ARCUS

PRE-CONSTRUCTION BAT MONITORING: HIGHLANDS WIND ENERGY FACILITIES, EASTERN CAPE PROVINCE

Final Environmental Impact Assessment Report

On behalf of

WKN Windcurrent SA (Pty) Ltd

September 2018

Prepared By:

Arcus Consultancy Services South Africa (Pty) Limited

Office 220 Cube Workspace
Icon Building
Cnr Long Street and Hans Strijdom Avenue
Cape Town
8001

T +27 (0) 21 412 1529 l **E** AshlinB@arcusconsulting.co.za
W www.arcusconsulting.co.za

Registered in South Africa No. 2015/416206/07

TABLE OF CONTENTS

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	Appendix 1, Appendix 2
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 2
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4.1, Section 5.4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 5
(g) an identification of any areas to be avoided, including buffers;	Section 4.5, Figure 1
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 1
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.2
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	Section 4
(k) any mitigation measures for inclusion in the EMPr;	Section 5
(l) any conditions for inclusion in the environmental authorisation;	Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 5
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 4.5
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None received as yet
(p) any other information requested by the competent authority	None received
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

1 INTRODUCTION

WKN Windcurrent South Africa (Ltd) Pty ('WKN-WC') are proposing the Highlands Wind Energy Facilities (WEF), and associated infrastructure including grid connection infrastructure (the Proposed Development), located near the town of Somerset East in the Eastern Cape Province. The Proposed Development Site is situated within the Cookhouse REDZ and the affected land parcels cover an area of approximately 11,180 hectares. The area of interest for development within these land parcels is approximately 9,000 hectares. The project has been split into three phases: North, Central and South.

The proposed Highlands North WEF will comprise of 17 turbines with a maximum generation capacity of 5 MW per turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible, and will be either overhead, or underground. One on-site substation location (Substation A) will form part of this application.

The proposed Highlands Central WEF will comprise of 14 wind turbines, with each turbine having an installed maximum generation capacity of 5 MW per turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible, and will be either overhead, or underground. One on-site substation location (Substation B) will form part of this application. An existing access road may require upgrading as part of this application.

The proposed Highlands South WEF will comprise of 18 wind turbines, with each turbine having an installed maximum generation capacity of 5 MW per turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible, and will be either overhead, or underground. Two on-site substation locations (Substation C1 and C2) will form part of this application. An existing access road may require upgrading as part of this application.

For all three phases, turbines with a maximum height to blade tip of 200 m will be considered (a hub height of up to 135 m, and a rotor diameter of up to 150 m).

Arcus have been appointed to conduct the pre-construction bat monitoring for the three WEFs, the results of which will feed into the impact assessment process. The aim of the monitoring is to document bat activity in the area of interest and, based on this activity, assess each WEF with regards to potential impacts to bats and the risk to development consent. These data will establish a pre-construction baseline of bat species diversity and activity and be used to undertake an environmental impact assessment. The monitoring data will also assist in providing solutions to mitigate impacts, if required, by informing the final design, construction and operational management strategy of the WEFs. The baseline should also be used to compare impacts to bats during the operational phase of the project.

This report presents the results from the bat activity monitoring undertaken between 23 May 2017 and 19 June 2018, and an indication of the potential risk of the WEF site to bats.

2 SCOPE OF STUDY

2.1 Terms of Reference

This report forms part of the application for environmental authorisation through a Basic Assessment (BA) process for the proposed development. The aim of this report is to present the baseline environment with respect to bats that may be influenced by the development of the WEFs and associated infrastructure. Based on this baseline, a description and evaluation of the potential impacts the project may pose to bats is provided. The following terms of reference were utilised for the preparation of this report:

- Describe the baseline environment of the project and its sensitivity with regard to bats;

- Identify the nature of potential impacts (positive and negative, including cumulative impacts) of the proposed project on bats during construction, operation and decommissioning;
- Conduct a significance rating and impact assessment of identified impacts;
- Conduct an assessment of any alternatives where relevant;
- Identify information gaps and limitations; and
- Identify potential mitigation or enhancement measures to minimise impacts to bats.

2.2 Assumptions and Limitations

The following assumptions and limitations relevant to this study are noted:

- The knowledge of certain aspects of South African bats including natural history, population sizes, local and regional distribution patterns, spatial and temporal movement patterns (including migration and flying heights) and how bats may be impacted by wind energy is very limited for many species.
- Bat echolocation calls (i.e. ultrasound) operate over ranges of metres therefore acoustic monitoring samples only a small amount of space (Adams et al. 2012). Recording a bat using sound is influenced by the type and intensity of the echolocation call produced, the species of bat, the bat detector system used, the orientation of the signal relative to the microphone and environmental conditions such as humidity. One must therefore be cautious when extrapolating data from echolocation surveys over large areas because only small areas are actually sampled.
- There can be considerable variation in bat calls between different species and within species. The accuracy of the species identification is also very dependent on the quality of the calls used for identification. Species call parameters can often overlap, making species identification difficult.
- Bat activity recorded by bat detectors cannot be used to directly estimate abundance or population sizes because detectors cannot distinguish between a single bat flying past a detector multiple times or between multiple bats of the same species passing a detector once each (Kunz et al. 2007a). This is interpreted using the specialists' knowledge and presented as relative abundance.
- There is no standard scale to rate bat activity as low, medium or high. A qualitative assessment is given based on the specialists experience and on data collected from other locations. Data from this study were compared to data from other similar locations to rate the levels of bat activity recorded.
- The potential impacts of wind energy on bats presented in this report represent the current knowledge in this field. New evidence from research and consultancy projects may become available in future, meaning that impacts and mitigation options presented and discussed in this report may be adjusted if the project is developed.
- While the data presented in this report provides a baseline of bat activity for the period sampled, it does not allow for an understanding of interannual variation in bat activity. It is therefore possible that during the lifespan of the facility, bat activity could be significantly different (lower or higher) compared to the baseline presented here.

2.3 Legislative Context

The following legalisation, policies, regulations and guidelines are all relevant to the project and the potential impact it may have on bats and habitats that support bats:

- Convention on the Conservation of Migratory Species of Wild Animals (1979)
- Convention on Biological Diversity (1993)
- Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)
- National Environmental Management Act, 1998 (NEMA, Act No. 107 of 1998)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
- Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009)

- The Equator Principles (2013)
- The Red List of Mammals of South Africa, Swaziland and Lesotho (2016)
- National Biodiversity Strategy and Action Plan (2005)
- South African Good Practise Guidelines for Surveying Bats in Wind Energy Facility Developments – Pre-Construction (2016)
- South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (2014)

3 METHODOLOGY

3.1 Desktop Review

A desktop study of available bat locality data, literature and mapping resources was undertaken to determine the likelihood of bats being present at the proposed project. Literature was also sought to understand the current state of knowledge of wind energy-bats impacts globally. Very little published research on this regard is available for the South African context. Data sources included:

- Academic sources such as research papers and published texts;
- Information on bat activity at other nearby renewable energy developments such as from pre-construction monitoring reports;
- Bat distribution records and maps; and
- A review of the habitats on the site to identify, if possible, habitats, roosts and features which may be associated with bats.

3.2 Field Surveys

The pre-construction monitoring was designed to monitor bat activity across the entire area of interest encompassed by all three WEFs. Data from all sampling points were used to assess the impacts of each respective WEF separately. The baseline environment was investigated by using acoustic monitoring to document bat activity. Bats emit ultrasonic echolocation calls for orientation, navigation and foraging. These calls can be recorded by bat detectors enabling bat species to be identified and their activity patterns quantified.

The monitoring was undertaken in accordance with South African best practice[1]. Sampling of bat activity took place at six locations (Figure 1) using Song Meter SM2Bat+ bat detectors (Wildlife Acoustics, Inc.). Ultrasonic microphones were mounted on masts at 12 m at each location. An additional ultrasonic microphone was also mounted at 90 m on a meteorological mast (METHIGH). All detectors were configured to record every night from 30 minutes before sunset until 30 minutes after sunrise. The distribution of monitoring locations across the site was determined based on vegetation types, land-use, and topography with the aim to sample bat activity in areas where bat activity was expected to be higher (e.g. near water and buildings, along riparian vegetation) but also in areas where bat activity was expected to be lower (e.g. on ridges, away from water and buildings, in open areas with low habitat complexity). To achieve this, a greater number of detectors than needed based on the minimum guideline recommendations was used as opposed to using transects to sample bat activity which would provide significantly less temporal data for only a small additional gain in spatial data.

In addition to the acoustic monitoring, potential structures that bats could use as roosts were investigated during the day for the presence or evidence of roosting bats (e.g. guano

[1] Sowler, S., Stoffberg, S., MacEwan, K., Aronson, J., Ramalho, R., Potgieter, K., Lötter, C. 2016. South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: 4th Edition. South African Bat Assessment Association. The monitoring also meets the requirements of edition 4.1 of the guidelines published in 2017.

and culled insect remains, etc.) whenever the Arcus team was on site. These included buildings, rocky outcrops and trees.

A known roost, Bloukrans cave, is located approximately 8 km west (to the location of the nearest proposed turbine) of the proposed WEF's at which specific roost surveys were undertaken. This roost was visited on 24 May 2017, 19 October 2017 and 6 June 2018 to determine if it is active, which species are present and to estimate the population of bats using the cave. A Song Meter SM2Bat+ bat detector (Wildlife Acoustics, Inc.) was placed outside the cave over two nights during the first visit to aid in the identification of species using the cave.

3.3 Data Analysis

Bats emit ultrasonic echolocation calls for orientation, navigation and foraging. These calls can be recorded by bat detectors enabling bat species to be identified from various features in their calls (e.g. the frequency of the call). A sequence of calls is a bat pass defined as two or more echolocation calls separated from other calls by more than 500 milliseconds (Hayes 1997; Thomas 1988). Quantifying the number of bat passes recorded can be used to quantify the relative abundance of bat species. However, bat passes recorded from bat detectors cannot be used to directly estimate population sizes because they cannot distinguish between a single bat flying past a detector multiple times or multiple bats of the same species passing a detector once each (Kunz et al. 2007a).

Acoustic data from each bat detector were analysed using Kaleidoscope (Version 4.5.4, Wildlife Acoustics, Inc.). Bat species were automatically identified from their echolocation calls using the embedded echolocation call library in the software. The results were vetted by randomly or selectively (for certain species) manually identifying recordings. Most files contained only a single bat pass and therefore the total number of files was used as a proxy for the number of bat passes. This would underestimate bat activity if any files contained more than one bat pass.

Wind speed data measured at 10 m and 90 m from the meteorological mast were obtained and analysed in relation to bat activity. Temperature data were obtained from the internal sensor in each bat detector. It is assumed that this internal temperature approximated the ambient nocturnal temperatures experienced during the monitoring. Both variables were paired with bat activity recorded during the same hourly time period they were measured (and at the same height for the wind speed data) for each night where data were available. This resulted in a total of 232 paired nights for the wind speed dataset[2] (at both heights), and 393 paired nights for the temperature dataset[3].

The wind speed and temperature data were used to create activity accumulation curves. These curves demonstrate how bat activity accumulates against an increasing measured variable (e.g. increasing wind speed) thus providing an estimate of the bat activity at (or below, or above) a given state of the measured variable (e.g. at a given wind speed). These curves were generated by adding the number of bat passes from a higher wind speed to the total number of bat passes recorded from all lower wind speeds, thus giving a running (and increasing) total of the number of bat passes. From these values, the accumulated proportion of total activity was calculated for each wind speed by dividing the accumulated total by the total number of bat passes recorded. The curves do not imply a causal relationship between bat activity and wind speed, but instead provide a useful tool to

[2] The number of nights per season for the wind speed dataset varied as follows: autumn = 92 nights, winter = 25 nights, spring = 26 nights and summer = 89 nights.

[3] The number of nights per season for the temperature dataset varied as follows: autumn = 100 nights, winter = 112 nights, spring = 91 nights and summer = 90 nights.

examine the likely amount of bat activity at a given wind speed which may be useful to understand during operation.

4 BASELINE ENVIRONMENT

4.1 Habitats

The landscape at the site consists of gently undulating plains which support open, dry grassland interspersed with woodland vegetation, particularly in drainage lines. The western edge of the site consists of steeper slopes which thicket vegetation. The predominant vegetation types at the site are Bedford Dry Grassland and Camdebo Escarpment thicket. There is also a small area of Southern Karoo Riviere vegetation. Grazing, and a small amount of cultivation, is the only current land use on the site and there are no existing impacts to bats.

Micro-habitats available to bats in and around the site for foraging and commuting include grassland, livestock water points and dams, drainage lines, thicket and woodland vegetation, cultivated areas, and stands of alien trees around farmsteads. Roosting micro-habitats include rocky outcrops, trees and buildings.

4.2 Bat Species

The project falls within the actual or predicted distribution range of approximately 14 species of bat (African Chiroptera Report 2013; Monadjem et al. 2010). However, the distributions of some bat species in South Africa, particularly rarer species, are poorly known so it is possible that more (or fewer) species may be present. Analysis of the acoustic monitoring data suggests that at least four species of bat are present (Table 1). The sensitivity of each of these species to the proposed WEF's is a function of their conservation status and the likelihood of risk to these species from WEF development. The likelihood of risk to impacts of wind energy was determined from the guidelines and is based on the foraging and flight ecology of bats and migratory behaviour.

