Bat Environmental Impact Assessment Report

for

12-Month Pre-construction Bat Monitoring

For the proposed Klipkraal Wind Energy Facility (WEF) 1
Northern Cape, South Africa

Compiled by

Werner Marais & Diane Smith

November 2022

PREPARED FOR:

KLIPKRAAL WIND ENERGY FACILITY 1 (PTY) LTD

By

ANIMALIA CONSULTANTS
2015/364493/07
Somerset West
Cape Town
7130

www.animalia-consult.co.za

Ref: R-2211-50

i) APPOINTMENT OF SPECIALIST

Specialist Company:	Animalia Consultants (Pty) Ltd
Fieldwork conducted by:	Werner Marais, Carel Malouf & Jan Jacobs
Report done by:	Werner Marais & Diane Smith
Appointed by:	Klipkraal Wind Energy Facility 1 (Pty) Ltd
For:	Bat Environmental Impact Assessment Report for 12-Month Pre-construction Bat Monitoring

Independence

Animalia Consultants (Pty) Ltd has no connection with the developer or any other party who stands to gain financially should the proposed development be approved by the relevant decision-making authorities. Animalia Consultants (Pty) Ltd is not a subsidiary, legally or financially, of the developer. Animalia Consultants (Pty) Ltd's remuneration for services by the developer in relation to this proposal is not linked to the approval by the decision-making authorities responsible for permitting this proposal.

Animalia Consultants (Pty) Ltd herewith discloses that it also renders services and distributes certain products that may assist in minimising and monitoring environmental impacts during the operational phase of renewable energy developments. This report is based on sound scientific principles and industry best practices and is in no way subject to or premised on Animalia Consultants (Pty) Ltd's aforementioned services and products. Animalia Consultants (Pty) Ltd thus confirms that it is independent as is defined in the Environmental Impact Assessment Regulations of 2014 and that its report herein is objective.

Applicable Legislation

Legislation dealing with biodiversity applies to bats and includes the following:

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97). The Act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive attention, in addition to those listed as Threatened or Protected.

THE SOUTH AFRICAN BEST PRACTICE GUIDELINES for preconstruction studies recommends sensitivity map buffer rules and mitigation by avoidance. MacEwan, K., Sowler, S., Aronson, J., and Lötter, C. 2020. *South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities - ed 5*. South African Bat Assessment Association.

THE BAT MORTALITY THRESHOLD GUIDELINES imposes sustainable bat mortality thresholds for operating wind farms, indicating when wind farms need to apply active mitigation measures. MacEwan, K., Aronson, J., Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W., Richards, L. 2018. *South African Bat Fatality Threshold Guidelines – ed 2*. South African Bat Assessment Association.

TABLE OF CONTENTS

TABLES

FIGURES

Table i. Explanation of Abbreviations used in this document

Abbreviation	**Explanation**
ACR	African Chiroptera Report
BP/h	Bat passes per hour
BESS	Battery Energy Storage System
COD	Commercial Operation Date
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
GHAF	Green Hydrogen & Ammonia Facility
IRP	Integrated Resource Plan
MM	Meteorological ("Met") Mast
PV	Photo-voltaic (facility)
REC	Renewable Energy Complex
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SABAA	South African Bat Assessment Association
SEA	Strategic Environmental Assessment
ShM	Short Mast (passive bat detection system)
WEF	Wind Energy Facility

ii) NEMA REQUIREMENTS

The content of a Specialist report is specified in the EIA Regulations GN R. 982, as amended (4 Dec 2014) Appendix 6. A Specialist report prepared in terms of these Regulations must contain:

NEMA Requirement	**Section/page in report**
Details of the Specialist who prepared the report, and the expertise of that Specialist to compile a Specialist report including a curriculum vitae.	**Separate curriculum vitae**
A declaration that the Specialist is independent in a form as may be specified by the competent authority.	**Page iii**
An indication of the scope of, and the purpose for which, the report was prepared.	**Section 0**
An indication of the quality and age of the base data used for the Specialist report.	**Sections 3 and 0**
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	**Sections 0 and 6**
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment.	**Section 3**
A description of the methodology adopted in preparing the report or carrying out the specialised process, inclusive of equipment and modelling used.	**Section 3**
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.	**Sections 3 and 6**
An identification of any areas to be avoided, including buffers.	**Section 5.7**
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 5.7**
A description of any assumptions made and any uncertainties or gaps in knowledge.	**Section 3.3**
A description of the findings and potential implications of such findings on the impact of the proposed activity, or activities.	**Sections 5, 6 & 9**
Any mitigation measures for inclusion in the EMPr.	**Section 7**
Any conditions for inclusion in the environmental authorisation.	**Sections 6, 7 & 8**
Any monitoring requirements for inclusion in the EMPr or environmental authorisation.	**Section 6 & 8**

NEMA Requirement	**Section/page in report**
A reasoned opinion whether the proposed activity or portions thereof should be authorised, and regarding the acceptability of the proposed activity or activities. And if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr.	**Sections 6, 7, 8 and 9**
A description of any consultation process that was undertaken during the course of preparing the Specialist report.	**Sections 3**

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED KLIPKRAAL WIND ENERGY FACILITY (WEF) 1

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

iii) SPECIALIST INFORMATION

Specialist Company Name:	Animalia Consultants (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Werner Marais			
Specialist Qualifications:	MSc Biodiversity & Conservation			
Professional affiliation/registration:	SACNASP *Pr.Sci.Nat* (Zoological Science)			
Physical address:	25 Bakkerskloof road, Lynn's View, Somerset West, 7130			
Postal address:	25 Bakkerskloof road, Lynn's View, Somerset West			
Postal code:	7130	Cell:	078 190 3316	
Telephone:		Fax:		
E-mail:	werner@animalia-consult.co.za			

iv) DECLARATION BY THE SPECIALIST

I, _________Werner Marais_________________________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Animalia Consultants (Pty) Ltd

Name of Company

30 November 2022

Date

Bat Environmental Impact Assessment Report

for

12-Month Pre-construction Bat Monitoring

For the proposed Klipkraal Wind Energy Facility (WEF) 1, Northern Cape, South Africa

---

1 OBJECTIVES AND TERMS OF REFERENCE FOR THE STUDY

- A description of the baseline characteristics and conditions of the receiving environment (e.g., site and/or surrounding land uses including urban and agricultural areas).
- An evaluation of the predicted impacts of the project on the receiving environment.
- An assessment of the probability of each impact occurring, the reversibility of each impact and the level of confidence in each potential impact.
- Consider and evaluate the cumulative impacts in terms of the current and proposed activities in the area.
- Recommendations to avoid negative impacts, as well as feasible and practical mitigation, management and/or monitoring options to reduce negative impacts that can be included in the Environmental Management Programme.
- A reasoned opinion as to whether the proposed activity, or portions of the activity should receive Environmental Authorisation.

2 INTRODUCTION

Aura Development Company (Pty) Ltd (hereafter referred to as 'Aura'), has appointed SiVEST Environmental (hereafter referred to as 'SiVEST') to undertake the required EIA processes for the proposed construction of five (5) wind farms and associated infrastructure [including substations and Battery Energy Storage Systems (BESS)] on a number of properties, the majority being adjacent to each other, near the town of Fraserburg in the Northern Cape Province of South Africa. The proposed wind farms make up a larger Wind Energy Facility (WEF) (with associated BESS) which will be referred to as the Klipkraal WEF. It should be noted that the proposed wind farm projects form part of separate EIA applications.

The overall objective of the proposed wind farm projects is to generate electricity by means of renewable energy technologies, capturing wind energy to feed into the national grid, which will be procured under either the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), other government-run procurement programmes, any other program it intends to supply power to, or for sale to private entities, if required. To further ensure efficient power delivery, the facility will also incorporate the use of storage technologies like batteries (i.e., BESS).

In terms of the EIA Regulations, various aspects of the proposed development may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. Specialist studies have been commissioned to verify the sensitivity and assess the impacts of the wind farms under the Gazetted specialist protocols (GN R 320 and GN R 1150 of 2020).

Animalia Consultants (Pty) Ltd has been appointed by Klipkraal Wind Energy Facility 1 (Pty) Ltd to undertake a Bat Environmental Impact Assessment for the proposed construction of the Klipkraal WEF and associated grid connection (refer to **Figure 3-2**).

The scope of this report is Klipkraal Wind Energy Facility 1. This report summarises the bat impact assessment process that was undertaken for Klipkraal WEF 1. It also provides an overview of baseline conditions and constraints, as well as potential site-specific and cumulative impacts, which have informed the bat assessment. The results of the full 12 months of passive data collected on site are presented and discussed in this report.

2.1 The Bats of South Africa

Bats form part of the Order Chiroptera and are the second largest group of mammals after rodents. They are the only mammals to have developed true powered flight and have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are compact and light, thereby reducing the total body weight. This unique wing profile allows for the manipulation of wing camber and shape, exploiting functions such as agility and manoeuvrability. This adaption surpasses the static design of the bird wings in function and enables bats to utilise a wide variety of food sources, including, but not limited to, a large diversity of insects (Neuweiler 2000). Species-based facial features may differ considerably as a result of differing lifestyles, particularly in relation to varying feeding and echolocation navigation strategies. Most South African bats are insectivorous and are capable of consuming vast quantities of insects on a nightly basis (Taylor 2000, Tuttle and Hensley 2001) however, they have also been found to feed on amphibians, fruit, nectar and other invertebrates. As a result, insectivorous bats are the predominant predators of nocturnal flying insects in South Africa and contribute greatly to the suppression of these numbers. Their prey also includes agricultural pests such as moths and vectors for diseases such as mosquitoes (Rautenbach 1982, Taylor 2000).

Urban development and agricultural practices have contributed to the deterioration of bat populations on a global scale. Public participation and funding of bat conservation are often hindered by negative public perceptions and unawareness of the ecological importance of bats. Some species choose to roost in domestic residences, causing disturbance and thereby decreasing any esteem that bats may have established. Other species may occur in large communities in buildings, posing as a potential health hazard to residents in addition to their nuisance value. Unfortunately, the negative association with bats obscures their importance as an essential component of ecological systems and their value as natural pest control agents, which actually serves as an advantage to humans.

Many species of bats roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas may adversely impact individuals of different communities concurrently (Hester and Grenier 2005). Secondly, nativity rates of bats are much lower than those of most other small mammals. This is because, for the most part, only one or two pups are born per female per annum. Under natural circumstances, a population's numbers may accumulate over long periods of time. This is due to the longevity of up to 30 years (O'Shea *et al*. 2003) and the relatively low predation of bats when compared to other small mammals. However, bat populations are not able to adequately recover after mass mortalities and major roost disturbances.

2.2 Bats and Wind Turbines

Although most bats are highly capable of advanced navigation through the use of echolocation and excellent sight, they are still at risk of physical impact with the blades of wind turbines. The corpses of bats have been found in close proximity to wind turbines and, in a case study conducted by Johnson *et al*. (2003), were found to be directly related to collisions. The incident of bat fatalities for migrating species has been found to be directly related to turbine height, increasing exponentially with altitude, as this disrupts the migratory flight paths (Howe *et al*. 2002, Barclay *et al*. 2007). Although the number of fatalities of migrating species increased with turbine height, this correlation was not found for increased rotor sweep (Howe *et al*. 2002, Barclay *et al*. 2007). In the USA it was hypothesized that migrating bats may navigate without the use of echolocation, rather using vision as their main sense for long distance orientation (Johnson *et al*. 2003, Barclay *et al*. 2007). Despite the high incidence of deaths caused by direct impact with the blades, most bat mortalities have been found to be caused by barotrauma (Baerwald *et al*. 2008). This is a condition where low air pressure found around the moving blades of wind turbines causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz *et al*. 2007). Baerwald *et al*. (2008) found that 90% of bat fatalities around wind turbines involved internal haemorrhaging consistent with barotrauma.

Although bats are predominately found roosting and foraging in areas near trees, rocky outcrops, human dwellings and water; in conditions where valleys are foggy, warmer air is drawn to hilltops through thermal inversion which may result in increased concentrations of insects and consequently bats at hilltops, where wind turbines are often placed (Kunz *et al*. 2007). Some studies (Horn *et al*. 2008) suggest that bats may be attracted to the large turbine structure as roosting spaces or that swarms of insects may get trapped in low pressure air pockets around turbines, also encouraging the presence of bats. The presence of lights on wind turbines has also been identified as a possible cause for increased bat fatalities for non-cave roosting species. This is thought to be due to increased insect activity and subsequent increased foraging activity of bats (Johnson *et al*. 2003). Clearings around wind turbines, in previously forested areas, may also improve conditions for insects, thereby attracting bats to the area. The swishing sound of turbine blades has also been proposed as a possible source for disorientation in bats (Kunz *et al*. 2007). Electromagnetic fields generated by the turbine may additionally affect bats which are sensitive to magnetic fields (Kunz *et al*. 2007). It could also be hypothesized, from personal observations that the echolocation capabilities of bats are designed to locate smaller insect prey or avoid stationary objects, and may not be primarily focused on the detection of unnatural objects moving sideways across the flight path.

South African operational monitoring studies currently point to South African bats being just as vulnerable to mortality from turbines as international studies have previously indicated. The main species of concern are *Laephotis capensis*, *Tadarida aegyptiaca* and *Miniopterus natalensis,* on this site and in general. They will be discussed in depth in this report (**Section 5.5**)

Whatever the reason for bat fatalities in relation to wind turbines, it is clearly a significant ecological problem which requires attention. Most bat species only reproduce once per year, bearing one young per female, therefore their numbers are slow to recover from mass mortalities. It is very difficult to assess the true number of bat deaths in relation to wind turbines, due to carcasses being removed from sites through predation, the rate of which differs from site to site as a result of habitat type, species of predator and their numbers (Howe *et al*. 2002, Johnson *et al*. 2003). Various mitigation measures are being researched and experimented with globally. The implementation of curtailment processes, where the turbine cut-in speed is raised to a higher wind speed, has been proven to be the most effective mitigation measure currently. This relies on the principle that the prey of bats will not be found in areas of strong winds and more energy is required for the bats to fly under these conditions anyways. The impact on bats foraging in the area will be higher when uncurtailed turbine blades are left to turn slowly in low wind speeds; it is a misperception that faster turning blades present a higher mortality risk.

A cautionary tale regarding the cumulative impacts that wind energy is able to exert on bat populations is provided through the case study of the hoary bat (*Lasiurus cinereus*). This bat is a common, migratory species across much of the Americas and is currently listed as Least Concern (Gonzalez *et al*. 2016). However, it is also the most frequently encountered victim of fatality around turbine stands in North America. Using population modelling, it has been calculated that hoary bats could decline by as much as 90% over the next 50 years, assuming static population growth rates, and allowing for the current expansion of the wind energy industry in the United States and Canada (Frick *et al*. 2017). There has been an urgent call to curb hoary bat deaths on account of wind farms before the risk of extinction escalates.

It is important from both a conservation and an ecological standpoint to maintain the abundance of even our common species, especially given the scale of wind energy prospecting occurring in South Africa at present.

3 METHODOLOGY

3.1 Site Sensitivity Verification

The methodology for the Specialist Site Sensitivity Verification process identifies bat species that may be impacted by wind turbines by taking into account the following features: the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water). These comparisons were done by briefly studying the geographic literature and available satellite imagery for the site and by ground truthing with site visits. Species probability of occurrence based on the above-mentioned factors was estimated for the site and the surrounding larger area, but also considers species historically confirmed on site as well as surrounding areas.

Several site visits were carried out from September 2021 to October 2022, to ground truth bat sensitivity features and habitats delineated in the bat sensitivity constraints map supplied in this report (and electronically).

3.2 Passive data collection

In September 2021, a passive bat detection system was set up on site using the Meteorological Mast (Klipkraal Met Mast M2) with microphones at 7m, 60m and 115m. Additionally, four Short Mast bat detection systems were also set up in October 2021, with microphones at 7m (referred to ShM1 – ShM4). These systems are set to gather bat activity data every night for 12 months to form part of the long-term pre-construction monitoring and inform the Environmental Authorisation process. The equipment setup is detailed below in **Table 3-1** and a photograph of one of the Short Mast systems is presented in **Figure 3-1**.

Figure 3-1. Photograph of Short Mast system 3 (ShM3)

Table 3-1. Equipment setup and site visit information.

<table>
<tr><td colspan="2" rowspan="2">Installation dates</td><td>Met Mast installation</td><td>14 September 2021</td></tr>
<tr><td>Short Mast installation</td><td>13 – 17 October 2021</td></tr>
<tr><td rowspan="3">Met Mast passive bat detection systems</td><td>Quantity on site</td><td colspan="2">1</td></tr>
<tr><td>Coordinates</td><td colspan="2">MM2: -32.091500° 21.797139°</td></tr>
<tr><td>Microphone heights</td><td colspan="2">7m, 60m & 115m</td></tr>
<tr><td rowspan="6">Short Mast passive bat detection systems</td><td>Quantity on site</td><td colspan="2">4</td></tr>
<tr><td rowspan="4">Coordinates</td><td colspan="2">ShM1: -32.114194° 21.830528°</td></tr>
<tr><td colspan="2">ShM2: -32.132475° 21.813839°</td></tr>
<tr><td colspan="2">ShM3: -32.112503° 21.765453°</td></tr>
<tr><td colspan="2">ShM4: -32.023517° 21.710589°</td></tr>
<tr><td>Microphone height</td><td colspan="2">7m</td></tr>
<tr><td colspan="2">Installation: First Visit</td><td colspan="2">The microphones were mounted such that they pointed approximately 30 degrees downward to avoid excessive water damage.
The bat detectors were installed within weatherproof containers, with a solar power setup each to enable a 12-month deployment.</td></tr>
<tr><td colspan="2">Second Visit</td><td colspan="2">29 – 31 January 2022</td></tr>
<tr><td colspan="2">Third Visit</td><td colspan="2">22 – 24 June 2022. A file naming software error on ShM1 resulted in complete data loss of this system, and hardware failure on ShM2 resulted in partial data loss. Redundancy has been incorporated into the study design to utilise an above minimum standards number of passive bat detection systems, therefore the data loss on these systems does not critically influence the ability to reach the objectives and terms of reference of the assessment.</td></tr>
<tr><td colspan="2">Fourth Visit</td><td colspan="2">14 – 17 October 2022</td></tr>
<tr><td colspan="2">Type of passive bat detector</td><td colspan="2">SM4BAT</td></tr>
</table>

Recording schedule	The bat detectors were set to operate in continuous trigger mode from dusk each evening until dawn (times were automatically adjusted in relation to latitude, longitude and season).
Trigger threshold	>16KHz, -16dB
Trigger window (time of recording after trigger ceased)	1 second
Microphone gain setting	12dB
Other methods	Terrain was investigated during the day for bat habitat observations.

