KHOE WIND ENERGY FACILITY: PRECONSTRUCTION BAT MONITORING

BAT SCOPING REPORT



OCTOBER 2023

energy TEAM

EkoVler

KHOE WIND ENERGY FACILITY: PRECONSTRUCTION BAT MONITORING BAT SCOPING REPORT

October 2023

Prepared for: *FE Hugo & Khoe (Pty)Ltd*
Attention: *Alex le Roux*

AUTHOR:
Stephanie C Dippenaar (MEM)
Stephanie Dippenaar Consulting trading as EkoVler
Professional Member of the South African Institute for Ecologists and Environmental Scientists (SAIEES)
sdippenaar@snowisp.com
Tel: +27 (0)21 880 1653
Cell: +27 (0)82 200 5244
VAT Number. 452027447

STATIC DETECTORS and FIELD WORK ASSITANT:
Inus Grobler (D.Eng.)

DATA ANALYSIS AND STATISTICAL SUPPORT:
Inus Grobler Jnr. (B.comm. actuarial science)

REPORT WRITING SUPPORT:
Madeleine de Wet (BSc.Hon)
Franky Nightingale (MA)

executive summary

Stephanie Dippenaar Consulting, trading as EkoVler, has been appointed by FE Hugo & Khoe (Pty) Ltd to conduct a bat study to feed into the EIA process for the proposed Khoe Wind Energy Facility (WEF). The project site is located west and east of the R318, the road between Montagu and De Doorns. It is situated within the Breede Valley and Langeberg Local Municipalities within Cape Winelands District Municipality of the Western Cape Province.

Bat monitoring started in December 2022, when the Met mast was installed and this report details the data collected between 30 December 2022 and 12 August 2023. The monitoring systems deployed within the study area consist of six Wildlife Acoustics SM4BAT full spectrum bat detectors, recording data from the met mast at 100 m, 50 m and 10 m, as well as from three temporary 10 m masts. This allows for coverage of all the biotopes in the area. During fieldwork, physical surveys are conducted to identify the location of possible roosts. Interviews were also conducted with people staying on-site or close to the site, to establish if they are aware of any roosts in the vicinity, or general bat occurrences.

The proposed study area falls within the Fynbos Biome, with the following main vegetation types being represented on site: Matjiesfontein Shale Renosterveld, North Langeberg Sandstone Fynbos and South Langeberg Sandstone Fynbos. There are several areas of conservation value in the region of the proposed Khoe WEF, but none of these borders the proposed wind farm. The nearest registered reserve, the Bokkeriviere Nature Reserve, is situated approximately 20 km in a northwesterly direction from the Khoe WEF. Two Mountain Catchment Areas are situated very close to the proposed Khoe WEF site, the Matroosberg Mountain Catchment Area, approximately 5 km from the border of the Khoe WEF, and the Langeberg-Wes Mountain Catchment Area, approximately 15 km from the border of Khoe WEF.

There are numerous perennial as well as non-perennial water bodies. Not only could these provide water for bats to drink, but stagnant water could be a breeding ground for insects, which in turn attracts bats. Rock formations along the hilltops and the river valleys and several human dwellings could provide ample roosting opportunities for bats. Mountainous areas surrounding the proposed site could have bat roosts, and bats from these neighbouring roosts, could traverse the proposed wind farm to forage and drink.

Of the 12 species with distribution ranges that include the proposed development area, four have a conservation status of Near Threatened in South Africa and one Vulnerable, while three have a global conservation status of Near Threatened.

According to the likelihood of fatality risk, as indicated by the latest pre-construction guidelines (MacEwan, 2020) six species, namely *Miniopterus natalensis* (Natal long-fingered bat), *T. aegyptiaca* (Egyptian free-tailed), *S. petrophilus* (Roberts's flat-headed bat), *L. capensis* (Cape serotine) and the two Pteropodidae species (fruit bats) have a high risk of fatality, while *Mytois tricolor* (Temminck's myotis bat) has a medium-high risk and the endemic *E. hottentotus* has a medium risk of fatality.

Calls like five of the 12 species that have distribution ranges overlaying the proposed development site were recorded by the static recorders. 63% of the calls were from *Neoromicia capensis (Laephotis capensis)*, which is the dominant species on site. The second highest percentage of calls were from *Tadarida aegyptiaca* (28%), which is physiologically adapted to flying high and is thus at high risk of fatality, followed by the global as well as regional Near Threatened *Miniopterus natalensis* (7%), then *Sauromys petrophilus* (1%) and the endemic *Eptesicus hottentotus* (1%).

In total, nearly 100% of the bats recorded at the two high systems on the met mast (Systems D and E) belong to the two Molossidae species, *T. aegyptiaca* and *S. petrophilus*, while activity by *Neoromicia capensis (L. capensis)* is more active at the 10 m systems. When the present data is considered bat activity as well as species diversity are higher at lower altitudes at the proposed wind development.

Weekly temporal distribution of bat activity over the monitoring period generally indicates higher activity during the warmer summer months with low activity in winter. Activity peaks in March and remains relatively high during April and May, with a sharp decline in June. Very little activity occurs in July and August, during the colder winter months.

The nightly bat activity per hour over the monitoring period indicates that activity across all the systems increases at sunset, with a gradual incline in activity about an hour after sunset. Most systems peak in activity at approximately an hour after sunset (10 m Mast G) or approximately two hours after sunset (100 m Mast D, 10 m Mast I, 50m Met E, 10m Mast H). The exception to this is 10m Met Low (F) which portrayed a peak after midnight. Mostly bats at Khoe remain active up to the early morning hours, when they are returning to their roosts before sunrise. Very little activity is recorded at sunrise.

Although the species diversity was quite similar when comparing each system's median at 100 m (D) and 50 m (E), the difference in bat activity between 100 m and 50 m, when compared, can be seen, with higher activity recorded at 50 m. System D, situated at 100 m, portrays lower activity when compared to System E, at 50 m, while the four 10 m systems (F, G, H and I) all recorded higher activity than the two systems at height (D and E), indicating a decrease in activity with altitude. The difference between 10 m Systems F, G and H is minimal, with System I indicating the lowest activity and System H the highest activity when comparing the 10 m systems.

Data from Systems D and E are of particular importance, as these systems are situated within the sweep of the turbine blades and recorded mainly activity from the high-flying *T. aegyptiaca.* If present data of operational wind farms are considered, this species has the highest risk of fatality. The final report will provide a more complete picture of the whole monitoring period, indicating possible mitigation measures to curb predicted bat activity, if necessary.

A preliminary bat sensitivity map was compiled with the available data up to now. The bat sensitivity zones still need to be refined, incorporating data from the whole monitoring year; Therefore, there will be some changes in sensitivity zones.

In general, there are no red flags at this stage that suggest that the development could not progress to the next phase. However, this can only be confirmed when 12 months of bat monitoring has been considered. Correlations between bat data and weather conditions will be included in the final bat monitoring report.

contents

figures

tables

List of Abbreviations

BA	Basic Assessment
BESS	Battery Energy Storage System
CBA	Critical Biodiversity Area
CDF	Cumulative Distribution Function
COD	Commercial Operation Date
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
IPP	Independent Power Producer
IRP	Integrated Resource Plan
Kv	Kilovolt(s)
MET	Meteorological
Ms	Milliseconds
MW	Megawatt(s)
REDz	Renewable Energy Development Zone
REF	Renewable Energy Facility
PV	Photovoltaic
WEF	Wind Energy Facility
SABAA	South African Bat Assessment Association
SSVR	Site Sensitivity Verification Report

Glossary

Definitions	
Bat monitoring systems	Ultrasonic recorders used to record bat calls
Torpor	A state of physical inactivity associated with lower body temperature and metabolism
SM_4BAT	Wildlife Acoustics' full spectrum ultrasonic bat monitoring recorder
$SMMU_2$	Wildlife Acoustics' ultrasonic microphones for recording bat sounds
Threshold	Bat activity threshold as provided by SABAA

KHOE WIND ENERGY FACILITY

PRECONSTRUCTION BAT SCOPING REPORT

This report serves as the Bat Specialist Assessment that was prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed development of the Khoe Wind Energy Facility (WEF). Khoe Wind Energy Facility (WEF) is located west and east of the R318, the road between Montagu and De Doorns, and is situated within the Breede Valley and Langeberg Local Municipalities within Cape Winelands District Municipality of the Western Cape Province.

1. INTRODUCTION

Stephanie Dippenaar Consulting, trading as EkoVler, has been appointed to conduct a minimum of 12 months' bat study for the proposed Khoe Wind Energy Facility (WEF) by FE Hugo & Khoe (Pty)Ltd, South Africa. Bat monitoring started in December 2022, when the Met mast was installed, and the last data was collected on 13 August 2023.

This progress report comprises the following sections:

- Section 1: Introduction, which contains the Scope and Objectives, Details of the Specialist, and Terms of Reference.
- Section 2: Approach and Methodology, including all Information Sources, Assumptions, Knowledge Gaps and Limitations.
- Section 3: Description of Project Aspects Relevant to Bat Impacts.
- Section 4: Baseline Environmental Description, including a General Description, Project Specific Description, and Identification of Environmental Sensitivities.
- Section 5: Identification of Potential Risks/Impacts.

The proposed wind farm is situated on the following farm portions:

- Eendragt 1(RE)38, 2/38, 11/38 and RE/37;
- Plaas 193.

This report provides an overview of the scoping exercise and progress of the bat monitoring programme at the Khoe Wind Energy Facility, hereafter referred to as Khoe WEF. More detailed statistical analysis of bat activity, such as results plotted against weather conditions, will be included in the final bat monitoring report.

1.1 Scope of the Work

This assessment forms part of an environmental assessment being undertaken by Environmental Resource Management (ERM) in terms of the Environmental Impact Assessment process. It presents the results undertaken up to August 2023, to predict the potential risk to the resident and migratory bats associated with the proposed development.

The study aims to present baseline information on bats that occur at the proposed Khoe WEF site to inform the mitigation strategies for the final design, construction, and operational phases. These mitigation strategies aim to avoid or reduce potential direct, indirect, and cumulative impacts associated with the proposed development. The primary impact on bats due to WEFs is fatality, due to bat collision with turbines or barotrauma. In addition, potential risks include habitat displacement and habitat loss.

The objective of collecting and providing the baseline environmental information is to present the nature of potential impacts of the proposed project during the construction, operation and decommissioning phases, as well as the mitigation and enhancement measures to avoid or minimise potential impacts to bats.

As knowledge in this field of study is growing and new evidence is constantly gained from currently operating WEFs, mitigation and enhancement options may be adjusted as this project develops.

1.2 Details of Specialist

This specialist assessment has been undertaken by Stephanie Dippenaar Consulting trading as EkoVler. Stephanie has been registered with SAIES since 2002 and her SACNASP registration is in process, see Appendix 1.

Stephanie Dippenaar has a track record of involvement in environmental management since 1991, and in particular environmental assessments, since 2003, See Appendix 2. She has managed several renewable energy EIAs and has since 2010 started to specialise in bats. Stephanie has done some of the first bat studies for wind energy developments in South Africa and is at present involved in several pre-construction as well as operational bat monitoring studies. She is the owner of EkoVler and although the business officially only consists of one specialist, she has a good working relationship with several sub-contractors, see page 2 of this report for involvement in this study.

Stephanie is a steering committee member of SABAA (South African Bat Assessment Association) and an active member of the National Bat Rescue Group. Dr Inus Grobler (D.Eng) provides technical support related to equipment and Inus Grobler Jr. (B.Com), a data analyst, supports statistical analysis of data.