Table 1: Bat Species Recorded at the Project and their Sensitivity to WEFs

Species	Species Code	# of Bat Passes[4]	Conservation Status[5]		Likelihood of Risk
			National	International	
Egyptian free-tailed bat *Tadarida aegyptiaca*	EFB	10,755	Least Concern	Least Concern	**High**
Natal long-fingered bat *Miniopterus natalensis*	NLB	1,937	Least Concern	Least Concern	**High**
Temminck's myotis *Myotis tricolor*	TM	224	Least Concern	Least Concern	**Medium-High**
Cape serotine *Neoromicia capensis*	CS	5,804	Least Concern	Least Concern	**Medium-High**

4.3 Spatio-Temporal Bat Activity Patterns

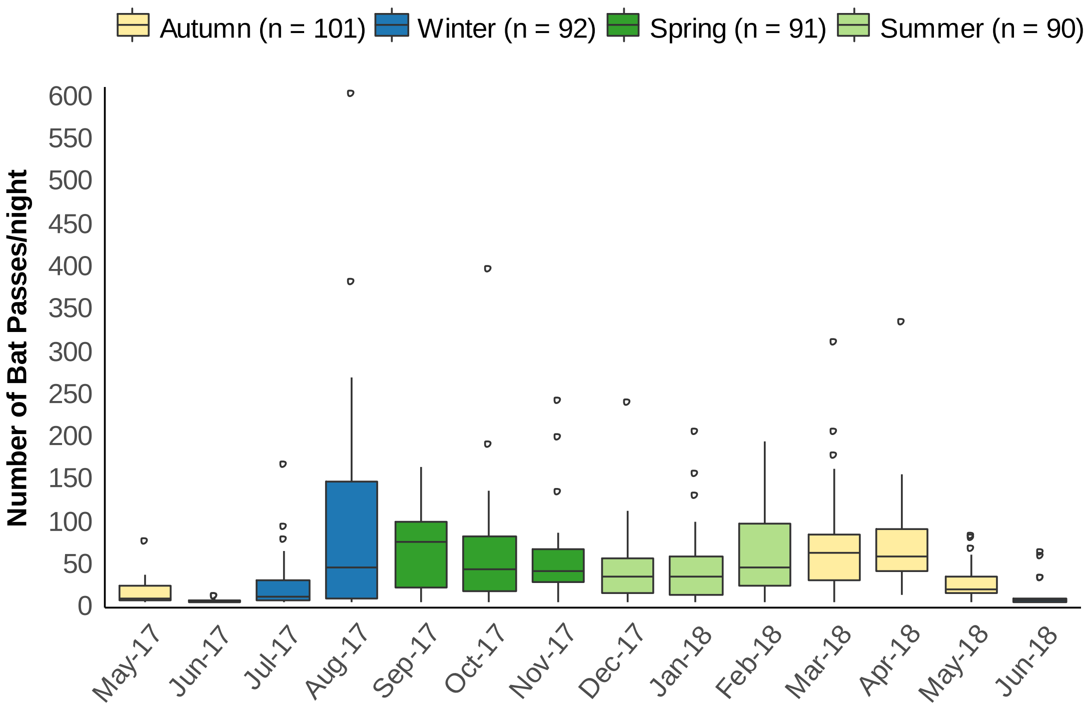
A total of 18,720 bat passes were recorded from 393 sample nights across the four species and across all bat detectors (Table 2). A median of 28 bat passes per night were recorded across the monitoring period. Overall, the levels of bat activity were low for most of the sampling period but this varied (Graph 1), and there were some periods when activity was moderate. Temporally isolated peaks in the total number of passes per night occurred in early August, at the end of October and during a one week period at the end of March leading into the beginning of April.

[4] A sequence of two or more echolocation calls separated from other calls by more than 500 milliseconds.

[5] Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D., Davies-Mostert, H.T. eds., 2016. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Table 2: Acoustic Monitoring Summary

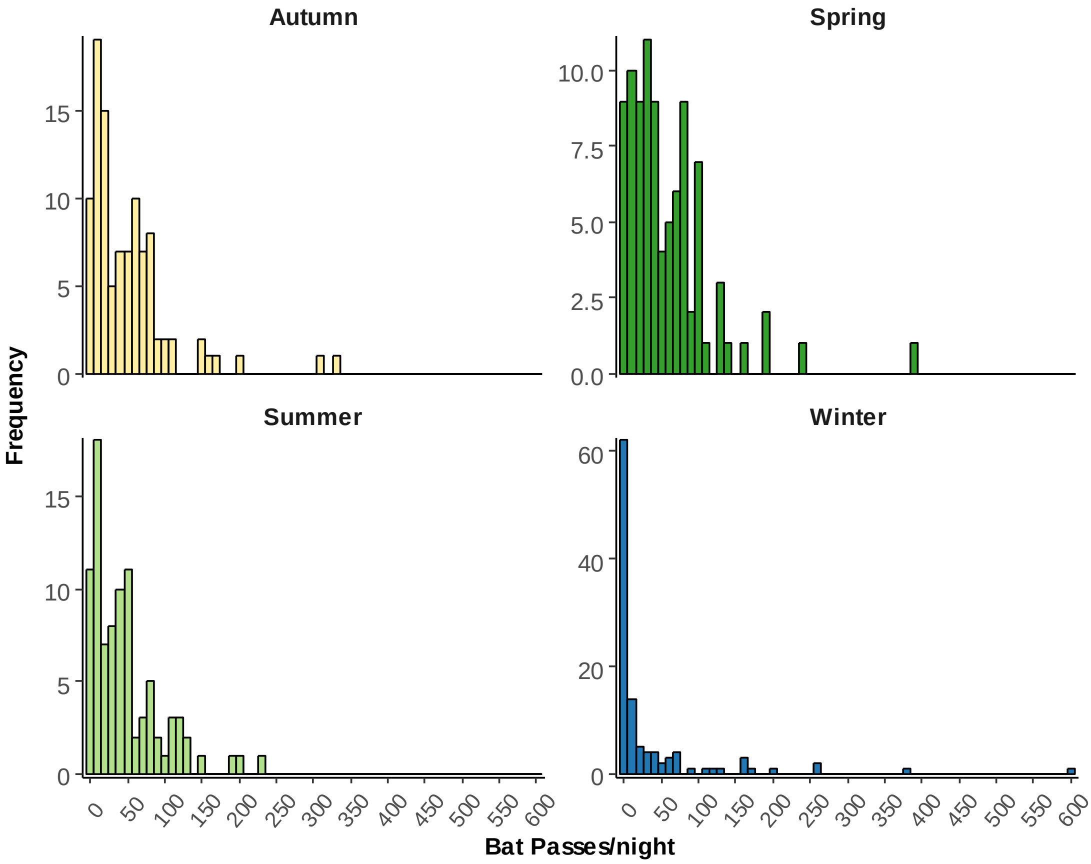
Monitoring Location	Altitude (masl)	# of Sample Nights	% of Sample Nights with Bat Activity	Total number of Bat Passes
HIGH1	871	347	86.2	4,003
HIGH2	957	370	74.3	2,449
HIGH3	1001	246	68.7	4,773
HIGH4	839	104	71.2	2,922
HIGH5	991	303	55.1	765
METLOW	1093	296	76.7	3,569
METHIGH	1183	296	23.6	239



Graph 1: Box and Whisker[6] plot showing the distribution of bat passes during each month.

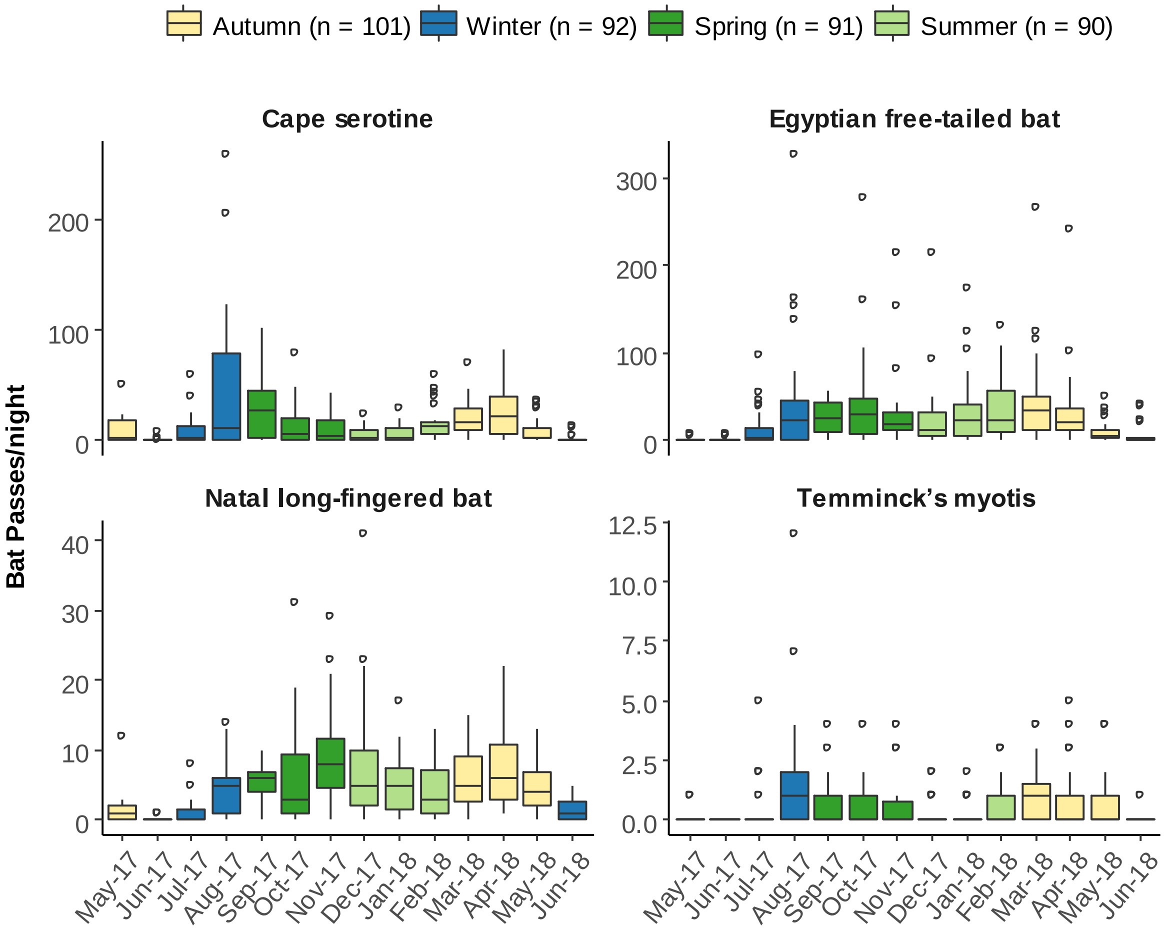
The monitoring data revealed seasonal patterns in bat activity. Bats were more active in spring (5,291 bat passes in total) and autumn (5,142 bat passes in total) and least active in winter (3,980 bat passes in total). Median bat activity in both spring and autumn was 39 bat passes per night, compared to 4 and 37.5 bat passes per night in winter and summer respectively (Graph 2). While median bat activity was similar in spring, autumn and summer the variation in bat activity within these seasons was different. For example, the range in the number of bat passes per night, and the number of nights with greater than 100 passes, was higher in spring (Graph 2). Winter had the highest number of nights when no bats were recorded (21 nights).

[6] The box spans the interquartile range of bat passes, the vertical lines show the range in the number of bat passes, and the dots represent outliers. The median number of bat passes per night for each month is show by the solid horizontal line in each box.



Graph 2: Histograms showing the frequency with which bat passes of different values occur in each season.

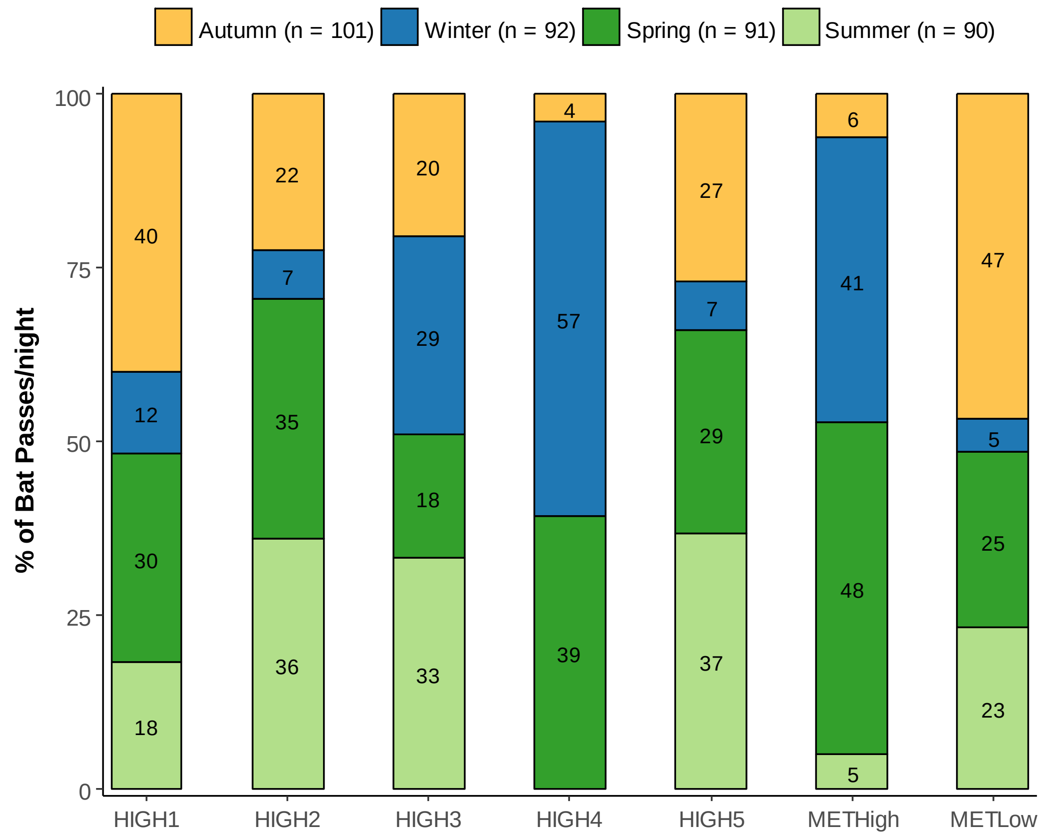
There was no clear pattern for individual species activity relative to months. The Cape serotine and Egyptian free-tailed bat, responsible for most activity, had highest median activity in September 2017 and March 2018 respectively (Graph 3). The migratory Natal long-fingered bat showed highest median activity in November 2017 and Temminck's myotis had consistently low levels throughout the survey period (Graph 3). All species had lowest activity in May and June. The maximum number of bat passes recorded on any individual night was 327 for the Egyptian free-tailed bat, 258 for the Cape serotine, 41 for the Natal long-fingered bat, and 12 for Temminck's myotis (Graph 3). Within seasons, the Egyptian free-tailed bat and Natal long-fingered bat had highest median activity in spring whereas the Cape serotine has highest median activity in autumn. There was no difference in median activity of Temminck's myotis across seasons.



