APPENDIX E

SPECIALIST REPORTS

APPENDIX E1: Wetland Delineation and Risk Assessment

Wetland Delineation and Risk Assessment for the proposed Altina Solar PV Development

Vierfontein, Free State Province

October 2022

Client

NEMAI CONSULTING

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Report Name	**Wetland Delineation and Risk Assessment for the Proposed Altiuna Solar PV, Vierfontein, Free State**
Reference	Wetlands Altina Solar PV
Submitted to	NEMAI CONSULTING
Report Writer	Tyron Clark (Meraki Consulting) Msc Zoology (cum-laude), Wetland Delineation and Management Accreditation (University of the Free State) (Pr. Sci. Nat. 121338)
Report contributer for updated (October 2022) layout, Review	Andrew Husted (Pr. Sci. Nat. 400213/11)
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 Ecological Assessment Regulations, 2014 (amended 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.

View over northern wetlands

Table of Contents

Tables

Figures

Declaration

I, Tyron Clark 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.

Tyron Clark

Pr. Sci. Nat. 121338

July 2022

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

Pr. Sci. Nat. 400213/11

October 2022

1 Introduction

This report represents the wetland baseline and impact (risk) assessment for the proposed establishment of Altina solar photovoltaic (PV) development. The presence of wetlands within the development area (hereafter reffered to as the project area) triggers the need for this wetland delineation and risk assesmment. The project area is situated 7 km south of Orkney near Vierfontein in the Free State Province. Access is from the R76. Two site visits were conducted on 22 March and 25 April. These consitute late summer and early autumn surveys respectively.

The proposed solar panels will be bifacial and thus the complete clearing of vegetation beneath the PV panels is required. Two infrastructure alternatives have been proposed namely Alternative 1 which represents the original layout (Figure 1-2) and Alternative 2 which represents the preferred layout that takes into account potential sensitivities.

This assessment was conducted in accordance with the 2014 EIA Regulations (No. R. 982-985, Department of Environmental Affairs, 4 December 2014) emanating from Chapter 5 of the National Environmental Management Act (Act No. 107 of 1998). The findings and information herein is in terms of Appendix 6 of the 2014 NEMA EIA Regulations (amended in 2017). Further to this a risk assessment was conducted in line with Section 21 (c) and (i) of the National Water Act, 1998 (NWA) (Act No 36 of 1998).

Although no protocols are specifically stated for wetlands, this study has also taken cognisance of the requirements for aquatic studies in the recently published Government Notice 320 in terms of NEMA dated 20 March 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”.

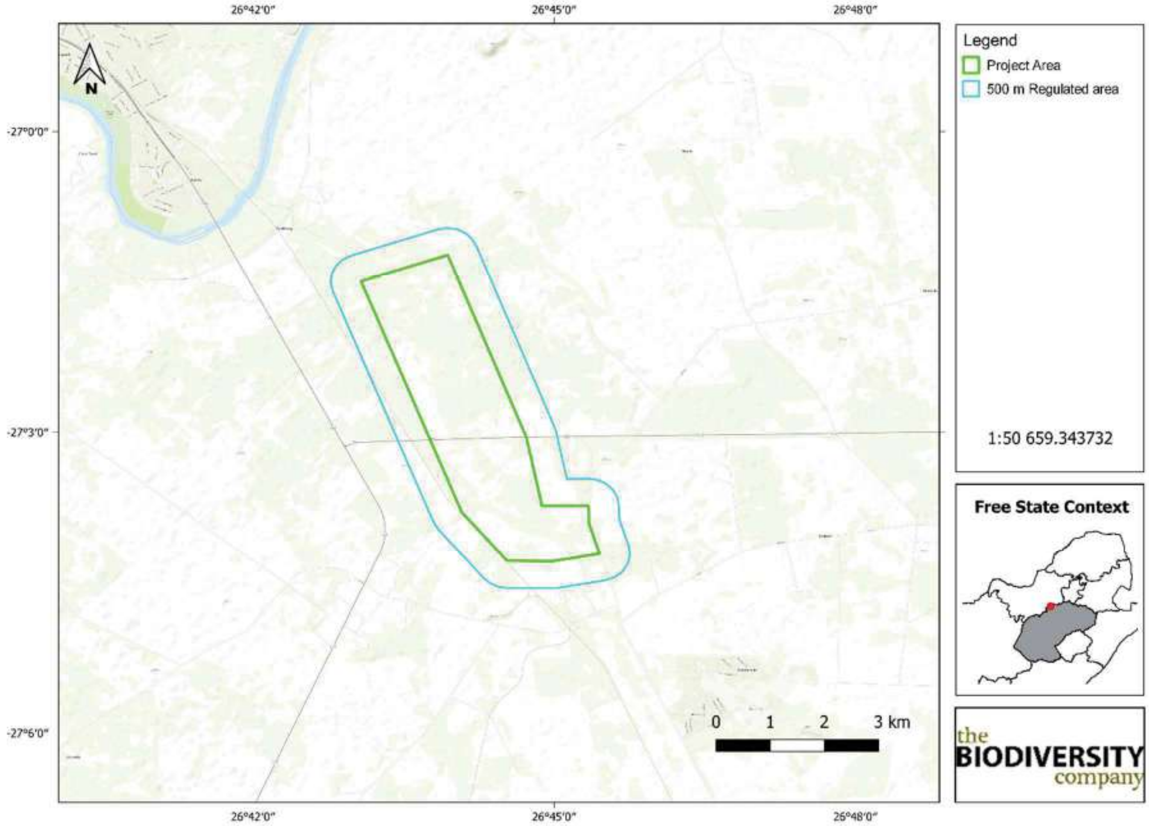

Figure 1-1 Project location

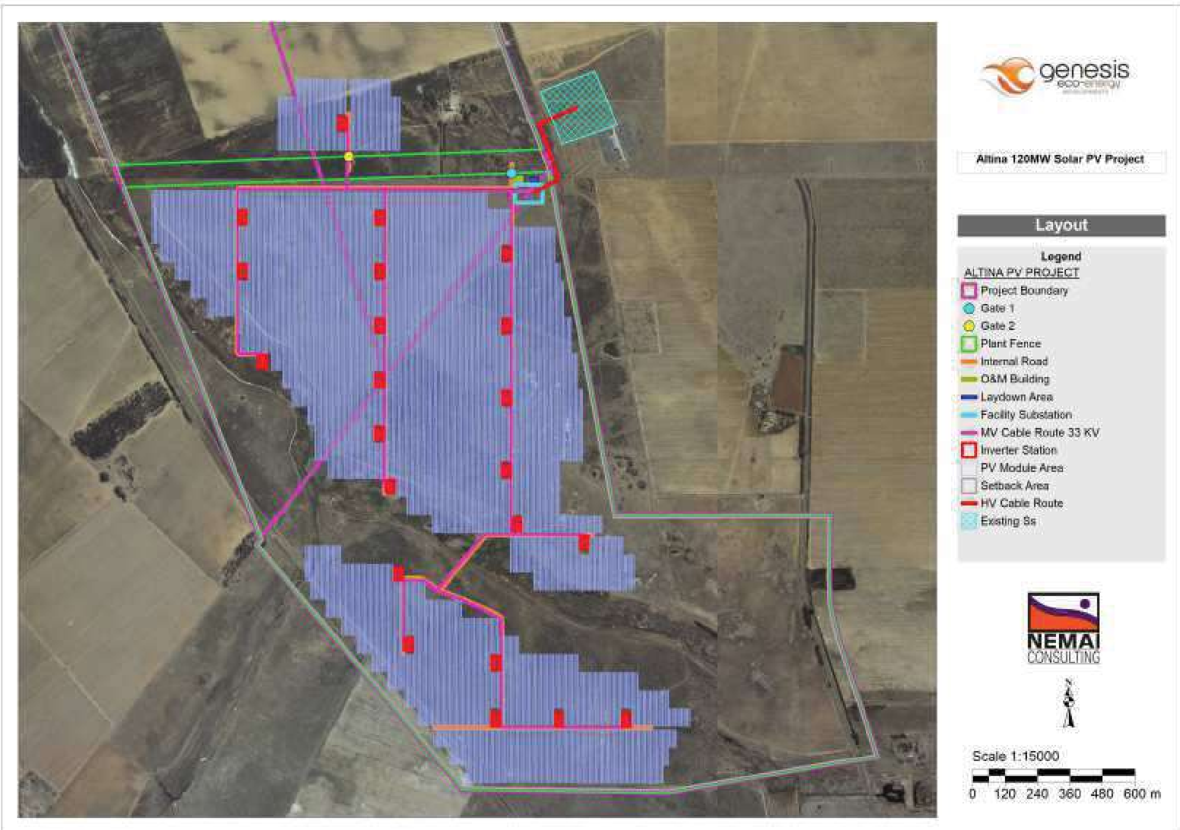

Figure 1-2 Infrastructure Alternative 1

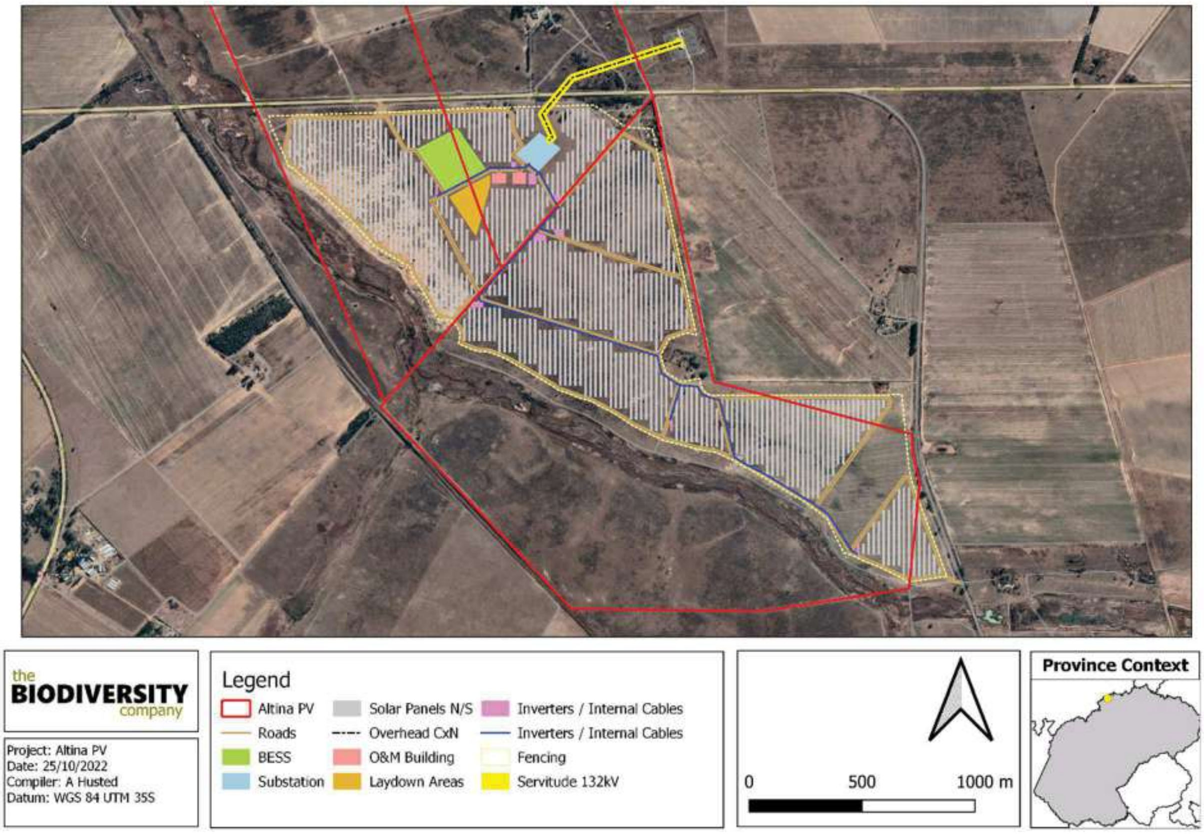

Figure 1-3 Infrastructure Alternative 2 (preferred)

1.1 Terms of Reference

The aim of the study was to provide a wetland and risk assessment for the establishment of the proposed Altina Solar PV facility. This was achieved through the following:

- The identification, deliniation and classiication of wetlands within the project area;
- Assessemnt of the Present Ecological State (PES) of the identified wetlands;
- Assessemnt of the Wetland Ecosystem Services provided by the identified wetlands;
- Assessemnt of the Ecological Importance and Sensitivity of the identified wetlands
- A risk assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

2 Key Legislative Requirements

2.1 National Water Act (NWA, 1998)

The Department of Human Settlements Water and Sanitation (DWS) 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 National Water Act (Act No. 36 of 1998 – 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;
- The prevention of the degradation of the water resource; and
- The 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 Section 21 (c) and (i).

2.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (Act No. 107 of 1998 – NEMA) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation application process needs to be followed. This could follow either the Basic Assessment (BA) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

New regulations were gazetted (43110) on the 20 March 2020 which have replaced the requirements of Appendix 6 of the Environmental Impact Assessment Regulations. 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 Environmental Authorisation (EA).

3 Receiving Environment

3.1 Quaternary Catchments and Water Management Areas

The project area is situated in the Middle Vaal Water Management area and more specifically the Quaternary Catchment C24B. Within this Quaternary Catchment the Vierfonteinspruits has been assigned a desktop ecological importance and sensitivity of Moderate and a present ecological state of Largely Modified (DWS, 2014). The main impacts listed for this system centre on rural effluent, mining pollution, industries, towns, effluent, agriculture, abstraction for irrigation, eutrophic, removal of riparian vegetation (DWS, 2014).

3.2 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 (NEM:BA) biodiversity goals (Nel *et al.,* 2011).

Figure 5-2 shows the location of the project area in relation to wetland FEPAs. Based on this information, the project area does not overlap with any class 1 FEPA Rivers or wetlands (Figure 3-1).

3.3 National Wetland Map 5

The National Wetland Map 5 spatial data was published in October 2019 (Deventer et al. 2019) in collaboration with SANBI with the specific aim of spatially representing the location, type and extent of wetlands in South Africa. The data represents a synthesis of a wide number of official watercourse data including rivers, inland wetlands and estuaries. This database recognises the presence of the Vierfontein Floodplain (Figure 3-2).

3.4 Free State Biodiversity Conservation Plan

The Free State Conservation Plan classified areas within the province on the basis of its contribution to reach the conservation targets within the province. These areas are classified as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) to ensure sustainability in the long term. The CBAs are classified as either ‘Irreplaceable’ (must be conserved), or ‘Important’.

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met.

According to this spatial dataset, large portions of the wetlands identified in the project area are zoned predominantly as a CBA1 (Figure 3-3).

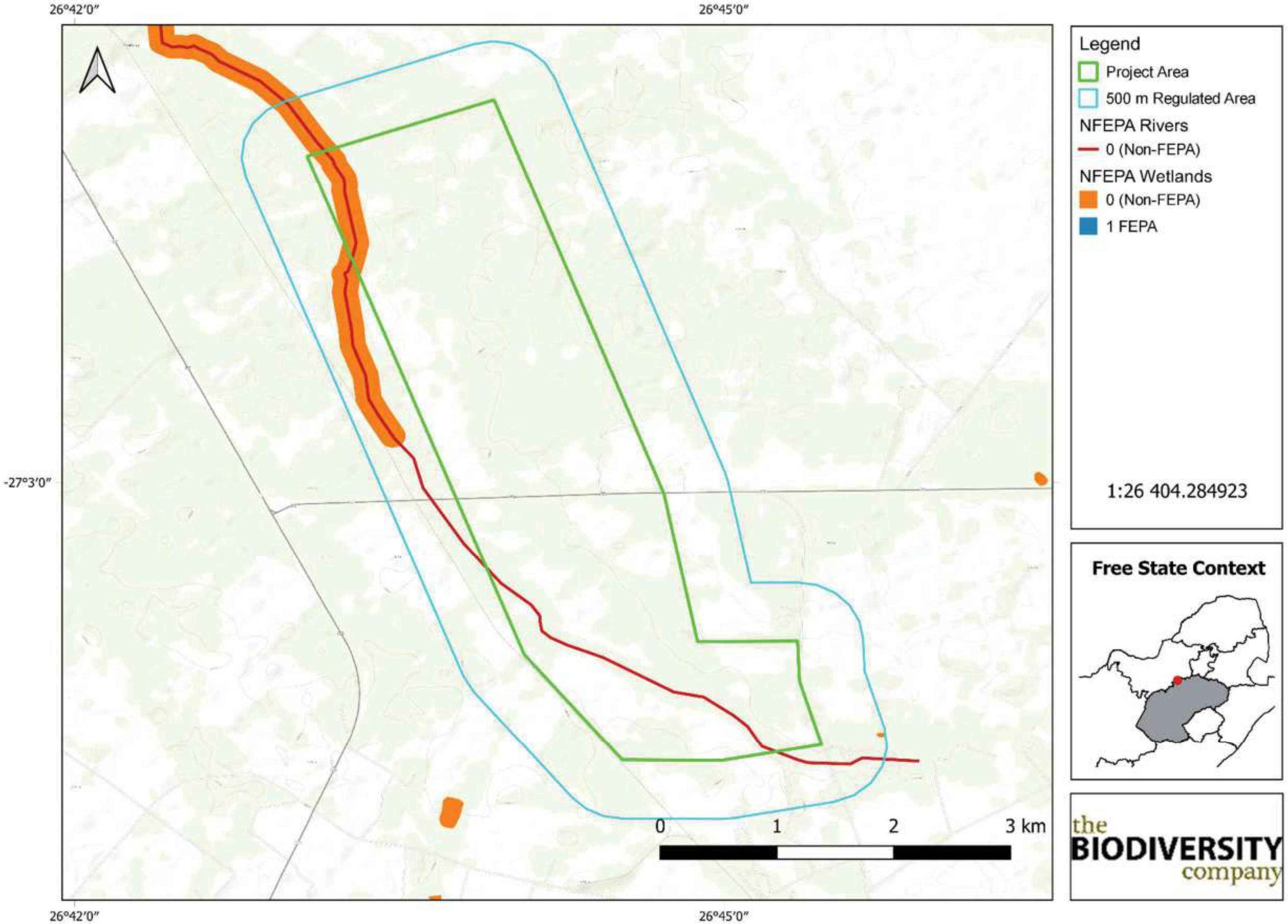

Figure 3-1 *NFEPA Rivers and Wetlands (no NFEPA listed Rivers occur within the 500m regulated area)*

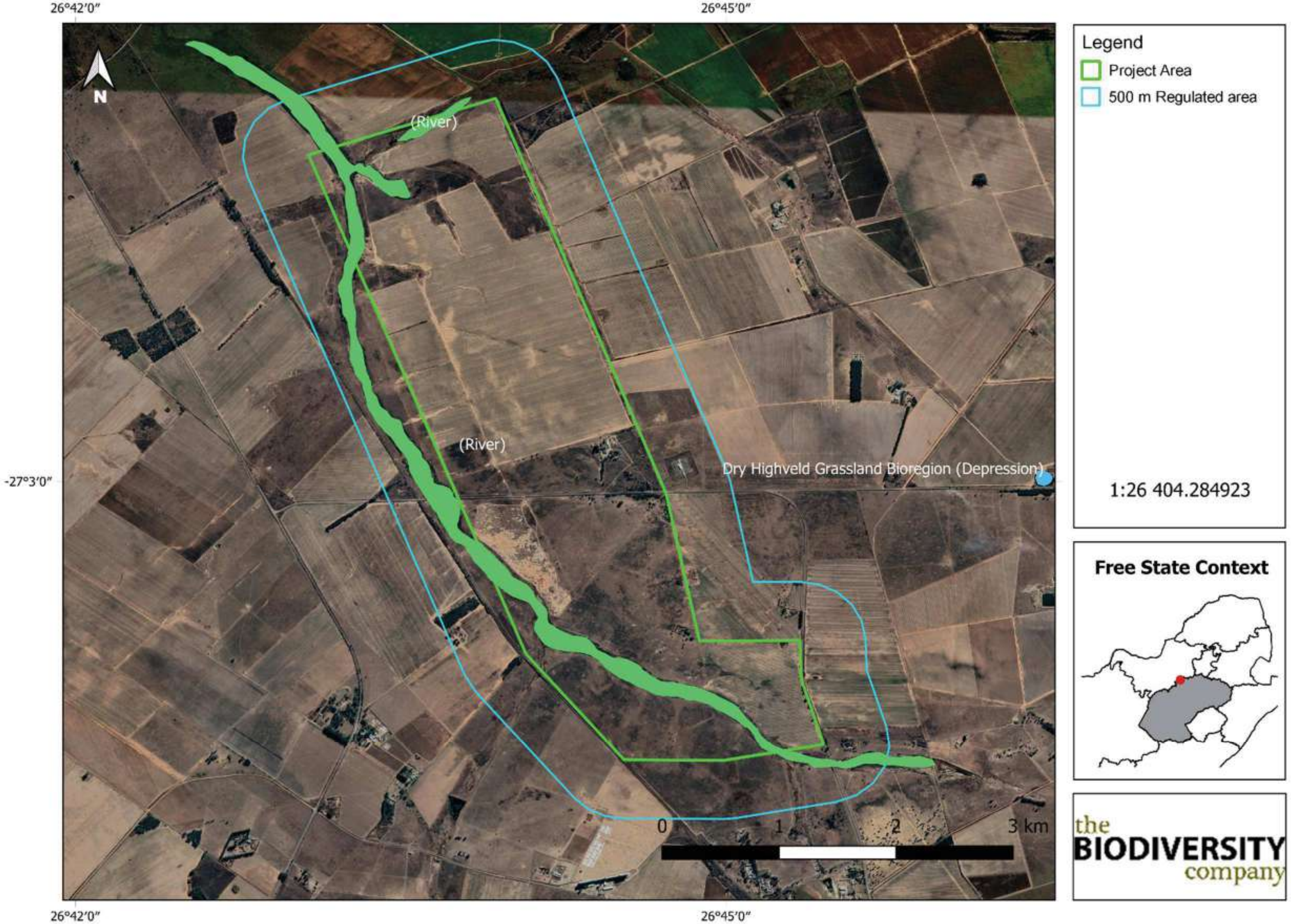

Figure 3-2 National Wetland Map 5

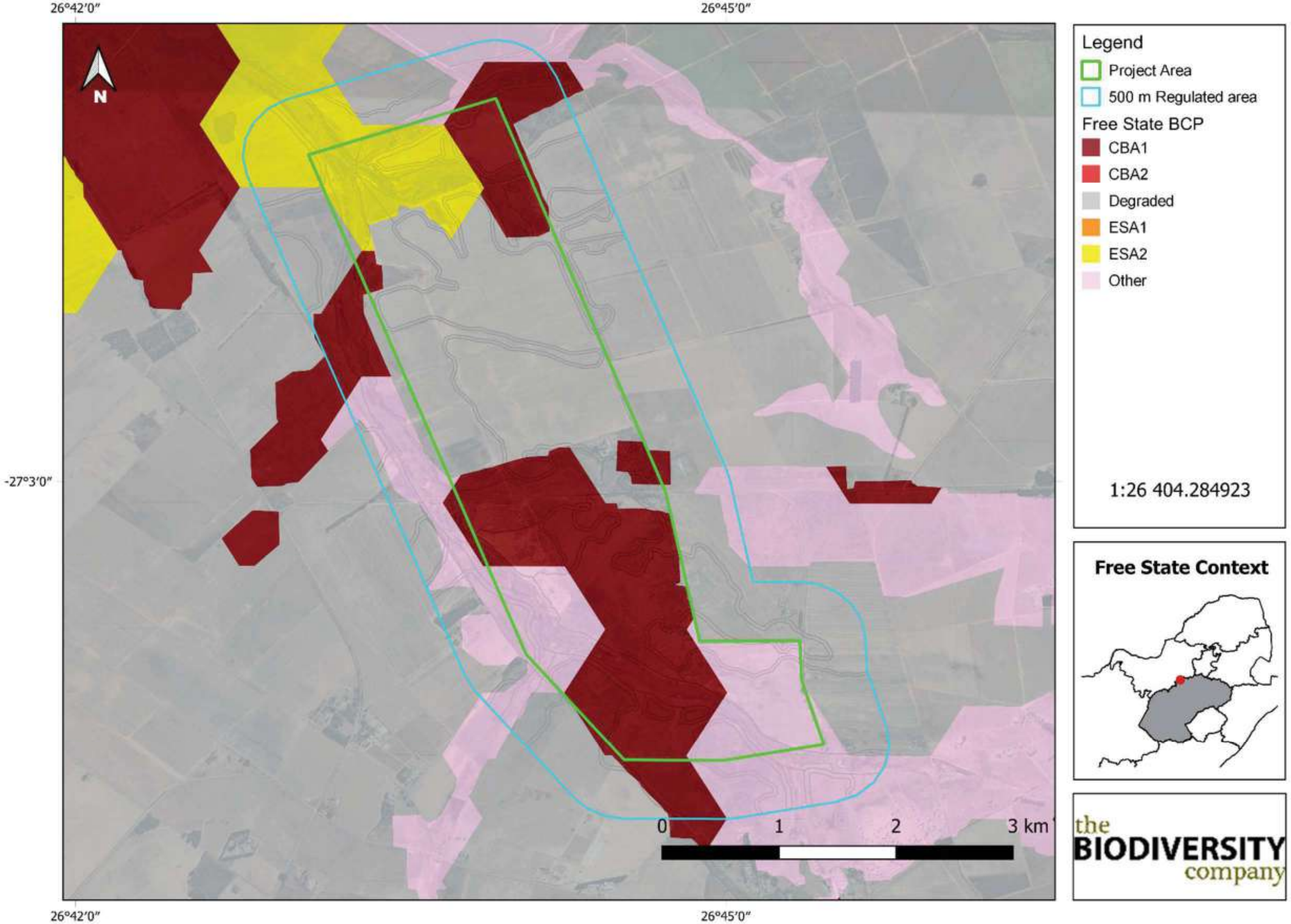

Figure 3-3 Free State Biodiversity Conservation Plan

4 Methodology

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).

4.2 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 4-1. 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;
- The 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);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The 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.

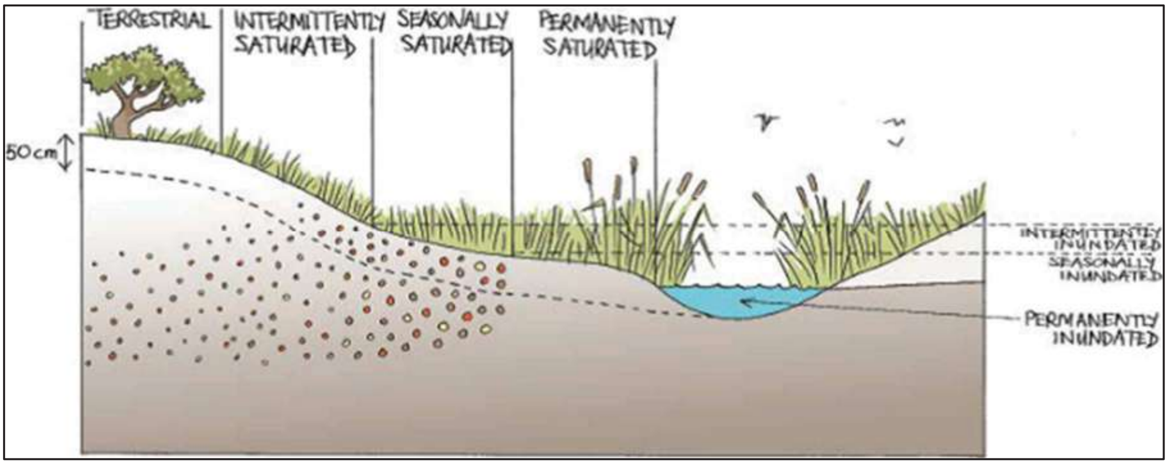

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

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 4-1.

Table 4-1 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

4.4 Ecological Importance and Sensitivity

The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 4-2 (Rountree and Kotze, 2013).

Table 4-2 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

4.5 Ecological Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be 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, and also then includes structural features at the lower levels of classification (Ollis *et al*., 2013).

4.6 Determining Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane and Bredin, 2017) was used to determine the appropriate buffer zone for the proposed activity.

4.7 Risk-based Impact Assessment

The risk-based impact 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 4-3.

Table 4-3 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 notably 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.

4.8 Limitations and Assumptions

The following aspects were considered as limitations and assumptions;

- Fieldwork and consequently the results of this assessment were limited to the area for which access was made possible.
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side
- All information provided by the client was taken as both truthful and correct;

5 Results and Discussion

5.1 Wetland Classification and Extent

In total six wetland hydrogeomorphic (HGM) units belonging to three HGM types (floodplain, unchannelled valley-bottom, and hillslope seeps) were identified both within the 500 m regulated area and the project area. The most prominent wetland feature with which all of the other identified wetlands are associated (drain into) is the Vierfonteinspruit Floodplain (HGM 1). The level 1-4 classification for these HGM units as per the national wetland classification system (Ollis *et al.,* 2013) is presented in (Table 5-1). A map showing the extent of these wetlands is shown in Figure 5-1.

Table 5-1 Wetland classification as per SANBI guideline (Ollis et al. 2013). Green indicates HGMs included in assessment, red indicates HGM excluded from assessment

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	Highveld	Dry Highveld Grasslands Group 3	Valley Floor	Floodplain	Flat	N/A
HGM 2	Inland	Highveld	Dry Highveld Grasslands Group 3	Valley Floor	Unchannelled valley-bottom	N/A	N/A
HGM 3	Inland		Dry Highveld Grasslands Group 3	Slope	Seep	Without Channelled Outflow	N/A
HGM 4	Inland		Dry Highveld Grasslands Group 3	Slope	Seep	Without Channelled Outflow	N/A
HGM 5	Inland	Highveld	Dry Highveld Grasslands Group 3	Slope	Seep	Without Channelled Outflow	N/A
HGM 6	Inland	Highveld	Dry Highveld Grasslands Group 3	Slope	Seep	Without Channelled Outflow	N/A

A summary of the extent (ha) of each wetland HGM unit as well as the extent of the buffers and terrestrial (non-wetland) habitat is given in Table 5-1 for both the project area as well as the broader 500 m regulated area surrounding it. From this table it is immediately apparent that wetlands occupy a large proportion (55% or 479.64 ha) of the total project area, and when considering their prescribed buffers this increases to (63.62% or 554.07 ha). This means that, assuming avoidance of all wetland areas and their buffers (most preferable option), that the total terrestrial land occupies 36.4% or 316.78 ha.

Table 5-2 A summary of the extent (ha) of each wetland HGM unit as well as the extent of the buffers and terrestrial (non-wetland) habitat

Feature	HGM type	Description	Area (ha) 500 m	Area (ha) Site
HGM1	Vierfonteinspruit Floodplain	Large permanently saturated north-south trending wetland	146.31	69.64
HGM2	Unchanneled valley-bottom	Unchanneled valley-bottoms	62.91	39.56
HGM3	Seep	South-western Seep	80.75	26.17
HGM4	Seep		171.56	142.23
HGM5	Seep		274.18	158.09

HGM6	Seep		118.76	43.95
Wetland Buffer	-		727.62	74.43
Terrestrial	-		130.34	316.78
Terrestrial and degraded seeps			976.72	435.16
Terrestrial and all seeps			1503.21	761.65
All wetlands			854.47	479.64
Wetlands & buffers			1582.09	796.42
Total			**1712.43**	**870.85**

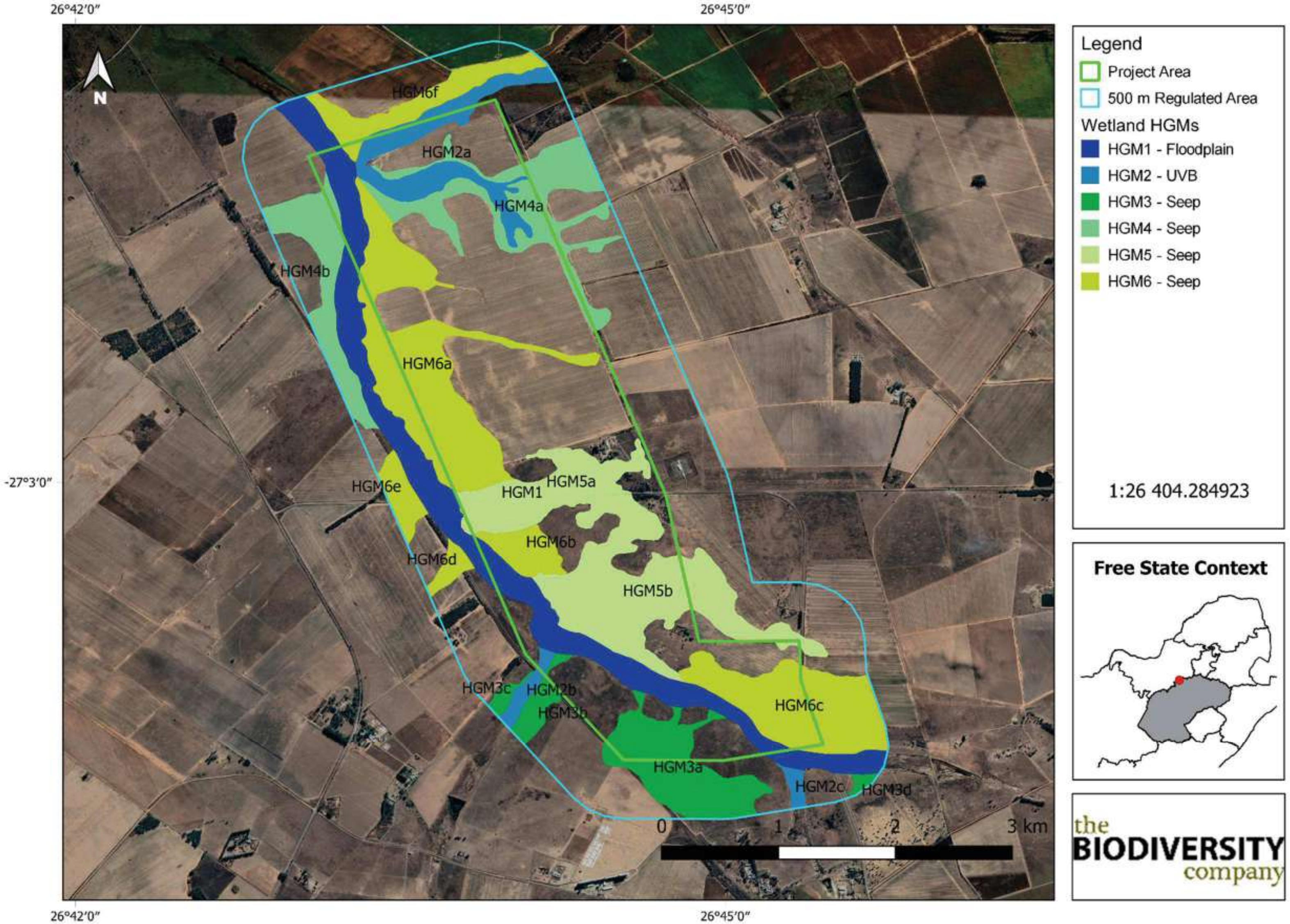

Figure 5-1 *Wetlands delineated within the 500 m regulation area around the proposed tower footprint*

5.2 Wetland Description

5.2.1 Soils

The lithology underlying the project area is typical of the Karoo Group rocks of the Ecca Supergroup. These are sedimentary rocks, more specifically sandstone and shales that were formed from sediments accumulated in a large inland sea that covered much of the Southern African interior. Due to the layered nature of these rocks which are generally dense and have a low permeability, they act as an aquitard to vertical movement of water, but horizontally they often act as an aquifer, and are thus referred to as “aquitardifer”. The project area is zoned under Land Type Bd13 characterised by its deep sandy soils, plinthic catena and general lack of eutrophic red soils. Soil types typically associated with this land type Avalon, Clovelley and Hutton soil forms that are suitable for cultivation.

In the project area soil sampling revealed a predominance of coarse sandy soils which bear resemblance to the alluviums found within the Vaal River floodplain (resembles that of a paleo-terrace). The sandiness of the soil generally increases from south to north the closer the project area comes to the Vaal River. In some places in the south a shallow, dark clay rich horizon overlies a sandier subsoil. However throughout most of the project area a plinthic horizon underlies the sands. The presence of redoximorphic features (mottles) and the colour and texture (hard or soft) of the plinthic layer ere the most consistent indicator of wetland presence throughout the project area.

Soils within the Vierfonteinspruit floodplain and valley bottom wetlands were characterised by a rich, black organic horizon which represents a prime example of the Champaign soil form. Although the presence of peat in these systems cannot be ruled out, the organic soils sampled were generally shallow (<20 cm) and too infiltrated by alluvium to constitute typical peat (it is likely the carbon content is not high enough). In seepage nearer the large floodplains the soils most closely resemble the Dundee soil form (mottles in stratified alluvium).

Soils higher up the landscape catena within the large temporary to seasonally saturated seepage areas were predominantly characterised by a coarse sandy non-eutrophic, yellow-brown apedal orthic topsoil overlying a soft and significantly leached grey plinthic B horizon with prominent red mottles. This soil type was classified as Avalon.

Soil within terrestrial (non-wetland) areas were characterised by deep red-brown apedal orthic topsoil overlying either a hard plinthic B horizon (Glencoe) or continued into an apedal B horizon beyond auger depth (Hutton). Examples of these soil form are shown in Figure 5-2.

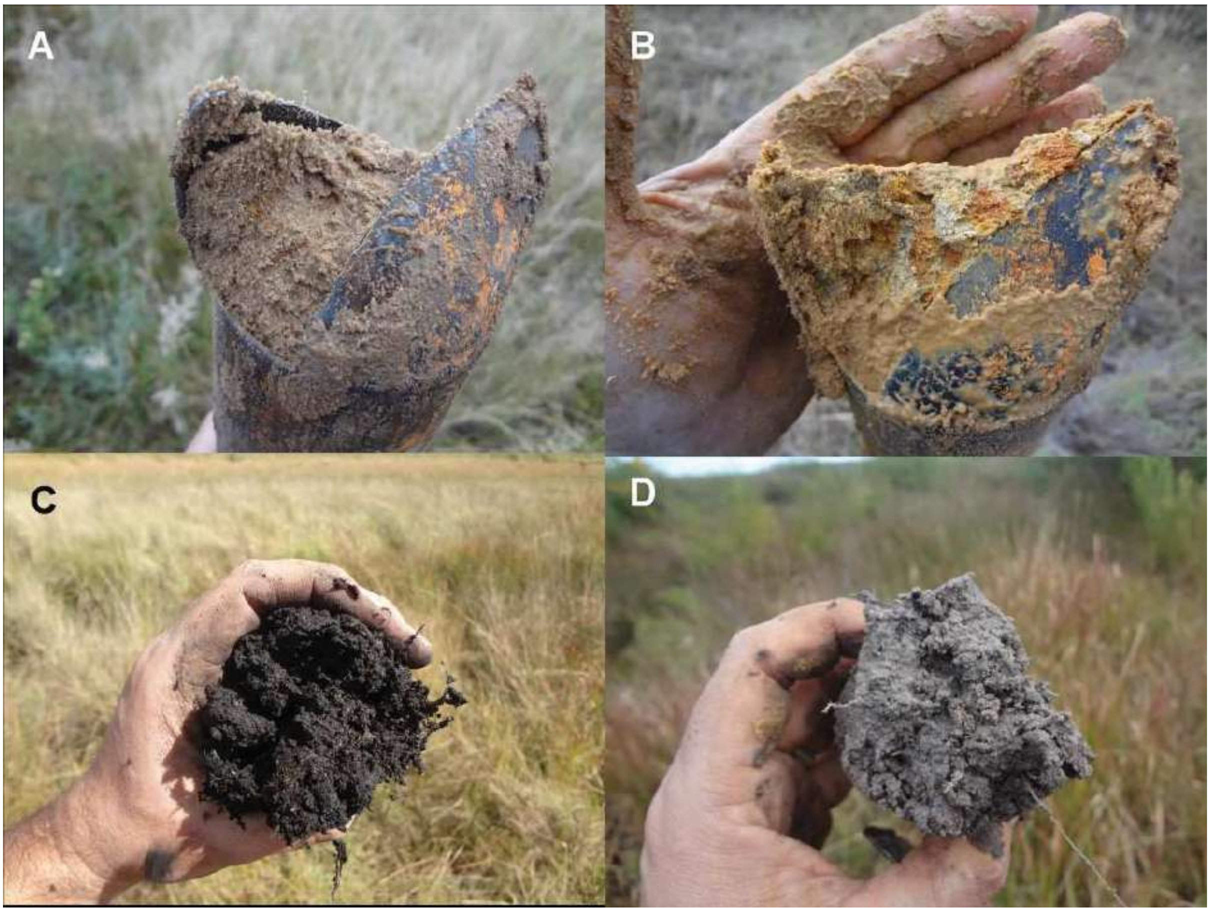

Figure 5-2 Wetland soils observed on site A) Avalon sandy topsoil horizon with mottles, B) Avalon showing soft plinthic subsoil horizon with mottling, C) Organic Champaign soil and D) G horizon

5.2.2 Vegetation

The vegetation within the large temporary to seasonally saturated hillslope seeps, in many places, shows signs of previous soil disturbance and overutilisation by cattle in that it the grass sward is generally sparse, species depauperate encroached by *Seriphium plumosum*. The moist grassland in these seeps is dominated by *Eragrostis gummiflua* with occasional patches of *Imperata cylindrica*. The most ubiquitous indicator of seep presence was *Scirpoides burkei* an obligative wetland hydrophyte. Additionally, although not yet recognised officially as a wetland indicator, very dense patches of *Seriphium plumosum* proved a useful indicator of seep presence in-field. Previous experience has revealed that the density of this species can be useful indicator of wetland presence in heavily transformed grassland.

More seasonally to permanently saturated seepage areas (such as in the far north or near the small farm dam on the eastern boundary of the southern portion) as well as the outer margins of the floodplain and valley bottom wetlands were characterised by a short dense covering of sedges and other obligate hydrophytes. Dominant hydrophytes in these areas included *Ranunculus multifidus, Plantago* sp.*, Imperata cylindrica, Scirpoides burkei* and *Juncus effuses.*

Permanent zones of within the flow paths of the floodplain and valley-bottom wetlands were dominated by dense, tall reedbeds comprised of a mix of *Phragmites australis* and *Typha capensis*. Some of these plants are shown in Figure 5-3.

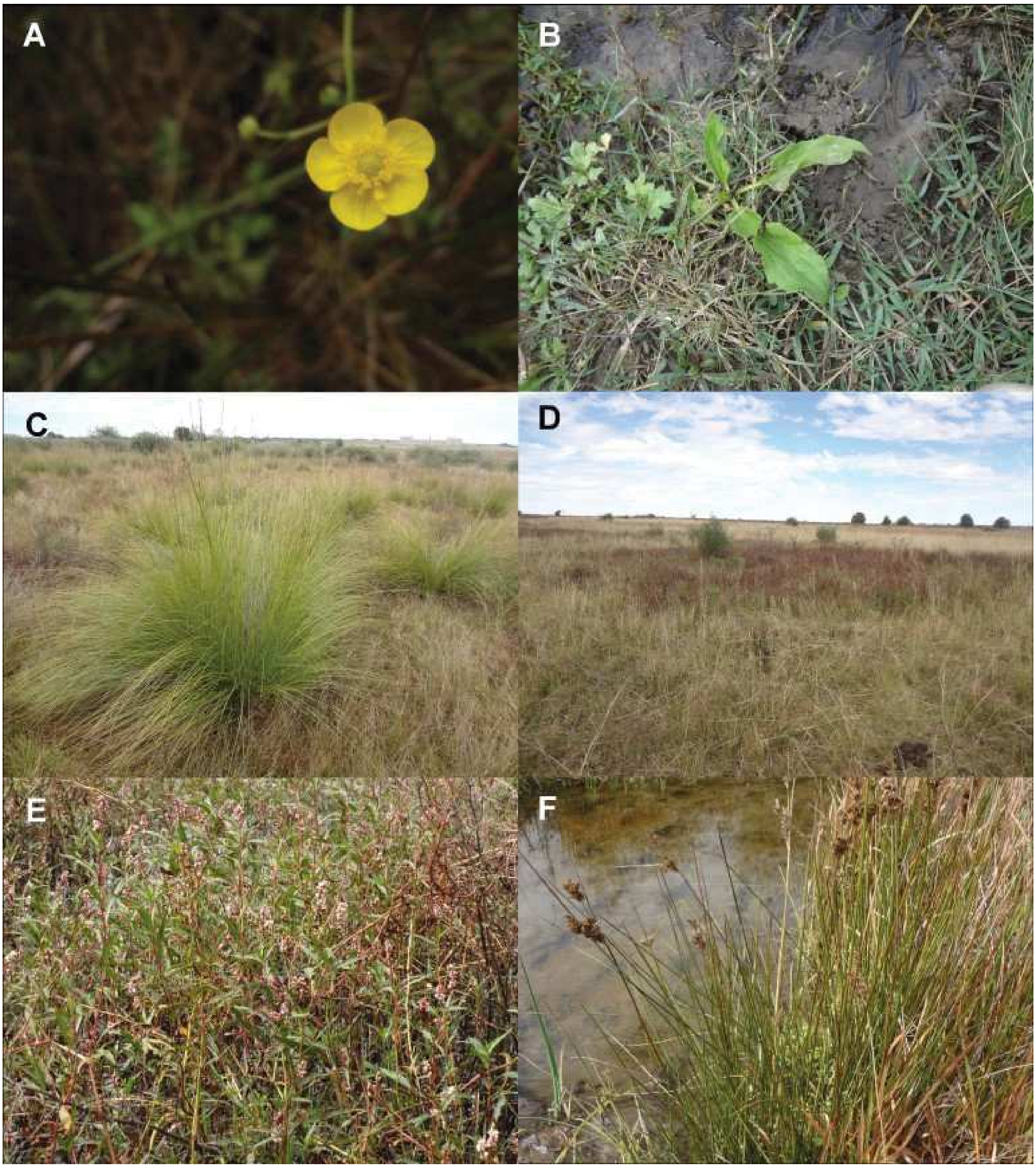

Figure 5-3 Wetland associated vegetation observed on site A) Ranunculus multifidus, B) Plantago sp., C) Scirpoides burkei, D) Imperata cylindrica, E) Persicaria sp. and F)Juncus effuses.

5.3 Wetland Ecosystem Services

The ecosystem services provided by each wetland HGM unit identified within the project area were assessed and rated using the latest WET-EcoServices Version 2 system and associated spreadsheets (Kotze *et al*. 2021). The summarised results of this assessment are shown in Table 5-3.

Overall, wetlands within the project area provide mainly indirect regulating and supporting services as well as biodiversity services but currently provide little in the way of direct provisional or cultural services. The Vierfonteinspruit floodplain (HGM 1) and unchanneled valley-bottom wetlands (HGM2) are considered most important in terms of the provision of these services. These wetlands (especially HGM 1) are particularly effective in trapping sediments and assimilating nutrients and toxicants. They also play an important role in carbon storage. In terms of Biodiversity maintenance the more natural and high saturation wetlands namely HGMs 1,2,3 and 4 are considered most important in terms of their threat status, provincial conservation targets (overlap with CBAs) and potential to support threatened species such as African marsh Harrier and African Grass Owl.

The large seeps zones of HGM 5 play an important role in streamflow regulation to the floodplain wetland and are also effective in trapping sediments and provide good grazing potential to livestock. The seeps of HGM 6 are highly degraded and their functionality has been highly compromised and as such are not considered particularly important in terms of ecosystem provision.

Table 5-3 Summary of the ecosystem services scores

Ecosystem Service		Importance Score					
		HGM1	HGM2	HGM3	HGM4	HGM5	HGM6
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.8	0.0	0.0	0.0	0.0	0.0
	Stream flow regulation	1.7	1.2	1.2	0.3	2.0	0.0
	Sediment trapping	2.8	1.8	1.0	0.8	2.8	2.0
	Erosion control	2.5	2.0	1.8	1.5	0.5	0.4
	Phosphate assimilation	2.2	1.6	1.1	0.6	1.6	1.0
	Nitrate assimilation	3.2	2.3	1.4	1.5	2.1	1.5
	Toxicant assimilation	2.8	1.9	1.1	0.9	1.9	1.1
	Carbon storage	2.8	2.4	1.3	1.6	0.8	0.4
	Biodiversity maintenance	4.0	2.4	3.3	2.5	2.4	0.0
PROVISIONING SERVICES	Water for human use	2.2	2.2	0.7	1.0	0.2	0.2
	Harvestable resources	0.7	0.7	0.7	0.0	1.2	0.0
	Food for livestock	0.7	0.7	1.7	0.0	2.2	0.2
	Cultivated foods	1.0	1.0	1.2	0.1	1.2	1.7
CULTURAL SERVICES	Tourism and Recreation	1.7	1.7	0.0	0.2	0.4	0.0
	Education and Research	1.5	1.5	0.4	0.1	0.0	0.0
	Cultural and Spiritual	1.7	1.7	0.5	0.4	0.0	0.0
Importance Categories		Low	0.8 – 1.29	Moderate	1.7 – 2.29	High	2.7 – 3.19
Very Low	0-0.79	Mod-Low	1.3 – 1.69	Mod-High	2.3 – 2.69	Very High	3.2 - 4.0

5.4 Wetland Health

The present ecological state (PES) of the wetlands identified within the project area is provided in Table 5-4. Overall, HGM 3 was found to be the most intact wetland with a PES of Largely Natural (Class B) while HGM 6 was found to be the most heavily impacted wetland unit with a rating of Seriously Modified (Class E). All remaining wetland HGM units (HGMs 1, 2, 4 and 5) were rated as Moderately Modified (Class C).

Although the upper reaches of Vierfonteinspruit floodplain (HGM 1) support small impoundments their effect on the hydrological and sediment regime of the wetland appear negligible. Due to the high saturation levels in this wetland soil disturbances within the wetland itself remain few and consequently the system supports a largely natural vegetation. Sand mining occurs in the project area but is mostly restricted to the seeps and only marginally encroaches on the floodplain. The floodplain likely experiences increased floodpeaks as a result of bare surfaces associated with croplands and certainly shows signs of sediment accumulation as a result.

HGM2 experiences similar catchments impacts relating widespread commercial crop cultivation as well as upstream dams. However, a larger proportion of this wetland type has been subject to soil disturbance as a result of crop cultivation. Additionally these valley-bottom wetlands show signs of increased susceptibility to flow path erosion.

HGM 3, is relatively remote and access to it both in terms of humans and livestock is limited. As such the seep remains in a Largely Natural state with no appreciable adverse catchment effects.

HGM 4 is impacted by commercial crop farming particularly in the eastern portions but otherwise remains in a Moderately Modified State with an abundance of short dense hydromorphic grasses and sedges surrounding the unchanneled valley-bottoms in the north.

Although the soils in HGM 5 are not currently being impacted by active croplands they do show signs of having been previously tilled. Nevertheless, the hydrological regime remains relatively intact. Sand mining has encroached on small portions of this seep closer to the floodplain. These impacts together with intense livestock grazing has altered the natural vegetation assemblage noticeably.

Although small portions remain, most of the HGM 6 seeps have been transformed by active crop cultivation. Vegetation loss and tilling have served to decrease rainslash protevtion of the soil, increase crust formation, alter infiltration rates and decrease the distribution and retention time of water in these seeps while increasing runoff, floodpeaks and erosion. Consequently the functionality of these wetlands has been seriously compromised however some natural habitat remains and these seeps still contribute to baseflows in the floodplain.

Table 5-4 Summary of the scores for the wetland PES

Wetland	Hydrology	Geomorphology	Vegetation	Overall
HGM 1	C: Moderately Modified (3.5)	C: Moderately Modified (2.5)	B: Largely Natural (1.9)	**C: Moderately Modified (2.8)**
HGM 2	D: Largely Modified (4)	C: Moderately Modified (2.8)	C: Moderately Modified (2)	**C: Moderately Modified (3.1)**
HGM 3	B: Largely Natural (1.5)	B: Largely Natural (1.1)	B: Largely Natural (1.8)	**B: Largely Natural (1.5)**
HGM 4	D: Largely Modified (4.5)	C: Moderately Modified (3)	C: Moderately Modified (2.1)	**C: Moderately Modified (3.4)**
HGM 5	C: Moderately Modified (3.5)	D: Largely Modified (4)	D: Largely Modified (4.2)	**C: Moderately Modified (3.7)**
HGM 6	E: Seriously Modified (6.5)	E: Seriously Modified (6.2)	E: Seriously Modified (7.5)	**E: Seriously Modified (6.7)**

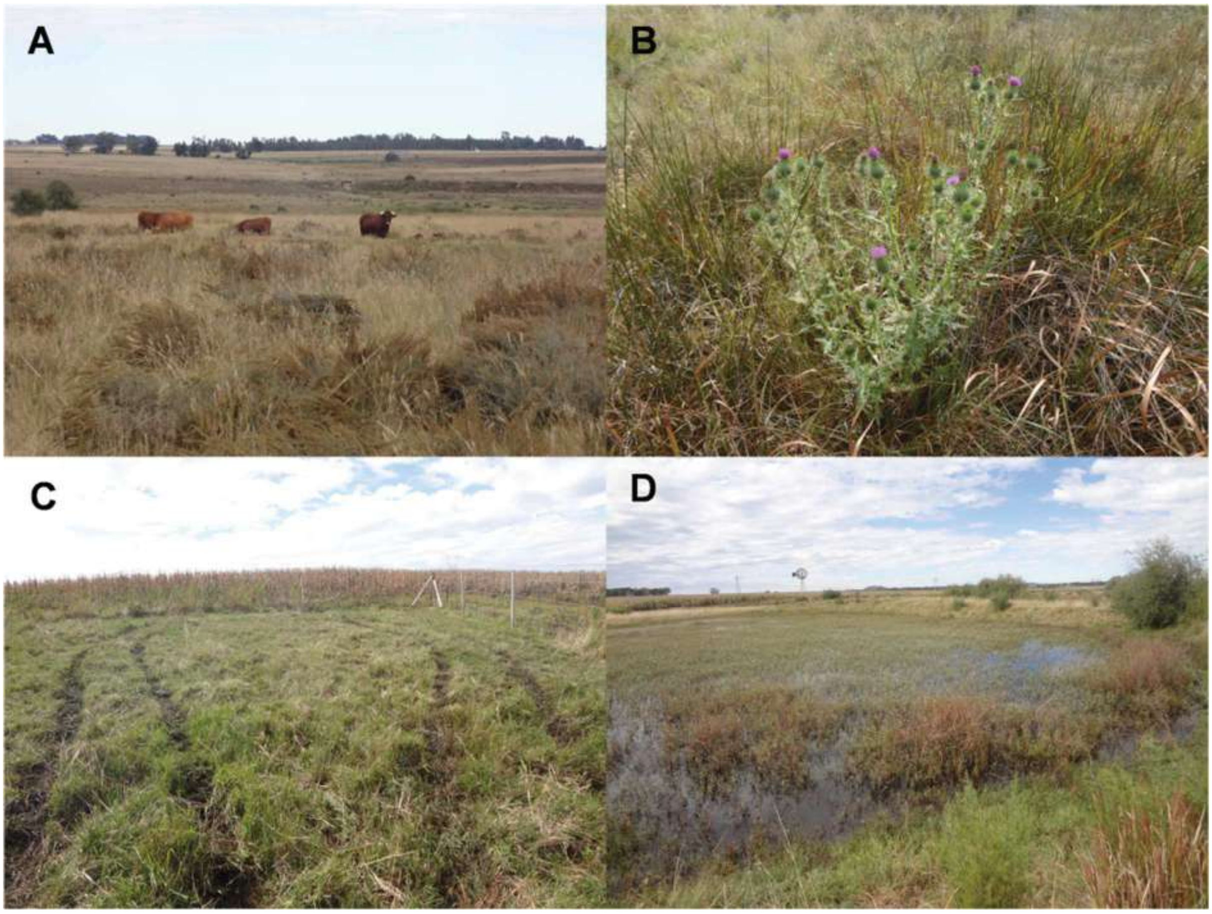

Figure 5-4 Examples of some of the impacts influencing the PES ratings; A) livestock grazing, B) alien vegetation, C) croplands in seep zones, D) dams

5.5 Ecological Importance and Sensitivity

The results of the ecological and importance (EIS) assessment are shown in Table 5-5. At a regional scale the NFEPA Wetveg database recognises Dry Highveld Grassland Group 3 floodplains as Critically Endangered, Valley-bottoms as Least Threatened and seeps as Endangered (Nel and Driver, 2012). None of the wetlands within the project area or the 500 m regulated surrounding it are recognised as NFEPA wetlands or rivers. However portions of HGMs 1, 2, 3, 4 and 5 are zoned as CBA 1 areas. The National Wetland Map 5 does not list updated conservation statuses for any the wetlands in the project area.

At a more local scale, HGMs 1, 2 and 4 are rated as having a Very High EIS based primarily on account of their high potential to support Threatened species but also due to their larger size, higher saturation levels, Threatened status and their importance from a provincial conservation planning perspective (portions zoned as CBA1). The Vierfonteinspruit floodplain (HGM1) and associated wetlands in the north (HGMs 2 and 4) provide ideal breeding habitat for two regionally occurring Threatened species namely such as African Marsh Harrier and African Grass Owl. The dense tall reedbeds along the Vierfonteinspruit floodplain provide ideal nesting and foraging conditions for African Marsh Harrier and link directly to an area of recognised importance for the species along the Vaal River less than 3 km north. The dense *Imperata cylindrica* dominated hydromorphic grasslands in the north (HGM2 and 4) provide ideal nesting and foraging habitat for African Grass Owl.

Habitat diversity within HGMs 3 and 5 is relatively low and these wetlands are not considered important in terms of maintaining viable populations of threatened species. These wetlands are ranked as High primarily on account of their intactness and importance from a provincial conservation perspective (portions are CBA 1). Based on the above the CBA 1 designation of these wetlands is warranted from a biodiversity perspective.

Table 5-5 The Ecological Importance and Sensitivity results for the wetland area

Aspect	HGM 1	HGM 2	HGM 3	HGM 4	HGM5	HGM 6
Ecological Importance & Sensitivity	VH (3.5)	VH (3.1)	H (2.8)	VH (3.4)	H (2.5))	L (0.5)

6 Sensitivity and Buffer Analysis

6.1 Desktop-based Screening Tool Sensitivity Assessment

The Aquatic Biodiversity Theme of the National Environmental Screening Tool recognises the presence of the Vierfonteinspruit floodplain. All other seeps and wetland areas have not been picked up in this national-scale sensitivity map.

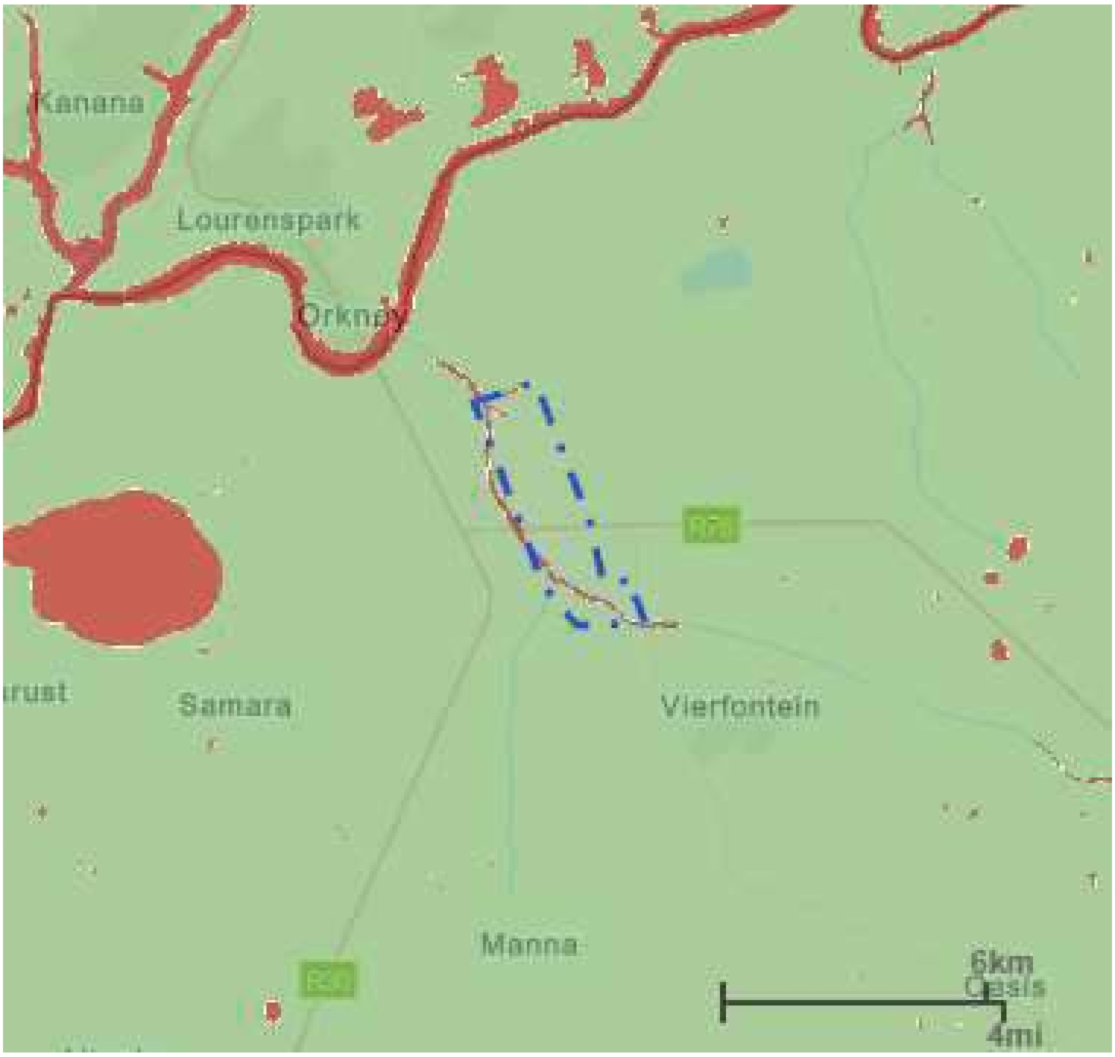

Figure 6-1 Aquatic Biodiversity Sensitivity Theme of the National Environmental Screening Tool (red= Very High sensitivity).

6.2 Site Sensitivity Verification

A map was produced to visually represent the sensitivity of the wetlands based on the findings of the wetland assessment (Figure 6-2). Less impacted wetlands (HGMs 1, 2, 3 4 and 5) were classified as having a High sensitivity while more impacted wetlands (HGM 6) were assigned a Moderate-High. All wetland buffers were assigned a Moderate sensitivity. All other non-wetland areas within the 500 m regulated area were assigned a Low sensitivity from a wetland perspective.

The "*Buffer zone guidelines for wetlands, rivers and estuaries*" (Macfarlane and Bredin 2017) was used to determine the appropriate wetland buffer zone for the proposed activity, in this case renewable energy. The Vierfonteinspruit floodplain (HGM1) and associated unchanneled valley-bottoms (HGM2) were assigned a minimum development buffer of 41 m. This was based primarily on their Moderately Modified PES and Very High EIS combined with the potential for increased sediments and turbidity as a result of the construction of the PV farm.

Less impacted Seeps belonging to HGMs 3,4 and 5 were assigned a buffer of 29 m while the more impacted and low EIS wetlands of HGM 6 were assigned a buffer of 24 m. The main impacts influencing the buffer determination tool, in all instances, included increase in sediment inputs & turbidity as well alteration of floodpeaks.

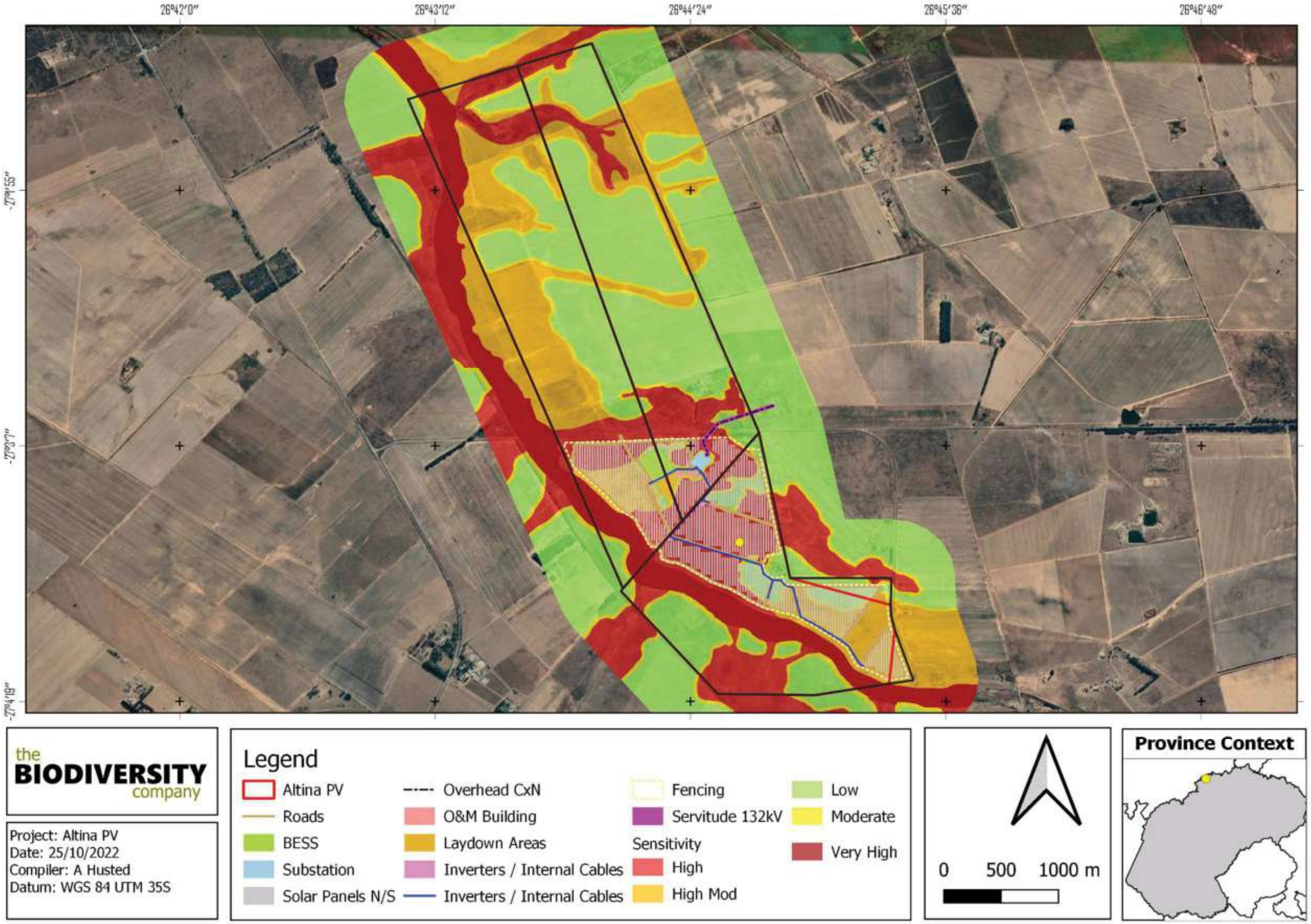

Figure 6-2 Wetland sensitivity map

7 Risk-based Impact Assessment

This risk-based impact assessment was conducted in line with Section 21 (c) and (i) of NWA to investigate the level of risk posed by the construction and operation of the proposed solar PV farm. Table 7-1 lists the potential risks posed by the development to the identified wetlands (HGMs 1-6). Significance ratings for each identified risk are given for scenarios with and without mitigation.

Based on the preferred infrastructure layout (Alternative 2) although the proposed development will avoid the floodplain and associated buffer it will overlap some seepage areas. These seeps are assigned a sensitivity rating of High as they still remain relatively intact and functional. Loss of seep wetland habitat (under infrastructure Alternative 2) equates to 126.3 ha or 26.3% of the total wetland extent in the project area. The developer has stated that the total footprint area would equate to 0.35% per hectare. Based on this, to extent of direct impacts to the wetland area would amount to 44.2 ha or 9.2% or 26.3% of the total wetland extent in the project area.

The loss of wetland area necessitates a Water Use Licence and a Wetland Offset Strategy. Decisions regarding the development of wetland areas and the required compensation have been considered in a preliminary rehabilitation strategy for the development. This approach is motivated by the mitigation hierarchy process. Efforts have been made to avoid (and also minimise) direct impacts to wetlands and to further mitigate any unavoidable impacts. Due to the loss of wetland area and the inadequacy of the avoidance and mitigation measures to achieve an acceptable level or residual risk, the (on-site) rehabilitation of wetland systems is required. The rehabilitation strategy presents rehabilitation measures to facilitate the recovery of impacted systems, but to also provide adequate compensation for the expected loss of wetland areas.

Considering the size of these seeps and the volumes of water delivered by them (during the height of the rainy season), the primary objective should be to avoid trying to drain them or divert flows around them but instead to allow for the diffuse subsurface flow of water beneath the solar panels.

However, it is mentioned that the solar PV panels will be bifacial and that, as a consequence, the ground beneath the PV grid will be completely cleared. Although the vegetation in most of the seeps is short, sparse, heavily overgrazed and in most places devoid of obligate hydrophytes (if not completely cleared by agriculture), the clearing of what little vegetation exists beneath the PV grids introduces a number of challenges. This is because vegetation plays an important role in the maintenance of hydrological and sediment regimes in wetlands. Removal of vegetation, particularly in the seep zones has the potential to decrease infiltration and increase surface runoff. It also has the potential to result in erosion of the seep zones while at the same time increasing sediment loads and potentially toxicants delivered to the valley-bottom and floodplain wetlands.

The challenge is how to allow the subsurface flow of water beneath the solar panels without promoting erosion (especially during high rainfall events) of these seep zones and sedimentation and or contamination of the floodplain and valley bottom wetlands. Mitigation should therefore focus on maintaining or, better still, improving on the current sediment regime of the hillslope seeps. However construction on concreted steel mono-pole plinths greatly reduces the actual surface footprint of the development and is considered unlikely to drastically alter the hydrological regime of the system and therefore the quantity of water delivered to the floodplain and valley-bottom wetlands. The following mitigation measures are proposed in light of the above:

- Use the wetland shapefiles to clearly demarcate (on the ground) the edge of the buffer on the floodplain and valley-bottom wetlands (41 m buffer). Regard these as strict no-go areas and sign post as environmentally sensitive.
- All activities (including driving and equipment storage) must remain outside of the floodplain and valley-bottom wetlands identified on site that will be conserved.
- Apply for a water use licence and start to initiate the development of an offset (on-site rehabilitation) strategy for all wetlands to be developed. Incorporate the wetland rehabilitation strategy and any remedial activities associated with this strategy in the master plan for the development and implement in tandem with construction.
- Towards this offset (on-site rehabilitation) strategy consider rehabilitating a 100 m stretch from the eastern outer boundary of the floodplain wetland wherever this intersects disturbed ground (either the sand mining activities or croplands both active or fallow).
- Hold off on the clearing of vegetation as long as possible, ensuring that all environmental and water use authorisations are in place, the site construction materials are in place and the PV infrastructure is sourced and ready prior to clearing.
- Take every measure to ensure that the bulk of the site clearing and earth moving activities take place in winter when rainfall is lowest (and the grass sward is thinnest) to minimize environmental damage, erosion, sedimentation and contamination.
- While clearing keep a nursery of plant sods (prioritise wetland plants such as sedges, rushes and grasses such as *Imperata cylindrica*) in an on-site nursery (consider a spot in or close to the sand mining area) for use in wetland restoration efforts as part of the offset (on-site rehabilitation) strategy.
- Minimize the disturbance footprint and the unnecessary clearing of vegetation outside of this area.
- Develop a sound stormwater management plan that is engineered to promote rainfall infiltration, maintain diffuse subsurface flows in seep areas, minimise the development of preferential flow paths. The stormwater plan would also benefit from Lidar based topography maps and / or site-specific contours that allow for the identification of flow paths.
- All low points, flow paths or clean water drains should be engineered to minimize erosion through the installation of small drop downs and flow attenuation structures especially out outlets into the floodplain.
- Stormwater leaving the site should not be concentrated in a single exit drain but spread across multiple drains around the site each fitted with energy dissipaters (e.g. slabs of concrete with rocks cemented in).

- Consider the use of a coarse gravel beneath the solar panels to promote infiltration and minimize surface run-off and erosion during high rainfall events. The gravel should be free of heavy metal contaminants.
- Educate staff and relevant contractors on the location and importance of the identified wetlands through toolbox talks and by including them in site inductions as well as the overall master plan.
- Promptly remove / control all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) must be removed.
- Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash.

Table 7-1 DWS Risk Impact Matrix for the proposed development

Activity	Aspect	Impact	Severity																Risk Rating	Control Measures
			Wetland Type	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance			
Construction																				
Clearing and preparation of PV footprint and access roads	Disturbance of wetland habitat.	Loss or degradation of wetland vegetation.	Without	4	4	4	5	5	2	5	12	4	4	5	3	16	192	H	• Use the wetland shapefiles provided by TBC to clearly demarcate (on the ground) the edge of the buffer on the floodplain and valley-bottom wetlands (41 m buffer). Regard these as strict no-go areas and sign post as environmentally sensitive. • All activities (including driving and equipment storage) must remain outside of the floodplain and valley-bottom wetlands identified on site that will be conserved. • Attempt to avoid development and activities within the seeps as far as possible. Apply for a water use licence and start to initiate the development of an offset (on-site rehabilitation) strategy for all wetlands to be developed. Incorporate the wetland offset / rehabilitation strategy and any remedial activities associated with this strategy in the master plan for the development and implement in tandem with construction. • Towards this offset (on-site rehabilitation) strategy consider rehabilitating a 100 m stretch from the eastern outer boundary of the floodplain wetland wherever this intersects disturbed ground (either the sand mining activities or croplands both active or fallow). • While clearing keep a nursery of plant sods (prioritise wetland plants such as sedges, rushes and grasses such as *Imperata cylindrica*) in an on-site nursery (consider a spot in or close to the sand mining area) for use in wetland restoration efforts as part of the offset (on-site rehabilitation) strategy. • Use existing access roads wherever possible.
			With	3	3	3	4	5	2	5	12	2	2	5	1	10	120	M	

Activity	Aspect	Impact	Wetland Type	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
		Increased bare surfaces, floodpeaks and potential for erosion	Without	4	5	4	4	5	2	5	12	4	4	5	1	14	168	H	• Hold off on the clearing of vegetation as long as possible, ensuring that all environmental and water use authorisations are in place, the site construction materials are in place and the PV infrastructure is sourced and ready prior to clearing. • Take every measure to ensure that the bulk of the site clearing and earth moving activities take place in winter when rainfall is lowest (and the grass sward is thinnest) to minimize environmental damage, erosion, sedimentation and contamination. • Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash. • Scrape the area where mixing and storage of sand and concrete occurred to clean and re-grass once finished. • Revegetate all denuded areas beyond the buildings as soon as possible
			With	3	3	3	3	5	2	2	9	3	3	1	1	8	72	M	
		Introduction and spread of alien and invasive vegetation	Without	2	2	4	4	3	2	5	10	3	3	5	1	12	120	M	• Promptly remove all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) . • Appropriately stockpile topsoil cleared from the site. • Minimize unnecessary clearing of vegetation beyond the infrastructure footprints. • Lightly till any disturbed soil around the development to avoid compaction.
			With	1	1	1	1	1	1	2	4	2	1	5	1	9	36	L	
Excavation and installation of PV infrastructure.	Alteration of Hydrological Regime	Decreased flow inputs to the Vierfontein spruit floodplain (HGM1)	Without	5	5	4	4	5	2	5	12	4	4	5	1	14	168	H	• Aim to maximise infiltration of rain water and maintain diffuse subsurface drainage below PVs in seeps. • Develop a sound stormwater management plan that is engineered to promote rainfall infiltration, maintain diffuse subsurface flows in seep areas, minimise the development of preferential flow paths. The

Activity	Aspect	Impact		Wetland Type	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Severity																
			With	4	3	3	3	5	2	5	12	3	3	1	1	8	96	M	stormwater plan would also benefit from Lidar based topography maps and / or site-specific contours that allow for the identification of flow paths. • All low points, flow paths or clean water drains should be engineered to minimize erosion through the installation of small drop downs and flow attenuation structures especially out outlets into the floodplain. • Stormwater leaving the site should not be concentrated in a single exit drain but spread across multiple drains around the site each fitted with energy dissipaters (e.g. slabs of concrete with rocks cemented in). • Minimise the extent of concreted / paved / gravel areas. • Avoid excessively compacting the ground beneath the solar panels. • Introduce coarse, preferably washed, gravel beneath PV arrays.
	Soil disturbance	Increased sediment loads to downstream reaches	Without	4	5	4	4	5	2	5	12	4	4	5	1	14	168	H	• See mitigation for increased bare surfaces, runoff and potential for erosion • Introduce coarse, preferably washed, gravel beneath PV arrays.
			With	3	3	3	3	5	2	2	9	3	3	5	1	12	108	M	
Operation																				
Routine operation and maintenance of PV farm	Residual vegetation disturbance	Proliferation of alien and invasive species	Without	1	1	2	2	5	2	5	12	2	2	5	1	10	120	M	• Continue to remove all alien and invasive plant species as they arise (i.e. weedy annuals and other alien forbs) . • Attempt to plant only locally indigenous plant species within the gardens. • Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility. • Do not store any construction materials or equipment within any of the identified wetlands or their buffers. • Mixing of concrete must under no circumstances take place within any wetland. • Release only clean water into the environment.
			With	1	1	1	1	1	2	5	8	2	2	1	1	6	48	L	
	Increased contamination	Nutrient enrichment of wetlands	Without	1	5	4	4	5	2	5	12	4	4	5	2	15	180	H	
			With	1	1	1	1	1	1	2	4	2	1	5	1	9	36	L	

Activity	Aspect	Impact		Wetland Type	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Severity																
	Altered sediment regime	Increased sedimentation from cleared ground beneath solar PV areas	Without	1	1	4	4	2.5	2	5	9.5	3	3	5	1	12	114	M	• Develop a sound stormwater management plan that is engineered to promote rainfall infiltration, maintain diffuse subsurface flows in seep areas, minimise the development of preferential flow paths. The stormwater plan would also benefit from Lidar based topography maps and / or site-specific contours that allow for the identification of flow paths. • Consider the use of a coarse heavy metal-free gravel beneath the solar panels to promote infiltration and minimize surface run-off and erosion during high rainfall events. The gravel should be free of heavy metal contaminants.
			With	1	1	4	4	2.5	2	5	9.5	3	3	5	1	12	114	M	
Decommissioning																				
Demolition	Vehicle access	Degradation of vegetation and proliferation of alien and invasive species	Without	1	4	4	4	3.3	5	3	11	3	1	1	1	6	68	M	• Decommissioning is unlikely for the foreseeable future, however, if the water supply infrastructure ever needs upgrading and needs to be moved the following is recommended: • See mitigation for the impacts on degradation of downslope wetlands and spread of alien and Invasive plants. • Alien and invasive species control should continue for a minimum of three years following decommissioning.
			With	1	1	1	1	1	1	2	4	2	1	1	1	5	20	L	
	Soil and vegetation disturbances	Increased bare surfaces, runoff and potential for erosion	Without	4	5	4	4	5	2	5	12	4	4	5	1	14	168	H	• See mitigation for increased bare surfaces, runoff and potential for erosion and increased sediment loads during construction • Landscape and rehabilitate project area.
			With	1	1	1	1	1	2	2	5	3	1	1	1	6	30	L	

8 Conclusion

The proposed development is situated (for the most part) on the eastern bank of the Vierfonteinspruit floodplain. Some smaller valley-bottom wetlands and seeps are associated with this floodplain. Aside from the valley bottom and floodplain wetlands large portions of the project area particularly south of the tar road are covered by extensive temporary to seasonal hillslope seepage areas.

The hillslope seeps show a strong linkage to the ground water regime which likely exhibits a shallow perched aquifer. Movement of water through this sandy subsurface aquifer was strong as evidenced by prominent gleying of the plinthic horizon and rapid recharge of water in auger holes. Undoubtedly these seeps play an important role in the streamflow regulation and recharge of the large floodplain wetland.

Based on the preferred infrastructure layout (Alternative 2) although the proposed development will avoid the floodplain and associated buffer it will overlap some seepage areas. These seeps are assigned a sensitivity rating of High as they still remain relatively intact and functional. Loss of seep wetland habitat (under infrastructure Alternative 2) equates to 126.3 ha or 26.3% of the total wetland extent in the project area. The developer has stated that the total footprint area would equate to 0.35% per hectare. Based on this, the extent of direct impacts to the wetland area would amount to 44.2 ha or 9.2% of the total wetland extent in the project area.

The loss of wetland area necessitates a Water Use Licence and a Wetland Offset Strategy. Decisions regarding the development of wetland areas and the required compensation have been considered in a preliminary rehabilitation strategy for the development. This approach is motivated by the mitigation hierarchy process. Efforts have been made to avoid (and also minimise) direct impacts to wetlands and to further mitigate any unavoidable impacts. Due to the loss of wetland area and the inadequacy of the avoidance and mitigation measures to achieve an acceptable level or residual risk, the (on-site) rehabilitation of wetland systems is required. The rehabilitation strategy presents rehabilitation measures to facilitate the recovery of impacted systems, but to also provide adequate compensation for the expected loss of wetland areas.

Although the project area overlaps a number of seeps it is conceivably possible, given the nature of the project, to maintain much of the current base flow to the floodplain and valley-bottom wetlands. Construction of the bifacial arrays on concreted steel mono-pole plinths greatly reduces the actual surface footprint of the development and is thus considered unlikely to drastically alter the hydrological regime of the seeps and therefore the quantity of water delivered to the floodplain and valley-bottom wetlands. The challenge lies in maintaining subsurface flow of water beneath the solar panels without promoting erosion (especially during high rainfall events) of these seep zones and sedimentation and or contamination of the floodplain and valley bottom wetlands. Mitigation provided in this report therefore focuses on maintaining or better yet improving the current sediment regime of the hillslope seeps beneath solar PVs. Although the risk of erosion and sedimentation during the construction phase is likely to be unavoidable and High regardless of mitigation, this impact is likely to be short-lived and can be reduced to a Moderate residual risk (or potentially lower) during operation.

Overall, development of the solar PV is conceivably viable from a wetland perspective. However, if the project is to proceed it recommended that the placement of solar PVs and associated infrastructure within wetland areas is minimised as far as possible. Complete wetland avoidance will not be feasible. Development within the wetlands will require a full water use licence application and decisions regarding the allowed activities and required compensation in terms of the loss of functional hectare equivalents would need to be addressed in the preliminary stages of an offset strategy.

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APPENDIX E2: Terrestrial Ecology Impact Assessment

THE TERRESTRIAL ECOLOGY BASELINE & IMPACT ASSESSMENT FOR THE PROPOSED ALTINA SOLAR PHOTOVOLTAIC DEVELOPMENT

Orkney, Free State Province

July 2022

CLIENT

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Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Background

The Biodiversity Company was appointed to undertake a fauna and flora baseline assessment for the proposed Altina 120 MW Solar Photovoltaic (PV) Project near the Town of Orkney, Free State Province (Figure 1-1).

The project is located in the northern part of the Free State Province and falls within the Fezile Dabi District Municipality and Moqhaka Local Municipality. The project is located approximately 7 km to the south of the town of Orkney and is traversed by the R76.

This assessment 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): “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 terrestrial sensitivity as “Very High” across the project area.

The purpose of the specialist studies is to provide relevant input into the basic assessment process and provide a report for the proposed activities associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.2 Project Information

The proposed project footprint is as follows:

- Potential Solar Areas – 149Ha and 63Ha (total of 212Ha); and
- Grid connection – approximately 1km (substation located to the immediate east of the project boundary).

The proposed project consists of the following systems, sub-systems or components (amongst others):

- PV panel arrays, which are the subsystems which convert incoming sunlight into electrical energy;
- Mounting structures to support the PV panels;
- On-site inverters to convert DC to facilitate AC connection between the solar energy facility and electricity grid;
- New 132 kV power lines between the on-site substation(s) and the grid connection point;
- Cabling between the project’s components, to be laid underground (where practical);
- Administration Buildings (Offices);
- Workshop areas for maintenance and storage;
- Temporary laydown areas;
- Internal access roads and perimeter fencing of the footprint;

- High Voltage (HV) Transformers; and
- Security Infrastructure.

Electricity generation sources need to be diversified to ensure security of supply and reduction in the carbon footprint created by the current heavy reliance of South Africa (SA) on coal to produce electricity. The electricity demand is increasing in SA, and in order to match that demand there is a need to supply a diversified power generation that includes renewable energy technologies. These technologies include solar, wind, small utility scale hydro, biomass, biogas and energy storage that the Department of Mineral Resources and Energy (DMRE) intends to develop and implement as identified in the approved Integrated Resource Plan (IRP) 2019. Genesis Eco-Energy Developments (Pty) Ltd (the Applicant) has proposed the development of the Altina 120MW Solar PV Project near the town of Orkney, in the Free State Province. The project falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice No. 142 of 26 February 2021. The electricity generated by the project will be injected into the existing Eskom 132 kV distribution system. The applicant intends to bid for Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) bid windows and /or other renewable energy markets within SA.

Alternatives that will be considered are outlined below:

- Layout Alternative 1 (Figure 1-3); and
- Layout Alternative 2 (Figure 1-4).

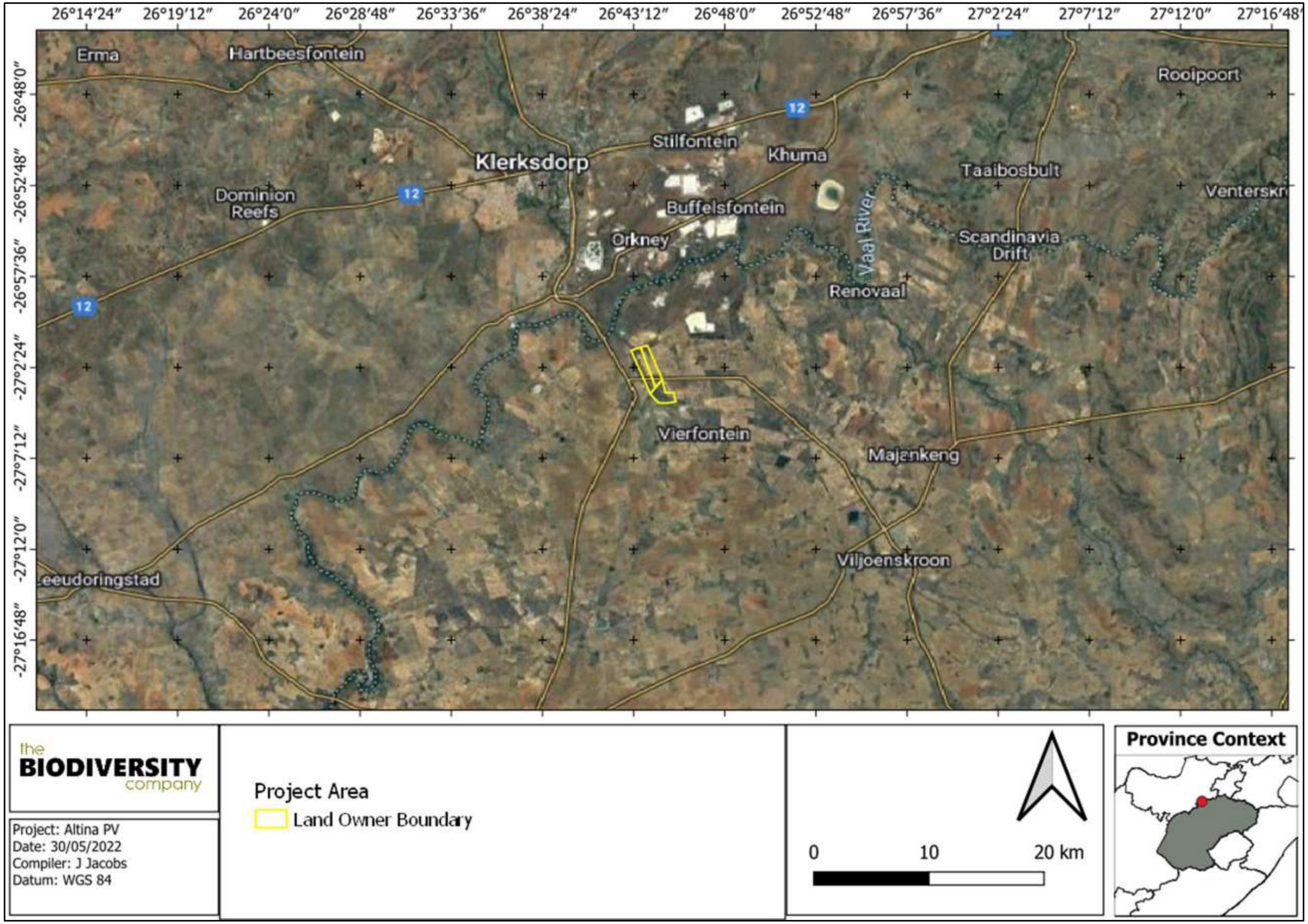


Figure 1-1 Map showing the proposed location of the project area in relation to the nearby towns.

