KHOE WIND ENERGY FACILITY: PRECONSTRUCTION BAT MONITORING

DRAFT BAT IMPACT ASSESSMENT REPORT

APRIL 2024

EkoVler

BAT IMPACT ASSESSMENT KHOE WIND ENERGY FACILITY, WESTERN CAPE

April 2024

PREPARED FOR:
Energy Team
Attention: Alex le Roux
15 Bridgeway Road, Bridgeway Precinct, Century City, 7441, South Africa
alex.leroux@energyteam.co.za
Tel: +27 84 582 8683

ENVIRONMENTAL ASSESSMENT PRACTITIONER
ERM
Attention: Sadiya Salie
1st Floor, 240 Main Road, Rondebosch, Great Westerford, Cape Town
Sadiya.Salie@erm.com
Tel: +27 21 681 5400
+27 60 739 6993

BAT SPECIALIST:
Stephanie C Dippenaar (MEM)
Professional Member of the South African Institute for Ecologists and Environmental Scientists (SAIEES)
sdippenaar@snowisp.com
Cell: +27 (0)82 200 5244
Stephanie Dippenaar Consulting
VAT Number. 4520274475

STATIC DETECTORS:
Inus Grobler (D. Eng)

DATA ANALYSIS AND STATISTICAL SUPPORT:
Inus Grobler Jnr. (BCom. (Actuarial Science)

REPORT WRITING SUPPORT
Madeleine de Wet (BSc. (Honours) Life Sciences)
Franky Nightingale (MPhil. Disaster Risk Science and Development)

declaration of independence

TO BE FORWARDED

executive summary

FE Hugo & Khoe (Pty) Ltd is proposing to develop the Khoe Wind Energy Facility (WEF), Battery Energy Storage System (BESS), and associated infrastructure with a maximum generation capacity of up to 290 megawatts (MW). The total study area was approximately 4 103 ha, but due to buffers from the avian study, part of the property was removed from development and the eventual layout comprises an area of approximately 2 463 ha. The project is located on farmland southeast of De Doorns and southwest of Touws River, in the Western Cape Province. The proposed wind farm is situated on a plateau, which then descends eastwards to the Karoo, beyond the Khoe WEF.

Stephanie Dippenaar Consulting trading as EkoVler, was appointed to assess the potential impact of the proposed wind development on bats in the area and to inform final design and management strategies by identifying measures that would mitigate the negative impacts of the development.

Data from passive monitoring systems, fieldwork sessions, roost surveys, and a desktop study informed this report. Six static SM4BAT systems were deployed within the project site, with four systems located near-ground at 10 m, to represent the various biotopes, and two on the met mast, within the sweep of the turbine blades, at 50 m and 100 m.

The proposed study area falls within the Fynbos Biome, with three main vegetation types being represented on site. 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 north-westerly direction. 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 do 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, the river valleys and several human dwellings provide ample roosting opportunities for bats. Mountainous areas surrounding the proposed site could have bat roosts, and bats from these neighbouring roosts would traverse the proposed wind farm to forage and drink.

Of the 12 species with distribution ranges that include the proposed development area, three have a conservation status of Near Threatened in South Africa and one Vulnerable, while two have a global conservation status of Near Threatened. According to the likelihood of fatality risk, as indicated by the latest pre-construction bat guidelines six species, namely *Miniopterus natalensis* (Natal long-fingered bat), *Tadarida aegyptiaca* (Egyptian free-tailed bat), *Sauromys petrophilus* (Roberts's flat-headed bat), *Laephotis capensis* (Cape roof bat) 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 *Eptesicus hottentotus* (Long-tailed house bat) has a medium risk of fatality.

Passive monitoring data for the period between 30 December 2022 and 7 March 2024 is included in this report. *L. capensis* was the most abundant species recorded (55%), while 37% of the calls were of those

bats like the high-flying *T. aegyptiaca*, which has a narrow wing morphology adapted for open air space. 4% of the activity recorded was similar to *M. natalensis*, 3% was *S. petrophilus,* and a statistically insignificant number of the endemic *E. hottentotus*.

The species diversity was largely similar for Systems D, at 100 m, and System E, at 50 m, on the met mast, with more than 90% of these calls by *T. aegyptiaca*. Alternatively, *L. capensis* showed a higher representation of more than 50% at the 10 m masts (Systems F, G, H, and I). Except for the endemic *E. hottentotus,* all these bat species are, according to the South African Bat Assessment Association (SABAA) bat guidelines, at high risk of being negatively impacted by wind farm developments.

When activity over the monitoring period is considered *L. capensis* demonstrated significantly higher activity during autumn, spring, and summer, while *T. aegyptiaca* presented a higher activity in spring and summer of 2023-2024. The average monthly activity shows that bats are generally most active during the summer months, followed by autumn and spring, with reduced activity during the winter months. Peak activity was recorded in March, November and December 2023, with general high activity from February to May 2023, and again from October 2023.

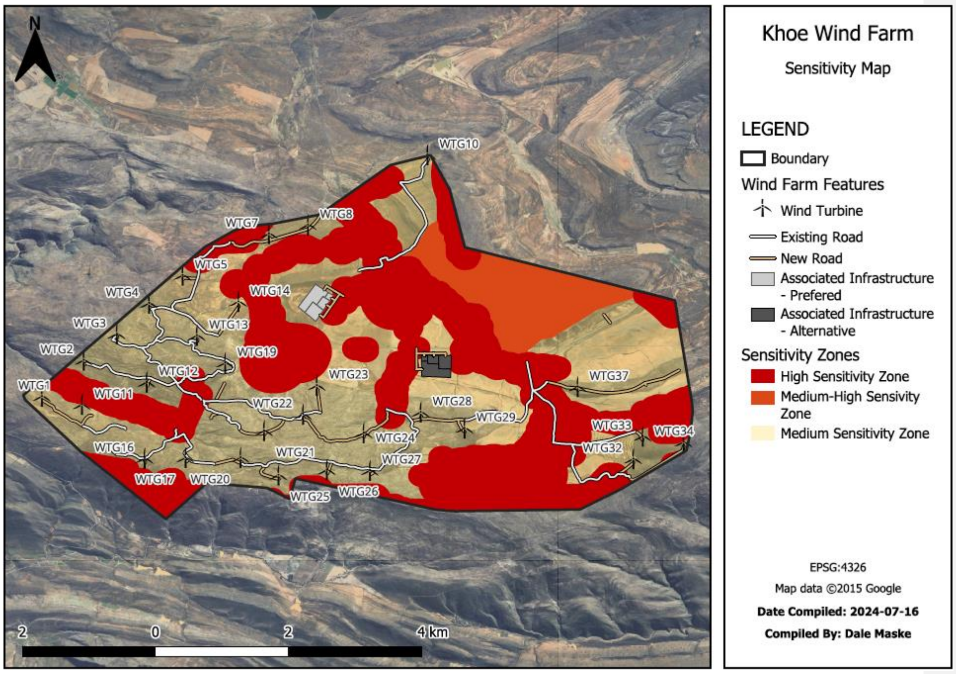
When hourly bat activity medians per year of various systems are compared, bat activity declined with an increase in altitude, with System D, at 100 m, portraying lower activity than System E, at 50 m, which again recorded lower activity than System F at 10 m. A similar decline in activity with altitude was recorded at the nearby proposed Hugo WEF and one could therefore, with caution, extrapolate this tendency to the rest of the site.

At the proposed Khoe WEF, the hourly nightly activity patterns portrayed at the different systems were quite similar. Higher activity was portrayed approximately two hours after sunset, when bats emerge to forage and drink water, with a peak in activity around three hours after sunset. Steady high activity occurred for the first seven hours after sunset, between 21:00 and 00:00, and a decline in activity was shown from midnight to approximately two hours before sunrise.

The hourly median of the combined bat activity over the monitoring period, is 2,43 bat passes/h/annum, while the total average bat passes per hour per year, namely the Bat Index, is 3,11 bat passes/h/annum. These figures indicate high activity. The hourly annual median bat activity at height is 0,36 while the near-ground median is 2,98. According to the SABAA pre-construction bat guidelines, both these medians fall within the high-risk category. The rotor sweep median is the most important measure, and development should progress with caution. Furthermore, fatalities in the lower section of the rotor sweep are highly probable, and bats represented by the 10 m monitoring systems could be at risk. Due to the high risk of collision, the bat guidelines dictate that fatality minimisation measures should be recommended during pre-construction and should be applied from the commencement of turbine rotation.

Temperature data from 14 m and wind, humidity and barometric pressure data from the Met mast at 117m were plotted with bat activity data from System D at 100 m, as this sampling system is situated in the area of collision and the closest to the weather monitors, for the statistical analyses. Results of linear regressions between weather conditions and bat activity indicate that in particular temperature, wind, and atmospheric pressure have an influence on bat activity at the Khoe Wind Energy Facility. Cumulative distribution functions (CDF) between weather and bats were utilised to illustrate the relationship between bat activity and weather conditions. They were further refined with Cumulative distribution function heat maps to establish the “sweet spots” where bats are expected to be most active. This information was then used to draw up a curtailment schedule which could be used as a starting point for discussions during the operational phase.

One of the most successful mitigation measures is to shift development away from sensitive areas. After specialist input was considered, the developer removed turbine positions from high-sensitivity areas. The below bat sensitivity map indicates the various sensitivity zones of Khoe WEF. Due to the general high bat activity on site, the development areas were classified as medium sensitive. It will therefore be necessary to mitigate turbines early in the operational phase. No turbine components are allowed in high-sensitivity zones. At present no turbines are positioned in medium-high sensitivity zones either, but if turbines are placed on medium-high sensitivity zones, curtailment will have to be applied after the testing of those turbines, when they start to turn.



Bat sensitivity map for Khoe WEF

At present no specific turbines are recommended for curtailment. Carcass searches will determine which turbines portray the highest mortality, and mitigation measures will then be applied, starting at those turbines. Close observation by the bat specialist during the operational phase must be conducted and the below curtailment schedule should inform the discussions about curtailment.

Curtailment schedule for turbines situated in medium sensitivity zone

Turbine numbers	Months	Time period	Temperature (°C)	Atmopheric Air Pressure (hPa)	Curtailment
Turbine numbers to be determined during the first months of bat monitoring	February, March, April, May, October, November, December	2 hours after sunset, up to 7 hours after sunset	Above 13 °C	Between 863 and 872 hPa	Raise cut-in speed to 5 m/s

It is recommended that the following mitigation measures be included in the Environmental Authorization (EA):

- *The final layout must be informed by the sensitivity map provided in Section 6. 10 of the main report.*
- *A bat specialist must be appointed before the commercial operation date. Mitigation measures, as per Section 7 of the main bat report, must form part of the operational EMPr, and be applied as directed.*
- *Turbines must be feathered below cut-in speed, and although they need not be at a complete standstill, there should be minimum movement so that bats are not at risk when turbines are not generating power.*
- *All newly built structures that have bat conducive features must be rehabilitated to discourage bat presence: Roofs of new buildings must be sealed and any open quarries and borrow pits created during construction must be rehabilitated.*
- *No roll-up garage doors should be installed at the new buildings.*
- *A minimum of two year's operational bat monitoring must be conducted after the commencement of operations at the proposed Khoe WEF, as per the guidance of the latest operational South African Bat Assessment Association (SABAA) guidelines. Due to the high bat activity and future installation of mitigation measures, it might be necessary to conduct operational monitoring beyond the minimum of two years.*

A summary of impact on bats at Khoe WEF is provided below. The highest negative impact on bats during wind farm developments is experienced during the operational phase, which is rated high negative without mitigation and moderate negative with mitigation. Although the overall combined impacts are rated as moderate negative before mitigation, and low negative after mitigation, it should be noted that the most important impact on bats, namely fatality during operation, is high before and after mitigation. This is supported by the bat activity category for Montane Fynbos and Renosterveld, which is high; Therefore, bat fatality during the operational phase could be high. Operational bat monitoring will shed further light on bat fatalities and the developer should prepare for turbine-specific curtailment and/or installing bat deterrents when more information is available.

Summary of impacts on bats: Khoe WEF		
Phase	**Impact before mitigation (negative)**	**Impact after mitigation (negative)**
Construction	Moderate	Low
Operation	Moderate	Moderate
Decommissioning	Moderate	Low
Cumulative (Only solar farms within 30 km, therefore only one cumulative effect)	Moderate	Low
Combined for the site	Moderate	Low

Khoe WEF is the first proposed wind farm in the area; therefore, the cumulative impact is low, as there are no other wind farms within a 30 km radius. When solar farms are considered, a low impact of habitat destruction is noted.

The Department of Forestry, Fisheries, and the Environment's (DFFE) Screening Tool Report showed a high sensitivity to the bats (wind) theme. The required Site Sensitivity Verification Report confirmed that the proposed Khoe WEF has high sensitivity in terms of bats, which had been confirmed by the bat monitoring exercise due to general high bat activity.

One year of pre-construction bat monitoring is required by legislation in South Africa. However, the dry Renosterveld and Fynbos are subject to erratic weather conditions, which could vary from year to year. Bat activity conducted during 2022 at another proposed development bordering Khoe WEF, indicated general lower bat activity. The exceptionally high rainfall during the following year could have contributed to the high bat activity during 2023. Increased rainfall often results in an increase in insect activity which could result in higher bat activity. Therefore, mitigation and enhancement options should be adjusted as this project develops and more site-specific information is collected. Furthermore, a growing knowledge in this field of study based on research and evidence gained from current similar development projects could add value to this project.

The overall potential negative impact of the proposed Khoe WEF on bats, combined for all the development phases, is predicted to be Moderate negative without mitigation, while Low negative with mitigation.

Based on the findings of the 14 months of pre-construction bat monitoring undertaken at the proposed Khoe WEF project site, the bat specialist is of the opinion that no fatal flaws exist which would prevent the construction and operation of this wind farm, but bat activity is high, and mitigation measures should be adhered to. The EA may be granted, subject to the implementation of the recommended mitigation as described in this report (Section 7).

abbreviations

BA	Basic Assessment
BESS	Battery Energy Storage System
CDF	Cumulative Distribution Function
CSIR	Council of Scientific and Industrial Research
ECO	Environmental Control Officer
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries, and the Environment
EA	Environmental Authorisation
EGI	Electrical Grid Infrastructure
EIA	Environmental Impact Assessment
EMPr	Environmental Management Program
ha	Hectares
IPP	Independent Power Producer
MET	Meteorological
ms	milliseconds
MTS	Main Transmission Substation
MW	Mega Watt
O&M	Operation and Maintenance
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
REF	Renewable Energy Facility
SABAA	South African Bat Assessment Association
SANBI	South African Biodiversity Institute
SEF	Renewable Energy Development Zone
ToR	Terms of Reference
WEF	Wind Energy Facility

glossary

Definitions	
Barotrauma	Damage to air-containing structures caused by rapid or excessive pressure change, often the case of fatal injuries suffered by bats due to a sudden shift in air pressure caused by the rotation of the turbine blades
Bat monitoring systems	Ultrasonic recorders used to record bat echolocation calls
Torpor	A state of physical inactivity associated with lower body temperature and metabolism
SM4BAT	Wildlife Acoustics' full spectrum ultrasonic bat monitoring recorder
SMMU2	Wildlife Acoustics' ultrasonic microphones for recording bat sounds
Threshold	Bat activity threshold as provided by SABAA

COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS (as amended)

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 (as amended)	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- b) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 2 and index page
c) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 3 to 6 of this report
d) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
(cA) an indication of the quality and age of base data used for the specialist report.	Sections 6
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 9
e) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6
f) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
g) 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;	Sections 1
h) an identification of any areas to be avoided, including buffers;	Section 6.10
i) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6.10
j) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
k) 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;	Sections 5,6, 7, and 9
l) any mitigation measures for inclusion in the EMPr;	Executive Summary and Section 9.2
m) any conditions for inclusion in the environmental authorisation;	Executive Summary
n) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7 and 9.5
o) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and 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;	Executive Summary, Conclusion
p) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
q) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
r) 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.	Part A of the Assessment Protocols published in GN 320 on 20 March 2020 is applicable (i.e. Site sensitivity verification requirements where a

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 (as amended)	Addressed in the Specialist Report
	specialist assessment is required but no specific assessment protocol has been prescribed).

contents

Figures

tables

1. INTRODUCTION

1.1 Background

FE Hugo & Khoe (Pty) Ltd is proposing to develop the Khoe Wind Energy Facility (WEF), Battery Energy Storage System (BESS), and associated infrastructure with a generation capacity of up to 290 megawatts (MW). Table 1 summarises the project details.

Table 1: Project name and affected property

Applicant	Project Name	Capacity (MW)	Affected Property
FE Hugo and Khoe (PTY) LTD	Khoe Wind Energy Facility Farm	290 MW	Portions 1/38, 2/38, 11/38 and RE/37 of Farm Eendragt
			Farm 193

To evaluate the energy generated by the WEF to supplement the national grid, FE Hugo & Khoe is also proposing an electrical grid infrastructure (EGI)/grid connection project which will be assessed in a separate Basic Assessment Process. The proposed development site is located west and east of the R318, the road between Montagu and De Doorns, and is situated within the Langeberg Local Municipality within the Cape Winelands District Municipality of the Western Cape Province, see Figure 1.

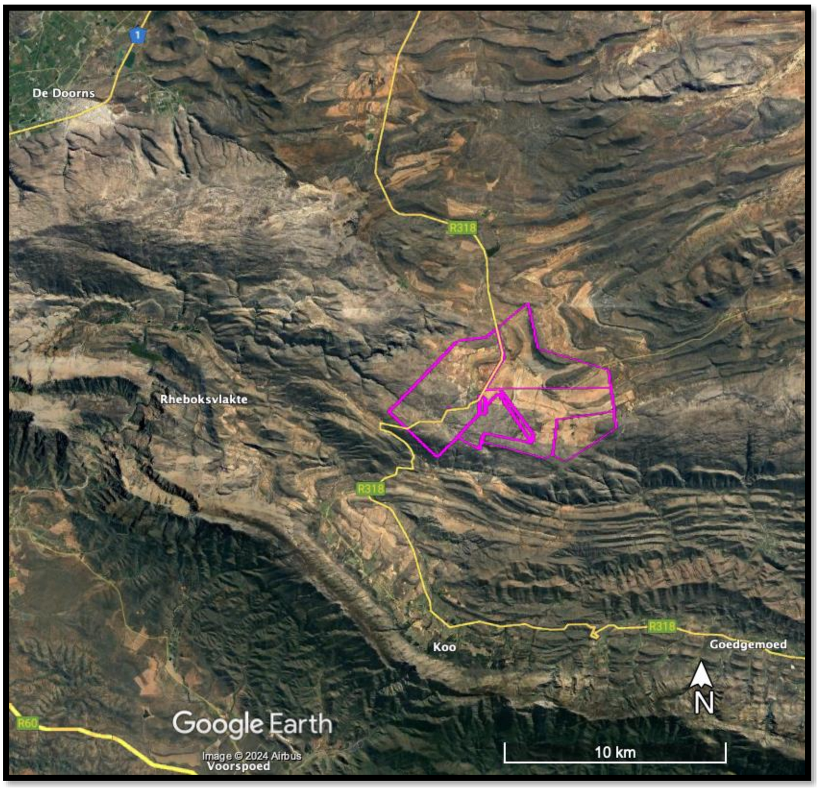


Figure 1: The proposed Khoe Wind Energy Facility

ERM is undertaking the prerequisite environmental assessment applications for this project. Stephanie Dippenaar Consulting, trading as EkoVler, has been appointed to assess the potential impact of the proposed development on bats in the area and to inform final design and management strategies by identifying measures that would mitigate direct, indirect, and cumulative impacts of the development and associated infrastructure. The bat specialist will also provide recommendations for inclusion in the Environmental Management Programme (EMPr) for the Environmental Impact Assessment (EIA).

This assessment presents baseline information on the environment with respect to bats and is informed by a bat monitoring programme at the proposed Khoe Wind Energy Facility (Figure 2) conducted from December 2022 to March 2024. A Site Sensitivity Verification Report (SSVR) has been appended in Annexure 1.

The report is structured as follows:

- Section 1 introduces the project;
- Section 2 outlines the scope of this study;
- Section 3 describes the methodology used for bat monitoring;
- Section 4 details the affected environment and baseline information.

- Section 5 provides an overview of site-specific features that could influence bat presence;
- Section 6 presents the results of bat monitoring, including the sensitivity map;
- Section 7 outlines the mitigation measures;
- Section 8 discusses the assessment of the cumulative impact;
- Section 9 describes the potential impacts as well as input in the EMPr; and
- Section 10 presents a conclusion.

Mitigation and enhancement options may be adjusted as the Khoe WEF develops to the operational phase. This may use growing knowledge in this field of study, especially fatality mitigation measures, based on research and evidence gained from current development projects.

1.2 Project description

The proposed wind energy facility (Figure 2) will comprise an estimated 34 turbines and will include a Battery Energy Storage System (BESS), an internal road network, a construction laydown area/camp, and an Operation and Maintenance (O&M) Building. Technology specifications are as follow:

- turbines will be three-bladed horizontal-axis design;
- hub height from ground level is anticipated to be up to 150 m;
- blade length and rotor diameter of up to 100 m and 200 m respectively;
- height of the complete structure is up to 250 m;
- The proposed turbine footprint and associated facility infrastructure will cover an area of up to 85 ha depending on the final design for Khoe WEF.

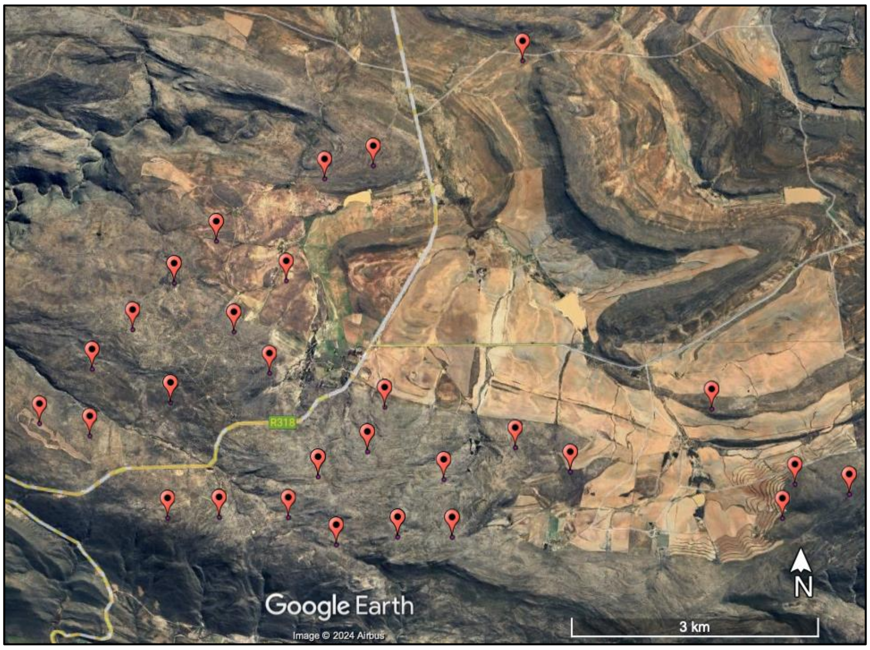
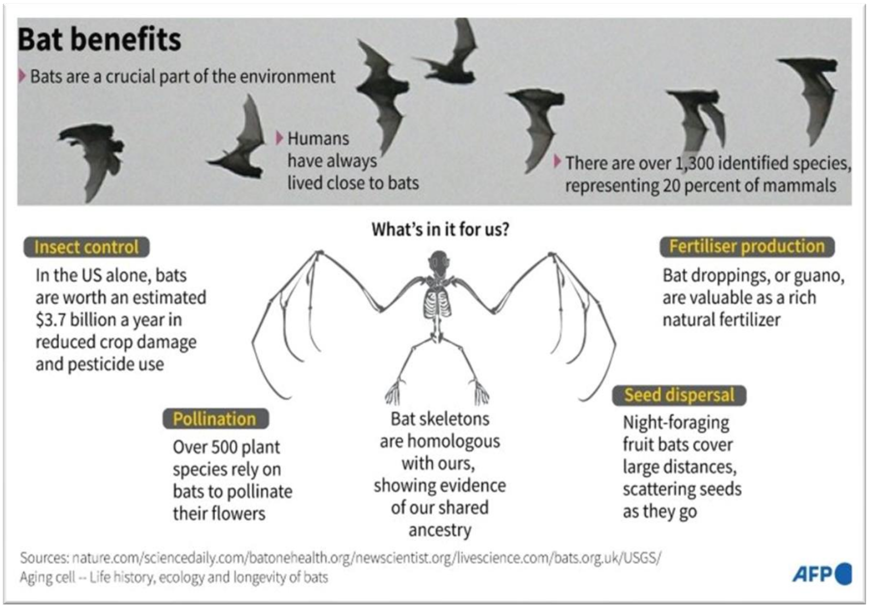


Figure 2: Khoe WEF Turbine Layout

1.3 The Importance of bats

Bats are the second largest group of mammals after rodents (Pennisi 2020). Approximately 62 bat species occur in South Africa (De Villiers 2022). Bats can be classified into three broad functional groups based on



their wing morphology and echolocation call structure, namely: clutter, clutter-edge, and open-air foragers (Aldridge and Rautenbach 1987, Neuweiler 1989, Schnitzler and Kalko 1998, Schnitzler and Kalko 2001). Of these three groups, open-air foragers, i.e. bats with a wing design adapted to flying fast and high above the vegetation, experience the highest negative impact from wind turbine developments. However, bats could change their flight characteristics when migrating, meaning that bats that usually forage at low altitudes could fly within the sweep of the turbine blades when migrating, regardless of their foraging behaviour.

