ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED ENAMANDLA PV4 SOLAR POWER PLANT:

FAUNA & FLORA SPECIALIST ASSESSMENT

PRODUCED FOR WSP

ON BEHALF OF BIOTHERM ENERGY (PTY) LTD

BY

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CONTENTS

NEMA 2014 CHECKLIST

Section		*NEMA 2014 Regulations for Specialist Studies*	Position in report (pg.)	check
1	1	A specialist report prepared in terms of these Regulations must contain—		
	(a)	details of-		
		(i) the specialist who prepared the report; and	See Main Report	
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	See Main Report	
	(b)	a declaration that the person is independent in a form as may be specified by the competent authority;		✓
	(c)	an indication of the scope of, and the purpose for which, the report was prepared;	4	✓
	(d)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	5-6	✓
	(e)	a description of any assumptions made and any uncertainties or gaps in knowledge;	6	✓
	(f)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	10-26	✓
	(g)	recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	26-34	✓
	(h)	a description of any consultation process that was undertaken during the course of carrying out the specialist report;	See main EIA report	✓
	(i)	a summary and copies of any comments that were received during any consultation process; and	See main EIA report	✓
	(j)	any other information requested by the competent authority.		
	2	Where a proposed development and the geographical area within which it is located has been subjected to a pre-assessment using a spatial development tool, and the output of the pre-assessment in the form of a site specific development protocol has been adopted in the prescribed manner, the content of a specialist report may be determined by the adopted site specific development protocol applicable to the specific proposed development in the specific geographical area it is proposed in.	N/A	✓

PROFESSIONAL PROFILE OF CONSULTANT:

Simon Todd Consulting has extensive experience in the assessment of renewable energy developments, having provided ecological assessments for more than 80 different renewable energy developments. This includes a large number of developments in the immediate vicinity of the current site as well as in the broader Northern Cape Province. Simon Todd is a recognised ecological expert and is a past chairman and current executive committee member of the Arid-Zone Ecology Forum and has 18 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

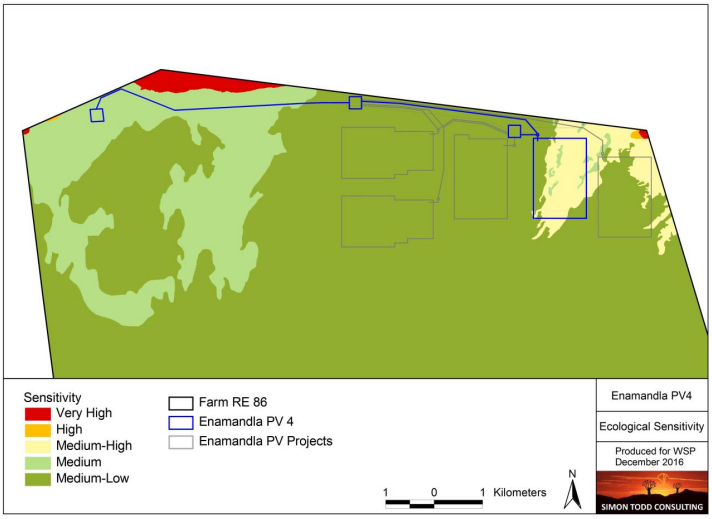
Recent experience and relevant projects in the vicinity of the current site include specialist fauna and flora studies for the following developments in the area:

- 75MW Solar PV Plant on Suurwater 62, Aggeneys. Cape EAPRac. 2013.
- Walkthrough of Biotherm Energy – Aggeneys Solar Farm. Savanah Environmental 2015.
- Gamsberg Zinc Mine - Concentrator Plant And Associated Infrastructure. ERM 2013.
- Pella Water Board – Pipeline to Aggeneys. ERM. 2012.
- Sol Invictus 1-4 PV Plants & Grid Connection, Aggeneys. Savannah Environmental. 2016.
- Konkoonsies Solar PV Plant. EScience Associates. 2012.
- Konkoonsies Solar II Grid Connection. Savannah Environmental 2015.
- Konkoonsies II walk- through. Savananh Environmental 2015.
- Putsberg Open Cast Mine, Pofadder. Ecopartners. 2013.

EXECUTIVE SUMMARY

BioTherm Energy (Pty) Ltd is proposing to develop the Enamandla PV 4 power plant on Hartebeest Vlei 86, situated approximately 18 km south of Aggeneys in the Northern Cape Province. The plant would occupy an area of approximately 350ha and would also include a connection to an on-site substation. This terrestrial fauna and flora specialist study details the ecological characteristics of the site and provides an assessment of the likely ecological impacts associated with the development of the PV Plant. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development. A site visit and a desktop review of the available ecological information for the area were used to identify and characterize the ecological features of the site and develop an ecological sensitivity map for the site, which is depicted below.

The development footprint is restricted to the Bushmanland Arid Grassland vegetation type, which is one of the most extensive vegetation types in South Africa. The Enamandla PV 4 site itself is an open, gently sloping plain, mostly on deep red soils with low dunes in the north and some areas of shallower soils in the west. The vegetation consists of *Stipagrostis* grasslands across the whole site, with some shifts in dominance related to the depth and texture of the soil. The vegetation is dominated by grasses with typical and dominant species including *Stipagrostis ciliata*, *S.brevifolia*, *S.obtusa*, *Cladoraphis spinosa*, *Brachiaria glomerata*, *Leucophrys mesocoma*, shrubs are occasional and include *Asparagus retrofractus*, *Requienia sphaerosperma*, *Pomaria lactea*, *Hermannia tomentosa* and *Hermannia gariepina*.



The majority of the development footprint is within an area that is considered medium-high sensitivity with some areas of medium and medium low sensitivity. The sensitivity is related to the sandy substrate and not to the composition of the vegetation *per se*. The deep sands which characterise a large proportion of the site are vulnerable to disturbance and wind erosion. However, with careful mitigation, it is likely that this risk can be managed and reduced to an acceptable level. In terms of the fauna and flora present, the site is not considered highly sensitive.

The potential for cumulative impacts is a concern given the large number of proposed renewable energy projects in the wider area. However, the contribution of the Enamandla PV 4 site to cumulative habitat loss would be low and even if all current projects are built, it is

estimated that this would amount to only 0.66% of the landscape. As this impact is concentrated within the Bushmanland Arid Grassland plains habitat, which is very widespread and of low diversity, the overall cumulative impact of development in the area is relatively low and a significant impact on biodiversity is not likely. The more sensitive elements of the landscape are currently outside of the development footprint of the proposed PV and wind farms of the area.

Due to the arid nature of the area, it is important that the mobility of fauna in the area is not compromised, as many arid-adapted fauna respond to the unpredictability of these systems by moving extensively across the landscape. The connectivity of the landscape should be maintained by making provision for some undeveloped corridors between the proposed facilities to facilitate movement through this area. There are however no identified corridors within the site that are currently likely to be important for fauna.

Provided that the erosion risks associated with development on the deep sands of the site can be appropriately managed, then, the primary impact of the development is likely to be some local-scale habitat loss for fauna and flora within the development footprint affecting the sandy plains habitat of the site. Overall and with the suggested mitigation measures implemented, the impact of the Enamandla PV 4 development would be of low magnitude and of local significance only. As such, the development is considered acceptable from a terrestrial ecological perspective.

Summary assessment of the impacts associated with the Enamandla PV 4 plant, for the different phases of the development, before and after mitigation.

Phase & Impact	Before Mitigation	After Mitigation
Planning & Construction Phase		
Impacts on vegetation and protected plant species:	Medium	Low
Faunal impacts due to construction activities	Medium	Low
Areas disturbed during construction will be vulnerable to wind and water erosion.	Medium	Low
Operational Phase		
Faunal Impacts due to Operation	Medium	Low
Alien invasive plants impacts	Medium	Low
Following construction, disturbed areas will remain vulnerable to erosion	Medium	Low
Decommissioning Phase		
Following decommissioning, the site will remain vulnerable to erosion	Medium	Low
Impacts on fauna due to decommissioning	Low	Low

Following decommissioning, the site will remain vulnerable to alien plant invasion	Medium	Low
Cumulative Impacts		
Reduced ability to meet conservation targets	Low	Low
Cumulative habitat loss and impacts on broad-scale ecological processes and loss of landscape connectivity	Medium	Low

1 INTRODUCTION

BioTherm Energy (Pty) Ltd is proposing to develop the Enamandla PV 4 solar PV plant on Hartebeest Vlei 86, situated approximately 13km southeast of Aggeneys in the Northern Cape Province. The plant would occupy an area of approximately 360ha and would also include a connection to an on-site substation. The power generated would be evacuated to the Eskom network via a 400kV overhead power line to the Aggeneys substation, which is subject to its' own environmental assessment process and is not considered here.

WSP are conducting the required environmental authorization process for the Enamandla PV4 solar development and have appointed Simon Todd Consulting to provide the terrestrial fauna and flora input for the development. The scoping report for the development has been accepted by DEA and the study is now in the EIA phase. As such, this terrestrial fauna and flora specialist details the ecological characteristics of the site and provides an assessment of the likely ecological impacts associated with the development of the PV Plant. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development.

2 STUDY APPROACH

2.1 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 may be affected by the proposed project.
- A description and evaluation of environmental issues and potential impacts (including assessment of direct, indirect and cumulative impacts) that have been identified.
- 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 of the development.
- A description and comparative assessment of all alternatives including cumulative impacts
- 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 issue 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.

2.2 ASSESSMENT APPROACH & PHILOSOPHY

The assessment is conducted according to the EIA Regulations, published by the Department of Environmental Affairs (2014) as well as 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.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:
The study will include data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:

- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

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

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

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)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species);
    - or, are of cultural significance.

- Provide monitoring requirements as input into the Environmental Management Programme (EMPr) for faunal related issues.

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.

2.3 RELEVANT ASPECTS OF THE DEVELOPMENT

The proposed Enamandla PV4 facility will comprise the following components:

- Photovoltaic Panels with either fixed axis mounting or single axis tracking solutions. Panels will be crystalline silicon or thin film technology;
- The panels will occupy an area of approximately 350ha, with a total peak generation capacity of 75MW.
- An onsite 132/400kV Substation, with the transformers for voltage step up from medium voltage to high voltage. Substation will occupy an area of 150m x 150m;

- Powerlines of up to and including 132kV is proposed and will run to the onsite substation;
- A laydown area of approximately 5ha for the temporary storage of materials during the construction activities;
- Access roads and internal roads of approximately 5m wide;
- Administration, control and warehouse buildings.

2.4 LIMITATIONS & ASSUMPTIONS

The major potential limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally, a site should be visited several times during different seasons to ensure that the full complement of plant and animal species present are captured. However, this is rarely possible due to time and cost constraints and therefore, the representivity of the species sampled at the time of the site visit should be critically evaluated.

The main site visit for the current study took place in April 2016 which is usually the end of the wet season in the area. The wet season had however been relatively poor and it was relatively dry over most parts of the site. There had however been some rains preceding the site visit and some parts of the site, especially areas of deeper sands were relatively wet with a high abundance of annuals and geophytes. Even within the drier parts of the site the shrubs and grasses present were green or had flowered and could be identified. As a result, the results of the site visit are considered reliable and additional fieldwork at the site would be unlikely to change the assessed sensitivity of the site. The desktop component of the study imposes some limitations as the available maps and databases do not have a high resolution and many areas have not been well sampled in the past. As a result, these databases may underestimate the diversity of the site. This is to some extent countered in the current study by previous experience of the specialist in the immediate area and knowledge of the nature and distribution of sensitive features in the area.