Figure 1-2 ***Map illustrating the proposed project area***

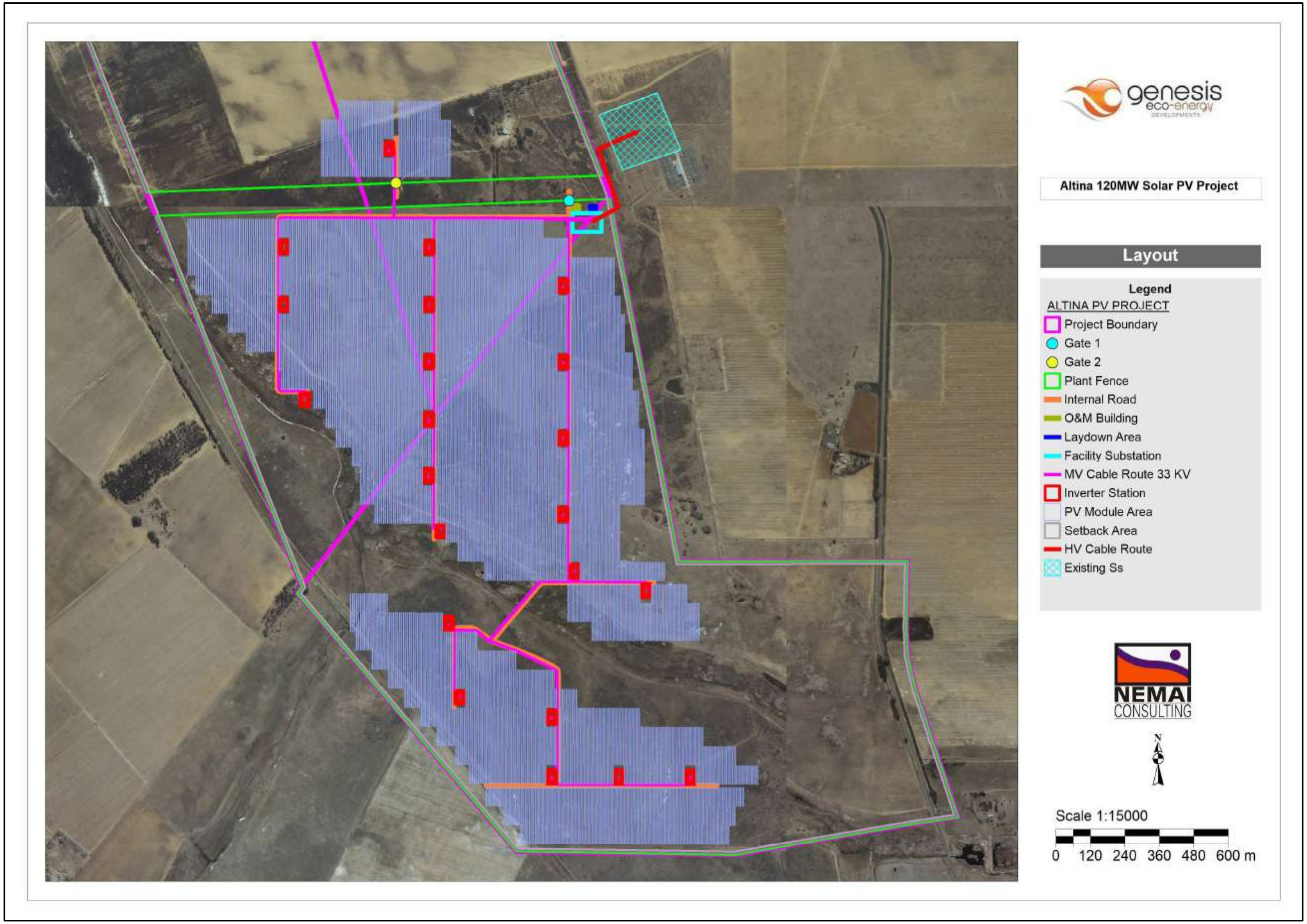


Figure 1-3 Project Layout Alternative 1 (As provided by Nemai Consulting)

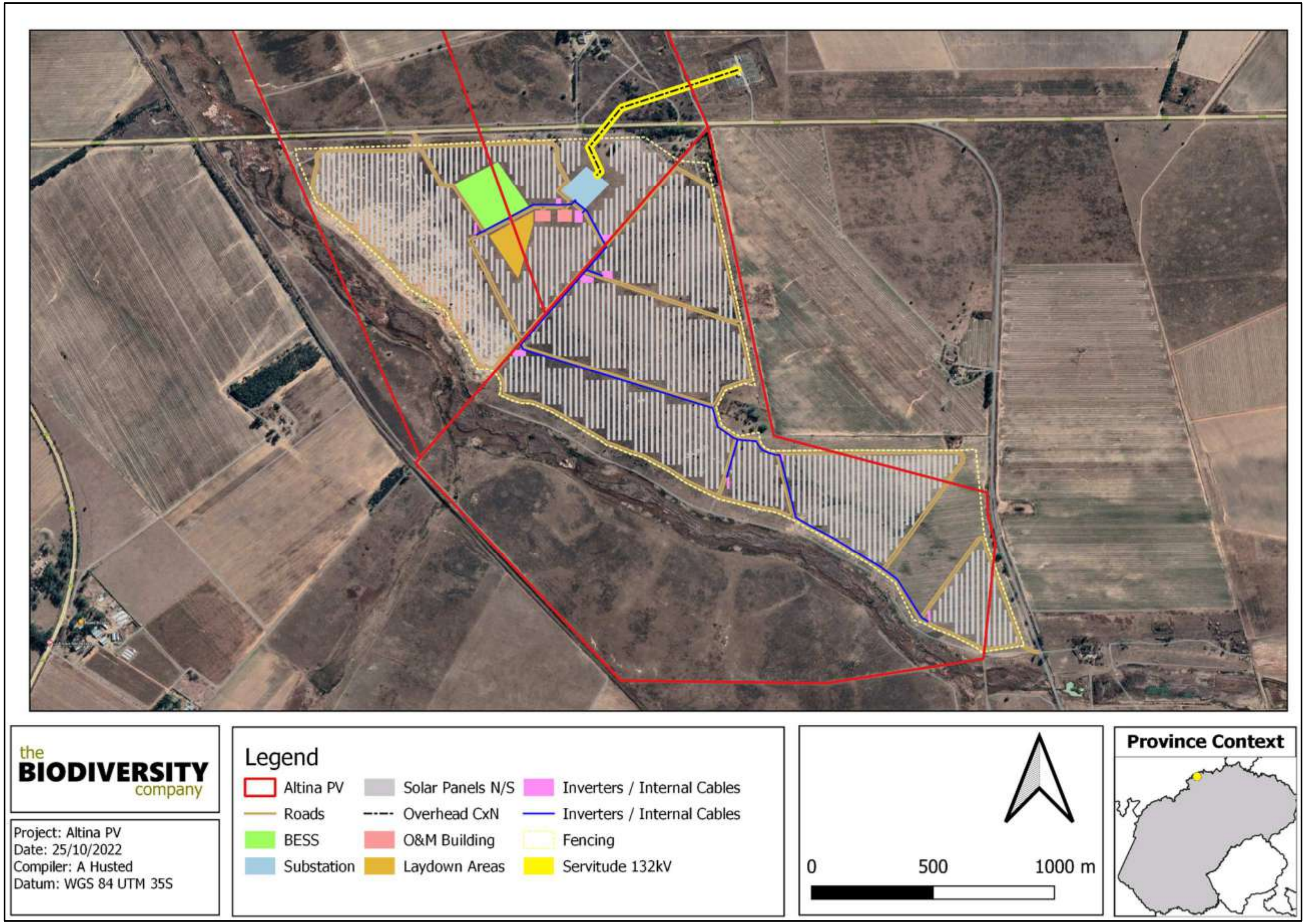


Figure 1-4 Project layout Alternative 2 (As provided by Nemai Consulting)

1.3 Specialist Details

Report Name	**THE TERRESTRIAL ECOLOGY BASELINE & IMPACT ASSESSMENT FOR THE PROPOSED ALTINA SOLAR PHOTOVOLTAIC DEVELOPMENT**
Reference	**ALTINA SOLAR PV**
Submitted to	NEMAI CONSULTING
Report Writer (Desktop)	**Jan Jacobs**
	Jan Jacobs completed his BSc Honours degree in Biodiversity and Conservation Biology at the University of the Western Cape in 2016. He completed his Master of Applied Science degree in Nature Conservation at the Tshwane University of Technology in 2022.
Report Writer	**Carami Burger**
	Carami Burger has completed her Bachelor of Science Honours degree in Ecological Interactions and Ecosystem Resilience. Carami is an ecologist and has completed various studies as part of Basic Assessments and Environmental Impact Assessments.
Reviewer	**Andrew Husted**
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
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.

2 Scope of Work

The principle aim of the assessment was to provide information to guide the risk of the proposed activity to the flora and fauna communities of the associated ecosystems within the project area. This was achieved through the following:

- Desktop assessment to identify the relevant ecologically important geographical features within the project area;
- Desktop assessment to compile an expected species list and possible threatened flora and fauna species that occur within the project area;
- Field survey to ascertain the species composition of the present flora and fauna community within the project area;
- Delineate and map the habitats and their respective sensitivities that occur within the project area;
- 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.

3 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 3-1 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 3-1 A list of key legislative requirements relevant to biodiversity and conservation in the Free State Province

Region	Legislation / Guideline
International	Convention on Biological Diversity (CBD, 1993)
	The Convention on Wetlands (RAMSAR Convention, 1971)
	The United Nations Framework Convention on Climate Change (UNFCC,1994)
	The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973)
	The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)
National	Constitution of the Republic of South Africa (Act No. 108 of 1996)
	The National Environmental Management Act (NEMA) (Act No. 107 of 1998)
	The National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004), Threatened or Protected Species Regulations
	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)
	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)
	The National Environmental Management: Waste Act, 2008 (Act 59 of 2008);
	The Environment Conservation Act (Act No. 73 of 1989)
	National Protected Areas Expansion Strategy (NPAES)
	Natural Scientific Professions Act (Act No. 27 of 2003)
	National Biodiversity Framework (NBF, 2009)
	National Forest Act (Act No. 84 of 1998)
	National Veld and Forest Fire Act (101 of 1998)

	National Water Act (NWA) (Act No. 36 of 1998)
	National Spatial Biodiversity Assessment (NSBA)
	World Heritage Convention Act (Act No. 49 of 1999)
	Municipal Systems Act (Act No. 32 of 2000)
	Alien and Invasive Species Regulations and, Alien and Invasive Species List 20142020, published under NEMBA
	South Africa's National Biodiversity Strategy and Action Plan (NBSAP)
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)
	Sustainable Utilisation of Agricultural Resources (Draft Legislation).
	White Paper on Biodiversity
Provincial	Boputhatswana Nature Conservation Act 3 of 1973
	Free State Nature Conservation Ordinance 8 of 1969

4 Methods

4.1 Project Area

The project area is located in the northern part of the Free State Province and falls within the Fezile Dabi District Municipality and Moqhaka Local Municipality. The project area is situated approximately 7 km to the south of the town of Orkney and is traversed by the R76 (Figure 4-1).

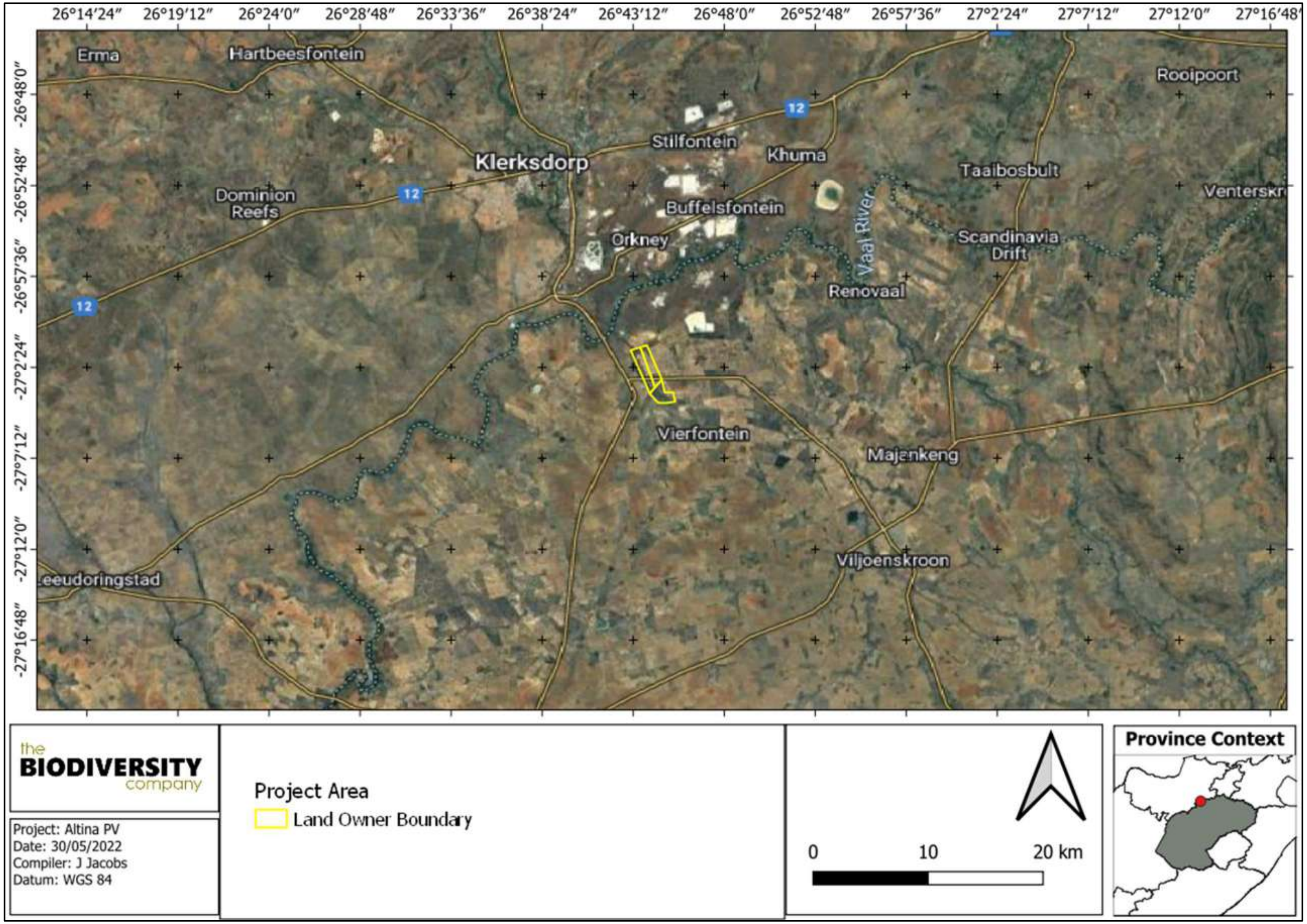


Figure 4-1 Map illustrating the location of the proposed project area

4.2 Desktop Assessment

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

4.2.1 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.

- Free State Biodiversity Sector Plan

- The Free State CBA classified areas within the province on the basis of its contribution to reach the conservation targets within the province. The C-Plan uses the following terms to categorise the various land used types according to their biodiversity and environmental importance:

- Critical Biodiversity Area (CBA);

- Ecological Support Area (ESA); and

- Other Natural Areas (ONA).

- In the spatial datasets a further distinction is made between CBAs that are likely to be in a natural condition (CBA 1) and those that are potentially degraded or represent secondary vegetation (CBA

2). This distinction is based on best available land cover data. Similarly, a distinction is made between ESAs that are likely to be functional (i.e., in a natural, near-natural or moderately degraded condition; ESA 1), and Ecological Support Areas that are likely severely degraded or have no natural cover remaining and therefore require restoration where feasible (ESA 2).

- It is important to note that the Critical Biodiversity Areas (CBA) map accounts for terrestrial fauna and flora only. The inclusion of the aquatic component was limited to the Freshwater Ecosystem Priority Areas (FEPA) catchments (included in the cost layer and for the identification of Ecological Support Areas (ESAs)) and wetland clusters (included in the ESAs only).

- A CBA is considered a significant and ecologically sensitive area and needs to be kept in a pristine or near-natural state to ensure the continued functioning of ecosystems (SANBI, 2017). A CBA represents the best choice for achieving biodiversity targets. ESAs are not essential for achieving targets, but they play a vital role in the continued functioning of ecosystems and often are essential for proper functioning of adjacent CBAs.

- 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

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

4.2.2 Desktop Flora Assessment

The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) and SANBI (2019) 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 project area (Figure 4-2). 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.

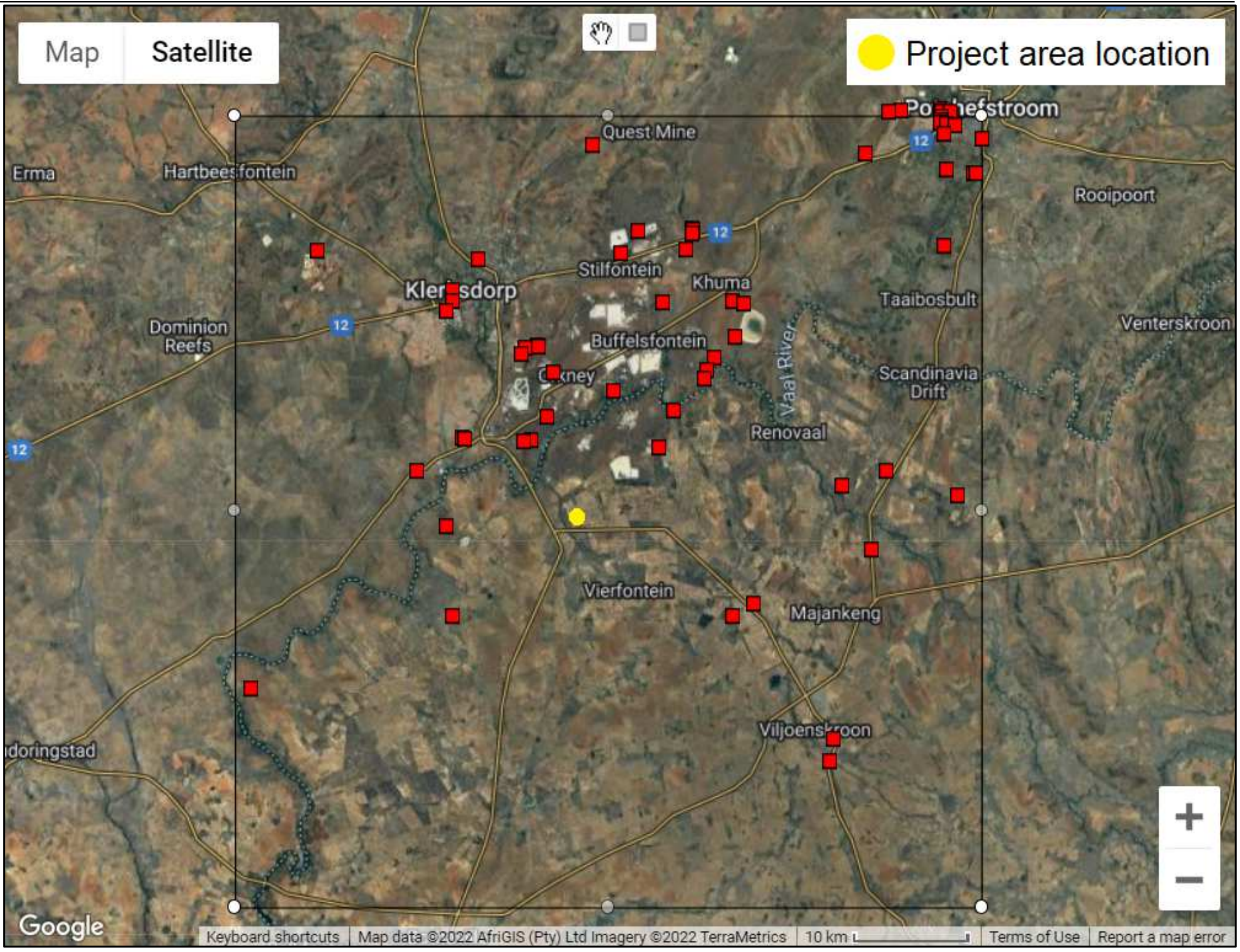


Figure 4-2 ***Map illustrating extent of area used to obtain the expected flora species list from the Plants of South Africa (POSA) database. Yellow dot indicates approximate location of the project area. The red squares are cluster markers of botanical records as per POSA data.***

4.2.3 Desktop Faunal Assessment

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

- Amphibian list, generated from the IUCN spatial dataset (2017) and AmphibianMap database (Fitzpatrick Institute of African Ornithology, 2021a), using the 2726 quarter degree square;
- Reptile list, generated from the IUCN spatial dataset (2017) and ReptileMap database (Fitzpatrick Institute of African Ornithology, 2021b), using the 2726 quarter degree square; and
- Mammal list from the IUCN spatial dataset (2017).

4.3 Biodiversity Field Assessment

A single field survey was undertaken in May 2022, which is a dry-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.

4.3.1 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 project area.

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 project areas.

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 project area.

4.3.2 Fauna Survey

The faunal assessment within this report pertains to herpetofauna (amphibians and reptiles) and mammals. A separate avifauna impact assessment was conducted in April 2022. 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.); and
- Utilization of local knowledge.

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);
- A Field Guide to the Tracks and Signs of Southern and East African Wildlife (Stuart and Stuart, 2000).

4.4 Terrestrial Site Ecological Importance

The different habitat types within the project area 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 4-1 and Table 4-2, respectively.

Table 4-1 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 4-2 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 4-3.

Table 4-3 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

Biodiversity Importance (BI)		Conservation Importance (CI)				
		Very high	High	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 4-4.

Table 4-4 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 4-5.

Table 4-5 Matrix used to derive Site Ecological Importance from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance		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 4-6.

Table 4-6 Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities

Site Ecological Importance	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.

Site Ecological Importance	Interpretation in relation to proposed development 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.

5 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- The assessment area was based on the area provided by the client and any alterations to the route and/or missing GIS information pertaining to the assessment area would have affected the area surveyed;
- The area was only surveyed during a single site visit and therefore, this assessment does not consider temporal trends;
- Only a single season survey will be conducted for the respective studies, this would constitute a dry season survey with its limitations;
- Flora identification is limited due to the lack of aboveground plant parts used to determine species, especially in regard to bulbous plants, the vegetation was dry, and most plants had already lost the green flush;
- It must be noted that during the survey, only a fraction of the expected geophytes were visible due to their variable emergence patterns.
- Whilst every effort is made to cover as much of the project area as possible, representative sampling is completed and by its nature, it is possible that some plant and animal species that are present across the project area were not recorded during the field investigations.

6 Results & Discussion

6.1 Desktop Assessment

6.1.1 Ecologically Important Landscape Features

The GIS analysis pertaining to the relevance of the proposed project to ecologically important landscape features are summarised in Table 6-1.

Table 6-1 Summary of relevance of the proposed project to ecologically important landscape features.

Desktop Information Considered	Relevant/Irrelevant	Section
Ecosystem Threat Status	Relevant – Overlaps with an Endangered Ecosystem	6.1.1.1
Ecosystem Protection Level	Relevant – Overlaps with a Not Protected Ecosystem	6.1.1.2
Protected Areas	Relevant – Lies 3.7 km from the closest Protected Area.	6.1.1.3
Renewable Energy Development Zones	Relevant – Overlaps with the Klerksdorp REDZ.	6.1.1.4
Powerline Corridor	Relevant – The project area falls within the Central Corridor.	-
Critical Biodiversity Area	Relevant – The project area overlaps with three CBA1s, a CBA2, an ESA2 and an ONA area.	6.1.1.5
National Protected Areas Expansion Strategy	Irrelevant – The project area does not overlap with a NPAES Priority Focus Area.	6.1.1.6
Important Bird and Biodiversity Areas	Irrelevant – Located 72 km from the Sandveld and Bloemhof Dam Nature Reserves.	-

6.1.1.1 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 area overlaps with an EN ecosystem (Figure 6-1).

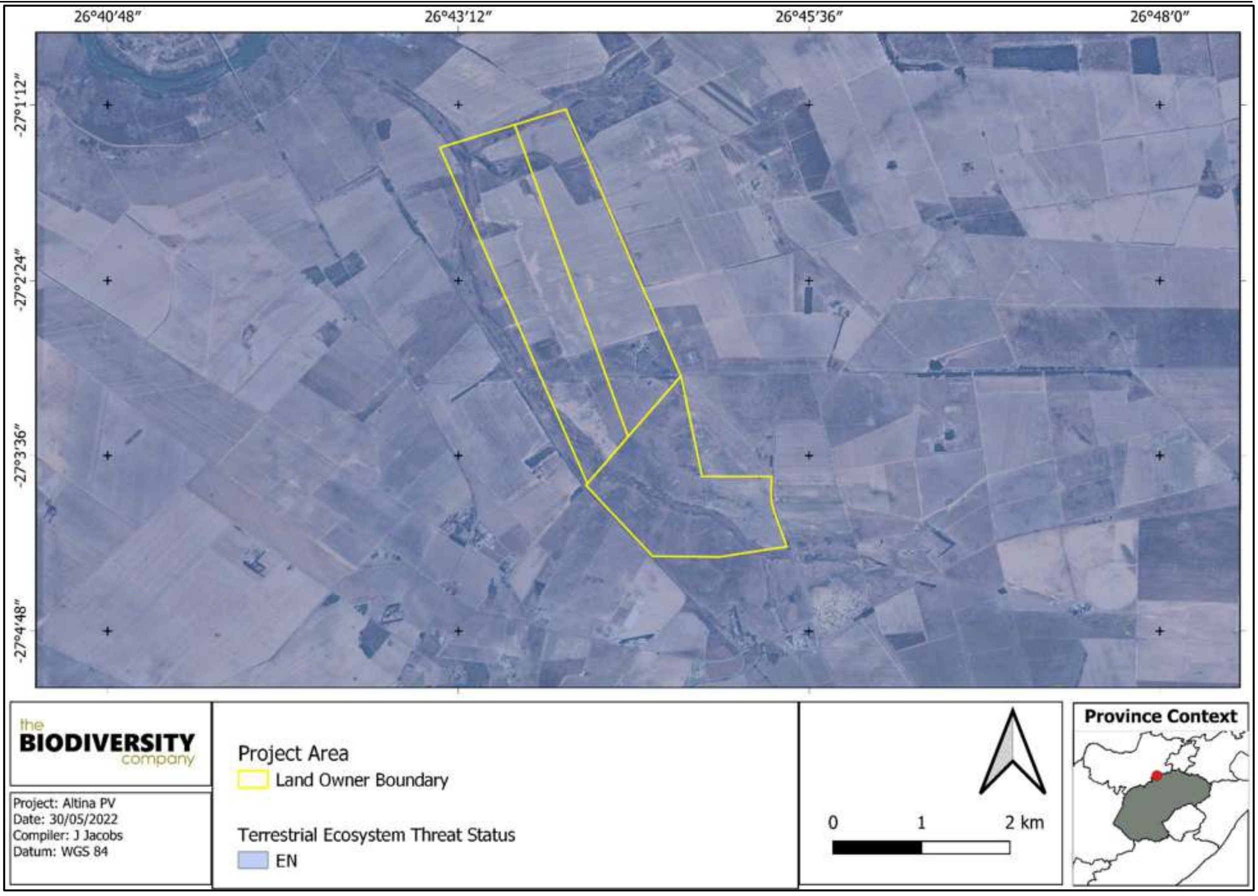


Figure 6-1 Map illustrating the ecosystem threat status associated with the project area.

6.1.1.2 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 proposed project overlaps with a Not Protected ecosystem (Figure 6-2).

Figure 6-2 Map illustrating the ecosystem protection level associated with the project area

6.1.1.3 Protected Areas

According to the spatial data for SAPAD (2021) and SACAD (2021), the project area lies 3.7 km South-East from Mispah Game Farm, and is thus within the 5 km Protected Area Buffer Zone of this game farm. Boskoppie Game Reserve is located 6.5 km North-West from the project area.

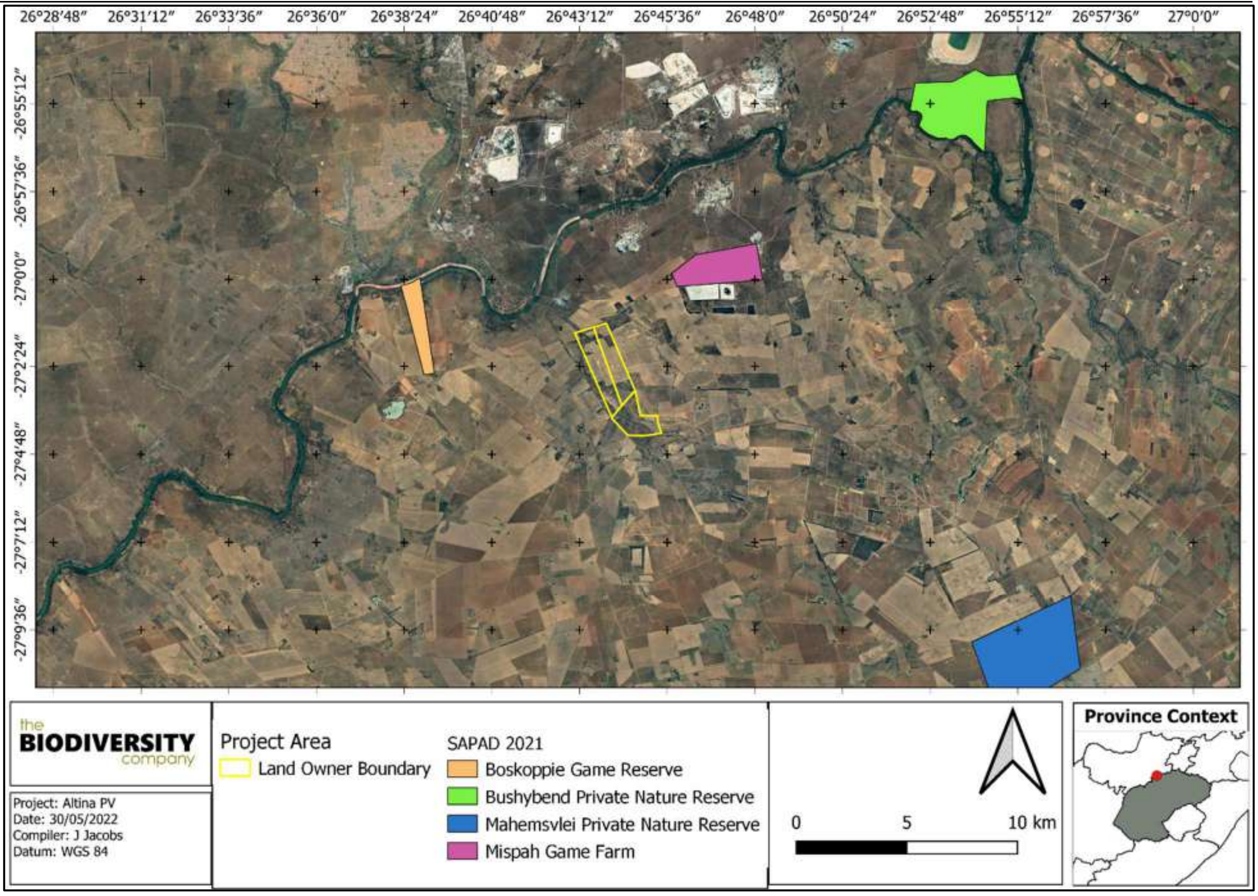


Figure 6-3 Map illustrating the project area in relation to the nearest protected areas

6.1.1.4 Renewable Energy Development Zones (REDZ)

In 2018 the Government Notice No. 114 in Government Gazette No. 41445 was published where 8 renewable energy development zones important for the development of large scale wind and solar photovoltaic facilities were identified. In 2021 an additional 3 sites were included. The REDZs were identified through the undertaking of 2 Strategic Environmental Assessments. The spatial dataset indicated that the project area overlaps with the Phase 2 Klerksdorp REDZ (Figure 6-4).

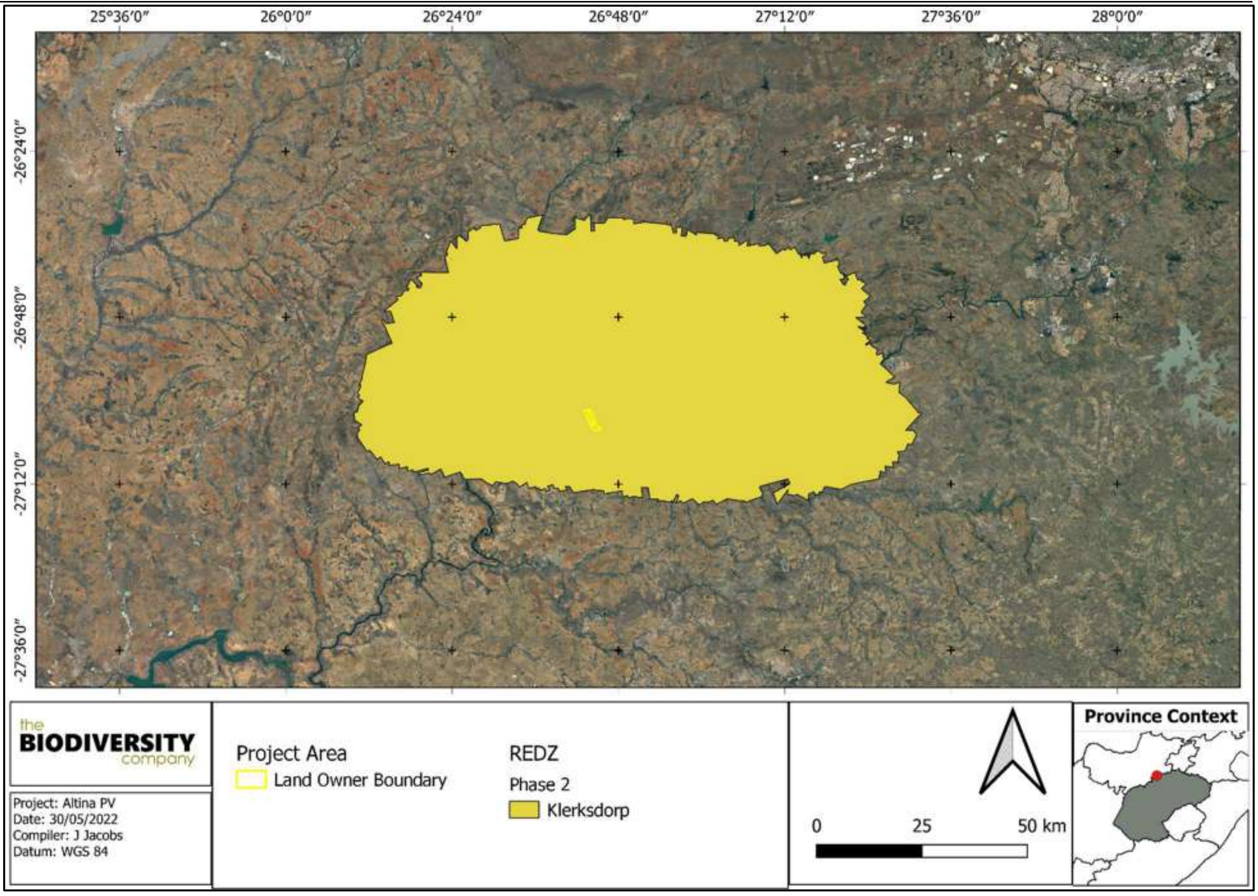


Figure 6-4 The project area in relation to the REDZ

6.1.1.5 Critical Biodiversity Areas and Ecological Support Areas

The key output of a systematic biodiversity plan is a map of biodiversity priority areas. The CBA map delineates Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Other Natural Areas (ONAs), Protected Areas (PAs), and areas that have been irreversibly modified from their natural state.

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI-BGIS, 2017).

Ecological Support Areas (ESAs) are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic (SANBI-BGIS, 2017).

Other Natural Areas (ONAs) consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs. A biodiversity sector plan or bioregional plan must not specify the desired state/management objectives for ONAs or provide land-use guidelines for ONAs (SANBI-BGIS, 2017).

Figure 6-5 shows the project area superimposed on the Terrestrial CBA map. The project area overlaps with CBA1s, an ESA2, ONA and degraded areas.

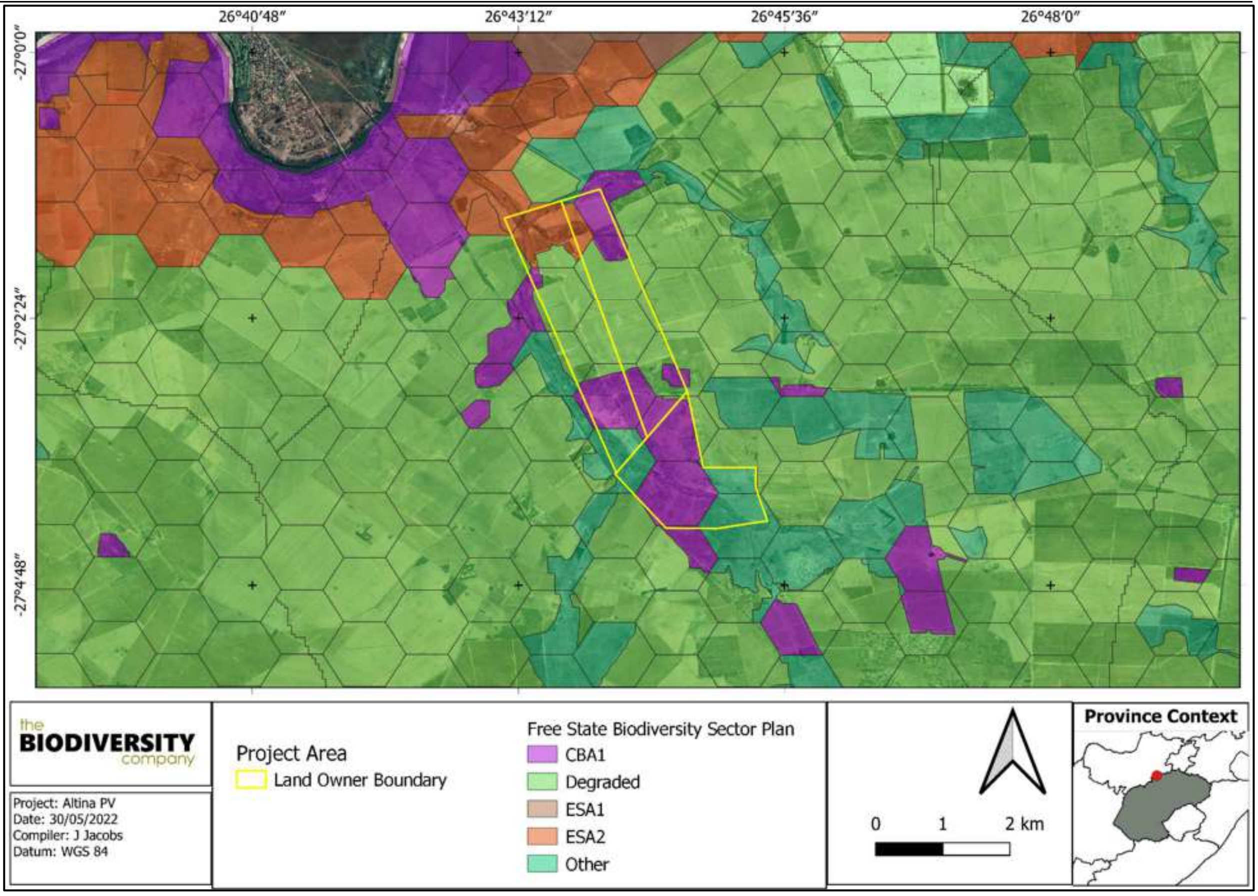


Figure 6-5 Map illustrating the locations of CBAs in the project area

6.1.1.6 National Protected Area Expansion Strategy

National Protected Area Expansion Strategy 2017 (NPAES) were identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for finescale planning which may identify a range of different priority sites based on local requirements, constraints and opportunities (NPAES, 2017). The project area does not overlap with any Priority Focus Areas, as per the NPAES (Figure 6-6).

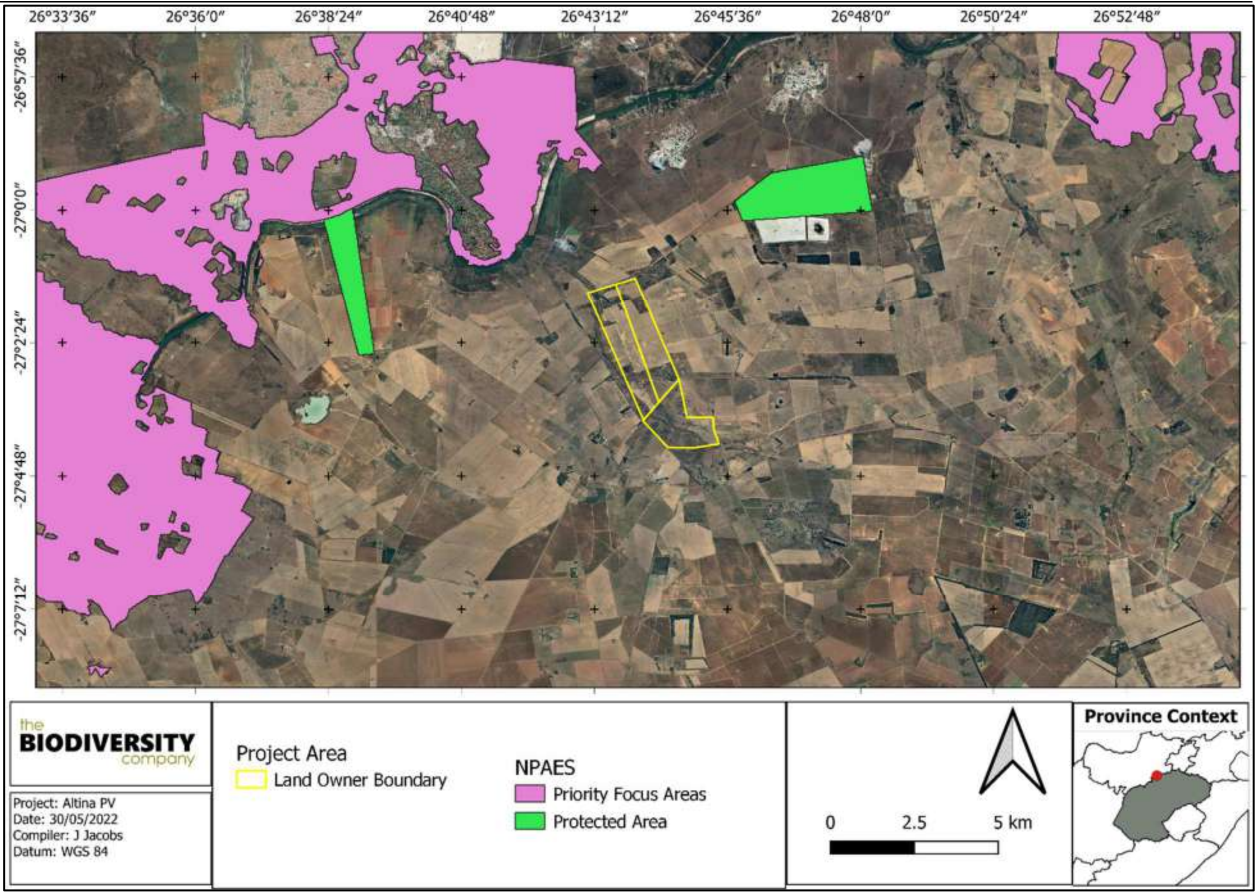


Figure 6-6 The project area in relation to the National Protected Area Expansion Strategy

6.1.1.7 Renewable Energy Projects

The South African Renewable Energy EIA Application Database (REEA) contains spatial data for renewable energy applications for environmental authorisation. It includes spatial and attribute information for both active (in process and with valid authorisations) and non-active (lapsed or replaced by amendments) applications. Data is captured and managed on a parcels level as well as aggregated to the project level. Only outer boundaries are provided in this release. The purpose of the spatial data is to produce and maintain a comprehensive spatial database on renewable energy EIA applications in the country. The database is suitable for a wide range of planning, assessment, analysis and display purposes. Several existing and planned applications for developments are found in the vicinity of the project site (Figure 6-7). The data used to determine the number of applications in the nearby area were obtained from SA Renewable Energy EIA Application Database (REEA) (https://egis.environment.gov.za/) and were accurate as per 31 August 2021.

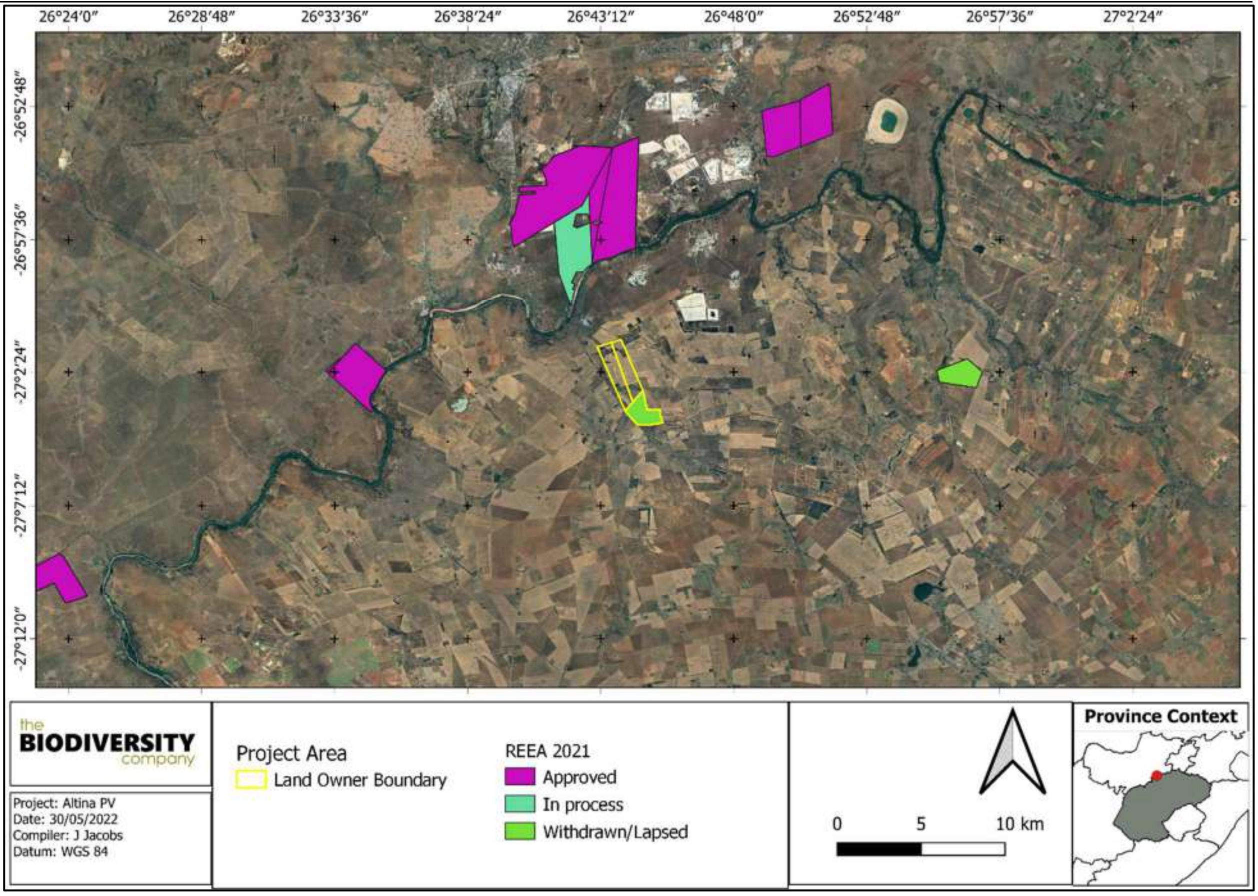


Figure 6-7 Renewable energy applications and projects close to the project area

6.1.2 Flora Assessment

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

6.1.2.1 Vegetation Type

The project area is situated within the Grassland biome.

Grassland biome

In South Africa, the Grassland Biome occurs mainly on the high central plateau (Highveld), the inland areas of the eastern seaboard, the mountainous areas of KwaZulu-Natal (KZN) and the central parts of the Eastern Cape (Mucina & Rutherford, 2006). However, grasslands can also be found below the Drakensberg, both in KZN and the Eastern Cape, with floristic links to the high-altitude Drakensberg grassland (Mucina & Rutherford, 2006). The topography is mainly flat to rolling, but also includes mountainous regions and the Escarpment (Mucina & Rutherford, 2006). Altitude is mostly from about 300 to 400 m.a.s.l, but reaches up to 3 482 m on Thabana Ntlenyana, the highest mountain in southern Africa (Mucina & Rutherford, 2006).

In terms of climate, the temperate grasslands of the Highveld in South Africa have cold and dry conditions, with rainfall during the summer (which can sometimes be a strong summer rainfall) and winter drought (Mucina & Rutherford, 2006). Frost is common and there is a high risk of lightning-induced fires (Mucina & Rutherford, 2006).

In terms of vegetation structural composition, grasslands are characteristically dominated by grasses of the Poaceae Family (Mucina & Rutherford, 2006). On the Lesotho Plateau and highest peaks of the Drakensberg, grassland plants xeromorphic characteristics due to the severity of the climate in these places (Mucina & Rutherford, 2006).

On a fine-scale vegetation type, the project area overlaps with the Vaal-Vet Sandy Grassland (Figure 6-8).

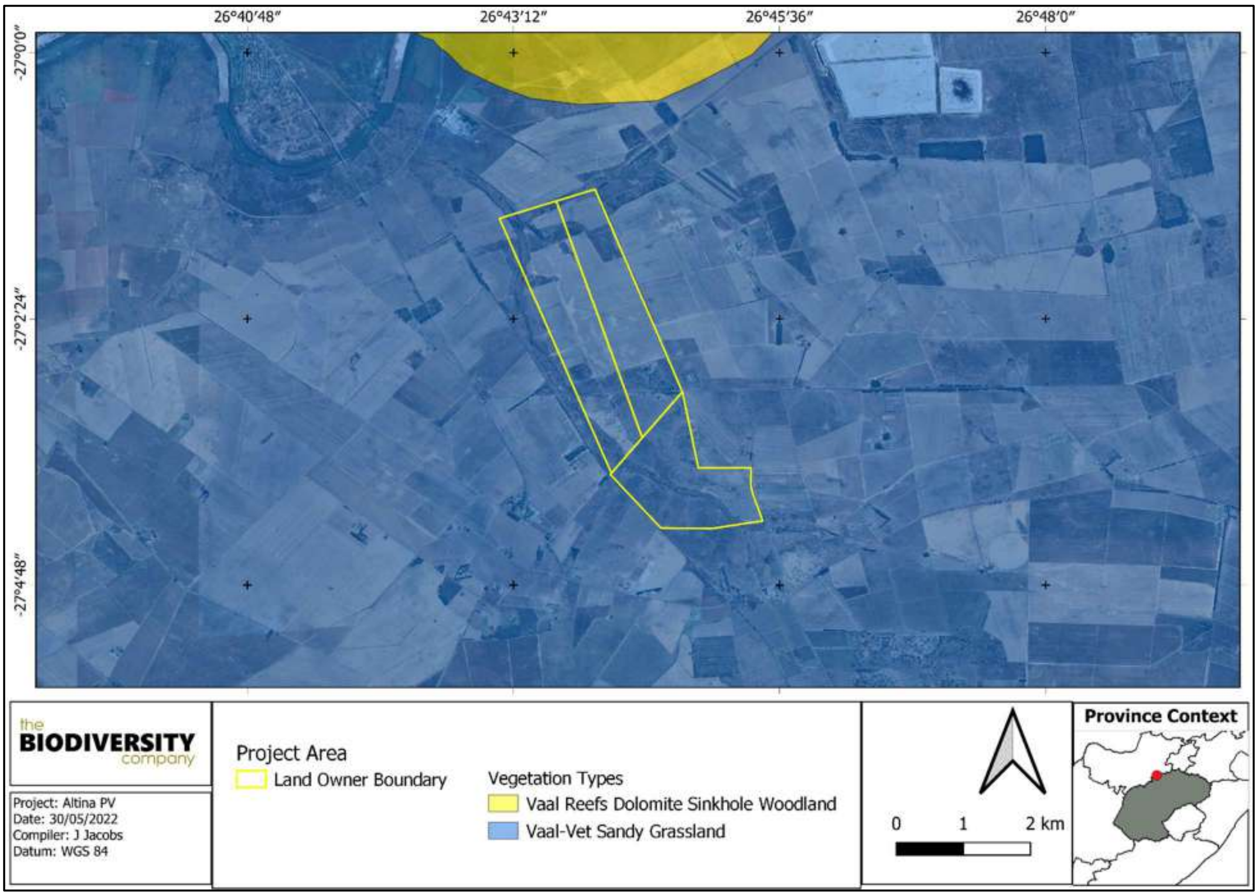


Figure 6-8 Map illustrating the vegetation type associated with the project area.

6.1.2.1.1 Vaal-Vet Sandy Grassland

The Vaal-Vet Sandy Grassland occurs on a plains-dominated landscape with some scattered, slightly irregular undulating plains and hills (Mucina & Rutherford, 2006). In terms of plant types, it consists mainly of low-tussock grasslands with an abundant karroid element (Mucina & Rutherford, 2006). It occurs in the North-West and Free State Provinces at altitudes of 1 260 to 1 360 m (Mucina & Rutherford, 2006).

Important Taxa (d = dominant)

Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha, Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*.

Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana, Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*.

Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*.

Succulent Herb: *Tripteris aghillana* var. *integrifolia*.

Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

Endemic Taxa

Herb: *Lessertia phillipsiana*.

Conservation Status

This vegetation is classified as EN, with a conservation target of 24% (Mucina & Rutherford, 2006).

6.1.2.2 Expected Flora Species

The POSA database indicates that 307 species of indigenous plants are expected to occur within the project area. Appendix A provides the list of species and their respective conservation status and endemism. One SCC based on its conservation status could be expected to occur within the project area and are shown in Table 6-2 below.

Table 6-2 Threatened flora species that may occur within the project area

Family	Taxon	Author	IUCN	Ecology
Fabaceae	*Pearsonia bracteata*	(Benth.) Polhill	NT	Indigenous; Endemic

6.1.3 Faunal Assessment

6.1.3.1 Amphibians

Based on the IUCN Red List Spatial Data and AmphibianMap, 17 amphibian species are expected to occur within the area (Appendix B). None are regarded as threatened.

6.1.3.2 Reptiles

Based on the IUCN Red List Spatial Data and the ReptileMAP database, 38 reptile species are expected to occur within the area (Appendix C). None are regarded as threatened.

6.1.3.3 Mammals

The IUCN Red List Spatial Data lists 81 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. Twelve of these expected species are regarded as threatened (Table 6-3**Error! Reference source not found.**), six of these have a low likelihood of occurrence based on the lack of suitable habitat and the level of disturbance nearby to the project area.

Table 6-3 Threatened mammal species that are expected to occur within the project area.

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional (SANBI, 2016)	IUCN (2021)	
Aonyx capensis	Cape Clawless Otter	NT	NT	Moderate
Atelerix frontalis	South African Hedgehog	NT	LC	Moderate
Crocidura maquassiensis	Makwassie Musk Shrew	VU	LC	Low
Eidolon helvum	African Straw-coloured Fruit Bat	LC	NT	Low
Felis nigripes	Black-footed Cat	VU	VU	Moderate
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	Moderate
Leptailurus serval	Serval	NT	LC	Moderate
Mystromys albicaudatus	White-tailed Rat	VU	EN	Low
Panthera pardus	Leopard	VU	VU	Low
Parahyaena brunnea	Brown Hyaena	NT	NT	Low
Poecilogale albinucha	African Striped Weasel	NT	LC	Low

Aonyx capensis (Cape Clawless Otter) is the most widely distributed otter species in Africa (IUCN, 2017). This species is predominantly aquatic, and it is seldom found far from water. Based on the presence of a nearby wetland area and seasonal stream, the likelihood of occurrence of this species occurring in the project area is considered to be moderate.

Atelerix frontalis (South African Hedgehog) has a tolerance of a degree of habitat modification and occurs in a wide variety of semi-arid and sub-temperate habitats (IUCN, 2017). Based on the Red List of Mammals of South Africa, Lesotho and Swaziland (2016), *A. frontalis* populations are decreasing due to the threats of electrocution, veld fires, road collisions, predation from domestic pets and illegal harvesting. Although the species is cryptic and therefore not often seen, there is suitable habitat in the project area and therefore the likelihood of occurrence is rated as moderate.

Felis nigripes (Black-footed cat) is endemic to the arid regions of southern Africa. This species is naturally rare, has cryptic colouring is small in size and is nocturnal. These factors have contributed to a lack of information on this species. Given that the highest densities of this species have been recorded in the more arid Karoo region of South Africa, the habitat in the project area can be considered to be sub-optimal for the species and the likelihood of occurrence is rated as moderate.

Hydrictis maculicollis (Spotted-necked Otter) inhabits freshwater habitats where water is un-silted, unpolluted, and rich in small to medium sized fishes (IUCN, 2017). Suitable habitat may be available in across the project area and therefore the likelihood of occurrence is moderate.

Leptailurus serval (Serval) occurs widely through sub-Saharan Africa and is commonly recorded from most major national parks and reserves (IUCN, 2017). The Serval's status outside reserves is not certain, but they are inconspicuous and may be common in suitable habitat as they are tolerant of farming practices provided there is cover and food available. In sub-Saharan Africa, they are found in habitat with well-watered savanna long-grass environments and are particularly associated with reedbeds and other riparian vegetation types. Large areas of grasslands are present in the project area and as such the likelihood of occurrence is rated as moderate.

6.2 Field Assessment

The following sections provide the results from the field survey for the proposed development that was undertaken the 23rd to the 24th of May 2022.

6.2.1 Flora Assessment

This section is divided into two sections:

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

6.2.1.1 Indigenous Flora

The vegetation assessment was conducted throughout the extent of the project area. A total of 49 tree, shrub, herbaceous and graminoid plant species were recorded in the project area during the field assessment (Table 6-4). Plants listed as Category 1 alien or invasive species under the NEMBA appear in green text. Plants listed in Category 2 or as 'not indigenous' or 'naturalised' according to NEMBA, appear in blue text. Some of the plant species recorded can be seen in Figure 6-9.

The list of plant species recorded to 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 however regarded as a sound representation of the local flora for the project Area.

Table 6-4 Trees, shrub and herbaceous plant species recorded in the project area

Family	Scientific Name	Common Name	Threat Status (SANBI, 2017)	SA Endemic	Alien Category
Acanthaceae	*Barleria macrostegia*	Tongklapper	LC	Not Endemic	
Anacardiaceae	*Searsia lancea*	Karee	LC	Not Endemic	
Apocynaceae	*Gomphocarpus tomentosus subsp. tomentosus*	Woolly Milkweed	LC	Not Endemic	
Asparagaceae	*Asparagus laricinus*	Cluster-leaf asparagus	LC	Not Endemic	
Asparagaceae	*Agave americana*	Sentry plant	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 3 in Western Cape
Asphodelaceae	*Aloe greatheadii*	Spotted Aloe	LC-Sched 6 Protected	Not Endemic	
Asteraceae	*Bidens pilosa*	Blackjack	NE	Not Endemic	
Asteraceae	*Seriphium plumosum*	Bankrupt Bush	LC	Not Endemic	
Asteraceae	*Cirsium vulgare*	Spear Thistle, Scotch Thistle	NE	Not Indigenous; Naturalised; Invasive	NEMBA Category 1b
Asteraceae	*Conyza bonariensis*	Flax-leaf Fleabane	NE	Not Indigenous; Naturalized exotic weed	
Asteraceae	*Tagetes minuta*	Khaki Bush, Khaki Weed, African Marigold	NE	Not Indigenous; Naturalized exotic weed	
Asteraceae	*Hilliardiella oligocephala*	Bicoloured-leaved vernonia	LC	Not Endemic	
Asteraceae	*Berkheya radula*	Boesmanrietjie	LC	Not Endemic	
Asteraceae	*Osteospermum muricatum subsp. muricatum*	Bietou	LC	Not Endemic	
Campanulaceae	*Wahlenbergia undulata*	African Bluebell	LC	Not Endemic	
Casuarinaceae	*Casuarina equisetifolia*	Horsetail Casuarina	NE	Not Indigenous	NEMBA Category 2
Cyperaceae	*Schoenoplectus corymbosus*	Plume sedge	LC	Not Endemic	
Fabaceae	*Vachellia karroo*	Sweet Thorn	LC	Not Endemic	
Fabaceae	*Crotalaria agatiflora*	Canary Bird Bush	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 1b
Meliaceae	*Melia azedarach*	Chinaberry	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 1b
Myrtaceae	*Eucalyptus grandis*	Saligna Gum	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 1b
Poaceae	*Aristida congesta subsp. congesta*	Tassel Three-awned Grass	LC	Not Endemic	

Poaceae	*Chloris gayana*	Rhodes grass	LC	Not Endemic	
Poaceae	*Cymbopogon caesius*	Broad-Leaved Turpentine Grass	LC	Not Endemic	
Poaceae	*Cynodon dactylon*	Couch Grass	LC	Not Endemic	
Poaceae	*Eragrostis chloromelas*	Blue Lovegrass	LC	Not Endemic	
Poaceae	*Eragrostis curvula*	Weeping Love Grass	LC	Not Endemic	
Poaceae	*Eragrostis gummiflua*	Gum grass	LC	Not Endemic	
Poaceae	*Panicum coloratum*	Bamboeskweek	LC	Not Endemic	
Poaceae	*Themeda triandra*	Red Grass	LC	Not Endemic	
Poaceae	*Digitaria eriantha*	Finger Grass	LC	Not Endemic	
Poaceae	*Hyparrhenia hirta*	Common Thatching Grass, Blougras (a)	LC	Not Endemic	
Poaceae	*Melinis repens*	Natal Red Top	LC	Indigenous, Not Endemic	
Poaceae	*Setaria sphacelata var. sphacelata*	Common bristle grass; Golden Timothy Grass	LC	Indigenous, Not Endemic	
Poaceae	*Sporobolus africanus*	Ratstail Dropseed; Rush Grass	LC	Not Endemic	
Poaceae	*Zea mays*	Corn			
Poaceae	*Imperata cylindrica*	Beady Grass, Bedding Grass, Cotton-Wool Grass, Silky Grass	LC	Not Endemic	
Poaceae	*Arundo donax*	Giant Reed	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 1b
Poaceae	*Eragrostis superba*	Flat-Seed Love Grass	LC	Not Endemic	
Poaceae	*Phragmites australis*	Common Reed	LC	Not Endemic	
Poaceae	*Pogonarthria squarrosa*	Herringbone Grass	LC	Not Endemic	
Poaceae	*Cortaderia selloana*	Pampas grass		Not Indigenous	NEMBA Category 1b
Rhamnaceae	*Ziziphus mucronata subsp. mucronata*	Buffalo Thorn, Wait-a-bit	LC	Indigenous, Not Endemic	
Rosaceae	*Prunus persica*	Peach	NE	Naturalized exotic weed	
Scrophulariaceae	*Selago densiflora*		LC	Not Endemic	
Solanaceae	*Datura ferox*	Large Thorn Apple	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 1b
Solanaceae	*Solanum sisymbriifolium*	Wild Tomato, Dense; Thorned Bitter Apple	NE	Not Indigenous; Naturalized exotic weed	NEMBA Category 1b

Typhaceae	*Typha capensis*	Bulrush, Common Cattail	LC	Not Endemic	
Verbenaceae	*Verbena bonariensis*	Wild Verbena			NEMBA Category 1b

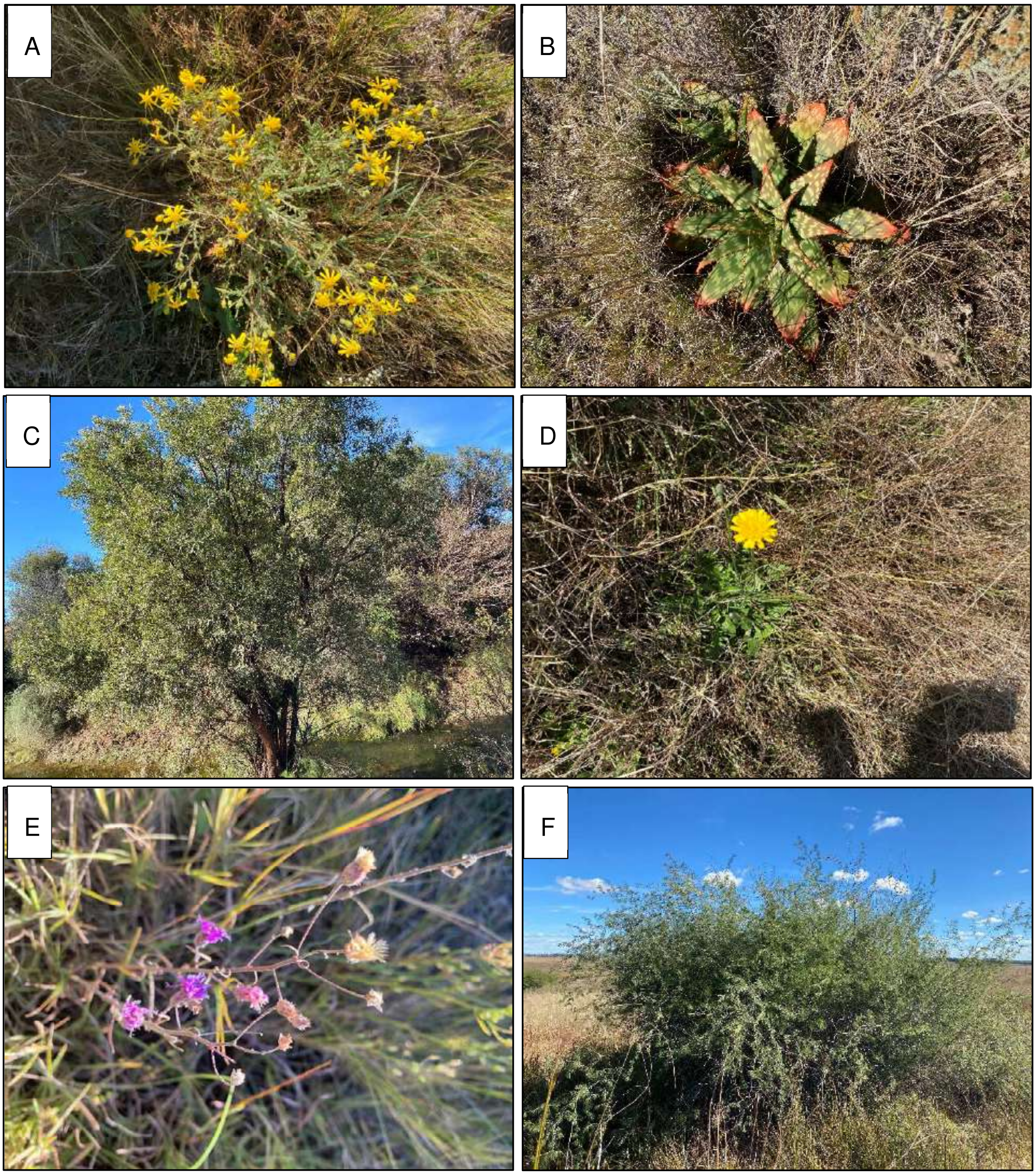


Figure 6-9 ***Photographs illustrating some of the flora recorded within the assessment area. A) Osteospermum muricatum, B) Aloe greatheadii (protected), (C) Searsia lancea, D) Berkheya radula, E) Hilliardiella oligocephala, F) Asparagus laricinus.***

6.2.1.2 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. 44182, 24th of February 2021. The legislation calls for the removal and / or control of IAP 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.

Twelve (12) IAP species were recorded within the project area. Nine (9) 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.

6.2.2 Faunal Assessment

Herpetofauna and mammal observations and recordings fall under this section. A separate Avifauna impact assessment was conducted for the avifauna species associated with the project area.

6.2.2.1 Amphibians and Reptiles

One (1) amphibian specie was recorded in the project area during survey period, namely *Amietia fuscigula* (Common River Frog) (Table 6-5). However, due to the presence of various wetlands across the project area providing suitable habitat there is a possibility of more amphibian species being present. No reptile species were recorded during the survey period observed. However, there is the possibility of several species being present, as certain reptile species are secretive and longer-term surveys are required in order to ensure adequate sampling. None of the herpetofauna species recorded are regarded as threatened.

Table 6-5 Summary of herpetofauna species recorded within the project area.

Family	Species	Common Name	Conservation Status		Free State Nature Conservation Ordinance 8 of 1969
			Regional (SANBI, 2016)	IUCN (2021)	
Pyxicephalidae	*Amietia fuscigula*	Common River Frog	LC	LC	-

Figure 6-10 Photograph illustrating the amphibian species recorded within the assessment area. Common River Frog (Amietia fuscigula).

6.2.2.2 Mammals

Ten (10) mammal species were observed during this survey of the project area (Table 6-6) based on either direct observation or the presence of visual tracks and signs (Figure 6-11). None of the species recorded are regarded as a SCC. Five mammal species are provincially protected.

Table 6-6 Summary of mammal species recorded within the project area

Species	Common Name	Conservation Status		Free State Nature Conservation Ordinance 8 of 1969
		Regional (SANBI, 2016)	IUCN (2021)	
Antidorcas marsupialis	Springbok	LC	LC	Schedule 2
Canis mesomelas	Black-backed Jackal	LC	LC	
Cryptomys hottentotus	Common Mole-rat	LC	LC	
Cynictis penicillata	Yellow Mongoose	LC	LC	
Damaliscus pygargus	Blesbok	LC	LC	Schedule 2
Hystrix africaeaustralis	Cape Porcupine	LC	LC	

Lepus saxatilis	Scrub Hare	LC	LC	Schedule 2
Raphicerus campestris	Steenbok	LC	LC	Schedule 2
Sylvicapra grimmia	Common Duiker	LC	LC	Schedule 2
Xerus inauris	Cape Ground Squirrel	LC	LC	

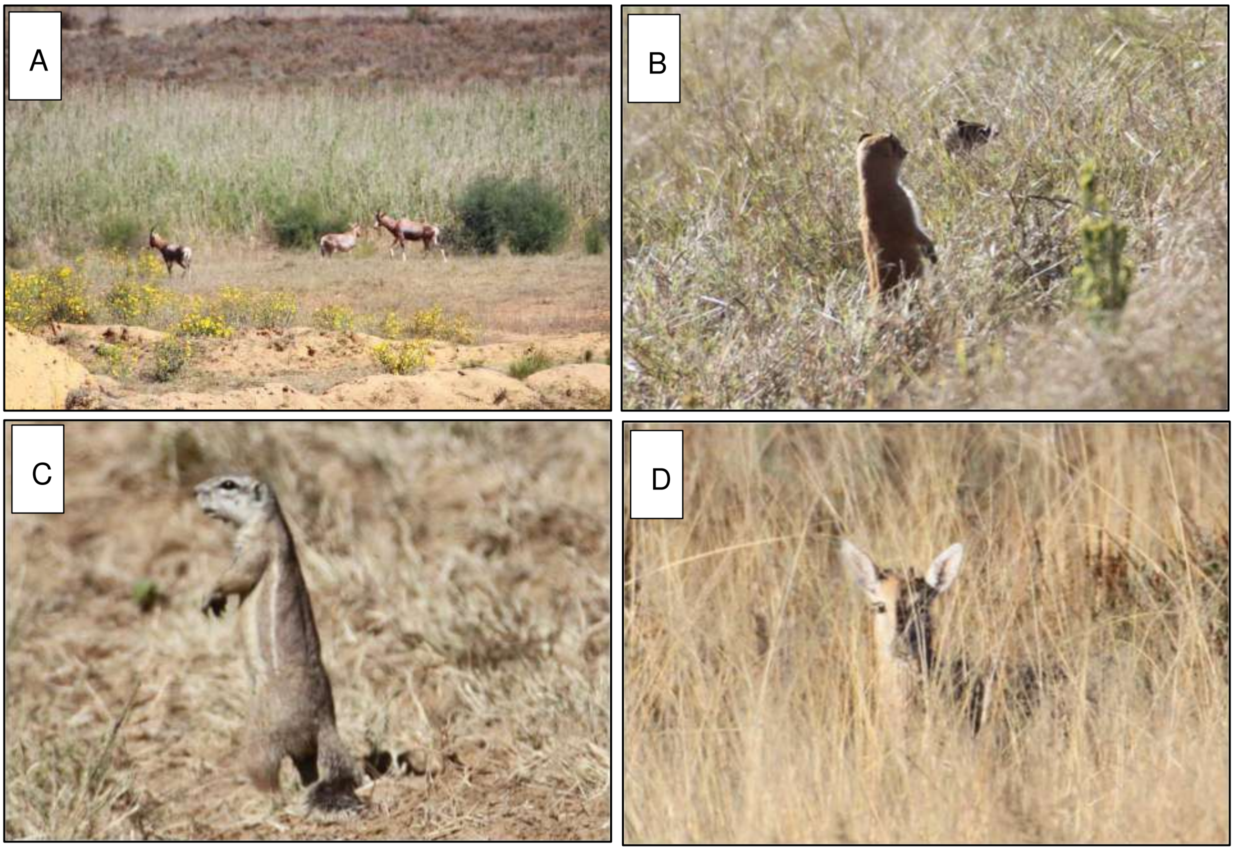


Figure 6-11 ***Photograph illustrating some of the mammal species recorded in the project area. A) Blesbok (Damaliscus pygargus), B)*** **Yellow Mongoose** ***(Cynictis penicillata), C)*** **Cape Ground Squirrel** ***(Xerus inauris)*** **and D) Common Duiker (*Sylvicapra grimmia*).**

7 Habitat Assessment and Site Ecological Importance

7.1 Habitat Assessment

The main habitat types identified across the project area were initially identified largely based on aerial imagery. These main habitat types were refined based on the field coverage and data collected during the survey; the delineated habitats can be seen in Figure 7-1. Emphasis was placed on limiting timed meander searches along the proposed project area within the natural habitats and therefore habitats with a higher potential of hosting SCC.

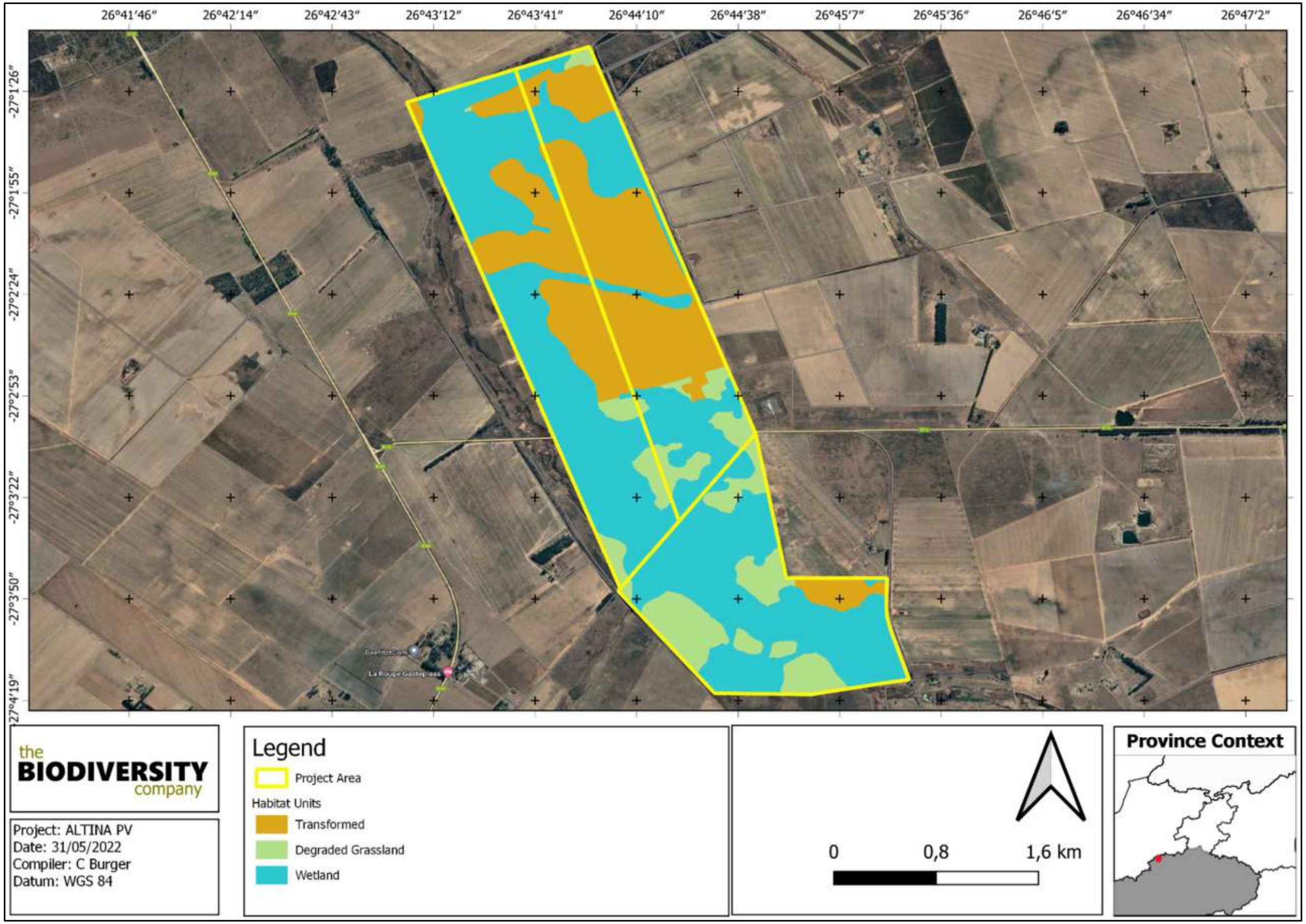


Figure 7-1 Habitats identified in the project area.

7.1.1 Degraded Vaal-Vet Sandy Grassland

Degraded Vaal-Vet Sandy Grassland was identified in scattered patches along the project area. This habitat unit is mainly characterised by graminoid species associated with the Vaal-Vet Sandy Grassland vegetation type such as *Aristida congesta, Cynodon dactylon, Eragrostis chloromelas, Pogonarthria squarrosa* and *Eragrostis curvula*. The invasive species *Seriphium plumosum* was however, proliferated throughout the majority of this habitat unit. Additionally, this habitat unit has been exposed to current and historical anthropogenic activities which has decreased the habitat integrity.

The condition within this habitat depends on the extent of the disturbance in some areas being more severe, usually related to one being more overgrazed than the other. As a result of the ongoing and historic disturbances the plant community is no longer considered as being fully representative of the reference vegetation.

The degraded grassland habitat is located adjacent to various seep, channelled valley bottom and floodplain wetlands, and as such still serves as a movement corridor as it creates a link between these systems and its surrounding terrestrial landscape for several faunal species, especially avifauna and mammals.

Figure 7-2 Degraded Grassland

7.1.2 Wetlands

This habitat unit represents the wetland areas located across the project area (Figure 7-3). The wetland assessment where these areas are identified can be found in a separate Wetland Delineation and Impact Assessment Report. Even though somewhat disturbed, the ecological integrity, importance and functioning of these areas play a crucial role as a water resource system and an important habitat for various fauna and flora. The preservation of these systems is an important aspect to consider for the proposed development, even more so due to the high sensitivity of the area according to the various ecological datasets. This habitat needs to be protected and improved due to the role of this habitat as a water resource.

Figure 7-3 Wetlands associated with the project area

7.1.3 Transformed

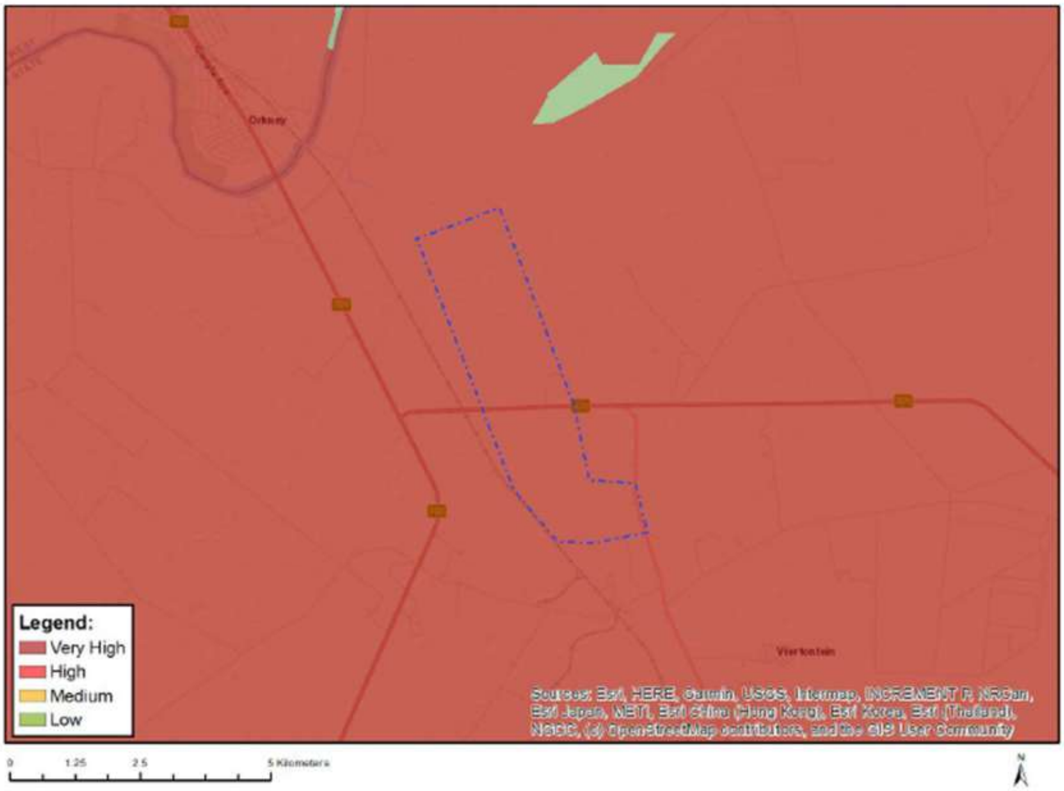
This habitat unit has previously been impacted upon and shows a change from their natural state, with little to no remaining natural vegetation due to land transformation. The transformed habitat predominantly comprised of agricultural fields, roads and residential buildings.

Figure 7-4 Transformed areas associated with the project area

7.2 Site Sensitivity Verification

The biodiversity theme sensitivity, as indicated in the screening report, was derived to be Very High, mainly due to scattered portions in the northern, southern and central portion of the project area being within a CBA 1, a northern portion being an ESA 2 and within an EN ecosystem (Figure 7-5).

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Ecological support area 2
Very High	Endangered ecosystem

Figure 7-5 Terrestrial Biodiversity Theme Sensitivity, National Web based Environmental Screening Tool.

The plant theme sensitivity, as indicated in the screening report, was derived to be Medium, mainly due to the possibility of Sensitive Species 1261 being present in the area (Figure 7-6).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Mammalia-Hydrictis maculicollis

Figure 7-6 Plant Theme Sensitivity, National Web based Environmental Screening Tool.

The animal theme sensitivity, as indicated in the screening report, was derived to be Medium, mainly due to the possibility of *Hydrictis maculicollis* being present in the area (Figure 7-7).

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY

Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1261

Figure 7-7 Animal Theme Sensitivity, National Web based Environmental Screening Tool.

Section 2.2 of the Site Sensitivity Verification requirements were addressed in Section 6.1 and 6.2 of this report. Section 2.3 a) of the Site Sensitivity Verification requirements were addressed in Section 7.2 of this report. Section 2.3 b) of the Site Sensitivity Verification requirements were addressed in Section 7 of this report. This report fulfils the requirements of Section 2.3 c) of the Site Sensitivity Verification.

The completion of the terrestrial biodiversity assessment found that the Degraded Grassland which overlap with the screening report is of medium sensitivity and thus do not corroborate the screening report in that regard. It was also found that the areas classified as CBA1 has been degraded and the alien and invasive species *Seriphium plumosum* has proliferated in these areas.

As per the terms of reference for the project, GIS sensitivity maps are required in order to identify sensitive features in terms of the relevant specialist discipline/s within the project area. The sensitivity scores identified during the field survey for each terrestrial habitat are mapped.

Three (3) different terrestrial habitat types were delineated within the project area, and one set of wetland habitats as a whole. Based on the criteria provided in Section 4.4 of this report, all habitats within the assessment area of the proposed project were allocated a sensitivity category (Table 7-1). The sensitivity of the wetland habitats ranged from high to medium with some of the wetland areas considered to have a high sensitivity predominantly due to the intact unique habitat provided for biodiversity, while some wetland areas are considered to be of medium sensitivity due to the severe transformation that occurred across these areas. The sensitivities of the habitat types delineated are illustrated in Figure 7-8.

Table 7-1 SEI Summary of habitat types delineated within field assessment area of project area

Habitat (Area)	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Wetlands	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 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	Medium	Low	High
Wetlands	Low < 50% of receptor contains natural habitat with limited potential to support SCC.	Low Several minor and major current negative ecological impacts.	Low	Low	Medium
Degraded Grassland	Medium > 50% of receptor contains natural habitat with potential to support SCC	Medium 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.	Medium	Medium	Medium
Transformed	Low < 50% of receptor contains natural habitat with limited potential to support SCC.	Low Several minor and major current negative ecological impacts.	Low	Medium	Low

Table 7-2 Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities

Site Ecological Importance	Interpretation in relation to proposed development activities
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.

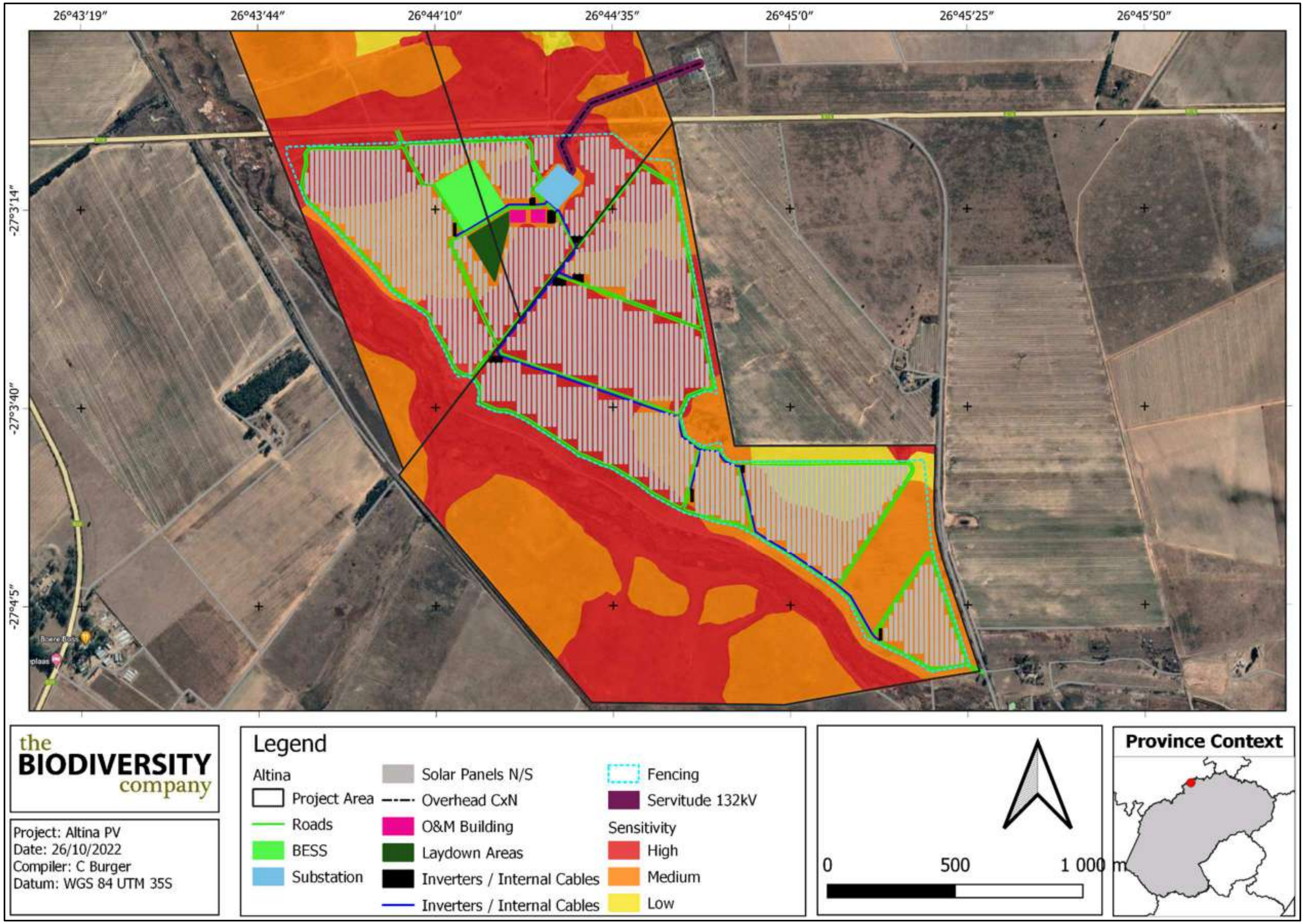


Figure 7-8 ***Sensitivity of the project area***

8 Impact Risk Assessment

The section below and associated tables serve to indicate and summarise the significance of perceived impacts on the terrestrial ecology of the project area. Potential impacts were evaluated against the data captured during the desktop and field assessment to identify relevance to the project area. The relevant impacts associated with the proposed construction of the development were then subjected to a prescribed impact assessment methodology and is available on request. The impact assessment was undertaken based on the two alternative layouts provided, and sections were only duplicated where the impact between the two layouts were considered different.

8.1 Biodiversity Risk Assessment

8.1.1 Present Impacts to Biodiversity

Considering the anthropogenic activities and influences within the landscape, several negative impacts to biodiversity were observed within the project area (Figure 8-1). These include:

- Historical and current mining activities;
- Agricultural practises;
- Farm roads and main roads (and associated traffic and wildlife road mortalities);
- Grazing and trampling of natural vegetation by livestock;
- Invasive species; and
- Fences and associated maintenance.

