Environmental Impact Assessment (EIA) report

For the proposed Camden I Solar (PV), Green Hydrogen and Ammonia Energy Facilities (GHA) Mpumalanga, South Africa

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For:	Bat Environmental Impact Assessment Report

Independence

Animalia Consultants (Pty) Ltd has no connection with the developer. Animalia Consultants (Pty) Ltd is not a subsidiary, legally or financially of the developer; remuneration for services by the developer in relation to this 12-Month Pre-construction Bat Environmental Impact Assessment Report 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 biodiversity applies to bats and includes the following:
NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97).

The Act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive attention, in addition to those listed as Threatened or Protected.

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Table i. Explanation of abbreviations used in this document

Abbreviation	Explanation
ACR	African Chiroptera Report
BESS	Battery Energy Storage System
DFFE	Department of Forestry, Fisheries & the Environment
DMRE	Department of Mineral Resources and Energy
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Plan report
GHAF	Green Hydrogen & Ammonia Facility
IRP	Integrated Resource Plan
MM	Meteorological ("Met") Mast
PV	Photo-voltaic (facility)
REC	Renewable Energy Complex
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SABAA	South African Bat Assessment Association
SEA	Strategic Environmental Assessment
ShM	Short Mast (passive bat detection system)
WEF	Wind Energy Facility

NEMA Requirements

The content of a specialist report is specified in the EIA Regulations GN R. 982, as amended (4 Dec 2014) Appendix 6. A specialist report prepared in terms of these Regulations must contain:

NEMA Requirement	**Section/page in report**
Details of the specialist who prepared the report, and the expertise of that specialist to compile a specialist report including a curriculum vitae.	**Separate Curriculum Vitae**
A declaration that the specialist is independent in a form as may be specified by the competent authority.	**Page 3**
An indication of the scope of, and the purpose for which, the report was prepared.	**Section 1**
An indication of the quality and age of the base data used for the specialist report.	**Sections 3; 4**
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	**Sections 4; 5**
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment.	**Section 3**
A description of the methodology adopted in preparing the report or carrying out the specialised process, inclusive of equipment and modelling used.	**Section 3**
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure.	**Section 5**
An identification of any areas to be avoided, including buffers.	**Section 4.5**

A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	**Section 4.5**
A description of any assumptions made and any uncertainties or gaps in knowledge.	**Section 3.4**
A description of the findings and potential implications of such findings on the impact of the proposed activity, or activities.	**Sections 4; 7**
Any mitigation measures for inclusion in the EMPr.	**Section 6**
Any conditions for inclusion in the environmental authorisation.	**Sections 5; 6; 7**
Any monitoring requirements for inclusion in the EMPr or environmental authorisation.	**Section 5; 7**
A reasoned opinion whether the proposed activity or portions thereof should be authorised, and regarding the acceptability of the proposed activity or activities. And if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr.	**Sections 5; 6; 7**
A description of any consultation process that was undertaken during the course of preparing the specialist report.	**Sections 3**

1 OBJECTIVES AND TERMS OF REFERENCE FOR THE STUDY

The objectives and terms of reference for the impact assessment are to provide the following:

- A description of the baseline characteristics and conditions of the receiving environment (e.g., site and/or surrounding land uses including urban and agricultural areas).
- An evaluation of the predicted impacts of the project on the receiving environment.
- An assessment of the probability of each impact occurring, the reversibility of each impact and the level of confidence in each potential impact.
- Consideration and evaluation of the cumulative impacts in terms of the current and proposed activities in the area.
- Recommendations to avoid negative impacts, as well as feasible and practical mitigation, management and/or monitoring options to reduce negative impacts that can be included in the Environmental Management Programme.
- A reasoned opinion as to whether the proposed activity, or portions of the activity should be authorised.
- Presentation of the findings regarding bat species assemblage and abundance on the site.
- Details regarding the types of mitigation measures that are possible if bat mortality rates are found to be unacceptable, including the potential times/circumstances which may result in higher mortality rates.

2 INTRODUCTION

This document is the Bat Environmental Impact Assessment Report for the proposed Camden I Solar (PV) and Green Hydrogen and Ammonia (GHA) Energy Facilities completed by Animalia Consultants (Pty) Ltd.

Camden I Solar (RF) Pty Ltd and Camden Green Energy (RF) Pty Ltd is proposing the development of a complex of commercial, solar and green hydrogen and ammonia energy facilities, along with their associated grid connections and infrastructure on a site located approximately 17km south-south-east of Ermelo and 200km east-south-east of Johannesburg, within the Msukaligwa Local Municipality of the Gert Sibande District Municipality, Mpumalanga Province. The below Table 2.1 gives the project description and summarises the infrastructure specifications for the Solar Energy Facility (SEF) and Table 2.2 for the Green Hydrogen and Ammonia Facility (GHAF). Figure 2.1 depicts the proposed Renewable Energy Complex (REC) site boundaries and positions of the Photo-voltaic (PV) and GHAF components.

Table 2.1. Project Summary - Camden I Solar Energy Facility (100MW)

Facility Name	**Camden I Solar Energy Facility**
Applicant	Camden I Solar Energy Facility (RF) Propriety Limited
Municipalities	Msukaligwa Local Municipality of the Gert Sibande District Municipality
Affected Farms[1]	Portion 1 of Welgelegen Farm No. 322
Extent	297 ha
Buildable area	Approximately 280 ha
Capacity	Up to 100MW
Power system technology	Solar PV
Operations and Maintenance (O&M) building footprint:	Located near the substation. Septic tanks with portable toilets Typical areas include: - Operations building – 20m x 10m = 200m^2 - Workshop – 15m x 10m = 150m^2 Stores - 15m x 10m = 150m^2
Construction camp and laydown area	Typical construction camp area 100m x 50m = 5,000m2. Typical laydown area 100m x 200m = 20,000m2.

[1] **Based on the current conceptual layout.**

	Sewage: Conservancy tanks and portable toilets
Cement batching plant (temporary):	Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo. The footprint will be around 0.5ha. Maximum height of the silo will be 20m.
Internal Roads:	Width of internal road – Between 4m and 5m, this can be increased to 6m on bends. Access or internal roads may be up to 20m to allow for larger component transport where required. Length of internal road – Approximately 8km.
Cables:	Communication, AC and DC cables.
Independent Power Producer (IPP) site substation and battery energy storage system (BESS):	Total footprint will be up to 6.5ha in extent (5ha for the BESS and 1.5ha for the IPP portion of the substation). The substation will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc. The associated BESS storage capacity will be up to 100MW/400MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.

The green hydrogen and ammonia facility proposed by Camden Green Energy (RF) Pty Ltd as part of the renewable energy projects will encompass approximately 25 hectares of land. The site of the hydrogen facility is still to be determined, as it is highly dependent on the location of the

Camden I main site substation. Two alternatives have however been provided for consideration towards authorisation.

“Green” hydrogen and ammonia production differs from traditional production technologies in that the process relies exclusively on renewable resources (renewable energy) and for input air and water (feedstock), to produce commercially usable green hydrogen and ammonia. The only solid waste stream is the production of brine from the water treatment plant. Ammonia spillages may occur however these will be accidental and mitigation measures will be developed and implemented.