1.3 Terms of Reference

The *South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities* (MacEwan, et al., 2020) guides the bat monitoring process. Based on these guidelines, acoustic monitoring of the echolocation calls of bats was used to determine the seasonal and diurnal activity patterns of bats at the proposed Khoe WEF. The following South African guideline documents were used in conjunction with the Pre-Construction Guidelines:

- Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (Aronson, et al., 2020);
- Mitigation Guidance for Bats at Wind Energy Facilities in South Africa (Aronson, et al., 2018); and
- South African Bat Fatality Threshold Guidelines (MacEwan, et al., 2018).

The following Terms of Reference are applicable to the monitoring exercise, as informed by the most current Pre-Construction Guidelines:

- Gathering information on bat species that inhabit the site, noting higher, medium, or lower risk species groups; as indicated in Table 4, p16, of the Guidelines (MacEwan, et al., 2020);
- Recording relative frequency of use by different species throughout the monitoring year;

- Monitoring spatial and temporal distribution of activity for different species;
- Identifying locations of roosts within and close to the site;
- Collecting details on how the surveys have been designed to determine the presence of rarer species; and
- Describing the type of use of the site by bats; for example, their relative position from the turbine locations in terms of foraging, commuting, migrating, and roosting, as can be observed through the monitoring data and site visits.

2. APPROACH AND METHODOLOGY

The methods for the investigation of bats at the proposed WEF development site are described below.

2.1 Desktop investigation of the development area as well as the surrounding environment

A desktop study was undertaken of the site, using the information provided by FE Hugo & Khoe (Pty)Ltd, as the developer**,** as well as information gathered through a literature review. Conservation areas in the vicinity were investigated and information from other developments in the area, particularly renewable energy projects and wind farms, were noted to discuss cumulative effects in the upcoming EIA report. Relevant guidelines and legislation were also consulted. The study area was visited to further inform the background assessment of the site. During seasonal fieldwork sessions, physical surveys were conducted to identify the location of possible roosts. Interviews were also conducted with people staying on site or close to the site, to establish if they are aware of roosts in the vicinity, or general bat occurrences.

2.2 Static Acoustic Monitoring

Static monitoring, using automated bat detector systems, provided invaluable data about the bats present on the site. The number of detectors required was calculated based on the surface area of the proposed site and the various biotopes. Measurements were taken at various fixed locations and varying altitudes, as representative of the area in general and of each biotope present within the proposed study area (**Error! Reference source not found.**). Static monitoring is essential in assessing the relative importance and temporal changes of features, locations, and potential migratory routes (MacEwan, et al., 2020). The monitoring systems deployed in the study area consist of six Wildlife Acoustics SM4BAT full spectrum bat detectors powered by 12V 7 Amp-h sealed lead acid batteries replenished by photovoltaic solar panels Each detector was set to operate in continuous trigger mode from dusk each evening until dawn. Times were correlated with latitude and longitude, to trigger half an hour before sunset. The trigger mode setting for the bat detectors, which record frequencies exceeding 16kHz and -18dB, was set to record for the duration of the sound, and 1000 ms after the sound ceased. This period is known as the trigger window.

The data from these recorders are downloaded every three to four months and analysed to provide an approximation of the bat frequency and diversity of species that visit and/or inhabit the site.

Table 1. Two SD memory cards, class 10 speed, with a capacity of 64 GB or 128 GB each were utilized in each detector to ensure substantial memory space with high-quality recordings, even under conditions of multiple false environmental triggers.

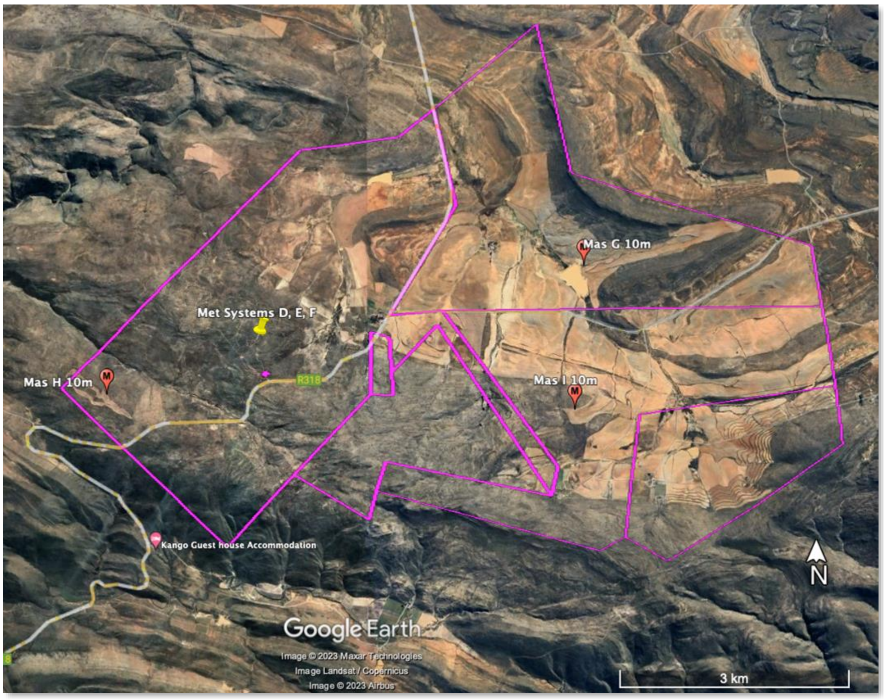

Figure 1: Position of bat monitoring systems.

Figure 2: Systems deployed on the Met mast.

Each detector was set to operate in continuous trigger mode from dusk each evening until dawn. Times were correlated with latitude and longitude, to trigger half an hour before sunset. The trigger mode setting for the bat detectors, which record frequencies exceeding 16kHz and -18dB, was set to record for the duration of the sound, and 1000 ms after the sound ceased. This period is known as the trigger window.

The data from these recorders are downloaded every three to four months and analysed to provide an approximation of the bat frequency and diversity of species that visit and/or inhabit the site.

Table 1: Summary of Passive Detectors deployed at the proposed Khoe WEF

Detector	Position	Coordinates	Micro-phone	Division ratio	High pass filter	Gain	Format	Trigger window	Calibration (on chirp) when the mic was installed
SM4BAT (Met D)	Met mast: mic at 100 m	33°35’58,69” S 19°50’59,90” E	SMM-U2	8	16kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-7,9 dB at the microphone
SM4BAT (Met E)	Met mast: mic at 50 m	33°35’58,69” S 19°50’59,90” E	SMM-U2	8	16kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-8,5 dB at the microphone
SM4BAT (Met F)	Met mast: mic at 10 m	33°35’58,69” S 19°50’59,90” E	SMM-U2	8	16kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-8,2 dB at the microphone
SM4BAT (Mast G)	Temporary mast: mic at 10 m	33°34’50,20” S 19°52’02,50” E	SMM-U2	8	16kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-51 dB at 10m
SM4BAT (Mast H)	Temporary mast: mic at 10 m	33°36’21,50” S 19°49’44,30” E	SMM-U2	8	16kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-57 dB at 10 m
SM4BAT (Mast I)	Temporary mast: mic at 10 m	33°36’27,40” S 19°53’40,60” E	SMM-U2	8	16kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-60 dB at 10 m (strong wind)

The position of the Met mast was determined by the developer and the bat monitoring systems on the Met mast represent the biotope associated with the undulating hills covered by North Langeberg Sandstone Fynbos (SANBI, 2012), while the positions of temporary bat monitoring masts were selected based on the representation of different biotopes, proximity to possible bat conducive areas, and accessibility to install a mast and download data. Locations of the monitoring systems shown in **Error! Reference source not found.** are motivated as follows:

- *System G; 10 m Mast*: Originally this system was placed east of the 318 road, as a large part of the site was eliminated by buffers created during the avifaunal study. When clarity was provided concerning these buffers, the development area was larger than originally expected. During the second fieldwork session, in April 2023, Mast H was then shifted to the other side of the R318, to increase representation of the whole site. The biotope was the same, and the system was placed close to a large farm dam, with cultivated cereal land in close vicinity, and in Matjiesfontein Shale Renosterveld, as was the case with the previous position.

- *System H; 10 m Mast:* This monitoring system was placed on the border of North Langeberg Sandstone Fynbos and South Langeberg Sandstone Fynbos, and is situated next to a valley, in disturbed cereal cropland. A dam is situated in the valley, which could serve as a flight corridor for bats, while rock formations along the valley could provide roosting opportunities. The area is used for livestock grazing, and one often experiences more insect activity when livestock is present.

- *System I; 10 m Mast:* Mast I, situated in Matjiesfontein Shale Renosterveld, represents the southern part of the terrain. The system was placed next to derelict cultivated cereal land with ridges towards the south. A non-perennial ditch, where water might collect during rainy spells, is found east of System I.

The location of the monitoring systems is shown in Figure 1, and the monitoring equipment on the Met mast is depicted in Figure 2.

2.3 Roost Surveys

Roost surveys were conducted when the bat specialist visited the site. While areas, where possible roosts could be situated, were investigated, all roosting areas are not accessible as bats sometimes roost in crevices or roofs with limited ceiling space. When day roosts are identified, bat counts are conducted at sunset and if deemed necessary, detectors are installed for short periods at point sources to monitor roosts. It should be noted that the site is large and roost searches are concentrated in areas where one would expect bats to roost. Within the 12 months and limitations of the bat monitoring study, some bat roosts might not be discovered. Up to now, no roosts have been discovered yet.

2.4 Manual Surveys – Driven Transects

Less emphasize are given to transects in the current guidelines, while more focus is placed on pointe sources. Manual activity surveys, such as driven transects, could provide additional spatial understanding of the bat species utilising the site. This is especially the case for the identification of key features, potential commuting routes, and overall activity within and surrounding the site. Transects complement static monitoring surveys in terms of spatial coverage. No transects have been performed during the scoping phase, but transects will be conducted in the upcoming summer season.

A SM4BAT full spectrum recorder with the microphone mounted on a pole is used for transects. Starting at sunset up to approximately two hours after sunset, the vehicle was driven at a speed between 10 to 20 km/h along a set route. As far as possible, transect routes were kept the same to allow for the comparison of data.

2.5 Point sources

A SM4BAT full spectrum recorder are used during point sources, where the detector is placed for one night at a place where there is expected to be optimum bat activity. In March a detector was placed next to a large farm dam, close to the Sandvlei dwellings. Up to now weather was quite cold during site visits. Bats are more active during warmer weather and more point source recordings will be conducted during the summer of 2023 and 2024.

2.6 Data Analysis

Data was downloaded manually approximately once every three to four months. Acoustic files downloaded from the detectors were analysed for bat activity with respect to the bat activity and the bat species. The latest version of Wildlife Acoustics Kaleidoscope Pro was used for analysing large quantities of data. In cases where there was uncertainty about details of a call (which is confirmed as a bat calling), the call was classified as Unclear.

2.7 Information Sources

The following information sources were used to inform this study:

- South African Bat guidelines as prescribed by the South African Bat Assessment Association, particularly South African Good Practice Guidelines for Surveying Bats in Wind Energy Facility Developments – Pre-construction Monitoring of Bats at Wind Energy Facilities. MacEwan *et al.* 2020.
- Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. University of the Witwatersrand, Johannesburg. Monadjem *et al*. 2010, as well as the 2020 editions.
- Academic references and papers, as per the reference list (Section 13).
- Climate and precipitation data sourced from various websites: AccuWeather; Meteoblue; Climate.org, MSN.com, World Weather Online, Yr.no.

Environmental and other related Legislation:

- Department of Forestry, Fisheries and the Environment: https://egis.environment.gov.za/data_egis/data_download/current South African Energy Integrated Resource Plan 2010-2030 promulgated 3/2011 (www.Energy.gov.za)

Personal conversation:

- Regular personal conversations were conducted with the landowners of the proposed WEF site during fieldwork sessions, to establish if they were aware of any bat roosts on the properties and whether there are certain times of the year when there is higher bat activity on the proposed site.