Figure 8-1 Negative impacts identified across the project area: A) Farm Road and house, B) Agricultural fields and fences, and C) Grazing

8.1.2 Terrestrial Impact Assessment

Anthropogenic activities drive habitat destruction causing displacement of fauna and flora and possibly direct mortality. Land clearing destroys local wildlife habitat and can lead to the loss of local breeding grounds, nesting/burrowing sites and wildlife movement corridors such as rivers, streams and drainage lines, or other locally important features. The removal of natural vegetation may reduce the habitat available for fauna species and may reduce animal populations and species compositions within the area.

8.1.3 Alternatives considered.

Two layout alternatives were provided and considered within the project area. As mentioned above sections below will only be duplicated where the impact between the two layouts were considered different.

8.1.4 Loss of Irreplaceable Resources

- Limited/degraded CBA 1 will be lost.

8.1.5 Anticipated Impacts

The impacts anticipated for the proposed activities are considered in order to predict and quantify these impacts and assess & evaluate the magnitude on the identified terrestrial biodiversity (Table 8-1).

Table 8-1 Anticipated impacts for the proposed activities on terrestrial biodiversity

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
	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
	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**
8. Staff and others interacting directly with fauna (potentially dangerous) or poaching of animals	All unregulated/supervised activities outdoors	Loss of SCCs

8.1.6 Unplanned Events

The planned activities will have anticipated impacts as discussed; however, unplanned events may occur on any project and may have potential impacts which will need management.

Table 8-2 is a summary of the findings of an unplanned event assessment from a terrestrial ecology perspective. Note, not all potential unplanned events may be captured herein, and this must therefore be managed throughout all phases according to recorded events.

Table 8-2 Summary of unplanned events for terrestrial biodiversity

Unplanned Event	Potential Impact	Mitigation
Spills into the surrounding environment	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Fire	Uncontrolled/unmanaged fire that spreads to the surrounding natural areas.	Appropriate/Adequate fire management plan need to be implemented.
Erosion caused by water runoff from the surface	Erosion on the side of the road	Storm water management plan must be compiled and implemented.

8.1.7 Identification of Additional Potential Impacts

8.1.7.1 Assessment of Impact Significance

The assessment of impact significance considers pre-mitigation as well as implemented of post-mitigation scenarios. The mitigation actions required to lower the risk of the impact are provided in Section 8.1.8 of this report.

8.1.7.2 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 main anticipated impact includes the clearing of vegetation, proliferation of alien plant species along the roads and cleared areas as well as the severing of movement corridors for fauna, and the fragmentation of habitat. The following potential impacts to terrestrial biodiversity were considered:

- Destruction, further loss and fragmentation of the of habitats, ecosystems and vegetation community;
- Introduction of alien species, especially plants;
- Destruction of protected plant species;
- Displacement of faunal community due to habitat loss, direct mortalities, and disturbance (road collisions, noise, dust, vibration and poaching); and
- Chemical pollution associated with dust suppressants.

8.1.7.3 Operational 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 do not only cause sensory disturbances to fauna, affecting their life cycles and movement, but will lead to direct mortalities due to collisions. The use of non-environmentally friendly chemical for the cleaning of the PV panels can lead to the pollution of water sources and ultimately death of fauna and flora.

The following potential impacts were considered:

- Continued fragmentation and degradation of habitats and ecosystems ;
- Spread of alien and/or invasive species;
- Ongoing displacement and direct mortalities of faunal community due to disturbance (road collisions, collisions with substation, noise, light, dust, vibration);
- Reduced dispersal of fauna;
- Chemical pollution associated with measures to keep PV clean; and
- Fencing of PV site.

8.1.7.3.1 Assessment of Significance

The assessment of impact significance considers pre-mitigation as well as implemented of post-mitigation scenarios.

8.1.7.3.1.1 Construction Phase

Table 8-3 summarises the significance of potential impacts associated with the project on fauna and flora before and after implementation of mitigation measures. The loss of habitat and the degradation of habitat were rated as ‘High’ prior to mitigations being implemented for Alternative 1 and as ‘Moderately High’ prior to mitigations being implemented for Alternative 2. Through the implementation of mitigations such as the restriction and demarcation of the project footprint this can only be lowered to ‘Moderate’ for both Alternatives 1 and 2, it can however not be mitigated completely as habitat will still be lost. The habitat and vegetation type recorded are not restricted and is well represented in the general area.

8.1.7.3.1.2 Operational Phase

Table 8-4 summarises the significance of the operational phase impacts on biodiversity before and after implementation of mitigation measures. The continued loss of habitat and the degradation of habitats within the area were rated as ‘Moderately High’ prior to mitigations being implemented for Alternative 1 and as ‘Moderately High’ prior to mitigations being implemented for Alternative 2. Through the implementation of mitigations this can be reduced to a ‘Moderate’ level for both Alternatives 1 and 2. The impact significance of displacement and direct mortalities of fauna were rated as ‘Moderate’ prior to mitigation for the project. Implementation of mitigation measures reduced the significance of the impact to a ‘Low’ level.

Table 8-3 Assessment of significance of potential impacts on the terrestrial fauna and flora associated with the construction phase

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Destruction, fragmentation and degradation of habitats, and ecosystems (ALTERNATIVE 1)	5	3	4	4	5		4	2	3	4	4	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Definite	**High**	Life of operation or less than 20 years: Long Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Highly likely	**Moderate**
Destruction, fragmentation and degradation of habitats, and ecosystems (ALTERNATIVE 2)	5	3	4	3	5		4	2	3	3	4	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology moderately sensitive/ /important	Definite	**Moderately High**	Life of operation or less than 20 years: Long Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Highly likely	**Moderate**
Spread and/or establishment of alien and/or invasive species	4	3	3	3	4		3	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted /	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Highly likely	**Moderate**	One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha	Small / ecosystem structure and function	Ecology with limited sensitivity/importance	Likely	**Low**

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
		Linear features affected < 1000m						impacted / Linear features affected < 100m	largely unchanged			
Destruction of protected plant species.	4	3	3	3	4		2	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Highly likely	**Moderate**	One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	**Low**
Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration).	4	3	3	3	5		2	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Definite	**Moderately High**	One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	**Low**

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Chemical pollution associated with dust suppressants	4	4	4	3	4		3	2	2	2	2	
	Life of operation or less than 20 years: Long Term	Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	Great / harmful/ ecosystem structure and function largely altered	Ecology moderately sensitive/ /important	Highly likely	**Moderately High**	One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Possible	**Low**

Table 8-4 Assessment of significance of potential impacts on terrestrial fauna and flora associated with the operational phase

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Continued fragmentation and degradation of habitats and ecosystems (ALTERNATIVE 1)	5	3	4	4	5		4	3	3	4	3	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Definite	**High**	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	**Moderate**
Continued fragmentation and degradation of habitats and ecosystems (ALTERNATIVE 2)	5	3	4	3	4		4	3	3	3	3	
	Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology moderately sensitive/ /important	Highly likely	**Moderately High**	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**
Spread and/or establishment of alien and/or invasive species	4	3	3	4	3		2	2	2	3	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	**Moderate**	One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features	Small / ecosystem structure and function largely unchanged	Ecology moderately sensitive/ /important	Likely	**Low**

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
		affected < 1000m						affected < 100m				
Ongoing displacement and direct mortalities of faunal community due to disturbance (road collisions, collisions with substation, noise, light, dust, vibration)	4	3	3	3	3		3	2	2	2	2	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Possible	**Low**
Reduced dispersal of fauna	4	3	3	3	3		2	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	**Low**
Chemical pollution associated with measures to keep PV clean	4	3	3	3	3		3	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted /	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha	Small / ecosystem structure and function	Ecology with limited sensitivity/importance	Likely	**Low**

Impact	Prior to mitigation						Post mitigation					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
		Linear features affected < 1000m						impacted / Linear features affected < 100m	largely unchanged			
Fencing of PV site	4	3	3	3	3		3	2	2	2	3	
	Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	**Low**

8.1.7.4 Cumulative Impacts

Cumulative impacts are assessed in context of the extent of the proposed project area; other developments in the area; and general habitat loss and transformation resulting from other activities in the area (Table 8-6).

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 in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for fauna and flora.

Localised cumulative impacts include the cumulative effects from operations that are close enough to potentially cause additive effects on the environment or sensitive receivers (such as nearby renewable energy activities within the area). These include dust deposition, noise and vibration, disruption of corridors or habitat, groundwater drawdown, groundwater and surface water quality, and transport.

Long-term cumulative impacts due to extensive solar farm footprint, powerlines and substations can lead to the loss of endemic species and threatened species, loss of habitat and vegetation types and even degradation of well conserved areas, this however needs to be quantified by monitoring. The PV panels and associated infrastructure are expected to have a moderate cumulative impact when considering the project in isolation, while the cumulative impacts associated with the proposed project as well as other project in the area are considered to be moderately high due to several existing and planned applications for renewable developments in the vicinity of the project area. Cumulatively these developments will be responsible for the destruction of a large portion of grasslands in the area.

From Table 8-5 it can be seen that in isolation the proposed project will contribute to a loss of approximately 0.35% of the vegetation type, while collectively with other solar projects in the area approximately 2.92% of the vegetation type will be lost.

Table 8-5 Cumulative impacts associated with the project in isolation and collectively

Vegetation Type	Proposed project area in isolation	Collective approved solar projects in area (REEA, 2021)
245493 ha	871 ha	7173 ha
% Contribution	0,35%	2,92%

Note: According to Mucina and Rutherford (2006) more than 63% of the vegetation type has been transformed for cultivation (ploughed for commercial crops) and the rest is under strong grazing pressure from cattle and sheep.

Table 8-6 Assessment of the cumulative impacts to biodiversity associated with the proposed project

Impact	Overall impact of the proposed project considered in isolation						Cumulative impact of the project and other projects in the area					
	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
Contribution to cumulative habitat loss, especially in the ecological corridors such as the wetland which will also have an impact on the water resource and ecological processes in the region	3	3	3	3	3		4	4	4	4	3	
	One year to five years: Medium Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology moderately sensitive/ /important	Likely	**Moderate**	Life of operation or less than 20 years: Long Term	Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Likely	**Moderately High**

8.1.8 Biodiversity Management Plan

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 8-7 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;
- As far as possible, reduce the negative fragmentation effects of the development and enable safe movement of faunal species;
- 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 8-7 Mitigation measures including requirements for timeframes, roles and responsibilities for the terrestrial study

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Management outcome: Vegetation and Habitats				
Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further. Clearing of vegetation should be minimized and avoided where possible. All activities must be restricted within the low/medium sensitivity areas. No further loss of high sensitivity areas should be permitted. It is recommended that areas to be developed be specifically demarcated so that during the construction phase, only the demarcated areas be impacted upon.	Life of operation	Project manager, Environmental Officer	Areas of indigenous vegetation	Ongoing
Existing access routes, especially roads must be made use of.	Construction/Operational Phase	Environmental Officer & Design Engineer	Roads and paths used	Ongoing
All laydown, chemical toilets etc. should be restricted to medium/low sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction phase has been concluded. No permanent construction phase structures should be permitted. Construction buildings should preferably be prefabricated or constructed of re-usable/recyclable materials. No storage of vehicles or equipment will be allowed outside of the designated project areas.	Construction/Operational Phase	Environmental Officer & Design Engineer	Laydown areas	Ongoing
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood and wind events. This will also reduce the likelihood of encroachment by alien invasive plant species. All livestock must always be kept out of the project area, especially areas that have been recently revegetated.	Operational phase	Environmental Officer & Contractor	Assess the state of rehabilitation and encroachment of alien vegetation	Quarterly for up to two years after the closure
A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. No servicing of equipment on site unless necessary. All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) in such a way as to prevent them leaking and entering the environment. Construction activities and vehicles could cause spillages of lubricants, fuels and waste material potentially negatively affecting the functioning of the ecosystem. All vehicles and	Life of operation	Environmental Officer & Contractor	Spill events, Vehicles dripping.	Ongoing

equipment must be maintained, and all re-fuelling and servicing of equipment is to take place in demarcated areas outside of the project area.				
It should be made an offence for any staff to take/ bring any plant species into/out of any portion of the project area. No plant species whether indigenous or exotic should be brought into/taken from the project area, to prevent the spread of exotic or invasive species or the illegal collection of plants.	Life of operation	Project manager, Environmental Officer	Any instances	Ongoing
A fire management plan needs to be complied and implemented to restrict the impact fire might have on the surrounding areas.	Life of operation	Environmental Officer & Contractor	Fire Management	During Phase
Any individual of the protected plants that are present needs a relocation or destruction permit in order for any individual that may be removed or destroyed due to the development. Hi visibility flags must be placed near any threatened/protected plants in order to avoid any damage or destruction of the species. If left undisturbed the sensitivity and importance of these species needs to be part of the environmental awareness program. Infrastructure, development areas and routes where protected plants cannot be avoided, these plants mainly being succulents should be removed from the soil and relocated/ re-planted in similar habitats where they should be able to resprout and flourish again.	Life of operation	Project manager, Environmental Officer	Protected Tree/Plant species	Ongoing

Management outcome: Fauna				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
A qualified environmental control officer must be on site when construction begins. A site walk through is recommended by a suitably qualified ecologist prior to any construction activities, preferably during the wet season. Should animals not move out of the area on their own relevant specialists must be contacted to advise on how the species can be relocated. In situations where the threatened and protected plants must be removed, the proponent may only do so after the required permission/permits have been obtained in accordance with national and provincial legislation. In the abovementioned situation the development of a search, rescue and recovery program is suggested for the protection of these species.	Construction Phase	Environmental Officer, Contractor	Presence of any floral or faunal species.	During phase
The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments, • Signs must be put up to enforce this.	Construction/Operational Phase	Project manager, Environmental Officer	Infringement into these areas	Ongoing
The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on fauna.	Construction	Project manager, Environmental Officer & Design Engineer	Construction/Closure Phase	Ongoing
Noise must be kept to an absolute minimum during the evenings and at night to minimize all possible disturbances to amphibian species and nocturnal mammals.	Construction/Operational Phase	Environmental Officer	Noise levels	Ongoing

No trapping, killing, or poisoning of any wildlife is to be allowed • Signs must be put up to enforce this;	Life of operation	Environmental Officer	Evidence of trapping etc	Ongoing
Outside lighting should be designed and limited to minimize impacts on fauna. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible.	Construction/Operational Phase	Project manager, Environmental Officer & Design Engineer	Light pollution and period of light.	Ongoing
Try incorporating motion detection lights as much as possible to reduce the duration of illumination. Heights of light columns to be minimised to reduce light spill. Baffles, hoods or louvres to also be used to reduce light spill.	Construction Phase	Environmental Officer & Design Engineer	Light pollution	Ongoing
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits (30km/h) must still be enforced to ensure that road killings and erosion is limited.	Life of operation	Health and Safety Officer	Compliance to the training.	Ongoing
Schedule activities and operations during least sensitive periods (winter months), to avoid migration, nesting and breeding seasons.	Life of operation	Project manager, Environmental Officer & Design Engineer	Activities should take place during the day in the case.	Ongoing
All areas to be developed must be walked through prior to any activity to ensure no nests or fauna species are found in the area. Should any Species of Conservation Concern not move out of the area, or their nest be found in the area a suitably qualified specialist must be consulted to advise on the correct actions to be taken.	Construction and Operational phase	Project manager, Environmental Officer	Presence of Nests and faunal species	Planning, Construction and Rehabilitation
Any holes/deep excavations must be dug and planted in a progressive manner and shouldn't be left open overnight; • Should the holes be left open overnight they must be covered temporarily to ensure no small fauna species fall in.	Planning and Construction	Environmental Officer & Contractor, Engineer	Presence of trapped animals and open holes	Ongoing
Ensure that cables and connections are insulated successfully to reduce electrocution risk.	Life of project	Environmental Officer & Contractor, Engineer	Presence of electrocuted fauna	Ongoing
Any exposed parts must be covered (insulated) to reduce electrocution risk.	Life of project	Environmental Officer & Contractor, Engineer	Presence of electrocuted fauna	Ongoing
Heat generated from the substations must be monitored to ensure it does not negatively affect the local fauna	Life of operation	Environmental Officer & Contractor	Heat generated by substations	Ongoing
Use environmentally friendly cleaning and dust suppressant products	Construction and operation	Environmental Officer & Contractor, Engineer	Presence of chemicals in and around the project area	Ongoing
Fencing mitigations: • Wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed every 50 m along the fence (with a size of 30 x 20 cm), 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.	Planning, construction and operation	Environmental Officer & Contractor, Engineer	Monitor fences for slack wires	Ongoing
Management outcome: Alien species				

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Compilation of and implementation of an alien vegetation management plan.	Life of operation	Project manager, Environmental Officer & Contractor	Assess presence and encroachment of alien vegetation	Twice a year
The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprint of the roads must be kept to prescribed widths.	Construction/Operational Phase	Project manager, Environmental Officer & Contractor	Footprint Area	Life of operation
Waste management must be a priority and all waste must be collected and stored adequately. It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests entering the site.	Life of operation	Environmental Officer & Health and Safety Officer	Presence of waste	Life of operation
A pest control plan must be put in place and implemented; it is imperative that poisons not be used.	Life of operation	Environmental Officer & Health and Safety Officer	Evidence or presence of pests	Life of operation
Management outcome: Dust				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes wetting of exposed soft soil surfaces. • No non environmentally friendly suppressants may be used as this could result in pollution of water sources	Life of operation	Contractor	Dustfall	Dust monitoring program.
Management outcome: Waste Management				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Waste management must be a priority and all waste must be collected and stored effectively.	Life of operation	Environmental Officer & Contractor	Waste Removal	Weekly
Litter, spills, fuels, chemicals and human waste in and around the project area.	Construction/Closure Phase	Environmental Officer & Health and Safety Officer	Presence of Waste	Daily
A minimum of one toilet must be provided per 10 persons. Portable toilets must be pumped dry to ensure the system does not degrade over time and spill into the surrounding area.	Life of operation	Environmental Officer & Health and Safety Officer	Number of toilets per staff member. Waste levels	Daily
The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility	Life of operation	Environmental Officer & Health and Safety Officer	Availability of bins and the collection of the waste.	Ongoing

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Where a registered disposal facility is not available close to the project area, the Contractor shall provide a method statement with regard to waste management. Under no circumstances may domestic waste be burned on site.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Collection/handling of the waste.	Ongoing
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 10 days.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Management of bins and collection of waste	Ongoing, every 10 days

Management outcome: Environmental Awareness Training				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project area to inform contractors and site staff of the presence of protected species, their identification, conservation status and importance, biology, habitat requirements and management requirements as within the Environmental Authorisation and EMPr. The avoidance and protection of the wetland areas must be included into a site induction. Contractors and employees must all undergo the induction and made aware of the "no-go" to be avoided.	Life of operation	Health and Safety Officer	Compliance to the training.	Ongoing

Management outcome: Erosion				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Speed limits must be put in place to reduce erosion. • Reducing the dust generated by the listed activities above, especially the earth moving machinery, through wetting the soil surface and putting up signs to enforce speed limit as well as speed bumps built to force slow speeds; • Signs must be put up to enforce this.	Life of operation	Project manager, Environmental Officer	Water Runoff from road surfaces	Ongoing
Where possible, existing access routes and walking paths must be made use of.	Life of operation	Project manager, Environmental Officer	Routes used within the area	Ongoing
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events and strong winds.	Life of operation	Project manager, Environmental Officer	Re-establishment of indigenous vegetation	Progressively
A stormwater management plan must be compiled and implemented.	Life of operation	Project manager, Environmental Officer	Management plan	Before construction phase: Ongoing

9 Conclusion and Impact Statement

9.1 Conclusion

The completion of a comprehensive desktop study, in conjunction with the results from the field survey, suggest there is a good confidence in the information provided. The survey ensured that there was an extensive ground truth coverage of the assessment area, and most habitats and ecosystems were assessed to obtain a general species (fauna and flora) overview and the major current impacts were observed.

Three habitat units were identified during the assessment and included Wetland, Degraded Grassland and Transformed areas. The sensitivity of the wetland habitats ranged from high to medium with some of the wetland areas considered to have a high sensitivity predominantly due to the intact unique habitat provided for biodiversity, while some wetland areas are considered to be of medium sensitivity due to the severe transformation that occurred across these areas. The degraded grassland habitat is considered to be of medium terrestrial sensitivity, as the area still provides habitat to various fauna and flora species, while the transformed habitat is considered to have a low sensitivity.

Two layout alternatives are considered for the proposed project, (Alternative 1 and Alternative 2). Both alternatives are considered to have a moderate to low negative impact on the terrestrial ecosystem associated with the project area after implementation of mitigation measures;

- The assessment area possesses a moderate diversity and density flora species, which is well represented in the general area. Moreover, fauna is ubiquitous within the assessment area and surrounding landscape.

Alternative 2 is, however, the preferred layout alternative due to the following:

- It excludes more high sensitivity areas than alternative 1; and
- More areas indicated by the database as CBA1 will be excluded from development.

Biodiversity maintenance is one key ecological service provided by the identified terrestrial biodiversity areas through their ecological integrity, importance and functioning. As such the preservation of these systems is an important aspect to consider for the proposed project.

Any development in high sensitivity areas must be avoided, which will occur with the selection of the project area. Development within the high sensitivity areas within the project area will lead the direct destruction and loss of functional habitats; and the faunal species that are expected to utilise this habitat. Thus, if these areas are not maintained in a natural or near natural state, destroyed or fragmented, then meeting targets for biodiversity features will not be achieved. The mitigation measures, management and associated monitoring regarding the expected impacts will be the most important factor of this project and must be considered by the issuing authority.

9.2 Impact Statement

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

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

Mitigation measures as described in this report must be implemented to reduce the significance of the risk, but there is still a possibility of impacts occurring. Considering that the area that has been identified as being of significance for biodiversity maintenance and ecological processes (Moderate and High sensitivity), development may proceed but with caution and only with the implementation of mitigation measures.

Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project location, may be favourably considered on condition that all prescribed mitigation measures and supporting recommendations are implemented.

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11 Appendix Items

11.1 Appendix A – Flora species expected to occur in the project area.

Family	Taxon	Author	IUCN	Ecology
Fabaceae	*Acacia sp.*			
Euphorbiaceae	*Acalypha angustata*	Sond.	LC	Indigenous; Endemic
Euphorbiaceae	*Acalypha caperonioides var. caperonioides*		DD	Indigenous
Euphorbiaceae	*Acalypha depressinervia*	(Kuntze) K.Schum.	LC	Indigenous; Endemic
Asteraceae	*Acanthospermum glabratum*	(DC.) Wild		Not indigenous; Naturalised
Asteraceae	*Acanthospermum hispidum*	DC.		Not indigenous; Naturalised
Lamiaceae	*Acrotome hispida*	Benth.	LC	Indigenous; Endemic
Crassulaceae	*Adromischus sp.*			
Amaranthaceae	*Aerva leucura*	Moq.	LC	Indigenous
Rubiaceae	*Afrocanthium mundianum*	(Cham. & Schltdl.) Lantz	LC	Indigenous
Loranthaceae	*Agelanthus natalitius subsp. zeyheri*	(Meisn.) Polhill & Wiens; (Harv.) Polhill & Wiens	LC	Indigenous
Poaceae	*Agrostis lachnantha var. lachnantha*		LC	Indigenous
Asteraceae	*Ambrosia artemisiifolia*	L.		Not indigenous; Naturalised; Invasive
Lythraceae	*Ammannia anagalloides*	Sond.		Indigenous; Endemic
Anacampserotaceae	*Anacampseros sp.*			
Boraginaceae	*Anchusa azurea*	Mill.		Not indigenous; Naturalised
Poaceae	*Andropogon appendiculatus*	Nees	LC	Indigenous
Poaceae	*Andropogon schirensis*	Hochst. ex A.Rich.	LC	Indigenous
Malvaceae	*Anisodontea scabrosa*	(L.) Bates	LC	Indigenous; Endemic
Poaceae	*Anthephora pubescens*	Nees	LC	Indigenous
Rubiaceae	*Anthospermum rigidum subsp. pumilum*	Eckl. & Zeyh.; (Sond.) Puff	LC	Indigenous
Apiaceae	*Apium graveolens*	L.		Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Aptosimum elongatum*	(Hiern) Engl.	LC	Indigenous; Endemic
Scrophulariaceae	*Aptosimum indivisum*	Burch. ex Benth.	LC	Indigenous; Endemic
Scrophulariaceae	*Aptosimum procumbens*	(Lehm.) Steud.	LC	Indigenous; Endemic
Asteraceae	*Arctotis arctotoides*	(L.f.) O.Hoffm.	LC	Indigenous; Endemic
Poaceae	*Aristida adscensionis*	L.	LC	Indigenous

Poaceae	*Aristida bipartita*	(Nees) Trin. & Rupr.	LC	Indigenous
Poaceae	*Aristida canescens subsp. canescens*		LC	Indigenous
Poaceae	*Aristida congesta subsp. congesta*		LC	Indigenous
Poaceae	*Aristida diffusa subsp. burkei*	Trin.; (Stapf) Melderis	LC	Indigenous
Poaceae	*Aristida junciformis subsp. junciformis*		LC	Indigenous; Endemic
Poaceae	*Aristida stipitata subsp. graciliflora*	Hack.; (Pilg.) Melderis	LC	Indigenous
Poaceae	*Aristida stipitata subsp. stipitata*		LC	Indigenous
Asteraceae	*Artemisia afra var. afra*		LC	Indigenous
Apocynaceae	*Asclepias aurea*	(Schltr.) Schltr.	LC	Indigenous
Apocynaceae	*Asclepias fulva*	N.E.Br.	LC	Indigenous
Apocynaceae	*Asclepias gibba var. gibba*		LC	Indigenous; Endemic
Apocynaceae	*Asclepias gibba var. media*	(E.Mey.) Schltr.; N.E.Br.	LC	Indigenous; Endemic
Apocynaceae	*Asclepias meyeriana*	(Schltr.) Schltr.	LC	Indigenous; Endemic
Apocynaceae	*Aspidoglossum biflorum*	E.Mey.	LC	Indigenous
Aspleniaceae	*Asplenium cordatum*	(Thunb.) Sw.	LC	Indigenous
Salviniaceae	*Azolla filiculoides*	Lam.		Not indigenous; Naturalised; Invasive
Iridaceae	*Babiana bainesii*	Baker	LC	Indigenous
Acanthaceae	*Barleria macrostegia*	Nees	LC	Indigenous
Acanthaceae	*Barleria obtusa*	Nees	LC	Indigenous
Asteraceae	*Berkheya carlinoides*	(Vahl) Willd.	LC	Indigenous; Endemic
Asteraceae	*Berkheya radula*	(Harv.) De Wild.	LC	Indigenous
Apiaceae	*Berula repanda*	(Hiern) Spalik & S.R.Downie	LC	Indigenous
Acanthaceae	*Blepharis angusta*	(Nees) T.Anderson	LC	Indigenous; Endemic
Nyctaginaceae	*Boerhavia erecta*	L.		Not indigenous; Naturalised
Orchidaceae	*Bonatea antennifera*	Rolfe	LC	Indigenous
Poaceae	*Brachiaria eruciformis*	(Sm.) Griseb.	LC	Indigenous
Apocynaceae	*Brachystelma sp.*			
Poaceae	*Bromus sp.*			
Bryaceae	*Bryum argenteum*	Hedw.		Indigenous
Asphodelaceae	*Bulbine abyssinica*	A.Rich.	LC	Indigenous
Asphodelaceae	*Bulbine capitata*	Poelln.	LC	Indigenous
Asphodelaceae	*Bulbine narcissifolia*	Salm-Dyck	LC	Indigenous; Endemic
Cyperaceae	*Bulbostylis burchellii*	(Ficalho & Hiern) C.B.Clarke	LC	Indigenous
Colchicaceae	*Camptorrhiza strumosa*	(Baker) Oberm.	LC	Indigenous
Apocynaceae	*Carissa bispinosa*	(L.) Desf. ex Brenan	LC	Indigenous

Amaranthaceae	*Celosia argentea forma argentea*	L.		Not indigenous; Naturalised
Cannabaceae	*Celtis africana*	Burm.f.	LC	Indigenous
Poaceae	*Cenchrus ciliaris*	L.	LC	Indigenous
Poaceae	*Cenchrus macrourus*	(Trin.) Morrone	LC	Indigenous
Asteraceae	*Centaurea melitensis*	L.		Not indigenous; Naturalised
Ceratophyllaceae	*Ceratophyllum muricatum subsp. muricatum*		LC	Indigenous
Apocynaceae	*Ceropegia barberae*	(Harv. ex Hook.f.) Bruyns		Indigenous
Apocynaceae	*Ceropegia circinata*	(E.Mey.) Bruyns		Indigenous
Apocynaceae	*Ceropegia ramosissima*	(Schltr.) Bruyns		Indigenous; Endemic
Apocynaceae	*Ceropegia rehmannii*	(Schltr.) Bruyns		Indigenous; Endemic
Scrophulariaceae	*Chaenostoma sp.*			
Verbenaceae	*Chascanum adenostachyum*	(Schauer) Moldenke	LC	Indigenous; Endemic
Verbenaceae	*Chascanum hederaceum var. natalense*	(Sond.) Moldenke; (H.Pearson) Moldenke	LC	Indigenous; Endemic
Verbenaceae	*Chascanum hederaceum var. hederaceum*		LC	Indigenous; Endemic
Pteridaceae	*Cheilanthes hirta var. hirta*		LC	Indigenous
Pteridaceae	*Cheilanthes involuta var. obscura*	(Sw.) Schelpe & N.C.Anthony; (N.C.Anthony) N.C.Anthony	LC	Indigenous
Amaranthaceae	*Chenopodium sp.*			
Gentianaceae	*Chironia purpurascens subsp. humilis*	(E.Mey.) Benth. & Hook.f.; (Gilg) I.Verd.	LC	Indigenous
Agavaceae	*Chlorophytum fasciculatum*	(Baker) Kativu	LC	Indigenous
Asteraceae	*Cineraria erodioides*	DC.		Indigenous; Endemic
Asteraceae	*Cineraria lyratiformis*	Cron	LC	Indigenous; Endemic
Asteraceae	*Cirsium vulgare*	(Savi) Ten.		Not indigenous; Naturalised; Invasive
Ranunculaceae	*Clematis brachiata*	Thunb.	LC	Indigenous
Cleomaceae	*Cleome rubella*	Burch.	LC	Indigenous
Cucurbitaceae	*Coccinia sessilifolia*	(Sond.) Cogn.	LC	Indigenous; Endemic
Commelinaceae	*Commelina africana var. krebsiana*	L.; (Kunth) C.B.Clarke	LC	Indigenous
Commelinaceae	*Commelina africana var. barberae*	L.; (C.B.Clarke) C.B.Clarke	LC	Indigenous; Endemic
Commelinaceae	*Commelina erecta*	L.	LC	Indigenous
Commelinaceae	*Commelina livingstonii*	C.B.Clarke	LC	Indigenous
Nyctaginaceae	*Commicarpus pentandrus*	(Burch.) Heimerl	LC	Indigenous
Apiaceae	*Conium chaerophylloides*	(Thunb.) Sond.	LC	Indigenous
Convolvulaceae	*Convolvulus sagittatus*	Thunb.	LC	Indigenous

Malvaceae	*Corchorus aspleniifolius*	Burch.	LC	Indigenous
Malvaceae	*Corchorus schimperi*	Cufod.	LC	Indigenous
Apocynaceae	*Cordylogyne globosa*	E.Mey.	LC	Indigenous; Endemic
Asteraceae	*Cotula microglossa*	(DC.) O.Hoffm. & Kuntze ex Kuntze	LC	Indigenous; Endemic
Asteraceae	*Cotula sp.*			
Acanthaceae	*Crabbea angustifolia*	Nees	LC	Indigenous; Endemic
Crassulaceae	*Crassula lanceolata subsp. transvaalensis*	(Eckl. & Zeyh.) Endl. ex Walp.; (Kuntze) Toelken	LC	Indigenous
Fabaceae	*Crotalaria burkeana*	Benth.	LC	Indigenous
Fabaceae	*Crotalaria distans subsp. distans*		LC	Indigenous
Fabaceae	*Crotalaria juncea*	L.		Not indigenous; Naturalised
Fabaceae	*Crotalaria lotoides*	Benth.	LC	Indigenous
Fabaceae	*Crotalaria magaliesbergensis*	A.S.Flores & Sch.Rodr.	LC	Indigenous; Endemic
Fabaceae	*Crotalaria sp.*			
Convolvulaceae	*Cuscuta campestris*	Yunck.		Not indigenous; Naturalised; Invasive
Orobanchaceae	*Cycnium tubulosum subsp. tubulosum*		LC	Indigenous
Poaceae	*Cymbopogon caesius*	(Hook. & Arn.) Stapf	LC	Indigenous
Poaceae	*Cynodon dactylon*	(L.) Pers.	LC	Indigenous
Boraginaceae	*Cynoglossum hispidum*	Thunb.	LC	Indigenous
Cyperaceae	*Cyperus capensis*	(Steud.) Endl.	LC	Indigenous; Endemic
Cyperaceae	*Cyperus fastigiatus*	Rottb.	LC	Indigenous; Endemic
Cyperaceae	*Cyperus margaritaceus var. margaritaceus*		LC	Indigenous
Cyperaceae	*Cyperus obtusiflorus var. flavissimus*	Vahl; (Schrad.) Boeckeler	LC	Indigenous
Cyperaceae	*Cyperus sphaerospermus*	Schrad.	LC	Indigenous
Lobeliaceae	*Cyphia persicifolia*	C.Presl	LC	Indigenous; Endemic
Vitaceae	*Cyphostemma hereroense*	(Schinz) Desc. ex Wild & R.B.Drumm.	LC	Indigenous; Endemic
Solanaceae	*Datura ferox*	L.		Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Daubenya comata*	(Burch. ex Baker) J.C.Manning & A.M.van der Merwe	LC	Indigenous; Endemic
Aizoaceae	*Delosperma herbeum*	(N.E.Br.) N.E.Br.	LC	Indigenous; Endemic
Apiaceae	*Deverra burchellii*	(DC.) Eckl. & Zeyh.	LC	Indigenous
Pedaliaceae	*Dicerocaryum senecioides*	(Klotzsch) Abels	LC	Indigenous
Acanthaceae	*Dicliptera leistneri*	K.Balkwill	LC	Indigenous; Endemic
Asteraceae	*Dicoma anomala subsp. anomala*		LC	Indigenous

Iridaceae	*Dierama reynoldsii*	I.Verd.	LC	Indigenous; Endemic
Poaceae	*Digitaria eriantha*	Steud.	LC	Indigenous
Poaceae	*Digitaria sp.*			
Ebenaceae	*Diospyros lycioides subsp. lycioides*		LC	Indigenous
Malvaceae	*Dombeya rotundifolia*	(Hochst.) Planch.		Indigenous
Malvaceae	*Dombeya rotundifolia var. rotundifolia*		LC	Indigenous
Acanthaceae	*Dyschoriste burchellii*	(Nees) Kuntze	LC	Indigenous; Endemic
Amaranthaceae	*Dysphania multifida*	(L.) Mosyakin & Clemants		Not indigenous; Naturalised; Invasive
Cyperaceae	*Eleocharis dregeana*	Steud.	LC	Indigenous; Endemic
Fabaceae	*Elephantorrhiza elephantina*	(Burch.) Skeels	LC	Indigenous
Poaceae	*Eleusine coracana subsp. africana*	(L.) Gaertn.; (Kenn.-O'Byrne) Hilu & de Wet	LC	Indigenous
Poaceae	*Eragrostis biflora*	Hack. ex Schinz	LC	Indigenous
Poaceae	*Eragrostis cilianensis*	(All.) Vignolo ex Janch.	LC	Indigenous
Poaceae	*Eragrostis curvula*	(Schrad.) Nees	LC	Indigenous
Poaceae	*Eragrostis gummiflua*	Nees	LC	Indigenous
Poaceae	*Eragrostis obtusa*	Munro ex Ficalho & Hiern	LC	Indigenous; Endemic
Poaceae	*Eragrostis rigidior*	Pilg.	LC	Indigenous
Poaceae	*Eragrostis rotifer*	Rendle	LC	Indigenous
Poaceae	*Eragrostis sp.*			
Poaceae	*Eragrostis superba*	Peyr.	LC	Indigenous
Poaceae	*Eragrostis trichophora*	Coss. & Durieu	LC	Indigenous
Ruscaceae	*Eriospermum sp.*			
Fabaceae	*Erythrina zeyheri*	Harv.	LC	Indigenous
Euphorbiaceae	*Euphorbia hirta*	L.		Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia inaequilatera*	Sond.	LC	Indigenous
Euphorbiaceae	*Euphorbia indica*	Lam.		Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia serpens*	Kunth		Not indigenous; Naturalised
Asteraceae	*Felicia muricata subsp. muricata*		LC	Indigenous
Asteraceae	*Galinsoga parviflora*	Cav.		Not indigenous; Naturalised; Invasive
Asteraceae	*Geigeria aspera var. aspera*		LC	Indigenous; Endemic
Asteraceae	*Geigeria brevifolia*	(DC.) Harv.	LC	Indigenous; Endemic
Asteraceae	*Geigeria ornativa*	O.Hoffm.		Indigenous

Amaryllidaceae	*Gethyllis transkarooica*	D.Mull.-Doblies	LC	Indigenous; Endemic
Gisekiaceae	*Gisekia africana var. africana*		LC	Indigenous
Gisekiaceae	*Gisekia pharnaceoides var. pharnaceoides*		LC	Indigenous
Iridaceae	*Gladiolus crassifolius*	Baker	LC	Indigenous
Scrophulariaceae	*Gomphostigma virgatum*	(L.f.) Baill.	LC	Indigenous
Malvaceae	*Grewia flava*	DC.	LC	Indigenous
Malvaceae	*Grewia occidentalis var. occidentalis*		LC	Indigenous
Celastraceae	*Gymnosporia buxifolia*	(L.) Szyszyl.	LC	Indigenous
Asteraceae	*Haplocarpha scaposa*	Harv.	LC	Indigenous
Poaceae	*Harpochloa falx*	(L.f.) Kuntze	LC	Indigenous; Endemic
Asteraceae	*Helichrysum argyrosphaerum*	DC.	LC	Indigenous
Asteraceae	*Helichrysum caespititium*	(DC.) Harv.	LC	Indigenous
Asteraceae	*Helichrysum callicomum*	Harv.	LC	Indigenous
Asteraceae	*Helichrysum dregeanum*	Sond. & Harv.	LC	Indigenous; Endemic
Asteraceae	*Helichrysum nudifolium var. nudifolium*		LC	Indigenous
Asteraceae	*Helichrysum paronychioides*	DC.	LC	Indigenous; Endemic
Asteraceae	*Helichrysum rugulosum*	Less.	LC	Indigenous; Endemic
Asteraceae	*Helichrysum zeyheri*	Less.	LC	Indigenous; Endemic
Poaceae	*Hemarthria altissima*	(Poir.) Stapf & C.E.Hubb.	LC	Indigenous
Malvaceae	*Hermannia grandistipula*	(Buchinger ex Hochst.) K.Schum.	LC	Indigenous
Malvaceae	*Hermannia quartiniana*	A.Rich.	LC	Indigenous
Malvaceae	*Hermannia stellulata*	(Harv.) K.Schum.	LC	Indigenous
Malvaceae	*Hibiscus calyphyllus*	Cav.	LC	Indigenous
Malvaceae	*Hibiscus microcarpus*	Garcke	LC	Indigenous
Malvaceae	*Hibiscus trionum*	L.		Not indigenous; Naturalised
Asteraceae	*Hilliardiella elaeagnoides*	(DC.) Swelank. & J.C.Manning		Indigenous
Hypoxidaceae	*Hypoxis acuminata*	Baker	LC	Indigenous; Endemic
Hypoxidaceae	*Hypoxis argentea var. sericea*	Harv. ex Baker; Baker	LC	Indigenous
Hypoxidaceae	*Hypoxis filiformis*	Baker	LC	Indigenous
Hypoxidaceae	*Hypoxis hemerocallidea*	Fisch., C.A.Mey. & Ave-Lall.	LC	Indigenous
Hypoxidaceae	*Hypoxis rigidula var. rigidula*		LC	Indigenous
Fabaceae	*Indigofera dimidiata*	Vogel ex Walp.	LC	Indigenous
Fabaceae	*Indigofera heterotricha*	DC.	LC	Indigenous
Fabaceae	*Indigofera oxalidea*	Welw. ex Baker	LC	Indigenous
Convolvulaceae	*Ipomoea crassipes var. crassipes*		LC	Indigenous

Convolvulaceae	*Ipomoea oenotheroides*	(L.f.) Raf. ex Hallier f.	LC	Indigenous; Endemic
Convolvulaceae	*Ipomoea ommanneyi*	Rendle	LC	Indigenous
Poaceae	*Ischaemum afrum*	(J.F.Gmel.) Dandy	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia aurantiaca*	(Burch.) Hilliard	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia burkeana*	(Benth.) Hilliard	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia sp.*			
Euphorbiaceae	*Jatropha zeyheri*	Sond.	LC	Indigenous; Endemic
Juncaceae	*Juncus rigidus*	Desf.	LC	Indigenous
Crassulaceae	*Kalanchoe rotundifolia*	(Haw.) Haw.	LC	Indigenous
Asphodelaceae	*Kniphofia ensifolia subsp. ensifolia*		LC	Indigenous
Asteraceae	*Lactuca serriola*	L.		Not indigenous; Naturalised
Thymelaeaceae	*Lasiosiphon anthylloides*	(L.f.) Meisn.	LC	Indigenous; Endemic
Thymelaeaceae	*Lasiosiphon burchellii*	Meisn.	LC	Indigenous; Endemic
Thymelaeaceae	*Lasiosiphon capitatus*	(L.f.) Burtt Davy	LC	Indigenous; Endemic
Thymelaeaceae	*Lasiosiphon kraussianus*	(Meisn.) Meisn.		Indigenous; Endemic
Hyacinthaceae	*Ledebouria burkei subsp. burkei*		LC	Indigenous
Hyacinthaceae	*Ledebouria luteola*	Jessop	LC	Indigenous; Endemic
Hyacinthaceae	*Ledebouria marginata*	(Baker) Jessop	LC	Indigenous; Endemic
Poaceae	*Leersia hexandra*	Sw.	LC	Indigenous
Euphorbiaceae	*Leidesia procumbens*	(L.) Prain	LC	Indigenous
Araceae	*Lemna gibba*	L.	LC	Indigenous
Araceae	*Lemna minor*	L.	LC	Indigenous
Lamiaceae	*Leonotis pentadentata*	J.C.Manning & Goldblatt	LC	Indigenous; Endemic
Fabaceae	*Lessertia phillipsiana*	Burtt Davy	DD	Indigenous; Endemic
Verbenaceae	*Lippia scaberrima*	Sond.	LC	Indigenous; Endemic
Fabaceae	*Listia bainesii*	(Baker) B.-E.van Wyk & Boatwr.	LC	Indigenous
Fabaceae	*Listia heterophylla*	E.Mey.	LC	Indigenous
Boraginaceae	*Lithospermum cinereum*	A.DC.	LC	Indigenous; Endemic
Asteraceae	*Litogyne gariepina*	(DC.) Anderb.	LC	Indigenous
Lobeliaceae	*Lobelia sonderiana*	(Kuntze) Lammers	LC	Indigenous
Lobeliaceae	*Lobelia thermalis*	Thunb.	LC	Indigenous
Solanaceae	*Lycium arenicola*	Miers	LC	Indigenous
Solanaceae	*Lycium pilifolium*	C.H.Wright	LC	Indigenous; Endemic
Malvaceae	*Mahernia sp.*			
Euphorbiaceae	*Manihot esculenta*	Crantz		Not indigenous;

				Cultivated; Naturalised
Aytoniaceae	*Mannia capensis*	(Steph.) S.W.Arnell		Indigenous
Marsileaceae	*Marsilea farinosa subsp. farinosa*		LC	Indigenous
Marsileaceae	*Marsilea sp.*			
Fabaceae	*Medicago laciniata var. laciniata*	(L.) Mill.		Not indigenous; Naturalised
Oleaceae	*Menodora africana*	Hook.	LC	Indigenous; Endemic
Oleaceae	*Menodora heterophylla var. australis*	Moric. ex DC.; Steyerm.	LC	Indigenous; Endemic
Asteraceae	*Mesogramma apiifolium*	DC.	LC	Indigenous
Fabaceae	*Mimosa pigra*	L.		Not indigenous; Naturalised; Invasive
Phrymaceae	*Mimulus gracilis*	R.Br.	LC	Indigenous
Poaceae	*Monocymbium ceresiiforme*	(Nees) Stapf	LC	Indigenous
Geraniaceae	*Monsonia angustifolia*	E.Mey. ex A.Rich.	LC	Indigenous
Geraniaceae	*Monsonia emarginata*	(L.f.) L'Her.	LC	Indigenous; Endemic
Haloragaceae	*Myriophyllum spicatum*	L.		Not indigenous; Cultivated; Naturalised; Invasive
Scrophulariaceae	*Nemesia fruticans*	(Thunb.) Benth.	LC	Indigenous
Fabaceae	*Neorautanenia ficifolia*	(Benth.) C.A.Sm.	LC	Indigenous
Amaryllidaceae	*Nerine krigei*	W.F.Barker	LC	Indigenous; Endemic
Asteraceae	*Nidorella resedifolia subsp. resedifolia*		LC	Indigenous
Asteraceae	*Nidorella sp.*			
Asteraceae	*Nolletia annetjieae*	P.P.J.Herman	LC	Indigenous; Endemic
Lamiaceae	*Ocimum angustifolium*	Benth.	LC	Indigenous
Onagraceae	*Oenothera rosea*	L'Her. ex Aiton		Not indigenous; Naturalised; Invasive
Onagraceae	*Oenothera tetraptera*	Cav.		Not indigenous; Naturalised; Invasive
Resedaceae	*Oligomeris dregeana*	(Mull.Arg.) Mull.Arg.	LC	Indigenous; Endemic
Apocynaceae	*Orbea lutea subsp. lutea*		LC	Indigenous
Asteraceae	*Osteospermum muricatum subsp. muricatum*		LC	Indigenous
Asteraceae	*Osteospermum scariosum var. scariosum*		NE	Indigenous; Endemic
Oxalidaceae	*Oxalis corniculata*	L.		Not indigenous; Naturalised; Invasive

Oxalidaceae	*Oxalis depressa*	Eckl. & Zeyh.	LC	Indigenous; Endemic
Apocynaceae	*Pachycarpus schinzianus*	(Schltr.) N.E.Br.	LC	Indigenous
Poaceae	*Panicum coloratum*	L.	LC	Indigenous
Poaceae	*Panicum maximum*	Jacq.	LC	Indigenous
Rubiaceae	*Pavetta zeyheri subsp. zeyheri*		LC	Indigenous
Malvaceae	*Pavonia burchellii*	(DC.) R.A.Dyer	LC	Indigenous
Fabaceae	*Pearsonia bracteata*	(Benth.) Polhill	NT	Indigenous; Endemic
Fabaceae	*Pearsonia cajanifolia*	(Harv.) Polhill		Indigenous
Geraniaceae	*Pelargonium sidoides*	DC.	LC	Indigenous; Endemic
Pteridaceae	*Pellaea calomelanos var. calomelanos*		LC	Indigenous
Asteraceae	*Pentzia globosa*	Less.	LC	Indigenous; Endemic
Poaceae	*Perotis patens*	Gand.	LC	Indigenous
Polygonaceae	*Persicaria amphibia*	(L.) Delarbre		Not indigenous; Naturalised
Polygonaceae	*Persicaria hystricula*	(J.Schust.) Sojak	LC	Indigenous; Endemic
Polygonaceae	*Persicaria lapathifolia*	(L.) Delarbre		Not indigenous; Naturalised; Invasive
Polygonaceae	*Persicaria nepalensis*	(Meisn.) H.Gross		Not indigenous; Naturalised
Molluginaceae	*Pharnaceum sp.*			
Poaceae	*Phragmites mauritianus*	Kunth	LC	Indigenous
Phyllanthaceae	*Phyllanthus incurvus*	Thunb.	LC	Indigenous
Phyllanthaceae	*Phyllanthus maderaspatensis*	L.	LC	Indigenous
Phyllanthaceae	*Phyllanthus parvulus var. parvulus*		LC	Indigenous
Solanaceae	*Physalis angulata*	L.		Not indigenous; Naturalised; Invasive
Solanaceae	*Physalis viscosa*	L.		Not indigenous; Naturalised; Invasive
Asteraceae	*Platycarphella parvifolia*	(S.Moore) V.A.Funk & H.Rob.	LC	Indigenous; Endemic
Plumbaginaceae	*Plumbago auriculata*	Lam.	LC	Indigenous
Poaceae	*Pogonarthria squarrosa*	(Roem. & Schult.) Pilg.	LC	Indigenous
Caryophyllaceae	*Pollichia campestris*	Aiton	LC	Indigenous
Asteraceae	*Polydora angustifolia*	(Steetz) H.Rob.	LC	Indigenous
Polygalaceae	*Polygala hottentotta*	C.Presl	LC	Indigenous
Polygalaceae	*Polygala leptophylla var. leptophylla*		LC	Indigenous
Polygalaceae	*Polygala sp.*			

Polygonaceae	*Polygonum aviculare*	L.		Not indigenous; Naturalised
Salicaceae	*Populus nigra var. italica*	L.; Munchh		Not indigenous; Naturalised; Invasive
Potamogetonaceae	*Potamogeton pectinatus*	L.	LC	Indigenous
Potamogetonaceae	*Potamogeton schweinfurthii*	A.Benn.	LC	Indigenous
Asteraceae	*Pseudognaphalium oligandrum*	(DC.) Hilliard & B.L.Burtt	LC	Indigenous
Pedaliaceae	*Pterodiscus speciosus*	Hook.	LC	Indigenous
Ranunculaceae	*Ranunculus multifidus*	Forssk.	LC	Indigenous
Apocynaceae	*Raphionacme hirsuta*	(E.Mey.) R.A.Dyer	LC	Indigenous; Endemic
Apocynaceae	*Raphionacme velutina*	Schltr.	LC	Indigenous
Asteraceae	*Rhaponticum repens*	(L.) Hildago		Not indigenous; Naturalised
Fabaceae	*Rhynchosia minima var. prostrata*	(L.) DC.; (Harv.) Meikle	NE	Indigenous
Fabaceae	*Rhynchosia sp.*			
Fabaceae	*Rhynchosia totta var. totta*		LC	Indigenous
Ricciaceae	*Riccia okahandjana*	S.W.Arnell		Indigenous
Apocynaceae	*Riocreuxia polyantha*	Schltr.	LC	Indigenous
Brassicaceae	*Rorippa fluviatilis var. fluviatilis*		LC	Indigenous
Polygonaceae	*Rumex conglomeratus*	Murb.	LC	Indigenous
Salicaceae	*Salix mucronata subsp. mucronata*		LC	Indigenous
Amaranthaceae	*Salsola kali*	L.		Not indigenous; Naturalised; Invasive
Lamiaceae	*Salvia runcinata*	L.f.	LC	Indigenous
Poaceae	*Schizachyrium sanguineum*	(Retz.) Alston	LC	Indigenous
Asteraceae	*Schkuhria pinnata*	(Lam.) Kuntze ex Thell.		Not indigenous; Naturalised
Cyperaceae	*Schoenoplectus muricinux*	(C.B.Clarke) J.Raynal	LC	Indigenous
Anacardiaceae	*Searsia lancea*	(L.f.) F.A.Barkley	LC	Indigenous
Anacardiaceae	*Searsia leptodictya forma leptodictya*		NE	Indigenous
Anacardiaceae	*Searsia pyroides var. pyroides*		LC	Indigenous
Anacardiaceae	*Searsia rigida var. margaretae*	(Mill.) F.A.Barkley; (Burtt Davy ex Moffett) Moffett	LC	Indigenous; Endemic
Anacardiaceae	*Searsia rigida var. rigida*		LC	Indigenous; Endemic
Convolvulaceae	*Seddera capensis*	(E.Mey. ex Choisy) Hallier f.	LC	Indigenous
Scrophulariaceae	*Selago burkei*	Rolfe	LC	Indigenous; Endemic
Scrophulariaceae	*Selago welwitschii var. australis*	Rolfe; Hilliard	LC	Indigenous; Endemic

Asteraceae	*Senecio reptans*	Turcz.	LC	Indigenous; Endemic
Fabaceae	*Senna italica subsp. arachoides*	Mill.; (Burch.) Lock	LC	Indigenous
Asteraceae	*Seriphium plumosum*	L.		Indigenous
Fabaceae	*Sesbania bispinosa var. bispinosa*	(Jacq.) W.Wight		Not indigenous; Naturalised
Poaceae	*Setaria incrassata*	(Hochst.) Hack.	LC	Indigenous
Poaceae	*Setaria nigrirostris*	(Nees) T.Durand & Schinz	LC	Indigenous
Poaceae	*Setaria sphacelata var. torta*	(Schumach.) Stapf & C.E.Hubb. ex M.B.Moss; (Stapf) Clayton	LC	Indigenous
Caryophyllaceae	*Silene burchellii subsp. pilosellifolia*	Otth ex DC.; (Cham. & Schltdl.) J.C.Manning & Goldblatt		Indigenous; Endemic
Solanaceae	*Solanum campylacanthum*	Hochst. ex A.Rich.		Indigenous
Solanaceae	*Solanum lichtensteinii*	Willd.	LC	Indigenous
Solanaceae	*Solanum tomentosum*	L.		Indigenous; Endemic
Lamiaceae	*Stachys hyssopoides*	Burch. ex Benth.	LC	Indigenous; Endemic
Lamiaceae	*Stachys spathulata*	Burch. ex Benth.	LC	Indigenous
Caryophyllaceae	*Stellaria apetala*	Ucria		Not indigenous; Naturalised; Invasive
Apocynaceae	*Stenostelma capense*	Schltr.	LC	Indigenous; Endemic
Poaceae	*Stipagrostis uniplumis var. neesii*	(Licht.) De Winter; (Trin. & Rupr.) De Winter	LC	Indigenous
Asteraceae	*Symphyotrichum squamatum*	(Spreng.) G.L.Nesom		Not indigenous; Naturalised; Invasive
Asteraceae	*Tagetes minuta*	L.		Not indigenous; Naturalised; Invasive
Talinaceae	*Talinum caffrum*	(Thunb.) Eckl. & Zeyh.	LC	Indigenous
Asteraceae	*Tarchonanthus camphoratus*	L.	LC	Indigenous
Fabaceae	*Tephrosia lupinifolia*	DC.	LC	Indigenous
Fabaceae	*Tephrosia semiglabra*	Sond.	LC	Indigenous; Endemic
Ranunculaceae	*Thalictrum minus*	L.	LC	Indigenous
Santalaceae	*Thesium costatum var. juniperinum*	A.W.Hill; A.W.Hill	LC	Indigenous; Endemic
Santalaceae	*Thesium impeditum*	A.W.Hill	LC	Indigenous; Endemic
Santalaceae	*Thesium transvaalense*	Schltr.	LC	Indigenous; Endemic
Asphodelaceae	*Trachyandra asperata var. macowanii*	Kunth; (Baker) Oberm.	LC	Indigenous; Endemic
Asphodelaceae	*Trachyandra erythrorrhiza*	(Conrath) Oberm.	LC	Indigenous; Endemic
Asphodelaceae	*Trachyandra saltii var. saltii*		LC	Indigenous
Asteraceae	*Tragopogon porrifolius*	L.		Not indigenous; Naturalised

Poaceae	*Tragus berteronianus*	Schult.	LC	Indigenous
Zygophyllaceae	*Tribulus terrestris*	L.	LC	Indigenous
Boraginaceae	*Trichodesma angustifolium subsp. angustifolium*		LC	Indigenous
Poaceae	*Trichoneura grandiglumis*	(Nees) Ekman	LC	Indigenous
Fabaceae	*Trifolium africanum var. africanum*		NE	Indigenous; Endemic
Poaceae	*Triraphis andropogonoides*	(Steud.) E.Phillips	LC	Indigenous; Endemic
Alliaceae	*Tulbaghia acutiloba*	Harv.	LC	Indigenous; Endemic
Fabaceae	*Vachellia karroo*	(Hayne) Banfi & Galasso	LC	Indigenous
Fabaceae	*Vachellia robusta subsp. robusta*		LC	Indigenous
Rubiaceae	*Vangueria pygmaea*	Schltr.	LC	Indigenous
Verbenaceae	*Verbena officinalis*	L.		Not indigenous; Naturalised
Plantaginaceae	*Veronica agrestis*	L.		Not indigenous; Naturalised
Plantaginaceae	*Veronica anagallis-aquatica*	L.	LC	Indigenous
Fabaceae	*Vicia sativa subsp. sativa*	L.		Not indigenous; Naturalised; Invasive
Fabaceae	*Vigna unguiculata subsp. stenophylla*	(L.) Walp.; (Harv.) Marechal, Mascherpa & Stainier	LC	Indigenous
Santalaceae	*Viscum verrucosum*	Harv.	LC	Indigenous
Campanulaceae	*Wahlenbergia denticulata var. transvaalensis*	(Burch.) A.DC.; (Adamson) Welman	LC	Indigenous; Endemic
Campanulaceae	*Wahlenbergia magaliesbergensis*	Lammers	LC	Indigenous; Endemic
Campanulaceae	*Wahlenbergia undulata*	(L.f.) A.DC.	LC	Indigenous
Solanaceae	*Withania somnifera*	(L.) Dunal	LC	Indigenous
Convolvulaceae	*Xenostegia tridentata subsp. angustifolia*	(L.) D.F.Austin & Staples; (Jacq.) Lejoly & Lisowski	LC	Indigenous
Rutaceae	*Zanthoxylum capense*	(Thunb.) Harv.	LC	Indigenous
Asteraceae	*Zinnia peruviana*	(L.) L.		Not indigenous; Naturalised; Invasive
Rhamnaceae	Ziziphus mucronata	Willd.		Indigenous
Rhamnaceae	Ziziphus zeyheriana	Sond.	LC	Indigenous

11.2 Appendix B – Amphibian species expected to occur in the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2021)
Amietia delalandii	Delalande's River Frog	LC	LC
Amietia fuscigula	Cape River Frog	LC	LC
Breviceps adspersus	Bushveld Rain Frog	LC	LC
Cacosternum boettgeri	Common Caco	LC	LC
Kassina senegalensis	Bubbling Kassina	LC	LC
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	LC
Phrynomantis bifasciatus	Banded Rubber Frog	LC	LC
Pyxicephalus adspersus	Giant Bull Frog	NT	LC
Schismaderma carens	Red Toad	LC	LC
Sclerophrys capensis	Raucous Toad	LC	LC
Sclerophrys garmani	Olive Toad	LC	LC
Sclerophrys gutturalis	Guttural Toad	LC	LC
Sclerophrys poweri	Power's Toad	LC	LC
Tomopterna cryptotis	Tremelo Sand Frog	Not listed	LC
Tomopterna natalensis	Natal Sand Frog	LC	LC
Tomopterna tandyi	Tandy's Sand Frog	LC	LC
Xenopus laevis	Common Platanna	LC	LC

11.3 Appendix C – Reptile species expected to occur in the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2021)
Acontias gracilicauda	Thin-tailed Legless Skink	LC	LC
Afroedura nivaria	Drakensberg Rock Gecko	LC	LC
Agama aculeata distanti	Distant's Ground Agama	LC	LC
Agama atra	Southern Rock Agama	LC	LC
Aparallactus capensis	Black-headed Centipede-eater	LC	LC
Atractaspis bibronii	Bibron's Stiletto Snake	LC	LC
Bitis arietans arietans	Puff Adder	LC	LC
Boaedon capensis	Brown House Snake	LC	LC
Chamaeleo dilepis	Common Flap-neck Chameleon	LC	LC
Cordylus vittifer	Common Girdled Lizard	LC	LC
Crotaphopeltis hotamboeia	Red-lipped Snake	LC	LC
Dasypeltis scabra	Rhombic Egg-eater	LC	LC
Elapsoidea sundevallii media	Highveld Garter Snake	LC	LC
Hemachatus haemachatus	Rinkhals	LC	LC
Lamprophis aurora	Aurora House Snake	LC	LC
Leptotyphlops scutifrons	Peter's Thread Snake	LC	LC
Lycophidion capense capense	Cape Wolf Snake	LC	LC
Lygodactylus capensis	Common Dwarf Gecko	LC	LC
Meroles squamulosus	Common Rough-scaled Lizard	LC	LC
Monopeltis capensis	Cape Worm Lizard	LC	LC
Nucras holubi	Holub's Sandveld Lizard	LC	LC
Nucras intertexta	Spotted Sandveld Lizard	LC	LC
Pachydactylus capensis	Cape Gecko	LC	LC
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	LC	LC
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard	LC	LC
Pelomedusa galeata	South African Marsh Terrapin	LC	LC
Psammobates oculifer	Serrated Tent Tortoise	LC	Not listed
Psammophis crucifer	Cross-marked Grass Snake	Not listed	LC
Psammophis leightoni	Cape Sand Snake	LC	LC
Psammophylax tritaeniatus	Striped Skaapsteker	LC	LC
Pseudaspis cana	Mole Snake	LC	LC
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	LC	LC
Stigmochelys pardalis	Leopard Tortoise	LC	LC
Trachylepis capensis	Cape Skink	LC	LC
Trachylepis punctatissima	Speckled Rock Skink	LC	LC
Trachylepis varia	Common Variable Skink	LC	LC

Varanus albigularis albigularis	Rock Monitor	LC	LC
Varanus niloticus	Water Monitor	LC	LC

11.4 Appendix D – Mammal species expected to occur within the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2021)
Aethomys ineptus	Tete Veld Rat	LC	LC
Aethomys namaquensis	Namaqua rock rat	LC	LC
Alcelaphus buselaphus	Sclater's Shrew	LC	LC
Aonyx capensis	Cape Clawless Otter	NT	NT
Atelerix frontalis	South African Hedgehog	NT	LC
Atilax paludinosus	Water Mongoose	LC	LC
Canis mesomelas	Black-backed Jackal	LC	LC
Caracal caracal	Caracal	LC	LC
Chlorocebus pygerythrus	Vervet Monkey	LC	LC
Crocidura cyanea	Reddish-grey Musk Shrew	LC	LC
Crocidura fuscomurina	Bicolored Musk Shrew	LC	LC
Crocidura maquassiensis	Makwassie Musk Shrew	VU	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Desmodillus auricularis	Cape Short-eared Gerbil	LC	LC
Eidolon helvum	African Straw-coloured Fruit Bat	LC	NT
Elephantulus myurus	Eastern Rock Sengi	LC	LC
Eptesicus hottentotus	Long-tailed Serotine Bat	LC	LC
Felis nigripes	Black-footed Cat	VU	VU
Felis silvestris	African Wildcat	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Gerbilliscus brantsii	Highveld Gerbil	LC	LC
Gerbilliscus leucogaster	Bushveld Gerbil	LC	LC
Herpestes sanguineus	Slender Mongoose	LC	LC
Hydrictis maculicollis	Spotted-necked Otter	VU	NT
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ichneumia albicauda	White-tailed Mongoose	LC	LC
Ictonyx striatus	Striped Polecat	LC	LC
Leptailurus serval	Serval	NT	LC
Lepus capensis	Cape Hare	Not listed	LC
Lepus saxatilis	Scrub Hare	LC	LC
Lepus victoriae	African Savanna Hare	LC	LC
Malacothrix typica	Gerbil Mouse	LC	LC
Mastomys coucha	Multimammate Mouse	LC	LC
Mellivora capensis	Honey Badger	LC	LC
Mus musculus	House Mouse	Not listed	LC
Mystromys albicaudatus	White-tailed Rat	VU	EN

Neoromicia capensis	Cape Serotine Bat	LC	LC
Neoromicia zuluensis	Zulu Pipistrelle Bat	LC	LC
Nycteris thebaica	Common Slit-faced Bat	LC	LC
Orycteropus afer	Aardvark	LC	LC
Otocyon megalotis	Bat-eared Fox	LC	LC
Otomys irroratus	Vlei Rat	LC	LC
Panthera pardus	Leopard	VU	VU
Papio ursinus	Chacma Baboon	LC	LC
Parahyaena brunnea	Brown Hyaena	NT	NT
Pedetes capensis	Springhare	LC	LC
Phacochoerus africanus	Common Warthog	LC	LC
Poecilogale albinucha	African Striped Weasel	NT	LC
Procavia capensis	Rock Hyrax	LC	LC
Proteles cristata	Aardwolf	LC	LC
Rattus rattus	House Rat	Not listed	LC
Rhabdomys pumilio	Xeric Four-striped Mouse	LC	LC
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	NT	LC
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	LC
Saccostomus campestris	Pouched Mouse	LC	LC
Scotophilus dinganii	Yellow House Bat	LC	LC
Steatomys krebsii	Kreb's Fat Mouse	LC	LC
Steatomys pratensis	Fat Mouse	LC	LC
Suncus varilla	Lesser Dwarf Shrew	LC	LC
Sylvicapra grimmia	Common Duiker	LC	LC
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	LC
Thryonomys swinderianus	Greater Cane Rat	LC	LC
Vulpes chama	Cape Fox	LC	LC
Xerus inauris	South African Ground Squirrel	LC	LC

11.5 Appendix E Specialist Declarations

DECLARATION

I, Carami Burger, 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.

Carami Burger

Ecologist

The Biodiversity Company

July 2022

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

July 2022

11.6 Appendix F Specialists CVs

Carami Burger

B.Sc. Honours – Ecological Interactions and Ecosystem Resilience (Cum Laude)

(*Cand Sci Nat*)

Cell: +27 83 630 9077

Email: Carami@thebiodiversitycompany.com

Identity Number: 9606250185084

Date of birth: 25 June 1996

Profile Summary

Working experience in South Africa and Mozambique.

Specialist experience with infrastructure development, road development, renewable energy, mining and prospecting.

Specialist expertise include terrestrial ecology, wetland resources, rehabilitation and management plans, environmental compliance and monitoring.

Areas of Interest

Renewable Energy & Bulk Services Infrastructure Development, Mining, Farming, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessments (EIA)
- Basic Assessments
- Terrestrial Ecological Assessments
- Wetland Delineation and Ecological Assessments
- Environmental Management Programmes (EMPr)
- Rehabilitation Plans
- Invasive Species Plans
- Search and Rescue Plans
- Environmental Compliance Audits
- Water Use License Applications
- Dust Fallout Monitoring
- Water Quality Monitoring

Countries worked in

South Africa

Mozambique

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- BSc Hons Ecological Interactions and Ecosystem Resilience.
- BSc Botany and Zoology.
- Cand Sci Nat (121757)

SELECTED PROJECT EXPERIENCE

Project Name: The Central Térmica de Temane (CTT) Project - Management Plans

Client: TSK

Personal position / role on project: Author

Location: Inhambane Province, Mozambique

Main project features: Compile a Plant Search and Rescue Plan, Site Clearance Plan, Invasive Alien Species Plan and a Rehabilitation Plan for the Central Térmica de Temane (CTT) project

Project Name: The Central Térmica de Temane (CTT) Project - Flora and Fauna Survey and Report

Client: TSK

Personal position / role on project: Terrestrial Specialist

Location: Inhambane Province, Mozambique

Main project features: Conduct a Flora and Fauna survey and report during the dry and wet season for the Central Térmica de Temane (CTT) project, located in the vicinity of the town of Inhassoro, Inhambane Province, Mozambique

Project Name: Sikhwetha Lodge - Ridge and Terrestrial Ecological Assessment

Client: Neels Bezuidenhout Architects

Personal position / role on project: Terrestrial Specialist

Location: Roodeplaat, Gauteng

Main project features: Conduct a Ridge And Terrestrial Ecological Assessment as part of the Environmental Authorisation process for the proposed Sikhwetha Lodge located on Portion 2 of the Farm Doornfontein 291 JR.

Project Name: Rama City Bulk Service Infrastructure Development - Watercourse Delineation and Assessment

Client: RCDC

Personal position / role on project: Wetland Ecologist

Location: Ga-Rankuwa Gauteng

Main project features: Conduct a Watercourse Delineation and Assessment for the Rama City Bulk Service Infrastructure Development.

Project Name: Katoloso Minerals Prospecting Right – Terrestrial and Wetland Ecological Opinion

Client: Katoloso Minerals

Personal position / role on project: Terrestrial/ Wetland Ecologist

Location: Ventersdorp North West

Main project features: To conduct a terrestrial and wetland ecological opinion for the proposed Prospecting Right.

Project Name: Wetland Assessment as part of the Environmental Authorisation process for the proposed construction of residential units on Portion 9 of the farm Olievenhoutbosch 389-JR, Gauteng Province.

Personal position / role on project: Avifaunal specialist

Location: Olievenhoutbosch, Gauteng Province.

Main project features: To conduct a wetland assessment for the proposed construction of residential units.

Project Name: Copperton Wind Farm Project - Rehabilitation Method Statement

Personal position / role on project: Terrestrial Ecologist

Location: Copperton Northern Cape Province.

Main project features: To compile a rehabilitation method statement for the Copperton Wind Farm Project located on the farm Nelspoortjie (Farm No. 103 Portion 4 (a portion of portion 2) and 7 (a portion of portion 5) near Copperton in the Northern Cape Province.

Project Name: Wonderfontein Road Diversion - Terrestrial Ecological Scan

Personal position / role on project: Terrestrial Ecologist.

Location: Belfast, Mpumalanga Province

Main project features: To conduct a terrestrial ecological scan as part of the Environmental Authorisation Process for the Proposed Wonderfontein Road Diversion Near Wonderfontein Colliery.

Project Name: Terrestrial Ecological Report for the proposed construction of a crematorium on a portion of the remaining extent of the Farm Vulcania 279 IR, Gauteng Province

Personal position / role on project: Terrestrial Ecologist

Location: Springs, Gauteng

Main project features: Conduct a detailed terrestrial ecology basic assessment for the proposed construction of a crematorium.

Project Name: Wetland study as part of the Environmental Authorisation process for the proposed construction of a crematorium on a portion of the remaining extent of the Farm Vulcania 279 IR, Gauteng Province.

Personal position / role on project: Wetland Ecologist

Location: Springs, Gauteng

Main project features: To conduct a wetland delineation and ecological assessment for the proposed construction of a crematorium.

OVERVIEW

An overview of the specialist technical expertise includes the following:

- Terrestrial Ecological Assessments.
- Faunal surveys which include mammals, birds, amphibians and reptiles.
- Wetland Ecological Assessment.
- Management plan compilation (Plant Search and Rescue, Rehabilitation, Site Clearance, Alien Invasive Species Plans).
- Compliance audits.
- Water Use Licenses.
- Water Quality and Dust Fall Monitoring.

EMPLOYMENT EXPERIENCE

CURRENT EMPLOYMENT: The Biodiversity Company (May 2022 - Present)

Terrestrial Ecological Assessments, Wetland Ecological Assessment and management Plans.

EMPLOYMENT: EP3 Environmental - Senior Consultant and Ecologist (June 2019 - April 2022)

Responsibilities:

- Specialist studies
- Environmental Procedures
- Basic Assessment Reports
- Environmental Impact Assessment Reports
- Water Use License Applications
- Environmental Management Programmes
- Environmental Control Officer Audits and Reports
- Surface Water Quality Monitoring Reports

- Groundwater Quality Monitoring Reports
- Dust Fallout Monitoring Reports

EMPLOYMENT: Scientific Aquatic Services (SAS)- Internship (November 2018 - June 2019)

Responsibilities:

- Specialist studies
- Background Information, Mapping (ArcGIS) and Desktop Studies

ACADEMIC QUALIFICATIONS

North-West University of Potchefstroom (2017): BACCALAUREUS SCIENTIAE IN NATURAL AND ENVIRONMENTAL SCIENCES. Majors: Botany and Zoology.

North-West University of Potchefstroom (2013): BACCALAUREUS SCIENTIAE HONORIBUS (Hons) – Ecological Interactions and Ecosystem Resilience (Cum Laude)

Title: Mini-Dissertation on ecological information in Environmental Impact Assessments (EIA) at Mooi River Mall.

Andrew Husted

M.Sc Aquatic Health (*Pr Sci Nat*)

Cell: +27 81 319 1225

Email: andrew@thebiodiversitycompany.com

Identity Number: 7904195054081

Date of birth: 19 April 1979

Profile Summary

Working experience throughout South Africa, West and Central Africa and also Armenia.

Specialist experience with on-shore drilling, mining, engineering, hydropower and renewable energy.

Experience with project management of national and international multi-disciplinary projects. Including managing and compiling ESHIAs and EMPs

Specialist guidance, support and facilitation for the compliance with legislative processes, for in-country requirements, and international lenders.

Specialist expertise include Instream Flow and Ecological Water Requirements, aquatic ecology and wetlands resources.

Areas of Interest

Mining, Oil & Gas, Renewable Energy & Bulk Services Infrastructure Development, Sustainability and Conservation.

Key Experience

- Familiar with World Bank, Equator Principles and the International Finance Corporation requirements
- Environmental, Social and Health Impact Assessments (ESHIA)
- Environmental Management Programmes (EMP)
- Ecological Water Requirement determination experience
- Wetland delineations and ecological assessments
- Terrestrial Ecological Assessments
- Aquatic Ecological Assessments
- Rehabilitation Plans and Monitoring
- Aquaculture

Country Experience

Botswana, Cameroon

Democratic Republic of Congo

Ghana, Ivory Coast, Lesotho

Liberia, Mali, Mozambique

Nigeria, Republic of Armenia, Senegal

Sierra Leone, South Africa

Swaziland, Tanzania

Nationality

South African

Languages

English – Proficient

Afrikaans – Conversational

German - Basic

Qualifications

- MSc (University of Johannesburg) – Aquatic Health.
- BSc Honours (Rand Afrikaans University) – Aquatic Health
- BSc Natural Science
- Pr Sci Nat (400213/11)
- Certificate of Competence: Mondi Wetland Assessments
- Certificate of Competence: Wetland WET-Management
- SASS 5 (Expired) – Department of Water Affairs and Forestry for the River Health Programme
- EcoStatus application for rivers and streams

Publication of scientific journals and articles.

SELECTED PROJECT EXPERIENCE

Project Name: The Environmental and Social Impact Assessment (ESIA) the proposed Nondvo Dam

Client: WSP

Personal position / role on project: Project Manager.

Location: Swaziland

Main project features: To conduct a dual season terrestrial and aquatic ecological baseline and impact assessment for the proposed dam. The study was required to meet national and IFC requirements, including a Critical Habitat assessment.

Project Name: The environmental flow assessment for the Mara River system

Client: IHE Delft Institute for Water Education

Personal position / role on project: Project Manager / Freshwater Ecologist

Location: Tanzania

Main project features: To conduct a dual season campaign to the Lower Mara River Basin in Tanzania to collect hydrological and ecological information as part of an environmental flow assessment on the Tanzanian side of the Mara River in collaboration with GIZ and NBI-NELSAP.

Project Name: The Environmental and Social Impact Assessment (ESIA) the proposed solar photovoltaic facility and transmission in Cuamba

Client: WSP

Personal position / role on project: Project Manager.

Location: Mozambique

Main project features: To conduct a single season terrestrial and aquatic ecological baseline and impact assessment for the proposed dam. The study was required to meet national and IFC requirements, including a Critical Habitat assessment.

Project Name: A biodiversity baseline assessment for the proposed Siguiri Gold Mine Project, in Kankan Province, Guinea.

Client: SRK Consulting.

Personal position / role on project: Project Manager.

Location: Siguiri, Guinea, West-Africa (2018).

Main project features: To conduct a dual season ecological baseline assessment for the expected impact footprint area. The study was required to meet national and IFC requirements, including a Critical Habitat assessment.

Project Name: A biodiversity baseline and impact assessment for the proposed Lesotho Bulk Water Supply Scheme, Lesotho.

Client: WSP.

Personal position / role on project: Wetland & Aquatic Ecologist, PROBFLO and Project Manager.

Location: Mohale's Hoek, Lesotho (2018).

Main project features: To conduct a dual season terrestrial and aquatic ecological baseline and impact assessment for the pipeline route and proposed weir. The study was required to meet national and IFC requirements, including a Critical Habitat assessment. The study also contributed to prescribing Instream Flow Requirements using PROBFLO for the system.

Project Name: A biodiversity baseline and impact assessment for the proposed Pavua Hydropower Project, in Sofala Province, Central Mozambique.

Client: Mott MacDonald.

Personal position / role on project: Project Manager.

Location: Sofala Province, Mozambique (2017).

Main project features: To conduct a dual season terrestrial and aquatic ecological baseline and impact assessment for the expected impact footprint area, including Gorongosa National. The study was required to meet national and IFC requirements, including a Critical Habitat assessment. The study also contributed to prescribing Instream Flow Requirements for the system.

EMPLOYMENT EXPERIENCE

CURRENT EMPLOYMENT: The Biodiversity Company (January 2015 – Present)

I founded The Biodiversity Company in 2015, now consisting of experienced ecologists who provide technical expertise and policy advice to numerous sectors, such as mining, agriculture, construction and natural resources. The team at The Biodiversity Company have conducted stand-alone specialist studies, and provided overall guidance of studies with a pragmatic approach for the management of biodiversity that takes into account all the relevant stakeholders, most importantly the environment that is potentially affected. We manage risks to the environment to reduce impacts with practical, relevant and measurable methods.

EMPLOYMENT: Digby Wells Environmental (October 2013 – December 2014)

Digby Wells assigned me to the role of Country Manager for the united Kingdom. This was a new endeavour for the company as the company's global footprint continues to increase. The primary responsibilities for the role included the following:

- **Client liaison** to be able to interact more efficiently and personally with current mining clients, mining industry service providers, legal firms and banking institutions in order to introduce Digby Wells as a services provider with the aim of securing work.
- **Project management** for international projects which may require a presence in the united Kingdom, this was dependent on the location and needs of the client. These projects would mostly be based on the Equator Principles (EP) and International Finance Corporation (IFC) Performance Standards.

- **Technical input** to provide specialist technical expertise for projects, this included fauna, aquatic ecology, wetlands and rehabilitation. Continued with the design and implementation of Biodiversity and Land Management Plans to assist clients with managing the natural resources. Responsibilities also included the mentorship and management (including reviewing and guiding) other expertise such as flora, fauna and pedology.

EMPLOYMENT: Digby Wells Environmental (March 2012 – September 2013)

Manager of a multi-disciplinary department of scientists providing specialist services in support of national and international requirements as well as best practice guidelines, primarily focussing on the mining sector. In addition to managing the department, I was also expected to contribute specialist services, most notably focusing on water resources. Further responsibilities also included the management of numerous projects on a national or international scale. A general overview of the required responsibilities are as follows:

- **Project management** for single as well as multi-disciplinary studies on a national and international scale. This included legislation and commitments for the respective country being operated in, as well as included the World Bank (WB), EP and IFC requirements.
- **Individual and/or team management** in order to provide mentoring and supportive structures for development and growth in support of the company's strategic objectives.
- **Scientific report writing** to ensure that the relevant standards and requirements have been attained, namely local country legislation, as well as WB, EP and IFC requirements.
- **Report reviewing** in order to ensure compliance and consideration of relevant legislation and guidelines and also quality control.
- **Specialist management** to facilitate the collaboration and integration of specialist skills for the respective projects. This also included the development of Biodiversity and Land Management Plan for clients.
- **Client Resource Manager** for numerous clients in order to establish as well as maintain working relationships.

An overview of the tenure working with the company is provided below**:**

- **October 2013 – December 2014: London Operations Manager** – Deployed to establish a presence for the company (remote office) in the united Kingdom by means of generating project work to support the employment of staff and operation of a business structure.
- **March 2012 – September 2013: Biophysical Department Manager** – Responsible for the development and growth of the department to consist of four specialist units. This included the development of a new specialist unit, namely Rehabilitation.
- **January 2011 - February 2012: Ecological unit Manager** – In addition to implementing aquatic and wetland specialist services, the role required the overall management of additional specialist services which included fauna & flora.
- **June 2010 - December 2010: Aquatic Services Manager** – This required the marketing and implementation of specialist programmes for the client base such as biomonitoring and wetland off-set strategies. In addition to this, this also included expanding on the existing skill set to include services such as toxicity, bioaccumulation and ecological flow assessments.
- **August 2008: Aquatic ecologist** – Employed as a specialist to establish the aquatic services within the company. In addition to this, wetland specialist services were added to the existing portfolio.

PREVIOUS EMPLOYMENT: Econ@UJ (University of Johannesburg)

- June 2007 – July 2008: Junior aquatic ecologist
  - Researcher

- Technical assistant for fieldwork
- Reporting writing
- Project management

ADDITIONAL EXPERIENCE

Compliance audits	Conducting site investigations in order to determine the level compliance attained, ensuring that the client maintains appropriate measure of compliance with environmental regulatic by means of a legislative approach
Control officer	Acting as an independent Environmental Control Officer (EC acting as a quality controller and monitoring agent regarding environmental concerns and associated environmental impacts
Screening studies	Project investigations in order to determine the level of complexity for environmental and social studies required for a project. This is a forn risk assessment to guide the advancement of the project.
Public consultation	The provision of specialist input in order to communicate proj findings as well as assist with providing feedback if and wh required.
Water use licenses	Consultation with the relevant authorities in order to establish project requirements, as well as provide specia (aquatics/wetland) input for the application in order to achie authorisation.
Closure	Primarily the review of closure projects, with emphasis on closure cost calculations. Support was also provided by assist with the measurements of structures during fieldwork.
Visual	The review of visual studies as well as the collation of field d considered for the visual interpretation for the project.

ACADEMIC QUALIFICATIONS

University of Johannesburg, Johannesburg, South Africa (2009): MAGISTER SCIENTIAE (MSc) - Aquatic Health:

Title: *Aspects of the biology of the Bushveld Smallscale Yellowfish (Labeobarbus polylepis): Feeding biology and metal bioaccumulation in five populations.*

Rand Afrikaans University (RAU), Johannesburg, South Africa (2004): BACCALAUREUS SCIENTIAE CUM HONORIBUS (Hons) – Zoology

Rand Afrikaans University (RAU), Johannesburg, South Africa (2001 - 2004): BACCALAUREUS SCIENTIAE IN NATURAL AND ENVIRONMENTAL SCIENCES. Majors: Zoology and Botany.

PUBLICATIONS

Mahomed D, Husted A, Fry C, Downsa CT and O'Brien GC. 2019. Spatial shifts and habitat partitioning of ichthyofauna within the middle-lower region of the Pungwe Basin, Mozambique, Journal of Freshwater Ecology, 34:1, 685-702, DOI: 10.1080/02705060.2019.1673221

Tate RB and Husted, A. 2015. Aquatic Biomonitoring in the upper reaches of the Boesmanspruit, Carolina, Mpumalanga, South Africa. African Journal of Aquatic Science.

Tate RB and Husted A. 2013. Bioaccumulation of metals in *Tilapia zillii* (Gervai, 1848) from an impoundment on the Badeni River, Cote D'Iviore. African Journal of Aquatic Science.

O'Brien GC, Bulfin JB, Husted A. and Smit NJ. 2012. Comparative behavioural assessment of an established and new Tigerfish (*Hydrocynus vittatus*) population in two manmade lakes in the Limpopo catchment, Southern Africa. African Journal of Aquatic Science.

Tomschi, H, Husted, A, O'Brien, GC, Cloete, Y, Van Dyk C, Pieterse GM, Wepener V, Nel A and Reisinger U. 2009. Environmental study to establish the baseline biological and physical conditions of the Letsibogo Dam near Selebi Phikwe, Botswana. EC Multiple Framework Contract Beneficiaries.8 ACP BT 13 – Mining Sector (EDMS). Specific Contract N° 2008/166788. Beneficiary Country: Botswana. By: HPC HARRESS PICKEL CONSULT AG

Husted A. 2009. Aspects of the biology of the Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*): Feeding biology and metal bioaccumulation in five populations. The University of Johannesburg (Thesis).

APPENDIX E3: Avifauna Impact Assessment

Proposed Altina PV Site– Avifaunal Baseline & Impact Assessment

Vierfontein, Free State Province

October 2022

CLIENT

Prepared by:

The Biodiversity Company

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Fax: +27 86 527 1965

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www.thebiodiversitycompany.com

Report Name	**Proposed Altina PV Site– Avifaunal Baseline & Impact Assessment**
Reference	**Altina PV site**
Submitted to	NEMAI CONSULTING
Report Writer (Fauna)	**Tyron Clark**
	Tyron Clark (Pr. Sci. Nat. 121338) has more than decade's worth of experience conducting biodiversity assessments in a number of African countries, affording him good experience in variety of development types, particularly avifaunal assessments. He attained his MSC in Zoological science from the University of the Witwatersrand. His research interests centre on biogeography and ecological niche modelling. Tyron has also completed courses in wetland delineation and management hosted by the University of the Free State.
Reviewer	**Andrew Husted**
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
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.

Pair of South African Shelduck (*Tadorna cana*) from the project area

DECLARATION

I, Tyron Clark, 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.

Tyron Clark (Pr. Sci. Nat. 121338)

Terrestrial Ecologist

The Biodiversity Company

August 2022

Table of Contents

List of Tables

List of Figures

1 Introduction

The Biodiversity Company was appointed to undertake an avifaunal baseline and impact assessment for the proposed Altina solar photovoltaic (PV) system. The proposed project area is located 3 km south-east of Orkney near Vierfontein in the Free State province (Figure 1-2). The project area is bisected by the R76 tar road which divides the project into northern and southern portions. The most significant habitat feature from an avifaunal perspective is the large floodplain which enters the project area in the south-west and again in the north.

The proposed solar panels will be bifacial and thus the complete clearing of vegetation beneath the PV panels is required. The project will tie into the existing substation bordering the project area (27.049034°; 26.746572°). Two infranstructure alternatives have been proposed namely Alternative 1 which represents the original layout (Figure 1-3) and Alternative 2 which represents the preferred layout that takes into account potential sensitivities (Figure 1-4). This study was conducted in line with relevant national legislation and best practice standards:

- The National Web-Based Environmental Screening Tool DEA website (2022);
- South African National Biodiversity Institute (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna Protocols for environmental impact assessments in South Africa;
- South African National Biodiversity Institute, Pretoria. Version 1.2020;
- 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; and
- BirdLife South Africa (BLSA). 2017.Best Practice Guidelines. Birds and Solar Energy. Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. A Regime 1 Level Assessemnt is warranted here based on the position of the PV footprint in an area of low overall avifaunal sensitivity both in terms of the National Environmental Screening Tool as well as the findings from the field verification.