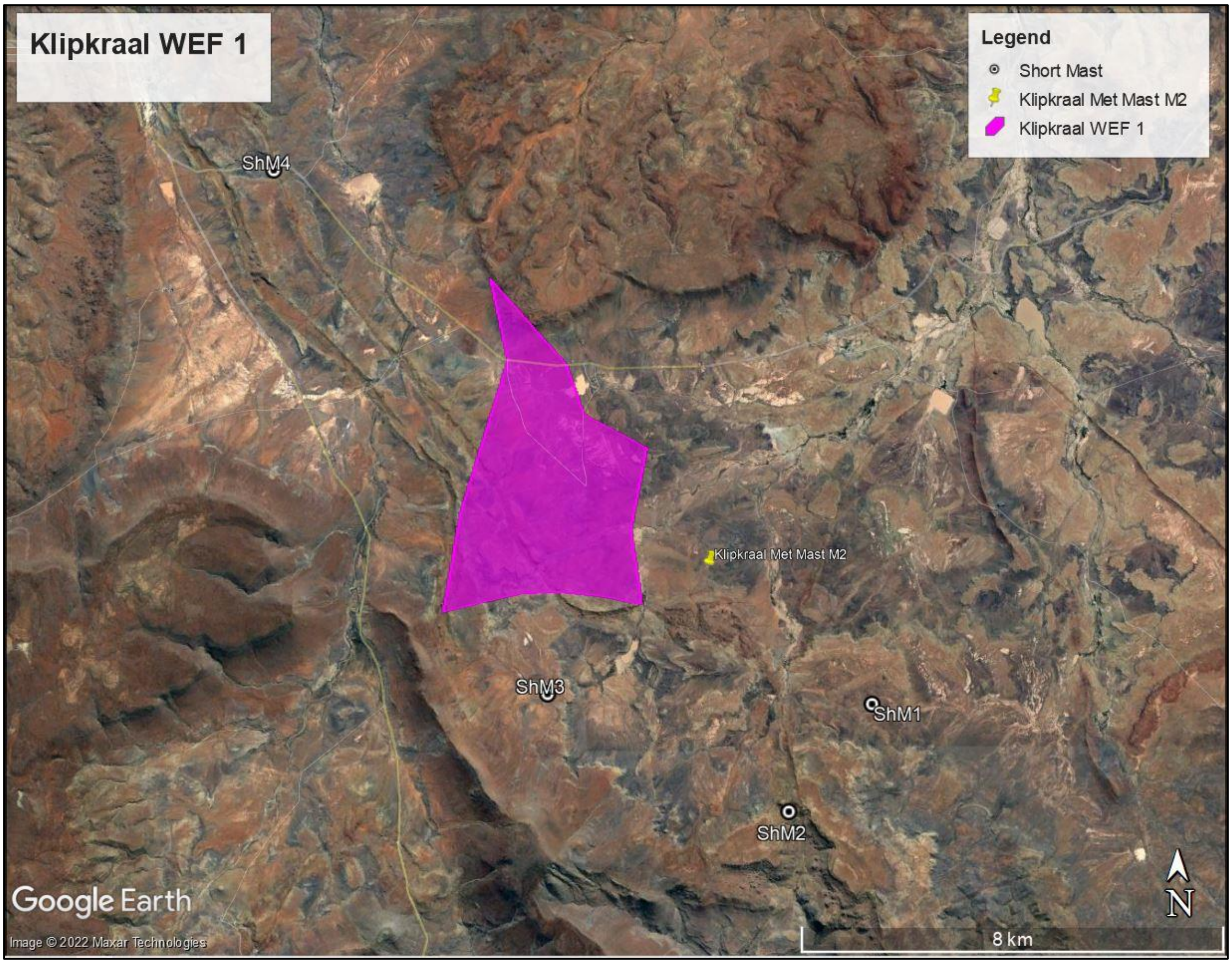


Figure 3-2. Passive bat detection systems set up on the Klipkraal WEF in relation to “Phase 1” or Klipkraal WEF 1.

It is important to note that the layout of the Klipkraal WEF was divided into separate WEFs (1 - 3) after the passive bat detection equipment was installed in 2021. Short Mast systems may thus not be precisely positioned within the current developable area of Klipkraal WEF 1, 2, or

3. Results from all Klipkraal WEF passive systems are collectively discussed in this report, since this increases the sample size and thus the robustness of the findings. Given that bats are highly mobile animals, and that biological systems are always subject to unpredictability, it is our opinion that combining the passive data strengthens the confidence in our findings and fairly informs their implications. The positions of the bat detection systems are displayed in **Figure 3-2**.

3.3 Assumptions and Limitations

As with any environmental study, there are certain assumptions and limitations that exist around the current knowledge we possess regarding bats and their behaviour, movements and distribution. Some important points are discussed briefly below:

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.
- The migratory paths of bats are largely unknown, thus limiting the ability to determine if the wind farm will have a large-scale effect on migratory species. This limitation should be partially overcome with the 12-months pre-construction sensitivity assessment, however some uncertainty in this regard will remain until the end of operational monitoring of at least 2 years. Based on the currently available information, there is nothing to date that indicates that the site is the location of a migratory path.
- The sensitivity map is based partially on satellite imagery, and from several site visits. However, given the large extent of the site there is always the possibility that what has been mapped may differ slightly to what is on the ground.
- Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification, nevertheless it is a very accurate and non-invasive indication of bat activity and presence with no harmful effects on bats being surveyed.
- Automated species identification by the Kaleidoscope software may produce a smaller portion of incorrect identifications or unknown identifications. In the last-mentioned case, the dominant frequency of the unknown call was simply used to group the bat into a family or genus group, using dominant frequency only as the determining factor.

However, the automated software is very effective at distinguishing bat calls from ultrasonic noise, therefore the number of bat passes is not significantly overestimated.

- It is not possible to determine actual individual bat numbers from acoustic bat activity data, whether gathered with transects or the passive monitoring systems. However, bat passes per night are internationally used and recognized as a comparative unit for indicating levels of bat activity in an area.
- Exact foraging distances from bat roosts or exact commuting pathways cannot be determined by the current methodology. Radio telemetry tracking of tagged bats is required to provide such information, if it is needed.
- Periods of exceptional drought or rain during the pre-construction assessment study can influence bat numbers, causing measurements of lower or higher bat activity due to less open water sources, lower insect prey numbers, or higher insect numbers and more available water.

4 PROJECT DESCRIPTION

The proposed WEF and associated grid connection infrastructure is located approximately 30km south east of Fraserburg in the Karoo Hoogland Local Municipality, in the Namakwa District Municipality.

4.1 Wind farm components

The specifications for the wind farm components for each of three wind farms, within the Klipkraal WEF (Klipkraal Wind Energy Facilities 1 – 3) are as follows:

- Approximately 50 turbines per wind farm, each between 5MW and 8MW, with a maximum export capacity of up to approximately 300MW for each wind farm. This will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) or any other program.
- Each wind turbine will have a maximum hub height of up to approximately 200m;
- Each wind turbine will have a maximum rotor diameter of up to approximately 200m;
- Permanent compacted hardstanding areas / platforms (also known as crane pads) of approximately 100m x 100m (total footprint of approx. 410 000m2) per wind turbine during construction and for on-going maintenance purposes for the lifetime of the proposed wind farm projects. This will however depend on the physical size of the wind turbine;
- Each wind turbine will consist of a foundation (i.e., foundation rings) which may vary in depth, from approximately 3m and up to 10m or greater, depending on the physical size of each wind turbine. It should be noted that the foundation can be up to as much as approximately 700m^3.

5 RESULTS AND DISCUSSION

5.1 Land Use, Vegetation, Climate and Topography

The predominant land use of the wind farm site and surrounding properties is low-density livestock farming (grazing).

According to Mucina and Rutherford (2012), the Klipkraal WEF 1 is situated entirely within the Eastern Upper Karoo and Western Upper Karoo vegetation units of the Nama Karoo Biome (**Figure 5-1**). Other surrounding vegetation units include Roggeveld Shale Renosterveld (bordering to the south-west of site), Upper Karoo Hardeveld and a small portion of Bushmanland Vloere to the east.

5.1.1 Eastern Upper Karoo

The Eastern Upper Karoo vegetation unit on Klipkraal WEF 1 is mostly flats and gently sloping plains with occasional washes. Dolerite rock tors (abrupt small koppies) and dolerite cliffs edges are located within the site, providing possible roosting space for crevice dwelling bats, as well as feeding spots sheltered from wind.

The Eastern Upper Karoo vegetation is mostly comprised of dwarf shrubs with some white grasses, last mentioned occurring to a lesser extent. Geology of the Eastern Upper Karoo is predominantly mudstone and sandstone. Rainfall is mostly in autumn and summer, peaking in March, with annual averages of 180mm – 200mm. Snowfall can occur in winter months and mean minimum and maximum temperature ranges from -8°C to 37°C respectively.

5.1.2 Western Upper Karoo

The Western Upper Karoo vegetation unit is a shrub-rich one, with drought-resistant grasses dominating, with *Eragrostis lehmanniana* a biogeographically important graminoid species. This relatively untransformed vegetation unit is considered to be Least Threatened.

Shales, mudstones and arenites of the Beaufort and Ecca Groups make up the underlying sedimentary rock, with intrusive dolerites featuring as well.

The majority of the relatively small amount of rainfall (MAP 120 – 220mm) received by the environment occurs in March (autumn). Mean maximum (January) and minimum (July) monthly temperatures are 36.2°C and -5.7°C respectively.

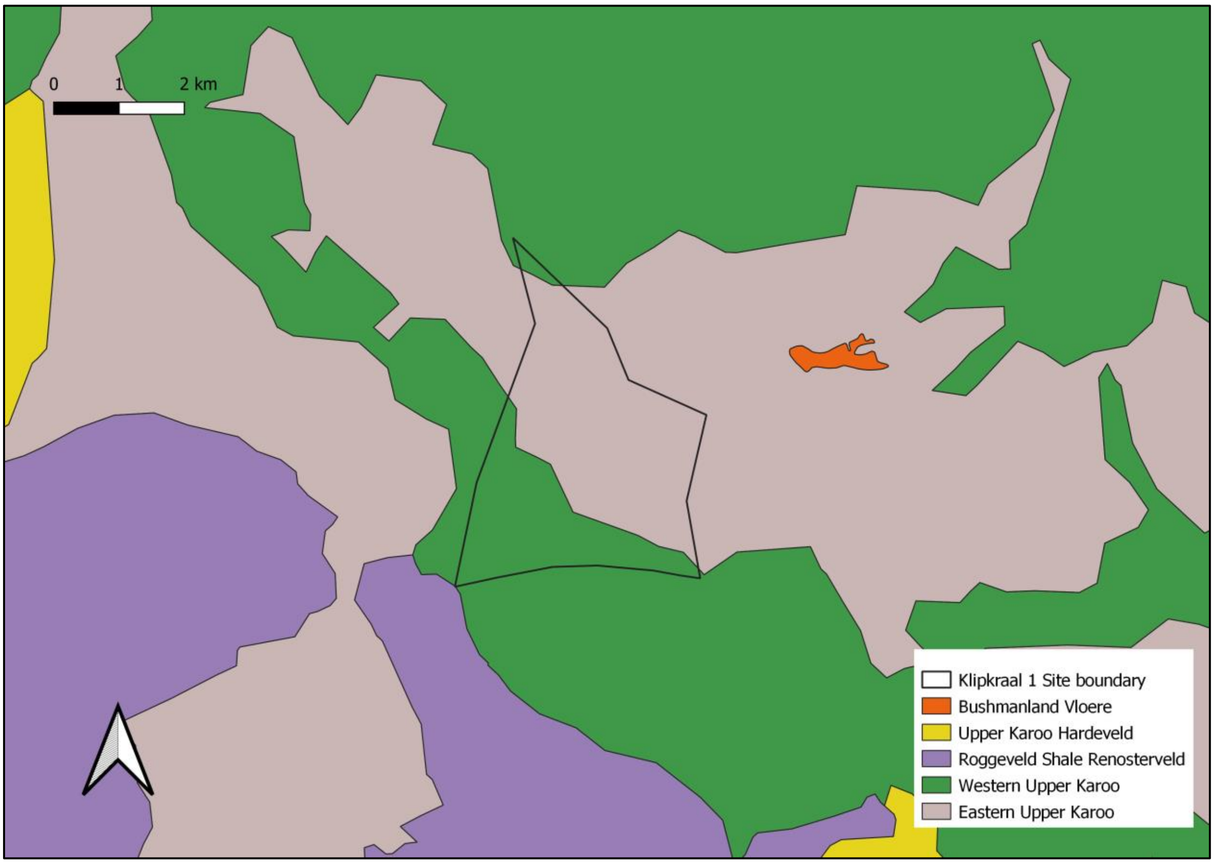


Figure 5-1. The vegetation units found on the Klipkraal WEF 1 site (Mucina and Rutherford 2012).

Vegetation units and geology are of great importance as these may serve as suitable sites for the roosting of bats and support their foraging habits (Monadjem *et al.* 2010). Houses and buildings may also serve as suitable roosting spaces (Taylor 2000; Monadjem *et al.* 2010). The importance of the vegetation units and associated geomorphology serving as potential roosting and foraging sites are described in **Table 5-1.** .

Table 5-1. Potential of the vegetation units to serve as suitable roosting and foraging spaces for bats.

Vegetation Unit	Foraging Potential	Roosting Potential	Comments
Eastern Upper Karoo	Moderate – High (seasonal)	Low	Foraging potential can be high in drainage areas and seasonally in washes.
Western Upper Karoo	Moderate (seasonal)	Moderate – High	Some exposed rocky cliffs and tors (abrupt piles of rocky boulders) are present, that can offer some roosting space. These landscape features can also offer wind shelter for insects, which in turn provide foraging opportunities for bats. Foraging potential can be high in drainage areas and seasonally in washes.

5.2 Protected areas, known sensitivities and caves/roosts within 100km of the site

The Karoo National Park and Steenbokkie and Henry Kruger Private Nature Reserves are the closest protected areas to the site, with Karoo National Park approximately 25km to the south-east (**Figure 5-2**). None of the nature reserves are well known hotspots for bat activity or bat roosts that may influence the site, although the presence of natural vegetation may promote bat diversity and activity levels. The Gouritz Cluster Biosphere Reserve is the nearest conserved area, but at almost 100km from site, it does not have bearing on the current study and is not discussed further.

The Strategic Environmental Assessment (DFFE 2019) assigns 50km buffers to large bat roosts for wind energy and 5km for solar PV energy, therefore any possible cave/roost locations may be assigned a buffer up to 50km if they are found to be supporting large enough bat colonies. There are currently no known caves supporting bat roosts on site, however, due to the difficulty in pinpointing these features, it is still possible that such colonies may still be found.

