | Low | X | Low | Yes |
| *Miniopterus fraterculus* | Lesser long-fingered bat | LC | NT | Med-High | X | Low | No |
| *Miniopterus natalensis* | Natal long-fingered bat | LC | NT | Med-High | X | High | Yes |
| *Cistugo lesueuri* | Lesueur's wing-gland bat | LC | NT | Low | - | Mod | No |
| *Cistugo seabrae* | Angolan wing-gland bat | LC | VU | Low | X | Mod | No |
| *Eptesicus hottentotus* | Long-tailed serotine | LC | LC | Med | - | Low | No |
| *Laephotis namibensis* | Namibian long-eared bat | LC | NE | Low | - | Mod | No |
| *Myotis tricolor* | Temminck's myotis | LC | NT | Med-High | X | Low | No |
| *Neoromicia capensis* | Cape serotine | LC | LC | Med-High | X | High | Yes |
| *Scotophilus leucogaster* | White-bellied house bat | LC | LC | Med-High | X | Low | No |
| *Rhinolophus capensis* | Cape horseshoe bat | LC | NT | Low | - | Low | No |
| *Rhinolophus clivosus* | Geoffroy's horseshoe bat | LC | NT | Low | - | Mod | No |
| *Rhinolophus darlingi* | Darling's horseshoe bat | LC | NT | Low | - | Low | No |
| *Sauromys petrophilus* | Robert's flat-headed bat | LC | LC | High | X | Low | No |
| *Tadarida aegyptiaca* | Egyptian free-tailed bat | LC | LC | High | X | High | Yes |

### *1.6.2 Habitat Loss (Construction Phase)*

- Nature: Destruction of natural vegetated areas due to the construction of crane platforms, workstation, substation, internal access roads, and turbines, underground cabling and overhead power lines installation – **negative impacts**.
- Significance of impact without mitigation measures: Relating to habitat loss is expected to be of **moderate** significance as the affected WEF footprint is not very big.
- Proposed mitigation measures: The minimisation of this impact is mainly achieved, in layout planning phase, through the avoidance of infrastructure siting (wind turbines, powerlines, sub-station infrastructures or other associated buildings) in very high (no-go) areas and wind turbines in areas of higher bat sensitivity (refer to map in section 1.3). Any roads crossing watercourses must do so perpendicularly and not be routed parallel to it, unless agreed with the aquatic specialist. Additionally, in affected areas, clearance and removal of vegetation should be kept to a minimum as far as possible. The beneficiation of existing accesses can be conducted with the removal of natural vegetation strictly reduced to the extent necessary.
- Significance of impact with mitigation measures: Despite the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a high degree, with mitigation measures in place. As such, the habitat loss is considered to have an impact of **low** significance, when mitigation is implemented.

### *1.6.3 Disturbance Effects (Construction Phase)*

- Nature: Disturbance of bat community due to the increase of people and vehicles in the area, and destruction of roost locations – **negative impacts**.
- Significance of impact without mitigation measures: The disturbance due to people and vehicle presence and driving is considered an impact of **low** significance due to the temporary nature and very restricted area of impact, having therefore a local extent.
- Proposed mitigation measures: In order to minimise this impact certain measures can be taken, such as lower the levels of noise whenever possible around very high and high sensitivity areas for bats (refer to map in section 1.3); avoid construction works during the night and avoid the destruction or disturbance of identified roosting sites. Movement of machinery, vehicles and persons should be restricted to the existing or new roads and avoid the existing natural areas.
- Significance of impact with mitigation measures: Despite the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a very low degree, with mitigation measures in place. As such, the disturbance of bat community is considered to have an impact of **very low** significance, when mitigation is implemented.

### *1.6.4 Displacement Effects (Construction Phase)*

- Nature: Displacement of the bat community due to the increase of disturbances in the area and destruction of roost locations – **negative impacts**.
- Significance of impact without mitigation measures: The displacement of species is considered an impact of **low** significance due to the temporary nature and very restricted area of the impact, having therefore a local extent.
- Proposed mitigation measures: In order to minimise this impact certain measures can be taken, such as lower the levels of noise whenever possible around very high and high sensitivity areas for bats (refer to map in section 1.3); avoid construction works during the night and avoid the destruction or disturbance of identified roosting sites. Movement of machinery, vehicles and persons should be restricted to the existing and new roads and avoid the existing natural areas.
- Significance of impact with mitigation measures: In spite of the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a high degree, with mitigation measures

in place. As such, the displacement is considered to have an impact of **very low** significance, when mitigation is implemented.

### *1.6.5 Fatality Events (Operational Phase)*

- Nature: Fatality of individuals due to collision with turbine blades or barotrauma caused by turbines operation – **negative impacts**.
- Significance of impact without mitigation measures: Considering the potential risk of fatality of bats at the study area, species of high, medium-high and medium collision risk can suffer fatality events in the wind energy facility. Bat fatality is considered a **moderate** significance impact, although there is high probability of occurrence of the impact.
- Proposed mitigation measures: The minimisation of fatalities caused by wind turbines can be mainly achieved through planning during the layout definition phase, by the avoidance of turbines installation in very high sensitive areas for bats (no-go areas) (refer to map in section 1.3).
  Additionally, it is recommended that no tall vegetation should be allowed within the 200 m buffer around the wind turbines to reduce the suitability of the areas for bat foragers. A construction and operational phase bat monitoring program should be implemented to determine the actual impacts of the wind energy facility on the bat community, as well as the implementation of mitigation measures, such as the utilisation of red lights in the turbines, instead of white, to minimise insect attraction and bat foraging behaviors near the turbines.
  Also, a monitoring plan is recommended during operation phase and, if high levels of mortality are observed during operational phase, management actions should be put into action to mitigate fatality.
- Significance of impact with mitigation measures: In spite of the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a high degree, with mitigation measures in place. As such, if mitigation measures are successfully implemented, then it is expected that the impact can be lowered to a degree that will have a **low** significance.

### *1.6.6 Disturbance Effects (Operational Phase)*

- Nature: Disturbance of bat community due to noise and movement generated by turbines operation and increase of people and vehicles in the area associated with maintenance activities – **negative impacts**.
- Significance of impact without mitigation measures: Disturbance of the bat community due to operational turbines and people / vehicles in the area is considered to be an impact of **low** significance. Generally, the people/vehicles on site (for maintenance activities) are not expected to cause a significant increased effect with regards to disturbance, as the area already has some movement through the site by local landowners and visitors to a local guesthouse.
- Proposed mitigation measures: Lower levels of noise disturbance are recommended whenever possible.
- Significance of impact with mitigation measures: In spite of the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a very low degree, with mitigation measures in place. As such, the disturbance of bat community is considered to have an impact of **very low** significance, when mitigation is implemented.

### *1.6.7 Displacement Effects (Operational Phase)*

- Nature: Displacement of the bat community due to the increase of disturbances in the area – **negative impacts**.
- Significance of impact without mitigation measures: The displacement of species due to the disturbance of operating turbines and maintenance activities is considered an impact of **low**

significance due to the small footprint of the project, and due to the disturbance likely not being of a significant aggressive nature.
- Proposed mitigation measures: Lower levels of noise disturbance are recommended whenever possible.
- Significance of impact with mitigation measures: Despite the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a high degree, with mitigation measures in place. As such, displacement effects are considered to have a **very low** significance, when mitigation is implemented.

#### *1.6.8 Population Decline (Operational Phase)*

- Nature: Population decline of the bat community due to long-term increasing fatality events – **negative impacts**.
- Significance of impact without mitigation measures: Long-term population decline due to fatality events is considered an impact of **low** significance, as the collision risk of species is not anticipated to be significantly high. This is mostly due to optimized placement of the 56 turbines, low activity levels and flights at ground and rotor level (recorded on site during the monitoring campaign) being quite low.
- Proposed mitigation measures: Caution should also be taken not to disrupt or destroy important bat habitats and roosts during the operational phase, particularly in very high (no-go) areas. Additionally, it is recommended that a construction and operational phase monitoring programme is conducted to validate the effectiveness of the proposed mitigation measures, and if need be, propose new measures – should the need arise.
- Significance of impact with mitigation measures: Although impacts cannot be completely avoided, the implementation of the aforementioned mitigation measures may reduce the magnitude and significance of these impacts. As such, population decline is considered to have an impact of **very low** significance, with the implementation of mitigation measures.

#### *1.6.9 Disturbance Effects (Decommissioning Phase)*

- Nature: Disturbance of bat community due to noise and movement generated by dismantling of turbines and associated infrastructure, as well as the dismantling of power lines – **negative impacts**.
- Significance of impact without mitigation measures: Disturbance of the bat community due to people and vehicle presence is considered an impact of **low** significance due to the temporary nature and very restricted area of the impact, having therefore a local extent.
- Proposed mitigation measures: To minimise this impact certain measures can be taken, such as lower the levels of noise whenever possible around very high and high sensitivity areas for bats (refer to map in section 1.3); avoid dismantling works during the night and avoid the disturbance of identified roosting sites. Movement of machinery, vehicles and persons should be restricted to the existing roads and avoid the existing natural areas.
- Significance of impact with mitigation measures: In spite of the mitigation measures, impacts cannot be completely prevented from occurring. However, the magnitude and significance of these effects can be minimised to a high degree, with mitigation measures in place. As such, the disturbance of bat community is considered to have an impact of **very low** significance, when mitigation is implemented.

#### *1.6.10 Displacement Effects (Decommissioning Phase)*

- Nature: Displacement of the bat community due to the increase of disturbances in the area, while dismantling wind turbines and associated infrastructure – **negative impacts**.
- Significance of impact without mitigation measures: The displacement of species is considered an impact of **low** significance due to the temporary nature of the impact, as well as the very restricted area where disturbances will take place. Additionally, after the disturbances have taken place and the project has been decommissioned, the available

habitat may increase which could attract species to the area again – ultimately leading to a positive impact.

- Proposed mitigation measures: In order to minimise this impact certain measures can be taken, such as lower the levels of noise whenever possible around very high and high sensitivity areas for bats (refer to map in section 1.3); avoid dismantling works during the night and avoid the disturbance of identified roosting sites. Movement of machinery, vehicles and persons should be restricted to the existing roads and avoid the existing natural areas.
- Significance of impact with mitigation measures: With mitigation, displacement is not expected to occur at any significant level. As such, the impact is considered to have a **very low** significance.

### *1.6.11 Cumulative Impacts*

- Nature: The effects of the Kudusberg WEF considering other projects, will produce impacts that are likely to accumulate on the bat communities – **negative impacts**. Although wind energy facilities' footprint is not intense, the construction of roads and building platforms can affect significant portions of natural vegetation. Also, it is important to consider that besides the wind energy facility, other renewable energy facilities, are also being planned and approved in the proximities of the Kudusberg WEF (Figure 5).
- Significance of impact without mitigation measures:
    - Cumulative impacts relating to habitat loss are expected to be of **moderate** significance, as the footprint of the Kudusberg WEF is relatively small. However, when added to other facilities, the footprint may seem relatively larger.
    - Cumulative impacts relating to disturbance effects are expected to be of **moderate** significance, as an increase in human presence and turbine operation across all facilities may disrupt the general pristine environment and habitats of several bat species in the broader region.
    - Cumulative impacts relating to displacement effects are expected to be of **moderate** significance, as the areas required to sustain a higher population size (originating from surrounding renewable energy facilities) may not be able to support it. Bats with a higher sensitivity to human presence will flee from these sites and seek refugee elsewhere, hence loosing available habitat.
    - Cumulative impacts relating to fatalities due to collision and/or barotrauma are expected to be of **moderate** significance, as wind energy facilities nearby or adjacent to one another are known to increase the likelihood of collision and/or barotrauma, due to the establishment of a relatively increased risk area.
    - Cumulative impacts relating to population decline are expected to be of **moderate** significance, due to the potential for several facilities to disrupt each of their populations over time, either through direct fatalities, or through disturbance/displacement effects. If this takes place at each facility, then the general population across all facilities may become under threat – ultimately leading to potential local extinctions.
- Proposed mitigation measures: Avoid infrastructure siting, especially turbines, in very high (no-go) areas. Keep all noise disturbance to a minimum, especially near areas that have been defined as being sensitive. Lower levels of noise disturbance are recommended whenever possible. The use of existing access routes must be used as far as possible during construction. A monitoring plan is recommended during the construction and operational phase to improve the understanding of the real impact caused by the WEF on local bat populations, as well as to validate the success of the mitigation measures proposed.
- Significance of impact with mitigation measures: The mitigation measures are recommended to lower the magnitude and significance of the impacts. This way, with mitigation measures, the cumulative impacts on the bat community is considered to have an impact of **low** significance.

It is however important to note that the quantification or even evaluation of cumulative impacts is uncertain as there is not a generalized knowledge of the large-scale movements or connection between bat populations within the region. If present, cumulative impacts will be reflected by a very rapid decline of bat populations, i.e. above that expected from a single wind energy facility operation. Further monitoring and meta-analysis of the results of the monitoring programmes of all operational phase WEF's and PVSEF's will help validate and determine these types of impacts.

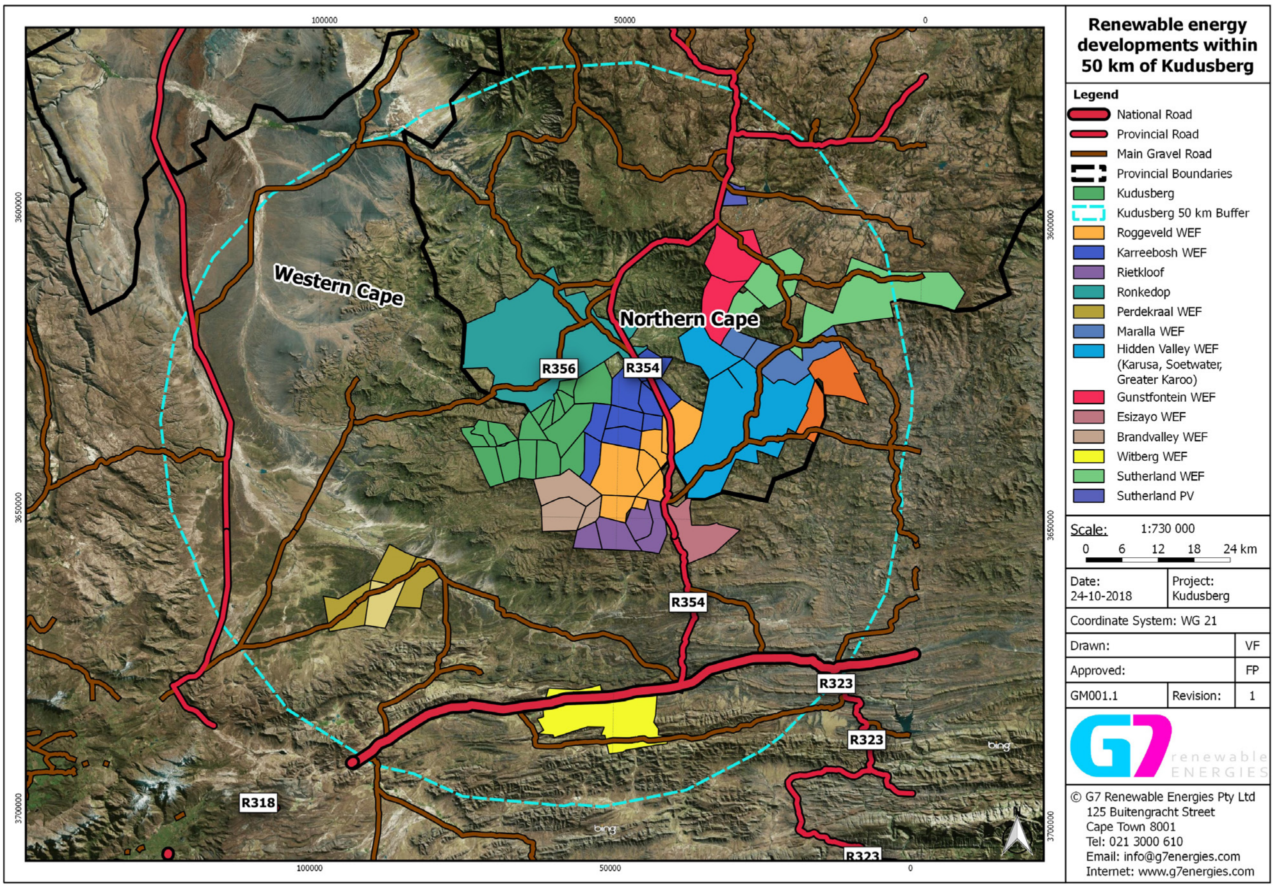


**Figure 5 - Other Renewable Energy projects currently proposed or approved in the surrounding area of the Kudusberg WEF (according to the REEA most recent available dataset – 2018 2nd Quarter).**

<u>**No-go Alternative**</u>

Should the Kudusberg Wind Farm not be constructed, then all impacts (whether it be negative or positive) identified within the impact analysis will not take place. As a result, it is expected that the present environmental characteristics relevant for the bat community on site will remain unchanged, relative to that which is being observed at present, under current land-use practices.

## 1.7 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above and collated in Table 5 to Table 8 below.

**Table 5 - Impact assessment summary table for the Construction Phase**

| Impact pathway | Nature of potential impact/risk | Status[2] | Extent[3] | Duration[4] | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BAT IMPACTS** | | | | | | | | | | | | | | | |
| **CONSTRUCTION PHASE** | | | | | | | | | | | | | | | |
| **Direct Impacts** | | | | | | | | | | | | | | | |
| Habitat Loss | Destruction of important habitat areas (natural vegetation, water features, roosts, etc.) due to the construction of wind turbines and associated infrastructures | Negative | Local | Permanent | Substantial | Very Likely | Irreversible | Moderate irreplaceability | Moderate | No | Yes | Avoidance of infrastructure siting in very high (no-go) areas; clearance and removal of vegetation should be kept to minimum extent possible; avoid destruction or disturbance of roosts; roads crossing watercourses must do so perpendicularly and not be routed parallel to it, unless agreed to by the aquatic specialist. | Low | 4 | High |
| Disturbance Effects | Disturbance of the bat community due to the increase of people and vehicles in the area, high levels of noise and machinery movements | Negative | Local | Short term | Slight | Likely | High reversibility | Replaceable | Low | No | Yes | Lower the levels of noise around highly sensitivity areas; avoid construction works during the night and destruction or disturbance of roosts; movement of machinery, a bat monitoring campaign is recommended for at least one year during the construction phase. | Very low | 5 | High |
| **Indirect Impacts** | | | | | | | | | | | | | | | |
| Displacement Effects | Displacement of bat community due to increased disturbances in the | Negative | Local | Medium-term | Moderate | Unlikely | Moderate reversibility | Low irreplaceability | Low | No | Yes | lower the levels of noise around highly sensitivity areas; avoid construction works during the night and | Very low | 5 | High |

[2] Status: Positive (+); Negative (-)
[3] Site; Local (<10 km); Regional (<100); National; International
[4] Very short-term (instantaneous); Short-term (<1yr); Medium-term (1-10 years); Long-term (project duration); Permanent (beyond project decommissioning)

| Impact pathway | Nature of potential impact/risk | Status[2] | Extent[3] | Duration[4] | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | area | | | | | | | | | | | destruction or disturbance of roosts; movement of machinery, vehicles and persons should be restricted to the existing roads. | | | |

**Table 6 - Impact assessment summary table for the Operational Phase**

| Impact pathway | Nature of potential impact/risk | Status | Extent | Duration | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BAT IMPACTS** | | | | | | | | | | | | | | | |
| **OPERATIONAL PHASE** | | | | | | | | | | | | | | | |
| **Direct Impacts** | | | | | | | | | | | | | | | |
| Fatality Events | Fatalities due to collision with turbine blades or barotrauma | Negative | Local | Permanent | Substantial | Likely | Non-reversible | High irreplaceability | Moderate | No | Yes | Avoidance of turbines installation in very high sensitive areas for bats (no-go areas); a monitoring plan is recommended during operation phase (including carcass searches and bias/scavenger trials) is recommended for a minimum of two years during the operational phase - if high levels of mortality are observed, management actions should be put into action to mitigate fatality; no tall vegetation should be allowed within the 200m buffer around the wind turbines; utilisation of red lights in the turbines, instead of white or whatever is in line with the requirements of the CAA. | Low | 4 | High |
| Disturbance Effects | Disturbance of bat community due to high levels of noise and movement generated by turbines operation and increase of people and vehicles associated with | Negative | Local | Long term | Moderate | Very likely | High reversibility | Replaceable | Low | No | Yes | Lower levels of noise disturbance are recommended whenever possible. | Very low | 5 | High |

| Impact pathway | Nature of potential impact/risk | Status | Extent | Duration | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | maintenance activities | | | | | | | | | | | | | | |
| **Indirect Impacts** | | | | | | | | | | | | | | | |
| Displacement Effects | Displacement of bat community due to increased disturbances in the area | Negative | Local | Long term | Moderate | Unlikely | Moderate reversibility | Low irreplaceability | Low | No | Yes | Lower levels of noise disturbance are recommended whenever possible. | Very low | 5 | High |
| Population Decline | Population decline due to long-term increasing fatality events | Negative | Local | Long term | Severe | Very unlikely | Low reversibility | High irreplaceability | Low | No | Yes | Bat habitats (including roosts) should not be severely destroyed, particularly in sensitive areas; a construction and operational phase monitoring programme is recommended to validate the effectiveness of the proposed mitigation measures, and if need be, propose new measures. | Very low | 5 | High |

**Table 7 - Impact assessment summary table for the Decommissioning Phase**

| Impact pathway | Nature of potential impact/risk | Status[5] | Extent[6] | Duration[7] | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BAT IMPACTS** | | | | | | | | | | | | | | | |
| **DECOMMISSIONING PHASE** | | | | | | | | | | | | | | | |
| **Direct Impacts** | | | | | | | | | | | | | | | |
| Disturbance Effects | Disturbance of bat community due to the increase of people and vehicles in the area, high levels of noise and machinery movements when dismantling wind turbines and associated infrastructures | Negative | Local | Short term | Slight | Likely | High reversibility | Replaceable | Low | No | Yes | Lower the levels of noise around highly sensitivity areas; avoid dismantling works during the night and disturbance of roosts; movement of machinery, vehicles and persons should be restricted to the existing roads. | Very low | 5 | High |
| **Indirect Impacts** | | | | | | | | | | | | | | | |
| Displacement Effects | Displacement of bat community due to increased disturbances in the area | Negative | Local | Medium term | Moderate | Unlikely | Moderate reversibility | Low irreplaceability | Low | No | Yes | Lower the levels of noise around highly sensitivity areas; avoid dismantling works during the night and destruction or disturbance of roosts; movement of machinery, vehicles and persons should be restricted to the existing roads. | Very low | 5 | High |

[5] Status: Positive (+); Negative (-)
[6] Site; Local (<10 km); Regional (<100); National; International
[7] Very short-term (instantaneous); Short-term (<1yr); Medium-term (1-10 years); Long-term (project duration); Permanent (beyond project decommissioning)

**Table 8 - Cumulative impact assessment summary table**

| Impact pathway | Nature of potential impact/risk | Status | Extent | Duration | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BAT IMPACTS** | | | | | | | | | | | | | | | |
| **CUMULATIVE IMPACTS** | | | | | | | | | | | | | | | |
| Habitat Loss | Destruction of important habitat areas (natural vegetation, water features, roosts, etc.) due to the construction of wind turbines and associated infrastructures | Negative | Regional | Permanent | Substantial | Likely | Non-reversible | High irreplaceability | Moderate | No | Yes | Avoidance of infrastructure siting in very high (no-go) areas; clearance and removal of vegetation should be kept to minimum extent possible; avoid destruction or disturbance of roosts. | Low | 4 | Medium |
| Disturbance Effects | Disturbance of the bat community due to the increase of people and vehicles in the area, high levels of noise and machinery movements | Negative | Regional | Long term | Substantial | Likely | High reversibility | Replaceable | Moderate | No | Yes | Lower the levels of noise around highly sensitivity areas; avoid construction/dismantling works during the night and destruction or disturbance of roosts; movement of machinery, vehicles and persons should be restricted to the existing roads. | Low | 4 | Medium |
| Displacement Effects | Displacement of bat community due to increased disturbances in the area | Negative | Regional | Long term | Substantial | Unlikely | Moderate reversibility | Low irreplaceability | Moderate | No | Yes | Lower the levels of noise around highly sensitivity areas; avoid construction/dismantling works during the night and destruction or disturbance of roosts; movement of machinery, vehicles and persons should be restricted to the existing roads. | Low | 4 | Medium |
| Fatality Events | Fatalities due to collision with turbine blades or barotrauma | Negative | Regional | Permanent | Substantial | Likely | Non-reversible | High irreplaceability | Moderate | No | Yes | Avoidance of turbines installation in very high sensitive areas for bats (no-go areas); a | Low | 4 | Medium |

| Impact pathway | Nature of potential impact/risk | Status | Extent | Duration | Conse-quence | Proba-bility | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk = consequence x probability (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated ? | Potential mitigation measures | Significance of residual risk/ impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | monitoring plan is recommended during operation phase (including carcass searches and bias/scavenger trials) is recommended for a minimum of two years during the operational phase - if high levels of mortality are observed, management actions should be put into action to mitigate fatality; no tall vegetation should be allowed within the 200m buffer around the wind turbines; utilisation of red lights in the turbines, instead of white or as per the requirements of the CAA. | | | |
| Population Decline | Population decline due to long-term increasing fatality events | Negative | Regional | Permanent | Substantial | Unlikely | Low reversibility | High irreplaceability | Moderate | No | Yes | Avoid turbine placement in very high sensitive (no-go) areas; bat habitats (including roosts) should not be severely destroyed, particularly in sensitive areas. | Low | 4 | Medium |

