Albany Wind Energy Facility: Bat Impact & Pre-Construction Monitoring Report

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Executive Summary

EDF Renewables South Africa (EDF) plan to develop a wind energy facility (WEF) of approximately 6 500 ha called the Albany WEF. The proposed location for the Albany WEF is on the outskirts of Grahamstown, roughly 12 km north-east of Grahamstown's CBD, in the Eastern Cape Province. The proposed Albany WEF will consist of up to 43 wind turbines with a rotor diameter of up to 170 m (blade length 85 m) and a hub height of up to 130 m.

EDF appointed IWS to conduct 12 months of bat monitoring at Albany according to the Pre-Construction Bat Surveying Guidelines – 4th Edition (Sowler *et al*., 2014). This report is the final pre-construction report based on the full 12 months' of data collected from static bat detector, manual point samples, roost surveys and ground-truthing between 7 April 2016 and 12 April 2017. Some of the key findings were as follows:

- Eleven bat species were confirmed for the proposed Albany WEF. None of these are threatened species according to Child *et al* (2016), but all are protected by the Ciskei Nature Conservation Act 10 of 1987 (the Act) and the Cape Nature: Nature Conservation Ordinance 19 of 1974 (the Ordinance).
- *T. aegyptiaca* was the most common species detected on site and particularly within rotor swept height. *N. capensis* was also abundant.
- Activity was highest in autumn and summer, followed by spring and lowest in winter.
- While activity was low in *Miniopterus natalensis*, there is some evidence to suggest possible migration of the species as activity was highest in autumn.
- Activity peaked just after season across all seasons, for a couple of hours, with smaller peaks throughout the night, particularly in summer and autumn.
- Approximately half the bat activity at 80m took place in wind speeds ≤ 5m/s and 75% in ≤7.5 m/s.
- Very little bat activity (10%) occurred below 12°C.
- A bat sensitivity map was produced and split into potentially low-medium, medium, medium- high and high sensitivity areas.
- In terms of the turbine fatality risk levels described in MacEwan *et al.* (2020), the Albany WEF falls within the Medium risk category for the Albany Thicket ecoregion and mitigation measures should be recommended based on the pre-construction monitoring results and implemented in the planning or at the start of operation. Several measures have been recommended by IWS in the current report to minimise bat fatalities, the key measures are listed below:
    - All turbines (including their full rotor swept zone) to be kept out of all **High** bat sensitivity areas. Layout 10.1 meets this requirement.
    - For turbines 15 turbines within the **Medium** and the 20 turbines with the **Medium-High** bat sensitive zones, the following curtailment strategy is recommended from the commencement of operation in order to keep bat fatalities to a minimum:

In the following Bat Sensitivity Zones:	Time of Year to be applied:	Time of Night to be applied:	When Temperatures exceed:	Apply a Cut-in Wind Speed of:
Medium	December, January and February	From sunset for 6 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium	March	Sunset to Sunrise	12°C	5 $m.s^{-1}$
Medium	April	From sunset for 2 hours and for 3 hours before sunrise	12°C	5 $m.s^{-1}$

Medium	May	From sunset for 2 hours	12°C	5 $m.s^{-1}$
Medium	June, July and August	From sunset for 1 hour	12°C	5 $m.s^{-1}$
Medium	September	Sunset to Sunrise	12°C	5 $m.s^{-1}$
Medium	October and November	From sunset for 4 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium-High	December, January and February	From sunset for 6 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium-High	March	Sunset to Sunrise	12°C	6 $m.s^{-1}$
Medium-High	April	From sunset for 2 hours and for 3 hours before sunrise	12°C	6 $m.s^{-1}$
Medium-High	May	From sunset for 2 hours	12°C	6 $m.s^{-1}$
Medium-High	June, July and August	From sunset for 1 hour	12°C	6 $m.s^{-1}$
Medium-High	September	Sunset to Sunrise	12°C	6 $m.s^{-1}$
Medium-High	October and November	From sunset for 4 hours and for 2 hours before sunrise	12°C	6 $m.s^{-1}$

- Post-construction/ operational bat monitoring must be performed according to the South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (Aronson, *et al.,* 2020) or later editions of the guidelines, valid at the time of monitoring. IWS recommends the initial 2 years and then every third year for the remainder of the project.
- The above measures are likely (50-60% certainty) to minimise bat fatalities, as only 50% of bat activity occurs above wind speeds of 5 m/s and 40% of bat activity occurs above 6 m/s.
- However, should operational monitoring show that adjusted annual bat fatalities (adjusted for biases such as searcher efficiency and carcass persistence) ever equal or exceed the threshold level of fatalities guided by SABAAP, then further mitigation will be required.
- For the 6500ha Albany WEF site, 57 bats per annum is the maximum number of bats that can be killed based on the thresholds provided for the Albany Thicket ecoregion in MacEwan *et al* (2020) or later editions of the guidelines, valid at the time of monitoring.
- Such additional mitigation actions will only be required at specific turbines that have killed two or more bats during the reporting period – see Aronson *et al* (2020) for guidance on fatality reporting periods.
- At the individual turbines that have killed two or more bats include, the cut-in wind speed should be increased to 7.5m/s (only exposing 25% of bat activity to spinning blades).
- When dealing with living animals that can respond in different and unpredictable ways to changing environmental, climatic and developmental parameters, it is very difficult to make guaranteed predictions. Lintott *et al*. (2016) state that the nightly and seasonal activity data collected during

pre-construction surveys may provide an indication of the extent of curtailment that is required and therefore the economic viability of the project, however, they highlight the need for a feedback mechanism for practitioners to share the success or failure of mitigation strategies, i.e. adaptive mitigation. The bat specialist conducting the operational monitoring has the right to make further recommendations should they see fit.

- Given the magnitude and extent of wind-turbine related bat fatalities worldwide, the conservation implications are critically important and bat fatalities should be avoided, minimised or mitigated proactively.

In addition to the responsibility of the WEF developer and operator to ensure minimal bat fatalities, there is a responsibility on government to manage cumulative impacts. IWS recommends that the DEFF and the ECDEDEAT commission an individual or a company to collate data gathered from the various projects in the area to assess the actual cumulative impact and to make recommendations from a regional perspective.

South Africa doesn't want to find themselves in the situation where the USA and Canada are, with hundreds of thousands of bats dying annually and declining species numbers because strategic mitigation action was not taken sooner.

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Acronyms and Definitions

Barotrauma	Barotrauma involves tissue damage to air- containing structures caused by rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald *et al* 2008).
BD	Bat Detector
Buffer zone	Non-disturbance areas that provide a protected zone for sensitive resources such as bat foraging habitat and bat roosts. In the case of wind energy development, no part of the infrastructure, including the blade can be positioned within the buffer zone. I.e. These are No-Go zones.
CI	Conservation Important (See Conservation Important Species)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora.
Conservation Important Species	Endemic (E), Not Evaluated (NE), Threatened – Vulnerable (V), Endangered (EN) and Critically Endangered (CE), Near-Threatened, Data Deficient (DD) Bats, Provincially Protected or TOPS species – these are already described in the acronyms section
CR	Critically Endangered
Curtailment	When a turbine is kept stationary at a very low wind speed and then allowed to rotate once the wind exceeds a specific speed
DD	Data Deficient
DEFF	Department of Environmental, Forestry and Fisheries
EIA	Environmental Impact Assessment
EN	Endangered
EW	Extinct in the Wild
EWT	Endangered Wildlife Trust
Foraging	Feeding
GDARD	Gauteng Department of Agriculture and Rural Development

GNorBIG	Gauteng and Northern Regions, Bat Interest Group
ha	hectare
HD-CF	High Duty-cycle Frequency
IWS	Inkululeko Wildlife Services
IUCN	International Union for the Conservation of Nature
LC	Least Concern
LD-CF	Low Duty-cycle Constant Frequency
LD-FM	Low Duty-cycle Frequency Modulated
Least Concern	IUCN Red Data status for a Non-threatened species
LoO	Likelihood of Occurrence
m	metre
m/s	Meters per second
MW	Megawatt
MAP	Mean Annual Precipitation
Nacelle	The head/hub of the wind turbine.
NBSAP	[South Africa's] National Biodiversity Strategy and Action Plan
NCDENC	Northern Cape Department of Environment and Nature Conservation
NE	Not Evaluated
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NFEPA	National Fresh Water Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
NSBA	National Spatial Biodiversity Assessment
NSS	Natural Scientific Services
NT	Near Threatened
RPM	Revolutions per Minute
SA	[Republic of] South Africa
SABAA	South African Bat Assessment Association
SABAAP	South African Bat Assessment Association Panel
SANBI	South African National Biodiversity Institute
SAWEA	South African Wind Energy Association
SDF	Spatial Development Frameworks
SPWA	Specially Protected Wild Animals
TOPS	[NEMA: Biodiversity Act, 2004]: Threatened and Protected Species
USA	United States of America
V	Vulnerable
WAC	A compressed sound storage file specific to Wildlife Acoustics products
Watercourse	Definition adapted from the National Water Act, 1996 (No. 36 of 1998): - a river or spring; - a natural channel in which water flows regularly or intermittently; - a wetland, lake or dam into which, or from which, water flows; and - any collection of water, such a natural pans and farm dams.
WEF	Wind Energy Facility / Wind Farm
ZC	Zero Crossing

Declaration of Independence

Inkululeko Wildlife Services (Pty) Ltd (IWS) is an independent consultancy. IWS has no legal or financial connection with the developer except for fulfilling the tasks required for this assessment.

Kate MacEwan is the lead bat specialist on this project. She is registered with the South African Council for Natural Scientific Professions (SACNASP).

Signed:

Kate MacEwan

for Inkululeko Wildlife Services (Pty) Ltd

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1. Project Introduction

EDF Renewables South Africa (EDF) plan to develop up to a 140 MW wind energy facility (WEF), called the Albany WEF, in an area of approximately 6 500 ha on the outskirts of Grahamstown, roughly 12 km north-east of Grahamstown's CBD, in the Eastern Cape Province (**Figure 1**). The infrastructure layout is shown in (**Figure** 2) and the proposed details for the project are as follows:

- Up to 43 wind turbines with a rotor diameter of up to 170 m, a hub height of up to 130 m and blade length of up to 85 m; each with an output of between 4 and 8MW
- Foundations (up to 550 m^2) for each wind turbines;
- A laydown area next to the locations of the proposed wind turbines (3,900 m^2 for crane hardstand per turbine);
- Temporary infrastructure including a site camp and a laydown area of approximately 30 m^2 per turbine (all to be rehabilitated post construction);
- 25 m^2 area for switchgear and/or transformer at each turbine;
- Internal access roads of between 8 m (during operation) and 14 m (during construction, to be part rehabilitated) wide to each turbine;
- Existing roads will be used as far as possible. However, where required, internal access roads will be constructed between the turbines;
- Temporary Areas of 90 000m^2 for: A Batching plant, laydown facilities, concrete tower manufacturing and steel tower processing and construction compound.
- Medium voltage cabling between turbines and the switching station, to be laid underground where technically feasible;
- Overhead medium voltage powerlines between turbine rows where necessary;
- Overhead power lines to connect the facility to the electrical grid;
- Specific on the grid connections:
  - Option 1 (preferred) - An up to 23000 m2 IPP Substation (MV/132kV) which will include, battery storage and site office area, situated in the middle of the site.
  - Two collector substations, each 10000 m2, (Collector s/s West and Collector s/s East) will be constructed.
  - The grid connection will be a LILO on the Pembroke-Albany 132kV line;
  - All turbines will connect, via underground MV lines, either directly to the IPP substation or to a collector. Each collector will in turn connect to the IPP substation via MV or 132KV overhead line/s within the grid corridor.
  - Grid corridor width is 500m wide to allow for manoeuvrability for the final line position within the corridor.
  - The corridor from Collector s/s West to the main corridor is 170m in width with a flanking area to accommodate for the line turn in.
  - Option 2 - direct connection, via the same corridors, to the Potential 132kV s/s adjacent to the Eskom Albany 132kV s/s, up to 23000 m2 which will include, battery storage and site office area, situated in the middle of the site.

EDF appointed IWS to conduct 12 months of bat monitoring at Albany according to the Pre-Construction Bat Surveying Guidelines – 4th Edition (Sowler *et al.*, 2014). This report is the final pre-construction report based on the full 12 months' of data collected between 7 April 2016 and 12 April 2017. IWS went to the Albany WEF site eight times during the 12 months and the eight technical reports associated with each field trip undertaken can be found under **Appendix A**.

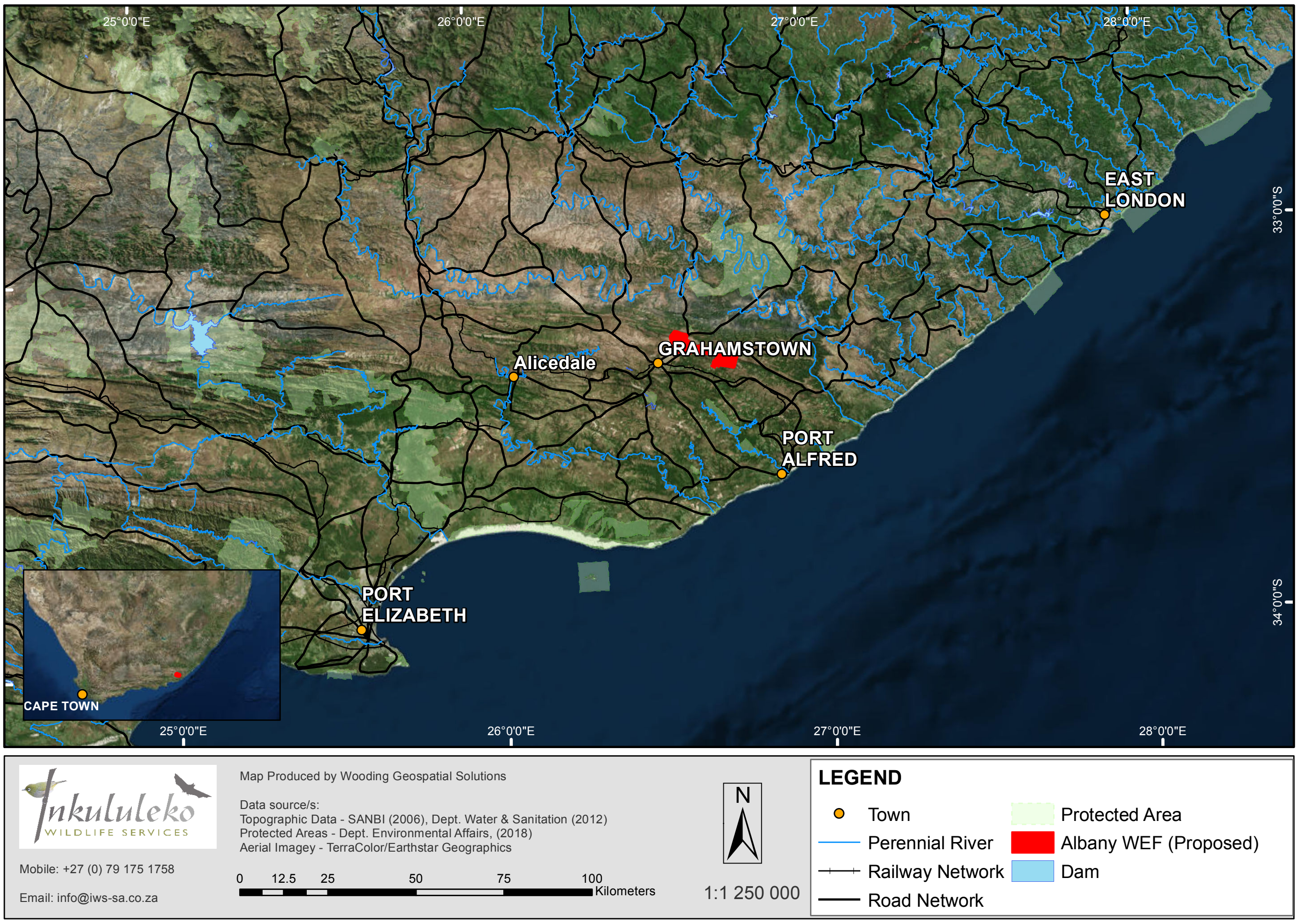


Figure 1 **Locality map of Albany WEF**

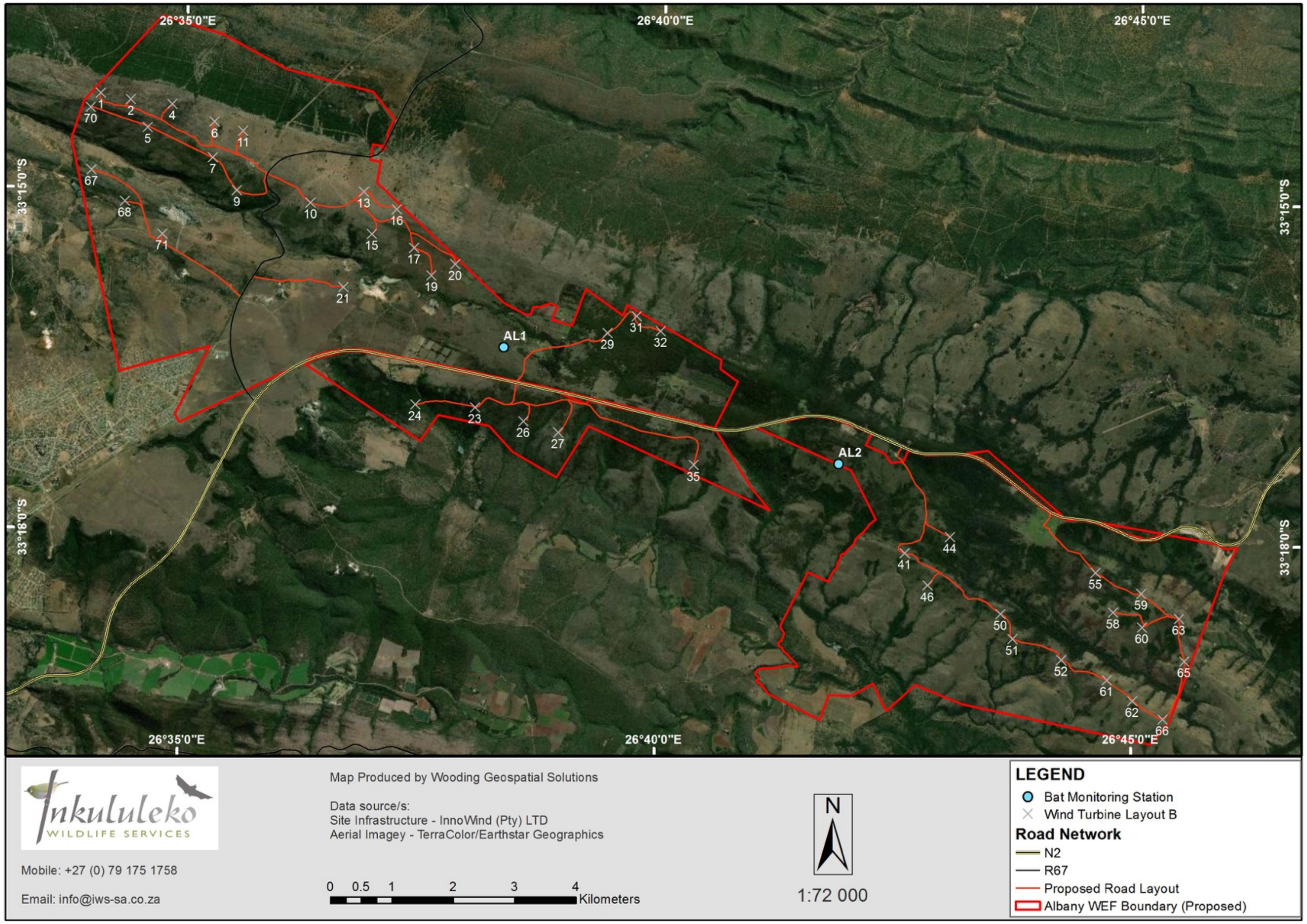


Figure 2 Turbine Layout 10.1 of Albany WEF

2. Bat Assessment Team

Inkululeko Wildlife Services (Pty) Ltd. (IWS) is a bat specialist consultancy founded in 2014 by Kate MacEwan, a former founding member of Natural Scientific Services for 11 years. The IWS team have conducted over 35 long-term pre-construction bat monitoring studies and 10 current or recently completed long-term operational bird and bat monitoring studies for wind energy development in South Africa and southern Africa. The team members have also been involved in numerous other bat specialist and inventory assessment for mines and protected areas in South Africa, Zambia and the DR Congo. Whilst there are several additional scientists and field assistants (local and SA based) that we work with, the lead bat specialist will be:

2.1 Kate MacEwan

Kate MacEwan, the director of IWS, is a SACNASP registered zoologist and environmental scientist and holds a BSc (Honours) in Zoology from Wits University. She has over 22 years of zoological and practical bat conservation experience and wide diversity of contacts with various African bat academics and biologists. Kate is currently the chairperson for the South African Bat Assessment Advisory Panel (SABAAP), and lead author of the South African Best Practise Guidelines for Surveying Bats in Wind Farm Developments – 5th ed. (MacEwan *et al*., 2020a) and co-author on the South African Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities – 2nd ed (Aronson *et al.,* 2020). Kate is also the co-author on several bat species accounts (including some from Mozambique) in the latest southern African Red Data mammal listings (Child *et al.,* 2016).

2.2 Trevor Morgan

Trevor Morgan has worked with Kate for over 9 years as the senior technical specialist on the bat monitoring projects. He has served as an active member on the Executive Committee of the GNorBIG for several years. He is very knowledgeable on South African bats and has extensive experience with bat detectors, their related software, mist-netting and harp-trapping. By trade, Trevor is an electrician and an inventor, and has constructed his own harp trap and heterodyne bat detector. Trevor's considerable field-based involvement in all long-term bat monitoring studies performed by NSS and IWS has been invaluable. In addition, he is Fall Arrest and Rescue accredited to climb heights exceeding 3m.

2.3 Joshua Weiss

Joshua Weiss was a full-time Junior Zoologist with IWS. He has a BSc in Geography and Environmental Sciences and an Honours in Ecology and Conservation. He has keen interests in and experience in biodiversity (particularly avifauna), conservation planning and spatial analysis. In previous work positions, he has done data analysis, compiling carbon footprint reports, researching and had some involvement in the EIA process. At IWS, he was responsible for mapping and GIS analysis for all projects, data handling and since gaining his fall arrest certification, has been involved in the field doing both active capture and setting up passive monitoring equipment. He is also a qualified Level 1 field guide and member of BirdLifeSA and GNorBIG.

3. Brief Introduction to Bats and Wind Energy

Bats represent a significant portion of vertebrate Biodiversity (Simmons, 2005), and are among the most overlooked, yet economically important, non-domesticated animals. Their conservation, therefore, is in the best interest of national and international economies (Boyles *et al.*, 2011). Insectivorous bats provide essential pest control service to farmers and eat substantial quantities of disease-carrying insects like mosquitoes (Kalka *et al.*, 2008; Gonsalves *et al.*, 2013). Frugivorous bats facilitate plant pollination and seed dispersal, and thereby, orchestrate habitat regeneration. By fulfilling these important ecological roles, bats are excellent indicators of environmental disturbance (Fenton and Ratcliffe, 2010).

Unfortunately, many bat species are vulnerable to severe population crashes. Compared to other similar-sized mammals, bats have low reproductive rates. Females usually give birth to only one or two pups at a time, and females of some species only give birth every second year. Bats are particularly susceptible to anthropogenic changes because of their low reproductive rate, longevity, and high metabolic rates (Voigt and Kingston, 2016). Regardless of causal mechanisms, bat fatalities raise serious concerns about population-level impacts because bats are long-lived and have exceptionally low reproductive rates, and their population growth is relatively slow, which limits their ability to recover from declines and maintain sustainable populations (Barclay and Harder, 2003). Adult survival in a population of big brown bats could be typical for a growing population of temperate zone insectivorous bats (O'Shea *et al.,* 2003).