Figure 3: The importance of bats

Bats in general play important functional roles as insect predators, as well as pollinators and seed dispersers, in the case of fruit bats (Kunz et al. 2011). Fruit bats are the main pollinators of numerous cacti species in the world because these plants open their flowers during the night (National Science Foundation 2012), as shown in Figure 3.

In addition to the mortality and disturbance resulting from wind turbine developments, the major threats faced by bats include habitat change and destruction, roosting disturbance, and natural disasters (Geda and Balakrishnan 2013). Bat populations are sensitive to changes in mortality rates and tend to recover slowly from declines. In general, environment-related risks for bats associated with human behavior include the reduction in food resources, overhunting of bats for bush meat, the maltreatment of bats due to misguided fears (such as those related to Covid-19), killing bats that roost in roofs, and a rise in the use of pesticides (MacFarland and Rocha 2020; Geda and Balakrishnan 2013). According to scientists, bats are one of the most endangered groups of animals on our planet (Bottollier-Depois et al. 2021).

The economic consequences of the widespread loss of bat populations could be substantial, even more so in sensitive semi-desert environments. Although the loss of bats in Southern Africa has not been quantified in economic terms, literature indicates that insectivorous bats play a crucial role in the disruption of population cycles of agricultural pests (Leelapaibul et al. 2005; Reiskind and Wund 2009; Boyles et al. 2011; National Park Service 2020), resulting in a reduced cost of pesticides. The cost of reduced pesticide usage stemming from bats controlling pests in the USA has been quantified, resulting in a saving of more than an estimated $3,7 billion (National Park Service 2020).

The consumption of insects by insectivorous bats also plays a role in the control of diseases that afflict humans, such as malaria and dengue. Insectivorous bat species can consume large numbers of mosquitoes as they typically consume the amount of insects equivalent to their body weight per night; notably, mosquitos and flies are important vectors in the transmission of diseases (Monadjem et al. 2010; National Science Foundation 2012). Malaria afflicts millions of people in Africa and the contribution bats make in reducing the number of insects that transmit diseases should not be underestimated (Monadjem et al. 2010).

Several distinctive attributes of bats, including the membranes of bat wings and their echolocation, were the inspiration behind some technology-related breakthroughs within the field of engineering, such as drones with navigating sonar systems (National Park Service 2020; National Science Foundation 2012). Further examples are base jumper wingsuits, sonar navigation for ships, and ultrasound devices.

Studies have revealed that blind people, as well as those that are visually impaired, use echolocation to establish the position of an object (Selemin J 2022). Researchers also assessed the saliva of vampire bats as practicable medication to treat strokes in humans (ESA 2011), as the enzyme that prevents blood from coagulating when vampire bats feed can be used to prevent or to break down blood clots in stroke patients. The drug known as “Draculin” has since been derived.

The three main species recorded at Khoe WEF, namely *Tadarida aegyptiaca, Laephotis capensis, Miniopterus natalensis* and *Sauromys petrophilus*, are discussed below:

1.3.1 *Tadarida aegyptiaca* (Egyptian free-tailed bat):

T. aegyptiaca, the Egyptian free-tailed bat, is known to forage over a wide variety of habitats in Southern Africa, with an approximate range of 1 340 000 km^2 (Eiting 2020; Monadjem et al. 2020). Generally, this bat species flies effortlessly above the vegetation’s canopy and is found in agricultural fields, grassland, savanna, and semi-desert scrub, as well as desert habitats (Monadjem et al. 2020). *T. aegyptiaca* consumes insects included in the orders Lepidoptera and Hymenoptera, which are likely damaging pests (Eiting 2020). However, this bat species tends to stay away from forest habitats (Monadjem et al. 2010). Within arid environments, the presence of *T. aegyptiaca* is to a large extent associated with permanent water bodies and/ or standing water that attracts concentrated densities of insects. *T. aegyptiaca* females give birth to a single pup annually.

In previous years, before the increase in wind farms, *T. aegyptiaca* was not perceived to be under threat (MacEwan et al. 2016), as its distribution is widely spread over Southern Africa. However, there is currently a serious cumulative threat from the proliferation of wind farms. Furthermore, the possibility that *T. aegyptiaca* could be subdivided into more than one species or sub-species, is at present being debated amongst zoologists and genetics specialists. If this is the case, wind farms concentrated in certain biomes in South Africa could threaten a species or sub-species that has not been described yet. When all South African bat species are considered, preliminary data indicate that *T. aegyptiaca* experiences the highest fatality from wind farms, and with the increase in these developments, one could expect that this trend will continue.

1.3.2 ***Laephotis capensis (Neoromicia capensis)*** **(Cape roof bat):**

When compared to all other bats from Southern Africa, likely, *L. capensis (*formerly *N. capensis)* (the Cape roof bat*)* has the most wide-ranging distribution; with an approximate range of 1 392 522 km^2 within Southern Africa (Monadjem et al. 2020). This bat species occurs in every part of the Southern African region (Monadjem et al. 2010). *L. capensis* seems to exploit a variety of environmental conditions, which include arid semi-desert localities, as well as mountain grasslands, forests, savanna, and to a smaller extent, low-lying savanna. They also seem to forage at various altitudes, and even though they are seen as a clutter-edge forager, a high number of carcasses of this species have been collected at wind farms up to now.

The females of this bat species have their birthing period once a year, during which twins are frequently born, although a single pup, triplets, as well as quadruplets, have been documented in the past (Monadjem et al. 2020). Even though *L. capensis (N. capensis)* currently has large population numbers, continuous, gradual decline in population numbers in certain areas can be expected, based on the number of confirmed deaths from wind turbines (Monadjem et al. 2020).

L. capensis with its clutter-edge foraging style, has a particular role to play in controlling insect populations that damage crops (Monadjem et al. 2020). Individuals of the species have been formally recorded hunting insects in groups, frequently gathering above water sources. This could be a particularly effective strategy in mosquito control.

1.3.3 ***Miniopterus natalensis*** **(Natal long-fingered bat)**

Although the conservation status of *Miniopterus natalensis* has recently changed from Near Threatened to Least Concern, this bat is a long-distance migratory species with a high risk of collision on wind farms. They are widespread insectivorous cave-dependent bats with populations that may be experiencing localised declines. Their presence is influenced by suitable cave roosting sites (Monadjem et al. 2020). They occur in large colonies and often form mixed-species colonies. The extent of occurrence is calculated as 1 387 139 km^2 (MacEwan et al. 2016).

Males are larger than females. Breeding occurs seasonally with mating in late autumn to winter. Females give birth to a single pup in spring to summer after 3-4 months gestation and the mother carries and nurses her pup while foraging till the pup transitions to solid food. Migration of more than 150 km occurs from winter to spring, and pregnant females and females with weaned young occur during summer.

M. natalensis forage along clutter edges and open areas and feed primarily on insects captured during flight such as moths, beetles, and flies that destroy crops. They roost in caves such as De Hoop Guano Cave in the Western Cape, and crevices and dark sheltered areas in clusters numbering thousands (Monadjem et al. 2020).

Peak nightly activity generally occurs 2-3 hours after sunset and the last 3 hours before sunset, with continuous activity throughout the night. Weather influences activity and heavy rains shorten and prevent flights. Females leave the roost first at night and return later in the morning. Males are active during the middle of the night. The greatest female activity occurs due to increased food and water requirements during pregnancy and lactation (Smith 1833).

It is important to consider the potential impact on *Miniopterus natalensis* and their habitat, with regards to the development of renewable wind energy. As the species rely on caves and dark, sheltered areas for roosting, the timing of the construction of wind turbines and associated infrastructure could potentially disrupt their reproduction (Pretorius et al. 2021).

1.3.4 *Sauromys petrophilus* (Roberts flat-headed bat):

S. petrophilus (Roberts' flat-headed bat) has an extensive, albeit patchy, distribution all through Southern Africa (Monadjem et al. 2020; Jacobs et al. 2022). *S. petrophilus'* dispersion expands towards the south into the Western Cape province and towards the east along the northern border of South Africa.

S. petrophilus is closely connected with rocky habitats, which accounts for its uneven distribution within its range (Jacobs et al. 2022). These habitats are typically found in dry woodland areas within mountain fynbos, or localities with arid scrubs, such as the arid areas in the western part of southern Africa. *S. petrophilus* requires narrow rock crevices, as well as fissures and exfoliating rock slabs (underneath which they roost) for roosting during the day, where they normally roost together in small groups of up to 10 bats (Monadjem et al. 2020).

S. petrophilus is an open-air forager (Monadjem et al. 2020; Jacobs et al. 2022) and feeds primarily on Diptera, Hemiptera, and Coleoptera, thus helping to control insect populations that can destroy crops (Jacobs et al. 2022).

It was observed in Namibia that these species need frequent access to water resources due to high levels of heterothermy (Monadjem et al. 2020; Jacobs et al. 2022).

The direct fatality risk of this species is increasing with the potential increase in wind farms, particularly in the Western Cape and along the Northern Cape's coastline (Jacobs et al. 2022). A further risk is that an increase in renewable energy developments in specific areas may reduce the habitat available to this species in the Northern as well as Western Cape.

Little data exist about the reproductive ecology of this bat species; however, there is evidence of a pregnant and lactating *S. petrophilus* female in the middle of November in Zimbabwe (Monadjem et al. 2020; Jacobs et al. 2022).

2. SCOPE OF STUDY

2.1 Scope and objectives

This Bat Impact Assessment Report forms part of an EIA process being undertaken in terms of the regulatory Environmental Authorisation Application process by ERM. The report presents baseline information on bats that occur at the proposed Khoe WEF site, informed by the findings of the pre-construction bat monitoring programme between December 2022 and March 2024. This allows for an assessment of the nature of the potential impacts on bats from the proposed project during the construction, operation, and decommissioning phases of the facility.

It also informs the development of mitigation strategies for the final design, construction, and operational phases. These mitigation strategies aim, as far as possible, to avoid or reduce the potential direct, indirect, and cumulative impacts associated with the proposed development. Potential risks to bats from wind farms include habitat displacement and loss during the construction phase, with the main impact on bats during the operational phase being fatalities due to collision with turbines, or through barotrauma.

Mitigation is an iterative process based on increasing knowledge in this field, informed by research and evidence gained from current operating wind farms. Strategies will be adjusted as the project develops.

The bat study was conducted on the area as indicated in Figure 1. After the information from various specialist studies had been incorporated, a section of the original area was then omitted for wind development.

2.2 Assumptions and limitations

An EIA must fit into a range of legislative and commercial processes, which dictate the timeframes and budgets of the studies that inform the EIA process. A rigorous scientific study would by its nature take longer and cost more than is feasible in terms of an EIA specialist study. The legislated time period for pre-assessment bat monitoring is approximately 12 months. Ideally, data collected over three or four years would provide a more comprehensive and robust indication of bat presence and activity under a range of weather conditions. These limitations are recognised, and every step is taken to manage them to ensure a thorough study is undertaken, based on credible scientific approaches.

Although it is an internationally accepted way of presenting bat data, the use of bat monitoring detectors to measure the relative abundance of bat activity as 'low', 'medium', or 'high', has limitations. This element of subjectivity is due to the extent that the results are based on the specialist's experience in interpreting the data into a qualitative baseline assessment report. A 'cautious' approach should be considered concerning accepting bat numbers as absolute true data, and hence recent guidelines regarding bat monitoring recommend a 'standardised' approach and include statistical formulas and calculations. Examples of assumptions and limitations in monitoring methods are highlighted below.

The knowledge of certain aspects of South African bats, such as population size, spatial and temporal movement patterns (e.g. migration and flying heights), and how bats may be impacted by wind energy, is limited, as their behaviour differs when comparing with the same type of European or American bat species.

Data is extrapolated from recordings of bat calls over large areas as acoustic monitoring only samples small areas of space (Adams et al. 2012). Furthermore, the sound recording of the bat echolocation could be influenced by the type and intensity of the call, the bat species, the recording system used, the orientation of the signal relative to the microphone, and other environmental conditions, such as weather conditions.

The accuracy of species identification is dependent on the calls used for proof of identity but can be influenced by variation in bat calls within species, and between different species, and the overlapping of species call parameters. Although species names are mentioned, true species identification can only really be conducted when handling the bat. Species are identified as those that are the most likely due to call parameters and distribution maps, but confirmation of species will only be possible during the post-construction phase when bat carcasses are collected.

Bat detectors record bat activity, but the sensors cannot distinguish between a single bat passing multiple times, which could lead to double counting or multiple bats of the same species passing the device once (Kunz et al. 2007). Therefore, if we discuss bat activity, it means that bats were active on-site. If we talk about high bat activity, one could nevertheless derive that there are many bats on the terrain. Comparative studies of bat activity from similar locations are used to verify baseline information. Due to the 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 as close as possible under the given circumstances, and within the limitations of the survey techniques.

Bats do not echolocate in a uniform, monotonous way. For example, when they go on a feeding frenzy, it is difficult to identify a species from the sound of a call. Sometimes a species could also echolocate at a frequency somewhat higher or lower than the normal identifiable frequency. These calls could then be nearer to the range of another species. For this study, bat calls from unidentifiable species were recorded as 'unclear'. These calls are identified as a bat, but uncertainty exists as to the species identification.

Weather stations were situated at 117 m, while the bat monitoring system with which the weather was correlated, was situated at 100 m. The ideal is that the weather monitor is at the system, but a 17 m difference should nevertheless provide a fairly accurate correlation. Due to some data loss at 117 m thermometer, the 14 m thermometer data was used for the temperature correlations.

It is not possible to search the entire site as well as the wider neighbouring terrain for bat roosts, as small roosts can be found in numerous rock crevices, aardvark holes, or under the bark of some trees. However, the site is walked through as thoroughly as possible, within the legislated time frames of a bat impact assessment, as discussed above, and any roosts or indication of bat presence discovered during ground-truthing are incorporated into the study.

Only a year of pre-construction bat monitoring is required by legislation in South Africa, but changing weather conditions result in sporadic changes in the bat situation with consequent higher insect activity, resulting in higher bat activity. Weather changes could therefore result in changes in bat activity, but during the operational monitoring, mitigation will be adapted as necessary.

This field of scientific practice is continuously informed by ongoing research and improved knowledge and data gained from similar projects.

2.3 Legislative framework and guidelines

Environmental law in the form of legislation, policies, regulations, and guidelines outlines and manages development practice to ensure informed decision-making and sound risk management of current and future projects, i.e., the impact of the proposed development on the ambient bat environment. These include:

- Constitution of the Republic of South Africa (Act No. 108 of 1996);
- National Environmental Management Act (NEMA, Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act (Act No. 10 of 2004);
- Convention on the Conservation of Migratory Species of Wild Animals (1979);
- Convention on Biological Diversity (1993);
- The Equator Principles (2013);
- The Red List of Mammals of South Africa, Swaziland, and Lesotho (2016);
- National Biodiversity Strategy and Action Plan (2005); and
- Aviation Act (Act no 74 of 1962).

The *South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities* (MacEwan et al. 2020) guided the bat monitoring process. 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)

3. METHODOLOGY

3.1 Terms of reference (ToR)

The following approach is followed during bat impact assessments:

- Undertake a desktop study of available literature to establish which bat species occur in the area, including the surrounding area as well as information from other wind developments in the area, if accessible;
- Provide background information regarding ecosystem services and the significance of the loss of bats on the broader environment;
- Determine local and global conservation status of all identified bat species;
- Conduct a minimum of four site visits, the first of which must include reconnaissance of the site and installation of equipment to inform the screening and scoping phase (although no formal scoping report is required);
- Conduct active surveys on-site visits after the initial site visit, one per season, as well as daytime investigations to cover the various biotopes occurring on-site, including the grid connection route;
- Set up and verify monitoring equipment, download data throughout the monitoring year, and analyse echolocation calls;
- Conduct interviews with the landowner(s), and where possible, employees who stay permanently on-site, as well as other relevant local people and/or NGOs, if relevant, regarding possible bat occurrence on the property and the surroundings;
- Provide input in the final layout of turbines;
- Assess the cumulative impact of each facility, together with existing wind farms in the close vicinity of the development site; and
- Recommend mitigation measures.

The data collected include the following:

- Assemblage of anticipated species using the site;
- Frequency of use by different species based on the monitoring period of one year;
- Description of the location and time of activity of the recorded species;
- Locations of known roosts found within and close to the site;
- Details concerning the potential presence of rare or sensitive species;
- Information on the type of use of the site by bats, for example, foraging, commuting, migrating, and roosting; and
- Geographical information such as buildings or any other features that provide potential bat roosts, known roosts, vegetated habitats, linear features such as tree lines, water bodies, and the project's proximity to any Protected Area.

3.2 Desktop investigation of the development area and surrounding environment

A desktop study was conducted for the site, using the information provided by the representative of the developer, as well as information gathered through a literature review. Although there are no other wind farms within a 30 km radius, other renewable energy developments were noted and consulted as appropriate. Bat species lists of nearby proposed wind farms, which is the closest wind farm applications, were consulted and compared to Khoe WEF.

We value local knowledge and discussing the bat situation with people who are familiar with the area and seasonal changes, this could provide valuable knowledge and input into the process. Therefore, interviews were conducted with the landowners staying permanently on the farm.

3.3 Passive acoustic monitoring systems

The monitoring systems consisted of six Wildlife Acoustics SM4BAT full spectrum bat detectors that were powered by 12V, 7Amp-h sealed lead acid batteries replenished by photovoltaic solar panels, see Table 2. Two SD memory cards, class 10 speed, with a capacity of 64 GB or 128 GB each, were utilised within each detector to ensure substantial memory space with high-quality recordings, even under conditions of multiple false environmental triggers. The sampling period is discussed in Section 6.1.

Table 2: Summary of passive detectors deployed at the proposed Khoe Wind Energy Facility

Detector	Situation	Coordinates	Micro-phone	Division ratio	High pass filter	Gain	Format	Trigger window	Approximate drop when calibrated (on chirp) at the microphone
SM4BAT (Met D)	Met mast: mic at 100 m	33°35'58,69" S 19°50'59,90" E	SMM-U2	8	16 kHz	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	16 kHz	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	16 kHz	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	16 kHz	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	16 kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-57 dB at 10m
SM4BAT (Mast I)	Temporary mast: mic at 10 m	33°36'27,40" S 19°53'40,60" E	SMM-U2	8	16 kHz	12 dB	FS, WAV@ 384 kHz	1 sec	-60 dB 10m (strong wind)

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

The data from these recorders was downloaded over three to four-month intervals and analysed to provide an approximation of the bat frequency and species diversity that visit and inhabit the site during the periods of monitoring. A summary of the passive detectors deployed at the site is shown in Table 2.

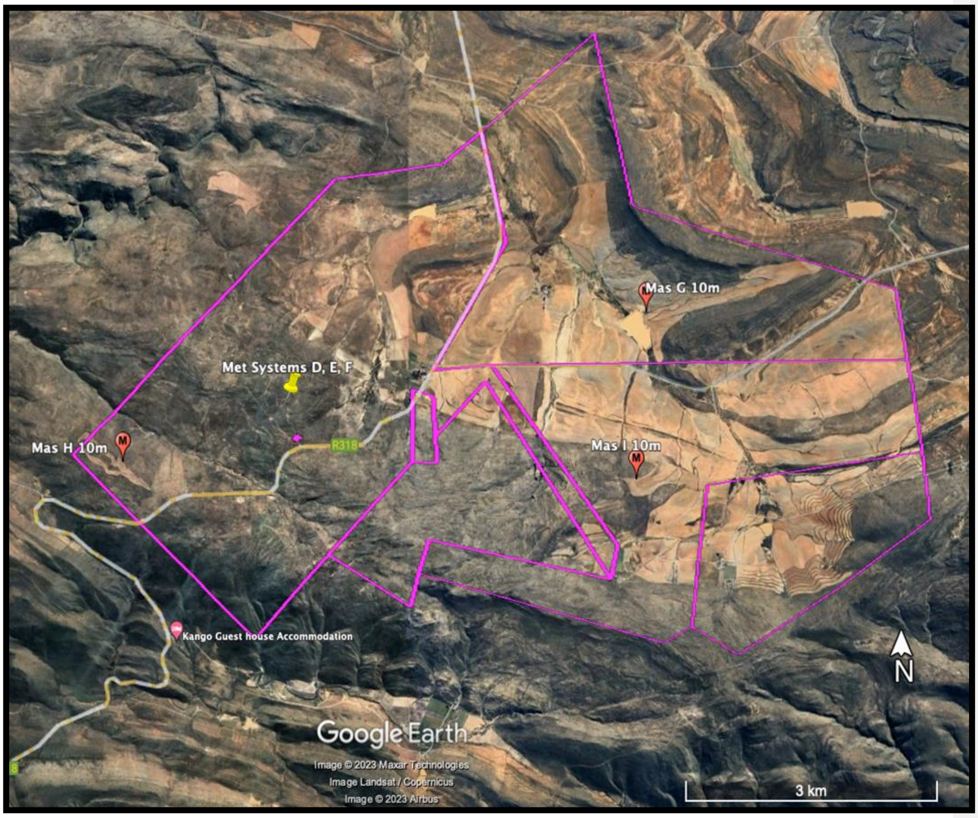


Figure 4: Location of the bat monitoring systems

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), 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 Figure 4 are motivated as follows:

- *System G, 10 m Mast* (Figure 5): Originally this system was placed east of the R318 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 proximity, and also 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. An open water body 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 collect during rainy spells, is found east of System I.