## 1.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| **A. DESIGN PHASE** | | | | | |
| **A.1. BAT IMPACTS** | | | | | |
| Potential impacts on bat (as a result of the proposed Kudusberg WEF and associated infrastructures) in future project phases, such as habitat loss, fatality, disturbance, displacement and population decline. | Avoid or minimise impacts on bat community on site. | ▪ Ensure that the design of the WEF takes the sensitivity mapping of the bat specialist into account to avoid and reduce impacts on bat species and bat important features.<br>▪ Regarding the above, minimise the footprint of the construction to an acceptable level, as defined by the bat specialist i.e. no placement of turbines in very-high sensitive areas.<br>▪ Use existing road networks as far as possible. | ▪ Ensure the very high (no-go) areas identified for the bat community should be excluded from turbine placement and the areas considered as high sensitivity avoided as much as possible, during the planning and design phase. | ▪ During design cycle and before construction commences. | ▪ Holder of the EA |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| **B. CONSTRUCTION PHASE** | | | | | |
| **A.1. BAT IMPACTS** | | | | | |
| Habitat Loss | Avoid habitat destruction caused by opening clearings for the working areas, construction of roads and landscape modifications | ▪ An independent ECO should be appointed to oversee that the EMP is being adhered to.<br>▪ Training & Education of the ECO and construction staff on bat and energy related impacts.<br>▪ Clearance and removal of natural vegetation should be kept to a minimum.<br>▪ Provide sufficient drainage along access roads to prevent erosion and pollution of adjacent watercourses or wetlands. No chemical spills or any other material dumps should be allowed within the WEF implementation area, with special focus on areas nearby riparian vegetation or drainage lines.<br>▪ No off-road driving. | ▪ Monitor the efficiency of the EMP and revise, if necessary. Also monitor whether proposed measures are being adhered to or not.<br>▪ The ECO should be trained to identify bat species, as well as their roosts locations. If any building, trees, or any structure with potential to provide bat roosting, needs to be demolished or removed, then a visit should be conducted, prior to the commencement of the works, by one specialist to verify the presence/absence of bats;<br>▪ The ECO should monitor the removal of natural vegetation. If significant portions of natural vegetation are removed | ▪ EMP efficiency monitoring during the construction phase.<br>▪ Training of ECO to be conducted shortly before construction commences.<br>▪ Natural vegetation removal monitoring during the construction phase.<br>▪ Erosion and pollution monitoring during the construction phase.<br>▪ Monitoring of potential off-road driving to occur during | ▪ Holder of the EA to appoint ECO.<br>▪ Bat specialist to conduct training of ECO, unless the ECO are already trained and educated. |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | | | (significantly more than what is currently proposed) in very high sensitive areas, then an appropriate rehabilitation specialist should be consulted for further actions.<br>▪ The ECO should monitor and prevent any erosion and pollution (chemical spills etc.) within the WEF boundaries, particularly when associated with water features such as drainage lines, riparian vegetation and water bodies / wetlands.<br>▪ Driving should, at all times, remain on existing or newly constructed roads. This should be strictly monitored so that habitat destruction does not occur. | construction phase. | |
| Disturbance Effects | Avoid disturbance of bat community due to the increase of people and vehicles in the area, as well as destruction of | ▪ Implement construction phase bat monitoring.<br>▪ An ECO should be appointed to oversee that the EMP is being adhered to. | ▪ Appoint a bat specialist to undertake a construction phase monitoring programme (minimum 1- | ▪ Appointment of bat specialist shortly before construction | ▪ Holder of the EA to appoint bat specialist. |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | roosts | ▪ Training & Education of the ECO and construction staff on bat and energy related impacts.<br>▪ Adequate training should be provided to all the construction personnel. Everybody working in the area should be aware of the sensitive areas, be alert to the possible presence of bats, especially when working close to potential and/or confirmed roosts (per example abandoned buildings).<br>▪ In the case that any confirmed or potential bat roost needs to be affected (e.g. utilisation conversion, demolition, recuperation) a bat specialist should confirm bat occupancy and define the necessary measures to be implemented to minimise the impact if necessary. | year) to assess the disturbances occurring on site, as well as the success of the mitigation measures. To be conducted in accordance with the relevant Best Practice Guidelines.<br>▪ Monitor the efficiency of the EMP and revise, if necessary. Also monitor whether proposed measures are being adhered to or not.<br>▪ The ECO should be trained to identify bat species, as well as their roosts locations.<br>▪ Reduce noise levels as far as possible. | commences.<br>▪ Appointment of ECO shortly before construction commences.<br>▪ Training of ECO shortly before construction commences.<br>▪ Minimise disturbances throughout the construction phase. | ▪ Bat specialist to provide training to ECO.<br>▪ Construction staff to adhere. ECO to oversee |
| Displacement Effects | Minimise displacement effects of the bat community due to on-site disturbances. | ▪ Minimise on-site disturbances. | ▪ Reduce noise levels as far as possible. | ▪ During the construction phase. | ▪ Construction staff to adhere. ECO to oversee. |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| **C. OPERATION PHASE** | | | | | |
| **A.1. BAT IMPACTS** | | | | | |
| Fatality events | Avoid fatality of individuals due to collision with turbine blades or barotrauma caused by turbines operation. | ▪ If turbines are to be lit at night, lighting should be kept to a minimum;<br>▪ Lighting of wind energy facility (for example security lights) should be kept to a minimum and should be directed downwards (with the exception of aviation security lighting);<br>▪ Appoint a bat specialist to develop and a post-construction monitoring programme (operation phase) to survey bat communities on the wind energy facility and the impacts resulting from the installed infrastructure, according to the Best Practice Guidelines available at that time;<br>▪ The results of the operational phase monitoring programme must be taken into account for the implementation of further mitigation measures, if necessary. | ▪ Develop and implement a bat monitoring programme in line with the most recent version of the Best Practice Guidelines that will be available at the time.<br>▪ Further operational mitigation measures to be researched during the operational monitoring campaign as an adaptive management approach, if required. If significant levels of fatalities are observed, then these measures should be implemented. Such measures could include curtailment, shut-down on demand technology, habitat management, or bat deterrence systems. | ▪ During the first two years of the projects' operational phase.<br>▪ During the operational phase of the project. | ▪ Bat specialist.<br>▪ Bat specialist for monitoring. Holder of the EA to implement. |
| Disturbance Effects | Avoid disturbance of bat community due to noise | ▪ Minimise general on-site disturbances. | ▪ Reduce noise levels as far as possible. | ▪ Minimise disturbances | ▪ All on-site personnel. |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | and movement generated by turbines operation. | ▪ No off-road driving.<br>▪ Implement speed limits. | ▪ Driving should, at all times, remain on existing or new roads.<br>▪ Avoid maintenance activities during the night and disturbance of roosts. | throughout the operational phase.<br>▪ No off-road driving throughout the operational phase. | ▪ All on-site personnel and monitored by the facility manager. |
| Displacement Effects | Minimise displacement effects of the bat community due to on-site disturbances. | ▪ Minimise on-site disturbances. | ▪ Reduce noise levels as far as possible.<br>▪ Avoid maintenance activities during the night and disturbance of roosts. | ▪ During the operational phase. | Operational staff to adhere. Facility Manger to oversee. |
| Population Decline | Reduce the risk of population decline within the area. | ▪ Appoint a bat specialist to develop and implement an operational monitoring programme with carcass searches, searcher efficiency trials and scavenger removal trials, to gain a better understanding of real impacts occurring on the bat community.<br>▪ Further operational mitigation measures to be researched during the operational monitoring campaign and implemented, if needed. | ▪ Conduct a monitoring campaign (with carcass searches, searcher efficiency trials and scavenger removal trials) during the first two years of the projects' operational phase. Further monitoring can, however, be recommended during later stages – if deemed relevant by the bat specialist.<br>▪ Further operational | ▪ During the first two years of the projects' operational phase.<br>▪ During the operational phase. | ▪ Bat Specialist.<br>▪ Bat specialist for monitoring. Developer for implementation. |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| | | | mitigation measures to be researched during the operational monitoring campaign as an adaptive management approach. If significant levels of fatalities are observed, then these measures should be implemented. Such measures could include curtailment, shut-down on demand technology, habitat management, or bat deterrence systems. | | |

| Impact | Mitigation/Management Objectives | Mitigation/Management Actions | Monitoring | | |
|---|---|---|---|---|---|
| | | | ***Methodology*** | ***Frequency*** | ***Responsibility*** |
| **D. DECOMMISSONING PHASE** | | | | | |
| **A.1. BAT IMPACTS** | | | | | |
| Disturbance/ Displacement Effects | Avoid disturbance and/or displacement of bat community due to noise and movement generated by the increase of people and vehicles in the area, for the dismantling of turbines and associated infrastructure. | ▪ Minimise on-site disturbances. | ▪ Adequate training should be provided to all the construction personnel.<br>▪ Everybody working in the area should be aware of the sensitive areas, be alert to the possible presence of bats, especially when working close to potential and/or confirmed roosts (per example abandoned buildings).<br>▪ Reduce noise levels as far as possible. | ▪ Minimise disturbances throughout the decommissioning phase. | ▪ All on-site personnel. |

# 1.9 CONCLUSION AND RECOMMENDATIONS

Results of the 12-month pre-construction bat monitoring indicate that the bat activity at the proposed Kudusberg WEF area is generally **low** considering the Bat Guidelines (Sowler *et al*., 2016).

One species with confirmed occurrence is perceived as having a potential high risk of collision with wind turbines (according to Sowler *et al*., 2016) due to their behaviour, i.e. *Tadarida aegyptiaca*. Two other species with confirmed presence in the area raise concerns regarding their probability of fatalities, as they have a medium-high risk of collision with wind turbines: *Neoromicia capensis* and *Miniopterus natalensis*. Additionally, *Miniopterus natalensis* is a migrant species that can use air space at rotor level during migration periods being prone to collision during these events. These are all “Near Threatened” or “Least Concern” species, according to the South African Red List (Friedmann & Daly, 2004b).

According to pre-construction monitoring results, the Kudusberg WEF site is considered to be classified has having **low bat sensitivity**, but with some areas in particular with high and very high sensitivity due to the presence of specific features and habitat that may have an increased bat activity. These include the presence of potential roosts, as well as watercourse lines which are important for bats, since they are likely to act as commuting routes, providing food resources, likely to be associated with higher bat activity. For this reason, mitigation measures are proposed to mitigate potential impacts mainly during the project design phase (including the layout), as well as during the construction and operational phase.

It is recommended that the very high bat sensitivity or no-go areas identified for the bat community should be excluded from development (excluding the use/upgrading of existing roads). Additionally, the areas considered to be of high sensitivity should be avoided as much as possible, but in line with the recommendations outlined in section 1.3. Therefore, the proposed layout considered in the present report, is acceptable.

At this stage, if the proposed mitigation measures are implemented, the project is not considered to cause irreplaceable loss of bat biodiversity, therefore considering the information available and to our best knowledge, **there are no fatal flaws identified for the project apart from the very high (no-go) areas (refer to section 1.3) which should be excluded from development as is already the case with the current proposed layout**.

The following recommendations are proposed to reduce the potential collision risk and potential negative impacts from the proposed wind development on the bat community:

Project design-Layout definition phase

- Considering the analysis in the sensitive areas section (refer to section 1.3) it is recommended to avoid the overlay of the proposed turbines layout, with the areas with a very high and high level of sensitivity to bats – already implemented.

Project Construction phase

- Adequate training should be provided to all the construction personnel (ECO and construction staff) to ensure that everybody working in the area should be aware of the bat sensitive areas, be alert to the possible presence of bats, especially when working close to potential and/or confirmed roosts (per example abandoned buildings);
- Construction activities to be restricted to the demarcated construction areas;
- A pre-construction walk-through should be conducted by a bat specialist, covering the final layout to identify any roosts/activity of sensitive species, as well as any additional sensitive habitats and to propose suitable mitigation measures to avoid or minimise impacts to these species;
- Sufficient and adequate drainage should be provided along access roads to prevent erosion and pollution of adjacent watercourses or wetlands;

- No chemical spills or any other material dumps should be allowed within the intervention area, with special focus on areas nearby riparian vegetation or drainage lines. All the maintenance of vehicles must be carried out in specially designated areas to prevent any type of pollution to the residual site.

Project Operational phase

Considering that bat species of high collision risk were confirmed using the area within the rotor swept area (although low activity), some recommendations are made to mitigate the risk involved for those populations. Since activity levels at rotor level are considered to be low to medium, no curtailment measures are required to be proposed at this stage.

However, if during the operation phase, high levels of mortality are identified this should be evaluated by a designated bat specialist as soon as possible. Subsequent mitigation measures, adjusted to the risk situation identified, should be then proposed and implemented.

At this stage, recommendations during operational phase are:

- If turbines are to be lit at night, lighting should be kept to a minimum;
- Lighting of wind energy facility (for example security lights) should be kept to a minimum and should be directed downwards (with the exception of aviation security lighting);
- Ensure the implementation of a post-construction monitoring programme (operation phase) to survey bat communities on the wind energy facility and the impacts resulting from the installed infrastructure, according to the prevailing Best Practice Guidelines;
- The results of the operational phase monitoring programme must be taken into account for the implementation of further mitigation measures, if necessary.

The monitoring programme should have a minimum duration of 2 years, start as soon as the wind energy facility becomes operational and be revised upon completion. It should include both the continuation of the assessment of bat communities in the site, complementing the information gathered during the pre-construction phase and allowing determination of any exclusion effects on the bat community. The operational phase monitoring programme should include carcass searches and the determination of correction factors (observer's efficiency and carcass removal) in order to accurately determine the impact of the wind turbine on bats and to determine any potential critical area and/or wind turbines. This will inform adjusted or further mitigation measures, if necessary, tailored to the site specifics. These mitigation measures must be evaluated on a case by case scenario.

A rigorous and well-planned monitoring programme is considered to be one of the most effective measures to validate the potential impacts identified and to verify the effectiveness of the mitigation measures proposed. It will provide important insights into the impacts of the wind energy facility at an early stage, thereby informing any necessary adjustments to what has previously been proposed. It will also allow for verifying if the mitigation measures are being effective or if they should be adjusted or interrupted and other more effective measures implemented. Mitigation of bat impacts on wind energy facilities should be site specific and embrace an evolutionary process throughout the development life (Hundt, 2012).

The continuation of the monitoring programme will contribute to: increased knowledge about bat communities in the Kudusberg WEF area and verification of the potential impacts identified during the pre-construction phase especially those concerning bat fatality caused by wind turbines. Although bat fatality may occur, based on pre-construction results, this is expected to affect mostly common and widespread species. However, if impacts identified in the subsequent phases of the project are more severe than expected additional mitigation measures may be evaluated, particularly if mortality occurs in levels that compromise the local population's viability. Nonetheless such measures should only be implemented if necessary and they should be carefully planned in order to find the best trade off in reduction of the collision risk and minimise the loss in revenue resulting from mitigation.

Decommissioning Phase

Vehicles to avoid very high sensitivity or no-go areas- and noise levels to be kept to a minim as far as possible.

Alternative/Updated Layouts

Regarding the available layout options that were provided for consideration in this Basic Assessment Report, it can be confirmed that all updated layouts, as well as the preferred options and all of their alternatives were thoroughly analysed to further inform the broader environmental authorisation process. The alternatives considered included:

- Access Roads: two alternatives to connect the public MN004469 road to the new wind farm road network between the turbines on the ridges. One of these roads is the western route (alternative 1) of approximately 4.6 km in length. The other is an eastern route (alternative 2) and is approximately 5.7 km in length.
- Construction Camps: three alternatives (including batching plants), of which one is located between turbines 43 and 47 (alternative 1), while another is located adjacent to the east of the MN4469 public road (south of construction camp 3) (alternative 2), and another also being located adjacent to the east of the MN4469 public road (but north of construction camp 2) (alternative 3).
- Substations: three alternatives (33/132kV), of which alternative 1 is located south of turbine 38 and north of turbine 39. Alternative 2 is located south of turbine 42 and north of turbine 33. Alternative 3 is located southeast of turbine 44.

After analysing all the above alternatives, it was found that all proposed layout options are deemed acceptable for development. It is subsequently our professional opinion that the project may proceed accordingly. It is however also important to note that this conclusion was drawn up with the information made available at the time of report compilation. Should any new layout alterations be proposed (differing from that which was previously analysed) in the interim, then it will be necessary for these changes to be re-assessed by the specialist prior to submission.

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# APPENDICES

# OTHER RENEWABLE ENERGY PROJECTS WITHIN A RADIUS OF 50 KM FROM THE PROPOSED KUDUSBERG WEF SITE

| DEA REFERENCE NUMBER | EIA PROCESS | APPLICANT | PROJECT TITLE | EAP | TECHNOLOGY | MEGAWATT | STATUS |
|---|---|---|---|---|---|---|---|
| **WIND PROJECTS** | | | | | | | |
| 14/12/16/3/3/2/967 | Scoping and EIA | Biotherm Energy (Pty) Ltd | Proposed 140 MW Esizayo Wind Energy Facility and its associated infrastructure near Laingsburg within the Laingsburg Local Municipality in the Western Cape | WSP/Parsons Brinckerhoff | Wind | 140 MW | Approved |
| East -14/12/16/3/3/2/962<br>West- 14/12/16/3/3/2/693 | Scoping and EIA | Biotherm Energy (Pty) Ltd | East: Proposed 140 MW Maralla West Wind Energy Facility on the remainder of the farm Welgemoed 268, the remainder of the farm Schalkwykskraal 204 and the remainder of the farm Drie Roode Heuvels 180 north of the town of Laingsburg within the Laingsburg and Karoo Hoodland Local Municipalities in the Western and Northern Cape Provinces | WSP/Parsons Brinckerhoff | Wind | 140 MW | Approved |

| DEA REFERENCE NUMBER | EIA PROCESS | APPLICANT | PROJECT TITLE | EAP | TECHNOLOGY | MEGAWATT | STATUS |
|---|---|---|---|---|---|---|---|
| | | | West: Proposed 140 MW Maralla West Wind Energy Facility on the remainder of the Farm Drie Roode Heuvels 180, the remainder of the farm Annex Drie Roode Heuvels 181, portion 1 of the farm Wolven Hoek 182 and portion 2 of the farm Wolven Hoek 182 north of the town of Laingsburg within the Karoo Hoodland Local Municipality in the Northern Cape Province | | | | |
| 12/12/20/1966/AM5 | Amendment | Witberg Wind Power (Pty) Ltd | Proposed establishment of the Witberg Wind Energy Facility, Laingsburg Local Municipality, Western Cape Province | Environmental Resource Management (Pty) Ltd / Savannah Environmental Consultants (Pty) Ltd | Wind | 140 MW | Approved |
| 12/12/20/1783/2/AM1 | Scoping and EIA | South Africa Mainstream Renewable Power Perdekraal West (Pty) Ltd | Proposed development of a Renewable Energy Facility (Wind) at the Perdekraal Site 2, Western Cape Province | Environmental Resource Management (Pty) Ltd | Wind | 110 MW | Under construction |
| 12/12/20/1783/1 | Scoping and EIA | South Africa Mainstream Renewable Power Perdekraal East (Pty) Ltd | Proposed development of a Renewable Energy Facility (Wind) at the Perdekraal Site 2, Western Cape Province | Savannah Environmental Consultants (Pty) Ltd | Wind | 150 MW | Approved |
| 14/12/16/3/3/2/899 | Scoping and EIA | Rietkloof Wind Farm (Pty) Ltd | Proposed Rietkloof Wind Energy (36 MW) Facility within the Laingsburg Local | EOH Coastal & Environmental Services | Wind | 36 MW | Approved |

| DEA REFERENCE NUMBER | EIA PROCESS | APPLICANT | PROJECT TITLE | EAP | TECHNOLOGY | MEGAWATT | STATUS |
|---|---|---|---|---|---|---|---|
| | | | Municipality in the Western Cape Province | | | | |
| TBC | BA | | Proposed Rietkloof Wind Energy Facility, Western Cape, South Africa | WSP | Wind | 140 MW | In progress |
| 14/12/16/3/3/2/826 | Scoping and EIA | Gunstfontein Wind Farm (Pty) Ltd | Proposed 200 MW Gunstfontein Wind Energy Facility on the Remainder of Farm Gunstfontein 131 south of the town of Sutherland within the Karoo Hooglands Local Municipality in the Northern Cape Province, south of Sutherland. | Savannah Environmental Consultants (Pty) Ltd | Wind | 200 W | Approved |
| 12/12/20/1782/AM2 | Scoping and EIA | Mainstream Power Sutherland | Proposed development of 140 MW Sutherland Wind Energy Facility, Sutherland, Northern and Western Cape Provinces | CSIR | Wind | 140 MW | Approved |
| Karusa - 12/12/20/2370/1<br>Soetwater -12/12/20/2370/2 | Scoping and EIA | African Clean Energy Developments Renewables Hidden Valley (Pty) Ltd | Proposed Hidden Valley Wind Energy Facility on a site south of Sutherland, Northern Cape Provinces (Karusa & Soetwater) | Savannah Environmental Consultants (Pty) Ltd | Wind | 140 MW each | Preferred bidders. Construction to commence in 2019 |
| 12/12/20/2370/3 | Scoping and EIA | African Clean Energy Developments Renewables Hidden Valley (Pty) Ltd | Proposed Hidden Valley Wind Energy Facility on a site south of Sutherland, Northern Cape Provinces (Greater Karoo)) | Savannah Environmental Consultants (Pty) Ltd | Wind | 140 MW | Approved |
| West -14/12/16/3/3/2/856<br>East - 14/12/16/3/3/2/857 | Scoping and EIA | Komsberg Wind Farm (Pty) Ltd | Proposed 275 MW Komsberg West Wind Energy Facility near Sutherland within the Northern and Western Cape Provinces | Savannah Environmental Consultants (Pty) Ltd | Wind | 140 MW each | Approved |

| DEA REFERENCE NUMBER | EIA PROCESS | APPLICANT | PROJECT TITLE | EAP | TECHNOLOGY | MEGAWATT | STATUS |
|---|---|---|---|---|---|---|---|
| | | | Proposed 275 MW Komsberg East Wind Energy Facility near Sutherland within the Northern and Western Cape Provinces | | | | |
| 12/12/20/1988/1/AM1 | Amendment | Roggeveld Wind Power (Pty) Ltd | Proposed Construction of the 140 MW Roggeveld Wind Farm within the Karoo Hoogland Local Municipality and the Laingsburg Local Municipality in the Western and Northern Cape Provinces | Savannah Environmental Consultants (Pty) Ltd | Wind | 140 MW | Preferred bidders. Construction to commence in 2019. |
| 14/12/16/3/3/2/807/AM1 | Scoping and EIA Amendment | Karreebosch Wind Farm (Pty) Ltd | Proposed Karreebosch Wind Farm (Roggeveld Phase 2) and its associated infrastructure within the Karoo Hoogland and Laingsburg Local Municipalities in the Northern and Western Cape Provinces | Savannah Environmental Consultants (Pty) Ltd | Wind | 140 MW | Approved |
| 14/12/16/3/3/2/900 | Scoping and EIA | Brandvalley Wind Farm (Pty) Ltd | Proposed 147 MW Brandvalley Wind Energy Facility North of the Town of Matjiesfontein within the Karoo Hoogland, Witzenberg and Laingsburg Local Municipalities in the Northern and Western Cape Provinces | EOH Coastal & Environmental Services | Wind | 140 MW | Approved |
| TBA | Scoping and EIA | Rondekop Wind Farm (Pty) Ltd | Proposed establishment of the Rondekop WEF, south-west of Sutherland in the Northern Cape | SiVEST SA (Pty) Ltd | Wind | 325 MW | In process |
| West 14/12/16/3/3/2/856<br>East 14/12/16/3/3/2/857 | Scoping and EIA | Komsberg Wind Farms (Pty) Ltd | Komsberg East and West WEF | Arcus Consulting Services (pty) Ltd | Wind | 140 MW each | |

| DEA REFERENCE NUMBER | EIA PROCESS | APPLICANT | PROJECT TITLE | EAP | TECHNOLOGY | MEGAWATT | STATUS |
|---|---|---|---|---|---|---|---|
| TBC | BA | ENERTRAG SA (Pty) Ltd | Proposed Development of the Tooverberg Wind Energy Facility and the associated grid connection near Touws River, Wester Cape Province) | SiVEST SA (Pty) Ltd | Wind | 140 MW | In process |
| **SOLAR PROJECTS** | | | | | | | |
| 12/12/20/2235 | BA | Inca Sutherland Solar (Pty) Ltd | Proposed Photovoltaic (PV) Solar Energy Facility on A Site South Of Sutherland, Within The Karoo Hoogland Municipality Of The Namakwa District Municipality, Northern Cape Province | CSIR | Solar | 10 MW | Approved |

# Bat Pre-construction Monitoring Report

bioinsight
SOUTH AFRICA

Prepared for:

Kudusberg Wind Farm (Pty) Ltd

# Kudusberg Wind Energy Facility

## Bat Pre-construction Monitoring Report

Pre-construction phase - 2015/2016

Final bat pre-construction monitoring Report

May 2018

LOOKING DEEP INTO NATURE

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## EXECUTIVE SUMMARY


The Kudusberg Wind Farm (hereafter referred to as "Kudusberg Wind Energy Facility" or "Kudusberg WEF") is a proposed 140MW wind farm development by Kudusberg Wind Farm (Pty) Ltd. The project is located in the border between the Western and Northern Cape, south of the R356 and west of the R354, at approximately 50km southwest of Sutherland. Bioinsight (Pty) Ltd. was appointed to conduct the bat pre-construction monitoring programme and compile the final bat pre-construction monitoring report in accordance with the best practice pre-construction monitoring guidelines.