Process information sourced from the client:

- Satellite images.
- Google Earth: https://www.google.com/earth/download/html.

Vegetation:

- Red List of South African Plants (SANBI).
- South African National Biodiversity Institute (SANBI), 2012: Vegetation Map of South Africa, Lesotho and Swaziland [vector geospatial dataset] 2012. Available from the Biodiversity GIS website: http://bgis.sanbi.org/SpatialDataset/Detail/18
- The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South African National Biodiversity Institute, Pretoria. Mucina, L., and Rutherford, M.C., 2006.

2.8 Assumptions, Knowledge Gaps and Limitations

The following limitations apply to this study:

Knowledge of various ecological aspects and behaviours, such as migration distances, flying height, population sizes, temporal movement patterns, etc., of several South African species is limited. Consequently, the knowledge of the impact of WEFs on such bat species also has limitations.

Monitoring bats with acoustic detectors is an internationally accepted method to assess bat activity levels and species richness; however, the use of bat detectors has limitations. Acoustic monitoring can only provide an estimate of relative bat activity levels and, as the same individual could pass the detector more than once, does not provide total population estimates of how many individuals are present on site.

Due to an overlap of calls, it is not possible to provide an exact number of bats passing the recorder. Therefore, the number of bats passing is not an exact count, but rather indicates activity, and is as close as possible under the given circumstances and within the limitations of the survey technique applied.

The recording of echolocation calls is dependent on the species being recorded as some species emit 'softer' calls than others, and weather conditions, low humidity and high wind speeds will reduce recording distance as it attenuates call intensity. Therefore, any monitoring based on echolocation calls covers only a limited area, depending on the type and intensity of the call.

The accuracy of the species identification is also dependent on the quality of the calls. Species identification through echolocation calls is complex. Bats alter the frequencies and durations of their calls based on whether they are feeding, commuting, or migrating. They may also alter call characteristics based on the habitat and surrounding vegetation. There are several species with overlapping frequencies that make identification challenging. For this study, if the species of a recording is unidentifiable, the species identification of the recording is marked as 'unclear'. Recordings for which the species identification was 'unclear' were still included in the analyses.

Transects only provide a snapshot in time and do not convey information about the long-term spatial distribution of bat activity across the project site. However, transects are useful in eliciting areas or periods of high activity for the duration of the site visit.

Bats can roost in tiny spaces, and one could easily miss some roosts where the study area comprises thousands of hectares; However, the project site was driven and walked through as thoroughly as possible, keeping in mind the time constraints of an environmental assessment.

The data collected during this study provided a baseline of bat activity across the project site for the relevant monitoring period. Future bat activity patterns and inter-annual variations could differ, and as such, bat activity in the future could vary substantially from the results presented here.

3. BASELINE ENVIRONMENTAL DESCRIPTION

The Khoe WEF site is located on farmland southeast of De Doorns and southwest of Touws River, in the Western Cape Province. The centre coordinates of the proposed wind farm site are 33°31'41.39" S and 19°52'4.52" E. The project is in proximity to the Hexrivier valley; however, the Khoe farm itself is situated on a plateau, which then descends into the Karoo, beyond the Khoe development towards the east. The terrain comprises an undulating landscape with mountainous areas towards the southwestern part of the site. Several non-perennial rivers are located on the proposed wind farm.

Figure 3: Locality map for the Khoe WEF.

3.1 General Description

3.1.1 Climate

The proposed Khoe WEF is situated on a plateau, which is occasionally called the "Agterveld". Most of the precipitation occurs in winter with a second rainfall that is often experienced from October to December. Seasonal snow occurs during winter.

Long-term climate data from the Matroosberg weather station, also situated on the plateau, is used for a general climate description for the Khoe WEF. Generally, January and September are the driest months, with an average of 14 mm of rainfall. April, with an average rainfall of 35 mm, is the peak rainfall month (see Figure 4 below). There is a difference of approximately 21 mm between the wettest and driest months (meteoblue.com, 2023).

The average maximum temperature is 29°C and the average minimum temperature 4°C, while the highest maximum recorded temperature is 36°C, and the lowest minimum is 0°C. The hottest months of the year are January and February, while the coldest month of the year is July (meteoblue.com, 2023). Bat activity is expected to be higher during months that display relatively higher temperatures, with lower wind speeds.

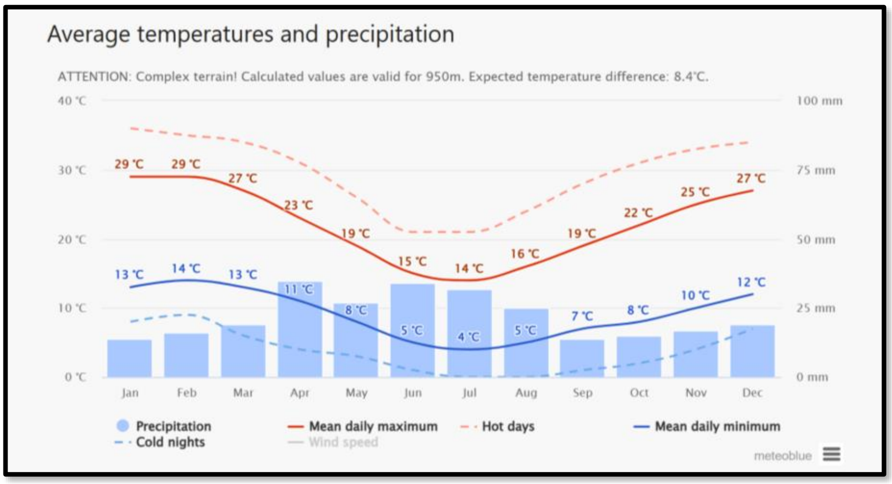

Figure 4: Climate of the Matroosberg weather station (meteoblue.com, 2023).

3.1.2 Vegetation

The proposed study area falls within the Fynbos Biome, with the following main vegetation types being represented on site: Matjiesfontein Shale Renosterveld, North Langeberg Sandstone Fynbos and South Langeberg Sandstone Fynbos as portrayed in Figure 5 (SANBI, 2018). Fynbos, which has a high species diversity, typically grows in nutrient-poor soil.

While approximately only 85 000km^2, or 6.7%, of South Africa's surface area is covered by Fynbos, this biome has the highest species diversity (around 7500 species) in South Africa (van Wyk, 2001; UWC, 2022). The Fynbos biome is mostly limited to the Cape Floristic Kingdom, occurring in a typically cool winter rainfall area. This biome is in general considered 'high' in red data conservation species.

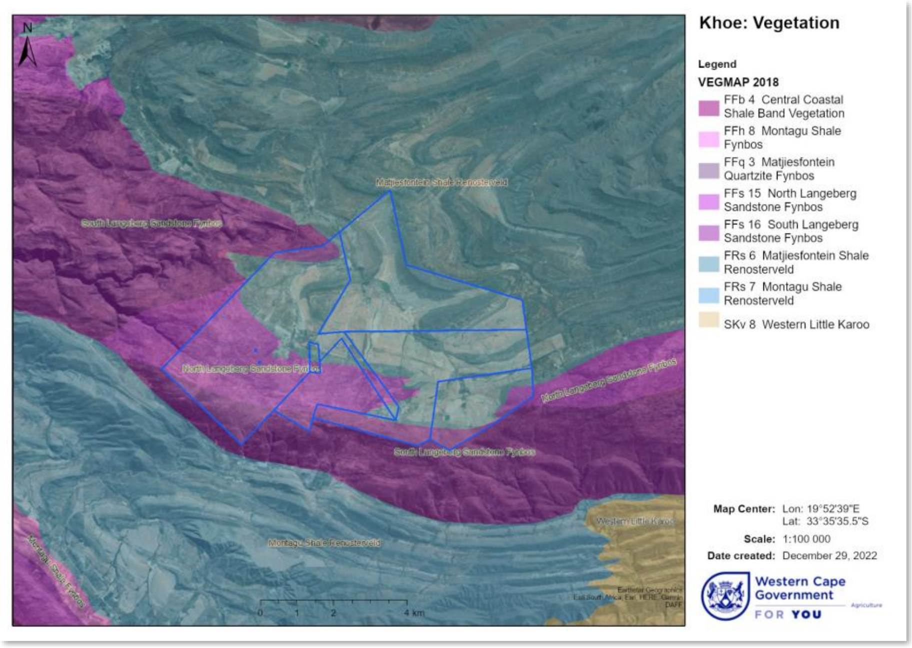

Figure 5: Khoe WEF Vegetation Zones (WCG, 2022).

3.1.3 Conservation Areas

There are several areas of conservation value in the region of the proposed Khoe WEF, but none of these are bordering the proposed wind farm, see Figure 6. The nearest registered reserve, the Bokkeriviere Nature Reserve, is situated approximately 20 km in a northwesterly direction from the Khoe WEF. Two Mountain Catchment Areas are situated very close to the proposed Khoe WEF site, the Matroosberg Mountain Catchment Area, approximately 5 km from the border of the Khoe WEF, and the Langeberg-Wes Mountain Catchment Area, approximately 15 km from the border of Khoe WEF.

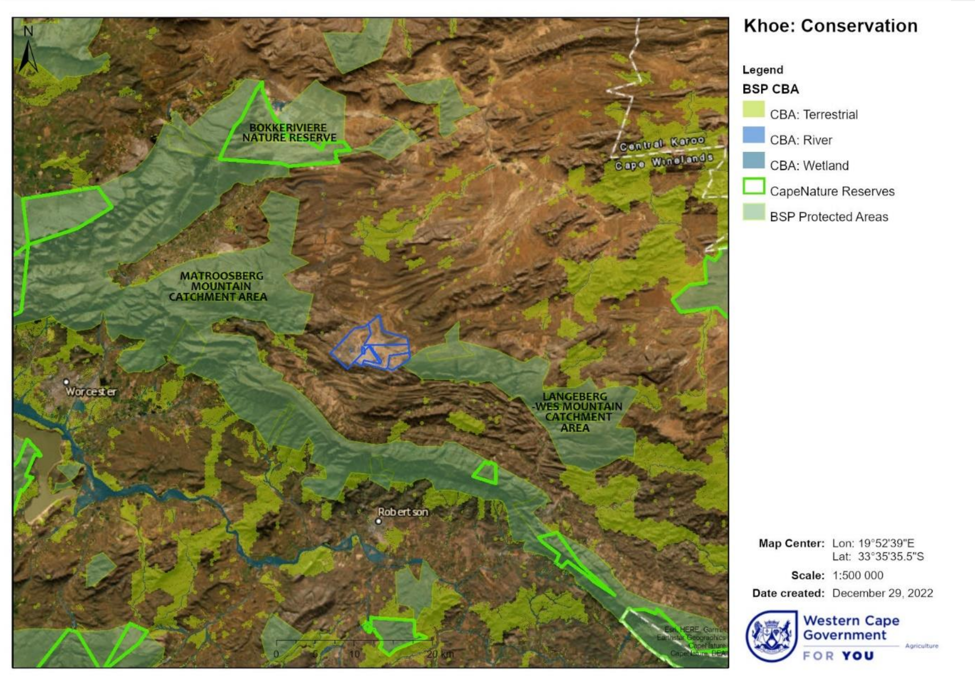

Figure 6: Protected areas in the vicinity of Khoe WEF (WCG, 2022).

3.1.4 Land use

The town of De Doorns is located northwest of the proposed wind farm site, in the Hex River Valley, which is a flourishing viticulture area.

The proposed Khoe WEF, on the other hand, is situated on a plateau before one descends to the Karoo, and although it is in the winter rainfall region, the land use differs from the De Doorns area. Although some onion seed cultivation and greenhouses do occur in the area, the main agricultural activities are livestock and wheat farming, depicted in **Error! Reference source not found.** below.

