ENVIRONMENTAL IMPACT ASSESSMENT: RIVERINE RABBIT SPECIALIST REPORT.

TAAIBOS SITE NEAR LOXTON, NORTHERN CAPE PROVINCE

OCTOBER 2022

Compiled for:

WKN Windcurrent South Africa (Pty) Ltd

Compiled by:

Bohemian Scientist

Christy Bragg, Pr.Sci.Nat (Ecology and Zoology)

Zoe Woodgate (Ecological Science)

Aliénor Brassine, Pr.Sci.Nat. (Ecological Science)

SPECIALIST DECLARATION

I, Christy Bragg, as the appointed independent specialist, in terms of the 2014 EIA Regulations, declare that:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have, and will not have, any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of Specialist: Christy Bragg

Date: 20 October 2022

Note: this report was co-authored with Zoe Woodgate and Aliénor Brassine. They too adhere to the principles listed above.

SUMMARY OF EXPERTISE – CHRISTY BRAGG

Christy Bragg has had over 10 years of experience with the conservation and research of the riverine rabbit, and is one of the few experts understanding the habitat characteristics and behaviour of the species. Christy has a MSc in Conservation Biology and has over 20 years' experience in academic research, monitoring and evaluation, climate change adaptation, ecosystem restoration, and environmental management. Her reports include at least 40 EIA specialist terrestrial ecology reports on various developments, including mining, renewable energy, residential and dam developments, examples of which include:

- Collins, K., Bragg, C. & Birss, C. 2019. *Bunolagus monticularis. In:* The IUCN Red List of Threatened Species 2019: e.T3326A45176532. http://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T3326A45176532.en. SANBI; the Endangered Wildlife Trust.
- *Bunolagus monticularis*. In: (Eds) Andrew T. Smith, Charlotte H. Johnston, Paulo C. Alves, and Klaus Hackländer Lagomorphs**:** Pikas, Rabbits, and Hares of the World. John Hopkins University Press.
- Christy Bragg and Marie Parramon-Gurney. 2013. National, Regional and Local Biodiversity Assessment of the South African Operations of Altron, in Compliance with the Global Reporting Indicators. Prepared for Altron. Cape Town, SA by the Endangered Wildlife Trust.
- Christy Bragg. 2014. Specialist Riverine Rabbit Survey. Proposed Harpuisberg Wind Energy Facility. Prepared for Windlab. Endangered Wildlife Trust's Drylands Conservation Programme.
- Christy Bragg. 2014. Specialist Riverine Rabbit Survey. Proposed Harpuisberg Wind Energy Facility. Prepared for Windlab. Endangered Wildlife Trust's Drylands Conservation Programme.
- Bragg, CJ; Paxton, BR; Shelton, JM; Bovim, L and Dallas HF. 2017. Freshwater Fishes of the Cape Fold Ecoregion and Climate Change: Volume 2: Policy Uptake Strategy. Prepared on behalf of the Table Mountain Fund by the Freshwater Research Centre. Pp. 14.
- Bragg, C. The Green Connection. 2010. Building the Resilience of Small Businesses and Projects to Climate Change: Adaptation of SKEPPIES nature-based enterprises in Namaqualand, South Africa. Cape Town: The Green Connection NGO.
- Bragg, C., Stanford, R., McDaid, L., Dramat, B. Munro, L. 20. Environmental Impact Assessment and Review: SUBTHEME 6: Representative demographics within service providers and civil society: the Green Connection. Written for DEA.
- The Green Connection. Input into the World Bank Energy Strategy Consultative Process- 2010: Best Practice Models for Energy Related Projects. BIC, Cape Town, SA.
- Contributor to the Water Research Commission-funded University of Free State report: Potential Environmental Impacts of Fracking in South Africa: Small and Large Mammals chapter.
- GIZ. 2018. Authors: Knowles, T., Bragg, C.J., and Amend, T. 2018. Entry Points for Mainstreaming Ecosystem-based Adaptation. The Case of Sudafrica. Alejandra Calzada Vázquez Vela (ed). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn.
- Bragg, C.J., Paxton, B.R. 2018. Realising the Ecological Reserve in a Time of Change: 20 Years On. Summary Report. 27 February 2018, Pretoria National Botanical Gardens. FRC and partners.
- Bragg, C.J. 2021. A preliminary desktop feasibility study on the Riverine Rabbit for two potential Areas of Interest: Sutherland and Loxton. Prepared for Windcurrent (Pty) Ltd.

SUMMARY OF EXPERTISE – ZOE WOODGATE

Zoe Woodgate recently completed her PhD at the University of Cape Town, with her thesis focusing on identifying drivers of species' distributions in the Karoo, South Africa. She worked extensively on riverine rabbit populations present throughout the Western Cape, using novel camera trap methodology and statistics to discover previously unknown details about their ecology and occurrence. She has extensive data analysis experience.

SUMMARY OF EXPERTISE ALIENOR (ELEANOR) BRASSINE

Aliénor is a professional registered Ecologist with SACNASP (Registration Number: 116197) and holds an MSc degree (Zoology) from Rhodes University. Aliénor has been involved in fauna and avifauna surveys for renewable energy projects since 2015. Her main work focus is the use of camera traps to monitor wildlife populations, including designing and implementing species-specific camera trapping surveys for rare and cryptic species. She has extensive field experience across southern Africa and particularly within the Northern Cape. Aliénor has contributed to both the faunal and avifaunal aspects of the Taaibos and Soutrivier sites and has spent a cumulative total of 76 days over the last two years on both these sites. Aliénor is contributing to the Species of Conservation Concern aspects of these projects including the assessment and surveys for the Riverine Rabbit.

Contents

1 INTRODUCTION

WKN Windcurrent South Africa (Pty) Ltd is proposing to develop a wind farm on a ~162km^2 site ('Taaibos') situated approximately 15km south–east of Loxton, in the Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape. The Bohemian Scientist and associates were appointed to provide specialist input on the critically endangered Riverine Rabbit (*Bunolagus monticularis*). An EIA report was requested by the developer to determine the potential impact of the proposed Wind Energy Facility on the riverine rabbit.

The riverine rabbit's presence has been closely associated with the Karoo's seasonal drainage lines (Duthie et al., 1989), which are characterised by higher plant biomass that offer greater structural complexity important to the local fauna (Dean & Milton, 1999). These drainage lines, and associated fertile soils, are also preferred by farmers for short rotation fodder crops (e.g., lucerne, Ncube, 2018), and are heavily impacted by livestock seeking both shelter and food (Collins & du Toit, 2016, Eccard *et al*. 2000). Consequently, the riverine rabbit population is thought to be decreasing based on perceived and assumed threats linked to these riparian zones (Collins & du Toit, 2016). These threats include the ongoing habitat degradation (Hughes et al., 2008), traditional hunting with dogs by farm workers (Ahlmann et al., 2000), climate change (Collins & du Toit, 2016) and catastrophic stochastic events (e.g., floods and disease; Alhmann *et al*. 2000).

The purpose of this specialist report is to describe and detail the ecological features of the proposed wind farm site relevant to riverine rabbits, to provide an assessment of the ecological sensitivity of the affected area and identify the likely impacts on riverine rabbit populations that may be associated with the development of the wind farm and associated infrastructure. Four site visits and two camera trap surveys (detailed in Section 2.3), as well as a desktop review of the available ecological information for the area, were conducted in order to identify and characterise the site's abiotic and biotic features. This information was used in conjunction with the initial desktop sensitivity study (Bragg 2021) to derive a more detailed map to evaluate the habitat suitability for the species within the AoI. Furthermore, this report aims to understand the potential presence, abundance and distribution of the Riverine Rabbit and, through this, assess the ecological constraints for the development.

2 METHODOLOGY

Scope of Study

The scope of the study includes the following activities

- a description of the environment that may be affected by the activity and the manner in which the environment and the riverine rabbit may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts (incl. using direct, indirect and cumulative impacts) that have been identified that are relevant to the riverine rabbit
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- an indication of the methodology used in determining the significance of potential environmental impacts

- an assessment of the significance of direct, indirect and cumulative impacts in terms of the following criteria (as guided by CES' Impact and Risk Assessment Methodologies):
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected;
    - the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international ;
    - the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0-5 years), medium-term (5- 15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or Permanent;
    - the probability of the impact, describing the likelihood of the impact occurring, indicated as Unlikely (improbable), May Occur (low likelihood), Probable (distinct possibility), or Definite (Impact will occur regardless of any preventable measures) ;
    - the severity/beneficial scale indicating whether the impact will be Very Severe/Beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit) Severe/Beneficial (long-term impact that could be mitigated/long-term benefit), Moderately Severe/Beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), Slight or have no effect;
    - the significance which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
    - the status which will be described as either positive, negative or neutral;
    - the degree to which the impact can be reversed;
    - the degree to which the impact may cause irreplaceable loss of resources
    - the degree to which the impact can be mitigated;
- a description and comparative assessment of all identified feasible alternatives
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr)
- an indication of the extent to which the impact could be addressed by the adoption of mitigation measures
- a description of any assumptions, uncertainties and gaps in knowledge
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity;
    - a comparative assessment of the positive and negative implications of identified alternatives

General Considerations:

- Disclose any gaps in information or assumptions made
- Identify recommendations for mitigatory measures to minimise impacts
- Outline additional management guidelines.

- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP)
- A description of the potential impacts of the development and recommended mitigation measures are to be provided which will be separated into the following project phases:

    - Construction
    - Operational Phase
    - Decommissioning

The following scope is therefore to be assessed:

- A description of the broad ecological characteristics of the site and its surrounds and the suitability for riverine rabbits
- Legal review, including local regulatory requirements, IFC Performance Standards and other relevant local and international regulations, including permit requirements
- Undertake a riverine rabbit survey to describe the baseline faunal characteristics of the affected area and place this in a regional context
- Provide a detailed baseline assessment using primary and secondary data
- Compile a sensitivity map depicting the distribution of the species, habitats and sensitive biological areas
- Comment on faunal sensitivity in terms of Red Data Sensitivity Index Score of species, habitats, ecological corridors and linkages with other ecological systems on and adjacent to the site
- Describe the existing impacts of current land use as they affect the fauna
- Describe and assesses the impact to the terrestrial fauna present in the area
- Assess the cumulative impact of development with current and planned developments in the area

Assessment Approach & Philosophy

The assessment will be conducted according to the EIA Regulations as published by the Department of Environmental Affairs in 2014, and within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

This includes adherence to the following broad principles:

- That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.
- Demonstrate how the proponent intends complying with the principles contained in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should in

order of priority aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;

- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;
- Control and minimise environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA. The following principles are relevant to this study. [Please note that this report does not cover Fauna and Flora Biodiversity, except in terms of how these relate to the risks to the riverine rabbit and its use of the landscape.]

Species level

- Red Data Book species (giving location if possible using GPS)
- The viability of an estimated population size of the RDB species that are present (include the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of process, the following will be identified or described:

The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.

- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and vegetation boundaries such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.

- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

2.1 Data sourcing and review

Data sources from the literature consulted and used (where necessary) in this study include the following:

Vegetation

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (2018 update).

Ecosystem

- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011) as well as the 2018 NBA.

Riverine rabbit & fauna

- The conservation status of mammals is based on the IUCN Red List Categories (EWT/SANBI 2016).
- Historical riverine rabbit sightings (Figure 1) were provided by the Endangered Wildlife Trust's Drylands Conservation Programme.
- Scientific reports and/or journal articles consulted and used were sourced online through open access or the University of Cape Town's digital databases

2.2 Initial desktop assessment

An initial desktop study was conducted to produce an initial ecological sensitivity map, delineating all riparian zones throughout the site. This was done using online satellite imagery (Google satellite [2021]). The identified riverine areas were thereafter sub–divided into units, which were rated in accordance to the following sensitivity scale:

- **Low** – Areas of natural or transformed habitat with a low sensitivity, where there is likely to be a negligible impact on local riverine rabbit populations. Infrastructure development can proceed within these areas.
- **Medium** – Areas of natural or transformed land where the impacts of any infrastructure development are likely to be largely localised. Development within these areas can proceed with relatively little impact, provided that appropriate mitigation measures are put in place.
- **High** – Areas of natural or transformed land where a high potential impact is anticipated, as they may contain important riparian habitat for riverine rabbits. Development within these areas is undesirable. If unavoidable, development should only proceed with caution as it likely not be possible to mitigate all impacts.
- **Very High** – Critical habitat for the riverine rabbit. These are 'no–go areas' from a developmental perspective, and should be avoided.

2.3 Site assessment

The site visit was conducted in two phases: an initial assessment of habitat suitability, informed by the desktop study, and a secondary camera trapping study. The site was visited on four occasions by Aliénor Brassine to undertake the camera trap surveys. Aliénor was given pre–site training by Christy Bragg on the characteristics of suitable riverine rabbit habitat Camera trap surveys were conducted from November 2021 – January 2022 and a repeat survey was conducted after the good rains; March – May 2022.

Habitat suitability

The AOI was first visited in November 2021, where all areas identified at a desktop level were visited and their suitability to support healthy riverine rabbit populations assessed (Figure 2). Although no formal assessment protocol exists, there are key indicators of habitat suitability that apply throughout the Nama–Karoo, which include: an alluvial floodplain area large enough to support the territory of the rabbit, specific plant species composition, a matrix of grass and shrubs, level of disturbance and cover, and how these traits vary to create different levels of suitability or habitat quality. Potentially suitable areas were photographed and given a habitat suitability score, ranging from 0–100%.

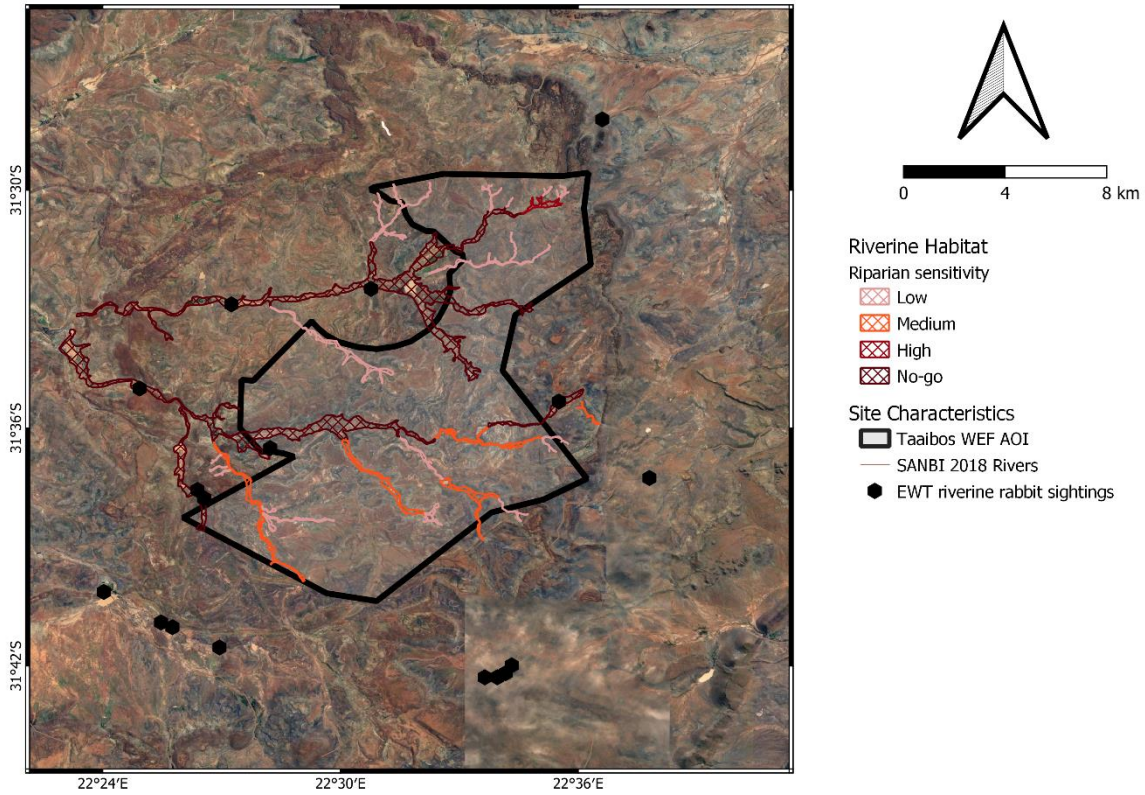

Figure 1: Ecological sensitivity map, colour coded by the sensitivity scale (see section 2.2), indicating the suitability of habitat for potential riverine rabbit populations. Location of the proposed Taaibos AOI (polygon encased by the black border) and historical riverine rabbit (*Bunolagus monticularis*) sightings are indicated by the black hexagons.

Camera trapping

The EWT DCP has successfully utilised remote camera trapping to detect and monitor a number of riverine rabbit populations throughout the Karoo. Camera traps were therefore used extensively throughout the site in this study to establish the presence or absence of riverine rabbit populations and to characterise the fauna of the site more generally. A total of 40 Camera traps were used; 39 Browning Trail Cameras (Command Ops ELITE: model number BTCX–4EX) and 1 Bushnell HD Infrared were deployed. Due to the scarcity and nocturnal nature of the target species, Cameras with infrared LEDs were preferable to standard flash, as white flashes have been shown to impact species' detectability (Larrucea et al., 2007). All cameras were mounted on metal stakes at a height of approximately 30 – 40cm above the ground. A 30s delay was programmed between successive photographs and the sensor sensitivity set to high.

Sites were selected using a random stratified design across the riverine areas present in the site and were distributed throughout the three main riverine rabbit sensitivity zones (as previously identified by Christy Bragg [namely: Low, Medium, High; figure 2]). Within these sites, cameras were placed where there were signs of animal activity (e.g. intersecting trails of a diameter suitable for lagomorphs) to maximise detection of riverine rabbits. Cameras were placed randomly within each sensitivity unit. All cameras were operational for a minimum of 40 days. The camera placement was submitted for comment, suggested edits were made, and the grid approved by the Riverine Rabbit Programme staff at the EWT.