The site is characterized by accentuated mountainous areas with very difficult human access and therefore in almost pristine natural conditions. Vegetation is adapted to the semi-arid conditions and harsh rocky conditions. Currently the area where Kudusberg WEF is proposed shows no signs of intense disturbance apart from the severe impacts on the veld caused by the three-year period of drought. Signs of human disturbance are characterised by the presence of a few farm dwellings and extensive sheep farming, mostly during the winter season.

Various techniques were implemented to study the local bat community and inform the assessment of potential risks from the construction and operation of the proposed project. The following techniques were applied at the proposed area for the wind energy development and its immediate surroundings: a desktop and bibliographic review, active acoustic detection surveys by means of vehicle-based transects, passive surveys by means of installation of five automatic acoustic detectors (rotor height and ground level in various habitats) and roost searches/inspection and monitoring.

The main results of the bat community pre-construction monitoring programme of the Kudusberg Wind Energy Facility are presented in this report resulting from the analysis of the surveys conducted between December 2015 and December 2016. These methodologies resulted in confirming the occurrence of four bat species and the identification of them. The confirmed species are the Egyptian free-tailed bat (*Tadarida aegyptiaca*), the Cape serotine (*Neoromicia capensis*), the Natal long-fingered bat (*Miniopterus natalensis*) and the Egyptian slit-faced bat (*Nycteris thebaica*). These are all "Near Threatened", or "Least Concern" species, according to the South African Red List (Friedmann & Daly, 2004b) and are considered sensitive species to the WEF development since three of them are considered to have medium to high risk of collision with wind turbines.

Results of the pre-construction bat monitoring indicate that the **bat activity at the proposed Kudusberg WEF area is in general low** considering the bat guidelines (Sowler et al., 2016).

According to pre-construction phase results, Kudusberg WEF is considered to be classified has having low sensitivity, but with some areas in particular with medium and high sensitivity due to the presence of specific features and habitat that may have an increased bat activity. These include the presence of potential roosts, as well as water lines which are important for bats, since they are likely to act as commuting routes, providing food resources likely to be associated to a higher bat activity. Impacts may also be magnified due to cumulative impacts caused by other wind energy developments proposed in the area.

It is recommended that the no-go areas identified for the bat community should be excluded from turbine placement and the areas considered as Medium sensitivity avoided as much as possible.

## TECHNICAL TEAM

The technical team responsible for the monitoring surveys and report compilation is presented in following table.

| Technician | Qualifications | Role on project |
|---|---|---|
| **Ricardo Branca** | BSc in Biology<br>MSc in Management and Conservation of Natural Resources | Data analysis<br>Report compilation |
| **Craig Campbell** | BSc in Conservation Ecology | Project Manager<br>Field observer |
| **Miguel Mascarenhas** | Graduation in Applied Biology to Plant Resources<br>MSc on Environmental Impact Assessment<br>Postgraduate studies on Geographic Information Systems | Technical coordination |
| **Nuno Salgueiro** | Graduation in Applied Biology to Plant Resources<br>Postgraduate on Environmental Sciences and Technologies | Technical coordination |
| **Sílvia Mesquita** | Graduation in Applied Biology to Terrestrial animal resources<br>Postgraduate Specialization in Nature Tourism | Technical coordination |
| **Helena Coelho** | Graduation in Biology<br>MSc in Marine and Coastal Sciences<br>PhD in Biology | Technical coordination |

Report compiled in May 2018.

## CITATION

Recommended citation when using this report as a reference: Bioinsight (2018). *Kudusberg Wind Energy Facility – Bat pre-construction monitoring* - Final Report. May 2018

## COPYRIGHT

# Specialist Declaration

## Professional registration

The Natural Scientific Professions Act of 2003 aims to "Provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith."

"Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-page 14)

Investigator: Miguel Mascarenhas (Pri.Sci.Nat)

Qualification: MSc on Environmental Impact Assessment – Univ. of Málaga (Spain)

Postgraduate on Business Management – INDEG Business School (Portugal)

Postgraduate on Geographic Information Systems – Univ. of Lisboa (Portugal)

BSc on Applied Biology to Plant Resources – Univ. of Lisboa (Portugal)

Affiliation: South African Council for Natural Scientific Professions

Registration number: 400168/14

Fields of Expertise: Ecological Science

Registration: Professional Member

## Declaration of Independence

The specialist investigator declares that:

- We act as independent specialists for this project.
- We consider ourselves bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- We 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 Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- We undertake to disclose any information, to relevant authorities, 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 Environmental Impact Assessment Regulations, 2006.

- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.

## Professional experience

Miguel Mascarenhas has been involved in environmental impact assessment and ecological monitoring for more than 10 years. He has experience with bat interactions with renewable projects, namely energy infrastructure for more than 6 years. During this period, he has been involved in impact assessments and ecological monitoring for over 100 projects, at least 50 of which involved onshore wind energy generation in South Africa. A full Curriculum Vitae can be supplied on request.

## Terms and Liabilities

- This report is based on a full pre-construction monitoring year, using the available information and data related to the site to be affected.
- The Precautionary Principle has been applied throughout this investigation.
- 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 amend 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 purpose without the specific and written consent from 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.

Signed on the 06th August 2017 by Miguel Rodolfo Teixeira de Mascarenhas in his capacity as specialist investigator.

Miguel Rodolfo Teixeira de Mascarenhas

## PREFACE: BATS AND WIND TURBINES

Wind power has grown exponentially in the last decade and it is one of the main alternative energy sources to fossil fuels (Gsänger & Pitteloud 2013). Its development in South Africa has just started and by the end of 2012 only 10 MW were installed in the country (Gsänger & Pitteloud 2013).

This energy source is not free from environmental impacts. The installation of wind energy facilities around the world has revealed issues regarding wildlife conservation (Eichhorn & Drechsler 2010), specially related to bird (Barrios & Rodríguez 2004; Drewitt & Langston 2008) and bat communities (Barclay, Baerwald & Gruver 2007; Arnett *et al.* 2011). Beyond the birds and bats, habitat loss affects all existing biodiversity (Kikuchi 2008).

The impact on natural populations is not only due to direct mortality caused by collisions and barotrauma[1], the latter affecting bats only (Baerwald *et al.* 2008). Impact on natural populations may also be caused by the disturbance effect, barrier effects and habitat loss (Drewitt & Langston 2006). These impacts, especially mortality, have become a source of major concern among a number of stakeholder groups (Erickson *et al.* 2002). Results obtained during several international monitoring studies indicated that wind farms were responsible for the decrease in population of some species' (Carrete *et al.* 2009), although many other studies revealed that these impacts were not important when compared to those originating from other man-made infrastructures (Drewitt & Langston 2008). Nevertheless, the potential for wind farms to affect bat populations should not be underestimated (Madders & Whitfield 2006).

Extensive research has been conducted internationally regarding bats and wind farms (Horn, Arnett & Kunz 2008; Baerwald & Barclay 2009; Arnett *et al.* 2011). However, not much research has been conducted on these matters in South Africa until recently. Research about seasonal and daily movement patterns of bat species and what the potential impacts of the development of multiple wind energy facilities and thousands of turbines across the country might be has been lacking and has begun only recently.

Also, information regarding bat distribution, seasonal and daily movements and migration is very limited for South African bat communities. Therefore, the need to evaluate the potential effects and interactions between bats and wind energy facilities is more relevant in South Africa, since the countries' experience in wind energy generation has been extremely limited to date and wind energy developments are currently under expansion. The potential impacts of wind turbines on South African bat communities is still largely unknown, due to a lack of research on bats in the country and a poor level of knowledge on bat abundance, locations of roost sites, and both foraging and migratory behaviour. Therefore, data collection and further investigations are needed. Pre- and post-construction monitoring at wind energy facilities can go some way to filling these gaps and promoting the sustainability of wind energy developments in South Africa.

[1] Barotrauma is used in the present report referring to bat deaths due to tissue damage to air- containing structures caused by rapid or excessive pressure change close to the rotating wind turbine blades surface. Death is usually caused by pulmonary barotrauma where lungs are damaged due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald *et al.* 2008).

Regarding the mitigation of those impacts, several studies have been conducted throughout time, testing for different hypothesis on ways to mitigate the potential negative effects of wind turbines on bats. Among the hypothesis tested can be included the modification of turbine design, adjustment of turbine placement and turbine layout, utilization of deterrents devices using radar or ultrasounds, removal of turbine lighting or curtailment measures. Though extensively studied, few of these measures have yet proved unanimously to produce any significant reduction in the negative impacts caused on bats (Berthinussen, Richardson & Altringham 2014). The utilization of ultrasound deterrent devices so far has proven to be effective in most situations, as well as the implementation of adequate curtailment measures (Arnett *et al.* 2011, 2013).

The Guidelines for Surveying Bats in Wind Farm Developments, now in its fourth edition (Sowler *et al*., 2016), were developed in collaboration with various contributors. These guidelines provide technical guidance for consultants to carry out impact assessments and monitoring programmes for proposed wind energy facilities, in order to ensure that pre-construction monitoring surveys produce the required level of detail for authorities reviewing environmental authorisation applications. These guidelines outline basic standards of best practice and highlight specific considerations relating to the pre-construction monitoring of proposed Wind Energy Facility sites in relation to bats.

# INDEX

# 1. INTRODUCTION

This report details the findings of the of the bat pre-construction monitoring surveys conducted at the proposed Kudusberg Wind Energy Facility. (hereafter referred as Kudusberg WEF), between December 2015 and December 2016.

The main objective of this report is to provide a detailed characterisation of the bat communities and to provide a general year-round evaluation during the pre-construction phase. The purpose of the bat monitoring was to characterise bat communities within the study area and allow for the establishing of a baseline scenario for the pre-construction phase, and identifying potential impacts caused by the construction and operation of the Wind Energy Facility on bat communities.

## 1.1. Scope of work and Objectives of the pre-construction monitoring report

The main objective of the pre-construction bat monitoring is to provide a detailed characterisation of the bat communities and to provide a general year-round evaluation during the pre-construction phase. The purpose of the bat monitoring was to characterise bat communities within the study area, and establishing a baseline scenario for the pre-construction phase, and inform identification potential impacts caused by the construction and operation of the Wind Energy Facility on bat communities.

The specific objectives of the pre-construction bat monitoring programme are:

a) Establish the pre-impact baseline reference and characterization of the bat communities occurring within the development area (e.g. species occurrence, activity and distribution);

b) Identify the bat species or groups that are more susceptible to potential impacts (sensitive species) during the construction and operation phase of the Wind Energy Facility;

c) Assess the use of roosts in the Wind Energy Facility development footprint and its immediate vicinity;

d) Outline sensitive areas and/or No-Go areas within the WEF if necessary;

e) Inform the Bat Specialist Impact Assessment Report (for identification and assessment of potential impacts of the proposed turbine layout of the Wind Energy Facility on the bat community);

f) Propose measures to avoid or, if unavoidable, mitigate, compensate and monitor, identified potential impacts.

In order to achieve the objectives of the pre-construction bat monitoring and impact assessment, the bat monitoring campaign was designed in line with the requirements listed in the 3rd Edition of the "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments" (Sowler et al. 2014). However, when later information was released, in the form of the 4th Edition of these guidelines (Sowler et al. 2016), all relevant information/recommendations were considered/implemented as far as possible.

To accomplish the above-mentioned objectives, the monitoring work of the community of bats included the following tasks:

- Sampling of ultrasound in the Wind Energy Facility site. This task provided data achieving Objectives a) and b);

- Inventory, search, inspection and monitoring of roosts in the area surrounding the Wind Energy Facility. This task provided data that achieved Objective c), Objective d) and Objective e).

The implementation of a similar monitoring programme during operation phase of the development should include bat carcass searches around the turbines and determination of the searcher detection efficiency and carcass removal (by scavengers or decomposition) which will provide data to quantify bat fatalities associated with the Wind Energy Facility and determine the species affected.

The results of this study will contribute to the establishment of the baseline situation in order to better assess the potential impacts for the relevant local bat communities and allow the accomplishment of all the objectives stated above.

The implementation of similar monitoring protocols and the same sampling locations during the subsequent phases of the project (for a minimum of two years after the facility becomes operational) will be very important to allow comparison between project phases. It will allow referring to the baseline scenario and implement a Before-After Control-Impact (BACI) analysis as proposed by international references (Atienza *et al.* 2011; Strickland *et al.* 2011; USFWS 2012). Only by means of this analysis will be possible to validate the potential impacts identified, to determine if other impacts are occurring and adequately adjust any mitigation measures proposed at this stage (or propose new and more appropriate ones if necessary).

All the above methodologies will enable Objective f) to be achieved.

## 1.2. Terms of reference

The following assessment was conducted according to the specialist terms of reference:

- Conduct a review of national and international specialised literature and experiences regarding bats and wind farms;
- Conduct a field investigation to determine the bat community present in the study area, describe the affected environment and identify species of special concern for the proposed Wind Energy Facility. Although the general community is considered, this study has special focus on the species considered to be more sensitive to wind energy development related impacts;
- Describe the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
- Describe and evaluate the environmental issues and potential impacts (including direct, indirect, cumulative impacts and residual risks) identified of the proposed project and identified alternatives in terms of the nature, the causes of the effect, what will be affected and how it will be affected;
- Identify any aspects which are conditional to the findings of the assessment which are to be included as conditions of the Environmental Authorisation;
- Identify and map sensitive and “no-go” areas within and around the proposed Wind Energy Facility site;
- Identify any gaps in knowledge as well as any areas that would constitute “acceptable and defendable loss”;

- Provide a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts and a reasoned opinion as to whether the proposed project should be authorised;
- Provide recommendations regarding any mitigation measures and management to be included in the Environmental Management Programme to be submitted with the Final Environmental Impact Assessment Report;
- Propose a suitable monitoring programme for the evaluation of the impacts expected during the operational phase of the development, if considered necessary.

## 1.3. Legal framework

The Kudusberg WEF is subject to the requirements of the National Environmental Management Act 104 of 1998. The EIA Regulations of December 2014 require that an EIA process must be undertaken for the development of the proposed project with strict timeframes.

In line with the principles of NEMA, impacts on the environment (and in this case, bats specifically) must be determined and assessed, and recommendations made on how to avoid, as far as possible, mitigate and manage negative impacts on bat species caused by human-made infrastructures (e.g. wind turbines and associated infrastructures). In this context, the bat assessment considers all bat species that may occur within the site, an assessment of potential impacts as well as the avoidance of impacts (if possible).

It is considered best practice for bat monitoring to be undertaken on WEF sites, thereby striving for the reconciliation of wind energy facilities and bats, with the aim of evaluating and minimising any potential impacts. This can be achieved by fulfilling the requirements outlined by the most recent version of the "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments" (Sowler *et al.* 2016).

There are no permit requirements dealing specifically with bats in South Africa. However, legislation which applies to bats includes the following:

**National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)**

Sections 2, 56 and 97 are of specific reference. Section 97 considers the Threatened or Protected Species Regulations: The Act calls for the management and conservation of all biological diversity within South Africa.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected.

NEM:BA also deals with endangered, threatened and otherwise controlled species, under the ToPS Regulations (Threatened or Protected Species Regulations). The Act provides for listing of species as threatened or protected, under one of the following categories:

- Critically Endangered: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.

- Vulnerable: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- Protected species: any species that is of such high conservation value or national importance that national protection is required. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

A ToPS permit is required for any activities involving any ToPS-listed species. A number of bat species are listed as critically endangered, endangered, vulnerable and protected in terms of Regulations published under this Act.

#### Nature and Environmental Conservation Ordinance No. 19 of 1974; Schedule 5:

Although the primary purpose of this Act is to provide for the amendment of various laws on nature conservation, it also deals with a number of other issues. This Act lists protected wild animals, including all bats except Fruit Bats of the family PTEROPODIDAE. A permit is required for any activities which involve endangered or protected flora and fauna.

#### IUCN Red List of Threatened Species

The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species ranks plants and animals according to threat levels and risk of extinction, thus providing an indication of biodiversity loss. This has become a key tool used by scientists and conservationists to determine which species are most urgently in need of conservation attention. In South Africa, a number of bats are listed on the IUCN Red List.

#### Convention on Biological Diversity

This Convention aims to protect and maintain biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits from the use of genetic resources. The Convention intends to enforce the concept of sustainable use of resources among decision-makers and that these are not infinite. It also offers decision-makers guidance based on the precautionary principle. South Africa is a Party to this convention since 1993.

#### Convention on the Conservation of Migratory Species of Wild Animals (CMS)

CMS is a treaty of the United Nations Environment Programme (UNEP), which provides a global platform for the conservation and sustainable use of migratory animals and their habitats. South Africa is a Party State since 1991. CMS includes the States through which migratory animals pass (Range States), and establishes the legal foundation for internationally coordinated conservation measures throughout a migratory range. Besides establishing obligations for each State joining the Convention, CMS promotes concerted action among the Range States of many of these species.

The CMS has two Appendices: Appendix I pertains to migratory species threatened with extinction and Appendix II that regards migratory species that need or would significantly benefit from international co-operation. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.

## 1.4. Proposed Wind Energy Facility and study area

Kudusberg WEF is being proposed and developed by Kudusberg Wind Farm (Pty) Ltd for the installation of wind turbine generators and associated infrastructure. The project is located on the border between the Western and Northern Cape, south of the R356 and west of the R354, at approximately 50km southwest of Sutherland (Figure 1). The WEF includes the proposed implementation of 98 wind turbines (layout to be refined during EIA process), however no information regarding additional project infrastructures (e.g. turbine specifications, road access, power lines, substation location) has been provided at this stage. The development comprises an area of approximately 11000 hectares in extent and is expected to be able to produce at least 140 MW.

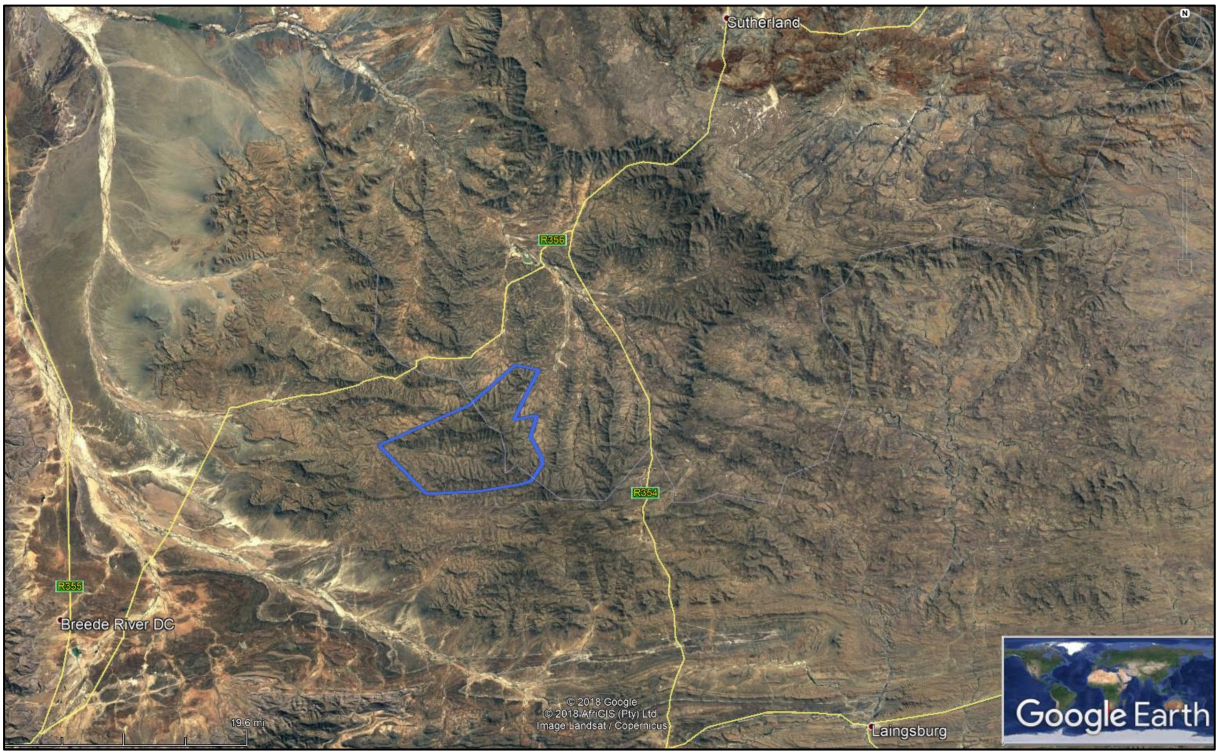



**Figure 1 – Location of the proposed Kudusberg Wind Energy Facility (source: Google Earth).**

### Vegetation unit types and bat "micro-habitats"

The site falls within the Succulent Karoo and the Fynbos biome, with the occurrence of two main vegetation types (Mucina & Rutherford 2006) (Figure 2):

- **Central Mountain Shale Renosterveld** (Fynbos biome): associated with areas of slopes and broad ridges where the vegetation is predominantly tall shrubland and renosterveld composed by non-succulent karoo shrubs and a rich flora in rockier areas.
- **Koedoesberge-Moordenaars Karoo** (Succulent Karoo biome): this type of vegetation is found in slightly undulating to hilly landscape and is characterized by low succulent scrub with interspersed taller shrubs.

Rain may occur through the year though it is more likely during winter season – two rainfall peaks during the year: one in March and the other in May – August.

