SAN KRAAL SPLIT 1 WIND ENERGY FACILITY
EA AMENDMENT REPORT

BAT ASSESSMENT

On behalf of

SAN KRAAL WIND POWER (PTY) LTD

May 2019

Prepared By:

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1 INTRODUCTION

San Kraal Wind Power (Pty) Ltd are submitting an amendment application to change various components related to the San Kraal Wind Energy Facility (WEF) and to split this WEF into two. The San Kraal WEF has been approved for the construction of up to 78 turbines. The individual rating of turbines authorised is between 3 and 5 MW, with a rotor diameter of 150 m, hub height of 150 m and a blade length of 75 m. The amendments being applied for in this application that are relevant for bats are as follows:

- Hub height 137 m and rotor diameter 175 m
- Turbine output up to 6.2 MW
- Project output 217 MW
- 35 turbines, new locations within the approved San Kraal WEF development footprint

1.1 Terms of Reference

The report has been compiled under the following terms of reference and provides:

- An assessment of all impacts related to the proposed changes;
- Advantages and disadvantages associated with the proposed changes;
- Measures to ensure avoidance, management and mitigation of impacts associated with such proposed changes; and
- Any changes to the EMPr.

2 METHODOLOGY

In carrying out this assessment, Arcus conducted a literature review on bats and wind energy impacts with a focus on the relationship between turbine size and bat fatality. The literature review was carried out using the Web of Science® and Google Scholar using the following search terms:

bat OR fatality OR wind energy OR turbine OR wind turbine OR fatalities OR mortality OR mortalities OR kill* OR tower height OR height OR rotor swept zone OR rotor zone OR rotor swept area OR blades OR turbine blades OR influence OR increas* OR trend OR positive OR decreas* OR relation* OR wind farm OR wind energy facility OR carcass* OR chiroptera OR rotor diameter OR correlat* OR size*

In addition, the pre-construction bat monitoring report for the San Kraal WEF was reviewed, along with the current bat sensitivity buffers. The monitoring was conducted between July 2015 and September 2016.

3 REVIEW

The core issue relevant to this assessment is the impact to bats of increasing the size of the turbines at the San Kraal Split 1 WEF. The proposed amendment to the turbines at the wind farm would result in a greater rotor swept area per turbine and hence a potentially greater likelihood that bats would collide with turbine blades or experience barotrauma. Currently, the rotor swept area for each turbine will be up to 17,671 m^2 but based on the amendment being applied for, this would increase to up to 24,053 m^2.

Numerous studies support the hypothesis that taller wind turbines are associated with higher numbers of bat fatalities. Rydell et al. (2010) found a significant positive correlation between bat mortality with both turbine tower height and rotor diameter in Germany. However, there was no significant relationship between bat mortality and the minimum distance between the rotor and the ground. The maximum tower height in their study was 98 m, and data on rotor diameter were not given. In addition, there was no relationship between bat fatality and the number of turbines at a wind energy facility.

In Greece, Georgiakakis et al. (2012) found that fatalities were significantly positively correlated with tower height but not with rotor diameter. In their study, maximum tower

height and rotor diameters were 60 m and 90 m respectively. In Minnesota and Tennessee, USA, both Johnson et al. (2003) and Fiedler et al. (2007) showed that taller turbines with a greater rotor swept area killed more bats. The maximum heights of turbines in these two studies were 50 m and 78 m respectively. In Alberta, Canada, bat fatality rates differed partly due to differences in tower height, but the relationship was also influenced by bat activity (Baerwald and Barclay 2009). For example, sites with high activity but relatively short towers had low bat fatality and sites with low activity and tall towers also had low bat fatality. At sites with high bat activity, an increase in tower height increased the probability of fatality. Maximum turbine height and rotor diameter in this study were 84 m and 80 m respectively. Despite the above support for the hypothesis that taller wind turbines kill more bats, in a review of 40 published and unpublished studies in North America, Thompson et al. (2017) found no evidence that turbine height or the number of turbines influence bat mortality. Berthinussen et al. (2014) also found no evidence of modifying turbine design to reduce bat fatalities. The relationship between bat mortality and turbine size, or the number of turbines at a wind energy facility, is therefore equivocal.