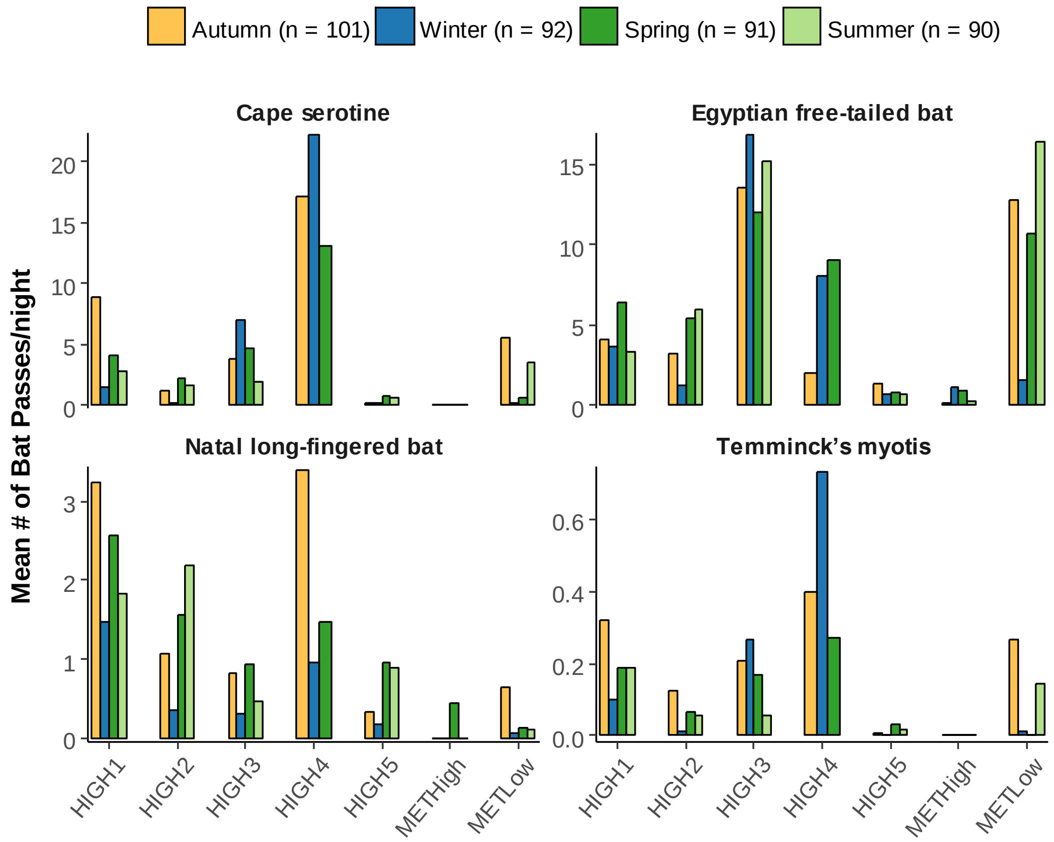
Graph 3: Box and Whisker plot showing the distribution of bat passes for each species per month.

At each monitoring location, there were differences in the proportion of bat activity recorded in each season. For example, at HIGH2, 36 % of all bat activity was recorded in summer whereas only 18 % of all bat activity recorded at HIGH1 was in summer. Instead, bats were recorded more often at HIGH1 in autumn (Graph 4). At HIGH3, HIGH4 and METHIGH, bat activity in winter made up a relatively high proportion of total activity (Graph 4). At METHIGH, the majority of bat activity was recorded in spring, while at METLOW, the majority was recorded during autumn (Graph 4). This variation was also reflected in how each species was recorded in different proportions in each season across the study area.

There was no consistent pattern in seasonal activity across species, and within species, at the different monitoring locations. For example, Temminck's myotis was recorded most often on average at HIGH4 during winter (Graph 5). The Cape serotine and Natal long-fingered bat were also recorded most often on average at HIGH4 but in winter and autumn respectively (Graph 5). The Egyptian free-tailed bat was recorded primarily at HIGH3 and METLOW which together accounted for 60 % of activity recorded of this species. On average there was little difference in activity of this species at HIGH3 across seasons while at METLOW, this species was not recorded often during winter (Graph 5). Activity recorded at HIGH5 and METHIGH was low for most species.

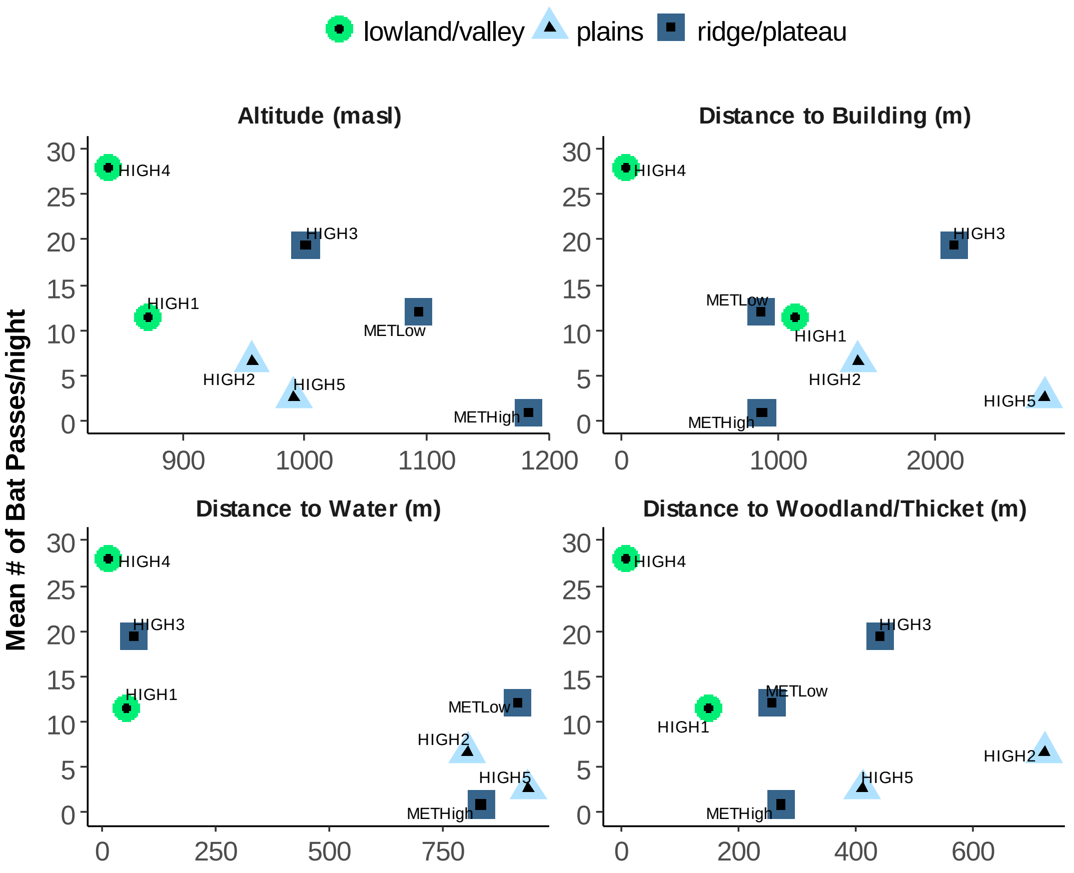


Graph 4: The percentage of bat activity recorded per season at each monitoring location.



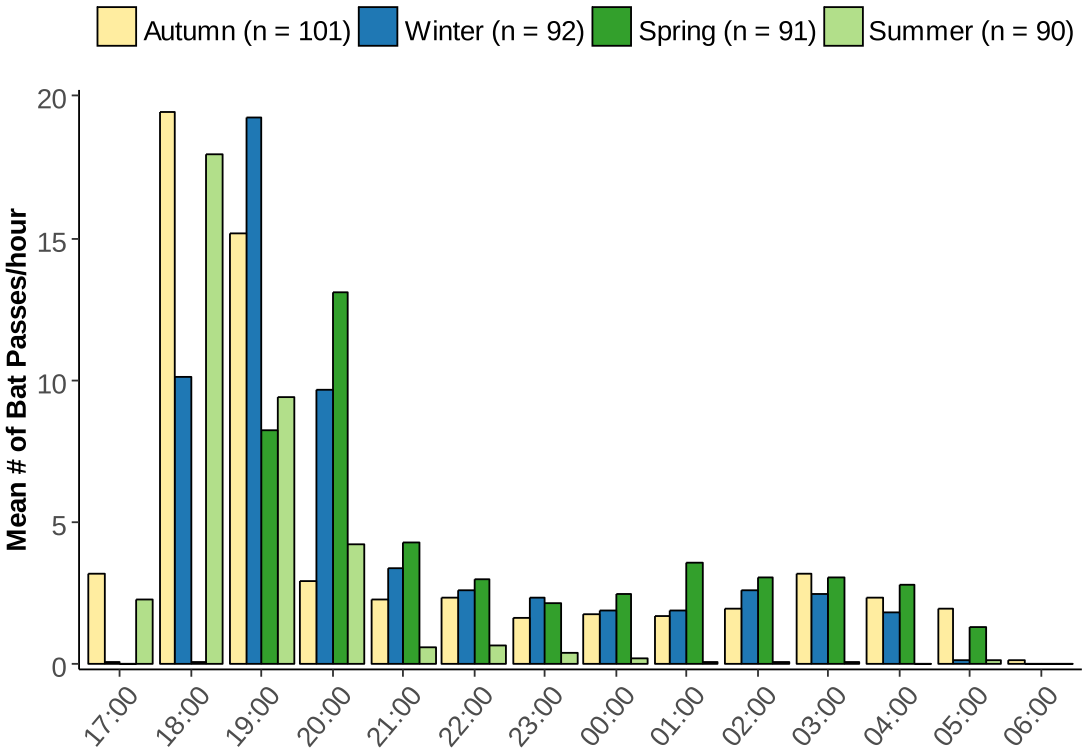
Graph 5: The mean number of bat passes per night at each monitoring location per species in each season.

Bat activity varied according to altitude and proximity to features important for bats. There was a negative relationship between bat activity and altitude, distance to buildings, water, and woodland/thicket habitat (Graph 6). However, these relationships were not very strong and only explained a small amount of the variation in bat activity. Activity was generally higher at lower altitudes such as in the valleys (e.g. HIGH 4) with the exception of HIGH3, situated on top of a ridge, which had relatively high activity compared to other locations at similar altitudes (Graph 6). This detector is approximately 71 m from a dam and this proximity to water might explain the higher activity despite the higher altitude. Detectors that were closer to wetlands and farm dams recorded higher activity compared to those further away (Graph 6). Detectors that were closer to important bat habitat such as woodland/thicket (for foraging) and buildings (for roosting) also recorded higher activity.

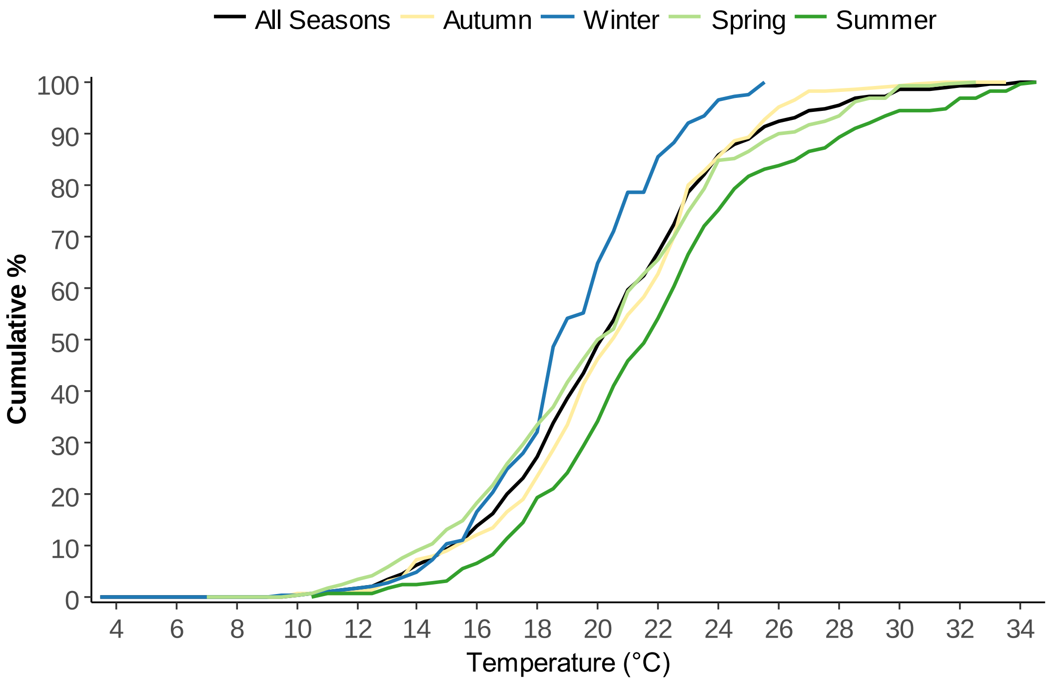


Graph 6: The mean number of bat passes/night in relation to altitude and distance to features important for bats.

Bats were active at the WEF site between 17:00 and 07:00 (Graph 7). There was a peak in activity in the early evening during all seasons which is typical for bats. In autumn bats were most active between 18:00 and 20:00. In winter and summer, bats were most active between 19:00 and 20:00. In spring, bat activity peaked between 19:00 and 21:00.



Graph 7: The mean number of bat passes/hour[7] across all species and locations during the study period.

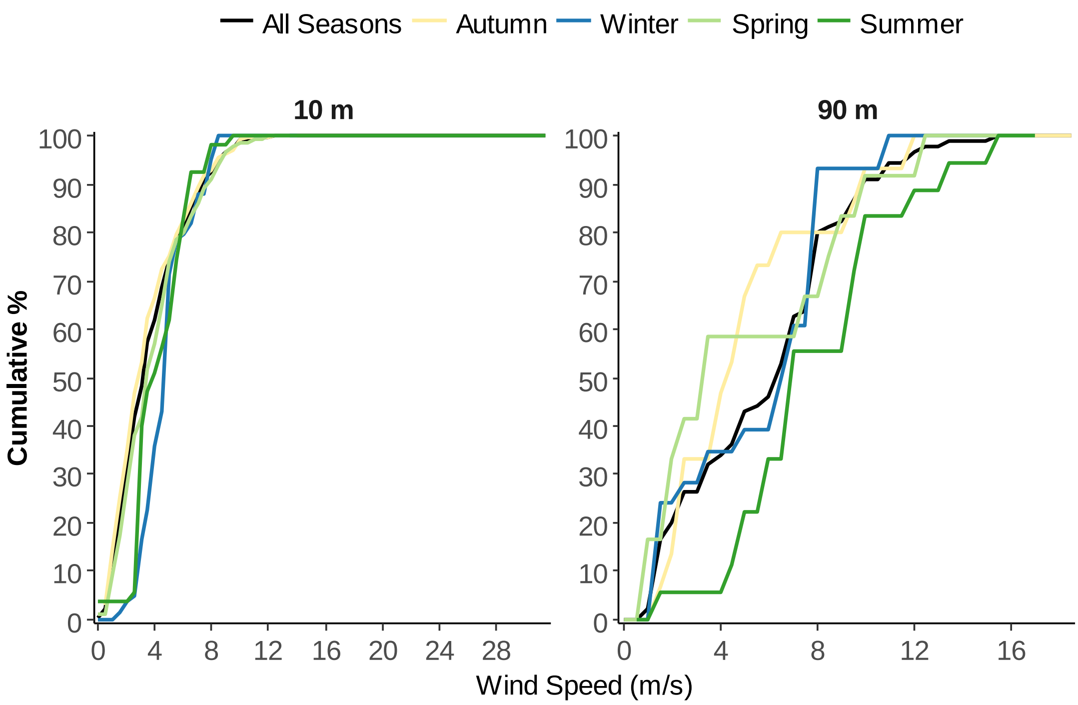


Graph 8: Accumulation curves of bat activity across all species with increasing temperature per season.