Cameras were active from November 2021 to January 2022. SD cards were only retrieved from cameras at the end the study to minimise human disturbance in the study area (Larrucea et al., 2007). Photographs of the same species were only considered independent if captures were taken >30 minutes apart or were obviously of a new individual (given unique markings or other features that allowed the image to be classified as independent). An independent camera trap night was defined as a 24hr period that begins at 00:00 and ends at 23:59 (Meek et al., 2014). All independent photographs of riverine rabbits were extracted for further analyses.

After anomalously heavy rainfall occurred a second survey was undertaken using roughly the same grid, but with some adjustments to avoid flooding rivers and to check patches of suitable habitat not captured in the first randomized grid. It was considered necessary, given the suitability of the habitat, the proximity of historical sightings and the possibility of influxes of the species after the drought-breaking rains to redo the survey. A total of 18 camera traps were placed at sites which were ranked with high habitat suitability. Cameras were active from March 2022 to May 2022 for a minimum of 40 days.

2.4 Sensitivity mapping, assessment and buffers

A final ecological sensitivity map was created by integrating the results of the site visits (including camera trapping surveys) with the available ecological and biodiversity information in the literature and initial desktop assessment described above.

3 RESULTS

3.1 Site assessment

Habitat suitability

Historically, riverine rabbits had been sighted at three separate locations within the site and in the general area: 31° 32' 29.26"S 22° 30' 46.15"E; 31° 36' 30.33"S 22° 28' 13.56"E. and 31° 32' 48.84"S 22° 27' 13.139"E (Figure 1, S.2). These sightings were all within the riparian zones of the two main drainage lines, each of which are roughly 400–500m in diameter (although they may be as small as 100m). These riparian zones were considered to largely consist of healthy habitat that may support riverine rabbit populations (>20 individuals) and were subsequently demarcated as High sensitivity (Figure 2, S.2). The two High sensitivity drainage lines do not have any significant landscape connectivity within the AOI, although they connect approximately 12km east of the site. There are a few minor drainage lines and washes present throughout the southern and northern portions of the study site. These are secondary drainage lines and consist of poor habitat (degraded largely as a result of drought and associated overgrazing by domestic livestock), and thus were deemed to be of either Medium to Low sensitivity (Figure 2, S.2).

Camera trapping

During the first phase 3 cameras were determined as being placed in High Sensitivity areas, whilst 20 in Very High sensitivity areas (Figure 1, 2). However, on–site assessments suggest that 14 cameras were located in areas with a habitat suitability score less than 15%, 9 between 15 – 29% and 17 above 30% and where thus categorized as either more than 40% or less than 40% habitat suitability (Figure 2).

The final dataset resulted in a total of 105 208 non–blank photographs. One camera was disturbed due to disturbance by select species (e.g., baboons and sheep), extreme weather conditions (hail and flooding) or human interference. Overall, 28 species from 14 families of mammal species (>0.5kg) were recorded (Table 1). Riverine rabbits were not detected at any of the 40 sites, despite the high density of cameras within the riparian areas identified as being potentially suitable for this species and the extended (>45 day) length of the survey. The failure to detect the species where it could be reasonably expected to occur led to the implementation of a second survey from March to May 2022 targeting higher suitability sites. This survey, of 18 cameras, resulted in a total of 16 220 non–blank photographs. Two cameras were disturbed due to disturbance by select species (e.g., baboons and sheep), extreme weather conditions (hail and flooding) or human interference. Overall, 15 species from 12 families of mammal species (>0.5kg) were recorded. One camera trap detected the presence of riverine rabbit in a large patch of suitable habitat in the southern large drainage line (Figure 3). No other new species where detected.

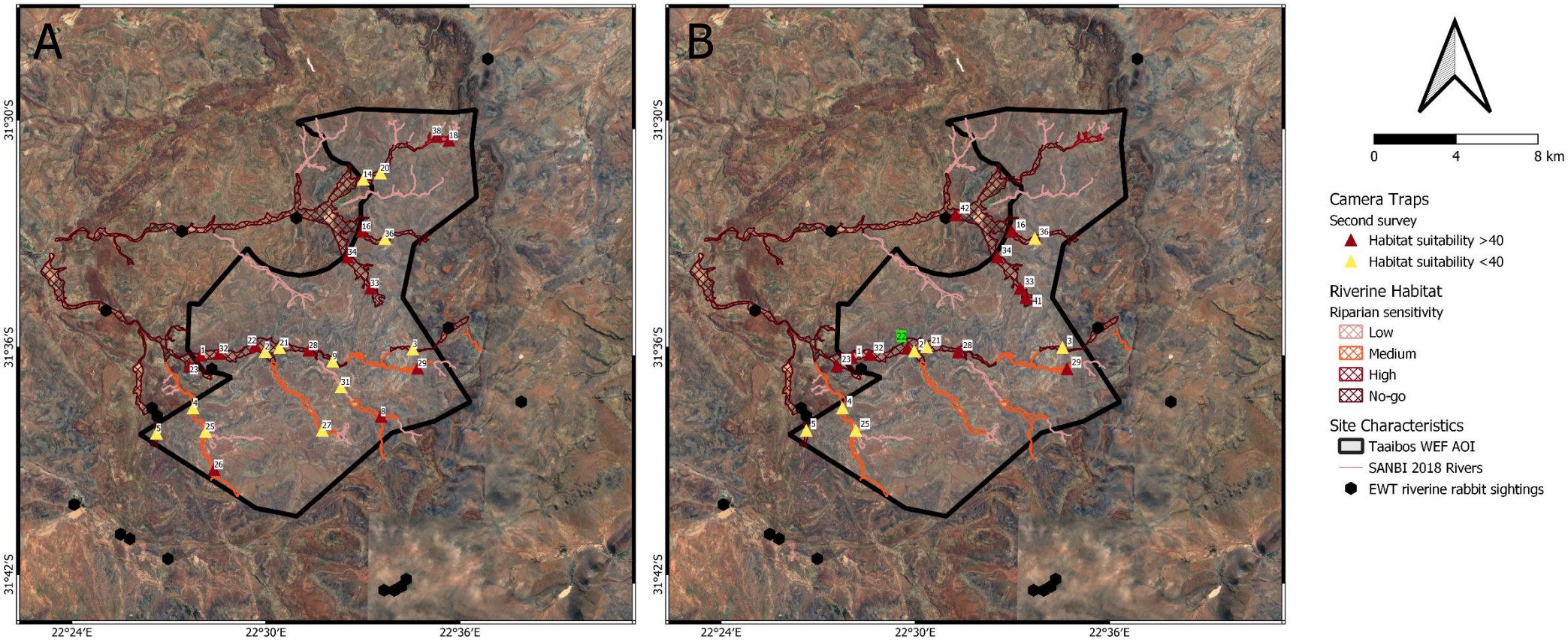

Figure 2: Location of cameras in the Taaibos AOI during both survey periods. Camera trap sites are colour coded to represent riverine rabbit habitat suitability (See section 2.2). Map A shows camera trap locations between November (2021) and January (2022). Map B shows camera trap locations between March and May (2022). Both riverine areas and camera traps are colour coded by the same sensitivity scale, indicating the suitability of habitat for potential riverine rabbit populations. Camera 22, situated in the southern large drainage line and indicated in green, detected riverine rabbit.

Table 1: General results of the camera trapping surveys, presented per family and species. The naïve occupancy is the proportion of sites at which the species was detected.

Family *Species*	Total cameras	Naïve occupancy (%)
Bovidae		
Goat *Capra aegagrus hircus*	4	10
Greater kudu *Tragelaphus strepsiceros*	6	15
Sheep *Ovis aries*	20	50
Springbok *Antidorcas marsupialis*	9	23
Steenbok *Raphicerus campestris*	22	55
Canidae		
Bat–eared fox *Otocyon megalotis*	9	23
Black–backed jackal *Canis mesomelas*	4	10
Cape fox *Vulpes chama*	15	38
Domestic dog *Canis familiaris*	3	8
Equidae		
Horse *Equus ferus caballus*	1	2
Felidae		
African wildcat *Felis sylvestris*	11	28
Black–footed cat *Felis nigripes*	1	3
Caracal *Caracal caracal*	7	18
Domestic cat *Felis catus*	1	3
Herpestidae		
Grey mongoose spp. *Herpestes ichneumon* and *Galerella pulverulenta*	18	45
Meerkat *Suricata suricatta*	15	38
Water mongoose *Atilax paludinosus*	8	20
Yellow mongoose *Cynictis penicillate*	18	45
Hyaenidae		
Aardwolf *Proteles cristata*	3	8
Hystricidae		
Porcupine *Hystrix africaeaustralis*	10	25
Leporidae		
Hare spp. *Lepus saxatilis* and *Lepus capensis*	30	75
Mustelidae		
African striped weasel *Poecilogale albinucha*	2	5
Striped polecat *Ictonyx striatus*	13	33
Orycteropodidae		
Aardvark *Orycteropus afer*	21	53
Pedetidae		
Springhare *Pedetes capensis*	5	2
Procaviidae		
Rock hyrax *Procavia capensis*	4	10
Sciuridae		