Figure 5: System G on a 10 m mast at the proposed Khoe WEF

3.3.1 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 14 months and limitations of the bat monitoring study, some bat roosts might not be discovered. Up to now, although bat presence was experienced at all the farm dwellings, no roosts were discovered.

3.3.2 Point sources

An SM4BAT full spectrum recorder is used during point sources, where the detector is placed for one night at a place where there is expected to be optimum bat activity.

3.3.3 Data analysis

Data were downloaded manually approximately once every three to four months. Acoustic files downloaded from the detectors were analysed for bat activity and possible bat species. The latest version Wildlife Acoustics Kaleidoscope 5.4.3 was used for analysing large quantities of data. In cases where there was uncertainty about the details of a call, but it was clear that it was a bat call, the call was classified as *Unclear*. As indicated in Section 2.2, there are limitations with electronic species identification, but for the purpose of impact assessment, this is a scientifically sound method.

3.3.4 Sources of information

The sources of information detailed below have been used to compile this report. A comprehensive bibliography is provided at the end of this report.

Bat information:

- Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. University of the Witwatersrand, Johannesburg. Monadjem et al. 2010 and 2020 versions;
- 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.
- Academic references and papers, as per the reference list (Section 11); and

Climate and precipitation data sourced from various websites:

- AccuWeather; Meteoblue; MSN.com, World Weather online, Yr.no.; and

Environmental and other related Legislation:

- Department of Forestry, Fisheries and the Environment: https://egis.environment.gov.za/data_egis/data_download/current; and
- 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; and
- Google Earth: https://www.google.com/earth/download/html.

Vegetation:

- Red List of South African Plants SANBI;
- Regions of Floristic Endemism in Southern Africa. Van Wyk AE and Smith G.;
- 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; and
- The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South African National Biodiversity Institute, Pretoria. Mucina L and Rutherford MC 2006.

4. DESCRIPTION OF AFFECTED ENVIRONMENT

A literature review of existing reports, studies and guidelines, legislation, and SANBI GIS database applications, as well as site visits to the study area, was conducted as part of the background study of the site and associated environment. The proposed development follows the South African national, regional, and municipal proposition in the Integrated Resource Plan (IRP) 2010-2030, that 17 800 MW of renewable energy capacity should be secured by 2 030 (energy.gov.za). Furthermore, wind energy development is perceived as an opportunity to address the key priority of job creation for the local communities.

4.1 Site background

The project 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 proposed wind farm is in proximity to the Hexriver Valley; however, the development 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.

4.2 Climate

Long-term climate data from the Matroosberg weather station, also situated on the plateau, is used for a general climate description. Generally, January and September are the driest months, with an average of 14 mm of rainfall. April, with an average of 35 mm rainfall, is the peak rainfall month (see Figure 6 below). There is a difference of approximately 21 mm between the average figures of the wettest and driest months (meteoblue.com 2023).

An average maximum temperature of 29 ºC and an average minimum temperature of 4 ºC were reported. The highest maximum recorded temperature is 36 ºC, and the lowest minimum temperature is 0 ºC. 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.

Most of the precipitation occurs in winter with a second rainfall that is often experienced from October to December. Seasonal snow usually occurs during winter.

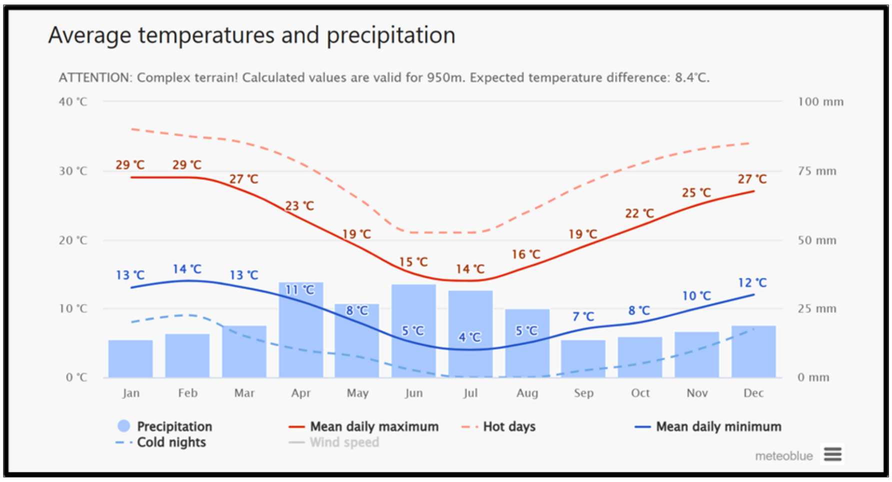


Figure 6: Climate of Matroosberg Weather station (meteoblue.com 2023)

4.3 Land use

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

The proposed Khoe WEF, on the other hand, is situated on the plateau before one descends to the Karoo, and although it is also in the winter rainfall region, the land use differs from the De Doorns area. Some onion seed cultivation and greenhouses do occur, but the main agricultural activities are livestock and wheat farming, see Figure 7 for a land use map.

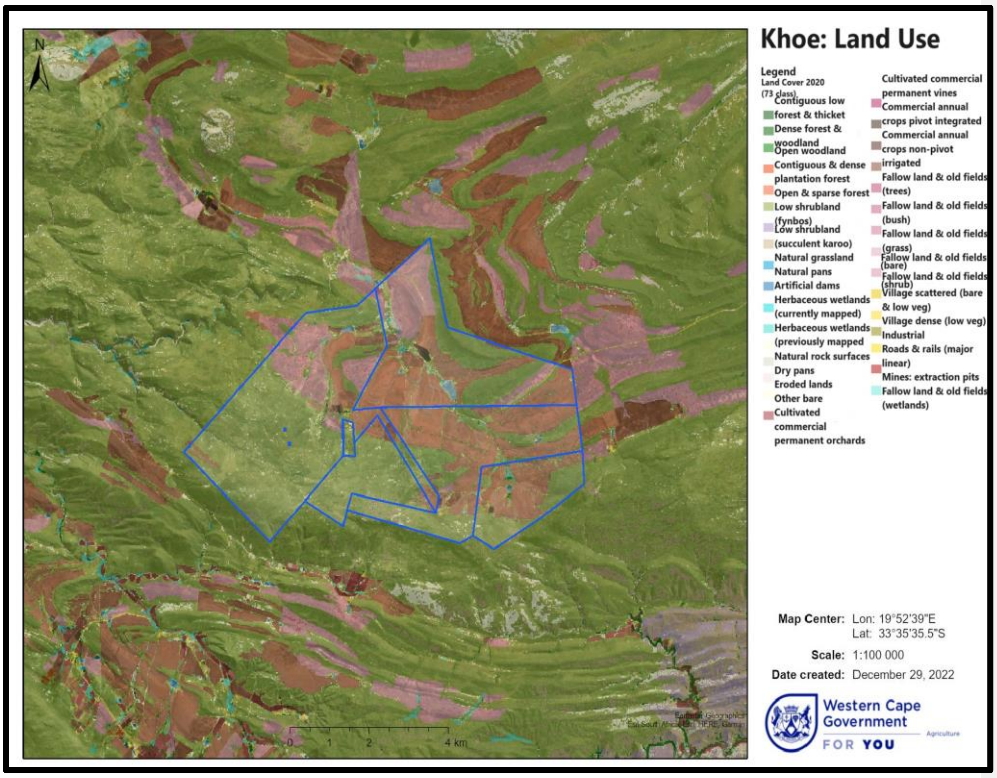


Figure 7: Land Use in the Khoe WEF area (WCG 2022)

4.4 Conservation areas

There are several areas of conservation value in the region of the proposed Khoe WEF, but none of these are adjacent to the proposed wind energy facility, see Figure 8. The nearest registered reserve, the Bokkeriviere Nature Reserve, is situated approximately 20 km in a north-westerly 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.

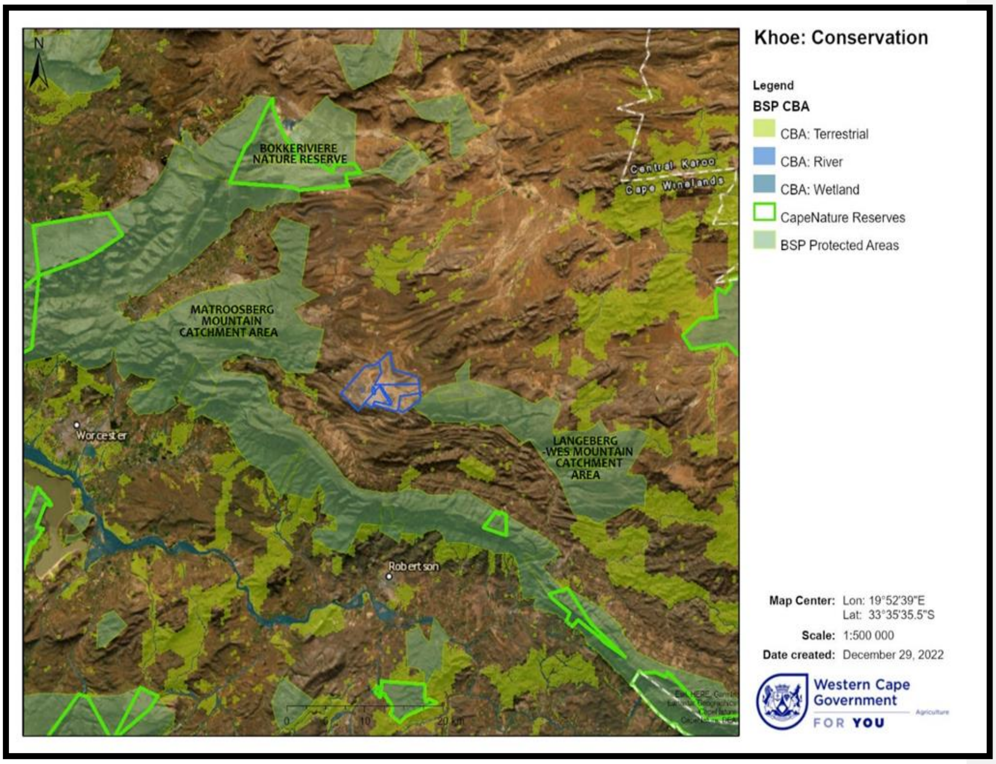


Figure 8: Surrounding conservation areas

4.5 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 9 (SANBI 2018). Fynbos, which has a high species diversity, typically grows in nutrient-poor soil.

While approximately only 85 000 km^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 and Smith 2001). 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.

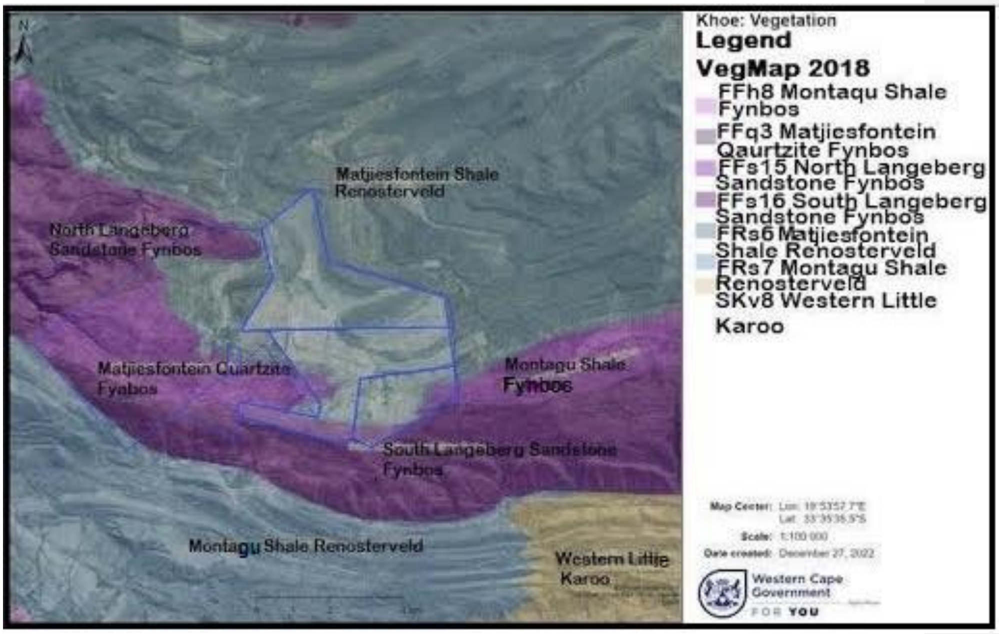


Figure 9: Vegetation zones on and surrounding the Khoe Wind Energy Facility

4.6 Water resources

There are numerous perennial and non-perennial water bodies (Figure 10) on the proposed development site. During the rainy season, water collects in these non-perennial ditches, depressions, and farm dams. Not only could these temporary open water sources provide water for bats to drink, but stagnant water could be a breeding ground for insects, which in turn attracts bats.

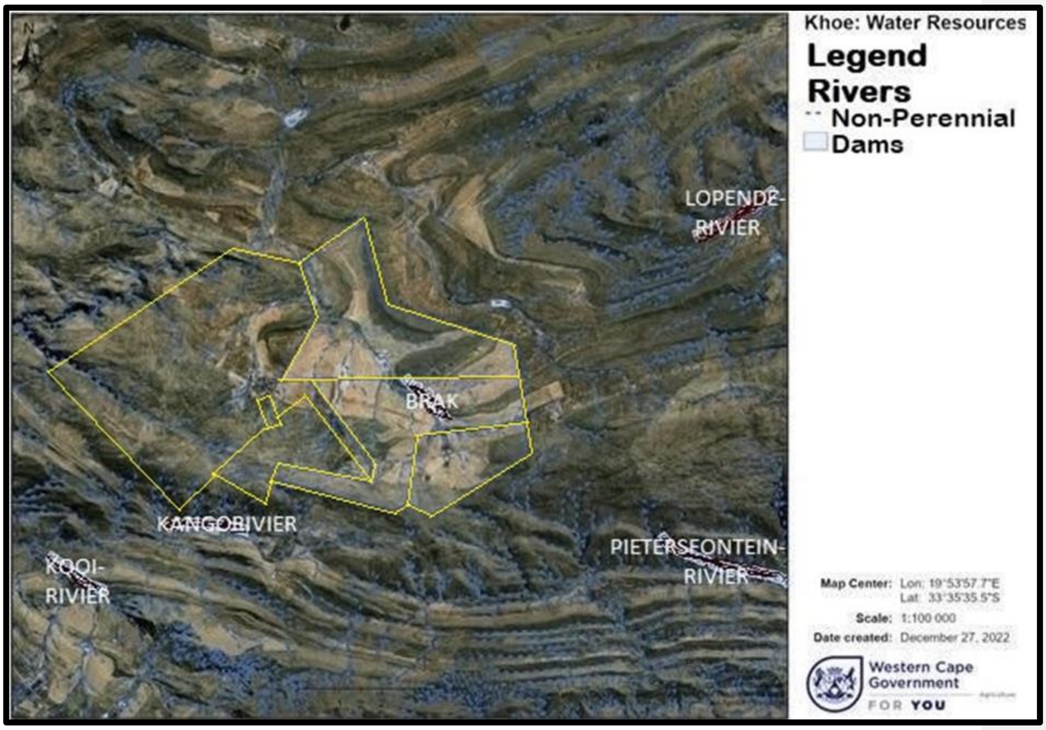


Figure 10: Water resources on the proposed Khoe Wind Energy Facility site and its vicinity (WCG 2022)

4.7 Diversity of bat species in the local area

A summary of bat species distribution, their feeding behaviour, preferred roosting habitat, and conservation status is presented in Table 3. These bats have distribution ranges covering the proposed Khoe WEF development site, and bats that have been confirmed up until now on the site itself are marked as such. The proposed wind farm falls within the distributional ranges of six bat families and approximately 12 bat species. Table 3 is informed by the most recent distribution maps of Monadjem et al*.* (2020) and will be updated as required, based on the outcomes of the monitoring programme.

Of the 12 bat species that have distribution maps overlaying the proposed development area, three have a Near Threatened status one a Vulnerable conservation status in South Africa, while two 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 2020).

The latest Pre-Construction Guidelines identify the likelihood of fatality risk (MacEwan et al 2020). Based on this, six species have a high risk of fatality due to their foraging habits at high altitudes, namely *Tadarida aegyptiaca* (Egyptian free-tailed), *Sauromys petrophilus* (Roberts's flat-headed bat), *Laephotis capensis*

(Cape roof bat) and *Miniopterus natalensis* (Natal long-fingered bat). The two fruit bat species, *Eidolon helvum* (African straw-coloured fruit bat) and *Rousettus aegyptiacus* (Egyptian rousette) also have a high risk of fatality, while *Myotis tricolor* (Temminck's myotis bat) has a medium-high risk, and *Eptesicus hottentotus* (Long-tailed serotine) has a medium risk of fatality.

The two *Pteropodidae* species (fruit bats) are not expected to roost on the project site itself. Due to the lack of fruit trees in the area, this environment is not their preferred habitat. However, the proximity of the mountains around the site, the agricultural activities of the Hex River 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. The possibility that they could sporadically be present in the development area should not be ruled out.

Rhinolophus clivosus (Geoffroy's horseshoe bat) was recorded in the surrounding area, but not on the Khoe terrain. There is a high likelihood that some of the bat species belonging to the genus *Rhinolophus* might occur in the more densely vegetated valleys. As indicated by Table 3 these bats are clutter foragers and have a low likelihood of fatality risk.

Table 3: Potential bat species occurrence on the proposed Khoe WEF (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	Least Concern	Least Concern	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		
MOLOSSIDAE	*Tadarida aegyptiaca*	Egyptian free-tailed bat	Least Concern	Least Concern	Roofs of houses, caves, rock crevices, under exfoliating of rocks, hollow trees	Open-air, insectivorous	Not known	High	✓	✓

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
	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 (endemic)	Near Threatened	Near Threatened	Caves, old mines. Night roosts used	Clutter, insectivorous	Not known	Low		
	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 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).*

5. FEATURES THAT COULD INFLUENCE BAT PRESENCE

There are several features that support bat presence in an area, as bats are dependent on suitable roosting sites provided by, amongst others: 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 accessibility of food. Thus, the vegetation, geomorphology, and geology of an area are important predictors of bat species diversity and activity levels. These aspects are discussed below.

5.1 Vegetation

The site is covered in typical Matjiesfontein Shale Renosterveld, South Langeberg Sandstone Fynbos, and North Langeberg Sandstone Fynbos, see Figure 11 and Figure 12. Although the natural vegetation does not support trees, there are limited trees situated in the non-perennial riverbeds and clumps of trees near farm dwellings, which could provide roosting opportunities for bats that prefer roosting in vegetation or under the bark of trees.

Figure 11: Fynbos on the proposed Khoe WEF

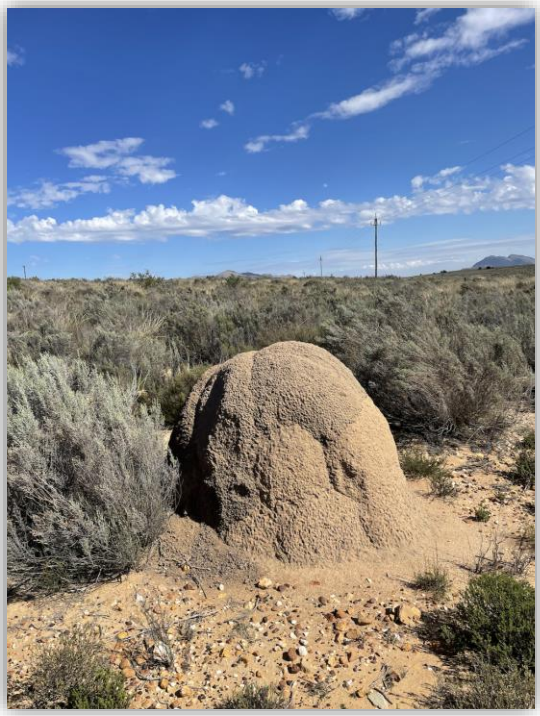


Figure 12: Typical renosterveld, with a termite/ant hill at the proposed Khoe WEF

5.2 Rock formations and rock faces

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 13. Numerous mountainous areas surrounding the proposed site could support bat roosts, and bats from these neighbouring roosts could traverse the proposed wind energy facility to forage, drink or migrate.

Figure 13: Rock formations that could provide roosting opportunities for bats

5.3 Human dwellings and building structures

Where roofs are not sealed off, human dwellings could provide roosting space for some bat species. Although bat presence was found at all the farm dwellings situated within the turbine development, no bat roosts were found. Roost searches should progress during the operational phase.

5.4 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 14).

Figure 14: Permanent, open water source at Sandvlei

6. RESULTS OF THE BAT MONITORING

6.1 Static recorders

Passive monitoring data for the period between 30 December 2022 and 7 March 2024, thus fourteen months of data, is included in this report. It is important to note that static recordings have limitations, as discussed in Section 2.2, but do provide a scientifically sound method of assessing the bat situation on-site.

Table 4 indicates the sampling periods per season as well as the gaps in data. The met mast systems started to operate in December 2022, while the 10 m masts were deployed in February 2023. Data gaps were experienced between 5 Feb 2024 and 7 March 2024 during the monitoring period and the two met masts systems were damaged by lightning during the last weeks of bat monitoring. Twelve months of monitoring, covering all seasons, is the minimum requirement for bat monitoring. Bat monitoring started in December 2022 and extra data were therefore recorded during summer, which is sufficient to fill the gaps during February 2024.

Table 4: Availability of data collected from the various systems with system gaps

Available Data: 14 months and 7 days	Gaps	Sampling Period
30 Dec 2022 – 11 Feb 2023	None	Summer (44 nights)
12 Feb 2023 – 23 Apr 2023	None	Summer (17 nights), Autumn (54 nights)
24 Apr 2023 – 12 Aug 2023	None	Autumn (38 nights), Winter (73 nights)
13 Aug 2023 – 7 Mar 2024	100 m Met High (D): 5 Feb 2024 – 7 Mar 2024 50 m Met (E): 5 Feb 2024 – 7 Mar 2024 10 m Mast (G): 13 Feb 2024 – 7 Mar 2024 10 m Mast (I): 1 Mar 2024 – 7 Mar 2024	Winter (19 nights), Spring (91 nights), Summer (91 nights), Autumn (7 nights).

Note that although all statistical analysis was considered for the report, to keep the report concise, not all graphs are shown. Readers are welcome to request additional graphs, as agreed to by the applicant.

Wildlife Acoustics Kaleidoscope 5.4.3 was used for data analysis and the codes for the species indicated in the graphs below is depicted in Table 5.

Table 5: Kaleidoscope software codes for species

Species name	Codes on graphs in this report
Laephotis capensis (former *Neoromicia capensis)*	LAECAP
Tadarida aegyptiaca	TADEAG
Sauromys petrophilus	SAUPET
Miniopterus natalensis	MINNAT
Eptesicus hottentotus	EPTHOT

6.2 Bat species diversity

L. capensis is the most abundant species (55%) (Figure 15 and Figure 16). In total 37% of the calls are those of the high-flying *T. aegyptiaca*, which has a narrow wing morphology adapted for open air. 4% of *M. natalensis*, 3% of the *S. petrophilus,* and a statistically insignificant number of the endemic *E. hottentotus* have also been recorded.