Turbine size has increased since the above studies were published, and no recent data of the relationship between bat fatality and turbine size are available. The maximum size of the turbines in the literature reviewed (where indicated in each study) for this assessment had towers of 98 m and rotor diameters of 90 m. Some towers were as short as 44 m and had blade tips extending down to only 15 m above ground level. The towers and blades under consideration in this assessment are significantly taller than this. The approved turbine dimensions would have a maximum ground clearance of 75 m assuming that the maximum dimensions (150 m hub height and 150 m rotor diameter) currently authorised are used. The amendment would result in a ground clearance of 49.5 m assuming that the maximum dimensions (137 m hub height and 175 m rotor diameter) being applied for are used. There would be no change to the maximum tip height, which will remain 225 m.

It is possible that some bats species, particularly those not adapted to use open-air spaces, are being killed at the lower sweep of the turbine blades so increasing the blade length and having a shorter distance between the ground and the lowest rotor point may have a negative impact and potentially place a greater diversity of species at risk. This is a disadvantage of the proposed amendments. However, a potential advantage is that there will be fewer turbines than currently authorised. In South Africa, evidence of fatality for species which typically do not forage in open spaces high above the ground is available from several wind energy facilities (Aronson et al. 2013; Doty and Martin 2012; MacEwan 2016). Although Rydell et al. (2010) did not find a significant relationship between bat mortality and the minimum distance between the rotor and the ground, data from Georgiakakis et al. (2012) suggest that as the distance between the blade tips and the ground increases, bat fatality decreases.

It is not known what the impact of turbines of the size proposed for the San Kraal Split 1 WEF would be to bats because of a lack of published data from wind energy facilities with turbines of comparative size. Hein and Schirmacher (2016) suggest that bat fatality should continue to increase as turbines intrude into higher airspaces because bats are known to fly at high altitudes (McCracken et al. 2008; Peurach et al. 2009; Roeleke et al. 2018). However, McCracken et al. (2008), who recorded free-tailed bats in Texas from ground level up to a maximum height of 860 m, showed that bat activity was greatest between 0 and 99 m. This height band accounted for 27 % of the activity of free-tailed bats, whereas the 100 m to 199 m height band only accounted for 6 %.

In South Africa, simultaneous acoustic monitoring at ground level and at height is a minimum standard for environmental assessments at proposed wind energy facilities. Based on unpublished data from 17 such sites Arcus has worked at, bat activity and species diversity are greater at ground level than at height. Therefore, even though bats are recorded at heights that would put them at risk from taller turbines, the proportion of bats

that would be at risk might be less. Further, the number of species that might be impacted would decrease because not all bat species use the airspace congruent with the rotor swept area of modern turbines owing to morphological adaptations related to flight and echolocation. Bats that are adapted to use open-air space, such as free-tailed and sheath-tailed bats, would be more at risk.

In the United Kingdom, both Collins and Jones (2009) and Mathews et al. (2016) showed that fewer species, and less activity, were recorded at heights between 30 m and 80 m compared to ground level. In two regions in France, Sattler and Bontadina (2005) recorded bat activity at ground level, 30 m, 50 m, 90 m and 150 m and found more species and higher activity at lower altitudes. Roemer et al. (2017) found that at 23 met masts distributed across France and Belgium, 87 % of bat activity recorded was near ground level. However, the authors also showed a significant positive correlation between a species preference for flying at height and their collision susceptibility, and between the number of bat passes recorded at height and raw (i.e. unadjusted) fatality counts. In a similar study in Switzerland, most bat activity was recorded at lower heights for most species, but the European free-tailed bat had greater activity with increasing height (Wellig et al. 2018). During the pre-construction bat monitoring at the San Kraal WEF, bat activity was recorded at 10 m and 80 m. Relatively high bat activity was recorded overall, but the majority of this was at 10 m. These results suggest that on average, bat activity is greater at lower heights but that there are important differences across species – those species adapted to using open-air spaces are at greater risk.

4 IMPACT ASSESSMENT

Of the impacts identified in the EIA, only mortality of species due to collision with turbine blades or due to barotrauma, and cumulative impacts are relevant to this amendment. The significance of all other identified impacts on bats associated with the development will remain the same as per the EIA. The potential collision impact to bats was originally assessed as high before mitigation and medium after the application of mitigation measures. The proposed changes to the development due to layout changes and changes to the turbine dimension, will not change the rating of this impact. Therefore for this amendment application the potential collision impact to bats will remain high before mitigation and medium after mitigation.

