ARCUS

BAT SPECIALIST REPORT FOR THE AMENDMENT OF THE MODDERFONTEIN WIND ENERGY FACILITY, NORTHERN AND WESTERN CAPE PROVINCES

On behalf of

TERRAMANZI GROUP (PTY) LTD

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Prepared By:

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Michael Brits and Mark Hodgson	**Craig Campbell**	**Ashlin Bodasing**
Michael Brits has a wide range of ecological expertise including experience with birds, bats, insects, amphibians and mammals. He has developed various monitoring plans to assist conservation bodies in adaptively managing wetlands, implemented baseline freshwater ecology monitoring plans and managed urban-wildlife conflicts, specifically with baboons and local residents in the City of Cape Town. He is skilled with various analytical techniques relevant to ecological projects, including four years of GIS experience. Michael assists with bat data downloads and will provide support with data analysis, and GIS. **Mark Hodgson** has experience ranging from aquatic and terrestrial ecological surveys, using molecular tools for tracking, and water drainage monitoring. Having obtained his Bachelor of Sciences Degree (Genetics, Ecology and Evolution) and BSc Honours (Applied Biology) from the University of Cape Town. Since then he has spent time as a researcher at the Knysna Basin Project assisting with Knysna seahorse censuses, aquatic plant life mapping and river drainage monitoring. He is also skilled in statistical analysis pertaining to ecological projects.	**Craig Campbell** is an Ecologist and graduated with a Degree in Conservation Ecology from Stellenbosch University, South Africa. He is registered as a Professional Natural Scientist, in the field of Ecological Sciences (SACNASP). Since 2013, Craig has had extensive experience in ecological baseline studies, biodiversity monitoring surveys and due diligence on several renewable energy and other projects in South Africa, Mozambique, Portugal and Turkey. He has a sound background in management and ecology, and also focusses on project design & layout, GIS mapping, report compilation and stakeholder engagement.	**Ashlin Bodasing** is the Technical Director at Arcus and a Registered EAP with EAPASA. Having obtained her Bachelor of Social Science Degree (Geography and Environmental Management) from the University of Kwa-Zulu Natal; she has over 15 years' experience in the environmental consulting industry in southern Africa. Ashlin has excellent Project Management experience and has gained major project experience in the development of Environmental Impact Assessments, Environmental Management Plans and the monitoring of construction activities. Her areas of expertise include project management, environmental scoping and impact assessments, environmental management plans, environmental compliance monitoring and environmental feasibility studies.

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1 INTRODUCTION

South African Renewable Green Energy (Pty) Ltd (the applicant) received environmental authorisation (EA) for the Modderfontein Wind Energy Facility (WEF) in February 2012. The site is located 40 km south of Victoria west in the Western and Northern Cape. In 2017, the applicant received an extension to the EA validity. The development site is located within the Beaufort West Renewable Energy Development Zone (REDZ 11). The applicant is now seeking to amend the technical details of EA and Arcus Consultancy Services South Africa (Pty) Ltd (Arcus) was appointed to conduct the bat impact assessment for the Part II amendment application.

The Modderfontein WEF is currently authorised for Up to 67 WTGs with a total generating capacity of 201 MW using turbines with a generating capacity of up to 3MW each.

1.1 Details of the Modderfontein WEF Amendment

It is understood that the authorised project will be amended as follows, with the development site be split into two clusters:

- Cluster 1 will comprise of up to 34 wind turbine generators (WTG) with a total generation capacity of 140 MW;
- Cluster 2 will comprise of 9 WTG with a total generation capacity of 50.4 MW.

Further details of the amendment include:

- Reduction in the number of turbines from 67 to 34;
- Increase in the individual turbine rating from up to 3 MW to up to 5.6 MW;
- Turbine dimensions of 119 m hub height and 162 m rotor diameter, 81 m blade length; and
- Total WEF generation capacity from 201 MW to 190.4 MW.

The facility area including temporary and permanent laydown areas to remain the same, as well as the substation compound and grid connection. The total development site is approximately 10 652 ha.

1.2 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 changes;
- An assessment of no-go and preferred alternatives, where the no-go alternative is the previously-authorised project consisting of 67 WTG's, and the preferred alternative is the updated layout (34 WTG's) currently being subjected to an amendment application;
- Comparative assessment of the impacts before the changes and after the changes; and
- Measures to ensure avoidance, management and mitigation of impacts associated with such proposed changes, and any changes to the EMPr.

This assessment has been conducted according to the National Environment Management Act (NEMA), 1998 (Act 107 of 1998) EIA Regulations, 2014, as amended and adheres to the precautionary principle and risk-averse approach applicable to projects that pose a risk to biodiversity and ecosystems.

1.3 Legislative and Policy Context

The following legalisation, policies and guidelines advised this amendment report:

- The National Environment Management Act, 1998 (Act 107 of 1998)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)

- Threatened or Protected Species List, 2015
- Constitution of the Republic of South Africa, 1996 (Act No. 108, 1996)
- The Equator Principles (2013)
- Cape Nature and Environmental Conservation Ordinance No. 19 of 1974; and Nature and Environmental Conservation Regulations (1975)
- National Environmental Management: Protected Areas Act, 2003 (Act No. 57, 2003)
- The Red List of Mammals of South Africa, Swaziland and Lesotho (2016)
- Environmental Impact Assessment Regulations, 2014, as amended
- Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended.
- The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) (1983)
- The Convention on Biological Diversity (CBD) (1993)
- South African Good Practise Guidelines for Surveying Bats in Wind Energy Facility Developments – Pre-Construction (2017)
- South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (2020)
- South African Bat Fatality Threshold Guidelines for Operational Wind Energy Facilities (2018)

1.4 Assumptions and Limitations

- This report has been produced with limited on-site acoustic monitoring.
- 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.
- 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.

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*

To compare the current assessed impacts of Modderfontein WEF to those related to the proposed changes, the final environmental impact report was reviewed. The environmental management plan and all relevant Environmental Authorisations were reviewed to assess the current mitigation measures that are to be adhered to. Finally, to assist with the cumulative impact assessment, any available post construction monitoring reports were reviewed.

The National Web Based Screening Tool was used to generate the potential environmental sensitivity of the site. The outputs were compared with satellite imagery and GIS maps of the project site.

The National Gazette, No. 43110 of 20 March 2020: "National Environmental Management Act (107/1998) Procedures for the Assessment and Minimum Criteria for Reporting on

Identified Environmental Themes in terms of sections 24 (5) (a) and (h) and 44 of the Act ('the Regulations'), when applying for Environmental Authorisation" includes the requirement that a Site Sensitivity Verification must be produced (Appendix 3).

2.1 Field Survey

The site sensitivity verification survey was conducted over two days (01-02 December 2020). A survey was done to map and ground truth important bat features on the site. Rocky outcrops, trees and buildings were also surveyed for potential bat roosts. Roost exit counts were done from 30 min before sunset to 30 min after sunset to get an estimation of the number of bats roosting in the attic of the landowner's house.

2.2 Impact Assessment

The potential impacts were assessed based on the methodology provided by the EAP. A significance rating and impact assessment was done for each impact and mitigation measures provided where appropriate, for both the authorised and new layout. For each impact, the significance was determined by identifying the extent, duration, magnitude, probability of occurrence, and reversibility of the impact (as well as the irreplaceability of resource loss) in the absence of any mitigation ('without mitigation'). Mitigation measures were identified, and the significance was re-rated, assuming the effective implementation of the mitigation ('with mitigation').

Cumulative impacts were assessed as the incremental impact of the proposed activity on the baseline, when added to the impacts of other past, present or reasonably foreseeable future activities in 50 km radius.