The accumulation curve showed that very little bat activity was recorded below 12 °C (Graph 8). In winter, bat activity increased markedly for temperatures between approximately 16 °C and 23 °C. In summer, the majority of the activity was recorded

[7] Each hour represents an hour time period. E.g. 17:00 represents bats recorded between 17:00 and 18:00.

between approximately 18 °C and 28 °C. In autumn, the majority of the bat activity was recorded between approximately 18 °C and 25 °C. In spring, the majority of the bat activity was recorded between approximately 16 °C and 26 °C.



Graph 9: Accumulation curves of bat activity across all species with increasing wind speed per season.

The highest wind speed in which bats were recorded was 15.5 m/s but the average wind speed in which bats were recorded was 4.9 m/s at 10 m, and 6.5 m/s at 90 m. At 10 m across all seasons, very little activity was recorded above 6 m/s to 7.5 m/s (Graph 9). At 90 m, in autumn, spring and summer, approximately 30 % to 40 % of recorded bat activity occurred below wind speeds of 3 m/s (the potential cut-in speed of the candidate turbines). In winter, only 5 % occurred below 3 m/s. Approximately 80 % to 90 % of the bat activity was recorded below 6.5 m/s in autumn, 8 m/s in spring, 9 m/s in summer and 10 m/s in winter respectively (Graph 9).

4.4 Bloukrans Cave

During our May 2017 survey, we estimated that approximately 2,000 – 3,000 Cape horseshoe bats are present in the cave. Herselman and Norton (1985) estimated that 1,000 Cape horseshoe bats might be present in the cave. These bats, which have a low risk to wind turbine induced mortality, were not recorded on the proposed development site. We also counted several individual Natal long-fingered bats but it is likely there were more present in the cave than we observed based on the acoustic data recorded over the two nights as bats emerged from the cave, and because not all areas of the cave could be surveyed. In addition, there were very large deposits of bat guano inside the cave suggesting that the cave has been occupied for a very long time by large numbers of bats. The large guano deposits also suggest that there has been consistent occupation of the cave by bats since 1985 when it was last surveyed.

Herselman and Norton (1985) estimated that 4,000 Natal long-fingered bats might use this cave as a maternity roost. If this is the case, it is possible that the low numbers we counted in May was due to a seasonal migration out of the cave during winter and that these bats might return to the cave in spring to give birth. During our visit to the cave in October 2017 (spring) we noted significantly more Natal long-fingered bats in the cave compared to the numbers present in May (autumn). The number of individuals was difficult to estimate as bats were disturbed which made counting difficult. A minimum of 500 Natal long-fingered bats were present in the cave but it is possible that over 1,000 individuals were present. Despite the difficulty in estimating the numbers of bats in the cave, there was a significant difference between the numbers of Natal long-fingered bats in the cave in May compared to October, which indicates that bats clearly moved into the cave in spring. In addition, very few Natal long-fingered bats were present in the cave during our June 2018 survey further indicating regular seasonal movement in and out of the cave.

Activity of Natal long-fingered bats on the site was low during the pre-construction monitoring. The period of highest activity for this species across the site was during November (1.8 passes per night) and December (1.9 passes per night). It was most often recorded at HIGH4 and associated with valleys and lowland areas of the site. The distance from the cave to the edge of the proposed WEFs (approximately 8 km) therefore appears to be of a sufficient distance that most Natal long-fingered bats do not forage there. The distance is however within the foraging range of this species; in France it can forage up to 29 km from their roosts (Vincent et al. 2011) and in Spain, foraging areas can by 15 km from their roosts (Serra-Cobo and Sanz-Trullen 1998). Aside from the potential risk to Natal long-fingered bats while foraging, this species is also vulnerable to impacts during migration.

The risks to Natal long-fingered bats would increase during the times of the year when they are moving to and from the cave (i.e. autumn and spring) as this might necessitate these bats moving across the wind farm, increasing risk of mortality. There was no obvious difference in Natal long-fingered bat activity recorded between autumn, spring and summer which might suggest that this species does not cross the site from the east (where there are known roosts) to reach the cave in the west, at least during the current monitoring period.

Based on these results and best-practise guidelines, a 20 km radial buffer has been placed around the cave inside which features that are important for bats have been buffered by larger distances than normal. For example, where appropriate a 350 m buffer has been applied to some farm dams or wetlands as opposed to the standard200 m buffer[8]. This 20 km buffer encompasses the entirety of the three proposed Highlands WEF’s. In addition, a 5 km no go buffer must be placed around the cave but this does not impact the current development boundaries.

4.5 Discussion

The bat activity data collected suggest primarily low levels of bat activity at the proposed WEF’s. Activity was greater at certain times of the year, particularly spring although the range in the number of bat passes per night was greatest in winter. The magnitude of overall recorded activity was such that bats should not face unacceptable risks should any of the WEFs be developed. This risk is variable across the site based on habitat and landscape features and how these influence the diversity of bat species and their activity. The risk to bats will also be limited to particular time periods(highest between 18:00 and 21:00 with slight variation across seasons), wind speeds and temperatures (bats tended to be most active in narrow range of wind speeds and temperatures).

Key findings are that bat activity decreased slightly with increasing altitude, and distance from water, buildings and woodland/thicket habitat respectively. Activity on the grassland plains in the east of the site and on top of ridges/plateaus was lower compared to bat activity in valleys. The diversity of species was not different but the magnitude of their

[8] Buffer distances were obtained from the bat guidelines.

activity was, with a higher preference across most species for the lowland and valley areas and areas near water. This is consistent with data from the Western Cape which showed that farm dams and artificial wetlands are important areas for bats (Sirami et al. 2013). Further, in a review of impacts of wind energy facilities in the United States, Thompson et al. (2017) showed that there was a negative relationship between bat mortality and the percentage of grassland surrounding turbines.

Based on these findings, buffer zones have been created around landscape features that are important for bats (Figure 1). These include hydrological features, including wetlands, farms dams, rivers and drainage lines which are important for connectivity. Areas of cultivation are also attractive to bats (e.g. activity at HIGH1) and these should be avoided as well as areas of thick bush, woodland and buildings which provide roosting spaces. No parts of the turbines, including the blade tips, should enter these buffers. Conversely, it would be preferable to place turbines in higher altitude areas of the site and in areas with greater grassland cover. All turbines adhere to the sensitivity buffers and turbine micro-siting must ensure that the blade tips do not intrude into these buffers (Figure 1).

5 IMPACT ASSESSMENT

WEFs have the potential to impact bats directly through collisions and barotrauma resulting in mortality (Horn et al. 2008; Rollins et al. 2012), and indirectly through the modification of habitats (Kunz et al. 2007b). Direct impacts pose the greatest risk to bats and, in the context of the project, habitat loss and displacement should not pose a significant risk because the project footprint (i.e. turbines, roads) is small compared to the size of the project.

Direct impacts to bats will be limited to species that make use of the airspace in the rotor-swept zone of the wind turbines. All the bat species that were recorded on site exhibit behaviour that may bring them into contact with wind turbine blades. They are this potentially at risk of negative impacts if not properly mitigated, although the magnitude of these impacts are unknown at this stage.

Impacts during the construction and operational phases were assessed for each of the three proposed WEFs, and their associated grid connections, together because the potential impacts are the same for each WEF. Therefore, only a single table per impact is presented. For the grid connection, the preferred alternatives for each WEF are shown in Figure 2. The potential impacts are assessed based on a methodology adapted from Hacking (1998).

5.1 Construction Phase Impact Assessment

5.1.1 Wind Energy Facilities

Impact Phase: Construction							
Possible Impact or Risk: Roost disturbance							
WEFs have the potential to impact bats directly through the disturbance of roosts during construction. Relevant activities include the construction of roads, Operation and Maintenance (O&M) buildings, sub-station(s), grid connection transmission line and installation of wind turbines. Excessive noise and dust during the construction phase could result in bats abandoning their roosts, depending on the proximity of construction activities to roosts. This impact will vary depending on the species involved; species that may roost in trees are likely to be impacted more (e.g. Cape serotine and Egyptian free-tailed bats; Monadjem et al. 2010) because tree roosts are less buffered against noise and dust compared to roosts in buildings and rocky crevices. Roosts are limiting factors in the distribution of bats and their availability is a major determinant in whether bats would be present in a particular location. Reducing roosting opportunities for bats is likely to have negative impacts. However, it is unlikely that this impact will occur as there are low numbers of roosting spaces where development is planned. Therefore, the significance of this impact would be low.							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**

Without Mitigation	Low	Medium	Low	Negative	Low	Low	Medium
With Mitigation	Low	Medium	Low	Negative	Low	Low	Medium

Can the impact be reversed?	UNKNOWN
Will impact cause irreplaceable loss of resources?	NO
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) It may be possible to limit roost abandonment by avoiding construction activities near roosts. No confirmed roosts have been found at the project but there are potential roosts that bats may be using including trees, rocky crevices and buildings.
2) It is recommended that a bat specialist survey the confirmed turbine locations and all other proposed site infrastructure for the presence of roosts within 200 m before any construction activities commence and once the preliminary design and layout of each WEF is complete.

Will this impact contribute to any cumulative impacts?	The cumulative impact of bats abandoning their roosts is dependent on the number of roosts affected, the species involved and extent of the impact across the assessed region. With effective management of the construction process across the cumulative developments and limiting roost disturbance, the cumulative impacts can be reduced.

Impact Phase: Construction

<u>Possible</u> Impact or Risk: Roost destruction

WEFs have the potential to impact bats directly through the physical destruction of roosts during construction. Relevant activities include the construction of roads, O&M buildings, sub-station(s), grid connection transmission lines and installation of wind turbines. Potential roosts that may be impacted by construction activities include trees, crevices in rocky outcrops and buildings. Roost destruction can impact bats either by removing potential roosting spaces which reduces available roosting sites or, if a roost is destroyed while bats are occupying the roost, this could result in bat mortality. Reducing roosting opportunities for bats or killing bats during the process of destroying roosts will have negative impacts. It is likely that roost destruction will occur if construction activities require the removal of trees, buildings and blasting rocky outcrops. If bats are occupying such roosts at the time they are destroyed it is likely this could result in mortality. However, a low numbers of roosts will likely need to be destroyed resulting in the significance of this impact being low after mitigation.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	High	Low	Negative	Medium	Medium	Medium
With Mitigation	Low	Low	Low	Negative	Low	Low	Medium

Can the impact be reversed?	NO
Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) The WEF and grid connection infrastructure must be designed and constructed in such a way as to avoid the destruction of potential roosts, particularly trees, rocky crevices (if blasting is required) and buildings.
2) No construction activities with the potential to physically affect any bat roosts will be permitted without the express permission of a suitably qualified bat specialist following appropriate investigation and mitigation.
3) It is recommended that a bat specialist surveys the confirmed turbine locations and the locations of all other site infrastructure, such as pylons, for the presence of occupied roosts among the potential roosts before any construction activities commence and once the preliminary design and layout of the site is complete.

4) If occupied roosts are confirmed these should be buffered based on best practise guidance, which includes a minimum buffer of 200 m.
5) A site-specific Construction Phase Environmental Management Plan (CEMP) must be created, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of bat habitat. All contractors are to adhere to the CEMP and should apply good environmental practice during construction.
6) During construction, laydown areas and temporary access roads should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation, while designated no-go areas must be enforced i.e. no off road driving.
7) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and a habitat restoration plan must be developed by a specialist and included within the CEMP.

Will this impact contribute to any cumulative impacts?	The cumulative impact of destroying multiple roosts across a region will be negative. With mitigation, effective design of WEFs and preventing roost destruction, the cumulative impacts can be reduced.

Impact Phase: Construction

Possible Impact or Risk: Habitat modification

Bats can be impacted indirectly through the modification or removal of habitats (Kunz et al. 2007b) and can also be displaced from foraging habitat by wind turbines (Millon et al. 2018). The removal of vegetation during the construction phase will impact bats by removing vegetation cover and linear features that some bats use for foraging and commuting (Verboom and Huitema 1997). The modification of habitat could create linear edges which some bats to commute or forage along. This modification could also create favourable conditions for insects upon which bats feed which would in turn attract bats. The footprint of the facility is small relative to the remaining habitat available in the surrounding area and as such the removal of vegetation is not likely to result in a significant impact. This impact can be reduced even further by limiting the removal of vegetation as far as possible.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Medium	Low	Negative	Low	Low	Medium
With Mitigation	Low	Medium	Low	Negative	Low	Low	Medium

Can the impact be reversed?	YES
Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:
1) This impact must be reduced by limiting the removal of vegetation as far as possible. A site-specific CEMP must be created, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of bat habitat. All contractors are to adhere to the CEMP and should apply good environmental practice during construction.
2) Before construction commences, a bat specialist should conduct a site walkthrough, covering the final road and power line routes as well as the final turbine positions, to identify any roosts/activity of sensitive species, as well as any additional sensitive habitats.
3) During construction laydown areas and temporary access roads should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation, while designated no-go areas must be enforced i.e. no off-road driving.
4) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and a habitat restoration plan must be developed by a specialist and included within the CEMP.

Will this impact contribute to any cumulative impacts?	Cumulative impacts should be low because of the limited amount of vegetation that would be removed at operating WEFs relative to the large area in the region that would not be developed. However, this will depend on the types of vegetation that are removed because the cumulative impact of removing endangered habitat will be greater than removing habitat that is not threatened.

Impact Phase: Construction

<u>Possible</u> Impact or Risk: Habitat creation in high risk locations

The construction of a WEF and associated building infrastructure may inadvertently provide new roosts for bats, attracting them to the area and indirectly increasing the risk of negative mortality impacts. It has been suggested that some bats may investigate wind turbines for their potential roosting spaces (Cryan et al. 2014; Horn et al. 2008; Kunz et al. 2007b) and bats could therefore be attracted to WEFs, increasing the chance of wind turbine-induced mortality. Bats may also be attracted to roosting opportunities in new buildings and other infrastructure such as road culverts at WEFs (J. Aronson, personal observation). The probability of large numbers of bats roosting in infrastructure at the project is low. However, if any bats do manage to do so, they would be at greater risk of mortality due to the proximity to wind turbines.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Medium	Low	Negative	Low	Low	Medium
With Mitigation	Low	Medium	Low	Negative	Low	Low	High

Can the impact be reversed?	YES
Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) Bats should be prevented from entering any possible artificial roost structures (e.g. roofs of buildings, road culverts and wind turbines) by ensuring that they are sealed in such a way as to prevent bats from entering. If bats colonise WEF infrastructure, a suitably qualified bat specialist should be consulted before any work is undertaken on that infrastructure or attempting to remove bats. Ongoing maintenance and inspections of buildings must be carried out to ensure no access to bats or actively roosting bats.