Cave-dwelling and/or migratory bats are especially vulnerable to disturbance because large numbers (hundreds or thousands) of individuals may be concentrated in a few restricted localities (Hester and Grenier, 2005). Consequently, disturbance of only a few populations can have a devastating impact on a species.

Given the ecological and economic importance of bats, and their susceptibility and low resilience to severe population crashes, the potential impacts of WEFs on bats deserve thorough evaluation and effective mitigation.

Whilst most biologists would support the development of potentially cleaner renewable energy sources, such as wind energy, the impacts that wind turbines are having and will have on South African bats is concerning. Evidence from South African WEFs (MacEwan, 2016; IWS unpublished) and studies in the United States of America, Canada and Europe show that wind turbines do kill bats (Kunz *et al.*, 2007; Arnett *et al.*, 2008; Rydell *et al.*, 2010; Baerwald and Barclay, 2011; Voigt *et al.*, 2012). Arnett and Baerwald (2013) conducted a synthesis of bat fatality data from 122 post-construction fatality studies between the years 2000 to 2011 from 73 regional wind energy facilities in the USA and Canada. The findings estimated that cumulative bat fatalities for these 12 years amounted to between 650 104 to 1 308 378. The figures have increased substantially since 2011, but the numbers are not yet published (C. Hein *pers comm.*, 28 August 2014).

3.1 Bats at Most Risk in SA

There are four main groups of bats that are at risk of collision or barotrauma fatality by wind turbines in South Africa, these being:

- Open-air foragers. These insectivorous bats fly across a range of elevations but mostly feed in the open-air, high above tree canopy height, possibly reaching heights of approximately 2km above the ground. This group is made up of the families Molossidae and Emballonuridae. They are adapted for speed and agility – having long narrow wings that provide high wing-loading and aspect ratios. All species within these families are at High risk of fatality and several Molossidae bats have been found dead beneath turbines in SA (Doty and Martin, 2012; MacEwan, 2016; IWS several assessments unpublished)
- Clutter-edge foragers. These insectivorous bats forage amongst and above the tree canopy. They consist mainly of bat species of the Vespertilionidae family. Certain species are at particular risk and have been found dead below turbines, e.g. *Neoromicia capensis* (Doty and Martin, 2012; MacEwan, 2016; IWS several assessments unpublished).

- Migrating bats. Whilst the three bats most well-known for seasonal movement or migration events in SA are *Miniopterus natalensis* (van der Merwe, 1975), *Myotis tricolor* (Monadjem *et al*., 2009) and *Rousettus aegyptiaca* (Herselman and Norton, 1985; Monadjem *et al*., 2010), evidence from Pre-Construction monitoring studies in SA is suggesting that other high-risk species may also be making seasonal movements. Whilst in the USA and Canada, migrating bats are tree-roosting species, here in SA, migrating bats are generally cavity roosting species. They cover large distances during their seasonal movements and are thought to travel well above the tree canopy height during migration events. As they occur in large numbers in caves, they possibly migrate in large numbers, which could result in large-scale fatalities by WEFs. Migrating bats are considered to be at Medium to High risk of fatality. A few *M. natalensis* carcasses have been found so far at a facility in the Eastern Cape, SA (MacEwan, 2016). Furthermore, Isotope studies in Europe have also revealed that wind farms may kill bats from populations more than 1 000 km away (Voigt *et al*,. 2012). Such severe fatality of bats from potentially large geographic areas could have a devastating, long-term impact on species.
- Fruit bats. Two fruit bat species have the potential to occur in wind energy development regions of SA - *Rosettus aegyptiacus* and *Epomophorus wahlbergi*. This group are at a Medium to High risk of fatality, and carcasses of both species have already been found at WEFs in the Eastern Cape, SA (MacEwan, 2016).

3.2 Bat Fatality Risk

Some bats are at a higher risk of fatality by wind turbines than others. The South African guidelines (MacEwan *et al.*, 2020a) have put together a risk level table for different bat families and genera. These have been applied to this report.

4. Conservation Areas and Important Legislation Pertaining to Bats

4.1 Conservation/Protected Areas

There are no protected areas in the immediate vicinity of the proposed site. The nearest designated protected areas are the Koos Ras Nature Reserve (8 km south-east) and the Andriesbergen Private Nature Reserve (24 km south-east) (DEA, 2017a). The site falls into the Amathole Tarkastad NPAES focus area and in a second-tier Critical Biodiversity Area (CBA) (ECBCP, 2007). A CBA is an area which has been identified that contains features critical for conserving biodiversity and maintaining healthy ecosystem functioning. A second-tier CBA contains endangered vegetation types or ecological corridors identified by experts (ECBCP, 2007).

4.2 International Legislation, Guidelines and Treaties

There are various Conventions, Unions and Treaties in place for the protection of biodiversity – to name just a few:

- Convention on Biological Diversity
    - This Convention, also referred to as the Biodiversity Convention, was established during the 1992 UN Conference on Environment and Development (UNCED), also known as the 1992 Earth Summit, held in Rio de Janeiro, Brazil. It represented the first global, comprehensive, legally-binding agreement to address all aspects of biological diversity ranging from genetic resources to species and ecosystems. It is regarded as the key document regarding sustainable development. The CBD has three main goals: conservation, sustainable use of biodiversity and equitable sharing of benefits arising from genetic resources. South Africa signed the treaty in 1998 showing further commitment to the conservation of biodiversity, including inter- and intra-specific bat diversity and bat habitat.
- The Bonn Convention (on the Conservation of Migratory Species of Wild Animals)
    - This Convention aims to conserve terrestrial, marine and avian migratory species throughout their range and ensure the sustainable use of these species. The treaty was signed in 1979 in Bonn, France, and entered into force in 1983. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme (UNEP), which is concerned with the conservation of wildlife and habitats on a global scale. South Africa is a party to this Convention, and several bat species in South Africa are known or suspected to be migratory, e.g. the Natal Long-fingered Bat (*Miniopterus natalensis*).
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)
    - CITES is an international agreement aimed at ensuring sustainable international trade in wild animal and plant specimens to ensure they are not threatened by trading. CITES was drafted as a result of a resolution adopted in 1963 at a meeting of members of IUCN (The World Conservation Union) and came into effect in 1975. There are currently 183 parties.
- Agenda 21 and Rio Declaration

    Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organisations of the United Nations System, governments, and major groups in every area in which human impacts on the environment.
- The IUCN (World Conservation Union)

The Union's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. The IUCN have assigned (through research and assessments) various red list (level of threat) conservation categories to animal and plant species (IUCN, 2012), from those requiring little conservation effort to those in desperate need of conservation:

- Least Concern (LC)
- Near Threatened (NT)
- Vulnerable (VU)
- Endangered (EN)
- Critically Endangered (CR)
- Extinct in the Wild (EW)
- Extinct (EX)

Being at an international level, these categories often don't meet the national conservation needs of certain species, therefore national lists are implemented.

- World Bank Group - Environmental Health, and Safety Guidelines for Wind Energy 2015

The World Bank Group consists of five institutions that share a commitment to reducing poverty, increasing shared prosperity, and promoting sustainable development. The International Finance Corporation (IFC) is one of the institutions.

These guidelines, among other aspects, highlight the environmental responsibility of onshore and offshore wind energy developers. There is recognition that there is a potential adverse impact on bats due to direct collision and barotrauma. It highlights that site selection should consider:

- The proximity of proposed WEFs to areas of high biodiversity value
- Consultation with relevant organisations to inform site selection
- Site-specific issues informed by specialists
- Species-specific issues informed by specialists
- Season-specific issues informed by specialists
- Siting of turbines relative to various environmental impacts

The guidelines further state that pre- and post-construction monitoring should occur and be informed by the most relevant monitoring guidelines, and that the results of such should be made available to stakeholders and mitigation measures should be adhered to or considered and revised where necessary.

The guidelines also state that where robust in-country guidelines are not yet developed, international guidelines should be used and should always consider the need for surveys to be site-, species-, and season-specific.

Species-specific issues: surveys should be targeted to species of flora and fauna of high biodiversity value, those with a special international or national conservation status, endemic species, and species that are at elevated risk of impact from wind energy facilities.

Season-specific issues: surveys should take into consideration certain periods during the year when the project site may have a greater or different ecological function or value (e.g., migration, breeding season, or winter seasons). Surveys should usually be conducted for at least one year when at-risk wildlife is identified. Longer surveys may sometimes be necessary in areas with exceptional aggregations of at-risk migratory birds and where existing biodiversity data are limited. This would be determined on a project-by-project basis.

Surveys for bats could include an assessment of feeding and/or roosting habitats both within the project area and in its vicinity, activity surveys (transects) using hand-held ultrasound bat detectors, trapping and release surveys, and deployment of static ultrasound detectors (particularly at turbine locations). It is preferable for static detectors to be deployed at height and could be attached to meteorological masts.

- IFC Performance Standard 6

  PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and managing living natural resources adequately are fundamental to sustainable development. This is especially relevant in developing countries, like Zambia, where natural resource-based livelihoods are prevalent.
- IFC Guidance Note 9

  GN9 of Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (January 1, 2012):

  As part of the ESIA, baseline studies should be conducted for the relevant biodiversity attributes and ecosystem services. Baseline studies should comprise some combination of literature review, stakeholder engagement and consultation, in-field surveys and other relevant assessments. The extensiveness of the baseline will vary depending on the nature and scale of the project. For sites with potentially significant impacts on natural and critical habitats and ecosystem services, the baseline should include in-field surveys over multiple seasons and conducted by competent professionals and external experts, as necessary. In-field surveys/assessments should be recent and data should be acquired for the actual site of the project's facilities, including related and associated facilities, and the project's area of influence.

4.3 Regional Agreements

- Action Plan of the Environmental Initiative of NEPAD
  - This New Partnership for Africa's Development (NEPAD) Action Plan was established during the 2003 African Convention on Conservation of Nature and Natural Resources held in Maputo. As a contracting state, South Africa has undertaken to adopt measures to ensure the conservation, utilisation and development of soil, water, floral and faunal resources in accordance with scientific principles and with due regard to the best interests of the people. The Action Plan encourages sustainable development and associated conservation and wise use of biodiversity in Africa. It has been recognised that a healthy and productive environment is a prerequisite for the success of NEPAD, together with the need to systematically address and sustain ecosystems, biodiversity and wildlife.

4.4 National Legislation and Guidelines

Unlike in the UK and the USA, bats are not directly legally protected in South Africa. However, there are various Acts and Regulations relevant to the protection of fauna, including bats:

- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA)
  - NEMA is an umbrella Act covering broad principles of environmental management. This Act can be regarded as the most important piece of general environmental legislation covering three main areas namely: Land, planning and development; Natural and cultural resources use and conservation; Pollution control and waste management. According to NEMA sustainable development requires the consideration of all relevant factors including:

  - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
  - That the development, use and exploitation of renewable resources and the ecosystems of which they are part, do not exceed the level beyond which their integrity is jeopardised.
  - Sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.
- NEM: Biodiversity Act, 2004 (Act 10 of 2004) (NEM:BA)
  - NEM:BA makes provisions to provide for the management and conservation of South Africa's biodiversity within the framework of NEMA and to ensure the sustainable use of indigenous biological resources. Chapter 4, Part 2 of NEM:BA provides for the listing of species that are threatened or in need of protection to ensure their survival in the wild while regulating the activities, including trade, which may involve such listed threatened or protected species and activities which may have a potential impact on their long-term survival. The Act also recognises invasive species and stipulates management protocol of these species.
- NEM: Biodiversity Act, 2004: Threatened and Protected Species (TOPS) Regulations
  - According to Section 56(1) of NEM:BA, in February 2007 the Minister of Environmental Affairs and Tourism published a list of Threatened (Critically Endangered, Endangered and Vulnerable) or Protected Species (referred to as TOPS). According to the NEM:BA TOPS Regulations a person may not carry out a restricted activity involving a specimen of TOPS without a permit. The Regulations fail to recognise most bat species of conservation concern - only one bat species, the Large-eared Free-tailed Bat (Otomops martiensseni) is listed on the TOPS list and other species are not protected at a national level. Fortunately, certain bat species are protected under various provincial environmental legislation which are primarily used to guide environmental decisions for any development (nature conservation is a parallel function of national and provincial government in terms of the Constitution (Act 108 or 1996).

4.5 Provincial Legislation and Guidelines

The Eastern Cape does not have any environmental legislation which refers to the current [entire] geographic scope of the province. Environmental/Biodiversity issues are still informed by the Ciskei Nature Conservation Act 10 of 1987 (the Act) and the Cape Nature: Nature Conservation Ordinance 19 of 1974 (the Ordinance). The Act recognises eight bats as Protected Species and the Ordinance recognises all the bats in the Province[1] as Protected Species, except the fruit bats of the family Pteropodidae. Two species of fruit bat (Pteripodidae) are protected under the Act. Both Acts specify among other things, that permits are required for work that involves catching and handling of wild animals and hunting of wild animals, including bats.

4.6 Bat Monitoring Guidelines

In addition to the above, the following national monitoring guidelines have been released and have been adopted as the best-practise guidelines by DEA, EAPs and specialists:

- South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities - ed 5. (MacEwan *et al.*, 2020a)
- South African Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities – ed 2. (Aronson *et al.,* 2020).

[1] Both the Act and the Ordinance cover what is now the Eastern Cape and thus all species listed in both pieces of legislation are considered Protected Species.

These Best Practice Guidelines are similar to existing international guidelines and provide technical guidance for consultants charged with carrying out Environmental Impact Assessments (EIAs) for proposed WEFs. Furthermore, the Guidelines ensure that bat scoping assessments and pre-construction monitoring studies produce the required level of detail to assist authorities with evaluating WEF applications. If the guidelines are followed correctly, pre-construction assessments should result in understanding:

- Seasonal and nightly bat activity patterns at the site.
- Bat activity levels and which species are utilising the site.
- Site-specific risks/ impacts to bats associated with a proposed WEF.
- Effective mitigation and monitoring methods that will be appropriate for the WEF.

As a minimum, the following should be conducted during pre-construction bat monitoring:

- Monitoring should cover one year (12 months)
- Successful static acoustic monitoring for a minimum of 75% of one year of data for each site, covering all four seasons.
- Permanent microphones at >7m and at least one at >50 m. The number of monitoring points is dependent on the size of the WEF and the number of vegetation types/biotopes.
- Roost searches and surveys
- Eight nights of manual surveys/ transects spread evenly across all four seasons

4.7 Buffer Zones

Buffer zones are prescribed in MacEwan *et al.* (2020a). Using these as a guide, appropriate site-specific buffers need to be selected by a qualified specialist for bat conservation important habitat (whether it is for foraging or roosting) that will meet the requirements of the particular species or populations occurring in the area.

5. Background Environmental Information

In order to interpret the results from the assessment and to get a better understanding of the potential impacts of the proposed development, it is important to have an understanding of the regional and local habitats on site from a bat perspective. This section provides a brief description of the regional environmental parameters relevant to bats.

5.1 Regional Vegetation and Topography

The proposed Albany WEF is situated in a highly heterogeneous landscape, spanning two ecoregions – the majority is in the Albany Thicket ecoregion and the south east portion is in the Fynbos Shrubland ecoregion (Dinerstein *et al.*, 2017). Five recognised vegetation types exist within the proposed site boundaries - the western portion dominated by Bhisho Thornveld, with smaller areas of Kowie Thicket and Suurberg Shale Fynbos, and the eastern section comprising Suurberg Quartzite Fynbos and small pockets of Southern Mistbelt Fynbos (**Figure 3**).

Bhisho Thornveld is a widespread vegetation unit found mostly between 200-700 m. It is characterised by open *Themeda triandra* grassland interspersed with *Vachellia natalitia* trees, which decrease in density with altitude. Grazing and fire are major factors contributing to the unit's characteristics at various locations. While containing a small number of important taxa and being relatively poorly formally protected the unit is classified as least threatened but it at high risk of cultivation, afforestation and urban sprawl (Mucina and Rutherford, 2006). On the site, much of the unit has been transformed by plantations and cultivation.

Kowie Thicket, found in the most northerly area of the proposed site, is distributed near large rivers in the region, especially around Grahamstown, found from sea level up to 700 m. The unit occurs mostly on dry, northern slopes (such as on the Albany site) dominated by euphorbias and aloes, with a very dense thicket understorey comprising lianas, large succulents and thorny shrubs. Kowie thicket is considered a major floristic node within the Albany Centre of Endemism as it contains exceptionally high numbers of important taxa and three endemic floral species, as well important species from overlapping vegetation units such as those found within the Albany site. The unit is considered least threatened and the conservation target of 19% has been met (Mucina and Rutherford, 2006).

Suurberg Quartzite Fynbos is a typically grassy fynbos with shrubbery comprising ericaceous and proteoid species. There are a high number of important taxa in this unit – typical of fynbos vegetation. While the unit is considered least concern from a conservation perspective, the unit is highly transformed on the proposed Albany site, particularly by *Acacia mearnsii* plantations which have spread over large areas, particularly along drainage lines. Other afforestation and agriculture have also replaced much of the natural vegetation on the site, with only small areas in the south-east of the site still intact. Suurberg Shale Fynbos has similar floral characteristics to Quartzite Fynbos but differs in parts due to the underlying geology.

While only occupying a tiny fraction of the proposed site, Southern Mistbelt Forest is an important habitat for bats due to the presence of large trees and a semi-continuous canopy. Much of the forest on the site has been encroached on by alien species.

The altitude of the site ranges from 460-845 m above sea level and covers a ridge area with steep southern slopes and a gentler north-facing slope in the north-west of the site. The highest areas are near the N2 highway, north-west of AL2 bat monitoring station. There are a number of small, steep valleys in the south-east of the site, while the extreme western portion of the site is relatively flat.

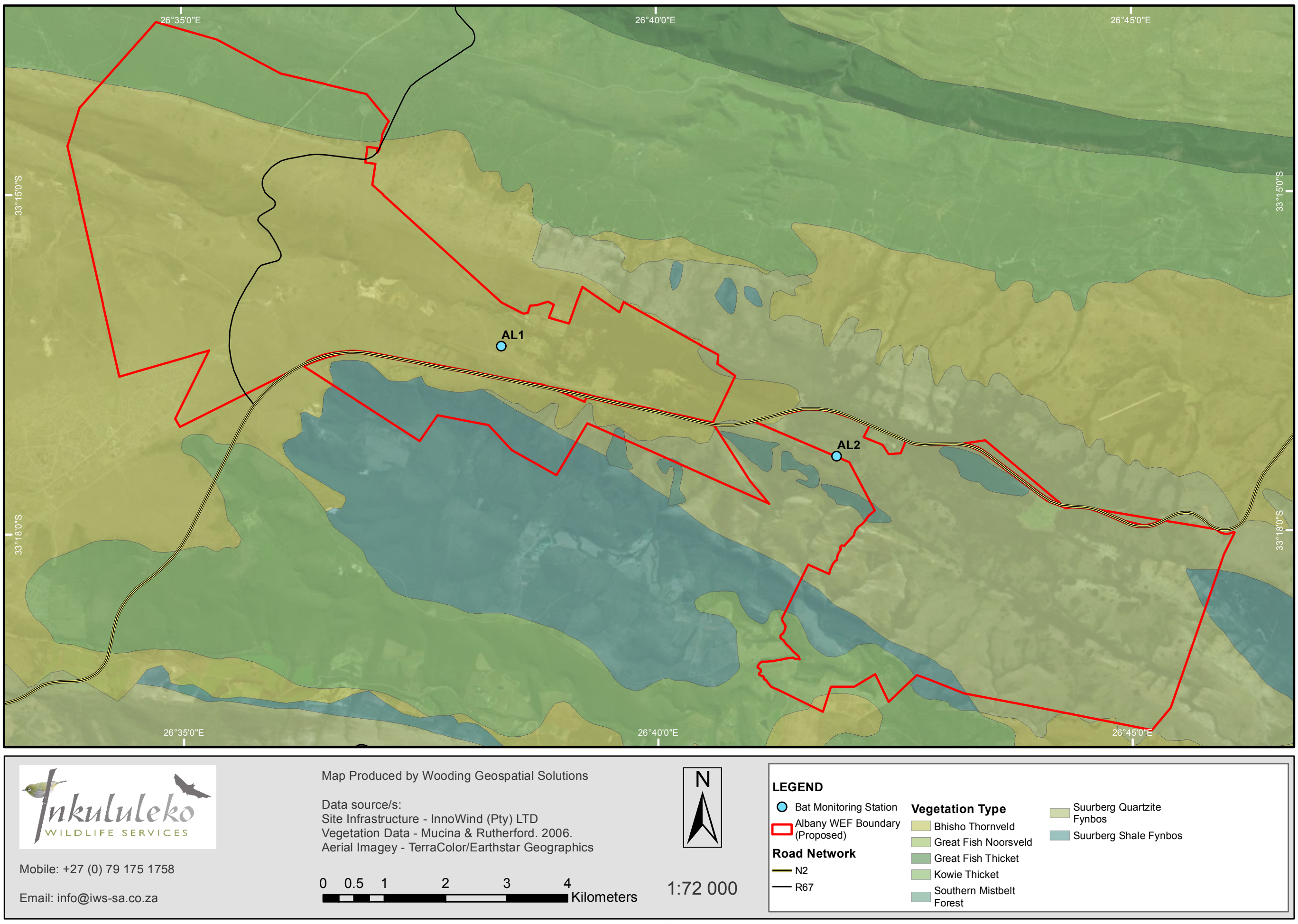


Figure 3 Regional Vegetation of the proposed Albany WEF site

5.2 Regional Climate and hydrology

Being situated on a ridge substantially higher than the surrounding landscape, the microclimate experienced on the site will differ from surrounding areas with generally cooler and windier conditions. This is true even within the site's boundaries – exposed, higher areas being more prone to higher winds and mist than lower valleys. Even with the transects performed to date by IWS, there have been instances of temperatures varying by over 5°C within a few kilometres and less than 30 minutes elapsing as well as wind speed differentials of over 25 km/h. Using Mucina and Rutherford's (2006) description of climate for the Suurberg Quartzite Fynbos, the mean annual precipitation (MAP) is around 545 mm peaking in October-November and February-March. Frost is said to occur only 2-10 days a year, despite very cold temperatures prevalent during the winter months. SAExplorer (2014) lists the nearby Grahamstown MAOP as 466 mm and also state's the maximum rainfall in October and March (bimodal rainfall), with the lowest rainfall in July. Average maximum temperatures range from ±26.8°C in February to ±18.9°C in July, while minima range from ±15°C in February to ±5.6°C in July (with the mercury dropping to below freezing on occasion).

Albany lies on a watershed, with the southern slopes falling into the Bushmans/Kowie Rivers Drainage Region and areas north of the watershed draining into the Great Fish River. Being on a watershed and at a relatively high altitude, the site would be regarded as a significant water source area, as it contains the headwaters of a number of low order rivers and streams. According to data from DWS (2012) and Nel *et al*. (2011), there are four 'major' rivers, all of which are non-perennial (**Figure 4**). The Botha's River flowing east-west (north of AL1) has been dammed in a number of locations and ceases to flow naturally year-round. The Kap River rises east of AL2 and flows in a south-easterly direction. The Brak River emanates in the north-west of the site and flows north. All rivers within the site are classified as being in a healthy condition despite any abstraction/modification taking place (Nel *et al*., 2011). According to the Nel *et al*. (2011) dataset, there are 23 recognised waterbodies in the proposed Albany site (**Figure 4**), six of which are natural slope wetlands, and one natural bench wetland. The remaining 16 are artificial 'farm dams'. While only one of these wetlands is said to be in a predominantly natural setting, these bodies all act as critical bat habitats (Sirami *et al*., 2013; Lisóon and Calvo, 2014) and IWS has already recorded high bat activity next to one of the artificial farm dams during transects. The groundwater yield and water supply/mean annual recharge are moderate relative to the associated primary catchments.