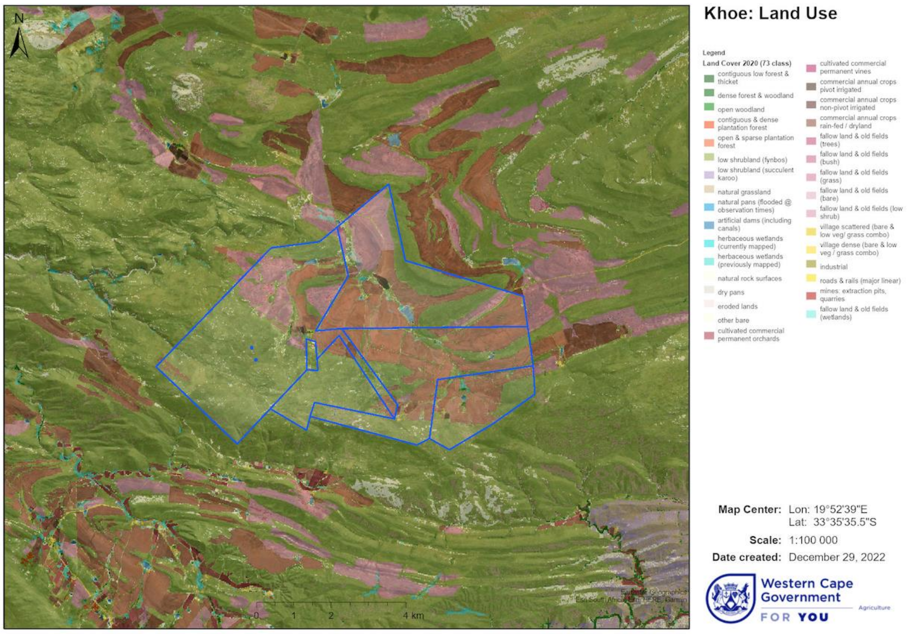

Figure 7: Land use in the Khoe WEF study area (WCG, 2022).

3.1.5 Water resources

There are numerous dry water courses and perennial as well as non-perennial water bodies (Figure 8). During the rainy season water collects in non-perennial ditches, depressions, and farm dams.

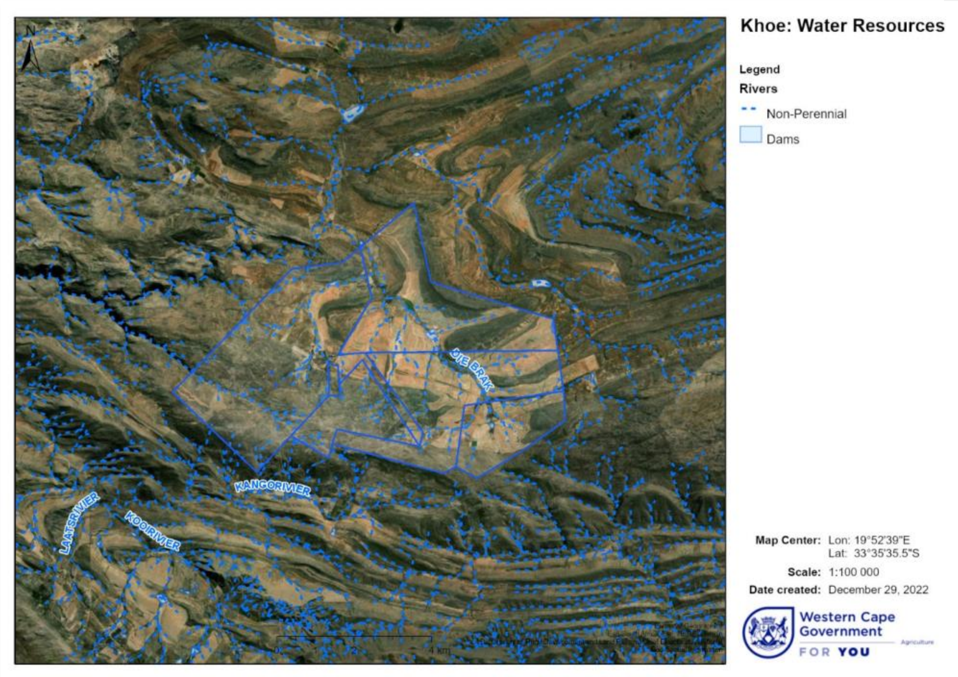

Figure 8: Water resources (WCG, 2022).

3.2 Features related to bats at the Khoe WEF

Bats are dependent on suitable roosting sites provided, amongst others, by vegetation, exfoliating rock, rocky outcrops, derelict mines and aardvark holes, caves, and human structures (Monadjem, et al., 2020). The foraging utility of a site is further determined by water availability and the availability of food. Thus, the vegetation, geomorphology, and geology of an area are important predictors of bat species diversity and activity levels.

3.2.1 Vegetation

The site is covered in typical Matjiesfontein Shale Renosterveld, South Langeberg Sandstone Fynbos and North Langeberg Sandstone Fynbos, see Figure 9. Although the natural vegetation does not support trees, there are limited trees situated in the non-perennial riverbeds and near houses, which could provide roosting opportunities for bats that prefer roosting in vegetation or under the bark of trees.

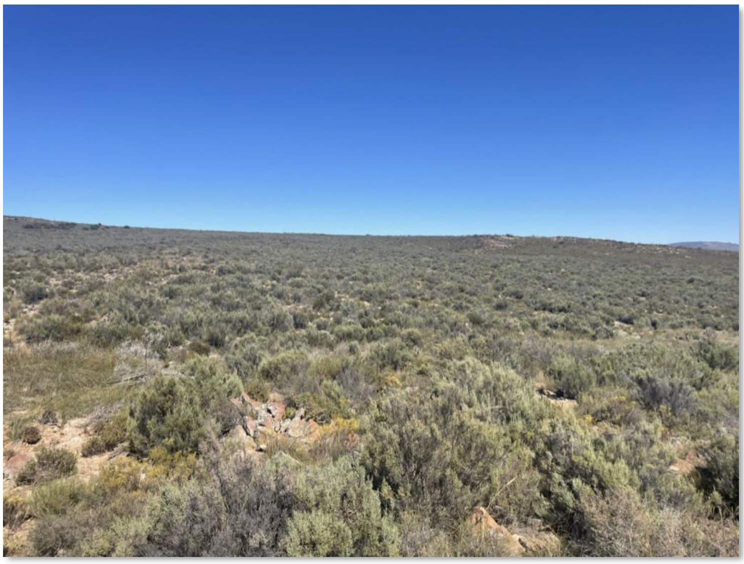

Figure 9: Typical vegetation at Khoe.

3.2.2 Rock formations rock faces and animal burrows

Rock formations along the hilltops, and the river valleys provide ample roosting opportunities for bats. Bats can also make use of abandoned burrows as roosts. Examples of rock formations on site are shown in Figure 10. Numerous mountainous areas surrounding the proposed site could support bat roosts, and bats from these neighbouring roosts, could traverse the proposed wind farm to forage, drink or migrate.

Figure 10: Rock formations which could provide possible roosting opportunities for bats.

3.2.3 Human dwellings and building structures

Where roofs are not sealed off, human dwellings could provide roosting space for some bat species. Up to now, no evidence of bat roosts has been found at the farm dwellings, but this is an ongoing study. There are still farm dwellings to investigate and further roost investigations will be conducted during late spring and summer.

3.2.4 Open water and food sources

During the rainy season, stagnant water that usually collects in small pans and dry ditches could serve as breeding grounds for insects which could serve as food for bats. High insect activity results in higher bat presence after sporadic rainy periods. Open dams provide permanent, open water sources for bats throughout the year (Figure 11).

Figure 11: Permanent, open water source at Sandvlei.

3.2.5 Background to bats in the area

The extent to which bats may be affected by the proposed wind farm will depend on the extent to which the proposed development area is used as a foraging site or as a flight path by local bats.

A summary of bat species distribution, their feeding behaviour, preferred roosting habitat, and conservation status is presented in Table 2. The bats identified in Table 2 have distribution ranges that include the Khoe WEF development site and bat presence that was confirmed on the site itself, or other wind farms in the area, are marked as such. The proposed WEF is located within the distribution range of six families and approximately 12 species. Table 2 is informed by the most recent distribution maps of Monadjem, et al. (2010 and 2020). The information in Table 2 will be updated as required, based on the outcomes of the monitoring programme.

Of the 12 species with distribution ranges that include the proposed development area, four have a conservation status of Near Threatened in South Africa and one Vulnerable, while three have a global conservation status of Near Threatened. *Eptesicus hottentotus* (the Long-tailed serotine), *Cistugo seabrae* (the Angolan wing-gland bat) and *Rhinolophus capensis* (Cape horseshoe bat) are endemic to Southern Africa and have limited suitable habitat left, mainly due to agricultural activities (Monadjem, et al., 2010).

According to the likelihood of fatality risk, as indicated by the latest pre-construction guidelines (MacEwan, 2020) six species, namely *Miniopterus natalensis* (Natal long-fingered bat), *T. aegyptiaca* (Egyptian free-tailed), *S. petrophilus* (Roberts's flat-headed bat), *L. capensis* (Cape serotine) and the two Pteropodidae species (fruit bats) have a high risk of fatality, while *Mytois tricolor* (Temminck's myotis bat) has a medium-high risk and the endemic *E. hottentotus* has a medium risk of fatality.

The two Pteropodidae species (fruit bats) are not expected to roost on the project site itself, as this environment is not expected to be their preferred habitat; however, the proximity of the mountains around the site, the agricultural activities of the Hexrivier valley situated in the north-westerly direction, and the presence of water sources in the area, might attract fruit bats if they migrate over the area and the possibility that they could sporadically occur at the development area should not be ruled out.

Rhinolophus clivoses was recorded in the surrounding area, but not on the Khoe terrain yet. There is a high likelihood that some of the Rhilophus species might occur in the more densely vegetated valleys. As indicated by Table 2 these bats are clutter foragers and have a low likelihood of fatality risk.

Table 2: Potential bat species occurrence at the proposed Khoe WEF site. Information about the species is from Monadjem, et al. (2010 and 2020).