The lists of amphibians, reptiles and mammals for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach which takes the study limitations into account.

3 METHODOLOGY

3.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes the following:

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Critical Biodiversity Areas for the site and surroundings were extracted from the Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008) and the recently developed Northern Cape Provincial Biodiversity Plan, developed by the Department of Environment and Nature Conservation, Northern Cape.
- Information on plant and animal species recorded for the Quarter Degree Squares (QDS) 2918 was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has probably not been well sampled in the past.
- The IUCN conservation status (Figure 1) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2016).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011). This includes rivers, wetlands and catchments defined under the study.
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna:

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 2016 (See Figure 1) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. To address this shortcoming, the distribution of

reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted.

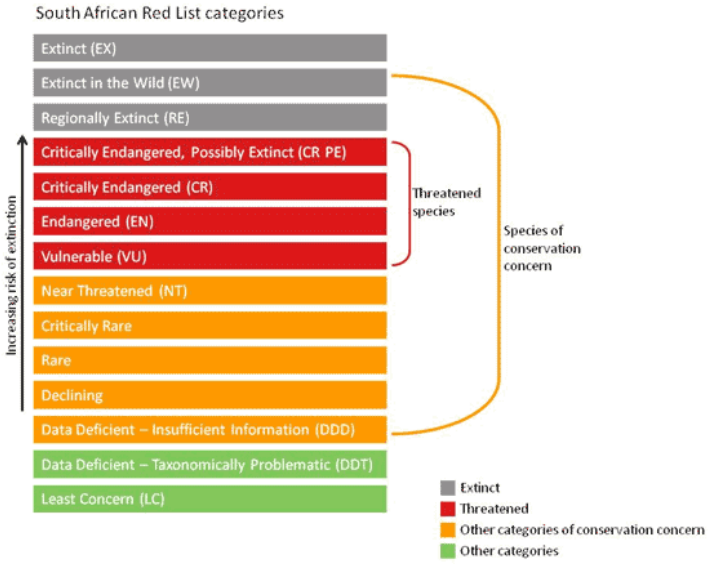


Figure 1. Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

3.2 SITE VISIT

The site was visited on 1st and 2nd of April 2016. During the site visit, the different biodiversity features, habitat, and landscape units present at the site were identified and mapped in the field. Specific features visible on the satellite imagery of the site were also marked for field inspection and were verified and assessed during the site visit. This included features such as any pans and rocky outcrops that were not visible from the access roads of the site and might have otherwise been missed. Walk-through-surveys were conducted within representative areas across the different habitats units identified and all plant and animal species observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site. Apart from the above site visit, the area has been visited by the consultant on multiple occasions in the past, especially the water supply pipelines which lie within corridors that were previously assessed for other developments.

3.3 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases. This includes delineating the different habitat units identified in the

field and assigning sensitivity values to the units based on their ecological properties, conservation value and the potential presence of species of conservation concern.
The ecological sensitivity of the different units identified in the mapping procedure for the broad-scale sensitivity map was rated according to the following scale:

- **Low** – Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. Most types of development can proceed within these areas with little ecological impact.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. These areas usually comprise the bulk of habitats within an area. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact may occur due to the high biodiversity value, sensitivity or important ecological role of the area. These areas may contain or be important habitat for faunal species or provide important ecological services such as water flow regulation or forage provision. Development within these areas is generally undesirable and should proceed with caution as additional specific mitigation and avoidance is usually required to reduce impacts within these areas to acceptable levels. High sensitivity areas are also usually more sensitive to cumulative impact and the footprint within these areas should be kept low.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided. However, in case of linear features such as drainage lines, it may be necessary for access roads and other infrastructure to traverse such features. However no infrastructure should be located within such areas and other disturbance should be minimized. Excessive disturbance or impact to such areas may be considered to constitute a fatal flaw of the development and as such should be avoided and minimized as much as possible.
- In some situations, areas were also classified between the above categories, such as Medium-High, where it was deemed that an area did not fit well into a certain category but rather fell most appropriately between two sensitivity categories.

4 BASELINE DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 BROAD-SCALE VEGETATION PATTERNS

According to the national vegetation map (Mucina & Rutherford 2006), (Figure 2) the Enamandla PV4 site is restricted to the Bushmanland Arid Grassland vegetation type.

Bushmanland Arid Grassland vegetation type is an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45 478 km^2. It extends

from the study area around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due to the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type. Although a description of the dominant and characteristic species associated with this vegetation type is provided in Mucina & Rutherford, this is not repeated here, as the actual vegetation as observed at the site is described in Section 4.6 It is clear, given the large extent of Bushmanland Arid Grassland that the development would not significantly impact the extent of intact habitat of this vegetation type.

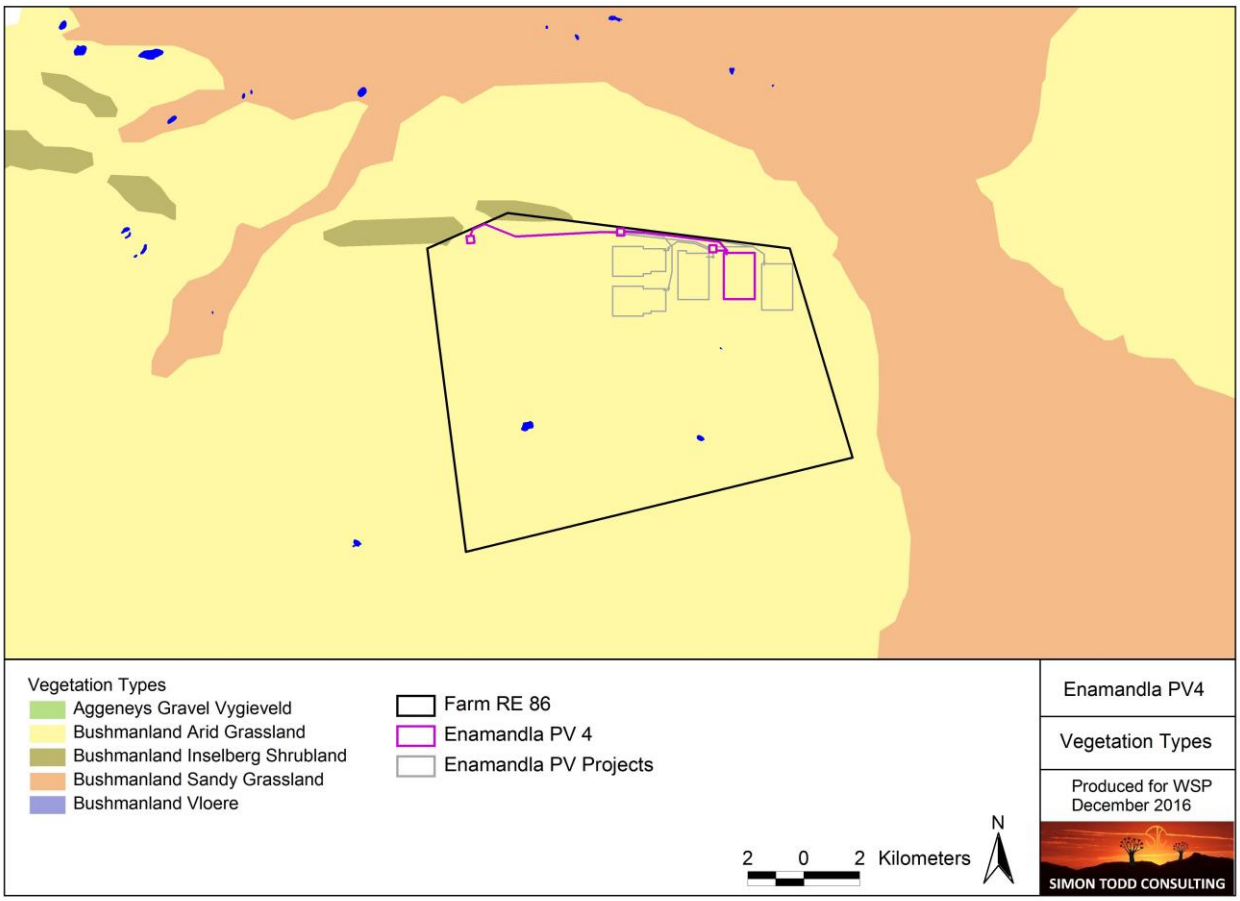


Figure 2. Broad-scale overview of the vegetation in and around the Enamandla PV4 solar site. The vegetation map is an extract of the national vegetation map as produced by Mucina & Rutherford (2006), and also includes rivers and wetlands delineated by the National Freshwater Ecosystem Priority Areas assessment (Nel et al. 2011).

4.2 LISTED AND PROTECTED PLANT SPECIES

According to the SANBI SIBIS database, 309 indigenous plant species have been recorded from the quarter degree squares 2918 AB, BA, AD and BC. This includes 11 species of conservation concern as listed below in Table 3. Only *Hoodia gordonii* can be confirmed present at the site and it is not likely that any of the other listed species are present at the site or within the development footprint of the PV facility. There are some *Boscia albitrunca* trees present on the hills of the area, which is a nationally protected species but would not be affected by the development which is restricted to the open plains. There are also some species protected under the Northern Cape Nature Conservation Act of 2009, which are present in the area including *Boscia foetida* subsp. *foetida* and all species within the *Mesembryanthemaceae*, *Euphorbiaceae*, *Oxalidaceae*, *Iridaceae* and all species within the genera *Nemesia* and *Jamesbrittenia*.

Table 2. Listed species known from the broad area around the site. These are largely restricted to rocky habitats and quartz patches, habitats which are not found within the PV4 study area. Of the species listed below, only *Hoodia gordonii* is likely to be present within the affected area.

Family	Species	Status
CRASSULACEAE	*Crassula decumbens var. brachyphylla*	NT
MESEMBRYANTHEMACEAE	*Conophytum limpidum*	NT
CRASSULACEAE	*Crassula exilis subsp. exilis*	Rare
FABACEAE	*Crotalaria pearsonii*	Rare
HYACINTHACEAE	*Lachenalia polypodantha*	Rare
MESEMBRYANTHEMACEAE	*Conophytum tantillum subsp. eenkokerense*	Rare
OXALIDACEAE	*Oxalis inconspicua*	Rare
ASTERACEAE	*Othonna euphorbioides*	Thr*
HYACINTHACEAE	*Daubenya namaquensis*	Thr*
MESEMBRYANTHEMACEAE	*Cheiridopsis rostrata*	VU
APOCYNACEAE	*Hoodia gordonii*	DDD
AMARYLLIDACEAE	*Brunsvigia namaquana*	DDT
ASTERACEAE	*Senecio glutinarius*	DDT
MESEMBRYANTHEMACEAE	*Drosanthemum breve*	DDT
AMARYLLIDACEAE	*Boophone disticha*	Declining

4.3 ALIEN PLANT SPECIES ABUNDANCE

Alien species abundance at the site is generally low, which can be ascribed to the very arid nature of the area. However, with disturbance and increased runoff from the facility, alien species may become more prevalent. The most conspicuous alien on the site is *Prosopis glandulosa* which has been planted to provide shade for livestock, but it has not spread and is not currently invading the site. The only other alien observed was *Salsola kali* which was

present near to some of the watering points. It was however relatively dry at the time of sampling and additional species are likely to appear after rains. Overall, the site can currently be considered very lightly to free of alien plant species and has not been significantly impacted by alien plants.

