Environmental Constraints Analysis with regards to bat (Chiroptera) sensitivity

- For the proposed Loeriesfontein Wind Energy Facility near Loeriesfontein, Northern Cape

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Terms of Reference

The Environmental Constraints Analysis aims to assess the sensitivity of the study area and undertake a desktop review of the site and surrounding area to identify bat species potentially present. A brief review of national and international literature on bat-wind farm interactions is also to be included, together with a desktop based Fatal Flaws Map indicating potential areas of bat sensitivity (to be reviewed in the detail phase assessment). Provide descriptions of the impacts and issues foreseen so far in relation to the proposed wind energy facility and its associating impacts. Draw up suggested terms of Reference for further work to assess/address the identified issues in the EIA full detail phase.

Appointment of Specialist

Animalia Zoological & Ecological Consultation CC was appointed by SiVEST Environmental Division to undertake a specialist Environmental Constraints Analysis bat sensitivity study for the proposed Loeriesfontein Wind Energy Facility near the town of Loeriesfontein, Northern Cape. The study was conducted by Werner Marais (CV available on request).

Independence:

Animalia Zoological & Ecological Consultation CC has no connection with the developer. Animalia Zoological & Ecological Consultation CC is not a subsidiary, legally or financially of the developer; remuneration for services by the developer in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project.

Applicable Legislation:

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

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; section 97): THREATENED OR PROTECTED SPECIES REGULATIONS:

All bats enjoy protection under this act. This act also calls for an environmental impact assessment for threatened and protected species.

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1. INTRODUCTION

1.1 Study Area

The site is located on portions of the farms Sous and Aan De Karree Doorn Pan close to the town of Loeriesfontein in the Northern Cape, totaling and area of approximately 30 105ha under consideration for the wind farm (**figure 1**). More precisely the site is located approximately 46km north of Loeriesfontein close to no major roads, mostly in grid square E19S30BC with a western section in E19S30AD and southern tip in E19S30DA. Several pans are situated 15-28km north and northeast of the site. Vegetation cover is very sparse and most of the site is flat with some drainage valleys in the southwestern part of the site and the Klein- and Groot Rooiberge starting approximately 5km south of the site (**figure 2**).

The proposed wind turbines will have a hub height of 60 to 120 meters, and a rotor blade diameter of 70 to 130 meters, with roads connecting the wind turbines and a service platform next to each turbine. The site will have a substation connecting to 132Kv or 66Kv overhead power lines, depending on the size off the wind farm. Turbines will be limited to buildable areas on the site which is determined by eliminating areas according to the following criteria: Slopes of more than 8 degrees; inland water bodies buffered by 100m; houses or buildings buffered by 500m; railways buffered by 200m; rivers buffered by 200m; buffers along a roads of 200m; boundary buffer around the site boundary of 200m; Buffers along electrical grid distribution or transmission lines of between 200m and 300m depending on the size of the line; and a substation buffer of 500m (**figure 3**).