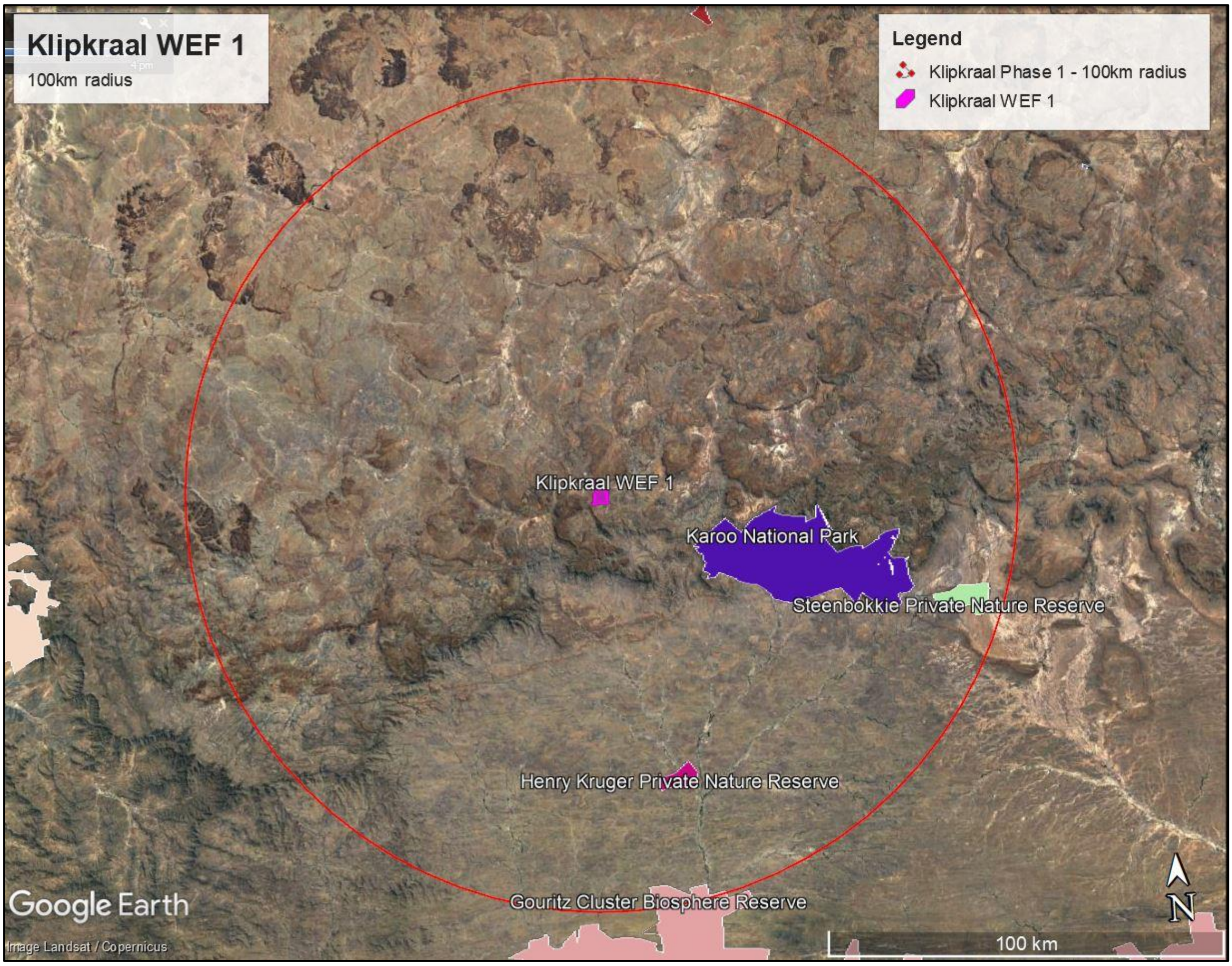


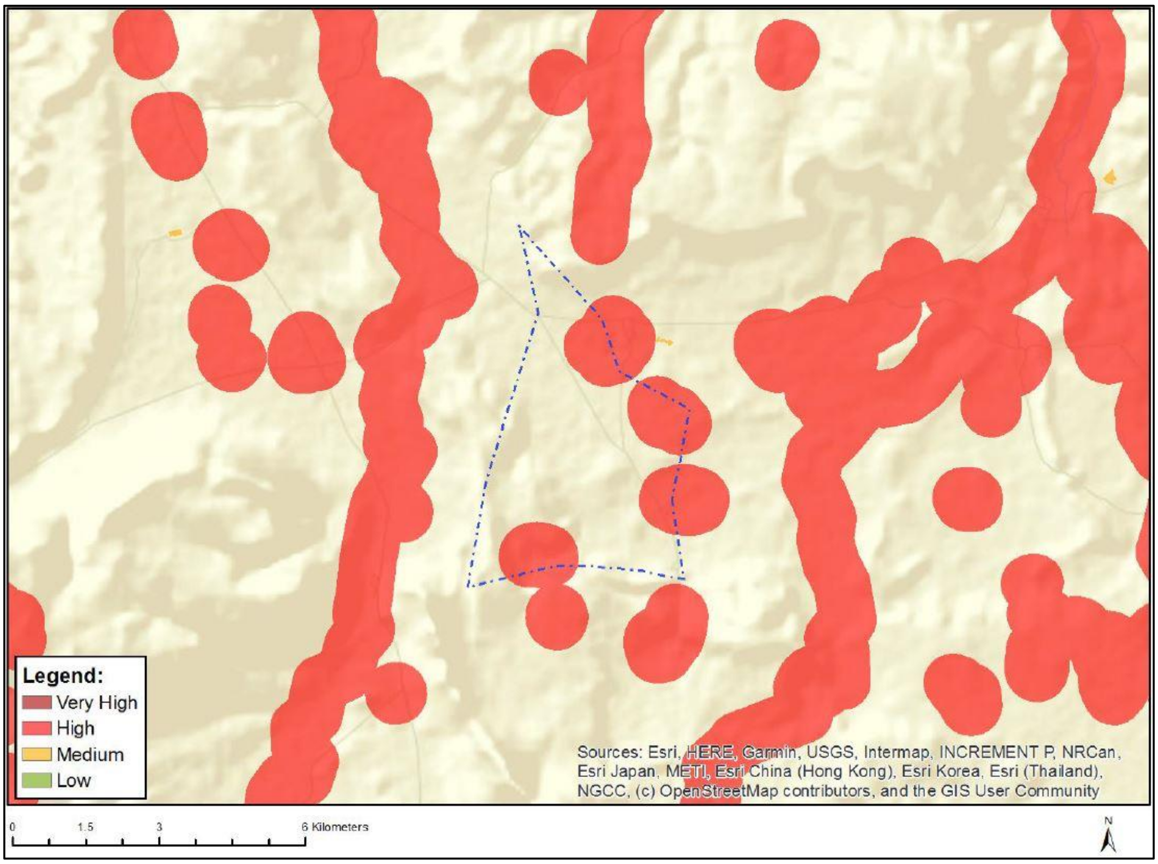
Figure 5-2. Conserved and Protected areas within a radius of 100km (red line) around Klipkraal WEF 1 (DFFE, Q1 2022).

5.3 National Screening Tool

The requirements for Specialist Studies being undertaken in support of applications for Environmental Authorisation are specified in Appendix 6 of the 2014 NEMA EIA Regulations (as amended), as well as the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. These protocols stipulate the 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 NEMA, when applying for EA.

We examined the Screening Tool output (dated 21 July 2022) and found the following:

- The Bat Theme is classed as High sensitivity (**Figure 5-3**) due to the presence of wetlands within the site boundary, as well as 500m wetland buffers.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Figure 5-3. Possible bat sensitivity features according to the National Environmental Screening Tool, as downloaded from: https://screening.environment.gov.za/screeningtool/index.html#/app/screen_tool/Wind on 21 July 2022

In **Figure 5-3**, the red areas indicate high bat sensitivity hydrology features due to placement on or within 500m of a wetland. The remaining areas are not assigned any sensitivity ranking by the Screening Tool. The sensitivities of the National Screening Tool have been considered, however the sensitivity map produced with this scoping study includes additional sensitivities. The deviations are based on detailed site visits and assessments.

Outcome and Conclusion of the Site Sensitivity Verification:

The bat sensitivity map produced by the Specialist, based on the methodology described above, share similarities to the Screening Tool sensitives with regards to the identification of several water courses and open water sources as high sensitivity areas. However, additional watercourses, rocky cliffs and koppies have been identified as high sensitivities by the Specialist.

The sensitivities identified in the Specialist assessment have been verified against the National Environmental Screening Tool.

5.4 Currently Confirmed and Previously Recorded Species, as well as Likelihood of Risk of Fatality

The column of “Likely risk of impact” describes the likelihood of risk of fatality from direct collision or barotrauma with wind turbine blades for each bat species. The risk was assigned by MacEwan *et al.* (2020) based on species distributions, altitudes at which they fly and distances they traverse; and assumes a 100% probability of occurrence.

Table 5-2. Table of species that are currently confirmed on site, and/or have been previously recorded in the area and their likelihood of risk of fatality. Roosting or foraging in the study area, the possible site-specific roosts, and their probability of occurrence based on literature as well as recordings and observations in the surrounding area, is also briefly described (Monadjem *et al.* 2020).

Species	**Common name**	**Occurrence in area**	**Conservation status (2016 Regional Listing)**	**Possible roosting habitat on site**	**Possible foraging habitat utilised on site**	**Likelihood of risk of fatality (MacEwan *et al.* 2020)**
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed on site	Least Concern	Roosts in rock crevices, hollows in trees, and behind the bark of dead trees. Exposed rocky cliffs and tors. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of natural and urbanised habitats.	High
Laephotis capensis	Cape serotine	Confirmed on site	Least Concern	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. But is predominantly a medium height clutter edge forager.	Medium – High
Miniopterus natalensis	Natal long-fingered bat	Confirmed on site	Near Threatened (2004 National Listing)	Cave and hollow dependent, no known caves nearby. Will also roost in small groups or individually in culverts and other hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium – High
Sauromys petrophilus	Roberts's flat-headed bat	Confirmed on site	Least Concern	It is a crevice dweller roosting in rock crevices, as well as other crevices in buildings. Exposed rocky cliffs and tors.	Open air forager.	High

Species	**Common name**	**Occurrence in area**	**Conservation status (2016 Regional Listing)**	**Possible roosting habitat on site**	**Possible foraging habitat utilised on site**	**Likelihood of risk of fatality (MacEwan *et al.* 2020)**
Eptesicus hottentotus	Long-tailed serotine	Confirmed on site	Least Concern	It is a crevice dweller roosting in rock crevices, as well as other crevices in buildings. Exposed rocky cliffs and tors.	It generally seems to prefer foraging on the clutter edge of vegetation, such as the vegetated drainage areas and also over open water sources such as farm dams.	Medium
Rhinolophus clivosus	Geoffroy's horseshoe bat	Confirmed on site	Near Threatened (2004 National Listing)	Roosts in caves and mine adits, no known caves in the area. May utilise man-made hollows, Aardvark burrows or hollows formed by rocky boulder tors.	It is associated with a variety of habitats including thickets that may be found in the vegetated drainage areas.	Low
Nycteris thebaica	Egyptian slit-faced bat	Possible in area	Least Concern	Roosts in rocky hollows, aardvark burrows, culverts under roads and the trunks of dead trees.	It appears to occur throughout the savannah and karoo biomes, but avoids open grasslands. May occur in the thickets that may be found in the vegetated drainage areas.	Low
Myotis tricolor	Temmink's myotis	Confirmed on site	Near Threatened (2004 National Listing)	Usually roosts gregariously in caves, and sometimes culverts or other hollows. No known caves or mine adits close to site.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium – High
Cistugo lesueuri	Lesueur's wing-gland bat	Confirmed within 100km of site	Near Threatened (2004 National Listing)	It is a crevice dweller roosting in rock crevices. Exposed rocky cliffs and tors.	Areas with available drinking water. Clutter edge forager. May forage in more open terrain during suitable weather.	Medium (refer to **Section 5.5.4**)

Species	Common name	Occurrence in area	Conservation status (2016 Regional Listing)	Possible roosting habitat on site	Possible foraging habitat utilised on site	Likelihood of risk of fatality (MacEwan *et al.* 2020)
Eidolon helvum	**African straw-coloured fruit bat**	Confirmed within 100km of site	Least Concern (2016 Regional Listing) (Globally Near threatened)	Non-breeding migrant with sparse scattered records.	Feeds on fruit, nectar, pollen and flowers, if and where available on site.	High

5.5 Ecology of bat species that may be impacted the most by the Wind Farm

There are several bat species in the vicinity of the site that occur commonly in the area. Some of these species are of special importance based on their likelihood of being impacted by the proposed wind farm, due to high abundances and certain behavioural traits. They have also been dominating records of fatalities at operational wind farms in South Africa. The relevant species are discussed below.

5.5.1 Tadarida aegyptiaca

The Egyptian Free-tailed Bat, *Tadarida aegyptiaca*, is a Least Concern species (IUCN Red List 2016) as it has a wide distribution and high abundance throughout South Africa and is part of the Free-tailed bat family (Molossidae). It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem *et al*. 2020). This species is protected by national legislation in South Africa (ACR 2018).

They roost communally in small (dozens) to medium-sized (hundreds) groups in rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem *et al*. 2020). Thus, the rocky boulder crevices and man-made structures on the site would be important roosts for this species.

Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem *et al*. 2020).

After a gestation of four months, a single young is born usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August. Maternity colonies are apparently established by females in November.

The Egyptian Free-tailed bat is considered to have a High likelihood of risk of fatality due to wind turbines (MacEwan *et al.* 2020) and are displaying moderate to high numbers of mortalities at operating wind farms in South Africa. Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species.

5.5.2 Laephotis capensis

Laephotis capensis (Cape serotine bat, formerly *Neoromicia capensis*) has a conservation status of Least Concern (IUCN Red List 2016) as it is found in high numbers and is widespread over much of Sub-Saharan Africa.

High mortality rates of this species due to wind turbines would be a cause for concern as L*. capensis* is abundant and widespread and as such has a more significant role to play within the local ecosystem than the rarer bat species. They do not undertake migrations and thus are considered residents of the site.

It roosts individually or in small groups of two to three bats in a variety of shelters, such as under the bark of trees, and inside the roofs of houses. They will use most man-made structures as day roosts which can be found on the site and surrounding areas (Monadjem *et al*. 2020).

Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occurs. They give birth to twins during late October and November, but single pups, triplets and quadruplets have also been recorded (van der Merwe 1994 and Lynch 1989).

They are tolerant of a wide range of environmental conditions as they survive and prosper within arid semi-desert areas to montane grasslands, forests, and savannas; indicating that they may occupy several habitat types across the site and are amenable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter mostly, but can occasionally forage in open spaces. They are thought to have a Medium likelihood of risk of fatality due to wind turbines (MacEwan *et al.* 2020) and are displaying moderate to high numbers of mortalities at operating wind farms in South Africa.

5.5.3 Miniopterus natalensis

Miniopterus natalensis (Natal long-fingered bat), occurs widely across the country but mostly within the southern and eastern regions and is listed as Near Threatened (Monadjem *et al*. 2020). This bat is a cave-dependent species and identification of suitable roosting sites may be more important in determining its presence in an area than the presence of surrounding vegetation. It occurs in large numbers when roosting in caves with approximately 260 000 bats observed making seasonal use of the De Hoop Guano Cave in the Western Cape, South Africa. Culverts and mines have also been observed as roosting sites for either single bats or small colonies in South Africa. Separate roosting sites are used for winter hibernation activities and summer maternity behaviour, with the winter hibernacula generally occurring at higher altitudes in more temperate areas and the summer hibernacula occurring at lower altitudes in warmer areas of the country (Monadjem *et al*. 2020).

Mating and fertilisation usually occur during March and April and is followed by a period of delayed implantation until July/August. Birth of a single pup usually occurs between October and December as the females congregate at maternity roosts (Monadjem et al. 2020 & Van Der Merwe 1979).

The Natal long-fingered bat undertakes short migratory journeys between hibernaculum and maternity roosts. Due to this migratory behaviour, they are considered to be at high risk of fatality from wind turbines if a wind farm is placed within a migratory path (MacEwan *et al*. 2020). The mass movement of bats during migratory periods could result in mass casualties if wind turbines are positioned over a mass migratory route and such turbines are not effectively mitigated. Very little is known about the migratory behaviour and paths of *M. natalensis* in South Africa with migration distances exceeding 150 kilometres. If the site is located within a migratory path the bat detection systems should detect high numbers and activity of the Natal long-fingered bat, this will be examined over the course of the 12-month monitoring survey. However, it should be noted that no migration routes are known to occur on site or in the surrounding area. Also, no known caves are present in the area of the site and the geology is not prone to cave formation. However, from personal observations it has been noted that they can occur individually or in small groups in rock hollows or man-made structures such as culverts.

MacEwan *et al*. (2020) advise that *M. natalensis* faces a Medium to High risk of fatality due to wind turbines. This evaluation was based on broad ecological features and excluded migratory information. The species is displaying low to moderate numbers of mortalities at operating wind farms in South Africa.

5.5.4 Cistugo lesueuri

Cistugo lesueuri (Lesueur's Wing-gland bat) and has a conservation status of Least Concern (IUCN Red List 2016) and Near Threatened in the 2004 IUCN Red List, it has a limited distribution and is endemic to South Africa and Lesotho with only a few museum records. It appears to be associated with high altitude montane grasslands where open drinking water and rock crevices are present (Monadjem *et al.* 2020). A specimen has been collected in 1979 just outside the town of Beaufort West, indicating that the habitat of the larger area can be suitable for this species.

It has relatively short and broad wings with an intermediate wing loading and low aspect ratio, indicating it's a clutter edge forager. It may arguably therefore be placed in the same risk category as *Laephotis capensis* at Medium likelihood of risk of fatality due to wind turbines.

5.6 Passive bat detection data

Passive bat data have been collected for the EIA Bat Monitoring Report at the Klipkraal WEF. Data collection commenced in September 2021 and concluded in October 2022, representing one year of passive bat activity monitoring. **Figure 5-4** to **Figure 5-11** graphically display the collected data, pertaining to the total bat passes recorded at each of the Met Masts (10m, 60m and 115m) and the Short Mast systems (7m), as well as the average hourly bat passes per system. The temporal distribution of bat activity is displayed, per night, in **Figure 5-12** to **Figure 5-15**.

Bat activity was divided into categories (**Table 5-3**) according to the risk of being impacted on by wind turbines, as well as other important ecological significance (as is the case with cave bats).

Table 5-3. The categories used for grouping and presenting bat activity in the passive bat activity graphs. "Risk" represents the likelihood of fatality to turbine collision.

Graph category and abbreviation	Motivation of graph category	Species detected in graph category
High risk (H)	• Open-air foragers • High flying in rotor swept zone	*Tadarida aegyptiaca* *Sauromys petrophilus*
High – Medium risk (HM)	• Migrant bats, can influence multiple ecologies • Cave bats, may possibly indicate presence of undiscovered bat cave roosts • Can also roost in non-cave hollows • Forages on the edges of vegetation clutter (clutter-edge foragers) • Medium height foraging, overlapping with lower rotor swept zone	*Miniopterus natalensis* *Miniopterus* spp. *Myotis tricolor*
Medium risk (M)	• Forages on the edges of vegetation clutter (clutter-edge foragers) • Medium height foraging, overlapping with lower rotor swept zone	*Laephotis capensis* *Eptesicus hottentotus* *Cistugo lesueuri** Other members of Vespertilionidae family
Low risk (L)	• Non-migrant cave and hollow dwelling bats, but may possibly indicate presence of caves, therefore presented in graphs • Forages in dense vegetation clutter (clutter foragers)	*Rhinolophus* spp.

Graph category and abbreviation	Motivation of graph category	Species detected in graph category
	- Low height foraging outside rotor swept zone	

*Echolocation call overlap with *Laephotis capensis*, presence could not be determined by echolocation data.

The seven bat species detected on site thus far are: *Eptesicus hottentotus, Tadarida aegyptiaca, Sauromys petrophilus, Laephotis capensis, Myotis tricolor*, *Rhinolophus clivosus* and *Miniopterus natalensis*. Even though the presence of *Cistugo lesueuri* could not be confirmed or disproved since the echolocation signature overlaps with the known call structure of *L. capensis*, it is included into the above table since it is endemic to South Africa and Lesotho and is represented in museum records from the larger area around site.

5.6.1 Total bat passes

The total number of bat passes from the 12 months of data retrieved shows that bat activity at the Met Mast decreased with increasing height, as shown in **Figure 5-4**. This is a well-known trend. The highest number of passes was recorded at the lowest microphone (7m) of Met Mast M2, with 23 121 passes recorded across all species, and with the lowest activity for this system (9 781 passes) recorded at the highest microphone (115m). ShM3 recorded the fewest bat passes overall, however, with a total of 7 295 at a height of 7m above ground. Bat activity was thus not consistent at the same height across the landscape (**Figure 5-4** – **Figure 5-7**), and reflects the spatial suitability of foraging resources for these animals. The landscape associated with ShM3 is relatively flat and situated further away from a drainage line compared to the more elevated topography and closer proximity to drainage lines at the remaining systems. These were associated with higher bat activity; this feeds back into our confidence in our spatial sensitivity mapping, where proximity to these features is indicative of higher activity levels.

Across all heights, and indeed across each system, the High-risk category of bats displayed the greatest number of total passes compared to the other categories, with the Medium-risk category displaying the next highest number of passes, although to a far lesser degree. Bats in the Medium-High and Low-risk profiles have not been well represented in the data thus far. It is noteworthy that overwhelmingly, the most commonly occurring bats on site are those at greatest risk of fatal collision with wind turbines. The species at risk in this High-risk category (*Tadarida aegyptiaca* and *Sauromys petrophilus*) are open air foragers which regularly fly at heights corresponding with the rotor swept zone.

