PROPOSED LIMESTONE PV2 SOLAR PHOTOVOLTAIC FACILITY PROJECT – BIODIVERSITY AND FRESHWATER IMPACT ASSESSMENT

Z F Mgcawu District Municipality, Northern Cape

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CLIENT

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Submitted to	savannah environmental
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Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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1 Introduction

1.1 Background

The Biodiversity Company was appointed to undertake a terrestrial and freshwater ecological assessment for the proposed Limestone Solar Photovoltaic (PV) project and associated infrastructure. The project comprises two development areas and this project is referred to as Limstone PV2 (Figure 1-2). The project is located on Portion 4 of the Farm Engeland 300, near Danielskuil, Northern Cape Province. The extent of the project components is referred to as "Project Area" and pertains to the project area. A 200 m buffer was added to the Project area for the assessments, referred to as the Project Area of Influence (PAOI).

Each project will have a contracted capacity of up to 150MW Maximum Export Capacity. A broader project site of 1842 ha and a preferred development area with an extent of 200-300 ha have been identified by AGV Projects (Pty) Ltd as technically suitable for the development of the PV facilities. Each facility is proposed to include the following infrastructure:

- PV modules mounted on either a single axis tracking & fixed structure, dependent on optimisation, technology available and cost;
- Inverters and transformers;
- Low voltage cabling between the PV modules to the inverters;
- Fence around the project development area with security and access control;
- Camera surveillance;
- Internet connection;
- 33kV cabling between the project components and the facility substation;
- 33/132kV onsite facility substation;
- Battery Energy Storage System (BESS) with a footprint of up to 6 ha
- Site offices and maintenance buildings, including workshop areas for maintenance and storage as well as parking for staff and visitors;
- Laydown/staging area less site in front of mounting structures during installation. Temporary store area close to site entrance (up to 2 ha);
- Access roads (up to 6m wide) and internal distribution roads (up to 5 m wide);
- Temporary concrete batching facility; and
- Stormwater management infrastructure as required.

The PAOI is in the Kgatelopele Local Municipality in the ZF Mgcawu District Municipality of the Northern Cape Province, South Africa. The area is approximately 9 km northeast of Lime Acres and 10 km northwest of the town of Witputs. The PAOI is also found approximately 8.3 km west of the R385 road and 6.4 km north of the R31 road. The surrounding land use includes limestone mining, watercourses, livestock, and game farming activities.

This desktop assessment and sensitivity verification was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020) in terms of NEMA, dated 20 March and 30 October 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation" (Reporting Criteria). The National Web based Environmental Screening Tool has characterised the sensitivity for the terrestrial and aquatic biodiversity themes for the PAOI as "Very High".

The wetland assessment has been completed in accordance with the requirements of the published GN 509 by the Department of Water and Sanitation (DWS). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM). This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation. A 500 m radius has been delineated for the project components for the identification of wetland systems.

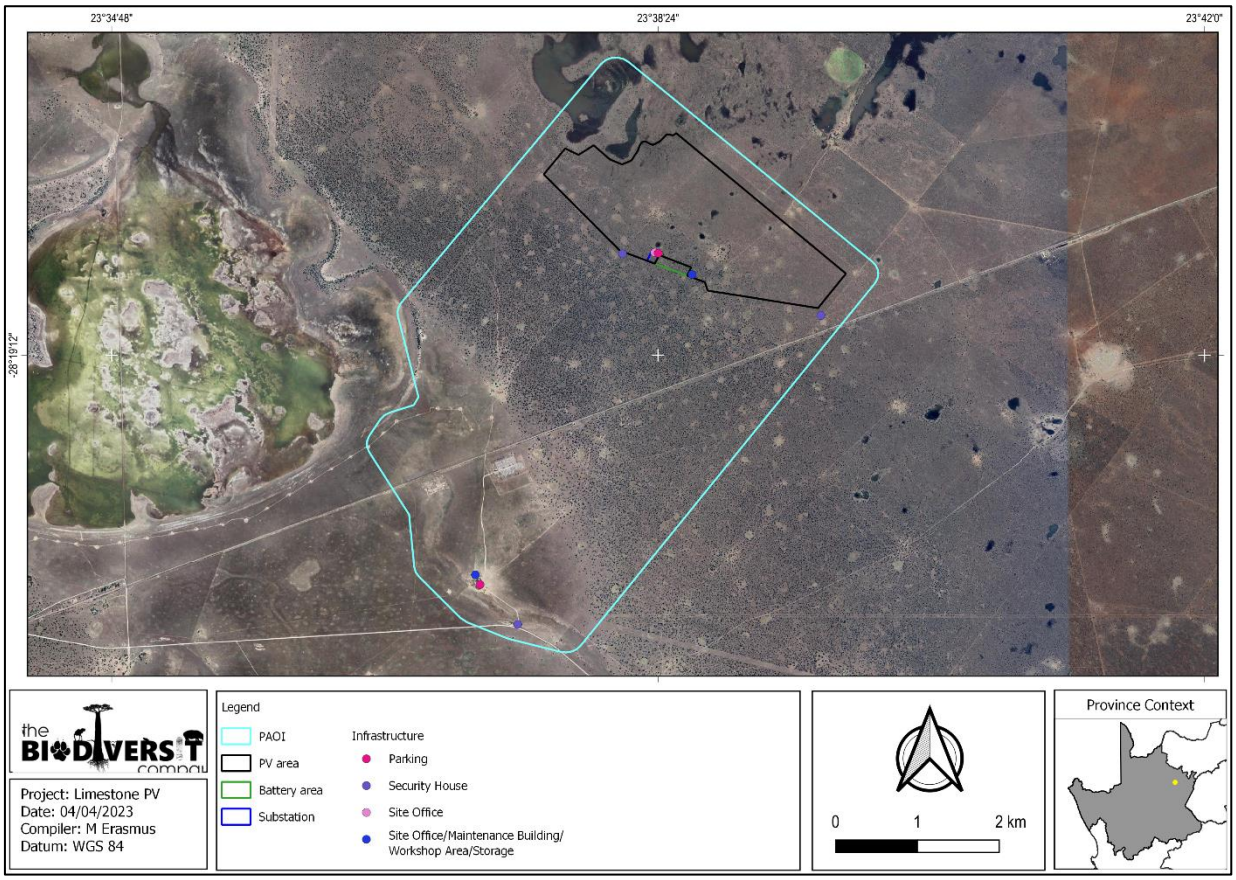


Figure 1-1 The project layout and components

Figure 1-2 The Project Area of Influence in proximity to the nearby towns

1.2 Scope of Work

The principle scope of work includes the following:

- Desktop assessment to identify the relevant ecologically important geographical features within the PAOI;
- Desktop assessment to compile an expected species list and possible threatened flora and fauna species that occur within the PAOI;
- Field survey to ascertain the species composition of the present flora and fauna community within the PAOI;
- Delineate and map the habitats and their respective sensitivities that occur within the PAOI;
- Identify the manner that the proposed project impacts the flora and fauna community and evaluate the level of risk of these potential impacts; and
- The prescription of mitigation measures and recommendations for identified risks.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- For the purposes of this assessment, the results from the desktop evaluation and field survey considered the entire PAOI;
- Whilst every effort was made to cover as much of the site as possible, it is possible that some flora and fauna species that are present on site were not recorded during the field survey, especially secretive or rare species;
- With regards to the fauna species assessment, only amphibians, reptiles and non-volant mammal species were considered. The volant mammal impact assessment were undertaken by separate specialists;
- No passive sampling techniques for small non-volant mammals were utilised within the PAOI due to time constraints;
- Only a single survey was undertaken in November (Summer) and hence there is a high probability that not all species of flora will be recorded. Due to time constraints no protected flora were geotagged;
- Any alterations and/or missing GIS information pertaining to the development layout subsequent to this assessment may affect the accuracy and/or outcomes of the assessment; and
- The GPS used in the assessment has an accuracy of 5 m and consequently any spatial features may be offset by 5 m.

1.4 Background

The following reports were reviewed in consideration for this development project:

- Final Scoping Report for Olien Solar Energy on Prt 4 of Farm 300 Barkly West Lime Acres, Northern Cape. Cape Environmental Assessment Practitioners (Pty) Ltd (2012); and
- Terrestrial Fauna & Flora Specialist Study for EIA for the Proposed Olien Solar Project, Portion 4 Of Farm 300 Barkly West, Lime Acres, Northern Cape. Simon Todd Consulting (2012).

1.5 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 1-1 are applicable to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Table 1-1 A list of key legislative requirements relevant to biodiversity and conservation in the Northern Cape Province

Region	Legislation / Guideline	Comment
National	The National Environmental Management Act (NEMA) (Act No. 107 of 1998)	Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), Appendix 6 requirements
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004), Threatened or Protected Species Regulations	The protection of species and ecosystems that warrant protection
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GNR 320 of Government Gazette 43310 (March 2020)	The minimum criteria for reporting.
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GNR 1150 of Government Gazette 43855 (October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	The National Environmental Management: Waste Act, 2008 (Act 59 of 2008);	The regulation of waste management to protect the environment.
	National Water Act (NWA) (Act No. 36 of 1998)	The regulation of water uses.
	Alien and Invasive Species Regulations and, Alien and Invasive Species List 20142020, published under NEMBA	The regulation and management of alien invasive species.
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	To provide for control over the utilization of the natural agricultural resources including the vegetation and the combating of weeds and invader plants.
Provincial	Northern Cape Planning and Development Act no. 7 of 1998	To provide for the management and conservation of the province's biophysical environment and protected areas. To inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management,
	Northern Cape Nature Conservation act no. 9 of 2009	

1.5.1 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) and the associated Environmental Impact Assessment (EIA) Regulations, as amended in April 2017, state that prior to certain listed activities taking place, an environmental authorisation application (EA) process needs to be followed. This could follow either the Basic Assessment (BA) process or the EIA process, depending on the scale of the impact. A BA process will be undertaken for the project.

GNR 1150 and a GNR 350 were gazetted on the 20 March and 30 October 2020, which have replaced the requirements of Appendix 6 of the EIA Regulations in respect of certain specialist reports. These regulations provide the criteria and minimum requirements for specialist's assessments, in order to consider the impacts on aquatic biodiversity for activities which require EA.

1.5.2 National Water Act (NWA, 1998)

The Department of Human Settlements Water and Sanitation (DHSWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The NWA allows for the protection of water resources, which includes the:

- Maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;

- Prevention of the degradation of the water resource; and
- Rehabilitation of the water resource.

A watercourse means;

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse, unless it is authorised by the DHSWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DHSWS in terms of Sections 21 (c) and (i) of the NWA.

1.6 Definitions

1.6.1 Species of Conservation Concern

In accordance with the National Red List of South African Plants website, managed and maintained by the South African National Biodiversity Institute (SANBI), a Species of Conservation Concern (SCC) is a species that has a high conservation importance in terms of preserving South Africa's rich biodiversity. This classification covers a range of red list categories as illustrated in Figure 1-3 below.

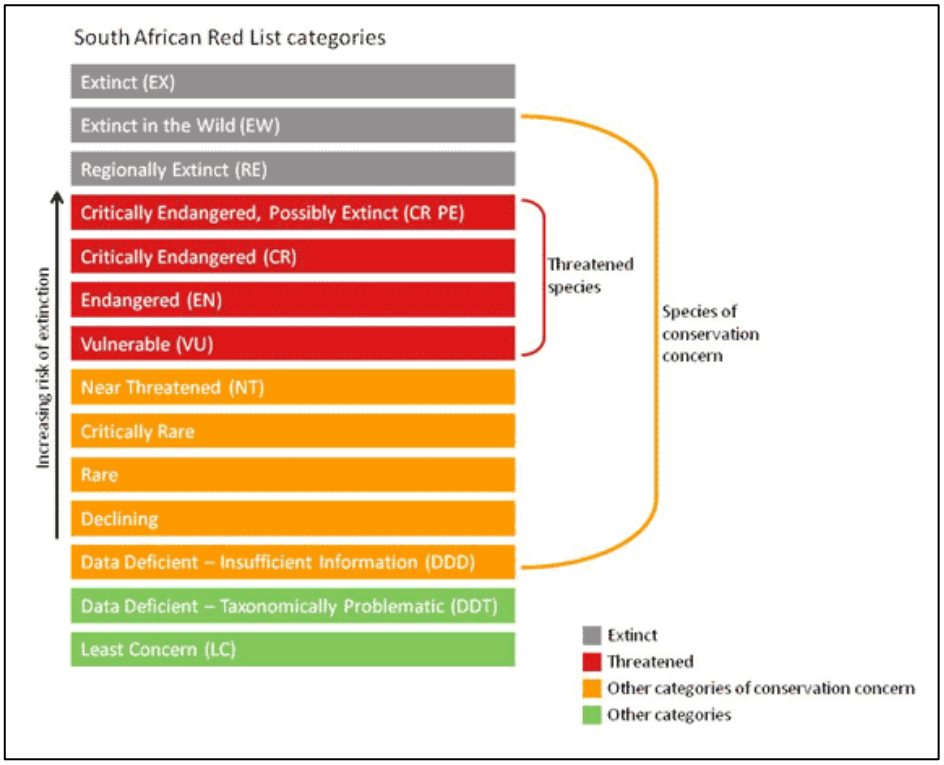


Figure 1-3 Threatened species and Species of Conservation Concern (SANBI, 2016)

South Africa uses the internationally endorsed International Union for Conservation of Nature (IUCN) Red List Categories and Criteria (IUCN, 2012). This scientific system is designed to measure species' risk of extinction and its purpose is to highlight those species that are in need of critical conservation action. As this system has been adopted from the IUCN, the definition of an SCC as described and categorised

above is extended to all red list classifications relevant to fauna as well as the IUCN categories, for the purposes of this report.

1.6.2 Protected Species

Protected species include both flora and fauna species that are protected according to some form of relevant legislation, be it provincial, national, or international. Provincial legislation may include that published in the form of a provincial ordinance, bill, or act, and national legislation includes that which is published in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) or the National Forests Act (Act No. 84 of 1998). Relevant international legislation includes the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2021).

2 Methods

2.1 Desktop Baseline

The desktop assessment was principally undertaken using a Geographic Information System (GIS) to access the latest available spatial datasets in order to develop digital cartographs and species lists. These datasets and their date of publishing are provided below.

The PAOI was derived by using the property areas provided, as the project components will be planned within.

2.1.1 Ecologically Important Landscape Features

Existing ecologically relevant data layers were incorporated into a GIS to establish how the proposed project might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:

- *National Biodiversity Assessment 2018 (Skowno et al, 2019) (NBA)*- The purpose of the NBA is to assess the state of South Africa's biodiversity based on best available science, with a view to understanding trends over time and informing policy and decision-making across a range of sectors. The NBA deals with all three components of biodiversity: genes, species and ecosystems; and assesses biodiversity and ecosystems across terrestrial, freshwater, estuarine and marine environments. The two headline indicators assessed in the NBA are:
    - *Ecosystem Threat Status* – indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition.
    - *Ecosystem Protection Level* – indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems.
- Protected areas:
    - *South Africa Protected Areas Database (SAPAD) (DEA, 2020)* – The (SAPAD) Database contains spatial data for the conservation of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. SAPAD is updated on a continuous basis and forms the basis for the Register of Protected Areas, which is a legislative requirement under the National Environmental Management: Protected Areas Act, Act 57 of 2003.

- *National Protected Areas Expansion Strategy (NPAES) (SANBI, 2010)* – The NPAES provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and therefore, of high importance for biodiversity, climate resilience and freshwater protection.

- Northern Cape Critical Biodiversity Areas (CBAs) (SANBI, 2016) - The identification of Critical Biodiversity Areas for the Northern Cape was undertaken using a Systematic Conservation Planning approach. Available data on biodiversity features (incorporating both pattern and process, and covering terrestrial and inland aquatic realms), their condition, current Protected Areas and Conservation Areas, and opportunities and constraints for effective conservation were collated. Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes. CBA categories are based on their biodiversity characteristics, spatial configuration and requirement for meeting targets for both biodiversity pattern and ecological processes:

  - Critical Biodiversity Area (CBA) – An area that must be maintained in a good ecological condition (natural or near-natural state) in order to meet biodiversity targets. CBAs collectively meet biodiversity targets for all ecosystem types as well as for species and ecological processes that depend on natural or near-natural habitat, that have not already been met in the protected area network (SANBI, 2016).

  - Ecological Support Area (ESA) – An area that must be maintained in at least fair ecological condition (semi-natural/moderately modified state) in order to support the ecological functioning of a CBA or protected area, or to generate or deliver ecosystem services, or to meet remaining biodiversity targets for ecosystem types or species when it is not possible or no necessary to meet them in natural or near-natural areas (SANBI, 2016).

  - Other Natural Area (ONA) – An area in good or fair ecological condition (natural, near-natural or semi-natural) that is not required to meet biodiversity targets for ecosystem types, species or ecological processes (SANBI, 2016).

- Important Bird and Biodiversity Areas (IBAs) (BirdLife South Africa, 2015) – IBAs constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria; and

- Hydrological Setting:

  - South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al,* 2018) – A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Impact Assessment of 2018. It is a collection of data layers that represent the extent of river and inland wetland ecosystem types as well as pressures on these systems.

  - Strategic Water Source Areas (SWSAs) (Le Maitre *et al*, 2021) – SWSAs are defined as areas of land that supply a quantity of mean annual surface water runoff in relation to their size and therefore, contribute considerably to the overall water supply of the country. These are key ecological infrastructure assets and the effective protection of surface water SWSAs areas is vital for national security because a lack of water security will compromise national security and human wellbeing.

- National Freshwater Ecosystem Priority Area (NFEPA) (Nel *et al.,* 2011) – The NFEPA database provides strategic spatial priorities for conserving the country's freshwater ecosystems and associated biodiversity as well as supporting sustainable use of water resources.

2.1.2 Desktop Flora Baseline

The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) was used to identify the vegetation type that would have occurred under natural or pre-anthropogenically altered conditions. Furthermore, the Plants of Southern Africa (POSA) database was accessed to compile a list of expected flora species within the PAOI (Figure 2-1). The Red List of South African Plants (Raimondo et al., 2009; SANBI, 2020) was utilized to provide the most current national conservation status of flora species.

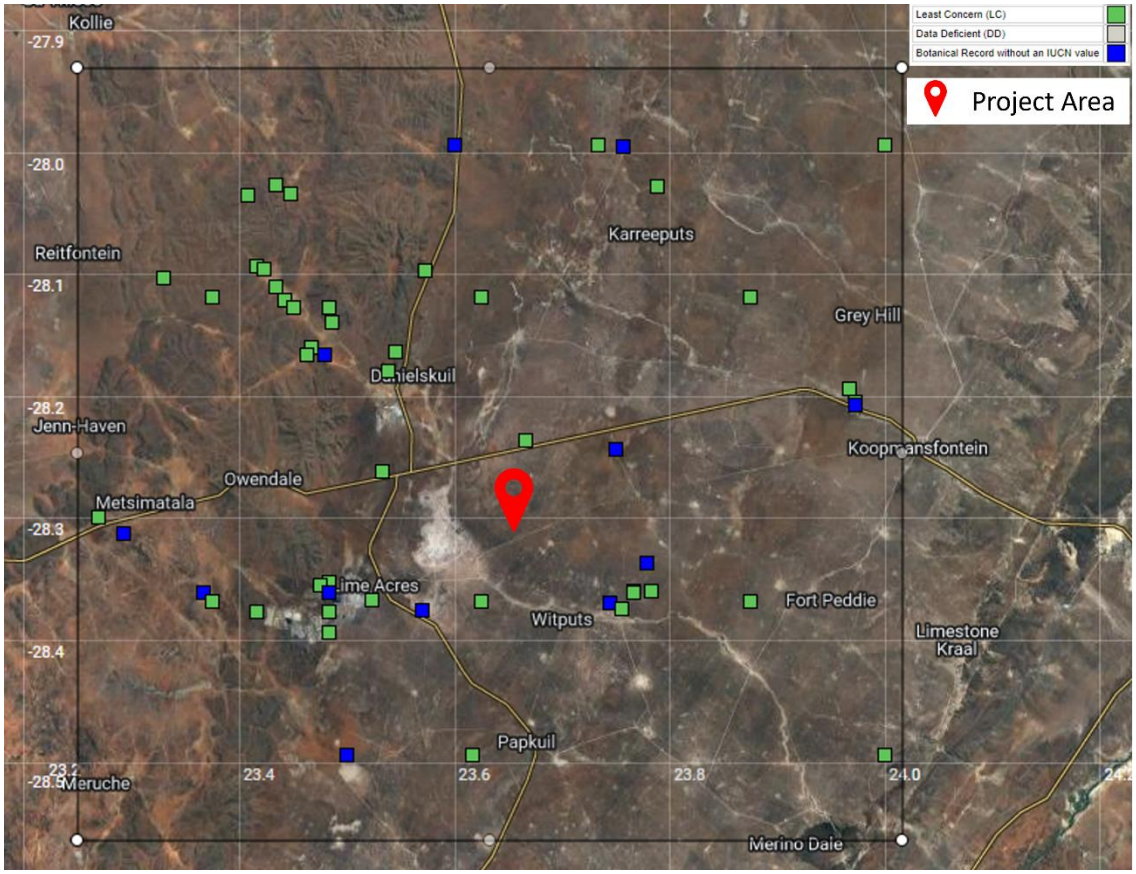


Figure 2-1 Map illustrating extent of area used to obtain the expected flora species list from the Plants of South Africa (POSA) database.

2.1.3 Desktop Faunal Assessment

The faunal desktop assessment comprised of the following, compiling an expected:

- Amphibian list, generated from the IUCN spatial dataset (2017) and ReptileMap database (FitzPatrick Institute of African Ornithology, 2021a), using the 2823 quarter degree square;
- Reptile list, generated from the IUCN spatial dataset (2017) and AmphibianMap database (FitzPatrick Institute of African Ornithology, 2021b), using the 2823 quarter degree square; and
- Mammal list from the IUCN spatial dataset (2017).

2.1.4 Desktop Freshwater Assessment

2.1.4.1 Desktop Research

The following spatial datasets were utilised:

- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- South African Inventory of Inland Aquatic Ecosystems (Van Deventer *et al*., 2019);
- The National Freshwater Ecosystem Priority Areas (Nel *et al*., 2011);
- Contour data (5m);
- NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data; and
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer, H., *et al*., 2018).

2.2 Biodiversity Field Assessment

Field surveys for the area was undertaken from the 31st of October to the 3rd of November 2022 (summer), which is a wet-season survey, to determine the presence of Species of Conservation Concern (SCC). Effort was made to cover all the different habitat types, within the limits of time and access.

2.2.1 Flora Survey

The fieldwork and sample sites were placed within targeted areas (i.e. target sites) perceived as ecologically sensitive based on the preliminary interpretation of satellite imagery (Google Corporation) and GIS analysis (which included the latest applicable biodiversity datasets) available prior to the fieldwork. The focus of the fieldwork was therefore to maximise coverage and navigate to each target site in the field, to perform a rapid vegetation and ecological assessment at each sample site. Emphasis was placed on sensitive habitats, especially those overlapping with the proposed PAOI.

Homogenous vegetation units were subjectively identified using satellite imagery and existing land cover maps. The floristic diversity and search for flora SCC were conducted through timed meanders within representative habitat units delineated during the scoping fieldwork. Emphasis was placed mostly on sensitive habitats overlapping with the proposed PAOIs.

The timed random meander method is highly efficient for conducting floristic analysis, specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost effective and highly suited for compiling flora species lists and therefore gives a rapid indication of flora diversity. The timed meander search was performed based on the original technique described by Goff *et al.* (1982). Suitable habitat for SCC were identified according to Raimondo *et al.* (2009) and targeted as part of the timed meanders.

At each sample site notes were made regarding current impacts (e.g. livestock grazing, erosion etc.), subjective recording of dominant vegetation species and any sensitive features (e.g. wetlands, outcrops etc.). In addition, opportunistic observations were made while navigating through the PAOI.

Relevant field guides and texts consulted for identification purposes in the field during the survey included the following:

- Identification Guide to Southern African Grasses: An Identification Manual with Keys, Descriptions, and Distributions (Fish *et al,* 2015);
- iNaturalist;
- Flowering Plants of the Southern Kalahari (Van Rooyen and Van Rooyen, 2019);
- Problem Plants and Alien Weeds of South Africa (Bromilow, 2010);
- Field Guide to Succulents in Southern Africa (Smith *et al,* 2017);
- Guide to the Aloes of South Africa (Van Wyk & Smith, 2014);
- Medicinal Plants of South Africa (Van Wyk *et al.,* 2013).

2.2.2 Fauna Survey

The faunal assessment within this report pertains to herpetofauna (amphibians and reptiles) and mammals. The faunal field survey comprised of the following techniques:

- *Visual and auditory searches* - This typically comprised of meandering and using binoculars to view species from a distance without them being disturbed; and listening to species calls;
- Active hand-searches - are used for species that shelter in or under particular micro-habitats (typically rocks, exfoliating rock outcrops, fallen trees, leaf litter, bark etc.).

Relevant field guides and texts consulted for identification purposes included the following:

- Field Guide to Snakes and other Reptiles of Southern Africa (Branch, 1998);
- A Complete Guide to the Snakes of Southern Africa (Marais, 2004);
- Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland (Bates et al, 2014);
- A Complete Guide to the Frogs of Southern Africa (du Preez and Carruthers, 2009);
- Smithers' Mammals of Southern Africa (Apps, 2000); and
- A Field Guide to the Tracks and Signs of Southern and East African Wildlife (Stuart and Stuart, 2000).

2.3 Terrestrial Site Ecological Importance (SEI)

The different habitat types within the PAOI were delineated and identified based on observations during the field assessment, and available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes.

Site Ecological Importance (SEI) is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and Receptor Resilience (RR) (its resilience to impacts) as follows.

BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows. The criteria for the CI and FI ratings are provided in Table 2-1 and Table 2-2, respectively.

Table 2-1 Summary of Conservation Importance (CI) criteria

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Extremely Rare or CR species that have a global extent of occurrence (EOO) of < 10 km^2. Any area of natural habitat of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent) of natural habitat of an EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population).
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population).
Medium	Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.