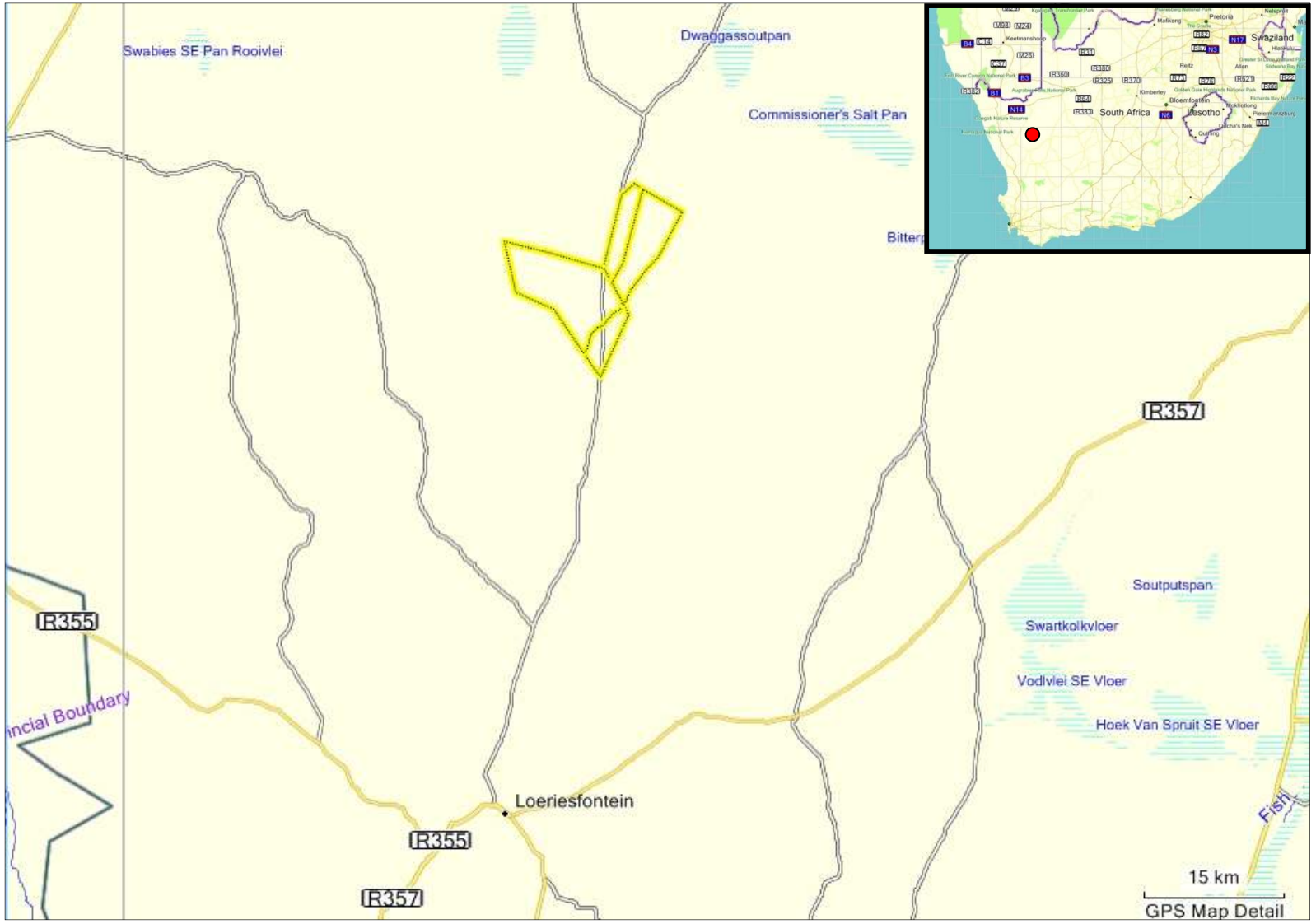


Figure 1: Map with an indication of the site (yellow outline), and an overview map with the approximate site locality (red dot).

Figure 2: Satellite image of the Loeriesfontein site, the boundary is indicated in red. All satellite images retrieved from Google Earth™.