The original cumulative assessment of bat mortalities due to direct blade impact or barotrauma during foraging was assessed for authorised and proposed developments within a 35 km radius of the original San Kraal WEF site. Since the original assessment, there have been a number of amendment applications that the specialist is aware of within the 35 km radius, and this was taken into consideration in this updated assessment. The cumulative impacts as assessed originally will not change and the assessment remains high before the application of mitigation measure and medium after mitigation measures have been applied.

The primary mitigation measures are avoiding sensitive areas for bats and curtailment. Curtailment as outlined in the orginal report must be adhered to and carried forward in the Environmental Management Programme. However, even though changes to the turbine dimensions are proposed, which may impact bats, the impact ratings, as mentioned above will not change from high before mitigation and medium after mitigation. The only change required is to update the sensitivity map, which has been done, in the EIA Amendment reports.

Sensitive areas were defined as either high (with a 200 m buffer) or moderate (with a 100 m buffer). The current turbine layout adheres to these buffers, with no turbines located within them. While not explicitly stated in the pre-construction monitoring report, these buffers must be to blade tip. To determine the buffer distances required to ensure that no

turbine blades enter the bat buffers, the following formula should be used (Mitchell-Jones and Carlin 2014):

$$b = \sqrt{(bd + bl)^2 - (hh - fh)^2}$$

Where: bd = buffer distance, bl = blade length, hh = hub height and fh = feature height (zero in this instance)

Thus, based on the above, assuming a high sensitivity buffer of 200 m, a turbine with a rotor diameter of 175 m and hub height of 137 m will need to be 253 m away from the buffered feature (i.e. the base of the turbine must be positioned 253 m away from the buffered feature). For the moderate sensitive areas, the turbine base needs to be 128 m from the buffered feature. No turbines in the layout being applied for are within the 253 m high sensitivity or 128 m moderate sensitivity buffers respectively.

No bat activity data are available in the area between the heights of 10 m and 80 m or over 80 m, because activity at these heights was not monitored. Despite the available pre-construction monitoring data showing that bat activity at 80 m is low, it would be preferential to maximise the distance between the ground and blade tips by using turbines with the shortest possible blades and the highest possible hub height. This would reduce the number of species potentially impacted upon by turbine blades during the operation phase. It would also be preferential to use shorter blades so that they don't intrude into higher airspaces and in doing so reduces the potential impact to high flying species such as free-tailed bats. Despite the low activity at height, increasing evidence suggests that bats actively forage around wind turbines (Cryan et al. 2014; Foo et al. 2017), so the installation of turbines in the landscape may alter bat activity patterns, either by increasing activity at height and/or increasing the diversity of species making use of higher airspaces.

5 CONCLUSION

Compared to the previous impact assessment undertaken by Animalia, it is unlikely that the amendments to the turbine dimensions proposed for the San Kraal Split 1 WEF would increase the currently rated impacts on bats and therefore the specialist has no objection to the amendment application and authorisation. This is assuming that the mitigation measures proposed in the pre-construction bat monitoring report, and which are included in the EMPr, are adhered to. These include avoiding the placement of turbines in bat buffers (which has been adhered to), and initiating curtailment from the start of operation of the facility as described in the pre-construction bat monitoring report and EMPr. No additional mitigation measures are required, and as such, no changes to the EMPr are required either.

6 REFERENCES

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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.

Hein, C.D., Schirmacher, M.R., 2016. Impact of wind energy on bats: a summary of our current knowledge. Human-Wildlife Interactions 10(1):19–27.

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Kumar, S., Ali, A., Arun, P., 2013. Bat mortality due to collision with wind turbines in Kutch District, Gujarat, India. . Journal of Threatened Taxa, 5(13), 4822-4824.

MacEwan, K., 2016. Fruit bats and wind turbine fatalities in South Africa. African Bat Conservation News 42.

Mathews, F., Richardson, S., Lintott, P., Hosken, D., 2016. Understanding the Risk of European Protected Species (Bats) at Onshore Wind Turbine Sites to Inform Risk Management. Report by University of Exeter. pp 127.