Low	No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC.
Very Low	No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.

Table 2-2 Summary of Functional Integrity (FI) criteria

Functional Integrity	Fulfilling Criteria
Very High	Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts, with no signs of major past disturbance.
High	Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts, with no signs of major past disturbance and good rehabilitation potential.
Medium	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.
Very Low	Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.

BI can be derived from a simple matrix of CI and FI as provided in Table 2-3.

Table 2-3 Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)

Biodiversity Importance (BI)		Conservation Importance (CI)				
		Very high	**High**	**Medium**	**Low**	**Very low**
Functional Integrity (FI)	**Very high**	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor, as summarised in Table 2-4.

Table 2-4 Summary of Resource Resilience (RR) criteria

Resilience	Fulfilling Criteria
Very High	Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of: (i) remaining at a site even

	when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
High	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to: (i) remain at a site even when a disturbance or impact is occurring, or (ii) return to a site once the disturbance or impact has been removed.

Subsequent to the determination of the BI and RR, the SEI can be ascertained using the matrix as provided in Table 2-5.

Table 2-5 Matrix used to derive Site Ecological Importance (SEI) from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance (SEI)		**Biodiversity Importance (BI)**				
		Very high	**High**	**Medium**	**Low**	**Very low**
Receptor Resilience (RR)	Very Low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very High	Medium	Low	Very low	Very low	Very low

Interpretation of the SEI in the context of the proposed project is provided in Table 2-6.

Table 2-6 Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities

Site Ecological Importance (SEI)	**Interpretation in relation to proposed development activities**
Very High	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

The SEI evaluated for each taxon can be combined into a single multi-taxon evaluation of SEI for the assessment area. Either a combination of the maximum SEI for each receptor should be applied, or the SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. For the latter, justification of the SEI for each receptor is based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa.

2.4 Wetland Assessment

2.4.1 Identification and Mapping

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) was considered for this assessment. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels. In addition, the method also includes the assessment of structural features at the lower levels of classification (Ollis *et al.,* 2013).

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2-2. The outer edges of the wetland areas were identified by considering the following four specific indicators, the:

- *Terrain Unit Indicator* helps to identify those parts of the landscape where wetlands are more likely to occur;
- *Soil Form Indicator* identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
    - The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- *Soil Wetness Indicator* identifies the morphological "signatures" developed in the soil profile due to prolonged and frequent saturation; and
- *Vegetation Indicator* identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

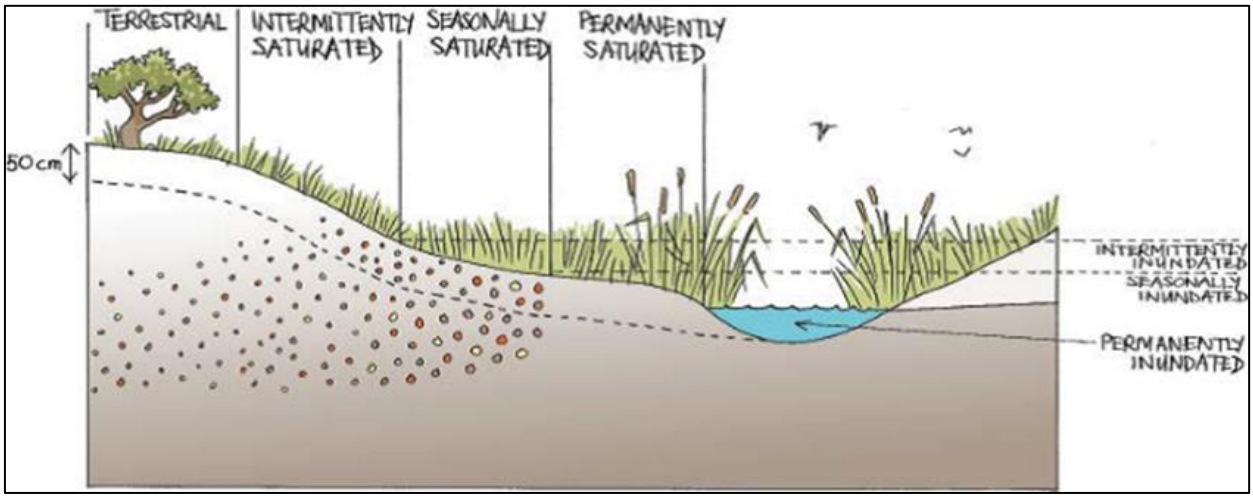


Figure 2-2 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

2.4.2 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands and humans. Eco Services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 2-7).

Table 2-7 Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

2.4.3 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 2-8.

Table 2-8 The Present Ecological Status categories (Macfarlane et al., 2009)

Impact Category	Description	Impact Score Range	PES
None	**Unmodified, natural**	**0 to 0.9**	**A**
Small	Largely Natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	F

2.4.4 Importance and Sensitivity

The importance and sensitivity of water resources is determined to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category, as listed in Table 2-9 (Rountree and Kotze, 2013).

Table 2-9 Description of Ecological Importance and Sensitivity categories

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

2.4.5 Determining Buffer Requirements

The "*Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries*" (Macfarlane *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

2.4.6 Risk Assessment

The risk assessment was conducted in accordance with the DHSWS risk-based water use authorisation approach and delegation guidelines. The significance of the impact is calculated according to Table 2-10.

Table 2-10 Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

3 Results & Discussion

3.1 Desktop Baseline

3.1.1 Ecologically Important Landscape Features

The GIS analysis pertaining to the relevance of the proposed project to ecologically important landscape features are summarised in Table 3-1. The figures below present data for the PAOI.

Table 3-1 Summary of relevance of the PAOI to ecologically important landscape features.

Desktop Information Considered	Relevant/Irrelevant	Section
Ecosystem Threat Status	Relevant – Overlaps with a Least Concern Ecosystem.	3.1.1.1
Ecosystem Protection Level	Relevant – The PAOI overlaps mainly with a MP ecosystem, with a small portion being NP	3.1.1.2
Critical Biodiversity Area	Relevant – the PAOI predominantly overlaps with areas classified as CBA; the majority of the area being CBA2	3.1.1.3
Renewable Energy EIA Application Database (REEA)	Relevant – An “approved” project occurs within the boundary of the PAOI.	3.1.1.4
South African Inventory of Inland Aquatic Ecosystems	Relevant – The PAOI overlaps with unclassified and LC wetlands and A CR River system	3.1.1.5.1
National Freshwater Priority Area	Relevant – The PAOI overlaps with several true NFEPA wetlands, as well as a FEPA River, classed as Freshwater Ecosystem Priority Area.	3.1.1.5.2
Strategic Water Source Areas	Irrelevant- The PAOI is more than 100 km from the closest SWSA.	
REDZ	Irrelevant – Does not overlap with any Renewable Energy Development Zones	
Powerline Corridor	Irrelevant – Does not overlap with any Powerline Corridor	
Important Bird and Biodiversity Areas	Irrelevant – Does not overlap with any IBA	
Protected Areas	Irrelevant – The PAOI is 29 km from the nearest Protected area.	
National Protected Areas Expansion Strategy	Irrelevant – The PAOI is 2.2 km from the nearest NPAES .	

3.1.1.1 Ecosystem Threat Status

The Ecosystem Threat Status is an indicator of an ecosystem’s wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition. According to the spatial dataset the proposed project site overlaps with a LC ecosystem (Figure 3-1).

Figure 3-1 Map illustrating the ecosystem threat status associated with the PAOI.

3.1.1.2 Ecosystem Protection Level

This is an indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems. The PAOI overlaps mainly with a MP ecosystem, with a small portion being NP (Figure 3-2).

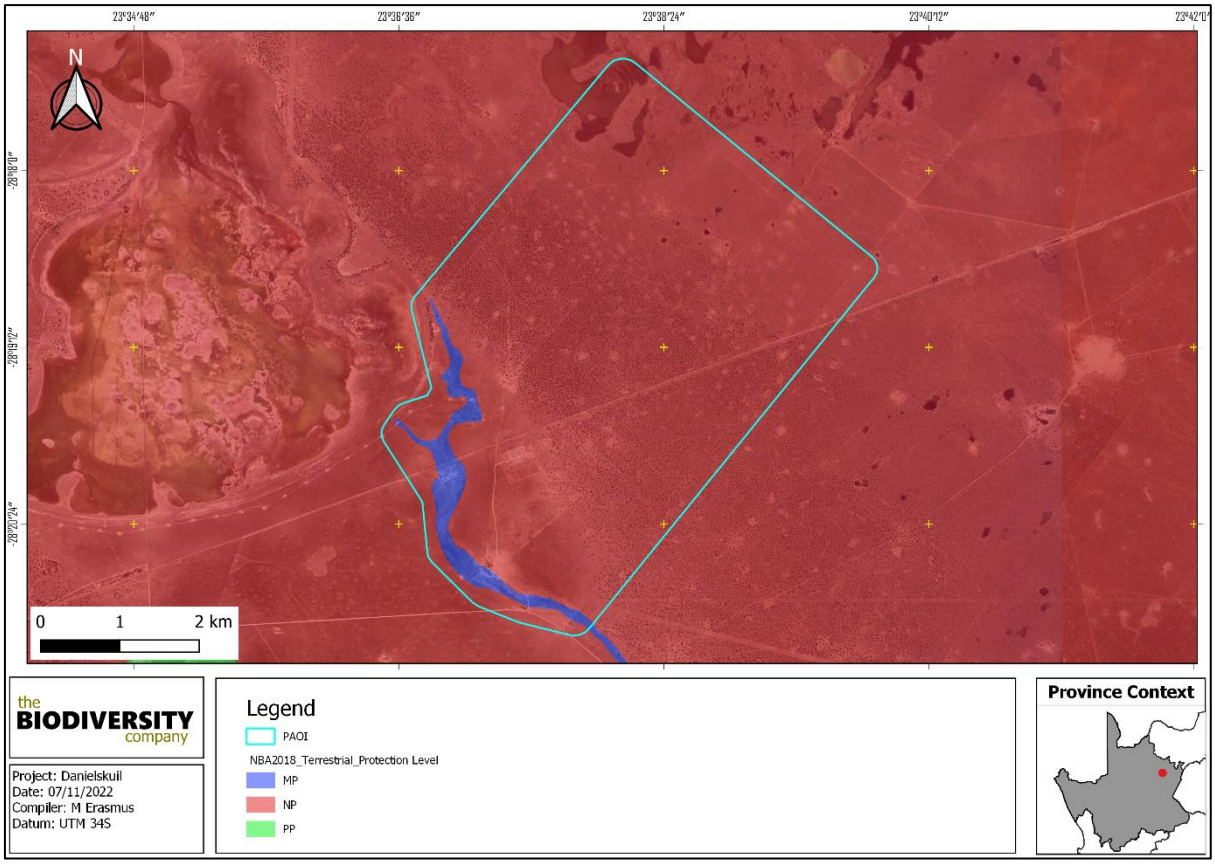


Figure 3-2 Map illustrating the ecosystem protection level associated with the PAOI

3.1.1.3 Critical Biodiversity Areas and Ecological Support Areas

Figure 3-3 illustrates that the PAOI predominantly overlaps with areas classified as CBA; most of the area being CBA2. CBAs are areas that must be maintained in a good ecological condition (natural or near-natural state) in order to meet biodiversity targets. CBAs collectively meet biodiversity targets for all ecosystem types as well as for species and ecological processes that depend on natural or near-natural habitat, that have not already been met in the protected area network (SANBI, 2016).

These areas are defined as their respective categories due to the presence of water resources and landscape structural elements.

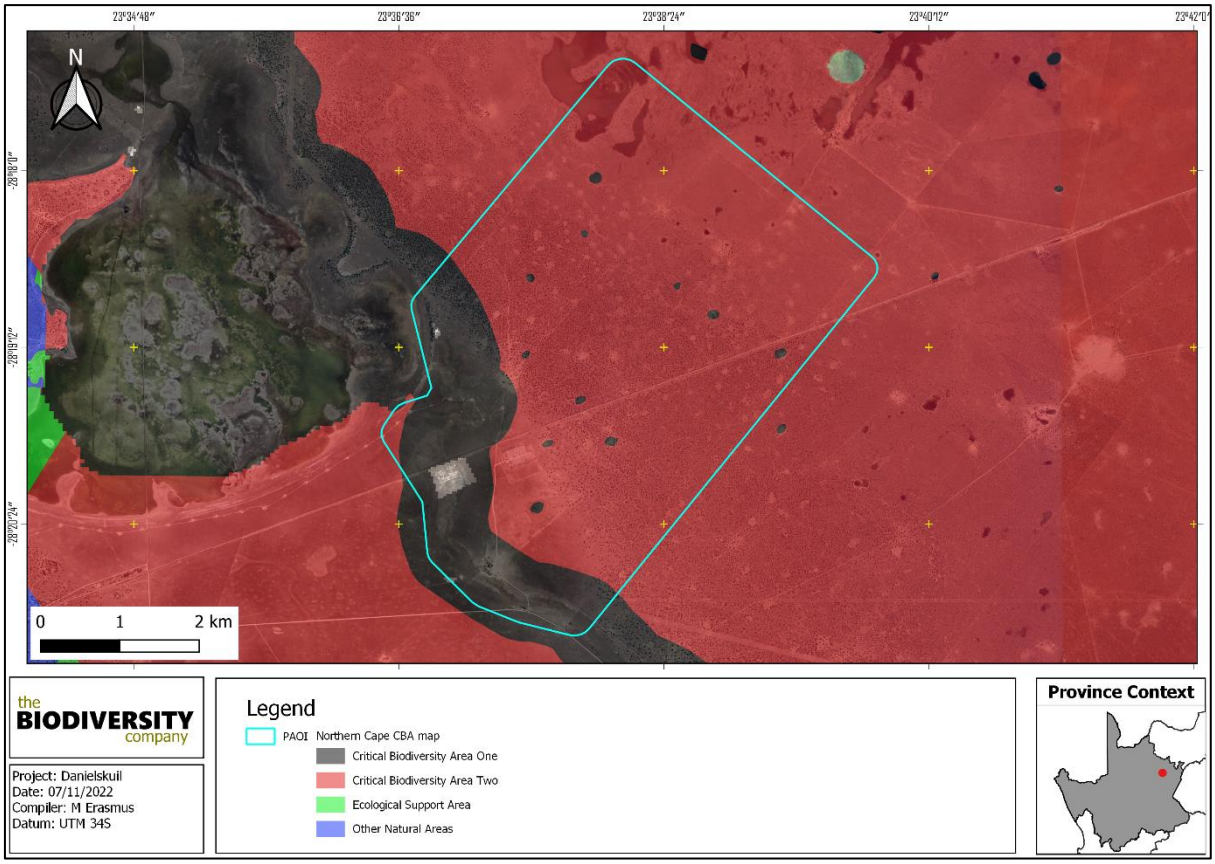


Figure 3-3 Map illustrating the locations of CBAs in the PAOI

3.1.1.4 Renewable Energy EIA Application Database

The Renewable Energy Database (http://egis.environment.gov.za/), shows that there several other projects in the near vicinity (Figure 3-4). This increases the overall impact on the habitats in the area. An "approved" project occurs within the boundary of the PAOI, however it is assumed that this EA has since lapsed.

Figure 3-4 The PAOI in relation to the renewable energy database projects in the area.

3.1.1.5 Hydrological Context

3.1.1.5.1 South African Inventory of Inland Aquatic Ecosystems (SAIIAE

The SAIIAE was released with the NBA 2018. Ecosystem threat status (ETS) of river and wetland ecosystem types are based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LT, with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al.,* 2019; Skowno *et al.,* 2019). The PAOI overlaps with unclassified and LC wetlands and A CR River system, that were assessed as part of the SAIIAE (Figure 3-5).

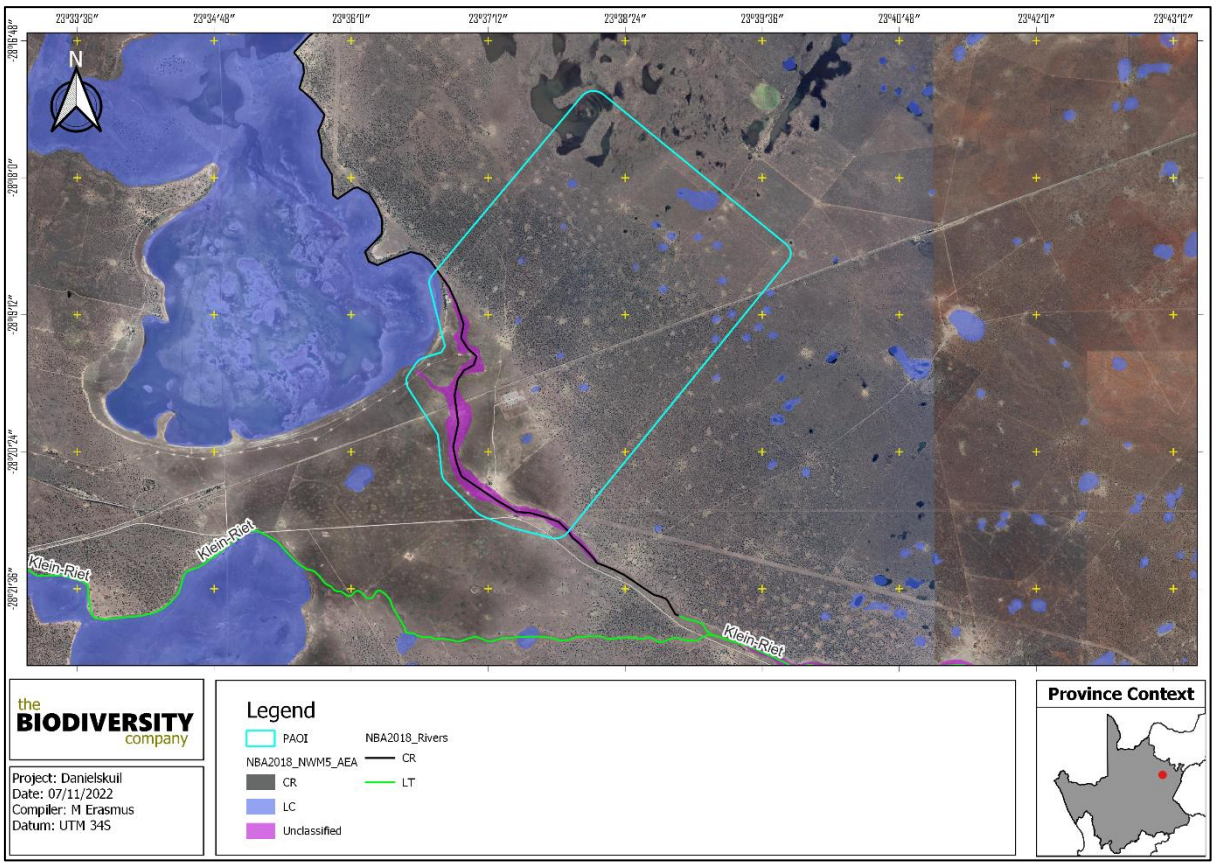


Figure 3-5 Map illustrating the hydrological context of the proposed PAOI

3.1.1.5.2 National Freshwater Ecosystem Priority Area Status

In an attempt to better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) biodiversity goals (Nel *et al.,* 2011).

Figure 3-6 shows that the PAOI overlaps with several true NFEPA wetlands, as well as a FEPA River, classed as Freshwater Ecosystem Priority Area.

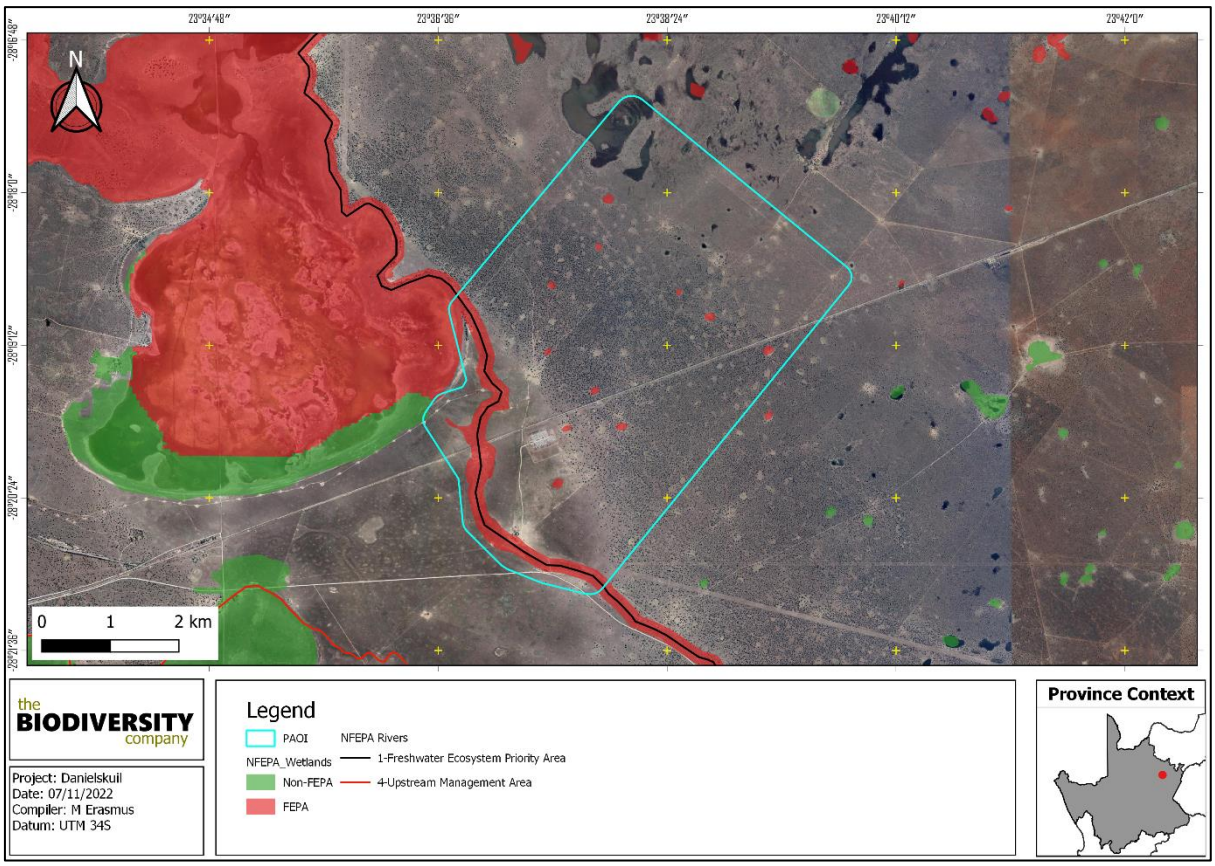


Figure 3-6 The PAOI in relation to the National Freshwater Ecosystem Priority Areas

3.1.2 Flora Assessment

This section is divided into a description of the vegetation type expected under natural conditions and the expected flora species.

3.1.2.1 Vegetation Type

The PAOI is situated within the savanna biome. The savanna vegetation of South Africa represents the southernmost extension of the most widespread biome in Africa (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the savanna biome include:

a) seasonal precipitation; and

b) (sub) tropical thermal regime with no or usually low incidence of frost (Mucina & Rutherford, 2006).

Most savanna vegetation communities are characterised by a herbaceous layer dominated by grasses and a discontinuous to sometimes very open tree layer (Mucina & Rutherford, 2006).

The savanna biome is the largest biome in South Africa, extending throughout the east and north-eastern areas of the country. Savannas are characterised by a dominant grass layers, over-topped by a discontinuous, but distinct woody plant layer. At a structural level, Africa's savannas can be broadly categorised as either fine-leaved (microphyllous) savannas or broad-leaved savannas. Fine-leaved savannas typically occur on nutrient rich soils and are dominated by microphyllous woody plants of the Mimosaceae family and a generally dense herbaceous layer (Scholes & Walker, 1993).

On a fine-scale vegetation type, the PAOI overlaps with two vegetation types: the Ghaap Plateau Vaalbosveld and the Southern Kalahari Mekgacha (Figure 3-7).

Figure 3-7 Map illustrating the vegetation type associated with the PAOI

3.1.2.1.1 Ghaap Plateau Vaalbosveld

The vegetation type is known for flat plateau areas with a well-developed shrub layer with *Tarchonanthus camphoratus* and *Vachellia karroo*. Areas may exhibit an open tree layer with *Olea europaea subsp. africana*, V*. tortilis, Ziziphus mucronata* and *Searsia lancea*. The presence of Olea is more important in the southern parts of the unit, while V*. tortilis, V. hebeclada* as well as *Senegalia mellifera* are more important in the north and part of the west of the unit. The south-central part of this unit has remarkably low cover of Thorn tree species for an arid savanna and is dominated by the nonthorny T*. camphoratus, s. lancea* and *O. europaea subsp. africana* (Mucina and Rutherford,2006).

Important Plant Taxa in Ghaap Plateau Vaalbosveld

Based on Mucina and Rutherford's (2006) vegetation classification, important plant taxa are those species that have a high abundance, a frequent occurrence (not being particularly abundant); or are prominent in the landscape within a particular vegetation type. They note the following species are important taxa in the Ghaap Plateau Vaalbosveld vegetation type:

Trees: *Vachellia erioloba*.

Small Trees: *Senegalia mellifera subsp. detinens, Searsia lancea, Vachellia karroo, V. tortilis subsp. heteracantha, Boscia albitrunca.*

Tall Shrubs: *Olea europaea subsp. cuspidata, Rhigozum trichotomum, Tarchonanthus camphoratus, Ziziphus mucronata, Diospyros austro-africana, D. pallens, Ehretia rigida subsp. rigida, Euclea crispa subsp. ovata, Grewia flava, Gymnosporia buxifolia, Lessertia frutescens, Searsia tridactyla*.