A gaseous ‘waste’ is oxygen generated from the electrolyses process. Another source of gaseous ‘wastes’ is from the Air Separation Unit. This is where nitrogen is removed from the air and the other natural gases as expelled back to the environment.

Commercially, hydrogen is used as a fuel for transport in hydrogen fuel cells. Alternatively, hydrogen is used for welding and in the production of other chemicals such as methanol and hydrochloric acid and also has other commercial uses like the filling of balloons. It is also a primary input to the production of ammonia. Ammonia in turn is primarily used in the production of ammonium nitrate (fertiliser) and is also used as refrigerant gas and the manufacture of plastics, explosives, textiles, pesticides and other chemicals. Ammonia can also be used as a stable ‘carrier’ of hydrogen, allowing hydrogen to be readily stored and transported.

The production, storage and transport of hydrogen and ammonia is an industry undergoing in-depth research and developments. Consequently, technological solutions are constantly being improved and changing. Thus, the facility description (Table 2.2) is based on available technological solutions, however, the underlying fundamentals will remain.

The facility comprises the following components as summarised in Table 2.2, where the footprint and capacities are presented. These parameters on based on the assumption that a 150MW electrolyser is installed (maximum).

Table 2.2. Facility components of green hydrogen and ammonia facility

No.	Component	Footprint (Ha)	Storage Capacity (m^3 / tons)	Maximum Throughput (m^3 / tpa)	Note
1	Water Reservoir	2	6 800 / 6 800	800 / 800	Process and utilities water
2	Water Treatment Unit	1.5	N/A	192 000 / 192 000	Process and utilities water
3	Electrolyser Unit	1	N/A	(1 239 157 – 301 932 367) / 20 000	Hydrogen Output Oxygen Output
4	Air Separation Unit	0.5	N/A	92 905 405 / 110 000	Air Input
5	Ammonia Processing Unit	2	N/A	149 253 / 100 000	Ammonia Output
6	Liquid Air Storage System (LAES)	1	3 983/ 3 505	460 227 / 405 000	Nitrogen Storage
7	Liquid Ammonia Storage Tank	2	2 273/ 1 523	261 194 / 175 000	
8	Hydrogen and Oxygen Storage Tank Farm	12	59 566/ 800	5 576 208 / 90 000	Hydrogen and Oxygen storage (combined tank farm), i.e. feedstock storage
9	Ancillary infrastructure	3	n/a	n/a	Includes temporary and permanent laydown areas, parking, offices and other related infrastructure.
	Total Footprint	**25**			

The Solar PV Facility is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Camden I Solar Energy Facility under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme or any similar procurement programme under the IRP, with the aim of evacuating the generated power into the national grid. Third party off-take is also considered, where feasible. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP), with the Camden I Solar and Facility set to inject up to 100MW into the national grid.

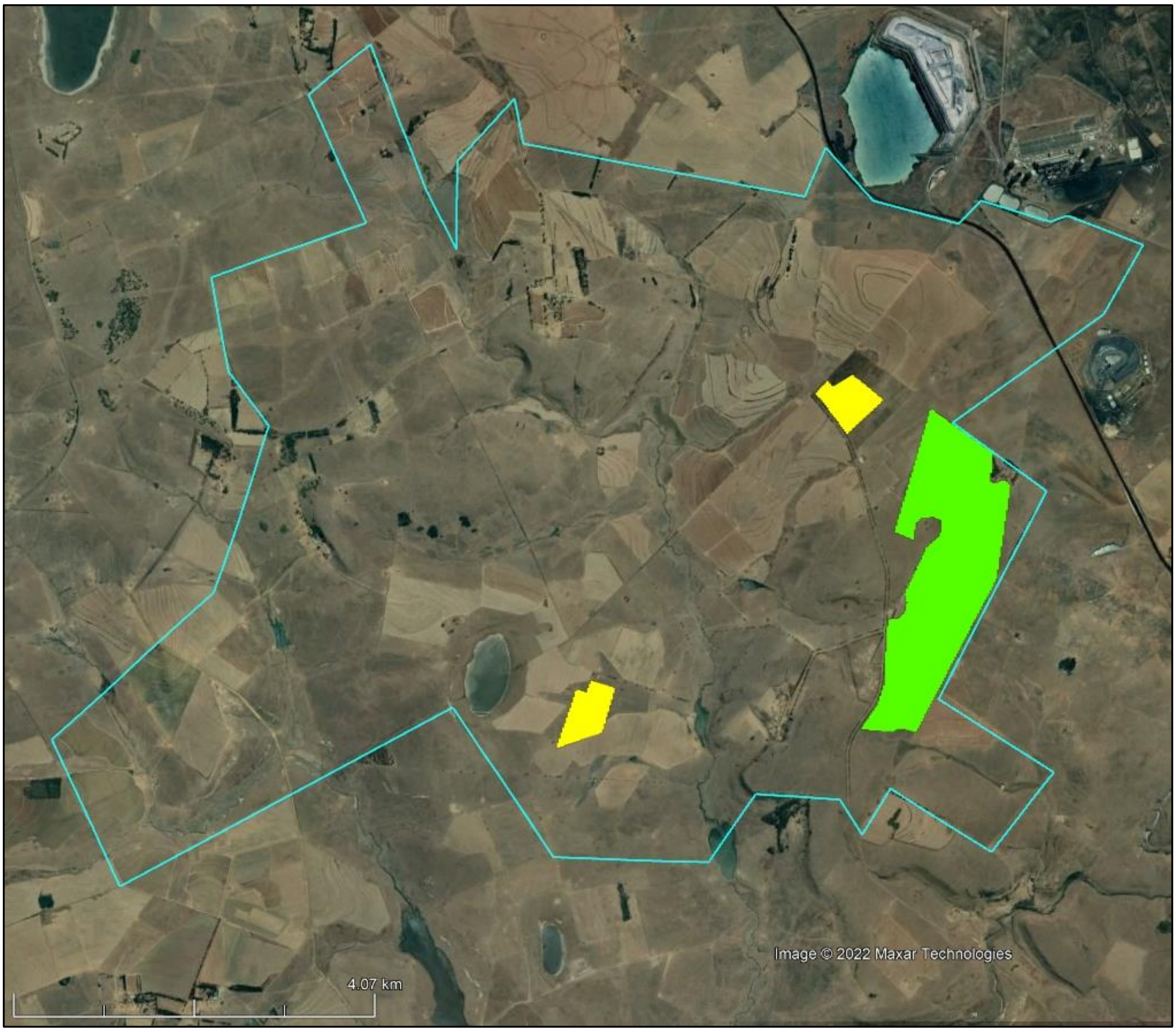

Figure 2.1. Layout of the proposed Camden I PV and GHA layout. Solar Energy Facility (green block) and Green Hydrogen & Ammonia Facilities (yellow blocks).