Figure 1-1 View across southern portion of project area

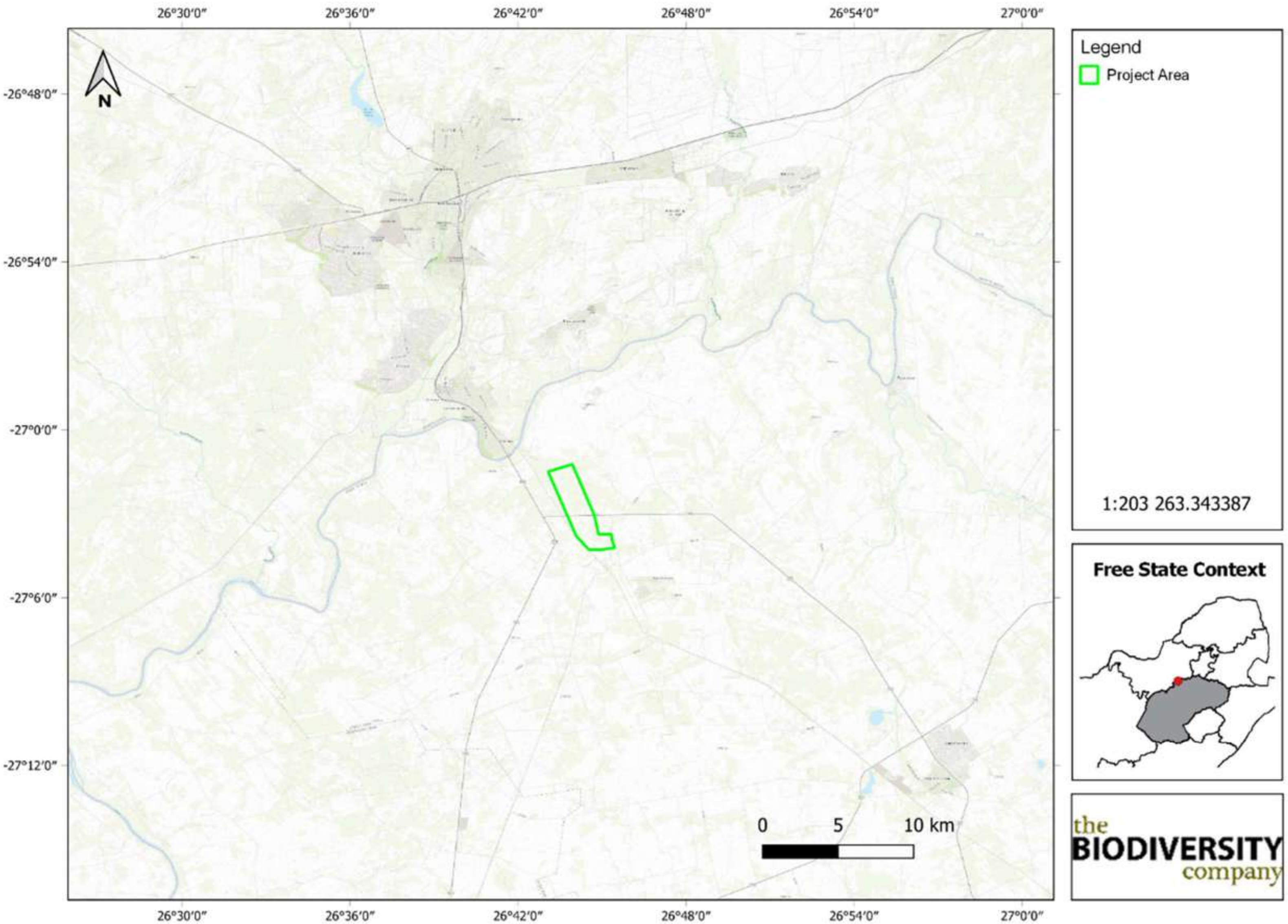

Figure 1-2 Location of the project area

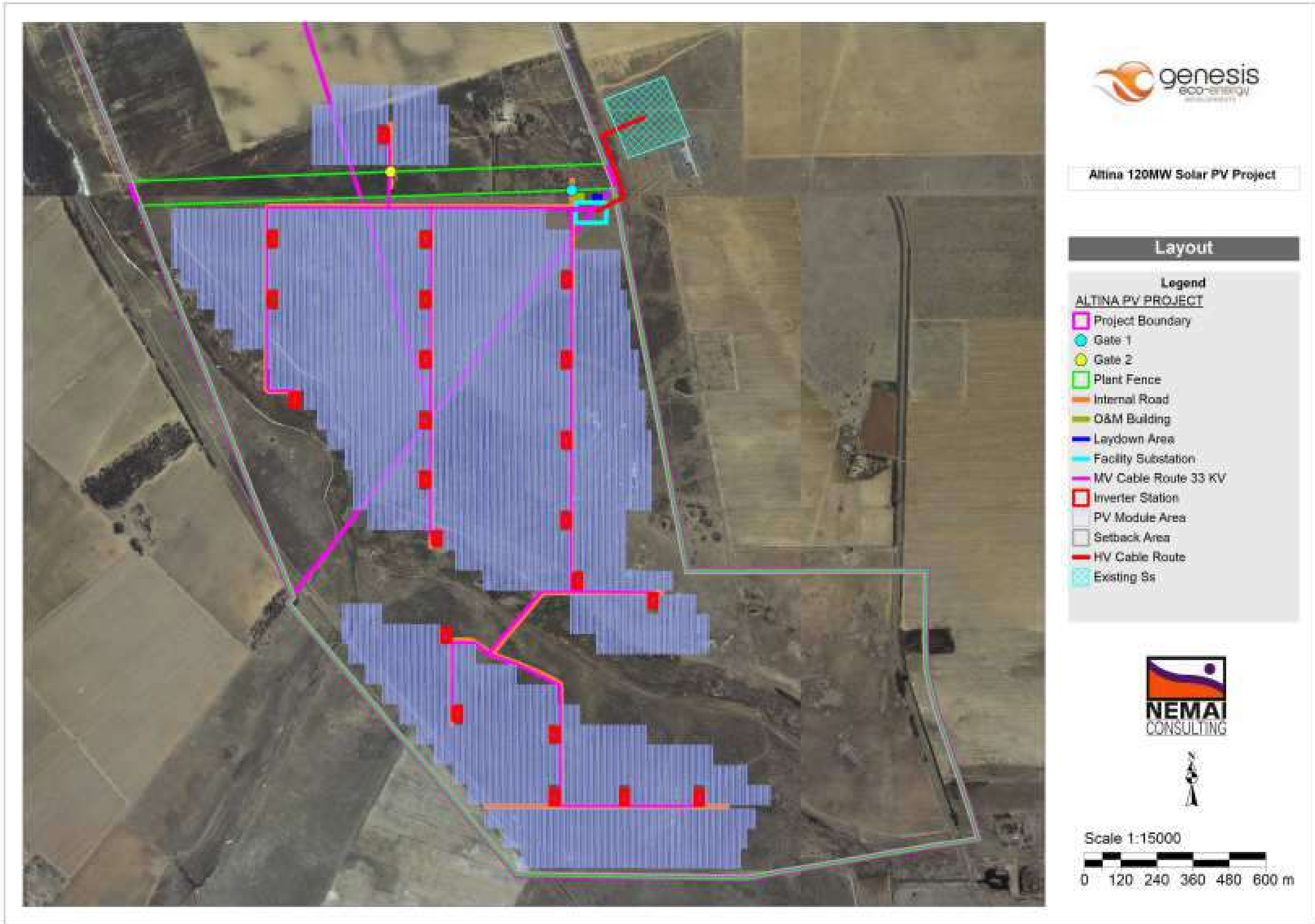

Figure 1-3 Infrastructure Alternative 1

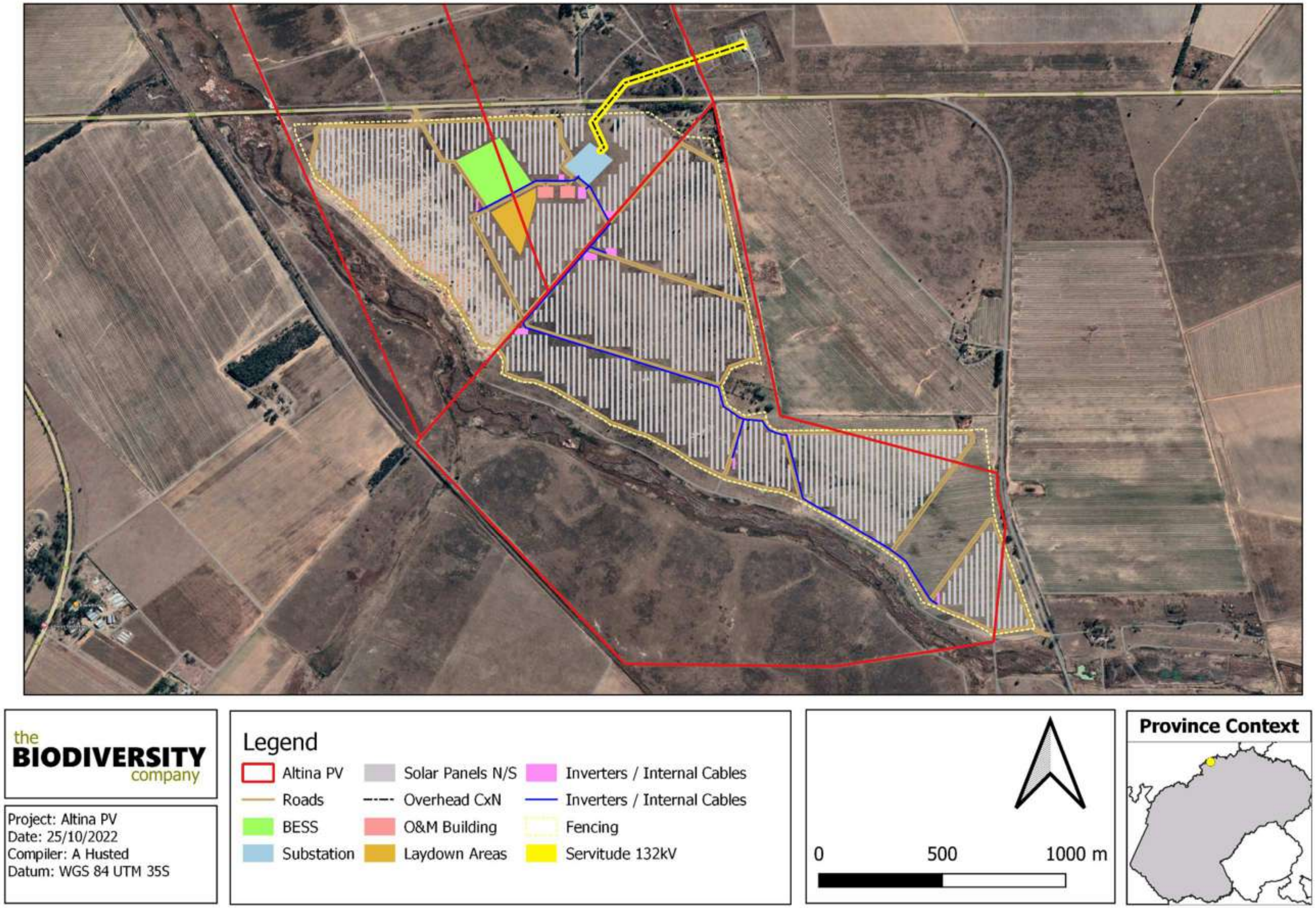

Figure 1-4 Infrastructure Alternative 2 (preferred)

1.1 Terms of Reference

The Terms of Reference (ToR) included the following:

- Description of the baseline avifaunal community;
- Identification of present or potentially occurring SCC;
- Sensitivity assessment and map to identify sensitive areas in the project area;
- Impact assessment, mitigation measures to prevent or reduce the possible impacts.

2 Key Legislative Requirements

The legislation, policies and guidelines listed below are applicable to the current project with regards to avifauna. The list below, although extensive, is not exhaustive and other legislation, policies and guidelines may apply in addition to those listed below (Table 2-1).

Table 2-1 A list of key legislative requirements relevant to these studies in the Free State

Region	Legislation
International	Convention on Biological Diversity (CBD, 1993)
	The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973)
	The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)
National	Constitution of the Republic of South Africa (Act No. 108 of 2006)
	The National Environmental Management Act (NEMA) (Act No. 107 of 1998)
	The National Environmental Management Act (NEMA) (Act No. 107 of 1998) Section 24 , No 42946 (January 2020)
	The National Environmental Management Act (NEMA) (Act No. 107 of 1998) Section 24 , No 43110 (March 2020)
	The National Environmental Management Protected Areas Act (Act No. 57 of 2003)
	The National Environmental Management Biodiversity Act (Act No. 10 of 2004)
	The National Environmental Management: Waste Act, 2008 (Act 59 of 2008);
	The Environment Conservation Act (Act No. 73 of 1989) and associated EIA Regulations
	National Protected Areas Expansion Strategy (NPAES)
	Environmental Conservation Act (Act No. 73 of 1983)
	Natural Scientific Professions Act (Act No. 27 of 2003)
	National Biodiversity Framework (NBF, 2009)
	National Spatial Biodiversity Assessment (NSBA)
	National Heritage Resources Act, 1999 (Act 25 of 1999)
	Alien and Invasive Species Regulations, 2014
	South Africa's National Biodiversity Strategy and Action Plan (NBSAP)
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
	White Paper on Biodiversity
	South African National Biodiversity Institute (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 1.2020.
	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
	Free State Nature Conservation Ordinance 8 of 1969

3 Methodologies

3.1 Desktop Assessment

The following resources were consulted during the desktop assessment and for the compilation of the expected species list:

- Hockey et al. (2005), Roberts Birds of Southern Africa (seventh end.). Primary source for species identification, geographic range and life history information.
- Sinclair and Ryan (2010), Birds of Africa. Secondary source for identification.
- South African Bird Atlas Project (SABAP 2). Full protocol atlassing data from relevant pentads used to construct expected species list. These included the two pentads covering the site (2700_2640 and 2700_2645) and one from the nearby town of Orkney (2655_2640).
- Taylor et al. (2015), Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Used for conservation status, nomenclature and taxonomical ordering.
- The National Web-Based Environmental Screening Tool DEA website (2022), specifically Animal, Avian and Terrestrial Biodiversity Themes.
- BirdLifeSa (2022) website for information on Important Bird and Biodiversity Areas.

3.2 Fieldwork

Fieldwork was conducted on two occasions on 22 March 2022 and 25 April 2022 constituting late summer and early autumn surveys. Sampling consisted of standardized point counts as well as incidental observations. Standardized point counts were conducted to gather data on the species composition and relative abundance of species within the various habitats within the project area. Each point count run over a 5 min period. The horizontal detection limit was set a 200 m. At each point the observer documented the date, start time and end time, habitat, numbers of each species, detection method (seen or heard), behaviour (perched or flying) and flight direction and general notes on habitat and nesting suitability for conservation important species. To supplement the species inventory with cryptic and illusive species that may not have been detected within the rigid point count protocol, incidental observations were included. A search of for signs of African Grass Owl breeding or presence was conducted in the north of the project area.

Figure 3-1 Avifaunal point count localities

3.3 Data analysis

Point count data was arranged into a matrix with point count samples in rows and species in columns. The table formed the basis of the various subsequent statistical analyses. This data was first used to generate a species accumulation curve to assess sampling adequacy. Random accumulation was assumed over 100 permutations. To distinguish similarities / differences in the species composition between the four identified avifaunal habitats the matrix was converted into a Bray-Curtis dissimilarity matrix and used to generate a two-axis non-metric multidimensional scaling (NMDS) ordination. Thirdly raw count data converted to relative abundance values and used to establish dominant species and calculate the diversity of each habitat. Shannon's Diversity Index H was the metric used to estimate diversity. All statistical analyses were performed in the R statistical environment.

3.4 Sensitivity Assessment

The habitat sensitivity is classed based on the following categories/scores (Table 3-1):

Table 3-1 Sensitivity criteria

Sensitivity	Criteria
Very High	• Habitat is occupied by a red-listed species. • Red-listed vegetation type exhibiting natural integrity. • Provides critical ecosystem services. • Protected by national or provincial legislation. • Low resilience to disturbance • Area overlaps with intact CBA • Overlap with NBA classified wetlands.
High	• Possesses a high diversity of protected species but does not possess red-listed species • Habitats that provide important ecosystem services but not necessarily possess high species richness. • Corridors and wetland buffer zones. • Natural habitats that are unique within the landscape • Natural habitats that possess a relatively high species richness in comparison to the rest of the landscape. • Area overlaps with intact CBA (small areas of disturbed habitat)
Moderate	• Natural areas that although listed as not threatened are regarded as Not Protected or Poorly Protected. • Degraded areas that provide some ecosystem services. • Area overlaps with intact Ecological Support Area (ESA) or Other Natural Area (ONA). • Such habitat is considered to have a strong chance of recovering if left undisturbed to restore through natural succession processes, even more so if successfully rehabilitated. • Species diversity is considered moderate.
Low	• Transformed areas. • Insignificant amounts of natural habitat or vegetation present. • Area does not overlap with any areas of ecological significance (also datasets). • Natural or degraded areas that are not red-listed vegetation types and Moderately Protected or Well Protected.

3.5 Impact Assessment

The assessment of impacts was based on the Department of Environmental Affairs and Tourism's (1998) Guideline Document: Environmental Impact Assessment Regulations. This assessment considered the impacts arising from the proposed activities of the project both before and after the implementation of appropriate mitigation measures for all phases of the project. The criteria used to arrive at an overall significance rating included extent, duration, magnitude (intensity), and probability. A description of this methodology is provided in the text box below.

Status of Impact
The impacts are assessed as either having a:
negative effect (i.e., at a `cost' to the environment),
positive effect (i.e., a `benefit' to the environment), or
Neutral effect on the environment.
Extent of the Impact
(**1**) Site (site only),
(**2**) Local (site boundary and immediate surrounds),
(**3**) Regional (within the City of Johannesburg),
(**4**) National, or
(**5**) International.
Duration of the Impact
The length that the impact will last for is described as either:
(**1**) immediate (<1 year)
(**2**) short term (1-5 years),
(**3**) medium term (5-15 years),
(**4**) long term (ceases after the operational life span of the project),
(**5**) Permanent.
Magnitude of the Impact
The intensity or severity of the impacts is indicated as either:
(**0**) none,
(**2**) Minor,
(**4**) Low,
(**6**) Moderate (environmental functions altered but continue),
(**8**) High (environmental functions temporarily cease), or
(**10**) Very high / Unsure (environmental functions permanently cease).
Probability of Occurrence
The likelihood of the impact actually occurring is indicated as either:
(**0**) None (the impact will not occur),
(**1**) improbable (probability very low due to design or experience)
(**2**) low probability (unlikely to occur),
(**3**) medium probability (distinct probability that the impact will occur),
(**4**) high probability (most likely to occur), or
(5) Definite.
Significance of the Impact
Based on the information contained in the points above, the potential impacts are assigned a significance rating (**S**). This rating is formulated by adding the sum of the numbers assigned to extent (**E**), duration (**D**) and magnitude (**M**) and multiplying this sum by the probability (**P**) of the impact.
S=(E+D+M) P
The significance ratings are given below
(**<30**) low (i.e., where this impact would not have a direct influence on the decision to develop in the area),
(**30-60**) medium (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),
(**>60**) high (i.e., where the impact must have an influence on the decision process to develop in the area).

4 Limitations

The following limitations should be noted for the assessment:

- Access was only arranged for survey work within the project area;
- The impact assessment residual ratings are based on the appropriate placement of the infrastructure footprint so as to exclude the floodplain and valley-bottom wetlands and not the development of the entire project area.

5 Desktop Assessment

5.1 Prevailing Land Use

Portions of the project area show a long history of commercial-scale crop cultivation. More recently some of this land has gone fallow. Signs of soil disturbance are widespread, and it appears that large portions (particularly in the south) were previously cleared and / or sand mined. Sand mining still persists along the eastern bank of the floodplain in the southern portion. There are however patches between these areas that support a more natural moist grassland species assemblage. Most non-cultivated grassland areas are utilised for beef cattle production. Grazing intensity is moderate to high with signs of encroachment from *Seriphium plumosum* which tends to thrive under heavy grazing particularly on sandy soils in seasonal seepage areas. Currently the national landcover map correctly classifies the central and far south-eastern regions as commercial annual croplands, the floodplain as wetland habitat and the land between these areas as grassland. However, the landcover map does incorrectly classify the northern wetland area as low shrubland instead of wetland (Figure 5-1).

5.2 Free State Biodiversity Conservation Plan

The Free State Biodiversity Conservation spatial layer was developed to illustrate the province's most Critical Biodiversity Areas. These areas need to be maintained to meet the province's biodiversity targets. The broad categories recognised are: Protected Areas (PA), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Other Natural Areas (ONA), and Modified Areas.

CBAs represent areas of high biodiversity significance in the province. Typically, two types of CBA are distinguished namely CBA1 and CBA2 areas. CBA1 areas are considered crucial in defining and achieving biodiversity conservation targets in the province. CBA2 areas represent areas of high biodiversity significance but do not necessarily result in the target not being achieved if they are lost, i.e., they represent areas for which options exist (SANBI-BGIS, 2017).

ESAs are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic (SANBI-BGIS, 2017).

ONAs consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI-BGIS, 2017).

Moderately or Heavily Modified Areas (sometimes called 'transformed' areas) are areas that have been heavily modified by human activity so that they are by-and-large no longer natural, and do not contribute to biodiversity targets (MTPA, 2014). Some of these areas may still provide limited biodiversity and ecological infrastructural functions but, their biodiversity value has been significantly, and in many cases irreversibly, compromised.

Moist grasslands in the south of the project area as well as in the far north-east are zoned as CBA1. The floodplain is mostly classified as an ONA and the wetland complex in the far north is classified as ESA2. All other croplands in the north-central regions of the project area are zoned as Degraded (Figure 5-2).

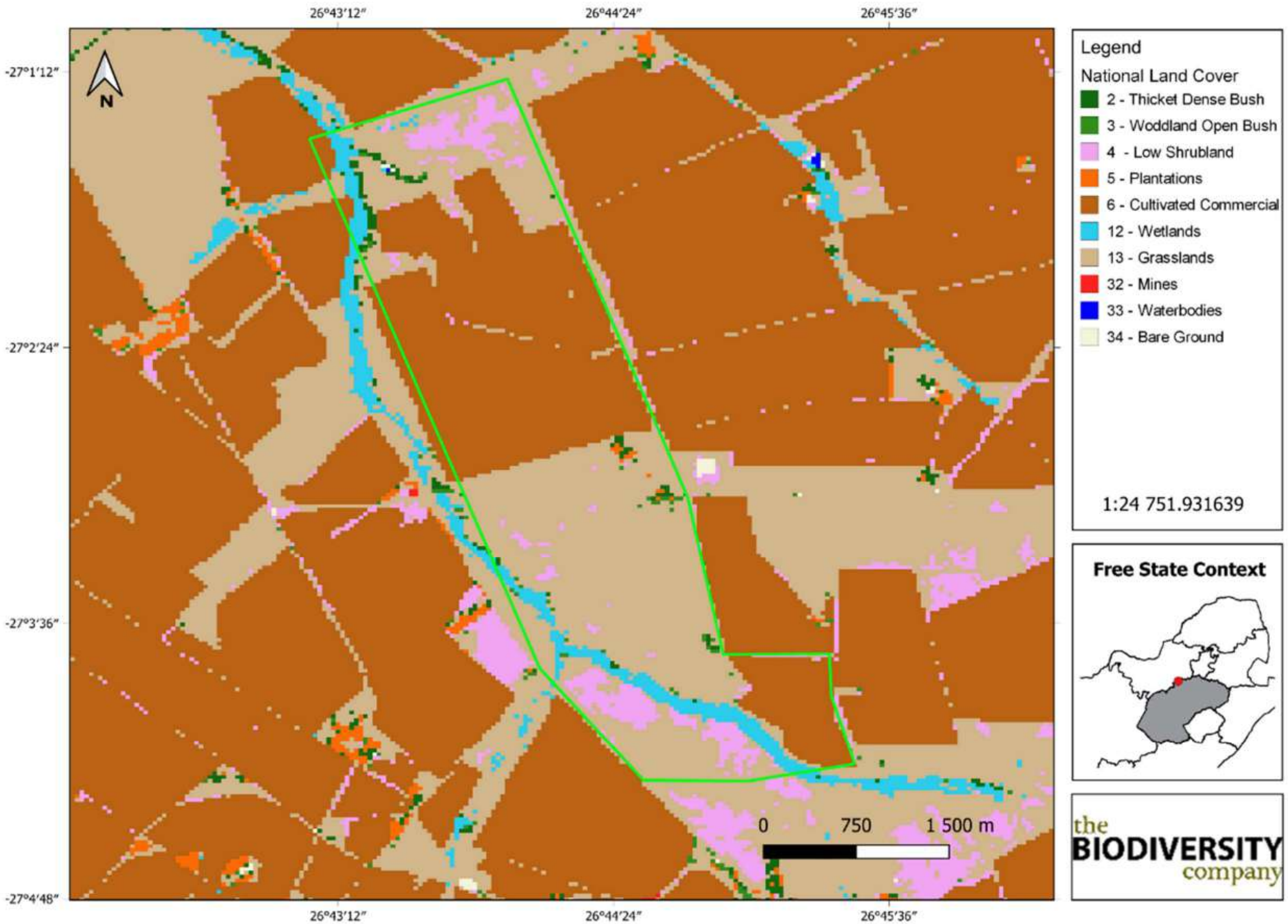

Figure 5-1 Landcover within the project area

Figure 5-2 Free State Biodiversity Conservation Plan

5.2.1 Important Bird Areas

The project area is not situated within any national or global Important Bird Area (IBA) as designated by Birdlife. The closest IBA is the Sandveld and Bloemhof Dam Reserve (ZA039). Sandveld Nature Reserve protects a small patch of the eastern form of Kalahari Thornveld, and supports reference state *Vachellia erioloba* savanna. The Bloemhof Dam Nature Reserve consists mainly of grassland, which borders the dam.

The dam is renowned for occasionally supporting more than 10 000 waterbirds when the water level is low and the shoreline is most exposed. One particularly notable observation included 3 000 flamingos, mostly Lesser Flamingo (*Phoeniconaias minor*) in April 2016. The dam's margins support several mixed heronries which occasionally exceeds more than a thousand breeding pairs. The dam also regularly holds significant numbers of Caspian Tern (*Sterna caspia*), Great Crested Grebe (*Podiceps cristatus*), White-breasted Cormorant (Phalacrocorax lucidus), African Darter (Anhinga rufa), Goliath Heron (*Ardea goliath*), Western Cattle Egret (*Bubulcus ibis*), African Spoonbill (Platalea alba), Yellow-billed Stork (*Mycteria ibis*), Egyptian Goose (*Alopochen aegyptiaca*), South African Shelduck (*Tadorna cana*), Yellow-billed Duck (Anas undulata), Cape Shoveler (*A. smithii*), Knob-billed Duck (*Sarkidiornis melanotos*), Spur-winged Goose (*Plectropterus gambensis*), Red-knobbed Coot (*Fulica cristata*), Pied Avocet (*Recurvirostra avosetta*) and a few pairs of African Marsh (*Harrier Circus ranivorus*).

The Kalahari Thornveld surrounding the dam supports several large raptors and terrestrial species, including White-backed Vulture (Gyps africanus) and Kori Bustard (*Ardeotis kori*), as well as the occasional Cape Vulture (*G. coprotheres*) (BirdlifeSA, 2022).

5.2.2 South African Bird Atlas Project 2

A total of 219 bird species have been recorded during SABAP2 surveys within the three pentads relevant to the project area (SABAP2, 2022). This inventory is considered to be a relatively accurate, if not slightly under representative, portrayal of the regional diversity. Consequently, this list was supplemented with additional species known to occur based on Hockey et al. (2005) and expert knowledge of avifauna from the region. This integrated inventory was used as the basis for the project's species probability list as presented in Appendix A-1.

5.2.3 Historical Context

The area is historically renowned for supporting exceptionally high abundances of Red-billed Quelea (*Quelea quelea*) which. Due to the extensive food source provided by commercial crop cultivation and the presence of suitable reedbeds for roosting population explosions are regular and intense, devasting annual crops as flocks reach pest levels. In the late 80's the species was culled "en masse" by attracting large flocks to bait stations after which an ordinance was discharged. These culling events killed an estimated 65-180 million birds per annum. Although the culling brought localised relief for some farmers, it did not appear to have any appreciable effect on the national population numbers and had the side effect of being indiscriminate, killing many non-target species as well (Bruggers and Elliott, 1989). The farms of the project area and surrounds were one of the target areas for culling.

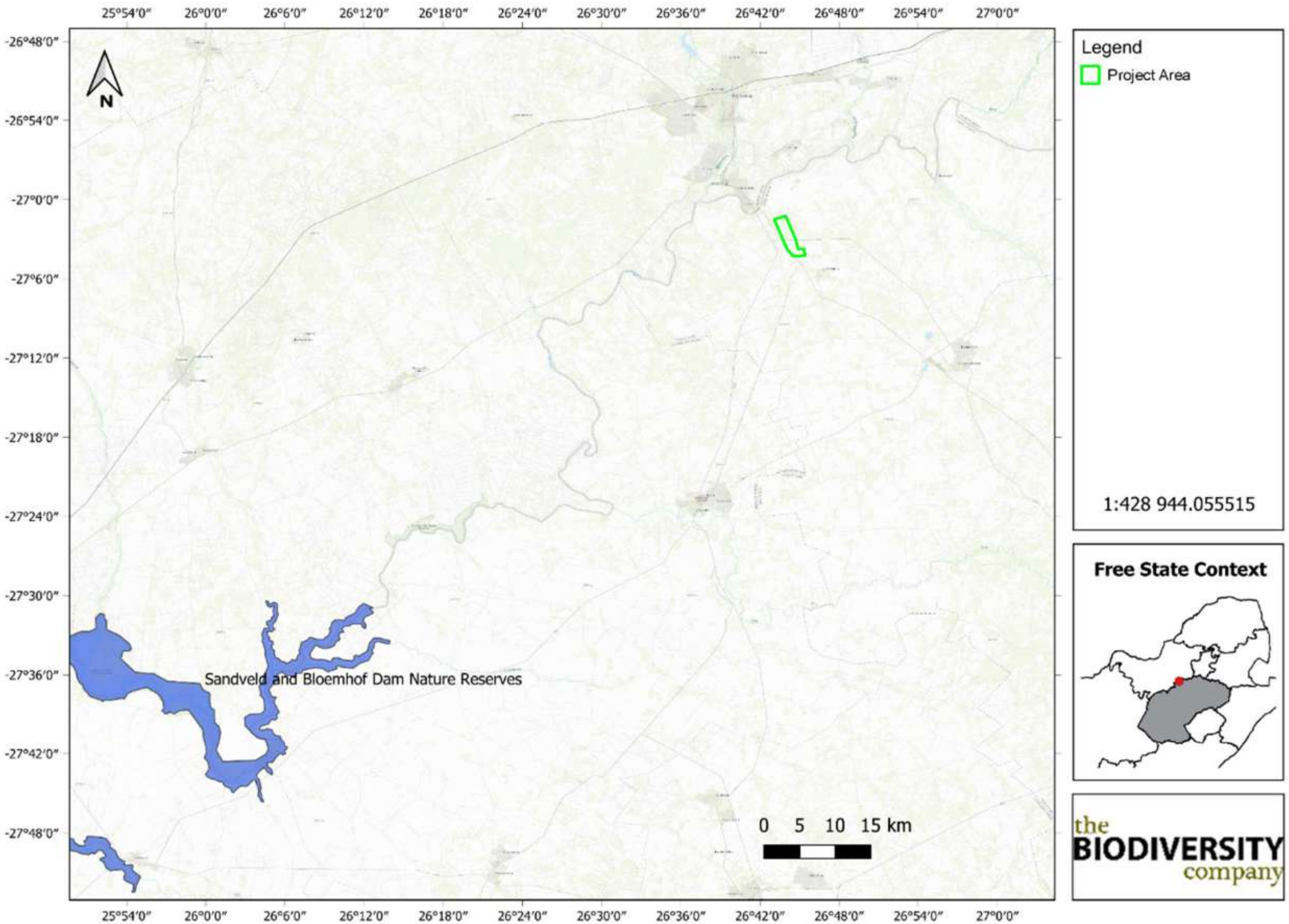

Figure 5-1 Project area in relation to Important Bird Areas

5.3 Results

5.3.1 Habitat Types Expected Site Diversity

Of the approximately 278 regionally occurring species, some 218 species are considered highly likely to occur on a regular basis. A further 48 species are likely to occur sporadically while the remaining species are only likely to occur very rarely or not at all. However, when considering seasonal variation in species assemblages and local movements the actual number of species likely to be encountered on any one day in the project area is likely to be < 100 species. This represents moderate diversity in the South African context.

5.3.2 Observed Site Diversity

During the site visit, a total of 71 bird species were recorded within the project area. Of these, 44 were recorded during the standardised point counts (n=20) while the remaining species were detected incidentally (while moving between point counts). Images of some of these species, as taken on site, are shown in Figure 1-4.

5.3.3 Sampling Adequacy

A species accumulation curve (Figure 1-2) generated for the point counts within the AOI suggests adequate sampling effort. The curve reached an asymptote (as defined by a straight-line tangent to the curve with a gradient of one) at 18 point count samples. This means that after 18 samples, less than one bird would be observed for every subsequent sample thereafter. However, this was a brief single-season site visit and their still remains considerable scope for more species additions with increased sampling time and seasonality.

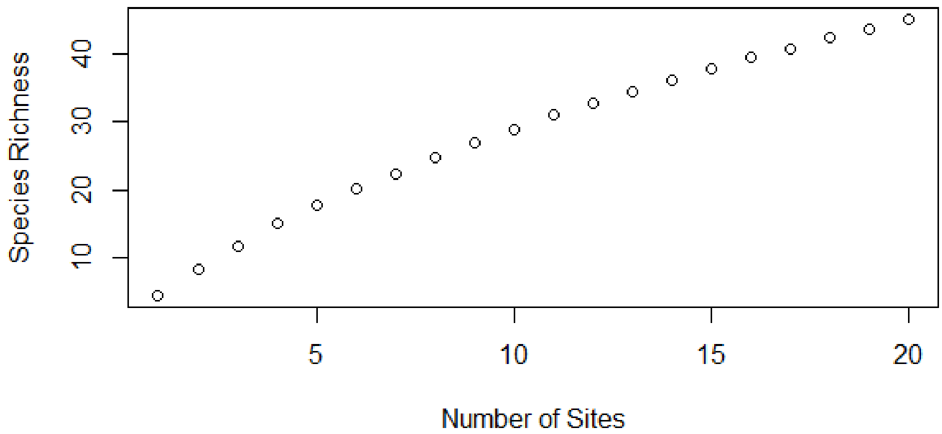

Figure 1-2 Species accumulation curve for the point counts within the project area

5.3.4 Habitat Diversity

A summary the point count data for each of the main avifaunal habitats within each area is given in **Error! Reference source not found.** together with their respective diversity rankings as indicated by Shannon's H (an index of habitat diversity). From this table it is apparent that the highest avian diversity was observed in the Wetland habitat followed by Grassland and lastly Croplands. The Wetland and Grassland habitats are the most diverse habitat types due to their higher microhabitat diversity, structural complexity and resource diversity.

Table 1-1 Comparison of the diversity between the main habitats

Habitat	Shannon's H
Wetlands	1.808
Grasslands	1.587
Croplands	1.199

5.3.5 Habitat Uniqueness

The non-metric multidimensional scaling (NMDS) ordination shown in **Error! Reference source not found.** provides a visual representation of the difference / similarity in the species composition between the three habitat types. Most noticeable is that the Wetland and Grassland species assemblages differed the most from each other and support largely unique avifaunal assemblages with some minor overlap. The Croplands habitat supports a low diversity assemblage that is intermediary in species composition between Wetlands and Grasslands. In other words the cropland habitat was characterised by habitat generalists.

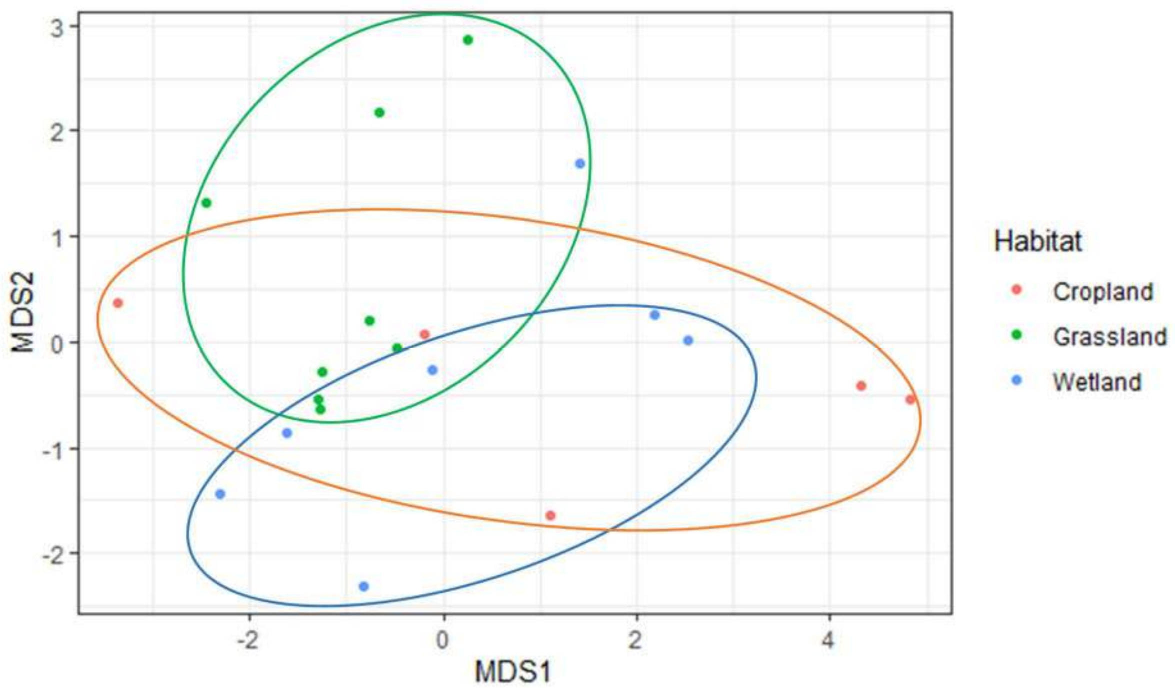

Figure 1-3 Non-metric multidimensional scaling ordination contrasting the avifaunal species assemblages within the project area

Figure 1-4 Some of the birds observed within the project area, A) Blacksmith Lapwing (Vanellus armatus), B) Hadeda Ibis (Bostrychia hagedash), C) Common Sandpiper (Actitis hypoleucos), D) Red-billed Quelea (Quelea quelea), E) Red-billed Teal (Anas erythrorhyncha), F) Zitting Cisticola (Cisticola juncidis), G) South African Cliff Swallow (Petrochelidon spilodera), H) Spur-winged Goose (Plectropterus gambensis)

Table 1-2 provides a summary of the relative abundance and frequency of each species within each habitat.

Table 1-2 Summary of the relative abundance (RA) and frequency (F) of avifauna in each habitat

Common Name	Scientific Name	Croplands		Grassland		Wetlands		Total	
		F	RA	F	RA	F	RA	F	RA
Red-billed Quelea	*Quelea quelea*	1	1	5	19	4	13	10	33
Southern Red Bishop	*Euplectes orix*	0	0	0	0	1	26	1	26
Hadeda Ibis	*Bostrychia hagedash*	0	0	0	0	3	17	3	17
Blacksmith Lapwing	*Vanellus armatus*	0	0	0	0	2	8	2	8
South African Cliff Swallow	*Petrochelidon spilodera*	0	0	2	0	1	3	3	3
Levaillant's Cisticola	*Cisticola tinniens*	0	0	0	0	4	2	4	2
White-rumped Swift	*Apus caffer*	0	0	0	0	2	1	2	1
Laughing Dove	*Streptopelia senegalensis*	1	0	2	1	0	0	3	1
Black-chested Prinia	*Prinia flavicans*	3	0	2	0	0	0	5	1
Red-eyed Dove	*Streptopelia semitorquata*	0	0	3	1	0	0	3	1
White-browed Sparrow-Weaver	*Plocepasser mahali*	0	0	4	1	0	0	4	1
Yellow-crowned Bishop	*Euplectes afer*	0	0	0	0	1	1	1	1
Cape Turtle Dove	*Streptopelia capicola*	1	0	0	0	1	0	2	1
South African Shelduck	*Tadorna cana*	0	0	0	0	2	1	2	1
Black-headed Heron	*Ardea melanocephala*	1	0	0	0	1	0	2	0
Zitting Cisticola	*Cisticola juncidis*	0	0	2	0	0	0	2	0
Southern Masked Weaver	*Ploceus velatus*	0	0	2	0	0	0	2	0
Southern Fiscal	*Lanius collaris*	0	0	0	0	0	0	0	0
Barn Swallow	*Hirundo rustica*	0	0	2	0	0	0	2	0
Glossy Ibis	*Plegadis falcinellus*	0	0	0	0	2	0	2	0
Malachite Kingfisher	*Alcedo cristata*	0	0	0	0	1	0	1	0
Western Cattle Egret	*Bubulcus ibis*	0	0	1	0	1	0	2	0
White-bellied Sunbird	*Cinnyris talatala*	0	0	1	0	0	0	1	0
Red-capped Lark	*Calandrella cinerea*	1	0	0	0	0	0	1	0
Common Swift	*Apus apus*	0	0	1	0	0	0	1	0
White-throated Swallow	*Hirundo albigularis*	0	0	1	0	0	0	1	0
African Quail-finch	*Ortygospiza fuscocrissa*	0	0	1	0	0	0	1	0
Kittlitz's Plover	*Charadrius pecuarius*	0	0	0	0	1	0	1	0
Common Sandpiper	*Actitis hypoleucos*	0	0	0	0	1	0	1	0
Spur-winged Goose	*Plectropterus gambensis*	0	0	0	0	1	0	1	0
African Swamphen	*Porphyrio madagascariensis*	0	0	0	0	1	0	1	0
Green-backed Heron	*Butorides striata*	0	0	0	0	1	0	1	0
Grey Heron	*Ardea cinerea*	0	0	0	0	1	0	1	0

Common Name	Scientific Name	Croplands		Grassland		Wetlands		Total	
		F	RA	F	RA	F	RA	F	RA
Little Rush Warbler	*Bradypterus baboecala*	0	0	0	0	1	0	1	0
Cloud Cisticola	*Cisticola textrix*	0	0	1	0	0	0	1	0
Southern Grey-headed Sparrow	*Passer diffusus*	0	0	1	0	0	0	1	0
Cape Longclaw	*Macronyx capensis*	0	0	1	0	0	0	1	0
Ant-eating Chat	*Myrmecocichla formicivora*	0	0	1	0	0	0	1	0
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*	0	0	1	0	0	0	1	0
Pied Crow	*Corvus albus*	0	0	1	0	0	0	1	0
Crested Barbet	*Trachyphonus vaillantii*	0	0	1	0	0	0	1	0
African Fish Eagle	*Haliaeetus vocifer*	0	0	0	0	1	0	1	0
African Pipit	*Anthus cinnamomeus*	0	0	0	0	1	0	1	0
Long-tailed Widowbird	*Euplectes progne*	0	0	0	0	1	0	1	0

5.3.6 Species of Conservation Concern

5.3.6.1 Red-listed Species

No SCC were detected within the project area during the site visit. A total of 24 SCC (Table **1**-**3**) are, however, known to occur in the region. Of these, only four have been recorded during SABAP2 surveys within the three pentads relevant to the project area namely Caspian Tern (*Sterna caspia*), Lanner Falcon (*Falco biarmicus*), Melodious Lark (*Mirafra cheniana*) and Maccoa Duck (*Oxyura maccoa*) (SABAP2, 2022). In the Free State all birds are protected except for generalist species; Mousebirds, Bulbuls, Red-winged Starling, Pied Starling, Common Myna, Cape and House Sparrow, Crows, weavers, Queleas, Widowbirds, Bishops, Rock Pigeon, Cape Turtle Dove, Ostrich, Laughing Dove, Reed Cormorant, and White-breasted Cormorant (Nature Conservation Ordinance 8 of 1969). The provincially protected species are listed in the full list provided in Appendix A.

Seven SCC are considered highly likely to occur within the project area based on habitat availability and suitability. These include African Marsh Harrier (*Circus ranivorus*), African Grass Owl (*Tyto capensis*), Blue Crane (*Anthropoides paradiseus*), Greater Flamingo (*Phoenicopterus roseus*), Lesser Flamingo (*Phoeniconaias minor*), Abdim's Stork (*Ciconia abdimii*) and Black-winged Pratincole (*Glareola nordmanni*). Of these, suitable breeding habitat exists only for African Marsh Harrier (*Circus ranivorus*), African Grass Owl (*Tyto capensis*) and Melodious Lark (*Mirafra cheniana*).

African Marsh Harrier (*Circus ranivorus*) – Endangered

This species is considered highly likely to occur along the floodplain wetland. This wetland provides ideal breeding habitat for the species in the form tall reedbeds. Although not observed on site, an area of High sensitivity is identified for this species along the Vaal River (2.5 km north of the project area) and may have easily been overlooked. This species forages primarily over wetlands. Although the species has an extremely large distributional range in sub-equatorial Africa, South African populations are declining due to the degradation of wetland habitats, loss of habitat through over-grazing and human disturbance and possibly, poisoning owing to over-use of pesticides (IUCN, 2017). The floodplain system is considered important for this species.

African Grass Owl (*Tyto capensis* – Vulnerable

An uncommon and illusive resident. In these areas, nests and re sites is most frequently associated with large, dense stands of *Imperata cylindrica*. Constructs a network of tunnels in this grass referred to as runs. The species is a habitat specialist and wetlands appear to be important for hunting and breeding. African Grass Owl is primarily threatened by widespread loss of grassland and wetland habitat. Additional threats include anthropogenically altered burn regimes, livestock (trampling of runs and nest) as well as roadkill's. Ideal breeding and foraging habitat occur in the wetland complex associated with the floodplain in the far north of the project area. Although no signs of the species were detected during the survey it is possible that this cryptic and illusive species was overlooked or may be temporarily absent as nesting suitability and prey availability (considerable amount of *Otomys* spp. droppings) is high. The species has not been recorded in the pentad during SABAP2 surveys. Together this suggests a low prevalence in the area or perhaps even localised extirpation. However, species presence cannot be conclusively ruled out and this area should be avoided in terms of solar PV and farming activities (remain uncultivated and fenced off from livestock).

Table 1-3 List of present and potentially occurring SCC avifauna

Common Name	Scientific Name	Status				LO	Atlas
		Global	Regional	NEMBA	FS		
White-backed Vulture	*Gyps africanus*	CR	CR	EN	PG	4	
Cape Vulture	*Gyps coprotheres*	EN	EN	EN	PG	4	
African Marsh Harrier	*Circus ranivorus*	LC	EN		PG	2	
Yellow-billed Stork	*Mycteria ibis*	LC	EN		PG	3	
Black Harrier	*Circus maurus*	VU	EN		PG	3	
Martial Eagle	*Polemaetus bellicosus*	VU	EN	EN	PG	3	
African Grass Owl	*Tyto capensis*	LC	VU		PG	2	
Caspian Tern	*Sterna caspia*	LC	VU		PG	3	x
Lanner Falcon	*Falco biarmicus*	LC	VU		PG	3	x
Great White Pelican	*Pelecanus onocrotalus*	LC	VU		PG	3	
Pink-backed Pelican	*Pelecanus rufescens*	LC	VU		PG	3	
Black Stork	*Ciconia nigra*	LC	VU		PG	4	
Secretarybird	*Sagittarius serpentarius*	VU	VU		PG	3	
Blue Crane	*Anthropoides paradiseus*	VU	NT	PS	OG	2	
Melodious Lark	*Mirafra cheniana*	NT	LC		PG	3	x
Greater Flamingo	*Phoenicopterus roseus*	LC	NT		PG	2	
Abdim's Stork	*Ciconia abdimii*	LC	NT		PG	2	
Marabou Stork	*Leptoptilos crumeniferus*	LC	NT		PG	4	
Maccoa Duck	*Oxyura maccoa*	NT	NT		PG	3	x
Chestnut-banded Plover	*Charadrius pallidus*	NT	NT		PG	3	
Black-winged Pratincole	*Glareola nordmanni*	NT	NT		PG	2	

Pallid Harrier	*Circus macrourus*	NT	NT		PG	3	
Red-footed Falcon	*Falco vespertinus*	NT	NT		PG	3	
Lesser Flamingo	*Phoeniconaias minor*	NT	NT		PG	2	

Key: Status: CR = Critically Endangered; DD = Data Deficient; EN = Endangered; LC = Least Concern; NA = Not Assessed; NT = Near Threatened; OG = Ordinary Game; PG = Protected Game; PS = Protected Species; VU = Vulnerable. Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate. Sources: Taylor et al. (2015); BirdLife South Africa (2016); SABAP 2 (2022)

5.3.6.2 Species Congregations and Flyways

The project area was not found to support any globally significant congregations of water birds or other birdlife. The floodplain wetland was, however, found to support significant flocks of Red-billed Quelea (*Quelea quelea*), Yellow-crowned Bishop (*Euplectes afer*) and Southern Red Bishop (*Euplectes orix*) as well as numerous waterbirds. These breeding congregations should be considered important on a regional scale. The project area is not situated in any globally recognised avifaunal flyway.

5.3.7 Collision Prone Species

The proposed solar PV may pose a collision risk to avifauna. However, the current body of scientific research on this topic is scant. Since the effects of PV solar farms on birds were investigated several monitoring studies have reported evidence of bird mortalities within and immediately surrounding PV farms. Several causes for these mortalities have been put forward but perhaps the widely cited are collisions. Collisions are thought to arise when birds (particularly waterbirds) mistake the panels for waterbodies, known as the “lake effect” (Lovich and Ennen 2011), or when migrating or dispersing birds become disorientated by the polarised light reflected by the panels. Mixed views have been presented on the significance of collisions as an impact, with a definitive answer precluded by a lack of long-term data. Currently the consensus is that collisions due to the lake effect is unlikely and that other impacts associated with the construction and operation of solar facilities (e.g., habitat loss, collision with fences, electrocution on transmission lines, increased predation pressure as birds attempt to forage beneath solar panels and struggle to escape) may be of greater overall consequence to avifauna (Birdlife, 2012). Nevertheless, given the paucity of empirical research on this topic, the precautionary principle is adopted here, and the potential for collision and (to a lesser intensity electrocution) considered possible.

For the purposes of this project a subset of collision prone species have been identified. These species are listed in Table **1**-**4** along with their likelihood of occurrence (LO), conservation status and mean SABAP2 reporting rate (%). The reporting rate provides a rough indication of the residency and commonness of these species, one of several factors which may increase their susceptibility to collision. Species are ranked in this table from highest to lowest reporting rate. Based on this data six species emerge with a high probability of collision having been seen on more 50% of the time during SABAP surveys. These include Hadeda Ibis (*Bostrychia hagedash*), Egyptian Goose (*Alopochen aegyptiaca*), Helmeted Guineafowl (*Numida meleagris*), Yellow-billed Duck (*Anas undulata*), Reed Cormorant (*Phalacrocorax africanus*) and Western Cattle Egret (*Bubulcus ibis*).

Species considered particularly prone and likely to collision based on in-field count data, and flight patterns include Red-billed Quelea (*Quelea quelea*), Hadeda Ibis (*Bostrychia hagedash*), Blacksmith Lapwing (*Vanellus armatus*), Black-headed Heron (*Ardea melanocephala*), Western Cattle Egret (*Bubulcus ibis*) and Spur-winged Goose (*Plectropterus gambensis*).

Table 1-4 List of collision and electrocution prone species sorted by reporting rate

Common Name	Scientific Name	LO	Status	Mean SABAP RR (%)
Hadeda Ibis	*Bostrychia hagedash*	1		80
Egyptian Goose	*Alopochen aegyptiaca*	1		57
Helmeted Guineafowl	*Numida meleagris*	2		53
Yellow-billed Duck	*Anas undulata*	1		52
Reed Cormorant	*Phalacrocorax africanus*	1		50
Western Cattle Egret	*Bubulcus ibis*	1		50
Swainson's Spurfowl	*Pternistis swainsonii*	1		44
Black-winged Kite	*Elanus caeruleus*	2		34
Grey Heron	*Ardea cinerea*	1		31
African Darter	*Anhinga rufa*	2		30
White-breasted Cormorant	*Phalacrocorax lucidus*	2		28
Northern Black Korhaan	*Afrotis afraoides*	2		26
South African Shelduck	*Tadorna cana*	1		24
Red-billed Teal	*Anas erythrorhyncha*	1		20
African Sacred Ibis	*Threskiornis aethiopicus*	2		18
Cape Shoveler	*Anas smithii*	2		16
Little Egret	*Egretta garzetta*	2		16
Black-headed Heron	*Ardea melanocephala*	1		14
White-faced Whistling Duck	*Dendrocygna viduata*	2		13
African Fish Eagle	*Haliaeetus vocifer*	1		12
Greater Kestrel	*Falco rupicoloides*	2		11
Common (Steppe) Buzzard	*Buteo buteo*	2		11
Spur-winged Goose	*Plectropterus gambensis*	1		10
Glossy Ibis	*Plegadis falcinellus*	1		9
Amur Falcon	*Falco amurensis*	1		8
African Spoonbill	*Platalea alba*	2		8
White-backed Duck	*Thalassornis leuconotus*	2		8
Maccoa Duck	*Oxyura maccoa*	3	NT, VU	7
African Black Duck	*Anas sparsa*	2		7
Southern Pochard	*Netta erythrophthalma*	2		5
Purple Heron	*Ardea purpurea*	2		5
Squacco Heron	*Ardeola ralloides*	1		4
African Wattled Lapwing	*Vanellus senegallus*	1		4
Spotted Eagle-Owl	*Bubo africanus*	2		3
Gabar Goshawk	*Melierax gabar*	2		3

Common Name	Scientific Name	LO	Status	Mean SABAP RR (%)
Hamerkop	*Scopus umbretta*	1		3
Black-crowned Night Heron	*Nycticorax nycticorax*	2		3
Cape Teal	*Anas capensis*	2		2
Black Heron	*Egretta ardesiaca*	2		2
Goliath Heron	*Ardea goliath*	2		1
Fulvous Whistling Duck	*Dendrocygna bicolor*	3		1
Lanner Falcon	*Falco biarmicus*	3	VU, LC	1
Great Egret	*Egretta alba*	3		0
Greater Flamingo	*Phoenicopterus roseus*	2	NT, LC	0
Lesser Flamingo	*Phoeniconaias minor*	2	NT, NT	0
Hottentot Teal	*Anas hottentota*	2		0
Yellow-billed (Intermediate) Egret	*Egretta intermedia*	2		0
Black Stork	*Ciconia nigra*	4	VU, LC	0
Secretarybird	*Sagittarius serpentarius*	3	VU, VU	0
African Marsh Harrier	*Circus ranivorus*	2	EN, LC	0
Yellow-billed Stork	*Mycteria ibis*	3	EN, LC	0
Western Barn Owl	*Tyto alba*	2		0
Marsh Owl	*Asio capensis*	2		0
Little Bittern	*Ixobrychus minutus*	2		0
Abdim's Stork	*Ciconia abdimii*	2	NT, LC	0

6 Sensitivity Assessment

6.1 Desktop-based Sensitivity: National Environmental Screening Tool

The national environmental screening tool is a web-based application hosted by the Department of Environmental Affairs that allows developers to screen their prospective site for environmental sensitives. Importantly, this tool now serves as the first step in the environmental authorisation process as laid out in the gazetted assessment protocols for each environmental theme. Guidance towards achieving these protocols for terrestrial biodiversity is provided in the Species Environmental Assessment Guideline (SANBI, 2020) which, in turn, relies on the results of the screening tool to inform the level of assessment required. The screening tool provides an avifaunal sensitivity theme.

There are two sensitivity layers produced by the screening tool that are of relevance for avifauna namely (1) Animal Species Theme and (2) Terrestrial Biodiversity Theme. The Animal Species Theme highlights the floodplain of being of Medium sensitivity on account of its suitability to support Spotted-necked Otter (*Hydrictus maculicollis*) while the rest is classified as Low sensitivity. It is important to note, however that this theme highlights the reedbeds along the Vaal River directly north of the project area as being of High sensitivity due to African Marsh Harrier (*Circus ranivorus*). The wetland habitat in the far north of the project area and along the floodplain which cuts through the project area is highly suitable for breeding by this species. Lastly the terrestrial Biodiversity Theme highlights the entire project area as being of High sensitivity on account of the presence of CBA1 areas.

6.2 Site Sensitivity Verification

Areas of avifaunal sensitivity within the project area is presented in Figure 6-1. Overall, floodplains and valley-bottom wetlands were designated High sensitivity, remaining less disturbed moist grassland as Medium and active croplands as Low sensitivity (Figure 6-1). These areas were based on a combination of selected wetland delineation data as deemed important for avifauna and count data gathered in-field. The floodplain and valley-bottom areas are assigned a High importance and sensitivity. This was based primarily on account of their capacity to support SCC. These wetlands, particularly the floodplain supports ideal breeding habitat for two Threatened species namely African Marsh Harrier (*Circus ranivorus*) and African Grass Owl (*Tyto capensis*). Similar habitat along the Vaal River 2.5 km north of the project area has been highlighted as an important area for African Marsh Harrier and is afforded a High Avifaunal sensitivity rating in the Environmental Screening Tool. This habitat also provides suitable foraging habitat for additional five potentially occurring SCC. Furthermore, these wetlands support exceptionally large flocks of roosting seed-eaters and waterbirds which are widely accepted in the literature as being most susceptible to collision with solar panels. These wetlands also supported by far the highest species richness and abundance of avifauna within the entire project area as well as the highest abundances of collision prone species. This habitat has been excluded from the development footprint and adherence to the prescribed wetland buffers on floodplains and valley-bottom wetlands important for roosting seed-eaters is assumed based on infrastructure Alternative 2 (preferred). Based on this layout the proposed infrastructure does not overlap any areas of High avifaunal sensitivity but instead only area of Very Low and Low sensitivity areas. The only Medium sensitive area is further north outside of the actual development footprint.

Figure 6-1 Screening tool Animal Species Theme sensitivity map based on DFFE data (red =high; orange-yellow = Medium). Note the medium sensitivity area in the project area is for Spotted-necked Otter, the avifaunal sensitivity throughout the project area is Low. The red polygon in the north indicates optimal breeding habitat for African Marsh Harrier.

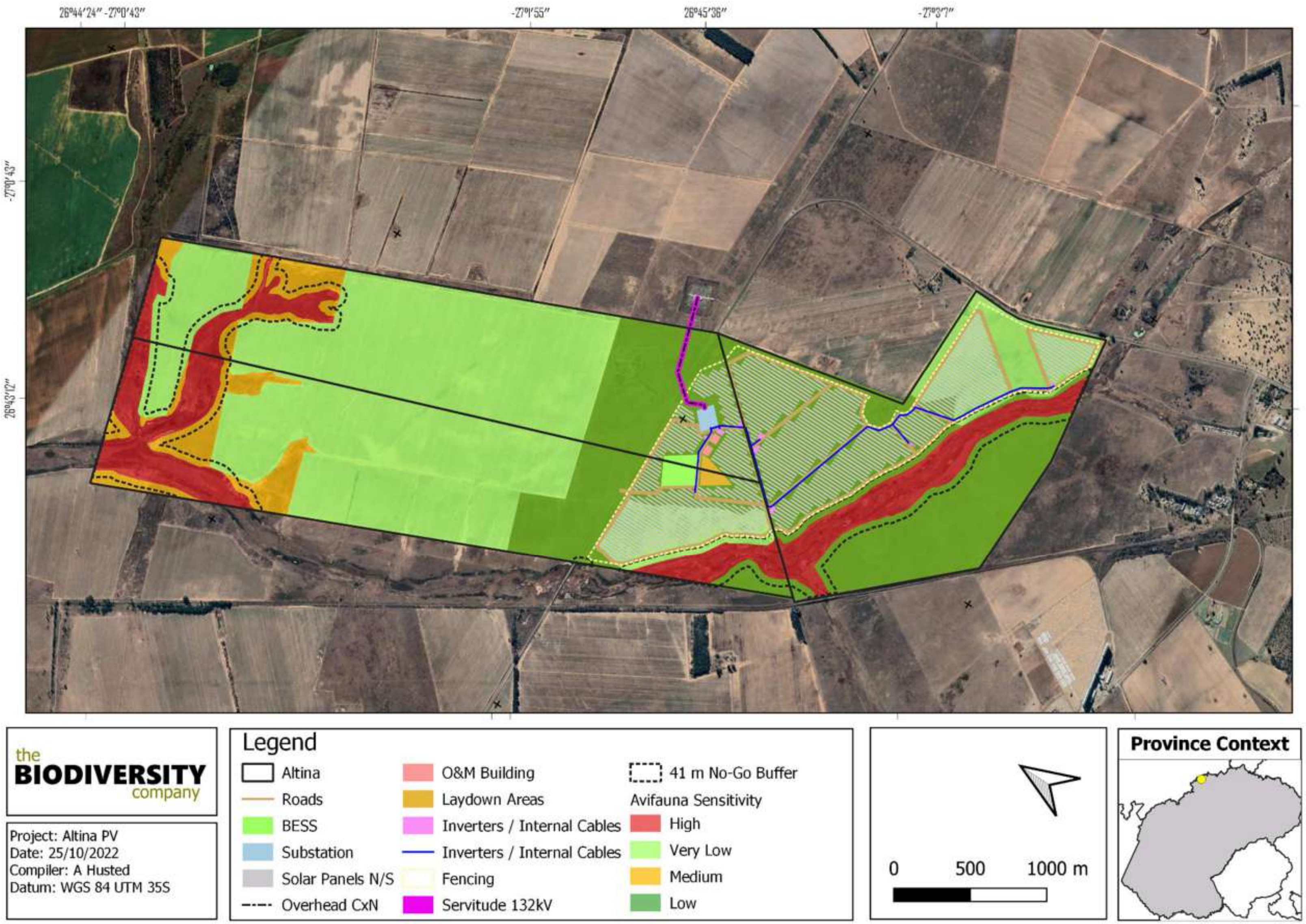

Figure 6-2 Site-based avifaunal sensitivity map showing overlaid preferred infrastructure layout Alternative 2

7 Impact Assessment

7.1 Existing Impacts

The following existing impacts were observed:

- Extensive commercial crop cultivation
- Historical agricultural land-use;
- Intense past cattle grazing practices;
- Extensive and intense sandmining in certain areas along the eastern bank of the floodplain;
- Roads and associated vehicle traffic; and
- Fences posing restrictive and entrapment risks.

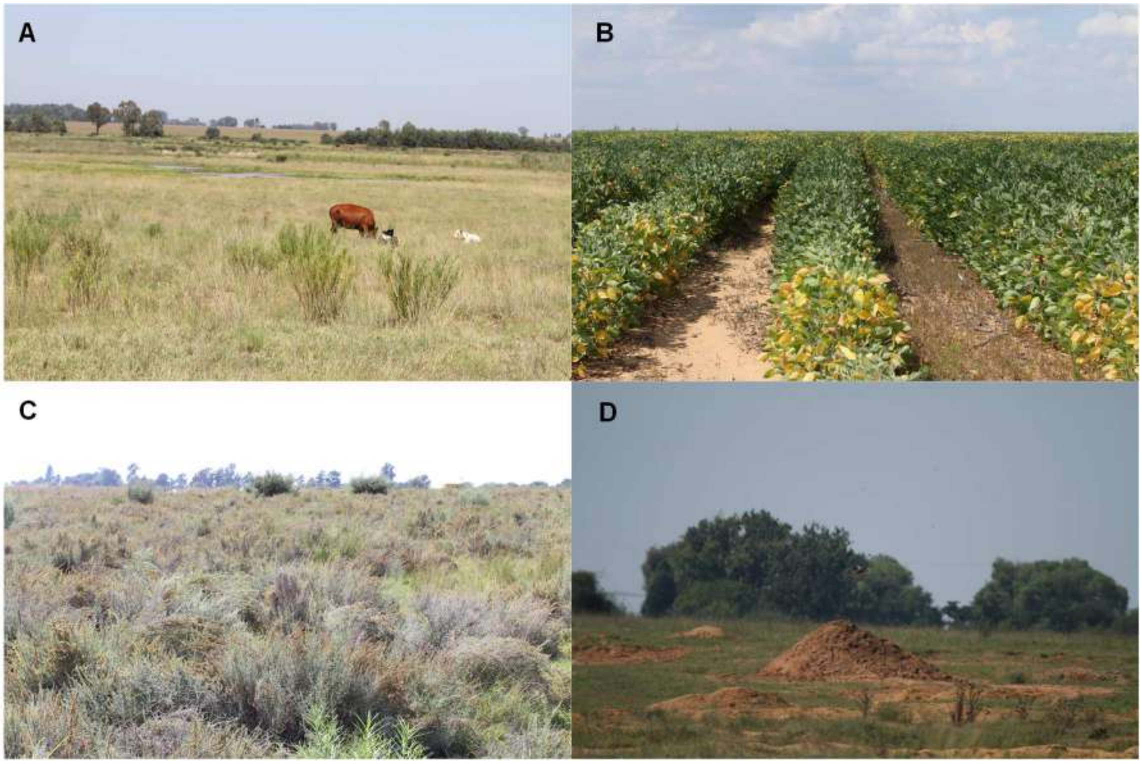

Figure 7-1 Existing impacts; A) livestock grazing, B) commercial crop production (soya), C) bush encroachment from overgrazing, D) sandmining

7.2 Anticipated Impacts

The anticipated impacts during the construction, operation and decommissioning phases of the proposed activity are presented in the tables to follow along with the prescribed mitigation and residual impact rating.

7.2.1 Loss, degradation and fragmentation of sensitive avifaunal habitat

Development of the PV plant within the project area and its associated infrastructure will invariably result in the loss of a significant area of avifaunal habitat. However, it must be noted that this habitat is of low to very low sensitivity as much of it has either been completely transformed by crop agriculture or otherwise altered by intense livestock grazing and past soil disturbances. Therefore, considering that the wetlands identified as highly sensitive for avifauna will be avoided (Assuming preferred Alternative 2) is only likely to have a Low residual effect on regional avifaunal assemblages as it does not host any breeding pairs of SCC. However, if loss or degradation of the highly sensitive wetland habitat as identified for avifauna occurs, particularly in the far north (see Figure 6-1), then a High residual impact applies as it would impact upon potentially suitable habitat for a number of water-associated SCC (e.g. African Marsh Harrier) and affect large regionally to nationally significant congregations of roosting waterfowl and seed-eaters.

Mitigation:

- Continue to use the sensitivity spatial layers provided by TBC to appropriately position all surface infrastructure so as to avoid sensitive avifaunal habitat.
- Avoid placing solar panels and associated infrastructure within the areas demarcated as being of High avifaunal sensitivity.
- Demarcate these areas on the ground during construction and sign post them as environmentally sensitive areas keep out.
- Ensure that the BESS and non-solar panel infrastructure occur in Low sensitivity portions of the project area.
- Rehabilitate all areas that may have been redundantly disturbed immediately after construction.
- Develop and implement an Alien and Invasive Plant Control Plan.

Table 7-1 Loss, degradation and fragmentation of sensitive avifaunal habitat

Alternative 1		
Criteria	**Without mitigation**	**With mitigation**
Extent	High (4)	Low (2)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Probable (3)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Alternative 2		
Criteria	**Without mitigation**	**With mitigation**
Extent	High (4)	Low (2)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Low (4)
Probability	Definite (5)	Improbable (2)
Significance	**High**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

7.2.2 Collision, electrocution and entrapment with PV infrastructure

There remains, as ever, a collision and electrocution risk associated with the solar PV plant. This is likely to be highest in situations where infrastructure is placed closer to the floodplain (Alternative 1) because its rank wetland vegetation and open water bodies attracts high concentrations of waterfowl and roosting seed-eaters. However, this impact can be reduced to a Low significance by avoiding the floodplain habitat and its associated buffers both in terms of PV placement as well as associated above-ground electrical transmission lines (as has been done with Alternative 2). The above-ground electrical transmission infrastructure is not anticipated to cross the floodplain wetland but will instead travel a relatively short distance to the nearby substation (-27.049034°; 26.746572°), greatly reducing the potential for collision. This is a preferable situation as it avoids crossing busy local wetland flight paths (mainly small passerines). If, however, the developers needs to establish a powerline that crosses the floodplain this would represent a significant hazard to birds (High residual impact). If this is required then bird diverters must be installed at the crossing point and the powerlines should cross at a point which parallels existing powerline infrastructure or otherwise along the main access tar road. From an electrocution point of view, few, potentially occurring SCC or priority species are likely to occur in the project area that have a wingspan large enough (>1.5 m) to bridge gaps between live and earthed components or between phases of powerlines. However electrocution of birds within the substations/switching areas cannot be ruled out. Although this is unlikely to involve SCC.

Mitigation:

- Keep to current preferred infrastructure Alternative 2. Avoid spanning above-ground powerlines in the northern quarter of the project area. Here a network of good avifaunal wetland habitat occurs. Collision and electrocution risk is highest in this area and along the floodplain in the south-western corner of the project area. Bird activity is highest in these areas and should be avoided. This eventuality is unlikely given Alternative 2.

- Avoid spanning fences and above-ground powerlines within the buffer of the floodplain wetland or across the small dam (-27.057851°; 26.746390°). This eventuality is unlikely given Alternative 2.

- All power cables within the project area should be thoroughly insulated and preferably buried in demarcated corridors.

- Install Eskom-approved flappers or coils on new transmission lines (particularly the earth wire). This can help to increase the visibility of transmission lines especially the thinner earth line with which most collisions tend to be associated. If there remains budget and scope for such interventions then they would be best placed on the portion of the line that crosses the road. Otherwise the existing lines which cross the wetland near the north-eastern corner of the project area would benefit greatly from the use of bird diverters such as these.

- White strips placed along the edges of the panels appear to help to increase visibility and deter birds based on work done by Horvath et al. (2010) and are recommended as far as practically feasible.

- Install bird deterrent devices around panels and on transmission line poles, pylons and / or monopoles to limit collision risk.

- The BESS must be covered in non-reflective surfaces and protected against thermal discharge and the risk of veld fires as a result.

Table 7-2 Collision, electrocution and entrapment with PV infrastructure

Alternative 1		
Criteria	**Without mitigation**	**With mitigation**
Extent	Moderate (3)	Moderate (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Highly probable (4)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Alternative 2		
Criteria	**Without mitigation**	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Long term (4)	Moderate term (3)
Magnitude	High (8)	Low (4)
Probability	Definite (5)	Probable (3)
Significance	**High**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

7.2.3 Direct loss of SCC nests or suitable nesting habitat

No SCC nests were encountered within the project area. However, suitable breeding habitat for African Grass Owl and African Marsh Harrier was identified, particularly in the northern parts of the floodplain wetland (-27.027538°;26.726753°). Nesting habitat along the floodplain wetland decreases in suitability in a southerly direction for both species, particularly African Grass Owl as the wetland and its surrounding hydromorphic grassland narrows. Alternative 1 would encroach on potential but suboptimal breeding habitat for African Marsh Harrier and would thus constitute a Medium residual impact significance. If, however, the preferred Alternative 2 is opted for risk of destroying nests or nesting habitat for these species is effectively eliminated.

Mitigation:

- If African Grass Owl and African Marsh Harrier (or their nests) are found during construction halt construction activities and call an avifaunal specialist immediately for advice on the way forward.
- It should be noted, however, that neither of these species have been recorded during SABAP2 surveys in the pentad and no signs of their recent present were detected during the survey. Consequently the presence in the area is likely sporadic and of low abundance. Still the presence of these illusive birds cannot be ruled out.
- Avoid all areas of Very High and High avifaunal sensitivity.

Table 7-3 Direct loss of SCC nests or suitable nesting habitat

Alternative 1		
Criteria	**Without mitigation**	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Permanent (5)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Alternative 2		
Criteria	**Without mitigation**	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Permanent (5)	Short term (2)
Magnitude	High (8)	Mlinor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**High**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

7.2.4 Sensory disturbance and extirpation of SCC or large roosting flocks

Sensory disturbances to avifauna are inevitable, but are unlikely to negatively impact upon nesting SCC and is mainly likely to be restricted to the construction phase. Although dust, noise and human activity during construction is unavoidable, much can be done to reduce the effect of these sensory disturbance impacts on avifauna by adopting temporal avoidance strategies by simply avoiding or lowering the intensity of construction activities during spring and summer. During operation, the residual impacts associated with sensory disturbance should drop to a Low significance.

Mitigation:

- Attempt as far as possible to conduct the majority of the high intensity construction activities during winter to minimize disturbance of avifauna during sensitive life stages such as lekking, courting, nesting and fledging).
- Keep lighting to a minimum and fit external lighting with downward facing hoods.
- Demarcate natural areas beyond the surface infrastructure footprint and restrict access of personnel into these areas through education and signposting.
- All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limit (40km/h), to respect all forms of wildlife. Speed limits must still be enforced to ensure that road killings and erosion is limited.
- Schedule activities and operations during least sensitive periods, to avoid migration, nesting and breeding seasons (July-September).

Table 7-4 Sensory disturbance and extirpation of SCC or large roosting flocks

Alternative 1		
Criteria	**Without mitigation**	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Alternative 2		
Criteria	**Without mitigation**	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium**	**Low**

Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

7.2.5 Cumulative effect on regional birdlife

Many solar developments are planned for the Free State. At least eight other renewable solar development farm parcels applications occur within a 30 km radius of the project area (Figure 7-2). This project has the potential to add to the cumulative loss of wetland habitat for African Grass Owl and African Marsh Harrier (under infrastructure Alternative 1). This impact is, however, likely to be minimised (under Alternative 2) by avoiding all areas identified as being of wetlands of High avifaunal sensitivity. This impact is considered to have a Low residual impact, on the premise that African Marsh Harrier and African Grass Owl have not been recorded in the pentad nor were they recorded during the survey (nor signs thereof) suggesting low prevalence or even localised extirpation in the area. Habitat is, however, ideal for breeding for both species and their presence should not be completely ruled out.

Mitigation:

- Avoid all areas rated as High avifaunal sensitivity
- Minimise above-ground electrical infrastructure and avoid transmission line crossing of the large floodplain.
- Rehabilitate all non-developed areas.
- Rehabilitated following decommissioning to re-instate moist grassland.

Table 7-5 Cumulative effect on regional birdlife

	Alternative 1	
Criteria	**Without mitigation**	**With mitigation**
Extent	Low (2)	Very low (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
	Alternative 2	
Criteria	**Without mitigation**	**With mitigation**
Extent	Low (2)	Very low (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium**	**Low**
Status (positive or negative)	Negative	Negative

Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Figure 7-2 Project area (green polygon) in relation to other solar renewable energy applications within a 30 km radius (grey = in progress solar; red = CSP).

8 Environmental Management Plan Inputs

Table **8–1** below provides an outline of the avifauna-specific management actions and performance criteria against which project due diligence can be gauged from an avifaunal perspective in future. These actions should be incorporated into the EMPr.

Table 8–1 Avifaunal EMP

Project phase	Potential impact	Mitigation	Responsible person/ entity	Management actions & performance criteria
Construction, Operation and Decommissioning	Loss, degradation and fragmentation of sensitive avifaunal habitat	Refer to 8.2.1	Developer ECO	Incorporate sensitivity shapefiles provided by TBC into masterplan of PV facility. Use these spatial files to demarcate the sensitive areas on the ground and signpost them as environmentally sensitive no-go areas.
				Develop and implement a CEMPr. The CEMPr must make clear the areas of High and Medium avifaunal sensitivity in relation to the construction footprint. The plan must also specify rules regarding speed limits, environmental no-go areas (floodplain wetland and 41 m buffer as well as far northern wetlands and grasslands,) off-road driving; use of existing access routes and indenting reporting protocol and contacts.
				Produce a map every year showing the development of the PV footprint in relation to the High and Medium sensitivity habitats. Data must be available in georeferenced shapefile format. Initiate an offset strategy if clearing of sensitive land is anticipated or has happened incidentally.
				Illustrate and briefly discuss habitat loss maps in a brief environmental annual ops report.
				Commission annual external audit of CEMPr and EMPr compliance as well as annual ops report
Construction and Operation	Collision, electrocution and entrapment with PV infrastructure	Refer to 8.2.2	Developer ECO and trained staff	Create bird and other biodiversity awareness signs and posters (interesting species and who to call regarding incidents).
				Although not a pre-requisite of Regime 1 developments it is recommended that standardised seasonal carcass searches are carried out by the ECO or trained staff (Jenkins et al. 2017 for details on search protocol) for at least the first-year post-construction). If no carcasses are found discontinue searches after a year. In contrast if the searches are yielding several carcasses per search then contact avifaunal specialist to take over searches and advise on potential re-active mitigation measures. Document any avifauna (or other biodiversity) carcasses or incidents in an annual environmental ops report. Additionally detail suspected cause of death and any actions taken to reduce mortalities. Produce a map showing the location of all bird mortality incidents and measures taken to reduce incidents (e.g. signs or speed humps, installation of insulating structures, bird flappers).
				Increase awareness and the training undertaken by staff through incorporating biodiversity aspects (e.g. sensitive areas and species and who to report an incident or carcass to) into inductions.

Construction	Direct loss of SCC nests or suitable nesting habitat	Refer to 8.2.3	Developer ECO	Although unlikely, if a nest of a suspected priority species (e.g. African Grass Owl, African Marsh Harrier or any raptor or large-terrestrial bird) is found in the project area, halt clearing activities, mark the nest both on the ground (dropper and flag) and with a GPS, signpost and report. A relevant avifaunal specialist should be consulted for advise on the way forward regarding the nest.
Construction and Operation	Sensory disturbance and extirpation of SCC	Refer to 8.2.4	Developer ECO	In the annual environmental ops report, document noise, dust and light levels recorded preferably near the floodplain wetland. Suggest what actions could be taken to minimise these disturbances wherever possible.

9 Conclusion

Two infrastructure alternatives have been proposed namely Alternative 1 which represents the original layout (Figure 1-3) and Alternative 2 which represents the preferred layout that takes into account potential sensitivities (Figure 1-4). Both infrastructure Alternatives 1 and 2 were rated in terms of their respective impact significance.

During the site visits a total of 71 species were observed within the project area through a combination of point counts and incidental observations. Of the three habitats the highest avian diversity was observed in the Wetland habitat followed by the Grassland and lastly Croplands Habitat. The Wetland habitat also supports the most diverse and unique avifaunal assemblage due to the presence of waterfowl and its overall higher microhabitat diversity, structural complexity and resource availability.

Although no SCC were observed during the site visit, ideal breeding habitat was identified along the floodplain wetland particularly in the far north of the project area for two threatened species namely the Endangered African Marsh Harrier (*Circus ranivorus*) and African Grass Owl (*Tyto capensis*).

In terms of avifaunal sensitivity the floodplains and valley-bottom wetlands were designated High sensitivity. The Grasslands surrounding the northern floodplain and valley-bottom wetlands are assigned a Medium sensitivity. All remaining less disturbed moist grassland is rated as Low sensitivity while active croplands were afforded a Very Low sensitivity.

Five impacts to avifauna are anticipated as a result of the establishment PV plant. These included (1) Habitat loss, degradation and fragmentation including loss of important bird congregations (2) Collision, electrocution and entrapment with PV infrastructure, (3) Direct loss of SCC nests or suitable nesting habitat, (4) Sensory disturbance and extirpation of SCC or large roosting flocks and (5) Cumulative effect on regional birdlife. Habitat loss was assigned a residual risk of Medium (under infrastructure Alternative 1) on account of the high likelihood of the development and long-term nature of the project which will lead to the probable encroachment on the High sensitivity wetland habitat. It is, however, assumed that the High sensitivity floodplains and valley-bottoms will be excluded from the PV footprint under the preferred infrastructure Alternative 2 which will reduce the residual impact to Low. Collision and electrocution was assigned a Medium significance under Alternative 1.However, this impact can be reduced to a Low significance under Alternative 2 by avoiding the floodplain habitat and its associated buffers both in terms of PV placement as well as associated above-ground electrical transmission lines. In this respect, avoid spanning fences and above-ground powerlines in the northern quarter of the project area and within the buffer of the floodplain wetland or across the small dam (-27.057851°; 26.746390°). Additionally, all power cables within the PV area should be thoroughly insulated and buried wherever practically feasible. Flappers and coils can help to increase the visibility of transmission lines especially the thinner earth line with which most collisions tend to be associated. Install Eskom-approved flappers or coils on new transmission lines (particularly the earth wire). Although not planned, it must be kept in mind for future activities that crossing the floodplain wetland with overhead electrical transmission lines, is considered undesirable from an avifaunal perspective. If there remains budget and scope for flappers or coils then they would be best placed on the portion of the line that crosses the road. Otherwise the existing lines which cross the wetland near the north-eastern corner of the project area would benefit greatly from the use of bird diverters such as these. White strips placed along the edges of the panels appear to help to increase visibility and deter birds and are recommended as far as practically feasible.

The remaining impacts are deemed to have a Low residual risk under infrastructure Alternative 2, on account of the general lack of SCC nests and individuals on site and the effective actions which are planned to be implemented to reduce disturbances to any potentially occurring SCC (avoiding the placement of PV infrastructure in High and Medium sensitivity habitat).

It is recommended that the floodplain wetland habitat and surrounding grassland particularly in the north continues to be excluded from all future PV and agricultural activities beyond this application. The northern wetland and surrounding grassland should remain fenced off to protect this ideal breeding habitat for harriers, grass owls and waterbirds. Overall, it is the opinion of the specialist that the project should be considered favourably from an avifaunal perspective, provided infrastructure Alternative 2 is taken and the suggested mitigation effectively applied.