3 BASELINE ENVIRONMENTAL DESCRIPTION

3.1 Habitat

The WEF falls within the Nama-Karoo Biome comprised mainly of Upper Karoo Hardveld with bands of Eastern Upper Karoo vegetation through the middle of the site and in the south eastern portion of Phaisant Kraal 1 (Figure 4). The topography of the site is mostly undulating. Mountainous areas can be found in the north-west portion of Modderfontein (Figure 1A) and through the middle of Phaisant Kraal 1, with an isolated koppie in the south-east portion of the latter. A smaller hill range runs from the north to south-east of Modderfontein (Figure 1B), connecting with the range traversing through Phaisant Kraal 1. The rest of the site is flat (Figure 1C) to undulating with slight valleys, small ridgelines (Figure 1D), and dry riverbeds.

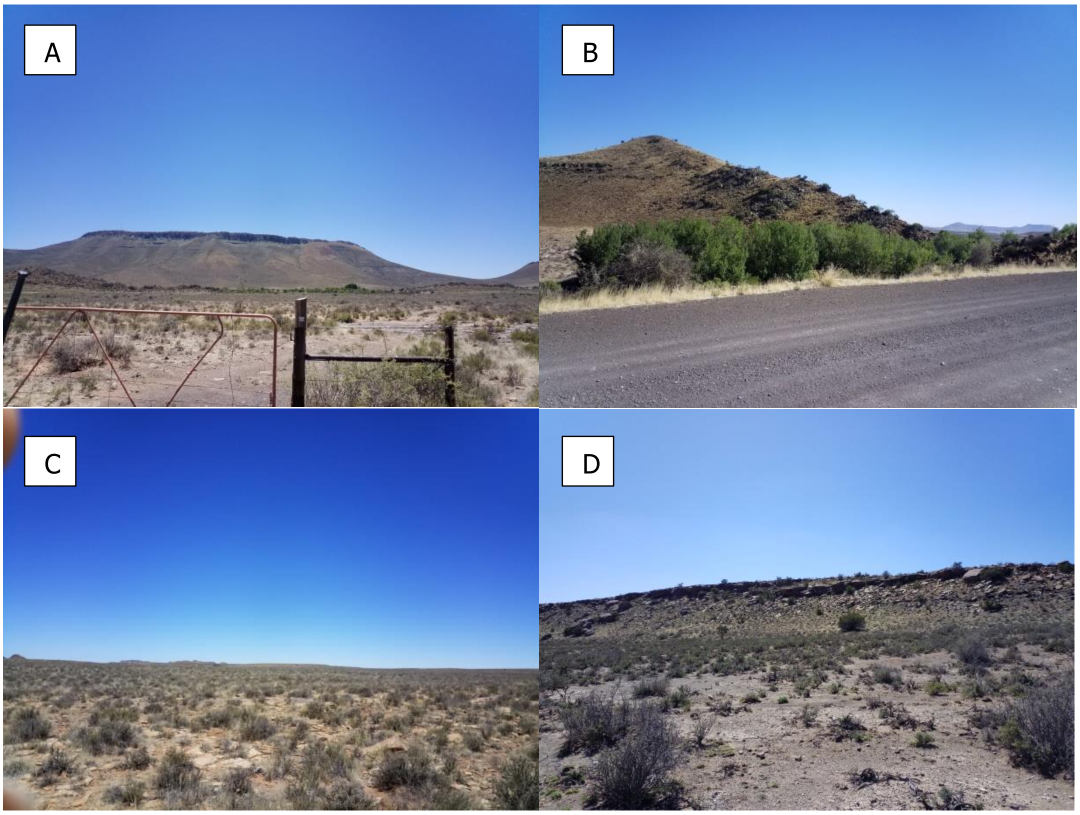

Figure 1 – Mountainous areas in the north-west (A), hills that run north to south-east of Modderfontein (B), flat plains (C) and typical ridges on the site.

Resources present within the site that are important for foraging bats include farm dams and wetlands with associated trees, perennial rivers, drainage areas and cultivated lands. During the field visit, some dams contained water whereas others were dry, so there is at least some access to water for bats for drinking during certain periods of the year. These dams also serve to promote insect abundance which in turn will attract bats to the area. The trees are restricted to drainage areas, particularly through the middle of the Modderfontein site along the NFEPA River, which is likely to support greater bat activity given the concentration of important bat features. Rocky outcrops in the mountains and koppies, buildings and trees will provide roosting spaces for bats. There is one confirmed roost on site, in the attic of the landowner’s house, hosting Serotine bats (Section 3.3). There are not major bat roosts within 100 km of the site (EWT and SABAA database).

Figure 2 – A broad view of the landscape around the middle of the site. Tall trees located around the landowner's house where the confirmed bat roost is located. The well-established riparian vegetation around the river and cultivated land on the banks.

3.2 Bat Species

The project falls within the actual or predicted distribution range of approximately seven species of bat (African Chiroptera Report 2020; 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 species may be present.

The sensitivity of each of these species to the project is a function of their conservation status and the likelihood of risk to these species from the 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 (MacEwan et al. 2020).

Table 1: Bat Species Potential Occurrence within the Study Area

Species	Code	Conservation Status[1]			Risk from Wind Energy
		National	Global	Population Trend	
Egyptian free-tailed bat *Tadarida aegyptiaca*	EFB	Least Concern	Least Concern	Unknown	**High**
Natal long-fingered bat *Miniopterus natalensis*	NLB	Least Concern	Least Concern	Unknown	**High**
Cape serotine *Laephotis capensis*	CS	Least Concern	Least Concern	Stable	**High**
Temminck's myotis *Myotis tricolor*	TM	Least Concern	Least Concern	Unknown	**Medium-High**
Long-tailed serotine *Eptesicus hottentotus*	LTS	Least Concern	Least Concern	Unknown	**Medium**

[1] 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.

Species	Code	Conservation Status[1]			Risk from Wind Energy
		National	Global	Population Trend	
Egyptian Slit-faced Bat *Nycteris thebaica*	ESB	Least Concern	Least Concern	Stable	**Low**
Cape horseshoe bat* *Rhinolophus capensis*	CHB	Least Concern	Least Concern	Stable	**Low**
Geoffroy's horseshoe bat *Rhinolophus clivosus*	GHB	Least Concern	Least Concern	Unknown	**Low**

* Endemic to South Africa.

4 RESULTS

4.1 Confirmed Roost

A roost was discovered in the attic (Figure 3A) of the landowner's house which hosted Cape Serotine bats (Figure 3B). It is an active roost with fresh droppings (Figure 3C). Roost exit counts were conducted from 30 min prior to sunset to approximately 30 min after sunset when bats ceased to exit the roof. A total of 77 individuals were observed to exit the western side of the house (Figure 3D), while seven individuals exited from the eastern side of the house.

The specialist conducting the pre-construction monitoring should be made aware of the roost and should conduct seasonal roost exit counts with bat detectors to confirm the species and number of bats roosting here.