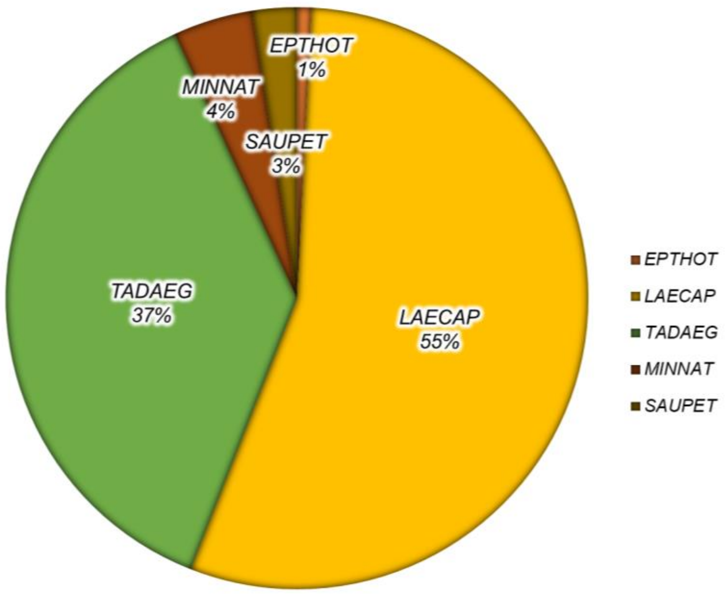


Figure 15: Combined species diversity at the Khoe WEF

The species diversity is to a large extent similar for Systems D, at 100 m, and System E, at 50 m, on the met mast. The activity of *T. aegyptiaca* is significantly higher at high altitudes, see Figure 16. 93% of the activity at 100 m (System D) and 95% at 50 m (System E) was represented by this species, while only 31%

of the activity was represented by *T. aegyptiaca* at 10 m, System F, on the met mast. Alternatively, *L. capensis* shows a much higher representation (the dominant species recorded) at the 10 m masts (Systems F, G, H, and I). Except for *E. hottentotus,* all these bat species are, according to MacEwan et al. (2020), at high risk of being negatively impacted by wind farm developments.

Figure 16: Species diversity recorded at each sampling point

Figure 17, below, depicts the weekly temporal distribution of bat passes over the whole monitoring period. The grey histogram indicates relatively higher activity across the monitoring period, demonstrating the significantly higher occurrence *of L. capensis* during autumn, spring, and summer. Peaks in activity for this species are observed in the middle of February 2023, the middle of May 2023 (the highest peak), and early December 2023, with a smaller peak in late February 2024. Notably, bats are often briefly active during autumn months (May) as they stock up on food supplies for the winter.

T. aegyptiaca shows high activity in spring and summer of 2023/2024; with a higher density of activity recorded in this period than the previous year. *T. aegyptiaca* activity drops significantly in the autumn and winter months in both 2023 and 2024. Although *T. aegyptiaca* is relatively the most abundant at height, as it is known to be a high-flying bat, the overall activity during the monitoring period of *T. aegyptiaca* is lower when compared to the overall activity of *L. capensis.*

M. natalensis has sporadic peaks in activity beginning in March of 2023 and continues to be active into the winter months of that year, with the highest peak occurring in May 2023. *M. natalensis* does not have significant activity recordings in late 2023 or early 2024. *S. petrophilus* has low recordings throughout the monitoring period, with a small peak in February and March of 2024.

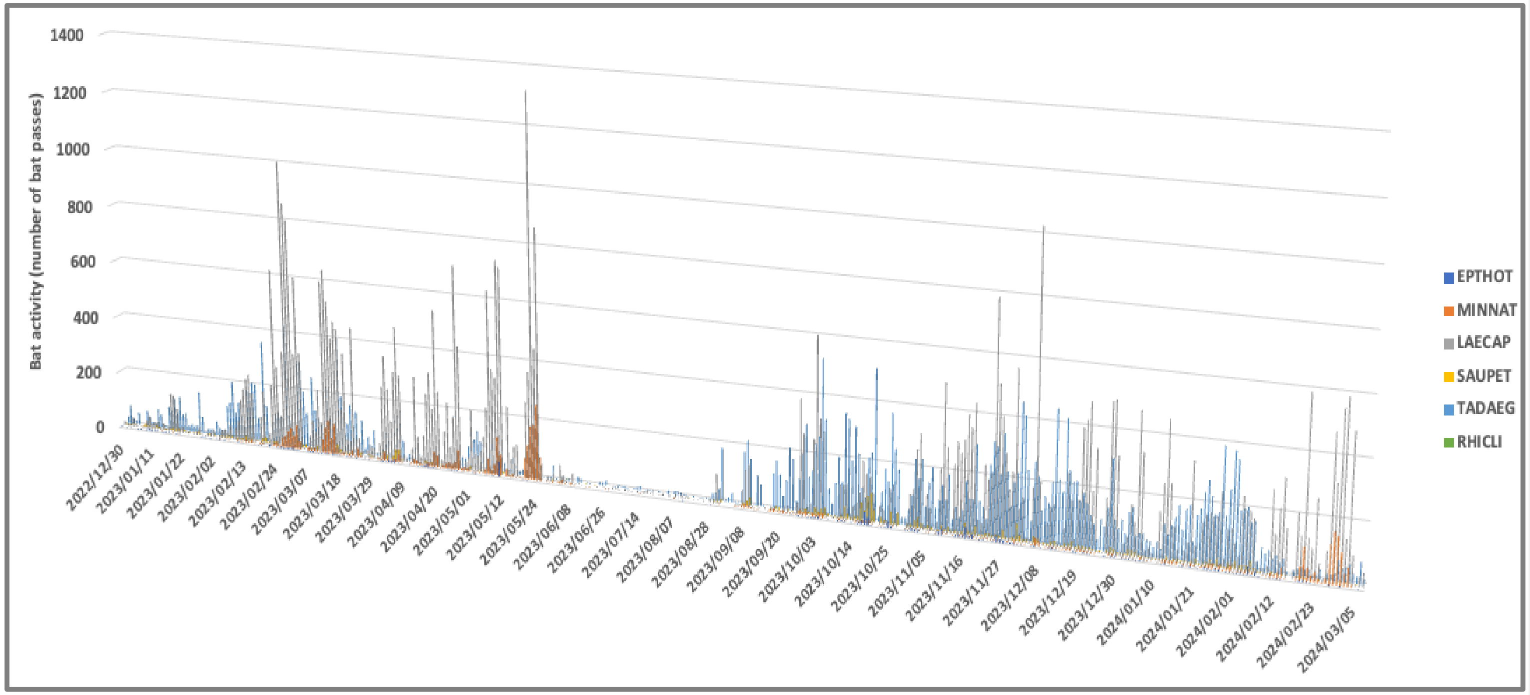


Figure 17: Temporal distribution over the monitoring period

Commented [VM1]: Indicate what code like EPTHOT is. It seems there are a couple of different names/codes used for a bat species e.g. E.hot, EPTHOT being used in this report. In some of the figures full species names are being used, there should be consistency throughout the document

6.3 Monthly activity

Figure 18 depicts the average monthly bat activity at the proposed Khoe Wind Energy Facility site, where bat activity is the number of bat passes. Bats are generally most active during the summer months, followed by autumn and spring, with reduced activity during the winter months. Peak activity was recorded in March, November, and December 2023, with general high activity from February to May 2023 and again from October 2023. A smaller peak in autumn (May 2023), when bats "stock up" for the colder winter months, is often experienced, with less activity, as bats spend more time in torpor, during colder winter months (June, July, August).

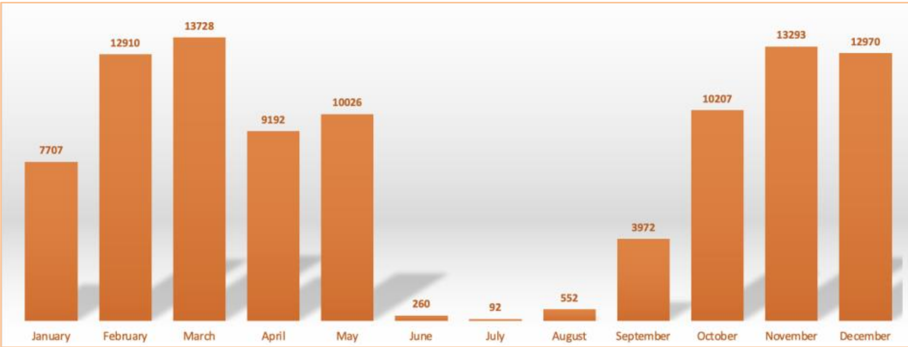


Figure 18: Monthly bat activity, , namely the number of bat passes, over the monitoring period

Figure 19 shows the proportional bat activity for the various season, where one can clearly see the high activity of spring, autumn and summer in comparison to the low activity during winter.

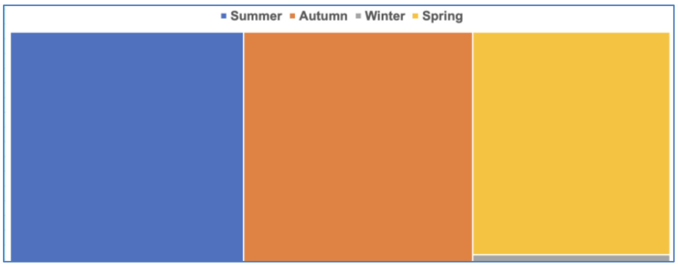


Figure 19: Proportional average bat activity per season

As indicated in Figure 20, bats are generally most active during the summer months. At the two higher systems (D and E) on the Met mast, and at the 10 m Mast G and Mast I, the peak in activity is recorded during the summer months. In contrast, at the 10 m Met Low system (H), the most active period was seen during autumn. Reduced activity was portrayed at all the systems during winter months, as indicated in the previous figures.

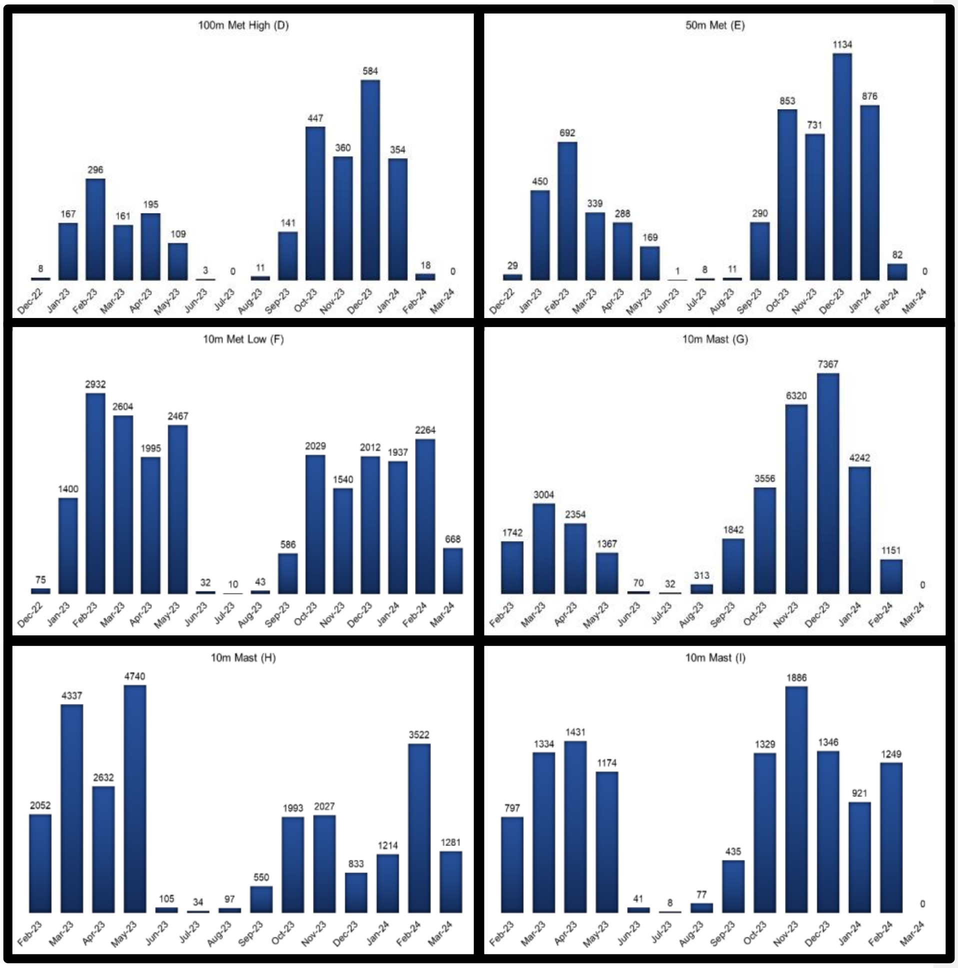


Figure 20: Total bat activity, number of bat passes, at each sampling point over the monitoring period

6.4 Total Species Activity per Monitoring System

Relatively high activity of *T. aegyptiaca* was recorded at all monitoring stations. However, higher activity of *L. capensis (N. capensis)* than that of *T. aegyptiaca* was recorded at monitoring stations F, G, H, and I (Figure 21).

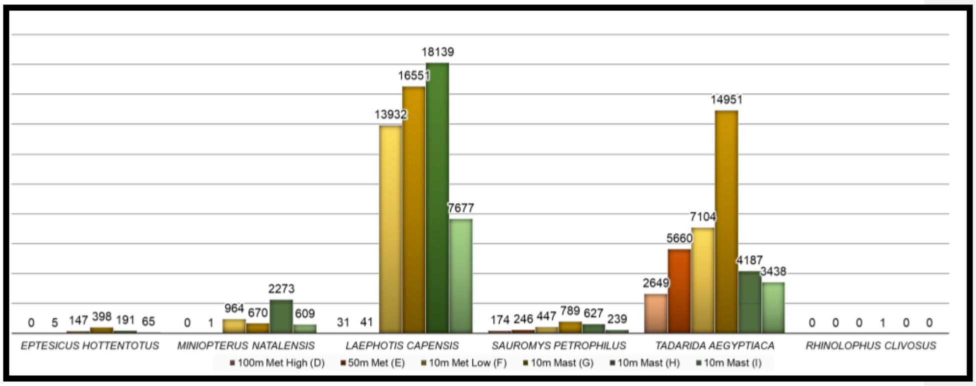


Figure 21: Total bat activity, number of bat passes, per monitoring station

Figure 22 below depicts the hourly bat activity median per monitoring system, showing the relatively higher activity at the near-ground systems, F, G, H, and I. Activity on the met mast shows a clear decline in activity with an increase in altitude, with System D, at 100 m, portraying lower activity than System E, at 50 m, which again recorded lower activity than System F at 10 m. The same decline in activity with altitude was recorded at the nearby proposed Hugo WEF and one could therefore, with caution, extrapolate this tendency to the rest of the site. Although this is not always the case, it is fairly common that activity as well as species diversity, as seen in Section 6.2, declines with altitude. The relatively high near-ground activity is confirmed by the hourly medians at Systems F, G, H and I (Figure 22). Systems D and E are sampling points within the sweep of the turbine blades. One would therefore expect that the highest bat fatality during the operational phase will be at the lower section of the turbine sweep, with more bats being active at lower altitudes.

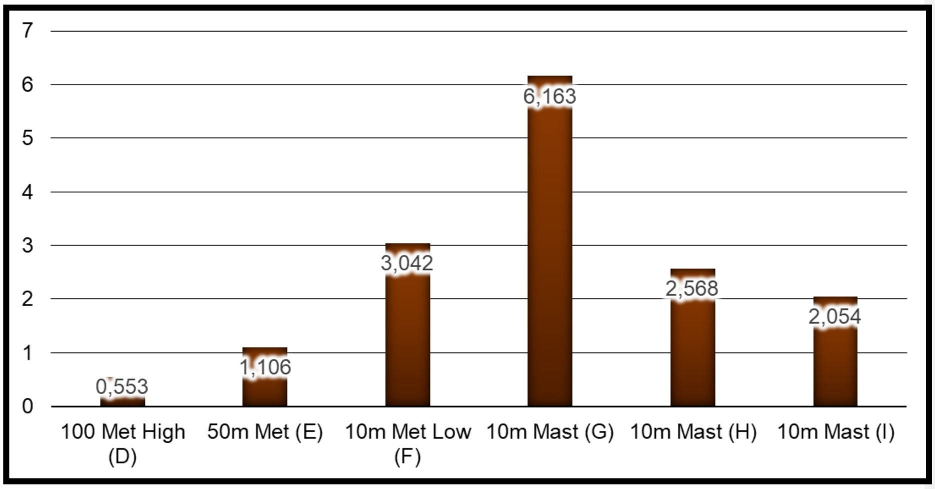


Figure 22: Annual hourly median bat activity per system at the proposed Khoe WEF

The hourly median of the combined bat activity over the monitoring period, is 2,43 bat passes/h/year, while the total average bat passes per hour for the year, namely the Bat Index, is 3,11 bats/h/annum. This indicates quite high activity.

Figure 23 indicates median hourly bat activity for each species for the monitoring year, confirming the high presence of *T. aegyptiaca* and *L. capensis*. These two high-risk species are by far the most dominant on site.

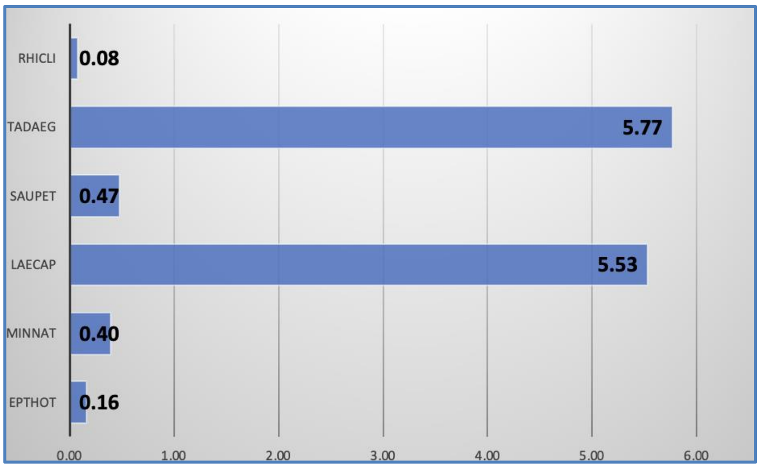


Figure 23: Median hourly bat activity for the monitoring year

6.5 Nightly hourly bat activity

Total hourly bat activity at the proposed Khoe Wind Energy Facility site for the monitoring period is portrayed in Figure 24, providing insight into the general distribution of bat activity from sunset to sunrise. These are combined figures over more than twelve months, and the shifting changes in sunset and sunrise should be kept in mind. Nevertheless, general activity patterns over the monitoring period can be observed.

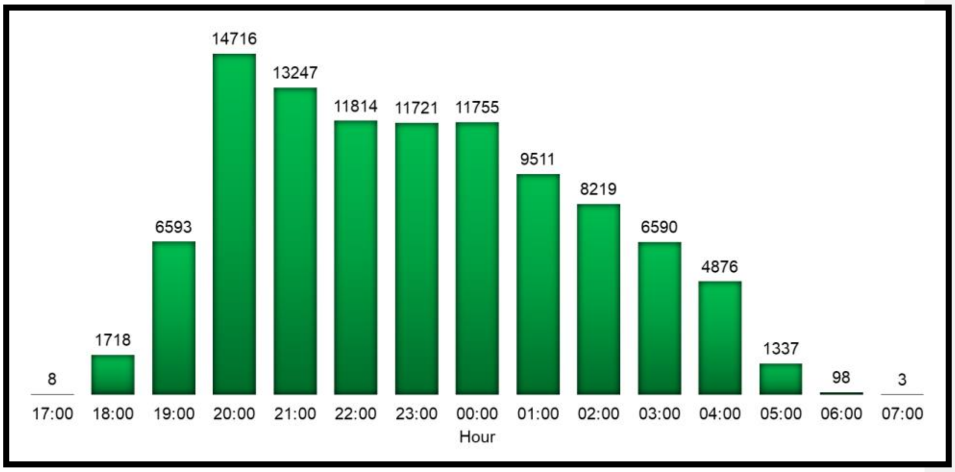


Figure 24: Nightly distribution of hourly bat activity, number of bat passes

Apart from minor variances, one observes that the hourly nightly activity patterns portrayed at the different systems are quite similar, see Figure 25. As expected, higher activity is portrayed approximately two hours after sunset, when bats emerge to forage and drink water, with a peak in activity around three hours after sunset. Steady high activity occurs for the first seven hours after sunset, between 21:00 and 00:00, and a significant decline in activity is shown from midnight to approximately two hours before sunrise. Note that these figures are a summary of all seasons and thus a generalisation. These patterns are of importance if mitigation measures are to be developed, as they indicate the most active periods during the night.

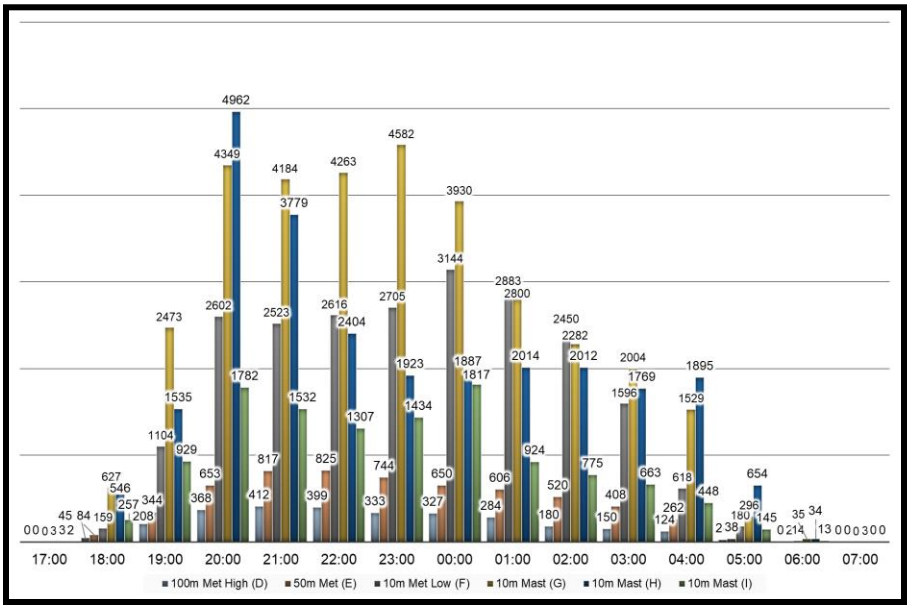


Figure 25: Nightly hourly bat activity per monitoring system at the proposed Khoe Wind Energy Facility

6.6 Point Sources

On 11 March 2023, a point source was deployed at the dam near the Sandvlei farm dwellings. Only four calls of *L. capensis* were recorded, but this confirms the presence of this species at Sandvlei. Further point sources at Sandvlei, on the eastern side of the R318 road, were deployed in April 2024, but no further bat calls were recorded.

6.7 Bat threshold

The South African Bat Fatality Threshold (MacEwan et al. 2018) and the South African Bat Guidelines for Preconstruction Monitoring of Bats at Wind Energy Facilities (MacEwan et al. 2020) report results from early operational facilities in South Africa that show a linear increase in bat fatalities as more turbines are deployed. Threshold guidelines are calculated based on proportional bat occupancy per hectare for each of South Africa's terrestrial ecoregions to predict and assess cumulative impacts on bat fatalities as new WEFs are constructed. These biomes and ecoregions are identified by diverse biodiversity patterns determined by climate, vegetation, geology, and landforms (Dinerstein et al. 2017). Threshold calculations add natural population dynamics and bat losses due to anthropogenic pressures to the sum to gauge the number of bat fatalities that may lead to population decline.