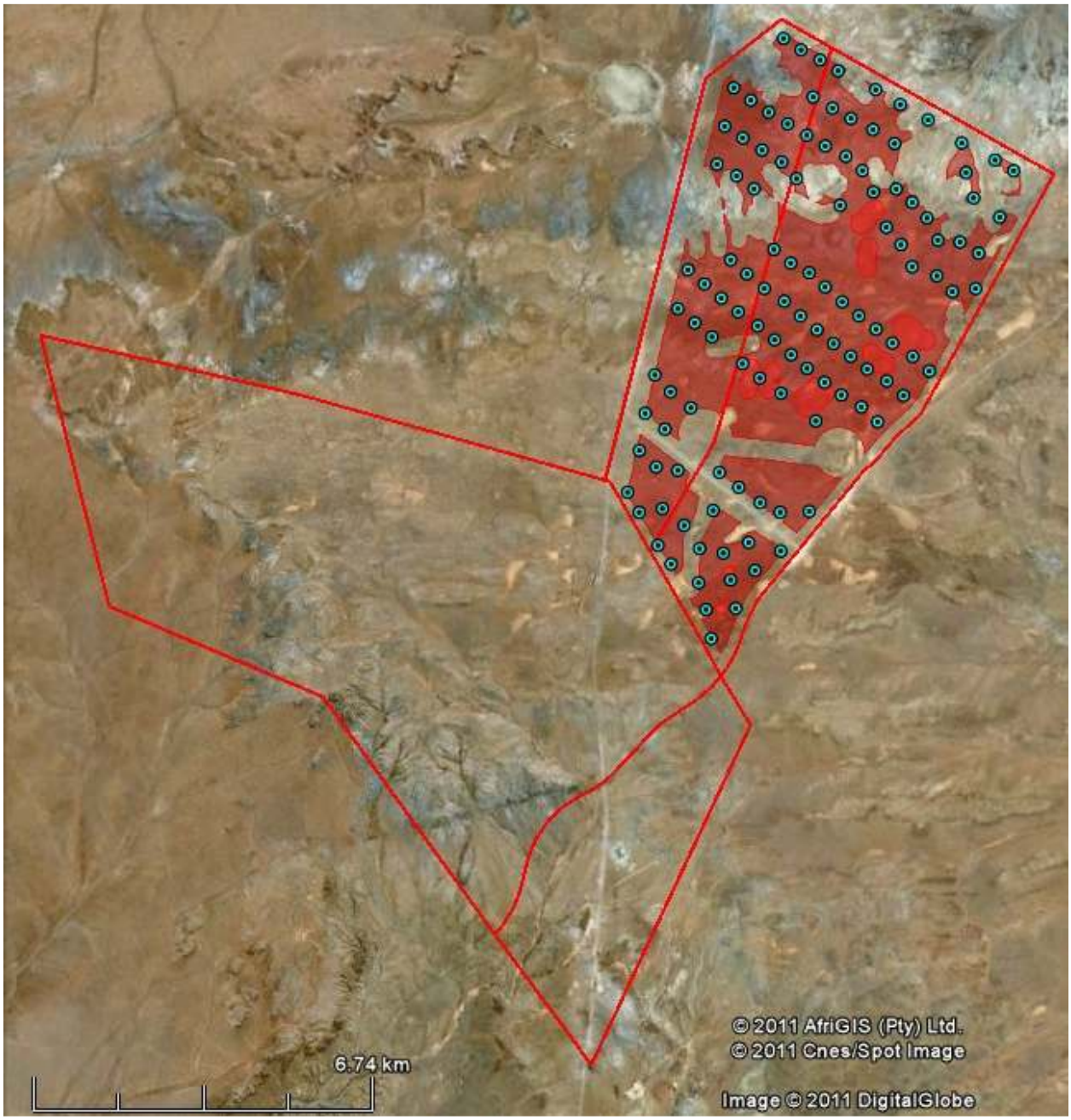


Figure 3: Satellite image of the site showing a portion where information was supplied on the buildable areas of that portion as well as the proposed wind turbine localities for the portion.

1.2 Land use and existing impacts on the study area

There is no direct impacts on the study area visible on the satelite images apart from farm buildings, and impact on natural vegetaion are probably only limited to livestock grazing as no ploughed fields can be observed.

1.3 Vegetation units, geology and climate

One vegetation unit is present on the study site (**figure 4**).

The Bushmanland Basin Shrubland is found in the Northern Cape Province between altitudes of 800-1200m. The landscape is comprised of slightly irregular plains with dwarf shrubland dominated by low sturdy and spiny shrubs. Surface rock cover is low compared to the Lady Grey and Noupoort sites and the rocks that are present is mainly mudstone and shales. Rainfall occurs in late summer and early autumn with an annual precipitation average of 100-200mm, and mean monthly maximum and minimum temperatures are 39.6°C and -2.2°C for January and July respectively. Status is Least Threatened with none of the unit currently statutorily conserved (target 21%), and no signs of serious transformation is present (Mucina & Rutherford, 2006).