Will this impact contribute to any cumulative impacts?	If there are no roosting opportunities for bats at the project or other developments, the cumulative impacts will be low.

Impact Phase: Construction

<u>Possible</u> Impact or Risk: Habitat creation in high risk locations

The construction of a WEF and associated building infrastructure may inadvertently provide new roosts for bats, attracting them to the area and indirectly increasing the risk of negative mortality impacts. It has been suggested that some bats may investigate wind turbines for their potential roosting spaces (Cryan et al. 2014; Horn et al. 2008; Kunz et al. 2007b) and bats could therefore be attracted to WEFs, increasing the chance of wind turbine-induced mortality. Bats may also be attracted to roosting opportunities in new buildings and other infrastructure such as road culverts at WEFs (J. Aronson, personal observation). The probability of large numbers of bats roosting in infrastructure at the project is low. However, if any bats do manage to do so, they would be at greater risk of mortality due to the proximity to wind turbines.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Medium	Low	Negative	Low	Low	Medium
With Mitigation	Low	Medium	Low	Negative	Low	Low	High

Can the impact be reversed?	YES

Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) Bats should be prevented from entering any possible artificial roost structures (e.g. roofs of buildings, road culverts and wind turbines) by ensuring that they are sealed in such a way as to prevent bats from entering. If bats colonise WEF infrastructure, a suitably qualified bat specialist should be consulted before any work is undertaken on that infrastructure or attempting to remove bats. Ongoing maintenance and inspections of buildings must be carried out to ensure no access to bats or actively roosting bats.

Will this impact contribute to any cumulative impacts?	If there are no roosting opportunities for bats at the project or other developments, the cumulative impacts will be low.

5.1.2 Grid Connections

Impact Phase: Construction

<u>Possible</u> Impact or Risk: Roost disturbance

The grid connection infrastructure may impact bats directly through the disturbance of roosts during construction. Excessive noise and dust during the construction phase could result in bats abandoning their roosts, depending on the proximity of construction activities to roosts. This impact will vary depending on the species involved; species that may roost in trees are likely to be impacted more (e.g. Cape serotine and Egyptian free-tailed bats; Monadjem et al. 2010) because tree roosts are less buffered against noise and dust compared to roosts in buildings and rocky crevices. Roosts are limiting factors in the distribution of bats and their availability is a major determinant in whether bats would be present in a particular location. Reducing roosting opportunities for bats is likely to have negative impacts.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Low	Low	Negative	Low	Low	Medium
With Mitigation	Low	Low	Low	Negative	Low	Low	Medium

Can the impact be reversed?	UNKNOWN
Will impact cause irreplaceable loss of resources?	NO
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) It may be possible to limit roost disturbance and abandonment by avoiding construction activities near roosts. These include trees, caves, rocky crevices and buildings along the grid connection route.
2) It is recommended that a bat specialist survey the confirmed grid connection route for the presence of roosts before any construction activities commence.
3) A no-go buffer zone of 200 m, in which no construction activities may take place or no infrastructure is to come within must be applied around any roosts or potential roosts identified.

Will this impact contribute to any cumulative impacts?	The cumulative impact of bats abandoning their roosts is dependent on the number of roosts affected, the species involved and extent of the impact across the assessed region. With effective management of the construction process across the cumulative developments and limiting roost disturbance, the cumulative impacts can be reduced to low.

Impact Phase: Construction							
Possible Impact or Risk: Roost destruction							
The grid connection infrastructure may impact bats directly through the physical destruction of roosts during construction. Roosts are limiting factors in the distribution of bats and their availability is a major determinant in whether bats would be present in a particular location. Reducing roosting opportunities for bats is likely to have negative impacts. Potential roosts that may be impacted by construction activities include trees, rocky crevices and buildings. Roost destruction can impact bats either by removing potential roosting spaces which reduces available roosting sites or, if a roost is destroyed while bats are occupying the roost, this could result in bat mortality. It is likely that roost destruction will occur if construction activities require the removal of trees, buildings and blasting rocky outcrops. If bats are occupying such roosts at the time they are destroyed it is likely this could result in mortality. However, a low numbers of roosts will likely need to be destroyed resulting in the significance of this impact being low after mitigation							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Low	High	Low	Negative	Medium	Medium	Medium
With Mitigation	Low	Low	Low	Negative	Low	Low	Medium
Can the impact be reversed?	NO						
Will impact cause irreplaceable loss of resources?	YES						
Can impact be avoided, managed or mitigated?	YES						

Mitigation measures to reduce residual risk or enhance opportunities:

1) The grid connection route can be designed and constructed in such a way as to avoid the destruction of potential roosts, particularly trees, caves, rocky crevices (if blasting is required) and buildings.
2) No construction activities with the potential to physically affect any bat roosts will be permitted without the express permission of a suitably qualified bat specialist following appropriate investigation and mitigation.
3) It is recommended that a bat specialist survey the confirmed grid connection route for the presence of roosts before any construction activities commence.
4) A no-go buffer zone of 200 m, in which no construction activities may take place or no infrastructure is to come within must be applied around any roosts or potential roosts identified (limited to rocky crevices and buildings).
5) A site-specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the CEMP and should apply good environmental practice during construction.
6) During construction, laydown areas and temporary access roads should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation, while designated no-go areas must be enforced i.e. no off-road driving.
7) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and a habitat restoration plan must be developed by a specialist and included within the Construction Environmental Management Plan (CEMP).

Will this impact contribute to any cumulative impacts?	The cumulative impact of destroying multiple roosts across a region will be negative. With mitigation, effective design of WEFs and preventing roost destruction, the cumulative impacts can be reduced to low.

Impact Phase: Construction
Possible Impact or Risk: Habitat modification
Bats can be impacted indirectly through the modification or removal of habitats (Kunz et al. 2007b). The removal of vegetation during the construction phase will impact bats by removing cover and linear

features that some bats use for foraging and commuting (Verboom and Huitema 1997). The footprint of the grid connection route is small relative to the remaining habitat available in the surrounding area and as such the removal of vegetation is not likely to result in a significant impact. This impact can be reduced even further by limiting the removal of vegetation as far as possible.							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Low	Low	Low	Negative	Low	Low	Medium
With Mitigation	Low	Low	Low	Negative	Low	Low	Medium
Can the impact be reversed?				YES			
Will impact cause irreplaceable loss of resources?				YES			
Can impact be avoided, managed or mitigated?				YES			

Mitigation measures to reduce residual risk or enhance opportunities:

1) This impact must be reduced by limiting the removal of vegetation as far as possible. A site-specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the CEMP and should apply good environmental practice during construction.
2) A bat specialist should conduct a site walkthrough, covering the final power line routes and the switching station and substation areas, to identify any roosts/activity of sensitive species, as well as any additional sensitive habitats.
3) During construction laydown areas and temporary access roads should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation, while designated no-go areas must be enforced i.e. no off-road driving.
4) Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and a habitat restoration plan must be developed by a specialist and included within the Construction Environmental Management Plan (CEMP).

Will this impact contribute to any cumulative impacts?	Cumulative impacts should be low because of the limited amount of vegetation that would be removed relative to the large area in the region that would not be developed. However, this will depend on the types of vegetation that are removed because the cumulative impact of removing endangered habitat will be greater than removing habitat that is not threatened.

5.2 Operational Phase Impact Assessment

5.2.1 Wind Energy Facilities

Impact Phase: Operational							
<u>Possible</u> Impact or Risk: Bat mortality during commuting and/or foraging							
The major potential impact of wind turbines on bats is direct mortality resulting from collisions with turbine blades and/or barotrauma (Grodsky et al. 2011; Horn et al. 2008; Rollins et al. 2012). These impacts will be limited to species that make use of the airspace in the rotor-swept zone of the wind turbines. All species of bat that were recorded at the project exhibit behaviour that may bring them into contact with wind turbine blades and so they are potentially at risk of negative impacts.							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Medium	Medium	Medium	Negative	Medium	Medium	Medium
With Mitigation	Medium	Medium	Low	Negative	Low	Low	Medium
Can the impact be reversed?				NO			
Will impact cause irreplaceable loss of resources?				YES			
Can impact be avoided, managed or mitigated?				YES			

Mitigation measures to reduce residual risk or enhance opportunities: 1) Designing the layout of the project to avoid areas that are more frequently used by bats may reduce the likelihood of mortality and should be the primary mitigation measure. Low lying areas, buildings, woodland/thicket and areas near water should be avoided. This has been adhered to as all turbines adhere to buffer zones around these features (Figure 1). 2) The type of turbine used may influence fatality. Taller towers have a positive relationship between the numbers of bats killed at some wind energy facilities in Greece and Canada (Barclay et al. 2007; Georgiakakis et al. 2012). However there are no published data on this relationship in South Africa but unpublished data from other pre-construction monitoring reports suggest that bat activity at height in South Africa is lower. However, some species in South Africa that are not adapted for flight at height have suffered mortality suggesting that some bats may be killed in the lower edge of the rotor swept zone. Therefore, it is preferable to use taller towers but limit the rotor diameter such that the minimum distance between the blades and the ground is maximised. 3) Operational acoustic monitoring and carcass searches for bats must be performed, based on best practice, to monitor mortality and bat activity levels. Acoustic monitoring should include monitoring at height (from more than one location i.e. such as on turbines) and at ground level. 4) If mortality does occur beyond threshold levels as determined based on applicable guidance, mitigation needs to be considered. Mitigation options may include using ultrasonic deterrents, raising the cut-in speeds of turbines and turbine blade feathering. Any operational minimization strategy (i.e. curtailment) should be targeted during specific seasons and time periods for specific turbines coincident with periods of increased bat activity. 5) It is advised that both pre-construction and operational monitoring data are used to confirm the need for above mentioned mitigation measures such as curtailment and to determine at what stage of the development such mitigation needs to be implemented, if at all.	
Will this impact contribute to any cumulative impacts?	The cumulative impacts will depend on the number of WEFs in the region, the species involved and the levels of bat mortality. Bats reproduce slowly (Barclay and Harder 2003) and their populations can take long periods of time to recover from disturbances so the cumulative impacts can be high if appropriate management and mitigation is not implemented.

Impact Phase: Operational							
Possible Impact or Risk: Bat mortality during migration							
It has been suggested that some bats may not echolocate when they migrate (Baerwald and Barclay 2009) which could explain the higher numbers of migratory species suffering mortality in WEF studies in North America and Europe. Therefore, the direct impact of bat mortality may be higher when they migrate compared to when they are commuting or foraging. This is therefore considered here as a separate impact of the WEF on the Natal long-fingered bat, which is the only species recorded during pre-construction monitoring known to exhibit long-distance migratory behaviour. The majority of bat mortalities at WEFs in North America and Europe are migratory species. However, evidence from the pre-construction monitoring does not suggest migratory behaviour through the site. It is therefore unlikely that mortality will occur during migration periods but during the operating lifespan of the WEFs it may be possible that migration patterns and species distributions may change in response to climactic and/or habitat shifts. There may also be inter-annual variation in bat movement patterns which cannot be observed with a single year of data							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	High	Medium	Medium	Negative	Medium	Low	Medium
With Mitigation	Medium	Medium	Medium	Negative	Low	Low	Medium

Can the impact be reversed?	NO
Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) Designing the layout of the project to avoid areas that are more frequently used by bats may reduce the likelihood of mortality and should be the primary mitigation measure. Low lying areas, buildings, woodland/thicket and areas near water should be avoided. This has been adhered to as all turbines adhere to buffer zones around these features (Figure 1).
2) The type of turbine used may also influence fatality. Taller towers have a positive relationship between the numbers of bats killed at some wind energy facilities in Greece and Canada (Barclay et al. 2007; Georgiakakis et al. 2012). However there are no published data on this relationship in South Africa but unpublished data from other pre-construction monitoring reports suggest that bat activity at height in South Africa is lower. However, some species in South Africa that are not adapted for flight at height have suffered mortality suggesting that some bats may be killed in the lower edge of the rotor swept zone. Therefore, it is preferable to use taller towers but limit the rotor diameter such that the minimum distance between the blades and the ground is maximised.
3) Operational acoustic monitoring and carcass searches for bats should be performed to monitor mortality and bat activity levels. Acoustic monitoring should include monitoring at height (from more than one location i.e. such as on turbines) and at ground level. In addition, surveys of the Bloukrans cave should be undertaken in spring and autumn to assess changes in the annual movement patterns of the Natal long-fingered bat.
4) If mortality does occur, the level of mortality should be considered by a bat specialist to determine if this is at a level where further mitigation needs to be considered. Mitigation options may include using ultrasonic deterrents, raising the cut-in speeds of turbines and turbine blade feathering. Any operational minimization strategy (i.e. curtailment) should be targeted during specific seasons and time periods for specific turbines coincident with periods of increased bat activity.
5) It is advised that both pre-construction and operational monitoring data are used to confirm the need for above mentioned mitigation measures such as curtailment and to determine at what stage of the development such mitigation needs to be implemented, if at all.

Will this impact contribute to any cumulative impacts?	The cumulative impacts will depend on the number of WEFs in the region, the species involved and the levels of bat mortality. Bats reproduce slowly (Barclay & Harder 2003) and their populations can take long periods of time to recover from disturbances so the cumulative impacts can be high if appropriate management and mitigation is not implemented. Impacts may also affect populations over a large geographic area (Lehnert et al. 2014; Voigt et al. 2012) if gene flow is prevented in migratory species.

Impact Phase: Operational
<u>Possible</u> Impact or Risk: Light pollution
Currently the local region experiences very little light pollution from anthropogenic sources and the construction of a WEF will marginally increase light pollution. This excludes turbine aviation lights which do not appear to impact bats (Baerwald and Barclay 2011; Horn et al. 2008; Jain et al. 2011; Johnson et al. 2003). During the operation of the WEFs, it is assumed that the only light sources would be motion sensor security lighting for short periods and lighting associated with the substation. This artificial lighting would impact bats indirectly via the mortality of their insect prey thereby reducing foraging opportunities for certain bat species. Lighting attracts (Blake et al. 1994; Rydell

1992; Stone 2012) and can cause direct mortality of insects. These local reductions in insect prey may reduce foraging opportunities for bats, particularly for species that avoid illuminated areas. This impact is likely to be low before mitigation because, relative to the large area in the region that would not be developed that likely supports large numbers of insects, the prey resource for bats is likely to be sufficient. The consequence of this impact will be moderate before and after mitigation but the probability of the impact would reduce to unlikely.