Error! Reference source not found. indicates the height-specific bat activity and fatality risk according to the South African pre-construction bat guidelines (MacEwan et al. 2020) together with the median of hourly bat activity at height over the monitoring period, from Systems D, at 100 m and System E, at 50 m, and near ground, from Systems F, G, H, I, at 10 m. For both near-ground level and rotor sweep height, the risk category is high, and the medians are significantly higher than the high-risk category for the monitoring year The rotor sweep median is the most important measure and development should progress with caution. Furthermore, fatalities in the lower section of the rotor sweep are highly probable, and bats represented by the 10 m monitoring systems could be at risk. Even though 2023 was an exceptionally good rainfall year, which might result in higher bat activity, there is a high collision risk, and the bat guidelines dictate that fatality minimisation measures should be recommended during pre-construction, and should be applied from the commencement of turbine rotation.

Table 6: The bat fatality risk threshold for Montane Fynbos and Renosterveld with the medians from within the sweep of the proposed turbine blades and from lower near-ground monitoring systems (MacEwan et al. 2018)

Montane Fynbos and Renosterveld	Near ground	0.00	> 0.00 - 0.33	> 0.33
	Rotor sweep	0.00	> 0.00 - 0.21	> 0.21

Monitoring systems at Khoe WEF	Median of hourly bat activity during the monitoring period
Median of bat activity within the sweep of the turbine blade (Systems D and E)	0,36
Median of near ground bat activity (Systems F, G, H, I)	2,98

When the estimated project size is used, the threshold for the true estimated mortality is 118 bats (MacEwan et al. 2018) per annum. This number of bats in addition to natural population losses, can be removed from the area before their conservation status or the ecosystem services they provide to the environment are severely affected. Therefore, over a 25-year lifespan of the facility, 2950 bat fatalities will still allow the bat population to recover from losses.

Population decline thresholds are subject to ongoing discussion as little is known about fecundity rates, migration routes, and population numbers (SABAA.org.za). Further mitigation measures, apart from the recommendations in this report, will have to be implemented where site-specific thresholds are exceeded. Should the proposed development be approved, a monitoring program during the operational phase will include bat carcass searches to provide data to quantify bat fatalities, and GenEst, or the most recent approved fatality estimator, will be applied.

6.8 Weather conditions and bat activity

The information provided in this section describes the relationship between weather conditions and bat activity, in particular the activity within the rotor-swept area of the turbine blades. Lower monitoring systems follow the same pattern to some extent, but as weather monitors are close to the high microphone, and the high microphone is within the rotor-swept area of the turbines, it is believed that this system provides more accurate data to plot with the weather data. This data is also used to compile a turbine curtailment schedule to be implemented from the onset of the operation of the wind farm.

Weather conditions, especially temperature and wind, have an influence on bat activity. Literature (Arnett et al. 2016; Baerwald et al. 2009; Kunz et al. 2007), as well as observations from personal experience, indicate that bats tend to be more active at lower wind speeds and at higher temperatures. Therefore, bats are, in general, more active on warm, quiet nights, often combined with elevated humidity; especially when there is an abundance of food, such as termites, mosquitoes, or moths. Higher activity has also been reported during dark moon periods.

Data from System D, at 100 m on the Met mast and weather data as indicated below were used for the statistical analyses:

- Temperature data from 14 m thermometer on the Met mast;
- Humidity data from 117 m on the Met mast and all point sources;
- Atmospheric pressure data from 117 m on the Met mast, and all point sources;
- Wind data from the 122 m anemometer situated on the Met mast, and all point sources.

6.8.1 Linear regressions

Results of a linear regression between weather conditions and bat activity are provided below (see Table 7Table 7 and Figure 26). There was a small sample size of bat data from all the monitoring systems for the monitoring period. Furthermore, bats are not necessarily active during various weather conditions and linear regressions could sometimes result in inadequate variation. Nevertheless, it does indicate the positive or negative relationship between weather conditions and bat activity. Linear regressions between weather conditions and bat activity should be conducted again during the operational phase of the wind farm when more data becomes available.

Temperature, wind, humidity and atmospheric pressure play a role in bat activity at the Khoe Wind Energy Facility. Although humidity at System D, situated at 100 m on the Met mast, showed no statistical relationship between humidity and bat activity, the combined data of all systems do indicate a negative correlation coefficient between bat activity and humidity.

Table 7: A summary of Linear Regression between weather conditions (December 2022 - March 2024) and the 100 m sampling system (System D) as well as combined systems.

	Correlation Coefficient	
Temperature vs. bat activity for System D	0.326	Positive relationship between temperature and bat activity. As temperature increases the bat activity increases.
Wind vs. bat activity for System D	-0.344	Negative relationship between wind speed and bat activity. As wind speed increases the bat activity decreases.
Humidity vs. bat activity for System D	-0.007	No statistical relationship between humidity and bat activity. As humidity increases the bat activity does not change statistically.
Atmospheric pressure vs. bat activity for System D	0.052	Weak relationship between atmospheric pressure and bat activity. As atmospheric pressure increases the bat activity increases slightly.
Temperature vs. bat activity for all systems	0.530	Strong positive relationship between temperature and bat activity. As temperature increases the bat activity increases with a strong correlation.
Wind vs. bat activity for all systems	-0.282	Negative relationship between wind speed and bat activity. As wind speed increases the bat activity decreases.
Humidity vs. bat activity for all systems	-0.217	Negative relationship between humidity and bat activity. As humidity increases the bat activity decreases.

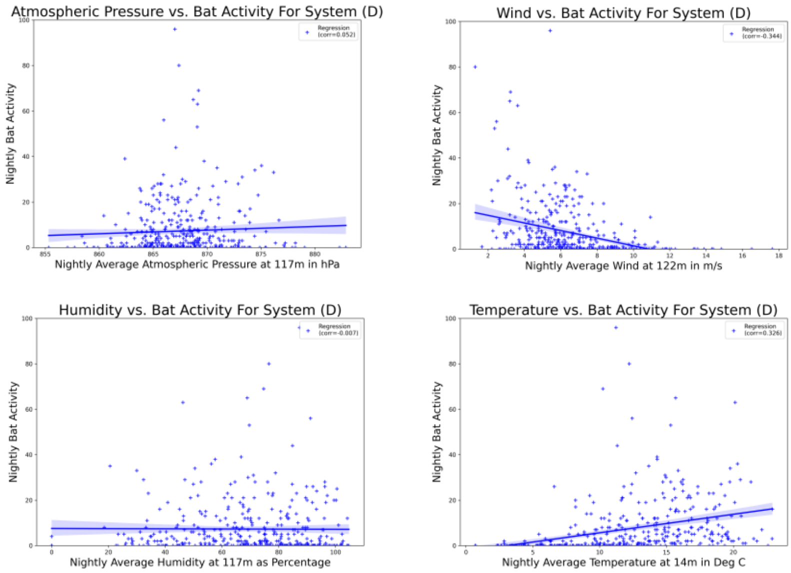


Figure 26: Linear regressions of pressure, wind, humidity, and temperature as predictors of the distribution of bat activity at System D

6.8.2 Cumulative distribution functions (CDF)

Figure 27 illustrates the relationship between bat activity and weather conditions through cumulative distribution functions, where cumulative means an increased quantity by successive additions. Cumulative bat activity recorded are plotted with temperature, wind speed, humidity, and atmospheric pressure.

If the cumulative percentage of bat passes at System D is plotted with temperature, wind speed, humidity, and air pressure, the following trends are observed:

- Approximately 90% of bat activity was recorded above 10ºC;
- Approximately 80% of the bat activity was recorded above 50% humidity;
- Nearly all the bats are active below 8 m/s wind speed;
- Approximately 90% of bat activity is occurring above 864 hPa atmospheric pressure.

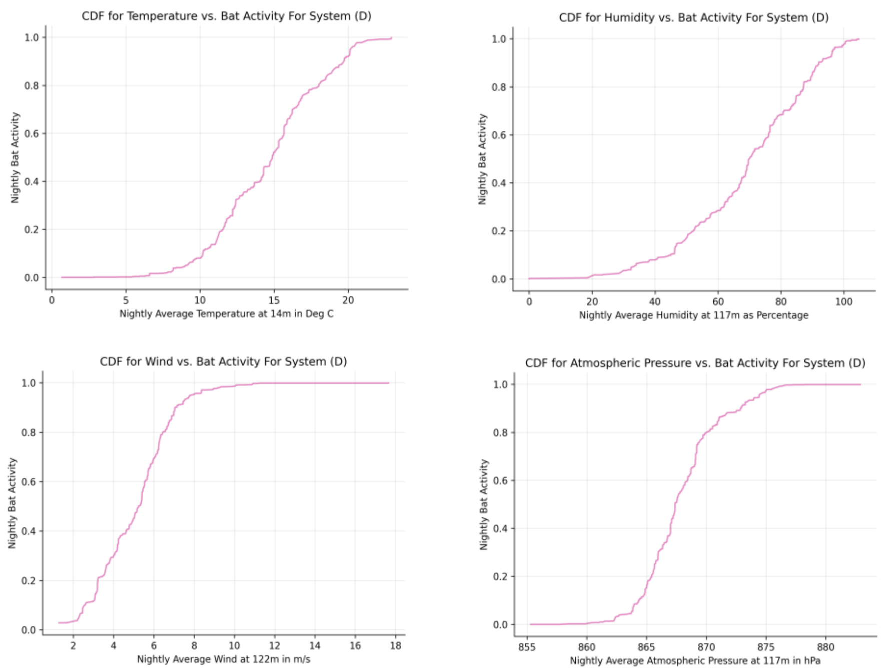


Figure 27: Cumulative distribution function of bat activity with average temperature, humidity, wind speed, and atmospheric pressure for System D

6.9 Cumulative distribution functions (CDF) heatmaps

CDF heatmaps provide a better visualisation of the distribution of bat activity plotted with the weather. Darker areas indicate a concentration of higher activity. The highest density of bat passes during certain temperatures, wind speed ranges, humidity and air pressure can be observed with CDF heatmaps. These can be used to confirm and refine linear regressions, to establish approximately the optimal conditions when bats are active, and then consequently, inform the mitigation regime. The following can be derived from the data depicted in Figure 28, which show heat maps for bat activity at 100 m and weather conditions as explained in Section 6.8.1 for temperature, humidity, wind and atmospheric pressure:

- The highest density occurs above approximately 9ºC and 14ºC, with a second concentration of bats between 12ºC and 18ºC ;
- Two pockets of bat activity concentrations occur above 50% humidity;
- Two pockets of high-concentration activity between approximately 2,5 m/s and 7,5 m/s, with hardly any activity portrayed above 8 m/s;
- Two pockets of high concentration are observed between around 863 hPa and 872 hPa.

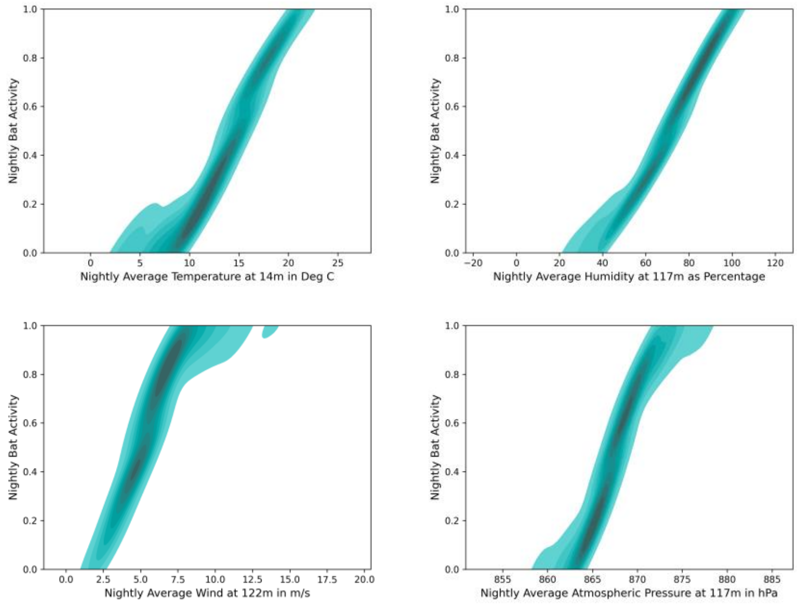


Figure 28: Cumulative distribution function heatmaps showing bat activity with temperature, wind speed and humidity at System D

6.10 Sensitivity map

The bat sensitivity map of the proposed Khoe WEF is portrayed in Figure 29 below. Sensitivity zones are based on buffer zones as indicated by the *South African Good Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities* (MacEwan et al. 2020). These zones are refined through field visits and visiting the bat conducive environments occurring at the development site, as well as through the static bat monitoring data and point sources.

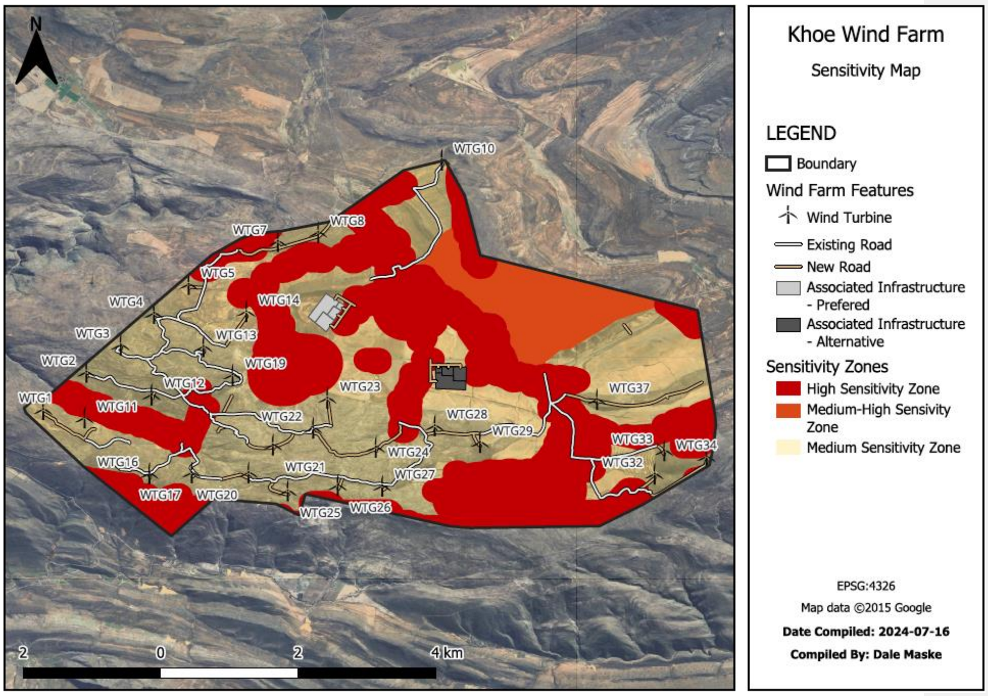


Figure 29: Bat sensitivity map of the proposed Khoe WEF

6.10.1 High sensitivity zones

The following features, which could encourage bat presence either at present or in the future, have been buffered as prescribed by the pre-construction bat monitoring guidelines (MacEwan et al. 2020) at the proposed Khoe WEF. The minimum buffer recommendation from SABAA is a 200 m buffer around all potentially bat important features. If two or more points of interest are in close vicinity, they are linked, to form an ecological corridor through one sensitivity zone.

- Open water sources, such as reservoirs, water troughs for livestock, dams, and pans (some of these are historic, but could be used in future) – 200 m buffer;
- Rivers – 200 m buffer;
- Riparian shrub – 200 m buffer;
- Relatively dense thicket – 200 m buffer;
- Rock formations, rocky outcrops and features which are conducive to bat roosts – 200 m buffer; and
- Human dwellings – 500 m buffer.

6.10.2 Medium-high sensitivity zones

It is recommended that mitigation measures are installed if medium-high sensitivity zones are encroached. Should any moving turbine components encroach into medium sensitivity zones, curtailment must be applied (see Section 7.3). The medium sensitivity zone areas are defined as follows:

- Slopes where there is a relatively low occurrence of rock formations and crevices, but which are favourable for bat activity;
- Dry runoffs with minimal riverine vegetation. The guidelines stipulate high sensitivity for rivers and areas containing water, but some of these dry ditches only have water during rainy spells and very limited riverine vegetation. Although the area often receives some rain in spring, from October to November, the area is classified as a winter rainfall area. During the colder winter months when there is expected to be water collecting in these dry runoffs, bats are less active;
- The area surrounding System G, was also included in the bird sensitivity map as a no-go area. System G recorded an exceptionally high bat activity, which might have been due to its situation close to a large farm dam; therefore, it is recommended that there is either no turbines placed, or that strict mitigation measures are applied if turbine positions are placed in this section of the development.

6.10.3 Medium sensitivity zones

Due to the general high bat activity for all systems, the rest of the site is classified as medium sensitivity. It is recommended that wind development be allowed on the terrain, but with mitigation as described in Section 7 and in the EMPR of this report.

7. MITIGATION MEASURES

7.1 Turbine positions

Mitigation by location involves the initial layer of precaution, namely, the correct placement of the wind energy facility and the individual turbines, where all high bat sensitivities and their buffers are avoided.

The first step in mitigating the potential negative impacts of a proposed wind energy facility on bats is therefore to site turbines outside of recommended high sensitive areas. Figure 29 indicates the sensitivity zones in the development area. The developer has already applied mitigation measures by considering the outcomes of specialist studies and shifted the turbine positions out of the high-sensitivity areas. As mentioned in Section 3.3, the study area has been reduced to incorporate the avian study. Not only is this favourable for bats due to potential roosting opportunities in the eastern part of the terrain, but System G, the 10 m system deployed on the border of the avian buffer, had recorded the highest bat activity on the terrain.

7.2 Feathering of turbines below cut-in speed

Normally, operating turbine blades are at a right angle to the wind. To avoid bat fatality when turbines are not generating power, feathering as a mitigation measure is applied where the angle of the blades is pitched parallel to the wind direction causing the blades to spin at very low rotation so that there is no risk to bats. The turbines do not need to be at a complete standstill, but the movement of the turbines will be minimal.

The cut-in speed is the lowest wind speed at which turbines generate power. Freewheeling occurs when turbine blades are allowed to rotate below the cut-in speed which increases the risk of collision in areas already sensitive to bat activity. As bats are more active at wind-still nights and nights with low wind speeds, fatalities during freewheeling should be prevented, so that bat mortality is avoided when no power is generated. It is recommended that this mitigation measure commences immediately after the installation of turbines, after the necessary tests on turbines have been concluded. This mitigation measure might therefore be in place before the commercial operation date, and for the duration of the project. Turbine blades are usually feathered around 90 degrees to prevent freewheeling, but the angle will depend on the turbine make and model.

7.3 Curtailment of turbines in medium-high sensitivity zones

Currently, the most reliable and effective mitigation is curtailment (Arnett and May, 2016; Hayes, 2019). Curtailment entails locking or feathering the turbine blades during high bat activity periods to reduce the risk of bat mortality via collision with blades and barotrauma. This results in a reduction of power generation during conditions when electricity would usually be supplied.

Curtailment regimes are developed by examining the relationship between relative bat activity levels and weather conditions. Bat activity is typically reduced at higher wind speeds, a certain level of humidity, lower temperatures, and a certain range of atmospheric pressure at each site. According to the weather correlations at Khoe WEF, humidity data did not prove to be reliable enough for predictions, so only temperature, wind and atmospheric pressure were used. The bat activity from the 100 m (A) system on the met masts was used as this system was within the sweep of the turbine blades and apart from the thermometer, was the closest to the weather station. Unfortunately, personal experience supported by unpublished data in South Africa indicates that *Molossidae* bats in Southern Africa fly at higher wind speeds than originally predicted. At Khoe WEF, see Section 6.8, this species tends to fly below 8 m/s, and is most active within the sweep of the turbine blades. At the development terrain, current data indicates that bats in general are more active in lower wind speeds, high temperatures, and atmospheric pressure between 863 hPa and 872 hPa. Bat mortality could therefore be reduced by using these weather conditions to predict bat activity.

This relationship between bats and weather conditions, as well as seasonal and monthly activity, are used to inform curtailment schedules that should be applied when bat activity is high to reduce potential encounters of bats with wind turbine blades. These relationships are presented in Section 6 of this report and were used to compile the curtailment schedule in Table 8 below. Months with high bat activity informed the seasonal mitigation schedule.

At present no form of curtailment is recommended as yet, as there are no particular turbines or development zones, apart from those areas that have already been omitted for development, that indicate the potential for relatively higher fatality. Close observation by the operational bat specialist should inform the curtailment during the first year of monitoring, preferably within the first half of the operational monitoring. If curtailed turbines show consistently low activity through static recordings as well as mortality in the low threshold range, the bat specialist could adapt curtailment downwards again, but bat monitoring during seasons with high fatality should follow any relaxation of curtailment.

Table 8 should form the starting point for curtailment discussions early in the operational phase. It is recommended that curtailment is applied during the specified periods when the relevant temperatures, wind speeds and atmospheric pressure prevail.

Table 8: Initial Curtailment Schedule

Turbine numbers	Months	Time Period	Temperature (°C)	Atmospheric Air Pressure (hPa)	Curtailment
Turbine numbers to be determined during the first months of bat monitoring	February, March, April, May, October, November, December	2 hours after sunset, up to 7 hours after sunset	Above 13 °C	Below 915 hPa	Raise cut-in speed to 5 m/s

The recently developed Smart Systems of Wildlife Acoustics could be considered during the planning phase of the wind energy facility. It is a real time system which can be set to automatically switch off the turbine when a certain number of bats are recorded. These systems comprise an intelligent microphone with a controller which is installed on turbines. Although the systems are new and have not been tested in South Africa yet, there is the potential to reduce the cost of curtailment. Although these are relatively expensive systems, they could save bats as well as cost, when compared to the above traditional curtailment systems.

7.4 Bat deterrents

According to the bat deterrent supplier, NRG, bat deterrents are particularly successful in deterring bats from the Vespertilionidae and Molossidae families, which comprise the majority of bats recorded at Khoe WEF. Instead of curtailment, the client might prefer to deploy bat deterrents as a mitigation measure, but although my personal experience as a bat specialist has noted the success of these systems on a wind farm, there is not enough research in South Africa to evaluate the true success in all environments.

Urland (2021) refers to research done by NRG Systems in the USA, where pairing pioneering ultrasonic acoustic deterrent systems with curtailment reduced bat fatalities by 54% at a wind plant (farm) in Texas and by 67% in Illinois. At present there is no published research in South Africa yet and the success of bat deterrents must be established before one could decide to replace curtailment with deterrents. Internationally, bat deterrent suppliers have indicated that they have good results with deterring bats, especially Molossids, with *Tadarida brasiliensis* (Brazilian free-tailed bat) showing an approximate reduction of 54% mortality in a study done in Texas (Weaver et al. 2020). During operational bat monitoring, those turbines with high mortality could be targeted for bat deterrents.

If bat deterrents are found to be effective, then the mitigation actions currently specified could be updated by a suitably qualified bat specialist to include the use of such deterrents, with the possible outcome that the cut-in speeds are lowered.

7.5 Avoid creating bat conducive areas

The aim of mitigation recommendations is to protect the current bat population and to avoid creating any features that might attract more bats from beyond Khoe WEF to the development site. It is therefore recommended that:

- The roofs of all new buildings are sealed, keeping in mind that a small bat could enter a hole of one square centimetre. If no bats are roosting in the current buildings on-site, the developer could discuss the situation with the landowner and seal the roofs of buildings to avoid any bat roosts in the future.
- Any new quarries or burrow pits which could collect standing water are rehabilitated.
- No roll-up garage doors are to be installed in management buildings.