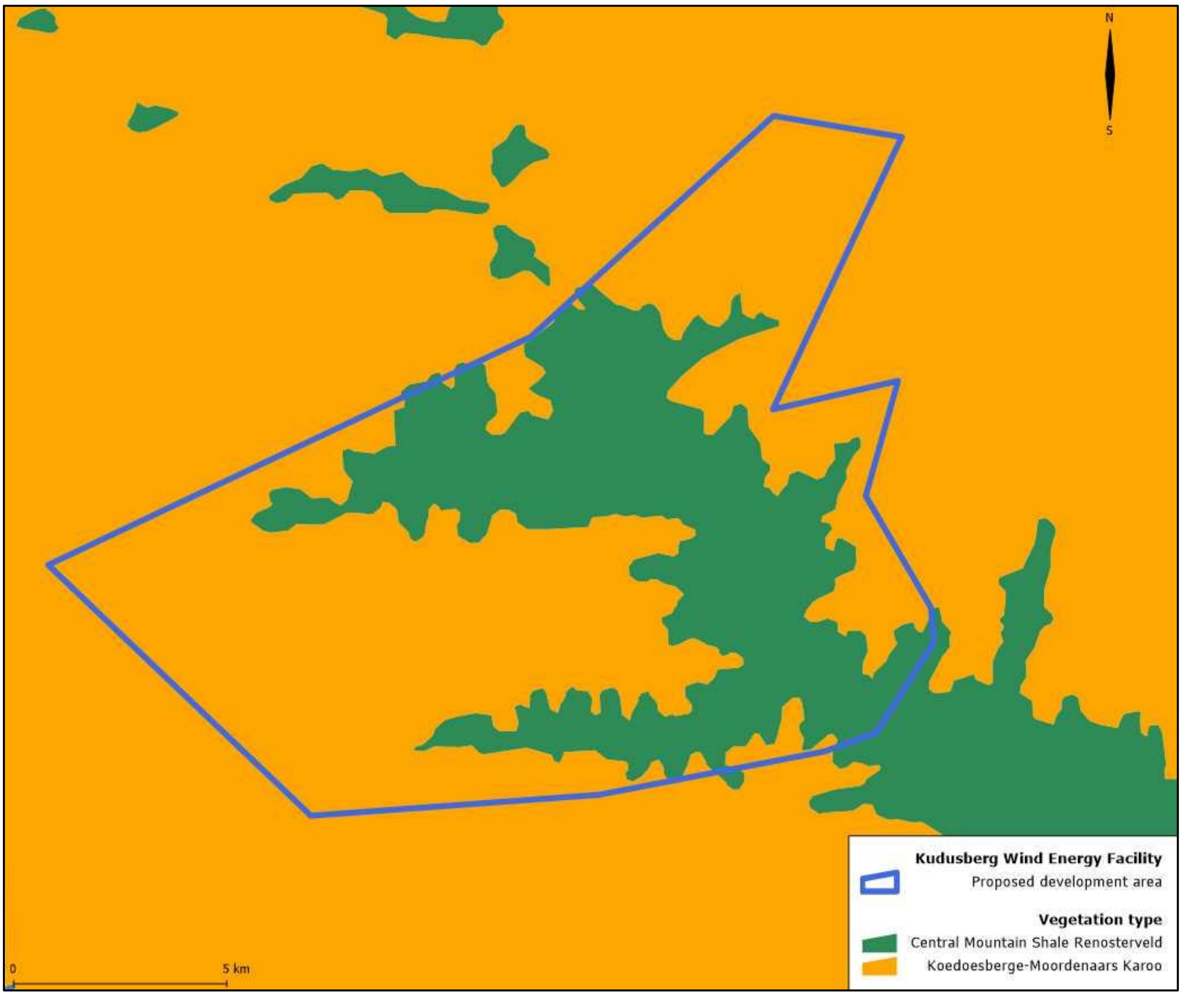
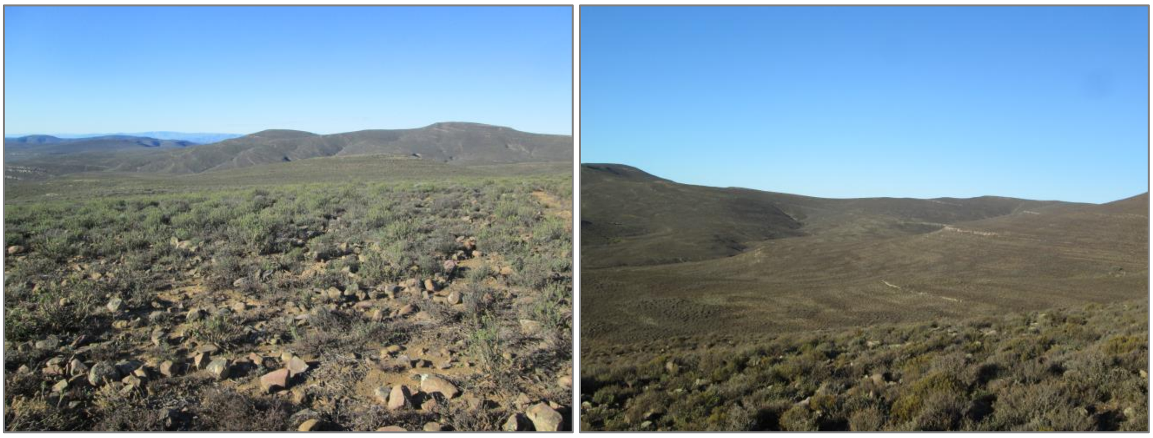



**Figure 2 - Vegetation units present within the Kudusberg WEF and surrounding area according to Mucina & Rutherford, (2006) updated to version 2012.**

As aforementioned the site is characterized by accentuated mountainous areas with very difficult human access and therefore in almost pristine natural conditions. Vegetation is adapted to the semi-arid conditions and harsh rocky conditions. Currently the area where Kudusberg WEF is proposed shows no signs of intense disturbance (Photograph 1). Signs of human disturbance are characterised by the presence of a few farm dwellings and extensive sheep farming, mostly during the winter season. A more detailed analysis of micro-habitats relevant for bats is shown in section 3.1.



**Photograph 1 - General framework of the proposed Kudsberg WEF: Mountainous area with rocky features and scrubby vegetation.**

## Bat micro-habitats

Vegetation structure is a key determining factor in bat distribution. The proposed Kudusberg WEF site is characterized by accentuated mountainous areas which is located between two vegetation types and major biotopes: the Fynbos biome and the Succulent Karoo biome. Both are characteristic of higher altitudes and are present both in the bottom and top of the mountains. Within the proposed Kudsberg WEF site the area is mostly comprised of natural vegetation that is adapted to the hot and seasonal climate. This type of habitat is generally associated with the presence of several bat species that occur in these arid and semi-arid habitats. Such species include the Egyptian slit-faced bat (*Nycteris thebaica*), the Lesueur's wing gland bat (*Cistugo lesueuri*), the Cape horseshoe bat (*Rhinolophus capensis*), or the Egyptian free-tailed bat (*Tadarida aegyptiaca*). Other species may be present in the area not for the vegetation structure but for the terrain features, which include mountains, cliffs and ridges. The Long-tailed serotine (*Eptesicus hottentotus*), the Natal long-fingered bat (*Miniopterus natalensis*) and the Temminck's myotis (*Myotis tricolor*) are examples of species which can be present in these areas due to their preference for roosting in caves and cracks in rocks (Monadjem *et al.* 2010).

Potential bat micro habitats identified at the site during the field visits and desktop analysis of the area are described below.

## Water bodies

The study area is not abundant in water sources at present, and therefore it is expected that the few water features present will have a high attraction factor for bats, especially during the wet season. Their importance is not restricted only to water availability but also to insect abundance due to the associated vegetation present.

## Natural vegetation

The proposed development area is occupied mainly by natural vegetation. The vegetation provides a very sparse coverage of the soil and does not provide much refugee to any bat species. It is however a good hunting ground for open-air foragers such as the Egyptian free-tailed bat. Natural shrubby vegetation is present both at the top of the mountain ridges and in the slope and flatter plain areas (Photograph 2).

**Photograph 2 - Example of area with natural vegetation within the Kudusberg WEF proposed wind farm portions.**

### Buildings

Both the WEF site and the surrounding area is mostly comprised of areas of natural vegetation, with low presence of man-made infrastructures (Photograph 3). These locations as well as others with similar characteristics are likely to be used by bat species with less restrictive roosting ecological requirements such as the Cape serotine or the Egyptian slit-faced bat.

**Photograph 3 - Man-made infrastructures with suitable characteristics for roosting of bat species.**

## Trees

Vegetation taller than shrub is very scarce in the study area and is generally associated with water lines, as shown in Photograph 4.These locations may have two different utilizations by the different bat species potentially present in the area: they may be used as roosts by tree-dwelling or be used as feeding roosts during the night by other bat species, such as the Geoffroy's horseshoe bat, which then roost during the day at separate locations (usually caves or mines).

**Photograph 4 – Scattered trees present in shrubland areas.**

## Conservancy areas

There are no nature conservancy areas, to our present knowledge, within a 30km radius of the proposed development area. The proposed Kudusberg WEF site is located approximately 55km south-east of the Tankwa Karoo National Park (Figure 3). Considering that this area is located at a considerable distance from the proposed WEF area it is not expected that the species using the National Park are affected in any way by the implementation of this project. Nonetheless the analysis of the bat species presents in the area, which are of similar nature to the Kudusberg WEF proposed area, may provide indication on the suite of species likely to be present in the study area.

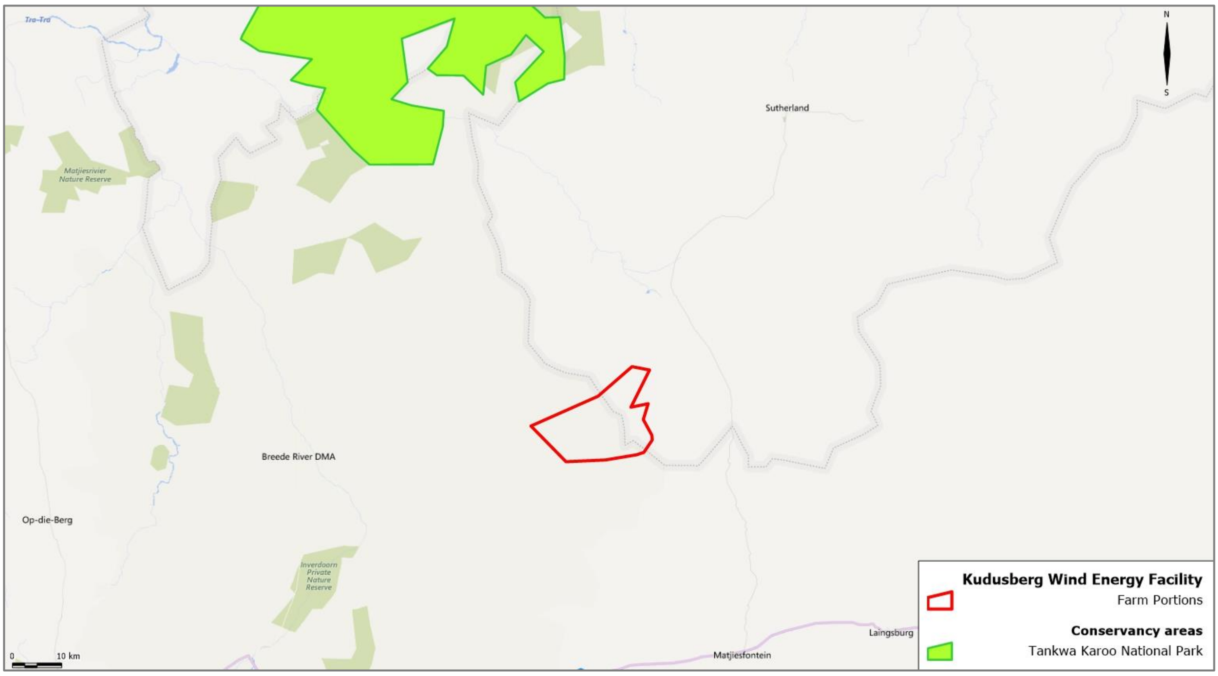



**Figure 3 – Location of the Kudusberg WEF in relation to the surrounding conservancy areas (background image source: Virtual Earth Street Map).**

## Cumulative impacts

The main known activities or projects, relevant for the cumulative impacts analysis, known in the broader area of the proposed Kudusberg WEF are mostly the presence of additional power lines and other proposed wind energy facilities.

The presence of additional wind energy facilities has the potential to exacerbate the impacts for the general bat species in the area.

Potential cumulative impacts may materialise if the bats species using the Kudusberg WEF also use the aforementioned sites and, in that case, they will be subjected to an increased reduction in available habitat availability and increased collision risk with the wind turbines and associated infrastructure. If this happens fatality occurring at each of these sites should be evaluated together as impacts are most likely being caused over the same populations.

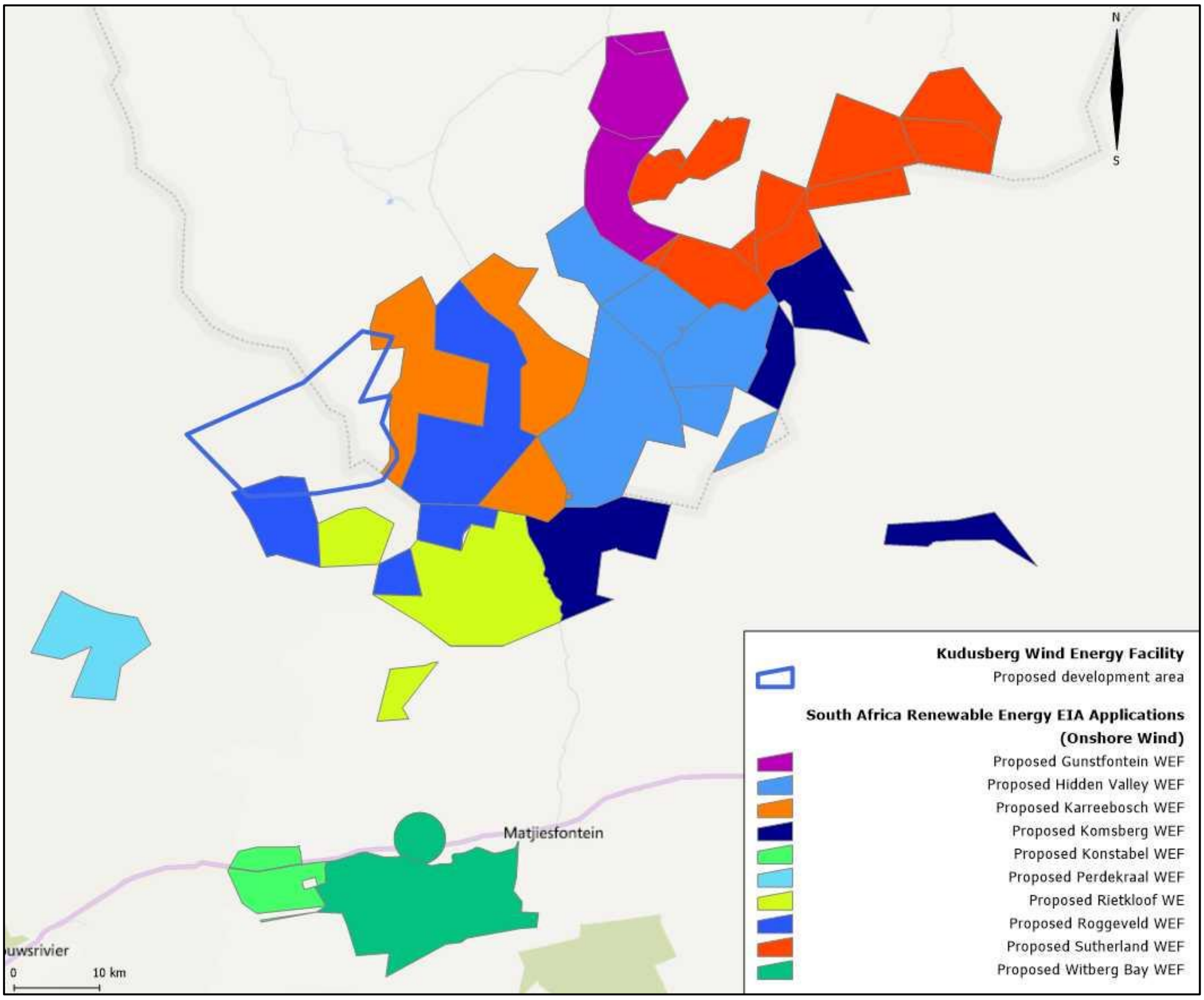



**Figure 4 – Onshore Renewable Energy projects currently proposed or approved in the surrounding area of the Kudusberg WEF site (according to the REEA most recent available dataset – 2017 4th Quarter).**

## 1.5. Summary of the Bat Scoping Assessment

The Bat Specialist Impact Assessment Scoping Report included a desktop study and field monitoring limited in time. The preliminary site visit allowed the confirmation of 2 species of bats by acoustic analysis of bat ultrasound calls recorded: Egyptian free-tailed bat (*Tadarida aegyptiaca*), and Cape serotine bat (*Neoromicia capensis*). A desktop analysis and further validation of relevant micro-habitats and roosts present on site allowed to determine that the general proposed development area is of low sensitivity regarding the bat community. Some specific areas were identified as having a high sensitivity, including rivers and water drainage lines and water bodies. A 200m buffer zone around these water features were applied and subsequently considered as sensitive (Figure 5). These areas should be avoided from the preliminary wind turbine sitting and, where technically possible, also from associated infrastructure layout.

The proposed Kudusberg Wind Energy Facility may have the following potential negative impacts on the local bat community: disturbance of bats and their habitat as well as roost destruction during the construction and maintenance phases of the facility and its associated infrastructure; displacement of bats from the area; bat collision and fatality with turbine blades during operation of wind turbines. These impacts are expected to be of low to medium significance (specifically bat fatality caused by wind turbines); however, more information should be gathered in order to provide an impact assessment with a higher degree of certainty.

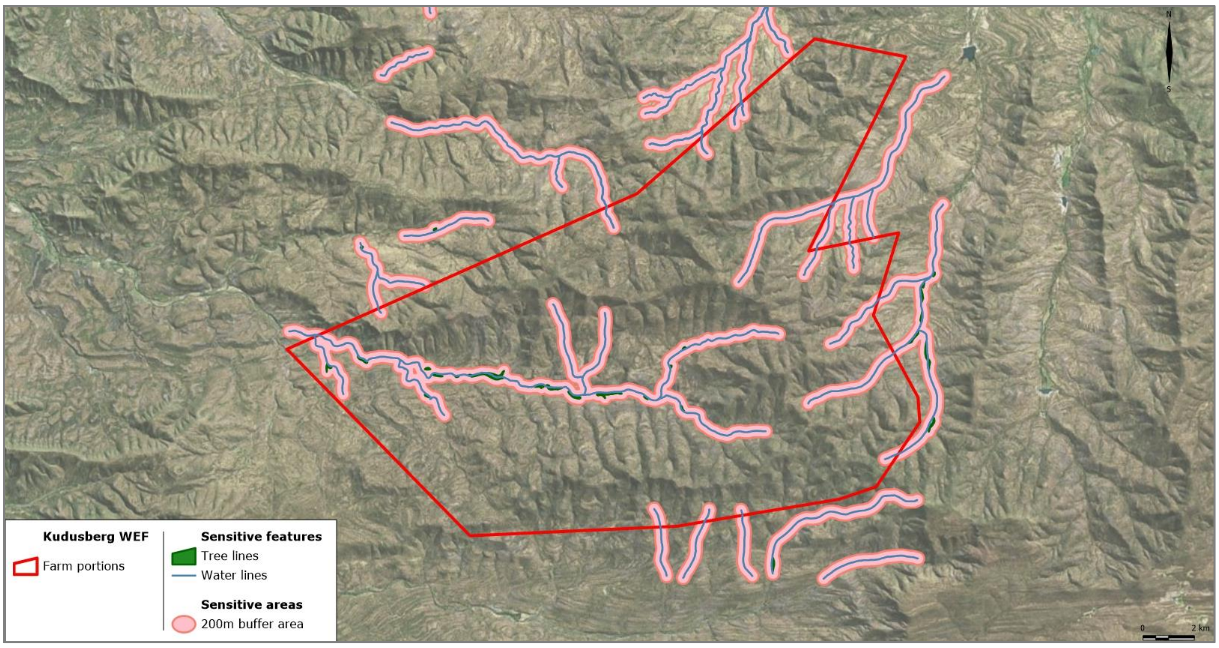



**Figure 5 – Sensitivity mapping of the high sensitivity areas for bats at the proposed Kudusberg WEF during scoping phase.**

# 2. MONITORING PROGRAMME DESCRIPTION

The bat monitoring programme is in line with the requirements outlined by the 4th Edition of the "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments" (Sowler *et al.* 2016).

The following sections describe the main aspects of the implemented monitoring programme, with regards to the experimental design and techniques used to collect the data in the field.

## 2.1. Desktop preparatory work

Prior to the initiation of field surveys, a desktop survey was conducted to compile the best information possible, in order to provide a better evaluation of all conditions present within the study area. Therefore, the available data sources (Table 1) were consulted to assess which species could occur in the different habitat occurring at the Kudusberg WEF study area. The following steps were taken:

- Based on a desktop review and considering all literature references available (Table 1), a list of all bat species with potential to occur within or in close proximity to the site was compiled.
- Literature references and local farmers were consulted concerning any available information regarding presence of known roosts in the vicinities of the proposed site. Literature review was conducted as well regarding wind developments in South Africa or similar environments.
- All listed species were assessed at a national level in terms of endemism, population trend, habitat preferences and conservation status.
- All listed species were classified in terms of probability of occurrence within the site, considering several criteria evaluated in conjunction with one another, such as historical confirmation of species in the area, presence of known roosts and presence of suitable habitats, etc.
- The vulnerability of these species to potential impacts caused by wind energy developments (in terms of potential collision risks with wind turbines) was evaluated according to the most recent "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments", the 4th Edition" (Sowler *et al.,* 2016)
- A short list of sensitive species was identified to which the assessment and monitoring programme should pay special attention to. Sensitive species were identified by means of a specific structured decision process (Figure 6) based each species' conservation status, vulnerability to collision and ecological characteristics such as migratory behaviour.
- A desktop study, based on all the available information such as topographical maps of South Africa, Google™ Earth imagery, and Geographical Information System software was conducted for a preliminary evaluation of the area. A reconnaissance field visit was conducted in February 2016 to achieve an initial understanding of its characteristics.
- It is important to characterise the study area in terms of the vegetation and habitat present on site. The method used for vegetation classification is that developed by Mucina & Rutherford (2006). At a micro level, more important than the biomes, is the presence of specific structures which shaped the local occurrence and bat distribution within the site. Bat abundance and movement are related to vegetation features such as tree-lined avenues, hedges and other relevant features which could potentially be used

as roosts (open water bodies, cliff faces, buildings with accessible roofs or attics etc.). It is therefore essential to characterise the study area in these terms. Google™ Earth imagery and most importantly, field work, was used to identify the available micro-habitats on site.

Table 1 includes, but is not limited to, the list of data sources and reports consulted and taken into consideration, for the compilation of this report, in varying levels of detail. Other references were consulted for particular issues (these are detailed in section 6).

**Table 1 – Main data sources consulted for the evaluation of bat species present in the study area (international references and guidelines used to support the methodological approach and resulting analysis are also presented).**

| Type | Name | Reference | Detail of information |
|---|---|---|---|
| Data sources | Bats of Southern and Central Africa | (Monadjem *et al.* 2010) | National level |
| | African Chiroptera Report 2013 | (ACR 2012) | National level |
| | Caves and Caving in the Cape | http://www.darklife.co.za/Caves/ | Regional level |
| | Endangered Wildlife Trust | www.ewt.org.za | Regional level |
| | Bat fatality at a wind energy facility in the Western cape, South Africa | (Aronson, Thomas & Jordaan 2013; Doty & Martin 2013) | Regional level |
| | The Vegetation of South Africa, Lesotho and Swaziland | (Mucina & Rutherford 2006) | National level |
| | Global List of Threatened Species | (IUCN 2013) | International level |
| | Renewable Energy Application Mapping – Report version I | (CSIR 2013) | National level |
| Guidelines and Other international references | Wind energy development and Natura 2000 | (European Commission 2011) | International level Methodological approach and analysis |
| | Directrices para la evaluación del impacto de los parques eólicos en aves y murciélagos | (Atienza *et al.* 2011) | International level Methodological approach and analysis |
| | Comprehensive Guide to Studying Wind Energy/Wildlife Interaction | (Strickland *et al.* 2011) | International level Methodological approach and analysis |
| | U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines | (USFWS 2012) | International level Methodological approach and analysis |
| | South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments | (Sowler & Stoffberg 2012) | Methodological approach |
| | Bat surveys: Good practice guidelines, 2nd edition | (Hundt 2012) | Methodological approach |
| | Guidelines for consideration of bats in wind farm projects | (Rodrigues *et al.* 2008) | International level Methodological approach and analysis |
| | Good Practice Wind Project | www.project-gpwind.eu/ | International level Methodological approach and analysis |

### Species occurrence

The probability of occurrence of bat species in the study area was evaluated according with several criteria, as described below. To evaluate species occurrence were used distribution maps published in South African publications (Monadjem *et al.* 2010; ACR 2013). In this evaluation, species that are known not to occur in the study area were not considered. The probability of occurrence of bat species in the Kudusberg proposed WEF study area (within 50 km buffer from the WEF) was characterised as:

- **Confirmed** – the species was confirmed using the area in past project reports (feasibility study, scoping, etc), either acoustically or by means of morphological identification;
- **High probability** – the species has been historically confirmed on, or near the site within the last 20 years; and the habitat present on site is suitable for the species preferences;
- **Moderate probability** – the species is within the higher probability modelled distribution of potential occurrence according to Monadjem *et al.* (2010); and the species has been historically confirmed in the area within the past 20-50 years; and/or the habitat is adequate for the species requirements;
- **Low probability** – the species is within the lower probability modelled distribution of potential occurrence according to Monadjem *et al.* (2010); and the species has been historically confirmed in the study area more than 50 years ago; and/or the habitat present in the site is adequate for the species preferences.

The use of two sources of information (ACR, 2013 and Monadjem *et al*., 2010) may cause some differences in the evaluation on the probability of a species occurrence, since ACR (2013) presents a compilation of records of the species and Monadjem *et al.* (2010) presents a modelled distribution of the species based on several factors, such as previous records and habitat conditions. Regardless, both sets of information were considered and evaluated according with the type of biotopes present at the Kudusberg WEF study area and a **list of species** was assembled for the site according to each species' probability of occurrence. At the final stage, the probabilities of occurrence of the species were updated with data from the most recent Scoping Desktop Study (Bioinsight 2016). Species that are known not to occur in the study area were not considered and the likelihood of occurrence was adjusted according to specialist expertise and knowledge.

### Definition of surrogate species

An evaluation of the potential impacts of the development over bat species was made in order to select the species that could be most affected by it – hereafter considered **sensitive species**. These were identified by implementing a structured decision process to species with present moderate to high probability of occurrence in the area (species with low probability of occurrence were not considered for the sensitive species selection process). This process (Figure 6) is based on several factors related to the species' physiology and biology are considered, such as: conservation status (Friedmann & Daly 2004a; IUCN 2016), vulnerability to collision with wind turbines (Strickland *et al.* 2011), and other ecological characteristics such as migratory behaviour.