Total bat passes can be used to compare activities between microphone heights, but results may be skewed by data gaps where the bat detector/microphone did not function. Some bat detectors experienced technical issues that resulted in gaps in their data collection (namely ShM1 and ShM2). However, the other bat detectors on site gathered complete data during such periods to collectively inform the impact assessment sufficiently. ShM2 malfunctioned during the transition from autumn into winter when bat activity is generally declining (see "Temporal activity").

5.6.2 Average hourly bat passes

Average hourly activity (**Figure 5-8** –

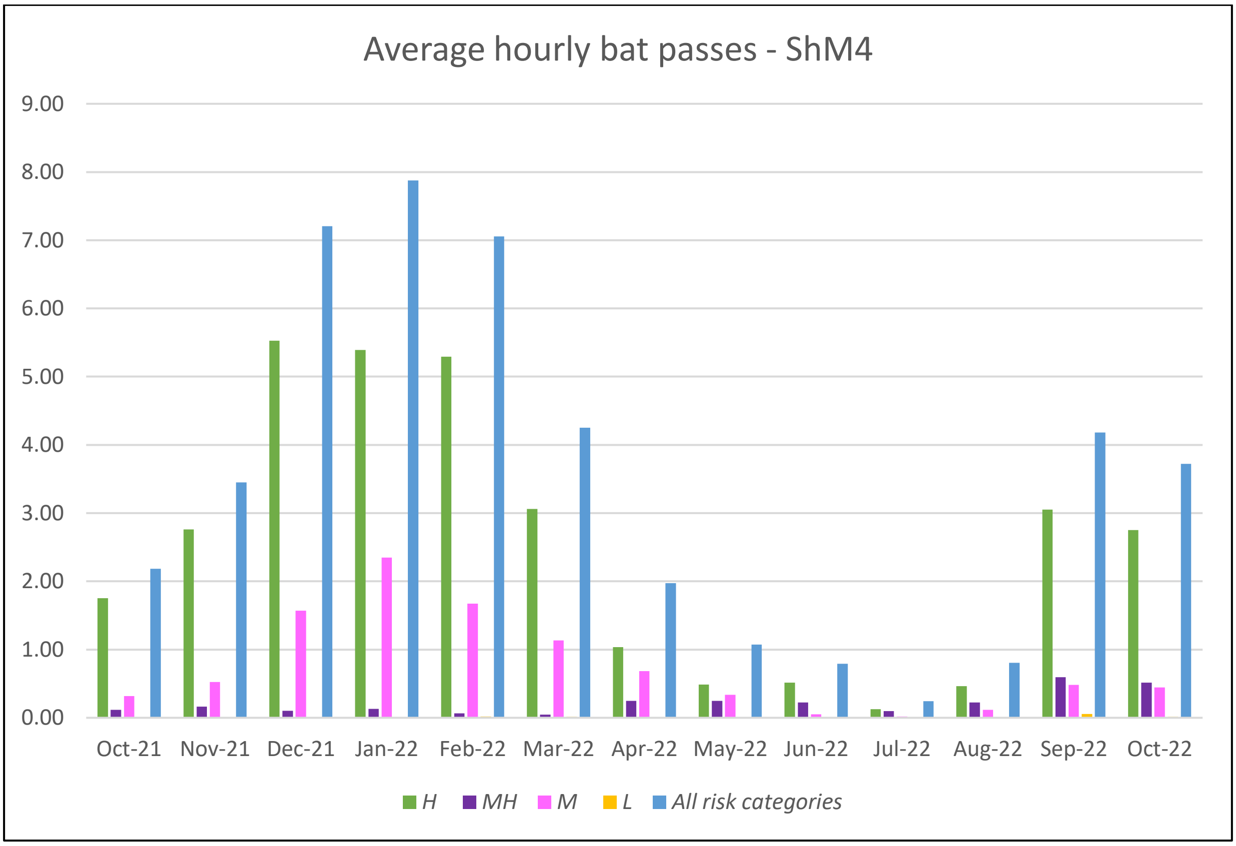


Figure 5-111) is more accurate for bat activity comparisons between different sample points than the total number of bat passes since it considers only the nights on which the systems recorded successfully, and are therefore a true indication of activity levels.

All microphones, except ShM4, detected the highest average hourly activity for all species in the month of February 2022 (ShM4 detected the greatest activity in January 2022). Average hourly activity decreased with increasing microphone height, with the 7m, 60m and 115m microphones on the Met Mast M2 detecting on average 16.6, 9.3 and 7.1 passes per hour respectively during the month of February, for example. Hourly activity of High-risk species increased gradually from September 2021 to February 2022 and then sharply decreased from March 2022 onwards. For Medium-risk species, the difference was somewhat less pronounced.

The year of bat monitoring contains two spring periods (2021 and 2022) and the average hourly activity was consistently greater in the latter spring period at every system and across all microphone heights. This was true for all risk categories, and may be due to the extended drought in the region coming to an end in 2022.

5.6.3 Temporal activity

The temporal data displays the spread of bat activity over each night and may indicate abrupt peaks in activity. The warmer months of the austral summer and early autumn seasons displayed markedly more bat activity than the cooler periods through May - August. This behaviour of higher bat activity during summer nights is to be expected when taking insect activity into consideration. The high elevation of the site lends to frequent frosts during colder nights and there is a distinct correlation between temperature, insect activity and thus bat activity. The area also received very good rainfall over the summer of 2021/2022, thus breaking the prolonged drought over the past decade.

Miniopterus natalensis and *Myotis tricolor* (the members of the ‘Medium-High’ or ‘MH’ graph category) are cave dwelling species but may also take residence in smaller numbers in culverts and other suitable man-made hollows, these species did not show any abrupt or anomalous peaks of activity that may indicate that the site is on any migration route. These species were not particularly frequently recorded on the systems, although they were present in the data from all systems.

Considering the Met Mast M2 system (**Figure 5-12**), the relationship between nightly activity and season was especially strong for the High-risk category. The Medium-risk category species showed some activity later into the autumn period (March - May 2022). The remaining categories displayed markedly lower activity over the period monitored and did not show a particularly strong seasonal pattern. Bat activity for the High-risk group peaked on the night of 7 February 2022.

Considering the Short Mast systems (**Figure 5-13** – **Figure 5-15**), activity for the Medium-risk category did not show a consistent trend across the systems, with relatively steady, low-level activity across the 12 months for the nights on which data were available at ShM2. A peak in early-mid May 2022 at ShM3 and in mid-December 2021 at ShM4 were recorded. These are particularly variable activity trends across a relatively small-scale area and demonstrate a level of unpredictability within this risk category. Across all species and heights, winter was consistently the period when the least bat activity was recorded, as expected.

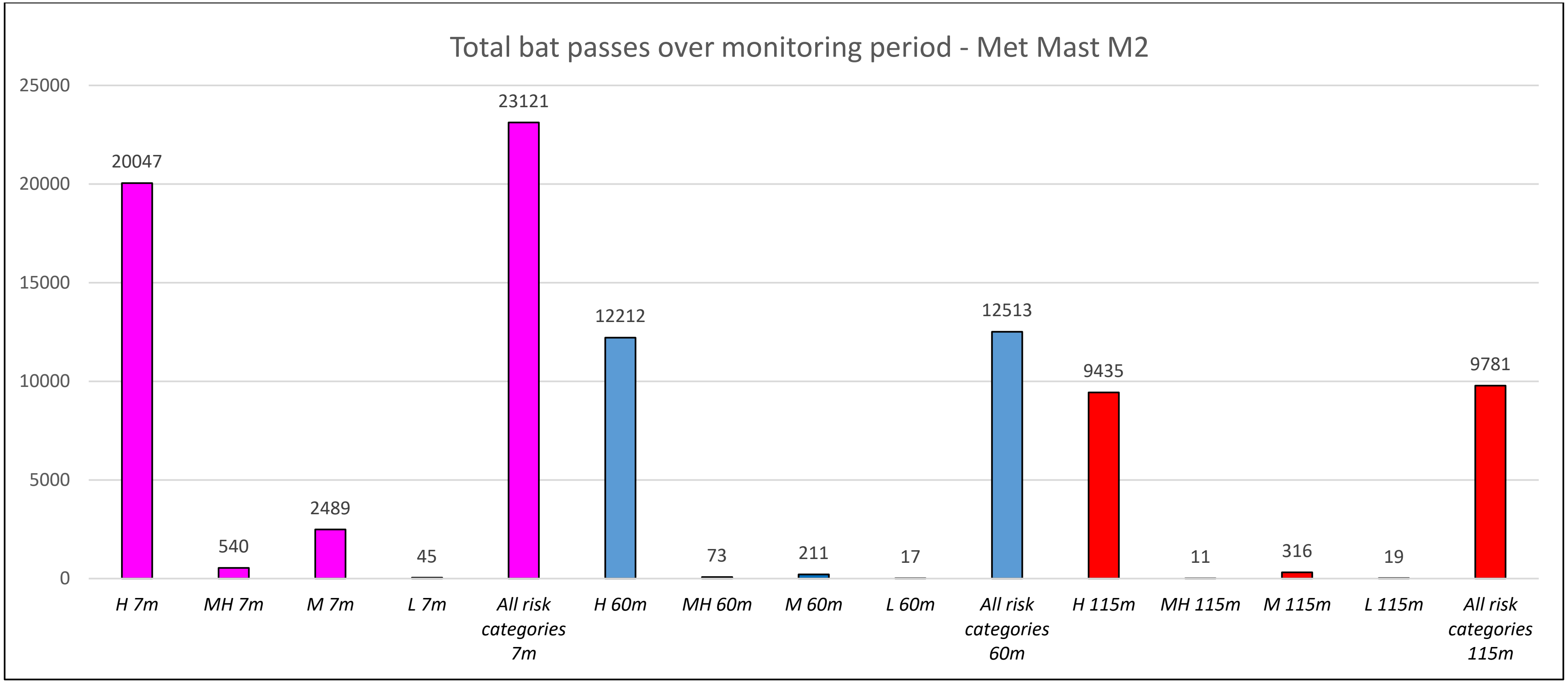


Figure 5-4. Total number of bat passes recorded over the monitoring period by Met Mast M2

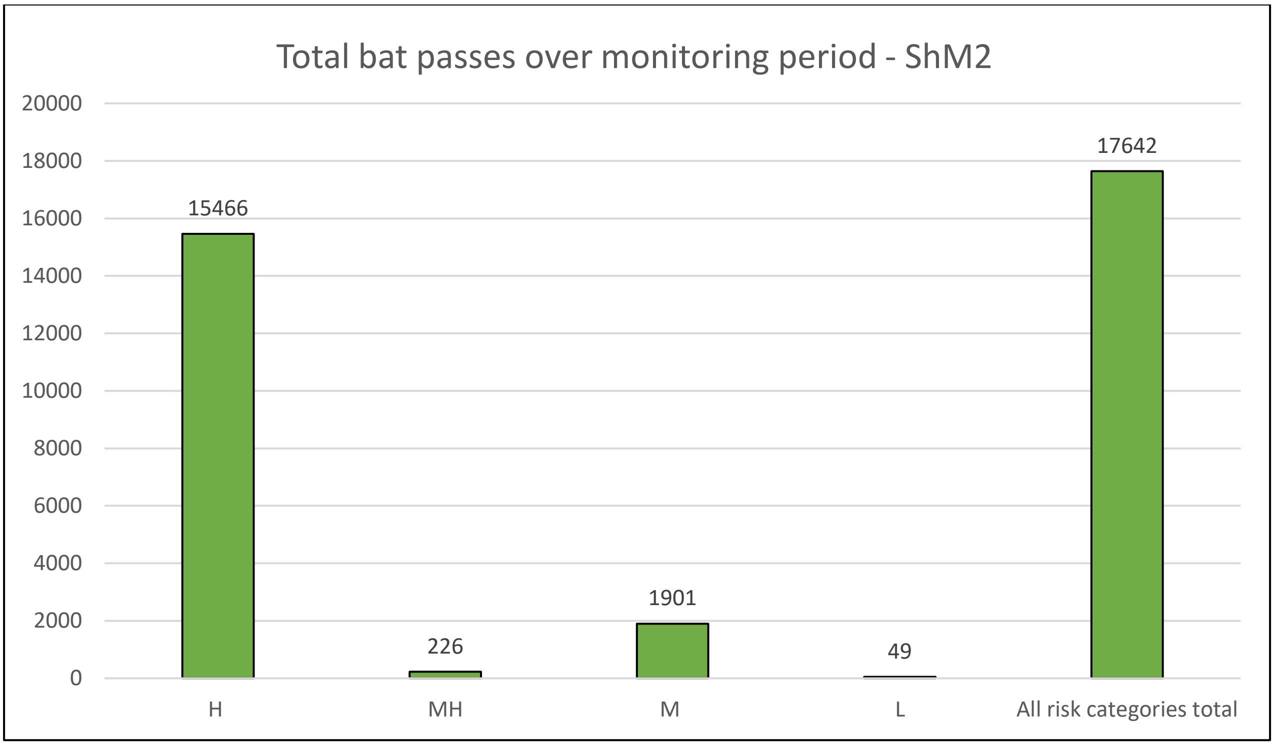


Figure 5-5. Total number of bat passes recorded over the monitoring period by ShM2

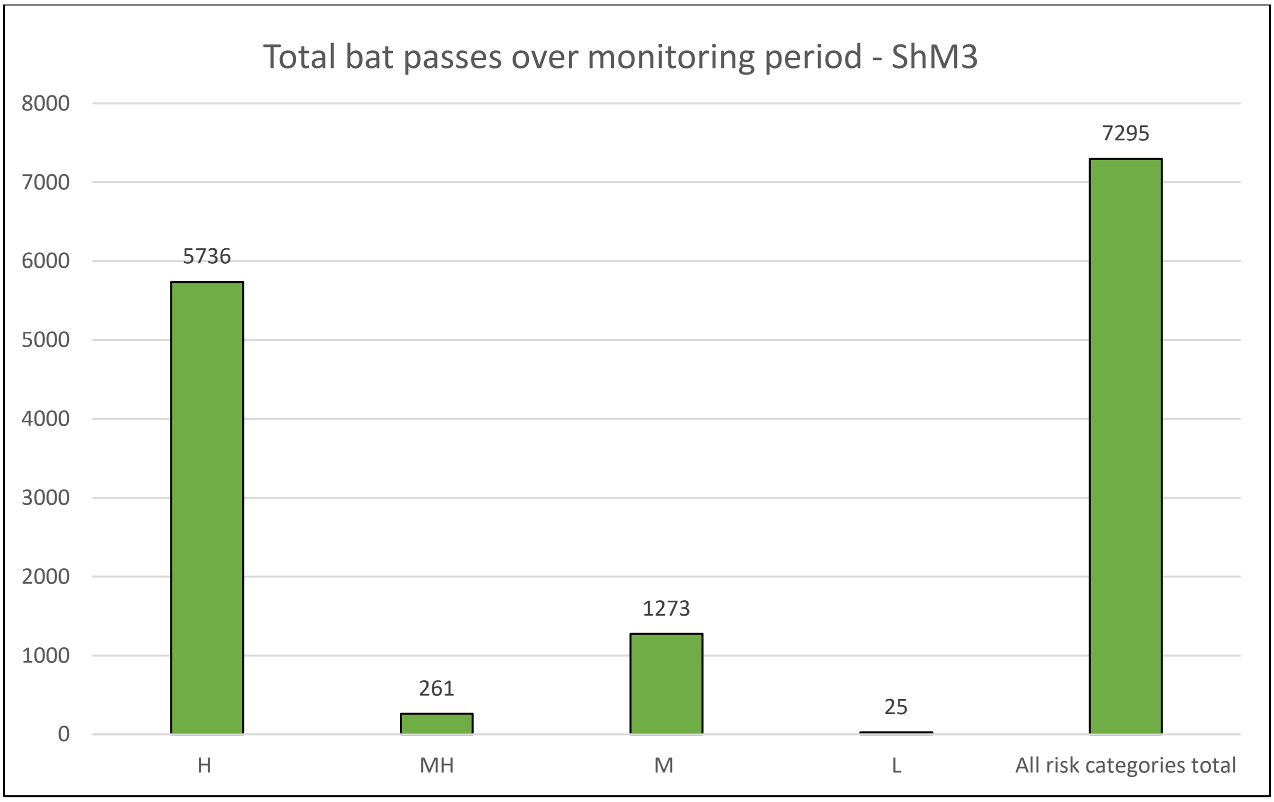


Figure 5-6. Total number of bat passes recorded over the monitoring period by ShM3

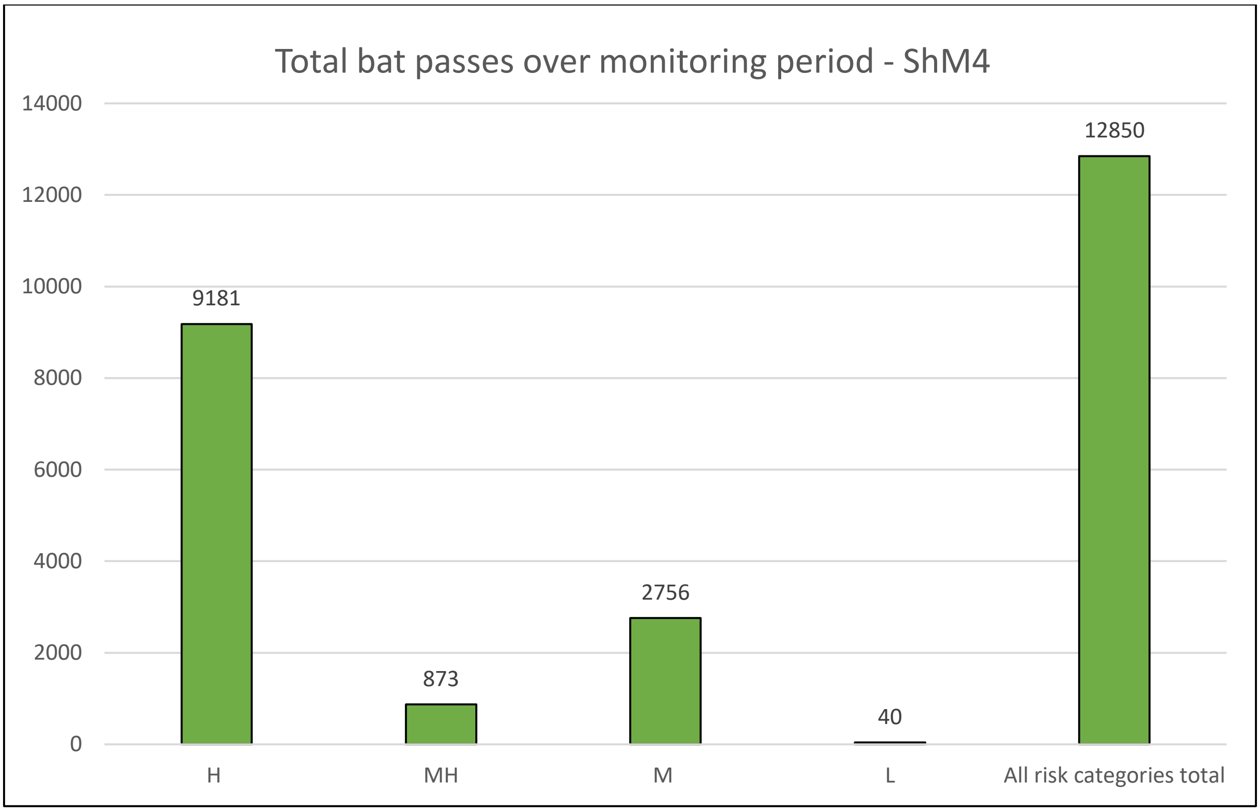


Figure 5-7. Total number of bat passes recorded over the monitoring period by ShM4