Other bat species actively forage around artificial lights due to the higher numbers of insects which are attracted to these lights (Blake et al. 1994; Rydell 1992; Stone 2012). This may bring these species into the vicinity of the project and indirectly increase the risk of collision/barotrauma particularly for species that are known to forage around lights. These include the Cape serotine and the Egyptian free-tailed bat (Fenton et al. 2004; J. Aronson, personal observation). This impact is likely to be low with mitigation but must be carefully considered because the consequence could be severe without mitigation. Lighting at the project should be kept to a minimum and appropriate types of lighting should be used to avoid attracting insects, and hence, bats.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Medium	Low	Negative	Low	Low	Medium
With Mitigation	Low	Medium	Low	Negative	Low	Low	High

Can the impact be reversed?	YES
Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities:

1) This impact can be mitigated by using as little lighting as possible. Where lights need to be used such as at the substation and switching station and elsewhere, these should have low attractiveness for insects such as low pressure sodium and warm white LED lights (Rydell 1992; Stone 2012). High pressure sodium and white mercury lighting is attractive to insects (Blake et al. 1994; Rydell 1992; Svensson & Rydell 1998) and should not be used as far as possible.

Will this impact contribute to any cumulative impacts?	Cumulative impacts should be low if mitigation is applied because fewer insects would be attracted to lighting, and hence fewer bats would be attracted to feed on them. This would reduce the likelihood of bats encountering wind turbines.

5.2.2 Grid Connections

Impact Phase: Operational

<u>Possible</u> Impact or Risk: Bat mortality through collision with transmission lines

Insectivorous bats are unlikely to collide with transmission lines due to their ability to echolocate. They are therefore able to detect and avoid obstacles in their path, such as electrical cabling. Fruit bats do not echolocate in the same manner and can collide and become electrocuted by transmission lines. There is no published evidence of this in South Africa but these events do occur globally.

The geographic distribution of at least two species of fruit bat, the Egyptian rousette and Wahlberg's epauletted fruit bat, may overlap with the proposed grid connection route. The existence of suitable caves for roosting and fruit trees along or across this route may increase the likelihood that this species is present however these features are not present along the proposed grid connection routes.

	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Medium	Low	Negative	Low	Low	Medium
With Mitigation	Low	Medium	Low	Negative	Very Low	Low	Medium

Can the impact be reversed?	NO
Will impact cause irreplaceable loss of resources?	YES
Can impact be avoided, managed or mitigated?	YES

Mitigation measures to reduce residual risk or enhance opportunities: 1) As this impact is unlikely to occur, no mitigation options are provided.	
Will this impact contribute to any cumulative impacts?	The cumulative impacts will depend on the number of WEFs in the region, the species involved and the levels of bat mortality. Bats reproduce slowly (Barclay and Harder 2003) and their populations can take long periods of time to recover from disturbances so the cumulative impacts can be high if appropriate management and mitigation is not implemented.

5.3 Decommissioning Phase Impact Assessment

The impacts to bat during this phase (for both the wind energy facilities and their associated grid connections) are likely to be restricted to disturbance. Provided decommissioning activities are restricted to daylight hours, the impact to bats should be low.

5.4 Cumulative Impacts Assessment

The cumulative impact on bats was considered by searching for current and potential future development of wind energy facilities within a 35 km and 250 km radius of the project. One project is within the 35 km radius and approximately 67 project applications (eleven operational, 14 in process and 44 approved) are within the 250 km radius (Figure 3). It is not likely that all of these facilities will reach commercial operation. This scale was chosen because it represents the average distance between known Natal long-fingered bat roosts within the geographic region the north-eastern subpopulation of this species is located. The proposed Highlands wind energy facilities are located within this region and it is possible that these bats migrate seasonally between such roosts. (Miller-Butterworth et al. 2003). It is important to consider cumulative impacts across the entire scale potentially affected animals are likely to move, especially mobile animals like bats. Impacts at a local scale could have negative consequences at larger scales if the movement between distant populations is impacted (Lehnert et al. 2014; Voigt et al. 2012). For example, Lehnert et al. (2014) demonstrated that among Noctule bats collected beneath wind turbines in eastern Germany, 28 % originated from distant populations in the Northern and North-eastern parts of Europe.

The cumulative impacts could be lower for species that do not migrate over such large distances or resident species that are not known to migrate. Three of the four species recorded during the pre-construction monitoring do not migrate over such large distances. The sphere of the cumulative impact would then likely be restricted to the home ranges and foraging distances of different species, which can range from 1 km to at least 15 km for some insectivorous bats (Jacobs and Barclay 2009; Serra-Cobo and Sanz-Trullen 1998) and up to at least 24 km for some fruit bats (Jacobsen et al. 1986).

Cumulative impacts on bats could increase as new facilities are constructed (Kunz et al. 2007b) but are difficult to accurately predict or assess without baseline data on bat population size and demographics (Arnett et al. 2011; Kunz et al. 2007b) and these data are lacking for many South African bat species. It is possible that cumulative impacts could be mitigated with the appropriate measures applied to wind farm design and operation. Cumulative impacts could result in declines in populations of even those species of bats currently listed as Least Concern, if they happen to be more susceptible to mortality from wind turbines (e.g. high-flying open air foragers such as free-tailed and fruit bats) even if the appropriate mitigation measures are applied. Further research into the populations and behaviour of South African bats, both in areas with and without wind turbines, is needed to better inform future assessments of the cumulative effects of WEFs on bats.

Possible Impact or Risk: Cumulative Impacts							
Cumulative indirect impacts to bats, such as those relating to changes to the physical environment (e.g. roost and habitat destruction) are likely to be low across the cumulative impact regions. Cumulative direct impacts to bats, specifically those related to bat mortality, are likely to be higher. For non-migratory species cumulative direct impacts could have a medium or high significance before mitigation but could reduce to medium or low with appropriate turbine siting and operational mitigation if determined as being necessary based on operational monitoring. Direct impacts on migratory species (i.e. the Natal long-fingered bat) may be high before mitigation but could also reduce to medium with appropriate turbine siting and operational mitigation. However, these ratings would be dependent on all other surrounding wind energy facilities also adopting similar mitigation strategies to reduce impacts to bats. Limited data are available on the actual impacts to bats at the eleven operational facilities in the cumulative impact region. In addition, pre-construction monitoring data of bat activity are not a good predictor of the impacts that may be expected at operational wind farms (Hein et al. 2013), limiting their use in understanding and predicting cumulative impacts. Data from five operational wind farms in the cumulative impact region which we were able to access suggested that impacts to bats ranged from low to high. No current information is available to suggest that operational mitigation strategies are being applied at this specific facility. The addition of wind farms in the cumulative impact region may therefore have negative consequences particularly for the north-eastern subpopulation of the migratory Natal long-fingered bat. However, because of a lack of published data on the impact of wind energy facilities on bats in South Africa, and limited baseline data on bat population size and demographics, the confidence in this assessment is low.							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	High	Medium	High	Negative	High	Medium	Low
With Mitigation	High	Medium	Low	Negative	Medium	Medium	Medium
Can the impact be reversed?	NO						
Will impact cause irreplaceable loss of resources?	YES						
Can impact be avoided, managed or mitigated?	YES						
Mitigation measures to reduce residual risk or enhance opportunities: 1) At operational wind energy facilities where impacts to bats are high, or exceed threshold values[9], mitigation strategies such as curtailment or deterrents must be used. 2) The operation of lights at substations should be limited to avoid attracting bats to the area. Where lights need to be used such as at the substation and switching station and elsewhere, these should have low attractiveness for insects such as low pressure sodium and warm white LED lights (Rydell 1992; Stone 2012). High pressure sodium and white mercury lighting is attractive to insects (Blake et al. 1994; Rydell 1992; Svensson & Rydell 1998) and should not be used as far as possible.							
Will this impact contribute to any cumulative impacts?	The cumulative impacts will depend on the number of WEFs in the region, the species involved and the levels of bat mortality. Bats reproduce slowly (Barclay and Harder 2003) and their populations can take long periods of time to recover from disturbances so the cumulative impacts can be high if appropriate management and mitigation is not implemented.						

6 CONCLUSION

The increased occupation of the Bloukrans cave by the Natal long-fingered bat in October (spring) appears not to have influenced bat activity at the site. This migratory species would

[9] 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 for Operational Wind Energy Facilities – ed 2. South African Bat Assessment Association.

be at risk of encountering and colliding with wind turbines as it moves across the landscape to and from winter hibernacula towards the cave in autumn and spring but increased activity during these periods was not observed. It is not known which direction these bats would travel across the landscape to the cave but it is possible that they might move through the proposed WEF's especially if they fly from the east, westwards towards the cave. The finding that activity is higher near water, buildings and in the valley or lowland areas is important as an initial step to reduce the impact of the proposed WEF's to bats as the facilities must be designed to avoid these areas based on the sensitivity map (Figure 1). No parts of the turbines, including the blade tips, should enter these buffers.

The significance ratings for the majority of the impacts to bats posed by the development are predicted to be low or medium before mitigation and low after mitigation. Impacts related to bat mortality during migration are predicted to be of high consequence, and medium significance before mitigation, driven by the extent of the impact which is high. After mitigation this impact is predicted to be of medium consequence, and low significance. However, cumulative impacts may remain medium after mitigation. At this stage, the mitigation measures are related to the design of the proposed Highlands WEFs and associated grid connections and avoiding the placement of turbines in areas that bats are most active based on the pre-construction monitoring data. Additional mitigation measures that must be considered now are the choice of turbine model, with a preference for taller towers with a small rotor diameter. Monitoring of bat activity and bat fatality during the operational phase of the WEF is needed to determine if any additional mitigation measures are needed. Mitigation options may then include using deterrents or an operational minimization strategy (i.e. curtailment) during specific seasons and time periods for specific turbines coincident with periods of increased bat activity and fatality.

The bat monitoring data collected and analysed suggest that the development of the three proposed Highlands WEFs can be achieved without unacceptable risks to bats.

7 REFERENCES

ACR, 2013. African Chiroptera Report 2013. AfricanBats, African Chiroptera Project, Pretoria. i-xix + 6330 pp.

Adams, A.M., Jantzen, M.K., Hamilton, R.M., Fenton, M.B., 2012. Do you hear what I hear? Implications of detector selection for acoustic monitoring of bats. Methods in Ecology and Evolution 3, 992-998.

Arnett, E.B., Hein, C.D., Schirmacher, M.R., Baker, M., Huso, M.M.P., Szewczak., J.M., 2011. Evaluating the effectiveness of an ultrasonic acoustic deterrent for reducing bat fatalities at wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Baerwald, E.F., Barclay, R.M.R., 2009. Geographic variation in activity and fatality of migratory bats at wind energy facilities. Journal of Mammalogy 90, 1341-1349.

Baerwald, E.F., Barclay, R.M.R., 2011. Patterns of activity and fatality of migratory bats at a wind energy facility in Alberta, Canada. The Journal of Wildlife Management 75, 1103-1114.

Barclay, R.M.R., Baerwald, E.F., 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.

Barclay, R.M.R., Harder, L.D., 2003. Life histories of bats: Life in the slow lane, In Bat Ecology. eds T.H. Kunz, M.B. Fenton, pp. 209-253. The University of Chicago Press, Chicago.

Blake, D., Hutson, A.M., Racey, P.A., Rydell, J., Speakman, J.R., 1994. Use of lamplit roads by foraging bats in southern England. Journal of Zoology 234, 453-462.

Cryan, P.M., Gorresen, P.M., Hein, C.D., Schirmacher, M.R., Diehl, R.H., Huso, M.M., Hayman, D.T.S., Fricker, P.D., Bonaccorso, F.J., Johnson, D.H., Heist, K., Dalton, D.C., 2014. Behavior of bats at wind turbines. Proceedings of the National Academy of Sciences 111, 15126-15131.

Fenton, M.B., Jacobs, D.S., Richardson, E.J., Taylor, P.J., White, W., 2004. Individual signatures in the frequency-modulated sweep calls of African large-eared, free-tailed bats Otomops martiensseni (Chiroptera: Molossidae). Journal of Zoology 262, 11-19.

Georgiakakis, P., Kret, E., Carcamo, B., Doutau, B., Kafkaletou-Diez, A., Vasilakis, D., Papadatou, E., 2012. Bat fatalities at wind farms in north-eastern Greece. Acta Chiropterologica 14(2), 459-468.

Grodsky, S.M., Behr, M.J., Gendler, A., Drake, D., Dieterle, B.D., Rudd, R.J., Walrath, N.L., 2011. Investigating the causes of death for wind turbine-associated bat fatalities. Journal of Mammalogy 92, 917-925.

Hacking, T., 1998. An innovative approach to structuring environmental impact assessment reports. In: IAIA SA 1998 Conference Papers and Notes.

Hayes, J.P., 1997. Temporal Variation in Activity of Bats and the Design of Echolocation-Monitoring Studies. Journal of Mammalogy 78, 514-524.

Hein, C.D., Gruver, J., Arnett, E.B., 2013. Relating pre-construction bat activity and post-construction bat fatality to predict risk at wind energy facilities: a synthesis. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International, Austin, TX, USA.

Herselman, J.C., Norton, P.M., 1985. The distribution and status of bats (Mammalia: Chiroptera) in the Cape Province. Annals of the Cape Provincial Museums (Natural History) 16 (4):1-126.

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

Jacobs, D.S., Barclay, R.M.R., 2009. Niche Differentiation in Two Sympatric Sibling Bat Species, Scotophilus dinganii and Scotophilus mhlanganii. Journal of Mammalogy 90, 879-887.

Jacobsen, N.H.G., Viljoen, P.C., Ferguson, W., 1986. Radio tracking of problem fruit bats (Rousettus aegyptiacus) in the Transvaal with notes on flight and energetics. . Zeitschrift fuer Saeugetierkunde 51, 205-208.

Jain, A.A., Koford, R.R., Hancock, A.W., Zenner, G.G., 2011. Bat mortality and activity at a Northern Iowa wind resource area. American Midland Naturalist 165, 185-200.

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

Kunz, T.H., Arnett, E.B., Cooper, B.M., Erickson, W.P., Larkin, R.P., Mabee, T., Morrison, M.L., Strickland, M.D., Szewczak, J.M., 2007a. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. The Journal of Wildlife Management 71, 2449-2486.

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., 2007b. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5, 315-324.