Low Shrubs: *Vachellia hebeclada subsp. hebeclada, Aptosimum procumbens, Chrysocoma ciliata, Helichrysum zeyheri, Hermannia comosa, Lantana rugosa, Leucas capensis, Melolobium microphyllum, Peliostomum leucorrhizum, Pentzia globosa, P. viridis, Zygophyllum pubescens*

Succulent Shrubs: *Hertia pallens, Lycium cinereum.*

Semiparasitic Shrub: *Thesium hystrix*

Woody Climber: *Asparagus africanus*

Graminoids: *Anthephora pubescens, Cenchrus ciliaris, Digitaria eriantha subsp. eriantha, Enneapogon scoparius, Eragrostis lehmanniana, Schmidtia pappophoroides, Themeda triandra, Aristida adscensionis, A. congesta, A. diffusa, Cymbopogon pospischilii, Enneapogon cenchroides, E. desvauxii, Eragrostis echinochloidea, E. obtusa, E. rigidior, E. superba, Fingerhuthia africana, Heteropogon contortus, Sporobolus fimbriatus, Stipagrostis uniplumis, Tragus racemosus.*

Herbs: *Barleria macrostegia, Geigeria filifolia, G. ornativa, Gisekia africana, Helichrysum cerastioides, Heliotropium ciliatum, Hermbstaedtia odorata, Hibiscus marlothianus, H. pusillus, Jamesbrittenia aurantiaca, Limeum fenestratum, Lippia scaberrima, Selago densiflora, Vahlia capensis subsp. vulgaris*.

Succulent Herb: *Aloe grandidentata.*

Conservation Status

Least threatened. Target 16%. None conserved in statutory conservation areas. Only about 1% already transformed. Erosion is very low. (Mucina & Rutherford, 2006).

3.1.2.1.2 Southern Kalahari Mekgacha

Sparse, patchy grasslands, sedgelands and low herblands dominated by C4 grasses on the bottom of (mostly) dry riverbeds. Low shrublands in places with patches of taller shrubland on the banks of the rivers.

Important Plant Taxa in Southern Kalahari Mekgacha

Based on Mucina and Rutherford's (2006) vegetation classification, important plant taxa are those species that have a high abundance, a frequent occurrence (not being particularly abundant); or are prominent in the landscape within a particular vegetation type. They note the following species are important taxa in the Southern Kalahari Mekgacha vegetation type:

Dry river-bottoms;

Tall Shrubs: *Lebeckia linearifolia, Sisyndite spartea, Deverra denudata subsp. aphylla.*

Herbs: *Amaranthus dinteri subsp. dinteri, A. praetermissus, A. schinzianus, Boerhavia repens, Chamaesyce inaequilatera, Cucumis africanus, Geigeria ornativa, G. pectidea, Heliotropium lineare, Indigofera alternans, I. argyroides, Kohautia cynanchica, Lotononis platycarpa, Osteospermum muricatum, Platycarpha carlinoides, Radyera urens, Stachys spathulata, Tribulus terrestris.*

Succulent Herb: *Zygophyllum simplex.*

Graminoids: *Cenchrus ciliaris, Chloris virgata, Enneapogon desvauxii, Eragrostis annulata, E. bicolor, Odyssea paucinervis, Panicum coloratum, Eragrostis porosa, Panicum impeditum, Sporobolus nervosus.*

Rocky slopes of river canals

Tall Tree: *Vachellia erioloba.*

Low Shrubs: *Aptosimum lineare, Pechuel-Loeschea leubnitziae*.

Graminoids: *Setaria verticillata, Enneapogon scaber, Oropetium capense, Stipagrostis uniplumis, Tragus racemosus.*

Herb: *Dicoma capensis.*

Biogeographically Important Taxa ([GW] Griqualand West endemic, [K] Kalahari endemic)

Small Tree: *Senegalia luederitzii var. luederitzii*[K].

Tall Shrub: *Lebeckia macrantha*[GW].

Low Shrubs: *Hermannia burchellii*[K], *Justicia puberula*[GW], *Putterlickia saxatilis*[GW], *Tarchonanthus obovatus*[GW].

Graminoid: *Anthephora argenteaK*.

Herb: *Sutera griquensis*[GW].

Conservation Status

Some 18% statutorily conserved in the Kgalagadi Transfrontier Park and Molopo Nature Reserve. About 2% has been transformed by road building. The mekgacha are under strong utilisation pressure by domestic animals (grazing, browsing and animal penning. Invasive *Prosopis* species have encroached in certain areas. (Mucina & Rutherford, 2006).

3.1.2.2 Expected Flora Species

The POSA database indicates that 470 species of indigenous plants are expected to occur within the PAOI. Appendix A provides the list of species and their respective conservation status and endemism. No SCC, based on their conservation status, are expected to occur within the PAOI – this does not include any potential protected tree species.

3.1.3 Faunal Assessment

3.1.3.1 Amphibians

Based on the IUCN Red List Spatial Data and AmphibianMap, 11 amphibian species are expected to occur within the area (Appendix B). One of these species are threatened (Table 3-2).

Table 3-2 Threatened amphibian species that are expected to occur within the PAOI

Family	Species	Common Name	Conservation Status		Likelihood of Occurrence
			Regional (SANBI)	IUCN)	
Pyxicephalidae	*Pyxicephalus adspersus*	Giant Bullfrog	NT	LC	Moderate

The Giant Bull Frog (*Pyxicephalus adspersus*) is listed as LC on a global scale (IUCN SSC Amphibian Specialist Group, 2013), but NT on a regional scale (Minter *et al*, 2004). The species is widely distributed in arid sub-saharan Africa, mainly at higher elevations. Within South Africa, it occurs in the north-eastern part of the Western Cape, central and southern Eastern Cape, northern, central and eastern parts of Northern Cape, northern KwaZulu-Natal (except the low-lying parts), Free State, North West, Gauteng and Limpopo provinces, and at only a few localities in Mpumalanga Province. It typically breeds in seasonal, shallow, grassy pans in flat, open areas but also utilises non-permanent vleis and shallow water on the margins of waterholes and dams. Although they sometimes inhabit clay soils, they prefer sandy substrates. Habitat loss due to crop agriculture and urbanisation is a major threat to this species. Due to the presence of suitable habitat, the likelihood is rated a moderate.

3.1.3.2 Reptiles

Based on the IUCN Red List Spatial Data and the ReptileMAP database, 35 reptile species are expected to occur within the area (Appendix C). None of these species are threatened.

3.1.3.3 Mammals

The IUCN Red List Spatial Data lists 64 mammal species that could be expected to occur within the area (Appendix D). This list excludes large mammal species that are limited to protected areas. Six (6) of these expected species are regarded as threatened (

Table 3-3), all but one of these have a low likelihood of occurrence based on the lack of suitable habitat in the PAOI.

Table 3-3 Threatened mammal species that are expected to occur within the PAOI.

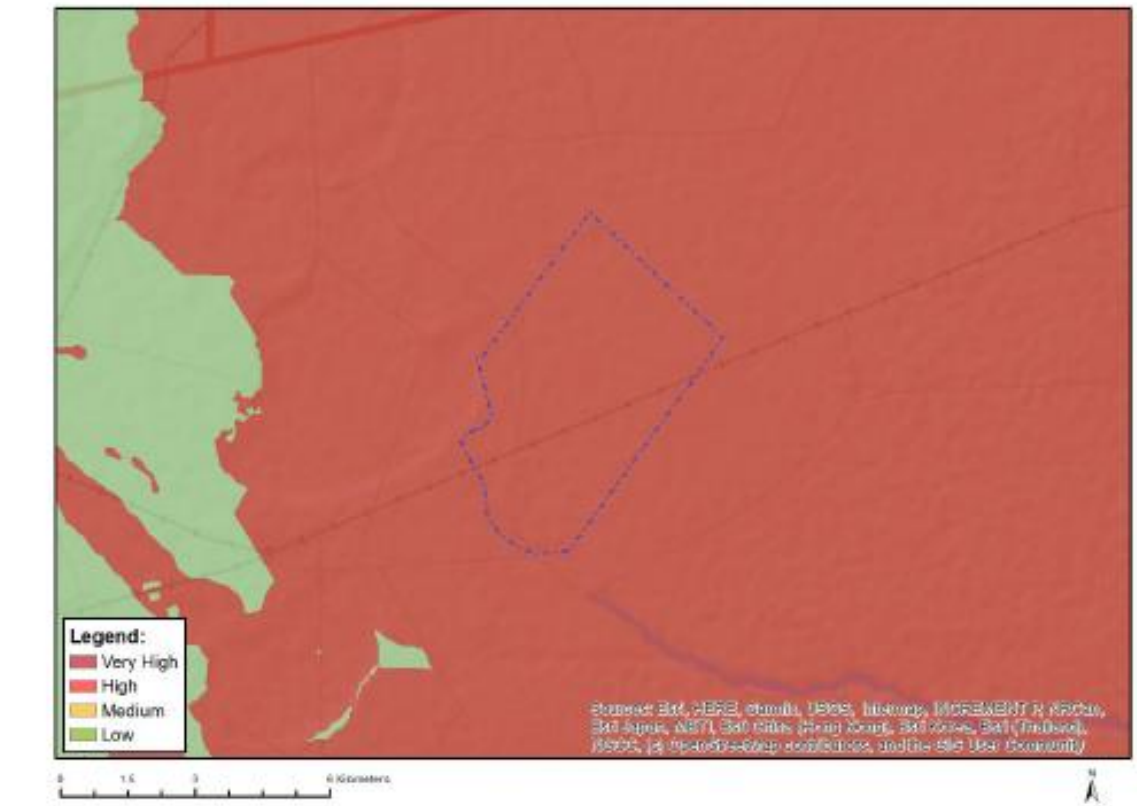
Family	Species	Common Name	Conservation Status		Likelihood of Occurrence
			Regional (SANBI)	IUCN)	
Felidae	*Felis nigripes*	Black-footed Cat	VU	VU	Low
Felidae	*Panthera pardus pardus*	African Leopard	VU	VU	Low
Hyaenidae	*Parahyaena brunnea*	Brown Hyaena	NT	NT	Low
Manidae	*Smutsia temminckii*	Temminck's Pangolin	VU	VU	Moderate
Mustelidae	*Aonyx capensis*	Cape Clawless Otter	NT	NT	Low
Pteropodidae	*Eidolon helvum*	Straw-coloured Fruit Bat	NT	NT	Low

Smutsia temminckii (Temminck's Pangolin) inhabits mainly savannas and woodlands in low-lying regions with moderate to dense scrub where average annual rainfall is between 250 mm and 1 400 mm. It also occurs in floodplain grassland, rocky slopes and sandveld up to 1 700 m above sea level. The population in South Africa is estimated to be between 16 329–24 102 mature individuals (Pietersen *et al*, 2019). In the Northern Cape Province, densities have been calculated at 0.16 reproductively active individuals/km² and overall densities at 0.23 individuals/km². The species' is over-exploited for medicinal use and is increasingly focused on core conservation areas. There has been a sharp increase in the number of individuals that have been seized from illegal trade since 2010. Changes in farming practices are directly impacting the species through habitat loss and alteration, while the increased human presence in these previously undisturbed areas is resulting in increased levels of poaching. Nomadic grazing is also having a negative impact across their range due to increased levels of poaching. Additional threats include fences (electrified and not), mining and roadkills.

3.1.4 DEA Screening Report

According to the Screening Tool Report generated (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended), the following sensitivity classifications were gathered from the National Web-based Environmental Screening Tool:

- The Terrestrial Biodiversity theme sensitivity, as indicated in the screening report, was derived to be Very High, (Figure 3-8), The Very High sensitivity is mainly attributed to the CBA status of the area, as well as the FEPA status of the subcatchments;
- Plant Species Theme sensitivity is Medium for the PAOI, with the possibility of multiple medium sensitivity plant species being present;
- Animal Species Theme sensitivity is High for the PAOI, with the possibility of one medium/high sensitivity species being present, avifauna species ;
- The Aquatic biodiversity theme sensitivity, as indicated in the screening report, was derived to be Very High, (Figure 3-9), The Very High sensitivity is mainly attributed to SWSA, Wetlands and estuaries as well as the FEPA status of the subcatchments.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

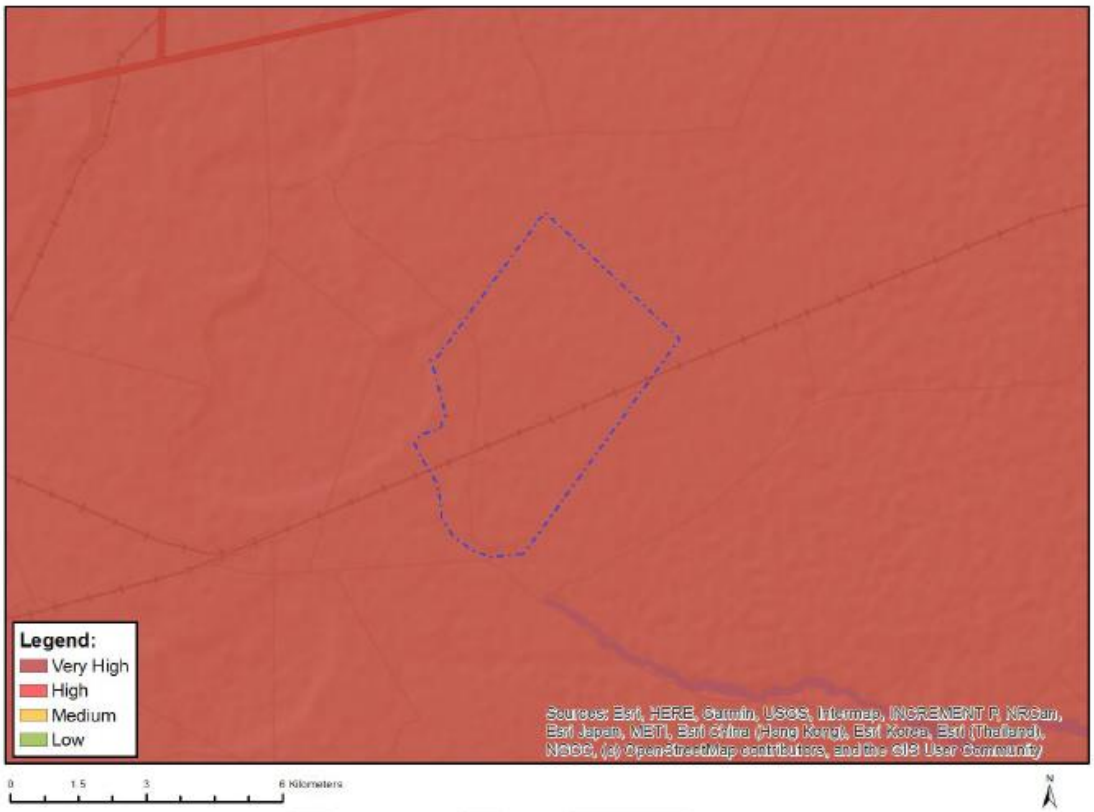
Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Critical biodiveristy area 2
Very High	FEPA Subcatchments

Figure 3-8 Terrestrial Biodiversity Theme Sensitivity

The aquatic biodiversity theme sensitivity, as indicated in the screening report, was derived to be Very High, (Figure 3-9). The Very High sensitivity is mainly attributed to the associated Strategic Water Source Area, presence of wetlands and the quinary catchments.

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Strategic water source area
Very High	Wetlands and Estuaries
Very High	Freshwater ecosystem priority area quinary catchments

Figure 3-9 Aquatic Biodiversity Theme Sensitivity

3.2 Field Assessment

The following sections provide the results from the field survey for the proposed development that was undertaken.

3.2.1 Flora Assessment

This section is divided into two sections:

- Indigenous flora; and
- Invasive Alien Plants (IAPs).

3.2.1.1 Indigenous Flora

The vegetation assessment was conducted throughout the extent of the study area. A total of 55 tree, shrub and herbaceous plant species were recorded in the study area during the field assessment. Notably, this is not a complete list of indigenous flora recorded within the survey area, but only species that were able to be recorded within the survey within the time and accessibility constraints (Table 3-4). Some of the plant species recorded can be seen in Figure 3-10.

The list of plant species recorded is by no means comprehensive, and repeated surveys during different phenological periods not covered, may likely yield up to 30% additional flora species for the project area. However, floristic analysis conducted to date is regarded as a sound representation of the local flora for the project area

Table 3-4 Trees, shrub and herbaceous plant species recorded in the project area.

Family	Scientific Name	Conservation Status
Acanthaceae	*Blepharis marginata*	LC-Endemic
Aizoaceae	*Prepodesma orpenii*	LC-Endemic Protected Provincially
Amaranthaceae	*Hermbstaedtia odorata*	NE
Amaryllidaceae	*Boophone disticha*	LC
Anacardiaceae	*Searsia lancea*	LC
Anacardiaceae	*Searsia ciliata*	LC
Anacardiaceae	*Searsia tridactyla*	LC-Endemic
Asparagaceae	*Asparagus laricinus*	LC
Asteraceae	*Tarchonanthus camphoratus*	LC
Asteraceae	*Felicia muricata*	LC
Asteraceae	*Felicia fascicularis*	LC
Asteraceae	*Pentzia calcarea*	LC
Asteraceae	*Chrysocoma ciliata*	LC
Asteraceae	*Selago densiflora*	LC
Asteraceae	*Tagetus minuta*	
Asteraceae	*Gazania krebsiana*	LC
Asteraceae	*Conyza bonariensis*	
Asteraceae	*Helichrysum caespititium*	LC
Asteraceae	*Geigeria filifolia*	LC
Asteraceae	*Pentzia globosa*	LC
Asteraceae	*Cotula microglossa*	LC-Endemic
Campanulaceae	*Wahlenbergia undulata*	LC

Celastraceae	*Gymnosporia buxifolia*	LC
Convolvulaceae	*Convolvulus boedeckerianus*	LC
Convolvulaceae	*Falkia oblonga*	LC
Crassula	*Crassula corallina ssp. corallina*	LC
Cyperaceae	*Cyperus marginatus*	LC
Fabaceae	*Melolobium canescens*	LC
Gentianaceae	*Sebaea leiostyla*	LC
Kewacaea	*Kewa salsoloides*	LC
Lamiaceae	*Stachys rugosa*	LC
Lobeliaceae	*Lobelia erinus*	LC
Malvaceae	*Grewia flava*	LC
Malvaceae	*Hermannia depressa*	LC
Malvaceae	*Hermannia linnaeoides*	LC
Malvaceae	*Hibiscus marlothianus*	LC-Endemic
Malvaceae	*Hermannia comosa*	LC
Oleaceae	*Olea europaea subsp. cuspidata*	LC-Protected Provincially
Poaceae	*Themeda triandra*	LC
Poaceae	*Aristida adscensionis*	LC
Poaceae	*Hyparrhenia hirta*	LC
Poaceae	*Loudetia flavida*	LC
Poaceae	*Eragrostis chloromelas*	LC
Poaceae	*Eragrostis lehmanniana*	LC
Poaceae	*Cynodon dactylon*	LC
Poaceae	*Cymbopogon caesius*	LC
Poaceae	*Stipagrostis ciliata*	LC
Rhamnaceae	*Ziziphus mucronata*	LC
Rubiaceae	*Kohautia cynanchica*	LC
Scrophulariaceae	*Jamesbrittenia tysonii*	LC-Endemic
Scrophulariaceae	*Jamesbrittenia aurantiaca*	LC
Scrophulariaceae	*Aptosimum procumbens*	LC
Scrophulariaceae	*Peliostomum leucorrhizum*	LC
Solanaceae	*Lycium horridum*	LC
Zygophyllaceae	*Tribulus zeyheri*	LC

Figure 3-10 Photographs illustrating some of the flora recorded within the assessment area: A) Blepharis marginata, B) Prepodesma orpenii, C) Cyperus marginatus, D) Aptosimum procumbens, E) Falkia oblonga and F) Boophone disticha.

3.2.1.2 Invasive Alien Plants

Invasive Alien Plants (IAPs) tend to dominate or replace indigenous flora, thereby transforming the structure, composition and functioning of ecosystems. Therefore, it is important that these plants are controlled by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species.

NEMBA is the most recent legislation pertaining to alien invasive plant species. In August 2014, the list of Alien Invasive Species was published in terms of the NEMBA. The Alien and Invasive Species Regulations were published in the Government Gazette No. 43726, 18 September 2020. The legislation calls for the removal and / or control of AIP species (Category 1 species). In addition, unless authorised thereto in terms of the NWA, no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse. Below is a brief explanation of the three categories in terms of the NEMBA:

- *Category 1a*: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- *Category 1b*: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- *Category 2*: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- *Category 3*: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

Note that according to the Alien and Invasive Species Regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- Notify the competent authority in writing
- Take steps to manage the listed invasive species in compliance with:
    - Section 75 of the NEMBA;
    - The relevant invasive species management programme developed in terms of regulation 4, and any directive issued in terms of section 73(3) of the NEMBA.

Four IAP species were recorded within the PAOI. Two of these species are listed under the Alien and Invasive Species List 2020, Government Gazette No. GN1003 as Category 1b. These IAP species must be controlled by implementing an IAP Management Programme, in compliance of section 75 of the NEMBA, as stated above.

Family	*Scientific Name*	Alien Category
Asteraceae	*Schkuhria pinnata*	Not indigenous
Solanaceae	*Datura ferox*	NEMBA 1b
Poaceae	*Pennisetum clandestinum*	NEMBA 1b
Poaceae	*Polypogon monspeliensis*	Not indigenous

3.2.2 Faunal Assessment

Herpetofauna and mammal observations and recordings fall under this section. A separate avifaunal report was compiled for this project.

3.2.2.1 Amphibians and Reptiles

Five (5) species of reptile and one amphibian species were recorded within the study area during the survey period (Table 3-5, Figure 3-11). However, there is the possibility of more species being present, as certain reptile species are secretive and require long-term surveys to ensure capture. None of the species recorded are regarded as threatened.

Table 3-5 Summary of herpetofauna species recorded within the study area.

Family	Scientific Name	Common Name	Conservation Status	
			Regional	Global
Agamidae	*Agama aculeata aculeata*	Common Ground Agama	LC	LC
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	LC	Unlisted
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	LC	LC
Scincidae	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	LC	Unlisted
Scincidae	*Trachylepis capensis*	Cape Skink	LC	Unlisted
Amphibians				
Pyxicephalidae	*Cacosternum boettgeri*	Boettger's dainty frog	LC	LC

Figure 3-11 ***Photographs illustrating the reptile species recorded within the assessment area associated with the project area during the survey period: A) Agama aculeata aculeata (Common Ground Agama), B) Cacosternum boettgeri (Boettger's dainty frog), C) Pachydactylus capensis (Cape Gecko) and, D) Panaspis wahlbergii (Wahlberg's Snake-eyed Skink) and E) Stigmochelys pardalis (Leopard Tortoise)***

3.2.2.2 Mammals

Seven (7) mammal species were observed during the survey of the study area (Table 3-6) based on either direct observation or the presence of visual tracks and signs (Figure 3-12).

Suricata suricatta (Suricate) and *Geosciurus inauris* (South African Ground Squirrel) are ecosystem engineers within the region. The former species is also regarded as a keystone species within the Nama Karoo biome. The burrows they create are also utilised as shelter by an array of faunal species, which is pertinent in the climatically variable and semi-arid environment of the PAOI and surrounding landscape (Whittington-Jones, Bernard, & Parker, 2011)

Table 3-6 Summary of mammal species recorded within the study area .

Family	Scientific Name	Common Name	Conservation Status	
			Regional	Global
Bathyergidae	*Cryptomys hottentotus*	Common Mole-rat	LC	LC
Bovidae	*Sylvicapra grimmia*	Common duiker	LC	LC
Canidae	*Lupulella mesomelas*	Black-backed jackal	LC	LC
Herpestidae	*Cynictis penicillata*	Yellow mongoose	LC	LC
Herpestidae	*Suricata suricatta*	Suricate	LC	LC
Leporidae	*Lepus capensis*	Scrub Hare	LC	LC
Sciuridae	*Geosciurus inauris*	Cape ground squirrel	LC	LC

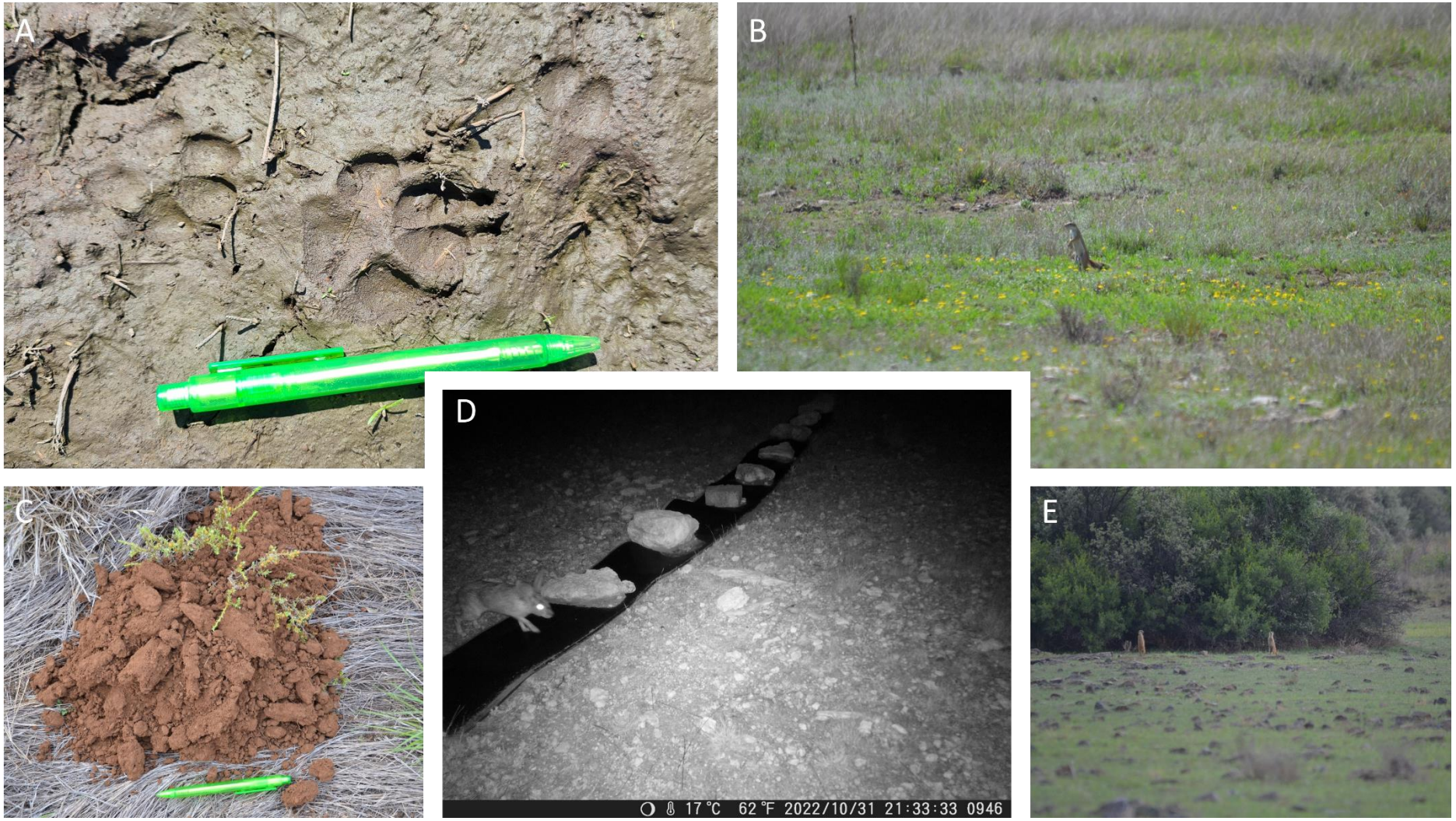


Figure 3-12 Photographs illustrating the mammal species recorded within the study area during the survey period. A) Lupulella mesomelas (Black-backed jackal), B) Geosciurus inauris (Cape ground squirrel), C) Cryptomys hottentotus (Common Mole-rat), D) Lepus capensis (Scrub Hare) and E) Suricata suricatta (Suricate)

3.2.3 Wetland Assessment

3.2.3.1 Classification and Extent

The water resources areas were delineated in accordance with the DWAF (2005) guidelines. Based on previous reports[1], spatial data together with the findings from the field verification, a total of two (2) natural HGM types were confirmed within the PAOI (Figure 3-14). Photographs of the identified resources are presented in Figure 3-13.