Ground squirrel *Xerus inauris*	7	18
Viverridae		
Genet spp. *Genetta tigrine* and *Genetta genetta*	13	33

Figure 3: Riverine habitat at Camera trap site 22 that detected riverine rabbit activity, photo taken in March 2022

Nineteen riverine rabbit detections were recorded at this site of which 15 were considered to be independent captures. It is not possible to determine whether these images were of the same or different individuals as riverine rabbits do not have unique markings. However, detections were consistent throughout the duration which the camera trap was active, first detection was two days after initial deployment and last detection was the day before the camera was decommissioned (Number of active days = 49). This suggest that it is unlikely to be transient individuals utilising this drainage line as a thoroughfare but rather a small subpopulation that either was not previously detected or that recolonised shortly after the good rains and enhanced habitat suitability. Activity pattern shows a morning activity peak at 06:00 and, a late afternoon peak at 18:00 (Figure 4). This indicates that the Riverine rabbit(s) were predominantly active in the early mornings and late afternoons into evenings with some nocturnal activity, corroborating known knowledge of the species (Skinner & Chimimba, 2005).

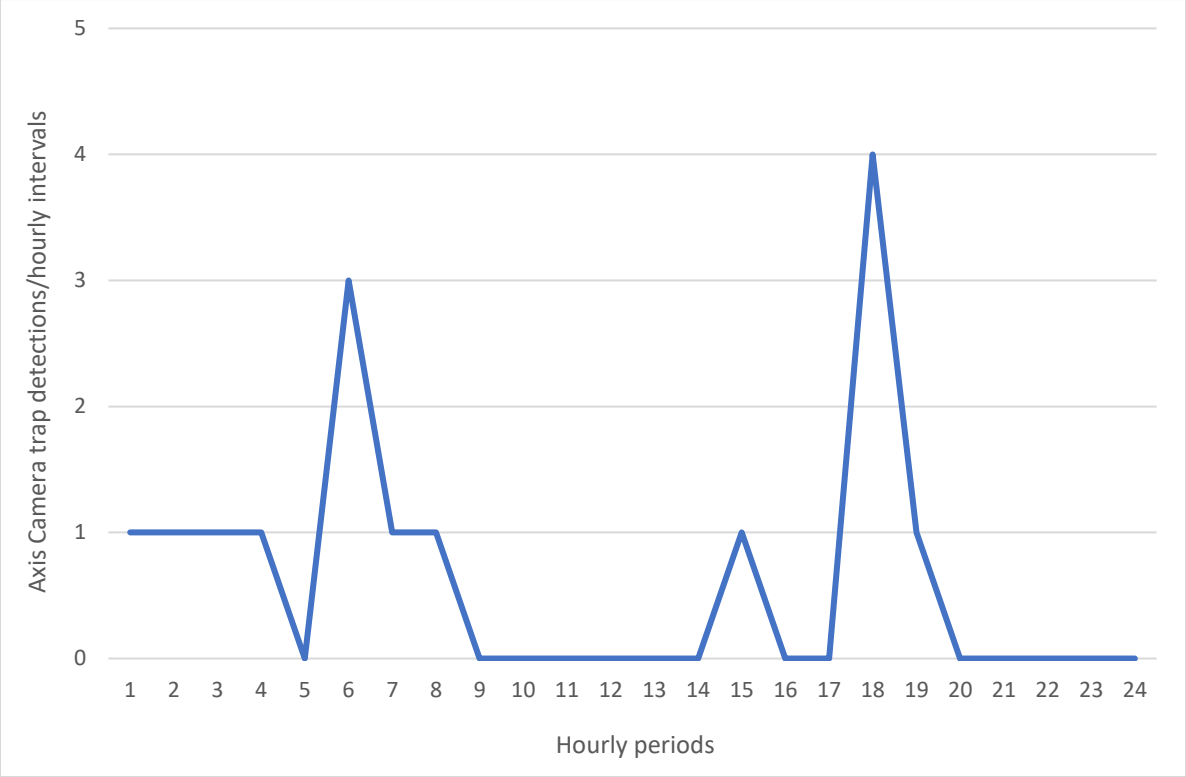

Figure 4: Activity period of riverine rabbit based on the camera trap detections during March-May 2022

3.2 Sensitivity mapping, assessment and buffers

The detection of riverine rabbit prompted a re-evaluation of the site with the possibility of a remaining extant subpopulation, although the status of this population is uncertain. Information derived from the desktop study, literature review (Brassine & Bragg 2022), site assessment and camera trapping detection were used in the construction of suitable buffers (Figure 5). Areas demarcated as Very High sensitivity were allocated a 700m buffer and those determined to be less likely to support rabbits (Medium Sensitivity) were allocated a 350m buffer. The buffered areas delineate no-go zones for development and accumulates to a total of 55.59km^2 of buffered area.

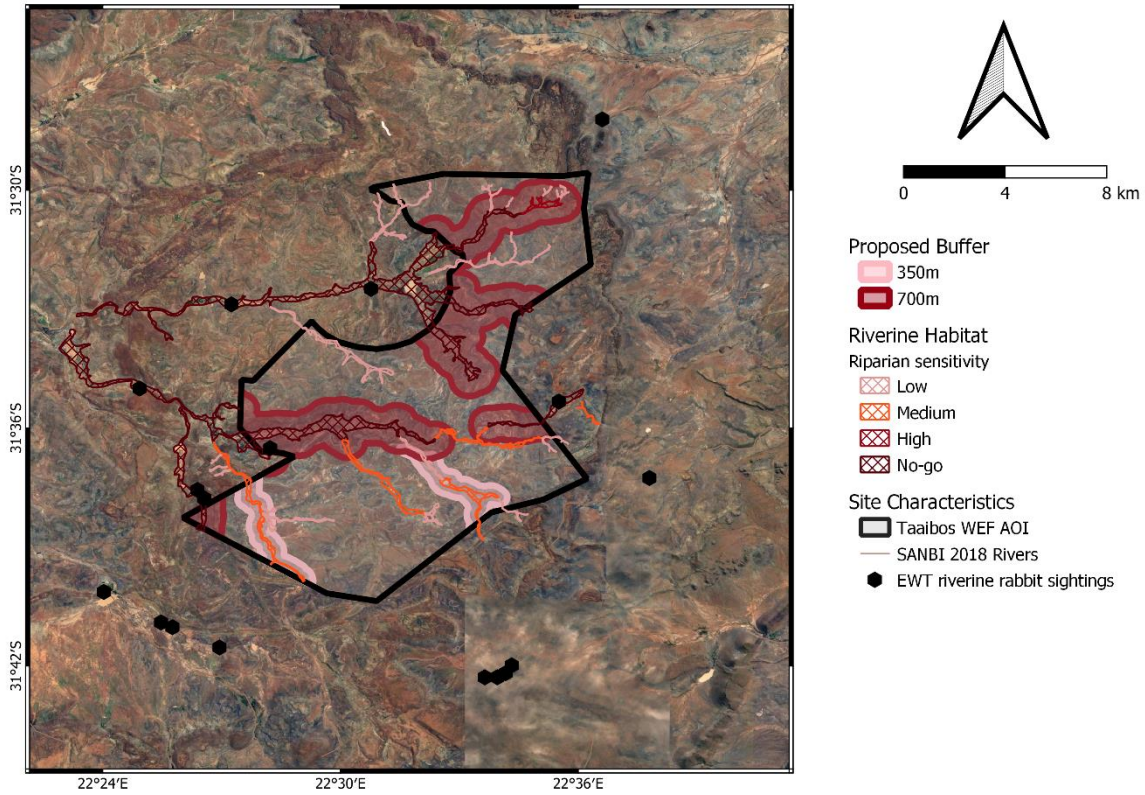

Figure 5: Ecological sensitivity map for the Taaibos AOI. Habitat suitability and proposed buffers are colour coded by the same sensitivity scale (See section 2.2), indicating the suitability of habitat for potential riverine rabbit populations. Buffers, colour coded for sensitivity and size, are superimposed over Low to High sensitivity zones.

4 DISCUSSION

4.1 Riverine Rabbit Impacts and mitigations

The proposed development of the Taaibos site is likely to lead to unfavourable environmental impacts on the Riverine Rabbit in the form of disturbance, mortality, habitat loss and fragmentation which may create barriers to geneflow. Of particular concern is the possible cumulative and cascading impacts on the ecosystem across trophic levels. During construction there is likely to be increased disturbance and mortalities from the influx in vehicles, machinery and noise related to construction. During operation, the impact of disturbance and noise would be reduced but turbine noise is still of concern as well as the disturbance from human activities from operational activities and maintenance (see special note below).