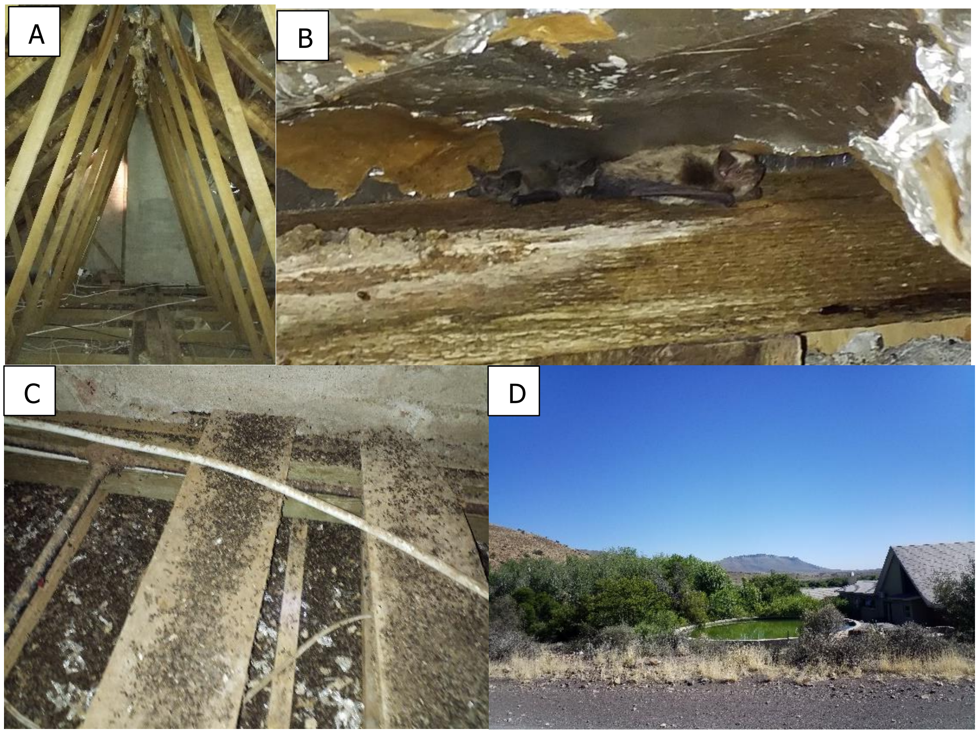

Figure 3 – The confirmed roost in an attic (A), Cape Serotine adult with pups found in the attic (B), droppings (C) and the main exit/entry point from the roof (D).

4.2 Bat Sensitivity Mapping

Important bat features such as buildings, ruins, trees, cultivated land, water reservoirs, farm dams, rivers, wetlands and the high sensitive rocky outcrops in the northern part of the site (Figure 1A) were buffered by 200 m. The low to medium sensitive rocky outcrops and drainage lines were buffered by 100 m. The confirmed bat roost is classified as a medium roost size of Least Concern classified bat species and was buffered by 1km according to the bat guidelines. The bat no go buffers are to blade tip, no turbine blades should enter these buffers (Figure 5).

5 DISCUSSION OF TURBINE DIMENSIONS AND IMPLICATIONS ON BATS

The core issue relevant to this assessment is the change in impact to bats due to the amendment of turbine dimensions. Currently, the rotor swept area for each turbine will be 9, 503 m^2 assuming turbines with blade lengths of 55 m. The amendment would result in an increase of the rotor swept area to 20, 611 m^2 assuming turbines with blade lengths of 81 m. The minimum and maximum tip heights currently approved are 70 m and 180 m respectively.

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, no relationship was found between bat fatality and the number of turbines at a wind energy facility.

In Greece, Georgiakakis et al. (2012) found that bat fatalities were significantly positively correlated with tower height but not with rotor diameter. In their study, maximum tower height and rotor diameter 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). 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 was 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 influenced bat mortality. Berthinussen et al. (2014) also found no evidence that modifying turbine design reduce bat fatalities. The relationship between bat mortality and turbine size, or 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.

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 having a shorter distance between the ground and the lowest rotor tip point may have a negative impact and potentially place a greater number of species at risk. Higher hub height and longer blades can intrude more into the higher air space and possibly have a negative impact on the higher flying free-tailed bats. 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 the size of turbines proposed for the Modderfontein WEF would be to bats because of a lack of published data from wind energy facilities with turbines of a 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 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 (MacEwan et al. 2020). Based on unpublished data from 18 such sites Arcus has worked at, bat activity and species diversity are greater nearer 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 of mortality may be less. Further, the number of species at risk of mortality may decrease as not all species utilise 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 at greater risk of fatality.

In the United Kingdom, both Collins and Jones (2009) and Mathews et al. (2016) showed that fewer species, and lower activity levels, 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 recorded higher species richness and higher activity rates 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).

6 CURRENT IMPACT ASSESSMENT AND MITIGATION MEASURES

The environmental impact assessment for the Modderfontein WEF did not specifically assess the impacts of the WEF on bats. Although no extensive surveys were done, bat activity and utilisation of the site by bats were assumed to be similar to those in the immediate surroundings. As such, impact assessments and mitigations were based on knowledge of surrounding areas, particularly from pre-construction and operational monitoring conducted at Noblesfontein Wind Farm and the original EIA for the proposed Karoo Renewable Energy Facility.

The original Environmental assessment for the Karoo Renewable Energy Facility outlined a number of conditions relevant to bats to be addressed prior to construction, namely:

- A bat monitoring program be implemented to document the effect of the energy facility on bats during operation, compiled by a qualified specialist. This should begin prior to construction and continue into operation of the facility.
- An environmental sensitivity map indicating environmental sensitive areas and features identified should be included in the EMP.
- The holder of the authorisation must appoint the relevant specialist to ground-truth the infrastructure footprints and their recommendations must inform the final layout of the facility.

Environmental authorisation was given in February 2012 with a subsequent extension of two years (until February 2017). The final extension extended the authorisation by three years (until 2020) and included the following conditions for bats:

- All the conditions set out in the original Environmental Authorisation remain unchanged and adhered to.
- A pre-construction bat monitoring programme should be implemented following the most recent guidelines for surveying bats at wind energy facility developments.

7 IMPACT ASSESSMENT

WEFs have the potential to impact bats directly through collisions (with spinning turbine blades) and barotrauma resulting in mortality (Horn et al. 2008; Rollins et al. 2012), and indirectly through the modification of habitats (Kunz et al. 2007b; Millon et al. 2018). Similarly, the grid connection may also impact bats directly through collisions (with transmission lines), and indirectly through habitat modification. Modification of habitat includes roost destruction, roosts disturbance, and displacement from foraging areas and/or commuting routes. Direct impacts pose the greatest risk to bats for the proposed amendment. Since the footprint (i.e. turbines, roads) of the proposed amendment is small compared to the original footprint, habitat modification impacts would be lower.

Direct impacts to bats posed by the turbines for the proposed amendment will be limited to species that make use of the airspace in the rotor-swept zone of the wind turbines. The previous layout included 67 turbines with a total Rotor Swept Area (RSA) of 636, 701 m^2 with each turbine having a lower blade tip height of 70 m and an upper blade tip height of 180 m. The proposed amendment reduces the number of turbines and increases the total RSA to 34 and 700, 807 m^2 respectively, with each turbine having a lower blade tip height of 38 m and an upper blade tip height of 200 m.

Five of the bat species that potentially occur on site exhibit behaviour that may bring them into contact with wind turbine blades. They are thus potentially at risk of negative impacts if not properly mitigated. This includes three high risk species (Egyptian free-tailed bat, Natal long-fingered bat, and Cape serotine) and one medium-high risk species (Temminck's myotis). The Egyptian free-tailed bat, Natal long-fingered bat and Cape serotine have all suffered mortality at operational wind energy facilities in South Africa (Aronson et al. 2013; Doty and Martin 2012; MacEwan 2016), with Egyptian free-tailed bat fatalities being confirmed at the adjacent Nobelsfontein WEF (Bioinsight 2017). Direct impacts of the grid connection transmission lines would primarily be limited to fruit bats which might migrate through the area but the impact would be low.

7.1 Assessment of Impacts

The potential impacts of the construction and operation of the WEF and the grid connection are described in more detail and assessed below. A significance rating and impact assessment was done for each potential impact and mitigation measures for each are provided where appropriate. The potential impacts are assessed based on the methodology provided by the EAP. The impacts to the bats during the decommissioning phase (for both the wind energy facility and the associated grid connection) are likely to be restricted to disturbance.

For each impact, the significance was determined by identifying the extent, duration, magnitude, probability of occurrence, and reversibility of the impact (as well as the irreplaceability of resource loss) in the absence of any mitigation ('without mitigation'). Mitigation measures were identified, and the significance was re-rated, assuming the effective implementation of the mitigation ('with mitigation').