The two (2) HGM types, comprise a reach of an unnamed tributary of the Klein-Riet River and numerous pans. The pans are dispersed across the PAOI and comprise systems which indicate some level of saturation, and other systems that do no (clearly) indicate any level of saturation. The distinction that was made between a wetland pan versus a non-wetland pan was primarily due to the depth of the basin catchment, with some signs of soil wetness within the profile. The absence of these indicators resulted in the respective pans not being classified as wetland systems. To facilitate the identification of wetland pan systems, remote sensing was also undertaken for the project.

The information collated from the survey assisted with the undertaking of remote sensing to aid with the identification and classification of wetland pans for the PAOI. The Semi-Automatic Classification Plugin for QGIS allows for the semi-automatic supervised classification of remote sensing images. This is achieved by providing tools to expedite the creation of regions of interest (ROI). The spectral signatures of training areas can be automatically calculated and displayed in a spectral signature plot. This was undertaken in order to determine a broad habitat identification and classification for the PAOI,. The land covers defined by remote sensing were further refined and calibrated with data recorded during the survey, this allowed for a more accurate description and delineation of habitat within the PAOI.

The level 1-4 classification for these HGM units, as per the national wetland classification system (Ollis *et al.,* 2013), is presented in Table 3-7. A map showing the extent of these wetlands is shown in Figure 3-14. Wetland units have been grouped based on the HGM type and also ecological condition. It is assumed that systems of a similar type, and also positioned in a similar landscape are likely to provide similar ecological services. Only systems at an appreciable level of risk of the project (i.e. traversed or proximal to infrastructure) have been classified and further assessed, resulting in only two (2) HGM units identified for the further assessment.

Table 3-7 Wetland classification as per SANBI guideline (Ollis et al. 2013)

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Ghaap Plateau	Eastern Kalahari Bushveld Group 5	Valley Floor	River	-	-
HGM 2	Inland	Ghaap Plateau	Eastern Kalahari Bushveld Group 5	Bench	Depression	Endorheic	Without channelled outflow

[1] Todd (2012): Terrestrial Fauna & Flora Specialist Scoping Study for EIA DEA Ref No. 14/12/16/3/3/2/371. Olien Solar Project.

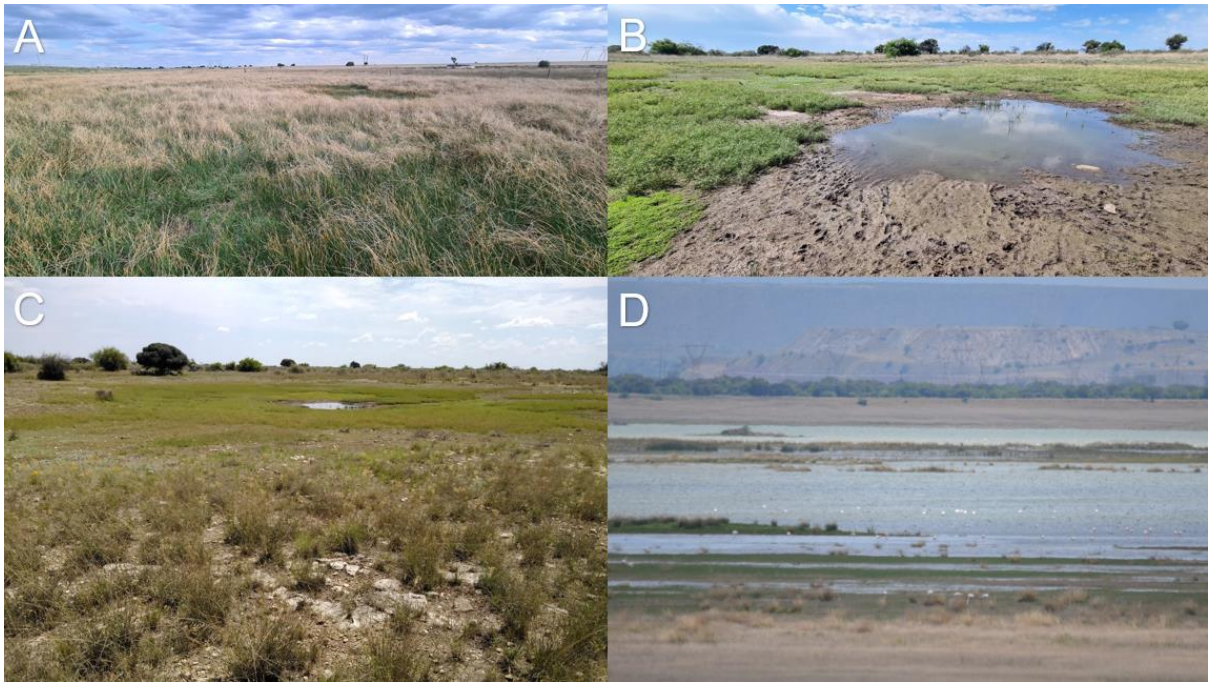


Figure 3-13 Photographs of the delineated resources

A) River system, HGM 1, B) Non-wetland pan, after rain, C) A wetland pan, HGM 2, D) Depression from Klein-Riet catchment

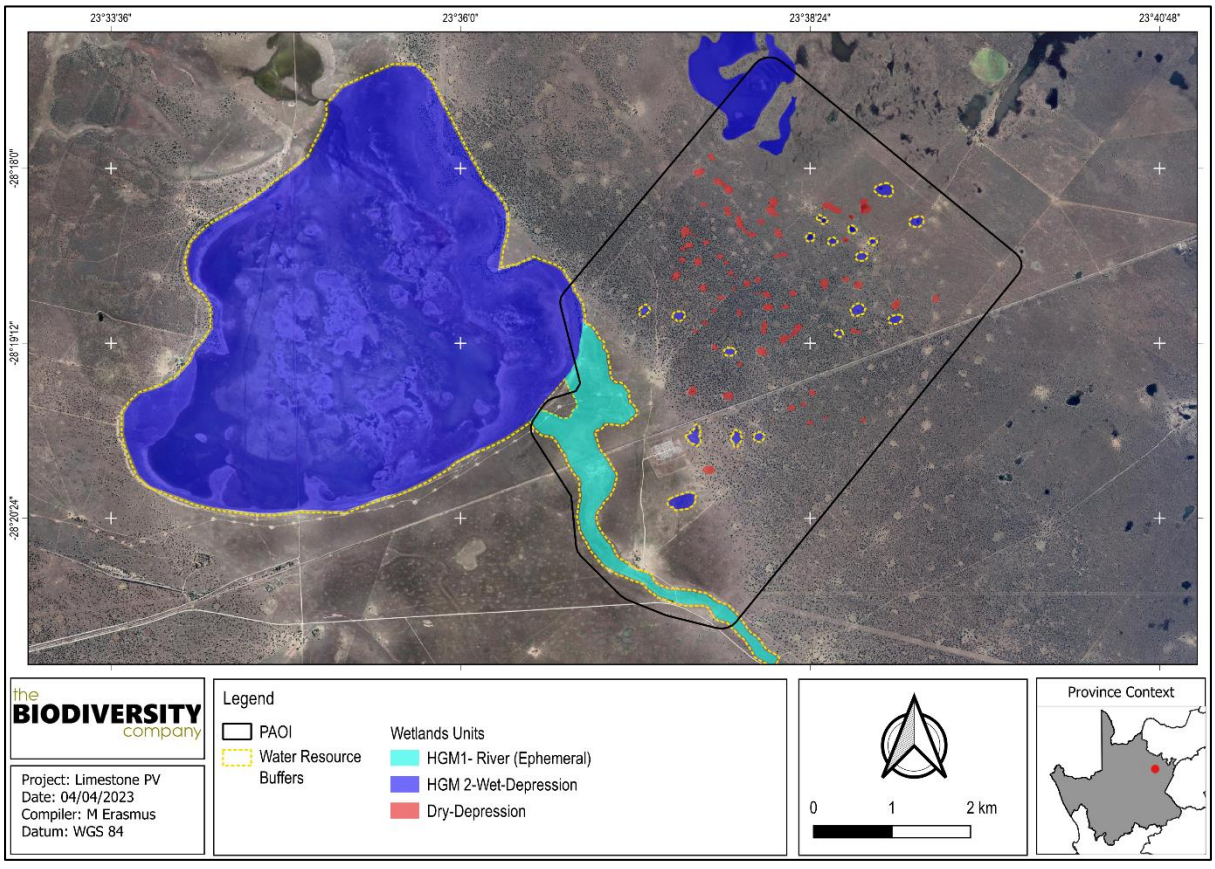


Figure 3-14 Wetlands delineated within the PAOI

3.2.3.2 Unit Setting

Rivers are a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit (Figure 3-15). Rivers can be divided into the 'active channel' and 'riparian zone'.

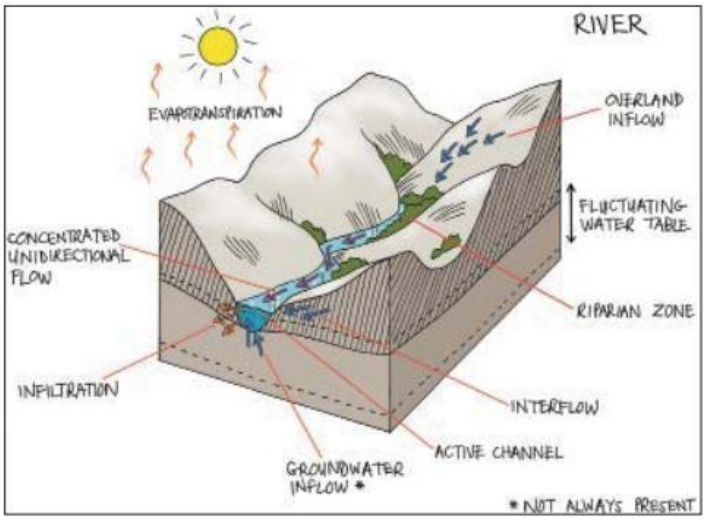


Figure 3-15 Amalgamated diagram of the HGM types, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

Depressions are inward draining basins with an enclosing topography which allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows. Figure 3-16 presents a diagram of the relevant HGM unit, showing the dominant movement of water into, through and out of the system.

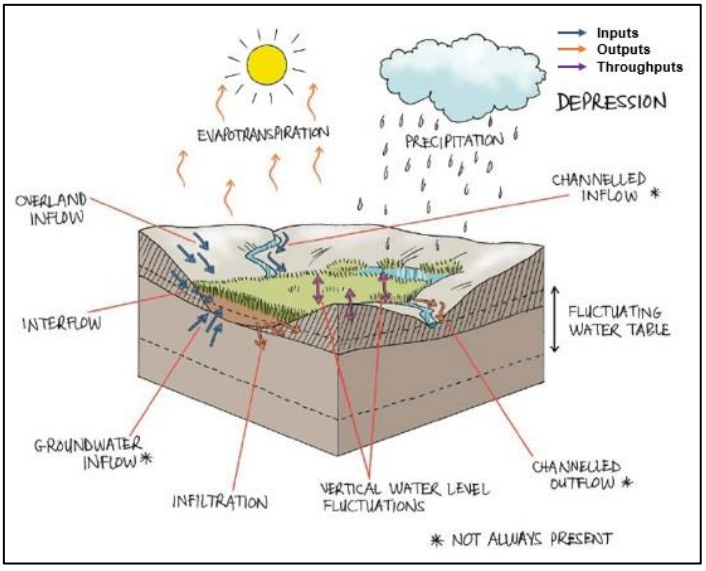


Figure 3-16 Amalgamated diagram of the HGM unit, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

3.2.3.3 General Functional Description

Unchanneled valley bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter. The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley-bottom wetlands, especially in cases where the

valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

The generally impermeable nature of depressions and their inward draining features are the main reasons why the streamflow regulation ability of these systems is mediocre. Regardless of the nature of depressions in regard to trapping all sediments entering the system, sediment trapping is another Eco Service that is not deemed as one of the essential services provided by depressions, even though some systems might contribute to a lesser extent. The reason for this phenomenon is due to winds picking up sediments within pans during dry seasons which ultimately leads to the removal of these sediments and the deposition thereof elsewhere. The assimilation of nitrates, toxicants and sulphates are some of the higher rated Eco Services for depressions. This latter statement can explain the precipitation as well as continues precipitation and dissolving of minerals and other contaminants during dry and wet seasons, respectively (Kotze *et al.,* 2009).

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services rated high for these systems on site might differ slightly to those expectations.

3.2.3.4 Functional Assessment

The ecosystem services provided by the wetlands identified within the PAOI were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2008) (Table 3-8). HGM 2 scored Moderately Low in terms of ecosystem services. The most beneficial services, albeit of moderately low benefit pertain to regulating and supporting benefits, such as flood attenuation and water quality enhancement. The provisioning benefits for water, food and harvestable resources is low. The overall cultural benefits are determined to be intermediate for the systems.

The systems are also generally considered relatively important (moderately high) from a biodiversity maintenance perspective, supporting more unique and diverse floral assemblage while providing important foraging and shelter for fauna. The wetlands are not considered important in terms of their direct provisioning of harvestable resources and cultivated foods for humans as the systems are not actively cultivated. HGM 2 is considered moderately important from tourism and recreation perspectives.

Table 3-8 Summary of the ecosystem services scores

Wetland Unit					HGM 2
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		**1.2**
			Streamflow regulation		**0.4**
			Water Quality enhancement benefits	Sediment trapping	**0.5**
				Phosphate assimilation	**0.6**
				Nitrate assimilation	**1.1**
				Toxicant assimilation	**0.9**
				Erosion control	**0.6**
			Carbon storage		**0.7**
	Direct Benefits	**Biodiversity maintenance**			**2.6**
		Provisioning benefits	Provisioning of water for human use		**0.0**
			Provisioning of harvestable resources		**0.0**
			Provisioning of cultivated foods		**0.3**
		Cultural benefits	Cultural heritage		**0.0**
			Tourism and recreation		**2.4**

Education and research	**2.1**
Overall	**13.4**
Average	**0.9**

3.2.3.5 Present Ecological State

The PAOI is located in the C92A quaternary catchment within the Lower Vaal Water Management Area (WMA). The Sub Quaternary Reach's (SQR) considered in the assessment included C92A-02837 (unnamed). The PAOI is adjacent to an unnamed second order stream C92A-02837 which is a tributary of the Klein-Riet. The Klein-Riet forms a confluence with the Vaal further downstream. The ecological integrity of the system is expected to be seriously modified (class E) (Table 3-9).

Table 3-9 The ecological descriptions for the SQR

SQR	River	Present Ecological State	Ecological Importance	Ecological Sensitivity
C92A-2837	Unnamed	E	Low	Moderate

The PES of the wetlands identified within the PAOI is provided in Table 3-10. The integrity of the systems was determined to be Largely Natural (class B). The most notable disturbance to these systems was grazing, with some evidence of trampling. The current land uses have not significantly altered (or reduced) the catchment area, and this has also not contributed to changes in topography and surface flows. Linear infrastructure has extended into selected wetland areas, resulting in these catchment areas being traversed but the systems remain largely intact. These disturbances have contributed to the establishment of alien vegetation to the area.

Table 3-10 Summary of the scores for the wetland PES

Wetland	Hydrology	Geomorphology	Vegetation	Overall
HGM 2	B: Largely Natural (1.0)	B: Largely Natural (1.6)	C: Moderately Modified (2.2)	B: Largely Natural (1.5)

3.2.3.6 Importance and Sensitivity

The results of the ecological IS assessment are shown in Table 3-11. Various components pertaining to the protection status of a wetland is considered for the IS, including SWSAs, the NFEPA wet veg protection status and the protection status of the wetland itself considering the NBA wetland dataset. At a regional scale, the NFEPA Wetveg database recognises pan wetland types within the Eastern Kalahari Bushveld Group 5 as Least Threatened and Not Protected (Nel and Driver, 2012). The wetlands within the project area are recognised as NFEPA priority wetlands. The following was also considered for the IS description, the project area:

- The Ghaap Plateau Vaalbosveld vegetation type is Least Threatened;
- Is not located in a Strategic Water Source Area (dataset 2021);
- Is proximal to Critical Biodiversity Area (CBA 1 and 2) areas; and
- The systems are considered to be FEPA priority wetlands.

Table 3-11 The IS results for the delineated HGM units

HGM Type	Wet Veg			NBA River/Wetlands			SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
HGM 1	Eastern Kalahari Bushveld Group 5	-	-	Class E (Desktop)	Critically Endangered	Not Protected	N	**High**
HGM 2		Least Threatened	Not Protected	Class B	Least Concern	Poorly Protected	N	**Moderate**

3.2.3.7 Sensitivity and Buffer Analysis

The "*Buffer zone guidelines for wetlands, rivers and estuaries*" (Macfarlane *et al.,* 2014) was used to determine the appropriate wetland buffer zone for the proposed project.

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. A buffer zone has been prescribed for this project to serve as a "barrier" between the proposed development and the wetland systems. This buffer area would only be applicable to wetland areas that will not be lost due to the project.

The buffer zone tool was used to calculate the appropriate buffer required for the proposed solar development. The model shows that the largest risk posed by the project during the construction phase is that of "increased sediment inputs and turbidity". During the operational phase, the flow patterns being altered (increase flood peaks); increased sediment inputs; and altered water quality are high risks. These risks are based on what could threaten the water resources and what buffer would be required at a desktop level. A buffer zone was suggested of 22 m and 15 m (Table 3-12) for the river system and pans respectively, this buffer is calculated assuming mitigation measures are applied.

Table 3-12 Post-mitigation buffer requirement

Required Buffer after mitigation measures have been applied	
River	**22 m**
Depression	**15 m**

3.2.3.8 Regulation Zone

Table 3-13 presents the legislated zones of regulation that would be applicable to the delineated water resources. In accordance with General Notice (GN) 509 of 2016 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means 100 m from the edge of a watercourse or a 500 m radius from the delineated boundary (extent) of any wetland or pan.

Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation, which in this case is a 32 m zone of regulation.

Table 3-13 The legislated zones of regulation

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation (DWS)	Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998). In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. Department of Environmental Affairs and	Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) states that: The development of: (ii) Infrastructure or structures with a physical footprint of 100 square metres or more— a) Within a watercourse; b) In front of a development setback; or

Development (DEA&DP)	Planning	c)	If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse. Excluding – … (dd) where such development occurs within an urban area… Activity 19 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA regulations, 2014 (as amended) states "The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse."

4 Site Sensitivity Verification

4.1 Site Ecological Importance (SEI)

The different habitat types within the PAOI were delineated and identified based on observations during the field assessment, and available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes. In relation to vegetation the sensitivity of the area related more to the structural vegetation component rather than diversity as such, due to the low diversity (which is expected) versus the large number of the provincially protected woody species (*Olea europaea subsp. africana)*). Wild Olive is known to be as an extremely slow-growing and valuable tree in the arid regions.

Six (6) different terrestrial habitat types were delineated within the PAOI, which includes an assigned water resource habitat unit (Table 4-2). Based on the criteria provided in Section 2.3 of this report, all habitats within the PAOI were allocated a sensitivity category. Illustrations of the habitats can be seen from in Figure 4-1 to Figure 4-7.The sensitivities of the habitat types delineated are illustrated in Figure 4-8

Figure 4-1 Watercourse habitat from the PAOI

Figure 4-2 Depression (Pan) habitat from the PAOI

Figure 4-3 Wooded Vaalbosveld habitat from the PAOI

Figure 4-4 Open Shrubveld habitat from the PAOI

Figure 4-5 Open Grassland habitat from the PAOI

Figure 4-6 Pan (non-wetland) habitat from the PAOI

Figure 4-7 Transformed habitat from the PAOI

4.2 Screening Tool Comparison

The allocated sensitivities for each of the relevant themes are either disputed or validated for the overall PAOI in Table 4-1 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC or protected species.

Table 4-1 Summary of the screening tool vs specialist assigned sensitivities

Screening Tool Theme	Screening Tool	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	**High**	**Medium**	Disputed- Habitat is generally disturbed and adjacent to roads and development, thus the presence of SCC is unlikely. SCC may forage in specific areas. High sensitivity of screening was mainly attributed to Avifauna species
Plant Theme	**Medium**	**Medium**	Validated - The composition, high species diversity and number of plant species recorded.
Terrestrial Theme	**Very High**	**Very High/High**	Validated – Certain habitat sensitivities are regarded as very high sensitivity due to the role of this intact habitat to biodiversity within an area being more fragmented locally, which is supported by the various ecological datasets.
Aquatic Theme	**Very High**	**High**	Validated – The presence of wetland systems, of high ecological importance.

Table 4-2 Summary of habitat types delineated within field assessment area of PAOI.

Habitat Type	Description	Ecosystem Processes and Services	Conservation Importance (CI)	Functional Integrity (FI)	Biodiversity Importance (BI)	Receptor Resilience (RR)	Site Ecological Importance (SEI) Guidelines for interpreting SEI in the context of the proposed development activities
Watercourse River	Channels/Areas through which surface water naturally flows and collects. An ephemeral system.	Provides surface water resources within the landscape.. Corridor for fauna dispersion within the landscape and important foraging and nesting habitat.	**Very High** CBA 1 CR River FEPA Wetland Freshwater Ecosystem Priority Area River	**Medium** Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance.	**High**	**Very Low** Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring.	**Very High** Avoidance mitigation – no destructive development activities should be considered. Applicable buffer may be added to the habitats.
Wooded Vaalbosveld	Terrain consists of a low to zero slope Mainly consists of woody tree species interspersed with variable in the presence or absence of grass species and shrub density.	Provides grazing and foraging resources for indigenous fauna and livestock. Aids in the filtration of water permeating through the soil into the drainage areas. Important corridor for fauna dispersion within the landscape.	Intact CBA 2 **Medium** > 50% of receptor contains natural habitat with potential to support SCC.	**High** Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.	**Medium**	**Very Low** Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring. Especially in regard to the Wild Olive (*Olea europaea subsp. africana*) which is known to be as an extremely slow-growing tree.	**High** Avoidance mitigation as much as possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Open Shrubveld	Terrain consists of a low to zero slope Mainly consists of *Tarchonanthus* (Shrub) species interspersed with variable in the presence or absence of grass species and shrub density.	Provides grazing and foraging resources for indigenous fauna and livestock. Aids in the filtration of water permeating through the soil into the drainage areas. Important corridor for fauna dispersion within the landscape.	Intact CBA 2 **Medium** > 50% of receptor contains natural habitat with potential to support SCC.	**High** Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological	**Medium**	**Low** Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality.	**High** Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities. Mitigations such as retaining vegetation and topsoil layers is applicable, as well as avoiding

Habitat Type	Description	Ecosystem Processes and Services	Conservation Importance (CI)	Functional Integrity (FI)	Biodiversity Importance (BI)	Receptor Resilience (RR)	Site Ecological Importance (SEI) Guidelines for interpreting SEI in the context of the proposed development activities
				impacts with no signs of major past disturbance and good rehabilitation potential.			certain areas and planning infrastructure layouts accordingly.
Open Grassland	Terrain consists of a low to zero slope Mainly presence of grass species with small shrubs.	Provides grazing and foraging resources for indigenous fauna and livestock. Aids in the filtration of water permeating through the soil into the drainage areas.	CBA 2 **Low** < 50% of receptor contains natural habitat with limited potential to support SCC. CBA 2	**High** Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Buffer for Water resources. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.	**Medium**	**Low** Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality.	**High** Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities. The nature of specific impacts to the topsoil is key in Karoo habitats. Mitigations such as retaining vegetation and topsoil layers is applicable, as well as avoiding certain areas and planning infrastructure layouts accordingly.
Water Resources (Depression/ Pan)	Depressions/Pan in the Calcrete that assist by collecting and storing runoff water from surrounding area. Important Surface Water Resource.	Provides surface water resources within the landscape. Aids in regulating and supporting benefits by surface runoff. Water resource for fauna within the landscape and important foraging and nesting habitat.	**Medium** > 50% of receptor contains natural habitat with potential to support SCC. CBA 2	**Medium** Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status Only narrow corridors of good habitat connectivity. Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance.	**Medium**	**Low** Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality.	**High** Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Transformed	Homesteads and associated infrastructure as well as prominent roads	N/A	**Very Low** No natural habitat remaining.	**Very Low** No habitat connectivity except for flying species or	**Very Low**	**Medium** Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and	**Very Low** Minimisation mitigation – development activities of medium to high impact acceptable and

Habitat Type	Description	Ecosystem Processes and Services	Conservation Importance (CI)	Functional Integrity (FI)	Biodiversity Importance (BI)	Receptor Resilience (RR)	Site Ecological Importance (SEI) Guidelines for interpreting SEI in the context of the proposed development activities
				flora with wind-dispersed seeds.		functionality of the receptor functionality.	restoration activities may not be required.