Note on uncertainties around acoustic impacts of wind farms on species

The amount of negative effects on species will vary depending on the type and size of the installation, location (whether it is situated in degraded or undisturbed habitat) and the life cycle stage of the installation (e.g., construction, operation, maintenance or decommissioning) (Helldin et al., 2012, Lovich & Ennen, 2013). The riverine rabbit has a home range small enough (<15Ha) for a wind farm to be an essential part of the areas they inhabit and large enough for them to avoid or search for turbines. In some studies, small mammals appear to habituate to turbines, others suggest that there is an

impact on species (ref). A study (Lopucki et al., 2017) on the European hare's response to wind farms showed that acoustic factors is the most probable reason for the lower presence of hares on the wind farm areas and their avoidance of turbines. They suggest that permanent and high noise levels may cause metabolic stress and be harmful for animals (Du et al., 2010, Kight & Swaddle, 2011) or that the hare relies more on hearing than other senses, particularly to avoid danger (Molinari-Jobin et al., 2004) and therefore the proximity of turbines may represent a risky habitat due to the animals' impaired ability to hear approaching predators.

The following impacts are identified as the major impacts that are likely to be associated with the development of the Taaibos site towards the Riverine Rabbit that is confirmed present within the site. Appendix I provides a breakdown of potential impacts on the riverine rabbits during the different phases of the development and potential significance thereof.

Construction phase:

IMPACT 1: HABITAT LOSS

Cause and comment:

The construction of roads, turbine hard-stands, roads and laydown areas etc. will result in the destruction of currently intact vegetation, including within areas of potential riverine rabbit habitat. The drainage lines and floodplains have been mapped as High sensitivity, and buffered appropriately (Figure 2), therefore no turbines should be located in these areas. Furthermore, the developer should strive to reduce the number of roads intersecting these riparian zones. As a result, the total potential extent of habitat loss would be very low, and the resulting impact from habitat loss would also be low.

Impact 1: Loss of habitat		
	Before mitigation	**After mitigation**
	VERY HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Locate developments away from identified sensitive habitats for riverine rabbits, this includes no go zones and buffer zones for turbine pads, electrical substations and housing facilities as well as construction laydown areas.
- Minimize project footprint by utilizing existing roads and disrupted areas as much as possible.
- Careful planning of road layout to minimise the length of roads traversing riparian areas that have been identified as Very high or high sensitivity which may create barriers and fragment habitats.
- An ECO must be employed to demarcate areas for use during construction, and to ensure that the construction activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint.
- Implement adequate dust control and erosion control.

IMPACT 2: CONSTRUCTION DISTURBANCE

Cause and comment:

The construction of roads, turbine hard-stands, roads and laydown areas etc. will result in noise and activity, which may displace rabbits out of home ranges. Noise effect from construction and associated human activities during this phase is highly probable and will likely reduce once the WEF is operational. Mitigation should include minimizing noise and educating workers. The buffered sensitive habitats will also ensure construction and associated disturbance noise is likely negligible. As a result, once mitigations are applied the potential disturbance and/or displacement of the species from home range is likely to be low.

Impact 2: Construction disturbance		
	Before mitigation	**After mitigation**
	HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Construction must occur outside of identified sensitive habitats for riverine rabbits, this includes no-go zones and buffer zones for turbine pads, electrical substations and housing facilities as well as construction laydown areas.
- An ECO must be employed to demarcate areas for use during construction, and to ensure that the construction activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint.
- Implementing adequate noise reduction measures where possible on machinery.
- Minimize noise disturbance during constructions by restricting noise to day time (9am – 5pm) periods when rabbits are less active.
- Ensure the construction phase is done in as a short period as possible.

IMPACT 3: MORTALITY FROM ROAD COLLISION, BUSHMEAT HUNTING AND OTHER CONSTRUCTION RELATED ACTIVITIES

Cause and comment:

The probability of vehicle-related mortality will increase with the added traffic. This would potential be within the site as well as on the larger public roads to the site such as the R381. This impact is likely to be of highest concern during construction but is also expected during operational phase. Roadkill is a significant source of mortality for riverine rabbits across their range. It is possible that the increase in traffic associated with construction would increase the probability of roadkill. As riverine rabbit activity is 'crepuscular' (i.e., highest between dusk and dawn), traffic during these periods should be curtailed. In addition, speed limits (<40km) in areas of potential conflict (High sensitivity) can be implemented as this reduces collision risk, and a reduction of roads within the drainage should be considered.

Impact 3: Mortality from road collision, bushmeat hunting and other construction related activities		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Careful planning of roads to minimise the length of roads traversing through riverine habitats that have been identified as Very high or high sensitivity.
- Use existing roads as much as possible.
- An ECO must be employed to demarcate areas for use during construction, and to ensure that the construction activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint.
- Implementation of speed limits on both internal access WEF roads (40km/h) as well as external public roads (60km/h).
- Reduced speed limits of 40km/h where roads (both internal and external) cross High and Very high sensitivity areas identified.
- Wildlife warning signage and speed reduction measures where roads cross High and Very high sensitivity areas.
- There is higher risk of collision when riverine rabbits are active which is typically from late afternoon to early morning. Traffic should be reduced during the early hours of the morning (04:00 – 09:00) and early evening (18:00 – 22:00). During these times a low speed limit (40km/h) needs to be implemented.
- Night-time driving should be avoided as much as possible but if necessary, speed needs to be reduced significantly to avoid collisions. Lagomorph species (hares and rabbits) often freeze in headlights and require headlights to be momentarily turned off to allow the animal to move off the road.
- Reduced speeds (40km/h) also need to be implemented during reduced visibility such as misty conditions that have been observed on the site.
- Roadkill monitoring program needs to be implemented on both internal and external public roads targeting sensitive habitats and wildlife corridors. The program must be initiated at pre-construction phase and continued during construction and post-construction as well as conducted over different seasons.
- Assess efficiency of roadkill mitigation approaches via a post-implementation roadkill monitoring program.
- Education and awareness campaigns on riverine rabbits and their habitat must form part of staff induction procedures to help increase awareness, respect and responsibility towards the environment for all staff and contractors.
- Any contractor employed for development work must ensure that no rabbit or hare species are disturbed, trapped, hunted or killed by them and their team during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.

- Inductions on safe wildlife passing and driving to reduce possible injury and roadkill alongside roads.
- Induction must include reporting of any vehicle/wildlife collision or found roadkill to the appointed Roadkill monitoring personnel.
- Any trenches built must have slopes that allow any dispersing rabbits that fall in to escape and must be backfilled.
- Prohibit all employees from hunting;
- Prohibit open fires;

Operational Phase:

IMPACT 4: DEGRADATION OF HABITAT BY EROSION

Cause and comment:

The construction of roads, turbine hard-stands, roads and laydown areas etc. will result in the destruction of currently intact vegetation, which may lead indirectly to soils being exposed and facilitating erosion. Erosion leads to river degradation through increased runoff and siltation processes. If erosion control is implemented, the resulting impact from erosion and would also be low.

Impact 4: Degradation of habitat by erosion		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Implement a Site Erosion Management and Control Plan to prevent erosion from high-lying areas impacting downstream ecosystems.

IMPACT 5: DISTURBANCE FROM VISUAL AND NOISE EFFECT

Cause and comment:

Disturbance will be primarily in the form of visual and noise effects as well as general human activities. Visual stimuli from movements of the turbine blades may cause a disturbance, this may be far reaching due to the site being open and unobscured. This impact will reduce once the WEF is operational however there will be continued noise pollution from turbines sound from both the hub as well as from the swish of the blades. Riverine Rabbits rely on hearing for predator detection and avoidance and so may be more susceptible to noise due to impaired hearing and masking effect. We do not know the effect of turbine noise on Riverine Rabbits, they may choose to avoid an area and relocate, it may also alter their activity pattern or cause behavioural abnormalities due to adverse effects on their nervous system where displacement is not observed. Wind turbine noise varies with design and size and noise reduction is continuously improving with new turbine design, however it is very likely that the Riverine rabbit hearing frequency range overlaps with the frequency range of wind turbine noise. Habitat specialist species, such as riverine rabbits, may be limited in their ability to relocate should

they be disturbed. Consequently, the difficulty in providing definitive levels of the point at which noise will have an impact necessitates a conservative approach to buffering preferred riverine rabbit habitat. The potential riverine rabbit habitat on the plateau has been buffered by a minimum of 350m and higher potential habitat, including where the presence of rabbits has been confirmed, has been buffered by 700m, which would reduce the potential significance of this impact. Given the distance between the turbines and High sensitivity zones, it is assumed, with a low level of certainty, that this impact would be of generally low magnitude.