Family	Species	Common Name	SA conservation status	Global conservation status (IUCN)	Roosting habitat	Functional group (type of forager)	Migratory behaviour	Likelihood of fatality risk*	Bats confirmed at Khoe and surroundings	Bats recorded on the Khoe project site
PTEROPODIDAE	*Eidolon helvum*	African straw-coloured fruit	Not evaluated	Least Concern	Little known about roosting behaviour	Broad wings adapted for clutter. Studies outside of South Africa list fruit and flowers in its diet.	Migrater. Recorded migration up to 2 518 km in 149 days, and 370 km in one night.	High		
	Rousettus aegyptiacus	Egyptian rousette	Least Concern	Least Concern	Caves	Broad wings adapted for clutter. Fruit, known for eating Ficus species.	Seasonal migration up to 500 km recorded. Daily migration of 24 km recorded.	High		
MINIOPTERIDAE	*Miniopterus natalensis*	Natal long-fingered bat	Near Threatened	Near Threatened	Caves	Clutter-edge, insectivorous	Seasonal, up to 150 km	High	✓	✓
NYCTERIDAE	*Nycteris thebaica*	Egyptian flit-faced bat	Least Concern	Least Concern	Cave, Aardvark burrows, road culverts, hollow trees. Known to make use of night roosts.	Clutter, insectivorous, avoid open grassland, but might be found in drainage lines	Not known	Low		
MOLISSIDAE	*Tadarida aegyptiaca*	Egyptian free-tailed bat	Least Concern	Least Concern	Roofs of houses, caves, rock crevices, under exfoliating rocks, hollow trees	Open-air, insectivorous	Not known	High	✓	✓
	Sauromys petrophilus	Robert's Flat-faced	Least Concern	Least Concern	Narrow cracks, under exfoliating of rocks, crevices.	Open-air, insectivorous		High	✓	✓
RHINOLOPHIDAE	*Rhinolophus capensis*	Cape horseshoe bat	Near Threatened	Near Threatened	Caves, old mines. Night roosts used	Clutter, insectivorous	Not known	Low		

Family	Species	Common Name	SA conservation status	Global conservation status (IUCN)	Roosting habitat	Functional group (type of forager)	Migratory behaviour	Likelihood of fatality risk*	Bats confirmed at Khoe and surroundings	Bats recorded on the Khoe project site
		(endemic)								
	Rhinolophus clivosus	Geoffroy's horseshoe bat	Near Threatened	Least Concern	Caves, old mines. Night roosts used	Clutter, insectivorous		Low	✓	
VESPERTILIONIDAE	*Laephotis capensis (Neoromicia capensis)*	Cape roof bat (Cape serotine)	Least Concern	Least Concern	Roofs of houses, under bark of trees, at basis of aloes	Clutter-edge, insectivorous	Not known	High	✓	✓
	Myotis tricolor	Temminck's myotis	Near Threatened	Least Concern	Roosts in caves, but also in crevices in rock faces, culverts, and manmade hollows	Limited information available	Not known	Medium-High		
	Eptesicus hottentotus	Long-tailed serotine (endemic)	Least Concern	Least Concern	Caves, rock crevices, rocky outcrops	Clutter-edge, insectivorous	Not known	Medium	✓	✓
	Cistugo seabrae	Angolan wing-gland bat (endemic)	Vulnerable	Near Threatened	Possibly buildings, but no further information	Clutter-edge, insectivorous	Not known	Low		

**Likelihood of fatality risk as indicated by the Pre-Construction Guidelines (MacEwan, et al., 2020b).*
***Neoromicia capensis has been reclassified as Laephotis capensis* (Cape roof bat*)*

3.3 Project Description

FE Hugo & Khoe (Pty) Ltd proposes to construct Khoe wind Energy Facility and the associated infrastructure, with a capacity of up to 250 MW WEF. Apart from a preliminary layout, see Figure 12, no other project information has been received yet. More project details will be provided in the final report.

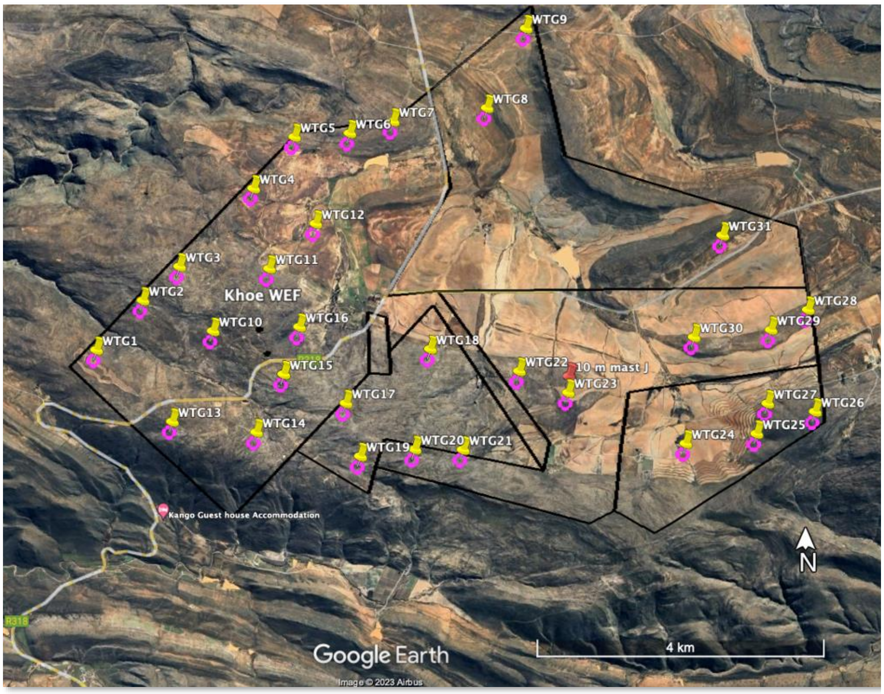

Figure 12: Preliminary Turbine Layout at the proposed Khoe WEF site.

4. ISSUES, RISKS, AND IMPACTS

4.1 Identification of Potential Impacts/Risks

Bats are long-lived mammals and females often produce only one pup per year, resulting in a life strategy characterized by slow reproduction (Barclay and Harder, 2003). Because of this, bat populations are sensitive to changes in mortality rates and their populations tend to recover slowly from declines.

The potential impacts on bats could be summarised as follow:

- Removal of limited roosting space on-site, such as rock formations or trees;
- Mortality during the operation of wind turbines;
- Habitat loss due to the operational wind farm;
- Change in foraging potential;
- Create new bat conducive habitat amongst the turbines; and
- The cumulative effect of the above together with the surrounding wind farms.

The ideal, when managing the impact of WEFs on bats throughout the project's lifespan, is to maintain bat populations as they occur on-site and avoid attracting more bats to the area of potential collision.

The potential impacts identified at this stage of the bat monitoring include:

Commented [SD1]: Comment from Deon Lottering: Please be cognisant that the below impact will need tabulated in the ratings table for DFFE

Commented [SD2R1]: Yes, we will tabulate these in the Final bat monitoring report version, when we do the impact assessment.

4.2 Construction Phase

1. Roost disturbance, destruction and fragmentation due to construction activities;
2. Creating new habitats amongst the turbines, such as buildings, excavations, or quarries; and
3. Disturbance to bats during the construction activities during night-time.

4.3 Operational Phase

1. Mortality due to direct collision or barotrauma of resident bats;
2. Mortality due to direct collision or barotrauma of migrating bats;
3. Loss of bats of conservation value;
4. The attraction of bats to wind turbines;
5. Loss of habitat and foraging space; and
6. Reduction in the size, genetic diversity, resilience, and persistence of bat populations.

4.4 Decommissioning Phase

1. Disturbance due to decommissioning activities.

4.5 Cumulative Impacts of Wind Farms within the Surrounding Areas

1. Cumulative effect of construction activities of several wind farms within 30 km from the proposed Khoe WEF site;
2. Cumulative resident bat mortality of all the wind farms;
3. Cumulative bat mortality of migrating bats;
4. Cumulative loss of bats of conservation value;
5. Cumulative effect of habitat loss over several thousand hectares of all wind farms; and
6. Cumulative reduction in the size, genetic diversity, resilience, and persistence of bat populations.

4.6 No-go Option

If the development does not progress, the status quo is expected to prevail, and no negative impact is expected.

5. RESULTS OF BAT MONITORING AT KHOE WEF

5.1 Static recorders

Passive monitoring data for the period between 30 December 2022 and 12 August 2023 is included in this progress report. It is important to note that static recordings have limitations, as discussed in Section 1, but do provide a scientifically sound method of assessing the bat situation on site.

Apart from the difference in installing the systems, the met mast systems started to operate in December 2022, while the 10 m masts were only deployed in February 2023, no data gaps were experienced during the monitoring period.

5.1.1 Bat Species Diversity

Calls like five of the 12 species that have distribution ranges overlaying the proposed development site were recorded by the static recorders (Table 2 and **Error! Reference source not found.**). Bats can be divided into groups, based on their preferred foraging altitudes. They are adapted, mostly by the physiology of their wings, to forage at a range of altitudes, namely lower altitudes (clutter) amongst bushes and trees, medium altitudes (clutter-edge), and open-air (high-flying bats). 63% of the calls were from *Neoromicia capensis (Laephotis capensis)*, which is the dominant species on site. The second highest percentage of calls were from *Tadarida aegyptiaca* (28%), which is physiologically adapted to flying high and is thus a species at high risk of collision with turbine blades as well as barotrauma. 7% of the activity recorded was from the global as well as regional Near Threatened *Miniopterus natalensis,* 1% from *Sauromys petrophilus* and 1% from the endemic *Eptesicus hottentotus*.

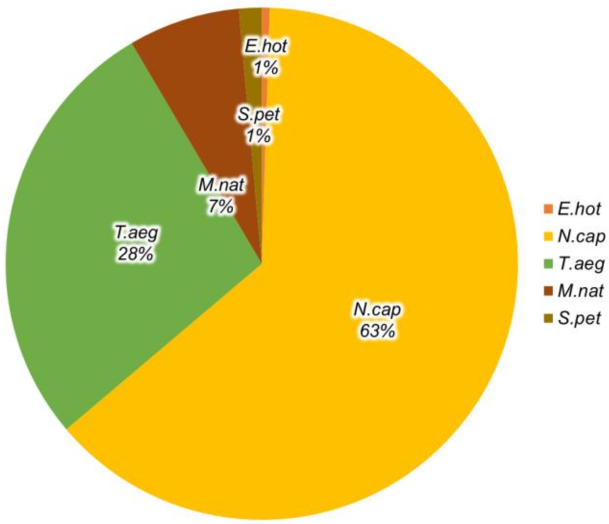

Figure 13: Overall bat species diversity at Khoe WEF.

N. capensis (L. capensis) of the Vespertilionidae family and *T. aegyptiaca* of the Molossidae family are the most dominant bats on site. Both these species fall within the high-risk fatality category (Table 2), resulting in a high percentage of the recorded bat activity at the Khoe WEF site being expected to be at high risk of fatality during the operational lifespan of the turbines.

Species diversity is often higher at lower altitudes, which is demonstrated in **Error! Reference source not found.**, depicting the species recorded at all the monitoring stations. System D, at 100 m on the Met mast, recorded 95% *T. aegyptiaca,* while the 50 m system (E) on the Met mast, recorded 96% of this species. The second highest percentage of calls were made by *S. petrophilus*, respectively 5% and 3% on these two systems. In total, nearly 100% of the bats recorded at these two systems belong to the two Molossidae species, *T. aegyptiaca* and *S. petrophilus,* which are high risk species .

The expected difference in species diversity between high altitude and 10 m systems is seen when the data from height is compared to the data from the 10 m systems. A much higher, and often dominant, percentage of *Neoromicia capensis (Laephotis capensis)* was recorded at four of the 10m systems (F, G, H and I). The Met low system (F) recorded 75% *N.capensis,* 18% *T. aegyptiaca*, 6% *M. natalensis, and* 1% *S. petrophilus.* While the 10 m mast system (G), recorded a higher percentage of *T. aegyptiaca,* namely 59%, followed by 34% *N.capensis,* 2% *S. petrophilus, 3% M. natalensis* and 2% *E. hottentotus.*

The other two 10 m systems (H and I) portray some similarity in species diversity. System H recorded 81% of *N. capensis,* while System I recorded 77% of this species. Recordings of *T.aegyptiaca* were respectively 8% and 13% on these two systems, with an additional 10% of *M. natalensis* at system H and 9% of the same species at System I. 1 % of the bats recorded at both systems are calls similar to *S. petrophilus*, while only a small number of calls are from *E. hottentotus*.