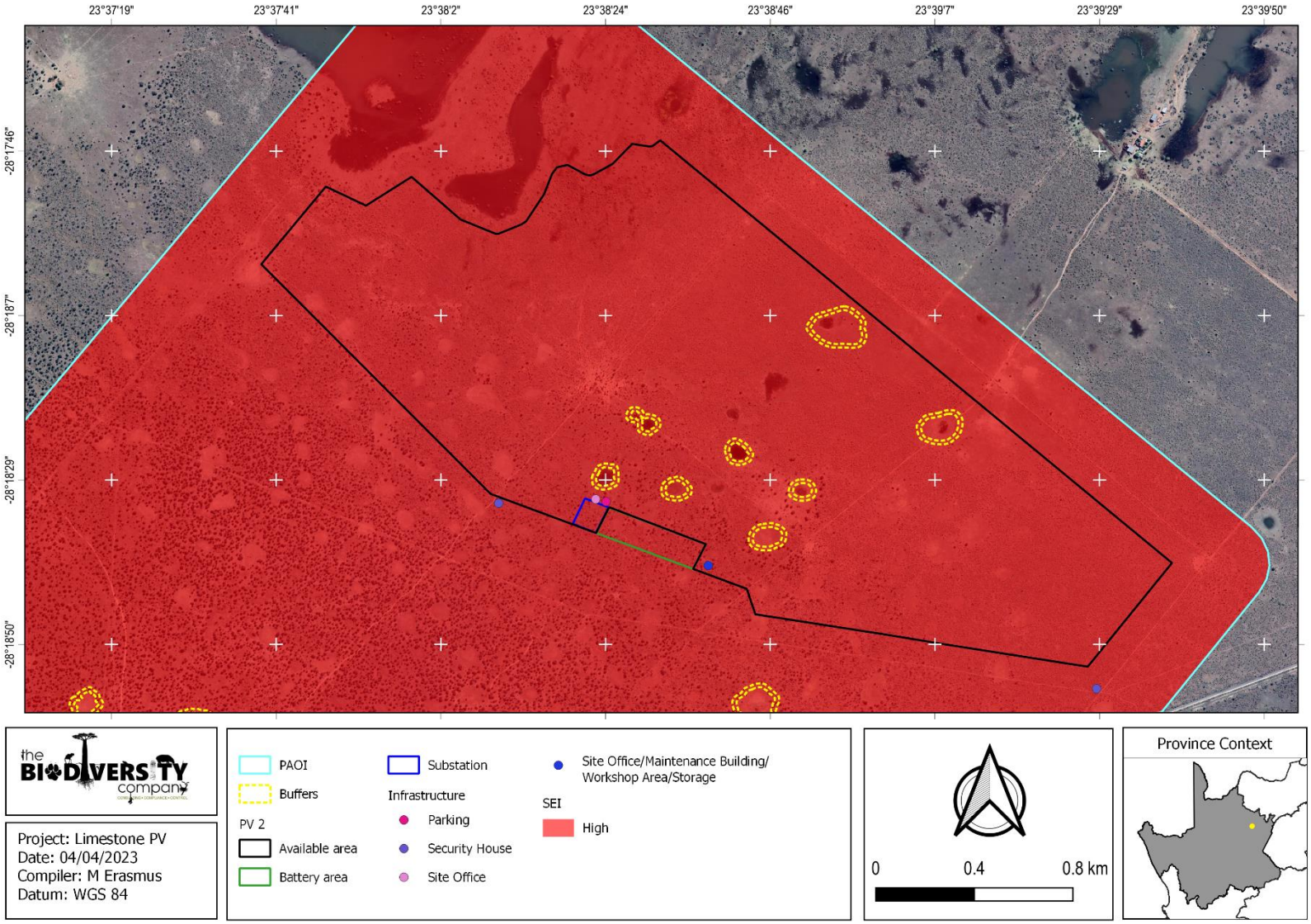


Figure 4-8 Terrestrial SEI of the PAOI

5 Impact Risk Assessment

5.1 Biodiversity: Risk Assessment

The assessment of the significance of direct, indirect and cumulative impacts was undertaken using the method as developed by Savannah. The assessment of the impact considers the following, the:

- Nature of the impact, which shall include a description of what causes the effect, what will be affected, and how it will be affected;
- Extent of the impact, indicating whether the impact will be local or regional;
- Duration of the impact, very short-term duration (0-1 year), short-term duration (2-5 years), medium-term (5-15 years), long-term (> 15 years) or permanent;
- Probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable, probable, highly probable or definite;
- Severity/beneficial scale, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit); severe/beneficial (long-term impact that could be mitigated/long-term benefit); moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit); slight; or have no effect;
- Significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high;
- Status, which will be described as either positive, negative or neutral;
- Degree to which the impact can be reversed;
- Degree to which the impact may cause irreplaceable loss of resources; and
- Degree to which the impact can be mitigated.

5.1.1 Present Impacts to Biodiversity

Considering the anthropogenic activities and influences within the landscape, limited negative impacts to biodiversity were observed within the study area. These include:

- Historical livestock grazing land-use and associated infrastructure;
- Roads and associated vehicle traffic and road kills;
- Existing powerline and substation infrastructure; and
- Fences.

Figure 5-1 Photographs illustrating impacts to biodiversity A) Overgrazing, B & D) Livestock and C) Existing powerline and substation infrastructure.

5.1.2 Identification of Additional Potential Impacts

The potential impacts during the construction and operation phases of the project are presented in Table 5-1.

Table 5-1 Potential impacts to biodiversity associated with the proposed activity

Main Impact	Project activities that can cause loss/impacts to habitat (especially with regard to the proposed infrastructure areas):	Secondary impacts anticipated
1. Destruction, fragmentation and degradation of habitats and ecosystems	Physical removal of vegetation, including protected species.	Displacement/loss of flora & fauna (including possible SCC)
	Access roads and servitudes	Increased potential for soil erosion
	Soil dust precipitation	Habitat fragmentation
	Dumping of waste products	Increased potential for establishment of alien & invasive vegetation
	Random events such as fire (cooking fires or cigarettes)	Erosion
Main Impact	**Project activities that can cause the spread and/or establishment of alien and/or invasive species**	**Secondary impacts anticipated**
2. Spread and/or establishment of alien and/or invasive species	Vegetation removal	Habitat loss for native flora & fauna (including SCC)
	Vehicles potentially spreading seed	Spreading of potentially dangerous diseases due to invasive and pest species
	Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents	Alteration of fauna assemblages due to habitat modification
	Creation of infrastructure suitable for breeding activities of alien and/or invasive birds	
Main Impact	**Project activities that can cause direct mortality of fauna**	**Secondary impacts anticipated**
3. Direct mortality of fauna	Clearing of vegetation	Loss of habitat
		Loss of ecosystem services
	Roadkill due to vehicle collision	
	Pollution of water resources due to dust effects, chemical spills, etc.	Increase in rodent populations and associated disease risk
	Intentional killing of fauna for food (hunting)	
Main Impact	**Project activities that can cause reduced dispersal/migration of fauna**	**Secondary impacts anticipated**
4. Reduced dispersal/migration of fauna	Loss of landscape used as corridor	Reduced dispersal/migration of fauna
		Loss of ecosystem services
	Compacted roads	Reduced plant seed dispersal
	Removal of vegetation	
Main Impact	**Project activities that can cause pollution in watercourses and the surrounding environment**	**Secondary impacts anticipated**
5. Environmental pollution due to water runoff, spills from vehicles and erosion	Chemical (organic/inorganic) spills	Pollution in watercourses and the surrounding environment
	Erosion	Faunal mortality (direct and indirectly)
		Groundwater pollution

		Loss of ecosystem services
Main Impact	**Project activities that can cause disruption/alteration of ecological life cycles due to sensory disturbance.**	**Secondary impacts anticipated**
6.Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and light pollution.	Operation of machinery (Large earth moving machinery, vehicles)	Disruption/alteration of ecological life cycles due to noise
		Loss of ecosystem services
	Project activities that can cause disruption/alteration of ecological life cycles due to dust	Secondary impacts associated with disruption/alteration of ecological life cycles due to dust
	Vehicles	Loss of ecosystem services
Main Impact	**Project activities that can cause staff to interact directly with potentially dangerous fauna**	**Secondary impacts anticipated**
7. Staff and others interacting directly with fauna (potentially dangerous) or poaching of animals	All unregulated/supervised activities outdoors	Loss of SCCs

5.1.3 Project Infrastructure layout

The project SEI in relation to the Limestone PV1 infrastructure layout can be seen in Figure 5-2. The Impact significance assessment that follows below pertains to the SEI in Figure 5-2 and the expected impact to these areas.

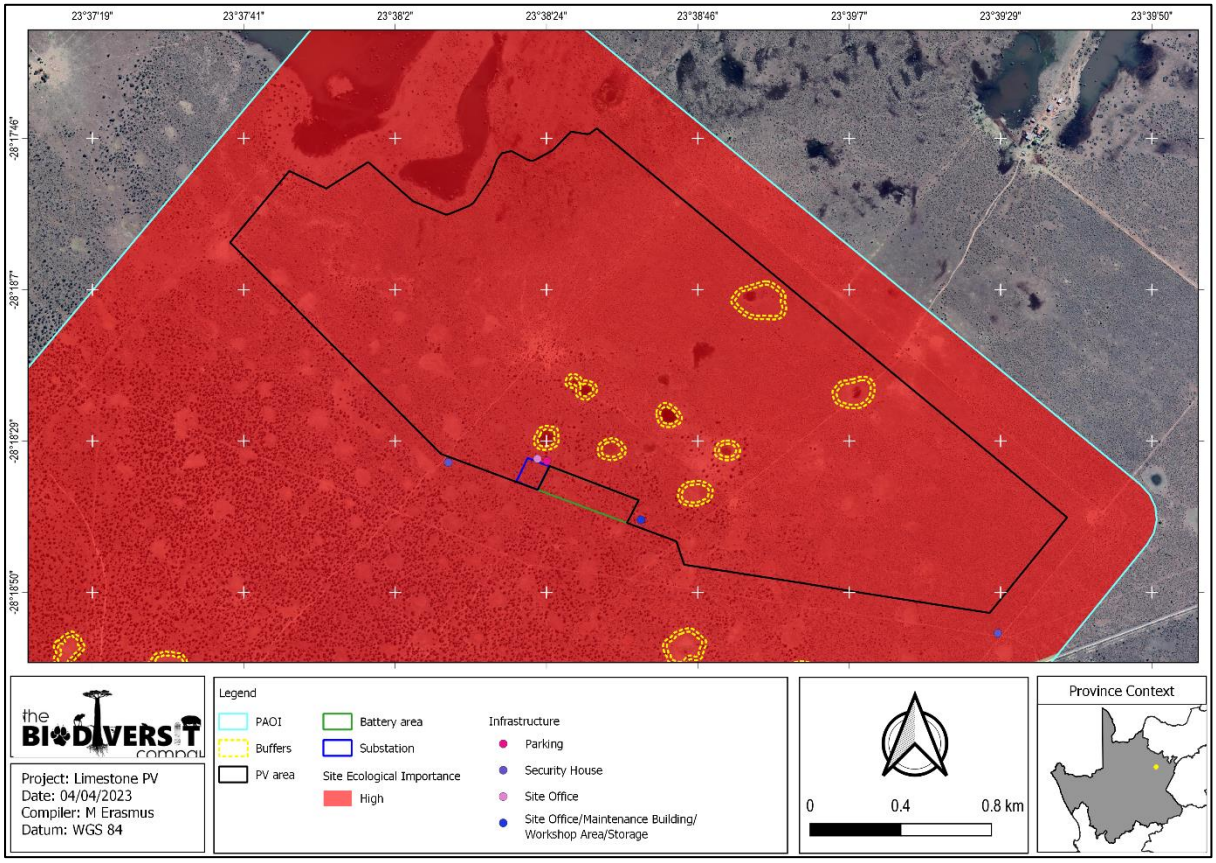


Figure 5-2 SEI in relation to Limestone PV 1 Infrastructure.

5.1.4 Alternatives considered.

No Alternatives were considered.

5.1.5 Assessment of Impact Significance

The assessment of impact significance was undertaken in accordance with the method developed by Savannah. The various identified impacts are assessed below for the different phases of the development. The impacts assessed are considered for all alternatives as they are considered to have negligible impact significance differences. No impacts have been considered for the decommissioning phase. It is assumed similar impacts (and severity) expected for the construction phase will be experienced for the decommissioning phase. Similar mitigation measures would therefore be applicable

5.1.5.1 Construction Phase

The following potential main impacts on the biodiversity (based on the framework above) were considered for the construction phase of the proposed development. This phase refers to the period during construction when the proposed features are constructed; and is considered to have the largest direct impact on biodiversity. The following potential impacts to terrestrial biodiversity were considered:

- Loss and fragmentation of the of habitats, ecosystems and vegetation community (Table 5-2),
- Introduction of alien and invasive species, especially plants (Table 5-3;
- Destruction of protected plant species (Table 5-4); and
- Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, dust, vibration and poaching) (Table 5-5).

Table 5-2 Impacts to biodiversity associated with the proposed construction phase.

Impact Nature: Loss of vegetation within development footprint		
Destruction, further loss and fragmentation of the of habitats, ecosystems and vegetation community		
	Without mitigation	**With mitigation**
Extent	Low (2)	Very low (1)
Duration	Permanent (5)	Moderate term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, although this impact cannot be well mitigated as the loss of vegetation is unavoidable.	
Mitigation:		

• All 'High' SEI habitats (watercourse) and associated buffer zones are to be avoided.
  ○ Avoid the disturbance or destruction of High SEI areas, as far as possible.
• Demarcate work areas during the construction phase to avoid affecting outside areas. Use physical barriers e.g., safety tape, not painted lines, and use signage
• Do not clear areas of indigenous vegetation outside of the direct project footprint
• Minimise vegetation clearing to the minimum required
• Consult a fire expert and compile and implement a fire management plan to minimise the risk of veld fires around the project site
• Compile and implement a rehabilitation plan from the onset of the project;
• Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and bare (unvegetated) areas.
  ○ Reduce the dust generated by operational vehicles and earth moving machinery, through wetting the soil surface (with "dirty water") and putting up signs to enforce speed limits to enforce reduced speeds.		

○ No non-environmentally friendly suppressants may be used as this could result in pollution of water sources. • Rehabilitate areas as soon as they are no longer impacted by construction ○ The rehabilitated areas must be revegetated with indigenous vegetation • Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation material can be applied to other others in need of stabilisation and vegetation cover • Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018). • Environmental Officer (EO) to provide supervision and oversight of vegetation clearing activities.
Residual Impacts:
The loss of currently intact vegetation is an unavoidable consequence of the project and cannot be entirely mitigated. The residual impact would however be low.

Table 5-3 Impacts to biodiversity associated with the proposed construction phase.

Impact Nature: Introduction of alien and invasive species, especially plants		
Degradation and loss of surrounding natural vegetation, persecution of indigenous fauna species		
	Without mitigation	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (36)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation:		
• Compile and implement an alien vegetation management plan from the onset of construction. The plan must identify areas for action (if any) and prescribe the necessary removal methods and frequencies to be applied. This plan must be also prescribing a monitoring plan and be updated as/when new data is collated; • Implementation of a waste management plan, this plan must be also prescribe a monitoring plan and be updated as/when new data is collated. Waste management must be a priority and all waste must be collected, stored and disposed of adequately. It is recommended that all waste be removed from site on a weekly basis (as a minimum) to prevent rodents and pests entering the site. • Refuse bins will be emptied and secured. • Temporary storage of domestic waste shall be in covered waste skips. • Maximum domestic waste storage period will be 7 days. • A pest control plan must be put in place and implemented; it is imperative that poisons not be used.		
Residual Impacts:		
Long-term broad scale. IAP infestation if not mitigated.		

Table 5-4 Impacts to biodiversity associated with the proposed construction phase.

Impact Nature: Destruction of protected plant species		
Construction activity will likely lead to direct loss of protected tree species		
	Without mitigation	**With mitigation**
Extent	Low(2)	Very low (1)
Duration	Permanent (5)	Short term (2)

Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (52)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation:		
• Vegetation clearing commences only after the necessary permits have been obtained, if the protected trees cannot be avoided.		
Residual Impacts:		
N/A		

Table 5-5 Impacts to biodiversity associated with the proposed construction phase.

Impact Nature: Displacement of faunal community due to habitat loss, direct mortalities and disturbance		
Construction activity will likely lead to direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills and persecution. Disturbance due to dust and noise pollution and vibration may disrupt behaviour.		
	Without mitigation	**With mitigation**
Extent	Moderate (3)	Very low (1)
Duration	Moderate term (3)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, to some extent. Noise and disturbance cannot be well mitigated, impacts on fauna due to human presence, such as vehicle collisions, poaching, and persecution can be mitigated.	
Mitigation:		
• Demarcate work areas during the construction phase to avoid affecting outside areas. Use physical barriers e.g., safety tape, not painted lines, and use signage. • Prior to vegetation clearing activities, the area to be cleared should be walked on foot by 1-2 individuals to create a disturbance in order for fauna to move off. Sites should be disturbed only prior to the area having to be cleared, not more than 1 day in advance. • Any fauna threatened by the construction activities should be removed safely by an appropriately qualified environmental officer or removal specialist. • All construction vehicles should adhere to a speed limit of maximum 40 km/h to avoid collisions. Appropriate speed control measures and signs must be erected. • Wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area • Minimise vegetation clearing to the minimum required. Areas should be cleared and disturbed on a needs basis only, as opposed to clearing and disturbing a number of sites simultaneously. • Provide All personnel and contractors to undergo Environmental Awareness Training to all personnel and contractors. A signed register of attendance must be kept for proof. Discussions The training must include. • The timing between clearing of an area and subsequent development must be minimized to avoid fauna from re-entering the site to be disturbed.		

• Any holes/deep excavations must done in a progressive manner on a needs basis only. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be covered to prevent fauna falling into these areas and subsequently inspected prior to backfilling • Where possible, work should be restricted to one area at a time and be systematic. This is to reduce the number and extent of on-site activities, allowing fauna to move off as the Project progresses. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories. • Considering that many of the mammal fauna recorded within the project area are nocturnal, no construction activity is to occur at night.
Residual Impacts:
It is probable that some individuals of susceptible species will be lost to construction-related activities despite mitigation. However, this is not likely to impact the viability of the local population of any fauna species.

5.1.5.2 Operation Phase

The operational phase of the impact of daily activities is anticipated to further spread the IAP, as well as the deterioration of the habitats due to the increase of dust and edge effect impacts. Dust reduces the ability of plants to photosynthesize and thus leads to degradation/retrogression of the veld. Moving maintenance vehicles don't only cause sensory disturbances to fauna, affecting their life cycles and movement, but will lead to direct mortalities due to collisions.

The following potential impacts were considered:

- Continued fragmentation and degradation of habitats and ecosystems (Table 5-6);
- Spread of alien and/or invasive species (Table 5-7);
- Ongoing displacement and direct mortalities of faunal community (including SCC) due to disturbance (road collisions, noise, light, dust, vibration) (Table 5-8).

Table 5-6 Impacts to biodiversity associated with the proposed operational phase

Impact Nature: Continued fragmentation and degradation of habitats and ecosystems		
Disturbance created during the construction phase will leave the project area vulnerable to erosion and IAP encroachment.		
	Without Mitigation	With Mitigation
Extent	Low (2)	Low (2)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes, with proper management and avoidance, this impact can be mitigated to a low level.	
Mitigation:		
• All 'High' SEI habitats and associated buffer zones are to be avoided. • Avoid the further disturbance or destruction of Sandy Grassland (High SEI areas) , as far as possible. • It should be made an offence for any staff to /take bring any plant species into/out of any portion of the PAOI. No plant species whether indigenous or exotic should be brought into/taken from the PAOI, to prevent the spread of exotic or invasive species or the illegal collection of plants. • A Rehabilitation Plan must be written for the development area and ensured that it be adhered to. • Access roads should have run-off control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.		

Impact Nature: Continued fragmentation and degradation of habitats and ecosystems
Disturbance created during the construction phase will leave the project area vulnerable to erosion and IAP encroachment.
• All erosion observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • There should be follow-up rehabilitation and re-vegetation of any remaining denuded areas with local indigenous perennial grass, shrubs and trees.
Residual Impacts
There is still the potential some potential for erosion and IAP encroachment even with the implementation of control measures but would have a low impact.

Table 5-7 Impacts to biodiversity associated with the proposed operational phase.

Impact Nature: Spread of alien and/or invasive species		
Degradation and loss of surrounding natural vegetation, persecution of indigenous fauna species		
	Without mitigation	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (52)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation:		
• Implementation of an alien vegetation management plan. o Regular monitoring for IAP encroachment during the operation phase to ensure that no alien invasion problems have developed as result of the disturbance. This should be every 3 months during the first two years of the operation phase and every six months for the life of the project. o All IAP species must be removed/controlled using the appropriate techniques as indicated in the IAP management plan • Compile and implement a Solid Waste Management Plan. Waste management must be a priority and all waste must be collected, stored and disposed of adequately. It is recommended that all waste be removed from site on a weekly basis as a minimum. • A pest control plan must be implemented; it is imperative that poisons not be used.		
Residual Impacts:		
Long term broad scale IAP infestation if not mitigated.		

Table 5-8 Impacts to biodiversity associated with the proposed operational phase

Impact Nature: Ongoing displacement and direct mortalities of faunal community (including potential SCC) due to disturbance (road collisions, noise, light, dust, vibration).		
The operation and maintenance of the proposed development may lead to mortality, disturbance or persecution of fauna in the vicinity of the development.		
	Without Mitigation	**With Mitigation**
Extent	Low (2)	Very low (1)
Duration	Long term (4)	Short term (2)

Impact Nature: Ongoing displacement and direct mortalities of faunal community (including potential SCC) due to disturbance (road collisions, noise, light, dust, vibration).		
The operation and maintenance of the proposed development may lead to mortality, disturbance or persecution of fauna in the vicinity of the development.		
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation:		
• Outside lighting should be designed and limited to minimize impacts on fauna. Lighting fixtures should be fitted with baffles, hoods or louvres and directed downward. Outside lighting should be directed away from highly sensitive areas such as the wetlands. Fluorescent and mercury vapor lighting should be avoided and sodium vapor (yellow) lights should be used wherever possible; • Where feasible, motion detection lighting must be used to minimise the unnecessary illumination of areas • No vehicle traffic nor the use of vehicle lights should be permitted during the night. • Noise must be kept to a minimum from dusk to dawn to minimize all possible disturbances to amphibian species and nocturnal mammals • Latest technology solar panels with an anti-reflective coating must be used. This will also improve the light transmittance and therefore increases the overall efficiency. • If panels do not possess anti-reflective coatings, then non-polarising white tape can be used around and/or across panels to minimise reflection (Bennun *et al*, 2021). • All personnel and contractors must undergo Environmental Awareness Training and must include awareness about not harming or collecting species. • Any fauna threatened by the maintenance and operational activities should be removed to a safe location by an appropriate individual. • All vehicles accessing the site should adhere to a max 40 km/h max to avoid collisions. Appropriate signs must be erected. • If any excavations are to be dug these must not be left open for more than a few hours without ramps for trapped fauna to leave and must be filled at night.		
Residual Impacts		
Disturbance from maintenance activities will occur albeit at a low and infrequent level.		

5.1.5.3 Cumulative Impacts

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts pre-existing in an area or region, it is appropriate to consider the cumulative effects of development or disturbance activities. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a specific point in time may actually represent a significant change from the original state of the system. This section describes the potential cumulative impacts of the project on local fauna and flora specifically.

Cumulative impacts are assessed within the context of the extent of the proposed project area, other similar developments and activities in the area (existing and in-process), and general habitat loss and transformation resulting from any other activities in the area. Localised cumulative impacts include those from operations that are close enough (within 30 km) to potentially cause additive effects on the local environment or any sensitive receptors (relevant operations include nearby large road networks, other solar PV facilities, and power infrastructure). Relevant impacts include the overall reduction of foraging and habitat where reproduction takes place, dust deposition, noise and vibration, disruption of functional

corridors of habitat important for movement and migration, disruption of waterways, groundwater drawdown, increase risk of collisions; and groundwater and surface water quality depletion.

Long-term cumulative impacts associated with the site development activities can lead to the loss of endemic and threatened species, including natural habitat and vegetation types, and these impacts can even lead to the degradation of conserved areas such as the adjacent game parks and reserves. In order to spatially quantify the cumulative effects of the proposed development, the project in isolation is compared with the overall effects of surrounding development (including total transformation and transformation as a result of new and proposed developments of a similar type, i.e., solar).

The total area within the 30 km buffer around the PV development area amounts to 302904.44 ha, but when considering the transformation (5258.63 ha) that has taken place within this radius, 297645.82 ha of intact habitat remains according to the 2018 National Biodiversity Assessment. Therefore, the area within 30 km of the project has experienced approximately 1.77 % loss in natural habitat. Considering this context, the PV infrastructure footprint is 329.56 ha (as provided) and similar projects exists (which includes the project area) in the 30 km region measuring a maximum of 17789.4 ha (as per the latest South African Renewable Energy EIA Application Database) which means that the total amount of remaining habitat lost as a result of the solar project amounts to 5.98 % (PV developments as a percentage of the total remaining habitat). Table 5-9 outlines the calculation procedure for the spatial assessment of cumulative impacts.