Impact 5: Disturbance from visual and noise effect		
	Before mitigation	**After mitigation**
	HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Precautionary buffers of 700m for identified very high sensitivity areas, whilst taking into consideration topographical variations at the site; i.e. turbines that are obstructed by a hill may be placed closer to riverine habitats as visual and noise impact would be buffered by the topography of the land.
- Precautionary buffers of 350m for secondary drainage lines that consist mostly of poor degraded riverine habitat and identified as either Medium or Low sensitivity.
- Implementing adequate noise reduction measures, including the use of insulation to reduce noise output from turbine hubs.
- Temporal (curtailment) restrictions. Temporal restriction strategies can focus on altering turbine operation during times or weather conditions when wildlife is most active or where a negative impact has been found during the monitoring program.
- Changing the minimum windspeed at which turbines begin to turn and generate energy (cut-in speed), so that they idle during gentle wind, reduces noise during periods of low ambient noise.
- Targeted operational timing by working with wind facility managers to target specific turbines under certain weather conditions where a negative impact has been identified.
- Measure sound pressure levels at the WEF site, taking measurements at ~0.25m from the ground with two sets of measurements taken; one when turbines are active and one when inactive and at different distances from turbines including within Riverine rabbit habitat.
- Minimize noise disturbance during construction. Restrict noise to daytime (9am – 5pm) periods when rabbits are less active.

IMPACT 6: DIRECT MORTALITY FROM ROAD COLLISION

Cause and comment:

There is an increased collision risk from expected increased traffic levels at the site. This impact is likely to be of highest concern during construction but is expected to continue during operational phase. Roads and roadsides may attract riverine rabbits due to edge enhancement of vegetation on verges and the potential facilitation of movement, thus further increasing collision risks. Access roads

that traverse riverine habitats require careful planning and monitoring to reduce risk of rabbit mortality.

Impact 6: Direct mortality from road collision		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Careful planning of roads to minimise the length that traverses riverine habitats that have been identified as Very high or high sensitivity.
- Use existing roads as much as possible.
- Roadkill monitoring program on both internal and external public roads targeting sensitive habitats and wildlife corridors. Roadkill Monitoring programs must be initiated at pre-construction phase and continued during construction and post-construction as well as conducted over different seasons.
- Pre-construction road planning to identify target sites for wildlife crossing structures which should be considered during the EIA process in conjunction with pre-construction roadkill monitoring findings. Wildlife crossing structures must be made in consultation with road planner, construction manager and wildlife biologist. This is generally more cost effective than retro fixing existing roads.
- Assess efficiency of roadkill mitigation approaches via a post-implementation roadkill monitoring program.
- Implementation of speed limits on both internal access WEF roads (40km/h) as well as external public roads (60km/h).
- Reduced speed limits of 40km/h where roads (both internal and external) cross High and Very high sensitivity areas identified.
- Wildlife warning signage and speed reduction measures where roads cross High and Very high sensitivity areas.
- Education and awareness campaigns on riverine rabbits and their habitat must form part of staff induction procedures to help increase awareness, respect and responsibility towards the environment for all staff and contractors.
- Any contractor employed for development work must ensure that no rabbit or hare species are disturbed, trapped, hunted or killed by them and their team during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Inductions on safe wildlife passing and driving to reduce possible injury and roadkill alongside roads.
- There is higher risk of collision when riverine rabbits are active which is typically from late afternoon to early morning. Traffic should be reduced during the early hours of the morning (04:00 – 09:00) and early evening (18:00 – 22:00). During these times a low speed limit (40km/h) needs to be implemented.

- Night-time driving should be avoided as much as possible but if necessary, speed needs to be reduced significantly (<40km/h) to avoid collisions. Lagomorph species (hares and rabbits) often freeze in headlights and require headlights to be momentarily turned off to allow the animal to move off the road.
- Reduced speeds also need to be implemented during reduced visibility such as misty conditions that have been observed on the site.
- Induction must include reporting of any vehicle/wildlife collision or found roadkill to the appointed Roadkill monitoring personnel.

IMPACT 7: CUMULATIVE IMPACT

Cause and comment:

The cumulative impact is of concern, given the fact that the renewable-energy industry is rapidly expanding in South Africa, including in the central Karoo where riverine rabbits occur. The riverine rabbit is already impacted and threatened by past and current land use and the combination of these existing anthropogenic impacts with planned developments may impact the riverine rabbits with unexpectedly large effects. Cumulative effects can also result where the construction phase occurs at several locations simultaneously or if a new project begins construction immediately following the completion of another. Cumulative effects can escalate a small localized impact (which may have a limited effect on its own) to have a significantly larger impact at a population level as there may be thresholds where the cumulative effects increase disproportionally. The development may fragment an already highly fragmented landscape which may create barriers to geneflow where subpopulations are disconnected and isolated. Roads and fences can affect the quality and quantity of available habitat, most notably through fragmentation, creating barriers to animal movement. This impact is particularly important as the species is a habitat specialist.

Impact 7: Cumulative Impact		
	Before mitigation	**After mitigation**
	VERY HIGH NEGATIVE	MODERATE NEGATIVE

Mitigation Measures:

- It is important to evaluate the consequences of each development before the next is begun.
- Initiate a monitoring program to understand baseline status of possible subpopulation and identify current threats.
- Use a precautionary approach and aim to minimise negative effects even when the effects are not fully known.
- Ensure the construction phase is done in as a short period as possible.
- Construction needs to be done during daytime, avoiding noise and disturbance when rabbits are most likely active, particularly where the construction is in proximity to their habitat. Sensitive habitats near construction will need to be clearly marked.

- Relating construction phase of the development with neighbouring developments and farming activity to ensure construction does not begin immediately after the completion of another or simultaneously.
- Pre-construction road planning to identify target sites for wildlife crossing structures which should be considered during the EIA process and with pre-construction roadkill monitoring findings. Wildlife crossing structures must be made in consultations with road planner, construction manager and wildlife biologist. This is generally more cost effective than retro fixing existing roads.
- The developer instigates a proactive mitigation measure by initiating a multi-stakeholder dialogue at a workshop to clarify these concerns and how they might be taken forward and co-funded.
- Recommendation of the establishment of a net positive gain program or stewardship program through a landscape conservation and wildlife corridor initiative. The program will need to adhere to the recently drafted Biodiversity Offset Guidelines to ensure that outcomes represent mitigation at the site level and the regional level, and follow the principles guiding effective biodiversity offsets.
- Establish wildlife passes, where artificial barriers are found; this particularly refers to physical barriers such as roads and fences. However, barriers may also be in the form of disturbance from noise or other disruptive human activities. Disturbance barriers are covered in Impact 2.

IMPACT 8: CASCADING IMPACT ACROSS TROPHIC LEVELS

Cause and comment:

The effect of the wind farm on one species may have indirect cascading effects (knock on effect) on other species within the same communities due to ecological relations to one another. This means that an effect on one species may in turn affect many others within the same ecosystem. Cascading effects may be complex and unpredictable as it may be the result of different types of interactions including competition, predation, parasitism, or symbiosis. These effects are indirect and not immediately noticeable and therefore requires that impact assessment be broadened and consider the wider ecosystem.

Impact 8: Cascading impact across trophic levels		
	Before mitigation	**After mitigation**
	DON'T KNOW	UNKNOWN – could be positive or negative

Mitigation Measures:

- A general fauna monitoring program must be initiated pre-construction to have baseline population status and monitoring must be ongoing postconstruction to identify any changes in occupancy in certain population species which may in turn indirectly impact the riverine rabbit population. Specific attention to species that may be competing including hare species as well as predator species such as black-backed jackal and caracal to better understand the effect of the WEF and be able to provide recommendations were needed.

IMPACT 9: PREDATION FROM POSSIBLE INFLUX OF MARTIAL EAGLES AND OTHER BIRDS OF PREY THAT USE POWERLINE PYLONS FOR NEST SITES

Cause and comment:

Martial Eagles (Polemaetus bellicosus) are known to nest on pylons that support high voltage transmission lines (Boshoff 1993, Machange et al. 2005, Berndt 2015) and despite these birds being threatened, the creation of artificial nest platforms and implications for local wildlife from eagles moving into new areas may be significant. We do not know enough about this possible impact, but personal observation of prey remnants underneath Martial Eagle nests and roosts suggest that Lagomorph species (rabbits and hares) make up a substantial part of their diets (Figure 6) and deem that impact significant. Studies on Martial Eagle corroborates each other and highlight the importance of hare and rabbit species in their diet (Boshoff & Palmer 1980; Boshoff 1990; Gibbon, 2016; Hatfield 2018, Manuel 2020). We recommend that artificial nests and roosts on pylons are discouraged. Mitigation measures includes the use of pylon designs that are less favourable for nesting sites (figure 7) and the fitting of nest deterrents/discouragers on horizontal and cross beam sections where self-supporting pylons are used.

Figure 6: Lagomorph remains under three different Martial Eagle nests found in the Karoo region.

Figure 7: Pylon design that provide fewer opportunities for nesting sites.

Impact 9: Predation from possible influx of Martial Eagles and other birds of prey that use Powerline Pylons for nest sites		
	Before mitigation	**After mitigation**
	VERY HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- The use of pylon designs that are less favourable for nesting sites see figure 9.
- The fitting of nest deterrents/discouragers on horizontal and cross beam sections where self-supporting pylons are used.