4.4 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

The site falls within the planning domain of the Namakwa Biodiversity Sector Plan (Desmet & Marsh 2008). However, this map has been replaced by the Northern Cape Conservation Plan which will be released in early 2017 (Oosthuysen & Holness, 2016). The Northern Cape Conservation Plan defines CBAs for the whole Northern Cape. In terms of this map, the site lies within an ecological support area, with some CBA level 2 areas to the north of the site (Figure 3). The extent of the ESA is large and the current development would not significantly compromise the overall functioning of the ESA. However, there a number of developments associated with the Enamandla and Letsoai facilities and cumulative impacts may be more significant, as discussed in the next section.

The site falls within a NPAES focus area, meaning that the area has been identified as a large currently intact area which has high biodiversity potential and is not currently well represented within the existing protected area network. The major concern in this regard is the availability of other similar habitat in the area. While the broader landscape contains several features and vegetation types of concern, these are outside of the study area; the typical Bushmanland grassy plains habitat within the site is very widely available in the area and the development of the site would not be likely to affect the availability of this habitat in the broader area. Therefore it is not likely that the development of the sites would significantly affect the Focus Area or the ability to meet conservation targets for the affected habitat types.

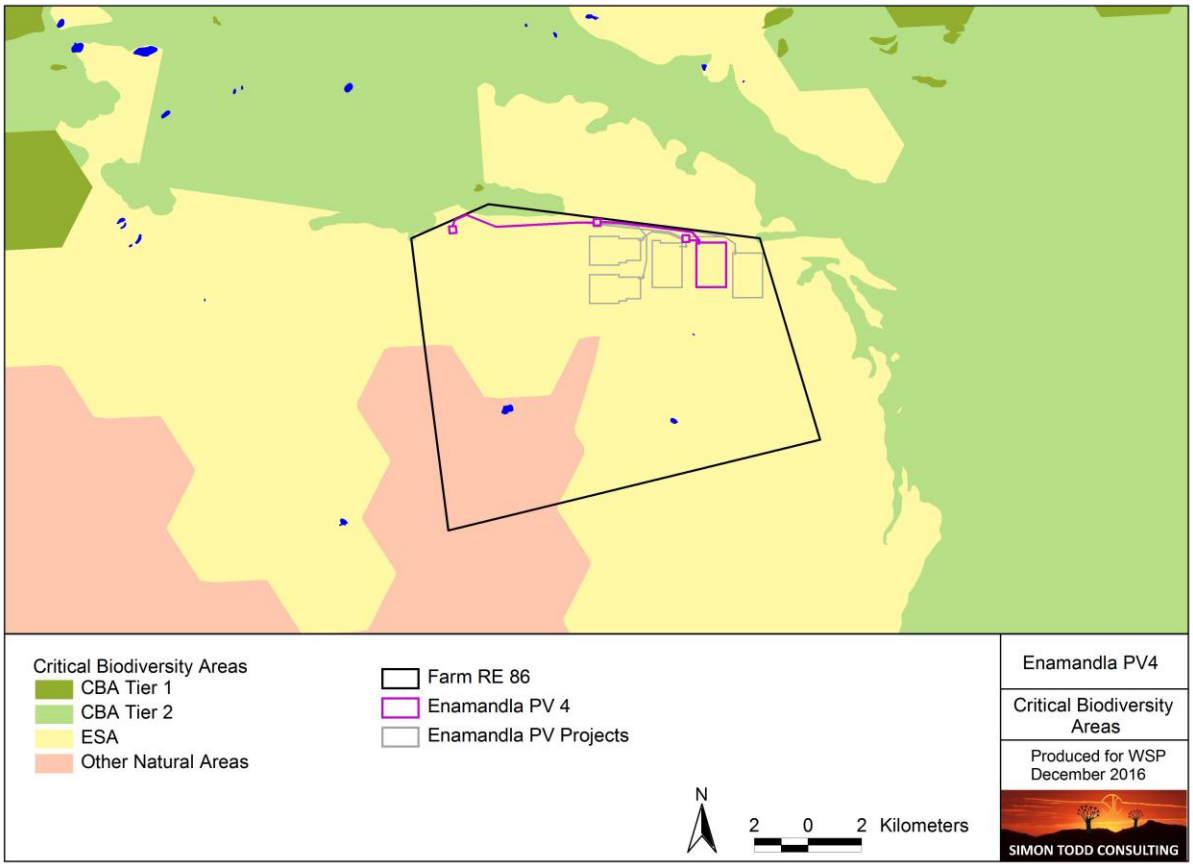


Figure 3. Critical Biodiversity Areas in the area around the Enamandla PV4 site. The entire development footprint is within an Ecological Support Area.

4.5 CUMULATIVE IMPACT

As mentioned above, the potential for cumulative impact in the area is a potential concern given the large number of different proposed renewable energy developments in the area. Although there are currently few preferred bidders, the projects are concentrated around the Aggeneys area and in the longer term a node of development is developing in this area (Figure 5). The total estimated direct footprint of the existing projects is estimated at around 800ha, with the proposed Letsoai and Enamandla projects adding approximately 2500ha to this, of which the PV 4 development would contribute approximately 200ha. In context, this is within an area of approximately 5000 square kilometers giving an impact of 0.66% of this area, which is not a significant direct impact at the landscape scale. Although this is largely concentrated within the open plains habitat of the Bushmanland Arid Grassland vegetation type, this is a widespread habitat of low fauna and flora diversity. Bushmanland Arid Grassland is one of the most extensive vegetation types in South Africa and the loss of 3000ha of this vegetation type is not significant either locally or regionally and the as mentioned already, the more sensitive elements of the landscape are currently outside of the development footprint.

In addition, not all of the authorized projects will ever be built under the REIPPP and ultimately, it is highly likely that the total extent of habitat lost to renewable energy development will remain

relatively low at the landscape level. The contribution of the current project to cumulative habitat loss in the area, which can be estimated at approximately 200ha, is considered relatively low. Although the Letsoai and Enamandla projects would potentially have a large footprint should they all be built, they are adjacent to one another within a concentrated area and as such their impact would be lower than if they were dispersed more widely.

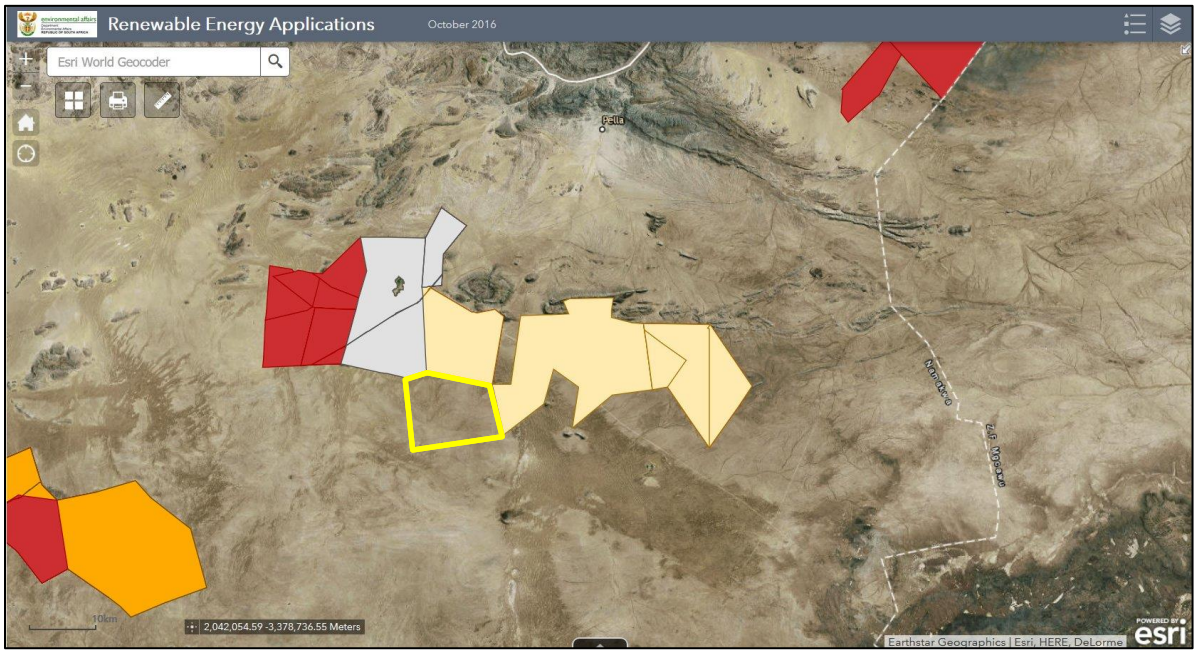


Figure 4. Map of DEA-registered renewable energy applications as at October 2016, showing the location of the Letsoai and Enamandla CSP and PV projects site in yellow outline. As the number and extent of the actual facilities is not apparent from this figure, the different renewable energy plants know from the area are also detailed below in Table 2. Red are cadastral units with solar projects and the yellow are wind energy facilities. The grey polygons are unspecified technologies, but are usually grid connections for renewable energy plants. Available at: https://dea.maps.arcgis.com/apps/webappviewer/index.html?id=b8452ef22aeb4522953f1fb10e6dc79e

Table 2. Other renewable energy projects in the vicinity (within 30km) of the Enamandla site and the similarity of the affected area to the Enamandla site and the estimated potential contribution of the project to cumulative impact in the area.

Project	Type	Output	Projected Footprint	Similarity to Letsoai site	Potential Contribution to Cumulative Impact
Existing Developments					
Namies Wind Farm	Wind	220MW	150ha	High	Medium-Low
Poortjies Wind Farm	Wind	140MW	100ha	High	Medium-Low
Korana Wind Farm	Wind	140MW	100ha	High	Medium-Low
Aroams PV	Solar	70MW	200ha	Moderate	Medium-Low
Boesmanland Solar Farm	Solar	75MW	200ha	Moderate	Medium-Low
Black Mountain PV	Solar	19MW	40ha	Moderate	Low
Current Proposed					
Letsoai CSP 1	Solar	200MW	774ha		Medium
Letsoai CSP 2	Solar	200MW	774ha	High	Medium
Enamandla PV 1-5	Solar	5 x 75MW	1000ha	High	Medium (total for 5)
Totals		**1439MW**	**3338ha**		

4.6 ENAMANDLA PV4 SITE DESCRIPTION

The Enamandla PV 4 site is an open, gently sloping plain, mostly on deep red soils with low dunes in the north and some areas of shallower soils in the west. The vegetation consists of *Stipagrostis* grasslands across the whole site, with some shifts in dominance related to the depth and texture of the soil. The vegetation is dominated by grasses with typical and dominant species including *Stipagrostis ciliata*, *S.brevifolia*, *S.obtusa*, *Cladoraphis spinosa*, *Brachiaria glomerata*, *Leucophrys mesocoma*, shrubs are occasional and include *Asparagus retrofractus*, *Requienia sphaerosperma*, *Pomaria lactea*, *Hermannia tomentosa* and *Hermannia gariepina*. The only tree present is *Parkinsonia africana*, which is not common and occurs are widely scattered individuals. Forbs are common on the deep sands and include *Galenia sarcophylla, Sesamum capense, Zygophyllum simplex, Gisekia pharnacioides* var. *pharnacioides*, *Arctotis leiocarpa*, *Dicoma capensis*, *Hirpicium echinus*, *Limeum sulcatum*, *Heliotropium ciliatum*, *Tribulus cristatus* and *Citrullus lanatus*. The abundance of listed or protected species within the study area is low and apart from a low density of *Hoodia gordonii*, no other significant species were observed. The major sensitive feature of the site is the soil itself, which is sensitive on account of the deep sands and the potential for wind erosion when these are disturbed.