Table 5-9 Loss of habitat within a 30 km radius of the project

	Total Habitat (ha)	Total Loss (ha)	Tot. Remaining Habitat (ha) (Remnants)	Total Historical Loss	PV Development Similar Projects including Project	Tot. Remaining Habitat (ha)	Cumulative Habitat Lost
Approximate Solar development cumulative effects (Spatial)	302904.44	5258.63	297645.82	**1.77 %**	17789.04	279856.78	**5.98 %**

The overall cumulative impact assessment is presented in Table 5-10 and Figure 5-3 and below. Note that this also accounts for the relative importance of the habitats within and adjacent to the development area, in the context of the value of the regional habitat. Approximately 1.77% of the habitat has already been lost, and as discussed above the proposed solar developments will result in a cumulative loss of approximately 5.98 % from the development in the area. The expected cumulative impact of PV development as a whole is expected to be of a 'Moderate' significance, however, the contribution of the project development footprint itself (329.56 ha) is calculated at 1.85% of the total (PV Development Projects), with overall low significance when considering the contribution in isolation. The overall medium cumulative residual impact does not present a fatal flaw for the development, and the project may be favoured for authorisation.

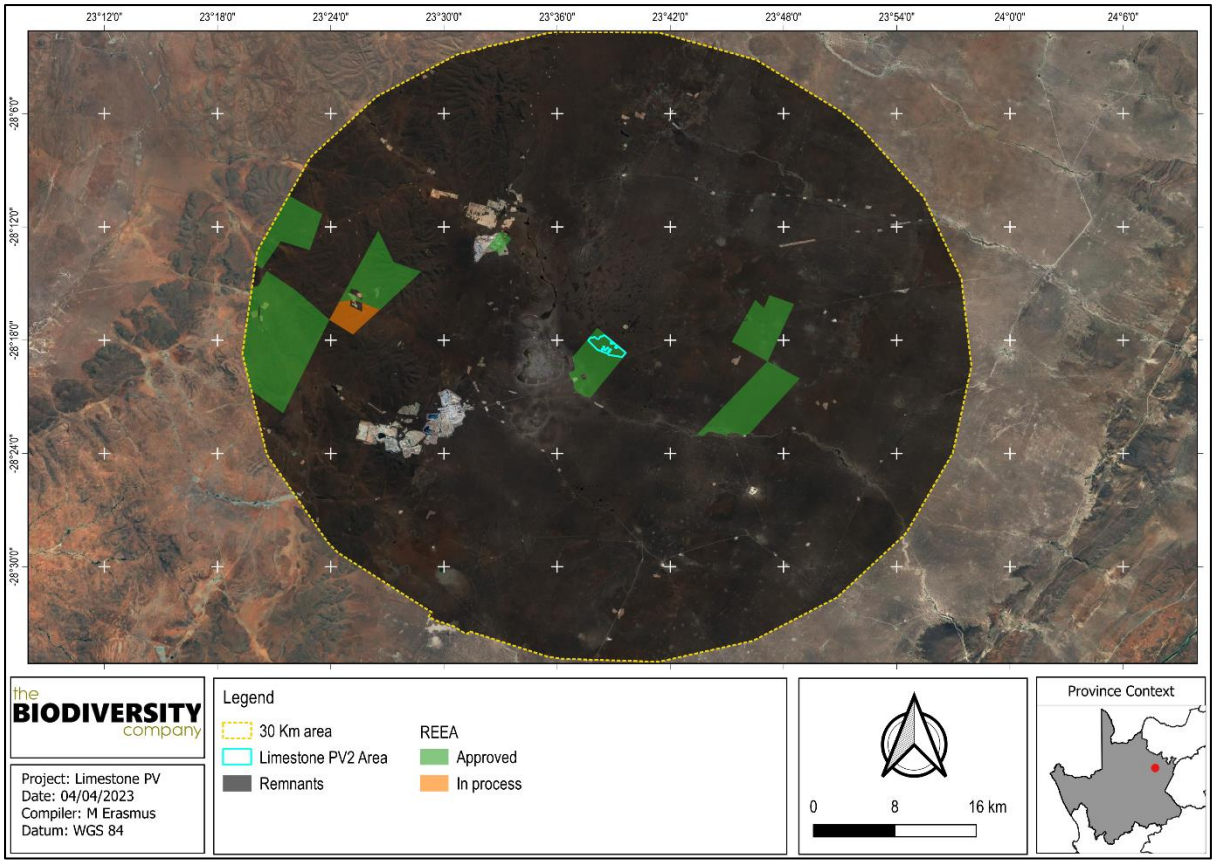


Figure 5-3 Map illustrating the additional renewable energy developments within the landscape overlaid onto the remnant vegetation types

Table 5-10 Cumulative impact assessment of the project

Impact Nature: Cumulative habitat loss within the region		
The development of the proposed infrastructure will contribute to cumulative habitat loss and thereby impact the ecological processes in the region.		
	Overall impact of the proposed development considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Very low (1)	Low (2)
Duration	Moderate term (3)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Definite (5)
Significance	**Low (24)**	**Medium (60)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated	To some degree, but most of the impact results from the presence of the various facilities which cannot be well mitigated.	
Mitigation:		
• Over and above all provided mitigation measures; ensure that a rehabilitation plan and IAP management plan be compiled for each development and are effectively implemented.		

5.2 Wetland Risk Assessment

A risk assessment was conducted in line with Section 21 (c) and (i) of the National Water Act, 1998, (Act 36 of 1998) to investigate the level of risk posed by proposed project, namely the proposed project together with the transmission lines servicing it. The risk assessment considered (and assumed) both direct and indirect impacts, if any, to the wetland system. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this of the assessment (Figure 5-4).

In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. The complete avoidance of wetland is likely for this project. The assigned sensitivities refer to “High” for the wetlands being encroached upon, with a “Medium” sensitivity assigned to the recommended buffer widths. The remaining extent of the development and corridor areas are assigned a ”Low” sensitivity. The absence of direct impacts posed to the delineated wetland areas achieves the requirements of the first step (avoidance). The second step (minimising) will be considered during the risk assessment to determine the possibility of significance ratings being decreased by means of mitigation for indirect risks.

Three levels of risk have been identified and determined for the overall risk assessment, these include low, moderate and high risk. High risks are typically regarded for the development and subsequent loss of wetlands. However, high risks are not applicable due to the nature of the development, and the potential for avoidance and minimisation. Moderate risk refers to wetland areas that are located proximal to the development footprint area and at an indirect risk. Low risks are wetland systems beyond the project area that would be avoided, which is the extent of the respective project area. The moderate risks were the priority for the risk assessment, focussing on the expected potential for these indirect risks. The significance of all post-mitigation risks was determined to be low.

The following tables present various aspects that are expected to impact upon the delineated wetlands during the construction and operational phases. Overall, all anticipated risks are considered to have a Low residual impact significance provided that the mitigation measures are effectively implemented. Under this assumption, it is the opinion of the specialist that the proposed development should not warrant any more than a General Authorisation in terms of water use licensing.

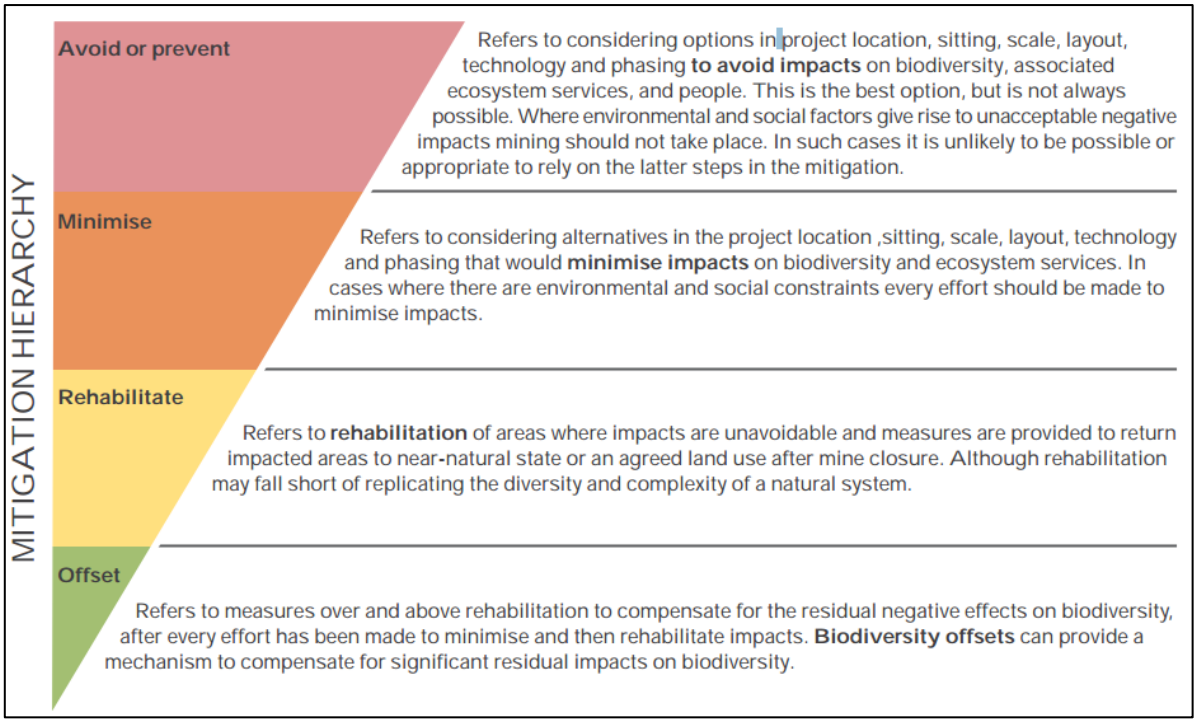


Figure 5-4 The mitigation hierarchy as described by the DEA (2013)

Table 5-11 Impacts assessed for the proposed project

Activity	Aspect	Impact
Construction Phase	Clearing of vegetation	• Altered surface flow dynamics; • Erosion; • Alteration of sub-surface flow dynamics; • Sedimentation of the water resource; • Direct and indirect loss of wetland areas; • Water quality impairment; • Compaction; • Decrease in vegetation; • Change of drainage patterns; • Altering hydromorphic properties; and • Indirect loss of wetland areas.
	Stripping and stockpiling of topsoil	
	Establish working area	
	Minor Excavations	
	Vehicle access	
	Leaks and spillages from machinery, equipment & vehicles	
	Solid waste disposal	
	Human sanitation& ablutions	
	Re-fuelling of machinery and vehicles	
	Laying of core samples	
	Backfill of material	
Operational Phase	Traffic	
	Overland flow contamination	
	Increased anthropogenic activities in wetland	
	Loss of sub-surface flows	
Decommissioning Phase	Removal of structures, machinery and equipment	
	Rehabilitation of site to agreed land use	

Table 5-12 DWS Risk Impact Matrix for the proposed project

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase (PV site, Substations and Powerline)								
Removal of vegetation	**4**	**2**	**3**	**3**	3	**1**	**4**	8
Stripping and stockpiling of soil	**3**	2	4	3	3	**1**	4	8
Establish working area	**3**	2	2	2	2.3	**1**	1	4.3
Minor Excavation	**3**	2	2	3	2.5	**1**	2	5.5
Vehicle access	**1**	2	2	2	1.8	**1**	2	4.8
Domestic and industrial waste	**1**	3	2	2	2	**1**	2	5
Storage of chemicals, mixes and fuel	**1**	3	2	2	2	**1**	2	5
Physical construction of buildings	**3**	2	2	2	2.3	**1**	2	5.3
Use of machinery/vehicles within and close to wetlands	**2**	3	2	2	2.3	**1**	4	7.3
Ablution facilities	**2**	3	2	2	2.3	**1**	2	5.3
Backfill of material	**2**	1	2	2	1.8	**1**	2	4.8
Operational Phase (PV site, Substations and Powerline)								
Traffic	**2**	**3**	**3**	**2**	2.5	**2**	**5**	9.5
Overland flow contamination	**2**	2	2	2	2	1	5	8
Increased anthropogenic activities in wetland	**3**	3	3	3	3	1	5	9
Loss of sub-surface flows	**1**	2	2	1	1.5	2	5	8.5
Decommissioning Phase (PV site, Substations and Powerline)								
Removal of structures, machinery and equipment	1	2	1	2	1,5	2	1	4,5
Rehabilitation of site to agreed land use	1	2	1	2	1,5	2	1	4,5

Table 5-13 DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Removal of vegetation	**2**	**3**	**5**	**2**	12	96	Moderate	Low
Stripping and stockpiling of soil	**2**	3	5	2	12	96	Moderate	Low
Establish working area	**1**	3	1	3	8	34	Low	Low
Minor Excavation	**1**	3	5	2	11	61	Moderate	Low
Vehicle access	**3**	3	2	3	11	52	Low	Low
Domestic and industrial waste	**1**	3	1	2	7	35	Low	Low
Storage of chemicals, mixes and fuel	**1**	3	1	3	8	40	Low	Low
Physical construction of buildings	**1**	3	2	2	8	42	Low	Low
Use of machinery/vehicles within and close to wetlands	**3**	3	5	2	13	94	Moderate	Low
Ablution facilities	**3**	3	5	2	13	68	Moderate	Low
Backfill of material	**1**	3	1	3	8	38	Low	Low
Operational Phase								
Traffic	**5**	**2**	**1**	**1**	9	86	Moderate	Low
Overland flow contamination	**2**	3	1	2	8	64	Moderate	Low
Increased anthropogenic activities in wetland	**2**	2	1	2	7	63	Moderate	Low
Loss of sub-surface flows	**2**	3	1	3	9	77	Moderate	Low
Decommissioning Phase								
Removal of structures, machinery and equipment	2	2	1	3	8	36	Low	Low
Rehabilitation of site to agreed land use	2	2	1	3	8	36	Low	Low

5.2.1 Mitigation Measures

The following mitigation measures are provided in view of the expected risks posed to the wetland areas:

- The wetland and buffer areas must be avoided;
- Avoid complete clearance of vegetation beneath the panels, apply brush cutting;
- Make use of existing access routes as much as possible, before new routes are considered. Any selected “new” route must not encroach into the wetland areas;
- Limit construction activities to the dry season when storms are least likely to wash concrete and sand into wetlands;
- Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash;
- Mixing of concrete must under no circumstances take place in any wetland or their buffers. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished;
- Promptly remove all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs);
- Limit soil disturbance;
- The use of herbicides is not recommended in or near wetlands (opt for mechanical removal);
- Appropriately stockpile topsoil cleared from the transmission line footprint;
- A stormwater management plan must be compiled and implemented for the project, facilitating the diversion of clean water to the delineated resources;
- The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- Laydown yards, camps and storage areas must be within project area;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Any possible contamination of topsoil by hydrocarbons must be avoided. Any contaminated soil must be treated in situ or be placed in containers and removed from the site for disposal in a licensed facility;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility;
- All chemicals and toxicants to be used for the construction must be stored within the drilling site and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;

- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of material on-site may take place; and
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported

6 Management Outcomes

6.1 Biodiversity

The aim of the management outcomes is to present the mitigations in such a way that the can be incorporated into the Environmental Management Programme (EMPr), allowing for more successful implementation and auditing of the mitigations and monitoring guidelines. Table 6-1 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators for the terrestrial study.

The focus of mitigation measures is to reduce the significance of potential impacts associated with the development and thereby to:

- Prevent the further loss and fragmentation of vegetation communities and the CBA areas in the vicinity of the project area;
- Prevent the direct and indirect loss and disturbance of faunal species and community (including potentially occurring species of conservation concern); and
- Follow the guidelines for interpreting Site Ecological Importance (SEI).

Table 6-1 Mitigation measures including requirements for timeframes, roles and responsibilities for this report

OBJECTIVE: Prevent the further loss and fragmentation of vegetation communities and the CBA areas in the vicinity of the project area;

Project component/s	**PV Footprint, laydown areas and road creation**
Potential Impact	**Destruction, further loss and fragmentation of the of habitats, ecosystems and vegetation community**
Activity/risk source	**Land clearing, fire and dust.**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation and ecosystems**

Mitigation: Action/control	Responsibility	Timeframe

• All 'High' SEI habitats and associated buffer zones are to be avoided.
  o Avoid the disturbance or destruction of High SEI areas , as far as possible.
• Demarcate work areas during the construction phase to avoid affecting outside areas. Use physical barriers e.g., safety tape, not painted lines, and use signage
• Where possible, existing access routes and walking paths must be made use of.
• Do not clear areas of indigenous vegetation outside of the direct project footprint
• Minimise vegetation clearing to the minimum required
• Consult a fire expert and compile and implement a fire management plan to minimise the risk of veld fires around the project site
• Compile and implement a rehabilitation plan from the onset of the project;
• Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and bare (unvegetated) areas.
  o Reduce the dust generated by operational vehicles and earth moving machinery, through wetting the soil surface (with "dirty water") and putting up signs to enforce speed limits to enforce reduced speeds.
  o No non-environmentally friendly suppressants may be used as this could result in pollution of water sources.
• Rehabilitate areas as soon as they are no longer impacted by construction
  o The rehabilitated areas must be revegetated with indigenous vegetation
• Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation material can be applied to other others in need of stabilisation and vegetation cover
• Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018).
	Project manager, Environmental Officer	Planning and Construction phase

Environmental Officer (EO) to provide supervision and oversight of vegetation clearing activities.		
Performance Indicator	Clearing restricted to 'allowable' areas, dust generated, limited unplanned fires, rehabilitation.	
Monitoring	Daily during the construction phase	

OBJECTIVE: Prevent the further loss and fragmentation of vegetation communities and the CBA areas in the vicinity of the project area;

Project component/s	**Project Area**
Potential Impact	**Introduction of alien and invasive species, especially plants**
Activity/risk source	**Land clearing, fire and dust.**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation and ecosystems**

Mitigation: Action/control	Responsibility	Timeframe

• Do not clear areas of indigenous vegetation outside of the direct project footprint
• Minimise vegetation clearing to the minimum required
• Consult a fire expert and compile and implement a fire management plan to minimise the risk of veld fires around the project site
• Compile and implement a rehabilitation plan from the onset of the project;
• Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and bare (unvegetated) areas.
  ○ Reduce the dust generated by operational vehicles and earth moving machinery, through wetting the soil surface (with "dirty water") and putting up signs to enforce speed limits to enforce reduced speeds.
  ○ No non-environmentally friendly suppressants may be used as this could result in pollution of water sources.
• Rehabilitate areas as soon as they are no longer impacted by construction
  ○ The rehabilitated areas must be revegetated with indigenous vegetation
• Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation material can be applied to other others in need of stabilisation and vegetation cover
• Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018).
Environmental Officer (EO) to provide supervision and oversight of vegetation clearing activities.
	Project manager, Environmental Officer	Planning and Construction phase

Performance Indicator	Clearing restricted to 'allowable' areas, dust generated, limited unplanned fires, rehabilitation.
Monitoring	Daily during the construction phase for all mitigation

OBJECTIVE: Prevent the further loss and fragmentation of vegetation communities, including protected tree species

Project component/s	**PV Footprint, laydown areas and road creation**
Potential Impact	**Destruction of protected plant species**
Activity/risk source	**Land clearing and Fire**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation, including protected tree species**

Mitigation: Action/control	**Responsibility**	**Timeframe**
• Vegetation clearing commences only after the necessary permits have been obtained, if the protected trees cannot be avoided.	Project manager, Environmental Officer	Planning and Construction phase
Performance Indicator	Avoidance or destruction of species (with necessary permits)	
Monitoring	Daily during the construction phase for all mitigation	

OBJECTIVE: Prevent the further loss and fragmentation of vegetation communities, including protected tree species

Project component/s	**PV Footprint, laydown areas and road creation**
Potential Impact	**Destruction of protected plant species**
Activity/risk source	**Land clearing and Fire**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation, including protected tree species**

Mitigation: Action/control	**Responsibility**	**Timeframe**
• Vegetation clearing commences only after the necessary permits have been obtained, if the protected trees cannot be avoided.	Project manager, Environmental Officer	Planning and Construction phase
Performance Indicator	Avoidance or destruction of species (with necessary permits)	
Monitoring	Daily during the construction phase for all mitigation	

OBJECTIVE: Prevent the direct and indirect loss and disturbance of faunal species and community (including potential SCCs)

Project component/s	**PV Footprint, laydown areas and road creation**
Potential Impact	**Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, dust, vibration and poaching)**
Activity/risk source	**Land clearing, Fire and human presence as well as roads.**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and mortality of fauna**

Mitigation: Action/control	Responsibility	Timeframe
• Demarcate work areas during the construction phase to avoid affecting outside areas. Use physical barriers e.g., safety tape, not painted lines, and use signage. • Prior to vegetation clearing activities, the area to be cleared should be walked on foot by 1-2 individuals to create a disturbance in order for fauna to move off. Sites should be disturbed only prior to the area having to be cleared, not more than 1 day in advance. • Any fauna threatened by the construction activities should be removed safely by an appropriately qualified environmental officer or removal specialist. • All construction vehicles should adhere to a speed limit of maximum 40 km/h to avoid collisions. Appropriate speed control measures and signs must be erected. • Wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area • Minimise vegetation clearing to the minimum required. Areas should be cleared and disturbed on a needs basis only, as opposed to clearing and disturbing a number of sites simultaneously. • Provide All personnel and contractors to undergo Environmental Awareness Training to all personnel and contractors. A signed register of attendance must be kept for proof. • The timing between clearing of an area and subsequent development must be minimized to avoid fauna from re-entering the site to be disturbed. • Any holes/deep excavations must done in a progressive manner on a needs basis only. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be	Project manager, Environmental Officer	Planning and Construction phase

covered to prevent fauna falling into these areas and subsequently inspected prior to backfilling • Where possible, work should be restricted to one area at a time and be systematic. This is to reduce the number and extent of on-site activities, allowing fauna to move off as the Project progresses. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories. • Considering that many of the mammal fauna recorded within the project area are nocturnal, no construction activity is to occur at night.		

Performance Indicator	Amount of observable fauna mortalities, Sequence ,direction and timing of land clearing. Speed limits adhered to
Monitoring	Daily during the construction phase for all mitigation

OBJECTIVE: Prevent the further loss and fragmentation of vegetation communities and the CBA areas in the vicinity of the project area;

Project component/s	**Operational Area, PV as well as roads.**
Potential Impact	**Continued fragmentation and degradation of habitats and ecosystems**
Activity/risk source	**Dust, unregulated clearing, IAP plant proliferation and edge effects**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation and ecosystems**

Mitigation: Action/control	Responsibility	Timeframe
• All 'High' SEI habitats and associated buffer zones are to be avoided. • Avoid the further disturbance or destruction of High SEI areas , as far as possible. • It should be made an offence for any staff to /take bring any plant species into/out of any portion of the PAOI. No plant species whether indigenous or exotic should be brought into/taken from the PAOI, to prevent the spread of exotic or invasive species or the illegal collection of plants. • A Rehabilitation Plan must be written for the development area and ensured that it be adhered to. • Access roads should have run-off control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.	Project manager, Environmental Officer	Operational phase

• All erosion observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • There should be follow-up rehabilitation and re-vegetation of any remaining denuded areas with local indigenous perennial grass, shrubs and trees.		
Performance Indicator	Clearing restricted to 'allowable' areas, dust generated, limited unplanned fires, rehabilitation.	
Monitoring	Daily during the operational phase for all mitigation	

OBJECTIVE: Prevent the further loss and fragmentation of vegetation communities and the CBA areas in the vicinity of the project area;

Project component/s	**Project Area**
Potential Impact	**Spread of alien and/or invasive species**
Activity/risk source	**Cleared Areas, laydown areas, fire and dust.**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation and ecosystems**

Mitigation: Action/control	**Responsibility**	**Timeframe**
• Implementation of an alien vegetation management plan. o Regular monitoring for IAP encroachment during the operation phase to ensure that no alien invasion problems have developed as result of the disturbance. This should be every 3 months during the first two years of the operation phase and every six months for the life of the project. o All IAP species must be removed/controlled using the appropriate techniques as indicated in the IAP management plan o Compile and implement a Solid Waste Management Plan. Waste management must be a priority and all waste must be collected, stored and disposed of adequately. It is recommended that all waste be removed from site on a weekly basis as a minimum.	Project manager, Environmental Officer	Operational phase
Performance Indicator	Clearing restricted to 'allowable' areas, dust generated, limited unplanned fires, rehabilitation.	
Monitoring	Daily during the construction phase for all mitigation	

OBJECTIVE: Prevent the direct and indirect loss and disturbance of faunal species and community (including potentially/occurring SCCs)

Project component/s	**Operations Area (PV Footprint, laydown areas and roads)**

Potential Impact	**Ongoing displacement and direct mortalities of faunal community (including SCC) due to disturbance (road collisions, noise, light, dust, vibration)**
Activity/risk source	**Moving vehicles, Fire and human presence and activites**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of vegetation.**

Mitigation: Action/control	**Responsibility**	**Timeframe**
• Outside lighting should be designed and limited to minimize impacts on fauna. Lighting fixtures should be fitted with baffles, hoods or louvres and directed downward. Outside lighting should be directed away from highly sensitive areas such as the wetlands. Fluorescent and mercury vapor lighting should be avoided and sodium vapor (yellow) lights should be used wherever possible; • Where feasible, motion detection lighting must be used to minimise the unnecessary illumination of areas • Minimise traffic and the use of vehicle lights of the road during the night. • Noise must be kept to a minimum from dusk to dawn to minimize all possible disturbances to amphibian species and nocturnal mammals • Latest technology solar panels with an anti-reflective coating must be used. This will also improve the light transmittance and therefore increases the overall efficiency. • If panels do not possess anti-reflective coatings, then non-polarising white tape can be used around and/or across panels to minimise reflection (Bennun *et al*, 2021). • All personnel and contractors must undergo Environmental Awareness Training and must include awareness about not harming or collecting species. • Any fauna threatened by the maintenance and operational activities should be removed to a safe location by an appropriate individual. • All vehicles accessing the site should adhere to a max 40 km/h max to avoid collisions. Appropriate signs must be erected. • If any excavations are to be dug these must not be left open for more than a few hours without ramps for trapped fauna to leave and must be filled at night.	Project manager, Environmental Officer	Operational phase
Performance Indicator	Amount of observable fauna mortalities, Speed limits adhered to	
Monitoring	Daily during the construction phase for all mitigation	

7 Conclusion and Impact Statement

7.1 Conclusion

7.1.1 Terrestrial Biodiversity

The PAOI has been altered, albeit limited, both currently and historically. The present land use has had a direct impact on both the fauna and the flora in the area, which is evident in the transformed habitats. Historically, grazing from livestock and mismanagement has led to (limited) deterioration of the area. Most areas can be regarded as important, not only within the local landscape, but also regionally; as they are used for habitat, foraging and movement corridors for fauna within a landscape fragmented by development. This is especially true regarding the water resource habitats.