Decommissioning:

The dismantling, collection, transportation and waste management treatment and final site restoration will be required during the decommissioning of the Wind Energy Facility. This will be required to be done in a timely manner and be done in a sustainable way and in accordance with environmental authority stipulation and national legislation. Decommissioning must start within 1 year after the wind farm has stopped operating at the latest. Typically, this will require all visible traces of the wind farm to be removed, including turbines and access roads, although access road may be best to leave as is for public or private usage. The concrete bases can also be removed, but it is often

better to leave them under the ground, as this causes fewer disturbances. If the turbine bases are left they would be covered with stone or other indigenous material, and the site returned as closely as practicable to its original state.

IMPACT 10: EROSION AND HABITAT DEGRADATION

Cause and comment:

The decommissioning phase may increase risk of soil erosion and habitat degradation unless adequate erosion avoidance is in place. This will add to existing erosion and degradation present in the area which results largely from historical land use practices.

Impact 10: Erosion and habitat degradation		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Disturbance in areas within or near drainage lines should be rehabilitated as quickly as possible
- An erosion monitoring programme should be put in place for at least 3 years after decommissioning. Any problems observed should be rectified as soon as possible using the appropriate revegetation and erosion control works.

IMPACT 11: DECOMMISSION DISTURBANCE

Cause and comment:

The decommission phase will likely result in increased disturbance, pollution, and human presence Mitigation should include minimizing noise and educating workers. The buffered sensitive habitats will also ensure decommission and associated disturbance noise is likely negligible. As a result, once mitigations are applied the potential disturbance and/or displacement of the species from home range is likely to be low as the affected environment will be able to recover from the impact.

Impact 11: Decommission disturbance		
	Before mitigation	**After mitigation**
	HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- An ECO must be employed to demarcate areas for use during decommissioning, and to ensure that the decommissioning activities remain within the designated area and that no unauthorised activities occur outside of the footprint.
- Implementing adequate noise reduction measures where possible.

- Minimize noise disturbance by restricting noise to day time (9am – 5pm) periods when rabbits are less active.
- Disturbance within or near (700m) drainage lines should be kept to a minimum
- Ensure the decommissioning phase is done in as a short period as possible.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- No excavated holes or trenches should be left open for extended periods as rabbits and other fauna may fall and become trapped.
- All above-ground infrastructures should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the facilities' decommissioning and recycling plan.
- Monitoring of site decommissioning by the EO to ensure that the infrastructure clearing, and waste material removal remains within the demarcated development footprint

IMPACT 12: DIRECT MORTALITY FROM ROAD COLLISION AND BUSHMEAT HUNTING

Cause and comment:

The probability of vehicle-related mortality will increase with the added traffic. This would potential be within the site as well as on the larger public roads to the site such as the R381.. Roadkill is a significant source of mortality for riverine rabbits across their range. It is possible that the increase in traffic associated with decomissioning would increase the probability of roadkill. As riverine rabbit activity is 'crepuscular' (i.e., highest between dusk and dawn), traffic during these periods should be curtailed. In addition, speed limits (<40km) in areas of potential conflict (High sensitivity) can be implemented as this reduces collision risk.

Impact 12: Direct mortality from road collision and bushmeat hunting		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- An ECO must be employed to demarcate areas for use during decommissioning, and to ensure that these activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint.
- Implementation of speed limits on both internal access WEF roads (40km/h) as well as external public roads (60km/h).
- Reduced speed limits of 40km/h where roads (both internal and external) cross High and Very high sensitivity areas identified.

- There is higher risk of collision when riverine rabbits are active which is typically from late afternoon to early morning. Traffic should be reduced during the early hours of the morning (04:00 – 09:00) and early evening (18:00 – 22:00). During these times low speed limit (40km/h) need to be implemented.
- Night-time driving should be avoided as much as possible but if necessary, speed needs to be reduced significantly to avoid collisions. Lagomorph species (hares and rabbits) often freeze in headlights and require headlights to be momentarily turned off to allow the animal to move off the road.
- Reduced speeds (40km/h) also need to be implemented during reduced visibility such as misty conditions that have been observed on the site.
- Any contractor employed for development work must ensure that no rabbit or hare species are disturbed, trapped, hunted or killed by them and their team during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Inductions on safe wildlife passing and driving to reduce possible injury and roadkill alongside roads.
- Induction must include reporting of any vehicle/wildlife collision or found roadkill to the appointed Roadkill monitoring personnel.
- Any temporary trenches must have slopes that allow any dispersing rabbits that fall in to escape and must be backfilled.
- Prohibit all employees from hunting;
- Prohibit open fires;

4.2 Concluding statement

The construction, operations and decommission of wind turbines may lead to unfavourable environmental impacts on the Riverine Rabbit in the form of disturbance, mortality, habitat loss and fragmentation which may create barriers to geneflow. Given that the species is present in the area of interest, there is a need to assess the significance of the impacts of the development on the population.

The majority of potential impacts are likely to occur during the construction phase, however with correct mitigation strategies and adherence to the ecological sensitivity map (Figure 2), these should be largely negligible. During operation, impacts are likely to be reduced, and the main cause of potential concern is noise generated by the turbines which would amount to habitat degradation within the affected areas for rabbits affected by noise impacts. At this point in time, however, there are no studies that assess or speculate on the likely ecological impacts associated with **disturbance by turbine noise and vibration on the species**, and given the species' rarity, this is of concern. A literature review (Brassine & Bragg 2022) of the effects of wind energy farms (WEF) on mammals referred to the following likely impacts: habitat deterioration and fragmentation, which may create barriers to geneflow, noise effect, road mortality, visual effect, vibration and shadow flicker effects, electromagnetic field generation, macro- and micro-climate change as well as increased fire risk. Of particular concern is the possible cumulative and cascading impacts on the ecosystem across trophic levels (Lopucki et al. 2017; Thaker et al. 2018).

There are thus significant levels of uncertainty around the effectiveness of the width of the buffers needed to mitigate these impacts on known populations, for example, and this requires a different approach to the BAU approach of guessing buffer sizes. Furthermore, the cumulative impact is also of

concern, given the fact that the renewable-energy industry is rapidly expanding in South Africa, including in the central Karoo where riverine rabbit occurs. A landscape level approach is required to ensure the best conservation strategies are implemented and that sub-populations remain connected through protected wildlife corridors.

The EIA phase will thus require proactive mitigation measures and it is recommended that ecologists, wind farm developers, NGOs and other stakeholders collaborate and share information to develop concerted and sound protocol for assessing, mitigating and monitoring the impact of Renewable Energy Facilities on Riverine Rabbits. A collaboration in this regard would allow coherent mitigations to be applied at the regional scale, aim for net positive gains and create clarity on the specs across all developments for:

a. No go areas

b. Buffer widths for wind turbine and solar PV;

c. Riverine rabbit activity patterns and curtailment of traffic accordingly;

d. Wildlife passes where large roads intersect important habitat;

e. Signage or traffic calming where roads intersect important habitats.

It is thus recommended that the developer instigates a proactive mitigation measure by initiating a multi-stakeholder dialogue at a workshop to clarify these concerns and how they might be taken forward and co-funded.

A highly recommended mitigation measure to be developed during the EIA phase would be for a long-term monitoring programme on site. Monitoring of a rare and cryptic species that inhabits dense riparian habitat is challenging but sound monitoring protocols are essential to ensure existing populations are effectively protected. Monitoring results are only comparable, however, when the method is standardized, and the same effort and methods should therefore be used on all wind farm developments in the area. It is recommended that such a coordinated monitoring programme be discussed and realized at the above-mentioned workshop.

It is recommended that research into uncertainties that may affect the long-term persistence of the species should be undertaken and research areas would be best decided by consensus from all the role-players and stakeholders.

It is further recommended that any nett positive gain projects adhere to the recently drafted Biodiversity Offset Guidelines to ensure that outcomes represent mitigation at the site level and the regional level, and follow the principles guiding effective biodiversity offsets.

5 REFERENCES

Agha, M., Lovich, J., Ennen, J., Augustine, B., Arundel, T., Murphy, M., Meyer-Wilkins, K., Bjurlin, C., Delaney, D., Briggs, J., Austin, M., Madrak, S. and Price, S. 2015. Turbines and terrestrial vertebrates: variation in tortoise survivorship between a wind facility and an adjacent undisturbed wildland area in the Desert Southwest (USA). *Environmental Management*, **56(2):** 332-341

Ahlmann, V., Collins, K. & Seal, U.S. 2000. Riverine Rabbit (*Bunolagus monticularis*): A population and habitat viability assessment workshop. Final Report. Final Report. Conservation breeding specialist group (SSC/IUCN) Apple Valley, MN.