No roosts were found during the bat monitoring study and if any roosts are found during the construction or operational phase, a bat specialist should be consulted immediately.

7.6 Operational bat monitoring

Operational bat monitoring should be conducted for at least two years, as prescribed by the latest SABAA operational bat guidelines of the time, and longer if deemed necessary by the operational bat specialist and thereafter, yearly at an interval of five years. In cases such as Khoe WEF, where bat activity is high, the developer should prepare for a longer initial period of operational bat monitoring, including carcass searches. This will be informed by the operational bat specialist.

The operational bat monitoring must start at the turn of the turbine blades after the testing of turbines has been completed, as the highest mortality is often experienced in the first operational year of a wind farm. It is therefore important that the bat specialist is appointed before the commencement of operations.

8. CUMULATIVE IMPACT

The Department of Environmental Affairs (DFFE) evaluates the potential risk of the proposed developments on a site-specific level, including additional cumulative impacts, against the obligation for conservation concerns. NEMA protocol (32.2.k.i) advises Environmental Impact Assessments to identify and reduce cumulative impacts that may hold the risk to become significant when added to "existing and potential impacts from similar diverse activities or undertakings in the area" (Madders and Whitfield 2006 in BioInsight 2014).

The South African Bat Fatality Threshold Guidelines (MacEwan et al. 2018) and the South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (MacEwan et al. 2020) report results from early operational facilities in South Africa that show a linear increase in bat fatalities as more turbines are added.

In this section, the status and magnitude of the impact from other wind and solar energy facilities within a 30 km radius of the proposed Khoe WEF are calculated and discussed to manage the cumulation of negative impacts on the resident and migratory bat population throughout the lifespan of the project. Due to the slow reproduction rate of bats, bat populations are sensitive to changes in mortality rates and populations tend to recover slowly from declines. Mitigation and enhancement measures are recommended to avoid and minimise potential direct, indirect, and cumulative negative impacts associated with the design, construction, operational and decommissioning of the proposed development.

Active and passive detection of bats at the proposed Khoe WEF was confirmed to be highest in summer, followed by spring and autumn, with very little activity during winter. **Error! Reference source not found.** below contains a summary of bat species confirmed on-site as well as bat conducive features specific to Khoe WEF.

Table 9: On-site features and bat species confirmed at the proposed Khoe WEF site.

REDZ	Khoe WEF is not situated in the REDZ. The Komsberg REDZis situated in a north-easterly direction and approximately 30 km from Khoe WEF.
Project footprint size	2463 ha
Municipality and Province	Langeberg Local Municipality, Cape Winelands District Municipality
Biome and Ecoregion	Fynbos Biome and Montane Fynbos & Renosterveld Ecoregion
Bat conducive features	Perennial and non-perennial water bodies, insect breeding ground in stagnant natural water resources, rock formations hilltops, mountainous areas surrounding the site, river valleys, human dwellings, derelict aardvark holes, abandoned burrows, tree bark.
Bat occurrence	*T.aegyptiaca, S. petrophilus, M. natalensis, E. hottentotus, L. capensis.*
Period of high activity	Activity is in general higher during higher temperatures from September to February.
Bats at risk of fatal impact by turbines	High activity from the Molossidae family at rotor sweep, *T. aegyptiaca* and *S. petrophilus,* and lower activity from *L. capensis* and *M. natalensis*. *L. capensis* is the dominant species on site, it is active at lower altitudes.

As summarised in **Error! Reference source not found.**, the bat species most likely to be impacted by the proposed Khoe WEF, as well as by other REFs within a 30 km radius of Khoe WEF, are the bats identified at the site and the nearby vicinity surrounding the terrain. Due to their mobility, bats recorded as resident on the Khoe WEF site, could originate from roosts situated at neighbouring farms or migratory bats that have distributional ranges beyond Khoe WEF.

Bats from the neighbouring areas could traverse the proposed wind facility to forage, drink water, and migrate, and would have to create corridors of movement to negotiate around clusters of wind development zones. Therefore, to lower the general negative impact on bats, turbine placements should avoid potential flight corridors such as valley areas, and rivers and rock formations along mountain ridges. Some bats would be searching for roosting opportunities, while other high-flying bats might cross these ridges to catch insects that are carried by the updraft from lower laying areas (CSIR 2020).

Applications for the neighbouring Hugo WEF is in process. However, no wind energy facilities have been approved within a 30 km radius of Khoe WEF and are therefore not considered for the cumulative impact yet. Tooverberg and Witberg WEFs, within the Komsberg REDZ, are more than 50 km from the proposed Khoe WEF site. Four solar energy facilities are included within a 30 km radius of the Khoe WEF namely Touwsrivier, Montagu Road, De Doorns Osplaats and Sanval SEFs. The project size of only two of the REFs were available and are provided in the table. In **Error! Reference source not found.** below, the cumulative impacts on bats by renewable energy facilities (WEFs and SEFs) within a 30 km radius of Khoe WEF are evaluated.

Table 10: Bat fatality risk levels at the proposed Khoe WEF.

RISK LEVELS AS PER SABAA GUIDELINES (MacEwan, et al., 2018 and MacEwan, et al., 2020)										
REFs within 30 km radius of Khoe WEF	Energy output in MW	EIA reference number	Project size (ha)	Median bat passes per hour per year at rotor sweep level	Median bat passes per hour per year at near ground level	Bat fatality levels for Montane Fynbos and Renosterveld ecoregion at rotor sweep category	Bat fatality risk levels based on Montane Fynbos and Renosterveld ecoregion at near ground category	Bat fatality risk levels based on Median activity at rotor sweep	Bat fatality risk levels based on Median activity at near ground	Fatality threshold based on ecoregion and project size: How many bats can be removed before population decline may arise
Khoe WEF	290		2463	0.36	2.98	>0.21	>0.33	High	High	118
De Doorns Osplaats SEF	2.5	12/12/20/2210								
Montagu Road SEF	75	14/12/16/3/3/2/810	250							
Sanval SEF	75	12/12/20/2019								
Touwsrivier SEF	36	12/12/20/1956								
	442.5		**2713**	**0.36**	**2.98**	**>0.21**	**>0.33**	**High**	**High**	**118**

Calculations presented in **Error! Reference source not found.** are based on data collection at renewable energy facilities and apart from energy output (MW) and project size, Solar PV is not included in bat fatality risk or threshold levels. Bat fatality levels are calculated for Montane Fynbos and Renosterveld ecoregion and the Threshold is calculated for 40% Fynbos shrubland and 60% Renosterveld shrubland. The fatality threshold-based ecoregions and project size are calculated at 118 bats that can be removed from the site before population decline arises. Should more bats be removed per annum, mitigation measures will be implemented.

Solar PV energy facilities are rated as having a low negative cumulative impact on bats and do not cause a direct risk of fatality to bats. However, land use change and habitat destruction influence biodiversity and ecological processes which could have an indirect impact on bats.

Insectivorous bats are the predominant predators of nocturnal insects and constitute a very important component of South Africa's biodiversity by suppressing the number of nocturnal flying insects. The magnitude of the cumulative impact on bat populations within 30 km of the proposed Khoe WEF (and in the vicinity of the Komsberg REDZ) will with certainty increase as more renewable energy facilities are added in the future. The onus is on every development not to exceed their site-specific threshold and to implement mitigation measures to reduce the negative impact of renewable energy on bat populations (MacEwan et al. 2020).

9. ASSESSMENT OF POTENTIAL IMPACTS ON BATS

The impact of the proposed Khoe WEF on bats in the area is discussed below. The potential impacts are summarised as:

- 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;
- Creating new bat conducive habitat amongst the turbines; and
- The cumulative effect of the above together with the surrounding wind farms.

The potential impacts on bats identified at the proposed Khoe WEF:

Construction Phase

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

Operational Phase

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

Decommissioning Phase

- Disturbance due to decommissioning activities.

Cumulative impacts of solar farms within the surrounding areas

- Destruction of natural habitat during construction; and
- A reduction in foraging space.

9.1 Impact assessment summary

The impact summary below (Table 11, Table 12, Table 13 and Table **14**) is based on the data collected during the monitoring period and it should be noted that the bat situation could change during the development of the wind energy facility; therefore, bat monitoring is ongoing and information collected from operational monitoring should be used to adapt mitigation.

Table 11: Impact Assessment Summary Table for the Construction Phase

Impact 1: Construction					
Nature of the impact: **Clearing and excavation of natural habitat**					
The destruction of features that could serve as potential roosts, such as rock formations and derelict aardvark holes, and the removal of trees or the fragmentation of woody habitat which includes dense bushes. The removal of limited trees and bushes would have also an impact on the foraging potential of clutter and clutter-edge-specific species.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Medium Term	Recoverable	Moderate	Definite
Score	2	3	3	3	5
With Mitigation	Local	Short Term	Recoverable	Low	Probable
Score	2	2	3	2	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (55)		Low Negative Impact (27)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- Apart from access roads and the management building, construction activities are to be kept out of all high bat-sensitive areas as far as possible.
- Rock formations occurring along the ridge lines should be avoided during construction, as these could serve as roosting space for bats.
- Destruction of limited trees should be avoided during construction.
- Care should be taken if any dense bushes are destroyed, to make sure that there are not bat roosts in the vegetation. If bat roosts are found, a bat specialist should be contacted immediately.
- Aardvark holes or any large derelict holes or excavations should not be destroyed before careful examination for bats.
- The Environmental Control Officer (ECO) or a responsible appointed person or site manager should contact a bat specialist before construction commences so that they know what to look out for during construction.

Residual impact	Yes, natural habitat will be removed, but with rehabilitation a component of this could be replaced.

Impact 2: Construction					
Nature of the impact: **Creating attractive bat habitat within the development terrain**					
Creating new habitat amongst turbines which might attract bats. This includes buildings with roofs that could serve as roosting space or open water sources from quarries or excavation where water could accumulate.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Medium Term	Recoverable	Moderate	Highly probable
Score	2	3	3	3	4
With Mitigation	Site	Short Term	Reversable	Very Low	Low probable
Score	1	2	1	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (44)			Low Negative Impact (10)	
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- Completely seal off roofs of new buildings (e.g., substations and site buildings). Note a small bat species could enter a hole the size of 1 cm^2.
- Roofs need to be regularly inspected during the lifetime of the wind farm and any new holes need to be sealed.
- Excavation areas, quarries or any other artificial depressions should be filled and rehabilitated to avoid creating new areas of open water sources which could attract bats during rainy spells.
- No roll-up garage doors should be installed.
- Inspect all existing buildings and infrastructure for possible roosting opportunities regularly, at least on a seasonal basis. If any holes are found, the ECO or operational bat specialist should be contacted to establish whether there are any bats in the roofs. If there is a roost in the roof, a bat specialist should be consulted.

Residual impact	No residual impact if mitigation measures are applied.

Impact 3: Construction					
Nature of the impact: Construction noise					
Disturbance of bats and bat roosts by construction noise, especially during night-time.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Short term	Reversible	Low	Definite
Score	2	2	1	2	5
With Mitigation	Site	Short Term	Reversable	Very Low	Definite
Score	1	2	1	1	5
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (35)		Low Negative Impact (25)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				
Mitigation measures to reduce residual risk or enhance opportunities: ▪ Noise levels should be prevented as far as possible. ▪ Avoid night-time construction activities as much as possible.					
Residual impact	No residual impact if mitigation measures are applied.				

Table 12: Impact Assessment Summary Table for the Operational Phase

Impact 4: Operation					
Nature of the impact: **Direct collision or barotrauma**					
Bat fatalities through direct collision, or barotrauma of resident bats occupying the airspace amongst the turbines. The turning blades of the turbines during operation are the most important aspect of the project that would impact negatively on bats.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long term	Irreversible	High	Definite
Score	3	4	5	4	5
With Mitigation	Regional	Long term	Recoverable	Moderate	Definite
Score	3	4	3	3	5
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	High Negative Impact (80)		High Negative Impact (65)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- All turbines and turbine components, including the rotor-swept zone, should be kept out of all high-sensitivity zones.
- Mitigation as proposed in Section 7, should be applied after testing and as soon as turbines start to turn.
- A bat specialist should be appointed before the turbines start to turn, and operational bat monitoring should start when all the turbines start to turn, for a minimum of two years, or as described by the latest South African bat guidelines.
- Mitigation should be discussed between the bat specialist and developer during the construction and operational phase. Mitigation measures should be applied, using Table 9, Section 7, as a starting point for discussions.
- Except for compulsory lighting required in terms of civil aviation, artificial lighting should be minimised, especially bright lights. Lights should rather be turned downwards where possible. Turbine tower lights should be switched off when not in operation, if possible.
- Two years of compulsory bat monitoring as per the latest SABAA bat monitoring guidelines is recommended, but this might be extended, depending on the bat specialist.

Residual impact	Yes. The fatality of bats is irreversible, and it is expected that there will be a decline in the population of high-risk species, but with mitigation, the bat population will be able to survive and still be functional. The resource will not be damaged irreparably, but will be altered.

<table>
<tr><td colspan="6">Impact 5: Operation</td></tr>
<tr><td colspan="6">Nature of the impact: Fatality of migrating bats</td></tr>
<tr><td colspan="6">A limited number of calls like that of Miniopterus natalensis (Natal Long-fingered bat) a migration species, had been recorded. Pteropodidae species on migration might also traverse the site. Limited research is available on the migration of bats in South Africa, and some of the bat species occurring on-site might also traverse the area during migration.</td></tr>
<tr><td colspan="6">Impact Status: Negative</td></tr>
<tr><td></td><td>E</td><td>D</td><td>R</td><td>M</td><td>P</td></tr>
<tr><td>Without Mitigation</td><td>National</td><td>Long term</td><td>Recoverable</td><td>Moderate</td><td>Probable</td></tr>
<tr><td>Score</td><td>4</td><td>4</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>With Mitigation</td><td>National</td><td>Long term</td><td>Recoverable</td><td>Low</td><td>Low probability</td></tr>
<tr><td>Score</td><td>4</td><td>4</td><td>3</td><td>2</td><td>2</td></tr>
<tr><td>Significance Calculation</td><td colspan="2">Without Mitigation</td><td colspan="3">With Mitigation</td></tr>
<tr><td>S=(E+D+R+M)*P</td><td colspan="2">Moderate Negative Impact (42)</td><td colspan="3">Low Negative Impact (26)</td></tr>
<tr><td>Was public comment received?</td><td colspan="5">No</td></tr>
<tr><td>Has public comment been included in mitigation measures?</td><td colspan="5">n.a.</td></tr>
<tr><td colspan="6">Mitigation measures to reduce residual risk or enhance opportunities:
• Care should be taken during post-construction monitoring to verify the activity of M. natalensis, especially within the rotor swept area of the turbine blades. Carcasses should be identified to establish the fatality of this species.
• All turbines and turbine components, including the rotor swept zone, should be kept out of all high sensitivity zones.
• Mitigation as proposed in Section 7 should be applied as soon as the test period of turbines is completed, and the turbines start turning.
• A bat specialist should be appointed before the turbines start to turn and operational bat monitoring should start when all the turbines start to turn, for a minimum of two years, or as described by the latest South African bat guidelines.
• Mitigation should be discussed between the bat specialist and developer during the construction and operational phase. Mitigation measures should be applied, using Table 9, Section 7, as a starting point for discussions.
• Except for compulsory lighting required in terms of civil aviation, artificial lighting should be minimised, especially bright lights. Lights should rather be turned downwards where possible. Turbine tower lights should be switched off when not in operation, if possible.
• Two years of compulsory bat monitoring as per the latest SABAA bat monitoring guidelines is recommended, but this might be extended, depending on the bat specialist.</td></tr>
<tr><td>Residual impact</td><td colspan="5">Not expected due to the low number of migratory bats, but some of the Pteropodidae species do not echolocate and one will only truly know the situation through carcass searches during the operational phase.</td></tr>
</table>

Impact 6: Operation					
Nature of the impact: Loss of bats of conservation value					
The endemic *Eptesicus hottentotus* (Medium to high risk of fatality) was recorded and *Rhinolophus clivosus* (Low risk), although not recorded on site, might occur in the valley areas and protea veld with relatively denser vegetation.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long term	Recoverable	Moderate	Probable
Score	3	4	3	3	3
With Mitigation	Regional	Long term	Reversable	Low	Low probability
Score	3	4	1	2	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (20)	
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- Care should be taken during post-construction monitoring to verify the activity of bats of conservation value, especially within the rotor swept area of the turbine blades. Carcasses should be identified to establish the fatality of these species.
- All turbines and turbine components, including the rotor swept zone, should be kept out of all high sensitivity zones.
- Mitigation as proposed in Section 7 should be applied as soon as the test period of turbines is completed, and the turbines start turning.
- A bat specialist should be appointed before the turbines start to turn and operational bat monitoring should start when all the turbines start to turn, for a minimum of two years, or as described by the latest South African bat guidelines.
- Mitigation should be discussed between the bat specialist and developer during the construction and operational phase. Mitigation measures should be applied, using Table 9, Section 7, as a starting point for discussions.
- Except for compulsory lighting required in terms of civil aviation, artificial lighting should be minimised, especially bright lights. Lights should rather be turned downwards where possible. Turbine tower lights should be switched off when not in operation, if possible.
- Two years of compulsory bat monitoring as per the latest SABAA bat monitoring guidelines is recommended, but this might be extended, depending on the bat specialist.

Residual impact	Not expected due to the low number of bats of conservation value that have been recorded, but one will only truly know the situation through carcass searches during the operational phase.

Impact 7: Operation					
Nature of the impact: **Fatality curiosity**					
Bat mortality due to the attraction of bats to wind turbines (Horn et al. 2008). Bats have been shown to sometimes be attracted to wind turbines out of curiosity or reasons still under investigation.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long term	Recoverable	Moderate	Probable
Score	2	4	3	3	3
With Mitigation	Local	Long term	Reversable	Low	Probable
Score	2	4	1	2	3
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (36)			Low Negative Impact (28)	
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- Except for compulsory lighting required in terms of civil aviation, artificial lighting should be minimized, especially bright lights. Lights should rather be turned downwards. Turbine tower lights should be switched off when not in operation, if possible.,
- Little is known about this impact and mitigation could be adapted if more research becomes available.

Residual impact	The airspace should be available and without risk when the wind farm ceases to exist. As far as foraging space is concerned, there will be no residual impact.

Impact 8: Operation					
Nature of the impact: Smaller genetic pool					
Reduction in the size, genetic diversity, resilience, and persistence of bat populations. Bats have low reproductive rates and populations are susceptible to reduction by fatalities other than natural death. Furthermore, smaller bat populations are more susceptible to genetic inbreeding.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long term	Recoverable	Moderate	Highly probable
Score	3	4	3	3	4
With Mitigation	Regional	Long term	Recoverable	Low	Probable
Score	3	4	3	2	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (52)		Moderate Negative Impact (36)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				
Mitigation measures to reduce residual risk or enhance opportunities: • All turbines and turbine components, including the rotor swept zone, should be kept out of all high sensitivity zones. • Mitigation as proposed in Section 7 should be applied as soon as the test period of turbines is completed, and the turbines start turning. • A bat specialist should be appointed before the turbines start to turn and operational bat monitoring should start when all the turbines start to turn, for a minimum of two years, or as described by the latest South African bat guidelines. • Mitigation should be discussed between the bat specialist and developer during the construction and operational phase. Mitigation measures should be applied, using Table 9, Section 7, as a starting point for discussions. • Except for compulsory lighting required in terms of civil aviation, artificial lighting should be minimised, especially bright lights. Lights should rather be turned downwards where possible. Turbine tower lights should be switched off when not in operation, if possible. • Two years of compulsory bat monitoring as per the latest SABAA bat monitoring guidelines is recommended, but this might be extended, depending on the bat specialist.					
Residual impact	Would the genetic pool be reduced due to high fatality resulting from the wind farm, it will depend on the severity of the influence, and it might take decades to recover.				

Impact 9: Operation					
Nature of the impact: **Foraging space lost due to the turning of turbine blades**					
Loss of habitat and foraging space during operation of the wind turbines					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long term	Recoverable	High	Definite
Score	3	4	3	4	5
With Mitigation	Regional	Long term	Reversable	Moderate	Definite
Score	3	4	1	3	5
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	High Negative Impact (70)		Moderate Negative Impact (55)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- Care should be taken during post-construction monitoring to verify the activity of bats of conservation value, especially within the rotor swept area of the turbine blades. Carcasses should be identified to establish the fatality of these species.
- All turbines and turbine components, including the rotor swept zone, should be kept out of all high sensitivity zones.
- Mitigation as proposed in Section 7 should be applied as soon as the test period of turbines is completed, and the turbines start turning.
- A bat specialist should be appointed before the turbines start to turn and operational bat monitoring should start when all the turbines start to turn, for a minimum of two years, or as described by the latest South African bat guidelines.
- Mitigation should be discussed between the bat specialist and developer during the construction and operational phase. Mitigation measures should be applied, using Table 9, Section 7, as a starting point for discussions.
- Except for compulsory lighting required in terms of civil aviation, artificial lighting should be minimised, especially bright lights. Lights should rather be turned downwards where possible. Turbine tower lights should be switched off when not in operation, if possible.
- Two years of compulsory bat monitoring as per the latest SABAA bat monitoring guidelines is recommended, but this might be extended, depending on the bat specialist.

Residual impact	No, if turbines are decommissioned, the foraging space will be available to bats again.

Table 13: Impact Assessment Summary Table for the Decommissioning Phase

Impact 10: Decommissioning					
Nature of the impact: Decommissioning activities					
Decommissioning activities at the end of the wind farm's lifespan					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Short term	Recoverable	Moderate	Definite
Score	1	2	2	3	5
With Mitigation	Local	Short term	Reversable	Low	Definite
Score	1	2	1	2	5
Significance Calculation	Without Mitigation		With Mitigation		
S=(E+D+R+M)*P	Moderate Negative Impact (40)		Low Negative Impact (30)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				
Mitigation measures to reduce residual risk or enhance opportunities: • Artificial lighting during decommissioning should be minimized as much as possible, especially bright lights or spotlights. Lights should avoid skyward illumination. • Night-time decommissioning activities should be avoided as far as possible.					
Residual impact	If mitigation measures are followed there should be no residual impact.				

Table 14: Impact Assessment Summary Table for the Cumulative Impact

There are no approved wind farms within 30 km of the Khoe WEF, but as described in Section 8, there are some solar farms approved within this radius. Solar farms in general do not have a high impact on bats, apart from construction activities and habitat destruction. The mitigation measures will therefore be similar to that of the wind facility.

Impact 11: Construction					
Nature of the impact: Activities associated with construction of solar farms within 30 km combined with the wind farm					
The destruction of features that could serve as potential roosts, such as rock formations and derelict aardvark holes, and the removal of trees or the fragmentation of woody habitat which includes dense bushes in the surrounding 30 km, together with the construction activities of the wind farm. See Section 8 for a more in dept dis					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Medium Term	Recoverable	Moderate	Definite
Score	2	3	3	3	5
With Mitigation	Local	Short Term	Recoverable	Low	Probable
Score	2	2	3	2	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (55)		Low Negative Impact (27)		
Was public comment received?	No				
Has public comment been included in mitigation measures?	n.a.				

Mitigation measures to reduce residual risk or enhance opportunities:

- No clearance of vegetation or construction activities should take place if there is a chance of disturbing a possible bat roost. If there is uncertainty about any feature that could comprise a bat roost, a bat specialist should be contacted.
- Apart from access roads and the management building, construction activities are to be kept out of all high bat-sensitive areas as far as possible.
- Rock formations occurring along the ridge lines should be avoided during construction, as these could serve as roosting space for bats.
- Destruction of limited trees should be avoided during construction.
- Care should be taken if any dense bushes are destroyed, to make sure that there are not bat roosts in the vegetation. If bat roosts are found, a bat specialist should be contacted immediately.
- Aardvark holes or any large derelict holes or excavations should not be destroyed before careful examination for bats.
- The Environmental Control Officer (ECO) or a responsible appointed person or site manager should contact a bat specialist before construction commences so that they know what to look out for during construction.