The habitat sensitivity of these habitats is regarded as High, and the following aspects support this classification:

- Functions as CBA 1 and CBA 2 as per the Northern Cape Critical Biodiversity Areas spatial database;
- As true NFEPA wetlands, as well as a FEPA River (NBA CR River), classed as Freshwater Ecosystem Priority Area; and
- Support various organisms and may play an important role in the ecosystem, if left to recover from the superficial impacts.

The ecological integrity, importance and functioning of these terrestrial biodiversity areas provide a variety of ecological services considered beneficial, with one key service being the maintenance of biodiversity. The preservation of these systems is the most important aspect to consider for the proposed project.

7.1.2 Freshwater

A total of two (2) natural HGM types were confirmed within the PAOI. The two (2) HGM types, comprise a reach of an unnamed tributary of the Klein-Riet River and numerous pans. The pans are dispersed across the PAOI and comprise systems which indicate some level of saturation, and other systems that do no (clearly) indicate any level of saturation.

The PAOI is adjacent to an unnamed second order stream C92A-02837 which is a tributary of the Klein-Riet. The Klein-Riet forms a confluence with the Vaal further downstream. The ecological integrity of the system is expected to be seriously modified (class E). The integrity of the pan systems was determined to be Largely Natural (class B).

The level of ecosystem service benefit provided by the pan systems was determined to be moderately low. The systems are generally considered relatively important (moderately high) from a biodiversity maintenance perspective. The ecological importance and sensitivity of the river and pan systems was determined to be high and moderate respectively.

A buffer zone was suggested of 22 m and 15 m for the river system and pans respectively, this buffer is calculated assuming mitigation measures are applied.

A risk assessment was conducted in line with Section 21 (c) and (i) of the National Water Act, 1998, (Act 36 of 1998) to investigate the level of risk posed by proposed project. The absence of direct impacts posed to the delineated wetland areas achieves the requirements of the first step of the mitigation hierarchy (avoidance). The second step (minimising) will be considered during the risk assessment to determine the possibility of significance ratings being decreased by means of mitigation for indirect risks. The moderate risks were the priority for the risk assessment, focussing on the expected potential for these indirect risks. Overall, all anticipated risks are considered to have a Low residual impact significance provided that the mitigation measures are effectively implemented. Under this assumption,

it is the opinion of the specialist that the proposed development should not warrant any more than a General Authorisation in terms of water use licensing.

7.2 Impact Statement

The main expected impacts of the proposed infrastructure will include the following:

- Habitat loss and fragmentation as well as degradation of surrounding habitat;
- Disturbance and displacement caused during the construction and maintenance phases; and
- Direct mortality during the construction phase.

The primary expected impacts of the proposed project will be the loss of habitat and emigration of fauna. Based on the outcomes of the SEI determination, there are areas within the PAOI that possess a 'Very High' SEI. This denotes that avoidance mitigation is the only appropriate option for these areas and no destructive development activities should be considered. There are areas within the PAOI that possess a 'High' SEI. This denotes that avoidance mitigation wherever possible must be implemented. This includes changes to project infrastructure design to limit the amount of habitat impacted. The maintenance of basal vegetation cover beneath the solar panels will contribute to achieving avoidance, so complete clearance is not recommended. The overall medium cumulative residual impact does not present a fatal flaw for the development, and the project may be favoured for authorisation.

Considering that this area has been identified as being of significance for biodiversity maintenance and ecological processes (CBAs and ESAs), development may proceed but with caution and only with the implementation of mitigation measures. The overall residual impacts are expected to be low. Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project may be favourably considered, on condition that all prescribed mitigation measures and supporting recommendations are implemented.

8 References

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9 Appendix Items

9.1 Appendix A – Flora species expected to occur in the PAOI.

Family	Species	Author1	Rank1	Sp2	IUCN	Ecology
Acanthaceae	*Blepharis marginata*	(Nees) C.B.Clarke			LC	Indigenous; Endemic
Acanthaceae	*Barleria macrostegia*	Nees			LC	Indigenous
Acanthaceae	*Barleria bechuanensis*	C.B.Clarke			LC	Indigenous; Endemic
Acanthaceae	*Glossochilus burchellii*	Nees			LC	Indigenous
Acanthaceae	*Justicia divaricata*	Licht. ex Roem. & Schult.				Indigenous
Acanthaceae	*Justicia puberula*	Immelman			LC	Indigenous; Endemic
Aizoaceae	*Trichodiadema densum*	(Haw.) Schwantes			LC	Indigenous; Endemic
Aizoaceae	*Nananthus aloides*	(Haw.) Schwantes			LC	Indigenous
Aizoaceae	*Ruschia sp.*					
Aizoaceae	*Galenia africana*	L.			LC	Indigenous
Amaranthaceae	*Atriplex semibaccata*	R.Br.				Not indigenous; Naturalised; Invasive
Amaranthaceae	*Dysphania schraderiana*	(Schult.) Mosyakin & Clemants				Indigenous
Amaranthaceae	*Sericorema sericea*	(Schinz) Lopr.			LC	Indigenous
Amaranthaceae	*Cyphocarpa angustifolia*	(Moq.) Lopr.			LC	Indigenous
Amaranthaceae	*Hermbstaedtia odorata*	(Burch.) T.Cooke	var.	aurantiaca	NE	Indigenous
Amaranthaceae	*Hermbstaedtia fleckii*	(Schinz) Baker & C.B.Clarke			LC	Indigenous
Amaranthaceae	*Hermbstaedtia odorata*	(Burch.) T.Cooke	var.	albi-rosea	NE	Indigenous
Amaranthaceae	*Salsola tuberculata*	(Moq.) Fenzl			LC	Indigenous
Amaranthaceae	*Chenopodium hederiforme*	(Murr) Aellen	var.	dentatum	LC	Indigenous
Anacampserotaceae	*Anacampseros filamentosa*	(Haw.) Sims	sub sp.	filamentosa		Indigenous; Endemic
Anacardiaceae	*Searsia ciliata*	(Licht. ex Schult.) A.J.Mill.			LC	Indigenous
Anacardiaceae	*Searsia lancea*	(L.f.) F.A.Barkley			LC	Indigenous
Anacardiaceae	*Searsia pendulina*	(Jacq.) Moffett			LC	Indigenous
Anacardiaceae	*Searsia tridactyla*	(Burch.) Moffett			LC	Indigenous; Endemic
Anacardiaceae	*Searsia burchellii*	(Sond. ex Engl.) Moffett			LC	Indigenous
Anacardiaceae	*Searsia pyroides*	(Burch.) Moffett	var.	pyroides	LC	Indigenous
Apiaceae	*Deverra burchellii*	(DC.) Eckl. & Zeyh.			LC	Indigenous
Apiaceae	*Deverra denudata*	(Viv.) Pfisterer & Podlech				Indigenous
Apiaceae	*Centella asiatica*	(L.) Urb.			LC	Indigenous
Apocynaceae	*Gomphocarpus fruticosus*	(L.) W.T.Aiton	sub sp.	fruticosus	LC	Indigenous
Apocynaceae	*Pentarrhinum insipidum*	E.Mey.			LC	Indigenous
Apocynaceae	*Pachypodium succulentum*	(L.f.) Sweet			LC	Indigenous; Endemic

Apocynaceae	*Microloma sp.*					
Apocynaceae	*Gomphocarpus tomentosus*	Burch.	sub sp.	tomentosus	LC	Indigenous
Apocynaceae	*Gomphocarpus fruticosus*	(L.) W.T.Aiton				Indigenous
Apocynaceae	*Fockea angustifolia*	K.Schum.			LC	Indigenous
Apocynaceae	*Orbea knobelii*	(E.Phillips) Bruyns			LC	Indigenous
Araliaceae	*Hydrocotyle verticillata*	Thunb.			LC	Indigenous
Asparagaceae	*Asparagus laricinus*	Burch.			LC	Indigenous
Asparagaceae	*Asparagus suaveolens*	Burch.			LC	Indigenous
Asparagaceae	*Asparagus exuvialis*	Burch.	forma	exuvialis	NE	Indigenous
Asphodelaceae	*Bulbine narcissifolia*	Salm-Dyck			LC	Indigenous
Aspleniaceae	*Asplenium cordatum*	(Thunb.) Sw.			LC	Indigenous
Asteraceae	*Oedera humilis*	(Less.) N.G.Bergh				Indigenous
Asteraceae	*Geigeria filifolia*	Mattf.			LC	Indigenous
Asteraceae	*Osteospermum microphyllum*	DC.			LC	Indigenous
Asteraceae	*Laggera decurrens*	(Vahl) Hepper & J.R.I.Wood			LC	Indigenous
Asteraceae	*Helichrysum nudifolium*	(L.) Less.	var.	nudifolium	LC	Indigenous
Asteraceae	*Lopholaena cneorifolia*	(DC.) S.Moore			LC	Indigenous
Asteraceae	*Flaveria bidentis*	(L.) Kuntze				Not indigenous; Naturalised; Invasive
Asteraceae	*Chrysocoma ciliata*	L.			LC	Indigenous
Asteraceae	*Cotula microglossa*	(DC.) O.Hoffm. & Kuntze ex Kuntze			LC	Indigenous; Endemic
Asteraceae	*Senecio reptans*	Turcz.			LC	Indigenous; Endemic
Asteraceae	*Gazania sp.*					
Asteraceae	*Pentzia calcarea*	Kies			LC	Indigenous
Asteraceae	*Helichrysum cerastioides*	DC.	var.	cerastioides	LC	Indigenous
Asteraceae	*Senecio intricatus*	S.Moore			LC	Indigenous; Endemic
Asteraceae	*Senecio inaequidens*	DC.			LC	Indigenous
Asteraceae	*Dicoma macrocephala*	DC.			LC	Indigenous
Asteraceae	*Sonchus asper*	(L.) Hill	sub sp.	asper		Not indigenous; Naturalised; Invasive
Asteraceae	*Pentzia stellata*	(P.P.J.Herman) Magee				Indigenous; Endemic
Asteraceae	*Lactuca inermis*	Forssk.			LC	Indigenous
Asteraceae	*Pentzia sp.*					
Asteraceae	*Amphiglossa triflora*	DC.			LC	Indigenous
Asteraceae	*Cineraria erosa*	(Thunb.) Harv.			LC	Indigenous; Endemic
Asteraceae	*Conyza sp.*					
Asteraceae	*Gazania krebsiana*	Less.	sub sp.	serrulata	LC	Indigenous
Asteraceae	*Helichrysum lucilioides*	Less.			LC	Indigenous
Asteraceae	*Pentzia viridis*	Kies			LC	Indigenous; Endemic

Asteraceae	*Phymaspermum aciculare*	(E.Mey. ex DC.) Benth. & Hook. ex B.D.Jacks.			LC	Indigenous
Asteraceae	*Geigeria brevifolia*	(DC.) Harv.			LC	Indigenous
Asteraceae	*Osteospermum sp.*					
Asteraceae	*Cirsium vulgare*	(Savi) Ten.				Not indigenous; Naturalised; Invasive
Asteraceae	*Ursinia nana*	DC.	sub sp.	leptophylla	LC	Indigenous
Asteraceae	*Felicia muricata*	(Thunb.) Nees	sub sp.	cinerascens	LC	Indigenous
Asteraceae	*Felicia fascicularis*	DC.			LC	Indigenous
Asteraceae	*Arctotheca calendula*	(L.) Levyns			LC	Indigenous
Asteraceae	*Eriocephalus ericoides*	(L.f.) Druce	sub sp.	griquensis	LC	Indigenous; Endemic
Asteraceae	*Tarchonanthus obovatus*	DC.			LC	Indigenous; Endemic
Asteraceae	*Nidorella resedifolia*	DC.	sub sp.	resedifolia	LC	Indigenous
Asteraceae	*Osteospermum spinescens*	Thunb.			LC	Indigenous
Asteraceae	*Tarchonanthus camphoratus*	L.			LC	Indigenous
Asteraceae	*Gazania krebsiana*	Less.	sub sp.	arctotoides	LC	Indigenous
Asteraceae	*Pentzia quinquefida*	(Thunb.) Less.			LC	Indigenous; Endemic
Asteraceae	*Zinnia peruviana*	(L.) L.				Not indigenous; Naturalised; Invasive
Asteraceae	*Platycarphella parvifolia*	(S.Moore) V.A.Funk & H.Rob.			LC	Indigenous; Endemic
Asteraceae	*Geigeria ornativa*	O.Hoffm.	sub sp.	ornativa	LC	Indigenous
Asteraceae	*Kleinia longiflora*	DC.			LC	Indigenous
Asteraceae	*Helichrysum zeyheri*	Less.			LC	Indigenous
Asteraceae	*Pteronia cylindracea*	DC.			LC	Indigenous
Asteraceae	*Senecio carnosus*	Thunb.			LC	Indigenous; Endemic
Asteraceae	*Helichrysum caespititium*	(DC.) Harv.			LC	Indigenous
Asteraceae	*Cineraria vallis-pacis*	Dinter ex Merxm.			LC	Indigenous
Asteraceae	*Hertia ciliata*	(Harv.) Kuntze			LC	Indigenous
Asteraceae	*Euryops subcarnosus*	DC.	sub sp.	vulgaris	LC	Indigenous
Asteraceae	*Helichrysum dregeanum*	Sond. & Harv.			LC	Indigenous
Asteraceae	*Pegolettia retrofracta*	(Thunb.) Kies			LC	Indigenous
Bignoniaceae	*Tecoma stans*	(L.) Juss. ex Kunth	var.	stans	NE	Not indigenous; Cultivated; Naturalised; Invasive
Boraginaceae	*Heliotropium lineare*	(A.DC.) Gurke			LC	Indigenous
Boraginaceae	*Ehretia alba*	Retief & A.E.van Wyk			LC	Indigenous
Boraginaceae	*Buglossoides arvensis*	(L.) I.M.Johnst.				Not indigenous; Naturalised
Boraginaceae	*Heliotropium ciliatum*	Kaplan			LC	Indigenous
Brassicaceae	*Brassica elongata*	Ehrh.	sub sp.	elongata		Not indigenous; Naturalised
Brassicaceae	*Erucastrum strigosum*	(Thunb.) O.E.Schulz			LC	Indigenous
Brassicaceae	*Heliophila suavissima*	Burch. ex DC.			LC	Indigenous

Brassicaceae	*Erucastrum austroafricanum*	Al-Shehbaz & Warwick			LC	Indigenous
Bryaceae	*Bryum argenteum*	Hedw.				Indigenous
Campanulaceae	*Wahlenbergia denticulata*	(Burch.) A.DC.	var.	denticulata	LC	Indigenous
Campanulaceae	*Wahlenbergia undulata*	(L.f.) A.DC.			LC	Indigenous
Campanulaceae	*Wahlenbergia sp.*					
Campanulaceae	*Wahlenbergia nodosa*	(H.Buek) Lammers			LC	Indigenous; Endemic
Campanulaceae	*Wahlenbergia androsacea*	A.DC.			LC	Indigenous
Capparaceae	*Boscia albitrunca*	(Burch.) Gilg & Gilg-Ben.			LC	Indigenous
Caryophyllaceae	*Pollichia campestris*	Aiton			LC	Indigenous
Caryophyllaceae	*Spergularia media*	(L.) C.Presl				Not indigenous; Naturalised
Celastraceae	*Gymnosporia buxifolia*	(L.) Szyszyl.			LC	Indigenous
Celastraceae	*Gymnosporia sp.*					
Celastraceae	*Maytenus undata*	(Thunb.) Blakelock			LC	Indigenous
Cleomaceae	*Cleome rubella*	Burch.			LC	Indigenous
Cleomaceae	*Cleome sp.*					
Cleomaceae	*Cleome angustifolia*	Forssk.	subsp.	diandra	LC	Indigenous
Colchicaceae	*Ornithoglossum dinteri*	K.Krause			LC	Indigenous
Colchicaceae	*Ornithoglossum vulgare*	B.Nord.			LC	Indigenous
Colchicaceae	*Colchicum melanthioides*	(Willd.) J.C.Manning & Vinn.	subsp.	melanthioides	LC	Indigenous
Commelinaceae	*Commelina africana*	L.	var.	krebsiana	LC	Indigenous
Commelinaceae	*Commelina livingstonii*	C.B.Clarke			LC	Indigenous
Convolvulaceae	*Convolvulus ocellatus*	Hook.				Indigenous
Convolvulaceae	*Convolvulus ocellatus*	Hook.	var.	ocellatus	LC	Indigenous
Convolvulaceae	*Evolvulus alsinoides*	(L.) L.			LC	Indigenous
Convolvulaceae	*Convolvulus boedeckerianus*	Peter			LC	Indigenous; Endemic
Convolvulaceae	*Ipomoea oenotheroides*	(L.f.) Raf. ex Hallier f.			LC	Indigenous
Cucurbitaceae	*Cucumis heptadactylus*	Naudin			LC	Indigenous; Endemic
Cucurbitaceae	*Coccinia sessilifolia*	(Sond.) Cogn.			LC	Indigenous
Cucurbitaceae	*Cucumis myriocarpus*	Naudin	subsp.	leptodermis	LC	Indigenous
Cucurbitaceae	*Cucumis myriocarpus*	Naudin	subsp.	myriocarpus	LC	Indigenous
Cucurbitaceae	*Kedrostis foetidissima*	(Jacq.) Cogn.			LC	Indigenous
Cyperaceae	*Kyllinga alba*	Nees			LC	Indigenous
Cyperaceae	*Cyperus difformis*	L.			LC	Indigenous
Cyperaceae	*Carex burchelliana*	Boeckeler			LC	Indigenous; Endemic
Cyperaceae	*Schoenoplectus pulchellus*	(Kunth) J.Raynal			LC	Indigenous

Cyperaceae	*Kyllinga pulchella*	Kunth			LC	Indigenous
Cyperaceae	*Cyperus marginatus*	Thunb.			LC	Indigenous
Cyperaceae	*Schoenoplectus tabernaemontani*	(C.C.Gmel.) Palla				Not indigenous; Naturalised
Cyperaceae	*Pycreus betschuanus*	(Boeckeler) C.B.Clarke			LC	Indigenous
Cyperaceae	*Cyperus margaritaceus*	Vahl	var.	margaritaceus	LC	Indigenous
Cyperaceae	*Fuirena pubescens*	(Poir.) Kunth	var.	pubescens	LC	Indigenous
Cyperaceae	*Afroscirpoides dioeca*	(Kunth) Garcia-Madr.				Indigenous
Cyperaceae	*Cyperus rupestris*	Kunth	var.	rupestris	LC	Indigenous
Cyperaceae	*Scirpoides burkei*	(C.B.Clarke) Goetgh., Muasya & D.A.Simpson			LC	Indigenous
Cyperaceae	*Cyperus laevigatus*	L.			LC	Indigenous
Cyperaceae	*Bulbostylis burchellii*	(Ficalho & Hiern) C.B.Clarke			LC	Indigenous
Dipsacaceae	*Scabiosa columbaria*	L.			LC	Indigenous
Ebenaceae	*Euclea crispa*	(Thunb.) Gurke	subsp.	ovata	LC	Indigenous
Ebenaceae	*Diospyros austroafricana*	De Winter	var.	microphylla	LC	Indigenous
Ebenaceae	*Diospyros lycioides*	Desf.	subsp.	guerkei	LC	Indigenous
Euphorbiaceae	*Seidelia triandra*	(E.Mey.) Pax			LC	Indigenous
Euphorbiaceae	*Euphorbia duseimata*	R.A.Dyer			LC	Indigenous
Euphorbiaceae	*Euphorbia mauritanica*	L.			LC	Indigenous
Euphorbiaceae	*Euphorbia inaequilatera*	Sond.			LC	Indigenous
Euphorbiaceae	*Euphorbia rhombifolia*	Boiss.			LC	Indigenous
Euphorbiaceae	*Euphorbia serpens*	Kunth			NE	Not indigenous; Naturalised
Fabaceae	*Indigofera cryptantha*	Benth. ex Harv.	var.	cryptantha	LC	Indigenous
Fabaceae	*Prosopis velutina*	Wooton			NE	Not indigenous; Naturalised; Invasive
Fabaceae	*Indigofera sp.*					
Fabaceae	*Indigofera sessilifolia*	DC.			LC	Indigenous
Fabaceae	*Indigofera daleoides*	Benth. ex Harv.			LC	Indigenous
Fabaceae	*Indigofera alternans*	DC.				Indigenous
Fabaceae	*Indigofera daleoides*	Benth. ex Harv.	var.	daleoides	NE	Indigenous
Fabaceae	*Melolobium candicans*	(E.Mey.) Eckl. & Zeyh.			LC	Indigenous
Fabaceae	*Melolobium canescens*	Benth.			LC	Indigenous
Fabaceae	*Calobota cuspidosa*	(Burch.) Boatwr. & B.-E.van Wyk			LC	Indigenous
Fabaceae	*Rhynchosia totta*	(Thunb.) DC.	var.	totta	LC	Indigenous
Fabaceae	*Melolobium microphyllum*	(L.f.) Eckl. & Zeyh.			LC	Indigenous
Fabaceae	*Styphnolobium japonicum*	(L.) Schott				Not indigenous; Cultivated; Naturalised; Invasive
Fabaceae	*Vachellia hebeclada*	(DC.) Kyal. & Boatwr.	subsp.	hebeclada	LC	Indigenous
Fabaceae	*Vachellia erioloba*	(E.Mey.) P.J.H.Hurter			LC	Indigenous
Fabaceae	*Tephrosia burchellii*	Burtt Davy			LC	Indigenous

Fabaceae	*Caesalpinia pulcherrima*	(L.) Sw.			NE	Not indigenous; Naturalised
Fabaceae	*Elephantorrhiza elephantina*	(Burch.) Skeels			LC	Indigenous
Fabaceae	*Vachellia karroo*	(Hayne) Banfi & Galasso			LC	Indigenous
Fabaceae	*Senna italica*	Mill.	sub sp.	arachoides	LC	Indigenous
Fabaceae	*Vachellia tortilis*	(Forssk.) Galasso & Banfi	sub sp.	heteracantha	LC	Indigenous
Fabaceae	*Lessertia depressa*	Harv.			LC	Indigenous
Fabaceae	*Argyrolobium pauciflorum*	Eckl. & Zeyh.			LC	Indigenous
Fabaceae	*Lotononis laxa*	Eckl. & Zeyh.			LC	Indigenous
Fabaceae	*Lessertia pauciflora*	Harv.	var.	pauciflora	LC	Indigenous
Fabaceae	*Prosopis glandulosa*	Torr.	var.	glandulosa	NE	Not indigenous; Naturalised
Fabaceae	*Lessertia affinis*	Burtt Davy			LC	Indigenous; Endemic
Fabaceae	*Parkinsonia aculeata*	L.			NE	Not indigenous; Naturalised; Invasive
Fabaceae	*Chamaecrista biensis*	(Steyaert) Lock			LC	Indigenous
Fabaceae	*Indigofera alternans*	DC.	var.	alternans	LC	Indigenous
Fabaceae	*Medicago sativa*	L.			NE	Not indigenous; Cultivated; Naturalised; Invasive
Fabaceae	*Indigofera filipes*	Benth. ex Harv.			LC	Indigenous
Fabaceae	*Rhynchosia confusa*	Burtt Davy			NE	Indigenous
Fabaceae	*Erythrostemon gilliesii*	(Hook.) Klotzsch				Not indigenous; Naturalised; Invasive
Fabaceae	*Melolobium macrocalyx*	Dummer	var.	macrocalyx	LC	Indigenous
Fabaceae	*Acacia sp.*					
Fabaceae	*Crotalaria griquensis*	L.Bolus			LC	Indigenous
Fabaceae	*Vachellia haematoxylon*	(Willd.) Seigler & Ebinger			LC	Indigenous
Gentianaceae	*Sebaea compacta*	A.W.Hill			LC	Indigenous; Endemic
Geraniaceae	*Pelargonium dolomiticum*	R.Knuth			LC	Indigenous
Geraniaceae	*Pelargonium multicaule*	Jacq.	sub sp.	multicaule	LC	Indigenous
Geraniaceae	*Monsonia angustifolia*	E.Mey. ex A.Rich.			LC	Indigenous
Gigaspermaceae	*Chamaebryum pottioides*	Ther. & Dixon				Indigenous
Hyacinthaceae	*Ledebouria glauca*	S.Venter			LC	Indigenous
Hyacinthaceae	*Albuca namaquensis*	Baker			LC	Indigenous
Hyacinthaceae	*Ledebouria undulata*	(Jacq.) Jessop ex Willd.			LC	Indigenous
Hyacinthaceae	*Massonia jasminiflora*	Burch. ex Baker			LC	Indigenous
Hyacinthaceae	*Albuca seineri*	(Engl. & K.Krause) J.C.Manning & Goldblatt			LC	Indigenous
Hyacinthaceae	*Ledebouria ensifolia*	(Eckl.) S.Venter & T.J.Edwards			LC	Indigenous
Hyacinthaceae	*Ledebouria minima*	(Baker) S.Venter			LC	Indigenous
Iridaceae	*Babiana hypogaea*	Burch.			LC	Indigenous
Iridaceae	*Moraea falcifolia*	Klatt			LC	Indigenous