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11 Appendix

11.1 Appendix A – Present and potentially occurring avifauna

Common Name	Scientific Name	Status				LO	SABAP2						
							2700_2640		2700_2645		2655_2640		Total
		Global	Regional	NEMBA	FS		FP	AP	FP	AP	FP	AP	
Common Ostrich	*Struthio camelus*	LC	LC			4	8.6		70	10	11.5		x
Orange River Francolin	*Scleroptila gutturalis*	LC	LC		OG	2			10		15.4		x
Natal Spurfowl	*Pternistis natalensis*	LC	LC		OG	2	8.6				3.8		x
Swainson's Spurfowl	*Pternistis swainsonii*	LC	LC		OG	1	37.1	6.7	50	10	46.2		x
Common Quail	*Coturnix coturnix*	LC	LC		OG	2							
Harlequin Quail	*Coturnix delegorguei*	LC	LC		OG	2							
Helmeted Guineafowl	*Numida meleagris*	LC	LC		OG	2	31.4	6.7	80	10	46.2		x
Fulvous Whistling Duck	*Dendrocygna bicolor*	LC	LC		PG	3	2.9						x
White-faced Whistling Duck	*Dendrocygna viduata*	LC	LC		PG	2	14.3		20		3.8		x
White-backed Duck	*Thalassornis leuconotus*	LC	LC		PG	2	2.9		20				x
Maccoa Duck	*Oxyura maccoa*	NT	NT		PG	3			20				x
Egyptian Goose	*Alopochen aegyptiaca*	LC	LC		PG	1	82.9	26.7	60		26.9		x
South African Shelduck	*Tadorna cana*	LC	LC		OG	1	31.4	6.7	40	20			x
Spur-winged Goose	*Plectropterus gambensis*	LC	LC		OG	1	11.4		20				x
Knob-billed Duck	*Sarkidiornis melanotos*	LC	LC		PG	2							
Cape Teal	*Anas capensis*	LC	LC		PG	2	5.7						x
African Black Duck	*Anas sparsa*	LC	LC		PG	2	20						x
Yellow-billed Duck	*Anas undulata*	LC	LC		OG	1	85.7	13.3	60	10	11.5		x
Cape Shoveler	*Anas smithii*	LC	LC		PG	2	28.6		20				x

Red-billed Teal	*Anas erythrorhyncha*	LC	LC		OG	1	42.9		10		7.7		x
Hottentot Teal	*Anas hottentota*	LC	LC		PG	2							
Southern Pochard	*Netta erythrophthalma*	LC	LC		PG	2	5.7	6.7	10				x
Greater Honeyguide	*Indicator indicator*	LC	LC		PG	3	8.6	6.7			3.8		x
Lesser Honeyguide	*Indicator minor*	LC	LC		PG	2	11.4	6.7					x
Golden-tailed Woodpecker	*Campethera abingoni*	LC	LC		PG	2	8.6				3.8	7.7	x
Cardinal Woodpecker	*Dendropicos fuscescens*	LC	LC		PG	2	22.9				11.5	15.4	x
Acacia Pied Barbet	*Tricholaema leucomelas*	LC	LC		PG	2	71.4	6.7	10		65.4		x
Black-collared Barbet	*Lybius torquatus*	LC	LC		PG	2	51.4	6.7	20		46.2		x
Crested Barbet	*Trachyphonus vaillantii*	LC	LC		PG	1	94.3	6.7	50	10	92.3	23.1	x
African Grey Hornbill	*Tockus nasutus*	LC	LC		PG	3							
African Hoopoe	*Upupa africana*	LC	LC		PG	2	42.9	6.7	30		50	15.4	x
Green Wood-hoopoe	*Phoeniculus purpureus*	LC	LC		PG	2	25.7				23.1		x
Common Scimitarbill	*Rhinopomastus cyanomelas*	LC	LC		PG	3	25.7	6.7			26.9		x
Malachite Kingfisher	*Alcedo cristata*	LC	LC		PG	1	11.4		10		7.7		x
Brown-hooded Kingfisher	*Halcyon albiventris*	LC	LC		PG	2	31.4	6.7			23.1	7.7	x
Giant Kingfisher	*Megaceryle maxima*	LC	LC		PG	2	20	13.3			3.8		x
Pied Kingfisher	*Ceryle rudis*	LC	LC		PG	2	22.9						x
White-fronted Bee-eater	*Merops bullockoides*	LC	LC		PG	2	17.1		10		34.6		x
Little Bee-eater	*Merops pusillus*	LC	LC		PG	2	14.3		10		7.7		x
Blue-cheeked Bee-eater	*Merops persicus*	LC	LC		PG	2	5.7				3.8		x
European Bee-eater	*Merops apiaster*	LC	LC		PG	2	40	6.7	10	20	15.4		x
White-backed Mousebird	*Colius colius*	LC	LC			2	34.3	6.7	20	10	46.2		x
Speckled Mousebird	*Colius striatus*	LC	LC			2	34.3	6.7	10	10	42.3		x
Red-faced Mousebird	*Urocolius indicus*	LC	LC			2	82.9	6.7	20		69.2	15.4	x

Jacobin Cuckoo	*Clamator jacobinus*	LC	LC		PG	2	2.9						x
Red-chested Cuckoo	*Cuculus solitarius*	LC	LC		PG	2	8.6				15.4		x
Diederik Cuckoo	*Chrysococcyx caprius*	LC	LC		PG	2	40		20	10	50		x
Burchell's Coucal	*Centropus burchellii*	LC	LC		PG	2	14.3	6.7			7.7		x
Rose-ringed Parakeet	*Psittacula krameri*				PG	3							
African Palm Swift	*Cypsiurus parvus*	LC	LC		PG	2	45.7	20	20	10	30.8		x
Alpine Swift	*Tachymarptis melba*	LC	LC		PG	3							
Common Swift	*Apus apus*	LC	LC		PG	1							
African Black Swift	*Apus barbatus*	LC	LC		PG	2	2.9						x
Little Swift	*Apus affinis*	LC	LC		PG	1	80	20	30	10	15.4		x
Horus Swift	*Apus horus*	LC	LC		PG	2							
White-rumped Swift	*Apus caffer*	LC	LC		PG	1	17.1	13.3	30	10	15.4		x
Western Barn Owl	*Tyto alba*	LC	LC		PG	2							
African Grass Owl	*Tyto capensis*	LC	VU		PG	2							
Southern White-faced Owl	*Ptilopsis granti*	LC	LC		PG	2							
Spotted Eagle-Owl	*Bubo africanus*	LC	LC		PG	2			10				x
Marsh Owl	*Asio capensis*	LC	LC		PG	2				10			x
Fiery-necked Nightjar	*Caprimulgus pectoralis*	LC	LC		PG	2							
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	LC	LC		PG	3							
European Nightjar	*Caprimulgus europaeus*	LC	LC		PG	4							
Rock Dove	*Columba livia*	LC	LC		PG	2	22.9		20		23.1		x
Speckled Pigeon	*Columba guinea*	LC	LC			1	85.7	6.7	80	10	76.9	7.7	x
Laughing Dove	*Streptopelia senegalensis*	LC	LC			1	94.3	13.3	90	20	96.2	38.5	x
Cape Turtle Dove	*Streptopelia capicola*	LC	LC			1	100	6.7	90	30	96.2	30.8	x
Red-eyed Dove	*Streptopelia semitorquata*	LC	LC		PG	1	94.3	26.7	100	20	88.5	30.8	x

Namaqua Dove	*Oena capensis*	LC	LC		PG	1			40	10	3.8		x
Northern Black Korhaan	*Afrotis afraoides*	LC	LC		PG	2	14.3		30	10	34.6	7.7	x
Blue Crane	*Anthropoides paradiseus*	VU	NT	PS	OG	2							
Red-chested Flufftail	*Sarothrura rufa*	LC	LC		PG	2							
African Rail	*Rallus caerulescens*	LC	LC		PG	2	2.9						x
African Crake	*Crecopsis egregia*	LC	LC		PG	2			10	10			x
Black Crake	*Amaurornis flavirostra*	LC	LC		PG	2	20		30				x
Baillon's Crake	*Porzana pusilla*	LC	LC		PG	2							
Spotted Crake	*Porzana porzana*	LC	LC		PG	3							
African Swamphen	*Porphyrio madagascariensis*	LC	LC		PG	1			20				x
Common Moorhen	*Gallinula chloropus*	LC	LC		PG	2	51.4	6.7	70				x
Red-knobbed coot	*Fulica cristata*	LC	LC		OG	2	48.6	6.7	90	30	3.8		x
African Snipe	*Gallinago nigripennis*	LC	LC		PG	1			10				x
Common Greenshank	*Tringa nebularia*	LC	LC		PG	2	2.9						x
Wood Sandpiper	*Tringa glareola*	LC	LC		PG	2	14.3						x
Common Sandpiper	*Actitis hypoleucos*	LC	LC		PG	1	17.1	6.7					x
Ruddy Turnstone	*Arenaria interpres*	LC	LC		PG	3							
Little Stint	*Calidris minuta*	LC	LC		PG	2	5.7						x
Ruff	*Philomachus pugnax*	LC	LC		PG	2	5.7	6.7					x
African Jacana	*Actophilornis africanus*	LC	LC		PG	2	2.9	6.7					x
Spotted Thick-knee	*Burhinus capensis*	LC	LC		PG	1	2.9				7.7		x
Black-winged Stilt	*Himantopus himantopus*	LC	LC		PG	2	31.4	6.7					x
Pied Avocet	*Recurvirostra avosetta*	LC	LC		PG	2							
Common Ringed Plover	*Charadrius hiaticula*	LC	LC		PG	3							
Kittlitz's Plover	*Charadrius pecuarius*	LC	LC		PG	1							

Three-banded Plover	*Charadrius tricollaris*	LC	LC		PG	1	17.1	6.7	30		3.8		x
Chestnut-banded Plover	*Charadrius pallidus*	NT	NT		PG	3							
Caspian Plover	*Charadrius asiaticus*	LC	LC		PG	3							
Blacksmith Lapwing	*Vanellus armatus*	LC	LC		PG	1	82.9	6.7	80	10	73.1	7.7	x
African Wattled Lapwing	*Vanellus senegallus*	LC	LC		PG	1	2.9				7.7		x
Crowned Lapwing	*Vanellus coronatus*	LC	LC		PG	1	54.3	6.7	50	10	76.9	7.7	x
Temminck's Courser	*Cursorius temminckii*	LC	LC		PG	3							
Black-winged Pratincole	*Glareola nordmanni*	NT	NT		PG	2							
Grey-headed Gull	*Chroicocephalus cirrocephalus*	LC	LC		PG	2	20				3.8		x
Caspian Tern	*Sterna caspia*	LC	VU		PG	3	8.6						x
Whiskered Tern	*Chlidonias hybrida*	LC	LC		PG	2	20						x
White-winged Tern	*Chlidonias leucopterus*	LC	LC		PG	2	5.7	6.7					x
Western Osprey	*Pandion haliaetus*	LC	LC		PG	2							
European Honey Buzzard	*Pernis apivorus*	LC	LC		PG	3							
Black-shouldered Kite	*Elanus caeruleus*	LC	LC		PG	2	8.6	13.3	70	40	23.1		x
African Fish Eagle	*Haliaeetus vocifer*	LC	LC		PG	1	20	20			15.4		x
White-backed Vulture	*Gyps africanus*	CR		EN	PG	4							
Cape Vulture	*Gyps coprotheres*	EN	EN	EN	PG	4							
African Marsh Harrier	*Circus ranivorus*	LC	EN		PG	2							
Black Harrier	*Circus maurus*	VU	EN		PG	3							
Pallid Harrier	*Circus macrourus*	NT	NT		PG	3							
African Harrier-Hawk	*Polyboroides typus*	LC	LC		PG	2	2.9				3.8		x
Gabar Goshawk	*Melierax gabar*	LC	LC		PG	2			10				x
Little Sparrowhawk	*Accipiter minullus*	LC	LC		PG	2					11.5		x
Black Sparrowhawk	*Accipiter melanoleucus*	LC	LC		PG	2							

Common (Steppe) Buzzard	*Buteo buteo*	LC	LC		PG	2	2.9	6.7	30	30			x
Jackal Buzzard	*Buteo rufofuscus*	LC	LC		PG	2						7.7	x
Booted Eagle	*Hieraaetus pennatus*	LC	LC		PG	3							
Martial Eagle	*Polemaetus bellicosus*	VU	EN	EN	PG	3							
Secretarybird	*Sagittarius serpentarius*	VU	VU		PG	3							
Greater Kestrel	*Falco rupicoloides*	LC	LC		PG	2	2.9		20	10	11.5		x
Red-footed Falcon	*Falco vespertinus*	NT	NT		PG	3							
Amur Falcon	*Falco amurensis*	LC	LC		PG	1	2.9		10	10	11.5		x
Lanner Falcon	*Falco biarmicus*	LC	VU		PG	3	2.9						x
Peregrine Falcon	*Falco peregrinus*	LC	LC		PG	3							
Little Grebe	*Tachybaptus ruficollis*	LC	LC		PG	1	51.4	6.7	60	10			x
Great Crested Grebe	*Podiceps cristatus*	LC	LC		PG	4	2.9						x
Black-necked Grebe	*Podiceps nigricollis*	LC	LC		PG	3							
African Darter	*Anhinga rufa*	LC	LC		PG	2	74.3	26.7			15.4		x
Reed Cormorant	*Phalacrocorax africanus*	LC	LC			1	80	13.3	50	10	19.2		x
White-breasted Cormorant	*Phalacrocorax lucidus*	LC	LC			2	71.4	13.3			11.5		x
Black Heron	*Egretta ardesiaca*	LC	LC		PG	2	5.7						x
Little Egret	*Egretta garzetta*	LC	LC		PG	2	48.6	13.3					x
Yellow-billed Egret	*Egretta intermedia*	LC	LC		PG	2							
Great Egret	*Egretta alba*	LC	LC		PG	3							
Grey Heron	*Ardea cinerea*	LC	LC		PG	1	62.9	6.7	20	20	11.5		x
Black-headed Heron	*Ardea melanocephala*	LC	LC		PG	1	8.6		30	40	3.8		x
Goliath Heron	*Ardea goliath*	LC	LC		PG	2	2.9						x
Purple Heron	*Ardea purpurea*	LC	LC		PG	2	11.4				3.8		x
Western Cattle Egret	*Bubulcus ibis*	LC	LC		PG	1	28.6	13.3	70	20	50	15.4	x

Squacco Heron	*Ardeola ralloides*	LC	LC		PG	1	11.4						x
Green-backed Heron	*Butorides striata*	LC	LC		PG	1	5.7				3.8		x
Black-crowned Night Heron	*Nycticorax nycticorax*	LC	LC		PG	2	5.7				3.8		x
Little Bittern	*Ixobrychus minutus*	LC	LC		PG	2							
Hamerkop	*Scopus umbretta*	LC	LC		PG	1	5.7				3.8		x
Greater Flamingo	*Phoenicopterus roseus*	LC	NT		PG	2							
Lesser Flamingo	*Phoeniconaias minor*	NT	NT		PG	2							
Glossy Ibis	*Plegadis falcinellus*	LC	LC		PG	1	14.3	6.7			11.5		x
Hadeda Ibis	*Bostrychia hagedash*	LC	LC		PG	1	94.3	6.7	60	20	84.6		x
African Sacred Ibis	*Threskiornis aethiopicus*	LC	LC		PG	2	42.9	6.7	10				x
African Spoonbill	*Platalea alba*	LC	LC		PG	2	14.3		10				x
Great White Pelican	*Pelecanus onocrotalus*	LC	VU		PG	3							
Pink-backed Pelican	*Pelecanus rufescens*	LC	VU		PG	3							
Yellow-billed Stork	*Mycteria ibis*	LC	EN		PG	3							
Black Stork	*Ciconia nigra*	LC	VU		PG	4							
Abdim's Stork	*Ciconia abdimii*	LC	NT		PG	2							
White Stork	*Ciconia ciconia*	LC	LC		PG	2							
Marabou Stork	*Leptoptilos crumeniferus*	LC	NT		PG	4							
Eurasian Golden Oriole	*Oriolus oriolus*	LC	LC		PG	3							
Fork-tailed Drongo	*Dicrurus adsimilis*	LC	LC		PG	2					3.8		x
African Paradise Flycatcher	*Terpsiphone viridis*	LC	LC		PG	2	28.6				26.9	7.7	x
Brubru	*Nilaus afer*	LC	LC		PG	3	2.9				26.9		x
Brown-crowned Tchagra	*Tchagra australis*	LC	LC		PG	2	45.7	6.7			30.8		x
Crimson-breasted Shrike	*Laniarius atrococcineus*	LC	LC		PG	3					11.5		x
Bokmakierie	*Telophorus zeylonus*	LC	LC		PG	2			10	20			x

Chinspot Batis	*Batis molitor*	LC	LC		PG	2	17.1				7.7		x
Pririt Batis	*Batis pririt*	LC	LC		PG	2	45.7	6.7			26.9		x
Pied Crow	*Corvus albus*	LC	LC			1	40	13.3	60	30	80.8	7.7	x
Red-backed Shrike	*Lanius collurio*	LC	LC		PG	3	5.7				15.4		x
Lesser Grey Shrike	*Lanius minor*	LC	LC		PG	3		6.7					x
Southern Fiscal	*Lanius collaris*	LC	LC		PG	1	40	6.7	80	40	46.2	7.7	x
Ashy Tit	*Parus cinerascens*	LC	LC		PG	2	14.3				3.8		x
Brown-throated Martin	*Riparia paludicola*	LC	LC		PG	1	45.7	13.3	30		11.5		x
Banded Martin	*Riparia cincta*	LC	LC		PG	2		6.7					x
Barn Swallow	*Hirundo rustica*	LC	LC		PG	1	17.1	13.3	10	10	23.1		x
White-throated Swallow	*Hirundo albigularis*	LC	LC		PG	1	48.6	6.7			19.2		x
Greater Striped Swallow	*Cecropis cucullata*	LC	LC		PG	1	60	6.7	20	20	57.7	15.4	x
South African Cliff Swallow	*Petrochelidon spilodera*	LC	LC		PG	1	40	20	30	10	23.1		x
Rock Martin	*Hirundo fuligula*	LC	LC		PG	3					7.7		x
African Red-eyed Bulbul	*Pycnonotus nigricans*	LC	LC			2	94.3	13.3	90		84.6	23.1	x
Fairy Flycatcher	*Stenostira scita*	LC	LC		PG	3	2.9						x
Long-billed crombec	*Sylvietta rufescens*	LC	LC		PG	3	14.3						x
Little Rush Warbler	*Bradypterus baboecala*	LC	LC		PG	1	11.4		10				x
African Reed Warbler	*Acrocephalus baeticatus*	LC	LC		PG	2	34.3	6.7			15.4		x
Marsh Warbler	*Acrocephalus palustris*	LC	LC		PG	3	2.9						x
Great Reed Warbler	*Acrocephalus arundinaceus*	LC	LC		PG	2	2.9		10	10	3.8	7.7	x
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	LC	LC		PG	2	80	6.7	70		23.1		x
Willow Warbler	*Phylloscopus trochilus*	LC	LC		PG	2	22.9				7.7		x
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*	LC	LC		PG	1	88.6	6.7	20	10	69.2	7.7	x
Garden Warbler	*Sylvia borin*	LC	LC		PG	2	2.9						x

Common Whitethroat	*Sylvia communis*	LC	LC		PG	4	5.7						x
Cape White-eye	*Zosterops virens*	LC	LC		PG	2	14.3				15.4		x
Orange River White-eye	*Zosterops pallidus*	LC	LC		PG	2	97.1	6.7	50		65.4	7.7	x
Lazy Cisticola	*Cisticola aberrans*	LC	LC		PG	3							
Rattling Cisticola	*Cisticola chiniana*	LC	LC		PG	2	57.1	6.7	20		34.6		x
Tinkling Cisticola	*Cisticola rufilatus*	LC	LC		PG	3					3.8		x
Wailing Cisticola	*Cisticola lais*	LC	LC		PG	3							
Levaillant's Cisticola	*Cisticola tinniens*	LC	LC		PG	1	48.6		60	30	34.6		x
Neddicky	*Cisticola fulvicapilla*	LC	LC		PG	2	65.7	6.7	40	30	65.4	23.1	x
Zitting Cisticola	*Cisticola juncidis*	LC	LC		PG	1		6.7	10	30	11.5		x
Desert Cisticola	*Cisticola aridulus*	LC	LC		PG	2	5.7		20	20	30.8		x
Cloud Cisticola	*Cisticola textrix*	LC	LC		PG	1			20	30	15.4		x
Tawny-flanked Prinia	*Prinia subflava*	LC	LC		PG	1			10		11.5	7.7	x
Black-chested Prinia	*Prinia flavicans*	LC	LC		PG	1	97.1	6.7	90	30	76.9	7.7	x
Bar-throated Apalis	*Apalis thoracica*	LC	LC		PG	2	48.6				11.5		x
Melodious Lark	*Mirafra cheniana*	NT	LC		PG	3					3.8		x
Rufous-naped Lark	*Mirafra africana*	LC	LC		PG	2	11.4		10	20	46.2		x
Eastern clapper Lark	*Mirafra fasciolata*	LC	LC		PG	2	2.9			20	11.5		x
Sabota Lark	*Calendulauda sabota*	LC	LC		PG	2	5.7				11.5		x
Fawn-coloured Lark	*Calendulauda africanoides*	LC	LC		PG	3							
Spike-heeled Lark	*Chersomanes albofasciata*	LC	LC		PG	1		6.7			11.5		x
Chestnut-backed Sparrow-lark	*Eremopterix leucotis*	LC	LC		PG	2	2.9				3.8		x
Red-capped Lark	*Calandrella cinerea*	LC	LC		PG	1			50	20	3.8		x
Pink-billed Lark	*Spizocorys conirostris*	LC	LC		PG	1					3.8		x
Karoo Thrush	*Turdus smithi*	LC	LC		PG	2	74.3	6.7	20		61.5		x

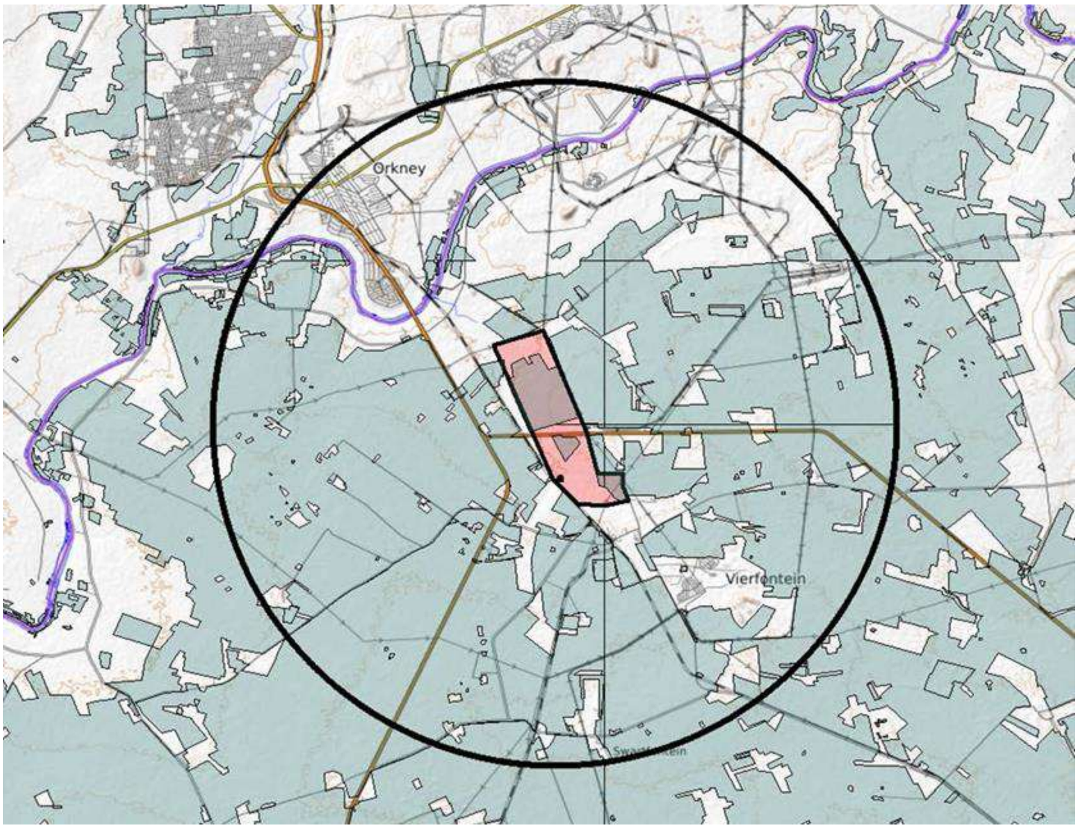
Fiscal Flycatcher	*Sigelus silens*	LC	LC		PG	2	62.9	13.3	50	10	61.5		x
Spotted flycatcher	*Muscicapa striata*	LC	LC		PG	2	17.1				19.2		x
Cape Robin-Chat	*Cossypha caffra*	LC	LC		PG	2	85.7	6.7	30	20	65.4	7.7	x
Kalahari Scrub Robin	*Erythropygia paena*	LC	LC		PG	2	57.1	6.7			50		x
African StoneChat	*Saxicola torquatus*	LC	LC		PG	1	34.3	20	100	30	30.8		x
Mountain Wheatear	*Oenanthe monticola*	LC	LC		PG	3					11.5		x
Capped Wheatear	*Oenanthe pileata*	LC	LC		PG	2					7.7		x
Familiar Chat	*Cercomela familiaris*	LC	LC		PG	1	2.9				11.5		x
Ant-eating Chat	*Myrmecocichla formicivora*	LC	LC		PG	1		6.7	40	30	3.8		x
Cape Glossy Starling	*Lamprotornis nitens*	LC	LC		PG	2	37.1		30	10	53.8	7.7	x
Pied Starling	*Lamprotornis bicolor*	LC	LC			2	2.9		20	10	53.8	15.4	x
Wattled Starling	*Creatophora cinerea*	LC	LC		PG	2	42.9	6.7	20		30.8		x
Common Myna	*Acridotheres tristis*					2	88.6	26.7	70	10	92.3	53.8	x
Amethyst Sunbird	*Chalcomitra amethystina*	LC	LC		PG	2	2.9	6.7					x
White-bellied Sunbird	*Cinnyris talatala*	LC	LC		PG	1	20				34.6		x
Scaly-feathered Finch	*Sporopipes squamifrons*	LC	LC			2	14.3	6.7	10		15.4		x
White-browed Sparrow-Weaver	*Plocepasser mahali*	LC	LC			1	51.4	6.7	100	30	88.5	15.4	x
Cape Weaver	*Ploceus capensis*	LC	LC			3	2.9						x
Southern Masked Weaver	*Ploceus velatus*	LC	LC			1	100	20	100	40	88.5	38.5	x
Red-billed Quelea	*Quelea quelea*	LC	LC			1	45.7	20	70	30	46.2		x
Yellow-crowned Bishop	*Euplectes afer*	LC	LC			1	5.7	6.7	20		11.5		x
Southern Red Bishop	*Euplectes orix*	LC	LC			1	62.9	13.3	50	30	69.2	23.1	x
White-winged Widowbird	*Euplectes albonotatus*	LC	LC			2	20		10	10	7.7		x
Red-collared Widowbird	*Euplectes ardens*	LC	LC			2	5.7				15.4	7.7	x
Long-tailed Widowbird	*Euplectes progne*	LC	LC			1	2.9	6.7	80	40	34.6		x

Thick-billed Weaver	*Amblyospiza albifrons*	LC	LC		PG	2	28.6				15.4		x
Orange-breasted Waxbill	*Amandava subflava*	LC	LC		PG	2			20	10	3.8		x
African Quail-finch	*Ortygospiza fuscocrissa*	LC	LC		PG	1	5.7		40	20	15.4		x
Red-headed Finch	*Amadina erythrocephala*	LC	LC		PG	2		6.7	10		15.4		x
Black-faced Waxbill	*Estrilda erythronotos*	LC	LC		PG	2	2.9				7.7	7.7	x
Common Waxbill	*Estrilda astrild*	LC	LC		PG	1	5.7		20	20	7.7		x
Violet-eared Waxbill	*Uraeginthus granatinus*	LC	LC		PG	4	2.9						x
Blue Waxbill	*Uraeginthus angolensis*	LC	LC		PG	2	45.7		10	10	46.2	15.4	x
Green-winged Pytilia	*Pytilia melba*	LC	LC		PG	2	14.3	6.7			19.2		x
Red-billed Firefinch	*Lagonosticta senegala*	LC	LC		PG	2	11.4				11.5		x
African Firefinch	*Lagonosticta rubricata*	LC	LC		PG	2	2.9				3.8		x
Jameson's Firefinch	*Lagonosticta rhodopareia*	LC	LC		PG	2	5.7	6.7	10		15.4		x
Bronze Mannikin	*Lonchura cucullata*	LC	LC		PG	2		6.7			3.8		x
Pin-tailed Whydah	*Vidua macroura*	LC	LC		PG	2	14.3		30	30	30.8		x
Long-tailed Paradise Whydah	*Vidua paradisaea*	LC	LC		PG	2	5.7				3.8		x
Village Indigobird	*Vidua chalybeata*	LC	LC		PG	3	2.9				3.8	7.7	x
Dusky Indigobird	*Vidua funerea*	LC	LC		PG	4					7.7		x
Purple Indigobird	*Vidua purpurascens*	LC	LC		PG	4					3.8		x
House Sparrow	*Passer domesticus*					1	71.4	6.7	40		61.5	23.1	x
Cape Sparrow	*Passer melanurus*	LC	LC			2	94.3	6.7	80	30	92.3	15.4	x
Southern Grey-headed Sparrow	*Passer diffusus*	LC	LC		PG	1	37.1	6.7	60	30	38.5		x
African Pied Wagtail	*Motacilla aguimp*	LC	LC		PG	3	22.9						x
Cape Wagtail	*Motacilla capensis*	LC	LC		PG	1	68.6	13.3	40	10	26.9		x
Cape Longclaw	*Macronyx capensis*	LC	LC		PG	1	8.6	13.3	20	20	23.1		x
African Pipit	*Anthus cinnamomeus*	LC	LC		PG	1	5.7	6.7	30		15.4		x

Plain-backed Pipit	*Anthus leucophrys*	LC	LC		PG	3					3.8		x
Buffy Pipit	*Anthus vaalensis*	LC	LC		PG	2							
Long-billed Pipit	*Anthus similis*	LC	LC		PG	2							
Yellow-fronted Canary	*Crithagra mozambica*	LC	LC		PG	2	2.9						x
Black-throated Canary	*Crithagra atrogularis*	LC	LC		PG	2	74.3		50	10	73.1	7.7	x
Yellow Canary	*Crithagra flaviventris*	LC	LC		PG	2	42.9	6.7	20	20	38.5		x
Cinnamon-breasted Bunting	*Emberiza tahapisi*	LC	LC		PG	4	2.9				15.4	7.7	x
Golden-breasted Bunting	*Emberiza flaviventris*	LC	LC		PG	2					3.8		x
Yellow-billed Kite	*Milvus aegyptius*	LC	LC		PG	2	2.9						x

Key: Status: CR = Critically Endangered; DD = Data Deficient; EN = Endangered; LC = Least Concern; NA = Not Assessed; NT = Near Threatened; OG = Ordinary Game; PG = Protected Game; PS = Protected Species; VU = Vulnerable. Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate. Sources: Taylor et al. (2015); BirdLife South Africa (2016); SABAP 2 (2022)

APPENDIX E4: Agricultural Potential Impact Assessment



AGRICULTURAL POTENTIAL ASSESSMENT AND IMPACT ASSESSMENT:

PROPOSED ALTINA SOLAR PHOTOVOLTAIC PROJECT NEAR THE TOWN OF ORKNEY, FREE STATE PROVINCE

Compiled for
Nemai Green

Compiled by
Dr Andries Gouws: Index

April 2022,
Revised October 2022

DECLARATION

The observations, conclusions and recommendations made in this report are based on the best available data and on best scientific and professional knowledge of the directors of INDEX (Pty) Ltd. The report is based on GIS programming and utilises satellite tracking to map survey points. Survey points are normally accurate to within 3 metres; which must be considered in the use of the information.

The directors of INDEX (Pty) Ltd exercises due care and diligence in rendering services and preparing documents. However, the company accepts no liability, and the client, by receiving this document, indemnifies INDEX (Pty) Ltd and its directors and employees, by the use of the information contained in this document, against any action, claim, demand, loss, liability, cost, damage and expense arising from or in connection with services rendered.

The property and copyright of this report shall remain vested in INDEX (Pty) Ltd. The client that commissioned the report may use the information as it may think fit; but only for the land for which it was commissioned.

General declaration:

- INDEX acted as the independent specialist in this application;
- Performed 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;
- There were no circumstances that may compromise INDEX's objectivity in performing such work;
- INDEX have expertise in conducting the specialist report relevant to this application, including knowledge of NEMA and its regulations and any guidelines that have relevance to the proposed activity;
- Have no and will not engage in conflicting interests in the undertaking of the activity.

The study was undertaken by Dr Andries Gouws. He is a registered member of SACNASP in the category of Agriculture.

Specialist for agriculture

1 May 2022

Contents

SUMMARY

The total area assessed is 850,4 ha. Of this, 180 ha comprise the land where the infrastructure will be placed. Altina is a mixed enterprise farm with both cultivated and grazing land. Soya and maize were planted in the 2021/2 season.

The climate is suitable for rainfed crop production. The soil in general has a sandy texture with a clay content of below 18%, and in some places even below 10%. This is the reason for the mine in the central western part of the site.

Veld condition is poor. The presence of *Seriphium plumosum* (bankrotbos) is common on most of the grazing land. The veld's grazing capacity is estimated by the Department as 7ha per LSU. It is our opinion that due to the encroachment; the capacity should be downgraded to around 10 ha/LSU. The footprint is 179 ha, which can accommodate approximately 17 LSU.

Footprint

The buildable area was confined to the uncultivated portion of the farm. It consists mainly of shallower uneven and mined land that has medium sensitivity according to the screening tool. It further excludes watercourses and wetlands.

According to the screening tool, the site has high sensitivity for the cultivated land and medium sensitivity for the grazing land.

Results of the site verification

Following the desktop study and site visit, the following were found:

a) Most of the site was correctly classified as *moderately sensitive*. The cultivated land in the south-eastern corner, however is not highly sensitive as found by the tool. The result of the tool is, therefore disputed. This portion is *moderately sensitive*.
b) The site is moderately sensitive because it falls within Land capability 6 – 7 in the new classification and in Class iv according to Montgomery (formerly used by DALRRD).

Specialist evaluation

The following were found:

- High capability land for crop production occurs in the central portion of the land north of the tarred road. The balance is medium to low capability.
- All highly sensitive land was retained for cropping and will not be impacted on by the development. The placement of the development will avoid any high potential land. The site survey also found that the grazing land is severely encroached that has degraded the livestock carrying capacity, in our view, to unsustainable levels. The mine has reached end of life and will be rehabilitated as part of the development. Further, the construction of the PV panels, although expected to have a life of 25 years, is temporary and will not destroy the land for agriculture after this period. Therefore, no reason can be found to not allow the development. It is our recommendation that the project be allowed to be implemented;

Impact description

- There will be no loss of high potential land. No impact and no mitigation required.
- Twenty-six hectare of cultivated land and 121 ha of poor quality grazing will be lost for the duration of the project. The impact is low. The present poor state of the veld can be rectified at the end of the project life. The grazing land that will be under PV can accommodate 12 LSU. The impact is low.
- No farming infrastructure will be lost.

- It is estimated that less than one labourer is required to tend the livestock. If implemented he can easily be absorbed in the present farming activities or at the PV Site.

Therefore, no reason can be found to not allow the development. It is our recommendation that the project be implemented.

1 BACKGROUND

Genesis Eco-Energy Developments (Pty) Ltd has proposed the development of the Altina 120MW Solar PV Project near the town of Orkney in the Free State Province (refer to locality map in Figure 1 below). The site falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice No. 142 of 26 February 2021. The electricity generated by the Project will be injected into the existing Eskom 132 kV distribution system.

The Applicant intends to bid for Renewable Energy Independent Power Producer Procurement Programme bid windows and /or other renewable energy markets within SA.

Specialist input is ordinarily required to assess potentially significant impacts to particular features of the receiving environment.

Index was appointed by the EIA practitioners Nemai Green to do an agricultural impact assessment in terms of Notice No. 320 Government Gazette 43110 20 March 2020.

The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) for agricultural resources, which is based on the land capability evaluation values provided by the department responsible for agriculture.

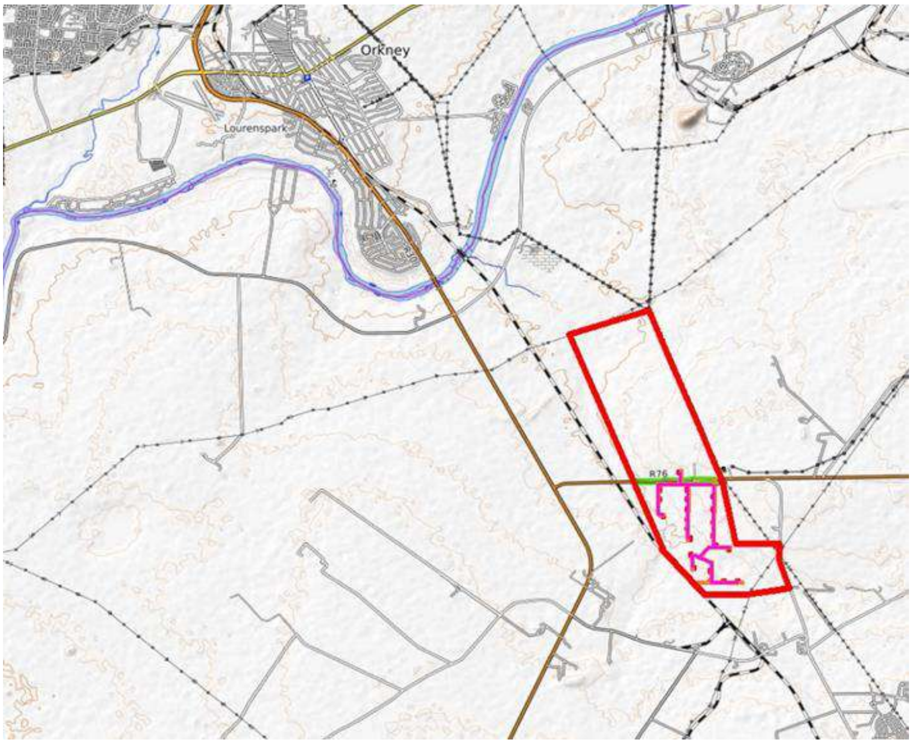


Figure 1. Locality of the site

The total area assessed was 850,4 ha.

Three iterations of the design were made, during which environmental concerns identified by various specialists were addressed. The final design is where the infrastructure will be placed is 180 ha.

2 METHODS AND PROCEDURES

Site sensitivity verification

The current use of the land and the environmental sensitivity of the site are available in the screening tool, and were used in assessing the site's sensitivity.

- The site sensitivity verification was done through use of satellite imagery and a site inspection;
- The outcome of the site sensitivity verification is described in this report.

The report will compare the current land use to the environmental sensitivity as identified by the screening tool, including information on new developments or infrastructure, the change in vegetation cover or status etc.; It will further indicate, according to the requirements of the Environmental Impact Assessment Regulations, the differences between the screening tool and the actual status as found by the site visit.

Site evaluation process

The results of this study followed a site visit on 19 April 2022. Bing and Google satellite images were used as backdrop and the present land uses digitised. A number of soil profiles were assessed by using a soil augur or probe. The dominant soil types were identified from which a generalised soil map was prepared.

Vegetation was simultaneously logged to determine veld condition. Grazing capacity is according to the DALRRD and then adapted to present veld conditions.

Capability classification is according to the guidelines published on the AGIS website of the NDA was used to determine the capability of soils and their agricultural potential (Department of Agriculture, 2019).

Climate data was obtained from SA Weather and other on-line sources available on the internet.

3 SITE EVALUATION

3.1 Present land uses

Altina is a mixed enterprise farm with both cultivated and grazing land. The lands are rented out. Soya and maize were planted in the 2021/2 season. The maize yield was estimated at 5,0 t/ha, and that of the soya, at 2,4 t/ha. Sand is being mined on a portion of the farm, but according to the farm owner, the licence will expire by end 2022/3.

The total area assessed was 850,4 ha. Of this 180 ha comprise the land where the infrastructure will be placed.

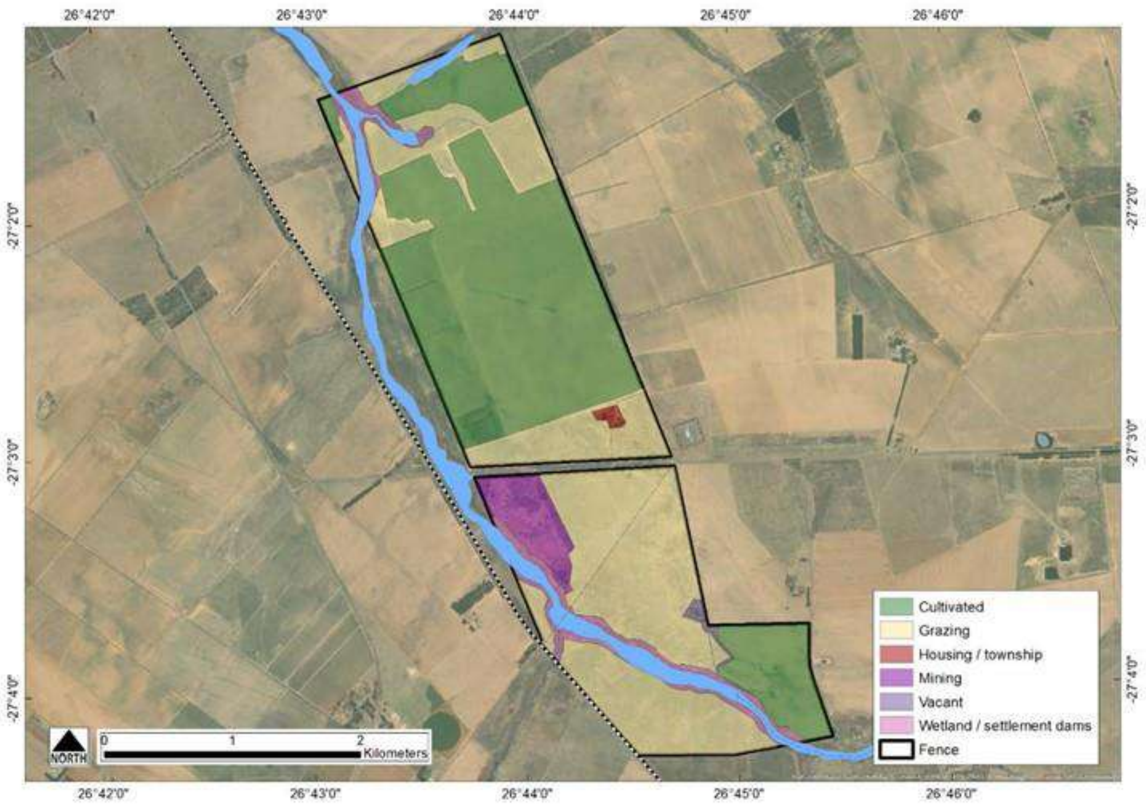


Figure 2. Present land uses

Table 1. Present land uses

Land use	Total area (ha)
Cultivated	393.1
Grazing / vacant	349.4
Mining	33.6
Housing	2.8
WC (watercourses)	71.5
Total area	**850.4**

3.2 Regional land uses

Most of the arable land is annually planted to summer crops like maize, sunflower, sorghum or beans. Five centre pivot irrigation machines were found within 10 km of the farm's centroid.

Most of the deeper soils are cultivated. Soils that are shallow or waterlogged are the only land that is used as grazing. Most of the farmers have mixed farms where livestock is reared in conjunction with cropping. Stover is used for fodder in the late winter.

The town of Orkney and some mines are also located in the region.

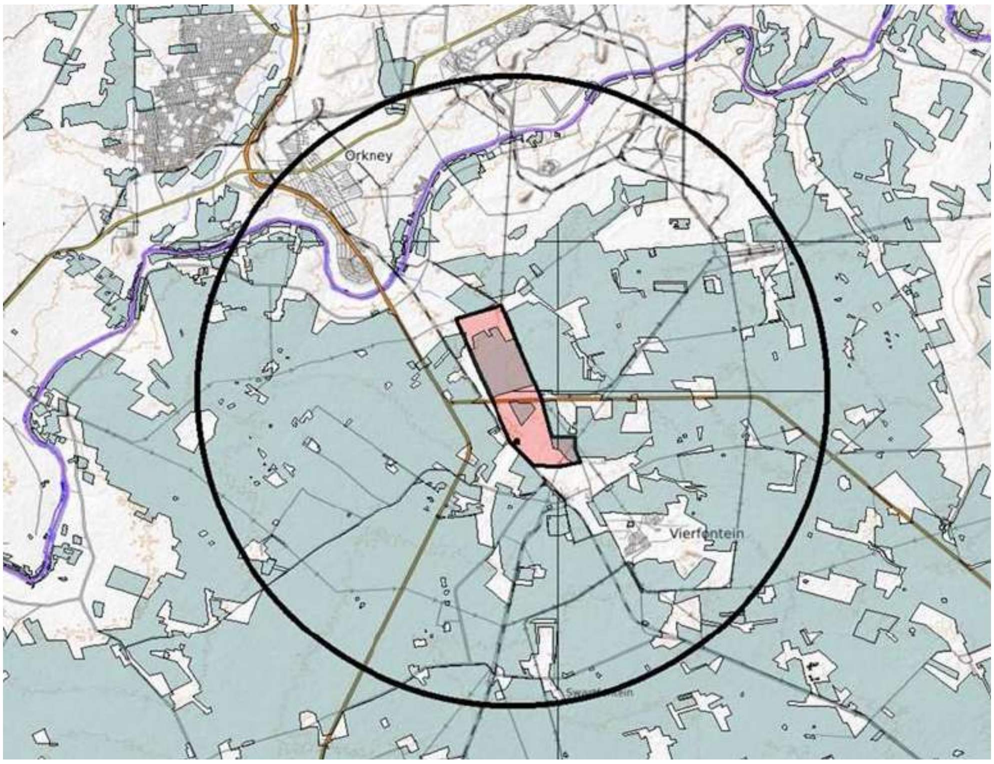


Figure 3. Regional land uses (light blue indicates cultivated land)

3.3 Climate

The long term average rainfall is 618 mm per year that falls mainly in the summer months.

The summers are long, warm and mostly clear and the winters are short, cold, dry, and clear. Over the course of the year, the temperature typically varies from *2°C* to *30°C* and is rarely below *-2°C* or above *34°C.* The *hot season* lasts for *4.4 months*, from *October 22* to *March 4*, with an average daily high temperature above *28°C*. The hottest month of the year in Orkney is *January*, with an average high of *30°C* and low of *17°C*. The *cool season* lasts for *2.3 months*, from *May 27* to *August 5*, with an average daily high temperature below *22°C*. The coldest month of the year in Orkney is *June*, with an average low of *3°C* and high of *20°C*.

The climate is suitable for rainfed crop production.

3.4 Soil properties

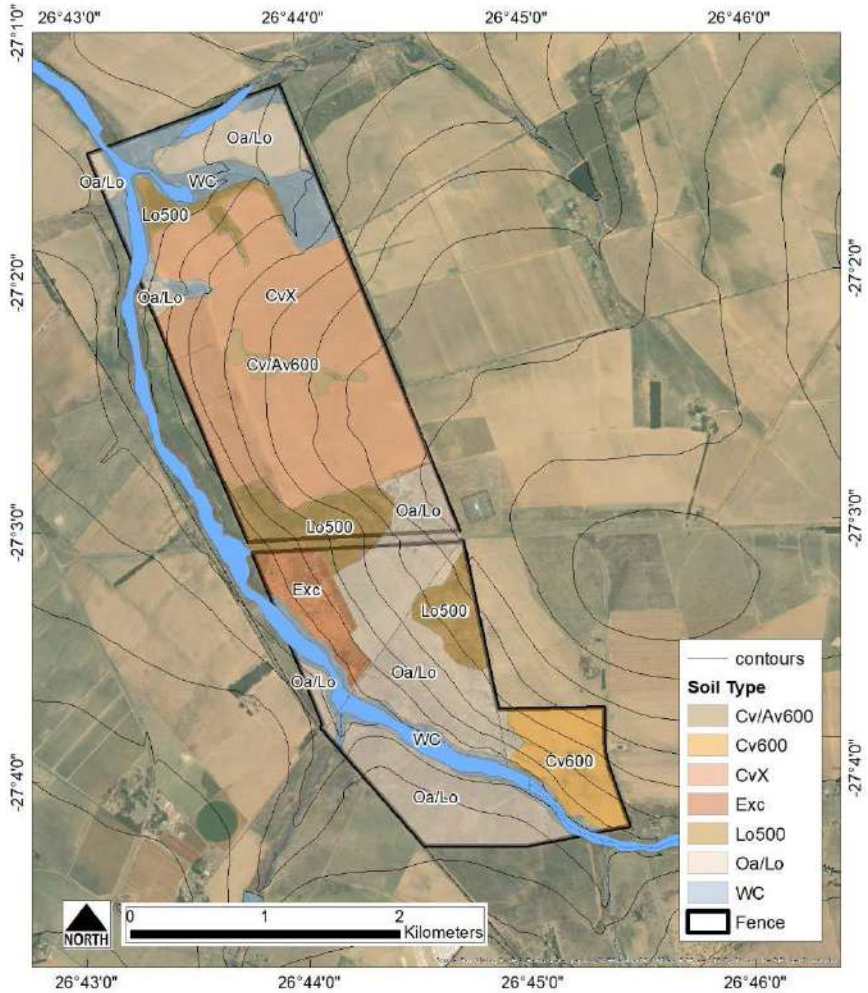


Figure 4. Soil types on the development areas

The soil derived from the weathering of Vryheid lithology of the Ecca formation. The rock formations are layered arenite and shale. These rocks usually produce sandy loam ferralitic soils of medium depth. Iron and manganese concretions and soft plinthite are common. Clay may accumulate in the subsoil to form cutanic blocky or peds. These restrict infiltration. Rainwater then drains laterally and deplete of iron to form a so-called e-horizon.

Watercourses are often wide and saturated with water for prolonged periods of the year. Soils with an e- horizon are important reservoirs for groundwater and contribute to the maintenance of wetlands downslope. In the case of Altina, the concave slopes are normally where these soils occur.

The soil in general has a sandy texture with a clay content of below 18%, and in some places below 10%. This is the reason for the mine in the central western part of the site.

The soil map and description of the dominant soils are provided below.

Table 2. Soil descriptions

Map unit	Description
CvX	Sandy soil with a clay content of 8 - 18%. The soil depth that is normally more than 600 mm. The topsoil is light brown with a grain structure. The topsoil is free of stones or nodules. The subsoil is yellowish brown sandy loam with poorly developed blocky or grain structure. The deeper subsoil can be ferricrete or have hard ferricrete nodules. The dominant soil forms identified are Clovelly, Avalon and Glencoe. The soils are arable and, in most cases, cultivated.
Cv/Av600	Sandy soil with a clay content of 8 - 18%. The soil depth that is normally between 400 and 600 mm. The topsoil is light brown with a grain structure. The topsoil may have ferricrete nodules. The subsoil is yellowish brown sandy loam with poorly developed blocky or grain structure. The deeper subsoil is soft plinthite and contains hard ferricrete nodules. The dominant soil forms identified are Avalon, Oakleaf, Clovelly and Glencoe. The soils are arable and mostly cultivated.
Cv600	Sandy soil with a clay content of 8 - 18% with a total rooting depth of more than 600 mm. The topsoil is light brown with a grain structure. The subsoil is yellowish brown sandy loam with poorly developed blocky or grain structure. This soil unit includes soils thar are waterlogged and shallow soils with dense hard plinthite at around 400mm. The dominant soil forms identified are Clovelly, Avalon and Glencoe. They are classified as medium potential soils mainly due to soil depth, waterlogged areas and ferricrete rocks.
Oa/Lo	Moderately deep yellowish-brown soil with a depth that varies over short distances. The subsoil consists of soft ferricrete or cutanic structured deeper subsoil. A bleached e-horizon may occur above the deeper subsoil. This cause lateral water movement in the subsoil, and is often the source of water that feeds the wetlands further downslope. The dominant soil forms identified are Oakleaf, Avalon and Longlands. These soils may be arable if deep enough. They are, however, not normally cultivated because they can become waterlogged and impassable for farm vehicles during high and prolonged rainfall events.
Lo500	Moderately deep and shallow greyish brown topsoil on soft plinthite or gleyed subsoil. These soils are very erodible and as in the case of Oa/Lo, a store of groundwater to recharge wetlands downslope. The dominant soil form found is Longlands. Escort and Kroonstad may also occur. They should not be cultivated but left as natural grazing.
Exc	This unit is the mine on the western portion of the land, which is adjacent to the river.
WC	This is the watercourse and/or wetlands.

3.5 Vegetation

Veld condition is poor. The presence of *Seriphium plumosum* (bankrotbos) is common on most of the rangeland and is indicative of overgrazing or where an *e-horizon* is present.

The veld's grazing capacity is estimated by the Department as 7ha per LSU. It is our opinion that due to the encroachment; the capacity should be downgraded to around 10 ha/LSU.

The footprint is 180ha, which can accommodate approximately 17 LSU. The mined area is not suitable for grazing until it has been rehabilitated.

3.6 Water

There are no water rights on the property that is used for irrigation purposes. There is a watercourse along the western boundary.

4 PROPOSED DEVELOPMENT

The present design is the third; the former had some environmentally sensitive areas that necessitated that the PV area to move.

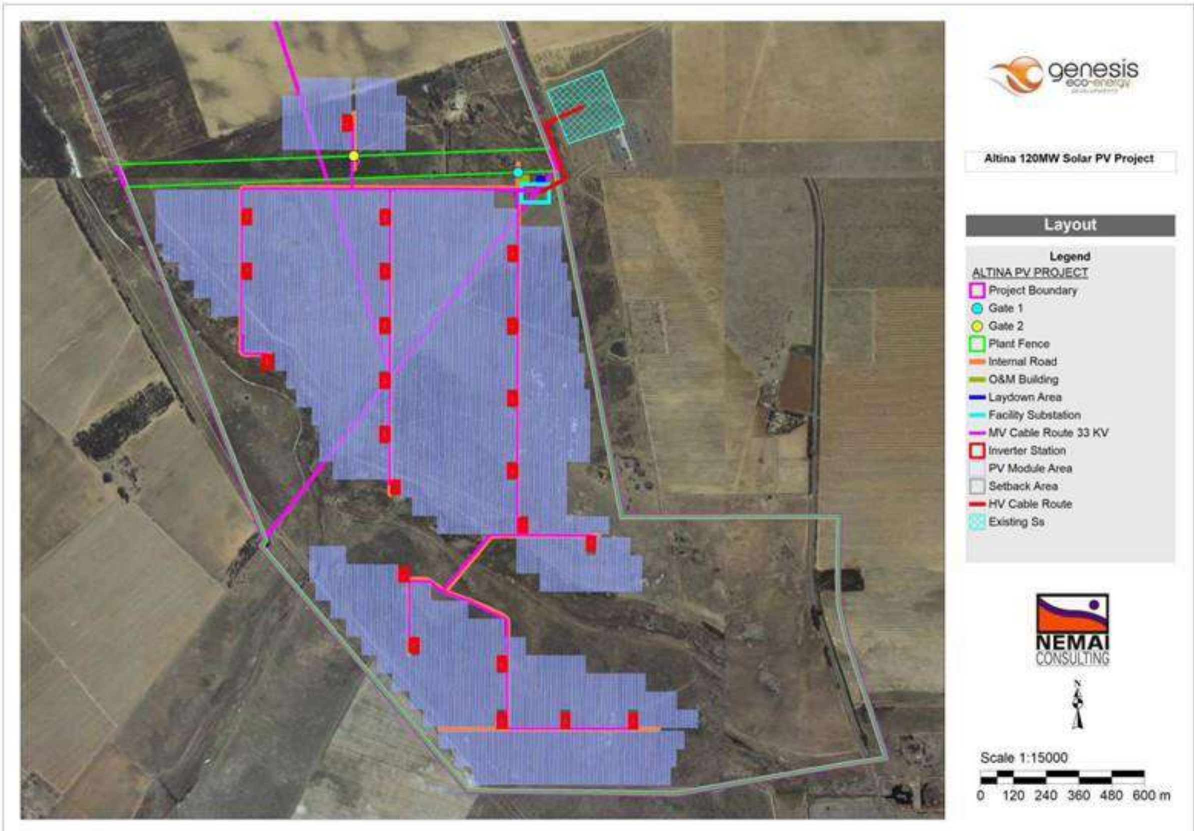


Figure 5. Original design

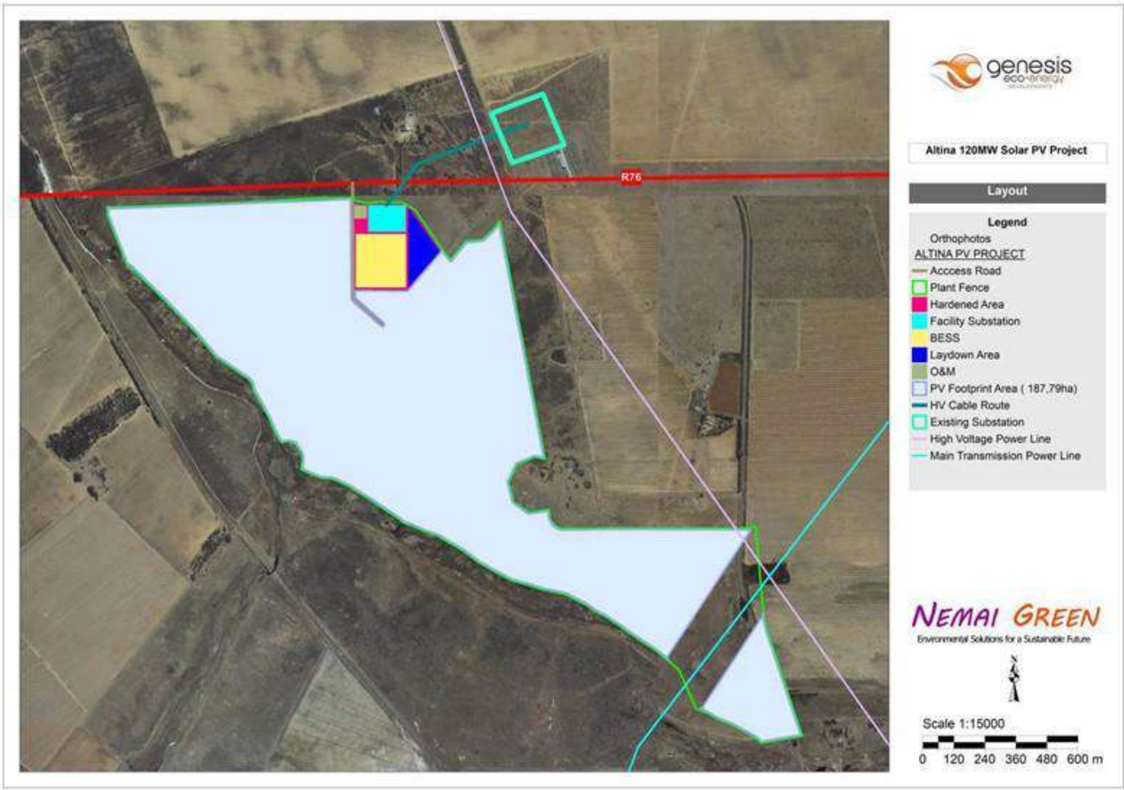


Figure 6. Second design

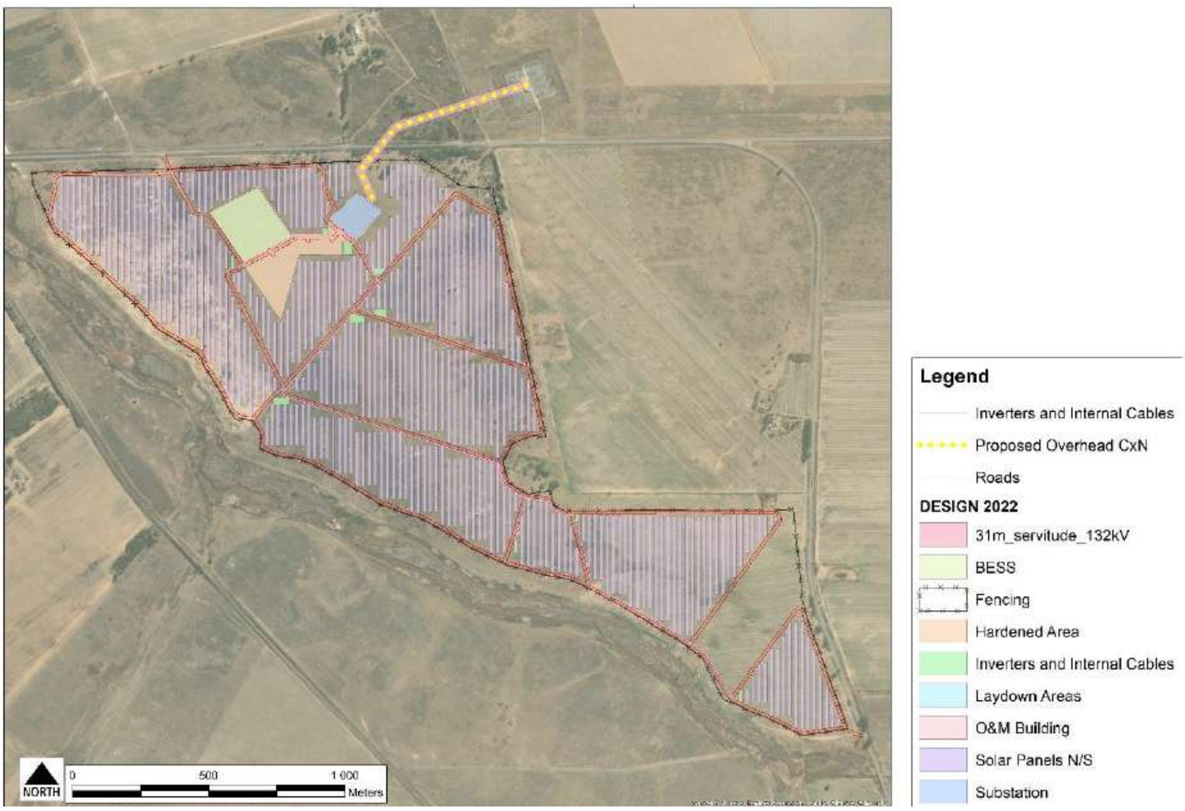


Figure 7. Final design

In order to address residual impact on the wetlands, and in response to DFFE comments received, the layout was amended to the final design:

1) Hardstanding infrastructure (on-site substation; BESS; O&M buildings, laydown area, etc.) have been shifted from highly sensitive wetlands to low wetland sensitive areas;
2) PV arrays displaced to make space for the hardstanding infrastructure have been moved to where the BESS etc. used to be for Alternative 2, and the development footprint has been shifted a little bit out in the NE corner of the site;
3) Internal details such as the PV arrays themselves and the internal roads have been added;
4) The access road proposed for the SE corner has been included.

The proposed Project footprint is as follows:

- Grid connection – approximately 778 m - located to the immediate east of the Project boundary.
- The perimeter fence is 193 ha.

The area of each component is as follows:

Table 3. Size of each component

Type	Area (ha)
31m servitude 132kV	2,7
BESS	3,9
Hardened Area	10,1
Inverters and Internal Cables	0,8
Laydown Areas	2,1
O&M Building	0,5
Solar Panels N/S	66,0
Substation	1,5
Total	**87,7**

5 SENSITIVITY ANALYSES

5.1 Site sensitivity verification

The Department of Environmental Affairs published Notice 320 in 2020 that describes the process to be followed and the minimum criteria when applying for environmental authorisation. The criteria are as follows:

Prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site as indicated by the screening tool must be confirmed by a site sensitivity verification.

Sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist, by using the following:

- a desk top analysis, using satellite imagery;
- a preliminary on-site inspection; and
- any other available and relevant information.

The outcome of the site sensitivity verification must be recorded in the form of a report that:

a) confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;
b) contains a motivation and evidence (e.g., photographs) of either the verified or different use of the land and environmental sensitivity; and
c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

The site sensitivity verification and the more detailed study was conducted simultaneously in order to save time and costs.

Results of the site verification

Following the desktop study and site visit, the following was found:

a) Most of the site was correctly classified as *moderately sensitive*. The cultivated land in the south-eastern corner, however is not highly sensitive as found by the tool. The result of the tool, therefore, is disputed. This portion is *moderately sensitive*.
b) The motivation is provided in Sections 3.4 and 5.3. The site is *moderately sensitive* because it falls within Land capability 6 – 7 in the new classification and in Class iv according to Montgomery (formerly used by DALRRD). See section 5.3.
c) The assessment report is the subject of this study.

5.2 Ecological sensitivity – screening tool

The Department of Environmental Affairs published Notice 320 in 2020 that describes the minimum criteria when applying for environmental authorisation.

This protocol provides the criteria for the assessment and reporting of impacts on agricultural resources for activities requiring environmental authorisation. The requirements of this protocol are according to the level of environmental sensitivity as indicated by the national web-based environmental screening tool for agricultural resources. It is based on the most recent land capability evaluation as provided by the DALRRD.

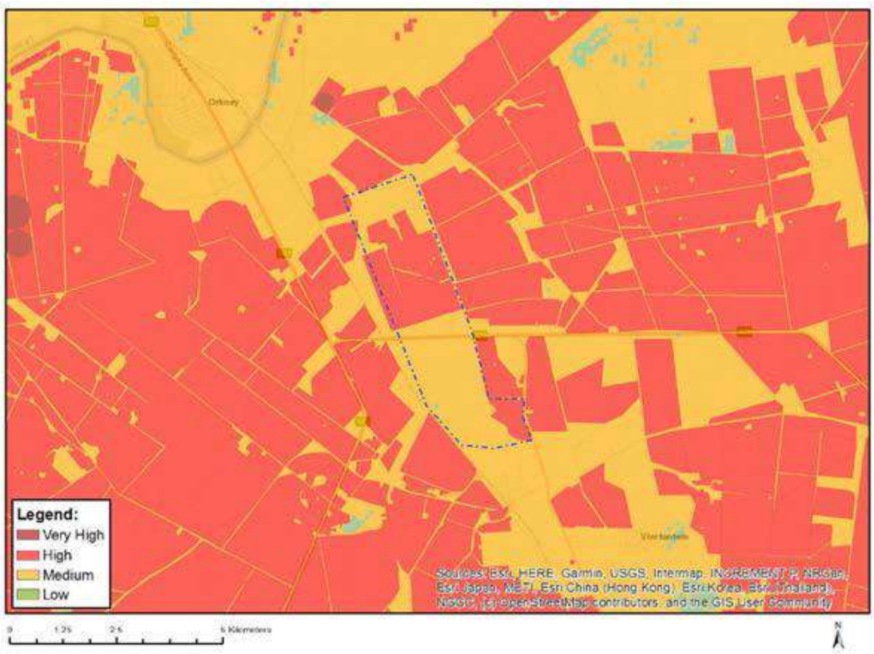


Figure 8. Results of the Screening tool

An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of “very high” or “high” sensitivity for agricultural resources must submit an Agricultural Agro-Ecosystem Specialist Assessment unless:

- the application is for a linear activity for which impacts on the agricultural resource are temporary and the land in the opinion of the soil scientist or agricultural specialist, based on the mitigation and remedial measures, can be returned to the current land capability within two years of the completion of the construction phase. This applies to the transmission line linking the PV project with the substation;

- the impact on agricultural resources is from an electricity pylon; or
- information gathered from the site sensitivity verification differs from the designation.

According to the screening tool, the site has *high sensitivity* for the cultivated land and *medium sensitivity* for the grazing land. The largest portion of the development is on *medium sensitive* land,

Because the cultivated land in the south eastern corner has portions that are waterlogged or underlain by hard plinthite, the soil is only *moderately sensitive*.

The finding of the screening tool that this portion is *highly sensitive*, is therefore incorrect (see below for the reasoning).

5.3 Specialist site analyses

Soil capability is a factor of soil properties like depth to restrictive layers, texture, presence of stones and rocks, etc.

The cultivated portion north of the tarred road that was under soya beans in 2021/2 has a depth of around 500 – 800 mm and has few rocks and stones. These soils have *high* to *moderate* arable potential.

The cultivated land in the south eastern part of the site that was planted with maize. Because the cultivated land has portions that are waterlogged or underlain by hard plinthite, the soil is only *moderately sensitive*. It consists of Clovelly, Avalon, Longlands or Dresden soils. This portion is shallow and moderately deep soils and are *moderately sensitive* and is contrary to that which was indicated by the screening tool.

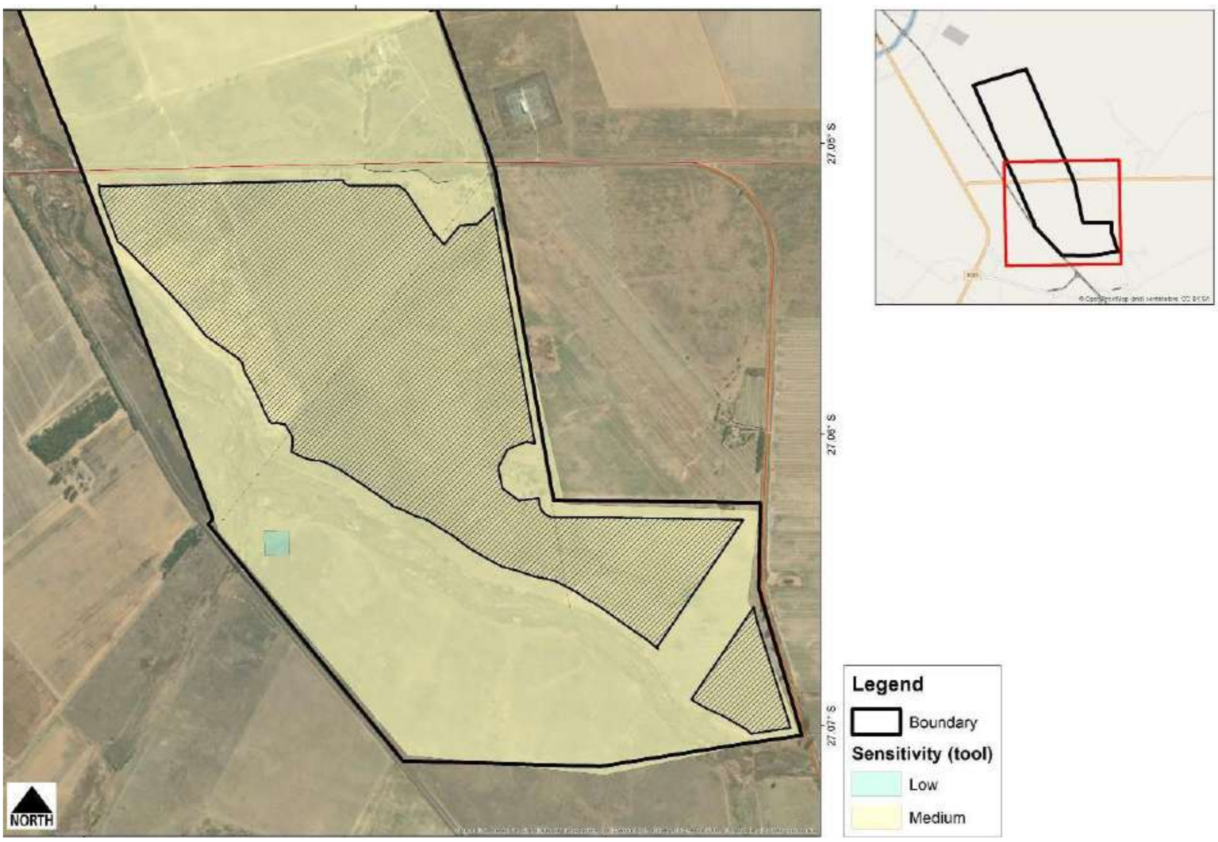


Figure 9. Micro placement of infrastructure

According to the guidelines of the protocol, for the assessment and minimum report content for EIA impacts on agricultural resources, the following applies:

The development is on *medium sensitive* land, which status was also indicated in the screening tool, and also confirmed by the site visit. Provision 1.1.3 in the Protocol applies, which requires the specialist to submit an *Agricultural Compliance Statement*. This statement is provided in Section 5.3.

The following will evaluate the land of the footprint for the development. As indicated earlier in the report, all *highly sensitive* land is excluded from the development through micro placement of infrastructure.

5.3.1 What is high potential land (high and very high sensitivity)

Norms and standards in terms of CARA (Conservation of Agricultural Resources Act) and HPUAL (National Policy of the Preservation of High Potential and Unique agricultural Land)

National policy on the protection of high potential and unique agricultural land published by Department of Agriculture in 2006 defines high potential land.

In terms of legislation high potential land includes:

- Land capability Classes i to iii;
- Unique agricultural land;
- Irrigated land; and
- Land suitable for irrigation.

5.3.2 Grazing

Grazing land, although important, is not a criterion in determining if land is high potential. Potential of land in the guidelines used in the Screening Tool is based on rainfed crop production. This is also the criteria in other legislation.

Wetlands in the Wetland Report include deep sand that contributes to the river through lateral flow deep in the profile. These upland soils are hydropedologically important because they maintain the streamflow of the river. The soils, however, have a clay content usually below 12% with a low water holding capacity. This makes the land medium to low potential for both cropping and animal grazing. The presence of *Seriphium plumosum* (bankrotbos) on these soils, and in most of the footprint is common and is indicative of overgrazing and/or, the presence of an e-horizon just above the clayey subsoil.

The grazing density of the veld is 7 ha /LSE for the region, but was estimated at more than 10 ha/LSU because of the poor state of the veld.

Vleis provide valuable grazing in the late winter and early autumn, especially when the livestock numbers are close to the grazing capacity. Most mixed enterprise farmers utilise stover from crops like maize as supplementary fodder. The vleis along the river were delineated and assigned Class vii and is low sensitivity land.

These are all outside the footprint of the development.

5.3.3 Land use capability

In 2002 the Directorate: Land Use and Soil Management (DLUSM) within DALRRD through the Agricultural Research Councils' (ARC), Institute of Soil, Climate and Water (ISCW) developed a national spatial land capability data set to depict the spatial delineation of the then defined eight land capability classes. The approach followed was based on the approach of Klingebiel and Montgomery (1961) but adapted for South Africa by the Multilateral Technical Committee for Agriculture and Environmental Affairs' Task team, to develop a system for soil and land capability classification, but it further aimed to incorporate the parameters within a Geographic Information System (GIS). The resulted spatial data set was derived at a scale of 1:250 000 with the land type data set being the main input data set for the derived land capability classes together with climatic and terrain parameters.

This dataset is used within the screening tool.

While the new dataset is more complex than that of Klingebiel *et al*, the latter has clear guidelines and is generally still followed when assigning capability to land. A comparison between the two systems is provided below.

Table 4. Relationship between grading of the Screening tool and that of Klingebiel *et al.*

DALRRD (2016)	Klingebiel	Capability	Arability
1-2	viii	Very low	Not arable
3-4	vii	Very low to low	
5-6	vi	Low	
7	v	Low to moderate	
8	iv	Moderate	Arable
9-10	iii	Moderate to high	
11-12	ii	High	
13-14	i	High to very high	
15	i	very high	

The soil on the property is arable but no water is available for irrigation. According to the agricultural potential map of NDA, the land is arable (*Department of Agriculture, 2019*).

Land capability classes are interpretive groupings of land with similar potential and limitations or similar hazards. Land capability involves consideration of difficulties in land use owing to physical land characteristics, climate and the risks of land damage from erosion and other causes.

The classic eight-class land capability system (Klingebiel & Montgomery, 1961) was adapted for use by the South African Department of Agriculture in their Agriculture Geographic Information System (AGIS).

Land capability is classified according to guidelines published by the National Department of Agriculture in AGIS.

Land Capability is determined by the collective effects of soil, terrain and climate features and shows the most intensive long-term use of land. At the same time, it indicates the permanent limitations associated with the different land-use classes (refer to Table 5).

- Order A: Arable land – high potential land with few limitations (Classes i and ii);
- Order B: Arable land – moderate to severe limitations (Classes iii and iv);
- Order C: Grazing and forestry land (Classes v, vi and vii);
- Order D: Land not suitable for agriculture (Class viii).

Table 5. Land capability classes – intensity of land uses

LAND CAPABILITY			Wildlife	Grazing and Forestry			Crop production			
Order		Class		Forestry	Veld	Pastures	Limited	Moderate	Intensive	Very intensiv
Arable	A	i								
		ii								
	B	iii								
		iv								
Non arable	C	v								
		vi								
		vii								
	D	viii								

Note: the shaded area indicates the suitable land use.

5.3.4 Findings

Figure 10 indicates the Land use capability and sensitivity as per the criteria in AGIS of DALRRD. The following were found:

- High capability land for crop production (Class ii and iii) occurs in the north of the tarred road. The far eastern portion of the property is also high capability land. The balance is *medium* to *low* capability (Classes iv and lower).
- The land capability was then used as input to determine agricultural sensitivity (refer to the previous section where the two classification systems are compared). There are portions of land that has developed shallow ferricrete which have *medium sensitivity* for agriculture and which was included as highly sensitive in the screening tool. These have, however, *low* or *medium sensitivity*.
- All highly sensitive land was retained for cropping and will not be impacted on by the development.

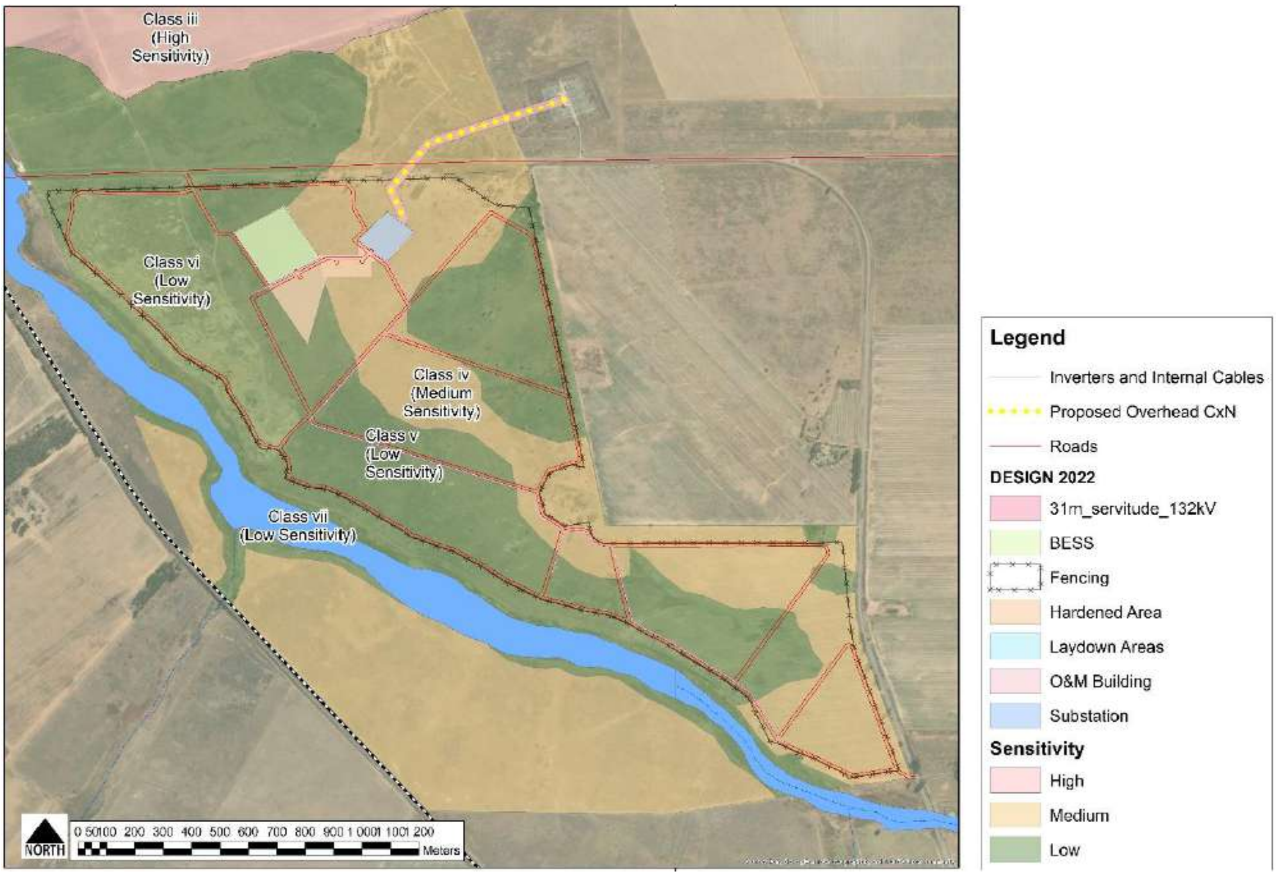


Figure 10. Land capability description

Placement of infrastructure

Detail placement excluded *highly sensitive* areas found north of the tarred road – the entire project will be on *medium* and *low* sensitive land.

Final placement of the panels and other infrastructure in indicated in Figure 10. The yellow shaded area is *medium sensitive* land and the green, low sensitivity land.

5.4 Specialist declaration

Agricultural compliance statement

- SACNASP registration of specialist and a curriculum vita – Refer to Section 9.2;
- A signed statement of independence by the specialist – Refer to Section 1;

- The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment. The main criteria for farming potential are soils, climate and water availability. These are not bound to seasons. However, the survey took place during the growing season of summer crops, which allowed the specialist to estimate the crop yield;
- For the description of the methodology used to undertake the on-site assessment: Refer to Section 2;
- A map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffer on the agricultural sensitivity map is provided in Paragraph 4 and 5;
- The site falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice. No. 142 of 26 February 2021. The site is located within the PV corridor be applicable to the preferred site and proposed development footprint;
- Confirm that the site is of low or medium sensitivity for agriculture. Refer to Section 5. The portion used for the infrastructure is low or medium sensitivity. The land that will be used for the PV is land with a low grazing potential due to severe encroachment by *Seriphium plumosum* and a portion which is being mined and which will have to be reclaimed. The proposed development will, therefore not have an unacceptable impact on the agricultural production capability Refer to Sections 3.4 and 5.2.
- A signed statement of independence is provided as preamble to the report.
- A map showing the proposed development footprint (including supporting infrastructure) overlaid on the agricultural sensitivity map is provided as Figure 10;
- Confirmation that all reasonable measures have been taken through micro placement to avoid or minimise fragmentation and disturbance of agricultural activities: All *highly sensitive* areas were excluded from the development;
- A statement from the soil scientist or agricultural specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development: The placement of the development will avoid any high potential cultivated land. The site survey found that the grazing land is severely encroached that has degraded the livestock carrying capacity, in our view, to unsustainable levels. The mine has reached end of life and will be rehabilitated as part of the development. Further, the construction of the PV panels, although expected to have a life of 25 years, is only temporary and will not destroy the land for agriculture after this period. Therefore, no reason can be found not to allow the development. It is our recommendation that the project be allowed and implemented;
- There are no conditions to which the statement is subjected;
- The substation is close to the site. There will, therefore, be no need for long transmission lines that will need to be restored after construction. The grazing land where the line will be placed is severely encroached by *Seriphium plumosum* and will have to be restored in any case before it can become viable grazing. It is our opinion that the land can be returned as improved grazing within two years of completion of the construction phase;
- Stormwater runoff measures should be put in place to ensure that erosion of the soil does not occur. The stormwater management plan should be included in the EMPr and strictly adhered to;
- The survey took place at the end of the growing season for cash crops. It was, therefore possible to assess the soil's productivity and also the present state of the grazing land. No gaps in knowledge or data were found.

6 IMPACT ASSESSMENT

6.1 Assumptions

Land uses

The impact assessment is done for a land use change from agriculture to PV generation.

The total area assessed was 850,4 ha. Of this, 180 ha comprise the land where the infrastructure will be placed. The impact description will be only for the footprint area.

Table 6. Land use assumptions

Land use	Total area (ha)	Footprint (ha)
Cultivated	393.1	26,5
Grazing / vacant	349.4	121,5
Mining	33.6	32
Housing	2.8	0
WC	71.5	0
Total area	**850.4**	**180**

6.2 Rating criteria

The following rating was used to indicate impacts:

Extent

- 1: Local - extend to the site and its immediate surroundings.
- 2: Regional - impact on the region but within the province.
- 3: National - impact on an interprovincial scale.
- 4: International - impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.

- 0: None – no resources will be lost.
- 1: Low - natural and social functions and processes are not affected or minimally affected.
- 2: Medium - affected environment is notably altered.
- 3: High - natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
- 4: Very high – Will affect the continued viability of the system/environment.

Duration

- 1: Short term: 0-5 years.
- 2: Medium term: 5-11 years.
- 3: Long term: impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- 4: Permanent: mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability

- 1: Rare/Remote - the event may occur only in exceptional circumstances.
- 2: Unlikely - the event could occur at some time.
- 3: Moderate - the event should occur at some time.
- 4: Likely - the event will probably occur in most circumstances.
- 5: Almost certain - the event is expected to occur in most circumstances.

Reversibility

- 1. Definite
- 2. Probable
- 3. Possible
- 4. Unlikely

Irreplaceability

- 1. No loss of resources. Can be replaced elsewhere.
- 2. Marginal
- 3. Significant
- 4. Complete loss

Significance

Provides an overall impression of an impact's importance, and the degree to which it can be mitigated.

6.1 Impact rating

The significance of each potential impact is calculated using the following formula:

Significance points = (extent + probability + reversibility + irreplaceable + duration) x magnitude

The maximum value is 100 SP (significance points). The unmitigated and mitigated scenarios for each potential environmental impact should be rated as per Table 10 below.

Table 7. Significance rating

Score	Significance	Description of Rating
2 – 10	Low Significance	No specific management action required
10 – 20	Medium-low significance	Administrative management actions required
20 – 40	Medium significance	Management and monitoring action plans required
40 – 60	Medium-high significance	Specific management and monitoring plans required
>60	High significance	Detailed plans required, potential red flag impact

Table 8. Impact rating – Direct impacts

POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	Before mitigation								MITIGATION
	Extent	Probability	Reversibility	Irreplaceabl e	Duration	Magnitude	TOTAL (SP)	Significance	
LOSS OF HIGH POTENTIAL LAND									
Loss of land	0	0	0	0	0	0	0	L	There will be no loss of high potential land. No impact. No mitigation required.
LOSS OF GRAZING LAND									
Loss of grazing land	1	5	1	1	3	1	11	L	121 ha of poor quality grazing will be lost for the duration of the project. The impact is low. The present poor state of the veld can be rectified at the end of the project life.
LOSS OF AGRICULTURAL PRODUCTION									
Loss of crop production	0	0	0	0	0	0	0	L	26 ha cultivated land will be lost. At an average annual yield of 5t/ha and a gross\ margin of R9 500 per ha, then the loss of farming income from maize will be R130 000. The loss is temporary and will last for the duration of the project. No mitigation required.
Loss of animal production	1	5	1	1	3	1	11	L	The 121 ha that will be under PV can accommodate 12 LSU. The gross margin of livestock is R8 500/LSU. The loss in income is R102 000.
LOSS OF AGRICULTURAL INFRASTRUCTURE									
Direct loss	0	0	0	0	0	0	0	L	No farming infrastructure will be lost. No impact.
LOSS OF JOBS FROM FARMING									
Direct loss	1	5	1	1	3	1	11	L	It is estimated that approximately one labourer is required per 400 hectares of grazing land. At most, one labourer will be required.

7 MITIGATION OF INDIRECT IMPACTS

Construction phase

- Security during construction.
    - Fence the construction area to restrict access and prevent injuries to livestock.
    - Provide security to the farmers during construction. Theft and vandalism tend to increase where construction takes place.
    - Join existing community policing forums and/or similar community structures.
- Establish a suitable storm water management system to divert runoff from operational areas or potentially contaminated areas. Place berms in runoff areas to trap silt and prevent erosion.
- The watercourse now provides drinking water for livestock. The site should provide watering facilities where the construction prevents cattle from watering points.
- Make the contact details of the main Contractor available to surrounding landowners and attend to any matters expediently.

Operational phase

- Maintain fences in order to protect cattle entering the site.
- Dust can be problematic and suppression is necessary. This can be done by either spraying with water. PV sites don't have large volumes of traffic. Plant grass on all open areas and under the panels to prevent dust from damaging crops or other farming activities. Graze with sheep where possible.
- Security against theft needs to be provided to protect land that is being cultivated and for livestock.
- Hazardous substances should be safely disposed of or stored to minimise any impact on animals and water resources.
- Maintain stormwater drains to ensure that no erosion takes place.
- Pollution of surface and groundwater can be problematic for livestock watering and domestic use, contamination should be prevented.
- Report and rectify erosion when detected.
- A complaints register should be placed at the entrance to the site and any legitimate grievance attended to expediently.
- Implement the EMPr for the duration of the operations to eliminate potential socio-economic impacts on land owners and their livelihoods.

Soil management plan

- The life of the project is projected for the long term. A mixture of seed that naturally occur on the Highveld should be sown on rolled and fertilised topsoil.
- The stormwater management plan should be followed in order to protect surrounding land from erosion that may occur during thunder storms.

8 CONCLUSIONS AND RECOMMENDATIONS

The buildable area was confined to the low and medium sensitive portion of the farm. It consists mainly of shallower uneven and mined land that has *medium sensitivity* according to the screening tool. It further excludes watercourses and riparian vegetation.

Specialist evaluation

The following were found:

- All highly sensitive land was retained for cropping and will not be impacted on by the development. The placement of the development will avoid any high potential cultivated land. The site survey also found that the grazing land is severely encroached that has degraded the livestock carrying capacity, in our view, to unsustainable levels.

Impact description

- There will be no loss of high potential land. No impact and no mitigation required.
- 121 ha of poor quality grazing will be lost for the duration of the project. The impact is low. The present poor state of the veld can be rectified at the end of the project life.
- No farming infrastructure will be lost.
- It is estimated that less than one labourer is required to tend the livestock. If implemented he can easily be absorbed in the present farming activities or at the PV Site.

Recommendation

No reason can be found not to allow the development. It is our recommendation that the project be implemented.

9 ADDENDA

9.1 Sources of information

a) Criteria for high potential agricultural land in South Africa, Department of Agriculture, Directorate Land Use and Soil Management, 2002.

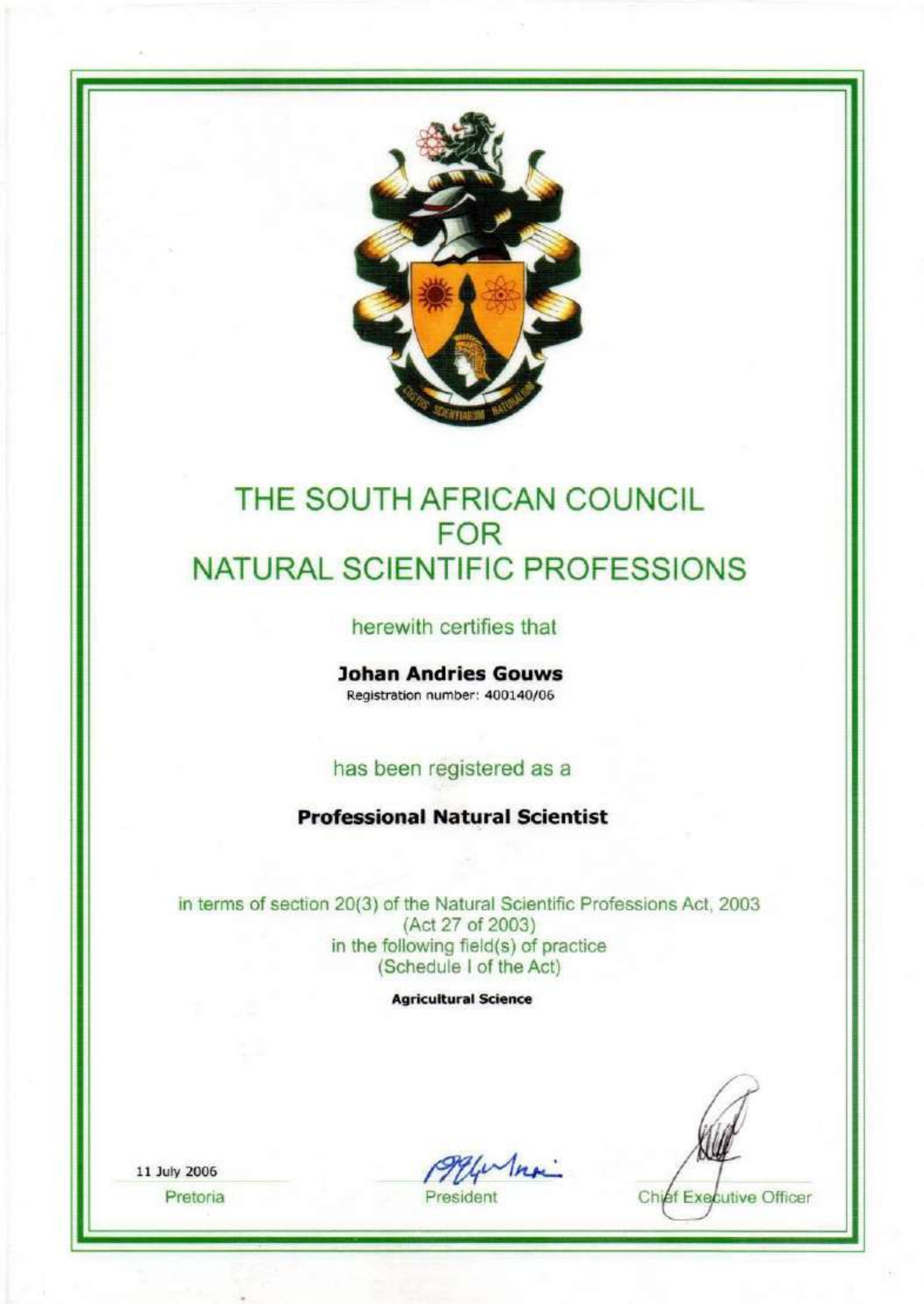
b) Grondklassifikasie Werkgroep, 1991. Grondklassifikasie, 'n Taksonomiese sisteem vir Suid Afrika, Departement van Landbou-ontwikkeling, Pretoria.

c) Department of Agriculture. Grazing capacity. Development of Agricultural Land Framework Bill , 2016

d) WRC, 2003 South African Atlas of Agrohydrology and Climatology, Water Research Commission

e) CROPWAT 8.0 has been developed by Joss Swennenhuis for the Water Resources Development and Management Service of FAO.

9.2 SACNASP certificate



THE SOUTH AFRICAN COUNCIL
FOR
NATURAL SCIENTIFIC PROFESSIONS

herewith certifies that

Johan Andries Gouws
Registration number: 400140/06

has been registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice
(Schedule I of the Act)

Agricultural Science

11 July 2006
Pretoria

President

Chief Executive Officer

9.3 CV of Author

Position Title and No.	Agriculture, Land use planning and wetland specialist. INDEX
Name of Expert:	Andries Gouws
Date of Birth	12/04/1955

Country of Citizenship /Residence	South Africa

Education

Name of institution: College/University or other	Degree/diploma/certificate or other specialized education	Date completed
University of Pretoria, South Africa	BSc. Agriculture	1979
University of Bloemfontein	BSc. Honors, Agriculture	1987
Potchefstroom Collage for Agriculture	Diploma: Stereoscopic aerial photo interpretation of natural resources for farm planning	1981
University of South Africa	Diploma: Financial management	1992
University of Trinity	PhD: Integrated agricultural development	2007

Employment record relevant to the assignment:

Period	Employing organization and your title/position. Contact info for references	Country	Summary of activities performed relevant to the Assignment
1993 - current	INDEX - Director and co-owner: Responsibility: Agriculture and land use planning. Contact: Eugene Gouws - Director +27 82 55 33 787	RSA	Provided specialist assessment services in agriculture and land use planning for various development projects.

Membership in Professional Associations and Publications:

Soil Science society of South Africa.

South African Council for Natural Scientific Professions – Registered Professional Scientist (Reg no: 400140/06)

Adequacy for the Assignment:

Detailed Tasks Assigned on Consultant's Team of Experts:	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks
Position: Agricultural Specialist	Agricultural Impact Assessment for the Proposed Mookodi-Mahikeng 400kv Line. 2018. Client: Nemai Consulting
	Agricultural Impact Assessment for the Proposed Foxwood Dam 2015 – 2016 Compiled the specialist report on Agricultural impact Client: Nemai Consulting, DWS
	Agricultural Impact Assessment for the Proposed Mokolo and Crocodile River (West) Water Augmentation Project (MCWAP) (2017 – 2019) Compiled the specialist report on Agricultural impact Client: Nemai Consulting, DWS

	MSOBO COAL – HARWAR; economic study for the farming enterprises Discussion of the natural resources that influences agricultural potential; Farming and the potential for different enterprises; Indicate the potential income from main enterprises and Indicate the financial impact of the development on the farmers. (2013/4) Client: Demacon
	Agricultural potential study of Portion 21 (Portion 1) of the farm Koppieskraal 1157-IR 2019. Client: Adv Johan du Plessis
	Agricultural Potential Assessment: Albany Wind Energy Facility & Grid Infrastructure Near Makhanda, Eastern Cape Province 2020 Client: CES Environmental and Social advisory Services
	Agricultural potential and impact assessment of Available Land At Mopeia, Mozambique 2016 Client: Barari Forest Management. Department: Research & Development Abu Dhabi

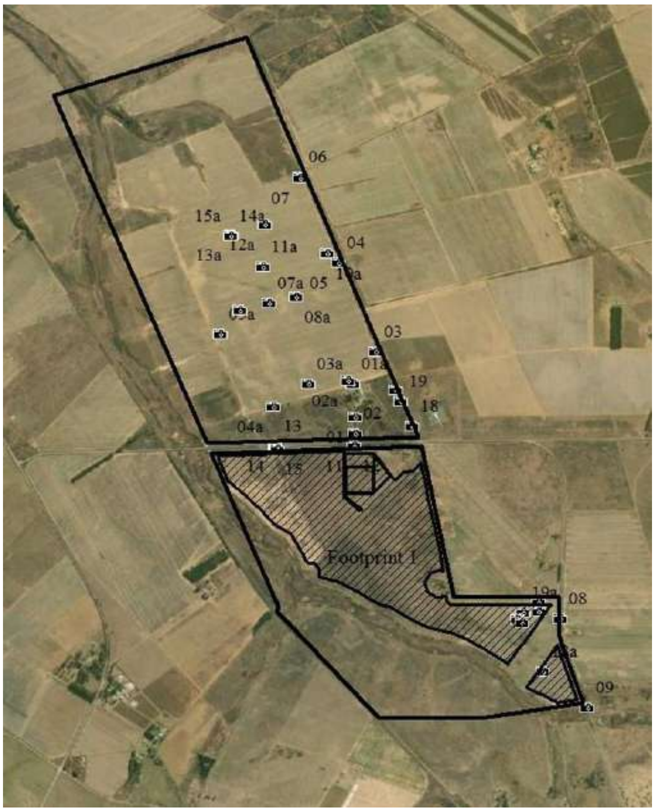
Expert's contact information: E-mail: index@iafrica.com
Phone: +27 (0) 82 807 6717

Certification:

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes my qualifications, my experience and myself.