2.1 **The Bats of South Africa**

Bats form part of the Order Chiroptera and are the second largest group of mammals after rodents. They are the only mammals to have developed true powered flight and have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are compact and light, thereby reducing the total body weight. This unique wing profile allows for the manipulation of wing camber and shape, exploiting functions such as agility and manoeuvrability. This adaption surpasses the static design of the bird wings in function and enables bats to utilise a wide variety of food sources, including, but not limited to, a large diversity of insects (Neuweiler 2000). Species-based facial features may differ considerably as a result of differing lifestyles, particularly in relation to various feeding and echolocation navigation strategies. Most South African bats are insectivorous and are capable of consuming vast quantities of insects on a nightly basis (Taylor 2000, Tuttle and Hensley 2001) however, they have also been found to feed on amphibians, fruit, nectar and other invertebrates. As a result, insectivorous bats are the predominant predators of nocturnal flying insects in South Africa and contribute greatly to the suppression of these numbers. Their prey also includes agricultural pests such as moths and vectors for diseases such as mosquitoes (Rautenbach 1982, Taylor 2000).

Urban development and agricultural practices have contributed to the deterioration of bat populations on a global scale. Public participation and funding of bat conservation are often hindered by negative public perceptions and unawareness of the ecological importance of bats. Some species choose to roost in domestic residences, causing disturbance and thereby decreasing any esteem that bats may have established. Other species may occur in large communities in buildings, posing as a potential health hazard to residents in addition to their nuisance value. Unfortunately, the negative association with bats obscures their importance as an essential component of ecological systems and their value as natural pest control agents, which actually serves as an advantage to humans.

Many species of bats roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas may adversely impact individuals of different communities concurrently (Hester and Grenier 2005). Secondly, nativity rates of bats are much lower than those of most other small mammals. This is because, for the most part, only one or two pups are born per female per annum. Under natural circumstances, a population's numbers may accumulate over long periods of time. This is due to the longevity of up to 30 years (O'Shea *et al*. 2003) and the relatively low predation of bats when compared to other small mammals. However, bat populations are not able to adequately recover after mass mortalities and major roost disturbances.

2.2 **Bats and Solar Energy, as well as Green Hydrogen and Ammonia facilities**

Currently there is no evidence of these facilities posing a direct threat of fatality impact on bats during operation. However, roosting and foraging habitats may be destroyed during the construction phase. This is primarily due the fact that such facilities require areas of land to be cleared, and in some cases, earthworks are required for levelling purposes. This can result in habitat that is suitable for micro roosts, such as rocky outcrops, clumps of trees and certain vegetation being destroyed, which can also be fatal to bats residing in such roosts. Natural vegetation can support higher insect food quantities and diversity than cleared land, therefore foraging habitat can also be displaced, especially by solar facilities.

The presence of security lights on and around these facilities creates significant light pollution that can impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light averse) species and favouring species that readily forage around insect-attracting lights. Additionally, if the buildings and associated infrastructure for these facilities are placed close to wind turbines, the light pollution at these buildings can attract photophilic bat species, thereby significantly increasing their chances of being killed by moving blades of turbines within close proximity.

3 METHODOLOGY

3.1 Literature-based and On-site Inspections

The site is evaluated by comparing the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water) to identify bat species that may be impacted. These comparisons are done principally by briefly studying the geographic literature of each site, available satellite imagery and by ground-truthing with site visits. The probability of occurrence based on the above-mentioned factors are estimated for the species both expected and confirmed on site as well as the larger surrounding area.

It should be noted that the implications of seasonality with regards to bat activity that are important to wind energy are not as applicable to PV or GHA technologies, since the operational phases of the latter do not incur the same nature of risk to bats as turbines do.

3.2 Passive Monitoring

Passive bat detection systems (Figure 3.1) were set up on a meteorological mast with microphones at 10m, 55m and 110m. Additionally, 3 short mast bat detection systems were also set up, with microphones at 7m (referred to as C1-ShM1 – C1-ShM3). These systems were set to gather bat activity data every night for 12 months to form part of the long-term pre-construction monitoring related to the Camden I Wind Energy Facility, and is used here to inform the EIA study given the close proximity of the data collected and this proposed development.

Several site visits were made to the Camden I Wind Energy Facility between August 2020 and October 2021 to ground truth bat sensitivity features and habitats delineated in the bat sensitivity constraints map, and to collect passive data from bat detection systems. These data were primarily used for the pre-construction monitoring of the Camden I Wind Energy

Facility, which informed the Bat Environmental Impact Assessment Report for the Camden I Wind Energy Facility, submitted by Animalia Consultants to Enertrag SA. The Camden I WEF shares a similar site boundary and thus the results are directly applicable to informing this report. However, the bat diversity data from the passive systems are applicable to the PV and GHA studies, seasonal fluctuations and levels of activity is not applicable to the PV and GHA facilities and therefore the passive data graphs are not displayed or discussed in this report.

The data from the four passive systems was fully analysed and discussed in Animalia Consultant's Final EIA Report for Camden I WEF.