The Enamandla PV4 site consists of an open grassy plain on deep red soils with few observable features, dominated by *Stipagrostis ciliata* and *S.brevifolia*.

Looking north from within the PV 4 site, showing a lone individual of *Parkinsonia africana* and a grass layer dominated by *Stipagrostis brevifolia* and *S.ciliata* with a fairly diverse annual community that is present after rains.

4.7 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 46 terrestrial mammals, although only around 20 are recorded in the area on a regular basis based on records from the Mammal Map database. Species that can be confirmed present in the area based on previous site visits to the area include Black-backed Jackal, African Wildcat, Cape Fox, Rock Hyrax, South African Ground Squirrel, Steenbok, Springbok, Gemsbok, Cape Porcupine, Yellow Mongoose, Cape Hare, Aardvark and Round-eared Elephant Shrew.

Species associated with the rocky outcrops of the area, which are not likely to occur within the site include Rock Hyrax *Procavia capensis*, Klipspringer *Oreotragus oreotragus*, Pygmy Rock Mouse *Petromyscus collinus*, Namaqua Rock Mouse *Aethomys namaquensis* and Western Rock Elephant Shrew *Elephantulus rupestris*. The open plains which characterise the development areas are likely to be dominated by species associated with open hard or sandy ground such as various gerbils including the Hairy-footed Gerbil *Gerbillurus paeba*. There were also many burrows of Ground Squirrels and Yellow Mongoose at the site and these appear to be the most common fauna within the development area. There are no areas of particular significance for mammals at the site as the habitat is repetitive and broadly homogenous.

Two listed species may occur in the area, the Black-footed cat Felis nigripes (Vulnerable) and Leopard *Panthera pardus* (Vulnerable). Given the extremely low cover at the site it is not likely that Leopard are present in the study area. The habitat is however suitable for the Black-footed Cat which favours a mix of open and more densely vegetated areas. However this species is widely distributed across the arid and semi-arid areas of South Africa, and the development would not amount to a significant amount of habitat loss for this species, although some cumulative impact in the area is a developing threat.

The major impact associated with the development of the sites for mammals would be habitat loss for resident species and potentially some disruption of the broad-scale connectivity of the landscape.

Reptiles

Although reptile diversity in the broader area is high with as many as 60 species known from the area, only a fraction of this is likely to be present within the development study area. A large proportion of the reptiles of the area consist of species associated with the inselbergs or rocky hills along the Orange River and would not occur on the open plains characteristic of the site. More typical plains species are likely to dominate the study area and is likely to include Verrox's Tent Tortoise *Psammobates tentorius verroxii*, Namaqua Sand Lizard *Pedioplanis*

namaquensis, Spotted Desert Lizard *Meroles suborbitalis*, Southern Rock Agama *Agama atra* and Plain Sand Lizard *Pedioplanis inornata*.

As with mammals, there are not likely to be any highly significant impacts on reptiles outside of some habitat loss resulting from the development. Although the deep sands are considered somewhat more sensitive than the adjacent plains with shallow soils, the site is on the fringes of the Koa River valley and the main sand-sea to the north of the site would not be affected by the development. Some species such as geckos will probably increase within the development on account of the increased vertical structure and shelter provided by the panels and their supports and other associated buildings of the development.


The most common reptiles at the site are the Namaqua Sand Lizard *Pedioplanis namaquensis* and Verrox's Tent Tortoise *Psammobates tentorius verroxii* which occurs at a low density.

Amphibians

Only eight frog species are known from the area around the site and even this is a gross overestimate of the number of amphibian species likely to be present within the site. There are few freshwater features present and only species able to live independently of water will be present at the site. As such the only species likely to be present within the site would be the Karoo Toad *Vandijkophrynus gariepensis*. Given the very low likely abundance of amphibians at the site, impacts on amphibians are likely to be local in extent and of low significance.

5 SITE SENSITIVITY ASSESSMENT

The sensitivity of the PV4 site is indicated below in Figure 6 and shows that the majority of the development footprint is within an area that is considered medium-high sensitivity with some areas of medium and medium low sensitivity. The sensitivity is related to the sandy substrate and not to the composition of the vegetation *per se*. The deep sands which characterise a large proportion of the site are vulnerable to disturbance and wind erosion. In addition, as the sandy soils will quickly become loosened by vehicles during construction, some kind of gravel base will likely need to be applied to most of the site, which is likely to significantly increase the extent of

disturbance associated with construction and the additional material would also have to be sourced from somewhere. However, with careful mitigation, it is likely that this risk can be managed and reduced to an acceptable level. In terms of the fauna and flora present, the site is not considered highly sensitive in this respect. The mobile dune field of the Koa River north of the site is considered sensitive, but the development of the site is not likely to have an effect on this system.

Wholesale clearing, as pictured here for a CSP plant near Upington, is not recommended as the resulting vulnerability to erosion can be very difficult to control, as the large amounts of dust coming from the operation of construction vehicles in the background illustrates. The sands of the PV 4 site will be vulnerable to wind erosion when disturbed and some vegetation cover should be left intact where possible. The soft sand is also likely to require that a firmer base layer is provided on all roads at the site, which will make rehabilitation more complicated.

The grid connection options are also largely within areas considered to be Medium-Low sensitivity, except for the option in the west (substation 1) which is within an area considered to be Medium sensitivity. In terms of the preferred on-site substation option, all three are considered acceptable and the preferred option should be the alternative which results in the least overall footprint and extent of power line based on the whole project and not just based on PV4. As such, this is likely to be either substation option 1 or substation option 3 and from an ecological perspective, these two options can be considered equivalent.

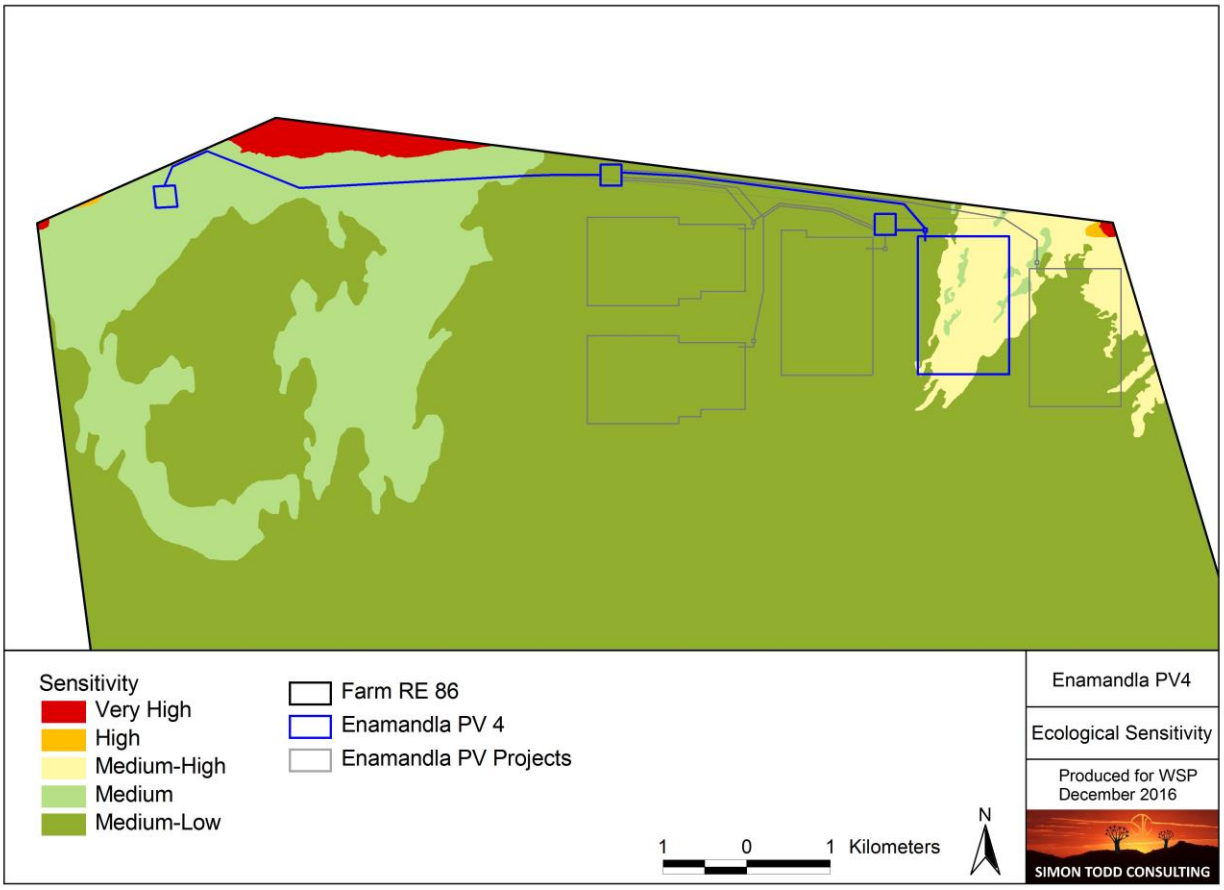


Figure 5. Ecological sensitivity map of the Enamandla project area, showing the development area of PV 4 as well as the three on-site substation options which are common to all the proposed PV projects at the site.

6 *IMPACTS AND ISSUES IDENTIFICATION*

6.1 IDENTIFICATION OF POTENTIAL IMPACTS

The likely impacts on the terrestrial ecology of the site resulting from the development of the Enamandla PV4 development are identified and discussed below with reference to the characteristics and features of the site. The development of the PV4 site is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as PV arrays, roads, operations buildings etc. The following impacts were identified during the scoping phase as the major impacts that are likely to be associated with the development, for the preconstruction, construction and operational phases of the development. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarized below before the impacts are assessed.

Impacts on vegetation and protected plant species

It is confirmed that some protected plant species such as *Hoodia gordonii* occur within the site and it is highly likely that some individuals will be impacted on by the development. However, as the abundance of such species is low, the major impact would be on vegetation loss in a general sense and not on any particular species.

Direct Faunal impacts

Construction and operational phase noise, pollution, disturbance and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some mammals or reptiles such as tortoises would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present.

Increased alien plant invasion

Alien plants are likely to invade the site as a result of the large amounts of disturbance created during operation. However as the construction phase would be less than 2 years, this is not long enough for significant alien problems to develop and the major impact and required mitigation measures would be expressed in the Operational phase. Current levels of plant invasion at the site are low. Alien species such as *Prosopis* are however present and would potentially invade the site along with other typical weedy species such as *Salsola kali*.