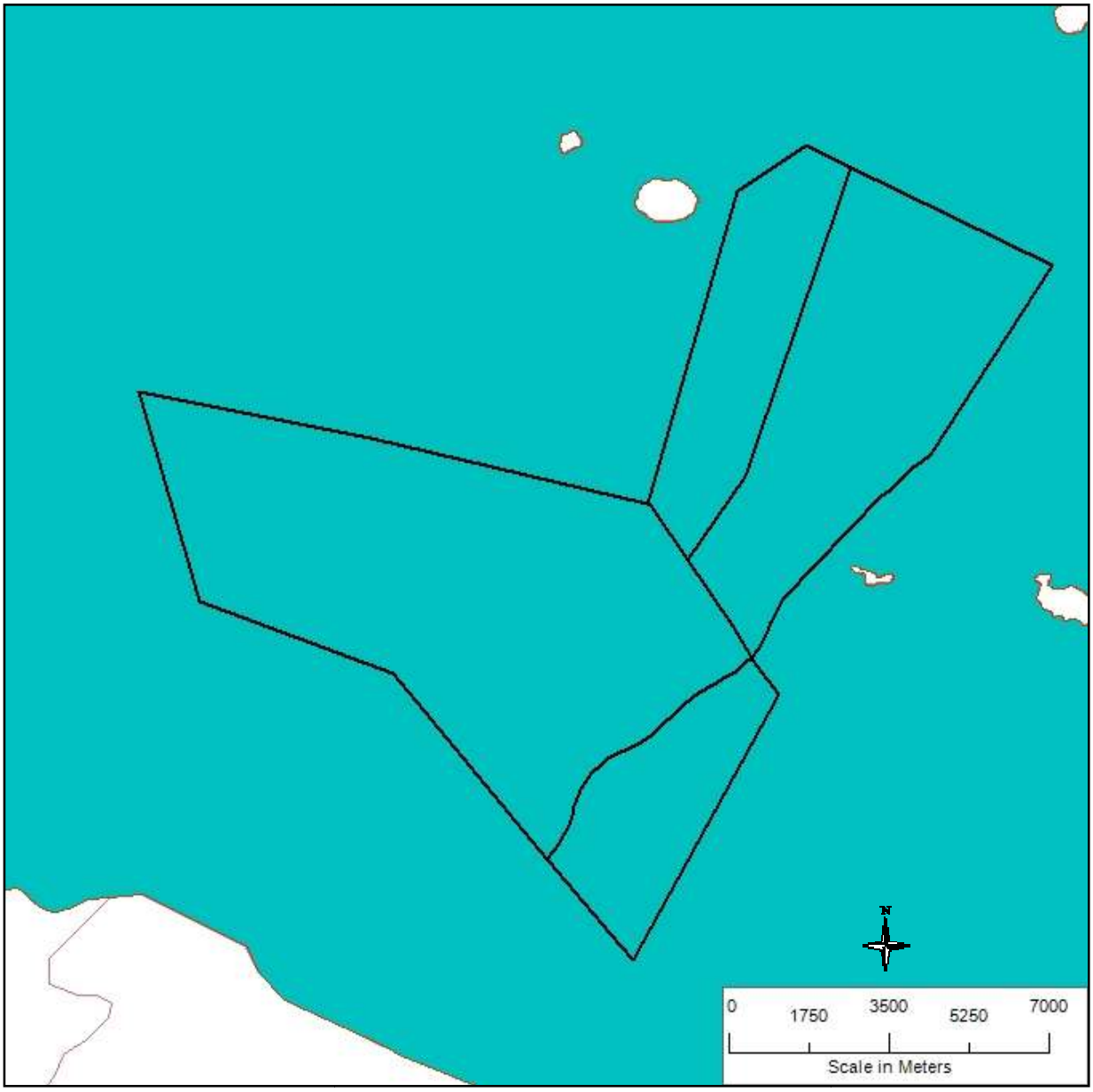


Figure 4: Vegetation unit present in the study area (Mucina & Rutherford, 2006).

1.4 The bats of South Africa

Bats are mammals from the order Chiroptera, and are the second largest group of mammals after the rodents. There are approximately 117 species of bats in the Southern African sub-region, of which 5 species have a global Red list status of Vulnerable and 12 are classified as Near Threatened (Monadjem, et al. 2010). More than 50 bat species occur in South Africa (Taylor, 2000; Monadjem, et al. 2010).

Bats are the only mammals to have developed true powered flight and they have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are dramatically reduced and shortened to lessen the total body weight. This unique wing support frame allows bats to alter the camber of their wings in order to adapt the wing shape to different flight conditions while maximizing agility and maneuverability. This adaptability and versatility of the bat wing surpasses the more static design of the bird wings and enables bats to utilise a wide variety of food sources and diversity of insects (Neuweiler, 2000). The facial characteristics between species may differ considerably to suit the requirements of their life style especially with regard to their feeding and echolocation navigation strategies. The majority of South African bats are insectivorous, and can consume vast numbers of insects on a nightly basis (Taylor, 2000; Tuttle and Hensley, 2001), but may also consume other invertebrates, amphibians, fruit and nectar.

Insectivorous bats are therefore the only major predators of nocturnal flying insects in South Africa and contribute greatly in the control of their numbers. Their prey also includes agricultural insect pests, such as moths and vectors for diseases such as mosquitoes (Rautenbach, 1982; Taylor, 2000).