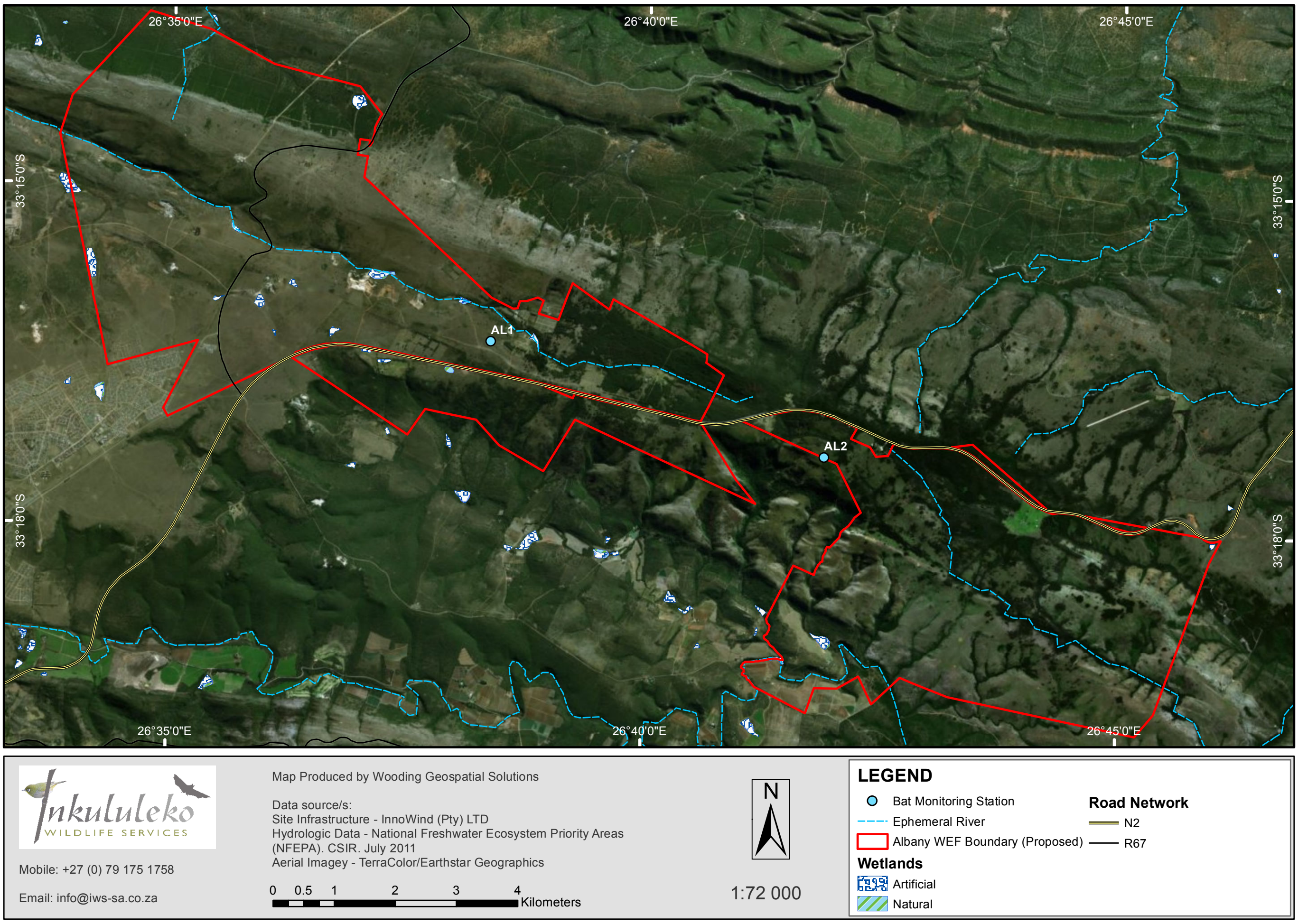


Figure 4 Hydrology of the proposed Albany WEF site

5.3 Geology

The majority of the site lies on Arenite (a type of quartz sandstone) (**Figure 5**). This is a medium-grained sedimentary clastic rock, which can be highly susceptible to weathering leading to sandy soils. This rock is part of the Witteberg Group of the Cape Supergroup (McCarthy and Rubidge, 2005; Büttner *et al.*, 2015). The arenite is underlain by older bedded shale and silcrete. The latter belongs to the Grahamstown Formation (**Figure 5**).

Shale layers in the surrounding areas (and possibly the site itself) have been shown to harbour excellent examples of aquatic specimen fossils dating back to the Late-Devonian period roughly 400 million years ago (McCarthy and Rubidge, 2005; Büttner *et al.*, 2015; Areff, 2016). The very sandy nature of the Witteberg Group rocks overlaying the shale does not preserve fossils as well as the shale (McCarthy and Rubidge, 2005)

Soils in the area lack development and occur on hard or weathering rock (AGIS, 2006). They are mostly sandy due to weathered sandstone. These belong to the Glenrosa and/or Mispah landforms. Soils derived from the shale have higher clay content and are less red in colour. All soils are considered to have low water-holding capacity.

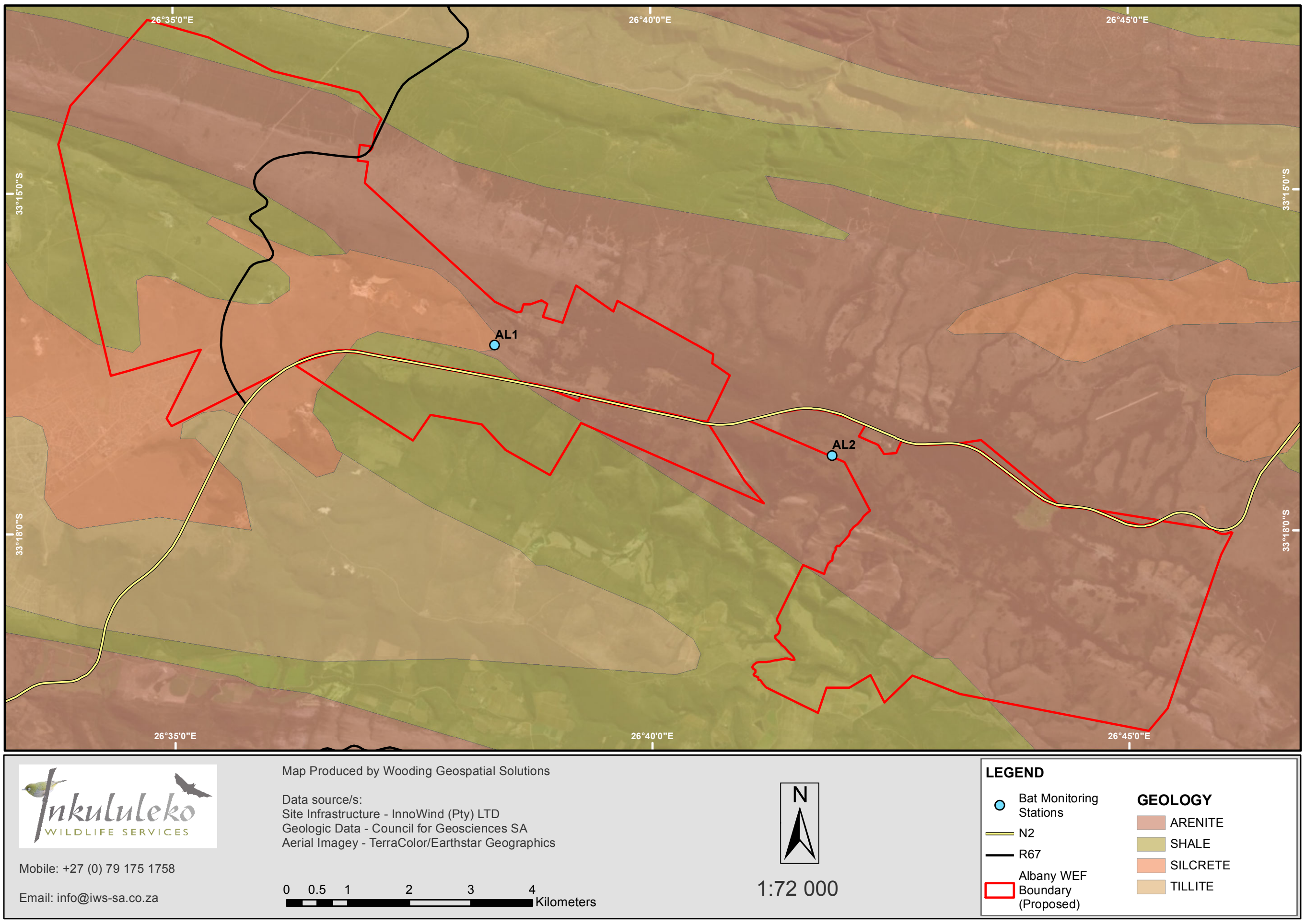


Figure 5 Regional Geology of the proposed Albany WEF site

5.4 Land Use/Cover

The land use/cover map (**Figure 6**) was derived using the most recent available land cover data for South Africa. It shows the area in the west of the site (Bhisho Thornveld in **Figure 3**) as grassland, with areas of woodland/thicket. Ground-truthing has revealed these areas to be in a mostly natural state. There is a small area classified as urban/built-up which is part of Rini township. Modified land uses include the areas of cultivation (both fields and orchards), particularly around AL1 and the open quarrying areas north-west of AL1. There are also significant areas of cultivation south of the site

The eastern portion of the site comprises a matrix of shrubland fynbos, indigenous forest, grassland and woodland/thicket, however, much of this area comprise alien vegetation (mostly *A. mearnsii*) and are thus not in a natural state, and have been not been classified as 'plantation' due to their similar reflectance values as natural woodland. The areas north of the slope are mostly thicket in a natural, mostly unmodified state.

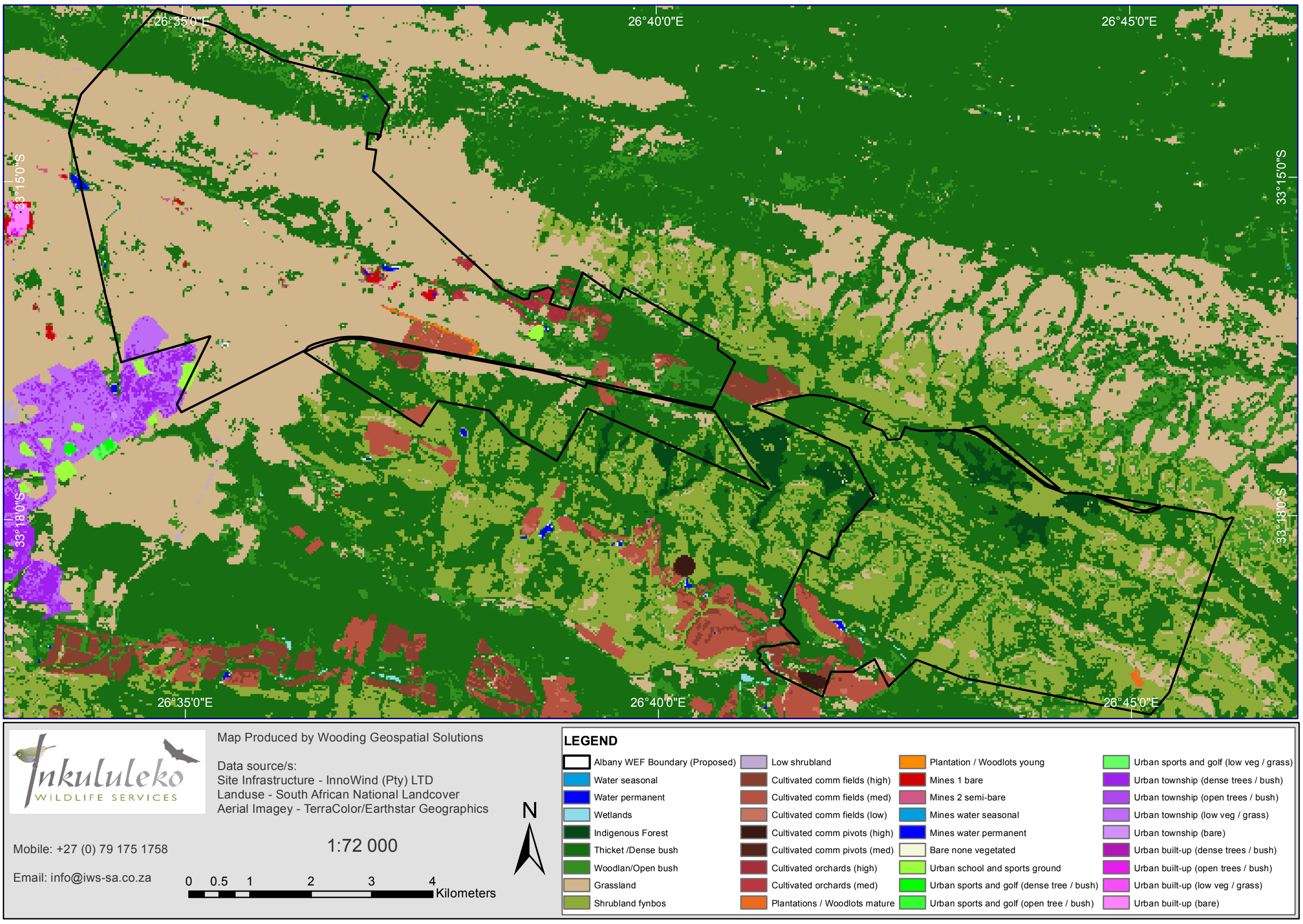


Figure 6 Land Use/Cover Map for the proposed Albany WEF

6. Methodology

6.1 Desktop Review

A desktop review of literature and the Likelihood of Occurrence (LoO) of specific species was conducted. The LoO was done according to the species distribution maps provided in Monadjem *et al.* (2010) and IWS's knowledge. The LoO was categorised as follows:

- If a species has been historically recorded on or near the site, it was assigned a High LoO;
- If a species' range could include the site due to favourable environmental variables, the species was assigned a Moderate LoO;
- If the site is adjacent to an area where a species range extends, that species was assigned a Low LoO, and
- Species known to definitely not occur within the study area were not listed.

6.2 Fieldwork/Data Collection

6.2.1 Passive Acoustic Monitoring

Two monitoring stations, comprising three microphones in total, were installed between 7 and 9 April 2016– AL1 10 m, AL1 80 and AL2 10 m. The positions of these stations are shown in **Figure 2**.

All detectors were powered by two 12 Volt 7 Amp/hour batteries and solar panels and were pre-programmed with the following programs:

- Recording schedule program SM3_AL_mono.PGM and SM3_AL_stereo.PGM were installed.
- Firmware V1.2.9 were used in the SM3's.

Despite some issues with the cards filling up due to excessive noise data in the early stages of the year, the detectors have functioned well for most of the 12 months, with the successful recording periods displayed in **Figure 7.** Of the potential 371 recording nights in the reporting period, AL1 10m recorded 337 nights (90.8%), AL1 80m recorded 348 nights (93.8%) and AL2 10m recorded successfully for 312 nights (84.1%). This means an overall successful recording period of 89.6%, well above the minimum requirements of 75%. In addition, all seasons are well represented by the data.

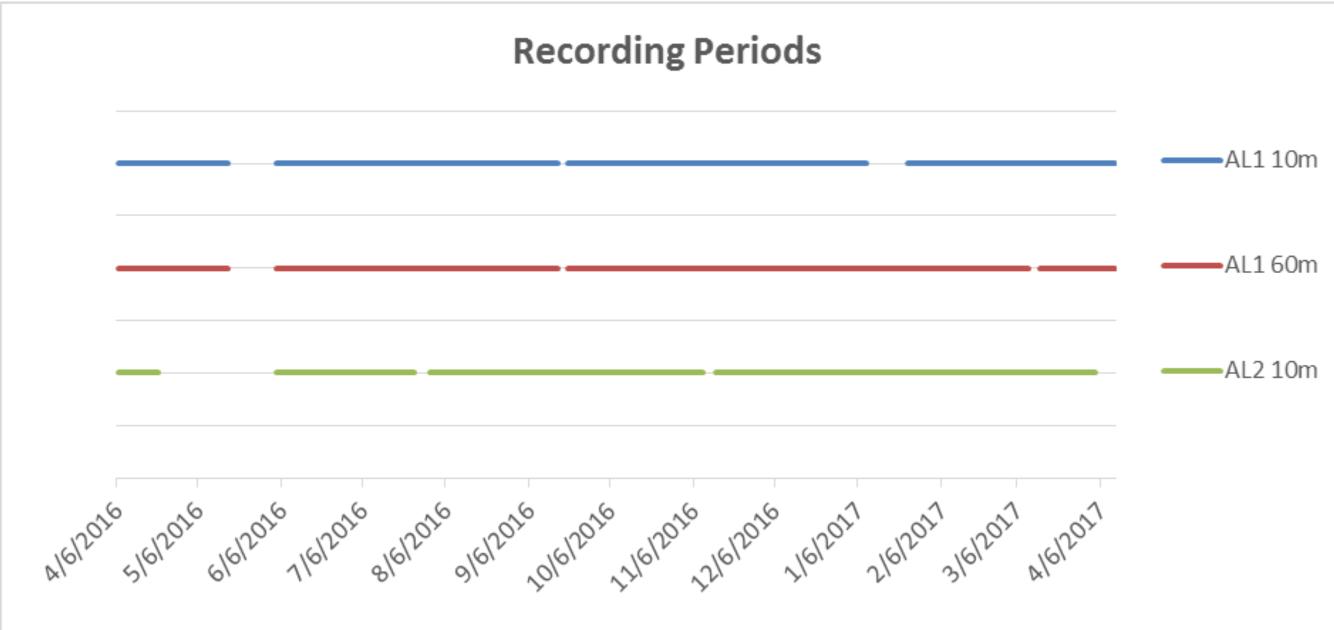


Figure 7 Successful recording periods at Albany WEF to date

6.2.2 Roost Surveys and Ground-truthing

By day, the main potential bat roosting habitats (mainly rock overhangs, trees and buildings) were searched for presence or evidence of bats or actual live bats. A few land owners were consulted about local knowledge of possible roosts on their properties. In addition, a detailed bat habitat ground-truthing exercise was conducted in November 2017.

In addition, a thermal imagery camera was erected overlooking the farm housing near AL1 on two nights in order to try and film any bat emergences from roosts.

6.2.3 Driven Transect Surveys/ Point Sampling

After the first night's transect, it was decided to adopt another method of manual sampling due to the danger of driving a slow driven transect along the N2 highway, especially with all the road works that were underway during the survey period. It was decided that point sampling would be more suitable for this site. From nautical dusk, the field team would conduct 10 minutes of ultrasonic recording using a Wildlife Acoustics EchoMeter 3 (EM3) handheld ultrasonic bat detector at six different points selected throughout the site.

6.3 Data Analysis

Acoustic monitoring produces huge amounts of data, hundreds of gigabytes of ultrasonic call data. This call data is recorded by the SM3BAT as .WAC or .WAV files onto four 32 GB SD cards for each detector. At the end of the monitoring period, IWS transferred the data onto a 1 terabyte hard drive for analysis and storage.

The files were converted, using Wildlife Acoustics' Kaleidoscope programme to both Zero Crossing (.ZC) files for analysis in the following two ultrasound analysis software programmes:

- The WAV files in BatSound Pro by Pettersson. This software allows for the detailed analysis of .WAV sound files. It provides call peak frequency, call duration, bandwidth, etc. In order to convert and scrub the .WAC files produced by the SM2 to .WAV files suitable for BatSound Pro, the Wildlife Acoustics Kaleidoscope conversion software was used.
- The ZC files in AnalookW Version 3.9s by Titley Electronics is used for analysing large quantities of .ZC files.

A bat call consists of a series of ultrasonic sound pulses, with each species calling at a different sound frequency. Pulses within a bat call can also vary in their sound frequency and characteristics, although this variation is within a certain range associated with a certain bat species. Certain call parameters are used to identify a bat species from its echolocation call. These include pulse length, pulse bandwidth, pulse interval and pulse dominant frequency, of which peak frequency is the most commonly used. When a bat is approaching a prey insect, it will increase the rate of its echolocation pulses dramatically, and each pulse becomes shorter until it is difficult to distinguish the pulses with standard instrumentation. This method of increasing its echolocation resolution while homing in on its prey is referred to as a feeding buzz.

Bat Activity in the current study was measured using an **Activity Index = Bat passes / unit time**. A bat pass is defined as a sequence of greater than two echolocation calls made as a single bat flies past the microphone.

6.4 Impact Assessment Methodology

To determine the impact the development could potentially have on bats, a standard Impact Assessment methodology was used. This involved ranking several impacts (listed in **Section 9**), and calculating a Significance value for the impact as (Extent + Duration + Intensity) x Probability as per the scores in **Table 1**. This calculated value was then used to classify the Significance of the impact as Low-Medium, Medium or Medium-High (**Table 2**).

Table 1 Bat Impact ranking matrix

Parameter	Ranking				
	0	1	2	3	4
Extent	None	Localised	Study Area	Regional/National	International
Duration	None	Short-term	Medium-term	Long-term	Permanent
Intensity	None	Low	Moderate	High	Very High
Probability	None	Improbable	Probable	Highly Probable	Definite

Table 2 Significance of Negative Impact Table

	Significance of Negative Impact		
	Low-Medium	Medium	Medium-High
	Impact will not have an influence on the decision or require to be significantly accommodated in the project design.	Impact could have an influence on the environment which will require modification of the project design and/ or alternative mitigation.	Impact could have a 'no-go' implication for the project unless mitigation and/ or re-design is practically achievable.
Significance Value (Extent + Duration + Intensity) x Probability)	1-16	17-32	33-48

7. Results

7.1 Live Bat Monitoring

7.1.1 Potential Bat Species on Site

Nineteen bat species have the potential to occur at the Albany WEF site, with 10 having a High likelihood of occurrence (LoO), 6 a moderate LoO and 3 a Low LoO, as listed in **Table 3** (Monadjem *et al*., 2010).