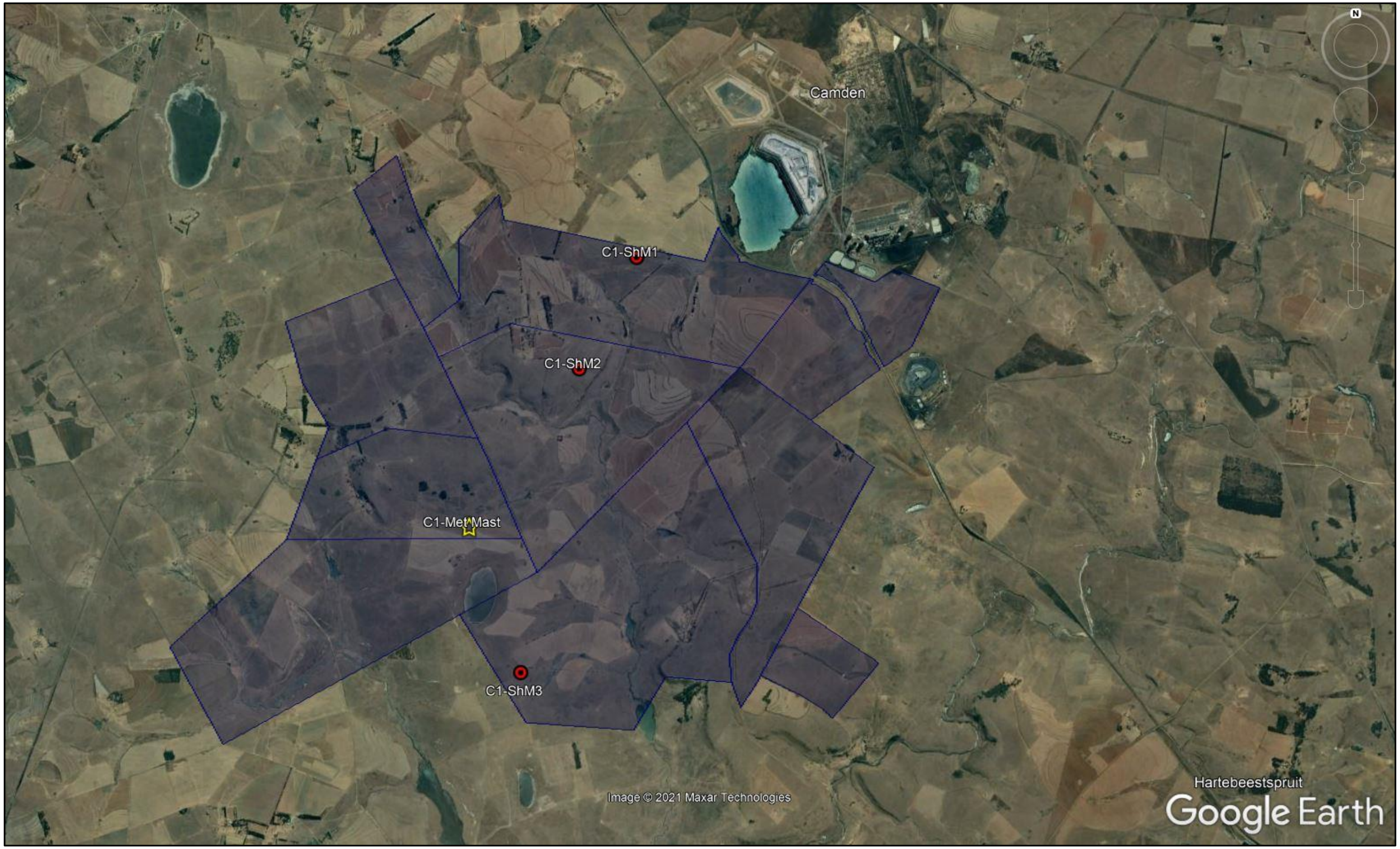

Figure 3.1. Positions of the passive bat detection systems on site used for the WEF study. The three Short Mast systems, ShM1, ShM2 and ShM3 are shown (red circles), as well as the location of the Meteorological Mast (Met1) system (yellow star).

3.3 Bat Sensitivity Mapping

Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and medium sensitivities relating to bat species ecology and habitat preferences. The map considers man-made structures and habitat alterations (such as dams), as well as natural terrain features that are likely to offer roosting and foraging opportunities for bat species found in the broader site area. Clumps of trees (as opposed to scattered or single trees) offer significantly better roosting and foraging habitat on this site; they have received priority during sensitivity mapping.

3.4 Assumptions and Limitations

As with any environmental study, there are certain assumptions and limitations that exist around the current knowledge we possess regarding bats and their behaviour, movements and distribution. Some important points are discussed briefly below:

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.
- The sensitivity map is based partially on satellite imagery and from detailed site visits, although given the large extent of the site, there is always the possibility that what has been mapped may differ slightly to what is on the ground.

4 RESULTS AND DISCUSSION

4.1 Land Use, Vegetation, Climate and Topography

The proposed Camden I REC with associated solar and GHA facilities falls within the Grassland Biome, and the Mesic Highveld Grassland Bioregion. The vegetation units found on site includes only Eastern Highveld Grassland (Figure 4.1, Mucina & Rutherford 2012). The general geology for these vegetation unit on site includes dolerite and arenite formations, which are not prone to cave formation suitable for roosting bats. Land use type is predominantly agricultural in nature and consists of grazing for livestock and ploughed soil for mixed crops.

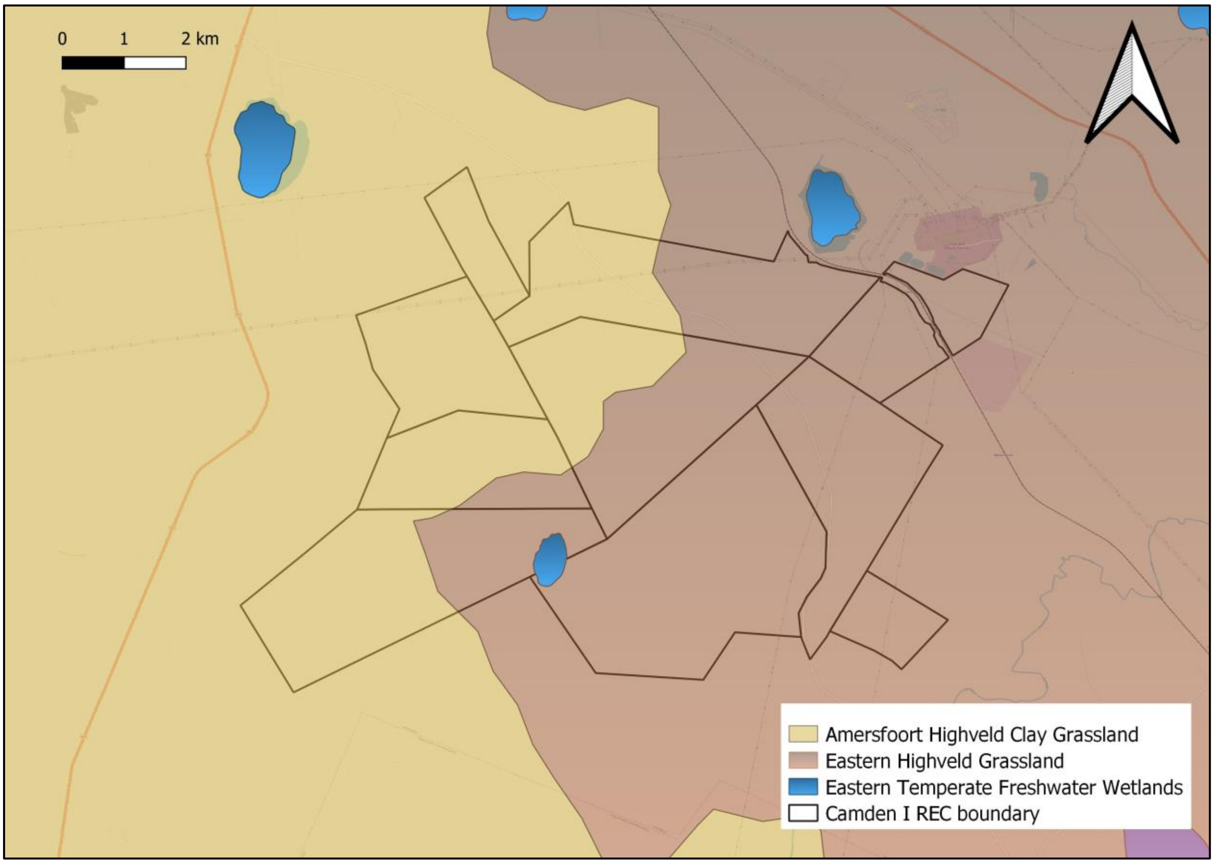

Figure 4.1. Vegetation units present on the proposed Camden I Solar and GHAF Site (Mucina & Rutherford 2012). Only Eastern Highveld Grassland is applicable to the Camden I Solar and GHAF developments.

4.1.1 Eastern Highveld Grassland

The Eastern Highveld Grassland vegetation unit is present on the Camden I REC to the east and south of site, and consists of slight to moderate undulating plains of short dense grassland cover. Important taxa include *Aristida*, *Digitaria*, *Eragrostis*, *Themeda* and *Tristachya*. Some rocky outcrops may occur, with associated sour grasses and certain woody species. There is a strongly seasonal rainfall pattern; precipitation ranges from 650 – 900mm per annum, predominantly in the summer. Very limited areas of this vegetation unit are currently conserved in statutory reserves and overall, the unit is endangered (Mucina & Rutherford 2006).

4.2 Currently Confirmed, Previously Recorded and Literature-based Species Probability of Occurrence

Table 4.1 below indicates the species of bat which have been confirmed to occur on site, those unconfirmed species which may potentially occur on site, as well as those occurring in the broader area of the site based on literature review.