Urban development and agricultural practices have contributed to the decline in bat numbers globally. Public participation and funding of bat conservation are often hindered by the negative images of bats created by a lack of knowledge and certain misconceptions about bats. The fact that some species roost in domestic residences also contributes to the negative reputation of bats. Some species may occur in large numbers in buildings and besides being a nuisance, may become a health risk to the residents. Unfortunately, the negative association people have towards bats, obscures the fact that they are an essential component of the ecology and by en large beneficial to humans.

Many bat species roost in large aggregations and concentrate in small areas. Therefore, any major disturbance to that area can adversely impact many individuals of a population at the same time (Hester and Grenier, 2005). Secondly, the reproduction rates of bats are much lower than those of most other small mammals, because usually only one or two pups are born per female annually. According to O'Shea et al. (2003), bats may live for up to 30 years. Under

natural circumstances, a population's numbers can build up over a long period of time, due to their longevity and the relatively low predation on bats, when compared to other small mammals. Therefore, the rate of recovery of bat populations is slow after major die-offs and roost disturbances.

1.5 Bats and wind turbines

Since bats have highly sophisticated navigation by means of their echolocation, it is puzzling as to why they would get hit by rotating turbine blades. It may be theorized that under natural circumstances their echolocation is designed to track down and pursue smaller insect prey or avoid stationary objects, not primarily focused on unnatural objects moving sideways across the flight path. Apart from physical collisions, a major cause of bat mortality at wind turbines is barotrauma. This is a condition where the lungs of a bat collapse in the low air pressure around the moving blades, causing severe and fatal internal hemorrhage. One study done by Baerwald, *et al*. (2008) showed that 90% of bat fatalities around wind turbines involved internal hemorrhaging consistent with barotrauma.

Some studies propose that bats may be attracted to the large turbine structure as roosting space, or that swarms of insects get trapped in low air pockets around the turbine and subsequently attract bats.

Whatever the reason for bat mortalities around wind turbines, the facts indicate this to be a very serious and concerning problem. During a study by Arnett, et al. (2009), 10 turbines monitored over a period of 3 months showed 124 bat fatalities in South-central Pennsylvania (America), which can cumulatively have a catastrophic long term effect on bat populations, if such a rate is persistent. Most bat species only reproduce once a year, bearing one young per female, meaning their numbers are slow to recover. Mitigation measures are being researched and experimented with globally, but are still only effective on a small scale. An exception to this is a mitigation measure called curtailment, where the turbine cut-in speed is raised to a higher wind speed. This relies on the fact that bats will be less active in strong winds and therefore less likely to be impacted by a moving turbine blade, however this mitigation is not as effective yet to move this threat to a category of low concern.

2. Methods

Three factors need to be present for most South African bats to be prevalent in an area: availability of roosting space, food (insects/arthropods or fruit), and accessible open water. However, the dependence of a bat on each of these factors depends on the species and its biology, and different species of bats make use of different types of roosting spaces. But nevertheless if all three of these factors are very common in an area the bat activity and abundance will also most likely be higher.

Concerning species of bats that may be impacted by wind turbines, the four sites Lady Grey, Noupoort, Prieska and Loeriesfontein were evaluated by comparing the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces), climate (can influence insect numbers and availability of fruit), and presence of surface water (influence insects and act as drinking water for bats). Species probability of occurrence based on above mentioned factors and distribution maps were also estimated for each site and the surrounding larger area.
These comparisons were done mainly by studying the geographic literature of each site and satellite imagery, as well as personal bat experience with some of the terrain types.

3. RESULTS

3.1 Species probability of occurrence

Table 1: Table of species that may be roosting on the study area, the possible site specific roosts, and their probability of occurrence. LC = Least Concern; NT = Near Threatened; V = Vulnerable; DD = Data Deficient (Monadjem *et al.*, 2010).

Species	Common name	Probability of occurrence	Conservation status	Possible roosting habitat to be utilised on study area
Rhinolophus capensis	Cape horseshoe bat	Low	NT	Roosts gregariously in caves, no known caves close to the study site.
Rhinolophus clivosus	Geoffroy's horseshoe bat	Low	LC	Roosts gregariously in caves, no known caves close to the study site.
Nycteris thebaica	Egyptian slit-faced bat	High	LC	Cavities, aardvark burrows, and culverts under roads. Any suitable hollows
Tadarida aegyptiaca	Egyptian free-tailed bat	High	LC	Crevices, buildings, rock crevices. Very common and adaptable.
Cistugo seabrae	Angolan wing-gland bat	Medium - High	NT	Endemic to West Coast, restricted to arid climates (semi-desert), netted in dry river beds.
Miniopterus natalensis	Natal long-fingered bat	Low	NT	Roosts gregariously in caves, no known caves close to the study site.