McCracken, G.F., Gillam, E.H., Westbrook, J.K., Lee, Y.-F., Jensen, M.L., Balsley, B.B., 2008. Brazilian free-tailed bats (Tadarida brasiliensis: Molossidae, Chiroptera) at high altitude: links to migratory insect populations. Integrative and Comparative Biology 48, 107-118.

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Wellig, S.D., Nusslé, S., Miltner, D., Kohle, O., Glaizot, O., Braunisch, V., Obrist, M.K., Arlettaz, R., 2018. Mitigating the negative impacts of tall wind turbines on bats: Vertical activity profiles and relationships to wind speed. PloS one 13, e0192493.

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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 and has worked on more than 40 WEF projects in South Africa, Kenya, Mozambique, Zambia and the UK undertaking pre-construction monitoring, operational monitoring, impact assessments and mitigation strategy design. He is a co-author of 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 has provided extensive input to Environmental Impact Assessments (EIA) and post-construction Environmental Management Plans (EMP) for bats.

Professional History

2019 to current - Senior Ecologist, Arcus Consultancy Services Ltd, Cape Town
2013 to 2019 - 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 Affiliations

- **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 2018)
- South African Bat Assessment Association (2013 to present)
- Professional Natural Scientist (Ecological Science) – SACNASP Registration #400238/14

Project Experience

<u>Pre-Construction Bat Monitoring and Environmental Impact Assessments</u>

- Pienaarspoort Wind Energy Facility (ABO Wind renewable energies (Pty) Ltd).
- Nuweveld Wind Energy Facility (Red Cap Energy (Pty) Ltd).
- Banna Ba Phifu Wind Energy Facility (WKN Windcurrent SA (Pty) Ltd).
- Choje Wind Farm (Wind Relic (Pty) Ltd).
- Kwagga Wind Energy Facility (ABO Wind renewable energies (Pty) Ltd).
- Wind Farm in Zambia (SLR Consulting).
- Namaacha Wind Farm (Consultec).
- Beck Burn Wind Farm. Post-construction Monitoring. (EDF Energy).
- Paulputs Wind Energy Facility (WKN Windcurrent SA (Pty) Ltd).
- Putsonderwater Wind Energy Facility (WKN Windcurrent SA (Pty) Ltd).
- Zingesele Wind Energy Facility (juwi Renewable Energies (Pty) Ltd).
- Highlands Wind Energy Facility (WKN Windcurrent SA (Pty) Ltd).
- Kap Vley Wind Energy Facility (juwi Renewable Energies (Pty) Ltd).
- Universal and Sonop Wind Energy Faculties (JG Afrika).
- Kolkies and Karee Wind Energy Facility (Mainstream Renewable Power South Africa).
- Komsberg East and West Wind Energy Facility (African Clean Energy Developments Pty Ltd).
- Pofadder Wind Energy Facility (Mainstream Renewable Power South Africa).
- Elliot Wind Energy Facility (Rainmaker Energy).
- Spitskop West Wind Energy Facility (RES Southern Africa/Gestamp).
- Spitskop East Wind Energy Facility (RES Southern Africa).
- Patryshoogte Wind Energy Facility (RES Southern Africa).
- Swartberg Wind Energy Facility (CSIR).
- Clover Valley and Groene Kloof Wing Energy Facility (Western Wind Energy).

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Operational Bat Monitoring Studies

- West Coast One Wind Energy Facility. Post-construction Monitoring (Aurora Wind Power (RF) (Pty) Ltd).
- Fazakerly Waste Water Treatment Works. Post-construction Monitoring. (United Utilities).
- Gouda Wind Energy Facility (Blue Falcon 140 (Rf) Pty Ltd)
- Hopefield Wind Farm (Umoya Energy).