For the amended WEF layout, the assessment 'without mitigation' assumes the worst-case scenario in which all 34 proposed turbines are constructed. The assessment 'with mitigation' assumes that all turbines are constructed outside of bat no-go areas, and all additional mitigations are adequately implemented. No-go areas (bat buffers) are presented in Figure 5 and no turbines, including their blades and blade tips, should enter inside these buffers. The current layout proposed avoids all pre-defined no-go areas.

Cumulative impacts were assessed as the incremental impact of the proposed amendment on the existing environment, when added to the impacts of other past, present or proposed renewable energy facilities in 50 km radius according to the Department of Environmental Affairs Renewable Energy Development Database Quarter one 2021.

7.1.1 Construction Phase - WEF

7.1.1.1 Roost Disturbance

IMPACT NATURE	**Bat Impact – Roost Disturbance Construction Phase**		**STATUS**	**NEGATIVE**
Impact Description	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), internal transmission lines 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. Roosting potential on site is highest in the mountainous areas to the north and south east of the site. One roost of Cape Serotine bats was confirmed in the attic of a house on site and has a buffer distance of 1 km. If all buffers of the sensitivity map are adhered to, significance of the impact should be low.			
Impact Source(s)	Construction activities for wind turbines and associated infrastructures. Disturbance near roosting locations.			
Receptor(s)	Bats and roosting structures (buildings, trees, rock crevices etc.).			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-1
	No-Go Alternative:	-3	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Medium (-48)	Preferred Alternative:	Low (-1)
	No-Go Alternative:	Medium (-48)	No-Go Alternative:	Low (-1)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) It may be possible to limit roost abandonment by avoiding construction activities near roosts. One confirmed roost was found on site and there may be more potential roosts that bats may be using including trees, rocky crevices (especially in the north and south-east of the site) and buildings.			

	2) It is recommended that potential roosts, specifically trees, buildings, and rocky crevices, are buffered by 200 m, inside which no construction activities may take place. These buffers have been mapped in Figure 5. No construction activities must occur within 1 km of the confirmed roost. 3) Prior to construction a bat specialists must conduct a walkthrough of the site and turbine locations and advise on the final design and layout of the facility.

7.1.1.2 Roost Destruction

IMPACT NATURE	**Bat Impact – Roost Destruction Construction Phase**		**STATUS**	**NEGATIVE**
Impact Description	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 is likely to result in bat mortality. Reducing roosting opportunities for bats or killing bats during the process of destroying roosts will have severe negative impacts on local populations. One roost of Cape Serotine bats was confirmed in the attic of a house on site and has been buffered 1 km.			
Impact Source(s)	Construction activities for wind turbines and associated infrastructures. Destruction of roosts and potential roosts.			
Receptor(s)	Bats and roosting structures (buildings, trees, rock crevices etc.).			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-1
	No-Go Alternative:	-3	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Medium (-48)	Preferred Alternative:	Low (-4)
	No-Go Alternative:	Medium (-48)	No-Go Alternative:	Low (-4)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) It may be possible to limit roost destruction by avoiding construction activities near roosts. One confirmed roost has been found at the project and there may be more potential roosts that bats may be using including trees, rocky crevices (especially in the north and south-east of the site) and buildings. No construction activities must occur within 1 km of the confirmed roost. 2) It is recommended that potential roosts, specifically trees, buildings, and high sensitive rocky crevices, are buffered by 200 m while low to moderate sensitive rocky crevices are buffered by 100 m inside which no construction activities may take place. These buffers have been mapped (Figure 5). 3) Prior to construction a bat specialists must conduct a walkthrough of the site and turbine locations and advise on the final design and layout of the facility.			

7.1.1.3 Habitat Modification

IMPACT NATURE	Bat Impact – Habitat Modification Construction Phase		STATUS	NEGATIVE
Impact Description	Bats can be impacted indirectly through the modification or removal of habitats (Kunz et al. 2007) and can also be displaced from foraging habitat by the construction of wind turbines (Millon et al. 2018). The removal of vegetation during the construction phase can 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 commute or forage along. This modification could also create favorable conditions for insects upon which bats feed which would in turn attract bats to the proposed wind farm area. This impact can be reduced if as much natural vegetation as possible remains unmodified by construction activities.			
Impact Source(s)	Construction activities for wind turbines and associated infrastructures. Modification of habitat.			
Receptor(s)	Bats and relevant habitats (vegetation cover, linear features etc.).			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-2	Preferred Alternative:	-1
	No-Go Alternative:	-3	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Low (-12)	Preferred Alternative:	Low (-3)
	No-Go Alternative:	Low (-18)	No-Go Alternative:	Low (-6)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) Prior to construction a bat specialists must conduct a walkthrough of the site and turbine locations and advise on the final design and layout of the facility. 2) During construction laydown areas and temporary access roads should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation. Construction should, where possible, be situated in areas that are already disturbed. 3) This impact must be reduced by limiting the removal of vegetation, particularly trees, as far as possible. Habitat modification should also not occur in the no-go areas of the sensitivity map. 4) Following construction, rehabilitation of all disturbed areas (e.g. temporary access tracks and laydown areas) must be undertaken and a habitat restoration plan must be developed by a botanical specialist and included within the EMPr.			

7.1.1.4 Light Pollution

IMPACT NATURE	Bat Impact – Light Pollution Construction and Operational Phases	STATUS	NEGATIVE
Impact Description	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 WEF, it is assumed that the only light sources would be motion sensor security lighting for short periods and lighting associated with the substation.		

	Certain 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 operating turbines and increase the risk of collision/barotrauma for these species. These include the Cape serotine and the Egyptian free-tailed bat (Fenton et al. 2004). 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. With mitigation this impact will have little to no effect.			
Impact Source(s)	Construction and Operational activities for wind turbines and associated infrastructures. Light Pollution from security lighting.			
Receptor(s)	Bats.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-2	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Low (-12)	Preferred Alternative:	Low (-3)
	No-Go Alternative:	Low (-12)	No-Go Alternative:	Low (-3)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) This impact can be mitigated by using as little lighting as possible, and only where essential for operation of the facility. 2) 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. 3) Lighting should be fitted with movement sensors to limit illumination and light spill, and the overall lit time. In addition, the upward spread of light near to and above the horizontal plane should be restricted and directed to minimise light trespass and sky glow. 4) Increasing the spacing between lights, and the height of light units can reduce the intensity and volume of the light to minimise the area illuminated and give bats an opportunity to fly in relatively dark areas between and over lights.			

7.1.2 Operational Phase -WEF

7.1.2.1 Habitat Creation in High-Risk Locations

IMPACT NATURE	**Bat Impact – Habitat Creation in High-Risk Locations Operational Phase**	**STATUS**	**NEGATIVE**
Impact Description	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 or be attracted to lights at the WEF as potential new foraging areas. One roost has been confirmed in a building on site and, if any bats take to roosting in new infrastructure, they would be at greater risk of mortality due to the proximity to wind turbines and this could result in increased mortality rates.			
Impact Source(s)	New buildings that inadvertently provide new roosts for bats.			
Receptor(s)	Bats potentially roosting in new buildings.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-2	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Low (-12)	Preferred Alternative:	Low (-3)
	No-Go Alternative:	Low (-12)	No-Go Alternative:	Low (-3)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Low			
MITIGATION MEASURES	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. 2) 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 and road culverts must be carried out to ensure access by bats is prevented and for the safe handling of actively roosting bats.			