Table 3 Likelihood of Occurrence of Bat Species at Albany WEF site

				CONSERVATION STATUS		
FAMILY	SPECIES	COMMON NAME	LoO	Provincial*	National **	Global ***
MINIOPTERIDAE	*Miniopterus natalensis*	Natal Long-fingered bat	High	PS	LC	LC
MOLOSSIDAE	*Tadarida aegyptiaca*	Egyptian Free-tailed bat	High	PS	LC	LC
NYCTERIDAE	*Nycteris thebaica*	Egyptian Slit-faced bat	High	PS	LC	LC
PTEROPODIDAE	*Rousettus aegyptiacus*	Egyptian Rousette	High	PS	LC	LC
PTEROPODIDAE	*Epomophorus wahlbergi*	Wahlberg's Epauletted fruit	High	PS	LC	LC
RHINOLOPHIDAE	*Rhinolophus capensis*	Cape Horseshoe bat	High	PS	LC	LC
RHINOLOPHIDAE	*Rhinolophus clivosus*	Geoffroy's Horseshoe bat	High	PS	LC	LC
VESPERTILIONIDAE	*Neoromicia capensis*	Cape Serotine bat	High	PS	LC	LC
VESPERTILIONIDAE	*Kerivoula lanosa*	Lesser Woolly bat	High	PS	LC	LC
VESPERTILIONIDAE	*Scotophilus dinganii*	Yellow-bellied House bat	High	PS	LC	LC
EMBALLONURIDAE	*Taphozous mauritianus*	Mauritian Tomb bat	Modera	PS	LC	LC
RHINOLOPHIDAE	*Rhinolophus swinnyi*	Swinny's Horseshoe bat	Modera	PS	V	LC
VESPERTILIONIDAE	*Eptesicus hottentotus*	Long-tailed Serotine	Modera	PS	LC	LC
VESPERTILIONIDAE	*Cistugo lesueuri*	Lesueur's Wing-gland bat	Modera	PS	LC	LC
VESPERTILIONIDAE	*Myotis tricolor*	Temminck's Myotis	Modera	PS	LC	LC
VESPERTILIONIDAE	*Pipistrellus hesperidus*	Dusky Pipistrelle	Modera	PS	LC	LC
MINIOPTERIDAE	*Miniopterus fraterculus*	Lesser Long-fingered bat	Low	PS	LC	LC
MOLOSSIDAE	*Chaerephon pumilus*	Little Free-tailed bat	Low	PS	LC	LC
VESPERTILIONIDAE	*Kerivoula argentata*	Damara Woolly bat	Low	PS	NT	LC

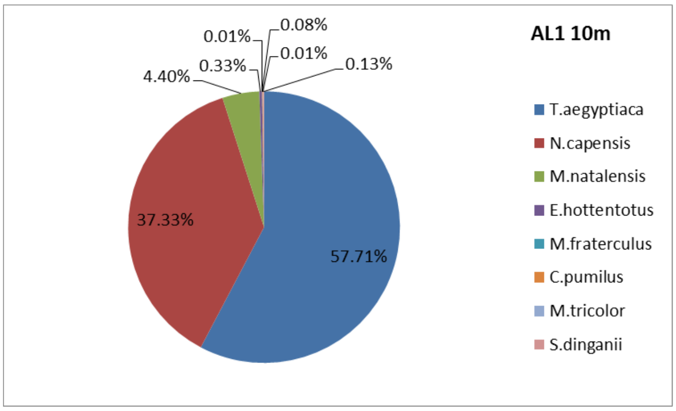
Legend: LC = Least Concern; NE = Not Evaluated; NT = Near Threatened; PS = Protected Species; VU = Vulnerable
* Ciskei Nature Conservation Act 10 of 1987 (the Act) and the [Western] Cape: Nature Conservation Ordinance 19 of 1974 (the Ordinance)
**Child *et al.* (2016)
***IUCN (2016)

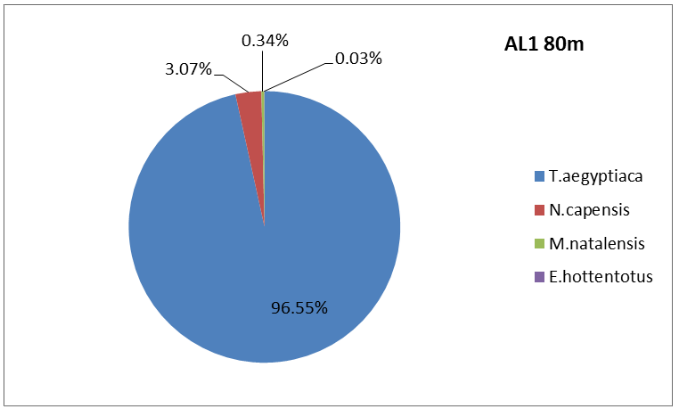
7.1.2 Bat Species Confirmed and Composition at Microphones

Of the 19 potentially occurring bats, 10 were confirmed and one more suspected at the proposed Albany WEF, through call analyses, roost surveys and driven transects. Further details on the confirmed and suspected species are presented in Table 4. All bat species confirmed or suspected are insectivorous foragers. No evidence of frugivorous bats was found. Four species are at a High risk of turbine fatality and three Medium risk.

Regarding the overall species composition, *T. aegyptiaca* dominated at all microphones but to varying degrees (**Figure 8**). The greatest diversity of bat species was confirmed near AL2, having recorded all 10 species. Whilst AL1 80m had only four species confirmed. There were eight species confirmed for AL1 10m.

Please Note: Whilst bat call structure is a useful tool in identifying bat species occurrence, the call structure of certain species can overlap, as well as there being geographic variances in calls of the same species. Therefore, whilst IWS is relatively certain of the confirmed list provided, there is the possibility that species identification is not 100% accurate.





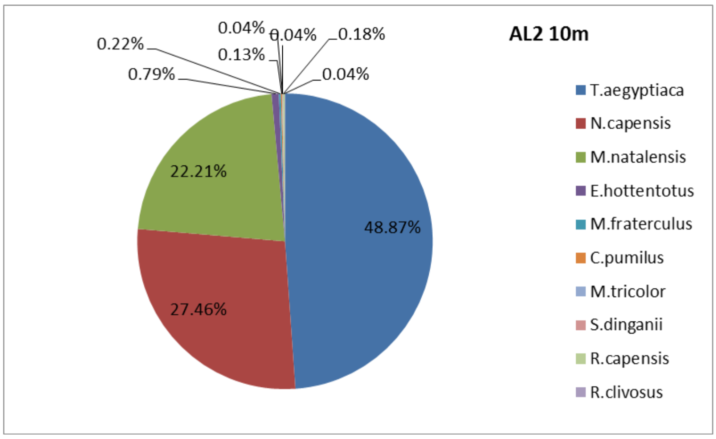


Figure 8 Species Composition at the Albany WEF bat monitoring microphones to date

Table 4 Confirmed Bat Species at the Albany WEF

FAMILY	SPECIES	COMMON NAME	HABITAT AND FORAGING BEHAVIOUR*	TURBINE FATALITY RISK**	CONFIRMATION METHOD
MINIOPTERIDAE	***Miniopterus natalensis***	**Natal long-fingered bat**	It is mostly cave-dependent and hence, the availability of suitable roosting sites may be more critical in determining its presence in an area than the surrounding vegetation. It roosts in medium to extremely large groups – up to tens to hundreds of thousands in some colonies. It is an aerial clutter-edge forager, known to migrate long distances between roost caves. It feeds on a variety of prey – Diptera, Hemiptera, Coleoptera, Lepidoptera and Isoptera.	High	Confirmed calls
MINIOPTERIDAE	***Miniopterus fraterculus***	**Lesser long-fingered bat**	It is cave-dependent, but roosts in smaller numbers than *M. natalensis*. Aerial clutter-edge forager, known to migrate long distances between roost caves. It feeds on a variety of prey – Diptera, Hemiptera, Coleoptera and Lepidoptera.	Medium-High	Confirmed calls
MOLOSSIDAE	***Chaerephon pumilus***	**Little Free-tailed bat**	Roosts communally in small to extremely large groups in narrow cracks in rocks and trees and in buildings. It is an open-air forager, feeding on Coleoptera, Hemiptera, Lepidoptera, Hymenoptera and Diptera.	High	Suspected calls
MOLOSSIDAE	***Tadarida aegyptiaca***	**Egyptian free-tailed bat**	Crevice dwelling species, commonly associated with granite hills and the numerous cracks provided in such terrain. They are aerial open-air foragers, feeding on Diptera, Hemiptera and Coleoptera and to a lesser degree Lepidoptera.	High	Confirmed calls
NYCTERIDAE	***Nycteris thebaica***	**Egyptian slit-faced bat**	Resident of Savanna and Karoo biomes. Roosts in a variety of day roosts from caves, Aardvark burrows, culverts, trunks of trees, etc. Also makes use of night roosts such as barns, rock overhangs, etc. in which prey-items are consumed. It is a clutter forager.	Low	Confirmed – night roosts found
RHINOLOPHIDAE	***Rhinolophus capensis***	**Cape horseshoe bat**	Roosts in caves and mine adits in groups consisting of a few individuals to thousands of individuals. It is a clutter forager and feeds mainly on Lepidoptera and Coleoptera.	Low	Confirmed calls
RHINOLOPHIDAE	***Rhinolophus clivosus***	**Geoffroy's horseshoe bat**	During the day it roosts in caves and mine adits in groups of up to several thousands of individuals and at night individuals will establish feeding stations or night roosts. It is a clutter forager and feeds mainly on Lepidoptera and Coleoptera.	Low	Confirmed calls
VESPERTILIONIDAE	***Myotis tricolor***	**Temminck's myotis**	Roosts in small to medium numbers in caves and mine adits. It is often found roosting with *M. natalensis*. It is an aerial clutter-edge forager, known to migrate long distances between roost caves. It feeds on a variety of prey – Diptera, Hemiptera, Coleoptera, Lepidoptera and Isoptera.	Medium- High	Confirmed calls

VESPERTILIONIDAE	***Eptesicus hottentotus***	**Long-tailed Serotine**	Roosts in small groups of 2-4 in caves and rock crevices. It is an aerial clutter-edge forager, eating mostly Coleoptera.	Medium	Confirmed calls
VESPERTILIONIDAE	***Neoromicia capensis***	**Cape serotine**	Roosts singly or in small groups of up to 10 individuals mainly in building roofs and under the bark of trees. Aerial clutter-edge forager, that feeds on a variety of prey – Diptera, Hemiptera, Coleoptera, Lepidoptera and Neuroptera.	High	Confirmed calls
VESPERTILIONIDAE	***Scotophilus dinganii***	**Yellow-bellied house bat**	Occurs in a wide range of habitats, but is mostly associated with the savannah biome. It roosts in mainly trees and buildings and is a clutter-edge forager.	Medium- High	Confirmed calls

* Monadjem *et al.,* 2010** MacEwan *et al.,* 2020a

7.2 Static Survey Results

7.2.1 Overall Average Bat Activity

Overall, bat activity was highest at AL1 10 m (2.59 bat passes/hour; 30.83 bat passes/ date) and lowest at AL2 10 m (0.62 bat passes/hour; 7.26 bat passes/ date) (**Figure 9** and **Figure 10**). It is interesting to note that, albeit a small difference, overall bat activity is higher at AL1 80m compared to AL2 10m, despite the higher diversity of species at AL2 10m. Based on the average hourly bat passes, Albany WEF falls within a Medium turbine related bat fatality risk category for the Albany Thicket ecoregion (MacEwan *et al*., 2020a), meaning that operational mitigation measures should be recommended based on the pre-construction monitoring findings.

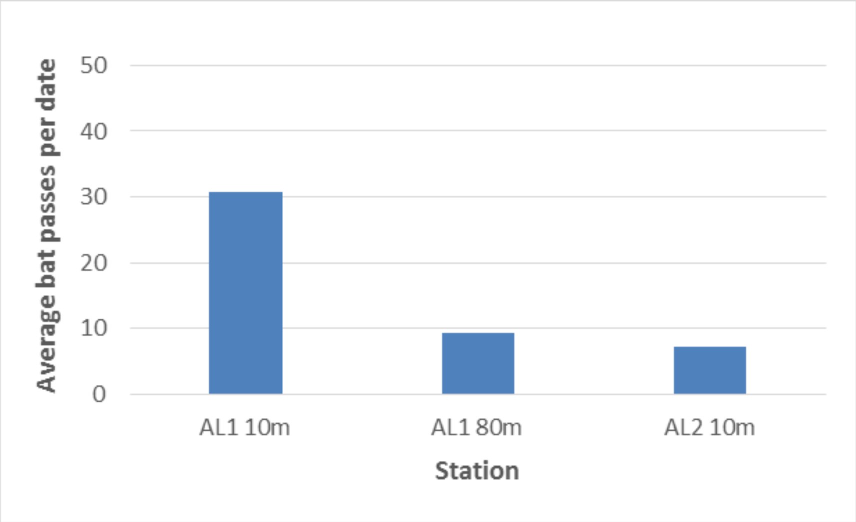


Figure 9 Average bat passes per date per microphone at the Albany WEF

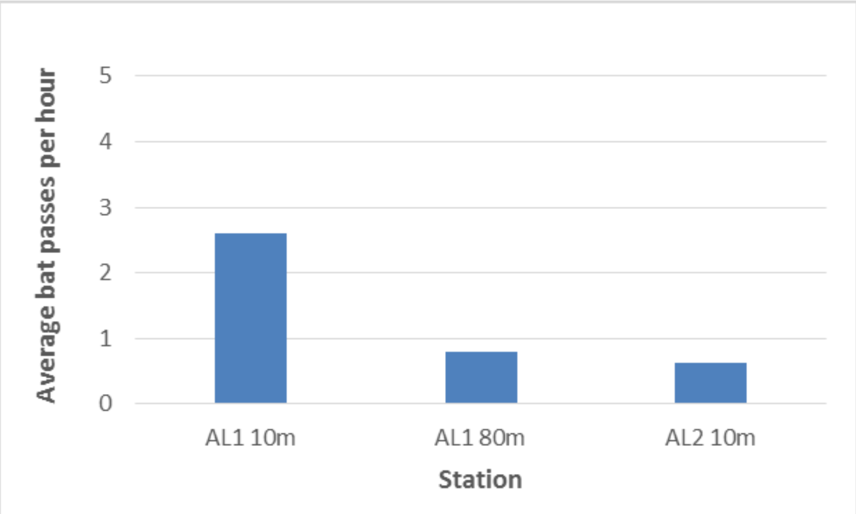


Figure 10 Average bat passes per hour per microphone at the Albany WEF

7.2.2 Average Bat Activity per Season

Average bat activity per date (at each station) was split into the different seasons, as activity can vary greatly between seasons (rather than between months). The average bat passes per date per season per microphone can be seen in **Figure 11** and the average bat passes per date per season per microphone can be seen in **Figure 12**. At all microphones, except AL1 10m, autumn was the season of highest bat activity, followed by summer, then spring and lowest activity in winter. This is consistent with several other sites in Eastern Cape where IWS has been conducting long-term monitoring. In addition, the period of highest bat fatalities at 7 operational sites where IWS has been monitoring is autumn.

More discussion on specific times of peak activity is under **Section 7.2.4**.

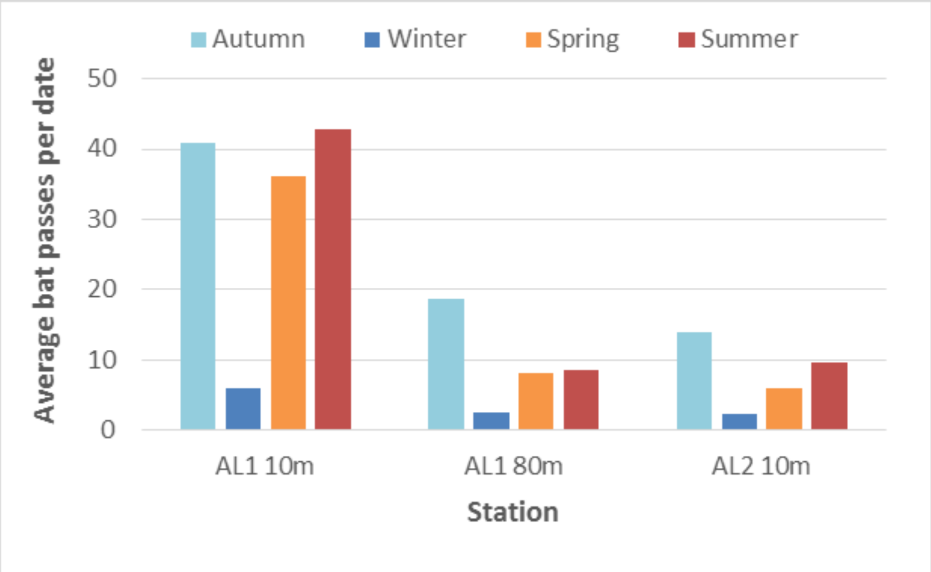


Figure 11 **Average bat passes per date per season per microphone at the Albany WEF**

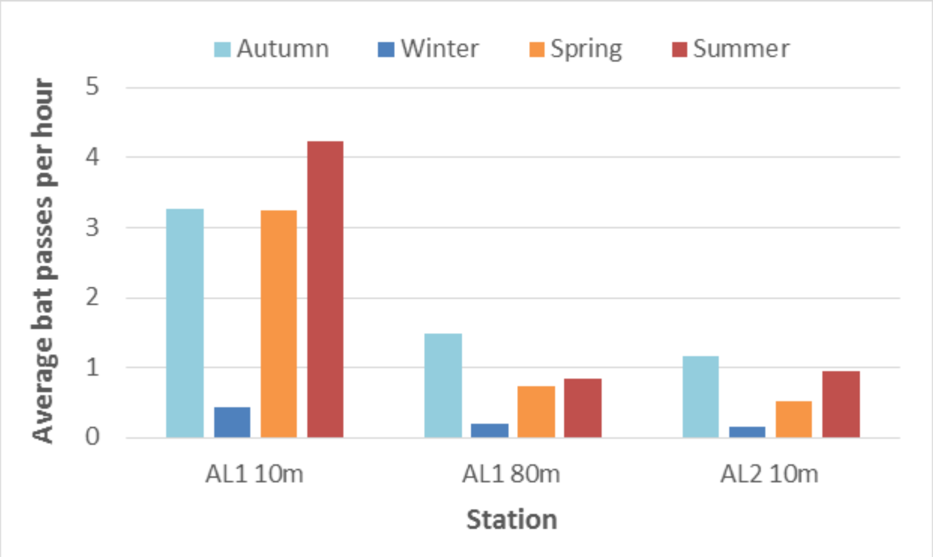


Figure 12 **Average bat passes per recording hour per microphone at the Albany WEF**

7.2.3 Average Activity per date per bat family

From **Figure 13**, the following can be deducted:

- Autumn was the highest activity seaon overall, followed by summer, then spring and lowest activity in winter.
- Molossidae – very similar activity for autumn, spring and summer, whilst slightly higher in autumn and spring.
- Vespertilionidae – highest activity in autumn, followed by summer and low in winter and spring.
- Miniopetridae - highest activity in autumn, followed by summer and low in winter and spring. The peak in autumn, could represent a small migration event.

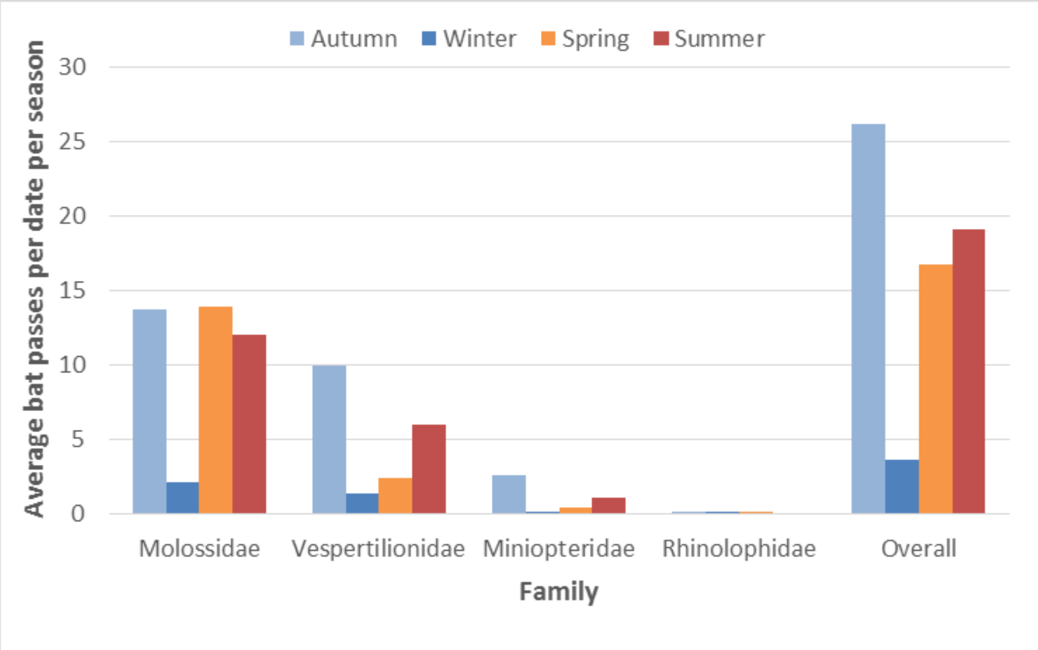


Figure 13 **Average bat passes per date per family in each season**

7.2.4 Total Bat Activity per Date

Whilst the averages are presented above, it is important and interesting to understand the total activity on each date at every station over the monitoring period. The total activity for each monitoring station is available in **Figure 14**.

At AL1 10m, substantial peak dates were observed autumn, summer and spring. In the case of *T. aegyptiaca*, there were dates in November and December 2016 whereby ≥100 bat passes were recorded, the highest being 242 bat passes on 29 November 2016.For *N. capensis* at the same microphone, the highest activity was experienced in autumn and there were three instances of ≥100 bat passes on a calendar date, with the highest being 188 bat passes on 19 April 2016.

At AL1 80m, we understand that activity is 70% less than at AL1 10m. Peak dates include 63 *T. aegyptiaca* on 25 October 2016, 66, 99 and 102 *T. aegyptiaca* between the 28th March to 31st March 2017.

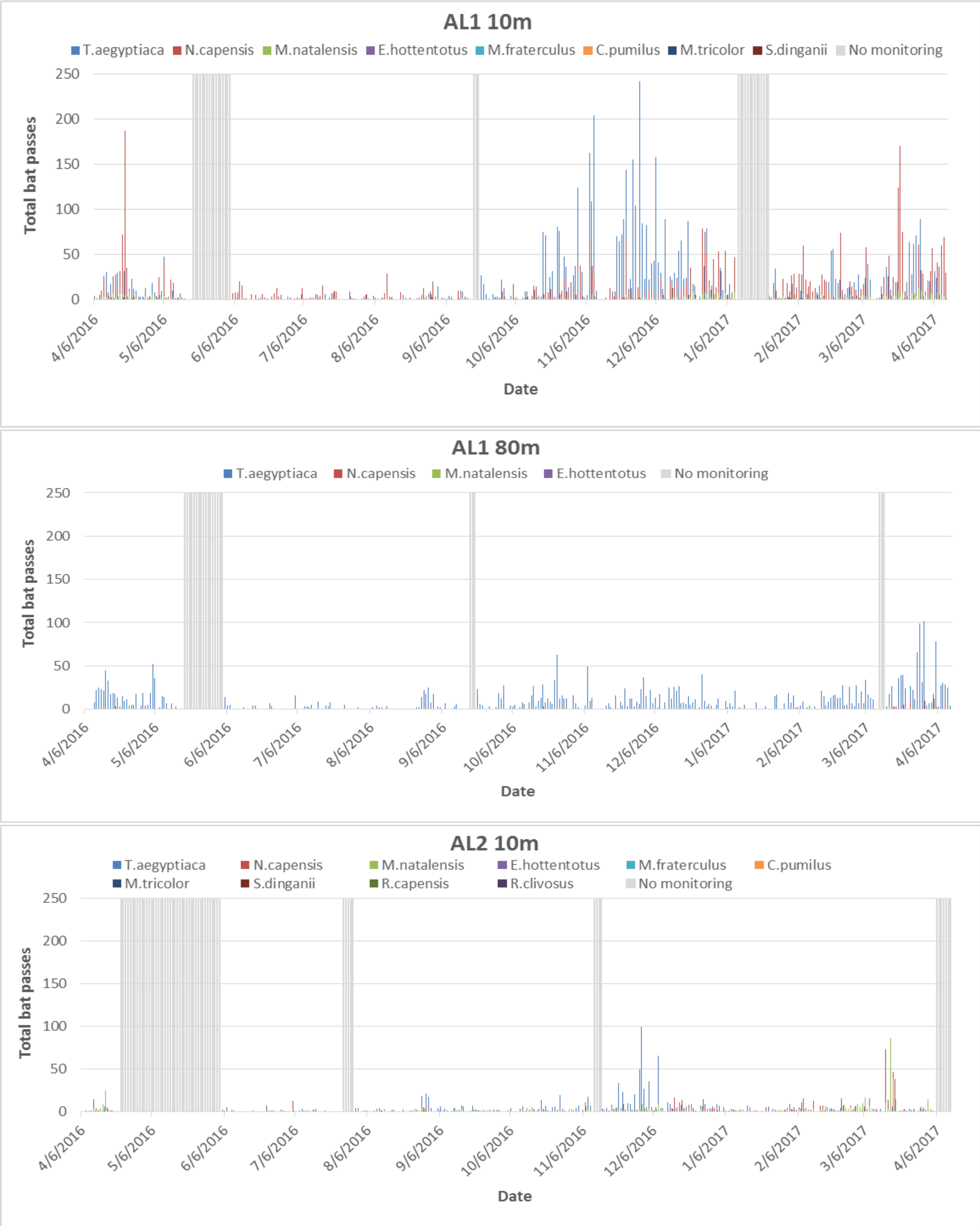


Figure 14 Total bat activity at each microphone at the Albany WEF

M. natalensis activity across Albany WEF shows the most substantial rises in activity in autumn and again to a lesser degree in spring. An extreme peak in *M. natalensis* activity occurred on the 17th March 2017 at AL2 10 m with 86 passes (**Figure 15**).