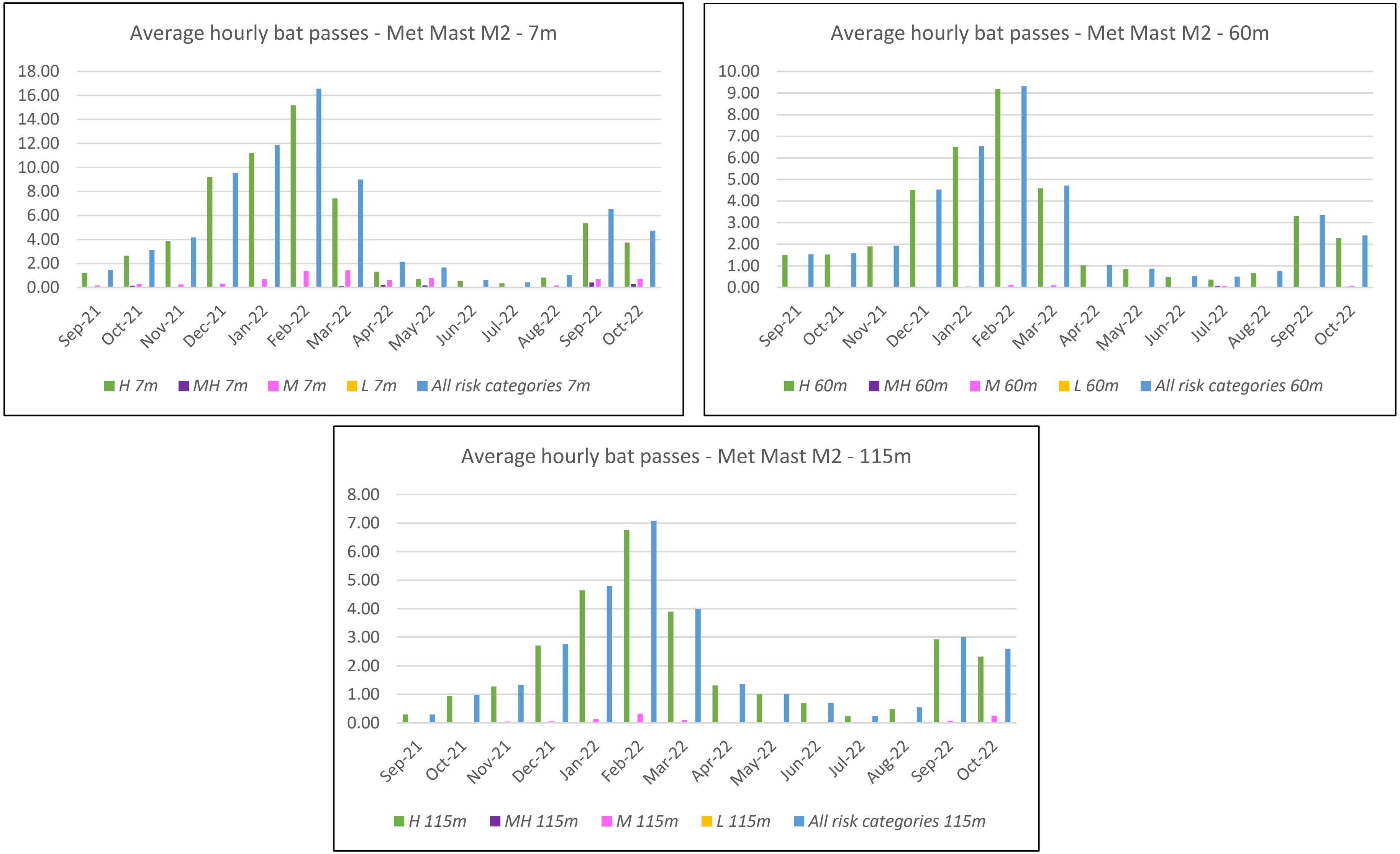


Figure 5-8. Average hourly bat passes recorded per month by Met Mast M2 – 10m, 60m and 115m

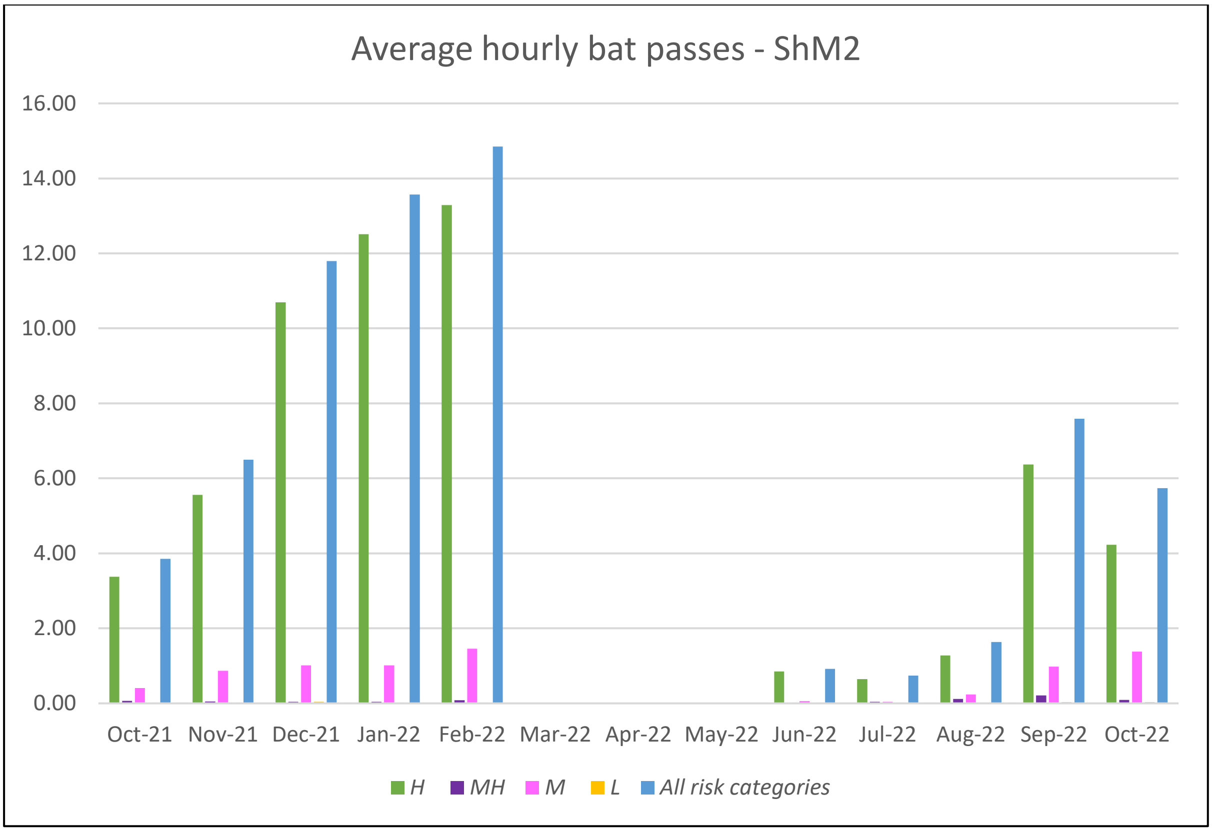


Figure 5-9. Average hourly bat passes recorded per month by ShM2 – 7m

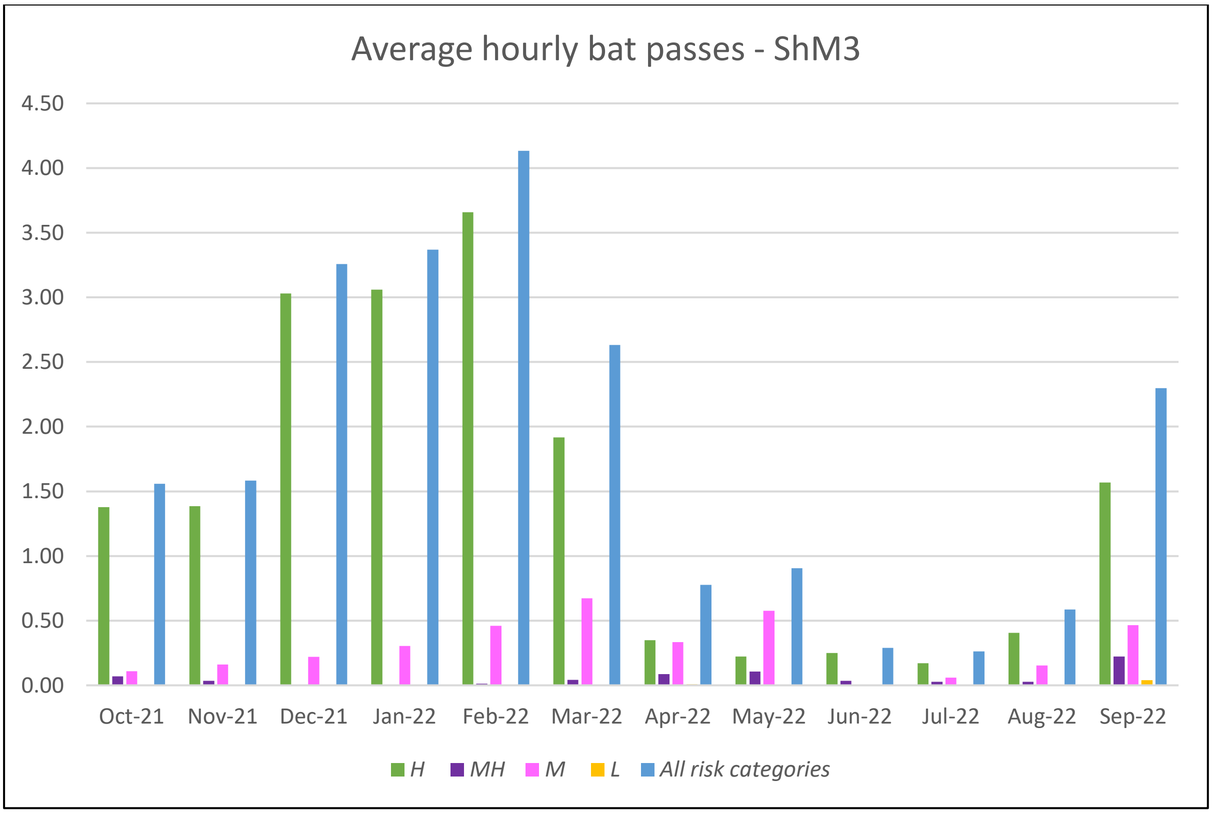


Figure 5-10. Average hourly bat passes recorded per month by ShM3 – 7m

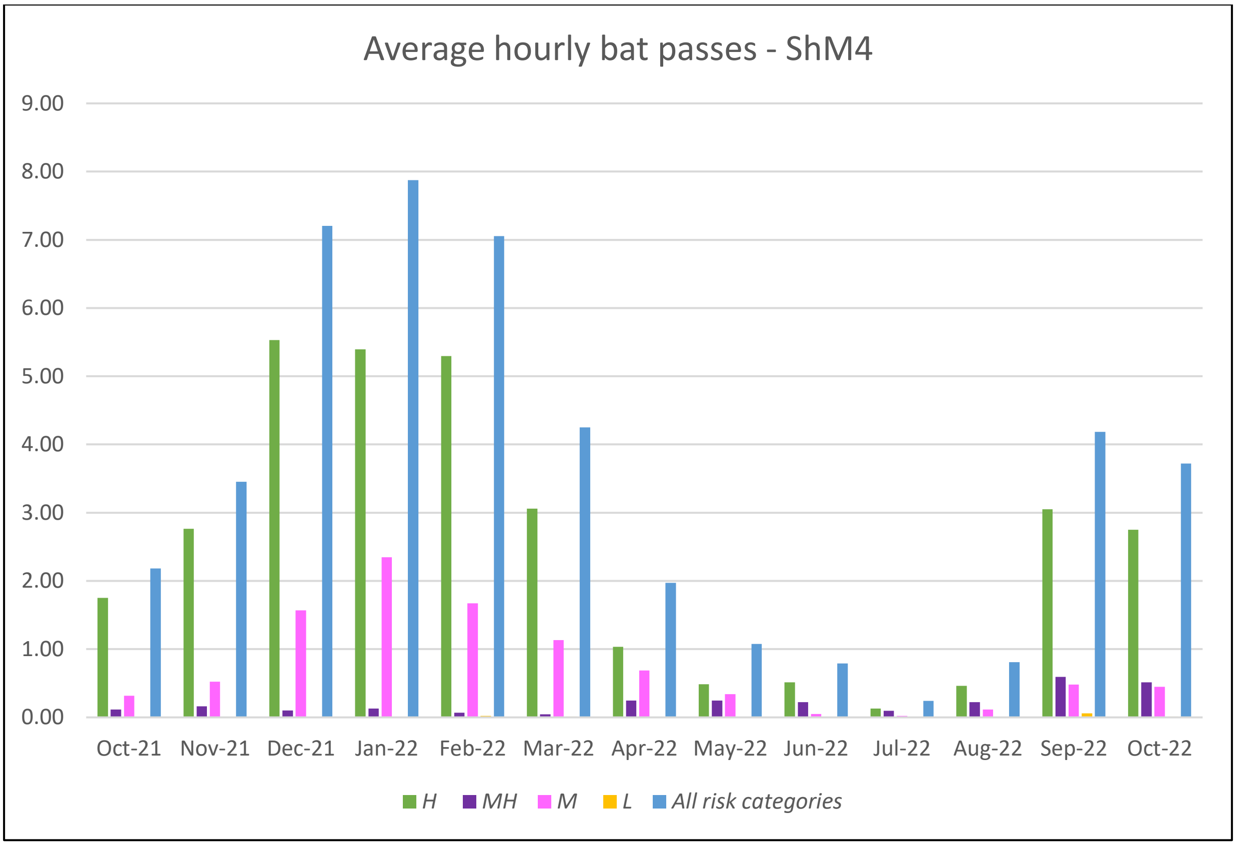


Figure 5-11. Average hourly bat passes recorded per month by ShM4 – 7m

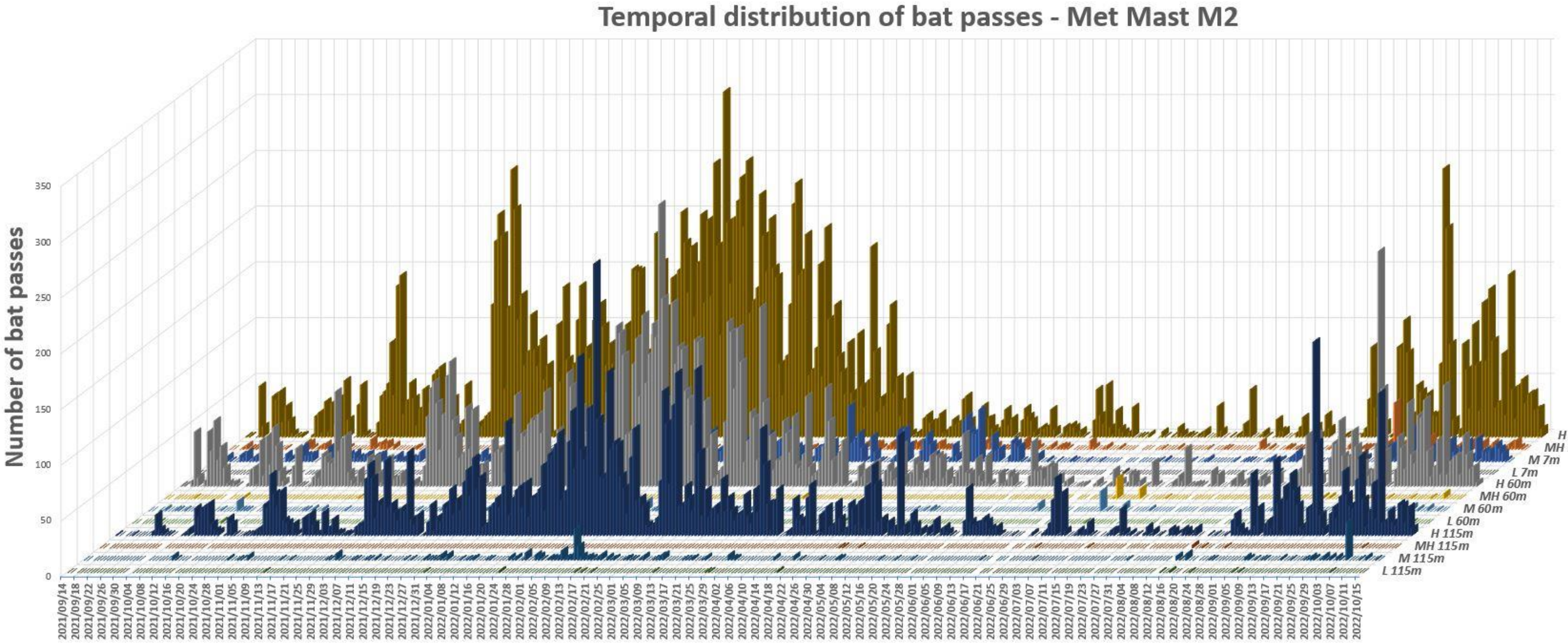


Figure 5-12. Temporal distribution of bat passes detected over the monitoring period by Met Mast M2