Andries Gouws		25/08/2022
Name of Expert	Signature	Date

9.4 Photos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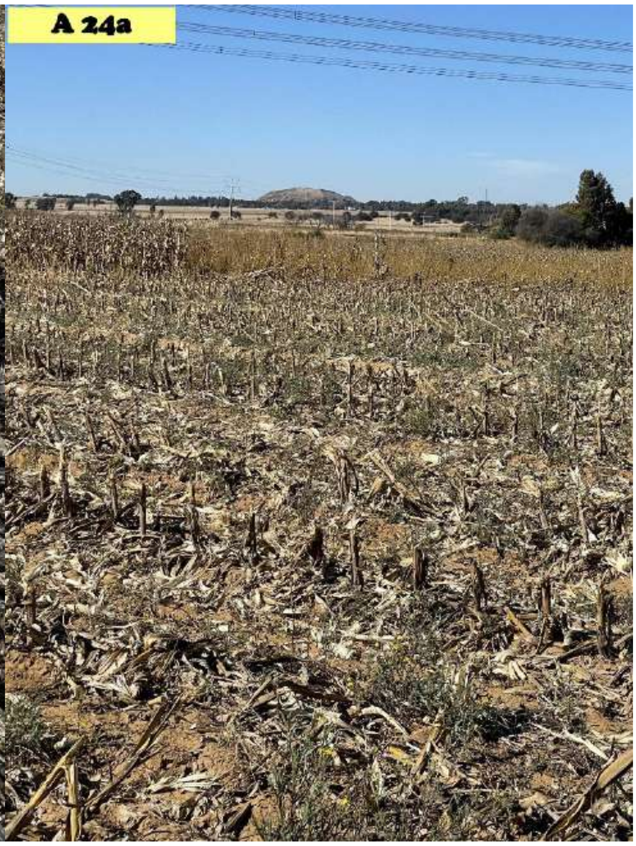
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APPENDIX E5: Heritage Impact Assessment

Phase 1 Cultural Heritage Impact Assessment:

THE PROPOSED ALTINA 120MW SOLAR PHOTOVOLTAIC PROJECT NEAR THE TOWN OF ORKNEY, FREE STATE PROVINCE

Prepared for:

Nemai Consulting: Mr D Henning

- Postal Address: P O Box 1673, Sunninghill, 2157; Tel: 011 781 1730; E-mail: donavanh@nemai.co.za

Prepared by:

J A van Schalkwyk (D Litt et Phil),

- Heritage Consultant: ASAPA Registration No.: 164 - Principal Investigator: Iron Age, Colonial Period, Industrial Heritage.
- Postal Address: 62 Coetzer Avenue, Monument Park, 0181; Tel: 076 790 6777; E-mail: jvschalkwyk@mweb.co.za

Report No: 2022/JvS/029

- Status: Final
- Date: June 2022
- Revision No: 2
- Date: October 2022

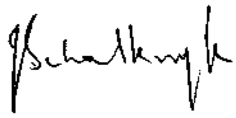
Submission of the report:

It remains the responsibility of the client to submit the report to the South African Heritage Resources Agency (SAHRA) or relevant Provincial Heritage Resources Agency (PHRA) by means of the online SAHRIS System.

Specialist competency:

Johan A van Schalkwyk, D Litt et Phil, heritage consultant, has been working in the field of heritage management for more than 40 years. Originally based at the National Museum of Cultural History, Pretoria, he has actively done research in the fields of anthropology, archaeology, museology, tourism and impact assessment. This work was done in Limpopo Province, Gauteng, Mpumalanga, North West Province, Eastern Cape Province, Northern Cape Province, Botswana, Zimbabwe, Malawi, Lesotho and Swaziland. Based on this work, he has curated various exhibitions at different museums and has published more than 70 papers, most in scientifically accredited journals. During this period, he has done more than 2000 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.



J A van Schalkwyk
Heritage Consultant
June 2022

SPECIALIST DECLARATION

I, J A van Schalkwyk, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

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

Signature of the specialist

J A van Schalkwyk
June 2022

EXECUTIVE SUMMARY

Phase 1 Cultural Heritage Impact Assessment:
THE PROPOSED ALTINA 120MW SOLAR PHOTOVOLTAIC PROJECT NEAR THE TOWN OF ORKNEY, FREE STATE PROVINCE

Nemai Green was appointed to conduct the basic assessment process for the development of Solar PV Project and associated infrastructure on Portions of the farms Batsfontein 290, Altona 50 and Rietvlei 539, Registration Division Viljoenskroon, Free State Province situated within the Moqhaka Local Municipality area of jurisdiction.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by *Nemai Green* to conduct a cultural heritage assessment to determine if the development of the solar power plant, associated infrastructure and power line corridor would have an impact on any sites, features or objects of cultural heritage significance.

The original layout was recently updated to avoid areas of high biodiversity sensitivity, based on the findings of the various specialists. Consequently, a new layout has been developed, and is included in the revised version of this report. A comparative analysis between the two alternatives was then done in order to identify the preferred option.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. The investigation consisted of a desktop study (archival sources, database survey, maps and aerial imagery) and a physical survey that also included the interviewing of relevant people. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region are made up of a pre-colonial element consisting of very limited Stone Age and Iron Age occupation, as well as a much later colonial (farmer) component, which also gave rise to an urban component.

Identified sites

During the survey no sites, features or objects of cultural significance were identified.

Impact assessment and proposed mitigation measures

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

- For the current study, as no sites, features or objects of cultural significance were identified, impact of the proposed develop is determined to be very low and no mitigation measures are proposed.

Alternatives assessment

Based on the outcome of the heritage survey, the two alternatives, i.e., Alternative 1 (original layout) vs. Alternative 2 (new layout) are rated as being either preferred, not-preferred, favourable or no preference.

Alternative	**Preference**	**Reason**
Altina Solar PV Site		
Alternative 1 (old)	No preference	Will not impact on any known sites of cultural heritage significance.
Alternative 2 (new)	No preference	Will not impact on any known sites of cultural heritage significance.

Legal requirements

The legal requirements related to heritage specifically are specified in Section 3 of this report.

- For this proposed project, the assessment has determined that no sites, features or objects of cultural heritage significance occur in the project area, therefore no permits are required from SAHRA or the PHRA.
- If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

Reasoned opinion as to whether the proposed activity should be authorised:

- From a heritage point of view, it is recommended that the Proposed Project be allowed to continue on acceptance of the mitigation measures presented above and the conditions proposed below.

Conditions for inclusion in the environmental authorisation:

- The Palaeontological Sensitivity Map (http://www.sahra.org.za/sahris/map/palaeo) indicate that the project area has a moderate sensitivity of fossil remains to be found and therefore a desktop palaeontological assessment is required.
- Should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made. The appropriate steps to take are indicated in Section 9 of the report, as well as in the **Management Plan: Burial Grounds and Graves, with reference to general heritage sites**, in the Addendum, Section 12.4.

J A van Schalkwyk
Heritage Consultant
August 2022

TECHNICAL SUMMARY

Project description	
Description	Development of a solar power plant and associated infrastructure
Project name	Altina Solar PPV Project

Applicant
Genesis Eco-Energy Developments (Pty) Ltd

Environmental assessment practitioner
Mr D Henning
Nemai

Property details						
Province	Free State					
Magisterial district	Viljoenskroon					
Local Municipality	Moqhaka					
Topo-cadastral map	2626DC & 2627BA					
Farm name	Remaining Extent of the farm Grootdraai 468					
Closest town	Orkney					
Coordinates	Centre point (approximate)					
	No	Latitude	Longitude	No	Latitude	Longitude
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	.kml files[1]		Altina Solar V3.kmz			

Development criteria in terms of Section 38(1) of the NHR Act	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	Yes
Construction of bridge or similar structure exceeding 50m in length	No
Development exceeding 5000 sq m	Yes
Development involving three or more existing erven or subdivisions	No
Development involving three or more erven or divisions that have been consolidated within past five years	No
Rezoning of site exceeding 10 000 sq m	No
Any other development category, public open space, squares, parks, recreation grounds	No

Land use	
Previous land use	Farming
Current land use	Farming

[1] Left click on the coloured icon to open the file in Google Earth, if installed on the computer. Alternatively, right click on the icon. In dialog box, select "Save Embedded File to Disk" and save to folder of choice.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Bioturbation: The burrowing by small mammals, insects and termites that disturb archaeological deposits.

Cumulative impacts: In relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Debitage: Stone chips discarded during the manufacture of stone tools.

Factory site: A specialised archaeological site where a specific set of technological activities has taken place – usually used to describe a place where stone tools were made.

Historic Period: Since the arrival of the white settlers - c. AD 1830 - in this part of the country.

Holocene: The most recent time period, which commenced c. 10 000 years ago.

Iron Age (also referred to as **Early Farming Communities**)**:** Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and herded cattle, sheep and goats. As they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Later Iron Age	AD 1300 - AD 1830

Midden: The accumulated debris resulting from human occupation of a site.

Mitigation, means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

National Estate: The collective heritage assets of the Nation.

Pleistocene: Geological time period of 3 000 000 to 20 000 years ago.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 500 000 - 250 000 Before Present
Middle Stone Age	250 000 - 40-25 000 BP
Later Stone Age	40-25 000 - until c. AD 200

Tradition: As used in archaeology, it is a seriated sequence of artefact assemblages, particularly ceramics.

ACRONYMS and ABBREVIATIONS

AD	Anno Domini (the year 0)
ASAPA	Association of Southern African Professional Archaeologists

BC	Before the Birth of Christ (the year 0)
BCE	Before the Common Era (the year 0)
BP	Before Present (calculated from 1950 when radio-carbon dating was established)
CE	Common Era (the year 0)
CRM	Cultural Resources Management
CS-G	Chief Surveyor-General
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Early Iron Age
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Early Stone Age
HIA	Heritage Impact Assessment
I & AP’s	Interested and Affected Parties
ICOMOS	International Council on Monuments and Sites
LIA	Late Iron Age
LSA	Later Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
NASA	National Archives of South Africa
NEMA	National Environmental Management Act 107 of 1998
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
WUL	Water Use Licence

COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	 Front page Page i Addendum Section 7
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 4
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 7; Figure 15
g) an identification of any areas to be avoided, including buffers;	Section 8
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 15 Section 7 & 8
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
k) any mitigation measures for inclusion in the EMPr;	Section 8 & 11
l) any conditions for inclusion in the environmental authorisation;	Section 11
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	 Section 11 Section 8, 9 & 11
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	-
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	-
q) any other information requested by the competent authority.	-
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	-

Phase 1 Cultural Heritage Impact Assessment:
THE PROPOSED ALTINA 120MW SOLAR PHOTOVOLTAIC PROJECT NEAR THE TOWN OF ORKNEY, FREE STATE PROVINCE

1. INTRODUCTION

1.1 Background

Genesis Eco-Energy Developments (Pty) Ltd (the Applicant) has proposed the development of the Altina 120MW Solar PV Project near the town of Orkney, in the Free State Province. The site falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice No. 142 of 26 February 2021. The electricity generated by the Project will be injected into the existing Eskom 132 Kv distribution system.

Nemai Green was appointed to conduct the basic assessment process for the development of the Altina Solar PV Project and associated infrastructure on Portions of the farms Batsfontein 290, Altona 50 and Rietvlei 539, Registration Division Viljoenskroon, Free State Province situated within the Moqhaka Local Municipality area of jurisdiction.

South Africa's heritage resources, also described as the 'national estate', comprise a wide range of sites, features, objects and beliefs. However, according to Section 27(18) of the National Heritage Resources Act, No. 25 of 1999 (NHRA), no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the heritage resources authority responsible for the protection of such site.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by *Nemai Green* to conduct a cultural heritage assessment to determine if the development of the solar power plant, associated infrastructure and power line corridor would have an impact on any sites, features or objects of cultural heritage significance.

The original layout was recently updated to avoid areas of high biodiversity sensitivity, based on the findings of the various specialists. Consequently, a new layout has been developed, and is included in the revised version of this report. A comparative analysis between the two alternatives was then done in order to identify the preferred option.

This report forms part of the Basic Assessment as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended and is intended for submission to the South African Heritage Resources Agency (SAHRA).

1.2 Terms and references

The aim of a full heritage impact assessment (HIA) investigation is to provide an informed heritage-related opinion about the proposed development by an appropriate heritage specialist. The objectives are to identify heritage resources (involving site inspections, existing heritage data and additional heritage specialists if necessary); assess their significances; assess alternatives in order to promote heritage conservation issues; and to assess the acceptability of the proposed development from a heritage perspective.

The result of this investigation is a HIA report indicating the presence/ absence of heritage resources and how to manage them in the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer may receive permission to proceed with the proposed development, on condition of successful implementation of proposed mitigation measures.

1.2.1 *Scope of work*

The aim of this study is to determine the cultural heritage significance of the area where the solar power plant, associated infrastructure will be located, is to take place. This included:

- Conducting a desk-top investigation of the total project area; and
- A visit to the proposed project area.

The project area includes the following properties:

- Portions of the farms Batsfontein 290, Altona 50 and Rietvlei 539

The objectives were to:

- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance; and
- Provide guideline measures to manage any impacts that might occur during the proposed project's construction and implementation phases.

1.2.2 *Assumptions and Limitations*

The investigation has been influenced by the following:

- It is assumed that the description of the proposed project, provided by the client, is accurate;
- It is assumed that the public consultation process undertaken as part of the Basic Assessment is sufficient and that it does not have to be repeated as part of the HIA;
- It is assumed that the information contained in existing databases, reports and publications is correct;
- The unpredictability of buried archaeological remains;
- No subsurface investigation (i.e. excavations or sampling) were undertaken, since a permit from SAHRA is required for such activities;
- The vegetation cover encountered during a site visit can have serious limitations on ground visibility, obscuring features (artefacts, structures) that might be an indication of human settlement.

2. LEGISLATIVE FRAMEWORK

2.1 Background

HIAs are governed by national legislation and standards and International Best Practise. These include:

- South African Legislation
    - National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA);
    - Mineral and Petroleum Resources Development Act, 2002 (Act No. 22 of 2002) (MPRDA);
    - National Environmental Management Act 1998 (Act No. 107 of 1998) (NEMA); and
    - National Water Act, 1998 (Act No. 36 of 1998) (NWA).
- Standards and Regulations
    - South African Heritage Resources Agency (SAHRA) Minimum Standards;
    - Association of Southern African Professional Archaeologists (ASAPA) Constitution and Code of Ethics;
    - Anthropological Association of Southern Africa Constitution and Code of Ethics.

- International Best Practise and Guidelines
    - ICOMOS Standards (Guidance on Heritage Impact Assessments for Cultural World Heritage Properties); and
    - The UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage (1972).

2.2 Heritage Impact Assessment Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the NHRA (Section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority, subject to the provisions of Section 38(8) of the NHRA.

The NHRA, Section 38, contains requirements for Cultural Resources Management and prospective developments:

"38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as:

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
(b) the construction of a bridge or similar structure exceeding 50m in length;
(c) any development or other activity which will change the character of a site:
(i) exceeding 5 000 m2 in extent; or
(ii) involving three or more existing erven or subdivisions thereof; or
(iii) involving three or more erven or divisions thereof which have been consolidated within he past five years; or
(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
(d) the re-zoning of a site exceeding 10 000 m2 in extent; or
(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development."

And:

"38 (3) The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(a) The identification and mapping of all heritage resources in the area affected;
(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;
(c) an assessment of the impact of the development on such heritage resources;
(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) plans for mitigation of any adverse effects during and after the completion of the proposed development."

3. HERITAGE RESOURCES

3.1 The National Estate

The NHRA defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-
    - ancestral graves;
    - royal graves and graves of traditional leaders;
    - graves of victims of conflict;
    - graves of individuals designated by the Minister by notice in the Gazette;
    - historical graves and cemeteries; and
    - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
    - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
    - objects to which oral traditions are attached or which are associated with living heritage;
    - ethnographic art and objects;
    - military objects;
    - objects of decorative or fine art;
    - objects of scientific or technological interest; and
    - books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

3.2 Cultural significance

In the NHRA, Section 2 (vi), it is stated that ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature’s uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- sites of significance relating to the history of slavery in South Africa.

A matrix (see Section 2 of Addendum) was developed whereby the above criteria were applied for the determination of the significance of each identified site. This allowed some form of control over the application of similar values for similar identified sites.

4. PROJECT DESCRIPTION

4.1 Site location

The Project is located in the northern part of the Free State Province and falls within the Fezile Dabi District Municipality and Moqhaka Local Municipality. The site is located approximately 7km to the south of the town of Orkney (located in North West Province) and is crossed by the R76 (Fig 1). For more information, see the Technical Summary on p. VI above.

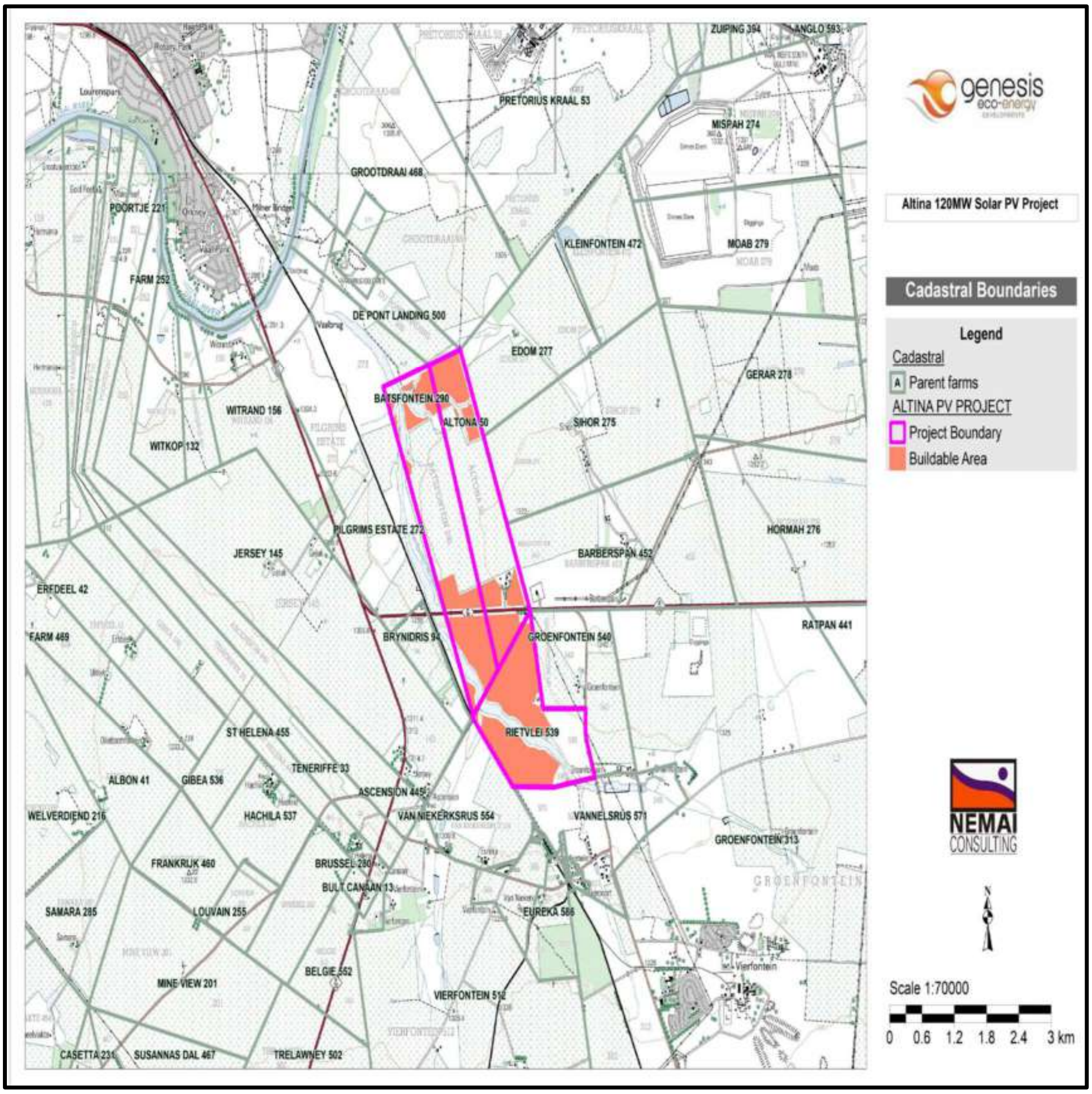


Figure 1. Location of the project area in regional context
(Map supplied by Nemai)

4.2 Development proposal

The proposed Project footprint is as follows:

- Potential Solar Areas – 149Ha and 63Ha (total of 212Ha); and
- Grid connection – approximately 1km (substation located to the immediate east of the Project boundary).

The proposed Project consists of the following systems, sub-systems or components (amongst others):
- PV panel arrays, which are the subsystems which convert incoming sunlight into electrical energy;
- Mounting structures to support the PV panels;
- On-site inverters to convert DC to facilitate AC connection between the solar energy facility and electricity grid;
- New 132 kV power lines between the on-site substation(s) and the grid connection point;
- Cabling between the Project's components, to be laid underground (where practical);
- Administration Buildings (Offices);
- Workshop areas for maintenance and storage;
- Temporary laydown areas;
- Internal access roads and perimeter fencing of the footprint;
- High Voltage (HV) Transformers; and
- Security Infrastructure.

The original layout (Fig. 2 below) was recently updated to avoid areas of high biodiversity sensitivity, based on the findings of the various specialists. Consequently, a new layout (Fig. 3 below) has been developed and is included in the revised version of this report.

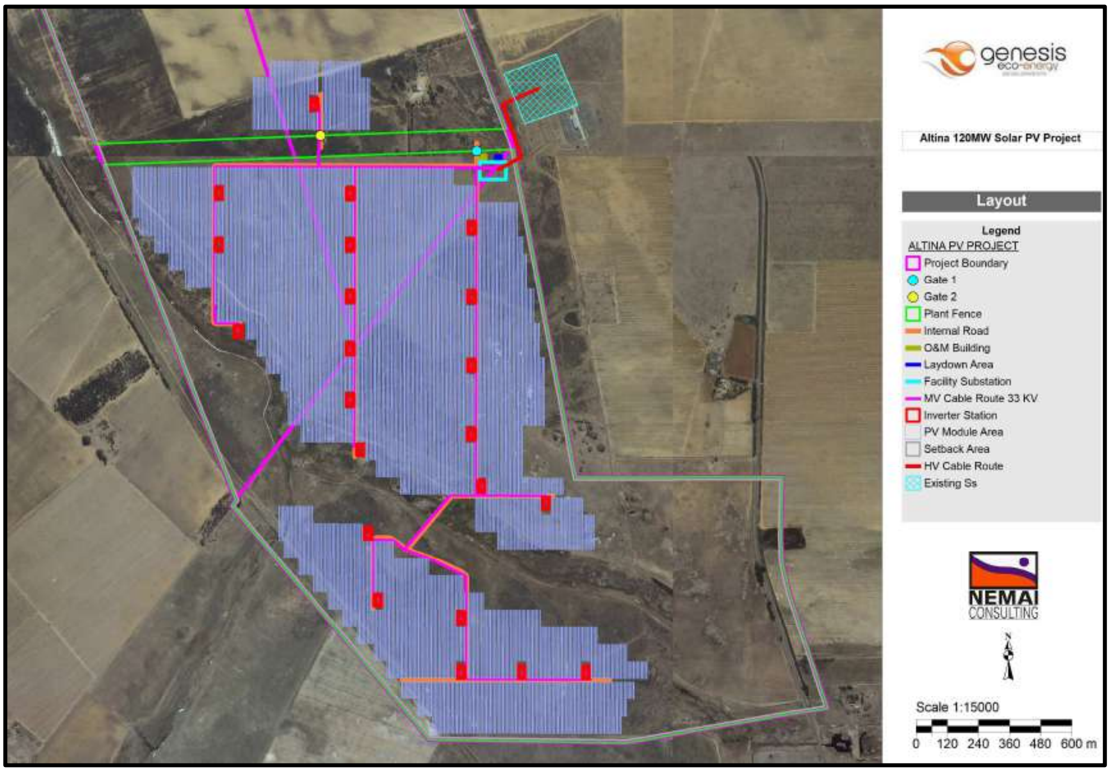


Figure 2. Original layout of the proposed project
(Map supplied by Nemai)

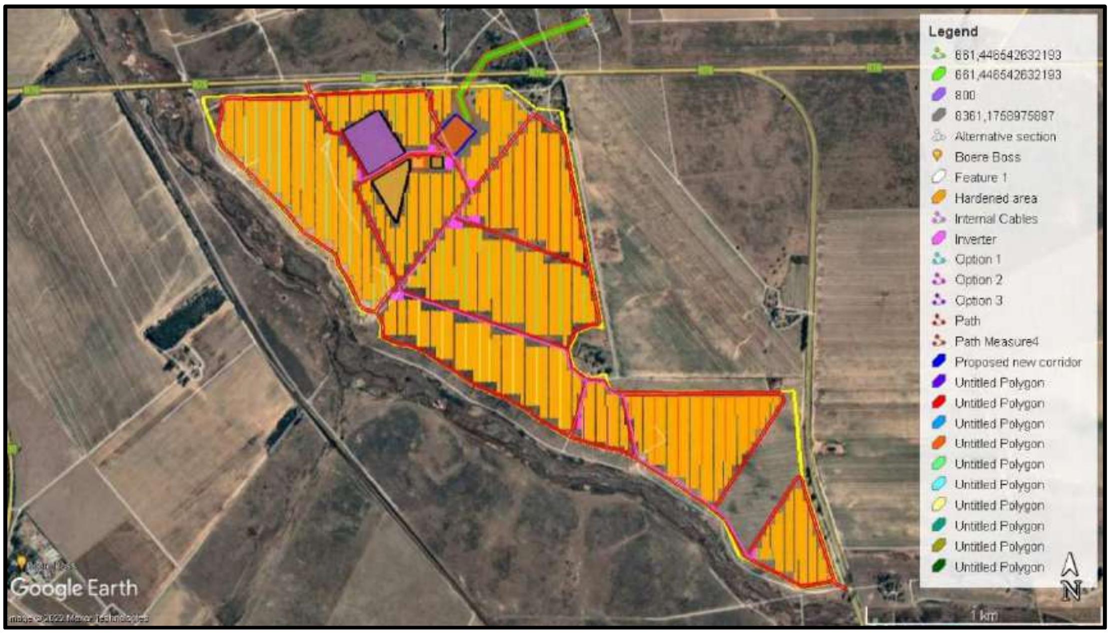


Figure 3. Revised, new layout of the proposed project
(Map supplied by Nemai)

5. STUDY APPROACH AND METHODOLOGY

5.1 Extent of the Study

This survey and impact assessment cover all facets of cultural heritage located in the project area, as presented in Section 4 above and illustrated in Figures 1 - 3.

5.2 Methodology

5.2.1 Pre-feasibility assessment

The objectives of this review were to:

- Gain an understanding of the cultural landscape within which the project is located;
- Inform the field survey.

5.2.1.1 Survey of the literature
A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. In this regard, various anthropological, archaeological and historical sources were consulted – see list of references in Section 11.

- Information on events, sites and features in the larger region were obtained from these sources.

5.2.1.2 Survey of heritage impact assessments (HIAs)
A survey of HIAs done for projects in the region by various heritage consultants was conducted with the aim of determining the heritage potential of the area – see list of references in Section 11.

- Information on sites and features in the larger region were obtained from these sources.

5.2.1.3 Data bases

The *Heritage Atlas Database,* various SAHRA databases, the *Environmental Potential Atlas*, the *Chief Surveyor General* and the *National Archives of South Africa* were consulted.

- Database surveys produced a number of sites located in the larger region of the proposed development.

5.2.1.4 Other sources

Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

- Information of a very general nature were obtained from these sources.

5.2.1.5 Results

The results of the above investigation are presented in Table 1 and Figure 4 below – see list of references in Section 11 – and can be summarised as follows:

- Reports indicate that Stone Age tools occur in very limited numbers sporadically across the larger region;
- Stone walled sites dating to the Late Iron Age occur some distance to the east and the north of the project area;
- Historic structures, inclusive of buildings, monuments and bridges, occur sporadically across the larger region;
- Formal and informal burial sites occur sporadically throughout the region.

*Based on the above assessment, the probability of cultural heritage sites, features and objects occurring in the project area is predicted to be **low**, but **possible**.*

Table 1: Pre-Feasibility Assessment

Category	Period	Probability	Reference
Landscapes			
Natural/Cultural		Low	Historic maps & aerial photographs
Early hominin	Pliocene – Lower Pleistocene		
	Early hominin	None	-
Stone Age	Lower Pleistocene – Holocene		
	Early Stone Age	Low	-
	Middle Stone Age	Low	Henderson & Koortzen (2007); Heritage Atlas Database
	Later Stone Age	Low	Heritage Atlas Database
	Rock Art	Low	Heritage Atlas Database
Iron age	Holocene		
	Early Iron Age	None	-
	Middle Iron Age	None	-
	Late Iron Age	Low	Heritage Atlas Database; Huffman (2007); Maggs (1976); Vorster (1981)
Colonial period	Holocene		
	Contact period/Early historic	Possible	Heritage Atlas Database
	Recent history	Possible	Heritage Atlas Database; Huffman (2005); Van Schalkwyk (2021a, 2021b)
	Industrial heritage	Low	Heritage Atlas Database

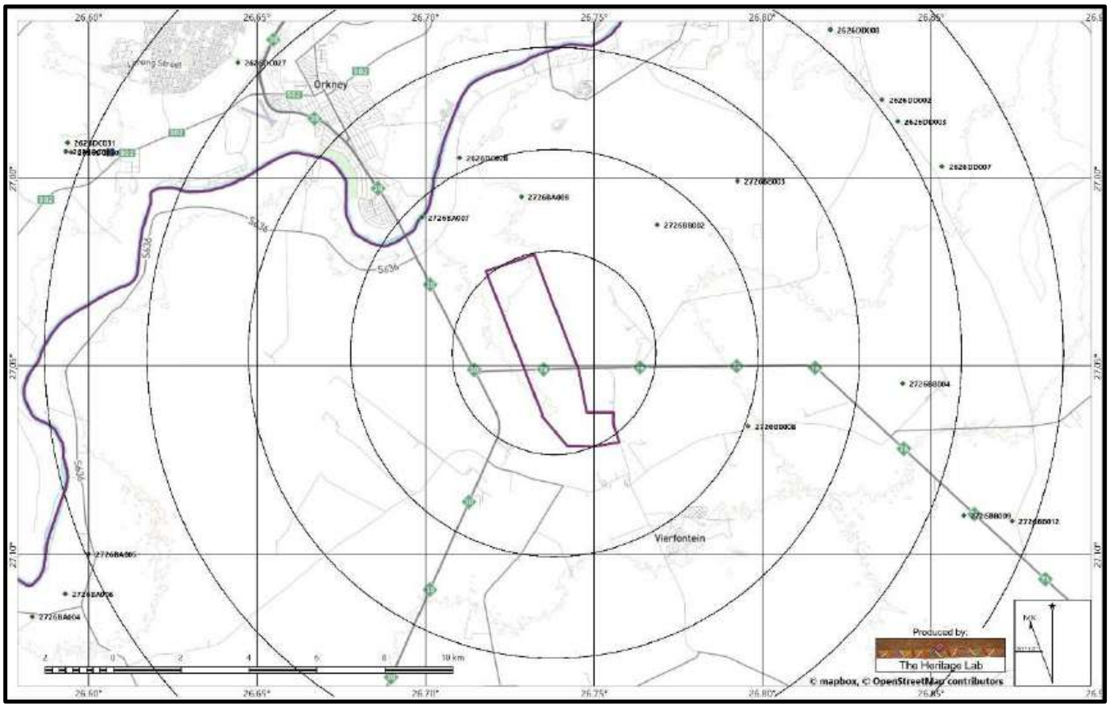


Figure 4. Location of known heritage sites and features in relation to the project area
(Circles spaced at a distance of 3km: heritage sites = coded green dots)

5.2.2 *Field survey*

The field survey was done according to generally accepted archaeological practices, and was aimed at locating all possible heritage sites, objects and structures. The area that had to be investigated was identified by *Nemai Green* by means of maps and .k*ml* files indicating the project area. This was loaded onto a Samsung digital device and used in Google Earth during the field survey to access the project area.

The project area was visited on 25 May 2022 and was investigated by accessing it by means of the various farm tracks and then walking transects.

During the site visit, Mr Jan Harm Steenkamp, owner of the farm was interviewed as to the presence of sites and features of cultural heritage significance.

- According to Mr Steenkamp, who has been on the farm for more than 20 years, there are no known graves or buildings older than 60 years.

Dense vegetation cover occurs in large sections of the project area, limiting ground visibility very much. Large sections of the area have been turned into agricultural fields. This would have destroyed any evidence of early settlement or used of the area. In addition, unseasonably high rainfall resulted in many areas to become waterlogged and expanding wetlands, making accessing it even by walking nearly impossible (Fig. 5). The strategy was therefore to examine natural and man-made features that are usually associated with human habitation and activities such as clumps of trees and rock outcrops.

	
Water-logged fields and tracks	Dense grass covering

Figure 5. Factors that impacted on the survey

Figure 6. Map indicating the track log of the field survey (excluding the power line corridor)
(Site = purple polygon; track log = green line)

5.2.3 *Documentation*

All sites, objects and structures that were identified are documented according to the general minimum standards accepted by the archaeological profession. Coordinates of individual localities are determined by means of the *Global Positioning System* (GPS) and plotted on a map. This information is added to the description to facilitate the identification of each locality. Map datum used: Hartebeeshoek 94 (WGS84).

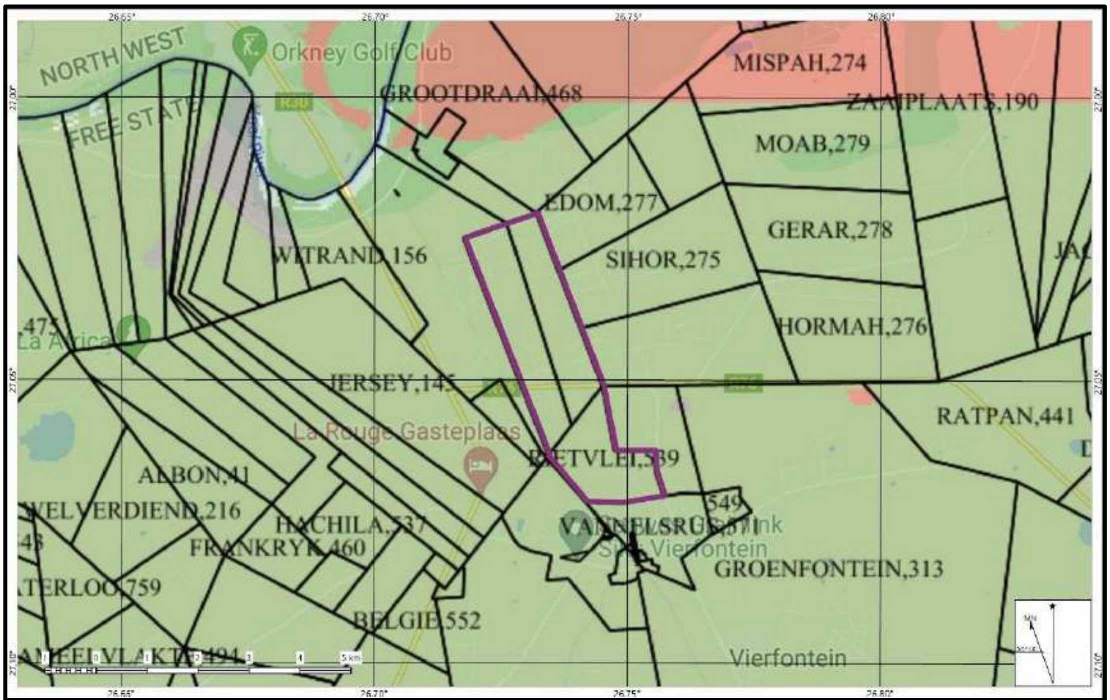
The track log and identified sites were recorded by means of a Garmin Oregon 550 handheld GPS device. Photographic recording was done by means of a Canon EOS 550D digital camera. Geo-rectifying of the aerial photographs and historic maps was done by means of a professional software package: ExpertGPS.

6. DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 Natural Environment

According to Almond (2021) the region of the project area is underlain near-surface or at depth by shallow marine carbonate bedrocks of the Malmani Subgroup of the Chuniespoort Group, of the Transvaal Supergroup of Precambrian age. This bedrocks are known to contain fossil stromatolites of various shapes and sizes. Almond indicates that the exposure levels of Precambrian bedrock within the project area are generally very low due to very low topographic relief and karstic weathering. He concludes that the palaeontological sensitivity of the project arearanges from Medium to Low.

However, the Palaeontological Sensitivity Map (http://www.sahra.org.za/sahris/map/palaeo) indicate that the project area (Fig. 7) has a moderate sensitivity of fossil remains to be found and therefore a desktop palaeontological assessment is required.



Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 7. The Palaeontological sensitivity of the project area

The original vegetation is classified as Vaal Reefs Dolomite Sinkhole Woodland, a grassland biome, forming part of the Dry Highveld Grassland Bioregion. However, in the project area, most of this has been transformed due to agricultural activities (Fig. 8).

The topography of the region is classified as plains and pans and no hills or outcrops are known to exist in the vicinity of the project area.


Natural grazing


Wetlands


Agricultural fields


Farming related features

Figure 8. Views over the project area

6.2 Cultural Landscape

The aim of this section is to present an overview of the history of the larger region in order to eventually determine the significance of heritage sites identified in the project area, within the context of their historic, aesthetic, scientific and social value, rarity and representivity.

6.2.1 *Stone Age*

Very little habitation of the highveld area took place during Stone Age times. Tools dating to the Early Stone Age period are mostly found in the vicinity of larger watercourses, e.g. the Vaal River, or in sheltered areas such as the mountainous regions north of Klerksdorp and as far east as the Vredefort Dome area. During Middle Stone Age (MSA) times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology. Open sites were still preferred near watercourses.

Late Stone Age (LSA) people had even more advanced technology than the MSA people and therefore succeeded in occupying even more diverse habitats. Also, for the first time we get evidence of people's activities derived from material other than stone tools. Ostrich eggshell beads, ground bone arrowheads, small bored stones and wood fragments with incised markings are traditionally linked with the LSA. The LSA people have also left us with a rich legacy of rock art, which is an expression of their complex social and spiritual believes. A number of sites containing rock engravings are known to exist to the east and south of the project area.

6.2.2 *Iron Age*

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Broederstroom south of Hartebeespoort Dam dating to AD 470. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior highveld area. Because of their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water.

As far as is known, no Early Iron Age sites have yet been identified in the Free State Province. The occupation of the larger geographical area (including the study area) did not start much before the 1500s. By the 16th century things changed, with the climate becoming warmer and wetter, creating conditions that allowed Late Iron Age (LIA) farmers to occupy areas previously unsuitable, for example the treeless plains of the Free State and the Mpumalanga highveld.

This wet period came to a sudden end sometime between 1800 and 1820 by a major drought lasting 3 to 5 years. The drought must have caused an agricultural collapse on a large, subcontinent scale.

The stone walled settlements dating to the Late Iron Age occur on a wide front over much of the central interior plateau area. In the larger vicinity of the project area, these sites conform to Maggs' (1976) type Z settlements. Such site consists mostly of a number of large primary enclosures clustered together, with, associated but on the outside, smaller primary enclosures.

This was also a period of great military tension. Military pressure from Zululand spilled onto the highveld by at least 1821. Various marauding groups of displaced Sotho-Tswana moved across the plateau in the 1820s. Mzilikazi raided the plateau extensively between 1825 and 1837. The Boers trekked into this area in the 1830s. And throughout this time settled communities of Tswana people also attacked each other.

As a result of this troubled period, Sotho-Tswana people concentrated into large towns for defensive purposes. Because of the lack of trees, they built their settlements in stone. These stone-walled villages were almost always located near cultivatable soil and a source of water. Such sites are known to occur north of Klerksdorp and in the Vredefort Dome area.

6.2.3 *Historic period*

White settlers moved into the area during the first half of the 19th century. They were largely self-sufficient, basing their survival on cattle/sheep farming and hunting. Pretoria was started in 1850, but Johannesburg only dates to the 1880s, after the discovery of gold.

In 1837 the establishment of a trekker settlement at Klerksdorp marked the beginning of a new phase in the history of the region. Originally twelve trekker families settled on the farm Elandsheuvel, belonging to C.M. du Plooy. This settlement, known as 'Oude Dorp', had its first landdros Jacob de Clercq, after which the settlement was then named. In 1853, the name was changed to Klerksdorp. With the discovery of gold in 1886 on the farm Rietpoort, the gold rush gave rise to a new settlement called 'Nieuwe Dorp'. In 1897 the railway line from Krugersdorp reached Klerksdorp. The railway line from Fourteen Streams (Warden region), on the main line from Kimberley to Zimbabwe (Then Rhodesia) was completed in 1906. (SESA 1973).

The town of Orkney was established in 1940 at the junction of the various railway lines. It was named after the old gold mine opened by Thomas Leask, who came from the Orkney Islands, in 1880 (SESA 1973).

6.3 Site specific review

Although landscapes with cultural significance are not explicitly described in the NHRA, they are protected under the broad definition of the National Estate (Section 3): Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate.

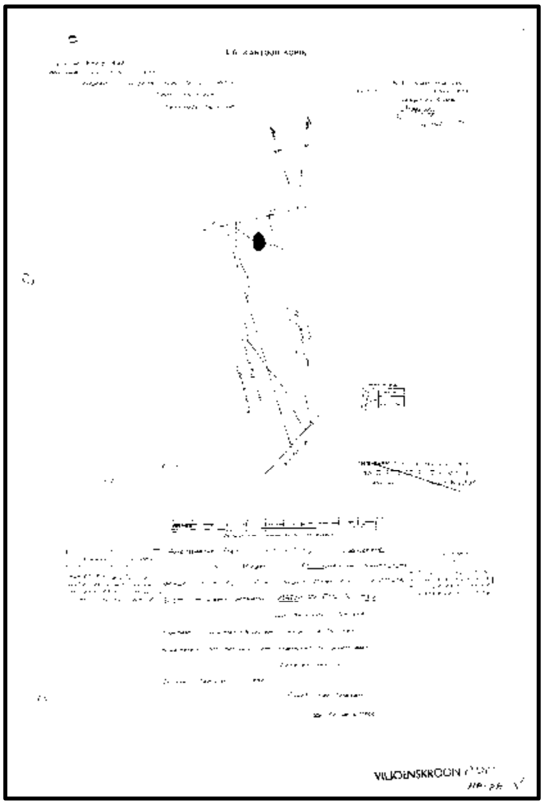
The examination of historical maps and aerial photographs help us to reconstruct how the cultural landscape has changed over time as is show how humans have used the land.

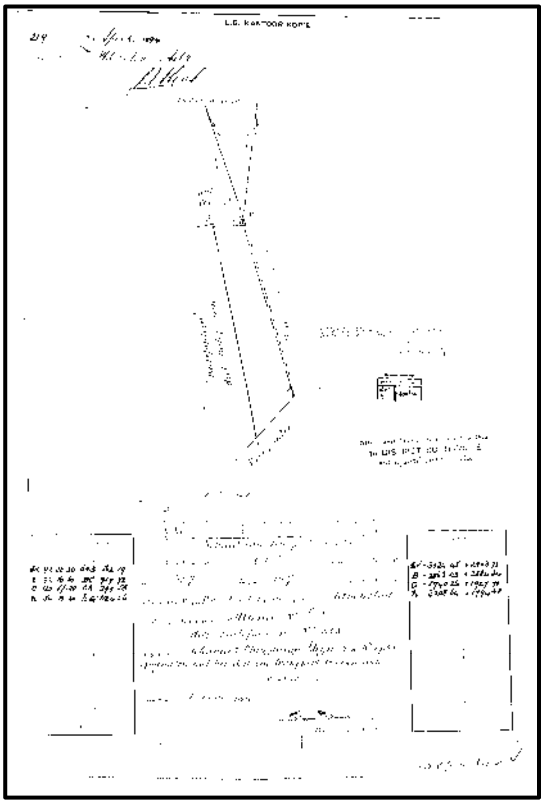
From the Deeds of Transfer (Fig. 9), it can be seen that both farms Altona and Batsfontein were surveyed in 1894. Rietvlei seems to have been deducted from Vierfontein and Van Niekerksrus in about 1959.

From a review of the available old maps and aerial photographs (Fig. 10 & 11) it can be seen that the project area has always been open space, with the main activity being agricultural fields. The only built structure development visible is the farm dam located on the north-western corner of the project area.

This situation carries on until recent times, with the only structures added are the current Altona farmstead (Fig. 12).

One feature that is depicted on the latest topographic map but is not present on the older maps and aerial photographs, is the Groenfontein farmstead (Fig. 13). These buildings have been reviewed and the following can be said: they are younger than sixty years, are all in ruins and shows no signs of unique or interesting architectural features. They have therefore been rated as having very low significance.





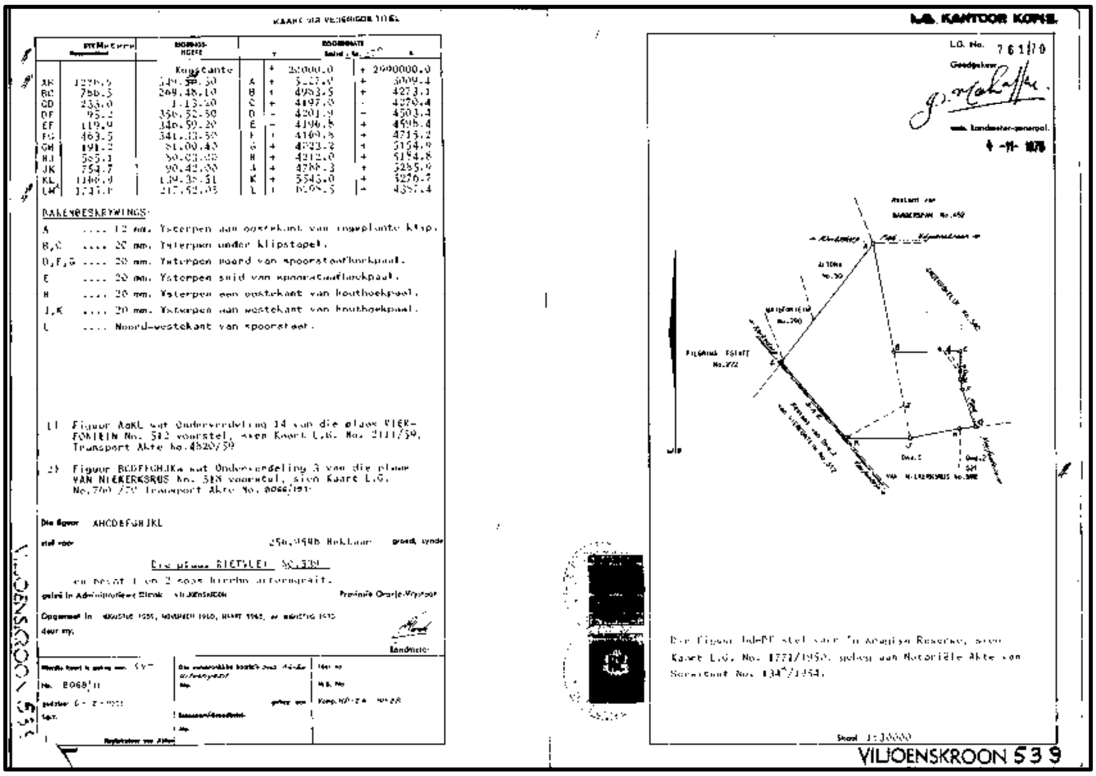


Figure 9. Copies of the Title Deeds for the three farms under consideration
(CS-G map: Batsfontein: 23291894; Altona: 2191894; Rietvlei: 101R1V02)

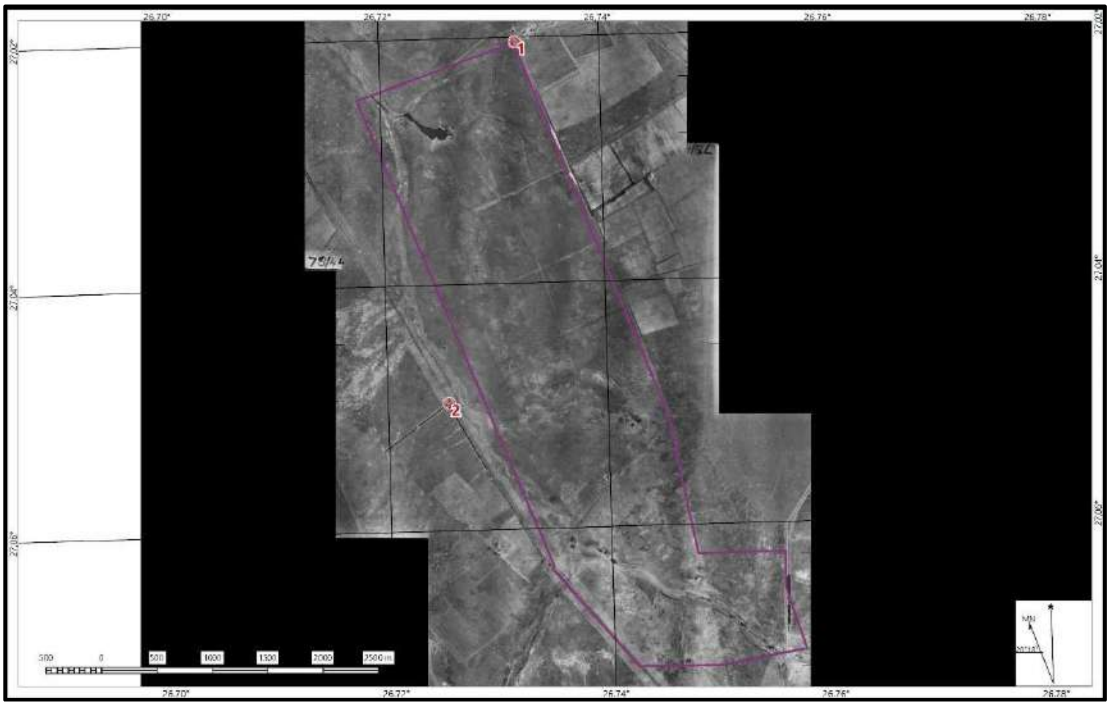


Figure 10. Aerial view of the project area dating to 1944
(CS-G photograph: 78_002_00663; 78_003_00704; 78_004_00750) (red wheel-crosses = calibration points)

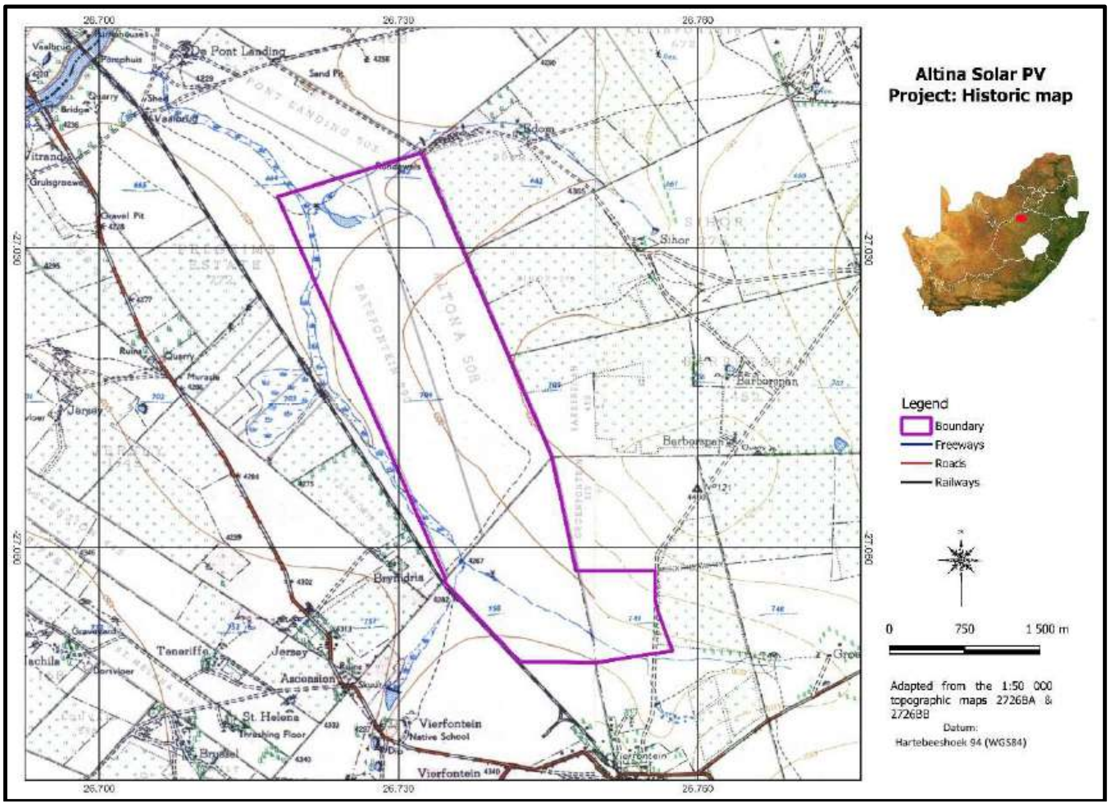


Figure 11. The project area indicated on the 1946/1947 versions of the 1:50 000 topographic maps

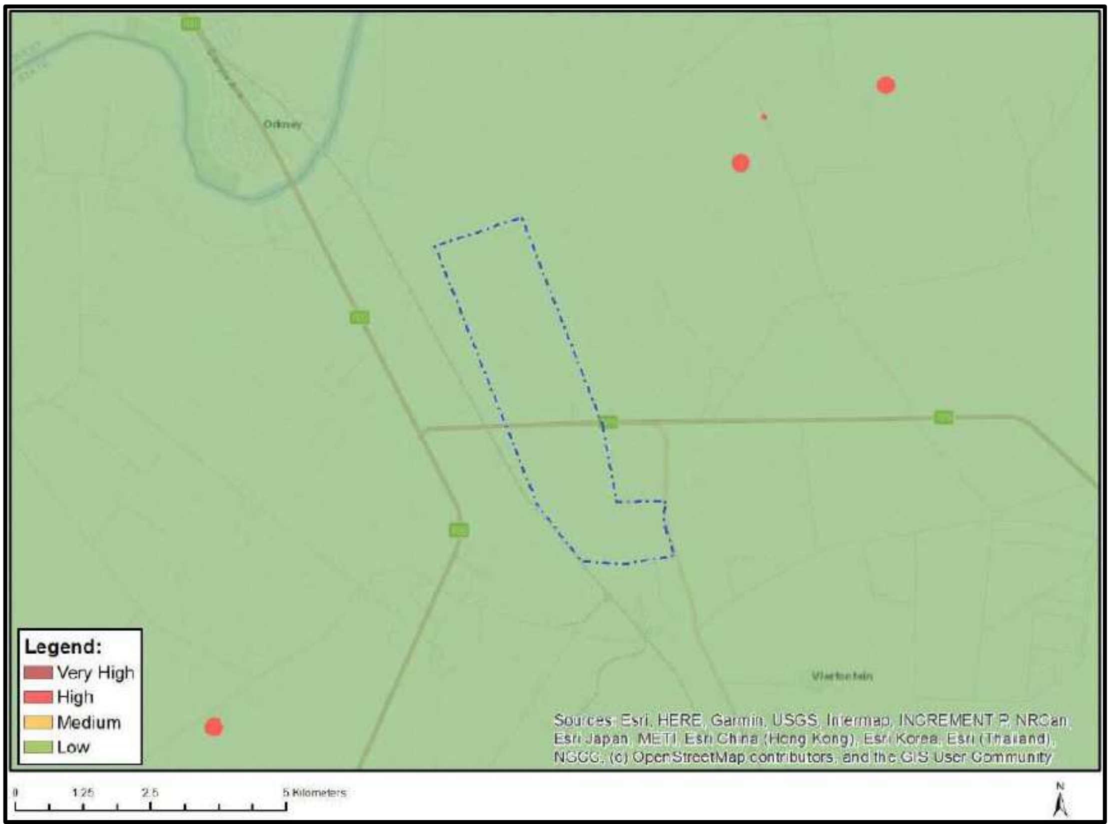
Figure 12. Aerial view of the project area dating to 2022
(Image: Google Earth)

Figure 13. Remains of the "Groenfontein" farmstead

6.4 Site Sensitivity Verification

According to the *DFFE National Screening Tool*, the project area has a low sensitivity for archaeological and cultural heritage themes, as indicated on the map in Fig. 14 below. This has been confirmed for this report in:

- Section 5.2.1: Prefeasibility Assessment (also see Table 1 & Fig. 4);
- Section 5.2.2 Field Survey;
- Section 6.2: Cultural Landscape;
- Section 6.3: Site Specific Review (also see Fig. 10 – 12); as well as
- Section 7: Survey Results.



Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Figure 14. Sensitivity for archaeological and cultural heritage themes as per the DFFE National Screening Tool
(https://screening.environment.gov.za/screeningtool)

7. SURVEY RESULTS

During the survey, the following sites, features and objects of cultural significance were identified in the project area (Fig. 15).

7.1 Stone Age

- No sites, features or objects of cultural significance dating to the Stone Age were identified in the project area.

7.2 Iron Age

- No sites, features or objects of cultural significance dating to the Iron Age were identified in the project area.

7.3 Historic period

- No sites, features or objects of cultural significance dating to the historic period were identified in the project area.

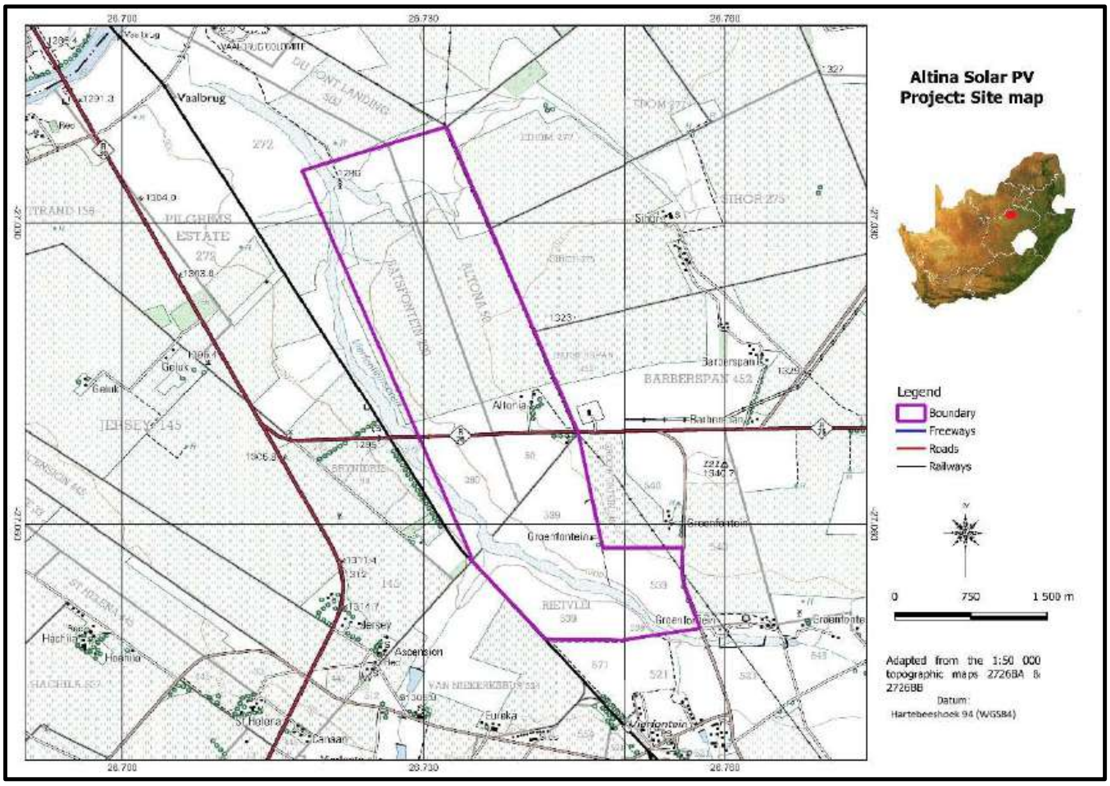


Figure 15. Location of heritage sites in the project area
(Please note that as no sites or features were identified, nothing is indicated on the map)

8. IMPACT ASSESSMENT RATINGS AND MITIGATION MEASURES

8.1 Impact assessment

Heritage impacts are categorised as:

- Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries;
- Indirect impacts, e.g. restriction of access or visual intrusion concerning the broader environment;
- Cumulative impacts that are combinations of the above.

The cumulative impact of the proposed Altina project is to be assessed by adding impacts from this proposed development to existing and other proposed developments with similar impacts within a 30 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts include a total of 10 other plants and are listed in Table 2.

Table 2: Existing and planned alternative energy generation facilities in the larger region

Site name	Distance from study area	Proposed generating capacity	DEFF reference	EIA process	Project status
Kabi Vaalkop PV	1.4km	75 MW	12/12/20/2513/3	Scoping and EIA	Approved

Kabi Solar (Pty) Ltd	5.4 km	75 MW	12/12/20/2513/2	Scoping and EIA	Approved
Kabi Vaalkop PV	1.4 km	75 MW	12/12/20/2513/4	Scoping and EIA	Approved
Kabi Vaalkop PV	1.4 km	75 MW	12/12/20/2513/1	Scoping and EIA	Approved
Buffels Solar PV 1	15.3 km	75 MW	14/12/16/3/3/2/777	Scoping and EIA	Approved
Buffels Solar PV 2	16 km	100 MW	14/12/16/3/3/2/778	Amendment	Approved
Witkop Solar	2 km	61 MW	12/12/20/2507/2	Scoping and EIA	In Process
Rietvlei solar	7 km	-	14/12/16/3/3/2/450	Scoping and EIA	Withdrawn/Lapsed
Genisis Orkney Solar (Pty) Ltd	14 km	100MW	14/12/16/3/3/2/954	Scoping and EIA	Approved
Afropulse 538 Pty Ltd	22 km	50MW	12/12/20/2280	BAR	Withdrawn/Lapsed

However, meaningful assessment of cumulative impacts requires a comprehensive review of all developments in the larger region of the project area and not only those involving renewable energy.

From a review of available databases, publications, as well as available[2] heritage impact assessments done for the purpose of developments in the region, see list of references in Section 12.2 below, it was determined that the Altina project is located in an area with a very low presence of heritage sites and features.

- The cultural heritage profile of the larger region is very low. Most frequently found are stone artefacts, mostly dating to the Middle Stone Age. Sites containing such material are usually located along the margins of water features (pans, drainage lines), small hills and rocky outcrops. Such surface scatters or 'background scatter' is usually viewed to be of limited significance (Orton 2016). In addition to the Stone Age profile, there is also the Iron Age element. However, this is located well outside the 30km radius, in the Vredefort Dome area and north of Klerksdorp. The colonial period manifests largely as individual farmsteads, in all its complexity, burial sites and infrastructure features such as roads, railways and power lines. For the purpose of this review, heritage sites located in urban areas have been excluded.

Heritage resources are sparsely distributed on the wider landscape with highly significant (Grade 1) sites being rare. Because of the low likelihood of finding further significant heritage resources in the area of the proposed for development and the generally low density of sites in the wider landscape the overall impacts to heritage are expected to be of generally low significance before mitigation.

For the project area, the impacts to heritage sites are expected to be of low significance. Impacts can be ameliorated by implementing mitigation measures, include isolating sites, relocating sites (e.g. burials) and excavating or sampling any significant archaeological material found to occur within the project area. The chances of further such material being found, however, are considered to be negligible. After mitigation, the overall impact significance would therefore be low.

- The potential impact that the proposed development might have, has been calculated and is presented for each individual site in Table 3 below (this also include the cumulative impact assessment).

[2] Only reports that were available on the SAHRIS database were consulted.

Table 3: Impact assessment

Altina Solar PV Project		
Impact assessment		
As no sites, features or objects of cultural heritage significance were identified on the project area, there would be no impact as a result of the proposed development		
	Without mitigation	With mitigation
Extent	Site (1)	Site (1)
Duration	Permanent (5)	Permanent (5)
Intensity	Minor (2)	Minor (2)
Probability	Very improbable (1)	Very improbable (1)
Significance	Low (8)	Low (8)
Status (positive or negative)	Neutral	Neutral
Reversibility	n/a	n/a
Irreplaceable loss of resources?	No	No
Can impacts be mitigated	n/a	
Mitigation: None		
Cumulative impact: None		

8.2 Alternatives assessment

Based on the outcome of the heritage survey, the two alternatives, i.e. Alternative 1 (original layout) vs. Alternative 2 (new layout) are rated as being either preferred, not-preferred, favourable or no preference. The comparative assessment is provided in Table 3 below.

Table 4: Comparative Assessment of Alternatives
<u>Key</u>

Not Preferred	The alternative will result in a high impact / increase the impact
Preferred	The alternative will result in a low impact / reduce the impact
Favourable	The impact will be relatively insignificant
No preference	All alternatives will result in similar impacts

Alternative	**Preference**	**Reason**
Altina Solar PV Site		
Alternative 1 (old)	No preference	Will not impact on any known sites of cultural heritage significance.
Alternative 2 (new)	No preference	Will not impact on any known sites of cultural heritage significance.

8.3 Mitigation measures

Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

- For the current study, as no sites, features or objects of cultural heritage significance were identified in the project area, no mitigation measures are proposed.

9. MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and are directly impacted by the proposed development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

Sources of risk were considered with regards to development activities defined in Section 2(viii) of the NHRA that may be triggered and are summarised in Table 5A and 5B below. These issues formed the basis of the impact assessment described. The potential risks are discussed according to the various phases of the project below.

9.1 Objectives

- Protection of archaeological, historical and any other site or land considered being of cultural value within the Project Area against vandalism, destruction and theft.

- The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during construction activities.

The following shall apply:

- Known sites should be clearly marked, so that they can be avoided during construction activities;
- The contractors and workers should be notified that archaeological sites might be exposed during the construction activities;
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer (ECO) shall be notified as soon as possible;
- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the ECO will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the NHRA, Section 51(1).

9.2 Control

In order to achieve this, the following should be in place:

- A person or entity, e.g. the ECO, should be tasked to take responsibility for the maintenance heritage sites.
- In areas where the vegetation is threatening the heritage sites, e.g. growing trees pushing walls over, it should be removed, but only after permission for the methods proposed has been granted by SAHRA. A heritage official should be part of the team executing these measures.

Table 5A: Construction Phase: Environmental Management Programme for the project

Action required	Protection of heritage sites, features and objects		
Potential Impact	The identified risk is damage or changes to resources that are generally protected in terms of Sections 27, 28, 31, 32, 34, 35, 36 and 37 of the NHRA that may occur in the Project Area.		
Risk if impact is not mitigated	Loss or damage to sites, features or objects of cultural heritage significance		
Activity / issue	**Mitigation: Action/control**	**Responsibility**	**Timeframe**

1. Removal of Vegetation 2. Construction of required infrastructure, e.g. access roads, water pipelines	See discussion in Section 9.1 above	Environmental Control Officer and the Contractor	During construction only
Monitoring	See discussion in Section 9.2 above		

Table 5B: Operation Phase: Environmental Management Programme for the project

Action required	Protection of heritage sites, features and objects		
Potential Impact	It is unlikely that the negative impacts identified for pre-mitigation will occur if the recommendations are followed.		
Risk if impact is not mitigated	Loss or damage to sites, features or objects of cultural heritage significance		
Activity / issue	**Mitigation: Action/control**	**Responsibility**	**Timeframe**
1. Additional construction / development of required infrastructure, e.g. access roads, water pipelines, etc.	See discussion in Section 9.1 above	Environmental Control Officer	During construction only
Monitoring	See discussion in Section 9.2 above		

9.3 Legal requirements

- The legal requirements related to heritage specifically are specified in Section 3 of this report. For this proposed project, the assessment has determined that no sites, features or objects of heritage significance occur in the project area therefore no permits are required from SAHRA or the PHRA.

- If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

10. CONCLUSIONS AND RECOMMENDATIONS

Nemai Green was appointed to conduct the basic assessment process for the development of Solar PV Project and associated infrastructure on Portions of the farms Batsfontein 290, Altona 50 and Rietvlei 539, Registration Division Viljoenskroon, Free State Province situated within the Moqhaka Local Municipality area of jurisdiction.

The original layout was recently updated to avoid areas of high biodiversity sensitivity, based on the findings of the various specialists. Consequently, a new layout has been developed, and is included in the revised version of this report. A comparative analysis between the two alternatives was then done in order to identify the preferred option.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. The investigation consisted of a desktop study (archival sources, database survey, maps and aerial imagery) and a physical survey that also included the interviewing of relevant people. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region are made up of a pre-colonial element consisting of very limited Stone Age and Iron Age occupation, as well as a much later colonial (farmer) component, which also gave rise to an urban component.

Identified sites

During the survey no sites, features or objects of cultural significance were identified.

Impact assessment and proposed mitigation measures

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

- For the current study, as no sites, features or objects of cultural significance were identified, impact of the proposed develop is determined to be very low and no mitigation measures are proposed.

Alternatives assessment

Based on the outcome of the heritage survey, the two alternatives, i.e., Alternative 1 (original layout) vs. Alternative 2 (new layout) are rated as being either preferred, not-preferred, favourable or no preference.

Alternative	Preference	Reason
Altina Solar PV Site		
Alternative 1 (old)	No preference	Will not impact on any known sites of cultural heritage significance.
Alternative 2 (new)	No preference	Will not impact on any known sites of cultural heritage significance.

Legal requirements

The legal requirements related to heritage specifically are specified in Section 3 of this report.

- For this proposed project, the assessment has determined that no sites, features or objects of cultural heritage significance occur in the project area, therefore no permits are required from SAHRA or the PHRA.
- If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

Reasoned opinion as to whether the proposed activity should be authorised:

- From a heritage point of view, it is recommended that the Proposed Project be allowed to continue on acceptance of the mitigation measures presented above and the conditions proposed below.

Conditions for inclusion in the environmental authorisation:

- The Palaeontological Sensitivity Map (http://www.sahra.org.za/sahris/map/palaeo) indicate that the project area has a moderate sensitivity of fossil remains to be found and therefore a desktop palaeontological assessment is required.
- Should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made. The appropriate steps to take are indicated in Section 9 of the report, as well as in the **Management Plan: Burial Grounds and Graves, with reference to general heritage sites**, in the Addendum, Section 12.4.

11. REFERENCES

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National Archives of South Africa
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SAHRIS Database

11.2 Literature

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11.3 Archival sources, maps and aerial photographs

1: 50 000 Topographic maps
Google Earth
Aerial Photographs: Chief Surveyor-General
http://artefacts.co.za
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http://www.sahra.org.za/sahris/map/palaeo

12. ADDENDUM

1. Indemnity and terms of use of this report

The findings, results, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and the author reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. The author of this report will not be held liable for such oversights or for costs incurred as a result of such oversights.

Although the author exercises due care and diligence in rendering services and preparing documents, he accepts no liability and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

2. Assessing the significance of heritage resources and potential impacts

A system for site grading was established by the NHRA and further developed by the South African Heritage Resources Agency (SAHRA 2007) and has been approved by ASAPA for use in southern Africa and was utilised during this assessment.

2.1 *Significance of the identified heritage resources*

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. SITE EVALUATION				
1.1 Historic value				
Is it important in the community, or pattern of history				
Does it have strong or special association with the life or work of a person, group or organisation of importance in history				
Does it have significance relating to the history of slavery				
1.2 Aesthetic value				
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group				
1.3 Scientific value				
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage				
Is it important in demonstrating a high degree of creative or technical achievement at a particular period				
1.4 Social value				
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons				
1.5 Rarity				
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage				
1.6 Representivity				
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects				
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class				
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.				
2. Sphere of Significance		High	Medium	Low
International				
National				
Provincial				
Regional				
Local				
Specific community				
3. Field Register Rating				
1.	National/Grade 1: High significance - No alteration whatsoever without permit from SAHRA			
2.	Provincial/Grade 2: High significance - No alteration whatsoever without permit from provincial heritage authority.			
3.	Local/Grade 3A: High significance - Mitigation as part of development process not advised.			

4.	Local/Grade 3B: High significance - Could be mitigated and (part) retained as heritage register site	
5.	Generally protected 4A: High/medium significance - Should be mitigated before destruction	
6.	Generally protected 4B: Medium significance - Should be recorded before destruction	
7.	Generally protected 4C: Low significance - Requires no further recording before destruction	

2.2 *Significance of the anticipated impact on heritage resources*

All impacts identified during the HIA stage of the study will be classified in terms of their significance. Issues would be assessed in terms of the following criteria:

Nature of the impact
A description of what causes the effect, what will be affected and how it will be affected.

Extent
The physical **extent**, wherein it is indicated whether:
- 1 - The impact will be limited to the site;
- 2 - The impact will be limited to the local area;
- 3 - The impact will be limited to the region;
- 4 - The impact will be national; or
- 5 - The impact will be international.

Duration
Here it should be indicated whether the lifespan of the impact will be:
- 1 - Of a very short duration (0–1 years);
- 2 - Of a short duration (2-5 years);
- 3 - Medium-term (5–15 years);
- 4 - Long term (where the impact will persist possibly beyond the operational life of the activity); or
- 5 - Permanent (where the impact will persist indefinitely).

Magnitude (Intensity)
The magnitude of impact, quantified on a scale from 0-10, where a score is assigned:
- 0 - Small and will have no effect;
- 2 - Minor and will not result in an impact;
- 4 - Low and will cause a slight impact;
- 6 - Moderate and will result in processes continuing but in a modified way;
- 8 - High, (processes are altered to the extent that they temporarily cease); or
- 10 - Very high and results in complete destruction of patterns and permanent cessation of processes.

Probability
This describes the likelihood of the impact actually occurring and is estimated on a scale where:
- 1 - Very improbable (probably will not happen);
- 2 - Improbable (some possibility, but low likelihood);
- 3 - Probable (distinct possibility);
- 4 - Highly probable (most likely); or
- 5 - Definite (impact will occur regardless of any prevention measures).

Significance
The significance is determined through a synthesis of the characteristics described above (refer to the formula below) and can be assessed as low, medium or high:

S = (E+D+M) x P; where
S = Significance weighting

E = Extent
D = Duration
M = Magnitude
P = Probability

Significance of impact		
Points	Significant Weighting	Discussion
< 30 points	Low	Where this impact would not have a direct influence on the decision to develop in the area.
31-60 points	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> 60 points	High	Where the impact must have an influence on the decision process to develop in the area.

Confidence

This should relate to the level of confidence that the specialist has in establishing the nature and degree of impacts. It relates to the level and reliability of information, the nature and degree of consultation with I&AP's and the dynamic of the broader socio-political context.

- High, where the information is comprehensive and accurate, where there has been a high degree of consultation and the socio-political context is relatively stable.
- Medium, where the information is sufficient but is based mainly on secondary sources, where there has been a limited targeted consultation and socio-political context is fluid.
- Low, where the information is poor, a high degree of contestation is evident and there is a state of socio-political flux.

Status

- The status, which is described as either positive, negative or neutral.

Reversibility

- The degree to which the impact can be reversed.

Mitigation

- The degree to which the impact can be mitigated.

Nature:		
	Without mitigation	With mitigation
Construction Phase		
Probability		
Duration		
Extent		
Magnitude		
Significance		
Status (positive or negative)		
Operation Phase		
Probability		
Duration		
Extent		
Magnitude		
Significance		
Status (positive or negative)		
Reversibility		
Irreplaceable loss of resources?		
Can impacts be mitigated		

3. Mitigation measures

- *Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.*

Impacts can be managed through one or a combination of the following mitigation measures:

- Avoidance
- Investigation (archaeological)
- Rehabilitation
- Interpretation
- Memorialisation
- Enhancement (positive impacts)

For the current study, the following mitigation measures are proposed, to be implemented only if any of the identified sites or features are to be impacted on by the proposed development activities:

- (1) Avoidance/Preserve: This is viewed to be the primary form of mitigation and applies where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact. This measure often includes the change / alteration of development planning and therefore impact zones in order not to impact on resources. The site should be retained *in situ* and a buffer zone should be created around it, either temporary (by means of danger tape) or permanently (wire fence or built wall). Depending on the type of site, the buffer zone can vary from
    - o 10 metres for a single grave, or a built structure, to
    - o 50 metres where the boundaries are less obvious, e.g. a Late Iron Age site.

- (2) Archaeological investigation/Relocation of graves: This option can be implemented with additional design and construction inputs. This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated. Mitigation is to excavate the site by archaeological techniques, document the site (map and photograph) and analyse the recovered material to acceptable standards. This can only be done by a suitably qualified archaeologist.
    - o This option should be implemented when it is impossible to avoid impacting on an identified site or feature.
    - o This also applies for graves older than 60 years that are to be relocated. For graves younger than 60 years a permit from SAHRA is not required. However, all other legal requirements must be adhered to.
        - ▪ Impacts can be beneficial – e.g. mitigation contribute to knowledge

- (3) Rehabilitation: When features, e.g. buildings or other structures are to be re-used. Rehabilitation is considered in heritage management terms as an intervention typically involving the adding of a new heritage layer to enable a new sustainable use.
    - o The heritage resource is degraded or in the process of degradation and would benefit from rehabilitation.
    - o Where rehabilitation implies appropriate conservation interventions, i.e. adaptive reuse, repair and maintenance, consolidation and minimal loss of historical fabric.
        - ▪ Conservation measures would be to record the buildings/structures as they are (at a particular point in time). The records and recordings would then become the 'artefacts' to be preserved and managed as heritage features or (movable) objects.
        - ▪ This approach automatically also leads to the enhancement of the sites or features that are re-used.

- (4) Mitigation is also possible with additional design and construction inputs. Although linked to the previous measure (rehabilitation) a secondary though 'indirect' conservation measure would be to use the existing architectural 'vocabulary' of the structure as guideline for any new designs.
  - The following principle should be considered: **heritage informs design**.
    - This approach automatically also leads to the enhancement of the sites or features that are re-used.

- (5) No further action required: This is applicable only where sites or features have been rated to be of such low significance that it does not warrant further documentation, as it is viewed to be fully documented after inclusion in this report.
  - Site monitoring during development, by an ECO or the heritage specialist are often added to this recommendation to ensure that no undetected heritage/remains are destroyed.

4. Management Plan: Burial Grounds and Graves, with reference to general heritage sites

1. Background

Burial grounds and graves are viewed as having high emotional and sentimental value and accordingly always carry a high cultural heritage significance rating. Best practice principles dictate that they should preferably be preserved *in situ*. It is only when it is unavoidable and the site cannot be retained, that the graves should be exhumed and relocated after all due processes had been successfully implemented.

For retaining the burial sites and graves, the SAHRA Burial Grounds and Graves (BGG) unit requires a detailed Heritage Management Plan (HMP) clearly outlining a grave management plan that provides details of grave management and access protocols. In addition, the HMP should also provide detailed change finds protocol or procedures in the case of the identification human remains.

The primary aim of the Burial Grounds and Graves Management Plan therefore is to assist in the implementation of mitigation measures to reduce potential negative impacts through the modification of the proposed project development design.

2. Legal Implications

South Africa's unique and non-renewable archaeological and palaeontological heritage sites, inclusive of burial grounds and graves, are 'generally' protected in terms various laws and by-laws:

- Nationally: National Heritage Resources Act, No. 25 of 1999;

In addition, the following also refer specifically to burial grounds and graves:
- Human Tissue Act, No. 65 of 1983;
- Section 46 of the National Health Act, No. 61 of 2003;
- Removal of Graves and Dead Bodies Ordinance (Ordinance No. 7 of 1925)
- By-laws:
  - R363 of 2013: Regulations Relating to the Management of Human Remains
  - Local Authorities Notice 34 of 2017, Cemeteries, Crematoria and Funeral Undertakers By-Laws as per Provincial Gazette of 7 April 2017 No. 2800.

In terms of the National Heritage Resources Act, No. 25 of 1999, graves and burial grounds are divided into the following categories:
- Ancestral graves;
- Royal graves and graves of traditional leaders;
- Graves of victims of conflict;
- Graves of individuals designated by the Minister by notice in the Gazette;
- Historical graves and cemeteries; and
- Other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);

In terms of Section 36(3) of the National Heritage Resources Act, no person may, without a permit issued by the relevant heritage resources authority:
- Destroy, damage, alter, exhume or remove from its original position of otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
- Destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

- Bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation, or any equipment which assists in the detection or recovery of metals.

Marked graves younger than 60 years do not fall under the protection of the NHRA (Act No. 25 of 1999) with the result that exhumation, relocation and reburial can be conducted by a register undertaker. This will include logistical aspects such as social consultation, purchasing of plots in cemeteries, procurement of coffins, etc.

Marked graves older than 60 years are protected by the NHRA (Act No. 25 of 1999) and as a result an archaeologist must be in attendance to assist with the exhumation and documentation of the graves. Unmarked graves are by default regarded as older than 60 years and therefore also falls under the NHRA (Act No. 25 of 1999, Section 36).

3. Management Plan

3.1 *Definitions*

Heritage Site Management: Heritage site management is the control of the elements that make up physical and social environment of a site, its physical condition, land use, human visitors, interpretation, etc. Management may be aimed at preservation or, if necessary, at minimizing damage or destruction or at presentation of the site to the public. A site management plan is designed to retain the significance of the place. It ensures that the preservation, enhancement, presentation and maintenance of the place/site is deliberately and thoughtfully designed to protect the heritage values of the place (from: *SAHRA Site management plans: guidelines for the development of plans for the management of heritage sites or places*).

Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

3.2 *Heritage management plan (HMP)*

3.2.1 Phase 1: Site identification and verification

This part of the process usually take place during the Phase 1 heritage impact assessment and is discussed in Section 7 of the main body of the HIA.

Locality and identification:
- The location of the identified site (e.g. farm name, GPS coordinates) is given;
- Determination of the number of graves and the date range of the burials.

The physical condition of the site is also described in terms of:
- The condition of the burial grounds and graves, e.g. has the headstones been pushed over;
- The approximate number of graves and the date range of the graves;
- Is the site fenced off;
- Is there access to the site, in the case it is fenced off;
- Has the site recently been visited by next of kin or other individuals;
- The status of the vegetation cover on the site.

3.2.2 Phase 2: Determination of the potential impact on the identified sites

Identified impacts on the graves and burial sites are calculated and discussed in Section 8.1 of the main body of the HIA.

The second phase consists of information that should be collected in order to develop the conservation management plan. This includes:

- The needs of the client;
- External needs, i.e. the next of kin;
- Requirements for the maintenance of the cultural significance.

From the above an evaluation is made of the impact of the proposed development project on the status of each of the identified burial grounds and graves.

3.2.3 Phase 3: Mitigation measures

Proposed mitigation measures for each identified burial ground or graves are developed and is discussed in the main body of the HIA (Section 8.2).

The main aim of the mitigation measures, as far as is feasible, is to remove any physical, direct impacts on the burial grounds and graves.

- A minimum buffer of 20m must be established around known burial grounds and graves for the duration of the construction phase. This is relevant where the burial site has been static for a considerable period of time and has already been fenced off;
- In cases the burial site is still in use and might expand in the future and is not fenced off, a minimum buffer of 100m should be implemented;
- In the case where blasting takes place during mining activities, the buffers should increase correspondingly to 200m;
- The buffers must be clearly demarcated, and signage placed during the construction/mining period;
- Access to the graves should be allowed to the descendants. However, they should adhere to the managing authorities' conditions regarding permissions, appointments, health, environment and safety.
- The areas with graves should be kept clean and the grass short so that visitors may enter it without any concerns.
    - However, this might create problems as in many cases not all graves are well-marked, carrying the possibility that they might inadvertently be damaged and therefore contractors/land-owners might not be will to accept this responsibility. The descendants should therefore be held responsible for the maintenance of the site.
- Sites that are located close to access/haul roads might need additional mitigation. All personnel and especially drivers of heavy haul vehicles should be informed where these sites are, and they should keep to the speed limits (usually 30km/h on mining sites);
- Any change in the development layout, future development plans, condition of the grave sites and individual graves should immediately be reported to the heritage inspector/SAHRA for guidance;
- Relevant strategies should be put in place for the managing of the burial grounds and graves after the closure of the mine or the completion of the project. It needs to be stated that the land-owner or developer always will be responsible for the preservation of the site. Therefore, measures should be put in place to ensure that the site is handled appropriately after closure, which, in essence would entail the continuation measures already put in place;

3.3 *Management strategy*

A general approach to this is set out in Section 9 of the main body of the HIA report and is equally applicable to general heritage sites and feature as well as to burial grounds and graves.

A strategy for the implementation of the conservation plan is developed:

- A heritage practitioner should be appointed to develop a heritage induction program and conduct training for the ECO, as well as team leaders, in the identification of heritage resources and artefacts;
- Known sites must be demarcated and fenced off and signage placed during the construction/mining period;
- This management strategy should be applicable to the construction, operation as well as the post operation phases of the development/mining activities.
- Relevant strategies should be put in place for the managing of the burial grounds and graves after the completion of the project. It needs to be stated that the land-owner or developer always will be responsible for the preservation of the site. Therefore, measures should be put in place to ensure that the site is handled appropriately after closure, which, in essence would entail the continuation measures already put in place;
- The managing authority should be able to regularly inspect the sites in order to ensure that construction and other such activities do not damage the graves;
    - SAHRA and the relevant PHRA are the competent authorities responsible for the regulation of the HMP in terms of the national legislative framework. The NHRA states:

      36(1) *Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make the necessary arrangement for their conservation as they see fit.*

4. Relocation of graves

Once it has been decided to relocate particular graves, the following steps should be taken:

- Notices of the intention to relocate the graves need to be put up at the burial site for a period of 60 days. This should contain information where communities and family members can contact the developer/archaeologist/public-relations officer/undertaker. All information pertaining to the identification of the graves needs to be documented for the application of a SAHRA permit. The notices need to be in at least 3 languages, English, and two other languages. This is a requirement by law.
- Notices of the intention needs to be placed in at least two local newspapers and have the same information as the above point. This is a requirement by law.
- Local radio stations can also be used to try contact family members. This is not required by law, but is helpful in trying to contact family members.
- During this time (60 days) a suitable cemetery need to be identified close to the development area or otherwise one specified by the family of the deceased.
- An open day for family members should be arranged after the period of 60 days so that they can gather to discuss the way forward, and to sort out any problems. The developer needs to take the families requirements into account. This is a requirement by law.
- Once the 60 days has passed and all the information from the family members have been received, a permit can be requested from SAHRA. This is a requirement by law.
- Once the permit has been received, the graves may be exhumed and relocated.
- All headstones must be relocated with the graves as well as any items found in the grave.

Information needed for the SAHRA permit application:

- The permit application needs to be done by an archaeologist.
- A map of the area where the graves have been located.
- A survey report of the area prepared by an archaeologist.
- All the information on the families that have identified graves.
- If graves have not been identified and there are no headstones to indicate the grave, these are then unknown graves and should be handled as if they are older than 60 years. This information also needs to be given to SAHRA.
- A letter from the landowner giving permission to the developer to exhume and relocate the graves.
- A letter from the new cemetery confirming that the graves will be reburied there.
- Details of the farm name and number, magisterial district and GPS coordinates of the gravesite.

5. Defining next of kin

An extensive Burial Grounds and Graves Consultation process must be implemented in accordance with NHRA Regulations to identify bona fide next of kin and reach agreement regarding relocation of graves.

Anthropologically speaking three type of kin are distinguished: patrilineal (called *agnates*), maternal (*uterine* kin) and kin by marriage (*affines*). All three categories have their important part to play in social life.

In terminologies used in the west the close-knit group of family members is clearly marked off from other kin - family terms, such as ‘father’, ‘mother’, ‘brother’ and ‘sister’ are never used for aunts, uncles and cousins.

In many non-western societies this is not the case and the family is merged with the wider group of kin and the family terms are applied much more widely. Next of kin for the Southern Bantu-language speakers is based on a classificatory system where a man uses a term to refer to three significant relatives – his father, his father’s brother and his mother’s brother.

For example, a man (A) may call his father’s brother (i.e. uncle) also a father. All of that latter person’s children will then also be called his (A) brothers and sisters, prohibiting him from marrying any of them (however, *vide* preferred marriages). In Anthropology this system is referred to as the Iroquois system (with reference to the North American Indian tribe where it was first described). When a man calls his father’s brother ‘father’ a suffix is usually added to indicate whether he is an elder or junior brother (e.g. (*ra)mogolo* = elder brother; (*ra)ngwane* = junior brother; also (*ra)kgadi* = younger sister; (*ma)lome* = mother’s brother)(SePedi terminology is used).

Consultants having to relocate graves might find it confusing if they do not have insight into this complex system of kinship, where, for example a single individual can have more than one father or mother.

6. Chance find procedures

A general approach to this is set out in Section 9 of the main body of the HIA report and is equally applicable to general heritage sites and features as to burial grounds and graves.

- A heritage practitioner should be appointed to develop a heritage induction program and conduct training for the ECO, as well as team leaders, in the identification of heritage resources and artefacts;
- An appropriately qualified heritage consultant should be identified to be called upon if any possible heritage resources or artefacts are identified;
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities be halted;
- The qualified archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and impact on the heritage resource;
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered;
- Should the heritage consultant conclude that the find is a heritage resource protected in terms of the NHRA (1999) Sections 34, 35, 37 and NHRA (1999) Regulations (Regulation 38, 39, 40), he or she should notify SAHRA and/or the relevant PHRA;
- Based on the comments received from SAHRA and/or the PHRA, the heritage consultant would present the relevant terms of reference to the client for implementation;
- Construction/Operational activities can commence as soon as the site has been cleared and signed off by the archaeologist.

7. Curriculum vitae

Johan Abraham van Schalkwyk

Personal particulars

Date of birth:	14 April 1952
Identity number:	520414 5099 08 4
Marital status:	Married; one daughter
Nationality:	South African

Current address: home

62 Coetzer Ave, Monument Park, Pretoria, 0181
Mobile: 076 790 6777; E-mail: jvschalkwyk@mweb.co.za

Qualifications

1995 DLitt et Phil (Anthropology), University of South Africa
1985 MA (Anthropology), University of Pretoria
1981 BA (Hons), Anthropology, University of Pretoria
1979 Post Graduate Diploma in Museology, University of Pretoria
1978 BA (Hons), Archaeology, University of Pretoria
1976 BA, University of Pretoria

Non-academic qualifications

12th HSRC-School in Research Methodology - July 1990
Dept. of Education and Training Management Course - June 1992
Social Assessment Professional Development Course - 1994
Integrated Environmental Management Course, UCT - 1994

Professional experience

Private Practice
2017 - current: Professional Heritage Consultant

National Museum of Cultural History
1992 - 2017: Senior researcher: Head of Department of Research. Manage an average of seven researchers in this department and supervise them in their research projects. Did various projects relating to Anthropology and Archaeology in Limpopo Province, Mpumalanga, North West Province and Gauteng. Headed the Museum's Section for Heritage Impact Assessments.
1978 - 1991: Curator of the Anthropological Department of the Museum. Carried out extensive fieldwork in both anthropology and archaeology

Department of Archaeology, University of Pretoria
1976 - 1977: Assistant researcher responsible for excavations at various sites in Limpopo Province and Mpumalanga.