Table 4.1. Species currently confirmed on site, previously recorded in the area, or potentially occurring. Roosting and foraging habitats in the study area, conservation status are also briefly described per species (Monadjem *et al*. 2020).

Species	Common name	Occurrence in area*	Conservation status (SANBI & EWT, 2016)	Possible roosting habitat on site	Possible foraging habitat utilised on site
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.
Mops midas	Midas free-tailed bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.
Mops (Chaerephon) pumilus	Little free-tailed bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.
Laephotis (Neoromicia) capensis	Cape serotine	Confirmed on site	Least Concern (2016 Regional Listing)	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. Predominantly a medium height clutter edge forager on site.

Laephotis zuluensis	Zulu serotine	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Predominantly a medium height clutter edge forager on site.
Laephotis nanus	Banana bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and in the folded leaves of banana trees in the larger area.	Predominantly a medium height clutter edge forager on site.
Pipistrellus hesperidus	Dusky pipistrelle	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Prefers vegetation edges and clutter with open water sources.
Miniopterus natalensis	Natal long-fingered bat	Confirmed on site	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager. May forage in more open terrain during suitable weather.
Miniopterus fraterculus	Lesser long-fingered bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Clutter-edge forager. May forage in more open terrain during suitable weather.
Eptesicus hottentotus	Long-tailed serotine	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	It is a crevice dweller roosting in rock crevices in the larger area, as well as other crevices in buildings.	It generally seems to prefer woodland habitats, and forages on the clutter edge. But may still forage over open terrain occasionally.
Myotis tricolor	Temmink's myotis	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager. May forage in more open terrain during suitable weather.

Rhinolophus blasii	Blasius's horseshoe bat	Confirmed in 100km radius	Near Threatened (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.
Rhinolophus clivosus	Geoffroy's horseshoe bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.
Rhinolophus swinnyi	Swinny's horseshoe bat	Confirmed in 100km radius	Vulnerable (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.
Rhinolophus simulator	Bushveld horseshoe bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.
Scotophilus dinganii	Yellow-bellied house bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roofs of buildings and other suitable hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.
Cloeotis percivali	Percival's short-eared trident bat	Confirmed in 100km radius	Endangered (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.
Epomophorus wahlbergi	Wahlberg's epauletted fruit bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts in dense foliage of large, leafy trees in the larger area, and may travel several kilometres each night to reach fruiting trees.	Feeds on fruit, nectar, pollen and flowers. If and where available on or near site.
Eidolon helvum	African straw-coloured fruit bat	Possible as migrant	Least Concern (2016 Regional Listing) (Globally Near threatened)	Non-breeding migrant with sparse scattered records.	Feeds on fruit, nectar, pollen and flowers, if and where available on site.

*Occurrence of species records based on ACR 2020 and Monadjem *et al*. 2020

4.3 Conservation and protected areas, known sensitivities and caves/roosts within 100km of the site

There is only a single conservation area within 100km of Camden I REC, namely the RAMSAR-recognised Seekoeivlei Nature Reserve of approximately 4 300 ha on the outer extent of the 100km boundary (see Figure 4.2). This has no bearing on the current site and will not be discussed further.

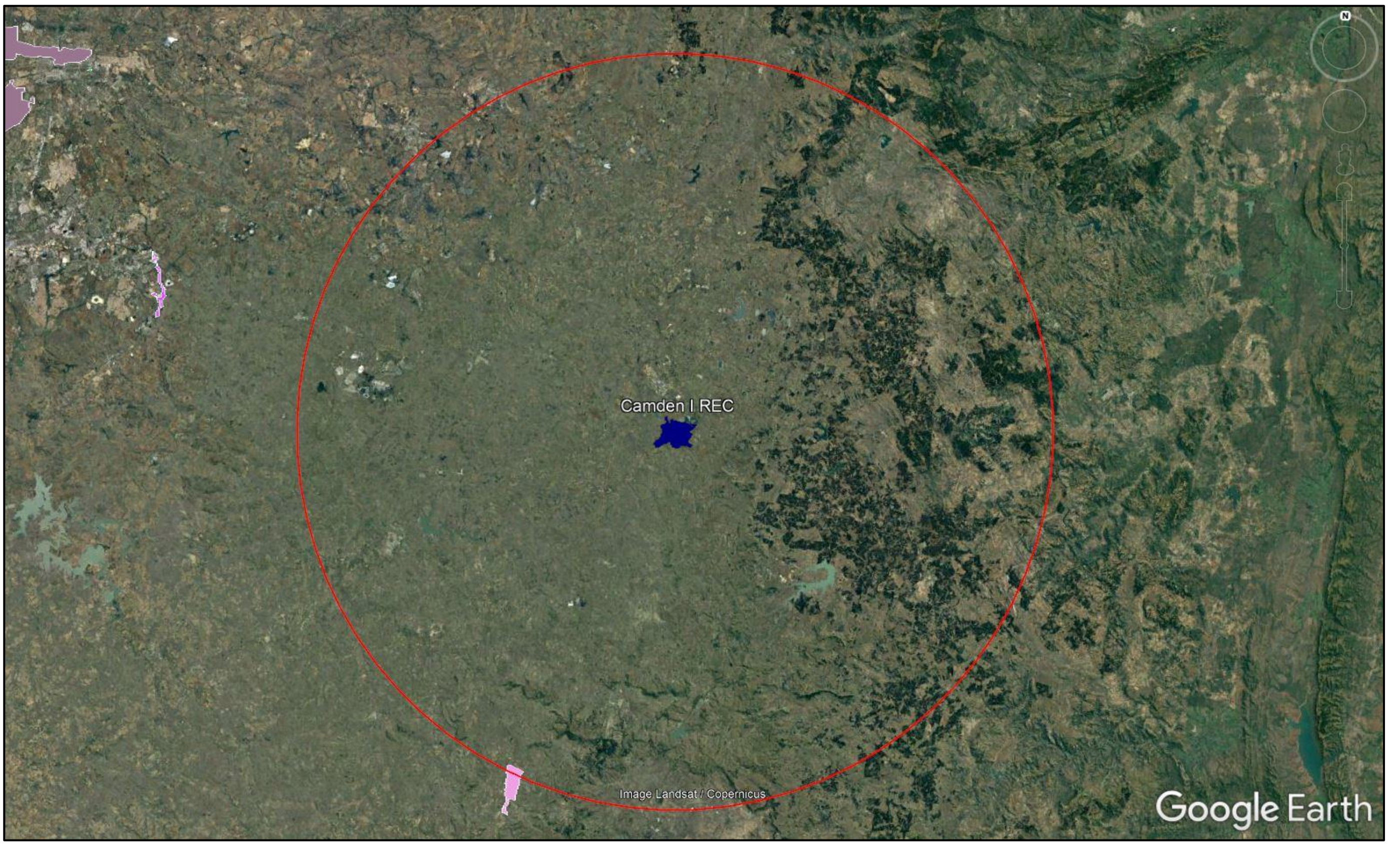

Figure 4.2. Protected areas within a radius of approximately 100km (red line) around the Camden I REC site (DEA, 2021)