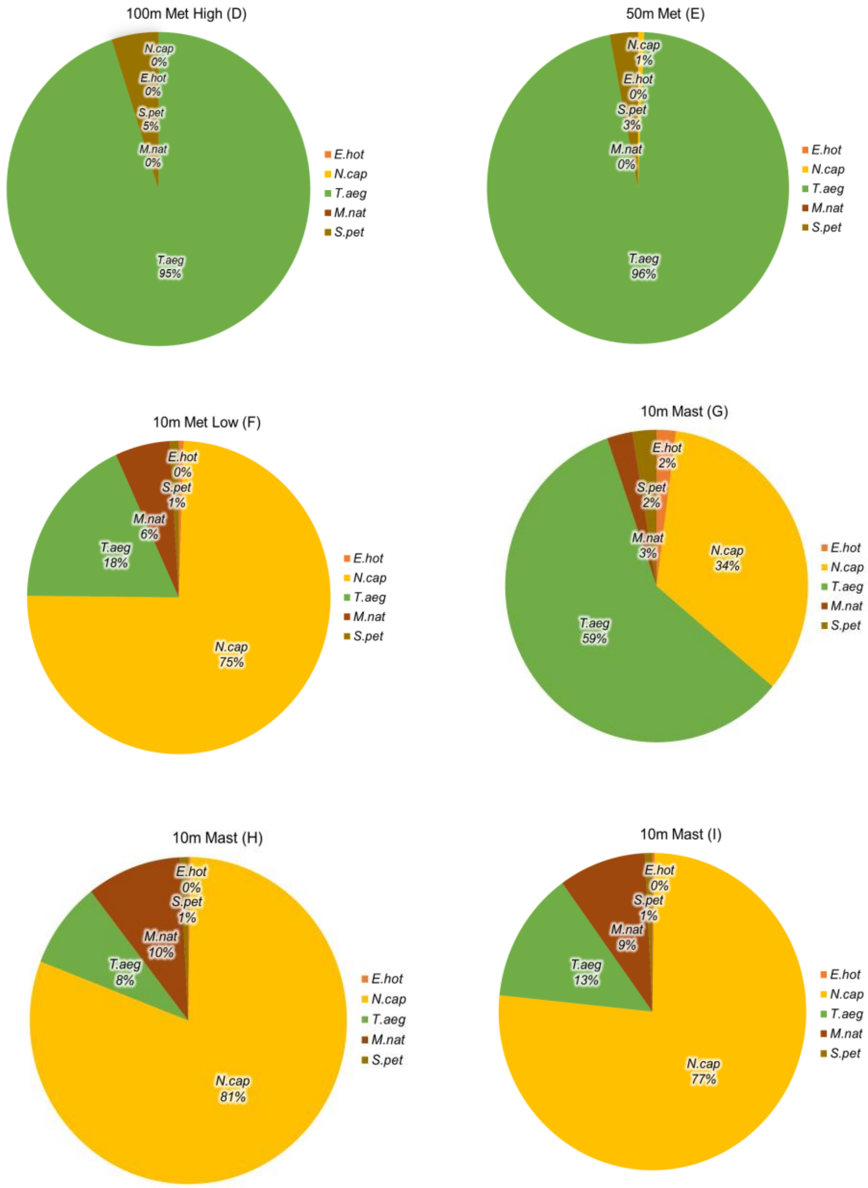

Figure 14: Species diversity at each monitoring site.

5.1.2 Temporal distribution of bat passes over the monitoring period

Error! Reference source not found. indicates the weekly temporal distribution of bat activity over the monitoring period. The grey and light blue bar in the histogram depicts higher activity, indicating the relatively higher occurrence of *N. capensis* and *T. aegyptiaca* respectively during the monitoring period. One can observe higher activity during the warmer, summer months of February and March, with an overall increase in activity across species through March, April and into May. This indicates high activity through late summer and into autumn (April and May). Low activity was recorded through the winter months of June, July, and August.

All systems were operational from the beginning of February, and the increase during the middle of February on the temporal graph could be due to this. *N. capensis* indicates an increased presence in mid-February, with a peak at the beginning of March. Thereafter it remains relatively high throughout the latter part of March and April, with several dips and peaks, until activity reaches its highest peak in late May. The activity of *T. aegyptiaca* also reaches its highest peak in the middle of February, although lower when compared to *N. capensis. T. aegyptiaca* goes on to experience a slight decline in activity, after which activity remains relatively constant throughout March, April and the beginning of May, with very little activity recorded after June. *M. natalensis* experiences sporadic activity throughout the monitoring period, with small peaks in early and mid-March, throughout April, and with its highest activity recorded in late May.

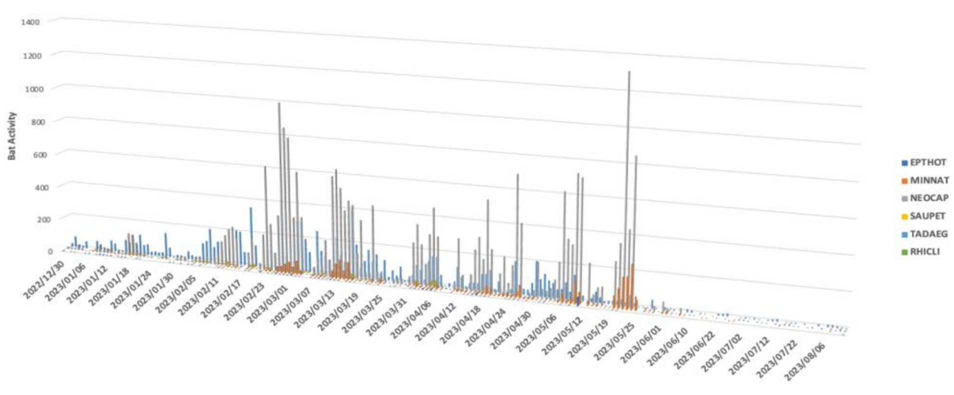

Figure 15: Temporal distribution of bat passes over the monitoring period.

5.1.3 Species distribution and activity per monitoring station

The difference in species recorded at the various systems can be observed in **Error! Reference source not found.**. This provides a picture of which species were recorded at which systems and we can, as a result, compare the total bat activity of the higher altitude systems with the lower altitude systems. *N. capensis* has the highest recorded activity across all the species, with significantly more activity recorded at the 10m masts in comparison to the 100 m (D) mast or the 50 m (E) mast. *T. aegyptiaca* had the second-highest total activity recorded, with significantly more activity of this species being recorded at the 100 m (D) mast and 50 m (E) mast. Relatively, just a few *M. natalensis* calls were recorded at the 10 m met masts.

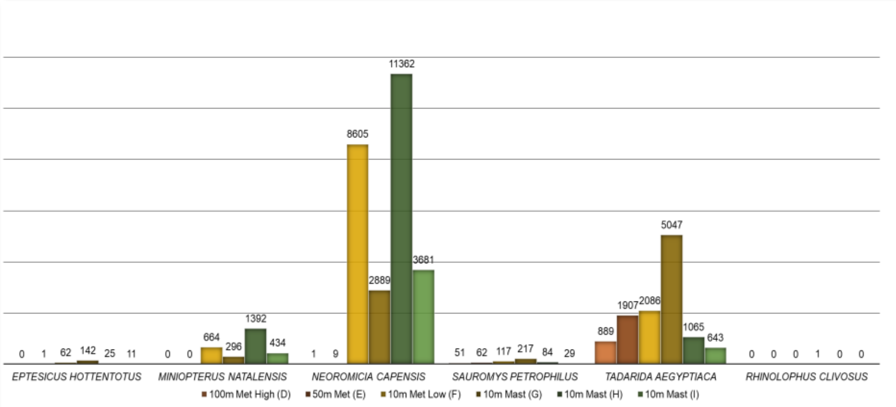

Figure 16: Species and activity per monitoring station.

5.1.4 Hourly bat passes per night

The nightly bat activity per hour over the monitoring period is shown **Error! Reference source not found.**. These figures provide insight into the general distribution of bat activity during each night, from sunset to sunrise. The hourly bat activity data is important for the development of mitigation recommendations. Activity across all the systems increases at sunset, with a gradual incline in activity about an hour after sunset. Most systems peak in activity at approximately an hour after sunset (10 m Mast G) or approximately two hours after sunset (100 m Mast D, 10 m Mast I, 50m Met E, 10m Mast H). The exception to this is 10m Met Low (F) which portrayed a peak after midnight. This is not very common when observing bat data, as bats are usually most active after sunset when they emerge from their roosts to forage and drink. General bats at Khoe remain active up to the early morning hours when they are returning to their roosts before sunrise. Very little activity is recorded at sunrise.

Error! Reference source not found. incorporates data for the monitoring period to date. These patterns are of importance if mitigation measures are to be developed, as they indicate the most active periods during the night, but more refined monthly data will be taken into consideration if a mitigation programme is developed.

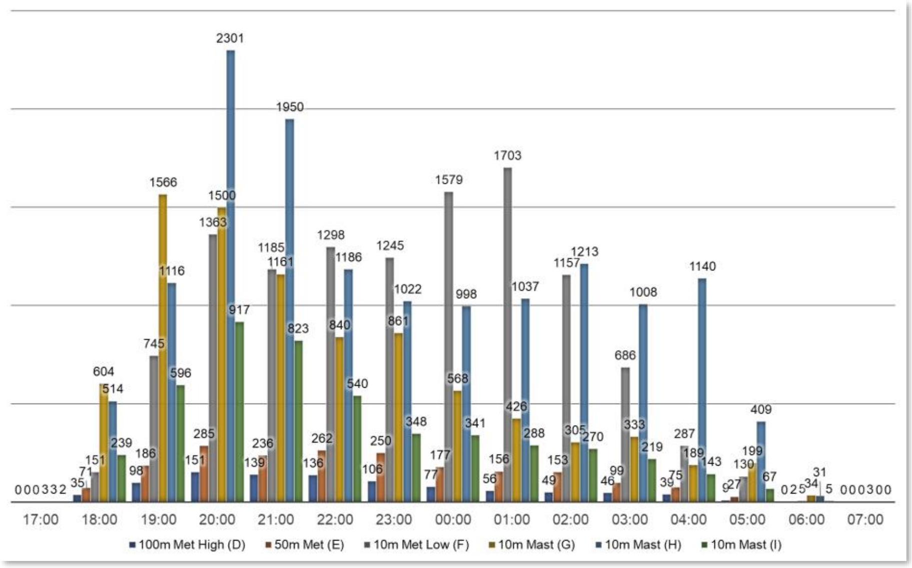

Figure 17: Total hourly nightly bat passes.

5.1.5 Monthly bat activity

The total monthly bat activity is portrayed in **Error! Reference source not found.**, keeping in mind that all systems were operational from February onwards. In this histogram, it can be observed that activity peaks in March and remains relatively high during April and May, with a sharp decline in June. Little activity occurs in July and August, during the colder winter months.

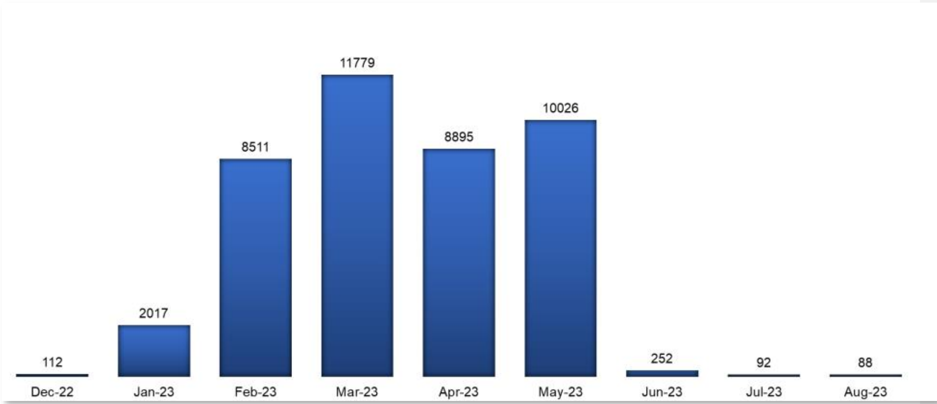

Figure 18: Total monthly bat activity.

5.1.6 Median bat activity of each system

Error! Reference source not found. indicates the median hourly bat activity for each monitoring station. By using medians, the activity of monitoring systems can be compared, even when recording days were missed. Although the species diversity, Section 5.1.1, was quite similar when comparing the 100 m (D) and 50 m (E) systems, the difference in bat activity between 100 m and 50 m, when compared, can be seen, with higher activity recorded at 50 m. There seems to be a decline in activity with increased altitude, as System D, situated at 100 m, portrays lower activity when compared to System E, at 50m. The four 10 m systems (F, G, H and I) all recorded higher activity than the two systems at height (D and E), indicating a decrease in activity with altitude.