Increased Erosion Risk

The majority of the site has deep sandy soils which are vulnerable to erosion when disturbed. Vegetation clearing could lead to increased wind erosion and mobilization of the dune system at the site. Specific attention should be paid to minimizing disturbance and the retention of vegetation cover wherever possible to limit erosion. In addition, the sandy substrate is not likely to be able support vehicles and some kind of surfacing will be required on all roads at the site to prevent vehicles from being bogged down in the loose sand. Dust suppression during construction will be required and erosion risk will extend into the operational phase until bare areas have been revegetated or protected with a less mobile substrate.

Impacts on Broad-Scale Ecological Processes and Loss of Landscape Connectivity

As there are several other renewable energy developments in the area, the development of the site will contribute towards cumulative impacts, particularly the loss of landscape connectivity. The site is likely to be fenced and the cleared parts of the site are also likely to be hostile to many smaller fauna which will prevent or impede their movement across the landscape.

Reduced ability to meet conservation obligations & targets

The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets. The receiving vegetation types in the study area are classified as Least Threatened and they are extensive vegetation types that are

still more than 99% intact. The development of the PV4 site would result in the loss of up to 350ha of intact habitat which on its own is not considered highly significant, but as there is an array of other developments in the area, the possibility for significant cumulative impact on the affected vegetation types or on more localised plant communities is a potential concern, especially given the NPAES status of the site. However, within PV 4 there are no significant features present and the development is restricted to the grassy plains of the area, which are not restricted and broadly available.

7 IMPACT ASSESSMENT

The assessment methodology used here is in accordance with the revised 2014 EIA regulations and based on the assessment approach recommended by Hacking (2001).

7.1 PLANNING & CONSTRUCTION PHASE IMPACTS

Phase & Impact	Before Mitigation	After Mitigation
Planning & Construction Phase Impacts		
IMPACT: Impacts on vegetation and protected plant species:		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
IMPACT: Faunal impacts due to construction activities		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
IMPACT: Areas disturbed during construction will be vulnerable to wind and water erosion.		
Enamandla PV 4	Medium	Low
No-Go Option	Low	

Summary of impacts:

Vegetation Impacts:

Impacts on vegetation and protected plant species will occur due to vegetation clearing and disturbance associated with the construction of the PV 4 plant. The site is however not sensitive and overall post-mitigation impacts are likely to be **Low**.

Mitigation Measures:

- Preconstruction walk-though of the final development footprint to ensure that sensitive habitats and species can be avoided where possible.
- The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas.
- Sensitive features near to construction areas should be demarcated as no-go areas with

construction tape or similar and signposted as such.

Faunal Impacts:

Disturbance, transformation and loss of habitat during construction of the solar PV plant will have a negative effect on resident fauna. However, faunal diversity and density within the site is low and post mitigation impacts are likely to be **Low** and of local significance only. Large amounts of noise and disturbance at the site during construction is largely unavoidable due to the operation of heavy machinery. All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and other vulnerable fauna.

Mitigation Measures:

- All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes and tortoises.
- Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- 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.
- Any trenches that need to be dug for construction should not be left open for extended periods of time as smaller fauna will fall in and become trapped.

Erosion Impacts:

Areas disturbed during construction will be vulnerable to disturbance from wind and rain erosion. Although the site is arid, exceptional rainfall events can cause significant erosion events, as the low vegetation cover does not provide adequate protection for the loose soils. Disturbance will raise the possibility of wind erosion and dust suppression will be required during construction. With mitigation, this impact can however be reduced to a **Low** level.

Mitigation Measures:

- Dust suppression and erosion management should be an integrated component of the construction approach.
- Disturbance near to drainage lines should be avoided and sensitive drainage areas near to the construction activities should be demarcated as no-go areas.
- Sediment traps and wind shields may be necessary to prevent erosion and soil movement if there are topsoil dumps exposed for extended periods of time.
- A low cover of vegetation should be left wherever possible within the construction footprint to bind the soil, prevent erosion and promote post-disturbance recovery of an indigenous ground cover.
- All roads and other hardened surfaces should have runoff control features.
- Runoff from the facility should be captured in ponds to allow sediment and pollution to settle before the water is released or allowed to evaporate.

7.2 OPERATIONAL PHASE IMPACTS

Phase & Impact	Before Mitigation	After Mitigation
Operation Phase Impacts		
IMPACT: Faunal Impacts due to Operation		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
Impact: Alien invasive plant impacts		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
IMPACT: Following construction, disturbed areas will remain vulnerable to erosion for some time.		
Enamandla PV 4	Medium	Low
No-Go Option	Low	

Summary of impacts:

Faunal Impacts due to Operation

The presence and operation of the facility will cause some impact to fauna due to disturbance or direct impact from electrical fencing, night lighting etc. Some fauna will inevitably find their way into the facility and want to live inside the plant. This is common for smaller mammals such as ground squirrels and mongoose. These should be tolerated and not persecuted but also not provided with food or other enticements. The presence of these animals in the site can be seen as beneficial because the mongoose will prey on rodents that can build up in PV and CSP plants and which might otherwise attract a lot of snakes, which also occurs.

Mitigation Measures:

- Management of the site should take place within the context of an Open Space Management Plan.
- No unauthorized persons should be allowed onto the site.
- Any potentially dangerous fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location.
- The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden by anyone except landowners with the appropriate permits where required.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
- 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.
- Any dams or evaporation ponds at the site should be covered or fenced to prevent larger animals from accessing these areas. If not covered, there should however also be a ramp or ladder present where fauna that fall into the water can escape. These dams are often lined with plastic of some or other slippery surface and animals may drown if they fall in and

are unable to get out due to the steep or slippery sides.

Alien invasive plants:

Alien plants are likely to invade the site as a result of the large amounts of disturbance created during construction. Alien plant invasion would contribute to cumulative habitat degradation in the area, but if alien species are controlled, then cumulative impact from alien species would not be significant during the operational phase.

Mitigation Measures:

- Problem woody species such as Prosopis are already present in the area and are likely to increase rapidly if not controlled.
- Regular (annual) monitoring for alien plants within and near the development footprint.
- Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.

Erosion Impacts:

Areas disturbed during construction will remain vulnerable to disturbance for some time into the operational phase and will require regular maintenance to ensure that erosion is minimised. With mitigation, this impact can however be reduced to a **Low** level.

Mitigation Measures:

- All cleared and disturbed areas should be re-vegetated and regularly (annually) monitored for wind erosion.
- All roads and other hardened surfaces should have runoff control features.

7.3 DECOMMISSIONING PHASE IMPACTS

Phase & Impact	Before Mitigation	After Mitigation
Decommissioning Phase Impacts		
IMPACT: Impacts on fauna:		
Enamandla PV 4	Low	Low
No-Go Option	Low	
IMPACT: Following construction disturbed soils will be vulnerable to erosion.		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
IMPACT: Following construction disturbed soils will be vulnerable to erosion.		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
Summary of impacts:		

Faunal Impacts:

Disturbance or persecution of fauna during the decommissioning phase may occur. The operation of heavy machinery and human presence at the site during decommissioning would impact fauna in and near the development. However, this would be temporary and faunal diversity and density within the site is low and post mitigation impacts are likely to be **Low.**

Mitigation

- All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes and tortoises.
- Any fauna threatened by the decommissioning activities should be removed to safety by the ECO or appropriately qualified environmental officer.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site.
- Any trenches that need to be dug should not be left open for extended periods of time as smaller fauna will fall in and become trapped.
- All waste and material on-site that is not recycled as part of decommissioning, should be removed from the site to a suitable waste disposal site.
- The site should be rehabilitated using locally occurring grasses and shrubs.

Erosion Impacts:

Areas disturbed during decommissioning will remain vulnerable to disturbance for some time and erosion should be minimised. With mitigation, this impact can however be reduced to a Low level.

Mitigation Measures:

- All cleared and disturbed areas should be re-vegetated after decommissioning.

Alien invasive plants:

Alien plants are likely to invade the site as a result of the large amounts of disturbance created during decommissioning. These may then spread to adjacent areas and impact a wider area with negative ecological consequences. Alien clearing will be required for several years after decommissioning until the natural vegetation has retuned sufficiently to suppress invaders.

Mitigation Measures:

- Problem woody species such as *Prosopis* are already present in the area and are likely to increase rapidly after decommissioning if not controlled.
- Regular (annual) monitoring for alien plants within disturbed areas created by decommissioning.
- Regular alien clearing should be conducted using the best-practice methods for the species concerned and should be conducted for at least 5 years after decommissioning or until the natural vegetation has returned.

7.4 CUMULATIVE IMPACTS

Phase & Impact	Before Mitigation	After Mitigation
Cumulative Impacts		
IMPACT: Cumulative habitat loss and impacts on broad-scale ecological processes and loss of landscape connectivity		
Enamandla PV 4	Medium	Low
No-Go Option	Low	
IMPACT: Reduced ability to meet conservation targets		
Enamandla PV 4	Low	Low
No-Go Option	Low	

Summary of impacts:

Cumulative impacts:

The contribution of the Enamandla PV4 development to cumulative impacts will be relatively low at 350ha of low sensitivity habitat. The development does however occur as part of a larger development consisting of 5 solar PV plants and 2 CSP plants, with a total footprint of more than 2000ha. As it is not possible to tell which of these will actually be built under the REIPPP, it is not possible to firmly predict the contribution of the PV 4 plant to cumulative impact in the area. However, at a broad scale, the area is not heavily developed and even with the development of several of the other proposed developments in the area, the overall level of cumulative impact in the area is likely to remain low. The current site is also located on the open plains of the area, which is considered to be the least sensitive habitat of the area. Provided that the deep sands of the Koa River valley itself and the inselbergs with their plateaus and surroundings toeslopes remain relatively free of development, then the overall impact of development on biodiversity in the area will be relatively low.

Mitigation Measures:

- The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas.
- If several of the PV plants are developed, then some undeveloped corridors to maintain connectivity should be allowed to persist between plants.
- There should be an open space management plan for the project area, which includes measures to allow for the maintenance of landscape connectivity for fauna, through maintaining some areas in a natural state to allow fauna to pass through the area.

Reduced Ability to Meet Conservation Targets:

The loss of unprotected vegetation types may impact the countries' future ability to meet its conservation targets. The area has been identified as an NPAES focus area and development within this area may compromise the value of the area for future conservation area expansion. However, the affected Bushmanland Arid Grassland vegetation type is extensive and the extent of habitat loss from the development (350ha) would not significantly impact the

remaining extent of this vegetation type, either locally or regionally.

Mitigation Measures:

- The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas.
- There should be an open space management plan for the project area, which includes measures to allow for the maintenance of landscape connectivity for fauna, through maintaining some areas in a natural state to allow fauna to pass through the area.
- Any fences surrounding the development should be fauna-friendly in their design, which includes restricting electrified strands to the inside of the fence.