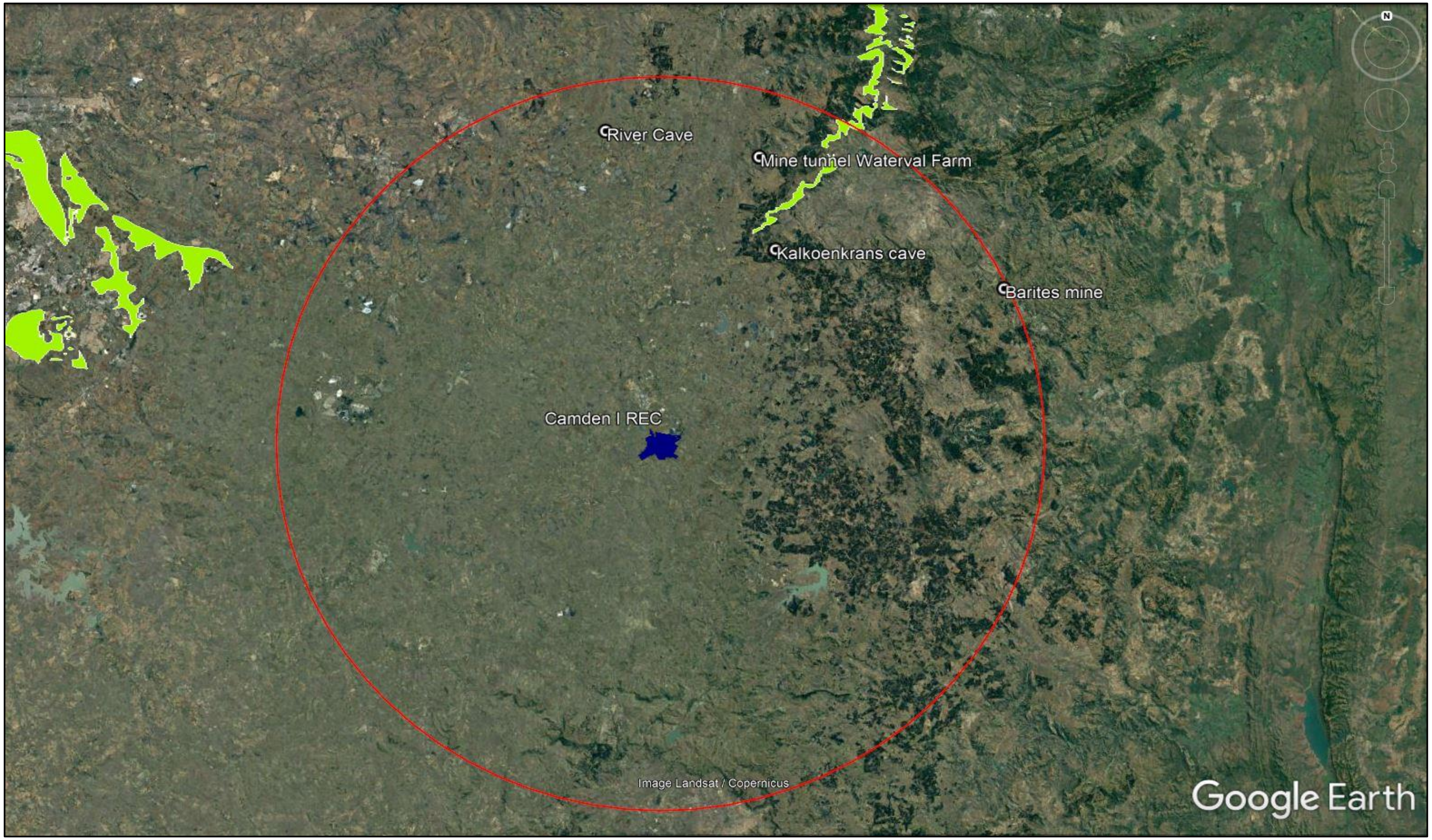

Figure 4.3. Approximate 100km radius (red circle) surrounding Camden I WEF (navy shape). Dolomite geology represented in lime green (SEA data), and four known bat roosts depicted with white circles.

Figure 4.3 shows the dolomitic geology of the greater area, with an approximate 100km site boundary radius shown in red. At its nearest, this extends to approximately 65km north-east of the REC. Dolomite is known to be prone to good cave formation, and many bat colonies are supported in such caves in the country, particularly in the province of Gauteng. Museum records of bats collected from two caves and two mines within approximately 100km of the site exist. Specimens of *Miniopterus. natalensis* and *Rhinolophus clivosus* were collected from River Cave (96km north of site); *R. simulator*, *Myotus tricolor* and *Cloeotis percivali* from a mine tunnel on Waterval Farm (91km north), *R. simulator*, *R. blasii*, *R. clivosus* and *Miniopterus fraterculus* from Kalkoenkrans Cave (64km north-east) and *Miniopterus. natalensis* from Barites mine (108km northeast). The habitat preferences and sensitivity of these species have been discussed in Table 4.1.

The Strategic Environmental Assessment (SEA) assigns 5km buffers to large bat roosts for PV energy, therefore any of the existing or possible cave/roost locations may be assigned a buffer up to 5km if they are found to be supporting large enough bat colonies. All of the above locations are further than 5km from the proposed site. The cave/roost buffers assigned by the SEA may be subject to change based on field-verified observations and roost buffers recommended by the South African Good Practice Guidelines for Surveying Bats (pre-construction) at Wind Energy Facility Developments (MacEwan *et al*. 2020).

The Department of Forestry, Fisheries & the Environmental (DFFE) Screening Tool (accessed 03/12/2021) was consulted and does not have a “Bat” theme pertaining to PV or GHA technology. It is important to note that the Screening Tool provides only a relatively low-level assessment of possible sensitivities.

4.4 Sensitivity Map

Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and medium sensitivities relating to bat species ecology and habitat preferences, where high sensitivities are no-go zones for infrastructure specified in Table 4.2 and Table 4.3. Medium sensitivities indicate areas of probable increased risk due to seasonal fluctuations in bat activity. Figure 4.4 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

Table 4.2. Description of parameters used in the development of the sensitivity map.

Last revision	**November 2021**
High sensitivities	Stands and clusters of tall trees
	Pans and depressions
	Dams
	Drainage lines capable of supporting riparian vegetation which in turn increases localised insect abundance.
	Other water bodies and other sensitivities such as manmade structures, buildings, houses, barns, sheds.
Medium sensitivities	Seasonal wetlands
	Seasonal drainage lines

Table 4.3. The significance of sensitivity map categories for each infrastructure component for PV & GHA technologies.

Sensitivity	PV panels and buildings, and GHA buildings	Roads and cables	Internal overhead transmission lines	Substation and construction camp/yards)
High Sensitivity	These areas are 'no-go' zones for infrastructure where earthworks and vegetation clearing are required.	Preferably keep to a minimum within these areas where practically feasible.	Allowed inside these areas.	Avoid these areas.
Medium Sensitivity	Not favourable for infrastructure where earthworks and vegetation clearing are required, excluding the other infrastructure mentioned in this table.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.