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

Amendment Applications

- Ukomeleza Wind Energy Facility (CES - Environmental and social advisory services).
- Great Kei Wind Energy Facility (CES - Environmental and social advisory services).
- Motherwell Wind Energy Facility (CES - Environmental and social advisory services).
- Dassiesridge Wind Energy Facility (CES - Environmental and social advisory services).
- Great Karoo Wind Energy Facility (Savannah Environmental (Pty) Ltd).
- Gunstfontein Wind Energy Facility (Savannah Environmental (Pty) Ltd).
- Komserberg East and West Wind Energy Facilities (Aurecon South Africa (Pty) Ltd).
- Soetwater Wind Energy Facility (Savannah Environmental (Pty) Ltd).
- Karusa Wind Energy Facility (Savannah Environmental (Pty) Ltd).
- 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 the Northern Cape (ABO Wind renewable energies (Pty) Ltd).
- 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.

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Publications

- Aronson, J.B., Shackleton, S., and Sikutshwa, L. (2019). Joining the puzzle pieces: reconceptualising ecosystem-based adaptation in South Africa within the current natural resource management and adaptation context. Policy Brief, African Climate and Development Initiative.
- 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, Conferences and Courses

- Conference on Wildlife and Wind Energy Impacts, Stirling, August 2019.
- GenEst Carcass Fatality Estimator Workshop, Stirling, August 2019.
- GenEst Carcass Fatality Estimator Workshop, Kirstenbosch Research Centre (KRC), October 2018.
- The Ecosystem Approach and Systems Thinking Course, United Nationals Environment Programme.
- Bats and Wind Energy Workshop, The Waterfront Hotel & Spa, Durban, July 2016.
- 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 Research Centre (KRC), 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 Research Centre (KRC), 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.
- 15th International Bat Research Conference, Prague, August 2010.
- 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.

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Peer review of bat specialist reports for amendments to San Kraal and Phezukomoya WEF's

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This letter pertains to the peer review of the following bat assessment reports dated May 2019: Hartebeesthoek East Wind Energy Facility EA Amendment Report, Hartebeesthoek West Wind Energy Facility EA Amendment Report, Phezukomoya Split 1 Wind Energy Facility EA Amendment Report and San Kraal Split 1 Wind Energy Facility EA Amendment Report. The 2017 good practice guidelines for surveying bats at wind energy developments (pre-construction) recommend the original specialist, that performed the pre-construction bat monitoring study, assess subsequent amendment applications. In this case, the original specialist, Animalia Consultants (Pty) Ltd, are no longer conducting bat assessment work and thus a different specialist, Arcus Consultancy Services South Africa (Pty) Ltd (Arcus), were employed for the amendment applications. Arcus has satisfied the requirements of the 2017 good practice guidelines for amendment applications relating to turbine dimensions/specifications by recommending an increased buffer distance to exclude turbine blade tips from bat sensitivity buffers. Additionally, Arcus has addressed the issue of increased impacts of lower blade tips (closer to the ground) on lower flying bat species. However, the cumulative impacts of the amendment application with neighbouring wind energy facilities was not addressed. In my experience as a panel member of South African Bat Assessment Advisory Association (SABAA) with the role of review of/comment on EIA and Monitoring Assessments, and in my capacity as a Bat Specialist Consultant, several amendment applications for greater turbine dimensions are in the process of submission for proposed wind farms across the country. Thus, it is important for Arcus to assess the cumulative impacts of the amendment applications. In my professional opinion, if the issue of cumulative impacts is addressed, Arcus has performed a thorough assessment of the above-mentioned amendment applications and I corroborate the results and recommendations.

The basic assessment of the proposed electrical grid connection and associated infrastructure for the San Kraal Split 1, Phezukomoya Split 1, and Hartebesthoek East and West wind energy facilities (dated 9 July 2019) was also reviewed. I am in agreement with the findings and recommendations provided by Arcus for this assessment.

Yours sincerely,

Monika Moir
Private Bat Specialist Consultant

Miss Monika Ilka Moir
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EDUCATION

Candidate for Doctor of Philosophy (PhD) degree **May 2017 – present**
Stellenbosch University, Stellenbosch, SA
Faculty of Natural Sciences
Department of Botany and Zoology

Supervisors: Dr. Victor Rambau (University of Stellenbosch), Dr. Leigh Richards (Durban Natural Science Museum), Prof. Michael Cherry (University of Stellenbosch)

Tentative title: Community structure of bats in forests of the Eastern Cape and southern KwaZulu-Natal

Magister Scientiae (MSc) degree in Biodiversity and Conservation (Full dissertation) **2012-2014**
University of Johannesburg, Auckland Park, SA
Faculty of Science
Department of Zoology

Supervisor: Dr. Francois Durand (University of Johannesburg)

Title: Habitat use, temporal distribution and preferred weather conditions of *Tadarida aegyptiaca* and *Neoromicia capensis*, and its application to wind farm development in South Africa.