Lehnert, L.S., Kramer-Schadt, S., Schönborn, S., Lindecke, O., Niermann, I., Voigt, C.C., 2014. Wind farm facilities in Germany kill noctule bats from near and far. PloS one 9, e103106.

Miller-Butterworth, C.M., Jacobs, D.S., Harley, E.H., 2003. Strong population substructure is correlated with morphology and ecology in a migratory bat. Nature 424, 187-191.

Millon, L., Colin, C., Brescia, F., Kerbiriou, C., 2018. Wind turbines impact bat activity, leading to high losses of habitat use in a biodiversity hotspot. Ecological Engineering 112, 51-54.

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

Rollins, K.E., Meyerholz, D.K., Johnson, G.D., Capparella, A.P., Loew, S.S., 2012. A forensic investigation into the etiology of bat mortality at a wind farm: barotrauma or traumatic injury? Veterinary Pathology Online 49, 362-371.

Rydell, J., 1992. Exploitation of insects around streetlamps by bats in Sweden. Functional Ecology 6, 744-750.

Serra-Cobo, J., Sanz-Trullen, J.P., 1998. Migratory movements of Miniopterus schreibersii in the north-east of Spain. Acta Theriologica 43, 271-283.

Sirami, C.l., Jacobs, D.S., Cumming, G.S., 2013. Artificial wetlands and surrounding habitats provide important foraging habitat for bats in agricultural landscapes in the Western Cape, South Africa. Biological Conservation 164, 30-38.

Stone, E.L., 2012. Bats and Lighting: Overview of current evidence and mitigation.

Svensson, A.M., Rydell, J., 1998. Mercury vapour lamps interfere with the bat defence of tympanate moths (Operophtera spp.; Geometridae). Animal Behaviour 55, 223-226.

Thomas, D.W., 1988. The distribution of bats in different ages of Douglas-Fir forests. The Journal of Wildlife Management 52, 619-626.

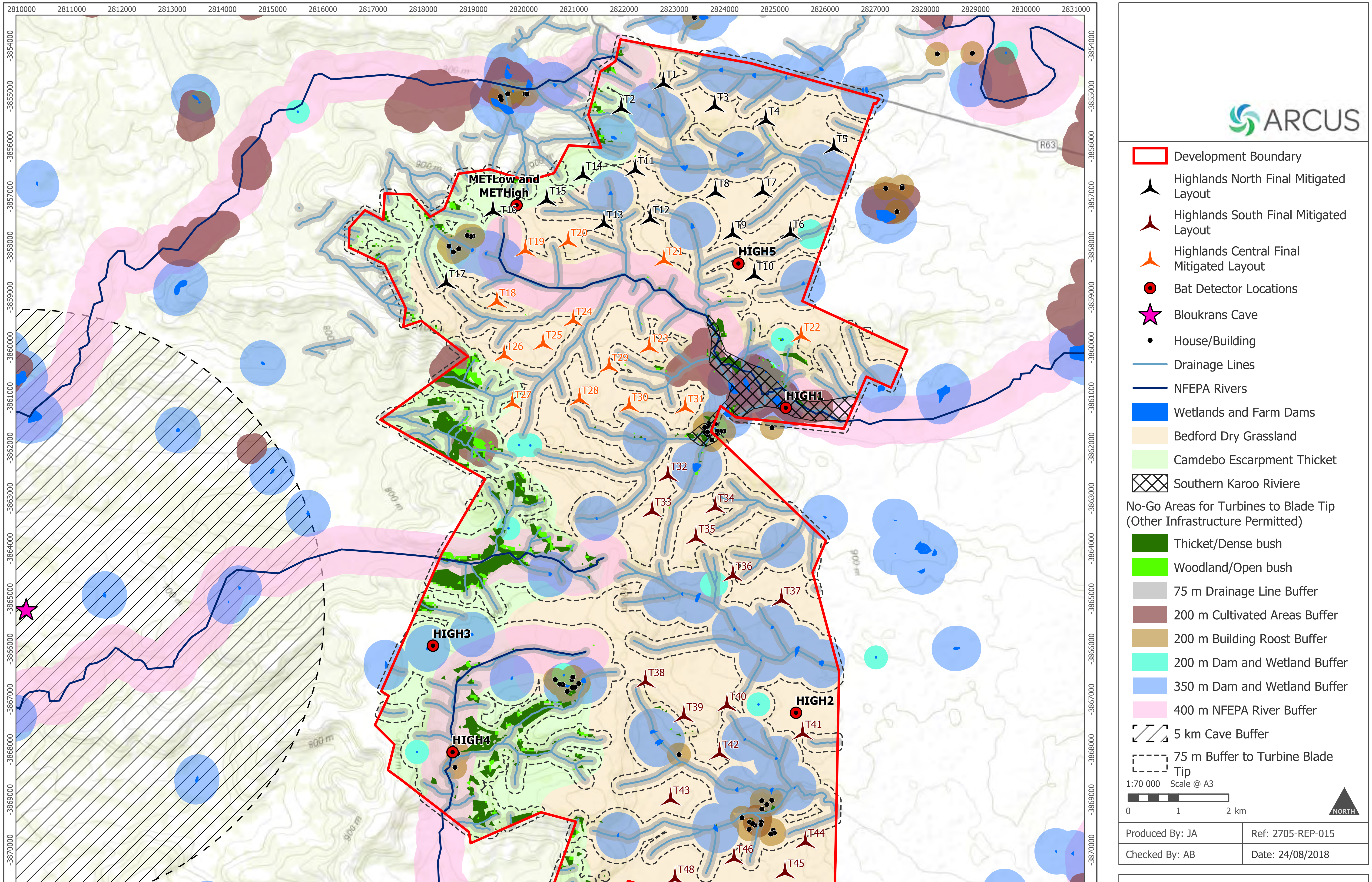
Thompson, M., Beston, J.A., Etterson, M., Diffendorfer, J.E., Loss, S.R., 2017. Factors associated with bat mortality at wind energy facilities in the United States. Biological Conservation 215, 241-245.

Verboom, B., Huitema, H., 1997. The importance of linear landscape elements for the pipistrelle Pipistrellus pipistrellus and the serotine bat Eptesicus serotinus. Landscape Ecology 12, 117-125.

Vincent, S., Nemoz, M., Aulagnier, S., 2011. Activity and foraging habitats of Miniopterus schreibersii (Chiroptera: Miniopteridae) in southern France: implications for its conservation. Hystrix - Italian Journal of Mammalogy 22, 57-72.

Voigt, C.C., Popa-Lisseanu, A.G., Niermann, I., Kramer-Schadt, S., 2012. The catchment area of wind farms for European bats: A plea for international regulations. Biological Conservation 153, 80-86.

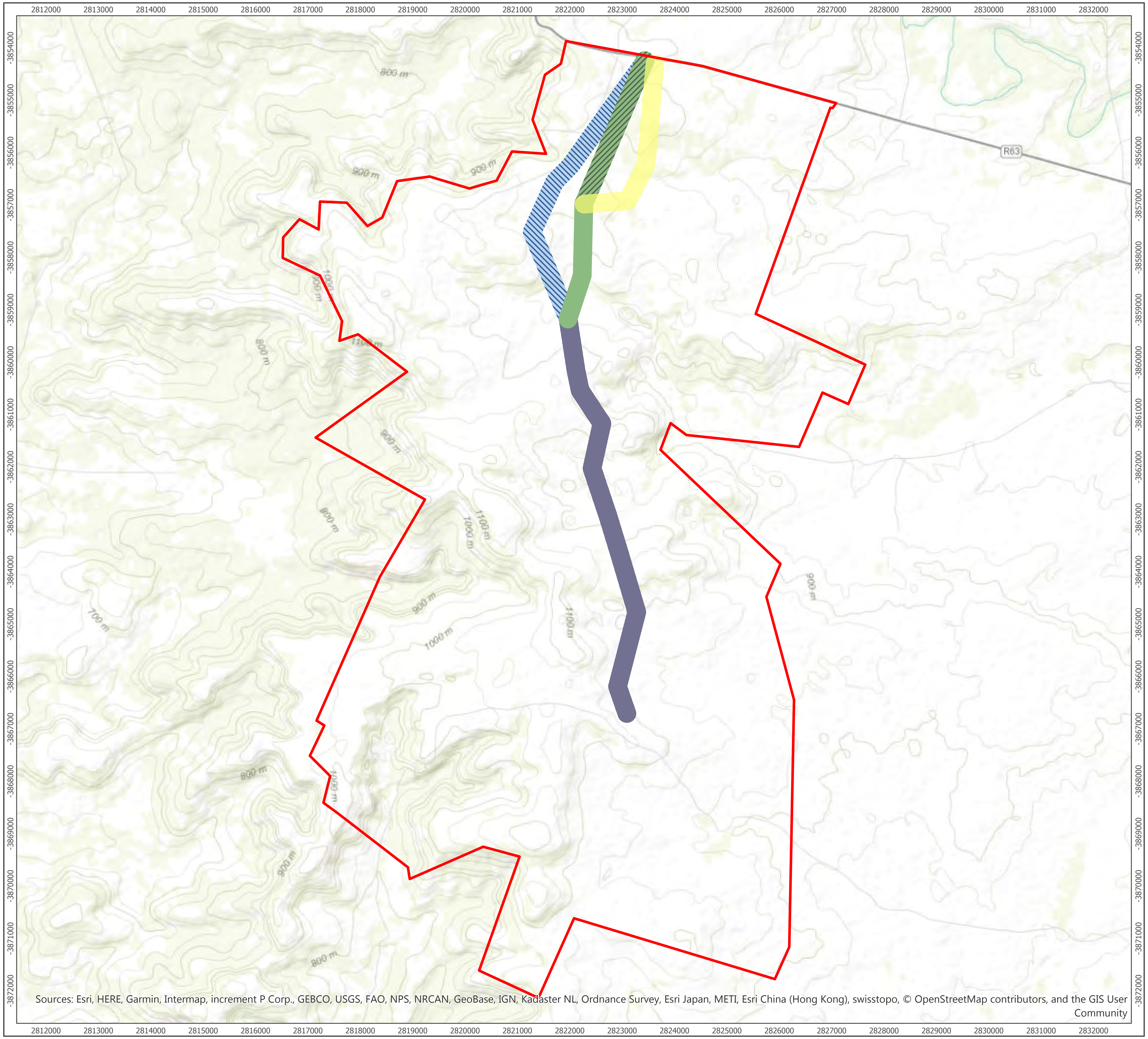
FIGURES



Bat Sensitivity Areas
Figure 1

Highlands Wind Farm
Pre-construction Bat Monitoring
Final EIA Repor

Z:\GIS\Projects\2705 Highlands WEF\2705 Highlands WEF\2705 Highlands WEF.aprx\Bat Fig 01



Z:\GIS\Projects\2705 Highlands WEF\2705 Highlands WEF\2705 Highlands WEF.aprx\Grid Connection

ARCUS

Development Boundary

Highlands North

- Grid Corridor Alternative 1 (Preferred)
- Grid Corridor Alternative 2

Highlands Central

- Grid Corridor Alternative 1
- Grid Corridor Alternative 2 (Preferred)

Highlands South

- Grid Corridor Alternative 1
- Grid Corridor Alternative 2 (Preferred)

1:70 000 Scale @ A3

0 1 2 km

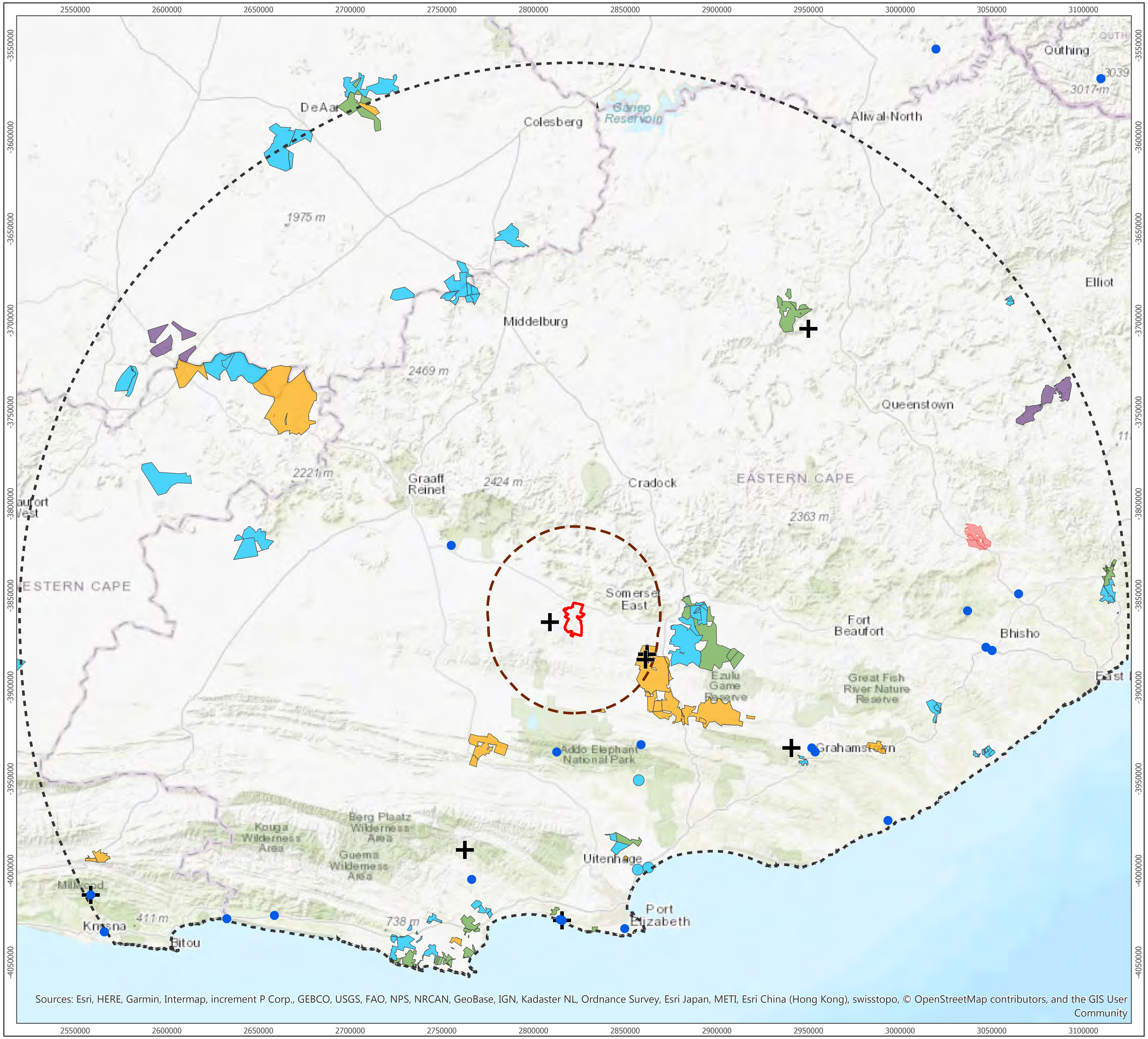
NORTH

Produced By: JA	Ref: 2705-REP-016
Checked By: AB	Date: 23/07/2018

Grid Connection Alternatives

Figure 2

Highlands Wind Farm
Pre-construction Bat Monitoring
Final EIA Report



ARCUS

- Development Boundary
- Miniopterus natalensis Locality Records
- Miniopterus natalensis Roost Locations
- Cumulative Impact Area 35 km radius
- Cumulative Impact Area 250 km radius