8 CONCLUSIONS & RECOMMENDATIONS

The majority of the Enamandla PV 4 site is within an area that is considered medium-high sensitivity with a lesser extent of areas of medium and medium low sensitivity. The sensitivity is related to the sandy substrate and not to the composition of the vegetation *per se*. The deep sands which characterise a large proportion of the site are vulnerable to disturbance and wind erosion. This is likely to complicate the construction of the development and increase the risks and impacts associated with the development. In terms of the fauna and flora present, the site is not considered highly sensitive in this respect. The mobile dune field of the Koa River north of the site is considered sensitive, but the development of the site is not likely to have an effect on this system.

In terms of the preferred on-site substation option, all three are considered acceptable and the preferred option should be the alternative which results in the least overall footprint and extent of power line based on the whole project and not just based on PV4. As such, this is likely to be either substation option 1 or substation option 3 and from an ecological perspective, these two options can be considered equivalent.

Provided that the erosion risks associated with development on the deep sands of the site can be appropriately managed, then, the primary impact of the development would be some habitat loss for fauna and flora within the sandy plains habitat of the site. The more sensitive rocky hills and deep sands of the Koa River valley are not within the footprint and would not be affected by the development.

The potential for cumulative impacts from renewable energy development is a concern associated with the development given the large number of proposed renewable energy projects in the wider area. However, the contribution of the Enamandla PV 4 site to cumulative habitat loss would be low and even if all current projects are built, it is estimated that this would amount to only 0.66% of the landscape, which is not significant, especially as this is concentrated within the Bushmanland Arid Grassland vegetation type which is very widespread and of low species richness for fauna and flora. Although the Letsoai and Enamandla projects

would potentially have a large total footprint should they all be built, they are adjacent to one another within a concentrated area and as such their impact would be lower than if they were dispersed more widely.

Due to the arid nature of the area, it is important that the mobility of fauna in the area is not impacted as many arid fauna respond to the unpredictability of these systems by moving extensively across the landscape. These impacts can be reduced by ensuring that fauna are still able to move about the landscape and are not impeded by extensive tracts of electrified fencing or similar impenetrable obstacles. As such, if several of the PV plants are developed, then provision should be made to maintain some undeveloped corridors between some of the facilities to maintain the connectivity of the landscape.

Overall and with the suggested mitigation measures implemented, then the impact of the Enamandla PV 4 development would be of moderate to low magnitude and of local significance only. As such, the development is considered acceptable from a terrestrial ecological perspective.

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10 ANNEX 1. LIST OF PLANTS

List of plant species known from the broad area around the Enamandla site, based on observations from the site as well as the SANBI SIBIS database.

Family	Species	IUCN	Family	Species	IUCN
ACANTHACEAE	*Acanthopsis hoffmannseggiana*	LC	ACANTHACEAE	*Barleria rigida*	LC
ACANTHACEAE	*Blepharis mitrata*	LC	ACANTHACEAE	*Justicia thymifolia*	LC
ACANTHACEAE	*Monechma mollissimum*	LC	ACANTHACEAE	*Monechma spartioides*	LC
ACANTHACEAE	*Petalidium setosum*	LC	AIZOACEAE	*Aizoon asbestinum*	LC
AIZOACEAE	*Galenia africana*	LC	AIZOACEAE	*Galenia crystallina var. crystallina*	LC
AIZOACEAE	*Galenia fruticosa*	LC	AIZOACEAE	*Galenia papulosa*	LC
AIZOACEAE	*Galenia sarcophylla*	LC	AIZOACEAE	*Tetragonia arbuscula*	LC
AIZOACEAE	*Tetragonia reduplicata*	LC	AIZOACEAE	*Trianthema parvifolia var. parvifolia*	LC
AMARANTHACEAE	*Amaranthus praetermissus*	LC	AMARANTHACEAE	*Hermbstaedtia glauca*	LC
AMARANTHACEAE	*Sericocoma avolans*	LC	AMARYLLIDACEAE	*Brunsvigia comptonii*	LC
AMARYLLIDACEAE	*Brunsvigia herrei*	VU	AMARYLLIDACEAE	*Brunsvigia namaquana*	DDT
AMARYLLIDACEAE	*Hessea speciosa*	LC	ANACARDIACEAE	*Ozoroa dispar*	LC
ANACARDIACEAE	*Searsia burchellii*	LC	ANACARDIACEAE	*Searsia populifolia*	LC
APOCYNACEAE	*Fockea comaru*	LC	APOCYNACEAE	*Hoodia alstonii*	LC
APOCYNACEAE	*Hoodia gordonii*	DDD	APOCYNACEAE	*Microloma incanum*	LC
APOCYNACEAE	*Microloma sagittatum*	LC	APOCYNACEAE	*Pachypodium namaquanum*	LC
APOCYNACEAE	*Sarcostemma pearsonii*	LC	APOCYNACEAE	*Stapelia similis*	LC
ASPARAGACEAE	*Asparagus capensis var. capensis*	LC	ASPHODELACEAE	*Haworthia venosa subsp. tessellata*	LC
ASPHODELACEAE	*Trachyandra jacquiniana*	LC	ASPHODELACEAE	*Trachyandra laxa var. laxa*	LC
ASTERACEAE	*Arctotis erosa*	LC	ASTERACEAE	*Arctotis hirsuta*	LC
ASTERACEAE	*Arctotis leiocarpa*	LC	ASTERACEAE	*Berkheya canescens*	LC
ASTERACEAE	*Berkheya fruticosa*	LC	ASTERACEAE	*Berkheya spinosissima subsp. spinosissima*	LC
ASTERACEAE	*Cineraria canescens var. canescens*	LC	ASTERACEAE	*Dicoma capensis*	LC
ASTERACEAE	*Didelta carnosa var. carnosa*	LC	ASTERACEAE	*Dimorphotheca polyptera*	LC
ASTERACEAE	*Dimorphotheca sinuata*	LC	ASTERACEAE	*Eriocephalus ambiguus*	LC
ASTERACEAE	*Eriocephalus microphyllus var. pubescens*	LC	ASTERACEAE	*Eriocephalus scariosus*	LC
ASTERACEAE	*Eriocephalus spinescens*	LC	ASTERACEAE	*Euryops multifidus*	LC
ASTERACEAE	*Euryops subcarnosus subsp. vulgaris*	LC	ASTERACEAE	*Felicia hirsuta*	LC
ASTERACEAE	*Felicia muricata subsp. muricata*	LC	ASTERACEAE	*Felicia namaquana*	LC
ASTERACEAE	*Foveolina dichotoma*	LC	ASTERACEAE	*Gazania lichtensteinii*	LC
ASTERACEAE	*Geigeria pectidea*	LC	ASTERACEAE	*Geigeria vigintisquamea*	LC
ASTERACEAE	*Gorteria corymbosa*	LC	ASTERACEAE	*Gorteria diffusa subsp. diffusa*	LC
ASTERACEAE	*Gymnodiscus linearifolia*	LC	ASTERACEAE	*Helichrysum herniarioides*	LC
ASTERACEAE	*Helichrysum micropoides*	LC	ASTERACEAE	*Helichrysum pulchellum*	LC
ASTERACEAE	*Helichrysum pumilio subsp. pumilio*	LC	ASTERACEAE	*Helichrysum tomentosulum subsp. aromaticum*	LC
ASTERACEAE	*Helichrysum zeyheri*	LC	ASTERACEAE	*Hirpicium alienatum*	LC
ASTERACEAE	*Hirpicium echinus*	LC	ASTERACEAE	*Hirpicium integrifolium*	LC
ASTERACEAE	*Ifloga molluginoides*	LC	ASTERACEAE	*Kleinia cephalophora*	LC
ASTERACEAE	*Kleinia longiflora*	LC	ASTERACEAE	*Nidorella resedifolia subsp. resedifolia*	LC

ASTERACEAE	*Oncosiphon piluliferum*	LC	ASTERACEAE	*Osteospermum karrooicum*	LC
ASTERACEAE	*Osteospermum muricatum subsp. muricatum*	LC	ASTERACEAE	*Osteospermum pinnatum var. pinnatum*	LC
ASTERACEAE	*Othonna abrotanifolia*	LC	ASTERACEAE	*Othonna arbuscula*	LC
ASTERACEAE	*Othonna furcata*	LC	ASTERACEAE	*Othonna sedifolia*	LC
ASTERACEAE	*Pegolettia retrofracta*	LC	ASTERACEAE	*Pentzia argentea*	LC
ASTERACEAE	*Pentzia globosa*	LC	ASTERACEAE	*Pentzia lanata*	LC
ASTERACEAE	*Pteronia glauca*	LC	ASTERACEAE	*Pteronia glomerata*	LC
ASTERACEAE	*Pteronia mucronata*	LC	ASTERACEAE	*Pteronia scariosa*	LC
ASTERACEAE	*Pteronia sordida*	LC	ASTERACEAE	*Pteronia unguiculata*	LC
ASTERACEAE	*Senecio bulbinifolius*	LC	ASTERACEAE	*Senecio eenii*	LC
ASTERACEAE	*Senecio niveus*	LC	ASTERACEAE	*Senecio pinguifolius*	LC
ASTERACEAE	*Senecio sarcoides*	LC	ASTERACEAE	*Senecio sisymbriifolius*	LC
ASTERACEAE	*Tripteris aghillana var. aghillana*	LC	ASTERACEAE	*Tripteris sinuata var. sinuata*	LC
ASTERACEAE	*Ursinia nana subsp. nana*	LC	ASTERACEAE	*Ursinia speciosa*	LC
ASTERACEAE	*Vernonia obionifolia subsp. obionifolia*	LC	BIGNONIACEAE	*Rhigozum trichotomum*	LC
BORAGINACEAE	*Codon royenii*	LC	BORAGINACEAE	*Heliotropium tubulosum*	LC
BORAGINACEAE	*Trichodesma africanum*	LC	BRASSICACEAE	*Heliophila carnosa*	LC
BRASSICACEAE	*Heliophila deserticola var. deserticola*	LC	BRASSICACEAE	*Heliophila deserticola var. micrantha*	LC
BRASSICACEAE	*Heliophila lactea*	LC	BRASSICACEAE	*Heliophila trifurca*	LC
BRASSICACEAE	*Lepidium trifurcum*	LC	BURSERACEAE	*Commiphora gracilifrondosa*	LC
CAMPANULACEAE	*Wahlenbergia meyeri*	LC	CAMPANULACEAE	*Wahlenbergia prostrata*	LC
CAPPARACEAE	*Boscia foetida subsp. foetida*	LC	CAPPARACEAE	*Cleome paxii*	LC
CARYOPHYLLACEAE	*Dianthus micropetalus*	LC	CARYOPHYLLACEAE	*Dianthus namaensis var. dinteri*	LC
CHENOPODIACEAE	*Salsola kalaharica*	LC	CHENOPODIACEAE	*Salsola rabieana*	LC
CHENOPODIACEAE	*Salsola tuberculata*	LC	COLCHICACEAE	*Ornithoglossum dinteri*	LC
COLCHICACEAE	*Ornithoglossum vulgare*	LC	CRASSULACEAE	*Adromischus diabolicus*	Rare
CRASSULACEAE	*Adromischus nanus*	LC	CRASSULACEAE	*Cotyledon orbiculata var. oblonga*	LC
CRASSULACEAE	*Cotyledon orbiculata var. orbiculata*	LC	CRASSULACEAE	*Crassula brevifolia subsp. brevifolia*	LC
CRASSULACEAE	*Crassula campestris*	LC	CRASSULACEAE	*Crassula corallina subsp. macrorrhiza*	LC
CRASSULACEAE	*Crassula cotyledonis*	LC	CRASSULACEAE	*Crassula deltoidea*	LC
CRASSULACEAE	*Crassula exilis subsp. exilis*	Rare	CRASSULACEAE	*Crassula exilis subsp. sedifolia*	LC
CRASSULACEAE	*Crassula garibina subsp. garibina*	LC	CRASSULACEAE	*Crassula macowaniana*	LC
CRASSULACEAE	*Crassula muscosa var. muscosa*	LC	CRASSULACEAE	*Crassula sericea var. sericea*	LC
CRASSULACEAE	*Crassula subaphylla var. subaphylla*	LC	CRASSULACEAE	*Crassula tenuipedicellata*	LC
CRASSULACEAE	*Crassula tomentosa var. glabrifolia*	LC	CRASSULACEAE	*Tylecodon reticulatus subsp. phyllopodium*	LC
CRASSULACEAE	*Tylecodon reticulatus subsp. reticulatus*	LC	CRASSULACEAE	*Tylecodon rubrovenosus*	LC
CUCURBITACEAE	*Coccinia rehmannii*	LC	CUCURBITACEAE	*Corallocarpus dissectus*	LC
CUCURBITACEAE	*Cucumis rigidus*	LC	CUCURBITACEAE	*Trochomeria debilis*	LC
CYPERACEAE	*Cyperus indecorus var. namaquensis*	LC	CYPERACEAE	*Isolepis hemiuncialis*	LC
EBENACEAE	*Diospyros austro-africana var. rubriflora*	LC	EBENACEAE	*Diospyros ramulosa*	LC
EUPHORBIACEAE	*Euphorbia dregeana*	LC	EUPHORBIACEAE	*Euphorbia gariepina subsp. gariepina*	LC
EUPHORBIACEAE	*Euphorbia mauritanica var. mauritanica*	LC	EUPHORBIACEAE	*Euphorbia spinea*	LC