Awards and grants

1. Hanisch Book Prize for the best final year Archaeology student, University of Pretoria - 1976.
2. Special merit award, National Cultural History Museum - 1986.
3. Special merit award, National Cultural History Museum - 1991.
4. Grant by the Department of Arts, Culture, Science and Technology, to visit the various African countries to study museums, sites and cultural programmes - 1993.
5. Grant by the USA National Parks Service, to visit the United States of America to study museums, sites, tourism development, cultural programmes and impact assessment programmes - 1998.
6. Grant by the USA embassy, Pretoria, under the Bi-national Commission Exchange Support Fund, to visit cultural institutions in the USA and to attend a conference in Charleston - 2000.
7. Grant by the National Research Foundation to develop a model for community-based tourism - 2001.

8. Grant by the National Research Foundation to develop a model for community-based tourism - 2013. In association with RARI, Wits University.

Publications
Published more than 70 papers, mostly in scientifically accredited journals, but also as chapters in books.

Conference Contributions
Regularly presented papers at conferences, locally as well as internationally, on various research topics, ranging in scope from archaeology, anthropological, historical, cultural historical and tourism development.

Heritage Impact Assessments
Since 1992, I have done more than 2000 Phase 1 and Phase 2 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

Latest publications
Van Schalkwyk, J.A. 2020. A cognitive approach to ordering of the world: some case studies from the Sotho- and Tswana-speaking people of South Africa. In Whitley, D.S., Loubser, J.H.N. & Whitelaw, G. (eds.) *Cognitive Archaeology. Mind, Ethnography, and the Past in South African and Beyond*. London: Routledge. Pp. 184-200.

Namono, C. & Van Schalkwyk, J.A. 2020. Appropriating colonial dress in the rock art of the Makgabeng plateau, South Africa. In Wingfield, C., Giblin, J. & King, R. (eds) *The pasts and presence of art in South Africa: Technologies, Ontologies and Agents*. University of Cambridge: McDonald Institute for Archaeological Research. Pp. 51-62.

APPENDIX E6: Desktop Paleontological Impact Assessment

BANZAI
ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT

ALTINA 120 MW SOLAR PHOTOVOLTAIC PROJECT NEAR ORKNEY IN THE FREE STATE

JULY 2022

COMPILED FOR:

NEMAI GREEN

BANZAI ENVIRONMENTAL (PTY) LTD.
Reg No. 2015/332235/07 | 7

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological 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 favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting palaeontological impact assessments, 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 will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application.
- 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.
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application.
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct.
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal, or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: info@banzai-group.com

SIGNATURE: Butler.

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment		Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 10	
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 10	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 10	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by NEMAI GREEN Environmental Solutions to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to verify if fossil material could potentially be present in the planned development area and to evaluate the potential impact of the proposed development on the Palaeontological Heritage.

The proposed development is underlain by Quaternary superficial deposits. The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Quaternary deposits is moderate (Almond and Pether, 2009; Almond *et al.*, 2013). These superficial sediments mantle sediments of the Ecca and Transvaal Supergroup at depth. These underlaying sediments will not impact on the development as the structures of the Altina PV Project will not penetrate that deep.

Two layout alternatives are considered for the proposed PV development. As both alternatives have the same geology and thus the impact of the proposed Altina PV Project on fossil heritage of the area, will be the same. From a Palaeontological view no alternative is more preferred above the other. A Moderate Palaeontological Significance has been allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage. If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a palaeontologist.

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

TABLE OF CONTENTS

List of Figures

List of Tables

Appendix A:

Curriculum Vitae Elize Butler

1 INTRODUCTION

Genesis Eco-Energy Developments (Pty) Ltd plans to develop the Altina 120MW Solar Photovoltaic (PV) Project near Orkney in the Free State. Nemai Green was appointed to conduct the Environmental Authorization of the proposed development.

Two layout alternatives are considered for the proposed Altina 120MW PV Project. Both alternatives fall within the development footprint.

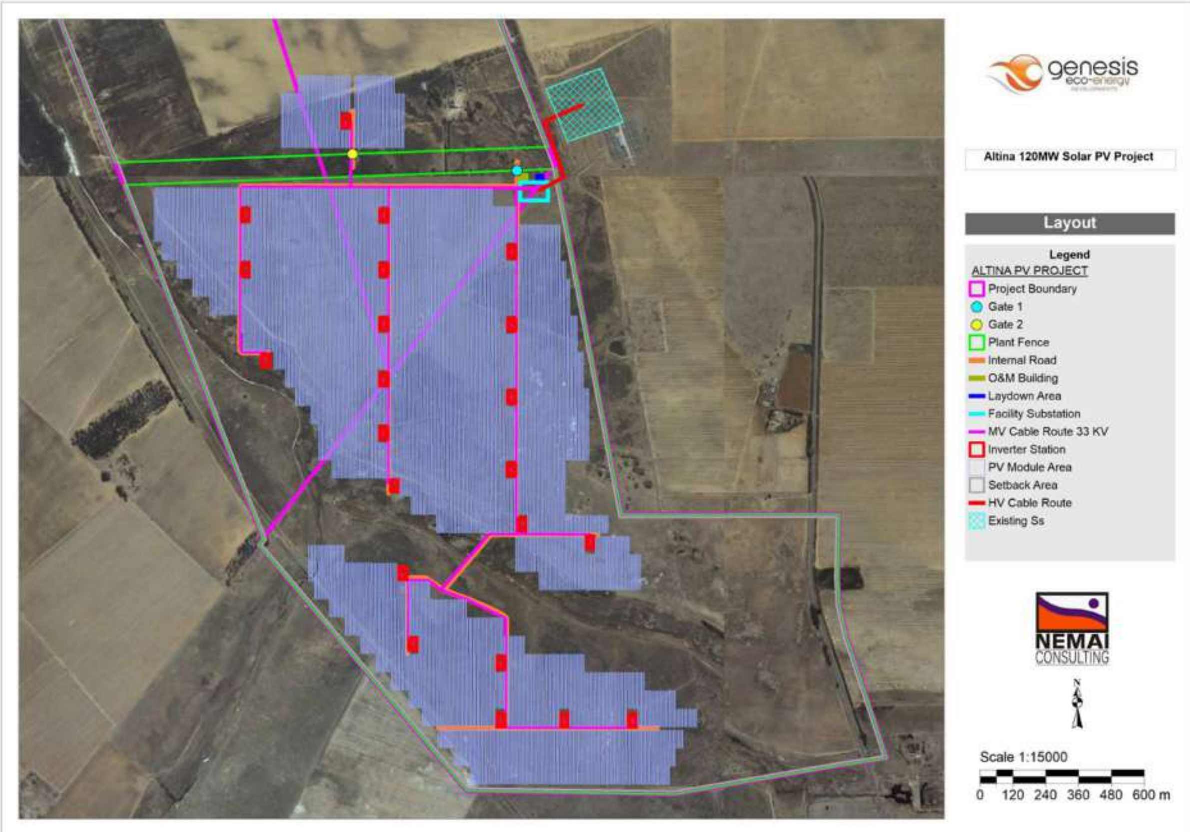

Figure 1: Alternative 1 of the proposed Altina 120MW Solar Photovoltaic (PV) Project near Orkney in the Free State.

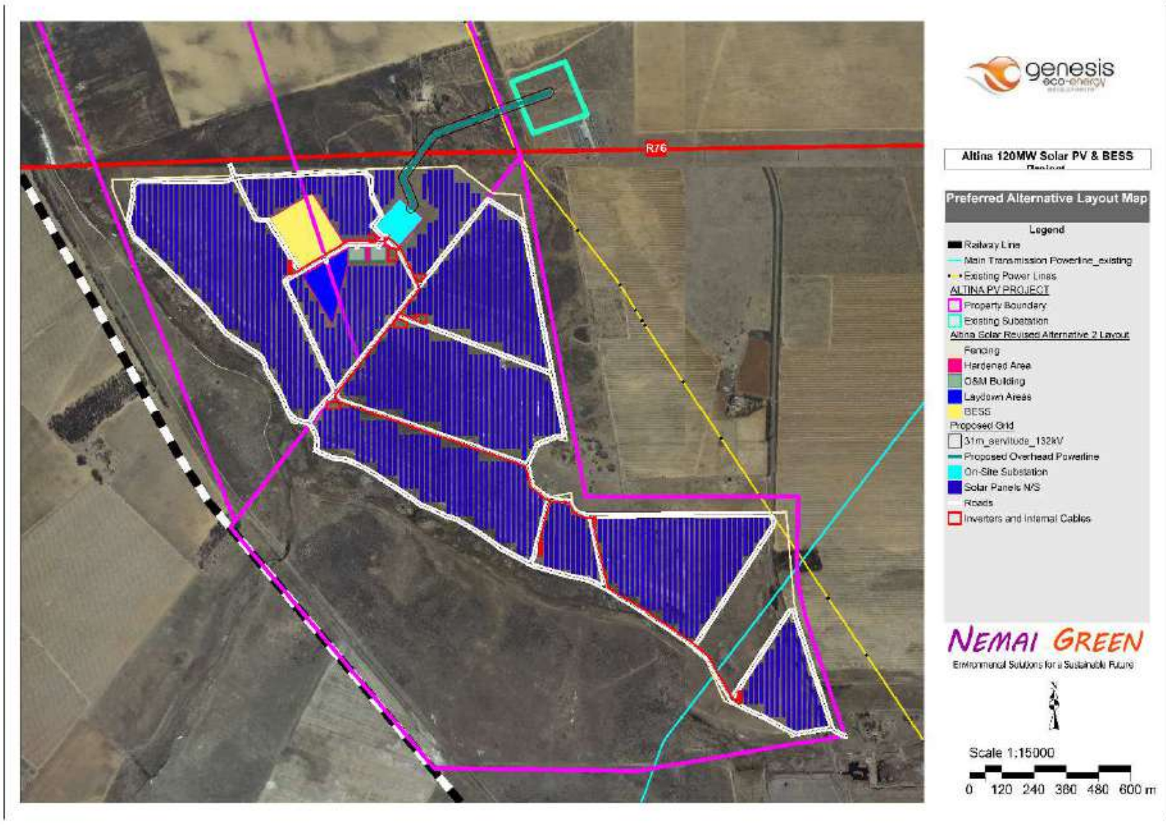

Figure 2: Alternative 2 of the proposed Altina 120MW Solar Photovoltaic (PV) Project near Orkney in the Free State*.*

The following information was provided by Nemai Green.

Electricity generation sources need to be diversified to ensure security of supply and reduction in the carbon footprint created by the current heavy reliance of South Africa (SA) on coal to produce electricity. The electricity demand is increasing in SA, and in order to match that demand there is a need to supply a diversified power generation that includes renewable energy technologies. These technologies include solar, wind, small utility scale hydro, biomass, biogas and energy storage that the Department of Mineral Resources and Energy (DMRE) intends to develop and implement as identified in the approved Integrated Resource Plan (IRP) 2019. Genesis Eco-Energy Developments (Pty) Ltd (the Applicant) has proposed the development of the Altina 120MW Solar PV Project near the town of Orkney, in the Free State Province (refer to locality map in Figure 1). The site falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice No. 142 of 26 February 2021. The electricity generated by the Project will be injected into the existing Eskom 132 kV distribution system. The Applicant intends to bid for Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) bid windows and /or other renewable energy markets within SA (Figure 1-3).

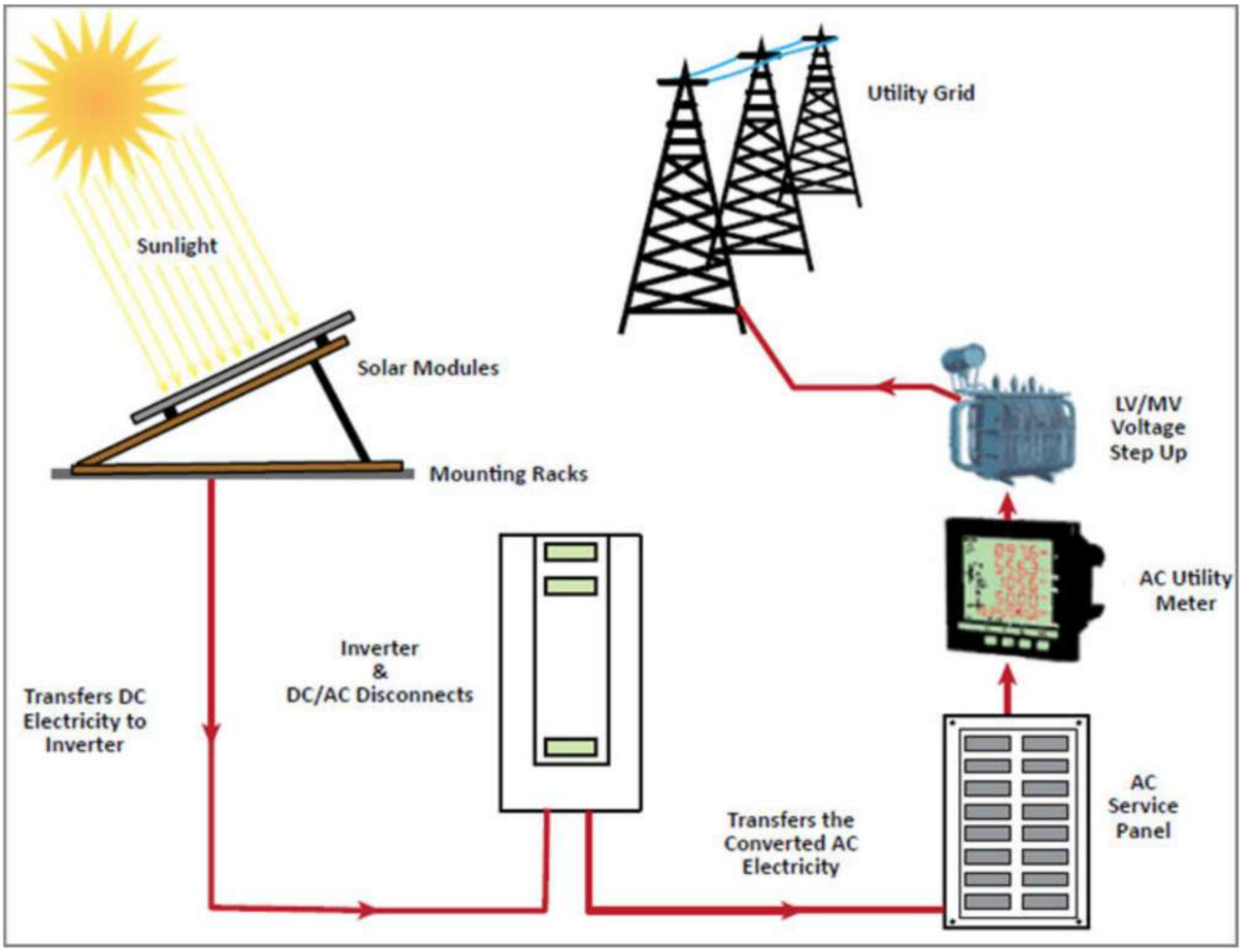

***Figure 3**:Overview of Solar PV Power Plant (Figure provided by Nemai Green, taken from International Finance Corporation, 2015. Utility-scale solar Photovoltaic Power Plants).*

1.1 Project Overview

The Project is located in the northern part of the Free State Province and falls within the Feiler Dabi District
Municipality and Moqhaka Local Municipality. The site is located approximately 7km to the south of the town of
Orkney and is crossed by the R76.

The proposed Project footprint is as follows:

- ♦ Potential Solar Areas – 149Ha and 63Ha (total of 212Ha); and
- ♦ Grid connection – approximately 1km (substation located to the immediate east of the Project boundary).

The proposed Project consists of the following systems, sub-systems or components (amongst others):

♦ PV panel arrays, which are the subsystems which convert incoming sunlight into electrical energy.

♦ Mounting structures to support the PV panels.

♦ On-site inverters to convert DC to facilitate AC connection between the solar energy facility and electricity grid.

♦ New 132 kV power lines between the on-site substation(s) and the grid connection point.

♦ Cabling between the Project's components, to be laid underground (where practical);

♦ Administration Buildings (Offices).

♦ Workshop areas for maintenance and storage.

♦ Temporary laydown areas.

♦ Internal access roads and perimeter fencing of the footprint.

♦ High Voltage (HV) Transformers; and

♦ Security Infrastructure

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens"**.

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "*…identify, predict, and evaluate the actual and potential impact on the environment, socio-economic conditions, and cultural heritage*".

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the impact on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact is possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    c. **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and

- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the Altina 120MW Solar Photovoltaic (PV) Project near Orkney in the Free State is indicated on the 1:250 000 Kroonstad 2726 (Schutte , 2000) Geological Map (Council for Geosciences, Pretoria) (**Figure 3, Table 2).** According to this map the proposed development is underlain by the Quaternary deposits comprising of aeolian sand. Recent Shape files produced by the Council of Geosciences (Pretoria) indicates that the proposed Altina PV Project is underlain by alluvium , colluvium, and eluvium (**Figure 5**). The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Quaternary deposits is moderate (Almond and Pether, 2009; Almond *et al.*, 2013) (**Figure 6**).

The Quaternary Era is also known as the “Age of the Mammals” and is preserved on coastal plains (Langebaanweg), cave systems (Makapan), and river gravel terraces (Cornelia), as well as other basins. These deposits have been subdivided in six African Land Mammal Ages, namely Recent, Florisian, Cornelian, Makapanian, Langebaanian, and Namibian (MacRae 1999). Quaternary deposits best known in the Free State is the Florisbad and Cornelia localities. Fossils recovered from these sites include teeth and bones of mammals, fish, reptiles, freshwater mollusks, trace fossils, wood, rhizoliths and diatom floras (Groenewald and Groenewald 2014). Quaternary fossils are usually very rare but may also include mammalian teeth and bone, ostrich eggshells, tortoise remains, ostracods, diatoms, and reptilian skeletons, trace fossils include burrows, vertebrate tracks, rhizoliths as well as calcretised termitaria (termite heaps). Plant remains include foliage, pear, wood, pollens. Microfossils and vertebrate remains are often found in Quaternary deposits near water courses and drainage lines.

The superficial deposits (represented by yellow on the geological maps, Qs/Qc,/Qd) are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments or larger spreads onshore. These sediments comprise of channel, floodplain and stream deposits, talus gravels and glacial drift sediments. Quaternary deposits are very important because palaeoclimatic changes are reflected in the different geological formations (Hunter et al., 2006). During the climate fluctuations in the Quaternary Era most geomorphologic features in southern Africa where formed (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Quaternary but states that climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past. Climate variations that occurred in the

Quaternary were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Underlaying these superficial sediments at depth is sediments of the Ecca Group (Vryheid Formation) as well as sediments of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup).

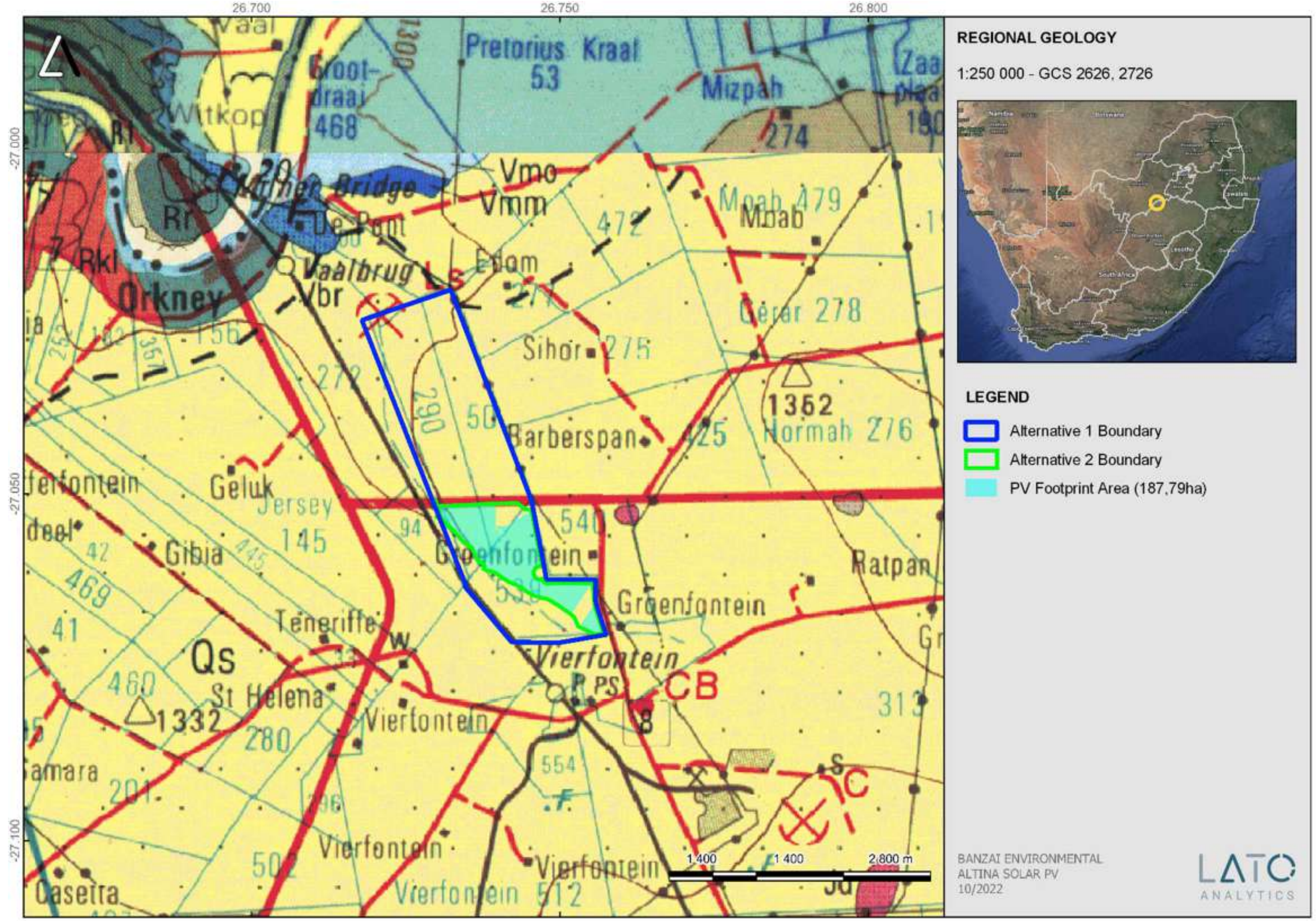

Figure 4: Extract of the 1:250 000 Kroonstad 2726 (Schutte, 2000) Geological Map (Council for Geosciences, Pretoria) indicating the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State. The development tis underlain by Quaternary (Os-dune sand.

Table 2: Legend of the 1:250 000 Kroonstad 2726 (Schutte , 2000) Geological Map (Council for Geosciences, Pretoria)

	GROEP GROUP	SUBGROEP SUBGROUP	FORMASIE FORMATION			
KWARTÊR QUATERNARY				~	~	Alluvium Alluvium
				~	~	Rivierterrasgruis River terrace gravel
				Qd	Qc	Kalksteen, toefa Limestone, tufa
				Qs	Qd	Duinsand Dune sand
				Qc	Qs	Eoliese sand Aeolian sand

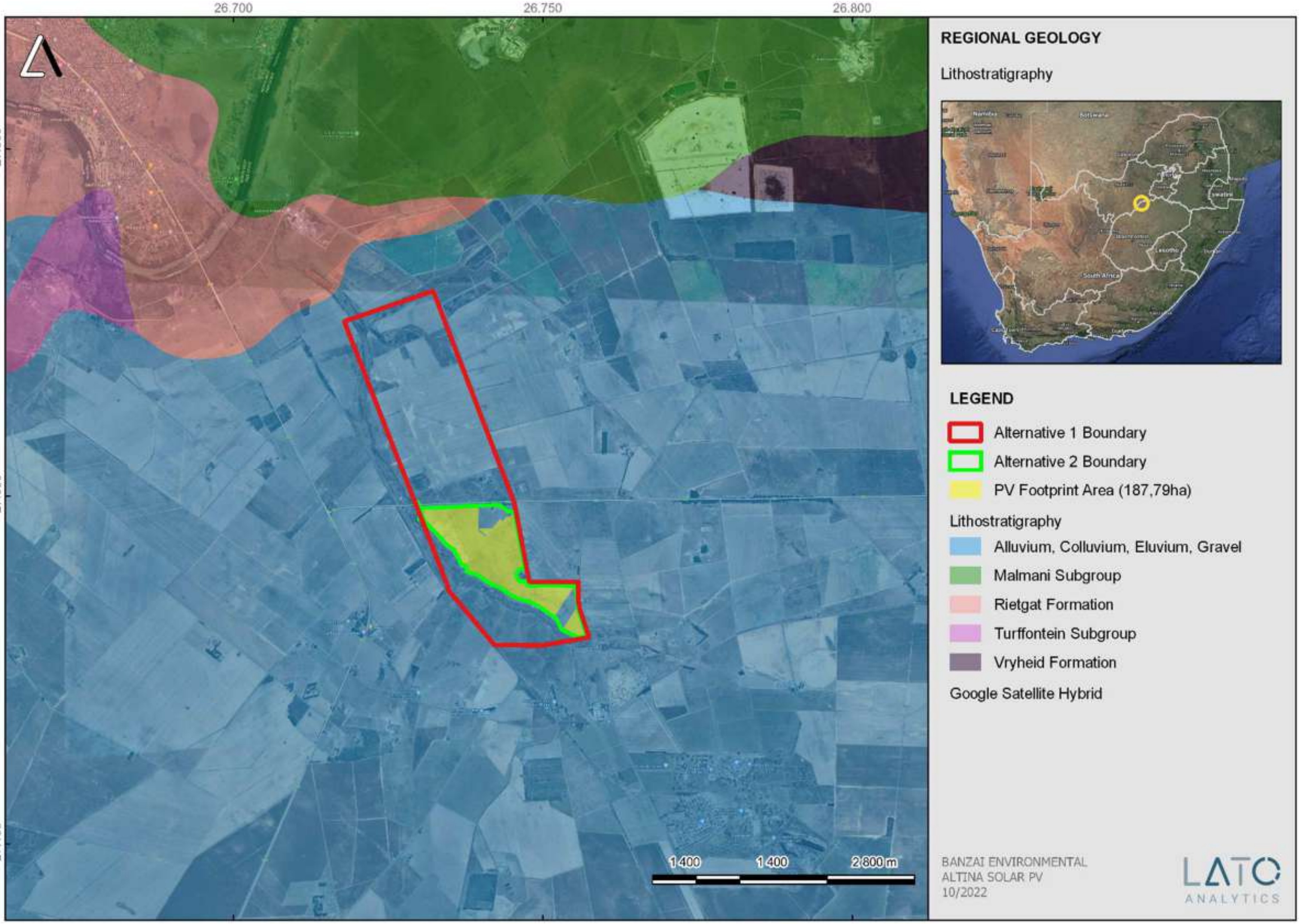

Figure 5: Updated geology indicates that the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State is underlain by alluvium, colluvium, elluvium and gravel.

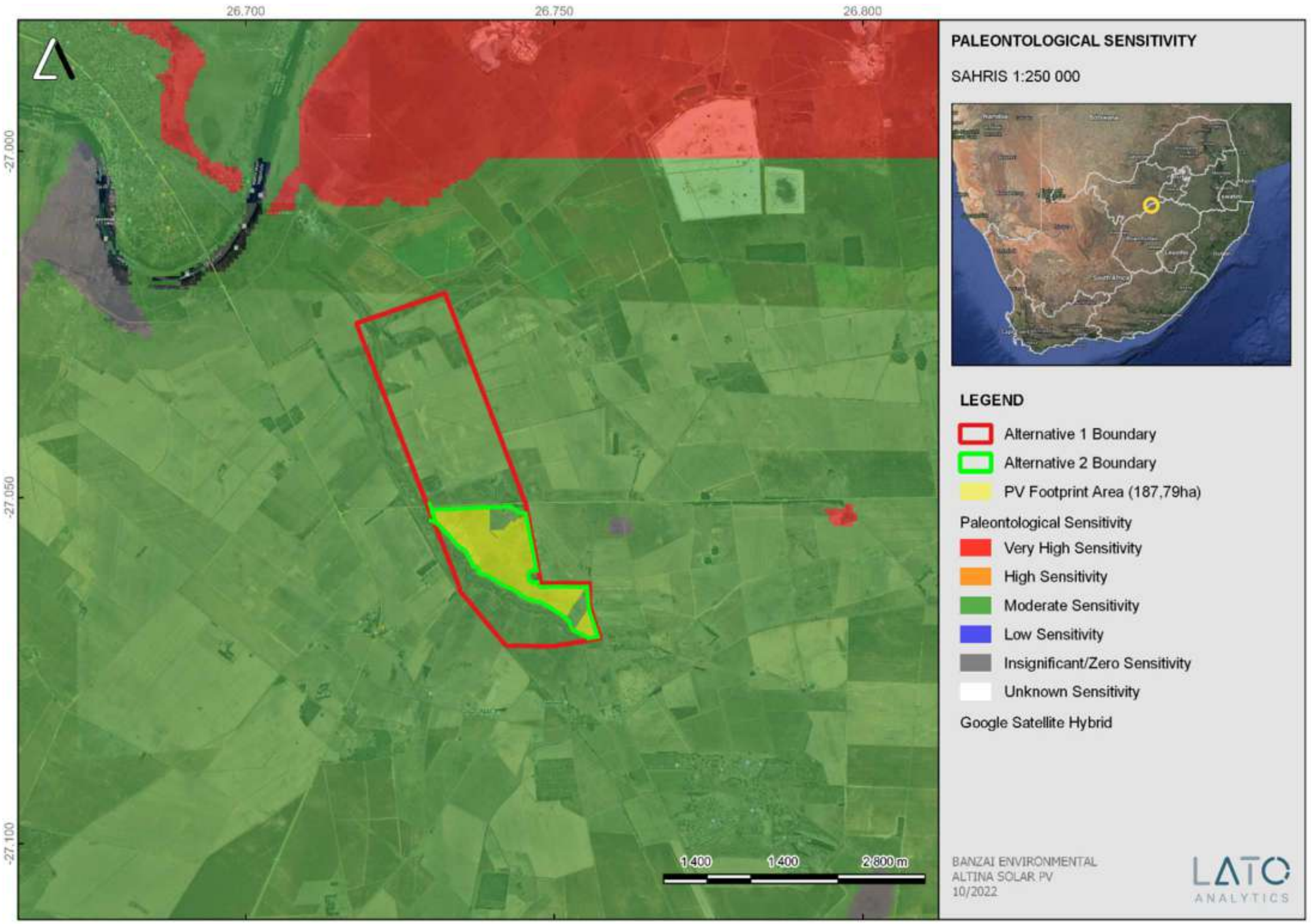

Figure 6: Extract of the 1:250 000 SAHRIS PalaeoMap (Council of Geosciences, Pretoria) indicating the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State.

According to the SAHRIS Palaeosensitivity map (**Figure 6**) the proposed development is underlain by sediments of a Moderate (green) Palaeontological Sensitivity.

Table 3: Palaeontological Significance

Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

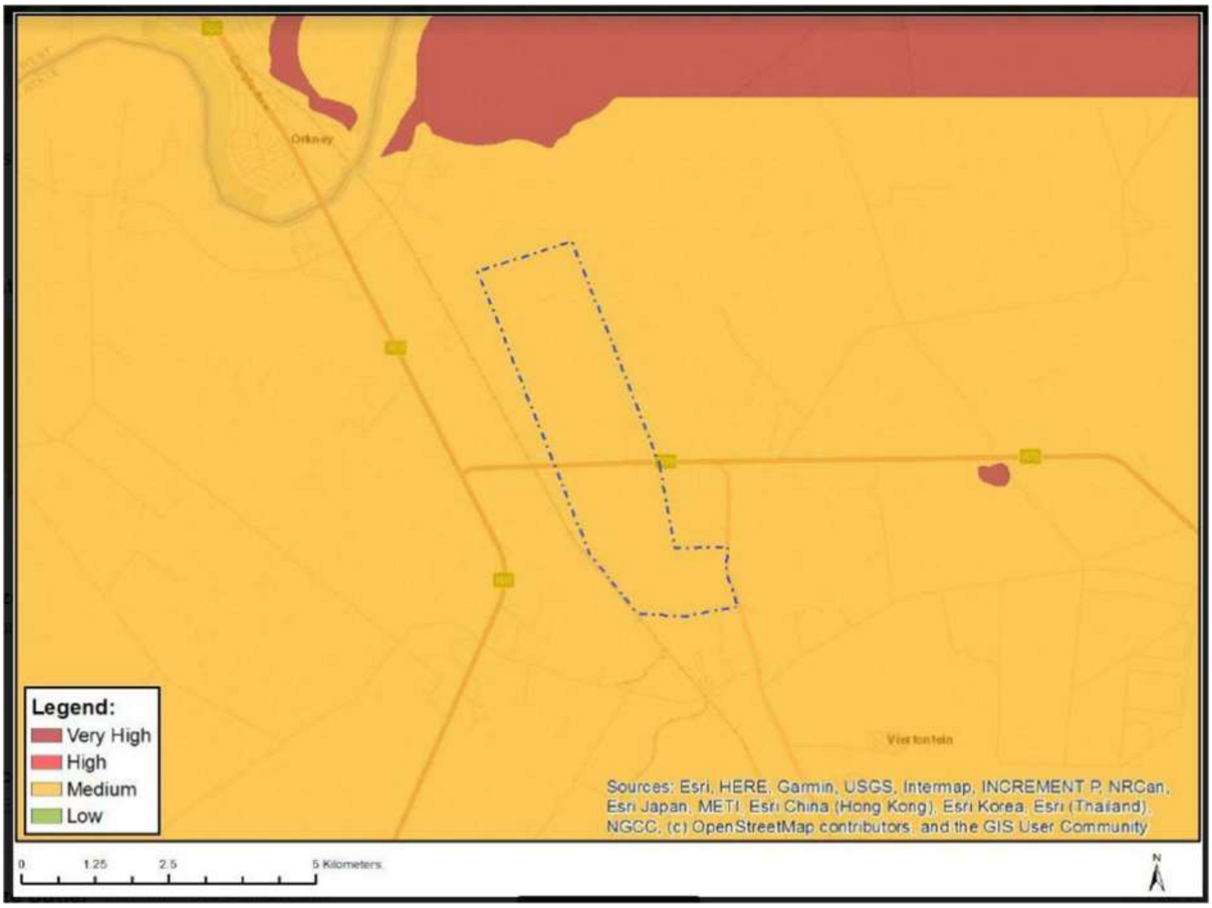

Figure 7: Palaeontological Sensitivity generated by the National Environmental Web-Based Screening Tool indicating the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State

The National Environmental Web-Based Screening Tool indicates that the proposed Altina Solar Pv Project has a medium Palaeontological Sensitivity. This corresponds with the Palaeontological Sensitivity on the SAHRIS PalaeoMap (Figure 6).

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State Is about 25km south west of Orkney (Figure1-2).

Farm Portion	Latitude	Longitude
Altina 120 MW Solar Photovoltaic (PV) Project	27° 1'30.03"S	26°43'5.10"E
	27° 1'14.53"S	26°43'55.95"E
	27° 3'48.32"S	26°44'4.51"E
	27° 4'17.33"S	26°44'31.63"E
	27° 3'44.41"S	26°44'52.11"E

	27° 3'45.23"S	26°45'20.52"E
	27° 4'13.67"S	26°45'26.49"E

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps. Scientific research articles of research conducted in the area is also sourced and included in the Impact Assessment.

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984).
- A Google Earth map with polygons of the proposed development was obtained from Nemai Green
- 1:250 000 Kroonstad 2726 (Schutte , 2000) Geological Map (Council for Geosciences, Pretoria
- *Nemai Green. 2022. BID for the he proposed* Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State
- Shape files produced by the Council of Geosciences (Pretoria).

9 IMPACT ASSESSMENT METHODOLOGY

PLEASE NOTE: Both alternatives of the Altina PV Project are located in the development footprint. As such, these alternatives have the same impact as they have the same geology. From a Palaeontological view no alternative is more preferred above the other.

Impact assessment must take account of the nature, scale, and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction.
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 4: The rating system

NATURE		
The Nature of the Impact is the possible destruction of fossil heritage		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).

4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may

		temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		

This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity = X.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.

51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

9.1 Summary of Impact Tables

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur and are regarded as having a medium probability. As fossil heritage will be destroyed the impact is irreversible. The significance of the impact occurring will be moderate

Table 5: Summary of Impact Tables

	Site	Probability	Duration	Magnitude	Reversibility	Irreplicable Loss	Cumulative Effect	Significance
Alternative 1	1	2	4	2	4	4	2	32
Alternative 2	1	2	4	2	4	4	2	32

10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary superficial deposits. The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Quaternary deposits is moderate (Almond and Pether, 2009; Almond *et al.*, 2013). These superficial sediments mantle sediments of the Ecca and Transvaal Supergroup at depth. These underlaying sediments will not impact on the development as the structures of the Altina PV Project will not penetrate that deep.

Two layout alternatives are considered for the proposed PV development. As both alternatives have the same geology, the impact of the proposed Altina PV Project on fossil heritage of the area, will be the same. From a Palaeontological view no alternative is more preferred above the other. A Moderate Palaeontological Significance has been allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage. If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a palaeontologist.

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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Appendix A

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	29 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988
	University of the Orange Free State
	B.Sc (Hons) Zoology, 1991
	University of the Orange Free State
	Management Course, 1991
	University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009
	University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part-time laboratory assistant	Department of Virology
	University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant	National Museum, Bloemfontein
and Collection Manager	1998–currently

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APPENDIX E7: Visual Impact Assessment

ENVIRONMENTAL & ENGINEERING

REPORT

GENESIS ECO-ENERGY DEVELOPMENTS (PTY) LTD

VISUAL IMPACT ASSESSMENT (VIA)

REPORT REF: 21-1743

FREE STATE PROVINCE.)

2022-10-27

VERSION 02

Document and Quality Control:

Document No:	21-1743 (Altina Solar PV - VIA)			
AA – draft	2022-05-06	Neel Breitenbach		First draft for review / comments
BB – draft				Technical Review
CC– draft				Quality review
DD– draft				Client review
EE - draft				Final Review
Approved for Distribution:				
0.1	2022-08-10	Neel Breitenbach		Final report
0.2	2022-10-27	Neel Breitenbach		Site Layout Update

Quality Control BY:

Nature of Signoff:	Responsible Person:	Role / Responsibility	Qualification
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Client			

DISCLAIMER:

This is not a legally binding document and many of the actions and recommendations remain the responsibility of the client (as the owner/lessee of the property). This is the Visual Impact Assessment for the Altina Solar PV Project 2022 and does not constitute a binding legal commitment of the parties.

Eco Elementum (Pty) Ltd and the authors of this report are protected from any legal action, possible loss, damage or liability resulting from the content of this report. This document is considered confidential and remains so unless requested by a court of law.

It is however important to note that although all effort is put into conducting a thorough audit, due to the length of time for an audit, or the nature of activities viewed on the day of the audit, only a sample of the operations can be reasonably assessed.

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EXECUTIVE SUMMARY

Genesis Eco-Energy Developments (Pty) Ltd appointed Nemai (Pty) Ltd to undertake environmental authorisations associated with the proposed Altina Solar PV project. The applicant wants to construct a solar PV plant in the Free State Province of South Africa.

Eco Elementum (Pty) Ltd is to undertake the Visual Impact Assessment for the Altina Solar PV project.

Electricity generation sources need to be diversified to ensure security of supply and reduction in the carbon footprint created by the current heavy reliance of South Africa (SA) on coal to produce electricity. The electricity demand is increasing in SA, and in order to match that demand there is a need to supply a diversified power generation that includes renewable energy technologies. These technologies include solar, wind, small utility scale hydro, biomass, biogas and energy storage that the Department of Mineral Resources and Energy (DMRE) intends to develop and implement as identified in the approved Integrated Resource Plan (IRP) 2019.

Genesis Eco-Energy Developments (Pty) Ltd has proposed the development of the Altina 120MW Solar PV Project near the town of Orkney, in the Free State Province. The site falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice No. 142 of 26 February 2021. The electricity generated by the Project will be injected into the existing Eskom 132 kV distribution system.

Two site alternatives exist.

The scope of work for this Visual Impact Assessment will include:

1. Describe the existing visual characteristics of the proposed sites and its environs;
2. Viewshed and viewing distance using GIS analysis up to 15 km from the proposed structures;
3. Visual Exposure Analysis.
4. Comparison of the 2 site alternatives and determine the option with the predicted least impact on the receiving environment.

SUMMARY OF FINDINGS

The construction and operation phase of the proposed Altina Solar PV project related activities and its associated infrastructure will have a MODERATE visual impact on the natural scenic resources and the topography. However, with the correct mitigation measures the impact might decrease to a point where the visual impact can be seen as less significant. The moderating factors of the visual impact of the proposed solar PV plant in close range are the following:

- Number of human inhabitants and mining operations located in the area;
- Natural topography and vegetation;
- Mitigation measures that will be implemented;

In light of the above mentioned factors that reduce the impact of the facility, the visual impact is assessed as MODERATE VISUAL IMPACT after mitigation measures have been implemented.

Table 1: Summary of the Quantified ranking of Visual Exposure each identified sensitive receptor may have due to proposed infrastructure

Visibility ratings		
ID	Alternative 1	Alternative 2
Count	33	34
AVG	1.2	1.5
Max	3.8	7.9

When comparing the two alternatives from a visual impact perspective alternative 1 is predicted to have the least impact on the receiving environment. The amount of receptors predicted to be impacted are 33 for alternative 1 compared to 34 for alternative 2. The average rating for all the predicted receptors are also higher for alternative 2. The predicted maximum rating for all the receptors are also higher in alternative 2.

From a visual impact perspective Alternative 1 is predicted to have the least impact on the receiving environment.

Table 2: The overall Assessment of the Visual Impact

Nature of impact: The overall Assessment of the Visual Impact of the area.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	2	2
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	4	2
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	4	4
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	5	5
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	4	3
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	1	1
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	3	3
Consequence	Severity + Spatial Scale + Duration	10	8
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	13	12
Risk	Consequence * Likelihood	**MODERATE (130)**	**MODERATE (96)**
Mitigation:	The visual impact can be reduced by revegetating the surface below the solar PV modules. Paint any supporting structures dark colours to match the Solar PV modules to reduce the contrast between the structures and solar PV modules		
Cumulative Impact:	The construction of the proposed Altina Solar PV structures with its associated infrastructure will increase the cumulative visual impact of Solar PV type infrastructure within the region. In context of the existing agriculture, mine and town, the added structures will contribute to a slight regional increase in small vehicles on the roads.		

The Visual Impact due to mining activities and associated infrastructure can be seen as having a MODERATE impact on the surrounding environment and inhabitants before mitigation measures are implemented. After mitigation, the visual impact can be seen as MODERATE. Although visual impacts of Solar PV plants cannot be mitigated effectively, it is important to reduce the visual impact to acceptable levels. The mitigation measures described in this report are best practice for the Burau of Land Management in the United States of America and considered effective to reduce the visual impact as reasonably possible for the project to go ahead.

CUMULATIVE IMPACTS

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise of a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the inter-visibility (visibility) of a range of developments and / or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effects on visual receptors within their combined visual envelopes. Inter-visibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The Landscape Institute, 1996).

- The cumulative visual intrusion of the proposed Altina Solar PV structures, will be MODERATE as it is a Solar PV operation. The site location is also in proximity to mining operations which decreases the visual impact further. The visual impact and impact on sense of place of the proposed project will contribute to the cumulative negative effect on the aesthetics of the study area. <u>It is recommended however,</u> that the environmental authorities consider the overall cumulative impact on the agricultural and scattered mining character and the areas sense of place before a final decision is taken with regard to the optimal number of solar PV projects in the area.

MITIGATION MEASURES

Mitigation measures may be considered in two categories:

- Primary measures that intrinsically comprise part of the development design through an iterative process. Mitigation measures are more effective if they are implemented from project inception when alternatives are being considered.
- Secondary measures designed to specifically address the remaining negative effects of the final development proposals.

Primary measures that will be implemented will mainly be measures that will minimise the visual impact by softening the visibility of the structures by “blending” with the surrounding areas. Such measures will include the following:

- Revegitate the surface below the solar PV modules.
- Paint any supporting structures the same dark colours as the solar PV modules to reduce the contrast.

- Secondary measures will include final rehabilitation, after care and maintenance of the vegetation and to ensure that the final landform is maintained.

CONTENTS

List of Tables

List of Figures

Definition of Terms

Assessment	A systematic, independent and documented review of operations and practises to ensure that relevant requirements are met.
Construction	The time period that corresponds to any event, process, or activity that occurs during the Construction phase (e.g., building of site, buildings, and processing units) of the proposed project. This phase terminates when the project goes into full operation or use.
Critical viewpoints	Important points from where viewers will be able to view the proposed or actual development and from where the development may be significant.
Cumulative Impacts	The summation of the effects that result from changes caused by a development in conjunction with the other past, present or reasonably foreseen actions (The landscape Institute, Institute of Environmental Management & Assessment. 2002)
Decommissioning	to remove or retire (a mine, etc.) from active service.
Environmental Component	An attribute or constituent of the environment (i.e., air quality; marine water; waste management; geology, seismicity, soil, and groundwater; marine ecology; terrestrial ecology, noise, traffic, socio-economic) that may be impacted by the proposed project.
Environmental Impact	A positive or negative condition that occurs to an environmental component as a result of the activity of a project or facility. This impact can be directly or indirectly caused by the project's different phases (i.e., Construction, Operation, and Decommissioning).
Field of view:	The field of view is the angular extent of the observable world that is seen at any given moment. Humans have an almost 180º forward-facing field of view. Note that human stereoscopic (binocular) vision only covers 140º of the field of view in humans; the remaining peripheral 40º have no binocular vision due to the lack of overlap of the images of the eyes. The lower the focal length of a lens (see below), the wider the field of view.
Landscape Integrity	Landscape integrity is visual qualities represented by the following qualities, which enhance the visual and aesthetic experience of the area
Mitigation (in the context of Visual Impact Assessment):	Any action taken or not taken in order to avoid, minimise, rectify, reduce, eliminate, or compensate for actual or potential adverse visual impacts.
Operation	The time period that corresponds to any event, process, or activity that occurs during the Operation (i.e., fully functioning) phase of the proposed project or development. (The Operation phase follows the Construction phase, and then terminates when the project or development goes into the Decommissioning phase.)
Record of Decision	Is an environmental authorisation issued by a state department.
Scenic value	Degree of visual quality resulting from the level of variety, harmony and contrast among the basic visual elements.
Sense of place	the character of a place, whether natural, rural or urban, it is allocated to a place or area through cognitive experience by the user.
Visual absorption capacity (VAC):	The ability of elements of the landscape to "absorb" or mitigate the visibility of an element in the landscape. Visual absorption capacity is based on factors such as vegetation height (the greater the height of vegetation, the higher the absorption capacity), structures (the larger and higher the intervening structures, the higher the absorption capacity) and topographical variation (rolling topography presents opportunities to hide an element in the landscape and therefore increases the absorption capacity).
Visual character	the overall impression of a landscape created by the order of the patterns composing it; the visual elements of these patterns are the form, line, colour and texture of the landscape's components. Their interrelationships are described in terms of dominance, scale, diversity and continuity. This characteristic is also associated with land use.
Visual Exposure	Visual exposure is based on distance from the project to selected viewpoints. Visual exposure or visual impact tends to diminish exponentially with distance. The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed mine activities and associated infrastructure were not visible, no visual impact would occur. Visual exposure is determined by the Viewshed or the view catchment being the area within which the proposed development will be visible.
Visual Integrity	Visual sensitivity can be determined by a number of factors in combination, such as prominent topographic or other scenic features, including high points, steep slopes and axial vistas
Visually sensitive	Areas in the landscape from where the visual impact is readily or excessively encountered.

Abbreviations

CA:	Competent Authority
DEA:	Department of Environmental Affairs (The former Department of Environmental Affairs and Tourism)
DMR:	The Department of Mineral Resources (The former Department of Minerals and Energy)
DWA:	Department of Water Affairs (Is now referred to the Department of Water and Sanitation – DWS)
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Plan
EMPr:	Environmental Management Programme
I&AP's:	Interested and Affected Parties
IWUL:	Integrated Water Use License
IWWMP:	Integrated Water and Water Management Plan
MPRDA:	Mineral and Petroleum Resources Development Act, 28 of 2002
NAAQS:	National Ambient Air Quality Standards
NEMA:	National Environmental Management Act, 107 of 1998
NEMAQA:	National Environmental Management: Air Quality Act, 39 of 2004
NEMBA:	National Environmental Management: Biodiversity Act, 10 of 2004
NEMWA:	National Environmental Management: Waste Act, 59 of 2008
NHRA:	National Heritage Resources Act, 25 of 1999
NWA:	National Water Act, 36 of 1998
ROD:	Record of Decision
VAC:	Visual Absorption Capability
VIA:	Visual Impact Assessment
WSA:	Water Services Act, 108 of 1997
WUL*:*	Water Use Licence

PROJECT INFORMATION

Table 3: Applicant Details

Name of Applicant:	Genesis Eco-Energy Developments (Pty) Ltd
Contact Person:	
Contact Number:	
Email:	
Postal Address:	
Physical Address:	
File Reference Number DMR:	MP 30/5/1/1/2/394 PR

Table 4: EAP Details

EAP Company:	Nemai Green (Pty) Ltd
Company Reg. No.:	
Physical Address:	147 Bram Fischer Drive Ferndale, 2194, South Africa
Postal Address:	PO Box 1673, Sunninghill, 2157, South Africa
Contact Person:	Donnavan Henning
Contact Number:	071 370 1168
Email:	donnavanh@nemai.co.za
Website:	www.nemai.co.za

Table 5: Specialist Details

Specialist Company:	Eco Elementum (Pty) Ltd
Company Reg. No.:	2012/021578/07
Physical Address:	442 Rodericks Road, Lynwood, Pretoria, 0081
Postal Address:	Postnet Suite #252, Private Bag X025. Lynnwood Ridge, Pretoria, 0040
Contact Person:	Neel Breitenbach
Contact Number:	012 807 0383
Email:	info@ecoe.co.za
Website:	www.ecoe.co.za

SPECIALIST DECLARATION OF INDEPENDENCE

In support of an application in terms of the National Environmental Management Act 107 of 1998 (GNR983, GNR984 and GNR985, GG38282 of 4 December 2014 ("Listed Activities") that will require an environmental authorisation if triggered. As amended by GNR 327, GNR 325 and GNR 324.

I, **Neel Breitenbach** as specialist, has been appointed in terms of regulation 12(1) or 12(2), and can confirm that I shall —

a. Be independent;
b. have expertise in undertaking specialist work as required, including knowledge of the Act, these Regulations and any guidelines that have relevance to the proposed activity;
c. ensure compliance with these Regulations;
d. 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 application'
e. take into account, to the extent possible, the matters referred to in regulation 18 when preparing the application and any report, plan or document relating to the application;
f. disclose to the proponent or applicant, registered interested and affected parties to the proponent or applicant, registered interested and affected parties and the competent authority all material information in the possession of the EAP and, where applicable, the specialist, that reasonably has or may have the potential of influencing –
g. any decision to be taken with respect to the application by the competent authority in terms of these Regulations; or
h. the objectivity of any report, plan or document to be prepared by the EAP or specialist, in terms of these Regulations for submission to the competent authority; and
i. Unless access to that information is protected by law, in which case it must be indicated that such protected information exists and is only provided to the competent authority.

Neel Breitenbach	
Name and Surname	Signature
2022-05-06	**George**
Date	Signed at

1. INTRODUCTION

Genesis Eco-Energy Developments (Pty) Ltd appointed Nemai (Pty) Ltd to undertake environmental authorisations associated with the proposed Altina Solar PV project. The applicant wants to construct a solar PV plant in the Free State Province of South Africa.

Eco Elementum (Pty) Ltd is to undertake the Visual Impact Assessment for the Altina Solar PV project.

Electricity generation sources need to be diversified to ensure security of supply and reduction in the carbon footprint created by the current heavy reliance of South Africa (SA) on coal to produce electricity. The electricity demand is increasing in SA, and in order to match that demand there is a need to supply a diversified power generation that includes renewable energy technologies. These technologies include solar, wind, small utility scale hydro, biomass, biogas and energy storage that the Department of Mineral Resources and Energy (DMRE) intends to develop and implement as identified in the approved Integrated Resource Plan (IRP) 2019.

Genesis Eco-Energy Developments (Pty) Ltd has proposed the development of the Altina 120MW Solar PV Project near the town of Orkney, in the Free State Province. The site falls within the Klerksdorp Renewable Energy Development Zone (REDZ), as published in Government Notice No. 142 of 26 February 2021. The electricity generated by the Project will be injected into the existing Eskom 132 kV distribution system.

Two site alternatives exists.

The proposed Project consists of the following systems, sub-systems or components (amongst others):

- PV panel arrays, which are the subsystems which convert incoming sunlight into electrical energy;
- Mounting structures to support the PV panels;
- On-site inverters to convert DC to facilitate AC connection between the solar energy facility and electricity grid;
- New 132 kV power lines between the on-site substation(s) and the grid connection point;
- Cabling between the Project's components, to be laid underground (where practical);
- Administration Buildings (Offices);
- Workshop areas for maintenance and storage;
- Temporary laydown areas;
- Internal access roads and perimeter fencing of the footprint;
- High Voltage (HV) Transformers; and
- Security Infrastructure.

Table 6: Project Locality

Magisterial District:	**Fezile Dabi District Municipality,** **Free State Province** **South Africa**
Distance and direction from nearest town:	The Project Area is ~ 7km south of . See Figure 1.

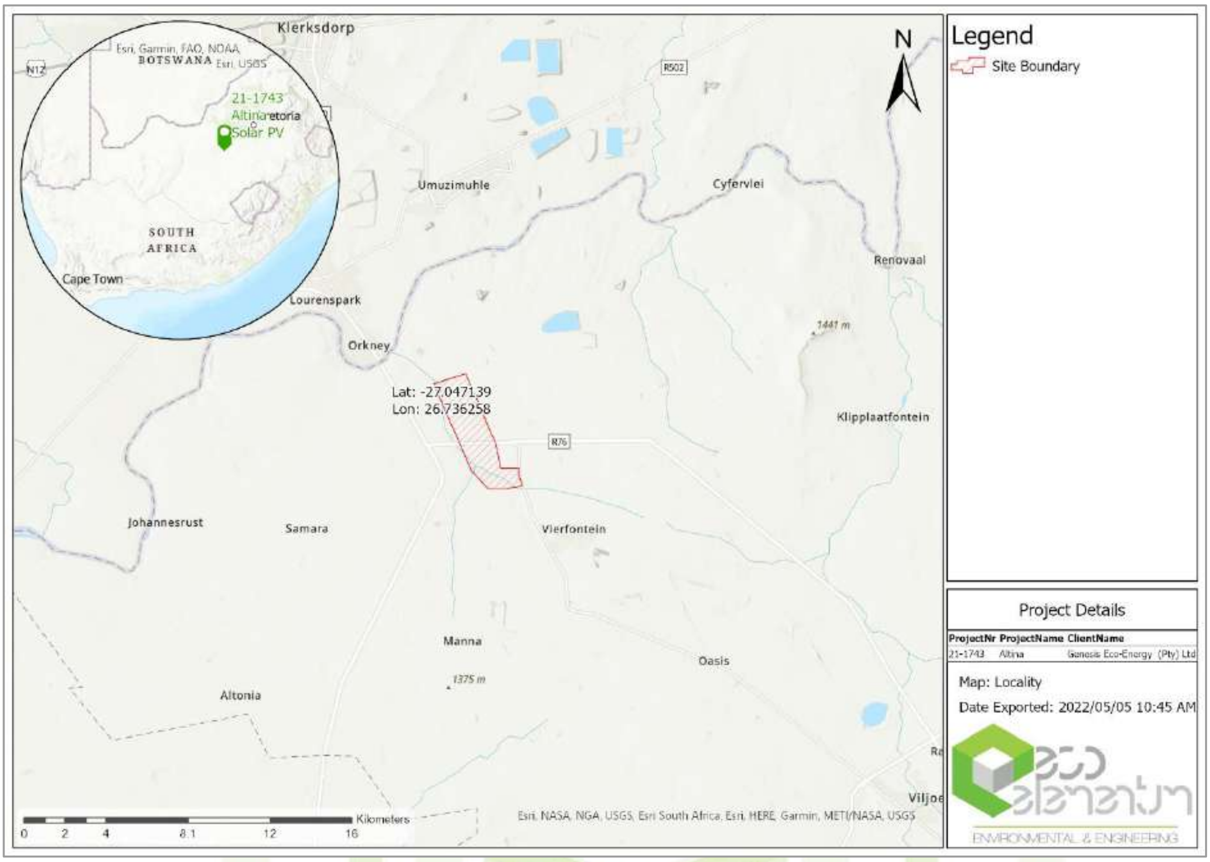

Figure 1: Locality map of the proposed Altina Solar PV project.

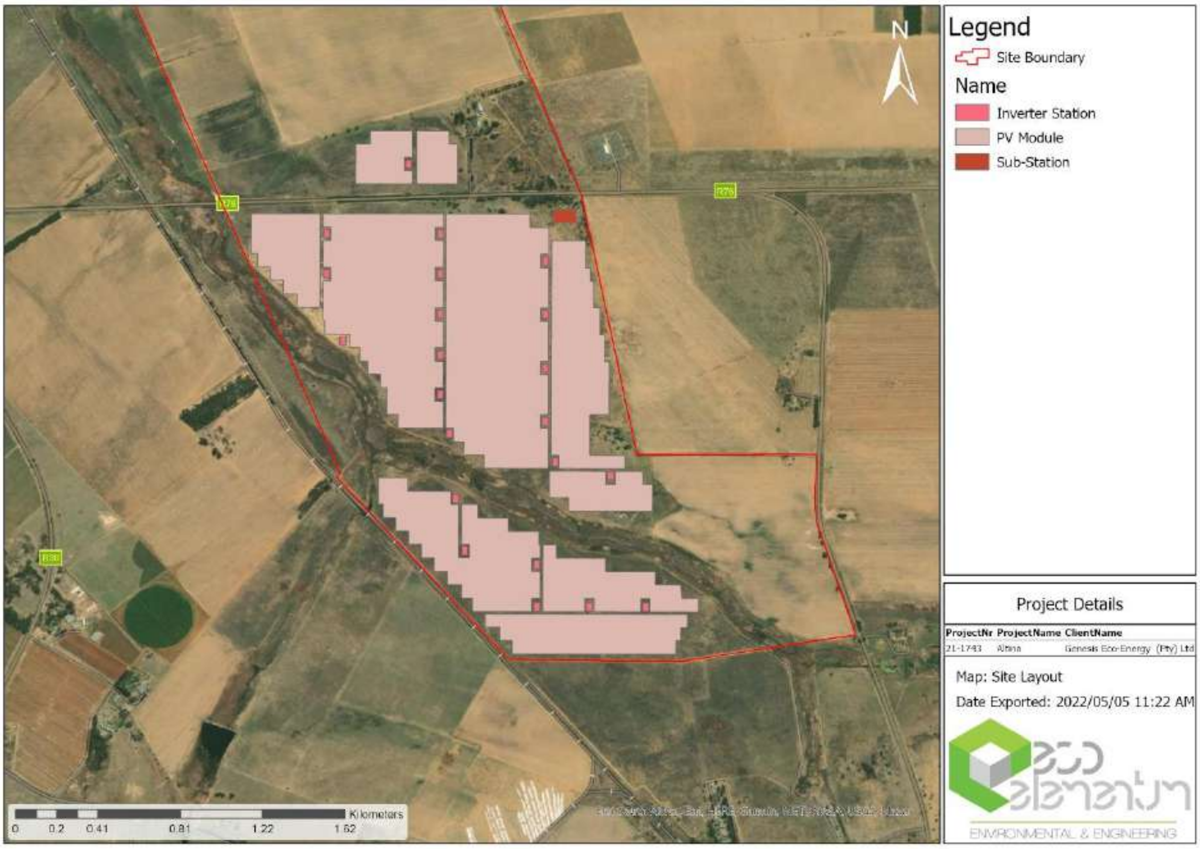

Figure 2: Proposed Site Layout for the proposed Altina Solar PV project for Alternative 1.

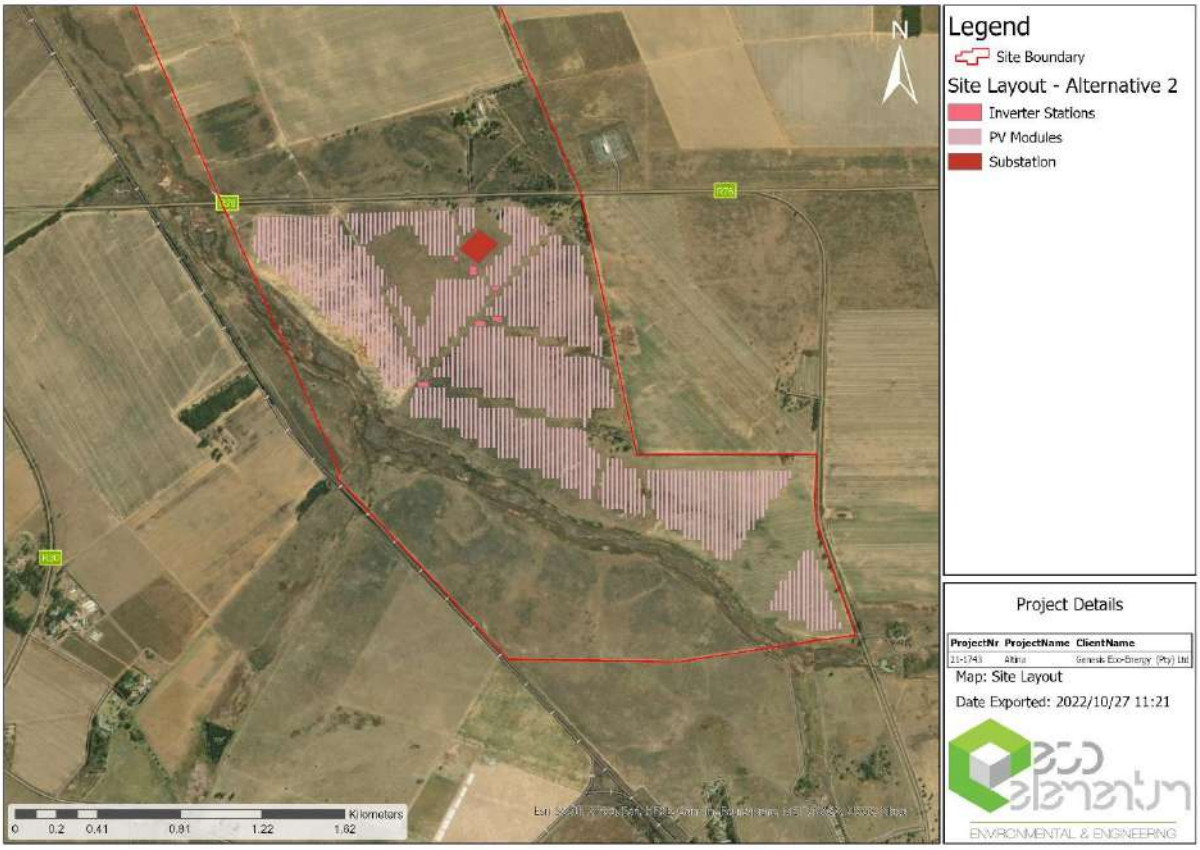

Figure 3: Proposed Site Layout for the proposed Altina Solar PV project for Alternative 2.

2. SCOPE OF WORK

The scope of work for this Visual Impact Assessment will include:

1. Describe the existing visual characteristics of the proposed sites and its environs;
2. Viewshed and viewing distance using GIS analysis up to 15 km from the proposed structures.
3. Visual Exposure Analysis comprising the following aspects:
   - Terrain Slope;
     - Slope angle is determined from the Digital Terrain Model (DTM) and the location of the proposed structures given a ranking depending on the steepness of the slope.
   - Aspect of structure location;
     - Aspect of the slope where the structures are to be built, are calculated from the DTM and given a ranking determined by the Sun angle.
   - Landforms;
     - Landform of the location of the proposed structures are determined from the DTM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys.
   - Slope Position of structure;
     - Using GIS analysis, the position of the proposed structure is determined and ranked according to the position on the slope the structure is to be built.
   - Relative elevation of structure;
     - Using the DEM the elevation of the proposed structure relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas.
   - Terrain Ruggedness;
     - The terrain ruggedness is determined from the DEM and given a ranking based on the homogeneousness of the terrain.
   - Viewer Sensitivity;
     - The Viewer sensitivity ranking of the surrounding areas is determined using various land cover and land use datasets and ranked according to the sensitivity of the related structures to the environment.
   - Overall Visual Impact;
     - Combing all the above dataset a final visual impact of the proposed structures is calculated.
4. Compare both alternatives and recommend an alternative with the least predicted impact on the receiving environment.

3. DESCRIPTION OF AFFECTED AREA AND ENVIRONMENT

This section of the report provides a description of the current status of the environment. This provides a baseline context for assessment of the proposed structures.

3.1 Location

3.1.1 Population

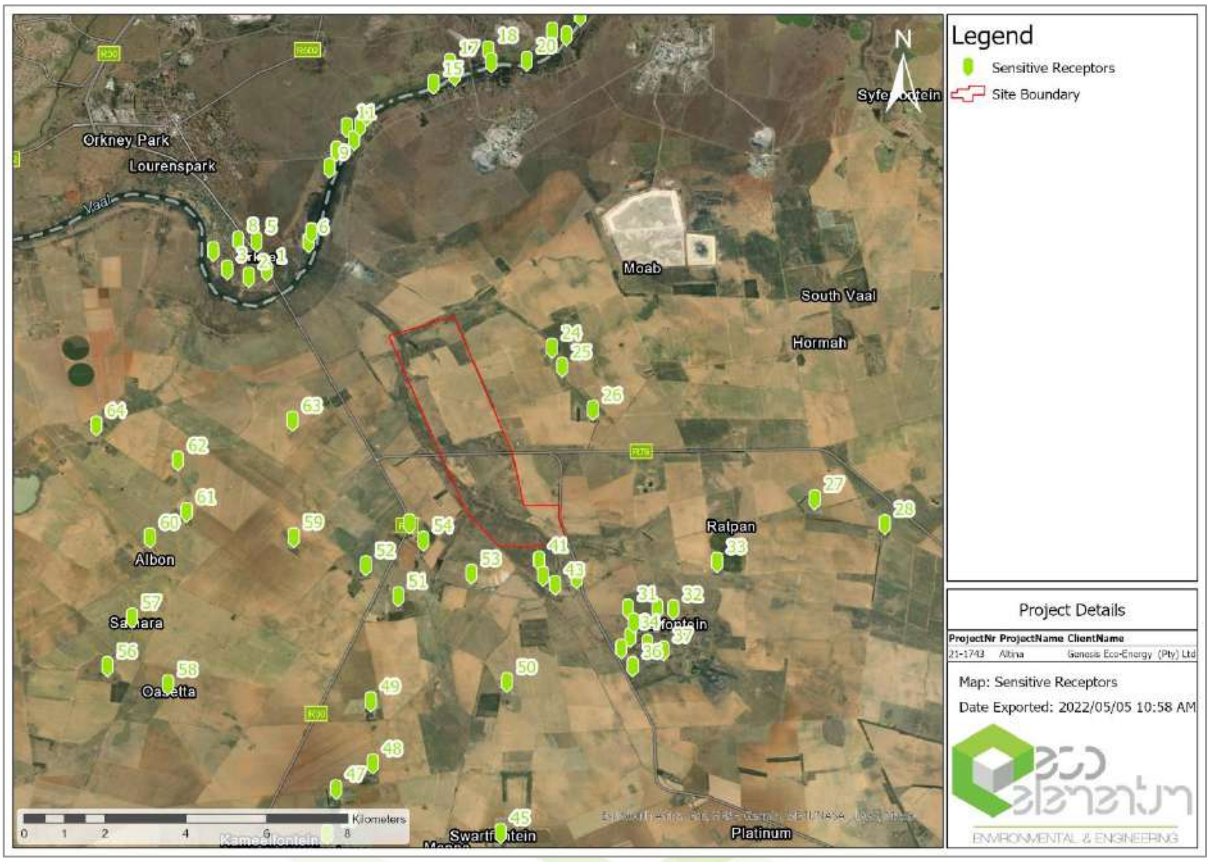

Figure 4: Population areas within close proximity of the proposed Altina Solar PV project.

From a desktop study of satellite imagery various sensitive receptors in the form of human habitation areas, consisting of the town of Orkney to the north and various dispersed homesteads surrounding the proposed Altina Solar PV project area can be seen in Figure 4. It should be noted that the sensitive receptors in the area may differ from those identified as not all areas may have been identified from the imagery successfully.

3.1.2 Topography

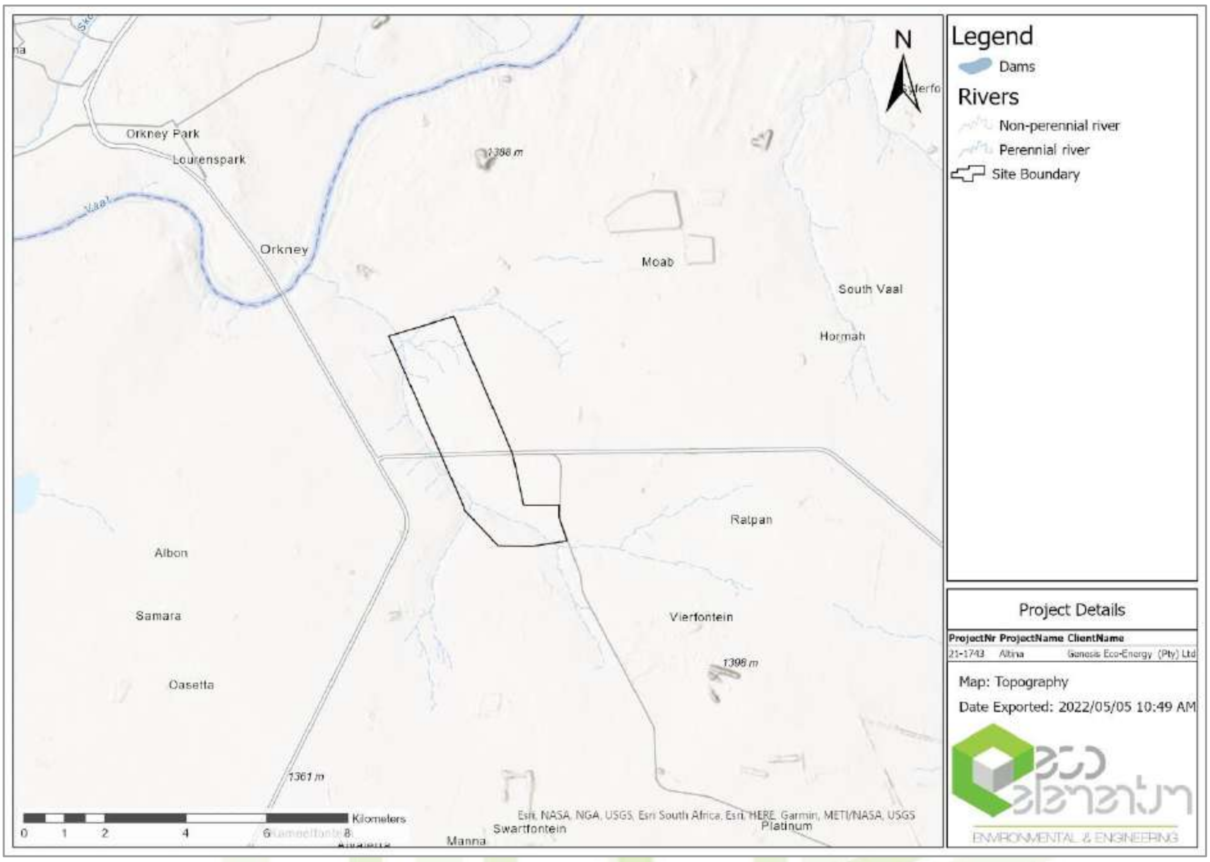

Figure 5: Map showing the Topography surrounding the proposed Altina Solar PV project.

The proposed operation area is situated in undulated terrain with no major topographical features found in the immediate vicinity as can be seen in Figure 5 above.

3.1.3 Landcover

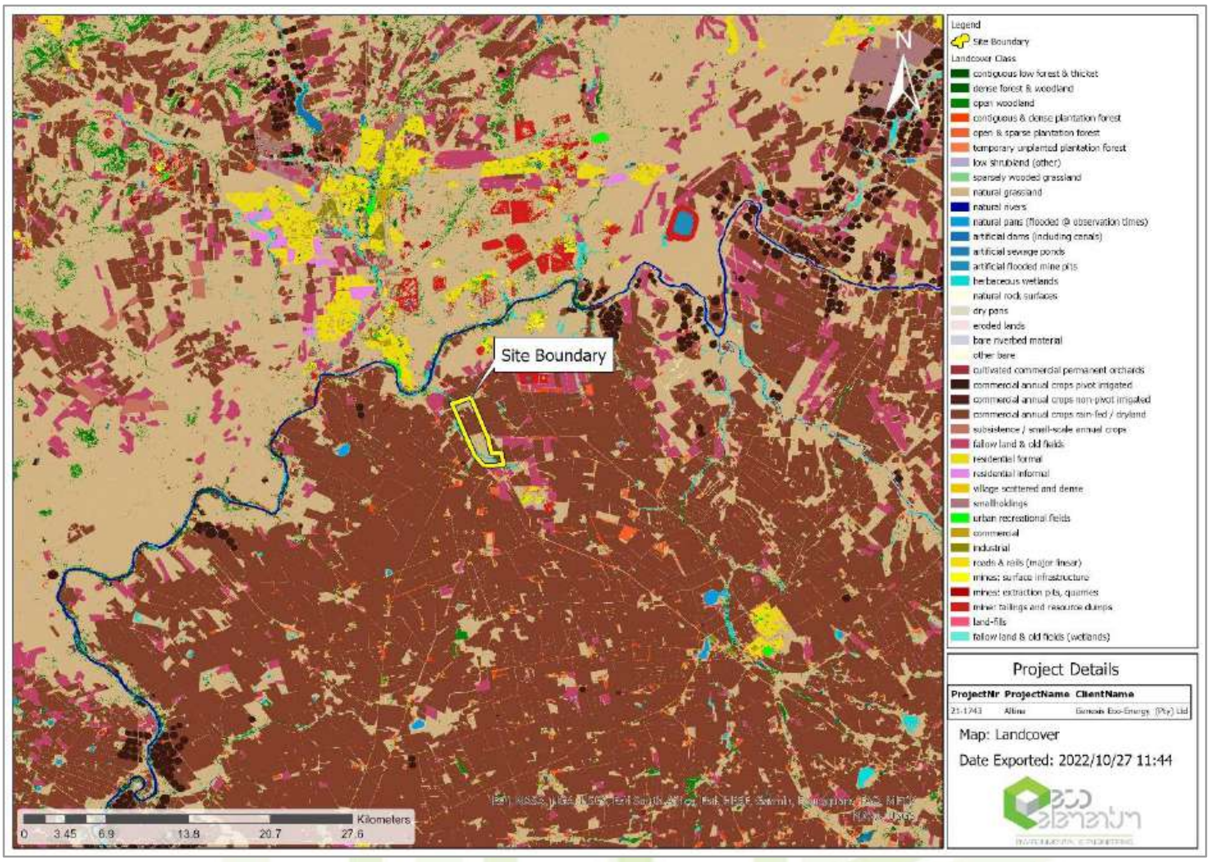

Figure 6: Map showing the Landcover surrounding the proposed Altina Solar PV project.

The proposed operation area is situated in farmlands with the urban structures of Orkney visible to the north as can be seen in Figure 6 above. The urban infrastructures will add to the Visual Absorption Capacity of the project.

3.2 New Infrastructure

The proposed Altina Solar PV project will comprise of various newly built structures. Some of the highest structures are included in this report as can been in Figure 7. It must be noted that no complete detail of the exact structures were available at the time of this report and general height and location assumptions were made where applicable.

Table 7: Maximum Height of the Relevant Proposed Structures.

Description	Height (m)
Sub-Station	10
Solar PV Modules	6
Inverter Stations	3

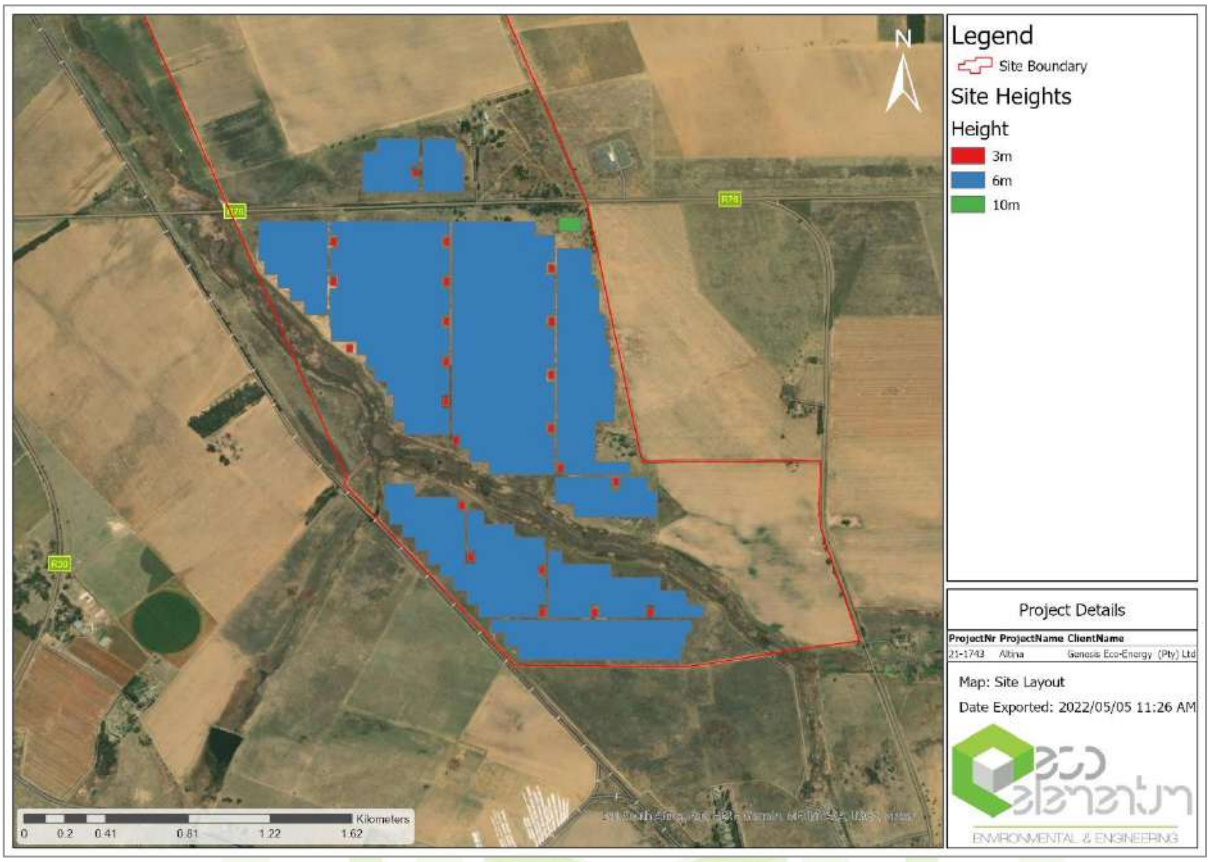

Figure 7: Infrastructure surface heights for Alternative 1

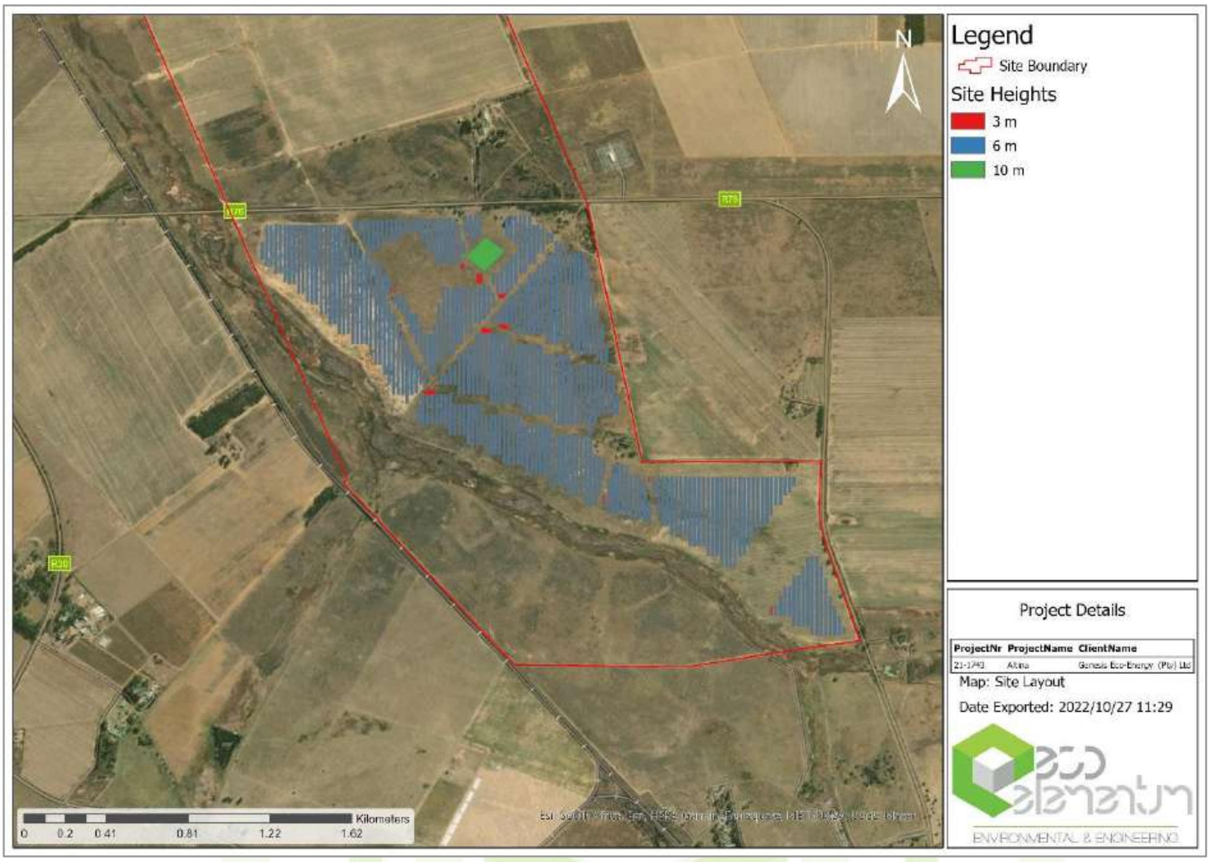

Figure 8: Infrastructure surface heights for Alternative 2

3.3 Sense Of Place

The concept of "a Sense of Place" does not equate simply to the creation of picturesque landscapes or pretty buildings, but to recognize the importance of a sense of belonging. Embracing uniqueness as opposed to standardization attains quality of place. In terms of the natural environment, it requires the identification, a response to and the emphasis of the distinguishing features and characteristics of landscapes. Different natural landscapes suggest different responses. The sense of place is created by the predominant agricultural activities in the area, mixed with mining areas and the human built up area of the town of Orkney.

4. SITE SENSITIVITY VERIFICATION

4.1 SITE SENSITIVITY VERIFICATION REQUIREMENTS FOR AN ASSESSMENT WITH NO SPECIFIC PROTOCOLS

4.1.1 Section 1.2

A desktop study has been done using various sources of satellite imagery and remote sensing techniques. Refer to *Section 3: DESCRIPTION OF AFFECTED AREA AND ENVIRONMENT* above.

4.1.2 Section 1.3

Satellite imagery for the area dated December 2021 as well as the latest Landcover dataset, dated 2020, were used in the calculations and study. The dates of the satellite imagery and landcover dataset are close enough to the current date for it to be considered valid data.

5. METHODOLOGY

The following sequence was employed in this Visual Assessment Report:

1. Viewshed and viewing distance using GIS analysis up to 15 km from the proposed structures utilizing ArcGIS Pro and Spatial Analyst extension.
2. In order to model the decreasing visual impact of the structures, concentric radii zones of 1 km to 15 km from the mine activities were superimposed on the viewshed to determine the level of visual exposure. The closest zone to the proposed structures indicates the area of most significant impact, and the zone further than 10 km from the structures indicates the area of least impact. The visual ratings of the zones have been defined as follows:
    - <1 km (very high);
    - 1 - 2 km (high);
    - 2 - 5 km (moderate);
    - 5 -10 km (low); and
    - > 15 km (insignificant).
3. A Visual Exposure Analysis were conducted that included the following parameters:
    - Terrain Slope
        - Slope angle is determined from the Digital Terrain Model (DTM) and the location of the proposed structures given a ranking depending on the steepness of the slope;
        - Structures built on steep slopes are assumed to be more visible and exposed than those on flat surfaces.
    - Aspect of structure location
        - Aspect of the slope where the structures are to be built, are calculated from the DTM and given a ranking determined by the Sun angle.
        - Structures on flat surface are illuminated by the sun the whole day and thus visible from all directions. In the southern hemisphere structures on North facing slopes are less visible from the south, structures on East and West facing slopes are only illuminated during half of the day thus less visible where structures on the southern slopes are mostly in the shade.
    - Landforms
        - Landform of the location of the proposed structures are determined from the DTM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys.
    - Slope Position of structure
        - Using GIS analysis, the position of the proposed structure is determined and ranked according to the position on the slope the structure is to be built.
    - Relative elevation of structure
        - Using the DEM the elevation of the proposed structure relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas. Structures built on higher ground are more visible than those built in low lying areas.
    - Terrain Ruggedness
        - The terrain ruggedness is determined from the DEM and given a ranking based on the homogeneousness of the terrain. Rugged terrain has a tendency to increase the visual absorption characteristics of the terrain.
    - Visual Absorption Capacity
        - To simulate the Visual Absorption Capacity (VAC) of the landscape, land cover data of the area were assigned a VAC ranking. The Visual Exposure results and VAC rankings of the landscape were use in an algorithm to determine a quantitative visual exposure for each sensitive receptor.

- Overall Visual Impact
  - Combing all the above dataset a final visual exposure ranking was determined for each of the identified sensitive receptor areas.

4. Comparison of the two alternatives
   - Compare the Visual Exposure Ratings for all the sensitive receptors

5.1 Assumptions

- The core study area can be defined as an area with a radius of not more than 10 km from the structures and a total study area with a radius of 15 km from the structures. This is because the visual impact of structures beyond a distance of 10 km would be so reduced that it can be considered negligible even if there is direct line of sight.
- It is assumed that there are no alternative locations for the structures and that the visual assessment, therefore, assessed only the proposed site.
- The height of the VIA is based on the heights as stipulated in Table 7.
- Geographic location within the boundary of infrastructure.
- The assessment was undertaken during the planning stage of the project and is based on the information available at that time.

5.2 Limitations

- Visual perception is by nature a subjective experience, as it is influenced largely by personal values. For instance, what one-viewer experiences as an intrusion in the landscape, another may regard as positive. Such differences in perception are greatly influenced by culture, education and socio-economic background. A degree of subjectivity is therefore bound to influence the rating of visual impacts. In order to limit such subjectivity, a combination of quantitative and qualitative assessment methods were used. A high degree of reliance has been placed on GIS-based analysis viewshed, visibility analysis, and on making transparent assumptions and value judgements, where such assumptions or judgements are necessary.
- The viewshed generated in GIS cannot be guaranteed as 100% accurate. Some viewpoints, which are indicated on the viewshed as being inside of the viewshed, can be outside of the viewshed. This is due to the change of the natural environment by surrounding activities as well as natural vegetation that play a significant role and can have a positive or negative influence on the viewshed.

5.3 Legal Requirements

There are no specific legal requirements for visual impact assessment in South Africa. Visual impacts are, however required to be assessed by implication when the provisions of relevant acts governing environmental impacts management are considered.

6. CRITERIA USED IN THE ASSESSMENT OF VISUAL IMPACTS

6.1 View Points And View Corridors

Viewpoints have been selected based on prominent viewing positions in the area. The selected viewpoints and view corridors are used as a basis for determining potential visual ability and visual impacts of the proposed structures.

6.2 Visual Exposure

Visual exposure is based on distance from the project to selected viewpoints. Visual exposure or visual impact tends to diminish exponentially with distance. The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed structures were not visible, no visual impact would occur. Visual exposure is determined by the following variables:

- Slope angle (Figure 9);
- Aspect of slope (Figure 10);
- Landforms (Figure 13);
- Slope Position of structure (Figure 14);
- Relative Elevation of structure (Figure 12); and
- Terrain Ruggedness (Figure 11).