7.1.2.2 Bat Mortality during Commuting and/or Foraging

IMPACT NATURE	**Bat Impact – Mortality during commuting and/or foraging** **Operational Phase**		**STATUS**	**NEGATIVE**
Impact Description	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. The proposed amended layout increases the total rotor swept area of the site, increasing the area where bats are in danger of collision. The amendment also increases the upper blade tip from 180 m to 200 m and decreases the ground to lower blade tip height from 70 m to 38 m, which could impact both lower and higher-flying species. Five of the six 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 the severe negative impacts of mortality.			
Impact Source(s)	Operation of wind turbines.			
Receptor(s)	Bats.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2

DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	2
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-2
	No-Go Alternative:	-3	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Medium (-54)	Preferred Alternative:	Low (-24)
	No-Go Alternative:	Medium (-54)	No-Go Alternative:	Low (-24)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Low			
MITIGATION MEASURES	1) Designing the turbine 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. These areas include key microhabitats such as water features, trees, buildings, and rocky crevices. The current turbine layout must be revised as twelve turbines are within bat sensitivity buffer zones around these features (Figure 5). Turbines must be sited outside of buffer areas such that blade tips do not encroach into buffer zones. 2) The height of the lower blade swept height must be maximised, and should not be lower than 38 m. 3) Pre-construction monitoring must be carried out in accordance with the conditions of the Environmental Authorization to determine an environmental baseline for the site and to determine a curtailment regime to be implemented if mortality occurs beyond threshold levels (MacEwan et al. 2018). 4) Operational acoustic monitoring and carcass searches for bats must be performed, according to the best practice guidelines current to the time of WEF operation. The operational phase monitoring plan must measure and monitor bat mortality via carcass searches and bat activity levels via acoustic monitoring methods. Acoustic monitoring should include monitoring at height (from more than one location i.e., such as on turbines) and at ground level.			

7.1.2.3 Mortality during Migration

IMPACT NATURE	**Bat Impact – Mortality during migration Operational Phase**	**STATUS**	**NEGATIVE**
Impact Description	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 considered here as a separate impact of the WEF on the Natal long-fingered bat and Temmink's myotis. The Natal long-fingered bat is the only species known to occur at the site and recorded during operational monitoring of the Noblesfontein WEF that exhibits long-distance migratory behaviour, whereas little is known about the Temmink's myotis's migration habits and this species has not been recorded on site as of yet. The proposed amended layout increases the total rotor swept area of the site. The amendment also increases the upper blade tip from 180 m to 200 m and decreases the ground to lower blade tip height from 70 m to 38 m, which could impact both lower and higher-flying species. The majority of bat mortalities at WEFs in North America and Europe are migratory species. The Natal long-fingered bat is known to occur in the area and a roost of this species was confirmed at the neighbouring Noblesfontein WEF. It is difficult to determine if unacceptable numbers of mortality will occur during migration periods but during the operating lifespan of the WEF 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 collection. With the current data the effects on bats could be severe without mitigation and have moderate effects with mitigation.			
Impact Source(s)	Operation of wind turbines.			
Receptor(s)	Bats.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-2
	No-Go Alternative:	-3	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	High (-81)	Preferred Alternative:	Medium (-54)
	No-Go Alternative:	High (-81)	No-Go Alternative:	Medium (-54)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Low			
MITIGATION MEASURES	1) Designing the turbine 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. These areas include key microhabitats such as water features, trees, buildings, and rocky crevices. The current turbine layout must be revised as twelve turbines are within bat sensitivity buffer zones around these features (Figure 5). Turbines must be sited outside of buffer areas such that blade tips do not encroach into buffer zones. 2) The height of the lower blade swept height must be maximised, and should not be lower than 38 m. 3) Pre-construction monitoring must be carried out in accordance with the best practice guidelines current to the time of monitoring, as stated in the conditions of the Environmental Authorization. This study must be used to determine an environmental baseline for the site and to determine a curtailment regime to be implemented if mortality occurs beyond threshold levels (MacEwan et al. 2018). 4) Operational acoustic monitoring and carcass searches for bats must be performed, according to the best practice guidelines current to the time of WEF operation. The operational phase monitoring plan must measure and monitor bat mortality via carcass searches and bat activity levels via acoustic monitoring methods. Acoustic monitoring should include monitoring at height (from more than one location i.e., such as on turbines) and at ground level.			

7.1.2.4 Roost Disturbance

IMPACT NATURE	**Bat Impact – Roost Disturbance Decommissioning Phase**	**STATUS**	**NEGATIVE**
Impact Description	WEFs have the potential to impact bats directly through the disturbance of roosts during decommissioning. Relevant activities include the dismantling and deconstruction of some/all infrastructure, such as Operation and Maintenance (O&M) buildings, sub-station(s), internal transmission lines and wind turbines. Excessive noise and dust during the decommissioning phase could result in bats abandoning their roosts, depending on the proximity of the 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. Roosting potential on site is highest in the mountainous areas to the north and south east of the site. One roost of Cape Serotine bats was confirmed in the attic of a house on site and has a buffer distance of 1 km. If all buffers of the sensitivity map are adhered to, significance of the impact should be low.			
Impact Source(s)	Decommissioning activities of wind turbines and associated infrastructures. Disturbance near roosting locations.			
Receptor(s)	Bats and roosting structures (buildings, trees, rock crevices etc.).			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
PROBABILITY (C)	Preferred Alternative:	4	Preferred Alternative:	1
	No-Go Alternative:	4	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-1
	No-Go Alternative:	-3	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Medium (-48)	Preferred Alternative:	Low (-1)
	No-Go Alternative:	Medium (-48)	No-Go Alternative:	Low (-1)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) It may be possible to limit roost abandonment by avoiding dismantling and deconstruction activities near roosts as well as limiting deconstruction of buildings as far as possible. One confirmed roost was found on site and there may be more potential roosts that bats may be using including trees, rocky crevices (especially in the north and south-east of the site) and buildings. No dismantling or deconstruction activities must occur within 1 km of the confirmed roost. 2) It is recommended that potential roosts, specifically trees, buildings, and rocky crevices, are buffered by 200 m, inside which no deconstruction activities may take place. These buffers have been mapped in Figure 5.			

7.1.2.5 Roost Destruction

IMPACT NATURE	**Bat Impact – Roost Destruction Decommissioning Phase**	**STATUS**	**NEGATIVE**
Impact Description	WEFs have the potential to impact bats directly through the physical destruction of roosts during dismantling and deconstruction. Relevant activities include the dismantling and deconstruction of some/all infrastructure, such as Operation and Maintenance (O&M) buildings, sub-station(s), internal transmission lines and wind turbines. Potential roosts that may be impacted by decommissioning activities include trees 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 is likely to result in bat mortality. Reducing roosting opportunities for bats or killing bats during the process of destroying roosts will have severe negative impacts on local populations. One roost of Cape Serotine bats was confirmed in the attic of a house on site and has been buffered 1 km.		
Impact Source(s)	Decommissioning activities of wind turbines and associated infrastructures. Destruction of roosting locations.		

Receptor(s)	Bats and roosting structures (buildings, trees, rock crevices etc.).			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-1
	No-Go Alternative:	-3	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Medium (-48)	Preferred Alternative:	Low (-4)
	No-Go Alternative:	Medium (-48)	No-Go Alternative:	Low (-4)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) It may be possible to limit roost destruction by avoiding deconstruction and dismantling activities near roosts. One confirmed roost has been found at the project and there may be more potential roosts that bats may be using including trees, rocky crevices (especially in the north and south-east of the site) and buildings. No deconstruction or dismantling activities must occur within 1 km of the confirmed roost. 2) It is recommended that potential roosts, specifically trees and buildings are buffered by 200 m, inside which no deconstruction activities may take place. These buffers have been mapped (Figure 5). 3) If bats have colonised WEF infrastructure, a specialist must be consulted before any decommissioning work is undertaken on that infrastructure or attempting to remove bats.			