The analysis of sensitive species, will add valuable information on these particular assessments, whether it be cumulative effects, turbine micro sitting or post-construction Before-After Control-Impact assessment.

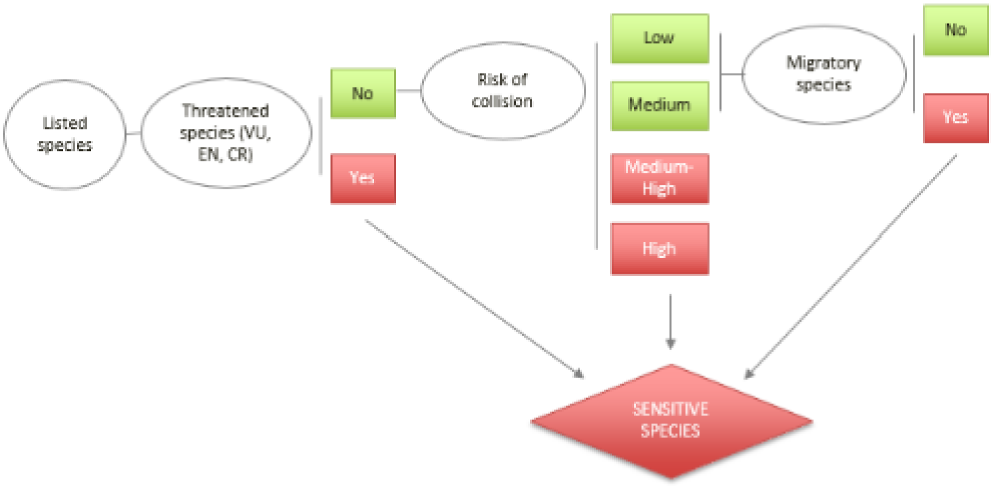



**Figure 6 - Decision process scheme used to define sensitive species. A species is considered sensitive when by following its characteristics through the scheme it ends in a red square. On the other hand, if it ends in a green square it will not be considered sensitive to the proposed Kudusberg WEF.**

## 2.2. Field Surveys

Surveys undertaken during the pre-construction bat monitoring programme included the use of several field techniques, adjusted to the specific characteristics of the study area. The pre-construction bat monitoring programme, implemented across a 12-month period, from December 2015 to December 2016, included the following:

- **Active acoustic bat surveys**, by means of vehicle-based transects and point-based monitoring with an ultrasound automatic bat detector;
- **Passive acoustic surveys** at ground level and rotor height with ultrasound automatic bat detectors;
- **Roost searches and inspections** - any structure thought to be used as a roosting location by bats was inspected, following the "South African Best Practice Guidelines for Surveying Bats in Wind Farm Developments" that were available at the time that the pre-construction monitoring programme initiated (Sowler & Stoffberg, 2014).

### 2.2.1. Sampling Period

The bat community monitoring programme started in December 2015 at Kudusberg proposed WEF development area. The area was surveyed for a total of 12 months, covering all seasons (Table 2) in order to comply with the requirements of the "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments" (Sowler *et al.* 2016).

Passive detection was conducted continually during a 12-month period (refer to section 2.2.4.2 for more details) and active detection surveys were conducted twice per season, starting in January 2016, covering all year seasons (refer to section 2.2.4.2).

For passive monitoring, four automated detection recorded continuously in order to achieve a total of 100% and a minimum of 75% of the total nights of the year, as recommended on the guidelines (Sowler *et al.* 2016).

The detectors coverage along the year is presented in Table 3. Three passive detectors were installed in the first reconnaissance survey and have been running since the 17th December 2015 (PQKDA01-10m, PQKDA01-90m, PQKDA02-10m, PQKDA02-90m, PQKDA03-10m and PQKDA03-90m) and the other two (PQKDA04-10m, PQKDA04-90m, PQKDA05-10m, PQKDA05-90m) were installed in 4th February 2016. Overall, 77,13% of the nights were surveyed by automated detection.

**Table 2 – Schedule of bat monitoring fieldwork at the Kudusberg proposed WEF site (* - not undertaken).**

| Year | Season | Survey | Bat Monitoring method | |
|---|---|---|---|---|
| | | | Active ultrasound detection & Roost search and monitor | Passive ultrasound detection |
| 2015 | Summer | December | * | Continuous |
| 2016 | | January | 13rd to 22nd January | Continuous |
| | | February | 3rd to 13rd February | Continuous |
| | Autumn | March | * | Continuous |
| | | April | 1st to 11st April | Continuous |
| | | May | 17th to 27th May | Continuous |
| | Winter | June | 21st to 28th June | Continuous |
| | | July | * | Continuous |
| | | August | 15th to 26th August | Continuous |
| | Autumn | September | 6th to 15th September | Continuous |
| | | October | 26th September to 5th October | Continuous |
| | | November | * | Continuous |

**Table 3 - – Percentage of the total nights covered by automated bat detection per detector. *- Incomplete month**

| Detector | Dec 2015* | Jan 2016 | Feb 2016 | Mar 2016 | Apr 2016 | May 2016 | June 2016 | July 2016 | Aug 2016 | Sep 2016 | Oct 2016 | Nov 2016 | Dec 2016* | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PQKDA01 | 48% | 100% | 100% | 100% | 100% | 100% | 27% | 16% | 100% | 100% | 100% | 57% | 10% | 79,83% |
| PQKDA02 | 45% | 100% | 100% | 100% | 37% | 45% | 100% | 100% | 100% | 100% | 100% | 57% | 39% | 85,25% |
| PQKDA03 | 42% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 81% | 0% | 48% | 89,25% |
| PQKDA04 | 0% | 0% | 90% | 13% | 67% | 45% | 87% | 68% | 100% | 100% | 100% | 57% | 13% | 61,66% |
| PQKDA05 | 0% | 0% | 90% | 23% | 73% | 100% | 100% | 100% | 100% | 100% | 100% | 40% | 10% | 69,66% |
| | | | | | | | | | | | | | | **77,13%** |

### 2.2.2. Weather conditions

Active surveys were conducted generally under mild weather conditions, with average temperatures of 17,7 °C, reaching highest temperatures in February (31 ºC) during summer survey. On the other hand, lowest temperatures were recorded during winter reaching 10 ºC. Wind speed conditions registered at ground level during the surveys were generally below 5.0 m/s. No precipitation was recorded during none of the active surveys.

At rotor height level, data from the met mast was analysed and evaluated in Figure 7. Temperature is lowest during winter (reaching 12 ºC in July 2016 for example) and summer months are the warmest. Average night wind speed was steady during most of the survey period between 7 and 9 m/s.

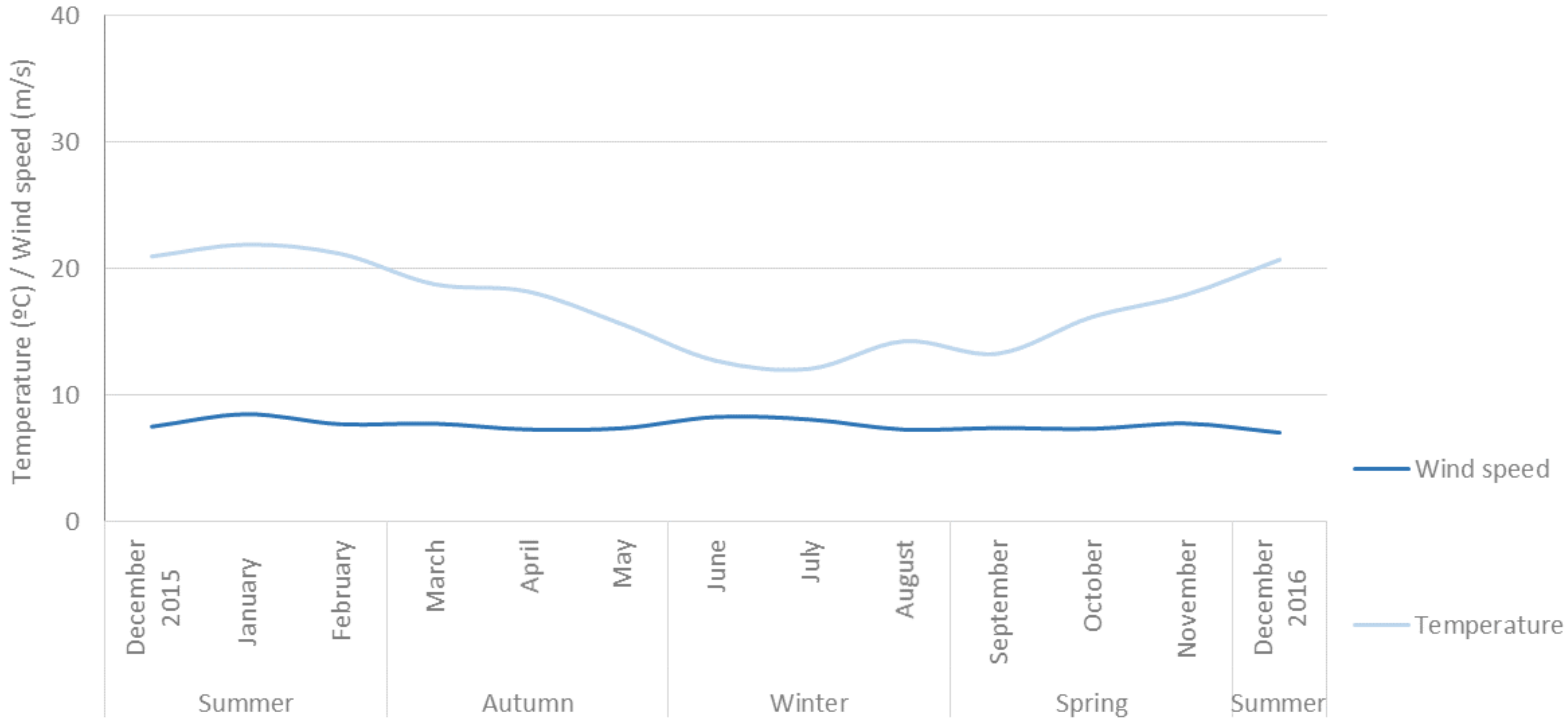



**Figure 7 - Average weather conditions (air temperature and wind speed at rotor height level) during 2015 and 2016 surveyed nights at Kudusberg WEF.**

### 2.2.3. Evaluated Parameters

To characterise the bat community present in the study area, the following parameters where evaluated for the Kudusberg WEF site:

- Species Richness;
- Activity Index;
- Location and use of roosts within and around the site;
- Type of utilisation of the study area by bats.

### 2.2.4. Data collection techniques and methods

Bats are usually divided into two main groups: echolocating and non-echolocating bats, the former usually use highly evolved ultrasound echolocation to navigate, forage and communicate (Schnitzler & Kalko 2001) and the latter uses vision for orientation, to navigate and search for food sources (Monadjem *et al.* 2010). Non-echolocating bats are commonly known as fruit bats (feeds mainly on fruits); whereas echolocating bats are known as insectivorous bats (insects are their main food resource). The different flight and echolocation inter-specific characteristics are directly related to differences in species' foraging habitats (Schnitzler & Kalko 2001).

Tracking the conservation status of bat populations through the abundance and distribution of echolocation calls has the potential to offer a more efficient alternative to trapping or visual sampling methods for bat survey and monitoring programmes (Walters *et al.* 2012). The detection, recording and analysis of ultrasounds is very useful in the detection and identification of different bat species, since these mammals are nocturnal and, in the majority of species, emit ultrasound calls to guide them, and to detect prey, as well as to communicate. Details pertaining to the collection techniques are provided below.

#### 2.2.4.1. Active detection

The active detection of ultrasounds was conducted with a portable ultrasound detector (Wildlife Acoustics® EM3+ automatic ultrasound detector with an attached GPS) along vehicle-based transects (Figure 8). The active detection surveys were conducted twice per season for a full year, and the established transects were intended to be representatives of the biotopes present at the study area. Therefore, four transects were established crossing all the main biotopes present within the development area and extending to the surrounding area. Characterization points were established for each transect, at approximately every 2 kms, where environmental variables were collected during each active survey.

Sampling commenced at evening civil twilight and continued for a minimum of 1.5 hours and a maximum 4 hours after sunset - ensuring that bat species that emerge early in the evening can be included in the surveys (according to Sowler & Stoffberg 2014). At each survey the order by which the sampling points established along transects was conducted was altered so that each transect would not be conducted at the same time of the night. Each Characterisation point was characterised in terms of lunar phase, cloudiness, temperature, precipitation and wind speed and direction at the time it was conducted. The manual surveys were not performed in adverse weather conditions (rain, very strong wind, fog, thunderstorms).[2]

After conducting transect sampling surveys, the recorded data was analysed in order to determine spatial use by bat community, as well as to acoustically confirm the presence of bat species that may occur in the area.

[2] The equipment is also extremely sensitive to high levels of humidity as well as to electromagnetic changes.

## 2.2.4.2. Passive detection

Passive detection for this monitoring programme was conducted by making use of automatic ultrasound detectors (Wildlife Acoustics® SM2BAT+) with automatic triggering (starting an ultrasound recording when a bat echolocation is detected). The equipment was scheduled to automatically record calls every night starting 30 min before evening civil twilight (hereafter referred as sunset time) and ending 30 min after morning civil twilight (hereafter referred as sunrise time).

Five different locations and five detectors were used: all the detectors were placed on meteorological masts (PQKDA01, PQKDA02, PQKDA03, PQKDA04 and PQKDA05) (Figure 8). These locations cover the different combinations of vegetation types and topography and were determined following the recommendations included in the 4th Edition of the "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments" (Sowler *et al.* 2016). The detectors had a microphone installed at 90m and at 10 m (ground level). Bat activity was measured continuously, aiming to cover a minimum of 75% of at least 365 nights (12-month period) (and aiming to cover 100% during the bat migration months – April, May and September). The placement of microphones at two different heights on the met mast will allow for comparisons of bat activity and diversity, both at approximate rotor height and ground level.

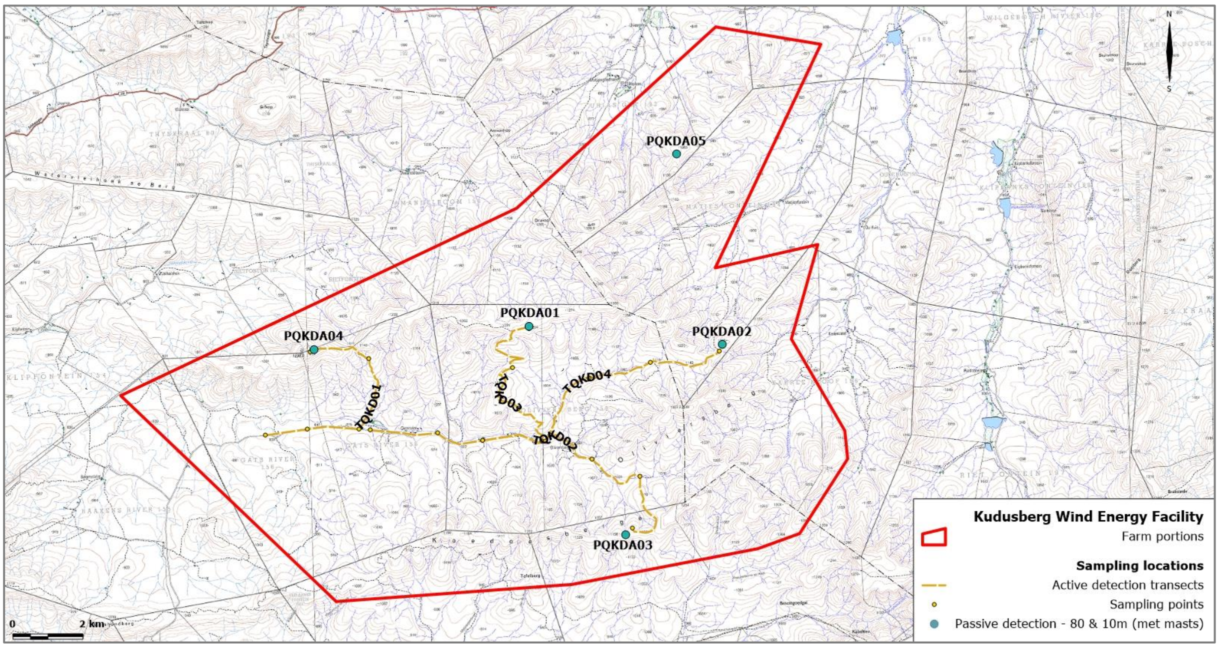



**Figure 8 - Bat sampling locations at Kudusberg WEF site.**

## 2.2.4.3. Non-echolocating bats

Bats are usually divided into two different groups, mostly by their diet: fruit-eating bats and insectivorous bats. The South African fruit bats feed on the fruits, flowers and nectar of a wide range of indigenous trees as well on domestic or commercial fruit trees (Monadjem *et al.* 2010). To determine the occurrence of fruit-eating bat species on the study area, searches were directed to potential roosting sites suitable to these species during daytime.

#### 2.2.4.4. Roost searches, inspection and monitoring

All structures considered to have potential for bat species roosting (e.g. caves, mines, abandoned buildings, bridges, etc.) were identified in the study area and its surroundings by means of a GIS based desktop study and during the fieldwork visits to the area. The potential roosting locations identified were then inspected in the subsequent surveys in order to record evidence of bats presence and occupation (such as live bats roosting, bat droppings accumulation, bat corpses or insect remains). During the fieldwork, the location of each prospected roost was recorded with a handheld GPS (Garmin® ETREX 10 or ETREX 20), and photographs were taken for documentation.

When a roost was considered to have potential to be occupied by bats (determined either by means of interviews to the local inhabitants or direct observation of traces of bat occupation), an active survey was conducted outside of the potential roost during sunset (to determine number of bats leaving the roost) using the same equipment described in section 2.2.4.1 (Wildlife Acoustics® EM3+ automatic ultrasound detector). Additionally, static Wildlife Acoustics® SM2+ automatic ultrasound detector was left overnight inside the roost (when possible) in order to confirm bat usage and determine roosting activity, such as, time of usage/time of arrival/time of exit). Determining time of arrival also aids to determine when is the best time to inspect roosts in order to determine the species and number of individuals inhabiting the roost.

### 2.2.5. Data analysis and criteria

#### 2.2.5.1. Ultra-sounds analysis

Automatic acoustic monitoring produces a large amount of data recorded by the SM2BAT+ as *.WAV format, automatic identification is needed to process data and determine bat activity analysis. In order to eliminate all non-bat ultrasounds detections and process data to determine bat activity, AnalookW4.1d© Software was used to identify and filter out non-biological noise such as rain, wind, birds and insect sounds. In this first step, files were converted to *.ZC format using Kaleidoscope© 2.1.0 and then a filter for bat pulses was applied with AnalookW©.

To determine bat activity, it was necessary to define a "**bat pass**". For this study, a bat pass was considered as a sequence of more than 1 echolocation calls where the duration of each pulse is ≥ 2ms (Weller & Baldwin 2012). Single call fragments do not apply, and therefore only complete pulses were considered for the analysis. Where there is a gap between pulses of >500ms in one file, this then represents a new bat pass (Sowler & Stoffberg 2014).

Considering the characteristics of a bat pass and the characteristics of echolocation pulses (e.g. characteristic frequency, slope, pulse duration, initial and final frequencies, bandwidth, interval between pulses) a set of filters were produced for the species/group of species identification. The reference values used were the ones presented in several published and unpublished sources of South Africa (Gauteng & Northern Regions Bat Interest Group; Taylor *et al.* 2005; Hauge 2010; Monadjem *et al.* 2010; Kopsinis *et al.* 2010; ACR 2012; Pierce 2012). This acoustic echolocation parameters reference table was reviewed and adjusted in order to use the most accurate reference parameters as possible, considering the limitations of the current knowledge on South African bats echolocation. The filters were cross-validated by selecting a proportion of recordings in each survey and analysing them manually by a specialized technician. The analysis of the recorded calls was performed using *Audacity© 2.0.0 – Cross-Platform Digital Audio Editor*, from Dominic Mazzoni. The results of the manual identification analysis were used to cross validate the results from the automatic identification with AnalookW and the filters were adjusted to the best extent possible.

As bats have extremely flexible call structures which may depend on various factors including habitat structure, foraging strategy, age, gender, morphology, and the presence of other conspecifics (Thomas, Bell & Fenton 1987; Obrist 1995; Murray, Britzke & Robbins 2001), call convergence has led to overlap in frequencies and call shapes, making it difficult to distinguishing some calls (Preatoni *et al.* 2005). For that reason, and to optimize the identification process, the filters produced in AnalookW aimed to identify groups of species, which shared similar acoustic characteristics, instead of individual species. These groups were assembled based on the list of species considered as potential for the area (refer to section 3.1.1), collision risk and characteristics of their echolocation calls (Table 4 in 3.2.1), i.e., species with the same collision risk and echolocation parameters were grouped together. Whenever species with different conservation status and relevant ecological behaviour (such as migration) were present, attempts to separate in different groups were made. If the filter cross-validation results were not satisfactory (over 80% capacity to correctly detect bat passes of the species), the filter would not be used for **activity analysis purposes**. These filters will, however, be used to aid in species confirmation at the site. Recordings selected by these filters were subject to manual identification by specialists.

#### 2.2.5.2. Spatial-temporal analysis

The results obtained from the surveys undertaken between December 2015 and December 2016 were analysed according to the number of bat passes at each sampling point and allowed the determination of the following parameters for active and passive detection:

- Average number of bat passes per hour (e.g. activity index) (data from passive detection);
- Average number of bat passes per sampling location (e.g. activity index) (data from active detection);
- Frequency of occurrence of each species/group of species identified (number of contacts of a species or group of species / total number of records identified).

Notice however that the activity index does not provide an absolute number of individuals, indicating solely a relative index of abundance (Hayes 2000). An analysis of the activity index for each hour of the recording period was also performed in order to evaluate the variation of activity through time, indicating periods of higher bat activity.

These parameters were also analysed in terms of environmental factors, such as temperature, wind speed and biotope. The same parameters were analysed in terms of space, according to the point locations (WEF site and control area).

## 2.3. Assumptions and limitations

- The pre-construction bat monitoring is based on both primary (data collection) and secondary data sources, such as those indicated in section 2.1.
- In South Africa, data on migratory paths of bats is still largely unknown, this limiting the ability to determine if the wind farm might have impact on migratory species.

- Any inaccuracies or lack of information in the bibliographic sources consulted could limit this study. In particular, 8 years have passed since the leading literature that is available for bat distribution in South Africa has been updated (Monadjem *et al.* 2010).
- Bat detectors were installed and used according to the manufacturer's indications. However, data gaps still occurred due to technical limitations of the detector and/or unavoidable malfunctions. Nevertheless, a sampling effort of more than 75% of the year was obtained as per the requirements of the 4th Edition of the "South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments" (Sowler *et al.* 2016).

# 3. Results and discussion

The results presented in this report include all data collected during the pre-construction bat monitoring programme for the Kudusberg WEF. Therefore, the baseline reference of the bat communities during pre-construction phase of the WEF is established in this section. The discussion is based on the analysis of data collected and specialised bibliographic information available.

## 3.1. Desktop review

### 3.1.1. Species with potential occurrence at the site

Approximately 67 bat species may occur within South Africa (Monadjem *et al.* 2010). Bat distribution areas are, however, strongly influenced by geographic and climatic variables, with only a few species occurring throughout the entire South African territory. Therefore, not all of these 67 bat species are likely to occur within Kudusberg WEF study area. Considering the criteria described in section 2.1, it was possible to determine that at least four species had confirmed occurrence in the area and fifteen have the potential to occur in the immediate vicinity of the site (Table 5). From all these fifteen species, nine of them are considered to be **sensitive** to the project development.