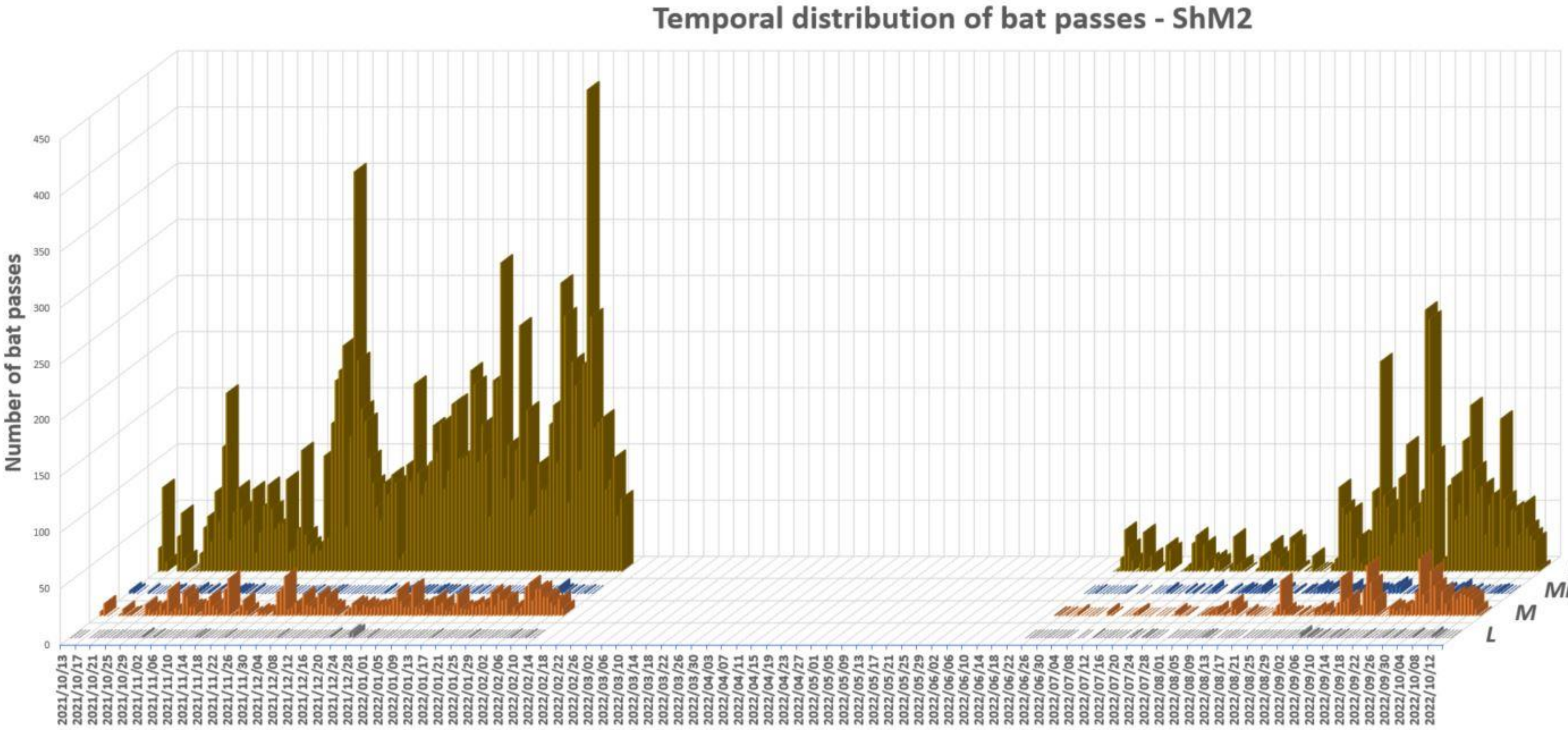


Figure 5-13. Temporal distribution of bat passes detected over the monitoring period by ShM2

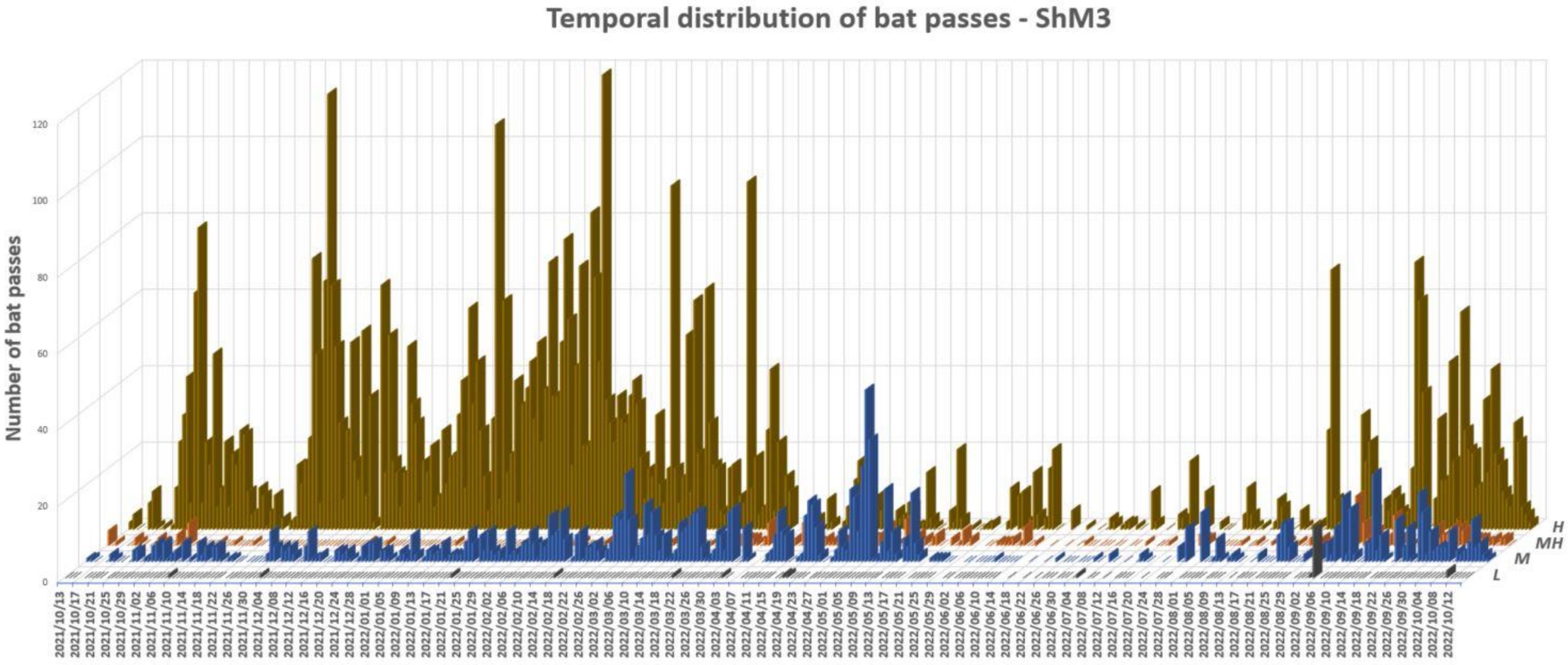


Figure 5-14. Temporal distribution of bat passes detected over the monitoring period by ShM3

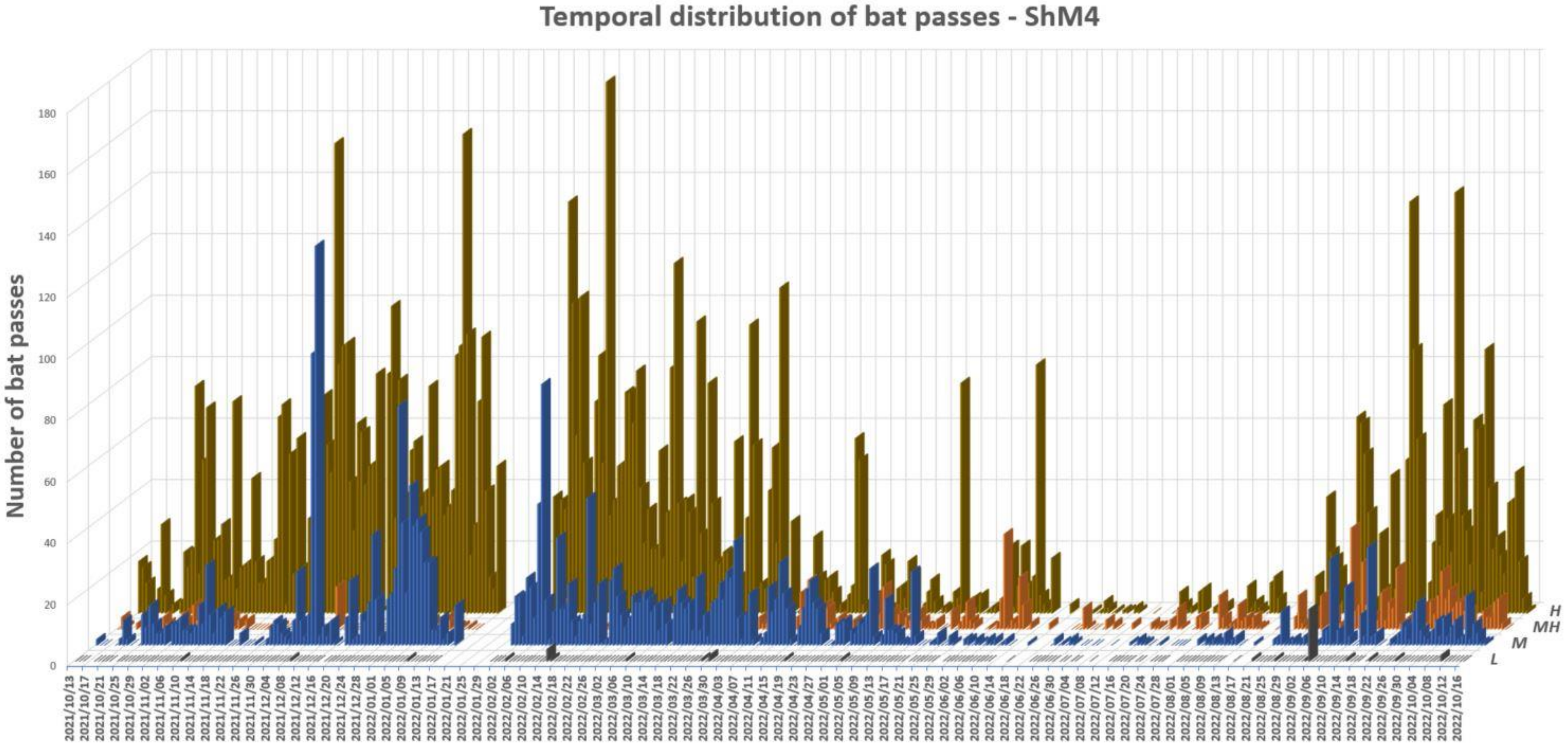


Figure 5-15. Temporal distribution of bat passes detected over the monitoring period by ShM4

5.7 Sensitivity Map

Figure 5-16 depicts the preliminary sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that most commonly occur on site. Thus, the sensitivity map is based on species ecology and habitat preferences.

Note that high sensitivity features delineated by the Specialist have been buffered by a 200m No-go area. No overhanging turbine blade may intrude into this buffer, meaning that should the final turbine model specify a rotor radius of 100m, the base of the turbine needs to be situated, at a minimum, an additional 100m from the outer edge of the High sensitivity No-go buffer. ***Turbines indicated in Table 5.5 are currently intruding into the High sensitivity buffer, and must be moved to have their blades outside of these buffers.***

Table 5-4. Description of parameters used in the construction of the sensitivity map.

Last revision	**August 2022**
High sensitivities and 200m buffers	Valley bottom wetlands
	Small wind pump farm dams
	Dams
	Rocky boulder koppies (tors)
	Exposed rocky cliff edges
	Drainage lines capable of supporting riparian vegetation
	Other water bodies and other sensitivities such as manmade structures, buildings, houses, barns and sheds
Moderate sensitivities and 150m buffers	Alluvial plains and washes
	Seasonal drainage lines
	Small and low exposed rocky cliffs and edges

Table 5-5. Klipkraal WEF Phase 1 number of turbines located within bat sensitive areas and buffers (including 100m turbine blades).

Bat sensitive area	**Turbine numbers proposed within sensitivity category (considering 100m blade length overhang)**
High bat sensitivity area (no-go areas)	None
High bat sensitivity buffer (no-go areas)	4, 8, 9, 10, 18, 26, 29, 31, 33, 36, 37, 42, 44

Bat sensitive area	Turbine numbers proposed within sensitivity category (considering 100m blade length overhang)
Moderate bat sensitivity area	11, 17
Moderate bat sensitivity buffer	1, 8, 9, 13, 15, 19, 20, 26, 32, 34, 44, 45, 50

Table 5-6. The significance of sensitivity map categories for each infrastructure component.

Sensitivity	Turbines	Roads and cables	Internal overhead transmission lines	Buildings (including substation, battery storage facility and construction camp/yards)
High Sensitivity	These areas are 'No-go' zones and turbines may not be placed in these areas. Turbine blades (blade overhang) may not intrude into these areas.	Preferably keep to a minimum within these areas where practically feasible.	Allowed inside these areas.	Avoid these areas (No-go areas).
High Sensitivity buffer	These areas are 'No-go' zones and turbines may not be placed in these areas. Turbine blades (blade overhang) may not intrude into these areas.	Allowed inside these areas.	Allowed inside these areas.	Preferably keep to a minimum within these areas where practically feasible.
Moderate Sensitivity	Turbines within these areas may require priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.
Moderate Sensitivity buffer	Turbines within these areas may require priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.

🟥 **High bat sensitivity area**

— **High bat sensitivity buffer 200m**

🟨 **Moderate bat sensitivity area**

— **Moderate bat sensitivity buffer 100m**

Figure 5-16. Bat sensitivity map of the proposed Klipkraal WEF 1, showing moderate and high sensitivity zones and their buffers.

6 IMPACT ASSESSMENT EVALUATION

Table 6-1. – Error! Reference source not found.**3** below assesses the identified potential impacts of the proposed project during construction and operational phases and propose possible mitigation measures to minimise the effects of the identified impacts. It also considers the cumulative impacts during the operational phase, which currently pertains only to the proposed Klipkraal WEF Phases 2, 3, 4, & 5. Decommissioning impacts are considered insignificant and have been scoped out of this assessment.

6.1 Construction Phase

Table 6-1. Impact Rating Table for Construction Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION*									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION*								
		E	P	R	I	D	I/M	TOTAL = E + P + R + I + D) x I/M	STATUS (+ OR -)	Significance Rating [S]		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	
Construction Phase																				
Loss of foraging habitat by clearing of vegetation.	Bat foraging habitat will be destroyed during construction, however the relative footprint is small.	1	4	2	2	3	1	12	-	Low	**Adhere to the sensitivity map criteria. Rehabilitate cleared vegetation where possible at areas such as laydown yards. The ECO on site during construction must ensure that the sensitivity map is adhered to during construction.**	1	3	2	2	3	1	11	-	Low
Roost destruction during earthworks.	Bat roosts in rock crevices may be destroyed during construction, this can cause bat mortalities	1	2	2	2	3	2	20	-	Low	**Avoid No-go areas by adhering to the sensitivity map. The ECO on site during construction must ensure that the sensitivity**	1	1	2	2	3	2	18	-	Low

	or permanent disturbances to roosts.										**map is adhered to during construction.**									

*E = Extent, P = Probability, R = Reversibility, I = Irreplaceable loss of resources, D = Duration, I/M = Intensity/Magnitude

6.2 Operational Phase

Table 6-2. Impact Rating Table for Operational Phase

ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION***									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION***								
		E	**P**	**R**	**I**	**D**	**I/M**	**TOTAL = E + P + R + I + D) x I/M**	**STATUS (+ OR -)**	**Significance Rating [S]**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	
Operational Phase																				
Bat mortalities during foraging.	Foraging bats can be killed by colliding with turbine blades, or by suffering barotrauma.	2	4	2	3	3	4	56	-	High	**Avoid No-go areas by adhering to the sensitivity map. Where needed, if indicated through operational monitoring, reducing blade movement at selected turbines and high-risk bat activity times/weather**	2	2	2	3	3	3	36	-	Medium

											conditions. Acoustic deterrents are developed well enough to be trialled and may be recommended during operational monitoring. Refer to Section 7.									
Bat mortalities during migration.	Migrating bats influence several ecosystems since they are cave dwelling species, also over a larger area due to the distances that may be travelled. If turbines are placed within a migration path, a larger area and higher diversity of ecosystems may be impacted.	3	2	2	3	3	4	52	-	High	**Avoid No-go areas by adhering to the sensitivity map. Where needed, if indicated through operational monitoring, reducing blade movement at selected turbines and high-risk bat activity times/weather conditions. Acoustic deterrents are developed well enough to be trialled and may be recommended during operational monitoring. Each WEF in a migration path should apply appropriate mitigation measures to ensure that each facility's bat mortalities are below a sustainable threshold. Refer to Sections 7.**	3	2	2	3	3	3	39	-	Medium

Increased bat mortalities due to light attraction and habitat creation.	Floodlights and other lights at turbine bases or nearby buildings, will attract insect eating bats and therefore significantly increase the likelihood of these bats being impacted on by moving turbine blades. Habitat creation in the roofs of nearby buildings can cause a similar increased risk factor.	1	4	1	3	3	4	48	-	High	**During the planning phase for wind farm it must become mandatory to only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools. This applies to the turbine bases (if applicable) and other infrastructure/buildings.** **Aviation lights should remain as required by aviation regulations. Floodlights should be down-hooded and where possible, lights with a colour (lighting temperature) that attract less insects should be used.** **Bi-annual visits to the facility at night must be conducted for the operational lifetime of the facility, to assess the lighting setup and whether the passive motion sensors are functioning correctly. The bat specialist conducting the operational bat**	1	2	1	3	3	2	20	-	Low

										🟥	**mortality monitoring must conduct these visits to site during night-time to assess the placement and setup of outside lights on the facility. When lights are replaced and maintenance on lights is conducted, these mitigation measures must be consulted. Refer to Sections 7.**									🟨

*E = Extent, P = Probability, R = Reversibility, I = Irreplaceable loss of resources, D = Duration, I/M = Intensity/Magnitude

6.3 Cumulative Impacts

There are currently no applications for wind energy that have received Environmental Authorisation within 30km of Klipkraal WEF 1. However, the Klipkraal WEF Cluster is comprised of five individual WEFs, each of which proposes up to 300MW of power from up to 50 turbines per WEF. The impacts for the five Klipkraal WEFs are assessed cumulatively in this report.