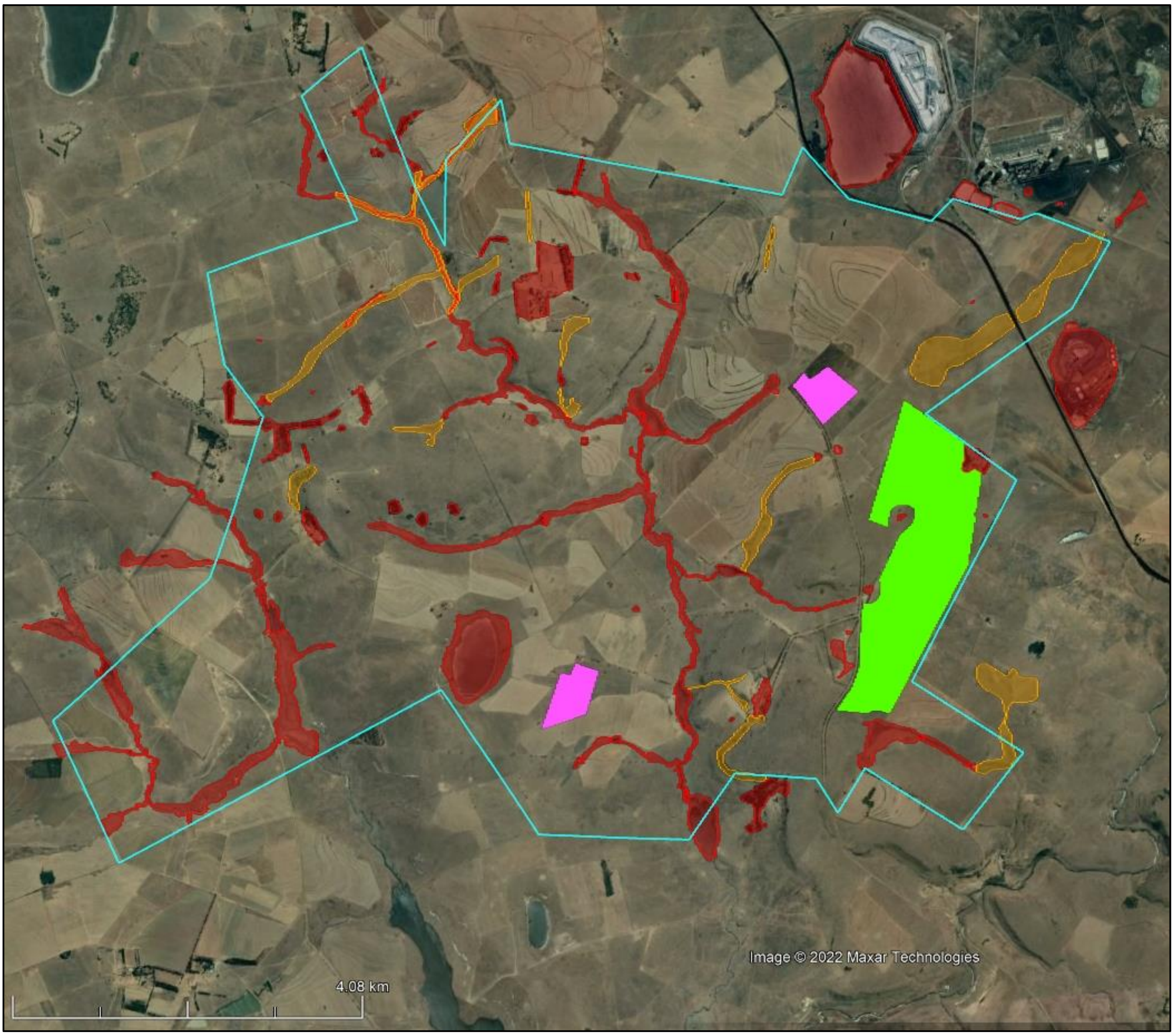

Figure 4.4. Bat sensitivity map of the site. Site area indicated in a blue boundary, proposed PV in green, proposed GHA in purple. Shaded red = high sensitivity; Shaded orange = medium sensitivity. The layout depicted adheres to the sensitivities identified in Table 4.3.

4.5 Cumulative impact consideration within a 30km radius

No cumulative impacts for the proposed Camden I PV and GHA projects are identified, since no other PV or GHA facilities are proposed within a 30km radius of the site.

5 IMPACT ASSESSMENT

Table 5.1Table 2.1 below indicates the identified impacts associated with the proposed Camden I PV and GHA facilities during the construction and operational phases. No significant impacts are identified for the decommissioning phase.

5.1 Photovoltaic (PV) facility Impact Assessment

Table 5.1. Identified potential impacts of the proposed Camden I PV project as well as possible mitigation measures.

Potential impact	Possible mitigation
Construction phase	
Loss of foraging habitat by clearing of vegetation.	Adhere to the sensitivity map criteria. Rehabilitate cleared vegetation where possible at areas such as laydown yards.
Roost destruction during earthworks.	Adhere to the sensitivity map criteria.
Operational phase	
Increased bat mortalities due to light attraction and habitat creation.	Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby while still adhering to safety and security requirements, to prevent the creation of regular insect gathering pools. For buildings, avoid tin roofs and roof structures that offer entrance holes into the roof cavity.

No cumulative impacts for the proposed Camden I PV are identified, since no other PV facilities are proposed within a 30km radius of the Camden I site.

Table 5.2. Impact assessment for Construction phase.

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Loss of foraging habitat by clearing of vegetation.	Construction activities, temporary and long term, such as construction yards and PV panel arrays, will clear vegetation supporting bat insect prey.	Construction	Negative	Easy	3	1	2	4	4	**40**	**N3**	3	1	1	4	3	**27**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 2:	Roost destruction during earthworks.	Construction activities may possibly disturb or destroy bat roosts in tall trees. Forcing bats to find alternative roosts.	Construction	Negative	Easy	3	1	3	4	3	**33**	**N3**	3	1	3	4	1	**11**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						

Table 5.3. Impact assessment for Operational phase.

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Increased bat mortalities due to light attraction and habitat creation.	Floodlights and other lights at buildings or structures that are placed close to wind turbines (applicable to the proposed Camden I and Camden II WEF's), will attract bats preying on insects and therefore significantly increase the likelihood of these bats being impacted on by the wind turbines. Habitat creation in the roofs of nearby buildings can cause a similar increased risk factor.	Operational	Negative	Easy	4	1	4	4	4	**52**	**N3**	4	1	4	4	2	**26**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						

5.2 Green Hydrogen and Ammonia (GHA) facility Impact Assessment

Table 5.4. Identified potential impacts of the proposed Camden I GHA project as well as possible mitigation measures.

Potential impact	Possible mitigation
Construction phase	
Loss of foraging habitat by clearing of vegetation.	Adhere to the sensitivity map criteria. Rehabilitate cleared vegetation where possible at areas such as laydown yards.
Roost destruction during earthworks.	Adhere to the sensitivity map criteria.
Operational phase	
Increased bat mortalities due to light attraction and habitat creation.	Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby while still adhering to safety and security requirements, to prevent the creation of regular insect gathering pools. For buildings, avoid tin roofs and roof structures that offer entrance holes into the roof cavity.

No cumulative impacts for the proposed Camden I GHA project are identified, since no other GHA facilities are proposed within a 30km radius of the Camden I site.

Table 1.5. Impact assessment for Construction phase.