The difference between 10 m Systems F, G and H is minimal, with System I indicating the lowest activity and System H the highest activity when comparing the 10 m systems.

Extra care is taken with activity at Systems D and E, as these systems are situated within the sweep of the turbine blades with high activity from *T. aegyptiaca.* If present data of operational wind farms are considered, this species has the highest risk of fatality. The final report will provide a more complete picture of the whole monitoring period, indicating possible mitigation measures to curb predicted bat activity, if necessary.

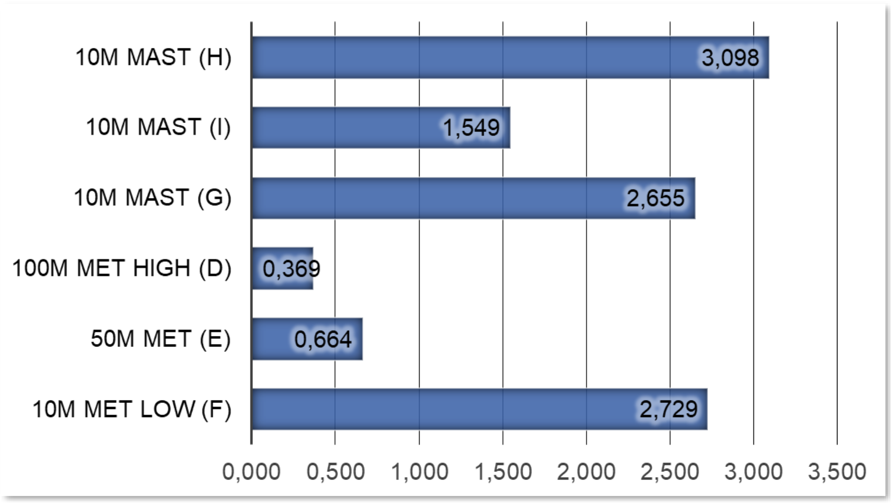

Figure 19: Median of hourly bat activity per system.

6. PRELIMINARY SENSITIVITY MAP

Figure 20 below depicts the preliminary sensitivity map. The bat sensitivity zones still need to be refined, incorporating data from the whole monitoring year. Correlations between bat data and weather conditions will be included in the final bat monitoring report. Therefore, there will be some changes in sensitivity zones.

At present, only high-sensitivity zones are identified on the sensitivity map. It is recommended that high-sensitivity zones are avoided for all moving turbine components. This includes the tips of turbine blades. Components of supporting infrastructure might occur in these areas, such as roads, grid connections, sub-stations and office buildings, as long as no bat roosts are disturbed during construction. Guidelines to avoid roost destruction will form part of the EMPr. The following are included in high-sensitivity zones at Khoe WEF with buffers as prescribed by the SABAA guidelines (MacEwan, et al, 2020):

- Clumps of trees which could serve as roosts – 200 m buffer;
- Watercourses. Non-perennial watercourses will have water during rainy spells and standing water which collects in the ditches is an important feature contributing to increased bat activity – 200 m buffer from the side of the water courses;
- Rock formations, rocky outcrops and features which are conducive to bat roosts – 200 m buffer; and
- Human dwellings – 500 m buffer.

The final bat sensitivity map can only be compiled when bat indexes, with data from all seasons, have been calculated. Mitigation measures will be recommended in the final bat impact assessment report after correlations between weather and bat activity have been conducted.

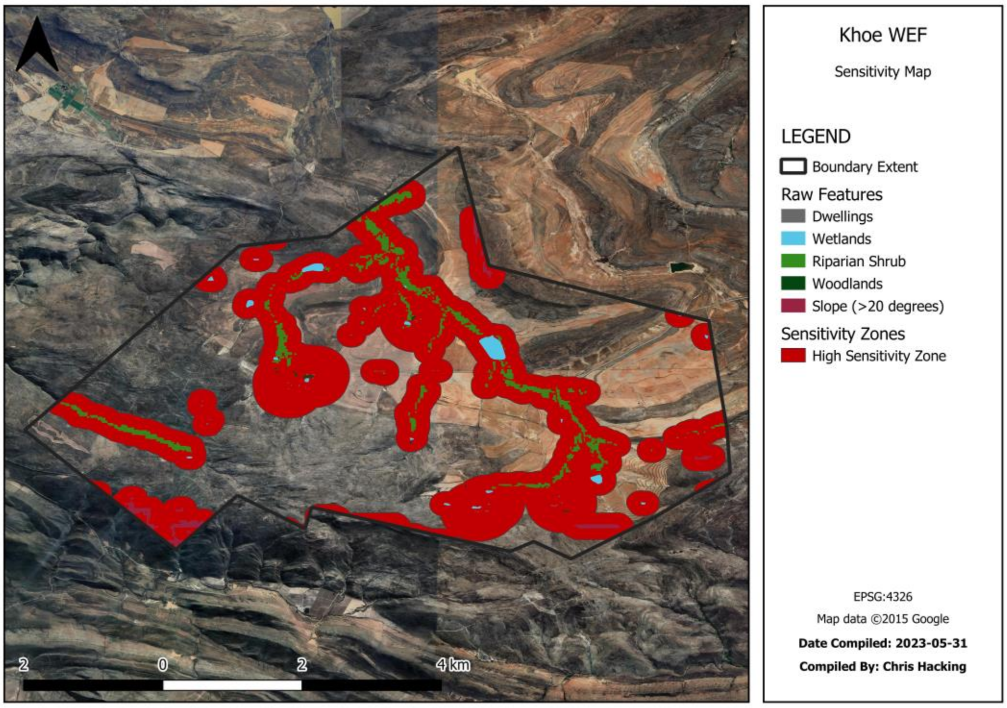

Figure 20: Preliminary bat sensitivity map

7. CONCLUSION

Of the 12 species with distribution ranges that include the proposed development area, four have a conservation status of Near Threatened in South Africa and one Vulnerable, while three have a global conservation status of Near Threatened.

According to the likelihood of fatality risk, as indicated by the latest pre-construction guidelines (MacEwan, 2020) six species, namely *Miniopterus natalensis* (Natal long-fingered bat), *T. aegyptiaca* (Egyptian free-tailed), *S. petrophilus* (Roberts's flat-headed bat), *L. capensis* (Cape serotine) and the two Pteropodidae species (fruit bats) have a high risk of fatality, while *Mytois tricolor* (Temminck's myotis bat) has a medium-high risk and the endemic *E. hottentotus* has a medium risk of fatality.

Calls like five of the 12 species that have distribution ranges overlaying the proposed development site were recorded by the static recorders. 63% of the calls were from *Neoromicia capensis (Laephotis capensis)*, which is the dominant species on site. The second highest percentage of calls were from *Tadarida aegyptiaca* (28%), which is physiologically adapted to flying high and is thus at high risk of fatality, followed by the global as well as regional Near Threatened *Miniopterus natalensis* (7%), then *Sauromys petrophilus* (1%) and the endemic *Eptesicus hottentotus* (1%).

In total, nearly 100% of the bats recorded at the two high systems on the met mast (Systems D and E) belong to the two Molossidae species, *T. aegyptiaca* and *S. petrophilus*, while activity by *Neoromicia capensis (L. capensis)* is more active at the 10 m systems. When the present data is considered bat activity as well as species diversity are higher at lower altitudes at the proposed wind development.

Weekly temporal distribution of bat activity over the monitoring period generally indicates higher activity during the warmer summer months with low activity in winter. Activity peaks in March and remains relatively high during April and May, with a sharp decline in June. Very little activity occurs in July and August, during the colder winter months.

The nightly bat activity per hour over the monitoring period indicates that activity across all the systems increases at sunset, with a gradual incline in activity about an hour after sunset. Most systems peak in activity at approximately an hour after sunset (10 m Mast G) or approximately two hours after sunset (100 m Mast D, 10 m Mast I, 50m Met E, 10m Mast H). The exception to this is 10 m Met Low (F) which portrayed a peak after midnight. Mostly bats at Khoe remain active up to the early morning hours, when they are returning to their roosts before sunrise. Very little activity is recorded at sunrise.

Although the species diversity was quite similar when comparing the each systems median at 100 m (D) and 50 m (E), the difference in bat activity between 100 m and 50 m, when compared, can be seen, with higher activity recorded at 50 m. System D, situated at 100 m, portrays lower activity when compared to System E, at 50 m, while the four 10 m systems (F, G, H and I) all recorded higher activity than the two systems at height (D and E), indicating a decrease in activity with altitude. The difference between 10 m Systems F, G and H is minimal, with System I indicating the lowest activity and System H the highest activity when comparing the 10 m systems.

Data from Systems D and E are of particular importance, as these systems are situated within the sweep of the turbine blades and recorded mainly activity from the high-flying *T. aegyptiaca.* If present data of operational wind farms are considered, this species has the highest risk of fatality.

The final report will provide a more complete picture of the whole monitoring period, indicating possible mitigation measures to curb predicted bat activity, if necessary.

A preliminary bat sensitivity map was compiled with the available data up to now. The bat sensitivity zones still need to be refined, incorporating data from the whole monitoring year; Therefore, there will be some changes in sensitivity zones.

In general, there are no red flags at this stage that suggest that the development could not progress to the next phase. However, this can only be confirmed when 12 months of bat monitoring has been considered. Correlations between bat data and weather conditions will be included in the final bat monitoring report.

8. BIBLIOGRAPHY

Aronson, J., Richardson, E., MacEwan, K., Jacobs, D., Marais, W., Taylor, P., Sowler, S., Hein. C. and Richards, L. 2020. South African Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities – ed 2. South African Bat Assessment Association.

Aronson, J., MacEwan, K., and Sowler, S. 2018. Mitigation Guidance for Bats at wind Energy Facilities in South Africa, 2nd Edition.

Barclay, R.M.R., and Harder, L.D. (2003). *Life histories of bats: Life in the slow lane*. Pp. 209-256 in T.H. Kunz and M.B. Fenton, editors. Bat ecology. University of Chicago Press, Chicago, Illinois, USA.

Climate.org: https://en.climate-data.org/location/26923/ As on 4 April 2019

Department of Environmental Affairs (DEA); 2019: *https://egis.environment.gov.za/data_egis/data_download/current* (accessed 12 March 2021).

CSIR, 2020: Basic Assessment for the Proposed Development of Electrical Grid Infrastructure to support the nine 175 MW Solar PV Facilities and Associated Infrastructure near Touws River, Western Cape.

Google Earth: https://www.google.com/earth/download/html.

MacEwan, K., Aronson, J., Richardson, K., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W. and Richards, L. (2018): South African Bat Fatality Threshold Guidelines, Edition 2.

MacEwan, K., Sowler, S., Aronson, J., and Lötter, C. 2020b. South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities - ed 5. South African Bat Assessment Association.

Meteoblu at http://www.meteoblue.org as on 20 May 2019.

Monadjem, A., Taylor, P.J., Cotterill, F.P.D., Schoeman, M.C., 2010: *Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis.* University of the Witwatersrand, Johannesburg.

Monadjem, A., Taylor, P.J., Cotterill, F.P.D., Schoeman, M.C., 2020: *Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis.* University of the Witwatersrand, Johannesburg.

Mucina L. and Rutherford M.C. (eds). 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

South African National Biodiversity Institute, 2012: Vegetation Map of South Africa, Lesotho, and Swaziland [vector geospatial dataset] 2012. Available from the Biodiversity GIS website, http://bgis.sanbi.org/SpatialDataset/Detail/18

Van Wyk, A.E. and Smith, G. (2001). Regions of Floristic Endemism in Southern Africa. Umdaus Press. Pretoria.