### High Probability of occurrence

**High Risk of collision:**

- *Egyptian free-tailed bat*

**Medium-High Risk of collision:**

- *Cape serotine*
- *Natal long-fingered bat*

### Moderate Probability of occurrence

**Low risk of collision:**

- *Angolan wing-gland bat*
- *Namibian long-eared bat*
- *Geoffroy's horseshoe bat*
- *Lesueur's wing-gland bat*

### Low Probability of occurrence

**High risk of colllision:**

- *Robert's flat-headed bat*

**Medium-High risk of colllision:**

- *Lesser long-fingered bat*
- *Temminck's myotis*
- *White-bellied house bat*

**Medium risk of colllision:**

- *Long-teiled serotine*

**Low risk of colllision:**

- *Egyptian slit-faced bat*
- *Cape horsehoe bat*
- *Darling's horsehoe bat*

*- Species with confirmed occurrence on site

A brief description of the bat species with high and moderate probability of occurrence at the site is presented below:

| | |
|---|---|
| **Egyptian free-tailed bat *** (*Tadarida aegyptiaca*) | This bat species is considered highly prone to collision with turbines (high risk of collision, according to Sowler & Stoffberg, 2014) since it is known to fly at high altitude and use the vertical space at rotor level for foraging. This species prefers to use open spaces while avoiding denser vegetation such as forests. It is therefore very likely to occur within the site while foraging over the open shrubland area. |
| **Cape serotine *** (*Neoromicia capensis*) | The Cape serotine bat is considered to be a sensitive species to the project due to the classification of medium to high risk of collision by Sowler & Stoffberg (2014). However, this species is considered to have a stable population (IUCN, 2016) and is widely common in South Africa. |

| | |
|---|---|
| **Natal long-fingered bat *** *(Miniopterus natalensis)* | The Natal long-fingered bat is a cave dependent, migrant species with a conservation status of concern (*Near Threatened*). The female bats are known to migrate seasonally between caves, which are sometimes up to 150 km apart. |
| **Geoffroy's horseshoe bat** (*Rhinolophus clivosus*) | This species may be present in a wide variety of habitats such as savannah, woodlands and riparian forest. It is also known to roost in caves and mine adits (entrances) (Monadjem *et al.* 2010). Due to its foraging characteristics (clutter forager with generally low height flight) this species is considered to have a low collision risk with wind turbines (Sowler & Stoffberg 2014) |
| **Angolan wing-gland bat** (*Cistugo seabrae*) | The Angolan wing-gland bat is mostly present further north of the study area, however due to characteristics of the study area (semi-arid environment with riverine vegetation along watercourses) it is considered that the species may be detected at the site, although not detected during the 12-month monitoring campaign. This is a clutter-edge forager species having a low risk of collision with wind energy facilities (Sowler & Stoffberg 2014). However due to its restricted distribution and poorly known population size the species is considered to be Near Threatened in South Africa (Friedmann & Daly 2004) |
| **Namibian long-eared bat** (*Laephotis namibensis*) | *Laephotis namibensis* is a clutter-edge forager endemic to southern Africa, known to be associated with semi-arid environment (Monadjem *et al.* 2010). The species was shown to use the area near water sources and rock vertical faces to roost during the day (Jacobs, Barclay & Schoeman 2005), both features which are present within the study area. |
| **Lesueur's wing-gland bat** (*Cistugo lesueuri*) | This species has a conservation status of concern (*Near Threatened*) for the SA Red List and presents a restricted distribution. Occurs in broken terrains in high altitude montage grassland, near water and roost in rock crevices. It is considered to have a low collision risk with wind turbines (Sowler & Stoffberg 2014). |

Based on the species list from Table 5, for automatic identification purposes, species were grouped in functional groups relevant for the analysis according to each species acoustic characteristics of their calls (Table 4). Note that the identification of a bat pass from a given group does not confirm the occurrence of all species present within the group. For this reason, a specific analysis was made for each of these groups in order to confirm the present of species within each of these groupings (refer to section 2.2.5.1 for further detail).

**Table 4 – Groups of bat species considered for ultrasound automatic analysis (bold - confirmed species;).**

| Group name | Echolocation characteristics | Species considered |
|---|---|---|
| **High Risk Group** | Fc 20 – 25 kHz<br>Long calls | ***Tadarida aegyptiaca (LC)**** <br>*Laephotis namibensis (LC)* |
| **Medium Risk Group** | Fc 28 – 34 kHz<br>Medium duration calls | *Eptesicus hottentotus (LC)*<br>*Sauromys petrophilus (LC)* |
| **Medium-High Risk Group** | Fc 36 – 52 kHz<br>Short to medium duration calls | ***Miniopterus natalensis (NT)****<br>*Miniopterus fraterculus (NT)*<br>*Myotis tricolor (NT)*<br>*Cistugo lesueri (NT)*<br>*Cistugo seabrai (NT)*<br>***Neoromicia capensis (LC)**** |

| Group name | Echolocation characteristics | Species considered |
|---|---|---|
| **Low Risk Group** | Fc 68-113 kHz<br>Long duration calls | ***Nycteris thebaica (LC)****<br>*Rhinolophus capensis (NT)*<br>*Rhinolophus clivosus (NT)*<br>*Rhinolophus darlingi (NT)* |

**Table 5 - List of species with possible occurrence at Kudusberg WEF (IUCN (2014) and South Africa Red List** (Friedmann & Daly 2004b): NT – Near Threatened; LC – Least Concerned; NE – Not Evaluated; Collision risk according to Sowler & Stoffberg 2014; Probability of occurrence: High; Low; Mod – Moderate; *- species was acoustically confirmed in previous phases of the project).

| Species name | Common name | IUCN* | SA Red List ** | Relative status (Sowler& Stoffberg, 2014) | Collision risk | Roost type | Habitat preferences | Foraging type | Migration & Foraging | Sensitive species | Probability of occurrence | Presence confirmed during campaign |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Nycteris thebaica* | Egyptian slit-faced bat | LC | LC | Common - widespread and restricted distributions | Low | Caves, burrows, culverts and trunks of large trees; houses. Have day and night roots. | Savannah and karoo biomes. Avoids open grasslands | Clutter forager | Can migrate 100km; Foraging rage average 1,1 km | X | Low | Yes |
| *Miniopterus fraterculus* | Lesser long-fingered bat | LC | NT | Common - widespread and restricted distributions | Med-High | Caves | Montane grasslands | Clutter-edge forager | - | X | Low | No |
| *Miniopterus natalensis* | Natal long-fingered bat | LC | NT | Common - widespread and restricted distributions | Med-High | Cave dependent. Uses separate caves as winter hibernacula and summer maternity roosts | Savannahs and grasslands. | Clutter-edge forager | Migration range of 150 km (females migrate seasonally between these caves) | X | High | Yes |
| *Cistugo lesueuri* | Lesueur's wing-gland bat | LC | NT | Restricted distributions | Low | Rock crevices | Broken terrain in high altitude montage grassland, near water. | Clutter-edge forager | - | - | Mod | No |
| *Cistugo seabrae* | Angolan wing-gland bat | LC | VU | Restricted distributions | Low | Buildings | Arid and semi-arid, riverine vegetation of dry river beds | Clutter-edge forager | - | X | Mod | No |
| *Eptesicus hottentotus* | Long-tailed serotine | LC | LC | Wide but sparse distribution | Med | Caves, rock crevices | Woodland, rocky regions. | Clutter-edge forager | - | - | Low | No |
| *Laephotis namibensis* | Namibian long-eared bat | LC | NE | Restricted distributions | Low | Narrow crevices in rock | Arid desert, fynbos, riparian vegetation | Clutter-edge forager | - | - | Mod | No |
| *Myotis tricolor* | Temminck's myotis | LC | NT | Wide distribution | Med-High | Caves. Switches between winter hibernacula and summer maternity caves. | Mountains. Absent from flat and featureless terrain. | Clutter-edge forager (only capture aerial prey) | Seasonal migration | X | Low | No |

| Species name | Common name | IUCN* | SA Red List ** | Relative status (Sowler& Stoffberg, 2014) | Collision risk | Roost type | Habitat preferences | Foraging type | Migration & Foraging | Sensitive species | Probability of occurrence | Presence confirmed during campaign |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Neoromicia capensis* | Cape serotine | LC | LC | Wide distribution | Med-High | Under the bark of trees, foliage, buildings | Semi-arid areas to montane grassland, forests and savannah. | Clutter-edge forager | - | X | High | Yes |
| *Scotophilus leucogaster* | White-bellied house bat | LC | LC | na | Med-High | Hollow trees, buildings | Woodland. Forager over floodplains | na | - | X | Low | No |
| *Rhinolophus capensis* | Cape horseshoe bat | LC | NT | Restricted distributions | Low | Caves and mines | Closely tied to fynbos and succulent karoo biomes. | Clutter forager | - | - | Low | No |
| *Rhinolophus clivosus* | Geoffroy's horseshoe bat | LC | NT | Restricted distributions | Low | Caves and mines. Uses feeding roosts during the night, as branches and roof of buildings | Savannah, woodland and riparian forest. | Clutter forager | - | - | Mod | No |
| *Rhinolophus darlingi* | Darling's horseshoe bat | LC | NT | Restricted distributions | Low | Caves and mines adits, also in culverts and cavities in piles of boulders | Savannah and woodland. | Clutter forager | - | - | Low | No |
| *Sauromys petrophilus* | Robert's flat-headed bat | LC | LC | Common - widespread | High | Narrow cracks, under slabs of exfoliating rock | Rocky habitats in woodland, fynbos or arid scrub | Open-air forager | - | X | Low | No |
| *Tadarida aegyptiaca* | Egyptian free-tailed bat | LC | LC | Common - widespread | High | Caves, rock crevices, under exfoliating rocks, hollow trees and behind the bark of dead trees, also buildings | Wide variety of vegetation, avoids forests. | Open-air forager (avoids forests) | - | X | High | Yes |

### 3.1.2. Known migration routes

Bat migration and dispersion behaviours and distances covered by South African bat species are not very well documented yet. There is a lack of information in South Africa regarding the distribution and abundance of bats as the migratory habits and migration routes of bats through the country are not yet clearly understood. Much research is needed in this subject. However, there is some evidence that some species undergo long-distance migration and seasonal movements within South Africa. For example, Natal Long-fingered Bat *(Miniopterus natalensis*) is known to migrate up to 260 km (Van Der Merwe 1975) between summer maternity caves and those used during mating and hibernation periods during the winter months. Temminck´s Myotis (*Myotis tricolor*) may undertake similar seasonal migrations (Monadjem *et al.* 2010). The frugivorous bat, Egyptian rousette (*Rousettus aegyptiacus*) is a gregarious cave-dweller, also thought to move distances of between 50 km to 500 km along the KwaZulu-Natal coast (Monadjem *et al.* 2010).

There is a lack of information available regarding South African bat species' home ranges and daily dispersion movements (mainly to forage). Non-migrating bats will require movement around its essential homing area: e.g. to forage, drink, and search for mates or search for new roosting locations. Some bat species will have daily roosts and night roosts (that they use for shorter periods while foraging in an area) (Monadjem *et al.* 2010). Daily dispersion will depend on several factors including the species, the habitat, weather conditions and food availability. Nevertheless, based on the available information for South Africa and/or international references regarding similar species elsewhere in the world, most bats species will cover, in general, less than 5 km from their roosting location per night. Nevertheless, some species have been recorded travelling longer distances, e.g. *Rousettus aegyptiacus* was radio tracked up to 24 km flying from a roosting cave to a feeding area (Jacobson *et al.* 1986 in Monadjem *et al.* 2010).

### 3.1.3. Known roosting locations

The presence of known roosts was also investigated by means of a desktop analysis. With-in a 100km radius of the proposed WEF several sources were consulted and some roosts were identified. The closest known roost to the Kudusberg WEF with species confirmation is the **Montagu Guano Cave**, located approximately 100km south of the site (Figure 9). The Montagu Guano Cave is a known roost location for *Miniopterus natalensis*, *Myotis tricolor*, *Rhinolophus clivosus* and *Tadarida aegyptiaca*. The **Die Hel Cave** is other confirmed roost that is located at approximately 110km west to the proposed WEF. In this roost were confirmed the species *Rhinolophus capensis*, *Rhinolophus clivosus*, *Miniopterus fraterculus*, *Miniopterus natalensis* and *Rousettus aegyptiacus*.

The results obtained in the roost inspections within the proposed WEF will be presented in section 3.4.

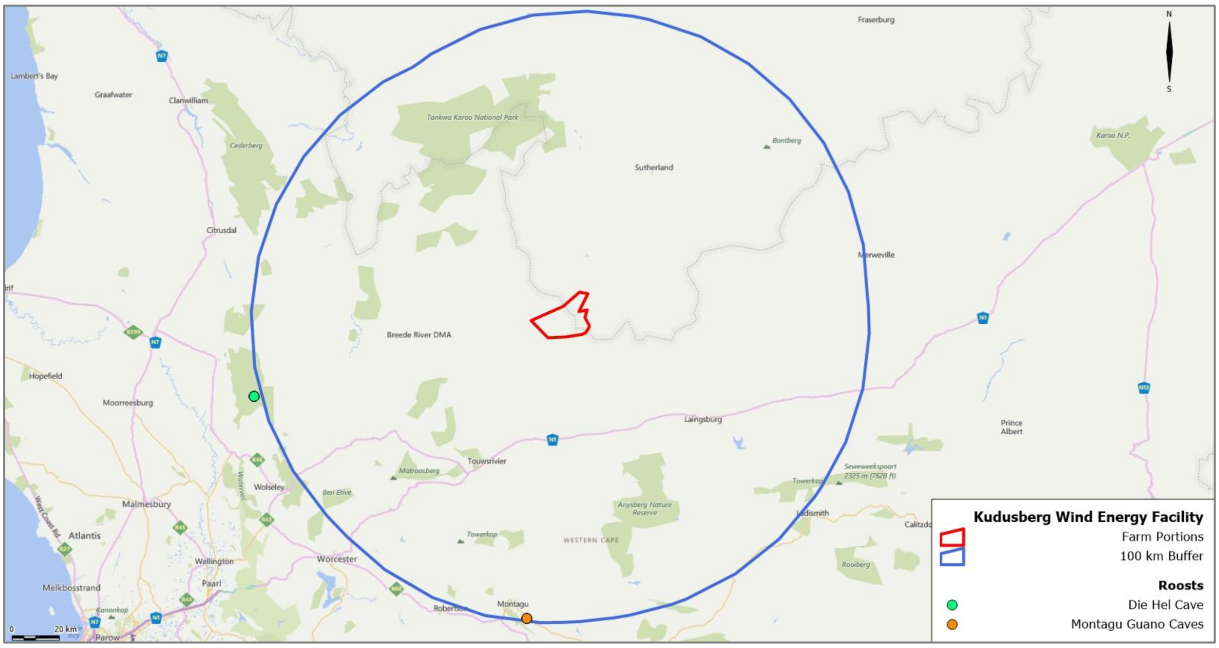



**Figure 9 – Confirmed roosts located in the vicinity of the proposed WEF site (background image source: Virtual Earth Street Image).**

## 3.2. Bat species

### 3.2.1. Echolocating bat species

The implementation of the present pre-construction bat monitoring programme allowed to acoustically confirm the occurrence of 4 echolocating bat species in the study area (Table 6) by means of manual acoustic identification analysis (refer to section 2.2.5.1 for further details on manual acoustic identification). Four species were confirmed in the WEF area, such as the Egyptian free-tailed bat (*Tadarida aegyptiaca),* Cape serotine *(Neoromicia capensis),* Natal long-fingered bat (*Miniopterus natalensis*) and Egyptian slit-faced bat (Nycteris thebaica). These are all "Near Threatened", or "Least Concern" species, according to the South African Red List (Friedmann & Daly, 2004b) and are considered sensitive species to the WEF development since three of them are considered to have medium to high risk of collision with wind turbines (refer to section 2.1).

**Table 6 – List of species with acoustic confirmed occurrence at Kudusberg WEF (◆ - sensitive species).**

| Common name | Scientific name | Group | Conservation status | | Risk of collision (Sowler *et al.*, 2016) |
|---|---|---|---|---|---|
| | | | Global (UICN, 2016) | South Africa Red List (Friedmann & Daly, 2004b) | |
| Natal long-fingered bat | *Miniopterus natalensis* ◆ | C | LC | NT | Med-High |
| Egyptian slit-faced bat | *Nycteris thebaica* ◆ | D | LC | NT | Low |
| Cape serotine | *Neoromicia capensis* ◆ | C | LC | LC | Med-High |
| Egyptian free-tailed bat | *Tadarida aegyptiaca* ◆ | A | LC | LC | High |

Bat species are susceptible to negative impacts caused by wind energy facilities operation, mostly due to the higher likelihood of collision with wind turbines, depending on the species characteristics. Therefore, it is important to analyse the bat community present on the site, mainly the activity of sensitive species, bearing in mind the potential risk caused by the project implementation.

The results from automatic acoustic identification analysis (refer to section 2.2.5.1 for further details on automatic acoustic identification) indicate that the most abundant species in the site belong to "group A" (High risk of collision), that includes *Tadarida aegyptiaca*, representing 58% of all activity detected at the site (Figure 10). The species *T. aegyptiaca* is very common in South Africa, but has a higher risk of collision due to its flight type and foraging behaviour, since this species forages in open areas and may fly at high altitudes, potentially entering the rotor swept area. Additionally, there are records of fatalities of species from *Tadarida* sp. on wind farms in South Africa and elsewhere in the world (Arnett *et al.* 2008; EUROBATS 2013; Doty & Martin 2013).

"Group B" (Medium risk of collision) includes *Eptesicus hottentotus* and *Sauromys petrophilus,* and represents 17% of all activity detected at the site.

Species from "group C" (Medium-high collision risk) includes *Miniopterus natalensis* and *Neoromicia capensis*, and represent 23% of the total activity detected at the site.

"Group D" (Low collision risk) includes *Nycteris thebaica*, *Rhinolophus capensis*, *Rhinolophus clivosus* and *Rhinolophus darlingi*, and represents only 2% of the total activity.

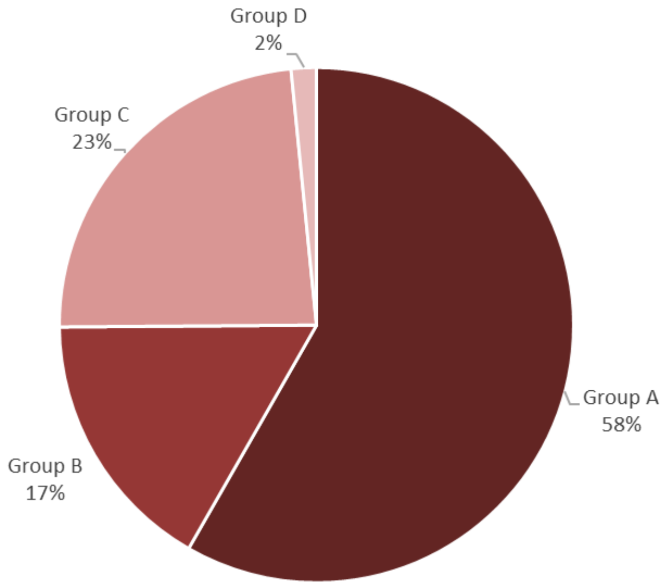



**Figure 10 – Percentage of total activity for the species groups at Kudusberg WEF (from data collected during passive surveys).**

### 3.2.2. Non-echolocating species

When surveying the proposed WEF area, attention was given to the presence fruit trees that could be used by fruit bats and to signs or clues of fruit bat species. In spite of the lack of fruit in the trees on the proposed development site it is considered that no fruit bat species, have likelihood to occur in the study area.

## 3.3. Spatial-temporal activity

The species that can occur in the study area are mainly insectivorous and their annual cycle is related to the abundance of food resources. Since the insect population increases with an increase in temperature and precipitation (favourable conditions for its proliferation), it is expected that bat activity will follow a similar pattern.

Bat activity intensity through time was inferred from the total number of bat passes collected through passive detection method. Activity at the study area is considered to be **low**, as the average number of passes per hour recorded monthly is, approximately, 0.3 passes/hour (refer to next section; Figure 11). Comparing this information with other wind farm monitoring locations in South Africa, bat activity in Kudusberg study area is lower than other nearby states such as Western Cape (e.g. average 4 passes/hour) and similar to the average for other locations in Free State (e.g. average 0.2 passes/hour) or Northern Cape (e.g. average 0.3 passes/hour) seasonal activity.

Figure 11 shows average bat activity (number of passes/hour) of all passive monitoring detectors along the 12-month monitoring period, revealing seasonality: higher activity during summer months (average number of passes of, approximately, 0,5 bat passes per hour) decreasing in autumn and winter months. Overall average bat activity was 0.3 bat passes per hour and maximum average bat activity was reached in September by 0,9 bat passes per hour. This observation is consistent with the knowledge of bat ecology, since it is expected that most of the activity will be recorded during spring and summer months (Erickson & West 2002; Arnett *et al.* 2008). Table 7 resume the live cycle of the species with high and moderate probability to occur in the Kudusberg WEF.

In regard to which groups of species were more frequently detected, Figure 12 presents relative frequency of occurrence of each species per season. The most frequent groups in most of the seasons are species from ”group A” as it was already noted (refer to Figure 10). During autumn and spring, species from "group C" were more active, however, species from "Group A" was more frequent during winter and summer. Also, the Group C that consists of some migrating species such as *M. natalensis* (refer to Table 4 in chapter 3.1.1) have a lower activity index during summer. The activity index of Group B is low during the year, while for Group D the activity index is residual, only occurring in winter and spring.

The breeding and birth patterns of the species that occur and potentially occur in the study area (only species with high or moderate probability of occurrence) are presented in Table 7.

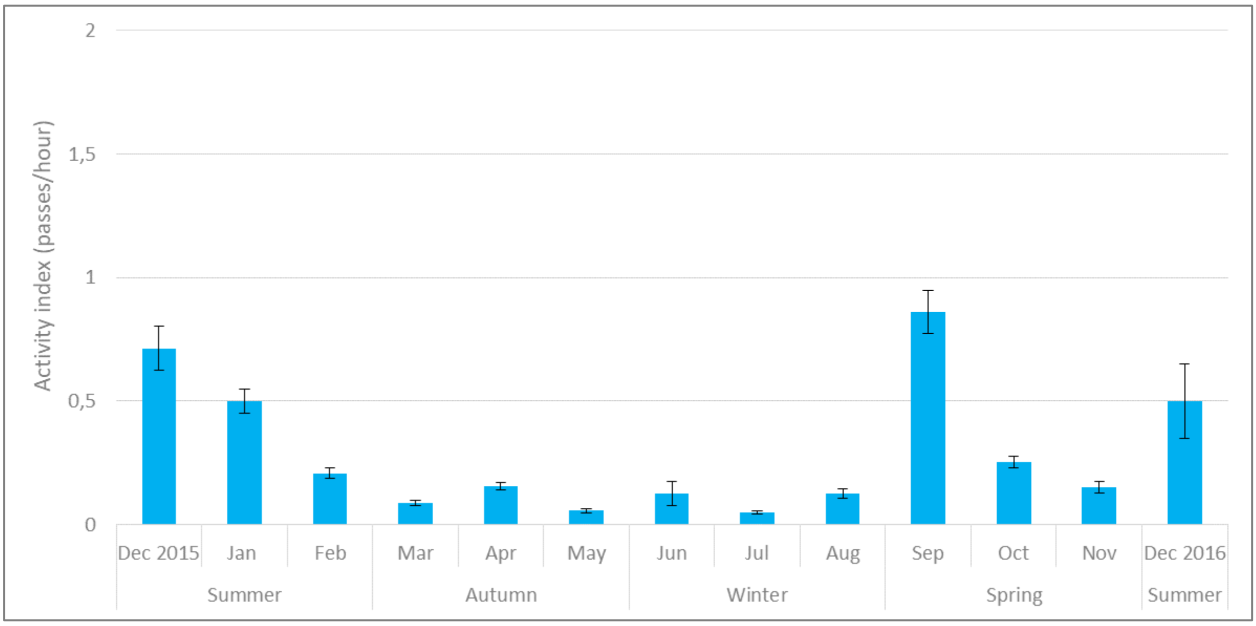



**Figure 11 – Average number of bat passes/hour (activity index) at Kudusberg WEF site (vertical lines represent standard error; data from passive detectors).**

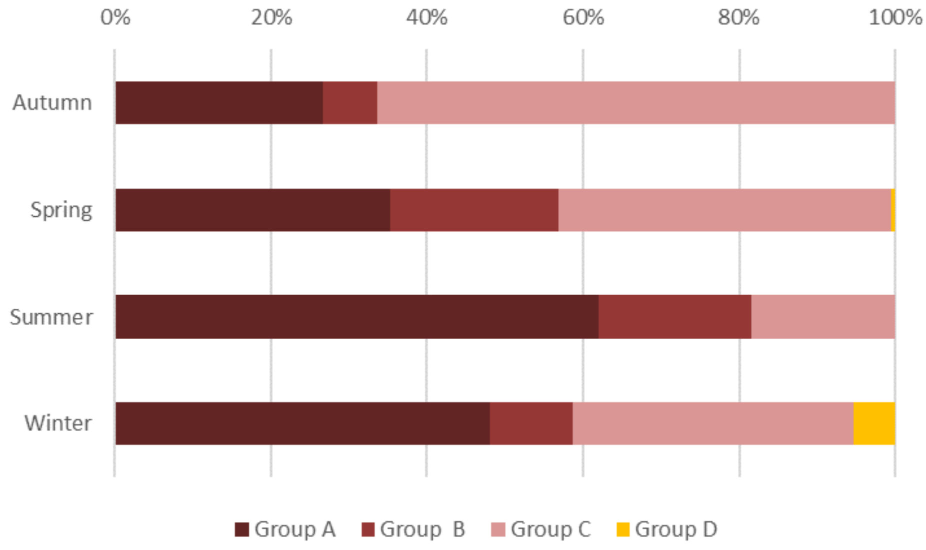



**Figure 12 – Frequency of occurrence (in percentage) of each group of species in each season at Kudusberg WEF site (data from passive ground detectors).**

**Table 7 – Migration, breeding and birth patterns of the species that occur and potentially occur in the study area (only species with high or moderate probability of occurrence are presented; n/a – information not available; bold- species with confirmed occurrence on site; ⬩ sensitive species; Life cycle: Brd – breeding, Bth – birth, YFli – young start flying).**

| Common name | Scientific name | Migration | Life cycle (months) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | J | F | M | A | M | J | J | A | S | O | N | D |
| Natal long-fingered bat | *Miniopterus natalensis* * | Migrates up to 150 km (females migrate seasonally between caves) | | | Brd | Brd | | | | | | Bth | Bth | Bth |
| Lesueur's wing-gland bat | *Cistugo lesueuri* | - | Bth | Bth | | | | | | | | | | |
| Angolan wing-gland bat | *Cistugo seabrae* | - | n/a | | | | | | | | | | | |
| Namibian long-eared bat | *Laephotis namibensis* | - | | | | | | | | | | | | Bth |
| Cape serotine | *Neoromicia capensis* * | - | | | Brd | Brd | | | | | | Bth | Bth | |
| Geoffroy's horseshoe bat | *Rhinolophus clivosus* | - | | | | | Brd | | | | | | | Bth |
| Egyptian free-tailed bat | *Tadarida aegyptiaca* * | - | | | | | | | | Brd | | | Bth | Bth |

## 3.3.1. Activity at different heights – rotor vs ground level

Considering the activity recorded from detectors installed in the met masts at ground and rotor level, it is possible to determine the proportion between bat activity recorded at ground vs rotor level. The bat activity detected within the Kudusberg WEF site was slightly higher at ground height level (51%) and lower at the rotor level (49%) across the monitoring period (Figure 13). The activity at rotor height represent a higher risk of impact, being therefore important to analyse the distribution of the activity at rotor height and at ground level through time to determine patterns and periods when these bats are at greater risk.