FABACEAE	*Acacia erioloba*	Declining	FABACEAE	*Crotalaria meyeriana*	LC
FABACEAE	*Crotalaria pearsonii*	Rare	FABACEAE	*Crotalaria virgultalis*	LC
FABACEAE	*Indigastrum argyroides*	LC	FABACEAE	*Indigofera pechuelii*	LC
FABACEAE	*Lessertia depressa*	LC	FABACEAE	*Lotononis falcata*	LC
FABACEAE	*Lotononis fruticoides*	LC	FABACEAE	*Lotononis platycarpa*	LC
FABACEAE	*Lotononis rabenaviana*	LC	FABACEAE	*Melolobium microphyllum*	LC
FABACEAE	*Parkinsonia africana*	LC	FABACEAE	*Pomaria lactea*	LC
FABACEAE	*Requienia sphaerosperma*	LC	FABACEAE	*Tephrosia dregeana var. dregeana*	LC
FABACEAE	*Tephrosia limpopoensis*	LC	GERANIACEAE	*Monsonia parvifolia*	LC
GERANIACEAE	*Pelargonium carnosum subsp. carnosum*	LC	GERANIACEAE	*Pelargonium crithmifolium*	LC
GERANIACEAE	*Pelargonium spinosum*	LC	GERANIACEAE	*Pelargonium xerophyton*	LC
GERANIACEAE	*Sarcocaulon crassicaule*	LC	GISEKIACEAE	*Gisekia africana var. africana*	LC
HYACINTHACEAE	*Albuca namaquensis*	LC	HYACINTHACEAE	*Albuca setosa*	LC
HYACINTHACEAE	*Albuca spiralis*	LC	HYACINTHACEAE	*Daubenya namaquensis*	Thr*
HYACINTHACEAE	*Dipcadi gracillimum*	LC	HYACINTHACEAE	*Drimia intricata*	LC
HYACINTHACEAE	*Lachenalia polypodantha*	Rare	HYACINTHACEAE	*Lachenalia undulata*	LC
HYACINTHACEAE	*Massonia bifolia*	LC	HYACINTHACEAE	*Ornithogalum glandulosum*	LC
HYACINTHACEAE	*Ornithogalum pruinosum*	LC	HYACINTHACEAE	*Ornithogalum subcoriaceum*	LC
HYDNORACEAE	*Hydnora africana*	LC	IRIDACEAE	*Ferraria variabilis*	LC
IRIDACEAE	*Gladiolus orchidiflorus*	LC	IRIDACEAE	*Gladiolus saccatus*	LC
IRIDACEAE	*Hesperantha rupicola*	LC	IRIDACEAE	*Lapeirousia littoralis subsp. littoralis*	LC
IRIDACEAE	*Lapeirousia plicata subsp. plicata*	LC	IRIDACEAE	*Moraea unguiculata*	LC
IRIDACEAE	*Tritonia karooica*	LC	LAMIACEAE	*Acrotome pallescens*	LC
LAMIACEAE	*Salvia garipensis*	LC	LAMIACEAE	*Stachys flavescens*	LC
LAMIACEAE	*Stachys rugosa*	LC	MALVACEAE	*Hermannia affinis*	LC
MALVACEAE	*Hermannia confusa*	LC	MALVACEAE	*Hermannia disermifolia*	LC
MALVACEAE	*Hermannia gariepina*	LC	MALVACEAE	*Hermannia minutiflora*	LC
MALVACEAE	*Hermannia spinosa*	LC	MALVACEAE	*Hermannia stricta*	LC
MALVACEAE	*Hermannia tomentosa*	LC	MALVACEAE	*Hermannia vestita*	LC
MALVACEAE	*Hibiscus elliottiae*	LC	MENISPERMACEAE	*Antizoma miersiana*	LC
MESEMBRYANTHEMACEAE	*Antimima tuberculosa*	LC	MESEMBRYANTHEMACEAE	*Arenifera stylosa*	LC
MESEMBRYANTHEMACEAE	*Aridaria noctiflora subsp. straminea*	LC	MESEMBRYANTHEMACEAE	*Aspazoma amplectens*	LC
MESEMBRYANTHEMACEAE	*Brownanthus arenosus*	LC	MESEMBRYANTHEMACEAE	*Brownanthus nucifer*	LC
MESEMBRYANTHEMACEAE	*Brownanthus schenckii*	LC	MESEMBRYANTHEMACEAE	*Cephalophyllum fulleri*	Rare
MESEMBRYANTHEMACEAE	*Cephalophyllum parvibracteatum*	LC	MESEMBRYANTHEMACEAE	*Cephalophyllum staminodiosum*	Rare
MESEMBRYANTHEMACEAE	*Cheiridopsis denticulata*	LC	MESEMBRYANTHEMACEAE	*Conicosia elongata*	LC
MESEMBRYANTHEMACEAE	*Conophytum burgeri*	EN	MESEMBRYANTHEMACEAE	*Conophytum calculus subsp. vanzylii*	LC
MESEMBRYANTHEMACEAE	*Conophytum limpidum*	NT	MESEMBRYANTHEMACEAE	*Conophytum marginatum subsp. haramoepense*	LC
MESEMBRYANTHEMACEAE	*Conophytum maughanii subsp. maughanii*	LC	MESEMBRYANTHEMACEAE	*Conophytum praesectum*	LC
MESEMBRYANTHEMACEAE	*Conophytum ratum*	VU	MESEMBRYANTHEMACEAE	*Conophytum tantillum subsp. eenkokerense*	Rare
MESEMBRYANTHEMACEAE	*Delosperma subincanum*	LC	MESEMBRYANTHEMACEAE	*Dinteranthus puberulus*	LC
MESEMBRYANTHEMACEAE	*Drosanthemum albens*	LC	MESEMBRYANTHEMACEAE	*Drosanthemum breve*	DDT
MESEMBRYANTHEMACEAE	*Drosanthemum godmaniae*	DDT	MESEMBRYANTHEMACEAE	*Drosanthemum hispidum*	LC
MESEMBRYANTHEMACEAE	*Drosanthemum karrooense*	LC	MESEMBRYANTHEMACEAE	*Drosanthemum lique*	LC

MESEMBRYANTHEMACEAE	*Drosanthemum luederitzii*	LC	MESEMBRYANTHEMACEAE	*Drosanthemum subcompressum*	LC
MESEMBRYANTHEMACEAE	*Ebracteola fulleri*	LC	MESEMBRYANTHEMACEAE	*Hereroa pallens*	LC
MESEMBRYANTHEMACEAE	*Hereroa teretifolia*	LC	MESEMBRYANTHEMACEAE	*Ihlenfeldtia excavata*	LC
MESEMBRYANTHEMACEAE	*Ihlenfeldtia vanzylii*	LC	MESEMBRYANTHEMACEAE	*Lapidaria margaretae*	LC
MESEMBRYANTHEMACEAE	*Lithops julii subsp. fulleri*	LC	MESEMBRYANTHEMACEAE	*Lithops olivacea*	VU
MESEMBRYANTHEMACEAE	*Mesembryanthemum crystallinum*	LC	MESEMBRYANTHEMACEAE	*Mesembryanthemum guerichianum*	LC
MESEMBRYANTHEMACEAE	*Phyllobolus latipetalus*	LC	MESEMBRYANTHEMACEAE	*Phyllobolus lignescens*	LC
MESEMBRYANTHEMACEAE	*Phyllobolus oculatus*	LC	MESEMBRYANTHEMACEAE	*Prenia tetragona*	LC
MESEMBRYANTHEMACEAE	*Psilocaulon articulatum*	LC	MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*	LC
MESEMBRYANTHEMACEAE	*Psilocaulon subnodosum*	LC	MESEMBRYANTHEMACEAE	*Ruschia aggregata*	DDT
MESEMBRYANTHEMACEAE	*Ruschia centrocapsula*	LC	MESEMBRYANTHEMACEAE	*Ruschia cradockensis subsp. triticiformis*	LC
MESEMBRYANTHEMACEAE	*Ruschia divaricata*	LC	MESEMBRYANTHEMACEAE	*Ruschia kenhardtensis*	LC
MESEMBRYANTHEMACEAE	*Ruschia muricata*	LC	MESEMBRYANTHEMACEAE	*Ruschia robusta*	LC
MESEMBRYANTHEMACEAE	*Ruschia spinosa*	LC	MESEMBRYANTHEMACEAE	*Schwantesia marlothii*	LC
MESEMBRYANTHEMACEAE	*Schwantesia ruedebuschii*	LC	MESEMBRYANTHEMACEAE	*Stomatium fulleri*	LC
MESEMBRYANTHEMACEAE	*Trichodiadema littlewoodii*	LC	MESEMBRYANTHEMACEAE	*Trichodiadema obliquum*	DDT
MOLLUGINACEAE	*Hypertelis salsoloides var. salsoloides*	LC	MOLLUGINACEAE	*Limeum aethiopicum var. intermedium*	LC
MOLLUGINACEAE	*Limeum arenicolum*	LC	MOLLUGINACEAE	*Limeum myosotis var. myosotis*	LC
MOLLUGINACEAE	*Pharnaceum croceum*	LC	MOLLUGINACEAE	*Pharnaceum viride*	LC
MOLLUGINACEAE	*Psammotropha obtusa*	LC	MOLLUGINACEAE	*Suessenguthiella scleranthoides*	LC
MONTINIACEAE	*Montinia caryophyllacea*	LC	MORACEAE	*Ficus cordata subsp. cordata*	LC
MORACEAE	*Ficus ilicina*	LC	NEURADACEAE	*Grielum humifusum var. humifusum*	LC
NEURADACEAE	*Grielum sinuatum*	LC	OXALIDACEAE	*Oxalis annae*	LC
PEDALIACEAE	*Rogeria longiflora*	LC	PLUMBAGINACEAE	*Dyerophytum africanum*	LC
POACEAE	*Aristida adscensionis*	LC	POACEAE	*Aristida congesta subsp. congesta*	LC
POACEAE	*Aristida diffusa subsp. burkei*	LC	POACEAE	*Aristida engleri var. engleri*	LC
POACEAE	*Brachiaria glomerata*	LC	POACEAE	*Cenchrus ciliaris*	LC
POACEAE	*Cladoraphis spinosa*	LC	POACEAE	*Ehrharta calycina*	LC
POACEAE	*Ehrharta pusilla*	LC	POACEAE	*Enneapogon cenchroides*	LC
POACEAE	*Enneapogon desvauxii*	LC	POACEAE	*Enneapogon scaber*	LC
POACEAE	*Eragrostis nindensis*	LC	POACEAE	*Fingerhuthia africana*	LC
POACEAE	*Leucophrys mesocoma*	LC	POACEAE	*Panicum arbusculum*	LC
POACEAE	*Schmidtia kalahariensis*	LC	POACEAE	*Stipagrostis amabilis*	LC
POACEAE	*Stipagrostis anomala*	LC	POACEAE	*Stipagrostis brevifolia*	LC
POACEAE	*Stipagrostis ciliata var. capensis*	LC	POACEAE	*Stipagrostis obtusa*	LC
POACEAE	*Stipagrostis uniplumis var. uniplumis*	LC	POLYGALACEAE	*Polygala leptophylla var. armata*	LC
POLYGALACEAE	*Polygala pungens*	LC	POLYGALACEAE	*Polygala seminuda*	LC
PORTULACACEAE	*Anacampseros baeseckei*	LC	PORTULACACEAE	*Anacampseros filamentosa subsp. namaquensis*	LC
PORTULACACEAE	*Avonia albissima*	LC	PORTULACACEAE	*Avonia herreana*	VU
PORTULACACEAE	*Avonia papyracea subsp. namaensis*	LC	PORTULACACEAE	*Avonia papyracea subsp. papyracea*	LC
PORTULACACEAE	*Avonia quinaria subsp. alstonii*	LC	PORTULACACEAE	*Avonia recurvata subsp. recurvata*	LC
PORTULACACEAE	*Ceraria fruticulosa*	LC	PORTULACACEAE	*Ceraria namaquensis*	LC
PORTULACACEAE	*Portulaca kermesina*	LC	RUBIACEAE	*Anthospermum spathulatum subsp. spathulatum*	LC
RUBIACEAE	*Kohautia caespitosa subsp. brachyloba*	LC	SANTALACEAE	*Thesium lineatum*	LC