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Loss of foraging habitat by clearing of vegetation.	Construction activities, temporary and long term, such as construction yards and clearing and grubbing, will clear vegetation supporting bat insect prey.	Construction	Negative	Easy	3	1	2	4	4	**40**	**N3**	3	1	1	4	3	**27**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 2:	Roost destruction during earthworks.	Construction activities may possibly disturb or destroy bat roosts in tall trees. Forcing bats to find alternative roosts.	Construction	Negative	Easy	3	1	3	4	3	**33**	**N3**	3	1	3	4	1	**11**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						

Table 1.61. Impact assessment for Operational phase.

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Increased bat mortalities due to light attraction and habitat creation.	Floodlights and other lights at buildings or structures that are placed close to wind turbines (applicable to the proposed Camden I and Camden II WEF's), will attract bats preying on insects and therefore significantly increase the likelihood of these bats being impacted on by the wind turbines. Habitat creation in the roofs of nearby buildings can cause a similar increased risk factor.	Operational	Negative	Easy	4	1	4	4	4	**52**	**N3**	4	1	4	4	2	**26**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						

6 POSSIBLE MITIGATION MEASURES

The correct placement of PV and GHA facilities, and the application of sufficient sensitivity maps for these technologies can significantly lessen the impacts on bat fauna in an area, and should be considered as the preferred and initial layer of mitigation.

With regards to the above-mentioned technologies, an essential mitigation to implement in the design of the facility is to keep artificial lighting to a minimum at infrastructure buildings, while still adhering to safety and security requirements. For example, this can be achieved by having floodlights down-hooded, installing passive motion sensors onto lights around buildings, and possibly utilising lights with lighting colours that attract fewer insects. Light pollution will impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light-averse) species and favouring species that readily forage around insect-attracting lights.

6.1 For PV technology

The primary impacts predicted for these facilities are destruction of bat roosting and foraging habitats during construction which can also lead to accidental bat fatalities if a roost is destroyed. This applies for micro roosts that may be present in tall vegetation (such as trees), buildings. Light pollution is also a significant factor to be considered.

An effective mitigation is to adhere to the bat sensitivity map during all phases of the facility's operation, thus avoiding all bat sensitive areas. This also applies to temporary activities such as storage yards and construction offices. Vegetation should be allowed to recover where it was cleared after the construction and decommissioning of the facility.

All lights on substation and/or Operations and Management (O&M) buildings, should be down-hooded and connected to motion sensors (where safe to do so), to minimise light pollution. Light pollution can attract bats that readily forage on insects attracted to light sources, significantly increasing the likelihood of collisions with wind turbines if PV infrastructure lighting is placed close to turbines.

Since it is not possible to discover all bat roosts or individual roosting bats, it remains possible that bat roosts could be present in terrain not identified or anticipated to be roosting habitat in the sensitivity map; roosts may subsequently be damaged and bat fatalities may occur. This is due to the large size of renewable energy development sites as well as the elusive nature of many roosting bat species in micro roosts, as well as their capability to roost in very small and/or inconspicuous spaces.

6.1 **For GHA technology**

The primary impacts predicted for these facilities are destruction of bat roosting and foraging habitats during construction which can also lead to accidental bat fatalities if a roost is destroyed. This applies for micro roosts that may be present in tall vegetation (such as trees), buildings. Light pollution is also a significant factor to be considered.

An effective mitigation is to adhere to the bat sensitivity map during all phases of the facility's operation, thus avoiding all bat sensitive areas. This also applies to temporary activities such as storage yards and construction offices. Vegetation should be allowed to recover where it was cleared after the construction and decommissioning of the facility.

All lights on substation and/or Operations and Management (O&M) buildings, should be down-hooded and connected to motion sensors (while still adhering to safety and security requirements), to minimise light pollution. Light pollution can attract bats that readily forage on insects attracted to light sources, significantly increasing the likelihood of collisions with wind turbines if GHA infrastructure lighting is placed close to turbines.

Since it is not possible to discover all bat roosts or individual roosting bats, it remains possible that bat roosts could be present in terrain not identified or anticipated to be roosting habitat in the sensitivity map; roosts may subsequently be damaged and bat fatalities may occur. This is due to the large size of renewable energy development sites as well as the elusive nature of many roosting bat species in micro roosts, as well as their capability to roost in very small and/or inconspicuous spaces.

7 CONCLUSION

This Bat Environmental Impact Assessment Report considered information gathered from site visits between August 2020 and October 2021, literature, and satellite imagery. The bat species most likely to be impacted on by the proposed PV and GHA facilities are *Laephotis* (formally *Neoromicia*) *capensis*. This species is of special importance based on their likelihood of being impacted by the proposed PV and GHA facilities, due to their habit of roosting readily in building roofs and stands of tall trees. These more abundant species are of a large value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species, due to their higher numbers.

Currently there is no evidence of PV and GHA facilities posing a direct threat of fatality impact on bats during operation. However, roosting and foraging habitats may be significantly impacted during the construction phase. This is primarily due the fact that such facilities require large areas of land to be cleared, and in some cases, earthworks are required for levelling purposes. This can result in habitat that is suitable for micro roosts, such as clumps of trees and certain vegetation being destroyed, which can also be fatal to bats residing in such roosts. Natural vegetation can support higher insect food quantities and diversity than cleared land, therefore foraging habitat can also be displaced, especially by solar facilities.

The presence of security lights on and around these facilities creates significant light pollution that can impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light averse) species and favouring species that readily forage around insect-attracting lights. Additionally, if the buildings and associated infrastructure for these facilities are placed close to wind turbines, the light pollution at these buildings can attract photophilic bat species, thereby significantly increasing their chances of being killed by moving blades of turbines within close proximity.

The Strategic Environmental Assessment (SEA) assigns 5km buffers to large bat roosts for PV energy, therefore any of the existing or possible cave/roost locations may be assigned a buffer up to 5km if they are found to be supporting large enough bat colonies. All of the above locations are further than 5km from the proposed site. Figure 4.3 shows the dolomitic geology of the greater area, with an approximate 100km site boundary radius shown in red. At its nearest, the dolomite extends to approximately 65km north-east of the REC. Dolomite is known to be prone to good cave formation, and many bat colonies are supported in such caves in the country, particularly in the province of Gauteng. Museum records of bats collected from two caves and two mines within approximately 100km of the site exist. Specimens of *Miniopterus. natalensis* and *Rhinolophus clivosus* were collected from River Cave (96km north of site); *R. simulator*, *Myotus tricolor* and *Cloeotis percivali* from a mine tunnel on Waterval Farm (91km north), *R. simulator*, *R. blasii*, *R. clivosus* and *Miniopterus fraterculus* from Kalkoenkrans Cave (64km north-east) and *Miniopterus natalensis* from Barites mine (108km northeast). All of the above locations are further than 50km from the proposed site.

A sensitivity map was drawn up indicating potential roosting and foraging areas. The High Bat Sensitivity areas are expected to have elevated levels of bat activity and support greater bat diversity. High Bat Sensitivity areas are 'no–go' areas for specific infrastructure specified in Table 4.3. Avoidance is the most affective mitigation measure for reducing the impact on bats, and should be implemented as the first layer of mitigation. The proposed layout adheres to the sensitivity map provided.

From a bat impact perspective, no reasons have been identified for the proposed Camden I PV and GHA facilities not to proceed to the Environmental Authorisation phase.

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