Arnett, E., Inkley, D., Johnson, D., Larkin, R., Manes, S., Manville, A., Mason, J., Morrison, M., Strickland, M. and Thresher, R. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. *Wildlife Society Technical Review,* **07-2**: 1-51

Barber, J., Crooks, K. and Fristrup, K. 2010. The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology and Evolution*, **25(3):** 180-189

Berndt, J. 2015. Martial Eagles and the national power grid in South Africa: the implications of pylon-nesting for conservation management. MSc thesis, University of Cape Town, South Africa

Boshoff, A., Palmer, G., & Avery, G. 1990. Variation in the diet of Martial Eagles in the Cape Province, South Africa, *South African Journal of Wildlife Research,* **20:** 57-68.

Boshoff, A., & Palmer. G., (1980). Macro-analysis of prey remains from Martial Eagle nests in the Cape Province. *Ostrich,* **51:** 7–13.

Boshoff, A. F. (1993) Density, breeding performance and stability of Martial Eagles *Polemaetus bellicosus* breeding on electricity pylons in the Nama Karoo, South Africa. *Annales-Musee Royal de l'Afrique Centrale Sciences Zoologiques (Belgium),* **268:** 95–104.

Brouček, J. 2014. Effect of noise on performance, stress, and behaviour of animals. *Sloval Journal of Animal Science,* **47(2):** 111-123

Collins, K. & du Toit, J.T. 2016. Population status and distribution modelling of the critically endangered riverine rabbit (*Bunolagus monticularis*). *African Journal of Ecology*, **54:** 195–206.

Dean, W.R.J. & Milton, S.J. (eds.). 1999. The Karoo: ecological patterns and processes. Cambridge, UK: Cambridge University Press.

Duthie, A.G. 1989. The Ecology of the Riverine *Bunolagus monticularis*. MSc thesis. University of Pretoria, South Africa.

Eccard, J.A., Walther, R.B. & Milton, S.J. 2000. How livestock grazing affects vegetation structures and small mammal distribution in the semi–arid Karoo. *Journal of Arid Environments,* **46:** 103–106.

Hatfield, R. 2018. Diet and space use of the martial eagle (*Polemaetus bellicosus*) in the Maasai Mara region of Kenya. Theses and Dissertations -- Forestry and Natural Resources.

Helldin, J., Jung, J., Kindberg, J., Lindberg, N., Neumann, W., Olsson, M., Skarin, A., and Widemo, F. 2012. Effects of wind power on terrestrial mammals – a review. National Wind Coordinating Collaborative Wind Wildlife Research Meeting IX

Hötker, H., Thomsen, K. and Jeromin, H. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.

Hughes, G.O., Thuiller, W., Midgley, G.F. & Collins, K. 2008. Environmental change hastens the demise of the critically endangered riverine rabbit (*Bunolagus monticularis*). *Biological Conservation*, **141:** 23–34.

Larrucea, E.S., Brussard, P.F., Jaeger, M.M. & H., B.R. 2007. Cameras, coyotes, and the assumption of equal detectability. *Journal of Wildlife Management.* **71:** 1682–1689.

Łopucki, R., Klich, D. and Gielarek, S. 2017. Do terrestrial animals avoid areas close to turbines in functioning wind farms in agricultural landscapes? *Environmental Monitoring and Assessment.* **189(7):** 1-11.

Machange, R. W., Jenkins, A. R. and Navarro, R. A. 2005. Eagles as indicators of ecosystem health: Is the distribution of Martial Eagle nests in the Karoo, South Africa, influenced by variations in land-use and rangeland quality? *Journal of Arid Environments.* **63(1):**223–43

McCallum, L., Whitfield Aslund, M., Knopper, L., Ferguson, G. and Ollson, C. 2014. Measuring electromagnetic fields (EMF) around wind turbines in Canada: Is there a human health concern. Environmental Health: *A Global Access Science Source*, **13(1):** 1-8

Morgan, K. and Tromborg, C. 2007. Sources of stress in captivity. *Applied Animal Behaviour Science,* **102(3-4):** 262-302

Mockrin, M. and Gravenmier, R. 2012. Synthesis of wind energy development and potential impacts on wildlife in the pacific northwest, Oregon and Washington. USDA Forest Service - General Technical Report PNW-GTR, **863:** 1-55

Ncube, B. 2018. Constraints to smallholder agricultural production in the Western Cape, South Africa. *Physics and Chemistry of the Earth*. **106:** 89–96.

Shannon, G. McKenna, M., Angeloni, L., Crooks, K., Fristrup, K., Brown, E., Warner, K., Nelson, M., White, C., Briggs, J., McFarland, S., Wittemyer, G. 2016. A synthesis of two decades of research documenting the effect of noise on wildlife. Biological Reviews, **91(4):** 982-1005

Skarin, A., Nellemann, C., Rönnegård, L., Sandström, P. and Lundqvist, H. 2015. Wind farm construction and impact reindeer migration and movement corridors. *Landscape Ecology*, **30(8):** 1527-1540

Skarin, A., Sandstrom, P, and Alam, M. 2018. Out of sight of wind turbines – reindeer response to wind farms in operation. *Ecology and Evolution*. **8(19):** 9906-9919

Skinner JD, Chimimba CT. 2005. The Mammals of the Southern African Subregion. Third edition. Cambridge University Press, Cambridge, UK.

Thaker, M., Zambre, A. and Bhosale, H. 2018. Wind farms have cascading impacts on ecosystems across trophic levels. *Nature Ecology and Evolution*, **2(12):** 1854-1858

Tosh, D. Montgomery, W. and Reid, N. 2014. A review of the impacts of onshore wind energy development on biodiversity. Report prepared by the Natural Heritage Research Partnership (NHRP) between Quercus, Queen's University Belfast and the Northern Ireland Environment Agency (NIEA) for the Research and Development Series No. 14/02

APPENDIX I: BREAKDOWN OF POTENTIAL IMPACTS ON THE RIVERINE RABBITS DURING THE DIFFERENT PHASES OF THE DEVELOPMENT AND POTENTIAL SIGNIFICANCE THEREOF.

Nature	Duration	Extent	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Construction Phase									
Impact 1: Direct Habitat Loss									
Negative	Permanent	Study Area	Severe	Definite	VERY HIGH NEGATIVE	Reversible	Habitat resource will be lost	Achievable	LOW NEGATIVE
Impact 2: Construction Disturbance									
Negative	Short term	Study area	Severe	Probable	HIGH NEGATIVE	Irreversible	Population displaced	Achievable	LOW NEGATIVE
Impact 3: Mortality from road collision, bushmeat hunting and other construction related activities									
Negative	Permanent	Regional	Moderately Severe	Probable	MODERATE NEGATIVE	Irreversible	Individuals of a rare spp will be lost	Achievable	LOW NEGATIVE
Operational Phase									
Impact 4: Degradation of habitat by erosion									
Negative	Permanent	Study Area	Moderately Severe	May Occur	MODERATE NEGATIVE	Reversible	Habitat will be unsuitable for species presence	Achievable	LOW NEGATIVE
Impact 5: Disturbance from visual and noise effect									
Negative	Long term	Study Area	Severe	Probable	HIGH NEGATIVE	Irreversible	Population displaced and/or behavioural abnormalities	Unknown but with mitigation and research Achievable	LOW NEGATIVE*
Impact 6: Direct Mortality from road collision									

Negative	Permanent	Regional	Moderately Severe	Probable	MODERATE NEGATIVE	Irreversible	Animals will be lost	Achievable	LOW NEGATIVE
Impact 7: Cumulative Impact									
Negative	Permanent	Regional	Severe	Probable	VERY HIGH NEGATIVE	Irreversible	Cumulative effect from the Combination of anthropogenic impacts	Difficult but achievable	MODERATE NEGATIVE**
Impact 8: Indirect Cascading Impacts across trophic levels									
Negative/Positive/Unknown	Permanent	Regional	Could be significant/ Long term	May Occur	DON'T KNOW	Irreversible	Species may be impacted negatively and requires proactive management plan	Very difficult	UNKNOWN – could be positive or negative ***
Impact 9: Predation from possible influx of martial eagles and other birds of prey that use powerline pylons									
Negative	Long term	Regional	Severe	May Occur	HIGH NEGATIVE	Reversible	Individuals of a rare spp will be lost	Achievable	LOW NEGATIVE
Decommissioning Phase									
Impact 10: Erosion and Habitat Degradation									
Negative	Medium term	Study Area	Moderately Severe	May Occur	MODERATE NEGATIVE	Reversible	Animals will be lost	Achievable	LOW NEGATIVE
Impact 11: Decommission Disturbance									
Negative	Short term	Study area	Severe	Probable	HIGH NEGATIVE	Irreversible	Population displaced	Achievable	LOW NEGATIVE
Impact 12: Direct mortality from road collision									
Negative	Permanent	Regional	Moderately Severe	Probable	MODERATE NEGATIVE	Irreversible	Animals will be lost	Achievable	LOW NEGATIVE

*It has not yet been established in the science whether the turbine noise and visual disturbance could negatively impact the behaviour and persistence of the species. Given the exponentially increasing number of commercial WEF developments in the area, this requires research before an adequate assessment can be made. Please see Mitigation section.

**Refer to Cumulative impact in document for further elaboration on mitigation measures
***Refer to document regarding a general faunal monitoring program to better understand this potential impact