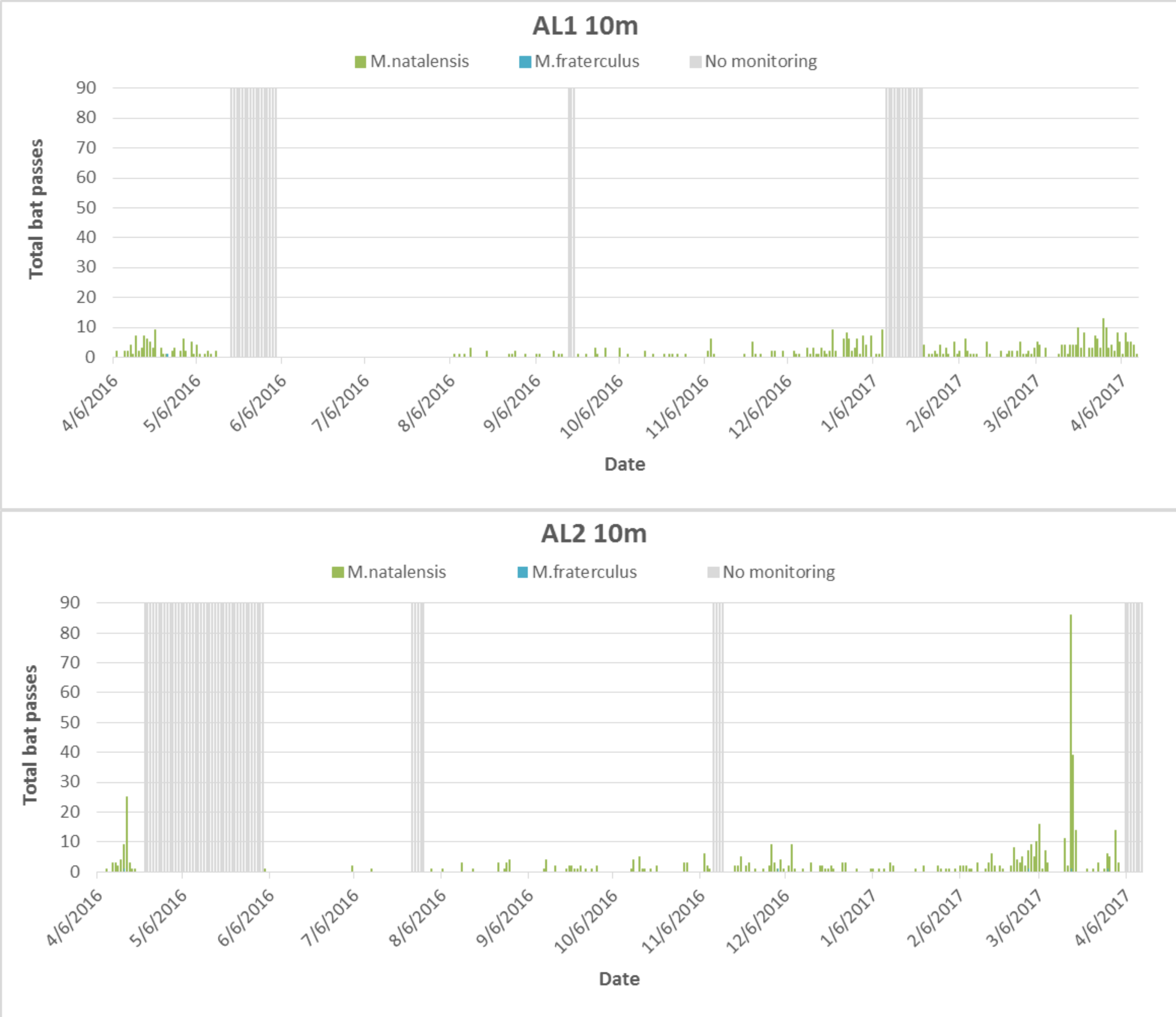


Figure 15 **Total *M. natalensis* activity at each 10m microphone at the Albany WEF**

7.2.5 Bat Activity per Time of Night

In order to analyse the distribution of bat activity over time of night, we considered each season separately. Graphs displaying these results can be found in (**Figure 16**).

At AL1 10m, bat activity levels are highest. In autumn at AL1 10m, it is unusual to just see an extreme peak in activity at dawn; this peak is usually at dusk for autumn. The winter pattern at AL1 10m is typical, with the highest peak in activity at dusk for a short period before the temperature gets too cold later in the night and the early hours of the next morning. For spring and summer at AL1 10m, bats are active throughout the night, with spring showing the highest peak in the middle of the night and summer showing a more typical bat activity pattern, with the highest peak at dusk, some activity throughout the night, and then a lower peak at dawn.

At AL1 80m, it is important to note, that whilst there is less activity at rotor height, there is consistent activity throughout the night in most seasons except winter, where there is little to no activity after midnight.

These data help in informing mitigation measures across the seasons and on a per-season basis, by identifying peak bat activity times both daily and across the year.

The monthly nightly patterns are provided in **Appendix B**.

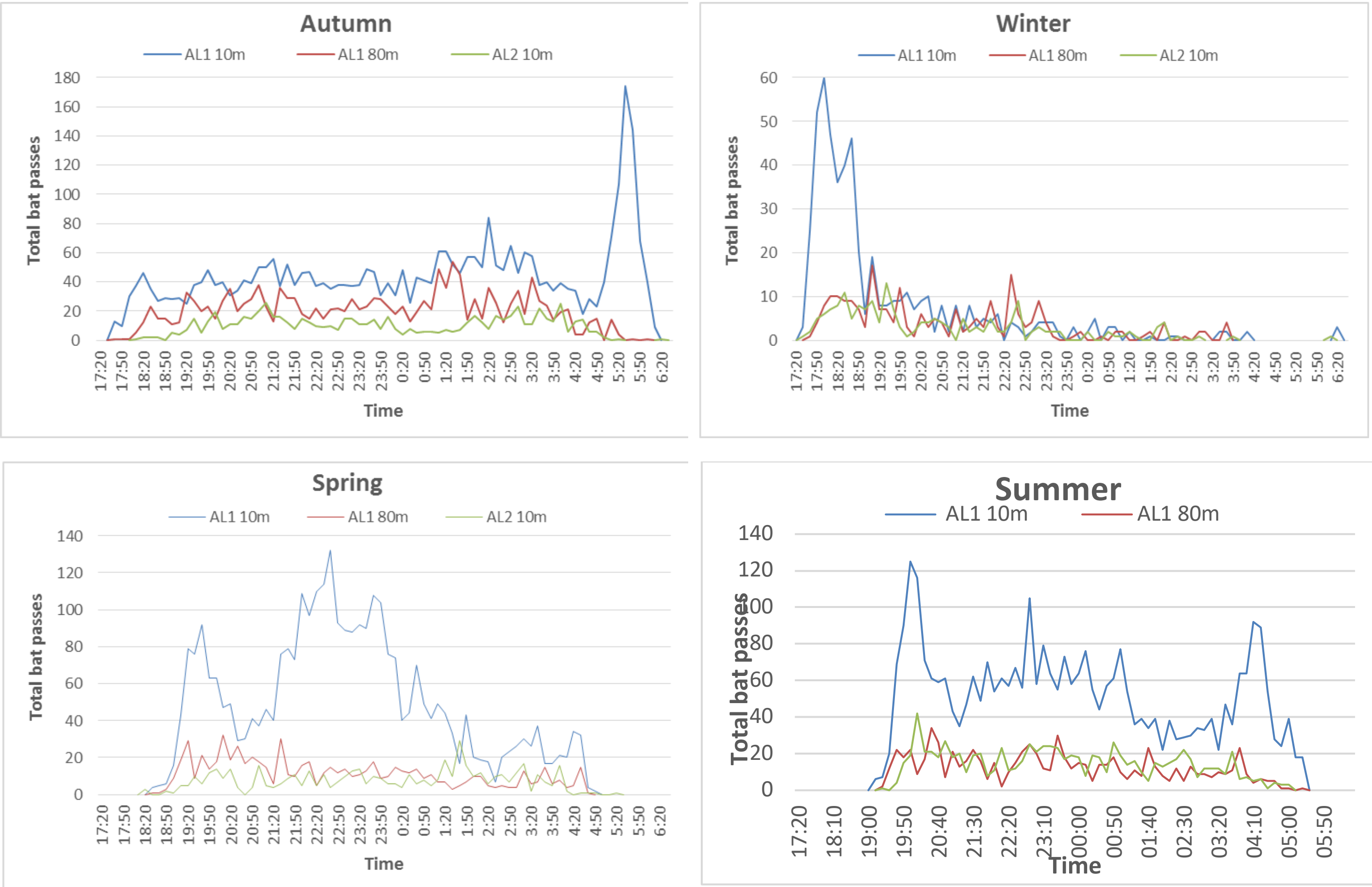


Figure 16 **Total bat passes per night of night per season at the Albany WEF**

7.3 Bat Activity vs Weather Variables

Understanding the conditions in which bat activity occurs is vital for informing mitigation actions and measures for reducing impacts on bats. Bat activity data recorded at the AL1 80m was paired with the weather data supplied by EDF from the same met mast as follows: the microphones were located on:

- Wind speed data recorded at 80m measured in m/s.
- Temperature data recorded at 97.5m measured in °C.
- Barometric pressure data recorded at 40m measured in mbar.

Thus, IWS was able to make comparisons with very specific wind speed data and local-scale temperature and pressure data. The graphs below depict accumulation curves for the three most common species recorded at the Albany WEF to show the proportion of activity in different conditions. While the total (% species detected) curves are almost mirrored by the *T. aegyptiaca* curves (due to the high proportion of the species activity at height), the lines of the other species are also important indicators of the differences between the species in terms of their climatic tolerances and activity spectrum.

7.3.1 Wind Speed

Figure 17 shows a cumulative curve in overall bat activity with increasing wind speed. It also shows bar lines where the distribution of species activity occurred across the wind speed range. Approximately 50% of bat activity occurred in wind speeds below 5m/s, 60% below 6m/s and 75% occurred below 7.5m/s. All activity occurred below 16m/s.

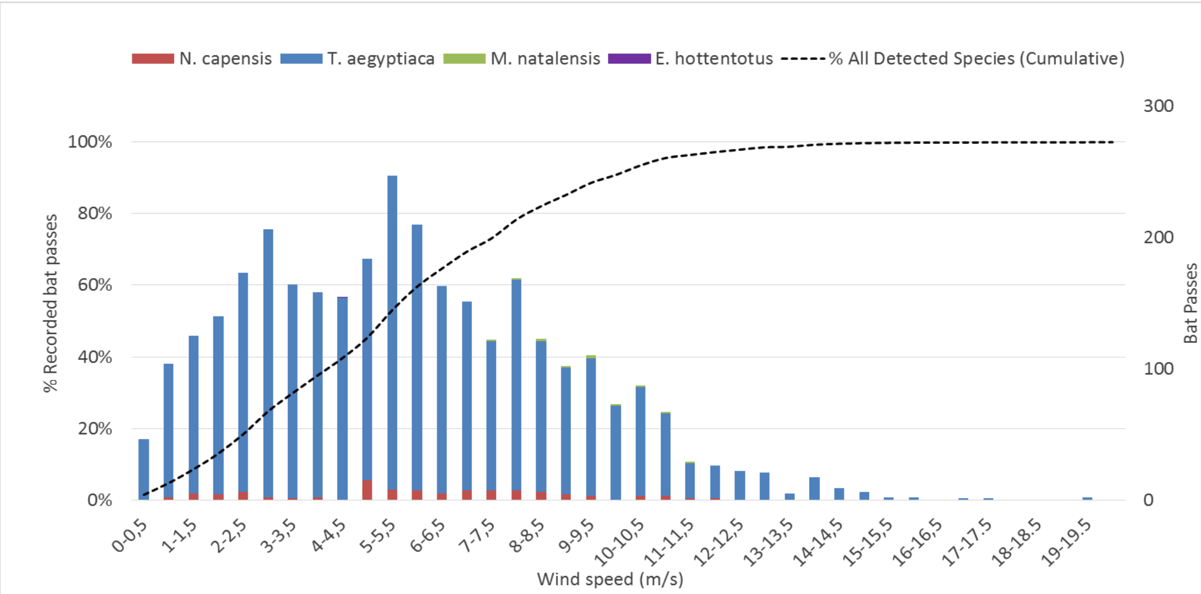


Figure 17 Activity Accumulation Curve and Distribution for bat species detected at AL1 80m at 0.5 m/s wind speed intervals

7.3.2 Temperature

Figure 18 shows that no bat activity occurred below 8°C and 10% below 12°C. The upper limit of activity was 31°C, but only because the temperature at night very rarely exceeded 31°C.

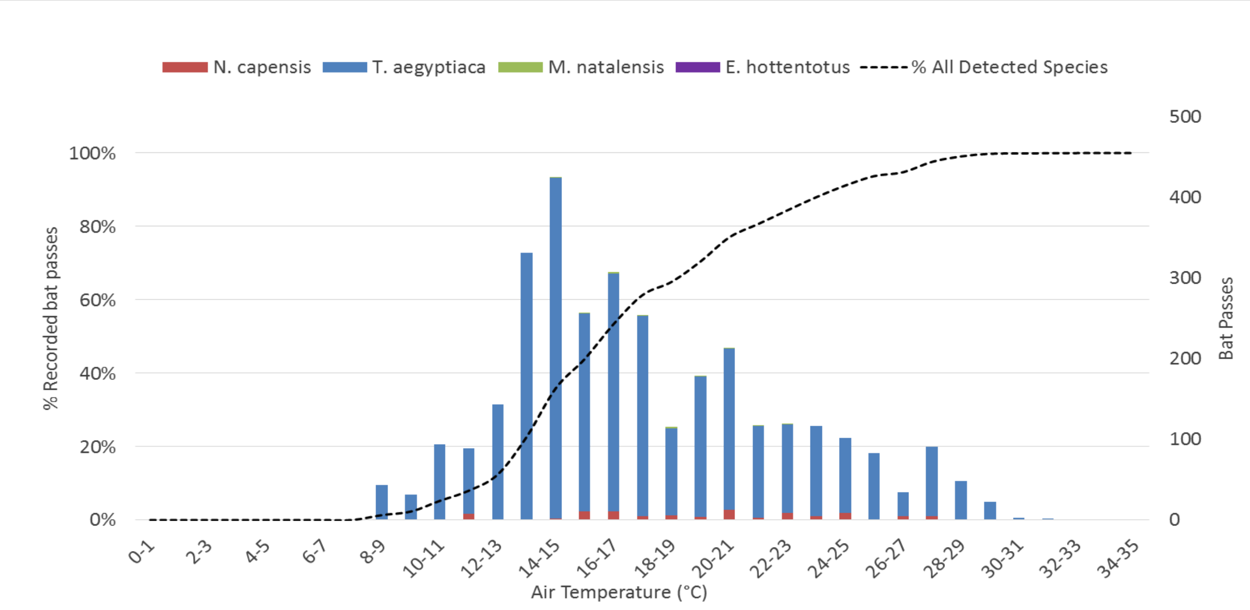


Figure 18 **Activity Accumulation Curve and Distribution for bat species detected at AL1 80m at 1°C air temperature intervals**

7.3.3 Barometric Pressure

Barometric pressure does not vary greatly on a local scale, and may only experience substantial changes in the event of a major meteorological event. As a result, even across the year, the range of air pressure measured on site was small and thus all bat activity occurred in small air pressure range (**Figure 19**) Approximately 80% of activity took place between 920 and 945mBar.

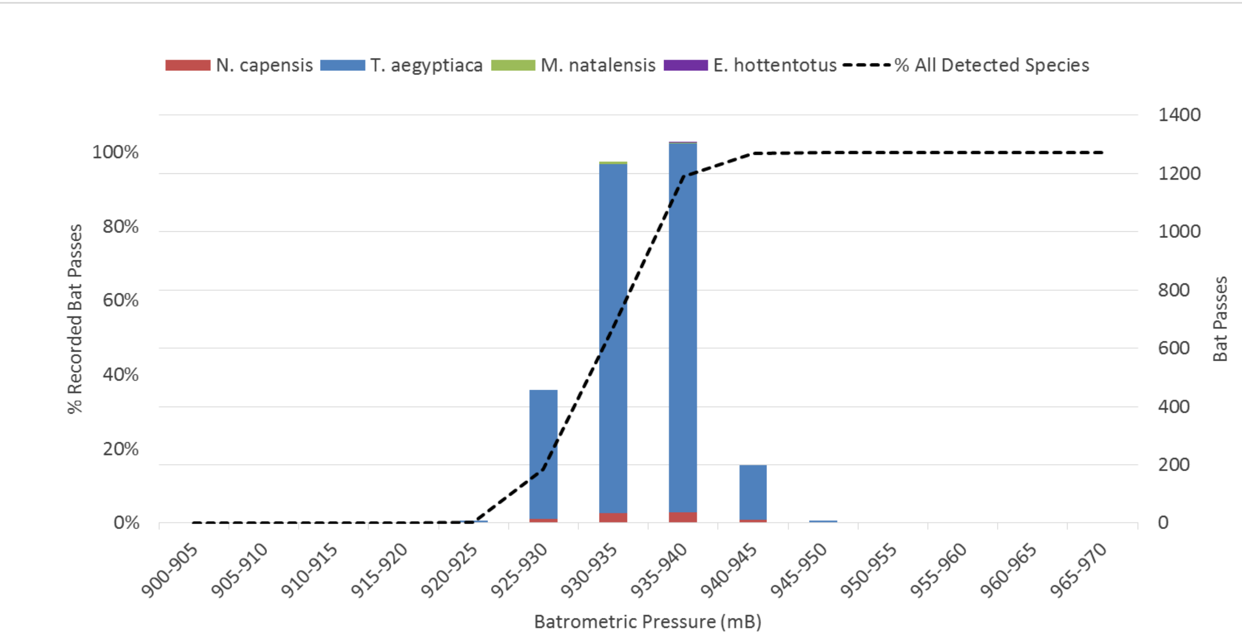


Figure 19 **Activity Accumulation Curve at AL1 80 m at 5mB barometric pressure intervals**

7.4 Active Survey Results

7.4.1 Point Sampling

Eight point sampling localities were used over the 12 month period (**Figure 20**), with results presented in **Table 12** in bat passes per 10 minutes. The highest activity was recorded at TP5 near the large farm dam, irrigated orchards and farm houses. Roosts of three species were confirmed in buildings near TP5. These results assisted in finalising the sensitivity map (**Figure 22**).

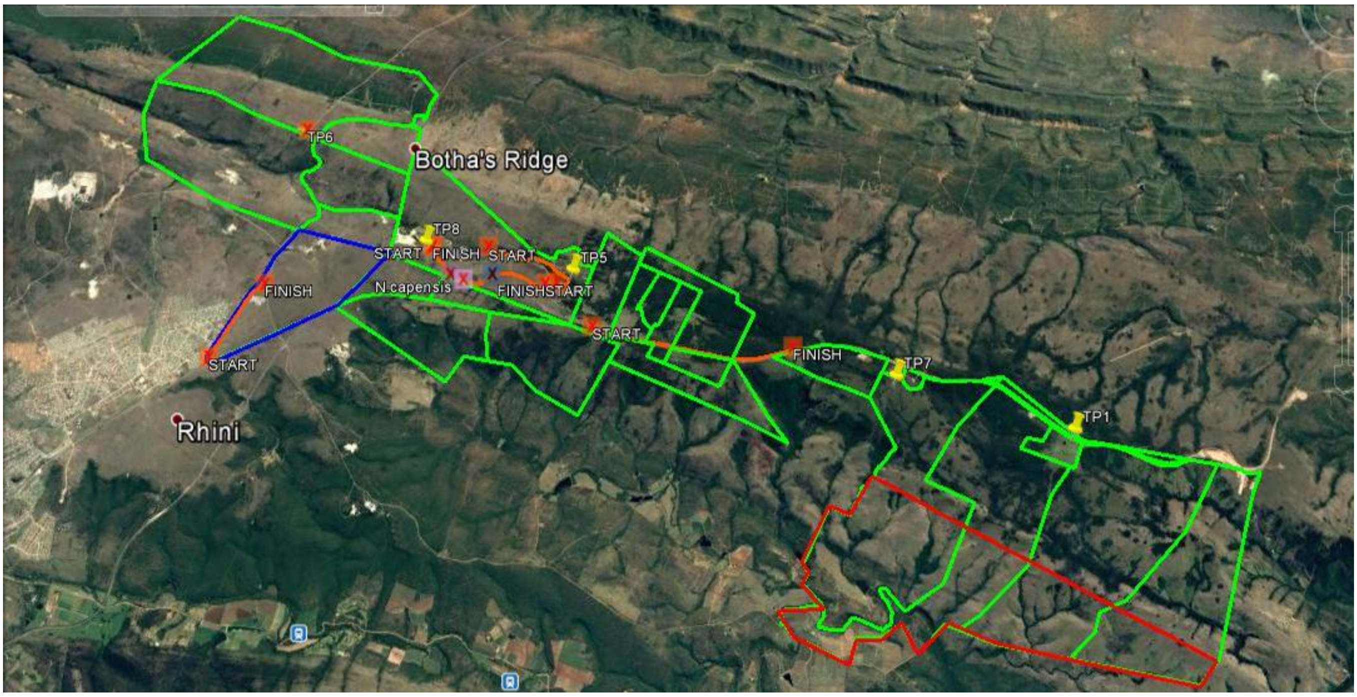


Figure 20 Manual sampling points

7.4.2 Ground-truthing Surveys

The results from the ground-truthing exercise can be found in **Appendix C** and **Appendix D**. These results assisted in finalising the sensitivity map (**Figure 22**).

7.4.3 Roost Surveys

Several buildings, both abandoned and used were inspected for the presence of bats or evidence of presence. *Rhinolophus capensis*, *Nycteris thebaica* and *Neoromicia capensis* were all confirmed to be roosting in farm buildings near TP5 (33° 16.304'S; 26° 38.725'E). Some photographs from the roost surveys are displayed in **Figure 21**. These results assisted in finalising the sensitivity map (**Figure 22**).

Figure 21 Roost Survey Photographs near TP5

Table 5 Manual Point Survey Results

	20160920			20160921			20161114			20161115			20170123				20170124		
	T.aegyptiaca	*N.capensis*	*M.natalensis*	*T.aegyptiaca*	*N.capensis*	*M.natalensis*	*T.aegyptiaca*	*N.capensis*	*M.natalensis*	*T.aegyptiaca*	*N.capensis*	*M.natalensis*	*T.aegyptiaca*	*N.capensis*	*M.natalensis*	*E. hottentotus*	*T.aegyptiaca*	*N.capensis*	*M.natalensis*
TP1	0	0	1	0	0	0	0	0	0	No monitoring			0	0	0	0	No monitoring		
TP2	No monitoring			0	0	0	No monitoring			No monitoring			No monitoring				No monitoring		
TP3	0	0	0	0	1	0	No monitoring			No monitoring			No monitoring				No monitoring		
TP4	1	5	0	No monitoring			No monitoring			No monitoring			No monitoring				No monitoring		
TP5	0	45	15	0	63	10	0	1	0	No monitoring			0	30	17	0	0	30	17
TP6	0	0	0	1	0	0	No monitoring			0	0	0	9	2	0	2	3	0	0
TP7	No monitoring			No monitoring			0	0	0	No monitoring			0	3	0	0	2	2	0
TP8	No monitoring			No monitoring			0	0	0	No monitoring			1	0	0	1	1	0	0

8. Bat Sensitivity Map

IWS produced a Bat Sensitivity Map for the entire study site (**Figure 22**). This was compiled based on the 12 months of static monitoring results, from point sampling, ground-truthing, roost searches and IWS's knowledge of the area and that gained from monitoring at operational facilities in similar habitats and specific habitat features[2]. Descriptions of the sensitivity classes are shown in **Table 6**. Where each turbine lies in terms of the sensitivity classes is shown in **Table 7**. Both the central tower position and the full rotor swept zone (blade length up to 85 m) is taken into consideration. The following can be said in terms of where turbines are situated in relation to bat sensitive areas, based on layout version Albany_Design Layout_rev 10.1 sent to IWS in September 2020:

35 turbines will require some form of mitigation measure in the form of raising the cut-in speed at which the turbines start spinning.