The cumulative impacts identified for the construction phase of the Klipkraal WEF 1 are considered as Low (negative) without mitigation and also Low (negative) with mitigation. For the operational phase all the identified cumulative impacts are considered as High (negative) without mitigation and Medium (negative) with mitigation, except for the impact of light pollution which was assessed as Low (negative) with mitigation.

Table 6-3. Impact Rating Table for Cumulative Impacts

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION*									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION*								
		E	P	R	I	D	I/M	TOTAL = E + P + R + I + D) x I/M	STATUS (+ OR -)	Significance Rating [S]		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	
Cumulative																				
Bat mortalities during foraging.	Bat mortalities over long periods of time can negatively impact species genetic diversity in a population. If this occurs over a larger area of several wind farms, it decreases the chances of bat populations recovering to a prior state. Bats play an important role in controlling insect numbers, certain species of insects may increase in numbers over a larger area if	3	3	2	3	3	4	56	-	High	**Bat mortalities over long periods of time can negatively impact species genetic diversity in a population. If this occurs over a larger area of several wind farms, it decreases the chances of bat populations recovering to a prior state. Bats play an important role in controlling insect numbers, certain species of insects may increase in numbers over a larger area if bats are negatively impacted. Each wind farm is responsible for monitoring**	3	2	2	3	3	3	39	-	Medium

	bats are negatively impacted.										**and mitigating its own impacts on bats.**									
Bat mortalities during migration.	Bat mortalities over long periods of time can negatively impact species genetic diversity in a population. If this occurs over a larger area of several wind farms, it decreases the chances of bat populations recovering to a prior state. Bats play an important role in controlling insect numbers, certain species of insects may increase in numbers	3	2	2	3	3	4	52	-	High	**Bat mortalities over long periods of time can negatively impact species genetic diversity in a population. If this occurs over a larger area of several wind farms, it decreases the chances of bat populations recovering to a prior state. Bats play an important role in controlling insect numbers, certain species of insects may increase in numbers over a larger area if bats are negatively impacted. For migrating bats the area**	3	2	2	3	3	3	39	-	Medium

	over a larger area if bats are negatively impacted. For migrating bats the area of influence are dependent on the migration routes, and may therefore involve WEF's not in the immediate larger area.										**of influence are dependent on the migration routes, and may therefore involve WEF's not in the immediate larger area. Each wind farm is responsible for monitoring and mitigating its own impacts on bats, this includes migrating bats.**									
Increased bat mortalities due to light attraction and habitat creation.	Floodlights and other lights at turbine bases or nearby buildings, will attract insect eating bats and therefore significantly increase the likelihood of these bats being impacted on by moving turbine blades. Habitat creation in the roofs of nearby buildings can cause a	2	3	1	3	3	4	48	-	High	**Considering several wind farms, each WEF should incorporate these mitigation measures during the planning phase or on existing infrastructure. Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering**	2	2	1	3	3	2	22	-	Low

	similar increased risk factor. Considering several WEF's, the overall mortality rate will be significantly higher with an increased likelihood of impact.								🟥	**pools. This applies to the turbine bases (if applicable) and other infrastructure/buildings. Aviation lights should remain as required by aviation regulations. Floodlights should be down-hooded and where possible, lights with a colour (lighting temperature) that attract fewer insects should be used.**									🟨

*E = Extent, P = Probability, R = Reversibility, I = Irreplaceable loss of resources, D = Duration, I/M = Intensity/Magnitude

6.4 No-Go Alternative

No other alternatives are being considered for the Klipkraal 1 WEF, and is therefore only being assessed against the ‘No-go’ alternative. The ‘No-go’ alternative is the option of not constructing the Project where the *status quo* of the current farming activities on the site would prevail. Therefore, the Specialist rates the No-Go Alternative as neutral and has no objection with further investigating the option of constructing the project.

7 RECOMMENDED MITIGATION OPTIONS PERTAINING TO THE EMPr

The available options to minimise bat mortalities are discussed in this Section. Details on how each option must be implemented are explained in the step-by-step Mitigation Action Plan in Section 8.

7.1 Minimisation of light pollution and artificial habitat creation

The likelihood of bats being killed by moving turbine blades increases significantly when they are attracted to their proximity when it has become an improved foraging airspace due to the presence of artificial light or artificial water sources.

A mitigation to consider in the design of Klipkraal WEF 1 is to keep artificial lighting to a minimum on the infrastructure (O&M buildings and on wind turbines), while still adhering to safety and security requirements. For example, this can be achieved by having floodlights down-hooded, installing passive motion sensors onto lights around buildings and possibly utilising lights with lighting colours (also referred to as lighting temperatures) that attract fewer insects. Light pollution will impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light averse) species and favouring species that readily forage around insect-attracting lights.

Stormwater management should also avoid creating artificial wetlands and open water sources in the turbine zones (less than 300m from any turbine base), as this will increase insect and bat activity around turbines.

7.2 Curtailment to prevent freewheeling

Freewheeling occurs when the turbine blades are rotating in wind speeds below the generator cut-in speed (also called the **manufacturer's cut-in speed**), thus no electricity is being produced and only some blade momentum is maintained.

Since bat activity tends to be negatively correlated with wind speed, it means that high numbers of bats are likely to be flying and impacted on in low wind speeds where freewheeling may occur. If turbine blades are feathered below the generator cut-in speed to prevent freewheeling, it can result in a very significant reduction of bat mortalities with minimal energy production loss.

7.3 Curtailment that increases the cut-in speed

The activity levels of South African bats generally decrease in weather conditions with increased wind speeds. However, in scenarios where above sustainable numbers of bats are being killed, and these bats fly in wind speeds above the turbine manufacturer's cut-in speed, the turbine's computer control system (referred to as the Supervisory Control and Data Acquisitions or SCADA system) can be programmed to a cut-in speed higher than the manufacturer's set speed. The new cut-in speed will then be referred to as the **mitigation cut-in speed** and can be determined from studying the relationship between long term (12-month) bat activity patterns on site and wind speed. This sustainable threshold of bat mortalities will be calculated according to the *South African Bat Fatality Threshold Guidelines* (MacEwan, *et al.*, Edition 2, October 2018). Turbines are curtailed in this manner by means of blade feathering, to render the blades motionless in wind speeds below the mitigation cut-in speed.

7.4 Acoustic bat deterrents

This technology is developed well enough to be tested on site and may be recommended during operational monitoring, if mortality data indicate bat mortalities above the sustainable threshold for the wind farm. This threshold will be calculated according to the *South African Bat Fatality Threshold Guidelines* (MacEwan, *et al.*, Edition 2, October 2018). Initial experiments with this technology on wind farms in South Africa are yielding positive results that may indicate the effectiveness of the devices in the correct scenarios.

Current data on the South African trials is still limited to a small sample set, and the technology will not necessarily be effective in all mitigation scenarios and for all bat species.

Therefore, it should be considered and tested on a case-by-case basis if possible, and it is highly recommended that adequate monitoring continues concurrently, to assess the effectiveness of the devices in reducing bat mortalities.

8 MITIGATION ACTION PLAN FOR INCLUSION INTO THE EMPr

8.1 Step 1: Minimisation of light pollution and artificial habitat creation (refer to Section 5.1)

During the planning phase for Klipkraal WEF 1 it must become mandatory to only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools, where practically possible without compromising security requirements. This applies to the turbine bases (if applicable) and other infrastructure/buildings. Aviation lights should remain as required by aviation regulations. Floodlights should be down-hooded and where possible, lights with a colour (lighting temperature) that attract fewer insects should be used. This mitigation step is a simple and cost-effective strategy to effectively decrease the chances of bat mortality on site. Bi-annual visits to the facility at night must be conducted for the operational lifetime of the facility by operational staff of the facility, to assess the lighting setup and whether the passive motion sensors are functioning correctly. The bat specialist conducting the operational bat mortality monitoring must conduct at least one visit to site during nighttime to assess the placement and setup of outside lights on the facility. When lights are replaced and maintenance on lights is conducted, this Mitigation Action Plan must be consulted.

The storm water drainage plan must avoid creations of artificial ponds/open water sources or wetlands in turbine zones (less than 300m from any turbine base), as these will increase insect activity and therefore bat activity in the area. This can result in turbines that were previously assessed as having a low risk to be financially and biologically costly high-risk turbines.

8.2 Step 2: Appointment of bat specialist to conduct operational bat mortality monitoring

As soon as Klipkraal WEF 1 facility becomes operational, a bat specialist must commence the minimum of 2 years operational bat mortality monitoring. This specialist must be appointed before the facility becomes operational, so the operational monitoring can start at the same time as the commercial operation date of the facility. The methodology of this monitoring must comply with the *South African Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities - 2nd Edition June 2020* (Aronson *et al.* 2020), or any newer version of the applicable guidelines that may be in force at the start of operation of the facility.

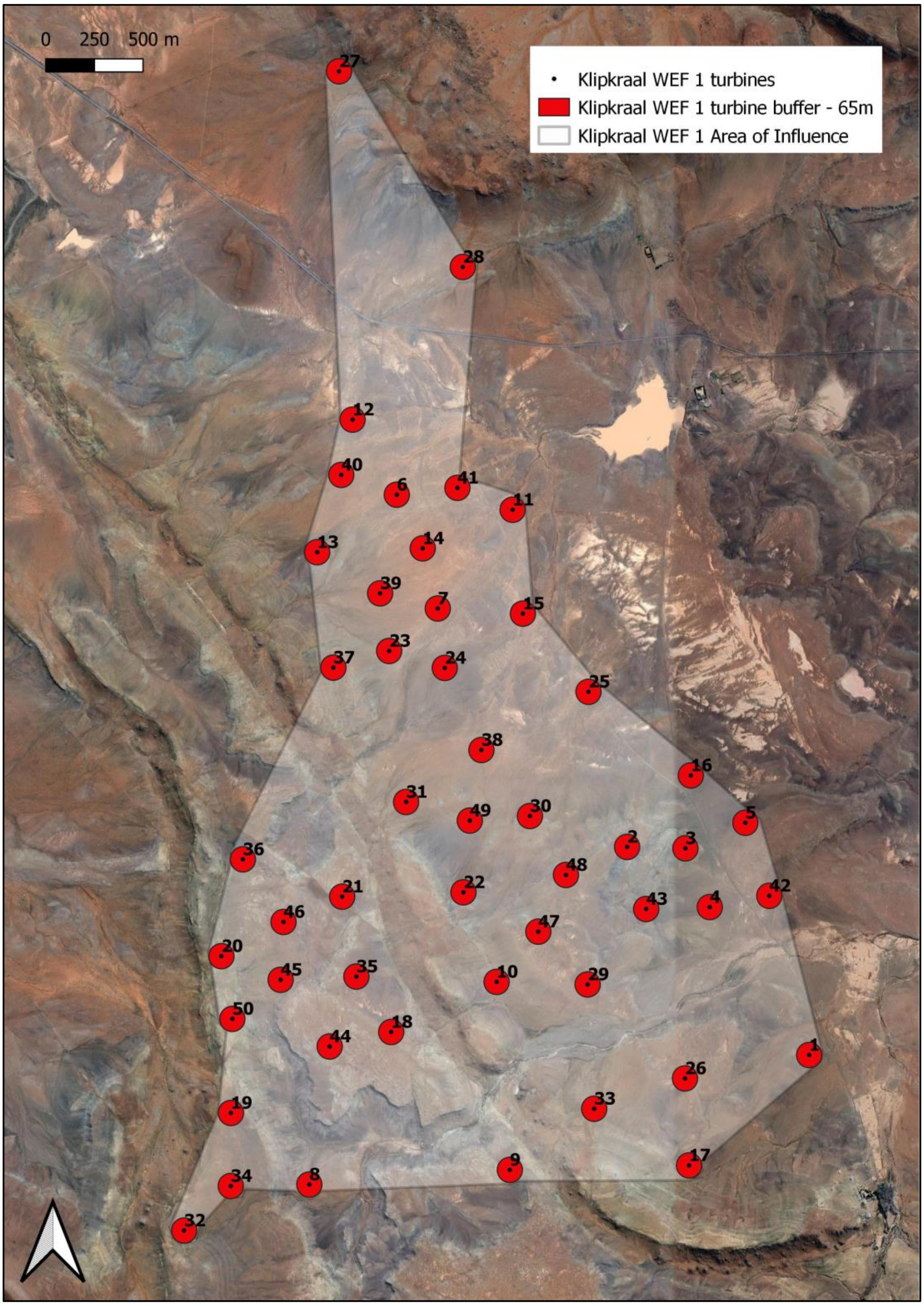
The results of the bat mortality study may be used to develop mitigation measures focused on specific problematic turbines. The results of the operational monitoring must be made available, on request, to other bat specialists conducting operational and preconstruction monitoring on WEF's in South Africa.

8.3 Step 3: Curtailment to prevent freewheeling (refer to Section 7.2)

Based on high bat activity detected during the 12-month pre-construction study, from 1 September to 28 February every night for the lifetime of the facility, curtailment must be applied to all turbines by ninety-degree feathering of blades below the **manufacturer's cut-in speed**, so it is exactly parallel to the wind direction and minimises freewheeling blade rotation as much as possible without locking the blades. This can significantly lower probability of bat mortalities. Influence on productivity is minimal since no power is generated below the manufacture's cut-in speed.

8.4 Step 4: Additional mitigation by curtailment or acoustic deterrents (refer to Sections 7.3 and 7.4)

If mitigation steps 1 – 3 are followed, and the bat mortality monitoring study detects bat mortalities that are above the sustainable threshold for Klipkraal WEF 1, then additional mitigation will need to be implemented to bring bat mortalities to or below the sustainable threshold. According to the *South African Bat Fatality Threshold Guidelines* (MacEwan, *et al.*, Edition 2, October 2018), this threshold is calculated by considering the hectare size of the WEF area of turbine influence and the value of 2% of bats/10ha/year for the ecoregions that the WEF is located in, to give an annual number of sustainable bat mortalities that is acceptable for the WEF. The area of turbine influence of a wind farm is dictated by the turbine layout and is a tight fitting polygon around the turbine layout (**Figure 8-1**). In this version of the guidelines the acceptable sustainable threshold is calculated as 0.20 bats/10ha/annum for the Nama Karoo ecoregion (Olson 2012) which occupies the turbine area of influence (928 ha). The calculated annual acceptable sustainable threshold of bat mortalities for Klipkraal WEF 1 is indicated in **Table 8-1** below. The threshold is based on



values adjusted for biases such as searcher efficiency and carcass persistence. Note that a newer version of the Threshold Guidelines or another similar applicable document may be adopted during the operation of the WEF.

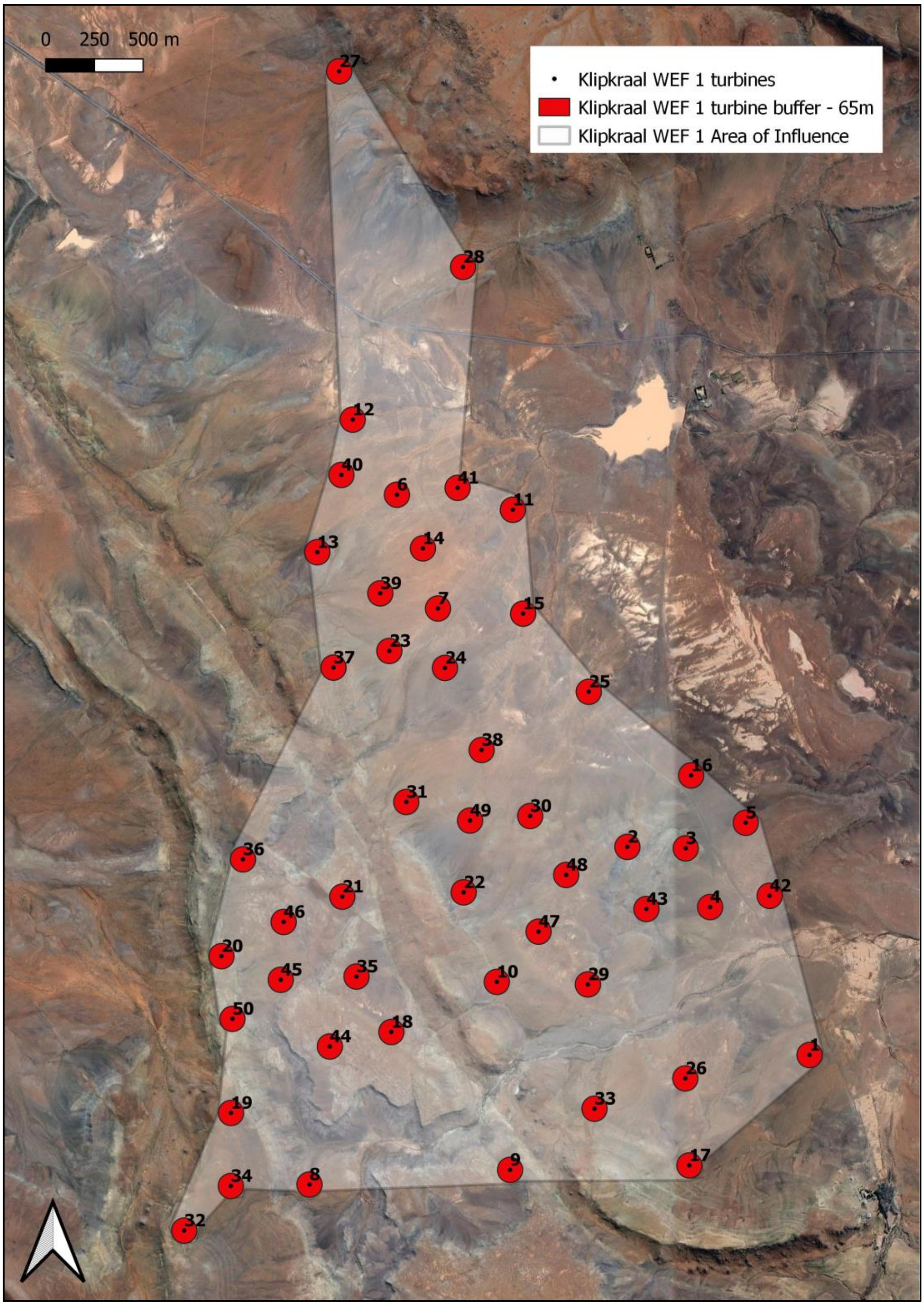


Figure 8-1: The turbine area of influence used to calculate the area applicable to the acceptable bat mortality thresholds.

Table 8-1: The sustainable acceptable mortality thresholds of Klipkraal WEF 1.