Iridaceae	*Lapeirousia kalahariensis*	Goldblatt & J.C.Manning				Indigenous
Iridaceae	*Babiana bainesii*	Baker			LC	Indigenous
Iridaceae	*Freesia andersoniae*	L.Bolus			LC	Indigenous; Endemic
Iridaceae	*Lapeirousia plicata*	(Jacq.) Diels	sub sp.	foliosa		Indigenous
Iridaceae	*Gladiolus permeabilis*	D.Delaroche	sub sp.	edulis	LC	Indigenous
Juncaceae	*Juncus rigidus*	Desf.			LC	Indigenous
Juncaceae	*Juncus bufonius*	L.				Cryptogenic
Lamiaceae	*Salvia disermas*	L.			LC	Indigenous
Lamiaceae	*Leonotis pentadentata*	J.C.Manning & Goldblatt			LC	Indigenous
Lamiaceae	*Salvia stenophylla*	Burch. ex Benth.				Indigenous
Lamiaceae	*Stachys spathulata*	Burch. ex Benth.			LC	Indigenous
Lamiaceae	*Stachys burchelliana*	Launert			LC	Indigenous
Lamiaceae	*Salvia verbenaca*	L.			LC	Not indigenous; Naturalised; Invasive
Limeaceae	*Limeum argute-carinatum*	Wawra ex Wawra & Peyr.	var.	argute-carinatum	LC	Indigenous
Limeaceae	*Limeum fenestratum*	(Fenzl) Heimerl	var.	fenestratum	LC	Indigenous
Limeaceae	*Limeum aethiopicum*	Burm.f.	var.	intermedium	NE	Indigenous; Endemic
Lobeliaceae	*Lobelia thermalis*	Thunb.			LC	Indigenous
Malpighiaceae	*Triaspis sp.*					
Malvaceae	*Hermannia linearifolia*	Harv.			LC	Indigenous; Endemic
Malvaceae	*Hermannia sp.*					
Malvaceae	*Hermannia quartiniana*	A.Rich.			LC	Indigenous
Malvaceae	*Hermannia marginata*	(Turcz.) Pillans			LC	Indigenous; Endemic
Malvaceae	*Hermannia stellulata*	(Harv.) K.Schum.			LC	Indigenous
Malvaceae	*Sida chrysantha*	Ulbr.			LC	Indigenous
Malvaceae	*Hermannia jacobeifolia*	(Turcz.) R.A.Dyer			LC	Indigenous
Malvaceae	*Pavonia burchellii*	(DC.) R.A.Dyer			LC	Indigenous
Malvaceae	*Hibiscus marlothianus*	K.Schum.			LC	Indigenous; Endemic
Malvaceae	*Grewia flava*	DC.			LC	Indigenous
Malvaceae	*Hermannia tomentosa*	(Turcz.) Schinz ex Engl.			LC	Indigenous
Malvaceae	*Corchorus aspleniifolius*	Burch.			LC	Indigenous
Malvaceae	*Hermannia comosa*	Burch. ex DC.			LC	Indigenous
Malvaceae	*Hermannia erodioides*	(Burch. ex DC.) Kuntze			LC	Indigenous
Malvaceae	*Hermannia eenii*	Baker f.			LC	Indigenous
Marsileaceae	*Marsilea burchellii*	(Kunze) A.Braun			LC	Indigenous
Menispermaceae	*Antizoma angustifolia*	(Burch.) Miers ex Harv.			LC	Indigenous
Myrtaceae	*Eucalyptus camaldulensis*	Dehnh.				Not indigenous; Cultivated; Naturalised; Invasive
Myrtaceae	*Eucalyptus sp.*					

Nyctaginaceae	*Commicarpus pentandrus*	(Burch.) Heimerl			LC	Indigenous
Nyctaginaceae	*Mirabilis jalapa*	L.				Not indigenous; Naturalised; Invasive
Oleaceae	*Olea europaea*	L.	sub sp.	cuspidata		Indigenous
Oleaceae	*Menodora africana*	Hook.			LC	Indigenous
Oliniaceae	*Olinia emarginata*	Burtt Davy			LC	Indigenous
Onagraceae	*Oenothera indecora*	Cambess.				Not indigenous; Naturalised
Orobanchaceae	*Harveya huttonii*	Hiern			LC	Indigenous; Endemic
Oxalidaceae	*Oxalis depressa*	Eckl. & Zeyh.			LC	Indigenous
Oxalidaceae	*Oxalis lawsonii*	F.Bolus			LC	Indigenous
Passifloraceae	*Adenia repanda*	(Burch.) Engl.			LC	Indigenous
Pedaliaceae	*Sesamum triphyllum*	Welw. ex Asch.	var.	triphyllum	LC	Indigenous
Phyllanthaceae	*Phyllanthus parvulus*	Sond.	var.	parvulus	LC	Indigenous
Phyllanthaceae	*Phyllanthus parvulus*	Sond.	var.	garipensis	LC	Indigenous
Plantaginaceae	*Veronica anagallis-aquatica*	L.			LC	Indigenous
Plantaginaceae	*Plantago lanceolata*	L.			LC	Indigenous
Poaceae	*Sporobolus fimbriatus*	(Trin.) Nees			LC	Indigenous
Poaceae	*Schmidtia kalahariensis*	Stent			LC	Indigenous
Poaceae	*Aristida adscensionis*	L.			LC	Indigenous
Poaceae	*Aristida stipitata*	Hack.	sub sp.	graciliflora	LC	Indigenous
Poaceae	*Panicum schinzii*	Hack.			LC	Indigenous
Poaceae	*Eragrostis obtusa*	Munro ex Ficalho & Hiern			LC	Indigenous
Poaceae	*Cymbopogon caesius*	(Hook. & Arn.) Stapf			LC	Indigenous
Poaceae	*Digitaria polyphylla*	Henrard			LC	Indigenous
Poaceae	*Eragrostis cilianensis*	(All.) Vignolo ex Janch.			LC	Indigenous
Poaceae	*Tragus racemosus*	(L.) All.			LC	Indigenous
Poaceae	*Setaria sphacelata*	(Schumach.) Stapf & C.E.Hubb. ex M.B.Moss	var.	torta	LC	Indigenous
Poaceae	*Eragrostis nindensis*	Ficalho & Hiern			LC	Indigenous
Poaceae	*Chloris virgata*	Sw.			LC	Indigenous
Poaceae	*Eragrostis pallens*	Hack.			LC	Indigenous
Poaceae	*Brachiaria serrata*	(Thunb.) Stapf			LC	Indigenous
Poaceae	*Eragrostis mexicana*	(Hornem.) Link	sub sp.	virescens	NE	Not indigenous; Naturalised
Poaceae	*Stipagrostis sp.*					
Poaceae	*Stipagrostis hirtigluma*	(Steud.) De Winter	sub sp.	patula	LC	Indigenous
Poaceae	*Themeda triandra*	Forssk.			LC	Indigenous
Poaceae	*Brachiaria marlothii*	(Hack.) Stent			LC	Indigenous
Poaceae	*Eragrostis lehmanniana*	Nees	var.	lehmanniana	LC	Indigenous
Poaceae	*Aristida stipitata*	Hack.	sub sp.	spicata	LC	Indigenous
Poaceae	*Digitaria eriantha*	Steud.			LC	Indigenous

Poaceae	*Enneapogon cenchroides*	(Licht. ex Roem. & Schult.) C.E.Hubb.			LC	Indigenous
Poaceae	*Stipagrostis uniplumis*	(Licht.) De Winter	var.	uniplumis	LC	Indigenous
Poaceae	*Triraphis purpurea*	Hack.			LC	Indigenous
Poaceae	*Panicum coloratum*	L.			LC	Indigenous
Poaceae	*Enneapogon desvauxii*	P.Beauv.			LC	Indigenous
Poaceae	*Digitaria ternata*	(A.Rich.) Stapf			LC	Indigenous
Poaceae	*Eragrostis remotiflora*	De Winter			LC	Indigenous; Endemic
Poaceae	*Eragrostis micrantha*	Hack.			LC	Indigenous
Poaceae	*Eragrostis sp.*					
Poaceae	*Eragrostis bicolor*	Nees			LC	Indigenous
Poaceae	*Brachiaria nigropedata*	(Ficalho & Hiern) Stapf			LC	Indigenous
Poaceae	*Eragrostis homomalla*	Nees			LC	Indigenous
Poaceae	*Eragrostis pseudobtusa*	De Winter			NE	Indigenous; Endemic
Poaceae	*Anthephora pubescens*	Nees			LC	Indigenous
Poaceae	*Eragrostis chloromelas*	Steud.			LC	Indigenous
Poaceae	*Eragrostis procumbens*	Nees			LC	Indigenous
Poaceae	*Stipagrostis ciliata*	(Desf.) De Winter	var.	capensis	LC	Indigenous
Poaceae	*Panicum stapfianum*	Fourc.			LC	Indigenous
Poaceae	*Aristida congesta*	Roem. & Schult.	sub sp.	barbicollis	LC	Indigenous
Poaceae	*Melinis repens*	(Willd.) Zizka	sub sp.	repens	LC	Indigenous
Poaceae	*Cynodon transvaalensis*	Burtt Davy			LC	Indigenous
Poaceae	*Heteropogon contortus*	(L.) Roem. & Schult.			LC	Indigenous
Poaceae	*Eragrostis trichophora*	Coss. & Durieu			LC	Indigenous
Poaceae	*Aristida vestita*	Thunb.			LC	Indigenous
Poaceae	*Enneapogon scoparius*	Stapf			LC	Indigenous
Poaceae	*Triraphis andropogonoides*	(Steud.) E.Phillips			LC	Indigenous
Poaceae	*Cynodon incompletus*	Nees			LC	Indigenous; Endemic
Poaceae	*Oropetium capense*	Stapf			LC	Indigenous
Poaceae	*Aristida congesta*	Roem. & Schult.	sub sp.	congesta	LC	Indigenous
Poaceae	*Hyparrhenia hirta*	(L.) Stapf			LC	Indigenous
Poaceae	*Pogonarthria squarrosa*	(Roem. & Schult.) Pilg.			LC	Indigenous
Poaceae	*Setaria sphacelata*	(Schumach.) Stapf & C.E.Hubb. ex M.B.Moss	var.	sphacelata	LC	Indigenous
Poaceae	*Eragrostis stapfii*	De Winter			LC	Indigenous
Poaceae	*Eragrostis truncata*	Hack.			LC	Indigenous
Poaceae	*Stipagrostis obtusa*	(Delile) Nees			LC	Indigenous
Poaceae	*Tragus koelerioides*	Asch.			LC	Indigenous
Poaceae	*Eragrostis pilgeriana*	Dinter ex Pilg.			LC	Indigenous

Poaceae	*Eragrostis echinochloidea*	Stapf			LC	Indigenous
Poaceae	*Eragrostis curvula*	(Schrad.) Nees			LC	Indigenous
Poaceae	*Trichoneura grandiglumis*	(Nees) Ekman			LC	Indigenous
Poaceae	*Stipagrostis uniplumis*	(Licht.) De Winter	var.	neesii	LC	Indigenous
Poaceae	*Sporobolus acinifolius*	Stapf			LC	Indigenous
Poaceae	*Eragrostis porosa*	Nees			LC	Indigenous
Poaceae	*Cymbopogon pospischilii*	(K.Schum.) C.E.Hubb.			NE	Indigenous
Poaceae	*Eragrostis gummiflua*	Nees			LC	Indigenous
Poaceae	*Aristida stipitata*	Hack.	sub sp.	stipitata	LC	Indigenous
Poaceae	*Cynodon dactylon*	(L.) Pers.			LC	Indigenous
Poaceae	*Fingerhuthia africana*	Lehm.			LC	Indigenous
Poaceae	*Aristida meridionalis*	Henrard			LC	Indigenous
Polygalaceae	*Polygala leptophylla*	Burch.				Indigenous
Polygalaceae	*Polygala krumanina*	Burch. ex Ficalho & Hiern			LC	Indigenous; Endemic
Polygalaceae	*Polygala leptophylla*	Burch.	var.	leptophylla	LC	Indigenous
Polygalaceae	*Polygala hottentotta*	C.Presl			LC	Indigenous
Polygonaceae	*Oxygonum sp.*					
Polygonaceae	*Rumex lanceolatus*	Thunb.			LC	Indigenous
Polygonaceae	*Oxygonum dregeanum*	Meisn.	sub sp.	canescens	NE	Indigenous
Polygonaceae	*Persicaria hystricula*	(J.Schust.) Sojak			LC	Indigenous
Polygonaceae	*Polygonum bellardii*	All.				Not indigenous; Naturalised
Polygonaceae	*Rumex rhodesius*	Rech.f.			LC	Indigenous
Potamogetonaceae	*Potamogeton schweinfurthii*	A.Benn.			LC	Indigenous
Pottiaceae	*Aloina bifrons*	(De Not.) Delgad.				Indigenous
Pteridaceae	*Cheilanthes hirta*	Sw.	var.	hirta	LC	Indigenous
Pteridaceae	*Pellaea calomelanos*	(Sw.) Link				Indigenous
Pteridaceae	*Cheilanthes eckloniana*	(Kunze) Mett.			LC	Indigenous
Pteridaceae	*Cheilanthes hirta*	Sw.	var.	brevipilosa	LC	Indigenous
Pteridaceae	*Pellaea calomelanos*	(Sw.) Link	var.	calomelanos	LC	Indigenous
Ranunculaceae	*Ranunculus multifidus*	Forssk.			LC	Indigenous
Resedaceae	*Oligomeris dipetala*	(Aiton) Turcz.	var.	dipetala	LC	Indigenous
Rhamnaceae	*Ziziphus mucronata*	Willd.	sub sp.	mucronata	LC	Indigenous
Ricciaceae	*Riccia okahandjana*	S.W.Arnell				Indigenous
Ricciaceae	*Riccia albolimbata*	S.W.Arnell				Indigenous
Rosaceae	*Alchemilla elongata*	Eckl. & Zeyh.	var.	elongata	NE	Indigenous
Rubiaceae	*Nenax microphylla*	(Sond.) T.M.Salter			LC	Indigenous
Rubiaceae	*Kohautia cynanchica*	DC.			LC	Indigenous

Rubiaceae	*Anthospermum rigidum*	Eckl. & Zeyh.	sub sp.	rigidum	LC	Indigenous
Rubiaceae	*Anthospermum rigidum*	Eckl. & Zeyh.	sub sp.	pumilum	LC	Indigenous
Santalaceae	*Thesium hystrix*	A.W.Hill			LC	Indigenous
Santalaceae	*Viscum rotundifolium*	L.f.			LC	Indigenous
Santalaceae	*Thesium sp.*					
Santalaceae	*Thesium lacinulatum*	A.W.Hill			LC	Indigenous
Sapindaceae	*Acer negundo*	L.				Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Jamesbrittenia aurantiaca*	(Burch.) Hilliard			LC	Indigenous
Scrophulariaceae	*Selago albida*	Choisy			LC	Indigenous
Scrophulariaceae	*Nemesia lilacina*	N.E.Br.			LC	Indigenous
Scrophulariaceae	*Jamesbrittenia tysonii*	(Hiern) Hilliard			LC	Indigenous; Endemic
Scrophulariaceae	*Selago paniculata*	Thunb.			LC	Indigenous; Endemic
Scrophulariaceae	*Aptosimum albomarginatum*	Marloth & Engl.			LC	Indigenous
Scrophulariaceae	*Selago sp.*					
Scrophulariaceae	*Peliostomum leucorrhizum*	E.Mey. ex Benth.			LC	Indigenous
Scrophulariaceae	*Sutera sp.*					
Scrophulariaceae	*Diclis petiolaris*	Benth.			LC	Indigenous
Scrophulariaceae	*Zaluzianskya pachyrrhiza*	Hilliard & B.L.Burtt			LC	Indigenous; Endemic
Scrophulariaceae	*Selago saxatilis*	E.Mey.			LC	Indigenous
Scrophulariaceae	*Chaenostoma halimifolium*	Benth.			LC	Indigenous
Scrophulariaceae	*Aptosimum elongatum*	(Hiern) Engl.			LC	Indigenous
Scrophulariaceae	*Jamesbrittenia sp.*					
Scrophulariaceae	*Jamesbrittenia atropurpurea*	(Benth.) Hilliard	sub sp.	atropurpurea	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia integerrima*	(Benth.) Hilliard			LC	Indigenous
Scrophulariaceae	*Chaenostoma patrioticum*	(Hiern) Kornhall			LC	Indigenous
Scrophulariaceae	*Sutera griquensis*	Hiern			LC	Indigenous; Endemic
Scrophulariaceae	*Selago mixta*	Hilliard			LC	Indigenous; Endemic
Solanaceae	*Lycium horridum*	Thunb.			LC	Indigenous
Solanaceae	*Solanum capense*	L.			LC	Indigenous
Solanaceae	*Solanum lichtensteinii*	Willd.			LC	Indigenous
Solanaceae	*Lycium pumilum*	Dammer			LC	Indigenous
Solanaceae	*Datura innoxia*	Mill.				Not indigenous; Naturalised; Invasive
Solanaceae	*Withania somnifera*	(L.) Dunal			LC	Indigenous
Stilbaceae	*Nuxia gracilis*	Engl.			LC	Indigenous; Endemic
Theophrastaceae	*Samolus valerandi*	L.			LC	Indigenous

Thymelaeaceae	*Lasiosiphon polycephalus*	(E.Mey. ex Meisn.) H.Pearson			LC	Indigenous
Thymelaeaceae	*Lasiosiphon burchellii*	Meisn.			LC	Indigenous
Typhaceae	*Typha capensis*	(Rohrb.) N.E.Br.			LC	Indigenous
Vahliaceae	*Vahlia capensis*	(L.f.) Thunb.	sub sp.	vulgaris	NE	Indigenous
Verbenaceae	*Chascanum pinnatifidum*	(L.f.) E.Mey.	var.	pinnatifidum	LC	Indigenous
Verbenaceae	*Verbena bonariensis*	L.				Not indigenous; Naturalised; Invasive
Verbenaceae	*Lantana rugosa*	Thunb.			LC	Indigenous
Verbenaceae	*Verbena brasiliensis*	Vell.				Not indigenous; Naturalised; Invasive
Zygophyllaceae	*Roepera pubescens*	(Schinz) Beier & Thulin				Indigenous
Zygophyllaceae	*Tribulus zeyheri*	Sond.	sub sp.	zeyheri	LC	Indigenous

9.2 Appendix B – Amphibian species expected to occur in the PAOI

Family	Species	Conservation Status	
		Regional (SANBI)	IUCN
Brevicipitidae	*Breviceps adspersus*	LC	LC
Bufonidae	*Sclerophrys gutturalis*	LC	LC
Bufonidae	*Sclerophrys poweri*	LC	LC
Bufonidae	*Vandijkophrynus gariepensis*	LC	LC
Hyperoliidae	*Kassina senegalensis*	LC	LC
Pipidae	*Xenopus laevis*	LC	LC
Pyxicephalidae	*Amietia angolensis*	LC	LC
Pyxicephalidae	*Cacosternum boettgeri*	LC	LC
Pyxicephalidae	*Pyxicephalus adspersus*	NT	LC
Pyxicephalidae	*Tomopterna cryptotis*	LC	LC
Pyxicephalidae	*Tomopterna tandyi*	LC	LC

9.3 Appendix C – Reptile species expected to occur in the PAOI

Family	Species	Common Name	Conservation Status	
			Regional (SANBI)	IUCN
Agamidae	*Acanthocercus atricollis*	Southern Tree Agama	LC	LC
Agamidae	*Agama aculeata aculeata*	Common Ground Agama	LC	Unlisted
Amphisbaenidae	*Zygaspis quadrifrons*	Kalahari Dwarf Worm Lizard	LC	Unlisted
Chamaeleonidae	*Chamaeleo dilepis*	Common Flap-neck Chameleon	LC	LC
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	LC	LC
Colubridae	*Dispholidus typus viridis*	Northern Boomslang	LC	LC
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake	LC	Unlisted
Cordylidae	*Karusasaurus polyzonus*	Karoo Girdled Lizard	LC	LC
Elapidae	*Aspidelaps scutatus scutatus*	Speckled Shield Cobra	LC	Unlisted
Elapidae	*Naja nivea*	Cape Cobra	LC	Unlisted
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko	LC	Unlisted
Gekkonidae	*Lygodactylus bradfieldi*	Bradfield's Dwarf Gecko	LC	Unlisted
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	LC	Unlisted
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	LC	Unlisted
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	LC	Unlisted
Lacertidae	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	LC	Unlisted
Lamprophiidae	*Boaedon capensis*	Brown House Snake	LC	LC
Lamprophiidae	*Lycophidion capense capense*	Cape Wolf Snake	LC	Unlisted
Lamprophiidae	*Psammophis brevirostris*	Short-snouted Grass Snake	LC	Unlisted
Lamprophiidae	*Psammophis notostictus*	Karoo Sand Snake	LC	Unlisted
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	LC	Unlisted
Lamprophiidae	*Psammophylax tritaeniatus*	Striped Grass Snake	LC	LC
Lamprophiidae	*Pseudaspis cana*	Mole Snake	LC	Unlisted
Leptotyphlopidae	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	LC	Unlisted
Pelomedusidae	*Pelomedusa galeata*	South African Marsh Terrapin	LC	Unlisted
Scincidae	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	LC	Unlisted
Scincidae	*Trachylepis capensis*	Cape Skink	LC	Unlisted
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	LC	LC
Scincidae	*Trachylepis spilogaster*	Kalahari Tree Skink	LC	Unlisted
Scincidae	*Trachylepis variegata*	Variegated Skink	LC	LC
Testudinidae	*Psammobates oculifer*	Serrated Tent Tortoise	LC	Unlisted
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	LC	LC
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	LC	Unlisted
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	LC	LC
Viperidae	*Bitis arietans arietans*	Puff Adder	LC	Unlisted

9.4 Appendix D – Mammal species expected to occur within the PAOI

Family	Species	Conservation Status	
		Regional (SANBI)	IUCN
Bovidae	*Alcelaphus buselaphus*	LC	LC
Bovidae	*Antidorcas marsupialis*	LC	LC
Bovidae	*Connochaetes gnou*	LC	LC
Bovidae	*Connochaetes taurinus*	LC	LC
Bovidae	*Oryx gazella*	LC	LC
Bovidae	*Raphicerus campestris*	LC	LC
Bovidae	*Sylvicapra grimmia*	LC	LC
Bovidae	*Syncerus caffer*	LC	LC
Bovidae	*Tragelaphus oryx*	LC	LC
Canidae	*Lupulella mesomelas*	LC	LC
Canidae	*Otocyon megalotis*	LC	LC
Canidae	*Vulpes chama*	LC	LC
Cercopithecidae	*Chlorocebus pygerythrus*	LC	LC
Cercopithecidae	*Papio ursinus*	LC	LC
Erinaceidae	*Atelerix frontalis*	NT	LC
Felidae	*Caracal caracal*	LC	LC
Felidae	*Felis nigripes*	VU	VU
Felidae	*Felis silvestris*	LC	LC
Felidae	*Panthera pardus*	VU	VU
Giraffidae	*Giraffa camelopardalis*	LC	VU
Herpestidae	*Cynictis penicillata*	LC	LC
Herpestidae	*Herpestes pulverulentus*	LC	LC
Herpestidae	*Herpestes sanguineus*	LC	LC
Herpestidae	*Suricata suricatta*	LC	LC
Hyaenidae	*Parahyaena brunnea*	NT	NT
Hyaenidae	*Proteles cristata*	LC	LC
Hystricidae	*Hystrix africaeaustralis*	LC	LC
Leporidae	*Lepus capensis*	LC	LC
Leporidae	*Lepus saxatilis*	LC	LC
Leporidae	*Pronolagus rupestris*	LC	LC
Manidae	*Smutsia temminckii*	VU	VU
Molossidae	*Tadarida aegyptiaca*	LC	LC
Muridae	*Aethomys ineptus*	LC	LC
Muridae	*Aethomys namaquensis*	LC	LC
Muridae	*Desmodillus auricularis*	LC	LC
Muridae	*Gerbilliscus brantsii*	LC	LC
Muridae	*Gerbilliscus leucogaster*	LC	LC
Muridae	*Gerbillurus paeba*	LC	LC
Muridae	*Mastomys coucha*	LC	LC
Muridae	*Mus musculus*	Unlisted	LC
Muridae	*Parotomys brantsii*	LC	LC
Muridae	*Parotomys littledalei*	NT	LC
Muridae	*Rattus rattus*	Exotic (Not listed)	LC
Muridae	*Rhabdomys pumilio*	LC	LC

Mustelidae	*Aonyx capensis*	NT	NT
Mustelidae	*Ictonyx striatus*	LC	LC
Mustelidae	*Mellivora capensis*	LC	LC
Mustelidae	*Poecilogale albinucha*	NT	LC
Nesomyidae	*Malacothrix typica*	LC	LC
Nesomyidae	*Saccostomus campestris*	LC	LC
Nesomyidae	*Steatomys krebsii*	LC	LC
Orycteropodidae	*Orycteropus afer*	LC	LC
Pedetidae	*Pedetes capensis*	LC	LC
Procaviidae	*Procavia capensis*	LC	LC
Pteropodidae	*Eidolon helvum*	LC	NT
Rhinolophidae	*Rhinolophus clivosus*	LC	LC
Rhinolophidae	*Rhinolophus darlingi*	LC	LC
Rhinolophidae	*Rhinolophus denti*	NT	LC
Sciuridae	*Xerus inauris*	LC	LC
Soricidae	*Suncus varilla*	LC	LC
Suidae	*Phacochoerus africanus*	LC	LC
Vespertilionidae	*Eptesicus hottentotus*	LC	LC
Vespertilionidae	*Neoromicia capensis*	LC	LC
Viverridae	*Genetta genetta*	LC	LC

9.5 Appendix E – Declaration

DECLARATION

I, Andrew Husted, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Andrew Husted

Ecologist

The Biodiversity Company

April 2023

DECLARATION

I, Martinus Erasmus, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Martinus Erasmus

Ecologist

The Biodiversity Company

April 2023