7.1.2.6 Habitat Modification

IMPACT NATURE	**Bat Impact – Habitat Modification Decommissioning Phase**		**STATUS**	**NEGATIVE**
Impact Description	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 the dismantling of wind turbines (Millon et al. 2018). The removal of vegetation during the decommissioning phase can impact bats by removing vegetation cover and linear features that some bats use for foraging and commuting (Verboom and Huitema 1997). This impact can be reduced if as much natural vegetation as possible remains unmodified by decommissioning activities.			
Impact Source(s)	Decommissioning activities of wind turbines and associated infrastructures. Modification of habitat.			
Receptor(s)	Bats and relevant habitats (vegetation cover, linear features etc.).			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	2	No-Go Alternative:	1
	Preferred Alternative:	-2	Preferred Alternative:	-1

INTENSITY OR MAGNITUDE (D)	No-Go Alternative:	-3	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	Low (-12)	Preferred Alternative:	Low (-3)
	No-Go Alternative:	Low (-18)	No-Go Alternative:	Low (-6)
CUMULATIVE IMPACTS	See section 7.3			
CONFIDENCE	Medium			
MITIGATION MEASURES	1) During decommissioning, laydown areas should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation. 2) This impact must be reduced by limiting the removal of vegetation, particularly trees, as far as possible. Habitat modification should also not occur in the no-go areas of the sensitivity map. 3) Following decommissioning, rehabilitation of all disturbed areas (e.g. temporary access tracks and laydown areas) must be undertaken and a habitat restoration plan must be developed by a botanical specialist. 4) If bats have colonised WEF infrastructure, a specialist must be consulted before any decommissioning work is undertaken on that infrastructure or attempting to remove bats.			

7.2 Residual Impacts

Residual impacts may still warrant additional mitigation measures and applying curtailment and using deterrents are the main options once turbines become operational. Both of these mitigation measures are known to reduce bat fatality rates (Arnett and May 2016; Arnett et al. 2011; Hayes et al. 2019; Romano et al. 2019; Weaver et al. 2020). Curtailment techniques that can be considered are blade-feathering, raising the cut-in speed and if needed, shutting down turbines. The exact choice will depend on the scale of the impact and this must be evaluated against threshold levels (MacEwan et al. 2018). Pre-construction monitoring must be conducted prior to commencement of the facility's operation and a curtailment plan drawn up by a qualified specialist based on the results of that monitoring.

Because so little is known about migration routes, fecundity rates and population numbers of bats in South Africa the fatality threshold is an ongoing discussion, but is usually influenced by natural mortality of bat species, density dependent factors, activity levels per ecoregion, percent loss to natural declines and size of the site. Research suggests above 2 % additional losses to bat populations from anthropogenic pressures in a particular ecoregion, bat populations start to decline (MacEwan et al. 2018). These losses can be calculated according to The South African Bat Assessment Association fatality threshold guidelines. Thresholds calculated for the Modderfontein WEF equate to a calculated estimate of 44 bat fatalities per least concern insectivorous bat species or family per annum.

If curtailment or deterrents are needed based on threshold values being exceeded, their use would be confined to specific periods of the year and under specific meteorological conditions. This curtailment plan must be produced by a bat specialist based on long term pre-construction acoustic monitoring and operational monitoring of the site.

7.3 Cumulative Impacts

The cumulative impact on bats was considered by searching for current and potential future development of wind energy facilities within a 50 km radius of the project. There is currently one operational wind energy facility (Noblesfontein WEF) and at least seventeen Renewable Energy Facilities (eight of which are Wind Energy Facilities), planned or approved, within this radius based on the Department of Environmental Affairs Renewable Energy Development Database Quarter one 2021.

It is important to consider cumulative impacts across the entire scale potentially affected animals are likely to move, especially volant animals such as bats. Impacts at a local scale could have negative consequences at larger regional scales if the movement between distant populations is impaired (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. This is particularly relevant to bats that migrate.

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 and have smaller home ranges. Five of the seven species expected to be present in the area do not migrate across 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. 2007) but are difficult to accurately predict or assess without baseline data on bat population size and demographics (Arnett et al. 2011; Kunz et al. 2007) 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 population estimates 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.

IMPACT NATURE	**Bat Impact – Cumulative Bat Mortality**		**STATUS**	**NEGATIVE**
Impact Description	Cumulative indirect impacts to bats, such as those relating to changes to physical environment (e.g. roost and habitat destruction) are likely to be moderate across the cumulative impact regions if site-specific mitigation measures are adhered to by all renewable energy developments. Cumulative direct impacts to bats, specifically related to bat mortality, are likely to be severe. For non-migratory species cumulative direct impacts could have a high significance before mitigation but could reduce to medium with appropriate turbine siting and operational mitigation as determined by preconstruction and operational monitoring studies. Direct impacts on migratory species (i.e. the Natal long-fingered bat and possibly Temmink's myotis) 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. There is currently one operational wind energy facility in the cumulative impact area and at least eight more that have been approved. Impacts to bats will increase when more WEFs are constructed. Operational monitoring at Noblesfontein WEF concluded that the facility did not significantly disrupt bat presence in the area. However, there is also 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. Therefore, the confidence in this assessment is medium but the impacts could be severe with the addition of a new WEF.			
Impact Source(s)	Changes to physical environment and bat mortality over projects on a cumulative scale.			
Receptor(s)	Bats and relevant habitats (vegetation cover, linear features, roosting structures etc.).			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**

EXTENT (A)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-3	Preferred Alternative:	-2
	No-Go Alternative:	-3	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	High (-81)	Preferred Alternative:	Medium (-54)
	No-Go Alternative:	High (-81)	No-Go Alternative:	Medium (-54)
CUMULATIVE IMPACTS	n/a			
CONFIDENCE	Medium			
MITIGATION MEASURES	4) At operational wind energy facilities where bat fatality rates exceed threshold values[2], mitigation strategies such as curtailment or deterrents must be implemented. These mitigation strategies and curtailment regimes must be based on pre-construction monitoring from the specific site and be drawn up by a qualified specialist. 5) 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. 6) Lighting should be fitted with movement sensors to limit illumination and light spill, and the overall lit time. In addition, the upward spread of light near to and above the horizontal plane should be restricted and directed to minimise light trespass and sky glow. 7) Increasing the spacing between lights, and the height of light units can reduce the intensity and volume of the light to minimise the area illuminated and give bats an opportunity to fly in relatively dark areas between and over lights. 8) Each development must avoid construction and turbine siting in bat no-go areas of the sensitivity maps determined for each site to ensure effective mitigation of cumulative impacts.			

[2] 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.

7.4 Summary of Impacts and assessment of Alternatives

DESCRIPTION OF IMPACT	Overall Significance (With Mitigation)	
	No-Go Alternative	Preferred Alternative
Roost Disturbance – Construction Phase	Low -	Low -
Roost Destruction – Construction Phase	Low -	Low -
Habitat Modification – Construction Phase	Low -	Low -
Light Pollution – Construction and Operational Phases	Low -	Low -
Habitat Creation in High-Risk Locations – Operational Phase	Low -	Low -
Mortality during commuting and/or foraging – Operational Phase	Low -	Low -
Mortality during migration – Operational Phase	Medium -	Medium -
Roost Disturbance – Decommissioning Phase	Low -	Low -
Roost Destruction – Decommissioning Phase	Low -	Low -
Habitat Modification – Decommissioning Phase	Low -	Low -
Cumulative Impacts	Medium -	Medium -

Based on the assessment of the two alternatives, it can be concluded that the no-go alternative is of a similar significance (with mitigation), relative to that of the current "preferred" alternative. It must be noted, however, that each alternative is unique relative to its potential impact on bats. While the current "preferred" alternative demonstrates a higher total rotor swept area together with relatively more unfavourable tip heights, it does not necessarily mean that such turbine dimensions do not warrant further consideration for development. At this present stage, it is noted that the authorised no-go alternative includes almost twice as many proposed wind turbine generators. By significantly reducing these numbers, it is expected that the level of impacts may be marginally reduced, together with less destruction of suitable bat habitats – due to fewer road infrastructures being developed. Although the increase in turbine dimensions are relatively less favourable for the local bat community, it is not currently expected for such changes to cause an irreplaceable loss to biodiversity, if appropriately managed. However, due to a lack of data from a suitable recent pre-construction monitoring campaign, it is not possible to adequately conclude that the proposed dimensions and layout are fully acceptable or not, due to the lack of information of bat activity data at various heights at the proposed facility. Regardless, based on specialist knowledge of the general area, it is not currently anticipated for the newly proposed layout to warrant significant concern, as many bats are likely to utilise the lower airspaces below the proposed turbine blades. A suitable pre-construction monitoring plan is however recommended to be conducted in order to validate the above, and to provide inputs into the final layout and proposed dimensions. As such, the most recently proposed layout, considering 34 WTG's, is currently considered acceptable – provided that a suitable pre-construction monitoring programme is implemented and that all mitigation measures are strictly adhered to.