Residual impact	Yes, natural habitat will be removed, but with rehabilitation a component of this could be replaced.

9.2 Summary of negative impacts on bats

Although some important components during the operational phase, such as bat mortality due to collision or barotrauma indicate that the impact on bats is expected to be high, the impact summary calculation, when all components are taken into account, indicates that the overall impact is moderate negative before mitigation and low after mitigation as portrayed in Table 15.

Table 15: Summary of Impacts

Phase	Impact before mitigation (negative)	Impact after mitigation (negative)
Construction	Moderate	Low
Operation	Moderate	Moderate
Decommissioning	Moderate	Low
Cumulative (Only solar farms within 30 km, therefore only one cumulative effect)	Moderate	Low
Combined for the site	Moderate	Low

9.3 Input for the Environmental Management Programme

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
DESIGN PHASE					
Negative impacts on bats.	▪ Mitigate impacts on bat habitat caused by destruction, disturbance, and displacement.	▪ Ensure the design of the wind energy facility takes the sensitivity mapping of the bat specialist into account to avoid and reduce impacts on bat species and bat important features. Maintain buffers around these sensitive areas.	▪ Ensure that high-sensitivity areas are identified and excluded from turbine placement. High-sensitivity areas should be avoided and treated as No-go areas for operational wind turbine components during the planning and design phase.	▪ Before construction during the design and planning phase.	▪ Project Developer
	▪ Prevent bat activity in sensitive areas.	▪ Minimize artificial light at night during the design phase. ▪ Do not procure any roll-up garage doors.	▪ Choice of lights and light placement is crucial. ▪ Bats can get trapped in roll-up garage doors and die.	▪ Final design ▪ Site planning phase.	▪ Project Developer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
	▪ Minimise the footprint of the construction to an acceptable level.	▪ Turbines need to be approximately 250 m apart from blade tip to blade tip.	▪ Final layout design	▪ During design and before construction commences.	▪ Project Developer
	▪ Avoid habitat loss and destruction caused by the clearing of vegetation for the working areas and construction, and landscape modifications.	▪ Appoint an ECO before construction to oversee that the EMPr is adhered to. ▪ Plan to use existing road networks as far as possible and ensure no off-road driving.	▪ Monitor whether proposed measures are adhered to. ▪ ECO should be trained to recognise possible roost locations. ▪ If buildings, trees, or structures providing potential roosts need to be demolished, a specialist visit is required before the commencement of the work.	▪ ECO should contact the bat specialist and be trained/informed before construction commences.	▪ Project Developer ▪ Operational bat specialist should work with/inform ECO
CONSTRUCTION PHASE					
Active roost destruction, potential roost	▪ Minimise impacts on bats during	▪ Adhere to high-sensitivity areas incorporated into the final layout.	▪ Visual inspection and continuous monitoring of	▪ Throughout construction. ▪ ECO to be present during	▪ Project Developer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
destruction, and habitat loss.	construction activities. ▪ Keep construction out of high bat-sensitive areas as far as possible. ▪ Avoid the destruction of rock formations along ridge lines. ▪ Avoid the destruction of trees as far as possible. ▪ Take care before destroying dense bushes/trees to avoid unnecessary roost destruction. ▪ All aardvark holes, derelict holes, or excavations should be carefully investigated for roosts before destruction.	▪ Appoint an independent ECO to oversee that the EMPr is being adhered to. ▪ Bat specialist to train ECO, if necessary, to identify possible bat roosts or signs of bat presence. ▪ Clearance and removal of natural vegetation should be kept to a minimum. ▪ Avoid pollution of water courses. ▪ No off-road driving.	high-sensitivity areas. ▪ ECO to be in contact with a bat specialist if bat roosts are encountered.	all site clearance activities. ▪ Access to bat specialist if ECO needs information or confirmation concerning bat presence.	▪ Holder of EA to appoint ECO. ▪ Appointed bat specialist to train the ECO, if necessary.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Creating new habitats amongst the turbines that might attract bats. This includes buildings with roofs that could serve as roosting spaces or open water sources from quarries or excavations where water could accumulate.	▪ Avoid creating new bat habitats that might attract bats to the wind farm.	▪ Inspect all existing buildings and infrastructure for possible roosting opportunities. ▪ No roll-up garage doors should be used on site.	▪ Carefully seal off the roofs of buildings to prevent bat roosting. Note that bats can move into a space of 1 X 1 cm. ▪ No installation of roll-up garage doors as bats can get killed when the doors are opened.	▪ Throughout construction phase	▪ Project Developer ▪ ECO
Construction noise, especially during night-time.	▪ Prevent disturbance to bat activity and behaviour.	▪ Noise levels should be prevented as far as possible.	▪ Monitor construction to reduce noise and minimise disturbance in bat-sensitive areas. ▪ Avoid construction activities at night.	▪ Throughout construction phase.	▪ Project Developer ▪ ECO ▪ All on-site personnel
OPERATIONAL PHASE					
The fatality of resident bats through direct	▪ Monitor potential impacts on bats during	▪ Maintain a register of action taken regarding bat	▪ Relevant SABAA guideline documents.	▪ Throughout operational bat monitoring.	▪ Project Developer ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
collision or barotrauma.	the operation of the wind farm. ▪ Prevent activities that will attract bats to the site.	mortality/injury as well as queries or complaints. ▪ Adhere to mitigation measures as per the pre-construction bat monitoring report. ▪ Adapt mitigation measures in consultation with an operational bat specialist.	▪ Monitoring reports.		
Bat fatality of migratory species.	▪ Monitor potential impacts on bats during the operation of the wind farm. ▪ Prevent activities that will attract bats to the site.	▪ Maintain a register of action taken regarding bat mortality/injury as well as queries or complaints. ▪ Adhere to mitigation measures as per the pre-construction bat monitoring report. ▪ Adapt mitigation measures in consultation with an operational bat specialist.	▪ Relevant SABAA guideline documents. ▪ Monitoring reports.	▪ Throughout operational bat monitoring.	▪ Project Developer ▪ ECO
Loss of bats of conservation value.	▪ Monitor potential impacts on bats during the operation of the wind farm. ▪ Prevent activities that will attract bats to high-risk areas on-site.	▪ Bat fatalities should be monitored by fatality searches and a record kept of the date, time, location, sex, and cause of death. Carcasses should be photographed to be used for searcher efficiency and carcass removal trails. ▪ Adhere to mitigation measures as per the pre-	▪ Relevant SABAA guideline documents. ▪ Monitoring reports.	▪ Throughout operational bat monitoring.	▪ Project Developer. ▪ ECO.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		construction bat monitoring report. ▪ Adapt mitigation measures in consultation with an operational bat specialist.			
Bat fatality due to the attraction of bats to turbine blades.	▪ Prevent activities that will attract bats to turbines.	▪ Maintain a register of action taken regarding bat mortality/injury as well as queries or complaints. ▪ Adhere to mitigation measures as per the pre-construction bat monitoring report. ▪ Adapt mitigation measures in consultation with an operational bat specialist.	▪ Relevant SABAA guideline documents. ▪ Monitoring reports.	▪ Throughout operational bat monitoring.	▪ Project Developer. ▪ ECO.
Loss of habitat and foraging space during operation of the wind turbines.	▪ Monitor potential impacts on bats during the operation of the wind farm. ▪ Prevent activities that will attract bats to high-risk areas on-site.	▪ Maintain a register of action taken regarding bat mortality/injury as well as queries or complaints. ▪ Adhere to mitigation measures as per the pre-construction bat monitoring report. ▪ Adapt mitigation measures in consultation with an operational bat specialist.	▪ Relevant SABAA guideline documents. ▪ Monitoring reports.	▪ Throughout operational bat monitoring.	▪ Project Developer and ECO.
Reduction in size, genetic diversity, resilience, and persistence of bat populations.	▪ Monitor potential impacts on bats during the operation of the wind farm.	▪ Maintain a register of action taken regarding bat mortality/injury as well as queries or complaints.	▪ Relevant SABAA guideline documents. ▪ Monitoring reports.	▪ Throughout operational bat monitoring.	▪ Project Developer. ▪ ECO.

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
	▪ Prevent activities that will attract bats to high-risk areas on-site.	▪ Adhere to mitigation measures as per the pre-construction bat monitoring report. ▪ Adapt mitigation measures in consultation with an operational bat specialist.			
DECOMMISSIONING PHASE					
Decommissioning activities and noise, especially at night- time.	▪ Mitigate disturbance due to decommissioning activities.	▪ Develop a decommissioning and remedial rehabilitation plan and adhere to the compliance monitoring plan.	▪ Implement the decommissioning and rehabilitation plan to reduce the footprint of the development to a pre-construction state.	▪ During decommissioning phase.	▪ Project Developer ▪ ECO. ▪ Commitment from all levels of management

9.4 "No-Go" alternative

The 'No-Go' alternative is the option of not constructing the WEF and associated infrastructure where the status quo of the current status and/or activities on the project site would prevail. This alternative would result in no additional impact on the receiving environment. Should the 'No-Go' alternative be considered, there would be no impact on the existing environmental baseline and no benefits to the local economy and affected communities. The alternative bears the opportunity cost of missed socio-economic benefits to the local community that would otherwise be realised from establishing the farms/properties which form part of the project site. The option of not developing also entails that the bid to provide renewable/clean energy to the national grid and contribute to meeting the country's energy demands will be forfeited.

9.5 Layout alternatives

A preferred infrastructure and alternative infrastructure were proposed and have been comparatively assessed. Table 16 below provides the results of the comparative assessment of the substation site and construction laydown area alternatives from a bat perspective.

Table 16: Comparative assessment of substation and laydown areas

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION SITE ALTERNATIVES		
Preferred infrastructure	Favorable	Although both positions are acceptable, this is the most favorable due to the high bat activity at the alternative site.
Alternative infrastructure	Least preferred	The infrastructure is situated in a region of the wind energy facility where the highest bat activity was recorded. Even though the infrastructure will not have a direct fatality risk on bats, and from a bat perspective the development could go ahead, it is not the most favorable position.

Although the preferred infrastructure is most preferable from a bat perspective, the impact of the substation and laydown areas is not expected to be high and therefore there are no fatal flaws associated with either of the positions.

10. CONCLUSION AND RECOMMENDATIONS

Passive monitoring data for the period between 30 December 2022 and 7 March 2024 is included in this report. *L. capensis* was the most abundant species recorded (55%), while 37% of the calls were of those bats like the high-flying *T. aegyptiaca*, which has a narrow wing morphology adapted for open air space. 4% of the activity recorded was similar to *M. natalensis*, 3% was *S. petrophilus,* and a statistically insignificant number of the endemic *E. hottentotus*.

The species diversity was largely similar for Systems D, at 100 m, and System E, at 50 m, on the met mast, with more than 90% of these calls by *T. aegyptiaca*. Alternatively, *L. capensis* showed a higher representation of more than 50% at the 10 m masts (Systems F, G, H, and I). Except for the endemic *E. hottentotus,* all these bat species are, according to the South African Bat Assessment Association (SABAA) bat guidelines, at high risk of being negatively impacted by wind farm developments.

When activity over the monitoring period is considered *L. capensis* demonstrated significantly higher activity during autumn, spring, and summer, while *T. aegyptiaca* presented a higher activity in spring and summer of 2023-2024. The average monthly activity shows that bats are generally most active during the summer months, followed by autumn and spring, with reduced activity during the winter months. Peak activity was recorded in March, November and December 2023, with general high activity from February to May 2023, and again from October 2023.

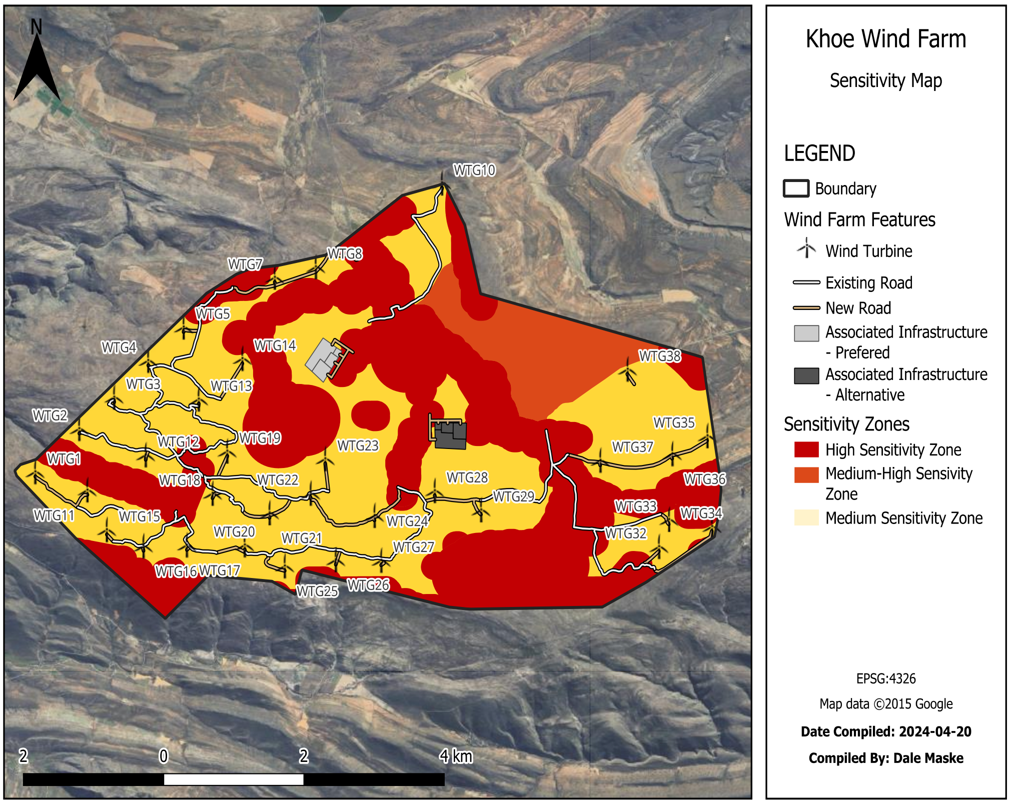
When hourly bat activity medians per year of various systems are compared, bat activity declined with an increase in altitude, with System D, at 100 m, portraying lower activity than System E, at 50 m, which again recorded lower activity than System F at 10 m. A similar decline in activity with altitude was recorded at the nearby proposed Hugo WEF and one could therefore, with caution, extrapolate this tendency to the rest of the site.

At the proposed Khoe WEF, the hourly nightly activity patterns portrayed at the different systems were quite similar. Higher activity was portrayed approximately two hours after sunset, when bats emerge to forage and drink water, with a peak in activity around three hours after sunset. Steady high activity occurred for the first seven hours after sunset, between 21:00 and 00:00, and a decline in activity was shown from midnight to approximately two hours before sunrise.

The hourly median of the combined bat activity over the monitoring period, is 2,43 bat passes/h/annum, while the total average bat passes per hour per year, namely the Bat Index, is 3,11 bat passes/h/annum. These figures indicate high activity. The hourly annual median bat activity at height is 0,36 while the near-ground median is 2,98. According to the SABAA pre-construction bat guidelines, both these medians fall within the high-risk category. The rotor sweep median is the most important measure, and development should progress with caution. Furthermore, fatalities in the lower section of the rotor sweep are highly probable, and bats represented by the 10 m monitoring systems could be at risk. Due to the high risk of collision, the bat guidelines dictate that fatality minimisation measures should be recommended during pre-construction and should be applied from the commencement of turbine rotation.

Temperature data from 14 m and wind, humidity and barometric pressure data from the Met mast at 117m were plotted with bat activity data from System D at 100 m, as this sampling system is situated in the area of collision and the closest to the weather monitors, for the statistical analyses. Results of linear regressions between weather conditions and bat activity indicate that in particular temperature, wind, and atmospheric pressure have an influence on bat activity at the Khoe Wind Energy Facility. Cumulative distribution functions (CDF) between weather and bats were utilised to illustrate the relationship between bat activity and weather conditions. They were further refined with Cumulative distribution function heat maps to establish the "sweet spots" where bats are expected to be most active. This information was then used to draw up a curtailment schedule which could be used as a starting point for discussions during the operational phase.

One of the most successful mitigation measures is to shift development away from sensitive areas. After specialist input was considered, the developer removed turbine positions from high-sensitivity areas. The below bat sensitivity map indicates the various sensitivity zones of Khoe WEF. Due to the general high bat activity on site, the development areas were classified as medium sensitive. It will therefore be necessary to mitigate turbines early in the operational phase. No turbine components are allowed in high-sensitivity zones. At present no turbines are positioned in medium-high sensitivity zones either, but if turbines are placed on medium-high sensitivity zones, curtailment will have to be applied after the testing of those turbines, when they start to turn.



Bat sensitivity map for Khoe WEF

At present no specific turbines are recommended for curtailment. Carcass searches will determine which turbines portray the highest mortality, and mitigation measures will then be applied, starting at those turbines. Close observation by the bat specialist during the operational phase must be conducted and the below curtailment schedule should inform the discussions about curtailment.

Curtailment schedule for turbines situated in medium sensitivity zone

Turbine numbers	Months	Time period	Temperature (°C)	Atmopheric Air Pressure (hPa)	Curtailment
Turbine numbers to be determined during the first months of bat monitoring	February, March, April, May, October, November, December	2 hours after sunset, up to 7 hours after sunset	Above 13 °C	Between 863 and 872 hPa	Raise cut-in speed to 5 m/s

It is recommended that the following mitigation measures be included in the Environmental Authorization (EA):

- *The final layout must be informed by the sensitivity map provided in Section 6. 10 of the main report.*
- *A bat specialist must be appointed before the commercial operation date. Mitigation measures, as per Section 7 of the main bat report, must form part of the operational EMPr, and be applied as directed.*
- *Turbines must be feathered below cut-in speed, and although they need not be at a complete standstill, there should be minimum movement so that bats are not at risk when turbines are not generating power.*
- *All newly built structures that have bat conducive features must be rehabilitated to discourage bat presence: Roofs of new buildings must be sealed and any open quarries and borrow pits created during construction must be rehabilitated.*
- *No roll-up garage doors should be installed at the new buildings.*
- *A minimum of two year's operational bat monitoring must be conducted after the commencement of operations at the proposed Khoe WEF, as per the guidance of the latest operational South African Bat Assessment Association (SABAA) guidelines. Due to the high bat activity and future installation of mitigation measures, it might be necessary to conduct operational monitoring beyond the minimum of two years.*

A summary of impact on bats at Khoe WEF is provided below. The highest negative impact on bats during wind farm developments is experienced during the operational phase, which is rated high negative without mitigation and moderate negative with mitigation. Although the overall combined impacts are rated as moderate negative before mitigation, and low negative after mitigation, it should be noted that the most important impact on bats, namely fatality during operation, is high before and after mitigation. This is supported by the bat activity category for Montane Fynbos and Renosterveld, which is high; Therefore, bat fatality during the operational phase could be high. Operational bat monitoring will shed further light on bat fatalities and the developer should prepare for turbine-specific curtailment and/or installing bat deterrents when more information is available.

Summary of impacts on bats: Khoe WEF		
Phase	**Impact before mitigation (negative)**	**Impact after mitigation (negative)**
Construction	Moderate	Low
Operation	Moderate	Moderate
Decommissioning	Moderate	Low
Cumulative (Only solar farms within 30 km, therefore only one cumulative effect)	Moderate	Low
Combined for the site	Moderate	Low

Khoe WEF is the first proposed wind farm in the area; therefore, the cumulative impact is low, as there are no other wind farms within a 30 km radius. When solar farms are considered, a low impact of habitat destruction is noted.

The Department of Forestry, Fisheries, and the Environment's (DFFE) Screening Tool Report showed a high sensitivity to the bats (wind) theme. The required Site Sensitivity Verification Report confirmed that the proposed Khoe WEF has high sensitivity in terms of bats, which had been confirmed by the bat monitoring exercise due to general high bat activity.

One year of pre-construction bat monitoring is required by legislation in South Africa. However, the dry Renosterveld and Fynbos are subject to erratic weather conditions, which could vary from year to year. Bat activity conducted during 2022 at another proposed development bordering Khoe WEF, indicated general lower bat activity. The exceptionally high rainfall during the following year could have contributed to the high bat activity during 2023. Increased rainfall often results in an increase in insect activity which could result in higher bat activity. Therefore, mitigation and enhancement options should be adjusted as this project develops and more site-specific information is collected. Furthermore, a growing knowledge in this field of study based on research and evidence gained from current similar development projects could add value to this project.

The overall potential negative impact of the proposed Khoe WEF on bats, combined for all the development phases, is predicted to be **Moderate negative without mitigation,** while **Low negative with mitigation.**

Based on the findings of the 14 months of pre-construction bat monitoring undertaken at the proposed Khoe WEF project site, the bat specialist is of the opinion that no fatal flaws exist which would prevent the construction and operation of this wind farm, but bat activity is high, and mitigation measures should be adhered to. The EA may be granted, subject to the implementation of the recommended mitigation as described in this report (Section 7).

11. BIBLIOGRAPHY

Aldridge, H.D.J.N. and Rautenbach, I.L. (1987). Morphology, echolocation and resource partitioning in insectivorous bats. *Journal of Animal Ecology*, 56(3): 763-779.

Arnett, E.B. and May, R.F. (2016). Mitigating Wind Energy Impacts on Wildlife: Approaches for Multiple Taxa. *Human - Wildlife Interactions*, Vol: Iss. 1, Article 5. doi:https://doi.org/10.26077/1jeg-7r13

Arnett, E.B., Baerwald, E.F., Mathews, F., Rodrigues, L., Rodriguez-Duran, A.,Rydell, J., Villegas-Patraca, R. and Voigt, C.C. (2015). *Impacts of Wind Energy Development on Bats: A Global Perspective*. Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-25220-9_11

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.

Baerwald, E.F., Edworthy, J., Holder, M. and Barclay, R.M. (2009). A large-scale mitigation experiment to reduce bat fatalities at wind energy facilities. *The Journal of Wildlife Management*, 73(7), pp.1077-1081. Retrieved March 2, 2023, from https://wildlife.onlinelibrary.wiley.com/doi/abs/10.2193/2008-233

Bottollier-Depois, A. (2021). *From the shadows: the secret, threatened lives of bats*. Retrieved February 21, 2022, from Phys.Org: https://phys.org/news/2021-08-shadows-secret-threatened.html#:~:text=Bats%20are%20one%20of%20the,fall%20prey%20to%20other%20animals.

Boyles, J.G., Cryan, P.M., McCracken, G.F. and Kunz, T.H. (2011). Economic Importance of Bats in Agriculture. *Science*, Vol. 332, No. 6025, pp. 41 - 42. Retrieved from https://www.science.org/doi/10.1126/science.1201366

CSIR. (2020). *Basic Assessment for the Proposed Development of Electrical Grid Infrastructure to support the proposed nine 175 MW Solar Photovoltaic Facilities and associated Infrastructure near Touws River, Western Cape*. Retrieved from https://www.csir.co.za/sites/default/files/Documents/04_EGI_DBAR_FINAL_03122020.pdf

De Villiers, M. (2022). *Batting at Groenvlei*. Retrieved February 24, 2022, from CapeNature: https://www.capenature.co.za/news/2022/batting-at-groenvlei

DEA. (2015). *SEA for Wind and Solar PV in South Africa*. Stellenbosch: CSIR Report.