Should the layout of turbines be revised, this sensitivity analysis will also need to be revised.

Section 9 below identifies and assesses impacts related to bats and the proposed Albany WEF. One of the key mitigation recommendations is that all turbines (including their full rotor swept area) stay outside of areas of High Bat Sensitivity. For any turbines remaining with either their tower or blade sweep in areas of Medium or Medium-High Bat Sensitivity, operational mitigation measures are recommended in Section 9.3.2 below.

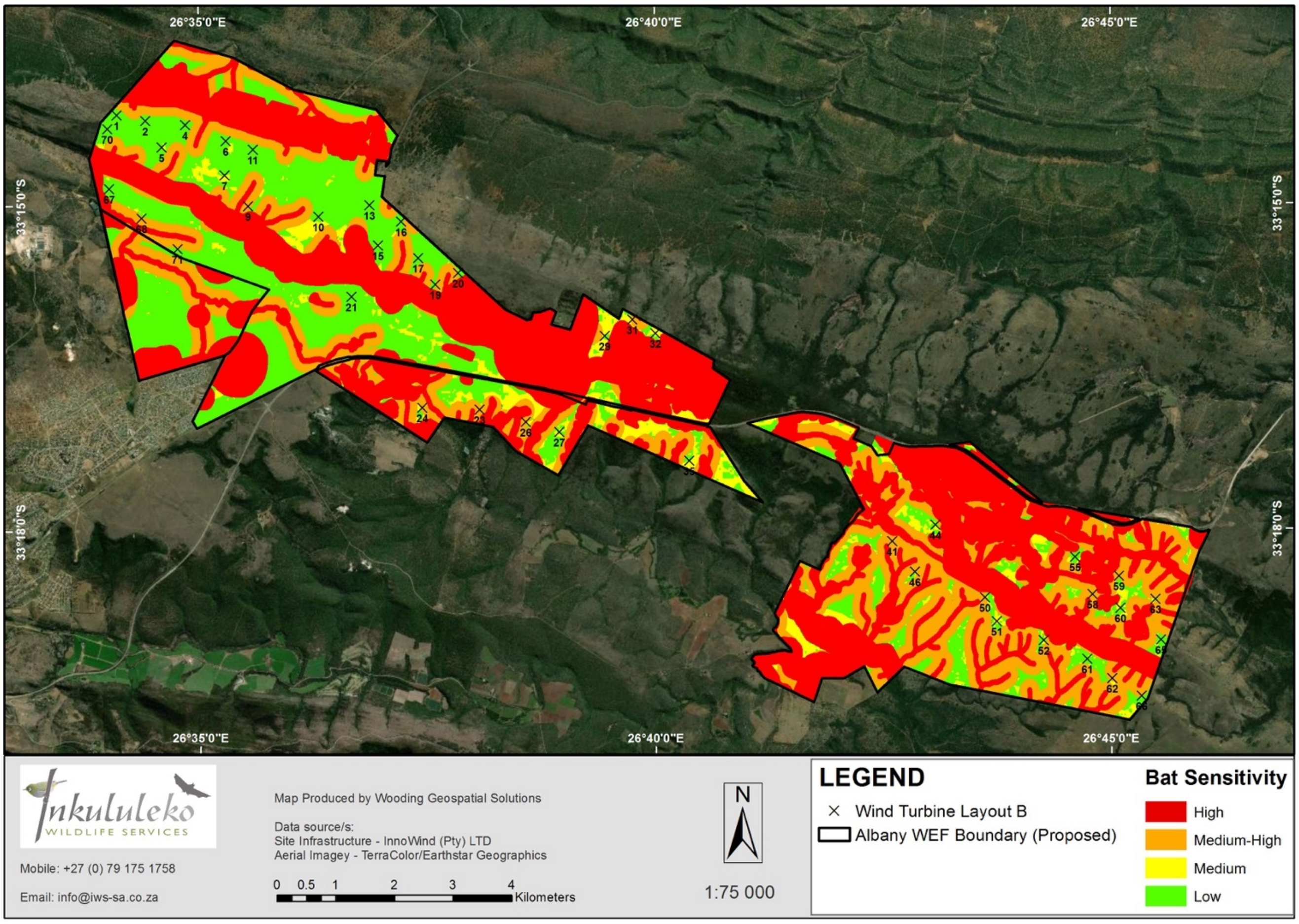


Figure 22 Bat Sensitivity Map for the Albany WEFs

[2] These features were based on IWS's observations in the field and the most recent available aerial imagery, land cover data and topographic spatial data.

Table 6 Bat Sensitivity Map Classes at Albany WEF

Sensitivity	Map Feature	Class	Buffer
High	Large rivers (Non-perennial and perennial) – Bothas, Kap, Bobbejaans, Bloukrans, Brak	Hydrological	200 m
	Perennial Wetlands (artificial and natural) (as per Nel *et al* (2011) and Dept. Water and Sanitation (2012) datasets and ground-truthing (IWS))	Hydrological	200 m
	Non-perennial Wetlands (artificial and natural) (as per Nel *et al* (2011) and Dept. Water and Sanitation (2012) datasets and ground-truthing (IWS))	Hydrological	50 m
	Non-perennial streams (as per Nel *et al* (2011) and Dept. Water and Sanitation (2012) datasets)	Hydrological	50 m
	Cliff on Property 241/0 (Makana Municipality)	Topographical	50 m
	Substation (north-east of Kings Flats township)	Man-made	500 m
	School (in King Flats township)	Man-made	200 m
	All indigenous forests and/or densely vegetated drainage lines and valleys (using 'Vegetation Area' (Chief-Surveyor General, 2009)	Botanical	50 m
	Western Riparian area on Property 240/9 (Makana Municipality)	Botanical and Topographical	50 m South 200 m North
	Eastern Riparian area on Property 240/9 (Makana Municipality)	Botanical and Topographical	200 m
	Known bat roosts and cultivated orchards on the farm 233/3 The Orchards	Zoological and Agricultural	500 m
	Dam and stream flowing north from dam in the most westerly portion of Property 240/0 (Makana Municipality)	Hydrological	200 m
	Farm buildings and large trees on Property 334/2 Grobbelers Kloof	Man-made and Botanical	200 m
Medium-High	Zone from 50-200 m (150 m real distance) buffer on cliff on Property 241/0 (Makana Municipality)	Topographical	200 m
	Zone from 50-200 m (150 m real distance) buffer on all streams (non-perennial and perennial) (as per Nel *et al*. (2011) and Dept. Water and Sanitation (2012) datasets)	Hydrological	200 m
Medium	Woodland/Open Bush, Cultivated Commercial Fields, Indigenous Forests, Plantations, Dense Bush as per DEA Land Cover Dataset (2015) which did not already fall under High or Medium-High Sensitivity Areas	Botanical	0 m
Low	All areas not classified i.e. remaining areas)	n/a	n/a

Table 7 Turbine Layout in relation to the Bat Sensitivity Areas for Albany WEF

Turbine No.	Tower Sensitivity	Distance from Med	Distance from Med-High	Distance from High
1	Low	N/A	N/A	N/A
2	Low	N/A	N/A	N/A
4	Low	N/A	N/A	N/A
5	Low	21.5	N/A	N/A
6	Low	N/A	N/A	N/A
7	Low	9.3	N/A	N/A
9	Medium-High	N/A	N/A	N/A
10	Low	72	N/A	N/A
11	Low	N/A	N/A	N/A
13	Low	N/A	N/A	N/A
15	Medium	N/A	N/A	N/A
16	Low	N/A	38	N/A
17	Low	N/A	N/A	N/A
19	Low	N/A	8.5	N/A
20	Medium-High	N/A	N/A	N/A
21	Low	N/A	N/A	N/A
23	Medium-High	N/A	N/A	N/A
24	Medium-High	N/A	N/A	N/A
26	Medium-High	N/A	N/A	N/A
27	Low	N/A	N/A	N/A
29	Medium	N/A	39.4	N/A
31	Medium-High	N/A	N/A	N/A
32	Medium	N/A	N/A	N/A
35	Medium	N/A	N/A	N/A
41	Medium-High	N/A	N/A	N/A
44	Medium	N/A	46	N/A
46	Medium-High	N/A	N/A	N/A
50	Medium-High	N/A	N/A	N/A
51	Medium	N/A	N/A	N/A
52	Low	4	48	N/A
55	Low	62	N/A	N/A
58	Medium-High	N/A	N/A	N/A
59	Medium-High	N/A	N/A	N/A
60	Low	9	N/A	N/A
61	Low	30	83	N/A
62	Medium-High	N/A	N/A	N/A
63	Low	4	6	N/A
65	Low	70	N/A	N/A
66	Medium-High	N/A	N/A	N/A
67	Low	N/A	N/A	N/A
68	Low	N/A	N/A	N/A
70	Low	N/A	N/A	N/A
71	Low	N/A	N/A	N/A

9. Bat Impact Assessment and Mitigation

The impacts and mitigation measures are based on the results from the near ground level and at-height monitoring, available spatial data, ground-truthing, roost searches, point sampling and knowledge IWS has gained from operational monitoring at seven different WEFs.

Six local potential impacts of the proposed Albany WEF were evaluated with regard to bat roosting, foraging and migration and two regional impacts associated with cumulative impacts.

9.1 Impact 1: Roost disturbance and/or destruction due to construction activities – Construction Phase

9.1.1 Cause and Significance

If the construction of roads, power lines, turbines, office and maintenance buildings, substations and other infrastructure for the proposed Albany WEF causes disturbance or destruction of a few small farm buildings on site, this would affect only a small number of house-dwelling bats. However, construction would have a significant impact on local bats if it affected larger roosts. While IWS only found small roosts, there is a moderate to high potential of roosts in the steeper, rocky sections in the south and south-east of the Albany WEF site. The deep rocky gorges are likely to provide suitable roosting habitat to several species and the diversity of species recorded at AL2 is testament to this. These areas were not accessible to fully assess. This potential impact, therefore, has a **Medium** Significance rating, which can be reduced to **Low** by the following recommended mitigation measures.

9.1.2 Mitigation and management

- Minimise disturbance and destruction of farm buildings on site.
- No part of any turbine, including the entire rotor swept zone to be constructed within areas of High and bat sensitivity. IWS discourages the development in areas of Medium and Medium-High bat sensitivity, however, operational mitigation measures are recommended Section 9.3.2 to minimise bat fatalities in these zones.
- Clearing of natural vegetation areas be kept to a minimum.
- Construction near cliff-faces and mountainous areas in south and south-east of site to be avoided.
- Whilst it is unlikely that any new large roosts (consisting of more than 50 bats) will be discovered on site or immediately adjacent, such roosts should be reported if found during the operational phase.

9.2 Impact 2: Fragmentation to and displacement from foraging habitat due to wind turbine construction and operation

9.2.1 Cause and Significance

If the construction of roads, power lines, turbines, office and maintenance buildings, substations and other infrastructure for the proposed Albany WEF causes disturbance or destruction of locally limited water resources and woody vegetation, this would have a significant impact on bats, especially the clutter-edge and clutter foraging bat species. Construction will involve vegetation clearance at the footprint of each turbine, along the road network and other office and substation buildings. General dust and noise will increase in the area which may cause more sensitive species to disperse either temporarily or permanently.

The physical infrastructure, movement, noise and lights of the operational turbines could act as barriers and disturbance to bats during foraging and movement. Lights could also act as an attractant to certain species. At some operational WEFs in the Eastern Cape where IWS is monitoring, artificial light around the substation and O&M buildings seem to be attract insects and therefore foraging bats, resulting in high activity recorded at the nearby bat monitoring stations. This potential impact, therefore, has a **Medium** significance rating, which can reduced to **Low** by the following recommended mitigation measures.

9.2.2 Mitigation and management

- Turbines, including the blade length, should be spaced ≥300 m from each other.
- All turbines (including their full rotor swept zone) to be kept out of all High bat sensitivity areas.
- There should be at least a 500m no turbine development zone around any sub-stations or office/ operations and maintenance buildings.
- Clearing of natural and agricultural areas be kept to a minimum.
- Minimise impacts to natural and artificial wetlands and water bodies.

9.3 Impact 3: Bat fatalities due to collision or barotrauma while foraging – Operational Phase

9.3.1 Cause and Significance

Bat deaths by collision with or due to barotrauma caused by wind turbines have been reported worldwide (Kunz *et al*., 2007; Arnett *et al*., 2008; Baerwald *et al*., 2008; Rydell *et al*., 2010; Baerwald and Barclay, 2011; ; Hull and Cawthen, 2013; Voigt *et al*., 2012; Lehnert *et al*., 2014), including for South Africa (SA) (Doty and Martin, 2012; MacEwan, 2016). There is not a single WEF in SA, where operational monitoring is being conducted, that has not had any bat fatalities (Perrold and MacEwan, 2017).

There are various hypotheses as to why certain species of bats are killed by wind turbines, but one common hypothesis that is emerging worldwide, is that bats that move and feed in less cluttered and more open air space environments, are more vulnerable to collisions with wind turbines than those moving and feeding in more cluttered environments (Arnett*,* 2017).

Arnett and Baerwald (2013) did a comparison of bat fatality data from 123 studies at 72 operational WEFs from all over the United States of America (USA) and Canada for the period 2000 to 2011. The results varied substantially based on geographic locality and habitat type with the lowest mean fatalities being 1.39 bats/MW/year in Great Basin/Southwest Open Range-Desert to 8.03 bats/MW/year in Northeastern Deciduous Forest (with one study site yielding an outlying results of 41.17 bats/MW/year in the Southeastern Mixed Forest).

Perrold and MacEwan (2017) did a comparison of bat fatality data from across 10 Year 1 studies at 10 operational WEFs from the Eastern, Northern and Western Cape Provinces of South Africa (SA). The results varied based on geographic locality and habitat type with the lowest mean fatalities at a site in the Drakensberg Montane Grasslands, Woodlands And Forests ecoregion being 0.91 bats/MW/year to 7.38 bats/MW/year at a site in the Nama Karoo ecoregion (with one study site yielding an outlying results of 16.8 bats/MW/year in the Lowland Fynbos ecoregion).

By applying the proposed 100 MW output capacity for the Albany WEF, we can predict a best case adjusted bat fatality rate (all species combined) for the whole facility at 91 bats per annum (based on an 100MW facility and 0.91 bat fatalities/MW/year) and an absolute worst case fatality rate for the whole facility at 1680 bats per annum (based on a 100MW facility and 16.8 bat fatalities/MW/year). **However,** of the 10 WEFs used to obtain this information, four of them fell predominantly in the Drakensberg Montane Grasslands, Woodlands and Forest ecoregion (the same ecoregion as for Albany). Using information from these sites only, the best and worst case fatality rates range from 91 bats per annum (based on an 100MW facility and 0.91 bat fatalities/MW/year) to a worst case fatality rate for the whole facility at 328 bats per annum (based on a 100MW facility and 3.28 bat fatalities/MW/year). Furthermore, it must be noted that none of these four facilities had any operational mitigation measures in place.

Based on the activity levels measured during pre-construction monitoring, the Albany WEF is classified as having a Medium turbine fatality risk for its Ecoregion, according to the estimated bat fatality risk levels in MacEwan *et al* (2020a). The significance of bat fatality impacts during foraging is considered High, especially considering the fact that numerous bat fatalities of the of *T. aegyptiaca* and *N. capensis* , the two most common bat species recorded at the Albany WEF, are being found at operational WEFs in the Eastern and Western Cape. This impact can be reduced to Low by the following mitigation measures.

9.3.2 Mitigation and Management

- Constructing a facility with the least rotor swept area is preferable.
- Turbines, including the blade length, should be spaced ≥300 m from each other.
- All turbines (including their full rotor swept zone) to be kept out of all High bat sensitivity areas.
- There should be at least a 500 m no turbine development zone around any existing or newly built or to be constructed sub-stations or office/ operations and maintenance buildings.
- During operational monitoring, quarterly progress reports and annual monitoring reports to be submitted to SABAAP, EWT, the DEA, the Eastern Cape Department of Economic Development (ECDEDEAT), Environmental Affairs and Tourism and to the SANBI Bird and Bat Database.
- The above recommendations should be written into the authorisation of this amendment application.
- With the exception of compulsory civil aviation lighting, minimise artificial lighting at night, especially high-intensity lighting, steady-burning, or bright lights such as sodium vapour, quartz, halogen, or other bright spotlights at sub-station, offices and turbines. All non-aviation lights should be hooded downward and directed to minimise horizontal and skyward illumination.
- All non-aviation internal turbine nacelle and tower lighting should be extinguished when unoccupied.
- No part of any turbine, including the entire rotor swept zone, should be constructed within areas of High bat sensitivity. Layout 10.1 meets this requirement.
- For turbines 15 turbines within the Medium and the 20 turbines with the Medium-High bat sensitive zones, the following curtailment strategy in **Table 8** is recommended from the commencement of operation in order to keep bat fatalities to a minimum:

Table 8 Initial Mitigation Strategy for the Albany WEF

In the following Bat Sensitivity Zones:	Time of Year to be applied:	Time of Night to be applied:	When Temperatures exceed:	Apply a Cut-in Wind Speed of:
Medium	December, January and February	From sunset for 6 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium	March	Sunset to Sunrise	12°C	5 $m.s^{-1}$
Medium	April	From sunset for 2 hours and for 3 hours before sunrise	12°C	5 $m.s^{-1}$
Medium	May	From sunset for 2 hours	12°C	5 $m.s^{-1}$
Medium	June, July and August	From sunset for 1 hour	12°C	5 $m.s^{-1}$
Medium	September	Sunset to Sunrise	12°C	5 $m.s^{-1}$

Medium	October and November	From sunset for 4 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium-High	December, January and February	From sunset for 6 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium-High	March	Sunset to Sunrise	12°C	6 $m.s^{-1}$
Medium-High	April	From sunset for 2 hours and for 3 hours before sunrise	12°C	6 $m.s^{-1}$
Medium-High	May	From sunset for 2 hours	12°C	6 $m.s^{-1}$
Medium-High	June, July and August	From sunset for 1 hour	12°C	6 $m.s^{-1}$
Medium-High	September	Sunset to Sunrise	12°C	6 $m.s^{-1}$
Medium-High	October and November	From sunset for 4 hours and for 2 hours before sunrise	12°C	6 $m.s^{-1}$

- Post-construction/ operational bat monitoring must be performed according to the South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (Aronson, *et al*., 2020) or later editions of the guidelines, valid at the time of monitoring. IWS recommends the initial 2 years and then every third year for the remainder of the project.
- The above measures are likely (50-60% certainty) to minimise bat fatalities, as only 50% of bat activity occurs above wind speeds of 5 m/s and 40% of bat activity occurs above 6 m/s.
- However, should operational monitoring show that adjusted annual bat fatalities (adjusted for biases such as searcher efficiency and carcass persistence) ever equal or exceed the threshold level of fatalities guided by SABAAP, then further mitigation will be required.
- For the 6500ha Albany WEF site, 57 bats per annum is the maximum number of bats that can be killed based on the thresholds provided for the Albany Thicket ecoregion in MacEwan *et al* (2020b) or later editions of the guidelines, valid at the time of monitoring.
- Such additional mitigation actions will only be required at specific turbines that have killed two or more bats during the reporting period – see Aronson *et al*. (2020) for guidance on fatality reporting periods.
- At the individual turbines that have killed two or more bats include, the cut-in wind speed should be increased to 7.5m/s (only exposing 25% of bat activity to spinning blades).
- When dealing with living animals that can respond in different and unpredictable ways to changing environmental, climatic and developmental parameters, it is very difficult to make guaranteed predictions. Lintott et al. (2016) state that the nightly and seasonal activity data collected during pre-construction surveys may provide an indication of the extent of curtailment that is required and therefore the economic viability of the project, however, they highlight the need for a feedback mechanism for practitioners to share the success or failure of mitigation strategies, i.e. adaptive mitigation. The bat specialist conducting the operational monitoring has the right to make further recommendations should they see fit.

- Given the magnitude and extent of wind-turbine related bat fatalities worldwide, the conservation implications are critically important and bat fatalities should be avoided, minimised or mitigated proactively.

9.4 Impact 4: Bat fatalities due to collision or barotrauma during migration – Operational Phase

Internationally, migrating bats have been shown to be at risk of fatality due to wind turbines. Whilst the migrating bats in South Africa are different species and are not tree-roosting species, the long distances that they travel and the height at which they fly also puts them at risk of fatality. In South Africa, migrating bat species, such as *M. natalensis* and the Egyptian Rosetta *Rousettus aegyptiacus* have been fatality victims at wind turbines in the Eastern Cape (MacEwan, 2016), however, only a handful of each to date.

At the Albany WEF, there is evidence of increased *M. natalensis* activity in autumn, although the numbers are moderate. The significance of this impact is considered to be **Medium**. Mitigation measures recommended above in **Section 9.3.2** will assist to reduce the risk of fatalities of migrating bats and reduce the significance of the impact to **Low**.

9.5 Impact 5: Bat fatalities due to collision or barotrauma due to attraction of bats to towers for roosting – Operational Phase

9.5.1 Cause and significance

Bats have been shown, through thermal imagery studies, to be attracted to wind turbines, either looking for potential roost sites, or out of curiosity and are often struck by the moving blades (Horn *et al.,* 2008). This has been further confirmed by Rollins *et al.* (2012).

Unfortunately, no mitigation measure has been found to effectively prevent this. Whilst ultrasonic sound emitters are currently being investigated as a deterrent for bats from wind turbines internationally and in South Africa, the research is still in its infancy. Hence, we cannot yet recommend this, but as more information comes available, deterrents could be a valuable mitigation measure. The most well-documented measure is curtailment, which is discussed under **Section 9.3.2**.

9.6 Impact 6: Disturbance or displacement of bats due to electromagnetic interference emitted from power lines – Operational Phase

9.6.1 Cause and significance

Bat collision with power lines is considered as a negligible impact on bats at the Albany WEF, owing to no evidence of this occurring in South Africa to date and no evidence of fruit bats occurring on site. Furthermore, whilst some laboratory studies have shown that electromagnetic radiation can have behavioural effects on bats and rats, it is uncertain that this would be the case outside of the lab in natural circumstances. The only mitigation, at this stage, would be for all power line routes to avoid High Bat Sensitive areas, where possible. Should evidence of bats being affected by power lines be reported at Albany WEF, adaptive mitigation measures must be implemented, in consultation with a bat specialist.

10. Cumulative Impacts

Whilst it is very important to consider the local impacts that may be caused by individual developments; it is equally important to consider the cumulative impacts of the facility in light of other similar developments nearby. **Figure 23** shows all EIA applications for renewable energy projects approved or received by the DEA as at the end of the fourth quarter of 2019 (DEA, 2019) within a 30km and 100km radius of the Albany WEF. In addition to the two other onshore wind and one solar PV developments planned around Grahamstown, within a 30km radius of the Albany WEF, there are extensive wind energy projects around Bedford and Cookhouse (roughly 70 km to the north-west) and along the Wild Coast (roughly 70km to the east).

Whilst the DEA may request that a 30km radius is used for the assessment of cumulative impacts, this is not based on ecological processes and certainly does not take into account the larger seasonal distances that bats move. Hence, IWS uses 100km as a minimum distance for assessing the cumulative impact on bats.