Neoromicia capensis	Cape serotine	Medium	LC	Under bark of trees and roofs of buildings. Common and adaptable

3.2 Larger area around site

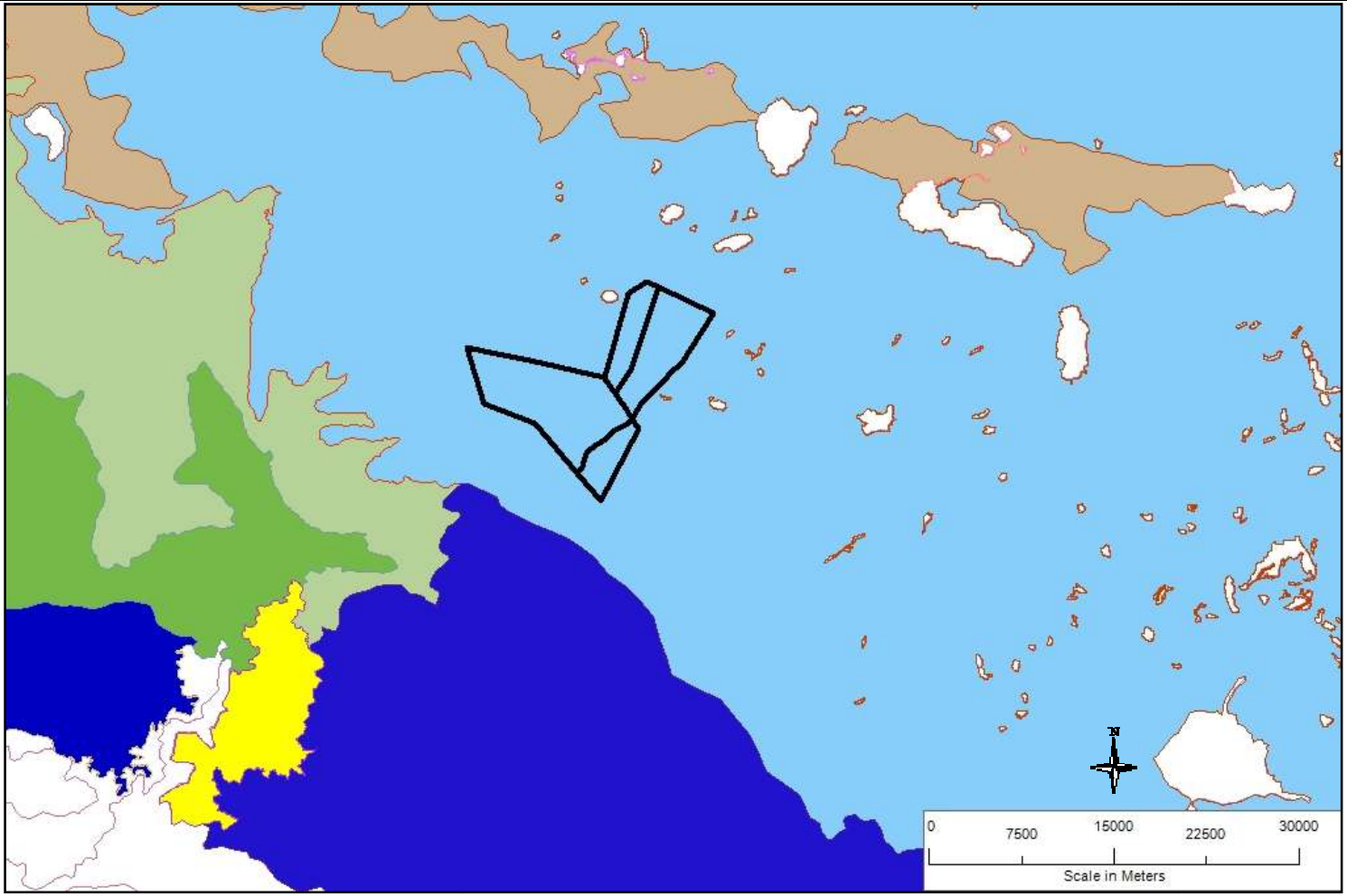


Figure 5: Vegetation units of the larger study area (Mucina & Rutherford, 2006).