	Area of influence of wind turbines (hectares)	Acceptable annual mortality of bats (adjusted values for biases such as searcher efficiency and carcass persistence)
Klipkraal WEF 1	928	0.20 x (928/10) = 0.20 x 92.8 = **19 bats**

Such additional mitigation measures may be to curtail problematic turbines according to the **mitigation cut-in speed** (**Section 7.3**), and/or to utilise acoustic deterrents on problematic turbines (**Section** Error! Reference source not found.). If the turbine layout is amended, the calculation in **Table 8-1** needs to be revised.

Preliminarily, it is advised that any additional mitigation measures that may be required be applied during 1 September to 28 February and must be applied to any turbines or group of turbines identified as causing the wind farm's mortalities to be above the sustainable threshold levels. This time period is based on high bat activity months as detected during the 12-month preconstruction study.

The bat specialist conducting the operational bat monitoring may recommend other time periods for additional mitigation, based on robust mortality data. If required, the bat specialist may make use of climatic data to allow for an active and adaptable mitigation schedule.

8.5 Step 5: Auditing of bat mortalities for the lifetime of the facility

During the implementation of mitigation Steps 1 – 4, it is crucial for the facility to determine and monitor bat mortalities in order to implement, maintain and adapt mitigations as efficiently as possible. For the duration of the lifetime of the facility, the impacts on bats must be audited/monitored by reliable methods of carcass searching and/or electronic devices capable of automatically counting bat mortalities. Such auditing should occur every 5 years (after the end of the initial 2-year operational study) for all turbines on site, and continuously for turbines where mitigations discussed in Step 4 (Sections 7.3 and **Error! Reference source not found.**) are implemented.

8.6 Acoustic bat deterrents

This technology is developed well enough to be tested on site and may be recommended during operational monitoring, if mortality data indicate bat mortalities above the sustainable threshold for the wind farm. This threshold will be calculated according to the *South African Bat Fatality Threshold Guidelines* (MacEwan, *et al.*, Edition 2, October 2018). Initial experiments with this technology on wind farms in South Africa are yielding positive results that may indicate the effectiveness of the devices in the correct scenarios.

Current data on the South African trials is still limited to a small sample set, and the technology will not necessarily be effective in all mitigation scenarios and for all bat species. Therefore, it should be considered and tested on a case-by-case basis, and it is highly recommended that adequate monitoring continues concurrently, to assess the effectiveness of the devices in reducing bat mortalities.

9 CONCLUSION

This 12-month bat Environmental Impact Assessment study considered passive bat activity data gathered between September 2021 and October 2022 and on-site evaluations of sensitivity features and habitats delineated in the bat sensitivity map delivered with this study. Information from literature as well as available bat activity data from site confirms that seven bat species occur on the site and another three species are likely to occur. Of this total of ten species, six have a Medium – High or High likelihood to be negatively impacted by wind energy due to their foraging and behavioural patterns.

A passive bat detection system (Error! Reference source not found.) was set up on Meteorological Mast M2 with microphones at 10m, 60m and 115m. Additionally, four short mast bat detection systems were set up, with microphones at 7m (referred to ShM1 – ShM4). These systems were set to gather bat activity data every night for 12 months for long-term pre-construction monitoring, to inform the Environmental Authorisation process.

The total number of bat passes from the 12 months of data retrieved shows that bat activity at the Met Mast decreased with increasing height. This is a well-known trend. The highest number of passes was recorded at the lowest microphone (7m) of Met Mast M2, with 23 121 passes recorded across all species, and with the lowest activity for this system (9 781 passes) recorded at the highest microphone (115m). ShM3 recorded the fewest bat passes overall, however, with a total of 7 295 at a height of 7m above ground. Bat activity was thus not consistent at the same height across the landscape, and reflects the spatial suitability of foraging resources for these animals. The landscape associated with ShM3 is relatively flat and situated further away from a drainage line compared to the more elevated topography and closer proximity to drainage lines at the remaining systems. These were associated with higher bat activity; this feeds back into our confidence in our spatial sensitivity mapping, where proximity to these features is indicative of higher activity levels.

Across all heights, and indeed across each system, the High-risk category of bats displayed the greatest number of total passes compared to the other categories, with the Medium-risk category displaying the next highest number of passes, although to a far lesser degree. Bats in the Medium-High and Low-risk profiles have not been well represented in the data thus far. It is noteworthy that overwhelmingly, the most commonly occurring bats on site are those at greatest risk of fatal collision with wind turbines. The species at risk in this High-risk category (*Tadarida aegyptiaca* and *Sauromys petrophilus*) are open air foragers which regularly fly at heights corresponding with the rotor swept zone.

Total bat passes can be used to compare activities between microphone heights, but results may be skewed by data gaps where the bat detector/microphone did not function. Some bat detectors experienced technical issues that resulted in gaps in their data collection (namely ShM1 and ShM2). However, the other bat detectors on site gathered complete data during such periods to collectively inform the impact assessment sufficiently. ShM2 malfunctioned during the transition from autumn into winter when bat activity is generally declining.

Average hourly activity is more accurate for bat activity comparisons between different sample points than the total number of bat passes since it considers only the nights on which the systems recorded successfully, and are therefore a true indication of activity levels. All microphones, except ShM4, detected the highest average hourly activity for all species in the month of February 2022 (ShM4 detected the greatest activity in January 2022). Average hourly activity decreased with increasing microphone height, with the 7m, 60m and 115m microphones on the Met Mast M2 detecting on average 16.6, 9.3 and 7.1 passes per hour respectively during the month of February, for example. Hourly activity of High-risk species increased gradually from September 2021 to February 2022 and then sharply decreased from March 2022 onwards. For Medium-risk species, the difference was somewhat less pronounced.

The year of bat monitoring contains two spring periods (2021 and 2022) and the average hourly activity was consistently greater in the latter spring period at every system and across all microphone heights. This was true for all risk categories, and may be due to the extended drought in the region coming to an end in 2022.

The temporal data displays the spread of bat activity over each night and may indicate abrupt peaks in activity. The warmer months of the austral summer and early autumn seasons displayed markedly more bat activity than the cooler periods through May - August. This behaviour of higher bat activity during summer nights is to be expected when taking insect activity into consideration. The high elevation of the site lends to frequent frosts during colder nights and there is a distinct correlation between temperature, insect activity and thus bat activity. The area also received very good rainfall over the summer of 2021/2022, thus breaking the prolonged drought over the past decade.

Miniopterus natalensis and *Myotis tricolor* (the members of the 'Medium-High' or 'MH' graph category) are cave dwelling species but may also take residence in smaller numbers in culverts and other suitable man-made hollows, these species did not show any abrupt or anomalous peaks of activity that may indicate that the site is on any migration route. These species were not particularly frequently recorded on the systems, although they were present in the data from all systems.

Considering the Met Mast M2 system, the relationship between nightly activity and season was especially strong for the High-risk category. The Medium-risk category species showed some activity later into the autumn period (March - May 2022). The remaining categories displayed markedly lower activity over the period monitored and did not show a particularly strong seasonal pattern. Bat activity for the High-risk group peaked on the night of 7 February 2022.

Considering the Short Mast systems, activity for the Medium-risk category did not show a consistent trend across the systems, with relatively steady, low-level activity across the 12 months for the nights on which data were available at ShM2. A peak in early-mid May 2022 at ShM3 and in mid-December 2021 at ShM4 were recorded. These are particularly variable activity trends across a relatively small-scale area and demonstrate a level of unpredictability within this risk category. Across all species and heights, winter was consistently the period when the least bat activity was recorded, as expected.

The topography and geology on site consists of localised rocky boulder tors and exposed cliffs which can offer suitable roosting space to several bat species. Considering hydrology, however, open surface water availability is relatively low and foraging activity trends and ranges may therefore be strongly dependent on seasonal patterns in rainfall.

Note that high sensitivity features delineated by the Specialist in the bat sensitivity map have been buffered by a 200m No-go area. No overhanging turbine blade may intrude into this buffer, meaning that should the final turbine model specify a rotor radius of 100m, the base of the turbine needs to be situated, at a minimum, an additional 100m from the outer edge of the High sensitivity No-go buffer. ***Turbines indicated in Table 5.5 are intruding into the high bat sensitivity buffer, and must be moved to have their blades outside of these buffers.***

Should **the proposed wind farm be approved, a minimum of 2 years of operational bat mortality monitoring should be conducted from the start of the operation of the facility.** The recommended mitigation measures have been presented in the Mitigation Action Plan in this EIA phase, which must be incorporated into the EMPr.

According to available information consulted during this study, **there are no fatal flaws from a bat sensitivity perspective.** Additionally, no known bat caves or large roosts occur in the vicinity of the site. No reasons have been identified for the Klipkraal WEF 1 development not to receive Environmental Authorisation.

10 REFERENCES

African Chiroptera Report, 2018. *African Bats, Pretoria.*

Baerwald, E. F., D'Amours, G. H., Klug, B.J. and Barclay, R. M. R. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. *Current Biology* 18: 695-695.

Barclay, R. M. R., Baerwald, E. F., and Gruver, J. C. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. *Canadian Journal of Zoology* 85: 381-387.

Department of Environment Forestry and Fisheries, 2019. Phase 2 Strategic Environmental Assessment for wind and solar PV energy in South Africa. CSIR Report Number: CSIR/SPLA/SECO/ER/2019/0085 Stellenbosch, Western Cape

Hester, S. G. and Grenier, M.B. 2005. *A conservation plan for bats in Wyoming*. Lander, WY: Wyoming Game and Fish Department, Nongame Program.

Horn, J. W., Arnett, E. B. and Kunz, T.H. 2008. Behavioural responses of bats to operating wind turbines. *Journal of Wildlife Management* 72: 123-132.

Howe, R. H., Evans, W. and Wolf, A. T. 2002. Effects of wind turbines on Birds and Bats on Northeastern Wisconsin. Report submitted to *Wisconsin Public Service Corporation and Madison Gas and Electric Company*.

Johnson, G. D., Erickson, W. P., Stickland, M. D., Shepherd, M. F., Shepherd, D. A. and Sarappo, S. A. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. *The American Midland Naturalist Journal* 150: 332-342.

Kunz, T. H., Arnett, E. B., Erickson, W. P., Hoar, A. R., Johnson, G. D., Larkin, R. P., Strickland, M. D., Thresher, R. W., Tuttle, M. D. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypothesis. *Frontiers in Ecology and the Environment* 5: 315-324.

Lynch, C. D. 1989. The mammals of the north-eastern Cape Province. *Mem. Nas. Mus. Bloemfontein* 25: 1-116.

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

Monadjem, A., Taylor, P.J., Cotterill, F.P.D. & Schoeman, M.C. 2020. Bats of southern and central Africa, 2nd Edition – A biogeographic and taxonomic synthesis, Wits University Press, Johannesburg.

Mucina, L. and Rutherford, M. C. 2012. The Vegetation of South Africa, Lesotho and Swaziland-*Strelitzia 19,* South African National Biodiversity Institute, Pretoria.

Neuweiler, G. 2000. *The Biology of Bats*. Oxford University Press.

O’Shea, T. J., Bogan, M. A. and Ellison, L. E. 2003. Monitoring trends in bat populations of the United States and territories: Status of the science and recommendations for the future. *Wildlife Society Bulletin*, 31: 16-29.

Rautenbach, I.L. 1982. *Mammals of the Transvaal*. Pretoria: Ecoplan.

Taylor, P. J. 2000. Bats of southern Africa, University of Natal Press, Pietermaritzburg.

Tuttle, M. D. and Hensley, D. L. 2001. *The Bat House Builder’s Handbook*. (BCI) Bat Conservation International.

van der Merwe, M. 1979. Growth of ovarian follicles in the Natal clinging bat. *South African Journal of Zoology* 14: 111-117.

van der Merwe, M. 1994. Reproductive biology of the Cape serotine bat, *Eptesicus capensis,* in the Transvaal, South Africa. *South African Journal of Zoology* 29: 36-39.

11 APPENDIX A: SITE SENSITIVITY VERIFICATION

SITE SENSITIVITY VERIFICATION
(IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

11.1 Introduction

The specifications for the wind farm components for each of five wind farms, within the Klipkraal WEF (Klipkraal Wind Energy Facilities 1 – 3) are as follows:

- Approximately 50 turbines per wind farm, each between 5MW and 8MW, with a maximum export capacity of up to approximately 240MW for each wind farm. This will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) or any other program.
- Each wind turbine will have a maximum hub height of up to approximately 140m;
- Each wind turbine will have a maximum rotor diameter of up to approximately 130m;
- Permanent compacted hardstanding areas / platforms (also known as crane pads) of approximately 90m x 50m (total footprint of approx. 4 500m^2) per wind turbine during construction and for on-going maintenance purposes for the lifetime of the proposed wind farm projects. This will however depend on the physical size of the wind turbine;
- Each wind turbine will consist of a foundation (i.e. foundation rings) which may vary in depth, from approximately 3m and up to 5m or greater, depending on the physical size of each wind turbine. It should be noted that the foundation can be up to as much as approximately 600m^3.

11.2 Site Sensitivity Verification Methodology

The methodology for the Specialist Site Sensitivity Verification process identifies bat species that may be impacted by wind turbines by taking into account the following features: the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water). These comparisons were done by briefly studying the geographic literature and available satellite imagery for the site and by ground truthing with site visits. Species probability of occurrence based on the above-mentioned factors were estimated for the site and the surrounding larger area, but also considers species historically confirmed on site as well as surrounding areas.

Several site visits were carried out from September 2021 to October 2022 thus far, to groundtruth bat sensitivity features and habitats delineated in the bat sensitivity constraints map supplied in this report.

11.3 Outcome of Site Sensitivity Verification

We examined the Screening Tool output (dated 21 July 2022) and found the following:

- The Bat Theme is classed as High sensitivity (**Figure 11-1**) due to the presence of wetlands within the site boundary, as well as 500m wetland buffers.

The bat sensitivity map produced by the Specialist, based on the methodology described above, share similarities to the Screening Tool sensitives with regards to the identification of several water courses and open water sources as high sensitivity areas. However, additional watercourses, rocky cliffs and koppies have been identified as additional high sensitivities by the Specialist.

11.4 National Environmental Screening Tool

In **Figure 11-1**, the red areas indicate high bat sensitivity hydrology features due to placement on or within 500m of a wetland. The remaining areas are not assigned any sensitivity ranking by the Screening Tool. The sensitivities of the National Screening Tool have been considered, however the sensitivity map produced with this scoping study deviates from these sensitivities. The deviations are based on detailed site visits and assessments.

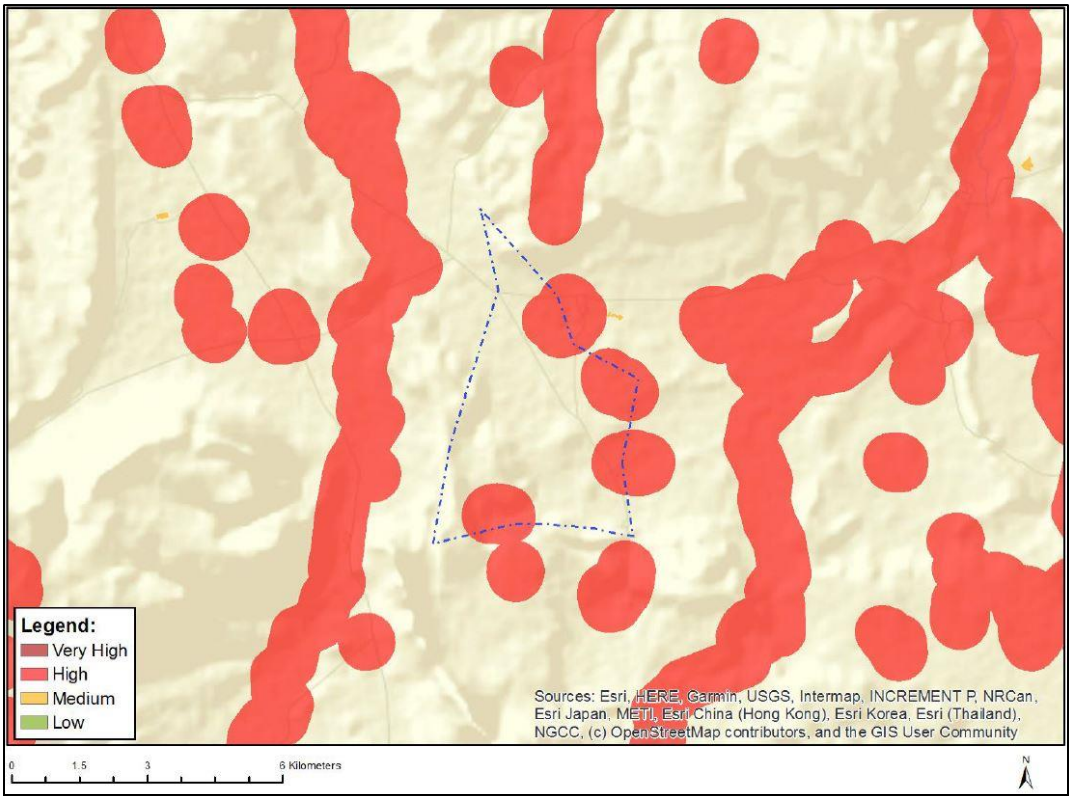


Figure 11-1. Possible bat sensitivity features according to the National Environmental Screening Tool, as downloaded from https://screening.environment.gov.za/screeningtool/index.html#/app/screen_tool/Wind on 21 July 2022

11.5 Conclusion

The sensitivities identified in the Specialist assessment have been verified against the National Environmental Screening Tool. Additional sensitivities have been identified as per **Figure 5-16**.

Werner Marais
Zoologist and Ecologist
MSc Biodiversity & Conservation
Pr.Sci.Nat. – SACNASP registration no. 400169/10
(Zoological Science)

DISCLAIMER

The services carried out and reported in this document have been done as accurately and scientifically as allowed by the resources and knowledge available to Animalia Consultants (Pty) Ltd at the time on which the requested services were provided to the client. Animalia Consultants (Pty) Ltd reserves the right to modify aspects of the document including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although great care and pride have been taken to carry out the requested services accurately and professionally, and to represent the relevant data in a clear and concise manner; no responsibility or liability will be accepted by Animalia Consultants (Pty) Ltd. And the client, by receiving this document, indemnifies Animalia Consultants (Pty) Ltd and its staff against all claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Animalia Consultants (Pty) Ltd; and by the use of the information contained in this document. The primary goal of Animalia's services is to provide professionalism that is to the benefit of the environment as well as the community.

COPYRIGHT

This document may not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this document which are supplied for the purposes of inclusion as part of other reports. Similarly, any recommendations, statements or conclusions drawn from or based on this document must make reference to this document.