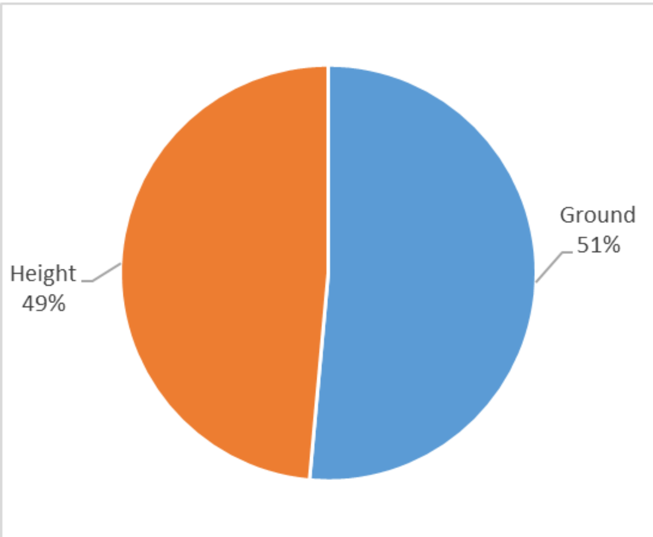



**Figure 13 – Frequency of total bat activity (in percentage) at ground and rotor height level.**

Analysis of bat activity by month shows that activity at rotor height is low (less than 0.3 bat passes per hour, in average) (Figure 14) along the year, reaching his peaks in December and September. It is clear that the activity detected at rotor height was mostly due to the presence species from "group A" (Figure 15), which include the high risk collision species *Tadarida aegyptiaca*.

However, the species *T. aegyptiaca,* is one of the most widespread and abundant species in southern Africa, being currently considered as a Least Concern species (Friedmann & Daly 2004b). As an open-air forager its diet varies seasonally (Monadjem *et al.* 2010) that could explain its presence at height in various periods when its prey also occurs at rotor height. These hunting habits and the occurrence of bat fatalities of this species with wind facilities in South Africa (Doty & Martin 2013) has led to the classification of the species as high risk of collision with wind turbines (Sowler & Stoffberg 2014). Therefore, fatality impacts for this species are expected to occur. Migrating species such as *M. natalensis* is also of concern during autumn migrating periods since appear to be using the area during that time.

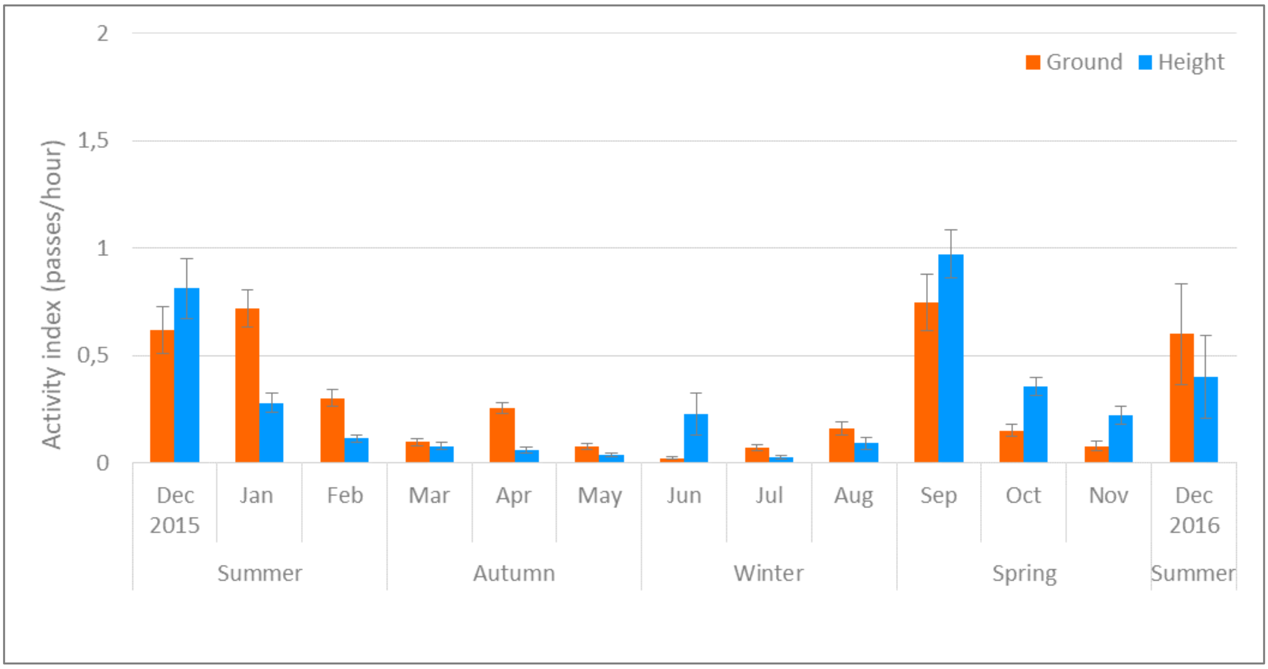



**Figure 14 - Average number of bat passes/hour at rotor height and ground level (vertical line bars represent standard error).**

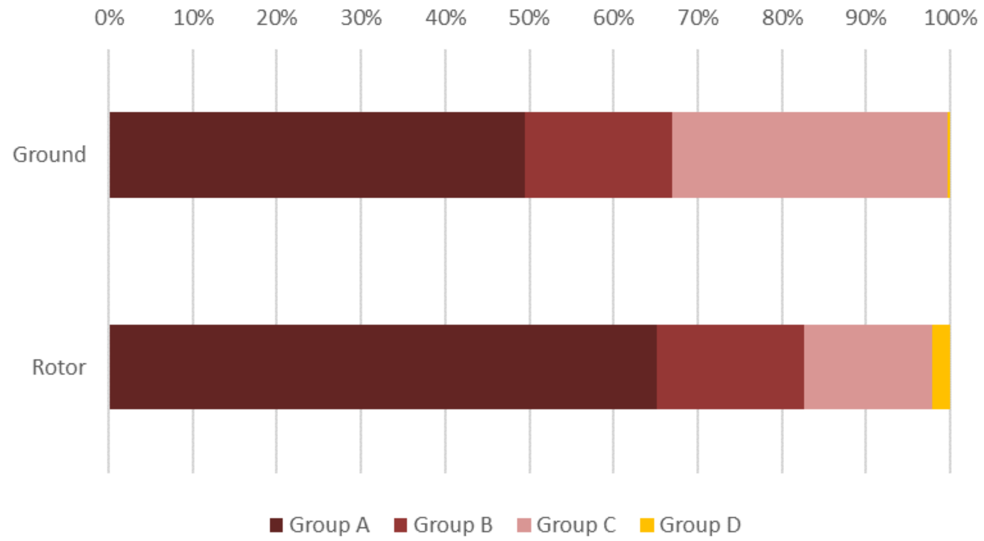



**Figure 15 – Average activity index (average number of passes/hour) for each groups of species at ground and rotor height.**

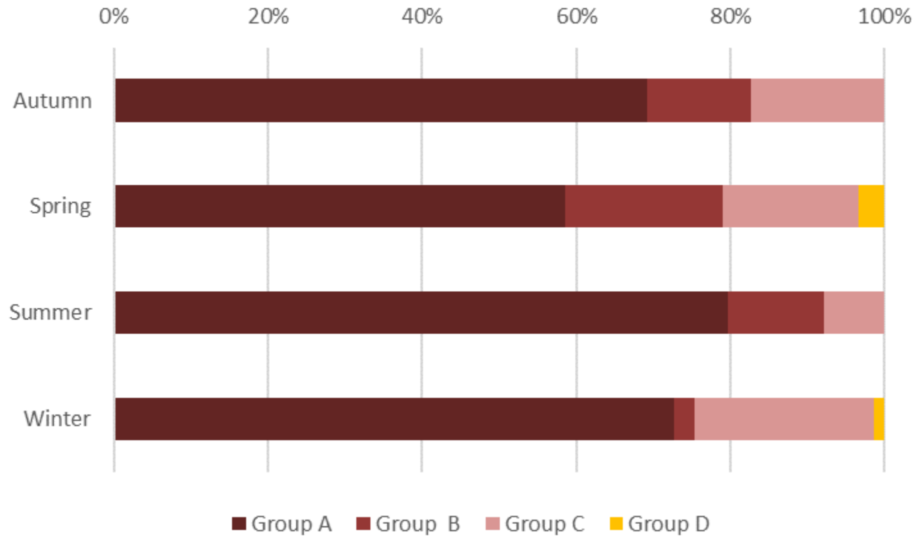



**Figure 16 – Average activity index (average number of passes/hour) per season for each groups of species at rotor height level.**

### 3.3.2. Activity throughout the night

Considering that species have different preferences with regards to their periods of foraging activity through the night, it is important to analyse which periods have higher activity in order to minimise the impacts of the operating Wind Energy Facility through the implementation of specific adjusted measures, if necessary. The average activity hour recorded within each hour period after sunset is presented in Figure 17.

Rotor level activity increases in the first 4 hours of the night and decreases significantly after this period, keeping it more or less steady during most of the night. Ground level activity increases in the first hour of the night and decreases significantly after the 4th hour and keeping it more or less steady during most of the night, except in the last quarter where it usually increases creating a peak, to decreased rapidly again. This last peak is probably due to individuals feeding right before sunrise (Figure 17).

Figure 18 shows activity per hour of the night during each season at ground level, and it is clear that a 2nd peak of activity usually occurs in the last hours of the night, earlier during summer when nights are shorter (around 10/11 hours) and later during winter, when nights are longer (around 14/15 hours). This last peak of activity in the last hours of the night during winter is also evident at rotor height, since there's a peak of activity in the 14th hour (Figure 19).

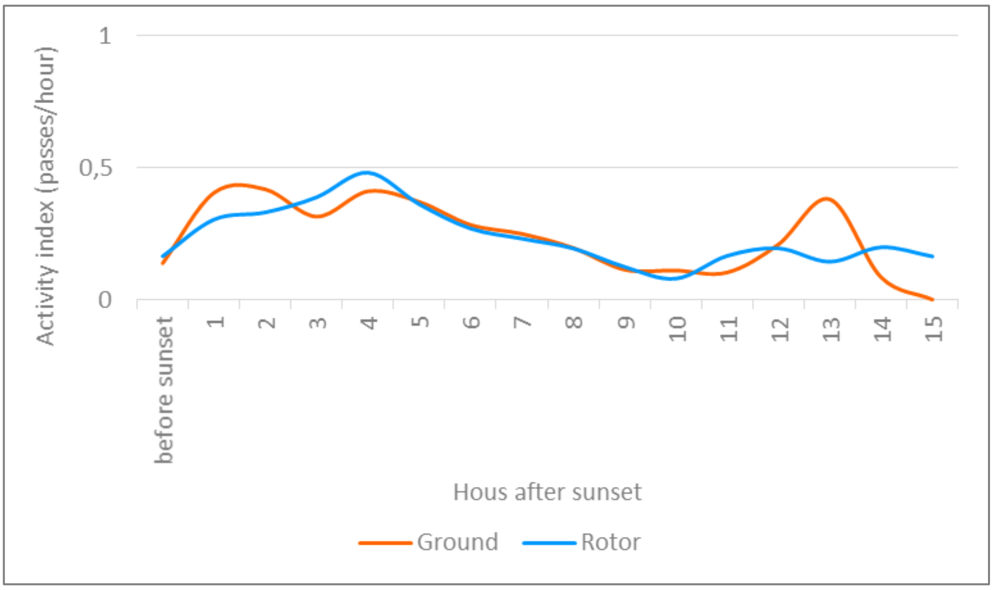



**Figure 17 – Average number of passes per hour after sunset (activity index) at rotor height and ground level recorded at Kudusberg WEF site.**

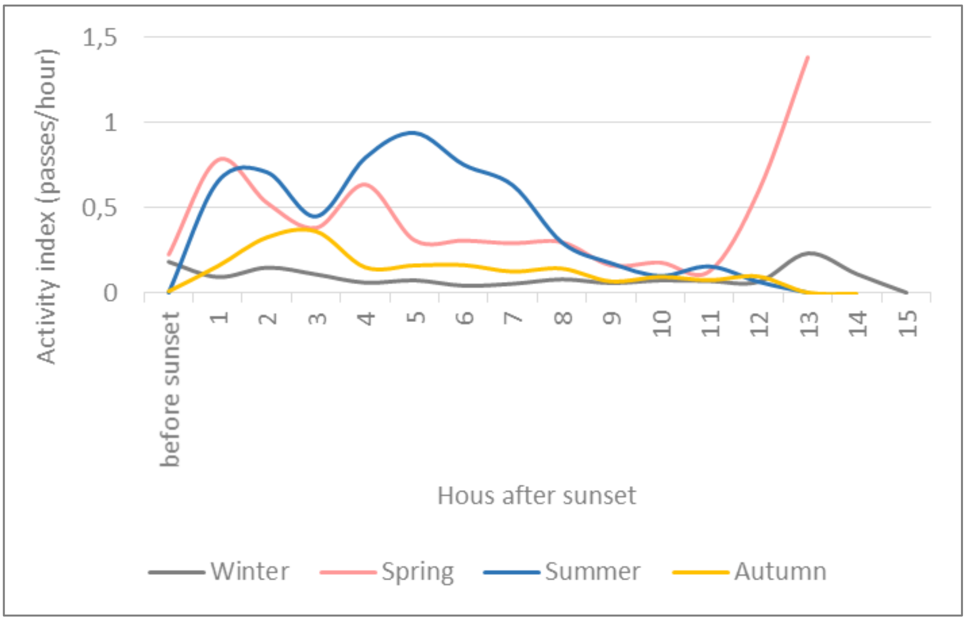



**Figure 18 – Average number of passes per hour after sunset (activity index) per season at ground level at Kudusberg WEF site.**

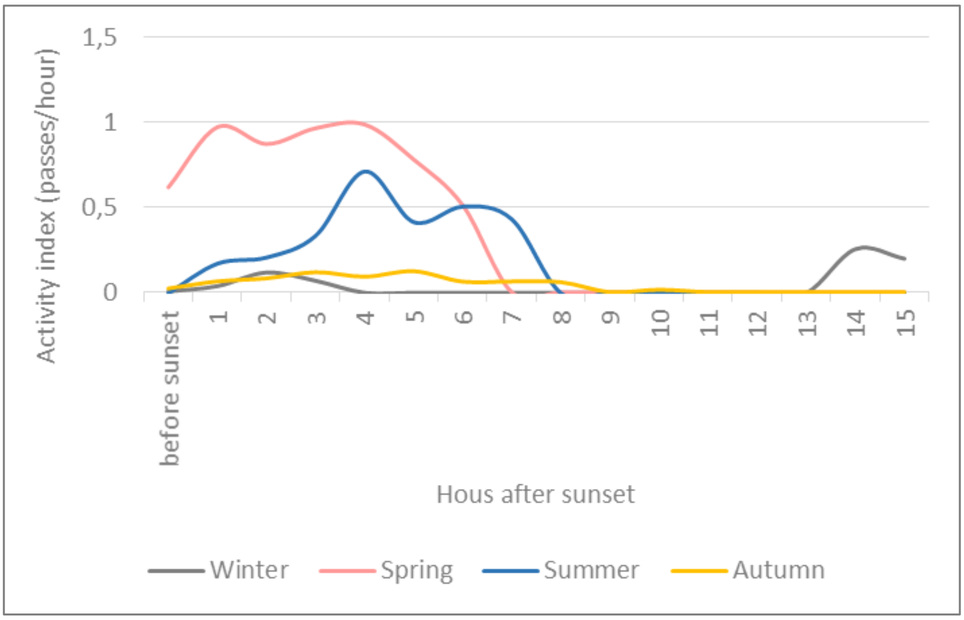



**Figure 19 - Average number of passes per hour after sunset (activity index) per season at rotor height at Kudusberg WEF site.**

### 3.3.3. Influence of Environmental variables

Since bat activity depends on environmental conditions, such as temperature and wind speed, it is important to analyse the possible influence of these factors on bat activity and how their fluctuation may help predict bat activity patterns in the study area.

Analysing the influence of wind speed on bat activity (Figure 20), no apparent influence of wind speed is detected for the average of all seasons (black dotted line) as bat activity was more or less steady at the different wind speeds registered. However, there are evident differences between seasons, since the peaks of activity occurred at different wind speeds, as in autumn and summer the peaks are at lower wind speed (under 7 m/s), while in winter there was a peak of activity at higher wind speed (16 m/s). In spring the highest bat activity indexes were observed at, approximately, 3 and 14 m/s of wind speed.

Therefore, cumulative indexes in Figure 21 show that 50% of the overall activity during spring and summer occurs at wind speed between 5 and 6 m/s, while for autumn, this threshold is reached around 4 m/s. In winter, 50% of the bat activity is reached at 15 m/s.

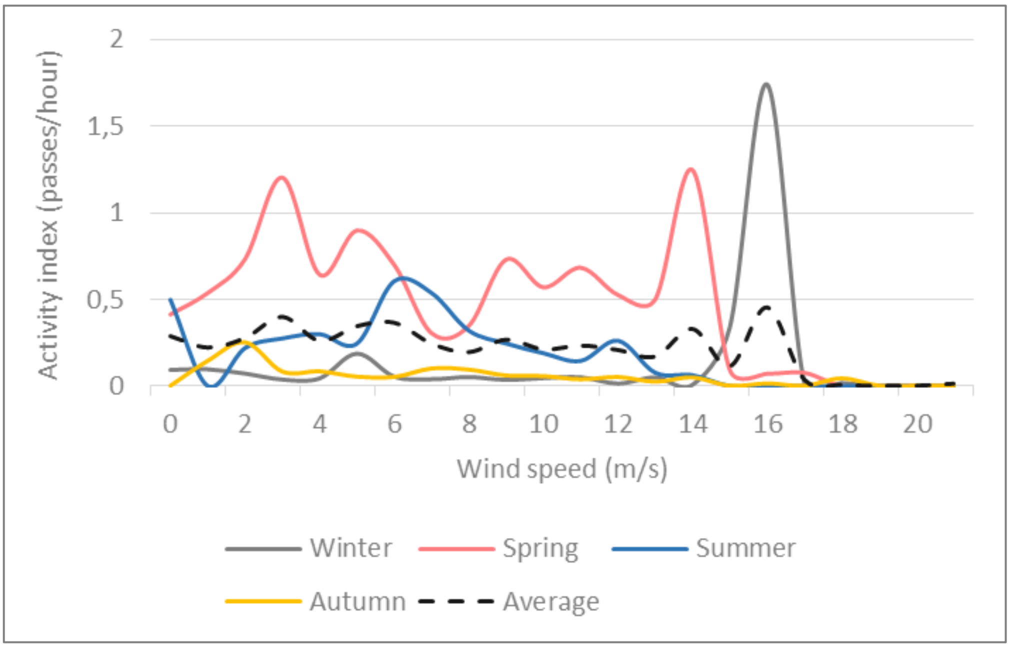



**Figure 20 - Average activity index (average number of bat passes/hour) at rotor height in relation to night wind speed per season (data from height detector).**

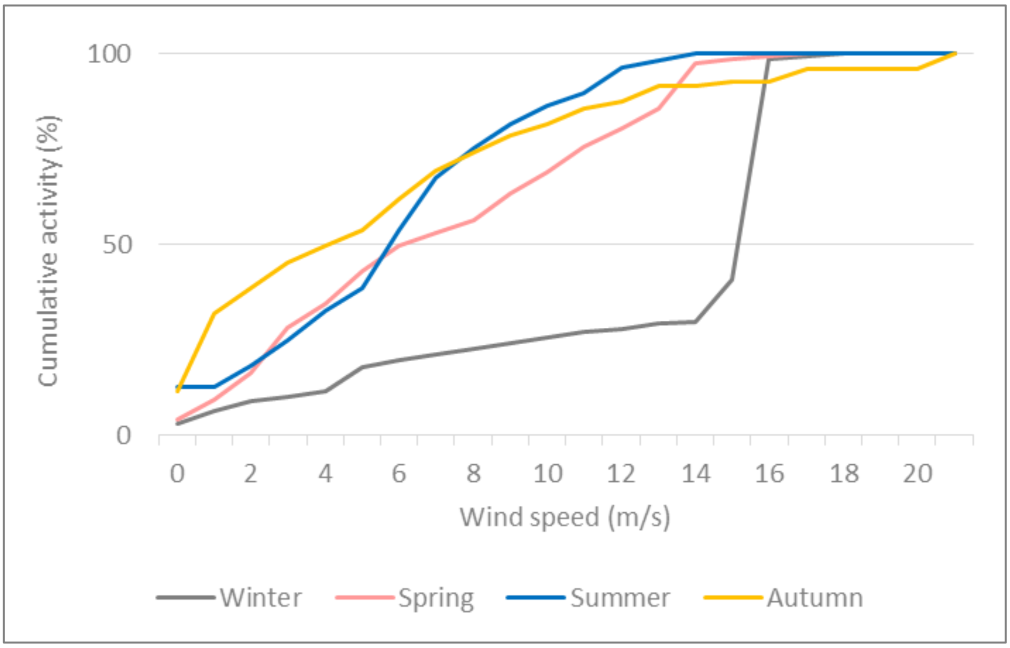



**Figure 21 - Cumulative activity index (cumulative number of bat passes/hour) at rotor height in relation to night wind speed per season (data from height detector).**

The analysis of Figure 22 considering air temperature influence on bat activity allows to retain a relationship between bat activity and night air temperature: in spring the bat activity peaks at low temperatures (3 to 4 °C) and decreases rapidly after those temperatures, while the other three seasons only have consistent activity indexes above 11 °C.

Cumulative activity indexes analysis indicates that 50% of the activity observed in autumn, summer and winter occurs at temperature between 20 to 23 °C, while the activity in spring reach this threshold at 11 to 12 °C (Figure 23).