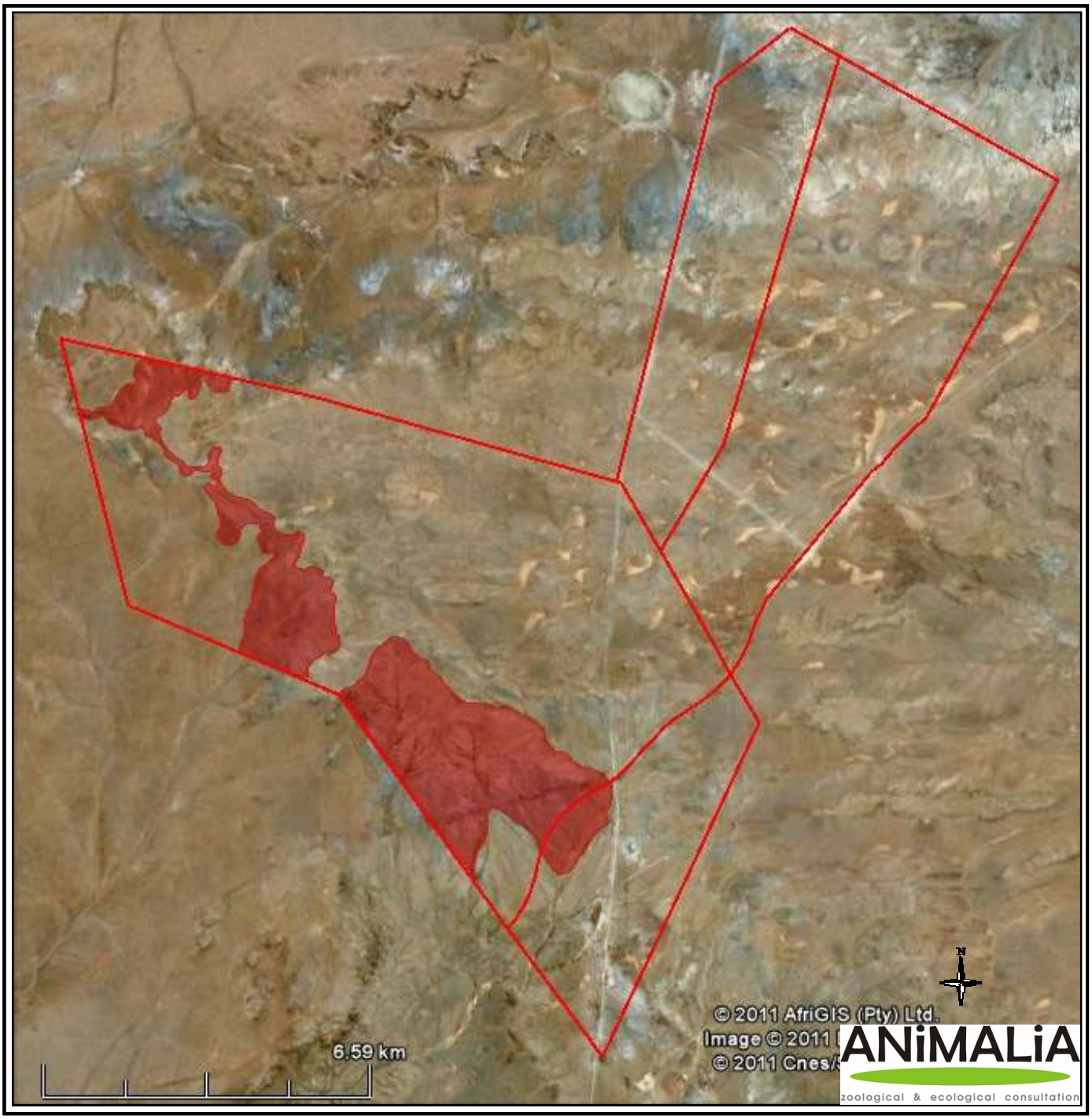
In general the larger area around the site (approximately 30km radius) is dominated by vegetation units with relatively similar characteristics as the unit present on the site. Although the Namaqualand Klipkoppe Shrubland can offer some bat roosts, this unit is almost 30km away from the site.

3.3 Surface rock, topography, climate, surface water and vegetation

The Loeriesfontein site is overall very flat with some mountainous terrain in the far south western part, and the mean annual precipitation is very low compared to the Noupoort and Lady Grey sites. Some pans are present in the north eastern part and dry stream beds in the south western. These streams are seasonal and can only provide limited surface water for bats.