7.5 Conditions to be included in the Environmental Authorisation

- Twelve months pre-construction acoustic monitoring to be completed prior to the commencement of construction, this must be according to the latest available monitoring guideline at the time of commencement. Results of the monitoring must inform the final design and layout of the facility and initial mitigation plan.
- Operational acoustic monitoring must be implemented at the commencement of operations accordingly to the latest guidelines and must be continued for at least the first two years of operations.
- Carcass searching must be undertaken according to latest guidelines and continue for at least two years into operations.

- Prior to construction a bat specialist must be appointed to conduct a site walkthrough to confirm turbine positions and approve final layout of the facility.
- A bat management plan must be produced based on the results of the pre-construction monitoring, this plan must be continuously updated by a bat specialists based on the results of the operational monitoring.

8 CONCLUSION

In 2016 Bioinsight confirmed that there have been no major changes to the habitat of the site since the initial study was completed in 2012. Additional operational monitoring reports also indicated that bat activity at the operational Noblesfontein WEF was generally low during winter and medium during autumn, activity increased significantly in spring and summer. Based on these reports and additional knowledge of the area, the significance ratings for the majority of the impacts to bats posed by the development are predicted to be low to medium before mitigation and low after mitigation. Impacts related to bat mortality are predicted to be of medium to high significance before mitigation. After mitigation these impacts are predicted to be of low significance for bat collision mortality and medium significance for cumulative impacts and mortality during migration.

Based on this data and the site visit completed by Arcus in December 2020, it can be confirmed that there have been no major changes to the habitat of the site since the initial study completed in 2012. With the proposed amended layout, a larger total RSA of the site increases the overall area where bats are at risk of collision. The amendment also increases the upper blade tip from 180 m to 200 m and decreases the ground to lower blade tip height from 70 m to 38 m, which could impact both lower and higher-flying species.

An updated impact assessment, specifically related to bats, revealed that with the implementation of mitigation measures the proposed Modderfontein WEF is likely to have low impacts to bats during the construction and operational phases of the development except for bat collisions during migration, which will be of medium significance. Cumulative impacts were assessed to be of medium impact after mitigation. The applicant must conduct 12 months of pre-construction acoustic monitoring on site to inform the final design and layout of the facility. Should these mitigation measures be implemented, the specialist is of the opinion that the application for the amendment of the EA can be approved, without unacceptable risks to bats.

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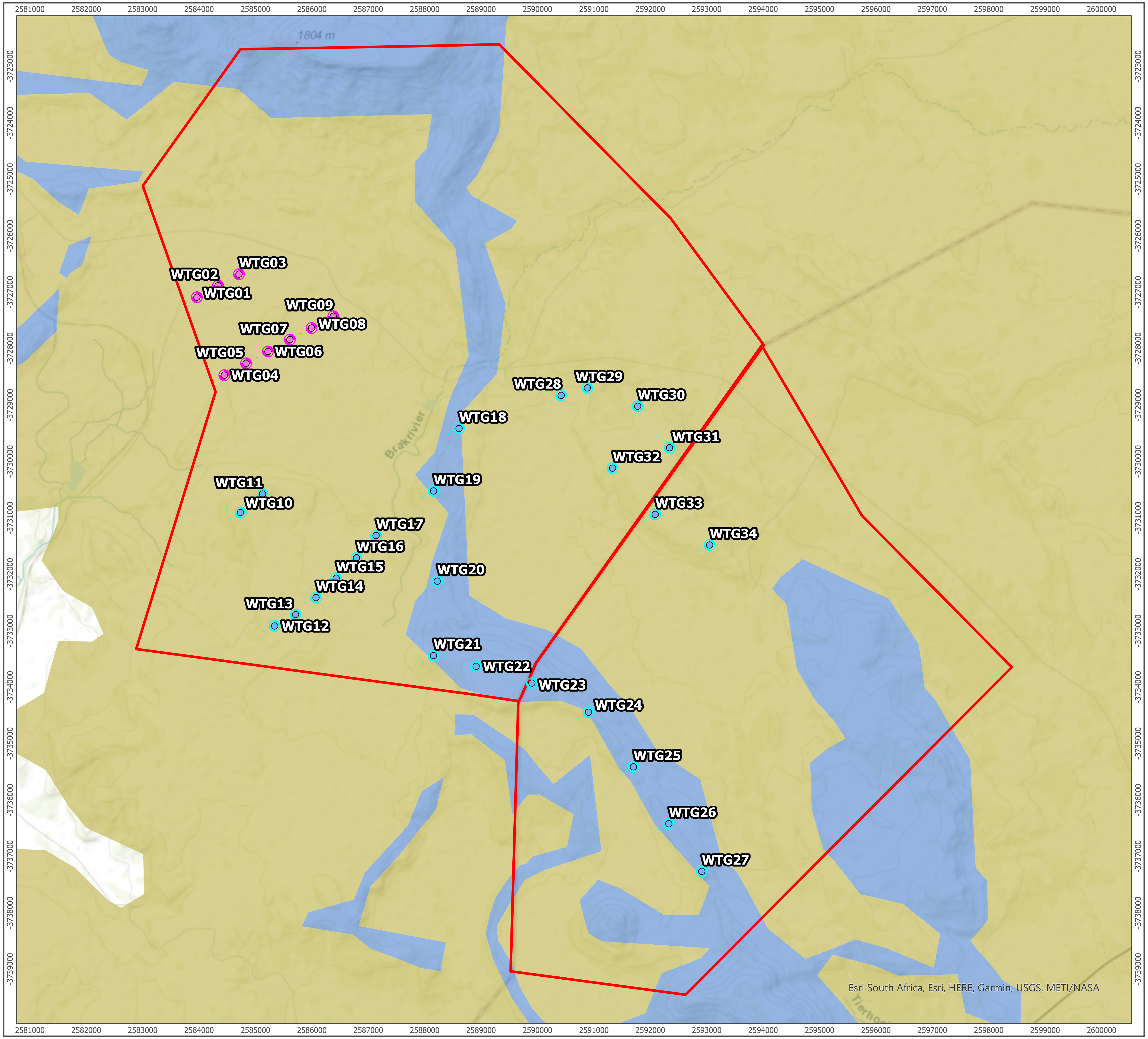