Based on IWS's experience at ten operational WEFs in the Eastern Cape already, bat species (of the same kind as found at Albany) are being killed by wind turbines. For example, *Tadarida aegyptiaca* and *Neoromicia capensis* are being killed in the thousands already and *Miniopterus natalensis* in the tens to hundreds already.

The greater the area of wind turbine development, the greater the impact will be on the high-risk species. IWS predicts some additive cumulative impact effect with each separate WEF being added to the region. Bat fatalities are concentrated to relatively fewer species than birds (in SA, at least seven of the over 60 bat species to date have been found as fatalities at WEFs). Therefore, cumulated fatalities can potentially have significant impacts on their populations (Barclay *et al*., 2017).

Population data are not likely to be available for most bat species in the near future and thus wind operators should practise the precautionary principle and avoid high-risk sites and implement operational minimisation measures at sites where bat fatalities are known or are predicted to be high (Arnett & Baerwald 2013; Arnett, 2017). SABAAP has developed initial Threshold Guidelines to reduce the potential effects of cumulative impacts on bat populations and to avoid SA reaching the millions of bat fatalities that have been observed in the USA, Canada and Europe. These threshold principles have been applied in the current report. It is not only conservation important or rare bats for which impact avoidance and mitigation measures should be implemented. Least Concern species are being killed in the largest numbers in SA (IWS unpublished data) and in the USA, the Hoary bat (*Lasiurus cinereus*) population could decline by as much as 90% in the next 50 years (Frick *et al*., 2017).

Arnett and Baerwald (2013) conducted a synthesis of bat fatality data from 122 post-construction fatality studies between the years 2000 to 2011 from 73 regional wind energy facilities in the USA and Canada. The findings estimated that cumulative bat fatalities for these 12 years amounted to between 650 104 to 1 308 378 and they predicted an additional 200 000 to 400 000 for the year 2012 alone. With growing numbers of operational wind turbines in North America, these fatality numbers are expected to grow annually. In Germany, between 2004 and 2015 (11 years), it is estimated that over two million bats have been killed by wind turbines (Voigt *et al*., 2015).

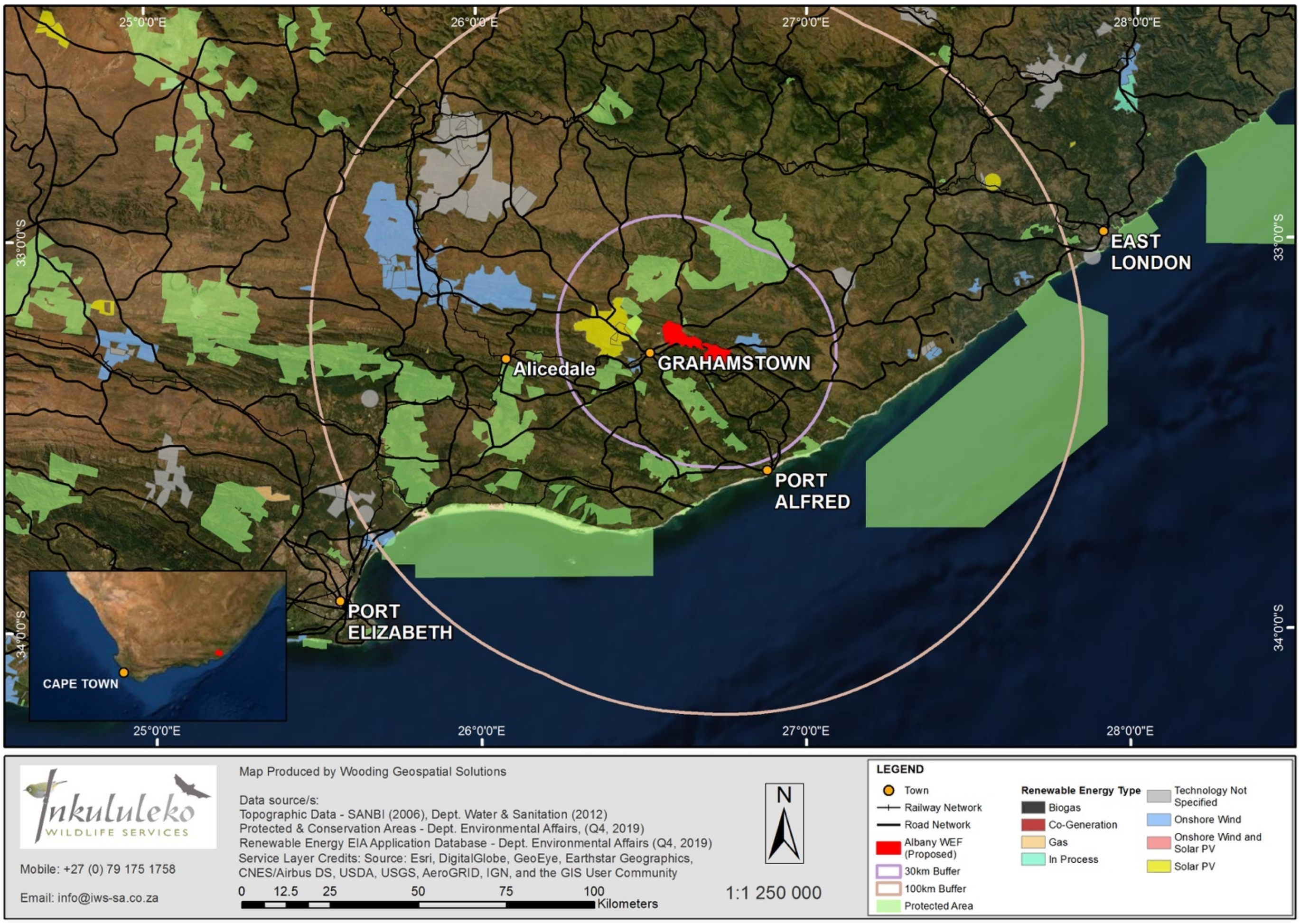


Figure 23 Renewable Energy Cumulative Impact Map – Renewable Energy Applications as at Quarter 4 of 2019 (approved and under review) in the vicinity of the proposed Albany WEF

10.1 Impact 7: Loss or population disturbances to Conservation Important bat species from the greater area due to construction and operation activities

10.1.1 Cause and significance

None of the eleven bat species confirmed for the Albany WEF study area are listed as Red Data species (Childs *et al.,* 2016), however, they are all listed as protected in terms of the Ciskei Nature Conservation Act 10 of 1987 (the Act) and the [Western] Cape: Nature Conservation Ordinance 19 of 1974 (the Ordinance). This impact was, therefore, given a **Medium** significance rating, which would be reduced to **Low** maintained by the mitigation measures described under **Section 9.3.2** and the recommendations given below:

10.1.2 Mitigation & Management

- IWS recommends that no development in the greater Grahamstown area should be approved without each project allowing for in their EMP and budget, operational monitoring at each WEF South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (Aronson *et al.,* 2020) or later editions valid at the time of monitoring and data sharing, and curtailment takes place at turbines where multiple bat fatalities are found.

- IWS also recommends that the DEA and the ECDEDEAT commission an individual or a company to collate data gathered from the various projects in the area to assess the actual cumulative impact and to make recommendations from a regional perspective.

10.2 Impact 8: Reduction in the size, genetic diversity, resilience and persistence of bat populations

10.2.1 Cause and Significance

Bat populations are likely to be reduced in size by the fatality of bats at WEFs, especially where multiple facilities occur. Because bats have low reproductive rates, they have slow generation turn-over and low population resilience against mass die-offs. Smaller populations also contain less genetic diversity, and are more susceptible to genetic drift and inbreeding. WEFs may, therefore, reduce the long-term persistence of local and even regional bat populations. This potential impact, therefore, has a **Medium-High** significance rating, which can reduced to **Low** by the mitigation measures described under **Section 9.3.2** and **Section 10.1.2**.

11.Impact Assessment Matrix

Table 9 displays the Bat Impact Assessment Matrix, based on the methodology described in **Section 6.4**.

Table 9 Impact Assessment Matrix

Impact No.	Impact		Status	Extent		Duration		Intensity		Probability		Significance		Confidence
				Details	Rating	Details	Rating	Details	Rating	Details	Rating	Details	Total	Level
1	Roost disturbance or destruction due to construction activities	Without Mitigation	Negative	Regional	3	Long-term	3	Very High	4	Probable	2	Medium	20	High
		With Mitigation	Negative	Localised	1	Short-term	1	Low	1	Probable	2	Low	6	High
2	Disturbance to and displacement from foraging habitat due to wind turbine construction	Without Mitigation	Negative	Study Area	2	Permanent	4	High	3	Highly Probable	3	Medium	27	High
		With Mitigation	Negative	Study Area	2	Short-term	1	Medium	2	Highly Probable	3	Low	15	High
3	Bat Fatalities due to collision or barotrauma during foraging activity (Operational)	Without Mitigation	Negative	Study Area	2	Permanent	4	High	3	Definite	4	High	36	High
		With Mitigation	Negative	Study Area	2	Permanent	4	Medium	2	Probable	2	Low	16	High
4	Bat Fatalities due to collision or barotrauma during migration (Operational)	Without Mitigation	Negative	Regional	3	Permanent	4	High	3	Highly Probable	3	Medium	30	High
		With Mitigation	Negative	Study Area	2	Permanent	4	Low	1	Improbable	1	Low	7	High
5	Bat fatalities due to collision or barotrauma due to attraction of bats to towers for roosting	Without Mitigation	Negative	Study Area	2	Permanent	4	Medium	2	Probable	2	Low	16	Medium
		With Mitigation	Negative	Study Area	2	Permanent	4	Low	1	Probable	2	Low	14	Low
6	Disturbance or displacement of bats due to electromagnetic interference emitted from power lines (Operational)	Without Mitigation	Negative	Study Area	2	Long-term	3	Medium	2	Improbable	1	Low	7	Medium
		With Mitigation	Negative	Study Area	2	Long-term	3	Low	1	Improbable	1	Low	6	Low
7	Loss of Conservation Important/Threatened species due to wind turbine construction & operation	Without Mitigation	Negative	Regional	3	Permanent	4	Medium	2	Probable	2	Medium	18	High
		With Mitigation	Negative	Study Area	2	Long-term	3	Low	1	Improbable	1	Low	6	High
8	Reduction in size, genetic diversity, resilience and persistence of bat populations	Without Mitigation	Negative	Regional	3	Permanent	4	High	3	Highly Probable	3	Medium	30	Medium
		With Mitigation	Negative	Study Area	2	Long-term	3	Medium	2	Improbable	1	Low	7	Medium

12.Conclusions

Eleven bat species were confirmed for the proposed Albany WEF. None of these are threatened species according to Child *et al.* (2016), but all are protected by the Ciskei Nature Conservation Act 10 of 1987 (the Act) and the Cape Nature: Nature Conservation Ordinance 19 of 1974 (the Ordinance) and five species have a high or medium-high risk of turbine-related fatality (MacEwan *et al.,* 2020a). It is not only conservation important or rare bats for which buffer zones, mitigation measures or fatality minimization strategies should be implemented. All bats are particularly susceptible to anthropogenic changes because of their low reproductive rate, longevity, and high metabolic rates (Voigt and Kingston 2016), limiting their ability to recover from declines and to maintain sustainable populations (Barclay and Harder 2003). Bat fatalities due to wind turbines raise serious concerns about population-level impacts (Barclay and Harder 2003; Frick *et al*. 2017). In the USA, *Lasiurus cinereus* Hoary bats, a once widespread and abundant species, are under serious threat due to wind energy and are facing population declines (Frick *et al*,. 2017).

Whilst most biologists would support the development of potentially cleaner renewable energy sources, such as wind energy, the impacts that wind turbines are having on South African, American and European bats is concerning. It is important to get to a point where wind farms and bats can co-exist with minimal impact on bats.

In terms of the turbine fatality risk levels described in MacEwan *et al.* (2020a), the Albany WEF falls within the Medium risk category for the Albany Thicket ecoregion and mitigation measures should be recommended based on the pre-construction monitoring results and implemented at the start of operation. Several measures have been recommended by IWS in the current report, but some of the key ones are listed below:

- All turbines (including their full rotor swept zone) to be kept out of all **High** bat sensitivity areas. Layout 10.1 meets this requirement.
- For turbines 15 turbines within the **Medium** and the 20 turbines with the **Medium-High** bat sensitive zones, the following curtailment strategy is recommended from the commencement of operation in order to keep bat fatalities to a minimum:

In the following Bat Sensitivity Zones:	Time of Year to be applied:	Time of Night to be applied:	When Temperatures exceed:	Apply a Cut-in Wind Speed of:
Medium	December, January and February	From sunset for 6 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium	March	Sunset to Sunrise	12°C	5 $m.s^{-1}$
Medium	April	From sunset for 2 hours and for 3 hours before sunrise	12°C	5 $m.s^{-1}$
Medium	May	From sunset for 2 hours	12°C	5 $m.s^{-1}$
Medium	June, July and August	From sunset for 1 hour	12°C	5 $m.s^{-1}$
Medium	September	Sunset to Sunrise	12°C	5 $m.s^{-1}$

Medium	October and November	From sunset for 4 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium-High	December, January and February	From sunset for 6 hours and for 2 hours before sunrise	12°C	5 $m.s^{-1}$
Medium-High	March	Sunset to Sunrise	12°C	6 $m.s^{-1}$
Medium-High	April	From sunset for 2 hours and for 3 hours before sunrise	12°C	6 $m.s^{-1}$
Medium-High	May	From sunset for 2 hours	12°C	6 $m.s^{-1}$
Medium-High	June, July and August	From sunset for 1 hour	12°C	6 $m.s^{-1}$
Medium-High	September	Sunset to Sunrise	12°C	6 $m.s^{-1}$
Medium-High	October and November	From sunset for 4 hours and for 2 hours before sunrise	12°C	6 $m.s^{-1}$

- Post-construction/ operational bat monitoring must be performed according to the South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (Aronson, *et al*., 2020) or later editions of the guidelines, valid at the time of monitoring. IWS recommends the initial 2 years and then every third year for the remainder of the project.
- The above measures are likely (50-60% certainty) to minimise bat fatalities, as only 50% of bat activity occurs above wind speeds of 5 m/s and 40% of bat activity occurs above 6 m/s.
- However, should operational monitoring show that adjusted annual bat fatalities (adjusted for biases such as searcher efficiency and carcass persistence) ever equal or exceed the threshold level of fatalities guided by SABAAP, then further mitigation will be required.
- For the 6500ha Albany WEF site, 57 bats per annum is the maximum number of bats that can be killed based on the thresholds provided for the Albany Thicket ecoregion in MacEwan *et al.* (2020b) or later editions of the guidelines, valid at the time of monitoring.
- Such additional mitigation actions will only be required at specific turbines that have killed two or more bats during the reporting period – see Aronson *et al*. (2020) for guidance on fatality reporting periods.
- At the individual turbines that have killed two or more bats include, the cut-in wind speed should be increased to 7.5m/s (only exposing 25% of bat activity to spinning blades).
- When dealing with living animals that can respond in different and unpredictable ways to changing environmental, climatic and developmental parameters, it is very difficult to make guaranteed predictions. Lintott et al. (2016) state that the nightly and seasonal activity data collected during pre-construction surveys may provide an indication of the extent of curtailment that is required and therefore the economic viability of the project, however, they highlight the need for a feedback mechanism for practitioners to share the success or failure of mitigation strategies, i.e. adaptive mitigation. The bat specialist conducting the operational monitoring has the right to make further recommendations should they see fit.

- Given the magnitude and extent of wind-turbine related bat fatalities worldwide, the conservation implications are critically important and bat fatalities should be avoided, minimised or mitigated proactively.

In addition to the responsibility of the WEF developer and operator to ensure minimal bat fatalities, there is a responsibility on government to manage cumulative impacts. IWS recommends that the DEA and the ECDEDEAT commission an individual or a company to collate data gathered from the various projects in the area to assess the actual cumulative impact and to make recommendations from a regional perspective.

South Africa doesn't want to find themselves in the situation where the USA and Canada are, with hundreds of thousands of bats dying annually and declining species numbers because strategic mitigation action was not taken sooner.

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14.Appendix A – Technical Field Reports

14.1 April 2016

On the 6th and 7th of April 2016, IWS installed two Bat Monitoring Stations at the proposed Albany WEF site (**Table 10**). The IWS team was unable to fit the 80 m microphone over these days due to high winds. IWS returned on the 9th of April 2016 to fit the 80 m mic in more favourable weather conditions. The technical details of the trip are as follows:

Table 10 **New Bat Monitoring Station Details at Albany WEF**

Mast No.	Mast Coordinates	Altitude	Microphone Height (above ground level)	Photographs
AL1	S 33° 16.352' E 26° 38.362'	701 m	Top Mic. 80 m Bottom Mic. 10 m	

				
AL2	S 33° 17.335' E 26° 41.891'	814 m	10 m	

Notes:

- One 10m steel mast with an SM3BAT detector was installed (AL2). The microphone was placed at a height of 9.5m. The original location suggested by EDF could not be accessed via a vehicle and consequently would not be able to be regularly lowered to access the equipment and data. Unfortunately, most locations for this mast would be very visible from the N2 highway, and as such, AL2 is visible. The positive thing is that is difficult to drive to.
- One SM3BAT detector was installed on the met mast (AL1). Microphones were installed at heights of 10 m and 80.3 m (to avoid the anemometer equipment at 80 m).
- Recording schedule program SM3_AL_mono.PGM and SM3_AL_stereo.PGM were installed.
- Firmware V1.2.9 were used in the SM3s.

No transects were performed.

14.2 June 2016

On the 3rd and 4th of June 2016, IWS conducted a field trip to check on and download data from the two Bat Monitoring Stations (installed in April 2016) at the proposed Albany WEF site (**Table 11**). The technical details of the trip are as follows:

Table 11 Bat Monitoring Station Details - June 2016

Mast No.	Microphone condition	Battery condition	Data Recorded
AL1	80 m Mic. – good 10 m Mic. – good	Good	115 GB
AL2	10 m Mic. - good	Good	115 GB

Notes:

- At AL1, all the SD cards were full and recordings between 20 May and 4 June 2016 were lost as a result. Settings on the bat detector were changed in the hope of avoiding this problem in the future.

- At AL2, all the SD cards were full and recordings between 5 May and 4 June 2016 were lost as a result. Settings on the bat detector were changed in the hope of avoiding this problem in the future.

On the night of the 3 June 2016, a 3.18 km driven transect was performed through the proposed site on the farm *The Orchards*. Weather conditions were cool (12˚C) with a 41km/h (strong) south-westerly wind. The transect was cut short due to rain.

Due to the layout of the site and lack of lengthy roads on which to perform transects, IWS decided to select six accessible transect points (TPs) across the site. At each point, IWS placed the detector to record for 10 minutes before moving on. The monitoring guidelines make provisions for such instances. The same six sites will be used in each season. Fifty-seven bat triggers were recorded at AL_TP6 – all *T. aegyptiaca*.

14.3 July/August 2016

On the 31st July and 1st August 2016, IWS conducted a field trip to check on and download data from the two Bat Monitoring Stations (installed in April 2016) at the proposed Albany WEF site (**Table 12**). The technical details of the trip are as follows:

Table 12 Bat Monitoring Microphone Details – April 2016

Mast No.	Microphone condition	Battery condition	Data recorded
AL1	80 m Mic. – good 10m Mic. – good	Good	121 GB
AL2	10 m Mic. – good	Good	118 GB

Notes:

- At AL1, it appears that the cards filled up on the 1st of August 2016.
- At AL2, it appears that the cards filled up on the 22nd of July 2016.

  The small losses in data are certainly not significant.

A roost search was conducted on one of the properties and a small roost of *Rhinolophus capensis* (Cape Horseshoe Bat) was found, with four individuals seen and recorded.

14.4 September 2016

On the 20th and 21st of September 2016, IWS conducted a maintenance trip to download data from the two bat monitoring stations at the proposed Albany WEF site (**Table 13**). The technical details of the trip are as follows:

Table 13 Bat Monitoring Microphone Details – September 2016

Mast No.	Microphone condition	Battery condition	Data recorded
AL1	80 m Mic. – good 10 m Mic – good	Good	118 GB
AL2	10 m Mic – good	Good	72.4 GB

Notes:

- At AL1, the SD cards filled up on 16 September 2016, resulting in only 4 days-worth of potential data lost. All cards at both stations were replaced with 64 GB cards to ensure future loss of data is minimized further. The firmware at AL1 was updated to SYS1.2.9.SM3.

The *Rhinolophus capensis* roost was investigated again and individuals were still present. In addition, evidence of *Nycteris thebiaca* was found in form of droppings and disposed insect body parts.

An additional roost search was conducted on a nearby farm and found to have evidence of bats but no individuals were observed or recorded.

On the night of 20 September 2016, IWs conducted recording at the six transect points across the site. The weather was cold (12°C), overcast with thick mist with a 26 km/h (moderate) southerly wind. No monitoring took place at TP2 as the EM3 batteries died. TP4 could not be accessed due to a locked gate however monitoring took place at the closest possible location.

On the night of 21 September 2016, IWs conducted recording at the six transect points across the site, in the opposite order. The weather was cold (11°C), partly-cloudy with a 17 km/h (gentle) southerly wind. No monitoring took place at TP4 as it was inaccessible due to a locked gate.

A summary of both nights transect results can be seen below in **Table 14**.

Table 14 Number of bat passes recorded at the static transect monitoring points at the proposed Albany Wind Energy Facility on 20 and 21 September 2016

	20/09/2016			21/06/2016		
Monitoring Point	*T. aegyptiaca*	*N. capensis*	*M. natalensis*	*T. aegyptiaca*	*N. capensis*	*M. natalensis*
TP1			1			
TP2		No monitoring				
TP3					1	
TP4	1	5			No monitoring	
TP5		45	15		63	10
TP6				1		

14.5 November 2016

From the 14th to 16th November 2016, Inkululeko Wildlife Services (IWS) conducted a field trip to check on and download data from the two Bat Monitoring Stations (installed in April 2016) at the proposed Albany Wind Energy Facility site. The technical details of the trip are as follows:

Table 15 Bat Monitoring Microphone Details – November 2016

Mast No.	Microphone condition	Battery condition	Data recorded
AL1	10 m Mic. – good 80 m Mic. – replaced	Good	201 GB
AL2	10 m Mic. - replaced	Good	160 GB

Notes:

AL1, it was found that water had entered the 80m microphone casing. The microphone was replaced and will be sent back to the supplier for possible replacement. No data has been lost due to the faulty microphone. The panels on the anti-climb device were found to be loose and causing significant noise which could have led to increased storage space being used on the SD cards. IWS have cable-tied the panels where possible to reduce the loud banging in windy conditions.

AL2, it was found that water had entered the 10m microphone casing. The microphone was replaced and will be sent back to the supplier for possible replacement. Only five nights' worth of data was lost due to the microphone problem.

Ten points across the farm were assessed as part of a ground-truthing exercise to verify bat habitat sensitivity. Additionally, a roost search was conducted at one of the properties not yet visited.

On the night of 14 November 2016, IWS conducted recording at four static points within the proposed site. The weather was very cold (8°C) and overcast with a 32 km/h (fresh) southerly wind.

On the night of 15 November 2016, IWS conducted recording at TP6 static transect point, and two short (1.57 km and 3.42 km respectively) driven transects within the proposed site. The weather was mild (18°C), partly cloudy with a 28 km/h (moderate) south-southwesterly wind. Three *N. capensis* bat passes were recorded on the driven transects.

14.6 January 2017

From the 23rd to 25th January 2017, Inkululeko Wildlife Services (IWS) conducted a field trip to check on and download data from the two Bat Monitoring Stations (installed in April 2016) at the proposed Albany Wind Energy Facility site. The technical details of the trip are as follows:

Table 16 Bat Monitoring Microphone Details – January 2017

Mast No.	Microphone condition	Battery condition	Data recorded
AL1	10 m Mic. – replaced 80 m Mic. – good	Good	227 GB
AL2	10 m Mic. - good	Good	209 GB

Notes:

AL1 It was found that water had entered the 10m microphone casing. The microphone was replaced and will be sent back to the supplier for possible replacement. Data from this microphone was lost from the 10th to the 23rd of January 2017 (13 nights).