The mountainous terrain in the south west can offer bat roosting space (**figure 6**). From a vegetation point of view the natural vegetation of the site does not offer any roosting space, and no farm buildings are visible on the site.

3.4 Desktop based fatal flaws map/sensitivity map – Figure 6



In **figure 6** the areas where natural bat roosting space may be available have been marked as sensitive (red shading), and includes the mountainous terrain in the south west. For the purpose of this study a buffer of 100 meter around inland water bodies and 200 meter around rivers is appropriate, this is the same buffers used for determining the buildable area of the site and is therefore not indicated in figure 6.

Although there are no South African guidelines for the consideration of bats in relation to wind farm developments, however, international guidelines such as the Eurobats Guidance and the Natural England Technical Note (Mitchell-Jones & Carlin 2009) give some indication of buffer zones which may be applicable. The Eurobats Guidance (Rodrigues et al. 2008) proposes a minimum distance of 200m to forest edges where tree felling is necessary to establish a wind farm. The Natural England Interim Guidance suggests a 50 meter buffer from blade tip to the nearest feature important to bats.

It is important to note that this Environmental Constraints Analysis sensitivity map is not intended to govern the ideal locations of wind turbines with regards to bat sensitivity, but rather to highlight areas that will require special attention during the full detail phase assessment, although the areas not marked with a high sensitivity should still be monitored.

4. FORESEEN IMPACTS OF THE PROPOSED OPERATION and PROPOSED TERMS OF REFERENCE FOR ASSESSING/ADDRESSING THE ISSUES

4.1 Bat mortalities due to blade collisions and barotrauma during foraging

In section 1.5 the concern of bats and possible wind turbine blade collisions/barotrauma have been mentioned, but yet international research and experiments are unable to suggest sustainable large scale mitigation measures that can move this threat to a category of no concern.

Suggested Terms of Reference for assessing/addressing the issue

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area. Therefore it is proposed that areas of high bat activity be identified in a detailed assessment and these areas preferable be avoided in turbine placement, additionally areas should be identified where special monitoring and implementation of mitigation measures be prioritized.

4.2 Bat mortalities due to blade collisions and barotrauma during migration

The migration paths of South African bats in the Cape Provinces are virtually unknown. Cave dwelling species like *Miniopterus natalensis* and *Myotis tricolor* undertakes annual migrations, although no caves are known to be in close proximity to the study area.

Suggested Terms of Reference for assessing/addressing the issue

Nevertheless, it will be beneficial to collaborate with academic institutions to promote research on the subject, doing affordable long term monitoring and quantifying the risks more accurately.

4.3 Destruction of foraging habitat

Some foraging habitat will be destroyed by the construction of the turbines and associated infrastructure. This impact will be effective during the lifespan of the wind farm.

Suggested Terms of Reference for assessing/addressing the issue

Areas of high bat foraging activity should be identified and these areas be treated with more caution.

4.4 Destruction of roosts

During the construction phase of the project bat roosts may be significantly impacted by earthworks and large machinery. Diggings related to the placement of underground cables can also damage bat roosts.

Suggested Terms of Reference for assessing/addressing the issue

All diggings and earthworks must be kept to a minimum especially in rocky outcrop areas, and blasting should be minimized.

5. CONCLUSION

The areas designated as sensitive must be treated as sensitive, implicating that no turbines are allowed to be placed in this zone due to the possible impacts it can have on bat mortalities.

The Loeriesfontein site displays only one factor of the three important factors relatively strongly, and this is possible roosting space, but also only in the south western part of the site. Surface water and probability of insects are low, suggesting that the site is likely to have aa lower bat activity than Lady Grey and Noupoort but possibly higher or equal to Prieska. In **Table 1** it can be seen that a total of 7 bat species may occur on the site and 3 have a high probability of occurring on the site, with 2 of them having a chance of being severely impacted by wind turbines (high aerial foragers). From a desktop bat sensitivity point of view the Loeriesfontein site is **recommended** as one of the two best sites for the wind farms.

The sensitivity map indicated in **Figure 6** should be treated as guidance for directing focus and special attention during future detailed assessments and preliminary decision making for comparing this site to the other three potential sites, it is not intended to govern final decision making with regards to sensitive bat habitat. The proposed Terms of Reference for further detailed studies described in Section 4 should be carried out in the detailed assessment phase.

6. REFERENCES

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