DEAT. (2004). *Cumulative Effects Assessment, Intergrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism (DEAT), Pretoria.* Retrieved from https://www.dffe.gov.za/sites/default/files/docs/series7_cumulative_effects_assessment.pdf

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N.D., Wikramanayake, E., Hahn, N., Palminteri, S., Hedao, P., Noss, R., Hansen, M., Locke, H., Ellis, E.C., Jones, B., Barber, C.V., Hayes, R., Kormos, C. et al. (2017). An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm. *BioScience*, Volume 67, Iss. 6, pp. 534 - 545. Retrieved February 24, 2022, from https://academic.oup.com/bioscience/article/67/6/534/3102935

Eiting, T. (2006). *Tadarida aegyptiaca*. Retrieved February 23, 2022, from Animal Diversity Web: https://animaldiversity.org/accounts/Tadarida_aegyptiaca/

Environmental Screening Tool. (n.d.). Retrieved April 2024, from https://screening.environment.gov.za/screeningtool/SolarPV

Geda, M.K. and Balakrishnan, M. (2013). Ecological and Economic Importance of Bats (Order Chiroptera). *ResearchGate*, ISRN Biodiversity 2013(1):1-9. Retrieved from ResearchGate: https://www.researchgate.net/publication/275459173_Ecological_and_Economic_Importance_of_Bats_Order_Chiroptera

Google Earth. (n.d.). Retrieved from https://www.google.com/earth/download/html.

Jacobs, D., MacEwan, K., Cohen, L., Monadjem, A., Richards, L.R., Schoeman, C.,Sethusa, T. and Taylor, P.J. Editors: In Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D. and Davies-Mostert, H.T. (2016). *A conservation assessment of Sauromys petrophilus.* Retrieved October 26, 2022, from http://the-eis.com/elibrary/sites/default/files/downloads/literature/A%20conservation%20assessment%20of%20Sauromys%20petrophilus.pdf

Janse van Vuuren, C.Y. and Vermeulen, H.J. (2019). Clustering of wind resource data for the South African renewable energy development zones. *Journal of Energy in Southern Africa*, 30(2), 126 - 143. doi:http://dx.doi.org/10.17159/2413-3051/2019/v30i2a6316

Kunz, T. B. (2011). Ecosystem services provided by bats. *Annals of the New York Academy of Sciences*, 1223 (1): 1-38. doi:https://doi.org/10.1111/j.1749-6632.2011.06004.x

Kunz, T.H., Arnett, E.B., Erickson, W.P., Hoar, A.R., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.W. and Tuttle, M.D. (2007). Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. *Frontiers in Ecology and the Environment*, 5(6), 315 - 324. doi:https://doi.org/10.1890/1540-9295(2007)5[315:EIOWED]2.0.CO;2

Leelapaibul, W., Bumrungsri, S. and Pattanawiboon, A. (2005). Diet of wrinkle-lipped free-tailed bat (Tadarida plicata Buchannan, 1800) in central Thailand: Insectivorous bats potentially act as biological pest control agents. *Acta Chiropterologica*, 7: 111-119.

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 - ed 2.* South African Bat Assessment Association.

MacEwan, K., Aronson, J., Richardson, K., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W. and Richards, L. (2020). *South African Bat Fatality Threshold Guidelines: Edition 3.* Published by the South African Bat Assessment Association.

MacEwan, K., Richards, L.R., Jacobs, D., Monadjem, A., Schoeman, C., Sethusa, T., Taylor, P.J. (2016). *A conservation assessment of Miniopterus natalensis. Editors: In Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D. and Davies-Mostert, H.T.* Retrieved from http://the-eis.com/elibrary/sites/default/files/downloads/literature/A%20conservation%20assessment%20of%20Miniopterus%20natalensis.pdf

MacFarlane, D. and Rocha, R. (2020). Guidelines for communicating about bats to prevent persecution in the time of COVID-19. *Biological Conservation*, Vol. 248. Retrieved March 01, 2022, from https://www.sciencedirect.com/science/article/pii/S0006320720307084

Madders, M. and Whitfield, D.P. (2006). Blue Wind Energy Facility Bat Monitoring. Pre-construction Report July 2013 - March 2014. *BioInsight 2014*.

Marais, W. (2018). *5th and Final Progress Report of a 12-month Long Term Preconstruction Bat Monitoring Study and Bat Impact Assessment for proposed San Kraal Wind Power (Pty) Ltd WEF. Animalia zoological and ecological consultants 2016 and 2018*.

Meteoblue.com. (n.d.). Retrieved from http://www.meteoblue.com

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

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

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

National Park Service. (2020). *Benefits of Bats*. Retrieved February 23, 2022, from https://www.nps.gov/subjects/bats/benefits-of-bats.htm

National Science Foundation. (2012). *The Night Life: Why We Need Bats All the Time - Not Just on Halloween*. Retrieved February 23, 2022, from https://new.nsf.gov/news/night-life-why-we-need-bats-all-time-not-just#:~:text=The%20ecological%20roles%20of%20bats,of%20insects%20and%20other%20arthropods.

Neuweiler, G. (1989). Foraging ecology and audition in echolocating bats. *Trends in Ecology and Evolution*, 4(6): 160-166.

Non-Perennial Rivers (from client). (n.d.). Retrieved from http://www.ngi.gov.za/

Pennisi, E. (2020, July 22). *How bats have outsmarted viruses—including coronaviruses—for 65 million years.* Retrieved February 24, 2022, from Science: https://www.science.org/content/article/how-bats-have-outsmarted-viruses-including-coronaviruses-65-million-years

Pretorius, M., Markotter, W. and Keith, M. (2021). Assessing the extent of land-use change around important bat-inhabited caves. *BMC Zooloogy*, 6(1):31. doi:10.1186/s40850-021-00095-5.

Public Affairs. (2011). *The evolution of beer yeasts, seedy pants and vampire bat venom-turned medicine*. Retrieved February 24, 2022, from esa: https://www.esa.org/esablog/2011/05/13/the-evolution-of-beer-yeasts-seedy-pants-and-vampire-bat-venom-turned-medicine/

Reiskind, M.H. and Wund, M.A. (2009). Experimental assessment of the impacts of northern long-eared bats on ovipositing Culex (Diptera: Culicidae) mosquitoes. *Journal of Medicinal Entomology*, 46(5): 1037 - 1044. doi:10.1603/033.046.0510.

SANBI. (2012). *Vegetation Map of South Africa, Lesotho, and Swaziland [vector geospatial dataset] 2012*. Retrieved from South African National Biodiversity Institute - Biodiviersity GIS web site: http://bgis.sanbi.org/SpatialDataset/Detail/18

SANBI. (n.d.). *2013/2014 Western Cape Landcover product*. Retrieved from http://bgis.sanbi.org/SpatialDataset/Detail/610

Schnitzler, G.U. and Kalko, E.K.V. (2001). Echolocation by Insect-Eating Bats: We define four distinct functional groups of bats and find differences in signal structure that correlate witht the typical echolocation tasks faced by each group. *BioScience*, Vol. 51, Iss. 7., pp. 557-569. Retrieved from https://doi.org/10.1641/0006-3568(2001)051[0557:EBIEB]2.0.CO;2

Schnitzler, H.U. and Kalko, E.K.V. (1998). How echolocating bats search and find food. *Bat Biology and Conservation*, 183-196.

Selemin, J. Editor: Begum, J. (2022). *How Blind People Can Use Echolocation*. Retrieved from WebMD: https://www.webmd.com/eye-health/how-blind-people-can-use-echolocation

Smith, A. (1833). Miniopterus natalensis in GBIF Secretariat (2022). GBIF Backbone Taxonomy. *The Integrated Taxonomic System South African Quarterly Journal*, Vol. 2, p. 59. Retrieved April 2023, from https: doi.org/10.15468/39omei

Sowler, S., MacEwan, K., Aronson, J. and Lotter, C. (2020). *South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities: Edition 5.* South African Bat Assessment Association.

Urland, J. (2021, September 20). *NRG Blog: Enel begins Bat Deterrent Trial at South African Wind Plant.* Retrieved from https://www.nrgsavesbats.com/new-blog

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

WC_NGI_TOPO_DATA_201701. (n.d.). Retrieved from http://media.dirisa.org/inventory/archive/spatial/ngi/topographic-vector-data/wc_ngi_topo_data_-201701-gdb.zip/view

Weaver, S.P., Hein, C.D., Simpson, T.R., Evans, J.W. and Castro-Arellano, I. (2020). Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines. *Global Ecology and Conservation*, Vol. 24. Retrieved from https://doi.org/10.1016/j.gecco.2020.e01099

APPENDIX 1: SITE SENSITIVITY VERIFICATION

1. INTRODUCTION

FE Hugo & Khoe (Pty) Ltd is proposing to develop, own, and operate the Khoe Wind Energy Facility (WEF), Battery Energy Storage System (BESS), and associated infrastructure with a generation capacity of up to 290 megawatts (MW).

To evaluate the energy generated by the WEF to supplement the national grid, FE Hugo & Khoe is also proposing an electrical grid infrastructure (EGI)/grid connection project which will be assessed in a separate Basic Assessment process. The proposed development site 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 the Cape Winelands District Municipality of the Western Cape Province.

Table 17: Khoe WEF farm portions

Applicant	Project Name	Capacity (MW)	Affected Property
FE Hugo and Khoe (PTY) LTD	Khoe Wind Energy Facility	290 MW	Portions 1/38, 2/38, 11/38 and RE/37 of Farm Eendragt
			Farm 193

The overall objective of the proposed development is to generate electricity by means of renewable energy technologies capturing wind energy to feed into the national grid.

It is proposed that the wind farm component of the renewable energy facility will consist of an estimated 29 wind turbine generators (WTG), with a hub height from ground level anticipated to be up to 150 m, and a blade length and rotor diameter of approximately 100 m and 200 m respectively. The wind farm will also include internal and/or access roads (with a width of up to 12 m during construction) as well as a Battery Energy Storage System (BESS), a construction laydown area/camp, and an Operation and Maintenance (O&M) Building. In totality, the proposed turbine footprint and associated facility infrastructure will cover an area of up to 85 ha depending on the final design for Khoe.

The findings of the specialist studies were used to inform the footprint of the wind turbines. All identified high-sensitivity areas (including their respective buffers) will be avoided accordingly, as required. As part of the proposed application / Scoping & Environmental Impact Assessment (EIA) processes for the wind farm project, location alternatives were assessed for the associated infrastructure such as the O&M Buildings, IPP Substations and BESS. The development was also assessed against the ‘no-go’ alternative.

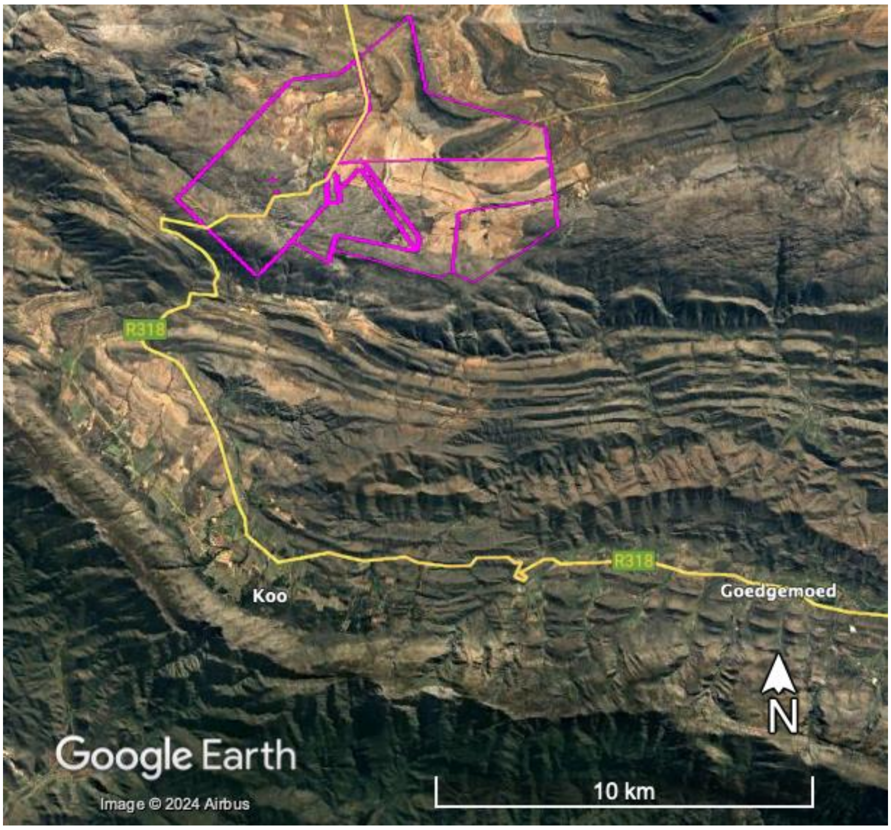


Figure 30: Locality Map of the Khoe Wind Energy Facility

2. NEMA REGULATIONS

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations [4 December 2014, Government Notice (GN) R982, R983, R984 and R985, as amended], various aspects of the proposed development will have an impact on the environment and are considered to be listed activities. These activities require environmental authorisation (EA) from the National Competent Authority (CA), namely the Department of Forestry, Fisheries, and the Environment (DFFE), prior to the commencement thereof. One (1) application for EA for the proposed development will be submitted to the DFFE, in the form of a Scoping & EIA process in terms of the NEMA EIA Regulations of 2014 (as amended). A bat specialist was commissioned to verify the bat sensitivity of the Khoe Wind Farm site under these specialist protocols.

In accordance with GN 320 and GN 1150 (20 March 2020)[1] of the NEMA EIA Regulations of 2014 (as amended), prior to commencing with a specialist assessment, a site sensitivity verification was undertaken to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (i.e., Screening Tool).

3. SITE SENSITIVITY VERIFICATION METHODOLOGY

The South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (MacEwan et al, 2020) guided the monitoring process. Based on these guidelines, acoustic monitoring of the echolocation calls of bats was, amongst others, were used to determine the seasonal and diurnal activity patterns of bats at the proposed Khoe development site.

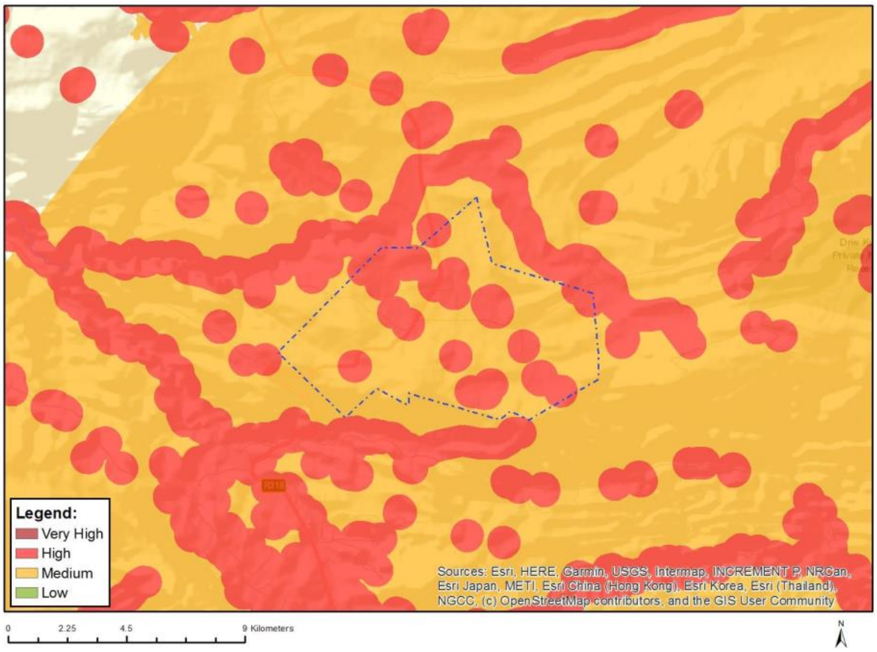
The environmental sensitivity of the proposed development area for the "bat species biodiversity theme" was established through the following methodology:

- A desktop analysis was undertaken, using available national and provincial databases, existing reports from the surrounding area, as well as digital satellite imagery (SANBI, Google Earth Pro and QGIS).
- On-site inspections and roost searches were conducted by a bat specialist during fieldwork sessions, as well as nightly point sources at strategic places.
- Data, consisting of nightly bat activity, was recorded for 14 months from six static monitoring points, which were positioned, amongst others, in the sweep of the proposed turbine blades at heights of 10 m, 50 m and 100 m respectively. The systems represented the different biotopes within the project site. The developer incorporated the avian buffers during the initial stage of the bat impact assessment, which eliminated a portion of the study area in the eastern section of the site. Apart from the detectors placed on the met mast, 10 m systems were placed on the rest of the proposed development site where turbine positions were expected.
- Interviews with landowners and investigations of farm dwellings were conducted during field visits.

[1] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorization

4. OUTCOME OF SITE SENSITIVITY VERIFICATION

The national web-based environmental screening tool was applied to the study area, and it was determined that areas of high bat sensitivity are expected to occur within the project site, as shown in Figure 31 below.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

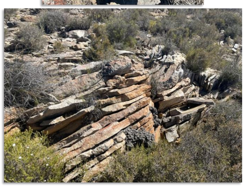
Sensitivity Features:

Sensitivity	Feature(s)
High	Within 500 m of a river
High	Wetland
High	Within 500 m of a wetland
Medium	Between 20 and 50 km from a large bat roost
Medium	Croplands

Figure 31: Map of relative bats (wind) theme sensitivity, showing sensitivities as per the DFFE Screening Tool, explaining the sensitivity features identified.

As indicated in the above Screening Tool Site Sensitivity Map, the project site is classified as high sensitivity for bats. The bat monitoring confirmed high sensitivity areas. Environmental features, amongst others, that may be favourable to bats are indicated in Table 18 below.

Table 18: Environmental features that may be favourable to bats.

	**Vegetation** The site is covered in typical Matjiesfontein Shale Renosterveld, South Langeberg Sandstone Fynbos, and North Langeberg Sandstone Fynbos. Although the natural vegetation does not support trees, there are limited trees situated in the non-perennial riverbeds and clumps of large trees near farm dwellings, which could provide roosting opportunities for bats that prefer roosting in vegetation or under the bark of trees. There are also areas with numerous termite/ant hills, which indicate an abundance of food for bats during certain times of the year.
 	**Rock formations and rock faces** 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. Numerous mountainous areas surrounding the proposed site could support bat roosts. In addition, bats from neighbouring roosts could traverse the proposed wind farm to forage, drink or migrate.
	**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 and water troughs for animals provide permanent, open water sources for bats throughout the year.

As indicated above in Table 18 and in the main bat impact assessment report, the proposed Khoe WEF, have numerous features which could potentially attract to bats. According to the bat activity categories (MacEwan et al 2020) the annual bat activity medians near-ground and at height, within the sweep of the turbine blades, for montane fynbos and renosterveld are high.

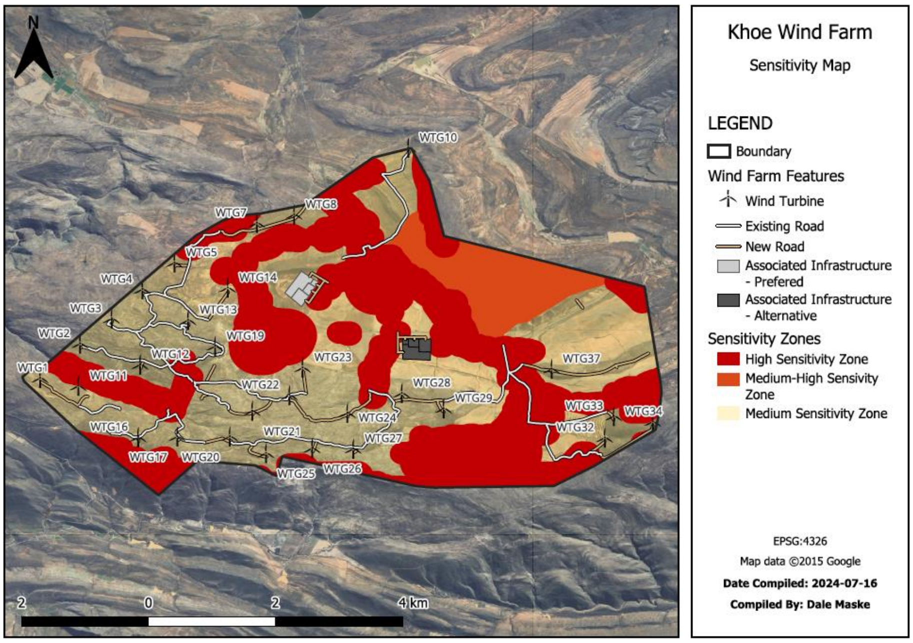


Figure 32: Khoe WEF bat sensitivity map with the input from the bat monitoring study incorporated.

5. CONCLUSION

The Site Sensitivity Verification Report indicates the proposed Khoe WEF area as having high and medium-high and medium bat sensitivities, with the site classified as high sensitivity.

During the monitoring period, various high-sensitivity areas as well as medium-high sensitivity areas have been verified by the specialist, but areas amongst these sensitivities are open for wind development. Mountainous areas with rocky outcrops and permanent water bodies, which are abundant on the site, are attractive bat features. The northeastern static monitoring system, System G, situated close to a large open water source, recorded very high annual bat activity; noticeably above the highest threshold for Montane Fynbos and Renosterveld Ecoregion, with an annual hourly median bat activity of 6,163 bats per hour. No turbines were placed in this part of the wind farm. The annual hourly median bat activity for all the other systems also fall within the high threshold category according to the SABAA guidelines (MacEwan et al 2020).

The high-sensitivity areas, as portrayed on the Site Verification Report Map, have been confirmed and expanded as more information was collected during the bat monitoring. It should be noted that 2023 received an exceptionally high rainfall which could have contributed to the high bat activity. The high-sensitivity areas in the Bat Monitoring Report were identified as 'no-go' areas for wind turbines, as shown in Figure 32 above. According to the activity levels in the SABAA pre-construction bat guidelines (MacEwan et al. 2020), the bat activity at the proposed project site is generally high near-ground as well as within the sweep of the turbine blades. Although there are some areas between the high-sensitivity zones which are available for development, the bat monitoring exercise confirms the Site Verification Report. A more in-depth discussion supporting this conclusion is presented in Section 6 and 7 of the report to which this appendix is attached.

APPENDIX 2: BAT SPECIALIST 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, as Stephanie Dippenaar Consulting trading as EkoVler.
- 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.
- 2023 onwards: Owner of EkoVler Environmental Management.

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	Fifth year operational bat monitoring at Tzitzikamma Community Wind Farm	Bat specialist
In progress	Fifth year operational bat monitoring at Khobab Wind Farm	Bat specialist
In progress	Fifth year operational bat monitoring at Loeriesfontein 2 Wind Farm	Bat specialist
In progress	Preconstruction Bat monitoring at Luipardskloof Wind Energy Facility	Bat specialist
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
2023	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

Completion	Project description	Role
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
2023	Preconstruction Bat monitoring at Kappa 1 Wind Energy Facility	Bat specialist
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
2019	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

Completion	Project description	Role
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
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

- 2024: Certificate: Wildlife Rescue South Africa (first responder).
- 2023 onwards: Member of the Steering Committee of the South Africa Bat Assessment Association.
- Guest speaker at Windaba, 2023: Bats and Wind Energy.
- 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