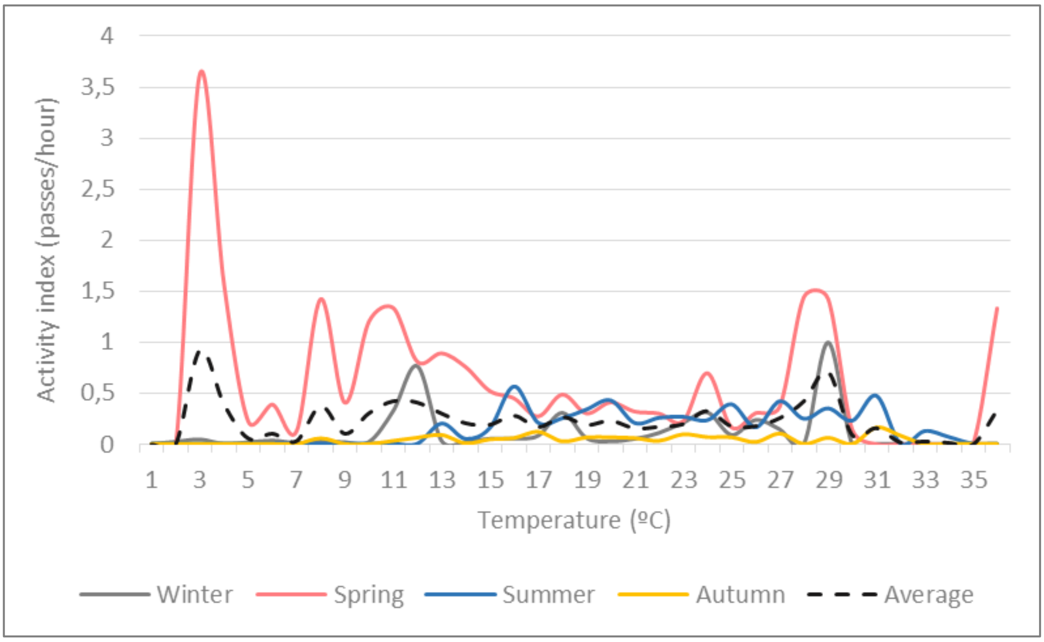



**Figure 22 - Average activity index (average number of bat passes/hour) in relation to night air temperature per season.**

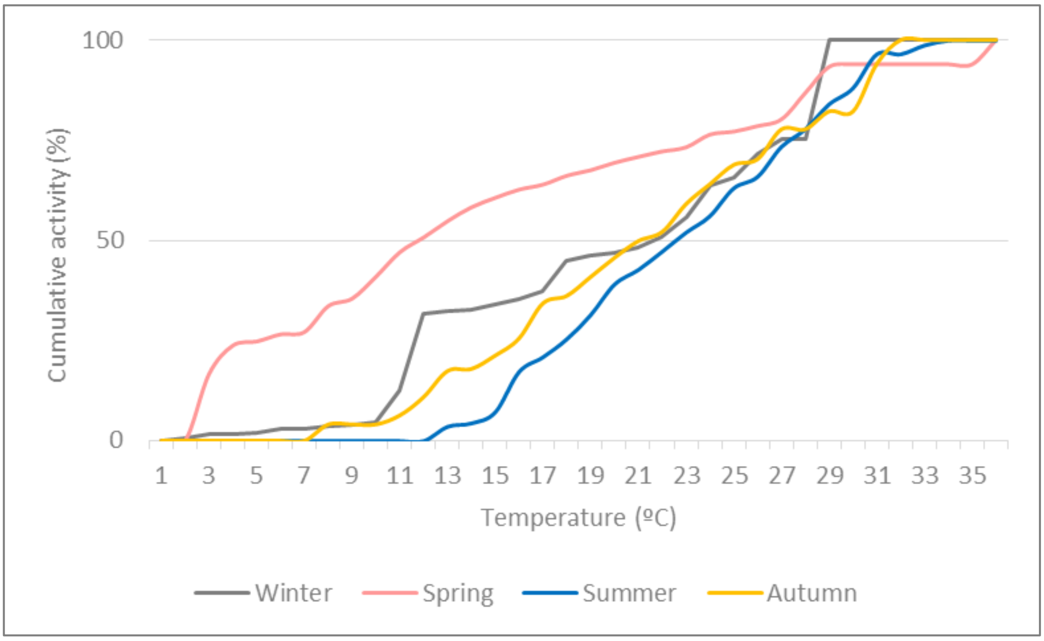



**Figure 23 – Cumulative activity index (cumulative number of bat passes/hour) in relation to night air temperature per season.**

## 3.4. Use of roosts

Any location representing a potential bat roost (i.e. buildings, rock crevices and cracks, trees) was searched for and inspected within the Kudusberg WEF and surroundings. During the pre-construction monitoring programme, a total of 9 locations were identified and inspected, 4 of them located in the proposed Kudusberg WEF area (Figure 24). Most of these locations are farms and buildings (Table 8).

Bat calls were detected in all the potential roosts identified and trough the bat call analysis it was possible to identify the presence of *Miniopterus natalensis* and *Nycteris thebaica* in the RORK01 and the presence of *Neoromicia capensis* in the RORK02. Also, it was founded guano in the roosts ROKD01 and RORK01, and individuals were observed (unidentified species) at roosts ROKD03, RORK04 and RORK05 (Table 8).

**Coordinates of Roosts:** ROKD01 (32°53'34.34"S | 20°18'9.51"E), ROKD02 (32°53'19.36"S | 20°16'8.21"E), ROKD03 (32°53'26.67"S | 20°16'56.50"E), ROKD04 (32°53'44.74"S | 20°19'48.75"E), RORK01 (32°39'33.60"S | 20°22'5.68"E), RORK02 (32°41'46.95"S | 20°21'55.81"E), RORK03 (32°44'36.86"S | 20°21'40.82"E), RORK04 (32°37'8.54"S | 20°27'14.41"E), RORK05 (32°41'37.99"S | 20°21'53.47"E).

During the construction activities precaution measures should be taken to prevent the destruction of this bats roost.

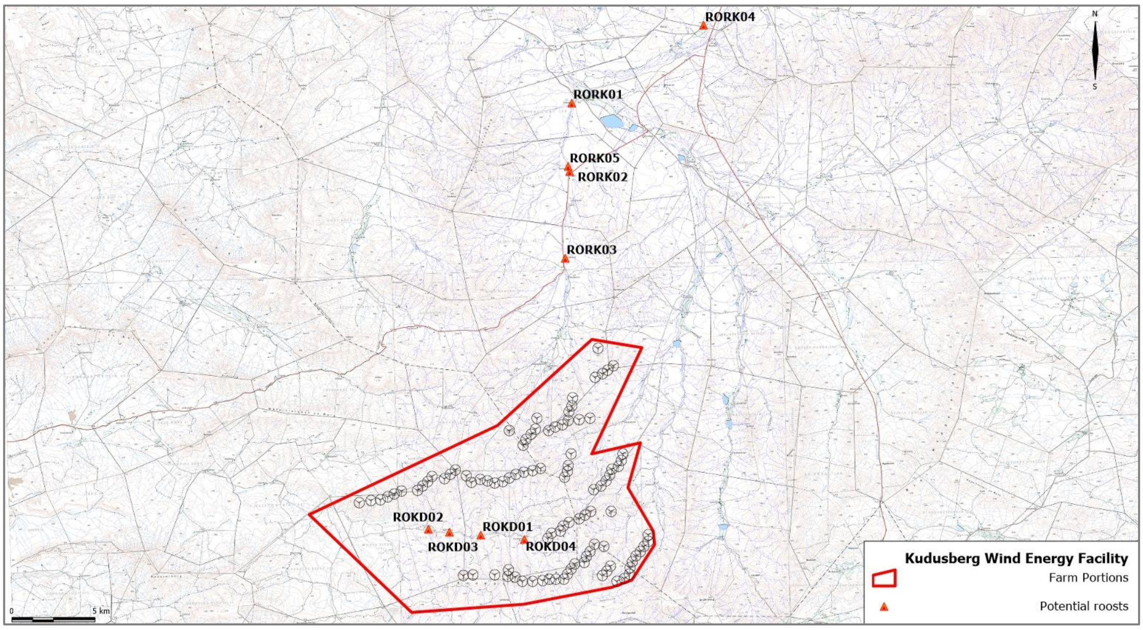



**Figure 24 - Searched locations for bat roosts monitoring at Kudusberg WEF.**

Table 8 – Structure with bat occupation, identified during field work at Kudusberg WEF and surrounding area.

| Roost reference | Traces identified | Photos |
|---|---|---|
| RORK05 | Individuals |  |
| RORK04 | Individuals |  |
| ROKD03 | Individuals |  |
| ROKD01 | Guano |  |

| Roost reference | Traces identified | Photos |
|---|---|---|
| RORK01 | Guano |  |

## 3.5. Sensitive areas analysis

At macro level, there are no known features considered to have relevant importance for bats in the broader area of the proposed Kudusberg WEF development area. As referred in section 3.1.3, the closest known roost is located at approximately 100 km from the site (Montagu Guano Cave).

At WEF site level, activity in the area is considered to be **low at ground and rotor level.** The general area of the site is being used by sensitive species, with a medium to high risk of collision with wind turbines (e.g. Natal long-fingered bat, Cape serotine and the Egyptian free-tailed bat). The mountains and ridges present throughout the site supply many rock crevices suitable for bat roosts, however the roosts identified within the proposed WEF area are all buildings identified to have potential to be used as roosts. It has been confirmed that the four roosts located within the proposed Kudusberg WEF area have bat occupation.

The general area of the proposed WEF, is classified as having **a low sensitivity** due to the very low activity observed during the 12-month monitoring. However, considering the presence of medium-high and high collision risk species, some precautionary measures are needed.

Therefore, **no-go** areas and other sensitive areas for bats are outlined in

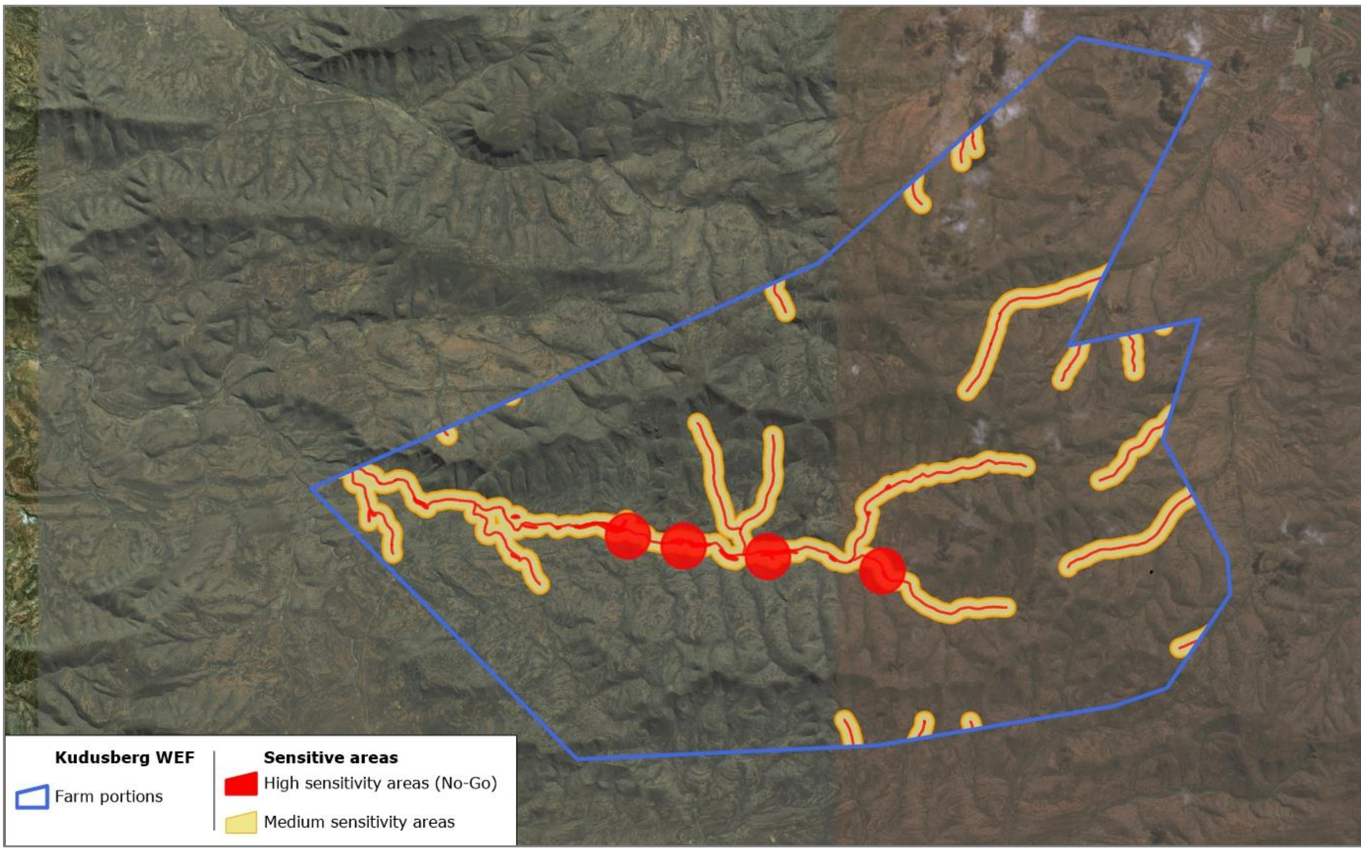



Figure 25 and follow the recommendation from the South African Bat Assessment Advisory Panel (SABAAP; *in* Sowler *et al.*, 2016). The no-go areas should exclude all new WEF-associated structures (wind turbines, roads, powerlines, sub-station infrastructures or other associated structures).

Considering the Best practice recommendations the sensitivity areas were delineated according to the buffer areas indicated in the "Bat Sensitivity Buffer Zone Recommendations" of the South African Bat Assessment Advisory Panel (SABAAP) (SABAAP 2013) and the fourth edition of the South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction:

- **Medium sensitivity** - 200m around all potentially bat important features:
    - Along water lines and associated riverine vegetation. Such features are important for bats, since they are likely to act as commuting routes, providing food resources, likely to be associated with higher bat activity, and likely to favour the occurrence of dispersion routes, besides local commuting routes. A 200m buffer was considered around those features. It is recommended that should new infrastructures (including roads and electrical infrastructures) cross these features (including buffers), then they should not be routed to run parallel with them, but rather cross them perpendicularly, as far as possible. Additionally, this avoidance recommendation will not include the use of existing roads, as long as they are not upgraded in such a manner that will re-route them (to be more parallel with the feature) within those buffered areas. However, no wind turbines or substations may be permanently placed within any of these buffered areas.

- **High sensitivity (No-Go):**
  - Confirmed Roosts. There are four confirmed roosts within the proposed Kudusberg WEF. During ultrasound monitoring and inspection of the roosts, it was confirmed that bats are using the identified buildings as roosts. While the number of individuals using the roosts remain relatively uncertain, we estimate that there are at least about 1-50 individuals, resulting in a 500m buffer, considering the known occurrence species with medium-high and high risk of collision with wind turbines. As such, no wind turbines, electrical infrastructure, substations or new roads may be permanently placed within the buffered areas. However, the use of existing roads may be used, as long as they are not upgraded in such a manner that will cause them to be re-routed and subsequently run more perpendicular to the roosts (and their buffered areas).

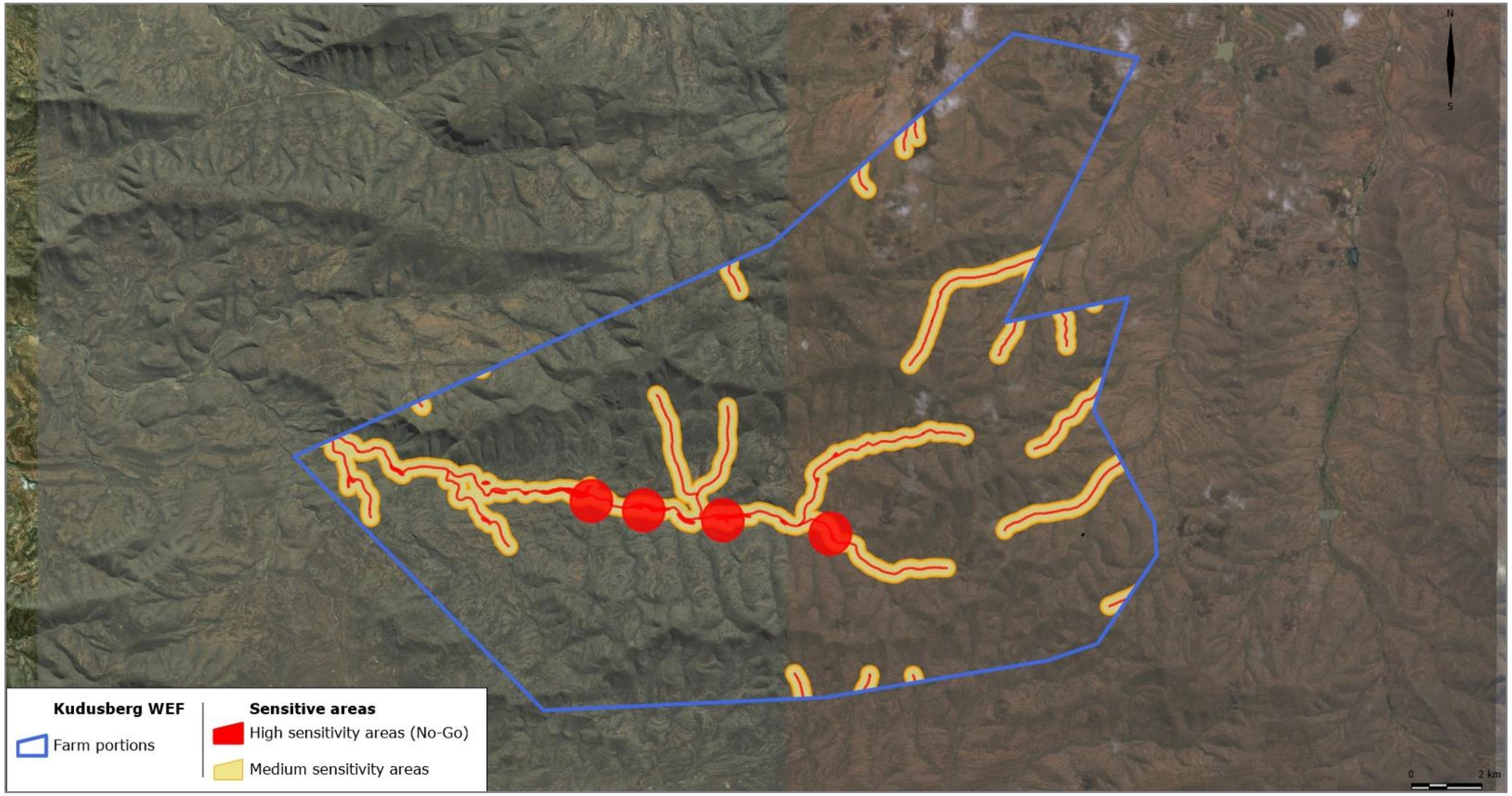



**Figure 25 – Sensitive areas for bats within the Kudusberg WEF.**

# 4. CONCLUSIONS

Results of the pre-construction bat monitoring indicate that the **bat activity at the proposed Kudusberg WEF area is in general low** considering the bat guidelines (Sowler *et al*., 2016).

One species with confirmed occurrence is perceived as having a potential high risk of collision with wind turbines (according to Sowler *et al*., 2016) due to their behaviour, i.e. *Tadarida aegyptiaca.* Two other species with confirmed presence in the area raise concerns regarding their probability of fatalities, as they have a medium-high risk of collision with wind turbines: *Neoromicia capensis* and *Miniopterus natalensis*. Additionally, *Miniopterus natalensis* is a migrant species that can use air space at rotor level during migration periods being prone to collision during these events.

According to pre-construction phase results, Kudusberg WEF is considered to be classified has having **low sensitivity**, **but with some areas in particular with medium and high sensitivity** due to the presence of specific features and habitat that may have an increased bat activity. These include the presence of potential roosts, as well as water lines which are important for bats, since they are likely to act as commuting routes, providing food resources, likely to be associated to a higher bat activity. For this reason, some recommendations are made to mitigate potential impacts mainly during layout definition phase, as well as construction and operational phase.

It is recommended that the no-go areas identified for the bat community should be excluded from development (excluding the use/upgrading of existing roads). Additionally, the areas considered as Medium sensitivity should be avoided as much as possible, but in line with the recommendations outlined in section 3.5.

# 5. ACKNOWLEDGEMENTS

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# 7. GLOSSARY

## Terminology

| | |
|---|---|
| **Acoustic bat survey** | Bat sampling conducted through recording and analysing echolocation calls. |
| **Active detection** | A method of recording echolocation calls whereby the researcher actively orients the bat detector to follow bats as long as possible in real time; this method generally results in higher quality pulses and longer call sequences than passive recording. |
| **Bat activity index** | A way of normalising data by dividing the number of bat calls by time. |
| **Bat detector** | Electronic device that converts the ultrasonic echolocation calls of bats into an audible or readable signal. |
| **Bat pass** | For the purpose of this study, a bat pass was considered as a sequence of more than 1 echolocation calls where the duration of each pulse is equal or greater than 2ms. |
| **Barotrauma** | Tissue damage to the lungs caused by rapid or excessive changes in pressure. |
| **Call sequence** | A series of bat echolocation call pulses. |
| **Cut-in wind speed** | The lowest wind speed at hub height at which the wind turbine starts to produce power. |
| **Echolocation** | The ability of bats and some other animals to orient themselves and locate obstacles and their prey using echoes from sound emitted, typically from the mouth or nostrils. |
| **Endemic species** | Species that are restricted to southern Africa. |
| **Frequency** | The "pitch" of a sound (high or low), determined by the number of wavelengths per second, measured in Hertz (1 Hz=1cycle per second. |
| **Insectivorous** | Species that feed exclusively from insects. |
| **Passive detection** | A method of recording echolocation calls whereby the researcher is absent and a bat acoustic detector is placed at fixed position and left operational for long periods of time (usually over 1-month period); this method provides great amounts of data and allows to understand bat activity at a certain location over a full night for long periods of time, covering various environmental characteristics (good weather, bad weather, etc). |
| **Red data species** | A list of international (IUCN) as well as southern African threatened species. |
| **Sensitive species** | Species that aggregate a set of characteristics (higher risk of collision with wind turbines, specific habitat or ecological requirements, etc) and that are prone to be most affected by the project development. |

## Abbreviations

| | |
|---|---|
| **CITES** | The Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| **GIS** | Geographical Information System |
| **WEF** | Wind Energy Facility |
| **IUCN** | International Union for Conservation of Nature (Global conservation status) |
| **SA** | South Africa |

# 8. Appendices

## 8.1. Appendix I - Figures

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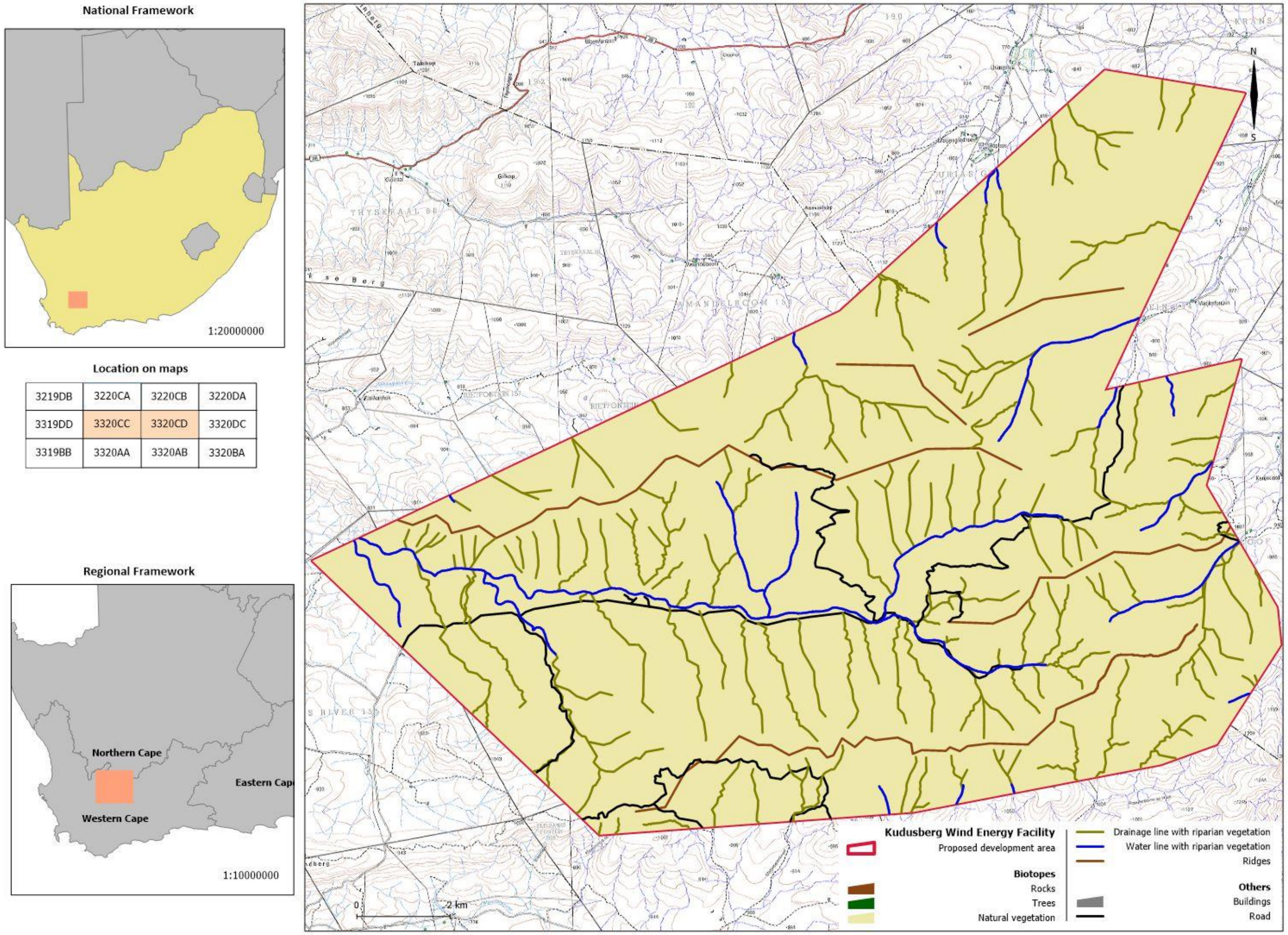


Figure 26 - Location of the proposed Kudusberg WEF and cartography of the area.

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