APPENDIX 1

CV : Stephanie Dippenaar

STEPHANIE DIPPENAAR: CV

***ABBREVIATED CURRICULUM VITAE*:**
STEPHANIE CHRISTIA DIPPENAAR
Business owner: Stephanie Dippenaar Consulting trading as EkoVler

PROFESSION: ENVIRONMENTAL MANAGEMENT, SPECIALISING IN BAT IMPACT ASSESSMENTS
Nationality: South African
ID number: 6402040117089

CONTACT DETAILS
Postal Address: 8 Florida Street, Stellenbosch, 7600
Cell: 0822005244
e-mail: sdippenaar@snowisp.com

EDUCATION
1986 BA University of Stellenbosch
1987 BA Hon (Geography) University of Stellenbosch
2000 MEM (Master in Environmental Management) University of the Free State

MEMBERSHIPS
- Steering committee of The South African Bat Assessment Association (SABAA)
- Active member of the National Bat Rescue Group (also known
- Member of the Southern African Institute of Ecologists and Environmental Scientists (SAIEES), since 2002.

EMPLOYMENT RECORD
- 1989: The Academy: University of Namibia. One-year contract as a lecturer in the Department of Geography.
- 1990: Windhoek College of Education. One-year contract as a lecturer in the Department of Geography.
  - Research assistant, Namibian Institute for Social and Economic Research, working on, amongst others, a situation analyses on women and children in Namibia, contracted by UNICEF.
  - Media officer for Earthlife African, Namibian Branch.
- 1991: University of Limpopo. One-year contract as a lecturer in the Department of Environmental Sciences.
- 1992: Max Planc Institute (Radolfzell-Germany). Mainly involved in handling birds and assisting with aviary studies.
- Swiss Ornithological Institute. Working in the Arava valley, Negev – Israel, as a radar operator, contracted by Voice of America, involved in an Impact Assessment Study concerning shortwave towers on bird migration patterns.
- 1993 - 2004: University of Limpopo. Lecturer in the sub-discipline Geography, School of Agriculture and Environmental Sciences. Teaching post- and pre-graduate courses in environment related subjects in the Faculty of Mathematics and Natural Sciences, Faculty of Law, Faculty of Health and the Water and Sanitation Institute.
  - 2002-2004: Member of the Faculty Board of the Faculty of Natural Sciences and Mathematics.
  - 2002: Principal investigator of the Blue Swallow project, Northern Province, Birdlife SA.

  - 2002: Evaluating committee for the EMEM awards (award system for environmental practice at mines in South Africa)
  - 2001-2004: Private consultancy work, focussing on environmental management plans for game reserves.
- 2004-2011: CSIR, South Africa, doing environmental strategy and management plans and environmental impact assessments, mainly on renewable energy projects.
- 2011 onwards: Sole proprietor private consultancy.
- From 2015 to 2017: Teaching a part-time course in Environmental Management to Post-graduate students at the Department of Geography and Environmental Studies, University of Stellenbosch.

PROJECT EXPERIENCE RECORD

The following table presents an abridged list of project involvement, as well as the role played in each project:

Completion	Project description	Role
In progress	Preconstruction Bat monitoring at Khoe Wind Energy Facility	Bat specialist
In progress	Preconstruction Bat monitoring at Hugo Wind Energy Facility	Bat specialist
In progress	Preconstruction Bat monitoring at Kraaltjies Wind Energy Facility	Bat specialist
In progress	Preconstruction Bat monitoring at Heuweltjies Wind Energy Facility	Bat specialist
2023	Preconstruction Bat monitoring at Ezelsjacht Wind Energy Facility	Bat specialist
2023	Operational bat monitoring at Roggeveld Wind Farm	Bat specialist
In progress	Operational bat monitoring at Kangnas Wind Farm	Bat specialist
In progress	Operational bat monitoring at Perdekraal East Wind Farm	Bat specialist
2022	Preconstruction Bat monitoring at Juno 2 Wind Energy Facility	Bat specialist
2022	Preconstruction Bat monitoring at Juno 3 Wind Energy Facility	Bat specialist
2022	Background study for the impact on bats by Small Scale Wind Turbines in Cape Town Municipality	Bat specialist
2022	Preconstruction Bat monitoring at Patatskloof Wind Energy Facility	Bat specialist
2022	Preconstruction Bat monitoring at Karee Wind Energy Facility	Bat specialist
In progress	Operational bat monitoring at Excelsior Wind Farm	Bat specialist
2021	Preconstruction Bat monitoring at Koup 1 Wind Energy Facility	Bat specialist
2021	Preconstruction Bat monitoring at Koup 2 Wind Energy Facility	Bat specialist
In progress	Preconstruction bat monitoring for two wind energy facilities at Kleinzee	Bat specialist
2021	Preconstruction bat monitoring at Gromis Wind Energy Facility	Bat specialist
2021	Preconstruction bat monitoring at Komas Energy Facility	Bat specialist
In progress	Preconstruction Bat monitoring at Kappa 1 Wind Energy Facility	Bat specialist

Completion	Project description	Role
In progress	Preconstruction Bat monitoring at Kappa 2 Wind Energy Facility	Bat specialist
2020	Preconstruction Bat monitoring at Kokerboom 3 and 4 Wind Energy Facilities	Bat specialist
2020	Operational bat monitoring at Khobab Wind Farm	Bat specialist
2020	Operational bat monitoring at Loeriesfontein 2 Wind Farm	Bat specialist
In progress (year 5)	Operational bat monitoring at the Noupoort Wind Farm	Bat specialist
2019	Paalfontein bat screening study	Bat specialist
2019	12 Amendment reports for Mainstream	Bat specialist
2019	Preconstruction bat impact assessment for the Bosjesmansberg Wind Farm	Bat specialist
2018	Preconstruction Bat Monitoring at the Tooverberg Wind Energy Facility	Bat specialist
2016	Bat "walk through" for the Hopefield Powerline associated with the Hopefield Community WEF	Bat specialist
2016	Environmental Management Plan for Elephants in Captivity at the Elephant Section, Camp Jabulani, Kapama Private Game Reserve.	Project Manager
2016	Environmental Management Plan for Hoedspruit Endangered Species Centre, Kapama Game Reserve.	Project Manager
2012-2013	Bat impact assessment for the Karookop Wind Energy Project EIA.	Bat specialist
2012	Bat specialist study for Vredendal Wind Farm EIA.	Bat specialist
2011-2012	Bat monitoring and bat impact assessment for the Ubuntu Wind Project EIA, Jeffreys Bay.	Bat specialist
2011	Bat specialist study for the Banna Ba Pifhu Wind Energy Development, Jeffrey's Bay.	Bat specialist
2011(project cancelled)	Basic Assessment for the development of an air strip outside Betty's Bay.	Project Manager
2011	Bat specialist study for the wind energy facility EIA at zone 12, Coega IDZ, Port Elizabeth.	Bat specialist
2010-2011	Bat specialist study for the Wind Energy Facility EIA at Langefontein, Darling.	Bat specialist
2010-2011	Bat specialist study for the EIA concerning four wind energy development sites in the Western Cape.	Bat specialist
2010	Bat specialist study for Electrawinds Wind Project EIA, Port Elizabeth.	Bat specialist
2010	Environmental Management Plan for the Goukou Estuary.	Project Manager
2010	EIA for the 180 MW Jeffrey's Bay Wind Project, Eastern Cape (Authorisation received).	Project Manager
2010	EIA for 9 Wind Monitoring Masts for the Jeffrey's Bay Wind Project (Authorisation received).	Project Manager
2009-2010	EIA for the NamWater Desalination Plant, Swakopmund (Authorisation received).	Project Manager
2007 -2011	EIA for the proposed Jacobsbaai Tortoise reserve, Western Cape (Letf CSIR before completion of project, Authorisation rejected).	Project Manager
2007-2008	Environmental Impact Assessment for the Kouga Wind Farm, Jeffrey's Bay, Eastern Cape (Authorisation received).	Project Manager
2006-2008	Site Selection Criteria for Nuclear Power Stations in South Africa.	Co-author
2005	Auditing the Environmental Impact Assessment process for the Department of Environment and Agriculture, Kwazulu Natal, South Africa	Project Manager

Completion	Project description	Role
2005	Background paper on Water Issues for discussions between OECD countries and Developing Countries.	Author
2005	Integrated Environmental Education Strategy for the City of Tshwane.	Co- author
2005	Developing a ranking system prioritizing derelict mines in South Africa, steering the biodiversity section.	Contributor
2005	Policy and Legislative Section for a Strategy to improve the contribution of Granite Mining to Sustainable Development in the Brits-Rustenburg Region, Northwest Province, South Africa.	Author
2005	Environmental Management Plan for the purpose of Leopard permits: Dinaka Game Reserve.	Project Manager in collaboration with Flip Schoeman✞
2004	Environmental Management Plan for the introduction of lion: Pride of Africa.	Project Manager in collaboration with Flip Schoeman✞
2004	Environmental Management Plan for the establishment of a Conservancy: Greater Kudu Safaris	Project Manager in collaboration with Flip Schoeman✞

MEMBERSHIPS, CONFERENCES, WORKSHOPS AND COURSES

- Member of the Steering Committee of the South Africa Bat Assessment Association.
- Active member of the National Bat Rescue Group.
- Attend binary Bats and Wind Energy workshops hosted by SABAA.
- Updated basic fall arrest certification and occupational health certificate.
- Presenting a paper at the South African Bat Assessment Association conference, October 2017: Ackerman, C and S.C Dippenaar, 2017: Friend or Foe? The Perception of Stellenbosch Residents Towards Bats, 2017.
- Attend Snake Awareness, Identification and Handling course by Cape Reptile Institute, 2016.
- Attend a course in the management and care of bats injured by wind turbines by Elaenor Richardson, Kirstenbosch, 27 August 2014
- Mist netting and bat handling course by Dr. Sandie Sowler, Swellendam, 5 November 2013.
- Attendance and fieldwork to identify bat species and look at new Analook software with Chris Corben, the producer of the Analook bat identification software package and the Anabat Detector, during 10 and 11 October 2013.
- A four-day training course on Bat Surveys at proposed Wind Energy Facilities in South Africa, hosted by The Endangered Wildlife Trust, Greyton, between 22 and 26 January 2012.
- Presentation as a plenary speaker at the 4th Wind Power Africa Conference and Renewable Energy Exhibition, at the Cape Town International Convention Centre, on 28 May 2012. Title: *Bat Impact Assessments in South Africa: An advantage or disadvantage to wind development EIAs.*
- Anabat course by Dr. Sandy Sowler, Greyton, February 2011.
- Attending a Biodiversity Course for Environmental Impact Assessments presented by the University of the Free State, May 2010.

LANGUAGE CAPABILITY

Fluent in Afrikaans and English, very limited Xhosa.

PUBLICATIONS

Dippenaar, S, and Lochner, P (2010): EIA for a proposed Wind Energy Project, Jeffrey's Bay in SEA/EIA Case Studies for Renewable Energy.

Dippenaar, S. and Kotze, N. (2005): People with disabilities and nature tourism: A South African case study. Social work, 41(1), p96-108.

Kotze, N.J. and Dippenaar, S.C. (2004): Accessibility for tourists with disabilities in the Limpopo Province, South Africa. In: Rodgerson, CM & G Visser (Eds.), Tourism and Development: Issues in contemporary South Africa. Institute of South Africa.

REFERENCES

Albert Froneman Bird specialist: Owner of AfriAvian *Contact Details:* Email: albert.froneman@gmail.com Mobile: +27 829014016	***Brent Johnson*** Vice President: Environment at Dundee Precious Metals *Contact Details:* email: b.johnson@dundeeprecious.com Office: +26 4672234201 Mobile: +26 4812002361