ARCUS

Modderfontein WEF Boundary

50 MW Facility Turbines

140 MW Facility Turbines

Vegetation Types

Eastern Upper Karoo

Upper Karoo Hardeveld

1:65 000 Scale @ A3

0 1 2 km

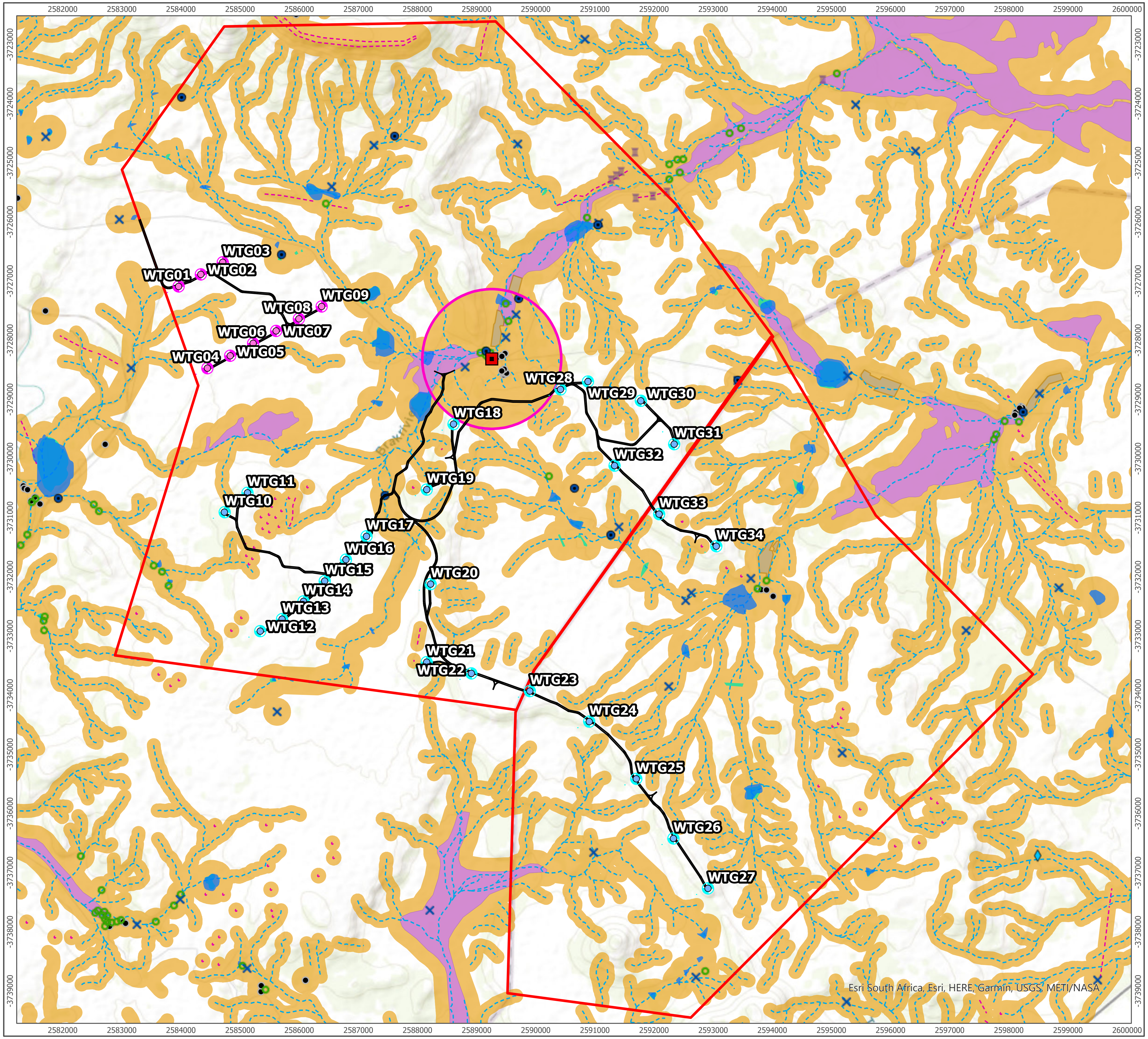
NORTH

Produced By: MB	Ref: 4090-REP-001
Checked By: AB	Date: 2021/06/21

Vegetation Types
Figure 4

Modderfontein WEF Amendment Report

S:\GIS\Projects\4090 Moddersfontein\4090 Moddersfontein WEF.aprx\4090-REP-001 Fig 4 Vegetation Types



ARCUS

Modderfontein WEF Boundary
Internal Roads
50 MW Facility Turbines
140 MW Facility Turbines
Confirmed Roost
Bat No Go Areas
Bat Roost 1km Buffer
Important Bat Features
House
Ruin
Spring
Tree
Water Reservoir
Wind Pump
Non-Perennial River Centre line
Rocky Outcrop
Cultivated Land
NFEPA Wetland
Dam
Dry Water Course

1:62,000 Scale @ A3

0 1 2 km

NORTH

Produced By: MH	Ref: 4090-REP-002
Checked By: CC	Date: 21/06/2021

Bat Sensitivity Map
Figure 5

Modderfontein WEF Amendment Report

S:\GIS\Projects\4090 Moddersfontein\4090 Moddersfontein WEF.aprx\4090-REP-002 Fig 5 Bat Sensitivity Map environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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

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

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

PROJECT TITLE

Modderfontein Wind Energy Facility Part 2 Amendment Application

Kindly note the following:

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

Departmental Details

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

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

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

SPECIALIST INFORMATION

Specialist Company Name:	Arcus Consultancy Services South Africa (Pty) Ltd.			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Craig Campbell			
Specialist Qualifications:	BSc (Conservation Ecology)			
Professional affiliation/registration:	SACNASP Professional Natural Scientist (Ecological Sciences) – 119649			
Physical address:	Icon Building, Cnr Long Street & Hans Strijdom Avenue, Cape Town 8001, South Africa			
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E-mail:	craigc@arcusconsulting.co.za			

1. DECLARATION BY THE SPECIALIST

I, Craig Campbell, declare that –

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

Signature of the Specialist

Arcus Consultancy Services South Africa (Pty) Ltd.

Name of Company:

2021-06-21

Date

2. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Craig Campbell, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Arcus Consultancy Services South Africa (Pty) Ltd.

Name of Company

2021-06-21

Date

Signature of the Commissioner of Oaths

SUID-AFRIKAANSE POLISIEDIENS
D3447
GEMEENSKAPDIENSSENTRUM
21 JUN 2021
COMMUNITY SERVICECENTRE
MILNERTON
SOUTH AFRICAN POLICE SERVICE

Date

CURRICULUM VITAE

Craig Campbell *(Pr. Sci. Nat – Ecological Sciences)*

Ecologist

Email: craigc@arcusconsulting.co.za

Specialisms

- Bird and Bat baseline assessments
- Field Research
- Project Management
- Reporting and GIS analysis

Summary of Experience

Craig is an Ecologist at Arcus. He graduated with a Degree in Conservation Ecology from Stellenbosch University, South Africa. He is registered as a Professional Natural Scientist, in the field of Ecological Sciences (SACNASP). Since 2013, Craig has had extensive experience in ecological baseline studies, biodiversity monitoring surveys and due diligence on several renewable energy and other projects in South Africa, Mozambique, Portugal and Turkey. He has a sound background in management and ecology, and also focusses on project design & layout, GIS mapping, report compilation and stakeholder engagement.

Professional History

- Mar 2021 to present - Ecologist, Arcus Consultancy Services, Cape Town
- Aug 2017 to Mar 2021 – National Manager & Senior Ecologist, Bioinsight, Cape Town
- Nov 2013 to Aug 2017 – Ecologist, Bioinsight, Cape Town

Qualifications

University of Stellenbosch, 2009 - 2013

BSc (hons) Conservation Ecology.

University of Stellenbosch, 2008-2008

Certificate in Aquaculture Production Management

Project Experience

Pre-Construction Monitoring and/or Impact Assessment

- Kudusberg Wind Energy Facility
- Sere Wind Energy Facility
- Boulders Wind Energy Facility
- Vredendal Wind Energy Facility
- Juno Wind Energy Facility
- Hartebeest Wind Energy Facility
- Rondekop Wind Energy Facility
- Noblesfontein 2 & 3 Wind Energy Facilities
- Haga Haga Wind Energy Facility
- Somerset East Wind Energy Facility
- Spitskop West Wind Energy Facility
- Witsand Wind Energy Facility
- Gouda 2 Wind Energy Facility
- Stormberg Wind Energy Facility
- Kruispad, Doornfontein and Heuningklip Photovoltaic Solar Energy Facilities

Operational Monitoring – Wind Energy Facility

- Noblesfontein Wind Energy Facility
- Sere Wind Energy Facility
- Nxuba Wind Energy Facility

Due Diligence

- Bird monitoring at Kiyikoy Wind Energy Facility, Turkey