Wind Energy Projects, Status

- Onshore Wind, Operational
- Onshore Wind, Approved
- Onshore Wind, In process
- Onshore Wind and Solar PV, Approved
- Onshore Wind and Solar PV, In process

1:2 000 000 Scale @ A3

0 50 100 km NORTH

Produced By: JA	Ref: 2705-REP-025
Checked By: AB	Date: 20/08/2018

Cumulative Impact Assessment Region

Figure 3

Highlands Wind Farm
Pre-construction Bat Monitoring
Final EIA Report

Z:\GIS\Projects\2705 Highlands WEF\2705 Highlands WEF\2705 Highlands WEF.aprx\Bat Fig 03

APPENDIX 1

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Highlands Wind Energy Facilities and associated infrastructure including grid connection infrastructure

Specialist:	Jonathan Aronson		
Contact person:	Ashlin Bodasing		
Postal address:	Office 220, Cube Workspace, Long Street cnr Hans Strijdom Avenue, Cape Town		
Postal code:	8001	Cell:	0790988595
Telephone:	0214121529	Fax:	
E-mail:	jonathana@arcusconsulting.co.za		
Professional affiliation(s) (if any)	SACNASP		

Project Consultant:	Arcus Consultancy Services South Africa (Pty) Ltd		
Contact person:	Anja Albertyn		
Postal address:	Office 220, Cube Workspace, Long Street cnr Hans Strijdom Avenue, Cape Town		
Postal code:	8001	Cell:	0762658933
Telephone:	0214121529	Fax:	
E-mail:	highlands@arcusconsulting.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Jonathan Aronson, declare that --

General declaration:

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:

Arcus Consultancy Services South Africa (Pty) Ltd

Name of company (if applicable):

Date: 24/08/2018

APPENDIX 2

CURRICULUM VITAE

Jonathan Aronson MSc Pr.Sci.Nat
Ecology Specialist
Email:JonathanA@arcusconsulting.co.za

Specialisms	• Ecological Impact Assessments • Pre-construction and Operational monitoring at wind energy developments • Data analysis and statistical assessment of ecological data • GIS mapping and Analysis
Summary of Experience	Jonathan has 12 years of experience studying and researching bats and has presented at the International Bat Research Conference and local bat workshops. He has been at the forefront of bats and wind energy research in South Africa. He has contributed to the Good Practise Guidelines for Surveying Bats at Wind Energy Facilities in South Africa, is the lead author on the operational monitoring guidelines for bats and is a founding member of the South African Bat Assessment Advisory Panel (SABAAP). He has experience managing wind energy facility projects including developing survey strategies, implementing field surveys, data analysis and report writing. He can conduct reviews and assessments of Environmental Due Diligence and compliance with international environmental standards. He has provided extensive input to Environmental Impact Assessments (EIA) and post-construction Environmental Management Plans (EMP) for bats.
Professional History	2013 to 2017 - Ecology Specialist, Arcus Consultancy Services Ltd, Cape Town 2011 to 2013 - Director, Gaia Environmental Services Pty (Ltd), Cape Town 2008 to 2008 - Research Assistant, Percy Fitzpatrick Inst. of African Ornithology, Cape Town
Qualifications and Professional Interests	• **University of Cape Town, 2009-2010** Msc Zoology • **University of Cape Town, 2007** BSc (Hons) Freshwater Biology • **University of Cape Town, 2003-2006** BSc Zoology • Member of Society for Conservation Biology (2011 to present) • South African Bat Assessment Advisory Panel (2013 to present) • Professional Natural Scientist (Ecological Science) – SACNASP Registration #400238/14

Project Experience

<u>Bat Monitoring and Environmental Impact Assessments</u>

- Beck Burn Wind Farm. Post-construction Monitoring. (EDF Energy).
- Fazakerly Waste Water Treatment Works. Post-construction Monitoring. (United Utilities).
- Paulputs Wind Energy Facility. 12 months pre-construction bat monitoring study (WKN Windcurrent SA (Pty) Ltd).
- Putsonderwater Wind Energy Facility. 12 months pre-construction bat monitoring study (WKN Windcurrent SA (Pty) Ltd).
- Zingesele Wind Energy Facility. 12 months pre-construction bat monitoring study (juwi Renewable Energies (Pty) Ltd).
- Highlands Wind Energy Facility. 12 months pre-construction bat monitoring study (WKN Windcurrent SA (Pty) Ltd).
- Kap Vley Wind Energy Facility. 12 months pre-construction bat monitoring study (juwi Renewable Energies (Pty) Ltd).
- Universal and Sonop Wind Energy Faculties. Pre-construction bat monitoring (JG Afrika).
- Kolkies and Karee Wind Energy Facility. 12 months pre-construction bat monitoring study (Mainstream Renewable Power South Africa).
- Komsberg East and West Wind Energy Facility. 12 months pre-construction bat monitoring study (African Clean Energy Developments Pty Ltd).
- Gouda Wind Energy Facility. 24 months of operational monitoring for bats including activity and fatality surveys. (Blue Falcon 140 (Rf) Pty Ltd).
- Hopefield Wind Farm. 12 months of operational monitoring for bats including activity and fatality surveys. (Umoya Energy)
- Elliot Wind Energy Facility. Pre-construction bat monitoring study. (Rainmaker).
- Pofadder Wind Energy Facility. 12 months pre-construction bat monitoring study (Mainstream Renewable Power South Africa).
- Spitskop West Wind Energy Facility. 12 months pre-construction bat monitoring study (RES Southern Africa/Gestamp).

Email:JonathanA@arcusconsulting.co.uk Tel: +27 (0) 790 988 595

ARCUS

- Spitskop East Wind Energy Facility. Analysis of 12 months of pre-construction bat monitoring data (RES Southern Africa).
- Patryshoogte Wind Energy Facility. Pre-construction bat monitoring study (RES Southern Africa).
- Swartberg Wind Energy Facility. 12 months pre-construction monitoring and surveys for the presence of bats roosting in farm buildings (CSIR).
- Clover Valley and Groene Kloof Wing Energy Facility. Arcus staff undertook 12 months of pre-construction bat monitoring which included acoustic surveys and mist-netting to catch bats. (Western Wind Energy).
- Spitskopvlakte Wind Energy Project. Arcus staff assisted with the implementation of a survey of bat activity on this site located near Laingsburg in the Western Cape. This work included acoustic monitoring at several locations including monitoring at height.

Ecological Surveys

- Killean Wind Farm. Bat acoustic surveys including a driven transect and commissioning of bat detectors for this proposed site in Scotland, UK. (Renewable Energy Systems Ltd).
- Maple Road, Tankersely. Bat acoustic surveys including a walked transect for this proposed site near Barnsley, UK (Rula Developments).

Due Diligence

- Due Diligence of Bat Monitoring at the Kangas, Excelsior and Golden Valley Wind Farms (ERM).
- Due Diligence of Bat Monitoring at the Roggeveld Wind Farm (IBIS Consulting).

Amendment Applications

- Review and impact assessment for amendment to turbine dimensions for the Soetwater Wind Energy Facility (Savannah Environmental (Pty) Ltd).
- Review and impact assessment for amendment to turbine dimensions for the Karusa Wind Energy Facility (Savannah Environmental (Pty) Ltd).
- Review and impact assessment for amendment to turbine dimensions for the Zen Wind Energy Facility (Savannah Environmental (Pty) Ltd).

Peer Review

- Peer Review for Three Bat Monitoring Reports for the Bokpoort II Solar Developments (Golder Associates)
- Peer Review of Operational Monitoring at the Jeffreys Bay Wind Farm, including updating the operational mitigation strategy for bats (Globeleq South Africa Management Services (Pty) Ltd).
- Oyster Bay Wind Energy Facility. Reviewing a pre-construction bat monitoring study and providing input into a stand-alone study (RES Southern Africa).
- Review and design mitigation strategies for bats at the Kinangop Wind Park, Kenya (African Infrastructure Investment Managers).

Feasibility Studies

- Feasibility assessment for four potential wind farms in Mozambique (Ibis Consulting (Pty) Ltd).
- Assessment of the Feasibility of a Wind Farm in the Northern Cape (juwi Renewable Energies (Pty) Ltd).
- Assessment of the Feasibility of a Wind Farm in the Eastern Cape (WKN Windcurrent SA (Pty) Ltd).

Research Projects

- Darling National Demonstration Wind Farm Project. Designed and implemented a research project investigating bat fatality in the Western Cape.

CURRICULUM VITAE

Jonathan Aronson MSc Pr.Sci.Nat
Ecology Specialist
Email:JonathanA@arcusconsulting.co.uk Tel: +27 (0) 790 988 595

Publications

- MacEwan, K., **Aronson, J.**, Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W., Richards, L. South African Bat Fatality Threshold Guidelines for Operational Wind Energy Facilities – South African Bat Assessment Association (1st Edition).
- **Aronson, J.B.** and Sowler, S. (2016). Mitigation Guidance for Bats at Wind Energy Faculties in South Africa.
- **Aronson, J.B.**, Richardson, E.K., MacEwan, K., Jacobs, D., Marais, W., Aiken, S., Taylor, P., Sowler, S. and Hein, C (2014). South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (1st Edition).
- Sowler, S. and S. Stoffberg (2014). South African Good Practise Guidelines for Surveying Bats in Wind Energy Facility Developments - Pre-Construction (3rd Edition). Kath Potgieter, K., MacEwan, K., Lötter, C., Marais, M., **Aronson, J.B**., Jordaan, S., Jacobs, D.S, Richardson, K., Taylor, P., Avni, J., Diamond, M., Cohen, L., Dippenaar, S., Pierce, M., Power, J. and Ramalho, R (eds).
- **Aronson, J.B.**, Thomas, A. and Jordaan, S. 2013. Bat fatality at a Wind Energy Facility in the Western Cape, South Africa. *African Bat Conservation News* 31: 9-12.

Workshops, Seminars and Courses

- The Ecosystem Approach and Systems Thinking Course, United Nationals Environment Programme, Currently undertaking.
- Why Carbon Footprinting Makes Business Sense, African Climate and Development Initiative Seminar, September 2016.
- The Age of Sustainable Development Course, The SDG Academy, 2016.
- Planetary Boundaries and Human Opportunities Course, The SDG Academy, 2015.
- Endangered Wildlife Trust (EWT) Bats and Wind Energy Training Course, October 2013.
- Ecological Networks Course, Kirstenbosch Botanical Gardens, July 2013.
- Social and Economic Network Analysis Course, online via Stanford University, 2013.
- Social Network Analysis Course, online via University of Michigan, 2013
- Introduction to Complexity Science Course, online via Santa Fe Institute, 2013.
- Introduction to Spatial Analysis using R, Kirstenbosch Botanical Gardens, May 2013.
- Google Geo Tools for Conservation, University of Cape Town, February 2013.
- Endangered Wildlife Trust (EWT) Bats and Wind Energy Training Course, January 2012
- Statistical Modelling Workshop for Biologists, University of Cape Town, September 2010.
- ESRI Virtual Campus Online GIS Courses, 2010.
- WAYS/ScholarShip IT Workshop: Remote Sensing and GIS Course, March 2009.

REVIEW:
PRE-CONSTRUCTION BAT MONITORING REPORT
HIGHLANDS WIND ENERGY FACILITIES, EASTERN CAPE PROVINCE
Final Environmental Impact Assessment Report

Stephanie Dippenaar Consulting
sdippenaar@snowisp.com
+27 82 200 5244
VAT no. 4520274475
Professional member: SAIEES

27 August 2018

Jonathan Aronson
Ecology Specialist
Arcus Consultancy Services South Africa (Pty) Limited
Office 220 Cube Workspace
Cnr Long Street and Hans Strijdom Road
Cape Town
8001
Tel: +27 (0) 21 412 1535
Cel: +27 (0) 79 0988 595
Email: JonathanA@arcusconsulting.co.za

1. Introduction

Jonathan Aronson, Ecology Specialist, Arcus Consultancy Services South Africa (Pty) Limited, approached Stephanie Dippenaar Consulting per email on 24 August, requesting a review of the bat specialist study related to the Final Impact Assessment Report for the Highlands Wind Energy Facilities, Eastern Cape.

2. Applicable Guidelines

Before any wind farm facility development application can be considered, it is essential that sufficient information is received from specialists as part of the pre-construction monitoring report. The South *African Good Practice Guidelines for Surveying Bats at Wind Farm Developments – Pre-Construction*, (Sowler, et al, 2016, p32) provides the guidance on assessing the standard of pre-construction bat monitoring reports for onshore wind energy facilities. The underneath table summarises information requested by the guidelines, where it is addressed in the report and comments concerning the contents of the report.

Information as per the guidelines	Section where information is addressed or explanation	Comments
Expertise of the specialist	The specialist is a SACNASP registered bat specialist with 12 years of experience, See Appendix 2	It is assumed that the bat specialist covered all the components of the study himself, as there is no mention of assistants involved in the report.
Summary of the Scoping Study	Section 4	The legal process of Scoping is not relevant to the BA process, but the baseline information collected provides sufficient information for a background to the monitoring.
Pre-construction monitoring methods	Section 3	Sufficiently addressed
Limitations of survey techniques and equipment	Section 2.2	Sufficiently addressed
Monitoring of information	Section 4	Monitoring information is appropriately provided, clear graphs summarise the results, followed by a relevant discussion afterwards.
Analyses of Impacts	Section 5	Clear analysis of impacts with appropriate mitigation actions, covering all phases of the wind development site.

Methodology and Presentation of Findings

The methodology used is recognised by SABAA; therefore, the reviewer agrees with the methodology and approach of the report and recognises that the findings are appropriately discussed and sufficiently presented.

3. Agreement with the proposed recommendations and mitigations

The proposed recommendations and mitigations are in alignment with the Mitigation Guidance for Bats at Wind Energy Facilities in South Africa (Aronson and Sowler, 2014).

4. Conclusion

The reviewer is of the opinion that the pre-construction bat monitoring was done with due diligence and that the suggested mitigation measures were well researched.