Bachelor of Science Honours (BSc Hons) in General Zoology (Cum laude) **2011**
University of Johannesburg, Auckland Park, SA
Faculty of Science
Department of Zoology

Supervisor: Dr. Francois Durand (University of Johannesburg)

Title: Environmental conditions affecting hibernating Natal Long-fingered Bats (*Miniopterus natalensis*) in Bakwena Cave, Irene

Areas of Concentration: Nature Conservation, Mammology, Population Genetics, Ecophysiology, Terrestrial Ecology, Indices for the health of aquatic ecosystems, Fish as a Test Organism, Aquatic Parasitology, Philosophy and Research Methodology

Bachelor of Science (BSC) in Zoology and Human Physiology (Cum laude) **2008-2010**
University of Johannesburg, Auckland Park, SA
Faculty of Science
Department of Zoology

EMPLOYMENT HISTORY

Director and Senior Environmental Consultant **2015 to April 2017**
Animalia Zoological and Ecological Consultation (Pty) Ltd
Contact person: Werner Marais
Contact number: +2778 190 3316
Email: werner@animalia-consult.co.za

Senior Environmental Consultant/Bat Specialist **2011 to 2015**
Animalia Zoological and Ecological Consultation (Pty) Ltd
Contact person: Werner Marais
Contact number: +2778 190 3316
Email: werner@animalia-consult.co.za

Environmental Characterization for Eskom power line maintenance **June – Aug 2012**
Envirolution Consulting (Pty) Ltd
Contact person: Gesan Govender
Contact number: +27834198905
Email: gesan@envirolution.co.za

CONFERENCE PROCEEDINGS

Environmental Conditions Affecting Hibernating Natal Long-fingered Bats (*Miniopterus natalensis*) in Bakwena Cave, Irene **2011**
Presented at the Department of Zoology Colloquium and Akademie vir Wetenskap Conference hosted in Johannesburg, SA

Comparison of genetic structure of two forest bats across Eastern Cape forests **2018**
Presented at 2018 BIMF-FBIP Forum held in Cape St Francis, SA

Genes on the wing. Effects of dispersal ability on genetic variation and structure of four forest associated bats **2018**
Presented at Department of Botany and Zoology Annual Research Meeting held at Stellenbosch University, SA (awarded best PhD presentation)

Who's out there? Bat diversity of forests in Eastern Cape and southern KwaZulu Natal **2019**
Presented at Zoological Society of southern Africa National Congress held at Skukuza, SA (awarded best PhD presentation)

The effects of dispersal ability on genetic diversity and population structure of six forest associated bats in the Eastern Cape, South Africa **2019**
Presented at International Bat Research Conference held in Phuket, Thailand

SHORT COURSES

Acoustic techniques and AnalookW workshop **2013**
Intructors: Chris Corben and Kim Livengood

NQF US229995 and US229998 Fall Arrest and Basic Rescue (Work at height) **2014**
Gravity Training CC

The Management of Bats Injured by Wind Turbines **2014**
Instructor: E.J. Richardson (Richardson and Peplow Environmental)

Bats and Wind Energy Annual Meeting/Workshop **2014**

NQF US229994 and US229998 Fall Protection Planner **2014**
Gravity Training CC

First Aid Level 1, 2 and 3 **2016**
JW First Aid Training and Skills Unlimited

Basic Fire Fighting in the Work Place **2016**
Skills Unlimited

MEMBERSHIPS

- Zoological Society of Southern Africa **2012 – 2013**
- SACNASP Professional Natural Scientist (Zoological Science; reg. 400575/14) **2014 to present**
- Member of the Gauteng and Northern Regions Bat Interest Group **2015 – 2017**
- Panel member of the South African Bat Assessment Advisory group (SABAA) **2018 to present**
- Western Cape post-graduate representative for the Foundational Biodiversity Information Programme (FBIP) **2018 to present**