SAPINDACEAE	*Pappea capensis*	LC	SCROPHULARIACEAE	*Aptosimum procumbens*	LC
SCROPHULARIACEAE	*Aptosimum spinescens*	LC	SCROPHULARIACEAE	*Aptosimum tragacanthoides*	LC
SCROPHULARIACEAE	*Hebenstretia parviflora*	LC	SCROPHULARIACEAE	*Jamesbrittenia aridicola*	LC
SCROPHULARIACEAE	*Jamesbrittenia ramosissima*	LC	SCROPHULARIACEAE	*Manulea nervosa*	LC
SCROPHULARIACEAE	*Peliostomum leucorrhizum*	LC	SCROPHULARIACEAE	*Zaluzianskya diandra*	LC
SCROPHULARIACEAE	*Zaluzianskya sanorum*	LC	SOLANACEAE	*Lycium cinereum*	LC
SOLANACEAE	*Solanum burchellii*	LC	SOLANACEAE	*Solanum giftbergense*	LC
SOLANACEAE	*Solanum namaquense*	LC	URTICACEAE	*Forsskaolea candida*	LC
VERBENACEAE	*Chascanum garipense*	LC	VISCACEAE	*Viscum rotundifolium*	LC
ZYGOPHYLLACEAE	*Augea capensis*	LC	ZYGOPHYLLACEAE	*Sisyndite spartea*	LC
ZYGOPHYLLACEAE	*Tribulus pterophorus*	LC	ZYGOPHYLLACEAE	*Tribulus terrestris*	LC
ZYGOPHYLLACEAE	*Zygophyllum retrofractum*	LC	ZYGOPHYLLACEAE	*Zygophyllum simplex*	LC

11 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the vicinity of the Enamandla site based on the literature. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2015 and South African Red Data Book for Mammals (Friedmann & Daly 2004).

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	High
Elephantulus rupestris	Western Rock Elephant Shrew	LC	Rocky koppies, rocky outcrops or piles of boulders where these offer sufficient holes and crannies for refuge.	Low
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Low
Lagomorpha (Hares and Rabbits):				
Pronolagus rupestris	Smith's Red Rock Rabbit	LC	Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines	Low
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Rodentia (Rodents):				
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Confirmed
Petromus typicus	Dassie Rat	LC	Mountainous regions and inselbergs, where they are confined to rocky outcrops and live in crevices or piles of boulders	High
Xerus inauris	South African Ground Squirrel	LC	Open terrain with a sparse bush cover and a hard substrate	Confirmed
Graphiurus platyops	Rock Dormouse	LC	Rocky terrain, under the exfoliation on granite bosses, and in piles of boulders	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
Thallomys paedulcus	Acacia Tree Rat	LC	Associated with stands of Acacia woodland	Low
Thallomys nigricauda	Black-tailed Tree Rat	LC	Associated with stands of Acacia woodland	Low
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	Low
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High
Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High

Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Gerbillurus tytonis	Dune Hairy-footed Gerbil	LC	Hot dry areas on shifting red sand dunes	High
Gerbilliscus leucogaster	Bushveld Gerbil	LC	Predominantly associated with light sandy soils or sandy alluvium	Moderate
Gerbilliscus brantsii	Higheld Gerbil	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland	Moderate
Saccostomus campestris	Pouched Mouse	LC	Catholic habitat requirements, commoner in areas where there is a sandy substrate.	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	Low
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low
Cercopithecus mitis	Vervet Monkey	LC	Most abundant in and near riparian vegetation of savannahs	Low
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	High
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Panthera pardus	Leopard	NT	Wide habitat tolerance, associated with areas of rocky koppies and hills, mountain ranges and forest	Low
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	Confirmed
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Atilax paludinosus	Marsh Mongoose	LC	Associated with well-watered terrain, living in close association with rivers, streams, marshes, etc.	Low
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	High

Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	High
Aonyx capensis	African Clawless Otter	LC	Predominantly aquatic and do not occur far from permanenet water	Low
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Rumanantia (Antelope):				
Tragelaphus strepsiceros	Greater Kudu	LC	Broken, rocky terrain with a cover of woodland and a nearby water supply.	Low
Oryx gazella	Gemsbok	LC	Open arid country	Confirmed
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	High
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Confirmed
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	Low

12 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur at the Enamandla site, based on the ReptileMap database of the ADU. Conservation status is from Bates et al. (2014).

Family	Genus	Species	Subspecies	Common name	Red list category	No. records
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern	2
Agamidae	*Agama*	*knobeli*		Knobel's Rock Agama	Not listed	1
Colubridae	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern	2
Colubridae	*Dipsina*	*multimaculata*		Dwarf Beaked Snake	Least Concern	3
Colubridae	*Telescopus*	*beetzii*		Beetz's Tiger Snake	Least Concern	2
Cordylidae	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern	2
Cordylidae	*Platysaurus*	*capensis*		Namaqua Flat Lizard	Least Concern	1
Elapidae	*Aspidelaps*	*lubricus*	*lubricus*	Coral Shield Cobra	Not listed	6
Elapidae	*Naja*	*nigricincta*	*woodi*	Black Spitting Cobra	Least Concern	1
Elapidae	*Naja*	*nivea*		Cape Cobra	Least Concern	2
Gekkonidae	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern	4
Gekkonidae	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern	7
Gekkonidae	*Goggia*	*lineata*		Striped Pygmy Gecko	Least Concern	4
Gekkonidae	*Pachydactylus*	*goodi*		Good's Gecko	Vulnerable	1
Gekkonidae	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern	8
Gekkonidae	*Pachydactylus*	*weberi*		Weber's Gecko	Least Concern	1
Gerrhosauridae	*Cordylosaurus*	*subtessellatus*		Dwarf Plated Lizard	Least Concern	1
Lacertidae	*Meroles*	*suborbitalis*		Spotted Desert Lizard	Least Concern	7
Lacertidae	*Nucras*	*tessellata*		Western Sandveld Lizard	Least Concern	1
Lacertidae	*Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Least Concern	1
Lacertidae	*Pedioplanis*	*namaquensis*		Namaqua Sand Lizard	Least Concern	8
Lamprophiidae	*Boaedon*	*capensis*		Brown House Snake	Least Concern	3
Lamprophiidae	*Psammophis*	*namibensis*		Namib Sand Snake	Least Concern	1
Lamprophiidae	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern	1
Lamprophiidae	*Pseudaspis*	*cana*		Mole Snake	Least Concern	1

Scincidae	*Acontias*	*namaquensis*		Namaqua Legless Skink	Least Concern	1
Scincidae	*Acontias*	*tristis*		Namaqua Dwarf Legless Skink	Least Concern	23
Scincidae	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Least Concern	1
Scincidae	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern	2
Scincidae	*Trachylepis*	*variegata*		Variegated Skink	Least Concern	2
Testudinidae	*Homopus*	*signatus*		Speckled Padloper	Vulnerable	1
Testudinidae	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed	13
Typhlopidae	*Rhinotyphlops*	*schinzi*		Schinz's Beaked Blind Snake	Least Concern	1
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern	1
Viperidae	*Bitis*	*caudalis*		Horned Adder	Least Concern	2

13 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in the vicinity of the Enamandla site. Based on the Frogmap database, while conservation status is from the IUCN Red Lists 2014 and Minter et al. (2004).

Family	Genus	Species	Common name	Red list category	No. records
Bufonidae	*Vandijkophrynus*	*gariepensis*	Karoo Toad (subsp. gariepensis)	Not listed	2
Bufonidae	*Vandijkophrynus*	*robinsoni*	Paradise Toad	Least Concern	10
Microhylidae	*Phrynomantis*	*annectens*	Marbled Rubber Frog	Least Concern	7
Pipidae	*Xenopus*	*laevis*	Common Platanna	Least Concern	1
Pyxicephalidae	*Amietia*	*fuscigula*	Cape River Frog	Least Concern	4
Pyxicephalidae	*Cacosternum*	*namaquense*	Namaqua Caco	Least Concern	3
Pyxicephalidae	*Strongylopus*	*springbokensis*	Namaqua Stream Frog	Vulnerable	2
Pyxicephalidae	*Tomopterna*	*delalandii*	Cape Sand Frog	Least Concern	3