The valley directly east of the large communications tower was assessed for its bat sensitivity as this was not achieved on the previous visit. The observations from this point will be included in IWS' final bat sensitivity report.

An Axis Q19342-E thermal imagery camera was set up 330 m north-east of AL1 to monitor bat activity around the farm houses overnight (**Figure 24**). Results will be analysed in the coming weeks to be available for the final 12-month report.

Figure 24 **The thermal imagery camera setup, north-east of AL1**

On the night of 23 January, IWS conducted recording at four static transect points within the proposed site (there was thick mist and rain at three other points) and a short (2.4 km) driven transect. The weather was overcast, warm-mild (21°C) with a 12 km/h (gentle) west north-westerly breeze. Details of the transect results can be found below in **Table 17**.

On the night of 24 January, IWS conducted recording at three static transect points, and a short (2.67 km) driven transect within the proposed site. The weather was clear and warm-mild (21°C), with a 30 km/h (fresh) southerly wind and near gale-force gusts of 58 km/h. Details of the transect results can be found below in **Table 18**.

Table 17 **Number of bat passes recorded at the static transect monitoring points at the proposed Albany Wind Energy Facility on 23 January2017**

	23/01/2017			
Monitoring Point	*T. aegyptiaca*	*N. capensis*	*M. natalensis*	*E. hottentotus*
TP1	0	0	0	0

TP2	No Monitoring			
TP3				
Quarry, The Orchards	0	0	0	1
TP5	0	30	17	0
TP6	9	2	0	2
Driven Transect	0	3	0	0

Table 18 Number of bat passes recorded at the static transect monitoring points at the proposed Albany Wind Energy Facility on 24 January2017

	24/01/2017			
Monitoring Point	*T. aegyptiaca*	*N. capensis*	*M. natalensis*	*E. hottentotus*
TP1	No Monitoring			
TP2				
TP3				
Quarry, The Orchards	1	0	0	0
TP5	0	50	25	0
TP6	3	0	0	0
Driven Transect	2	2	0	0

14.7 March 2017

From the 13th to 14th March 2017, Inkululeko Wildlife Services (IWS) conducted a field trip to check on and download data from the two Bat Monitoring Stations (installed in April 2016) at the proposed Albany Wind Energy Facility site (**Table 19**). The technical details of the trip are as follows:

Table 19 Bat Monitoring Microphone Details – March 2017

Mast No.	Microphone condition	Battery condition	Data recorded
AL1	10 m Mic. – good 80 m Mic. – good	Good	243GB
AL2	10 m Mic. - good	Good	236GB

Notes:

AL1

The 80m microphone at AL1 could not be tested as it was deemed too dangerous to climb due to the high winds and wet conditions, however it was still seen to be working in the early hours of the morning of the 11th of March.

AL2

A new wind-sock was fitted to the microphone at AL2.

IWS hoped to conduct a night driven transect on 13 March, however due to inclement weather with thick mist, the transect was aborted. IWS will endeavor to complete the two required autumn transects on the next field-trip (scheduled for April)

14.8 April 2017

From the 11th to 12th of April 2017, Inkululeko Wildlife Services (IWS) conducted a field trip to download data from the two Bat Monitoring Stations (installed in April 2016) and decommission the equipment at the proposed Albany Wind Energy Facility site (**Table 20**). The technical details of the trip are as follows:

Table 20 Bat Monitoring Microphone Details – April 2017

Mast No.	Microphone condition	Battery condition	Data recorded
AL1	10 m Mic. – good 80 m Mic. – good	Good	138 GB
AL2	10 m Mic. - faulty	Good	131 GB

Notes:

AL2 - The microphone at AL2 was found to have failed on the 3rd of April, consequently no calls were recorded from the 3rd to the 12th of April.

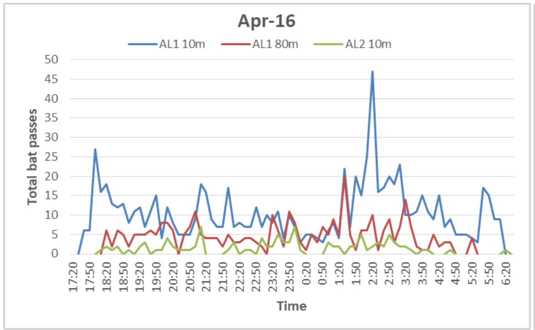
Table 21 Chart showing condition and number of each equipment item returned to EDF (PE office) on 13April 2017

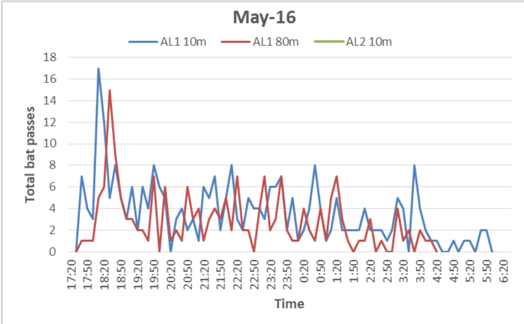
	SM3 bat detector	12volt 7ah batteries	Solar regulator	SM3 power connector	20watt solar panel	Ultrasonic microphone	10m microphone cable	50m microphone cable + microphone	Plastic housing for equip.	10m mast, steel cables and base plates	10m mast guy pegs	Short base plate pegs	U-bolts
AL1	Good	Good	Good	Good	Good	Both Good	Good	Good	Good	N/A	N/A	N/A	Good
AL2	Good	Good	Good	Good	Good	Possibly damaged**	Possibly damaged **	N/A	Good	Good	Good	Good	Good
Total items returned to EDF	2	4	2	2	2	0*	2	2	2	1	4	4	4

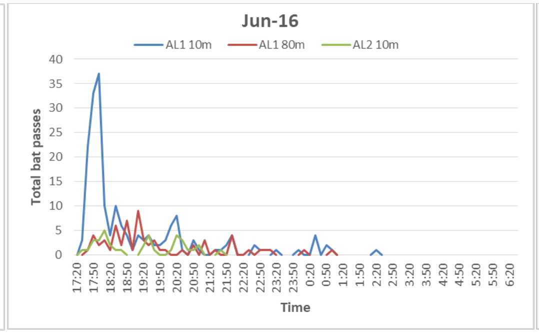
*Microphones not returned to EDF

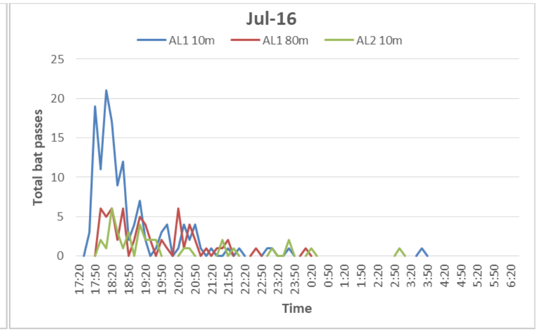
** IWS found the AL2 microphone to be totally dead (no response when tested). It was noted that substantial amount of moisture had gotten into the microphone connections thus both the mic. and the cable *may* be damaged, however it is possible that only one of the items is or neither and they may work fine once dried out. IWS will test this mic. at a later stage.

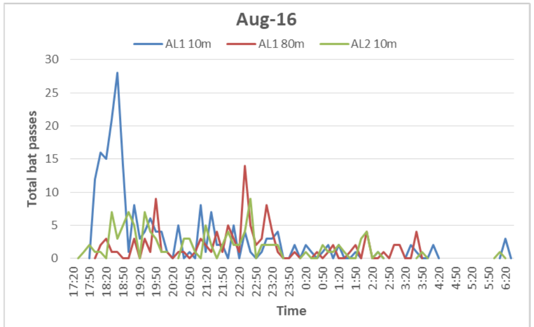
15. Appendix B – Monthly Nightly Bat Activity Patterns

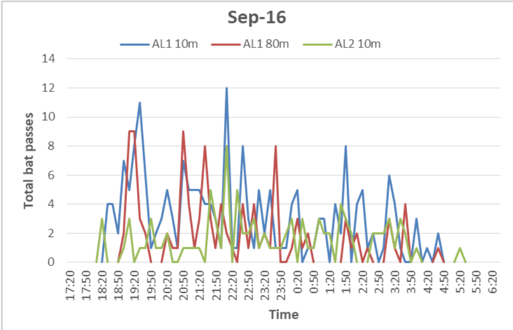


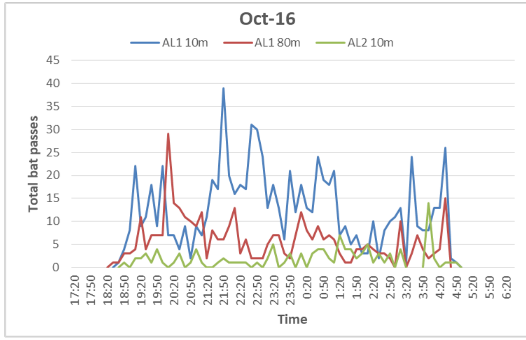


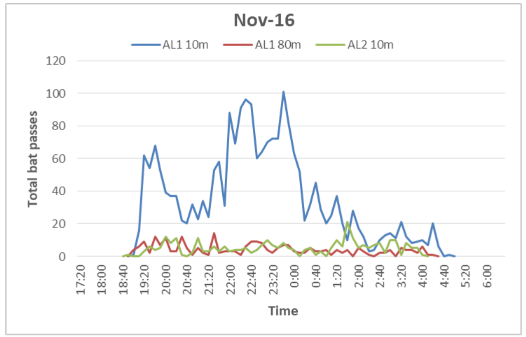


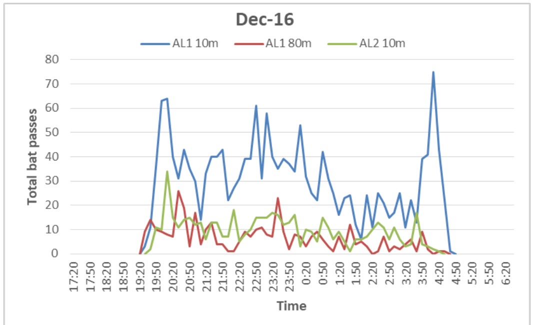


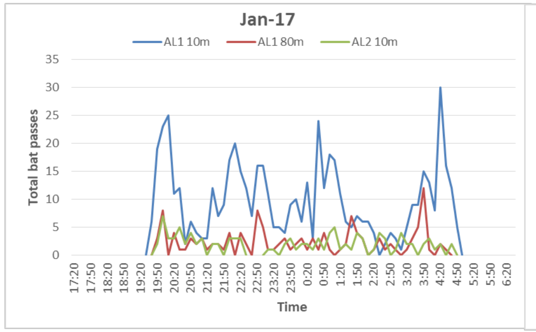


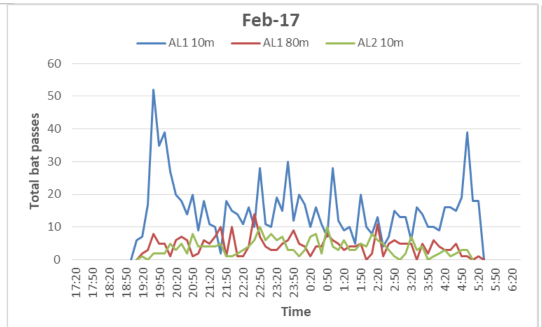


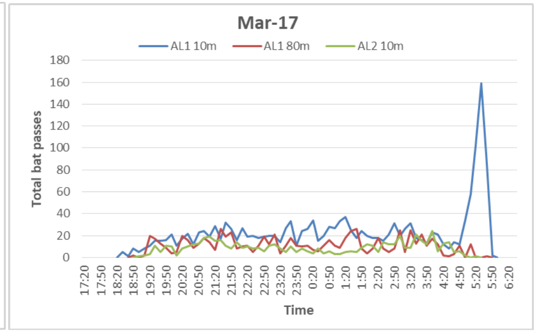












16.Appendix C - Albany WEF: Bat-sensitivity Ground-truthing Report

From the 14th to 16th November 2016, IWS conducted a ground-truthing exercise at various points within the boundaries of the proposed Albany Wind Farm. These points were chosen as they represented areas of high bat sensitivity according to IWS' preliminary (6-month) monitoring report. IWS has two monitoring stations set up to record bat activity passively throughout the 12 months, while an additional six static transect points were selected to record bat activity for short periods in each season. A further eleven points (with basic names assigned) were selected for ground-truthing. The details of each point are provided below and a photo gallery of each point in **Appendix D**.

Assigned name: Wetland Co-ordinates: 33 14.258' S, 26 36.907' E Property: 241/0, Farm Tempe Owner: Makana Municipality	This wetland, in the north of the site is classified as an artificial (man-made) seep wetland by Nel *et al.* (2011) and provides a representative sample of a wetland and the area of Kowie Thicket on the site. This was buffered by 500 m. The wetland itself does not appear to be man-made, however it was also completely dry at the time of our visit. This may be due to the lack of rainfall experienced in the last few months in the area. The wetland was also littered with discarded tyres. There was evidence of substantial livestock grazing around the wetland. The thicket surrounding the wetland is virtually impenetrable and levels of alien (prickly pear) invasion is very high. Roughly 170 m northeast of the wetland are abandoned farm ruins, including buildings and kraals. The *Eucalyptus* trees around these ruins provide the best possible roosts for bats however the wetland itself would be an important foraging and drinking source, when full. Two farmsteads exist near this site, both classified as medium sensitivity in the preliminary map. These points were not checked for roosts. The nearby (~770 m) Ecca Local Authority Nature Reserve may affect sensitivity in the area but it has not previously been buffered.
Assigned name: 1 Co-ordinates: 33 14.431' S, 26 34.990' E Property: 241/0, Farm Tempe Owner: Makana Municipality	This point was provided by EDF. It falls in a high sensitivity zone due to the 500 m placed on the non-perennial source of the Brak River. It is roughly 200 m north of the ridge on which an MTN tower and reservoirs are located. IWS assessed the point and walked downstream for a few hundred metres until the gradient increases at a cliff-face. The river was not flowing however the channel was damp after recent rain. Despite not being sensitive from a waterbody perspective, the densely-vegetated channel and steep sides provide numerous roost potential for bats. Evidence of grazing was found however it is low with only small amounts of old dung found and only a couple of animal paths seen. The vegetation (Bhisho Thornveld unit) is in a healthy condition with high diversity of fynbos and grassland species and little to no alien vegetation present in the immediate surroundings.
Assigned name: AL_TP6	

<table>
<tr><td>Co-ordinates:
33 14.791’ S, 26 35.714’ E
Property: 241/0, Farm Tempe
Owner: Makana Municipality</td><td>This transect point is located next to reservoirs for the Makana Municipality. IWS has previously recorded some bat activity at this point
The reservoirs are covered and thus provide no drinking or foraging for bats, however, the bright orange lights (only one working at the time of visit, as seen in photo) next to the reservoirs attract insects at night which explains the presence of bats.</td></tr>
<tr><td>Assigned name:
2 and Dam</td><td rowspan="2">Point 2 was supplied by EDF. IWS assessed this point and further west through the valley to the edge of the property. IWS was not able to access the dam however it remains an important foraging and drinking source. The valley is gently sloped in the south and is bound by a steep densely-vegetated face to the north, leading up the ridge south of Point 1. This slope has high bat roosting potential.
The river itself is non-perennial and are the main channel of the Bothas River. The channel is densely vegetated with reeds, sedges and other hydrophilic flora, with very little open areas. The river was not flowing at the time of visiting.
Alien encroachment is high within the flood-line and the banks on the southern side of the river, with many young Acacia trees growing. At some parts, these are fully fledged trees where the river channel widens.
Another tributary of the Bothas River flowing north from the dam was assessed. This river was flowing with small pools evident and short, dense riparian vegetation present. The river falls partly outside of the boundary however the area falls within a high sensitivity zone due to the 500 m buffers on the dam and the streams. The stream is flanked by a shale ridge to the east which may provide some level of roosting potential for bats.
This area presents very high bat sensitivity. The presence of open water sources, riparian vegetation and the steep, densely vegetated cliffs make this area suitable for bat activity including foraging, roosting and a movement channel. The valley is also likely to be warmer than the higher-lying areas on either side of it. Placement of turbines on the ridges would be detrimental to bats in the area.
There is evidence of grazing and movement of cattle through the property.
The area upstream of Point 2 (near where the R67 crosses over the drainage line) has several wetlands which could be important bat habitats. These did have water in at the time of visit.
The kraals, homesteads, informal housing and Eucalyptus stand (DSCN2406) was given a 500 m buffer due to the high roosting potential in both the buildings and the trees.</td></tr>
<tr><td>Co-ordinates:
33 14.867’ S, 26 34.846’ E (2)
33 15.028’ S, 26 33.985’ E (Dam)
Property: 240/9, Farm Tempe
Owner: Makana Municipality</td></tr>
<tr><td>Assigned name:
Urban night point/UntitleHousing Activity</td><td>This area was buffered to the urban land of King Flats township. Most of the buildings are low-cost housing or informal buildings with little roosting potential, however, the large school provides a possible roost. The surrounding area is flat, with few trees.</td></tr>
</table>

Co-ordinates: 33 16.652' S, 26 35.182' E Property: RE/4807 Owner: Makana Municipality	A night driven transect was performed through the area after sunset with *N. capensis* bat detected near the school. The substation (north-west of the point), with its bright lights, is likely to attract insects and subsequently bats as well. EDF has stated that the land portion is 'servitude only' and it is unclear if any turbines will be placed here.
Assigned name: 3 Co-ordinates: 33 16.592' S, 26 37.935' E Property: 334/2, Farm Grobbelers Kloof Owner: Mr P. Wylie	The point was supplied by EDF to verify the high sensitivity zone. The point itself sits within a natural depression wetland which has been full on every one of IWS' visits. This wetland was buffered by 500 m. There are also another two farm dams along the N2, slightly further west of Point 3.
Assigned name: Upper Gletwyn- Cliffs Co-ordinates: 33 16.658' S, 26 37.451' E Property: 334/2, Farm Grobbelers Kloof Owner: Mr P. Wylie	The slopes south of the farm Upper Gletwyn descend steeply into the valley below. The one kloof, in particular, is very well vegetated with large indigenous trees and steep rocky cliffs, ideal for bat roosting. IWS however, did not have time to walk into the valley on this occasion, but will hopefully be able to assess this area on the next site visit. The valley floor comprises a mix of natural vegetation and cultivated areas.
Assigned name: Quarry 1 & Quarry 2 Co-ordinates: 33 15.937' S, 26 37.022' E Property: 233/3, The Orchards Owner: Mr A. Moss	The two quarries plus the water bodies both within them and the dam to the north of Quarry 1 could act as important bat foraging and drinking areas. These points were not buffered however they do fall within the 500 m high sensitivity buffer of the Bothas River nearby. The vegetation in the area is low fynbos with small shrub patches. A point night transect was conducted. No bats were recorded; however, it must be noted that the weather was cold, with a strong wind blowing. IWS may assess this site again on future visits.
Assigned name: River Ground-truth Co-ordinates: 33 16.489' S, 26 39.411' E Property: 581/0, Farm Allandale Owner: Mr B. Sweetman	This point was selected to assess the state of the Bothas River which has been buffered by 500 m on either side. The river itself has been dammed at many points and as a result does not flow perennially any longer. The riverbanks are completely invaded by dense *Acacia* alien vegetation, while other alien plants (*Pinus*, *Solanum*) are common in the stream channel. It is unlikely due to the alien vegetation and abstraction that natural ecological processes still persist in these reaches of the river. High bat activity has been recorded further downstream next to the farm dams and where the *Acacia* is less dense. The habitat is the same upstream (33 16.649' S, 26 40.314' E, Photos: Roost Search (7-10)) with extensive plantations on the fringes if the river.
Assigned name: Roost Search	

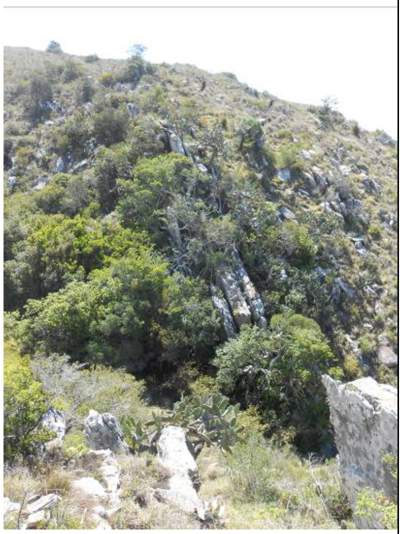
Co-ordinates: 33 16.693' S, 26 40.200' E Property: 235/0, Collingham Towers Owner: Mr J. Tarr	The farmhouse and surrounding buildings were checked for existing bat roosts. Only one gutter/hole (33.278635 S, 26.67167 E) had any evidence of bats, however, no bats were observed or recorded. The owner had only been on the property for a few days and was thus still unaware of any bat activity around the homestead. An *N. capensis* pass was recorded at night at the entrance to the property, 515 m south of the farmhouse. Two significant wetlands which have not been buffered (as they were not identified in any of the GIS data) exist next to the N2 highway at the southern end of the property and the adjacent farm. This is potentially an important bat habitat
Assigned name: Major Gorge West	A large gorge exists in the State Land 353 (previously Beggars Bush Nature Reserve) between points Major Gorge West and Major Gorge East (see below). Altitude ranges from 780 m to 480 m. The gorge comprises indigenous Southern Mistbelt forest, however, alien *Acacia* stands are present, particularly near the top of the gorge. The gorge is flanked be a steep cliff to the west and forested and grassy slopes to the north and east. This area present extremely high bat potential in ideal habitats. The nearby AL2 monitoring station shows that seven different species have already been recorded here. The gorge falls outside the WEF boundaries, however, it should be buffered and these buffers will affect the WEF portions. There are also several forested drainage lines west of this point which are smaller than the large gorge but still significant and may require buffers. They are currently classed as Medium-High Sensitivity.
Co-ordinates: 33 17.118' S, 26 40.584' E Property: Unknown Owner: Mr P. Wylie	
Assigned name: Major Gorge East	See 'Major Gorge West' for gorge description. IWS assessed the eastern edge of the gorge as well, however, the thick fynbos vegetation and steep slope made it difficult to get to the GPS point. We walked from AL2 to the edge of the ridge. The vegetation surrounding the kloofs comprises intact quartzite fynbos. The drainage line north of the ridge is choked-up with *Acacia* alien vegetation, however, all the slopes, cliffs and forests have high bat habitat suitability. There is evidence of low levels of grazing as well as old evidence of powerline infrastructure. The area now remains one of the most natural and undisturbed portions of the site.
Co-ordinates: 33 17.301' S, 26 41.421' E Property: State Land 353 Owner: SA Government	
Assigned name: Gorge Access/Parking	The riparian zones are largely dominated by *Acacia* alien vegetation. A 50 m buffer was placed on these streams and they are classified as Medium-High Sensitivity areas. They are likely to, as with any other vegetated riparian area, be a potential area of bat presence. The streams were flowing at the time of IWS' visit.
Co-ordinates: 33 17.227' S, 26 42.344 E Property: RE/1/663 Owner: Mlanjeni Cooperative/CPA	

17. Appendix D – Photographic Gallery from the Ground-truthing



Assigned name: Wetland





Assigned name: 1



Assigned name: 2 and 3

		
Assigned name: Urban		
		
Assigned name: Upper Gletwyn- Cliffs		
		
Assigned name: River Ground-truth		
		
Assigned name: Roost Searches		

		
Assigned name: Major Gorge East		
		
Assigned name: Major Gorge West		
		
Assigned name: Gorge Access		