6.3 Landscape Integrity

Landscape integrity is visual qualities represented by the following qualities, which enhance the visual and aesthetic experience of the area:

- Intactness of the natural and cultural landscape;
- Lack of visual intrusions or incompatible structures; and
- Presence of a 'sense of place'.

6.4 Determine The Visual Absorption Capacity (VAC)

The VAC is the capacity of the receiving environment to absorb the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing, sparse and patchy vegetation will have a low VAC. Topography and built forms have the capacity to 'absorb' visual impact.

The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate potential visual absorption capacity (VAC). It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, topography and structures. Land cover is used in the ranking of the VAC.

7. VIEWSHED

7.1 SLOPE

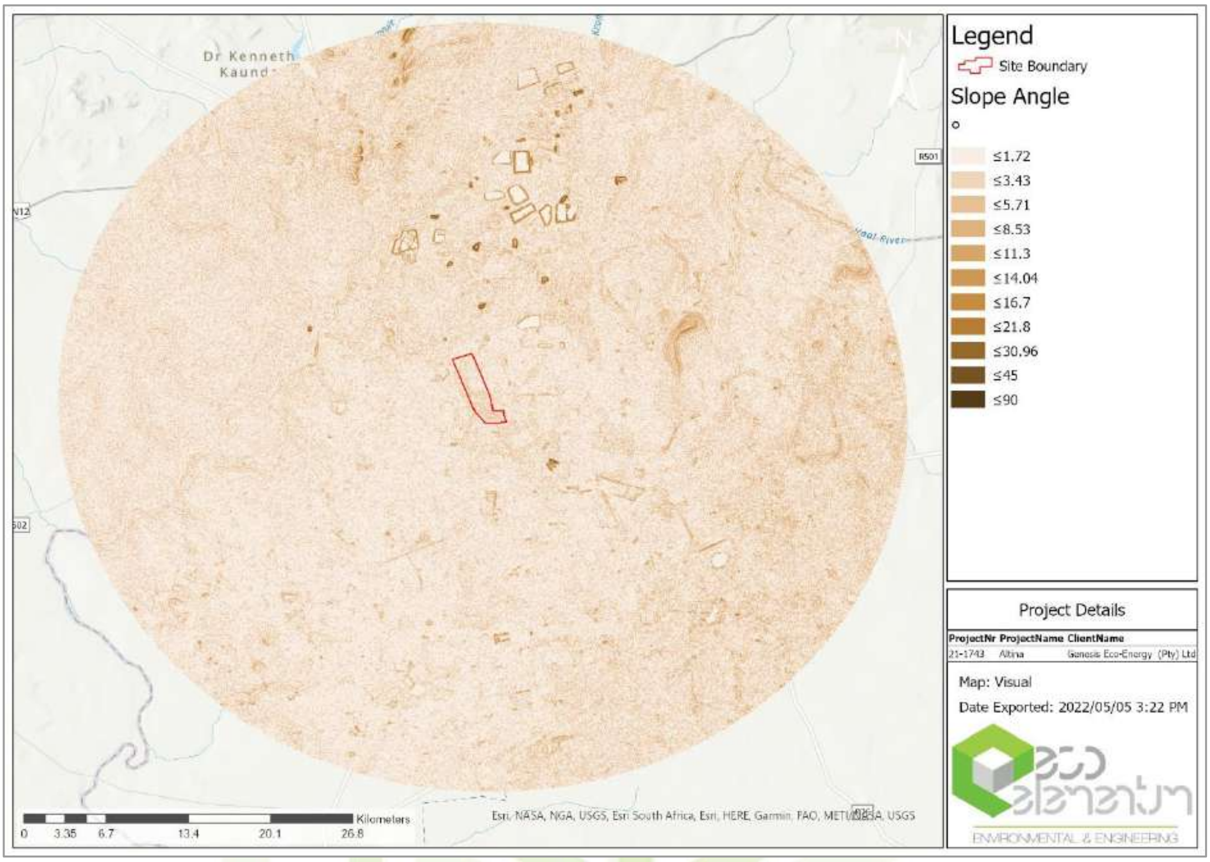

Figure 9: Slope angles of the terrain in the 15 km buffer area surrounding the proposed Altina Solar PV project

7.2 Aspect

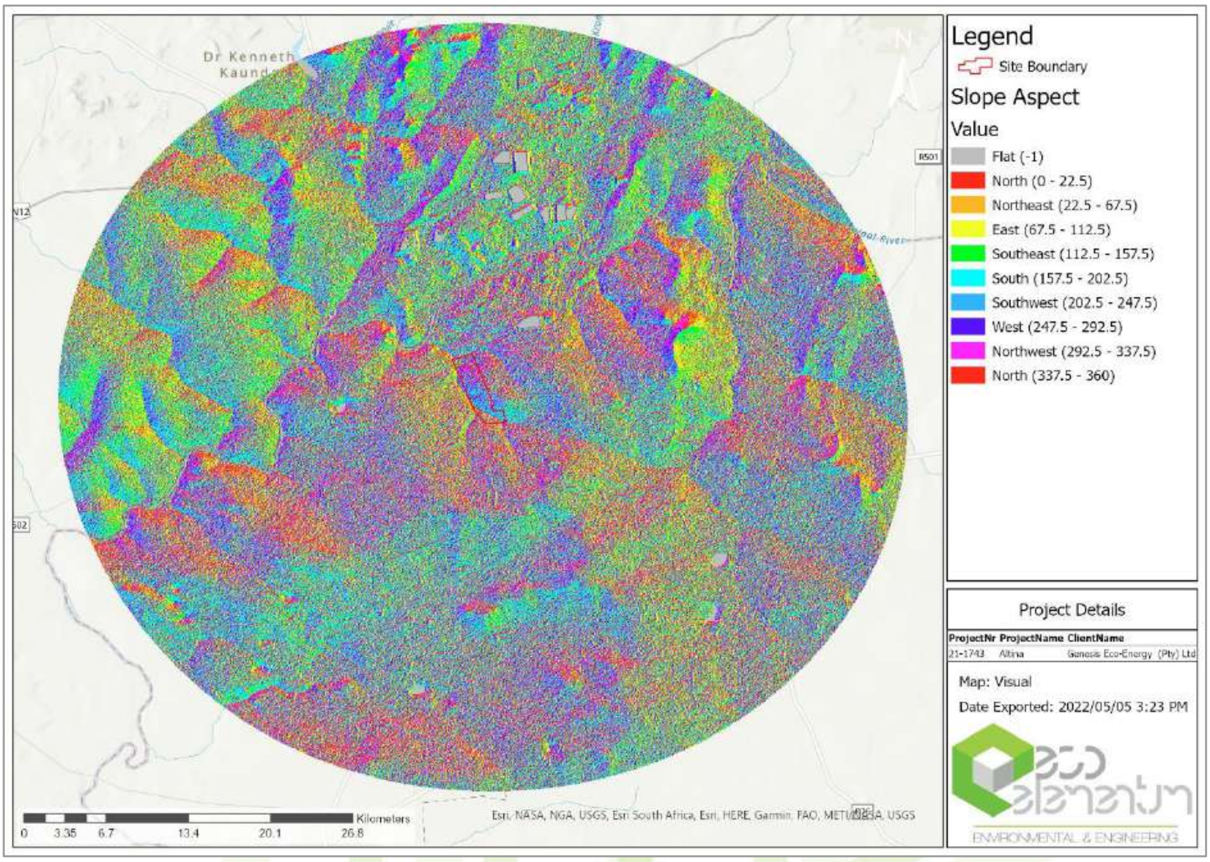

Figure 10: Aspect direction of the terrain in a 15 km buffer area surrounding the proposed Altina Solar PV project

7.3 Terrain Ruggedness

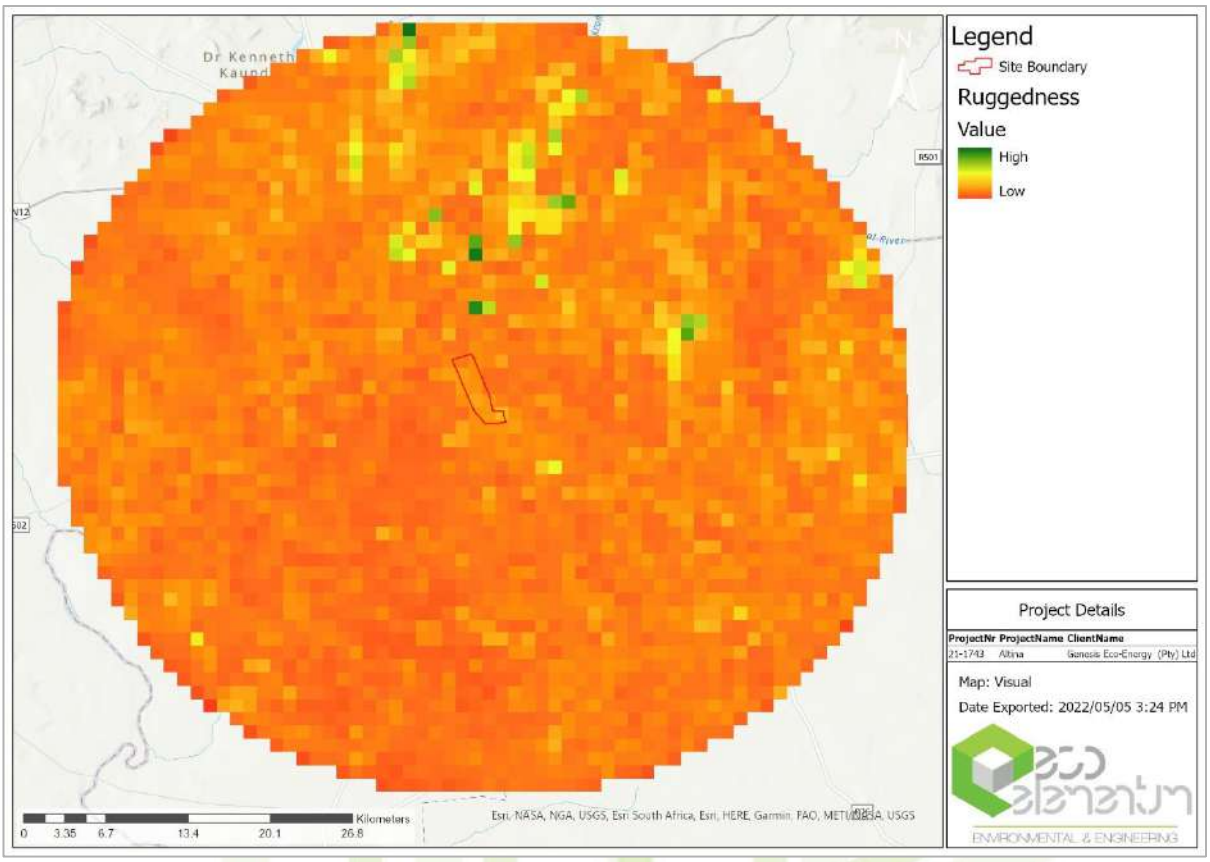

Figure 11: Terrain ruggedness in a 15 km buffer area surrounding the proposed Altina Solar PV project

7.4 RELATIVE ELEVATION

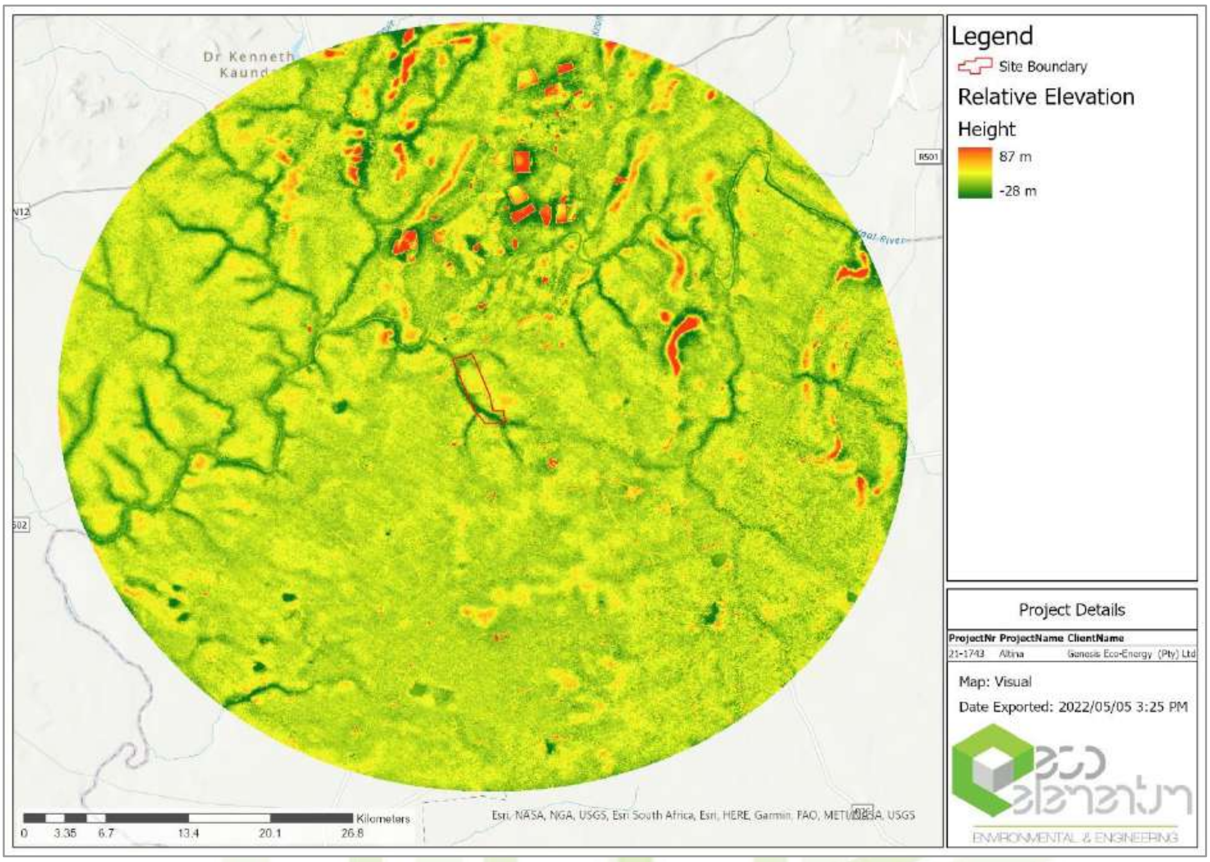

Figure 12: Relative Elevation of terrain in a 15 km buffer area surrounding the proposed Altina Solar PV project

7.5 LANDFORMS

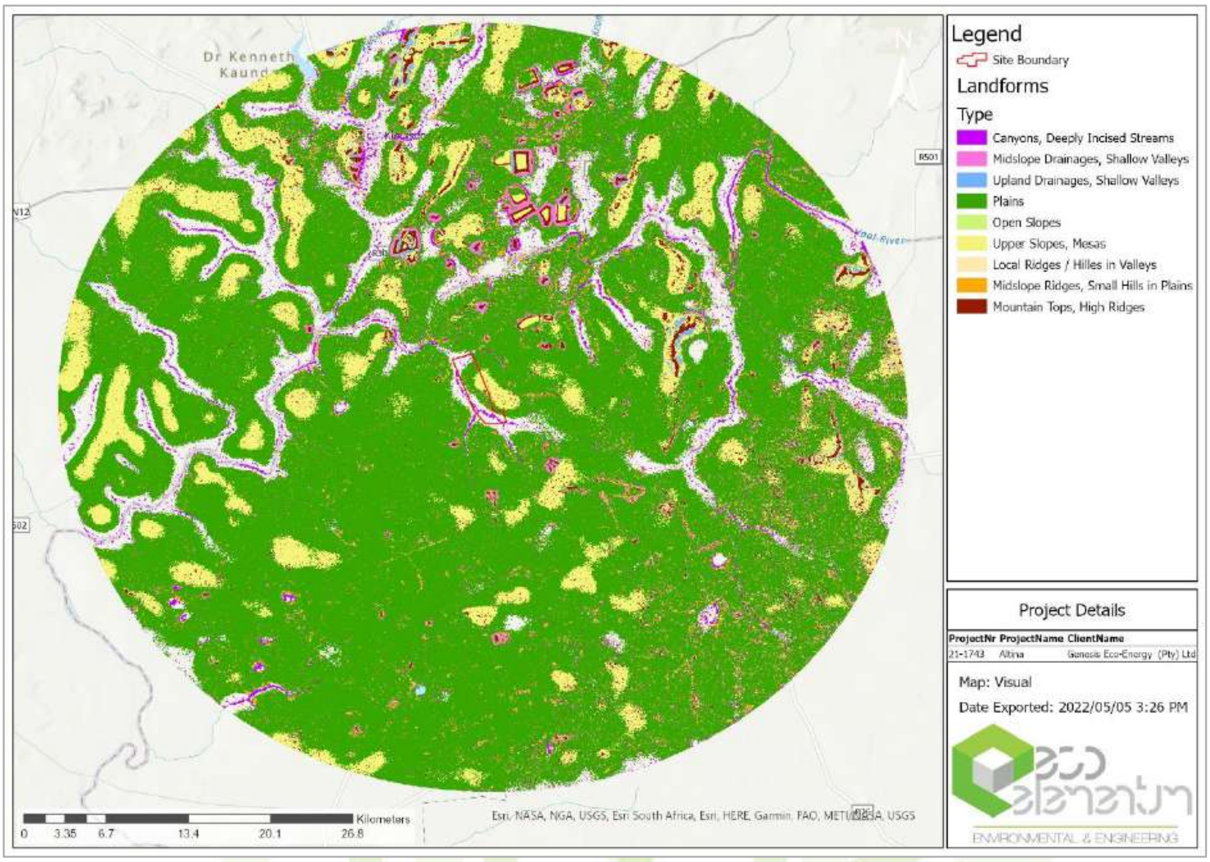

Figure 13: Landforms in a 15 km buffer area surrounding the proposed Altina Solar PV project

7.6 Slope Position

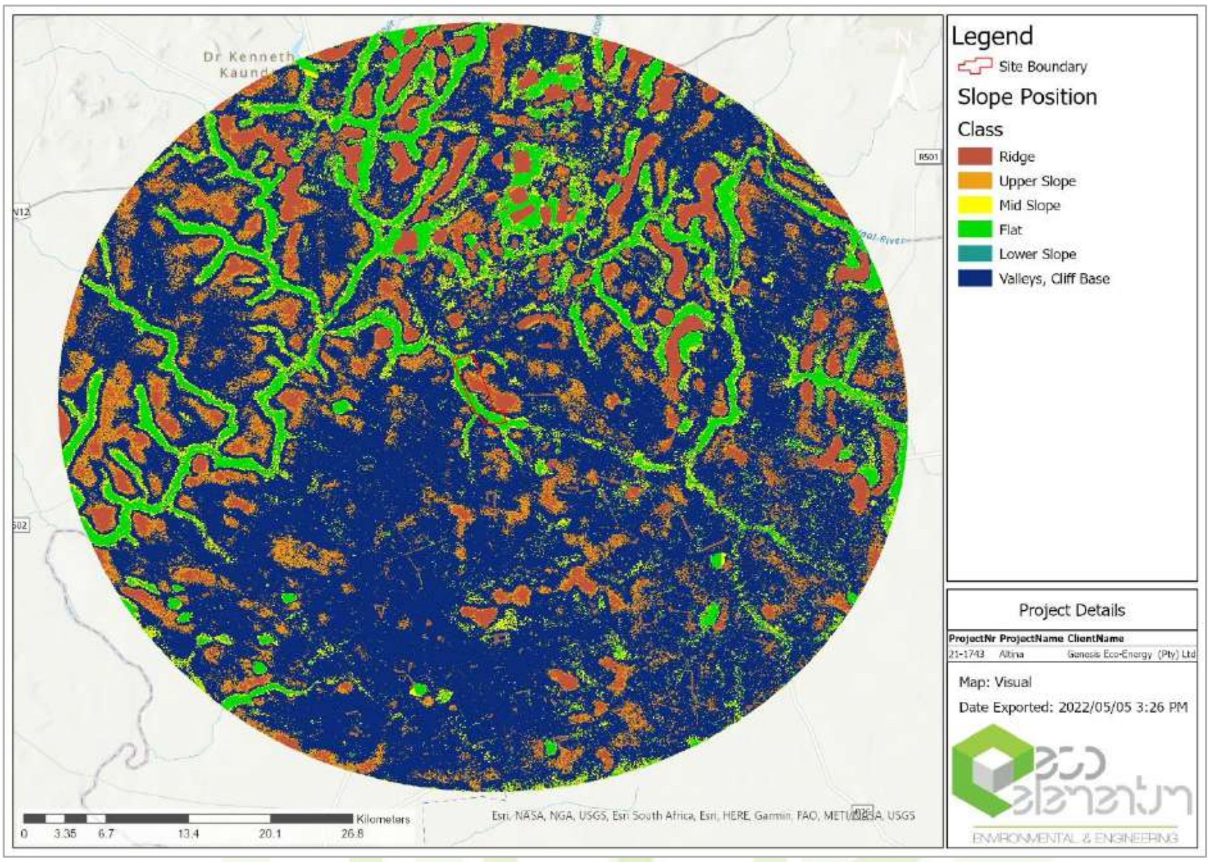

Figure 14: Slope Positions in a 15 km buffer area surrounding the proposed Altina Solar PV project

7.7 Landcover VAC

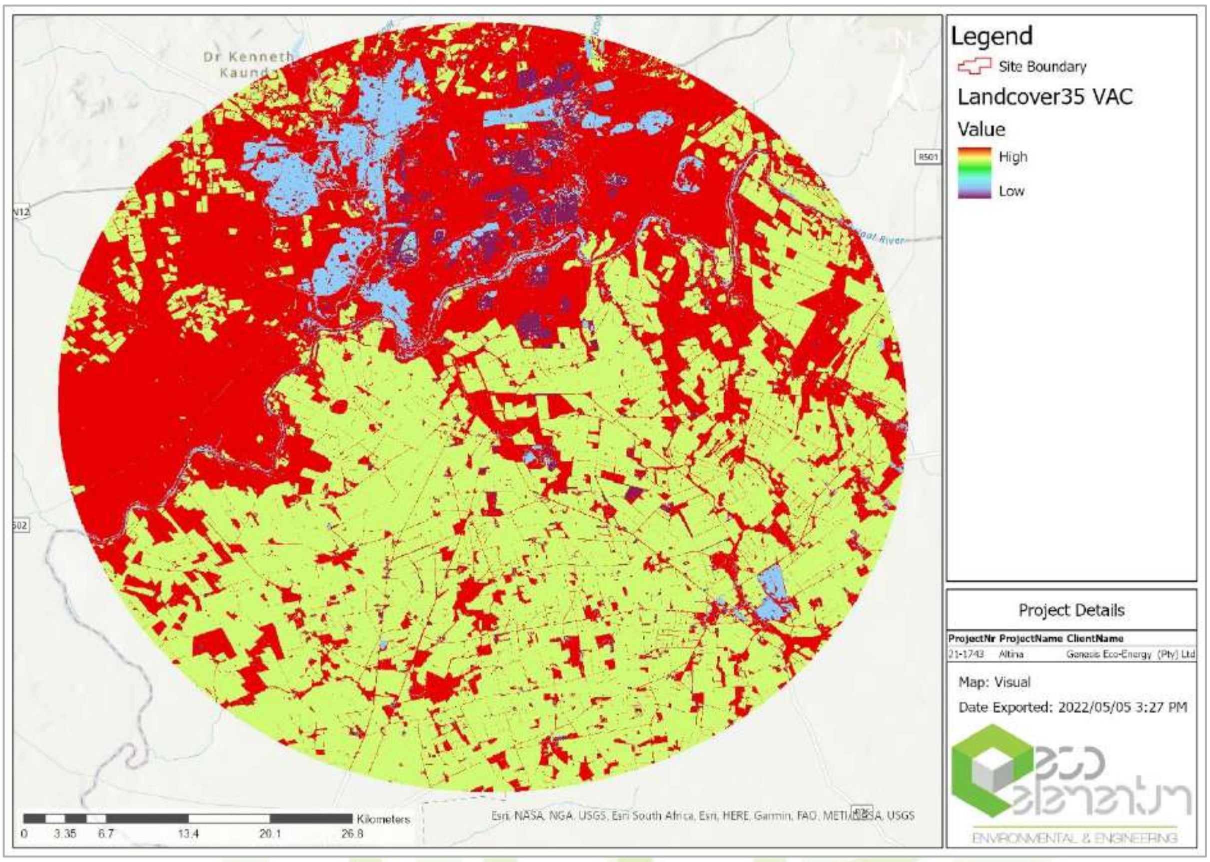

Figure 15: Possible VAC of the Landcover in a 15 km buffer area surrounding the proposed Altina Solar PV project

7.8 VIEWSHED VISIBILITY

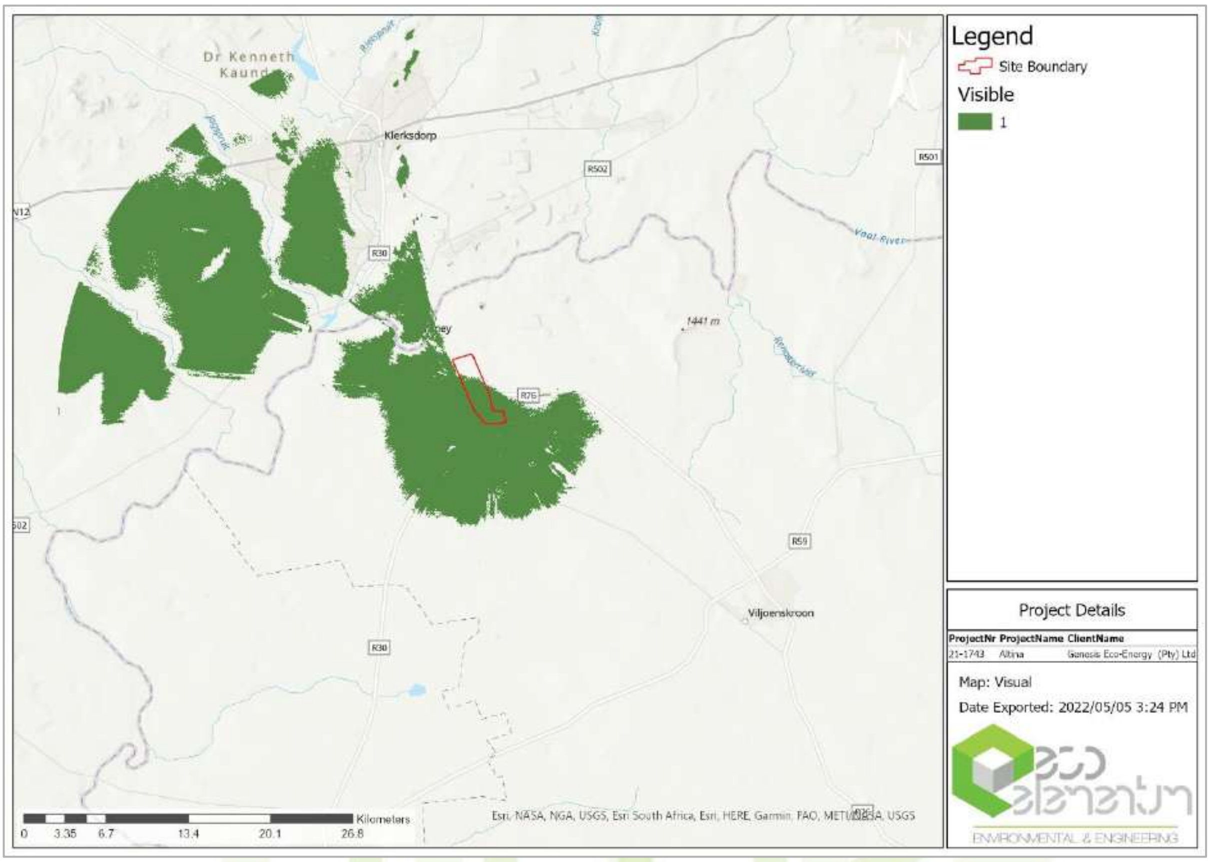

Figure 16: Viewshed of proposed Altina Solar PV project – Visibility of the surface infrastructure locations for Alternative 1

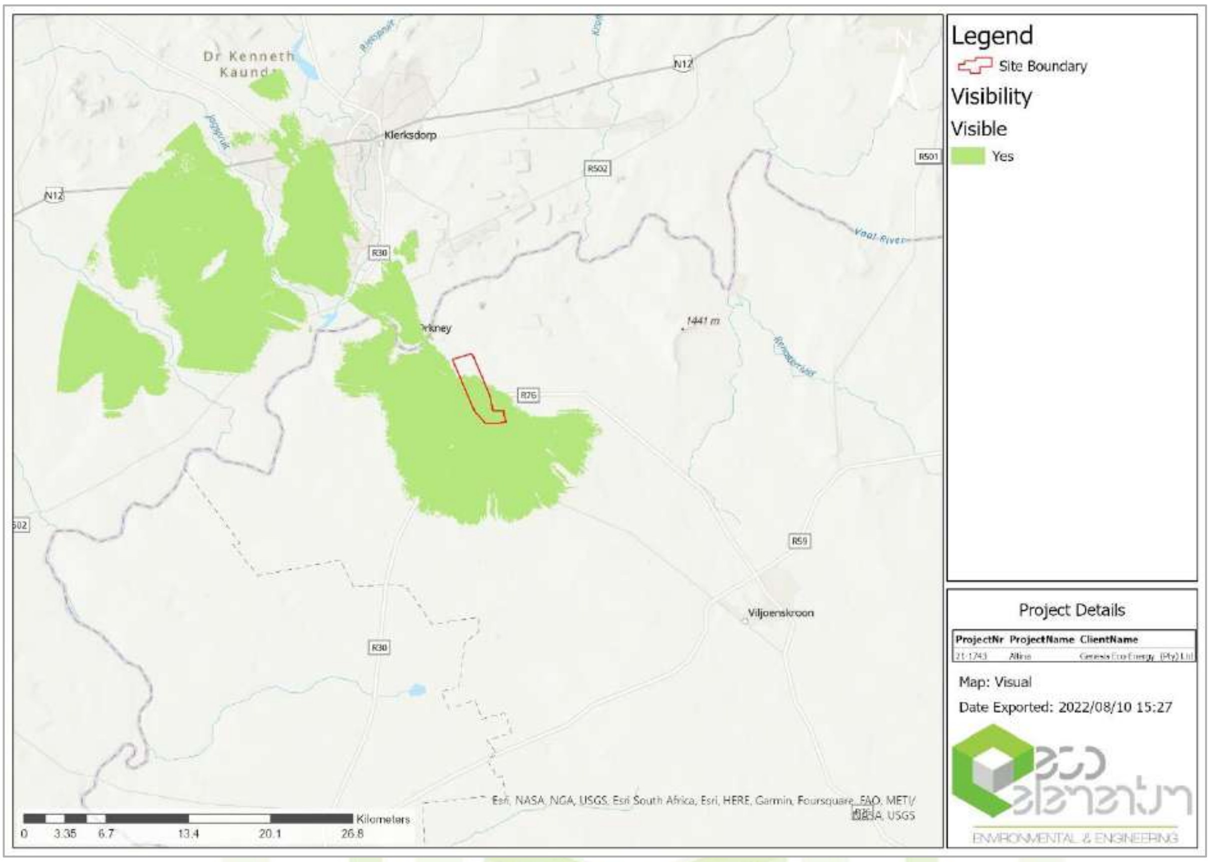

Figure 17: Viewshed of proposed Altina Solar PV project – Visibility of the surface infrastructure locations for Alternative 2

For the assessment of the visibility of the area, the viewshed has been calculated from where the surface infrastructure can be seen from any point on the map as seen in Figure 16 and Figure 17.

7.9 Viewshed Visibility – Distance Ranking

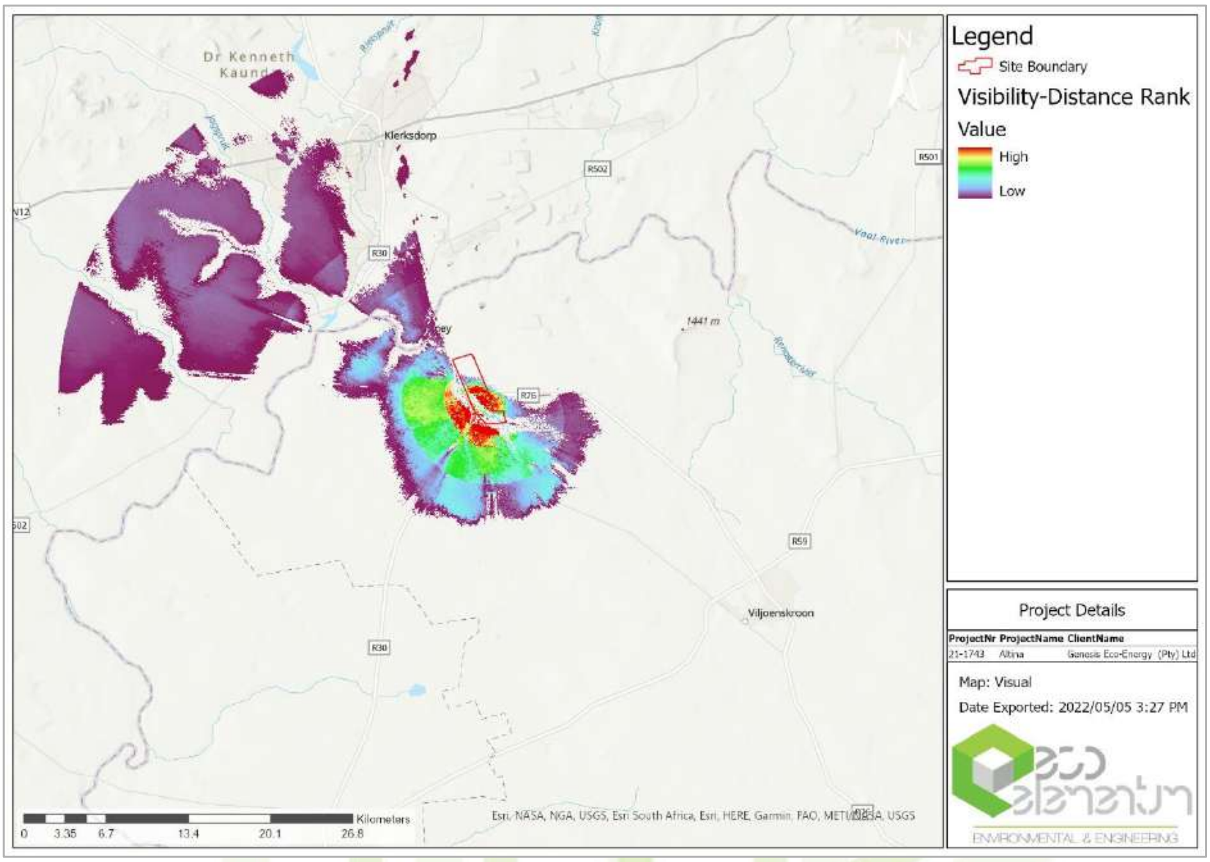

Figure 18: Viewshed of proposed Altina Solar PV project – Visibility ranked according to distance from source for Alternative 1

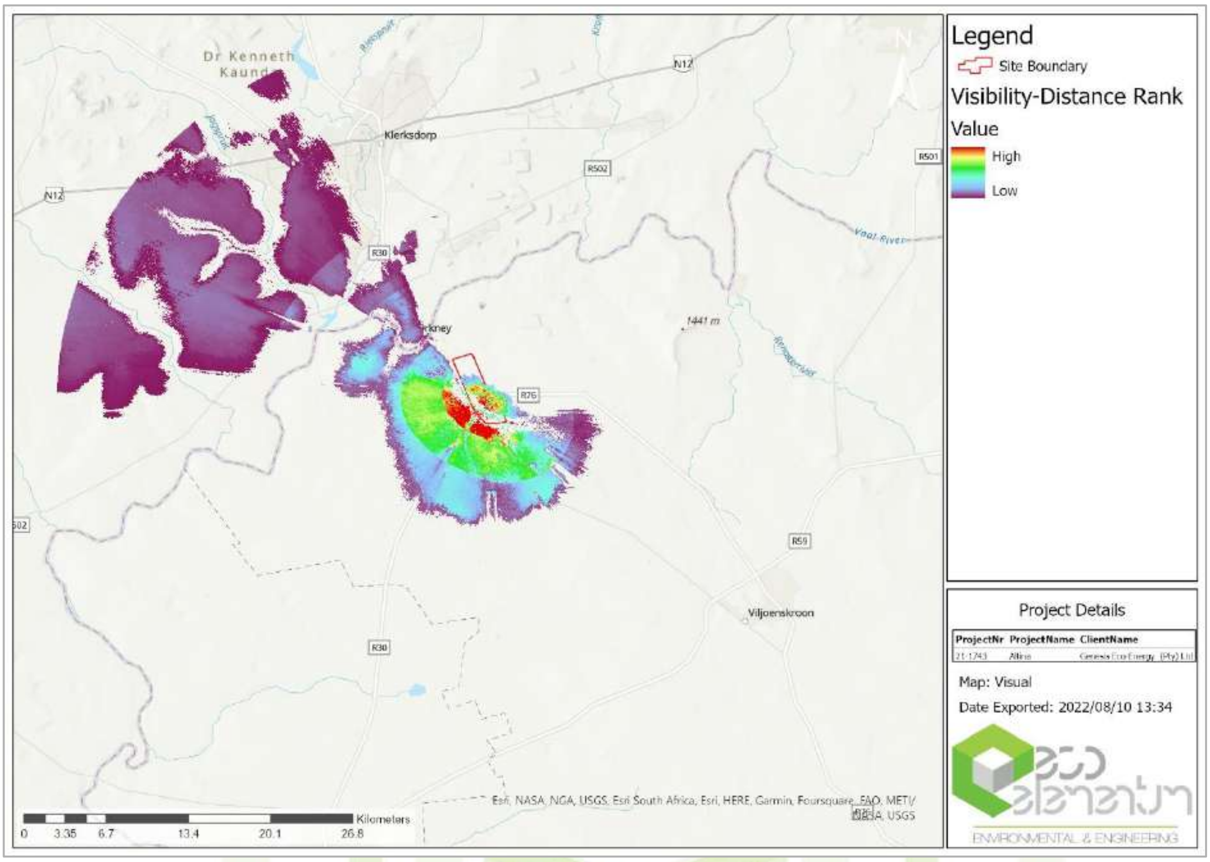

Figure 19: Viewshed of proposed Altina Solar PV project – Visibility ranked according to distance from source for Alternative 2

The View from the visibility section above is then further ranked based on distance from the centre of the proposed infrastructure site as seen in Figure 18 and Figure 19. Distances are ranked according to the table below.

Table 8: Visibility rating – Distance from proposed infrastructure development

12 – 15 km	Very Low
9 – 12 km	Low
6 – 9 km	Medium
3 – 6 km	High
0 – 3 km	Very High

7.10 VISUAL EXPOSURE RANKING

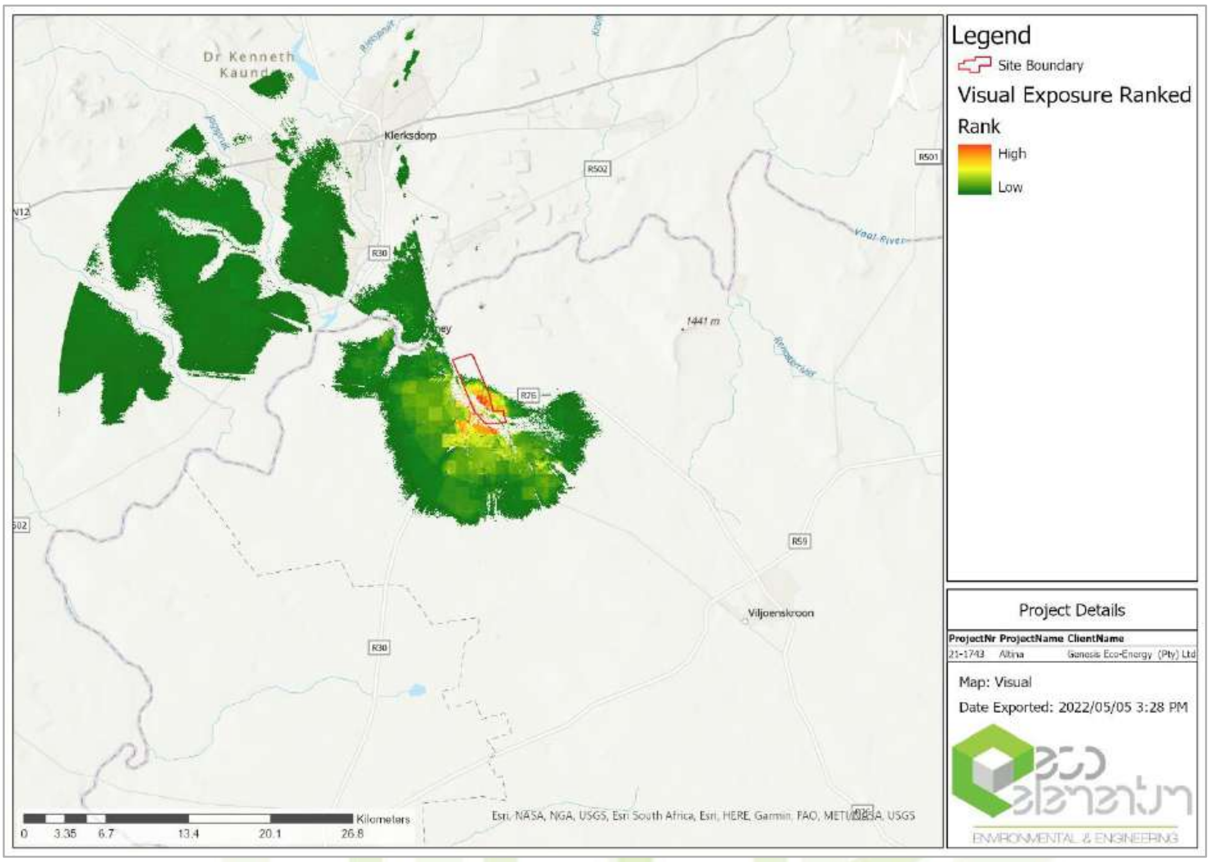

Figure 20: Visual Exposure ranking within a 15 km radius of the proposed Altina Solar PV project for Alternative 1

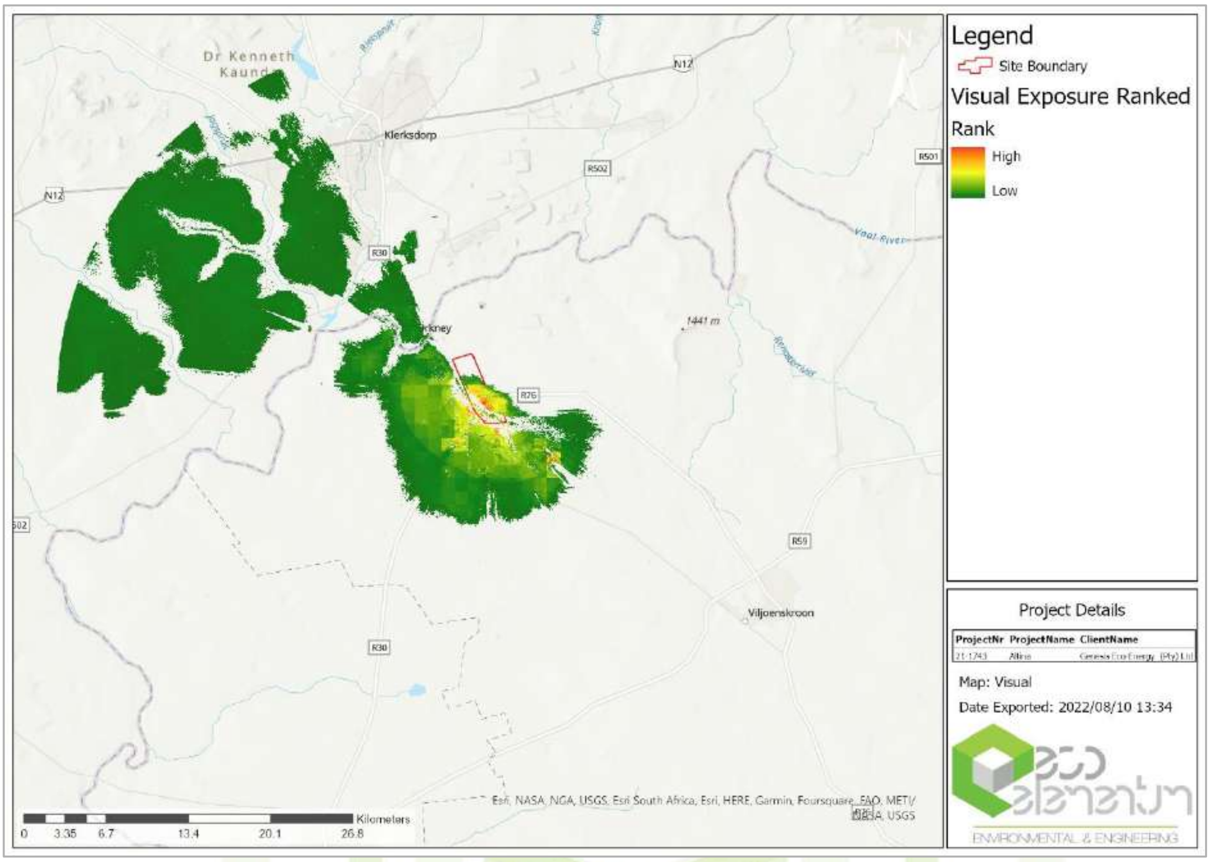

Figure 21: Visual Exposure ranking within a 15 km radius of the proposed Altina Solar PV project for Alternative 2

The visible infrastructure count is combined with the distance from the source ranking together with the VAC of the land cover types, the slope, aspect, ruggedness, relative elevation, landforms and slope position to get a quantitative Visual Exposure ranking of all the areas where it may be possible to see the proposed development as seen in Figure 20 and Figure 21.

Table 9: Visual Exposure Ranking – Distance from Proposed Infrastructure Development

1	Very Low
2	Low
3	Medium
4	High
5	Very High

7.11 VIEW POINTS

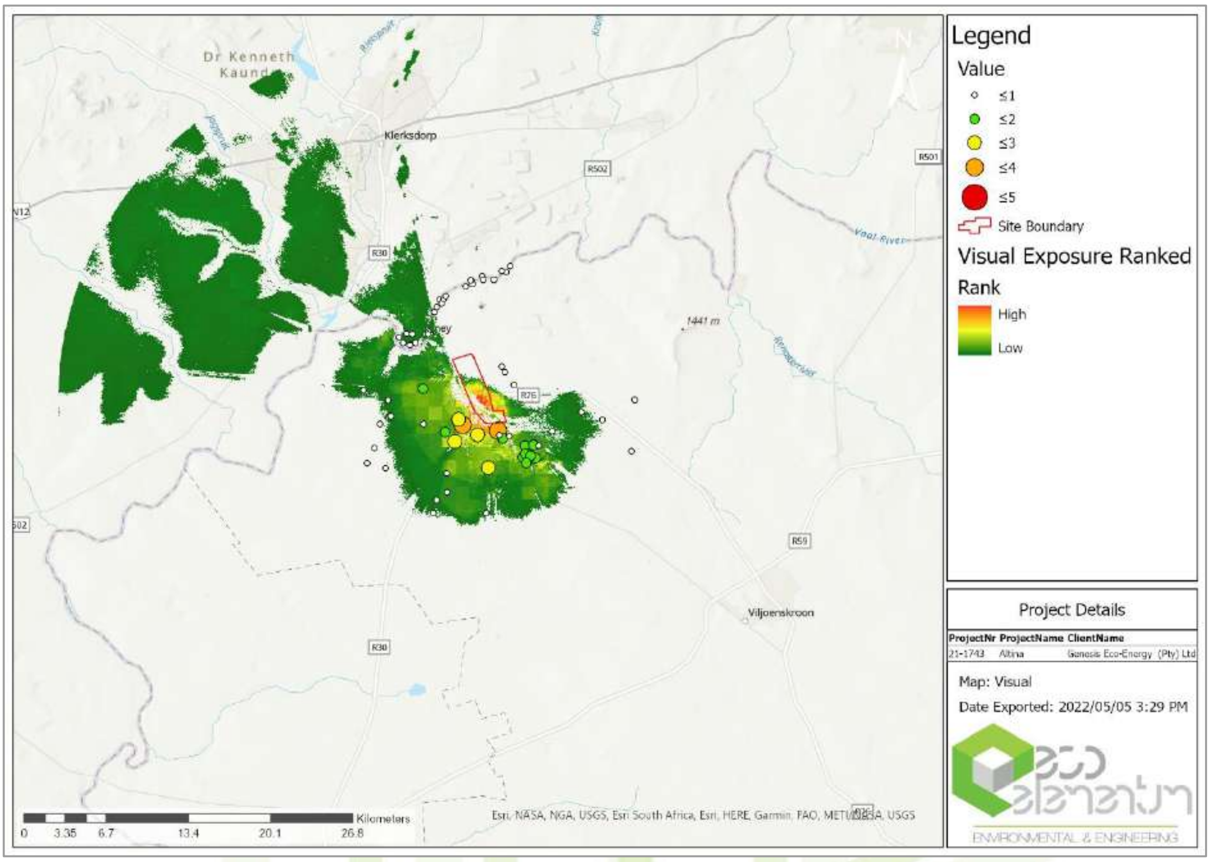

Figure 22: Viewpoint sensitive receptors overlaid on the Visual Exposure Ranking for Alternative 1

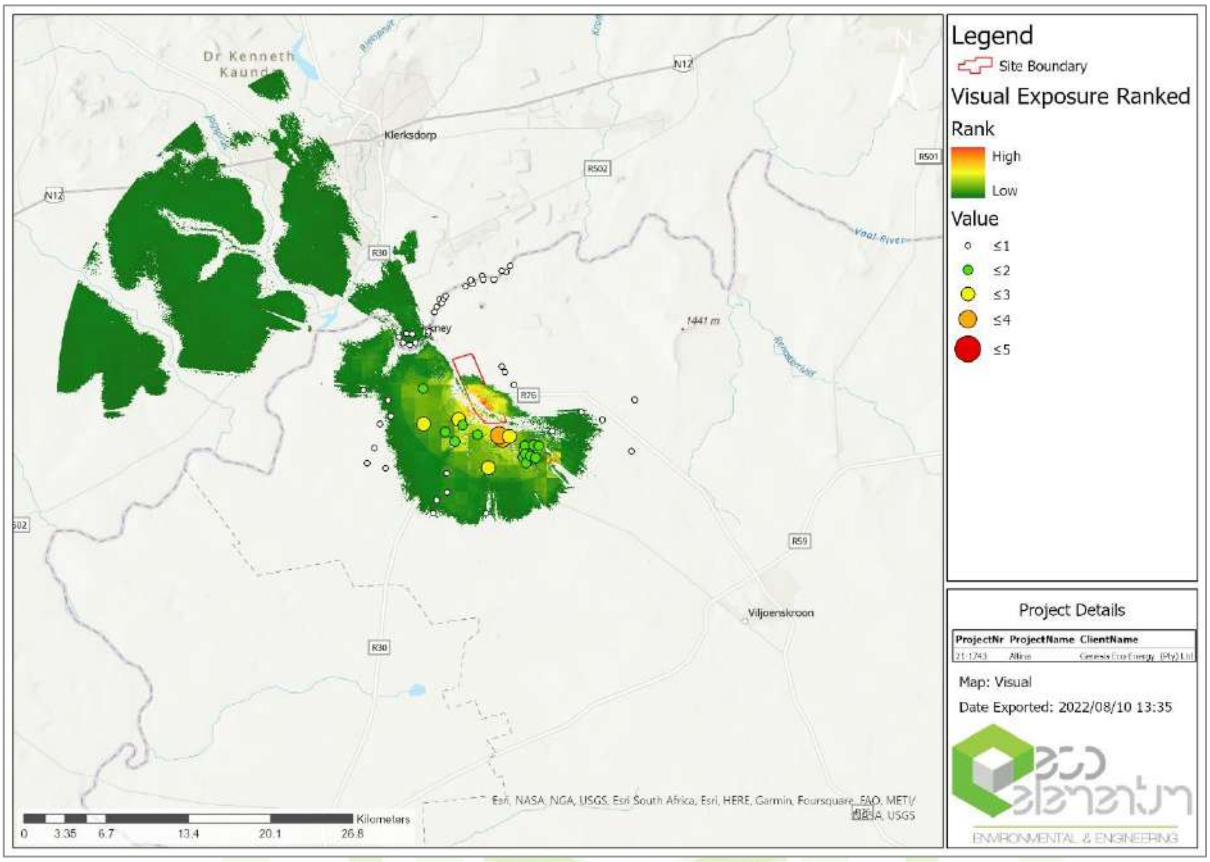

Figure 23: Viewpoint sensitive receptors overlaid on the Visual Exposure Ranking for Alternative 2

Each identified sensitive receptor is then overlaid on the Visual Exposure Ranking and the value extracted to that pixel to give a quantitative ranking for each of the identified sensitive receptors as can be seen in Figure 22 and Figure 23. Ranking is done from 1 to 5, 1 being very low and 5 very high.

Due to fact that topographic modification can take place by agricultural, vegetation and other activities in the area, the viewshed is only a theoretical study. The viewpoints have been identified based on the sensitivity of the areas to visual disturbance and areas that can be negatively impacted by the related structures.

Table 10: Quantified ranking of Visual Exposure each identified sensitive receptor may have due to proposed infrastructure

Visibility ratings		
ID	Alternative 1	Alternative 2
3		0.17
5	0.58	0.81
6	0.21	0.28
7	0.26	
8	0.23	0.41
27	0.27	
31	1.74	1.90
32	0.69	1.34
33	0.52	0.39
34	1.30	1.31
35	1.79	1.75
36	1.12	1.42
37	1.16	1.07
38	1.13	1.22
39	1.97	2.39
40	1.50	1.59
41	3.54	7.90
42		3.11
43	1.98	3.40
44		2.48
45	0.19	0.28
46	0.08	0.13
47	0.45	0.36
48	0.51	0.72
49	0.45	0.76
50	2.48	2.40
51	2.26	1.25
52	1.07	1.29
53	2.40	1.62
54	3.82	1.98
55	2.64	2.05
59	0.90	2.28

Visibility ratings		
ID	Alternative 1	Alternative 2
61	0.07	0.13
62	0.58	0.60
63	1.37	1.87
64	0.19	0.48
Count	33	34
AVG	1.2	1.5
Max	3.8	7.9

The above table display the results as calculated by the GIS. Only locations that did not receive a 0 are shown. Ratings are ranked 1 - 10, 1 being very low and 10 very high. The system only takes into account the variables as described in this report and the amount of infrastructure that would be visible. Factors like real time and micro scale vegetation are not taken into account, thus the actual rating may be lower or higher depending on the updated land use in the vicinity or latest vegetation growth or height on a micro and macro scale.

The table is by no means a rating of visual quality; it is rather used to determine the likelihood that the proposed infrastructure will be seen from the viewpoint receptors. It is also used to quantitively determine the best option in terms of visual impact.

When comparing the two alternatives from a visual impact perspective alternative 1 is predicted to have the least impact on the receiving environment. The amount of receptors predicted to be impacted are 33 for alternative 1 compared to 34 for alternative 2. The average rating for all the predicted receptors are also higher for alternative 2. The predicted maximum rating for all the receptors are also higher in alternative 2.

7.12 VISUAL IMPACT CRITERIA

The level of detail as depicted in the EIA regulations were fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project.

The impact assessment criteria used to determine the impact of the proposed development are as follows:

1. ***Severity*** of the impact;
2. **Spatial Scale** - The physical and spatial scale of the impact;
3. ***Duration*** - The lifetime of the impact, measured in relation to the lifetime of the proposed development;
4. ***Frequency of the Activity*** – How often do the activity take place;
5. ***Frequency of the incident/impact*** – How often does the activity impact on the environment;
6. ***Legal Issues*** – How is the activity governed by legislation; and
7. ***Detection*** – How quickly/easily the impacts/risks of the activity be detected on the environment, people and property.

To ensure uniformity, the assessment of potential impacts will be addressed in a standard manner so that a wide range of impacts is comparable. For this reason a clearly defined rating scale is provided for the specialist to assess impacts associated with the investigation.

Table 11: Assessment criteria

SEVERITY

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful / within a regulated sensitive area	5
SPATIAL SCALE	
Area specific (at impact site)	1
Whole site (entire surface right)	2
Local (within 5 km)	3
Regional / neighboring areas (5 km to 50 km)	4
National	5
DURATION	
One day to one month (immediate)	1
One month to one year (Short term)	2
One year to 10 years (medium term)	3
Life of the activity (long term)	4
Beyond life of the activity (permanent)	5
FREQUENCY OF THE ACTIVITY	
Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5
FREQUENCY OF THE INCIDENT/IMPACT	
Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5
LEGAL ISSUES	
No legislation	1
Fully covered by legislation	5
DETECTION	
Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5
Immediately	1

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

7.12.1 Consequence

Consequence is determined by the following equation after the assessment of each impact.

Consequence = Severity + Spatial Scale + Duration

7.12.2 Likelihood

The Likelihood of the activity is then calculated based on frequency of the activity and impact, how easily it can be detected and whether the activity is governed by legislation. Thus:

Likelihood = Frequency of activity + frequency of impact + legal issues + detection

7.12.3 Risk

The risk is then based on the consequence and likelihood.

Risk = Consequence x likelihood

7.12.4 Impact Ratings

The impact is then rated according to the following table:

Table 12: Impact Rating Table

Rating	Class
1-55	(L) Low Risk
56-169	(M) Moderate Risk
170-600	(H) High Risk

8. VISUAL IMPACT ASSESSMENT

The previous section identified specific areas where, and likelihood of, the potential visual impact would occur as well as scenario with the least predicted visual impact on the sensitive receptors. This section will attempt to quantify these visual impacts in their respective geographic locations and in terms of the identified issues related to the visual impact.

8.1 POTENTIAL CONSTRUCTION PHASE VISUAL IMPACT OF THE STRUCTURES

Table 13: Summarizing the significance of visual impacts on the viewpoint with an Exposure rating for the Construction phase.

Nature of impact: Potential visual impact on the viewpoints that had a visual exposure rating for the construction phase.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**2**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**1**	**1**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**2**	**2**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**4**	**4**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**1**	**1**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**3**	**3**
Consequence	Severity + Spatial Scale + Duration	**5**	**5**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**12**	**11**
Risk	Consequence * Likelihood	**MODERATE (60)**	**LOW (55)**
Mitigation:	The visual impact can be minimized by not clearing the full surface below the solar PV module. Clear only the areas that is necessary.		
Cumulative Impact:	The construction of the proposed Altina Solar PV project with its associated infrastructure will increase the cumulative visual impact of Solar PV type infrastructure within the region. In context of the existing agriculture, mine, and town border, the construction phase of Altina Solar PV structures will contribute to a regional increase in heavy vehicles on the roads in the region, with construction activity noticeable.		

The impact on the surrounding farmers and land users will be more significant but can still be seen as MODERATE because of the short time the proposed activity will be undertaken. Although the construction activities will be highly visible, the time of exposure is short and thus the impact on the users will be low after mitigation measures have been implemented.

8.2 Potential Permanent Visual Impact Of The Structures

Visibility is determined by a line of sight where nothing obscures the view of an object. Exposure is defined by the degree of visibility, in other words "how much" of it can be seen. This is influenced by topography and the incidence of objects such as trees and buildings that obscure the view partially or in total.

Potential permanent visual impact on the Viewpoints is expected to have a MODERATE impact before mitigation and MODERATE significance after mitigation, as indicated in the table below. The structures will be MODERATE visible from the Viewpoints, the time of exposure is permanent and thus the impact on the users will still remain MODERATE.

Table 14: Impact table summarising the significance of the structures on users of roads and land-users

Nature of impact: Potential visual impact on the viewpoints that had a visual exposure rating.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**2**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**4**	**2**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**4**	**4**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**5**	**5**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**1**	**1**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**3**	**3**
Consequence	Severity + Spatial Scale + Duration	**10**	**8**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**13**	**12**
Risk	Consequence * Likelihood	**MODERATE (130)**	**MODERATE (96)**
Mitigation:	The visual impact can be reduced by revegetating the surface below the solar PV modules. Paint any supporting structures dark colours to match the Solar PV modules to reduce the contrast between the structures and solar PV modules.		
Cumulative Impact:	The construction of the proposed Altina Solar PV structures with its associated infrastructure will increase the cumulative visual impact of Solar PV type infrastructure within the region. In context of the existing agriculture, mine and town, the added structures will contribute to a slight regional increase in small vehicles on the roads.		

The permanent impact on the surrounding farmers and land users will be increased due to the solar PV structures added to the area.

The modelling of visibility is merely conceptual. Being based on DEM and Land cover data, it does not take into account the real world effect of buildings, trees etc. that could shield the structures from being visible or could have changed over time.

The viewshed analysis therefore signifies a worst-case scenario. The immediate landscape surrounding the observer has a determining influence on long distance views. It is expected that different land cover may offer some degree of visual screening, especially where tall trees occur around farmsteads. This influence was quantified using the land cover data, it must however be noted that this can change on a micro scale or land cover may have changed over time.

The viewshed analysis was generated and refined to reflect the visual exposure of the development according to its actual position in the landscape, as per the general assumed mining related infrastructure.

8.3 Cumulative Impacts

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise of a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the inter-visibility (visibility) of a range of developments and / or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effects on visual receptors within their combined visual envelopes. Inter-visibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The Landscape Institute, 1996).

- The cumulative visual intrusion of the proposed Altina Solar PV structures, will be MODERATE as it is a Solar PV operation. The site location is also in proximity to mining operations which decreases the visual impact further. The visual impact and impact on sense of place of the proposed project will contribute to the cumulative negative effect on the aesthetics of the study area. It is recommended however, that the environmental authorities consider the overall cumulative impact on the agricultural and scattered mining character and the areas sense of place before a final decision is taken with regard to the optimal number of solar PV projects in the area.

8.4 Mitigation Measures

Mitigation measures may be considered in two categories:

- Primary measures that intrinsically comprise part of the development design through an iterative process. Mitigation measures are more effective if they are implemented from project inception when alternatives are being considered.
- Secondary measures designed to specifically address the remaining negative effects of the final development proposals.

Primary measures that will be implemented will mainly be measures that will minimise the visual impact by softening the visibility of the structures by "blending" with the surrounding areas. Such measures will include the following:

- Revegitate the surface below the solar PV modules.
- Paint any supporting structures the same dark colours as the solar PV modules to reduce the contrast.

Secondary measures will include final rehabilitation, after care and maintenance of the vegetation and to ensure that the final landform is maintained.

9. CONCLUSION

The construction and operation phase of the proposed Altina Solar PV project related activities and its associated infrastructure will have a MODERATE visual impact on the natural scenic resources and the topography. However, with the correct mitigation measures the impact might decrease to a point where the visual impact can be seen as less significant. The moderating factors of the visual impact of the proposed solar PV plant in close range are the following:

- Number of human inhabitants and mining operations located in the area;
- Natural topography and vegetation;
- Mitigation measures that will be implemented;

In light of the above mentioned factors that reduce the impact of the facility, the visual impact is assessed as MODERATE VISUAL IMPACT after mitigation measures have been implemented.

Table 15: Summary of the Quantified ranking of Visual Exposure each identified sensitive receptor may have due to proposed infrastructure

Visibility ratings		
ID	Alternative 1	Alternative 2
Count	33	34
AVG	1.2	1.5
Max	3.8	7.9

When comparing the two alternatives from a visual impact perspective alternative 1 is predicted to have the least impact on the receiving environment. The amount of receptors predicted to be impacted are 33 for alternative 1 compared to 34 for alternative 2. The average rating for all the predicted receptors are also higher for alternative 2. The predicted maximum rating for all the receptors are also higher in alternative 2.

From a visual impact perspective Alternative 1 is predicted to have the least impact on the receiving environment.

Table 16: The overall Assessment of the Visual Impact

Nature of impact: The overall Assessment of the Visual Impact of the area.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**2**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**4**	**2**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**4**	**4**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**5**	**5**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**

Nature of impact: The overall Assessment of the Visual Impact of the area.			
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**1**	**1**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**3**	**3**
Consequence	Severity + Spatial Scale + Duration	**10**	**8**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**13**	**12**
Risk	Consequence * Likelihood	**MODERATE (130)**	**MODERATE (96)**
Mitigation:	The visual impact can be reduced by revegetating the surface below the solar PV modules. Paint any supporting structures dark colours to match the Solar PV modules to reduce the contrast between the structures and solar PV modules		
Cumulative Impact:	The construction of the proposed Altina Solar PV structures with its associated infrastructure will increase the cumulative visual impact of Solar PV type infrastructure within the region. In context of the existing agriculture, mine and town, the added structures will contribute to a slight regional increase in small vehicles on the roads.		

The Visual Impact due to the activities and associated infrastructure can be seen as having a MODERATE impact on the surrounding environment and inhabitants before mitigation measures are implemented. After mitigation, the visual impact can be seen as MODERATE. Although visual impacts of Solar PV plants cannot be mitigated effectively, it is important to reduce the visual impact to acceptable levels. The mitigation measures described in this report are best practice for the Burau of Land Management in the United States of America and considered effective to reduce the visual impact as reasonably possible for the project to go ahead.

10. REFERENCE

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- *CSIR/ARC, 2000. National Land-cover Database 2000 (NLC 2000).*
- *The Landscape Institute, Institute of Environmental Management & Assessment. 2002.* ***Guidelines for Landscape and Visual Impact Assessment****. Second Ed. E & FN Spon, London (117).*
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APPENDIX E8: Social Impact Assessment

Genesis Eco-Energy Developments (PTY) LTD

PROPOSED ALTINA 120MW SOLAR PHOTOVOLTAIC & 40MW BATTERY ENERGY STORAGE SYSTEMS PROJECT NEAR THE TOWN OF ORKNEY, FREE STATE PROVINCE

SOCIAL IMPACT ASSESSMENT REPORT

31 October 2022

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Executive Summary

Genesis Eco-Energy Developments (PTY) LTD has proposed the construction of the Altina 120MW Solar Photovoltaic, 40MW Battery Energy Storage Systems Project in the Free State Province. The purpose of the project is to generate electricity to supplement the national electricity supply.

Project Alternatives

Various technical alternatives were provided by the developer, the choice between these alternatives do not impact upon the conclusions drawn in this study.

Methodology

The following activities were conducted as part of the SIA: defining the study area; detailing the project scope; a situation analysis describing the social status of the study area, engagement with stakeholders through the EIA public participation process; and an impact assessment and recommended mitigation measures to reduce the identified impacts.

The study area for the project has been defined for the purposes of analysing the project and its social impacts as the Fezile Dabi District Municipality.

Situation Analysis

The land use of the project is predominantly agricultural, with grazing lands forming the bulk of the land use.

The Fezile Dabi District Municipality covers a geographical area of 20 829.9 square kilometres (km^2) and has a population of 527 788 people living within 166 000 households. This gives the municipality a population density of 23.8 people per square kilometre people and a household density of 3.4/km. The official unemployment rate in the regional study area was 33.9% in 2011. Educational attainment in the district municipality shows that 35% of the population are functionally illiterate, having either never been to school, or who have partially completed primary school. A further 39% are literate, having completed primary school and some secondary education. Twenty three percent of the population have completed high school, with a further four percent having obtained some tertiary qualification.

During the period of 2020 & 2021, the wholesale and retail trade and community services were the largest sectors of the regional economy. Together they accounted for 42% of the economic output.

Manufacturing, private household and agriculture comprise the nest 38% of the economy, with a roughly equal split of 13% of the economy.

The community sector, which includes the government services, is generally a large contributor towards the economic output in smaller and more rural local municipalities. This, combined with the large contributions made by agriculture and from private household economic activity reveal a rural economy with a base found in farming and providing services to its population. Manufacturing makes a 13% contribution, and this serves to broaden the base of the economic output of the region.

Stakeholder Engagement

Stakeholder engagement was carried out using the public participation process during the EIA. Stakeholders involved in the engagement were landowners, community groups and other interested groups. During this engagement no social concerns were raised by members of the community. It is hoped that during the draft phase, additional comments will surface and this report will be updated accordingly.

Identification of Activities, Aspect and Impacts

The social impacts of the proposed development were generated both by engagement with stakeholders, as well as by using the specialist's teams experience of projects of this nature. The impacts were divided into categories and were identified as follows:

- Family and Community impacts – related to an influx of workers to the area;
- Institutional, legal, political and equity impacts - attitude formation towards the project, decreased level of community participation in decision making, loss of empowerment and compliance with municipal by-laws;
- Gender relations - Cultural resistance towards women; and Division of labour
- Economic opportunity (positive) – the economic stimulus created by the project, increase in employment opportunities, increased electricity supply to the national grid, increased opportunities for SMMEs and indirect employment impacts;
- Economic opportunity (negative) – these pertain to the potential negative impact on agricultural production should the proposed project go ahead. This technical determination was the subject of agricultural specialists to assess in a separate study to the EIA;
- Construction Phase Impacts – noise and dust, workers health and safety and security.

Mitigation Measures

Relevant and appropriate mitigation measures are proposed in the report and the implementation of these mitigation measures is expected to reduce the social impacts of the project to lower levels.

Local labour and business stand to benefit from the economic stimulus of construction of the proposed project. As a result, mitigation measures encourage active participation of the local community.

Disturbances that may occur during the construction phase can be successfully mitigated through contractor management.

Impact Statement

The regional study area is a rural economy with a narrow base, population growth is lower than in surrounding areas and the per capita economic performance is lower than in surrounding local jurisdictions. The project site has very few social receptors surrounding the site, and the project has a low footprint on the social environment. The social and economic impacts of the project are expected to be mainly positive in the sense that the local economy will be stimulated and broadened. The negative impacts are limited in nature and scope and can be successfully mitigated by management rules and practises. It is therefore found that the project, once the recommended mitigation measures have been implemented, has a nett positive impact on the social environment of the regional study area.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AIDS	Acquired immunodeficiency syndrome
COVID-19	(Novel) Coronavirus Disease 2019
CRR	Comments and Response Report
DEA	Department of Environmental Affairs
DFA	Development Facilitation Act (Act 67 of 1995)
DWAF	Department of Water Affairs and Forestry
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
FDDM	Fezile Dabi District Municipality
GIS	Geographic Information System
HIV	Human Immunodeficiency Virus
IAP	Interested and Affected Party
ILO	International Labour Organisation
ISO	International Organisation for Standardization
km	Kilometre (1 000m)
NDP	National Development Plan
NEMA	National Environmental Management Act (No. 107 of 1998)
MLM	Moqhaka Local Municipality
MW	Mega Watt (one million watts)
OHS	Occupational Health and Safety
PAJA	Promotion of Administrative Justice Act ((PAJA) Act 3 of 2000)
PV	Photovoltaic
SIA	Social Impact Assessment
STI/STD	Sexually Transmitted Infections / Sexually Transmitted Disease

1 INTRODUCTION

Caroline Tanhuke and Ciaran Chidley of Nemai Consulting have been appointed to undertake the Social Impact Assessment (SIA) as part of the environmental authorisation process for the proposed Altina 120MW Solar Photovoltaic (PV) and 40MW Battery Energy Storage (BESS) Project.

This solar PV generator aims to provide 120MW of electricity to the electrical grid, as well as to supply 40MW of Battery Energy Storage. The project is being prepared for submission to bid for the current and future Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) bid windows and/or other renewable energy markets within SA.

The proposed project is located to the south east of the town of Orkney in the Free State Province.

One of the specialist studies required by the Environmental Impact Assessment (EIA) is a Social Impact Assessment. This report fulfils the requirements of the Social Impact Assessment and its recommendations will be included into the EIA.

This report was issued in draft form on 11 September 2022 for the purposes of public review. This version is the final report, dated 31 October 2022. Changes made in the final version are the updating of alternative layout 2, adding findings from the stakeholder engagement phase of the study and adding water use considerations into the mitigation measures. There has been no material change to the findings and recommendations in the final report.

1.1 Terms of Reference

The terms of reference for the study are as follows:

- Describe the Social baseline conditions that may be affected by the project;
- Describe the approach proposed for assessing the potentially significant issues that should be addressed by the SIA during the EIA phase;
- Determine the specific local social impacts of the project;
- Identify the potential social issues associated with the project;
- Suggest suitable mitigation measures to address the identified impacts; and
- Make recommendations on preferred options from a social perspective.

1.2 Structure of the report

The remainder of the report is structured as follows:

Section 2: Legislation – A description of the statutory and regulatory requirements that informed this report.

Section 3: Project Description – This section provides an introduction and motivation to the project. It includes a description of the study area.

Section 4: Methodology – Outline the methodology used to determine the social impacts of the proposed project.

Section 5: Situational Analysis – A desktop analysis of the baseline situation in the study area. The section includes a discussion on the findings that resulted from community engagement, site visits and stakeholder participation.

Section 6: Identification of Impacts - Aspects and Impacts – The identification of the project activities and an investigation into what aspects of these activities will result in social impacts.

Section 7: Analysis of Alternatives – Decision making with regards the preferred project alternatives from a social perspective.

1.2 Specialist Details

This report is written by Caroline Tanhuke and Ciaran Chidley. Ciaran Chidley obtained bachelor degrees in civil engineering, economics and philosophy, and holds a Master of Business Administration. His experience over the past 26 years includes economic and social assessments for a wide variety of linear and site-based infrastructure and industrial projects. Caroline Tanhuke holds B.A Environmental Management (Geography) Degree and has three years of experience. Her experience in assessing social impacts of infrastructure projects include powerlines and pipelines. She has conducted social facilitation projects throughout South Africa.

1.3 Specialist Declaration

Nemai Consulting operates as an independent consultant conducting environmental impact assessments and associated specialists' studies. 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).

2 LEGISLATION

Legislation, policy, plans and strategy provide an important framework and governance of the SIA. This section provides a summary of the prevailing acts, policies, plans and strategy which were considered by this study.

2.1 Constitution of the Republic of South Africa (Act 108 of 1996)

As contained in the Constitution the rights of all South Africans are protected as outlined in Chapter 2: The Bill of Rights. These rights form the basis of democracy in South Africa. The Constitution (including the Bill of Rights) binds the Legislature, the Executive, the Judiciary and all organs of state and is the overriding legislation of South Africa.

While all items in the Bill of Rights are considered to be of equal importance, key items in the Bill of Rights that have a bearing on social rights and issues in this project include (but are not necessarily limited to):

- Life: Everyone has the right to life;
- Human Dignity: Everyone has inherent dignity and the right to have their dignity respected and protected;
- Equality: Everyone is equal before the law and has the right to equal protection and benefit from the law;
- Freedom of religion, belief and opinion: Everyone has the right of freedom of conscience, religion, thought, belief and opinion;
- Environment: Everyone has the right to an environment that is not harmful to their health or well-being, and to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development;
- Property: No person may be deprived of property except in terms of the law of general application, and no law may permit arbitrary deprivation of property. Property may be expropriated only in terms of the law of general application for a public purpose (e.g. National Water Act, Act No. 36 of 1998 and Expropriation Act, Act No. 63 of 1975) or in the public interest. The public interest includes South Africa’s commitment to land reform and to reforms to bring about equitable access to all South Africa’s natural resources. Property is not limited to land;
- Health care, food, water and social security: Everyone has the right to have access to health care services, including reproductive health care, sufficient food and water and social security,

including, if they are unable to support themselves and their dependents, appropriate social assistance;

- Language and culture: Everyone has the right to use the language and participate in the cultural life of their choice, but no one exercising these rights may do so in a manner inconsistent with any provision of the Bill of Rights;
- Cultural, religious and linguistic communities: Persons belonging to cultural, religious or linguistic communities may not be denied the right, with other members of the that community to enjoy their culture, practice their religion and use their language, and to form, join and maintain cultural, religious and linguistic associations and other organs of civil society. These rights must be exercised in a manner that is consistent with any provision in the Bill of Rights;
- Access to information: Everyone has the right of access to any information held by the state and any information that is held by another person and that is required for the exercise or protection of any rights; and
- Just administrative action: Everyone has the right to administrative action that is lawful, reasonable and procedurally fair. Everyone whose rights have been adversely affected by administrative action has the right to be given written reasons. This right has been given effect via the Promotion of Administrative Justice Act ((PAJA) Act 3 of 2000).

2.2 National Environmental Management (Act 107 of 1998)

The National Environmental Management Act (NEMA) and the principles contained therein have a significant influence on the need to identify and assess social impacts. The NEMA principles are based on the basic rights as set out in Chapter 2 (Bill of Rights) of the Constitution as referred to above.

According to Barber (2007:16) the following NEMA principles have an important impact on social issues:

- Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably;
- Development must be socially, environmentally and economically sustainable;
- Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must consider the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option;
- Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons;
- Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination;

- The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured;
- Decisions must consider the interests, needs and values of all interested and affected parties, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge;
- Community well-being and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means;
- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in light of such consideration and assessment;
- The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected;
- Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law;
- The environment is held in public trust for the people. The beneficial use of environmental resources must serve the public interest and the environment must be protected as the peoples' common heritage; and
- The vital role of women and youth in environmental management and development must be recognised and their full participation therein must be promoted.

2.3 Development Facilitation Act (Act 67 of 1995)

The Development Facilitation Act (DFA) outlines various principles concerning land development in Section 3 of the Act. Some of the relevant principles are briefly highlighted below (Babour, 2007). These principles include (but are not limited to):

- Promoting the integration of the social, economic, institutional and physical aspects of land development;
- Promoting integrated land development in rural and urban areas in support of each other;
- Promoting the availability of residential and employment opportunities in close proximity to or integrated with each other;
- Optimising the use of existing resources including such resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;
- Promoting a diverse combination of land uses, also at the level of individual erven or subdivisions of land;
- Discouraging the phenomenon of "urban sprawl" in urban areas and contributing to the development of more compact towns and cities;

- Contributing to the correction of the historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure in excess of current needs;
- Encouraging environmentally sustainable land development practices and processes;
- Promoting land development which is within the fiscal, institutional and administrative means of the Republic;
- Promoting the establishment of viable communities; and
- Promoting sustained protection of the environment.

2.4 Restitution of Land Rights Act 22 of 1994

The aim of the Restitution of Land Rights Act 22 of 1994 is as follows:

- To provide for the restitution of rights in land in respect of which persons or communities were dispossessed under or for the purpose of furthering the objects of any racially based discriminatory law;
- To establish a Commission on Restitution of Land Rights and a Land Claims Court; and
- To provide for matters connected therewith.

2.5 National Development Plan (2011)

The National Development Plan (NDP) of 2010 proposes to "invigorate and expand economic opportunity through infrastructure, more innovation, private investment and entrepreneurialism.

The Plan aims to ensure that all South Africans attain a decent standard of living through the elimination of poverty and reduction of inequality. The core elements of a decent standard of living identified in the Plan are:

- Housing, water, electricity and sanitation;
- Safe and reliable public transport;
- Quality education and skills development;
- Safety and security;
- Quality health care;
- Social protection;
- Employment;
- Recreation and leisure;
- Clean environment; and
- Adequate nutrition.

2.6 Guideline for Involving Social Assessment Specialists in EIA Processes (Barbour, 2007)

These guidelines direct the role of social assessment specialists in the Environmental Impact Assessment (EIA) process within the South African context.

2.7 Social Impact Assessment: Guidance document (2015) (Vanclay, Esteves, Aucamp, & Franks, 2015)

This document encapsulates the core values of the international SIA community providing a set of principles to guide SIA practitioners in incorporating the social element into environmental impact assessments.

2.8 International Labour Organisation

A guide on gender issues in employment and labour market policies: working towards women's economic empowerment and gender equality

"The objective of this resource guide is to strengthen the capacities of International Labour Organisation (ILO) constituents and development policy makers in the formulation of employment policies. There is a well-known proclivity among many policy-makers and practitioners to treat employment as a "residual" of economic growth" (Otobe, 2014).

2.9 International Organisation for Standardization, ISO 14001:2004

The International Organisation for Standardization (ISO) is used for identifying impacts. The ISO 14001: 2004 – Environmental Management Systems definitions for aspect, activity and impact are used in keeping with best practice.

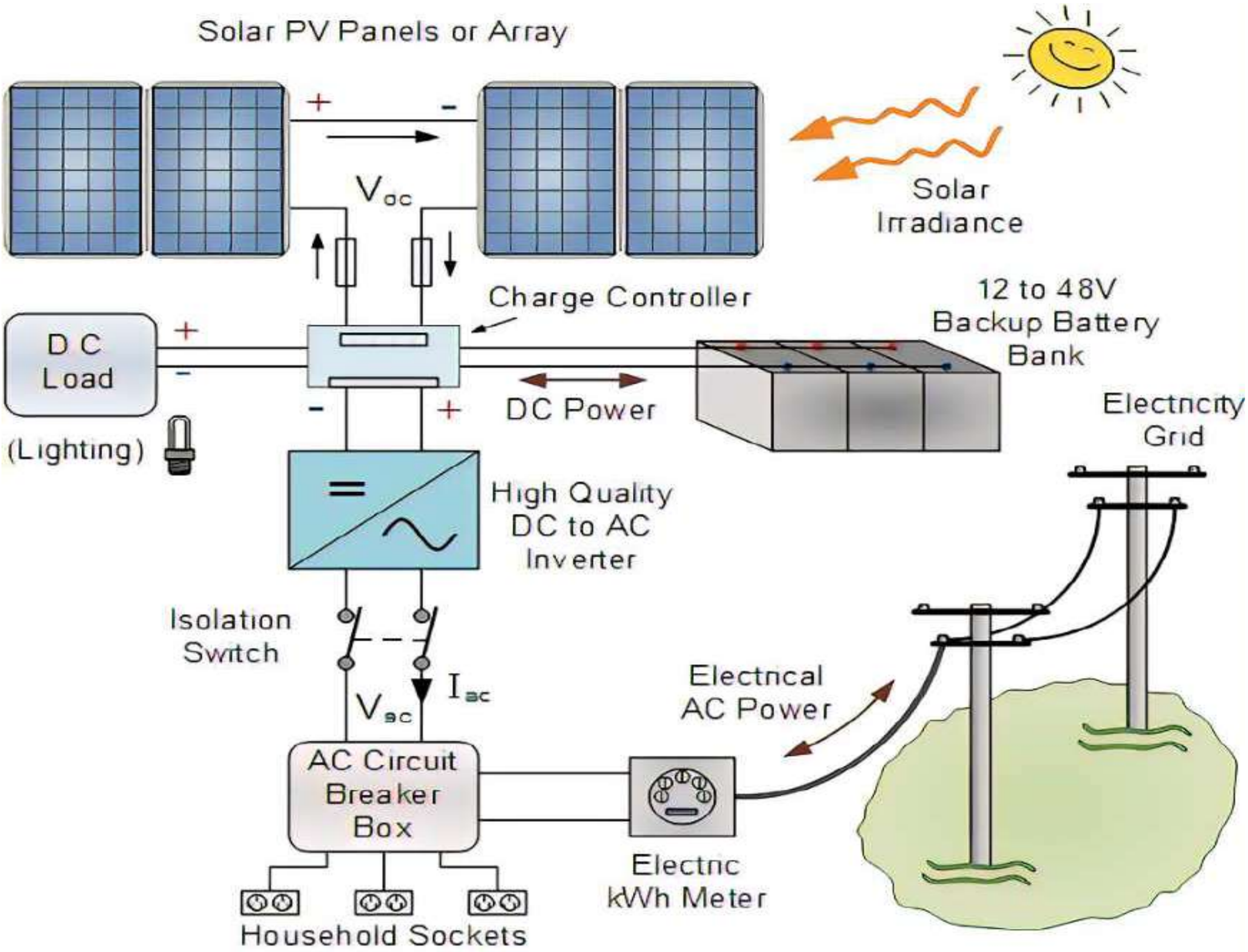
ISO 14001:2004 specifies requirements for an environmental management system to enable an organization to develop and implement a policy and objectives and information about significant environmental aspects. It applies to those environmental aspects that the organization identifies as those which it can control and those which it can influence.

3 Project Description

The project has been conceived to generate electrical power for the national grid. This power will be used nationally to increase grid stability in South Africa. Currently Eskom is facing significant energy supply challenges and is seeking sustainable measures to increase generation capacity.

The proposed project is a solar photovoltaic project which uses to radiant energy from the sun to produce electrical current by means of photovoltaic cells. The cells generate direct current (DC) electricity, which is then converted to alternating current (AC) via power electronic inverters. The illustration below provides an overview of a typical Solar PV Power Plant system.

A general grid connected solar PV system



Implementing Solar energy comes as a long-term environmental clean measure. The proposed project is rated at a capacity of 120 MW and 40 MW of battery energy storage.

3.1 Location

The project is in the northern part of the Free State Province, within the Fezile Dabi District Municipality (FDDM). The project falls within Ward 22 of the Moqhaka Local Municipality (MLM), with the municipal code of FS201. The site is located approximately 7km to the south east of the town of Orkney and is accessed from the R76 which runs along the northern boundary of the site.

Figure 1: Project Locality within South Africa

The directly affected local municipality for the proposed project are listed in Table 1 below.

Table 1: Affected Local Municipalities

Local Municipality	Affected Wards
Moqhaka Local Municipality	Ward 22

3.2 Project Description

The project comprises three segments: the solar PV segment and a battery energy storage segment, which falls within a single development area, and the transmission line, which connects the project to grid. The site has a total combined area of approximately 172ha. The project intends to make its grid connection into the existing 88kV/132kV Jersey Distribution Substation, which is located approximately 650m to the north-east of the site.

The location of the solar PV park, as well as the route of the power line is shown in the figure below.

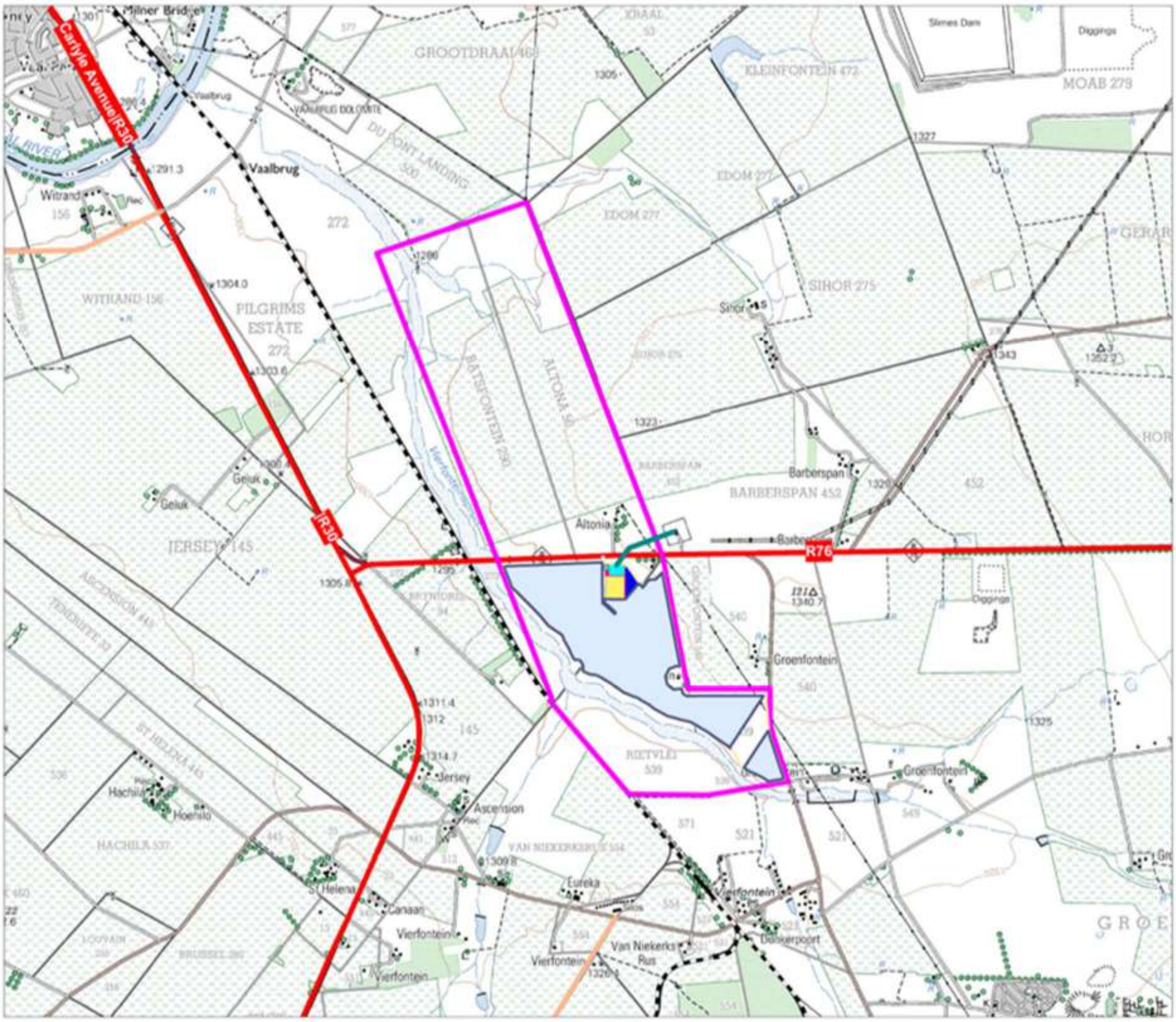


Figure 2: Project Components and Locality

The overall project components consist of the following segments:

- **Solar PV Park**
    - 172 hectares of un-used land;
    - Photovoltaic Panels and Support Structures – the panels will be installed on single-axis trackers, which will follow the sun from east to west throughout the day;
    - Guardhouses, operation, maintenance and visitor centre buildings and the internal road network;
    - Access road onto the R76;
    - Stormwater works;
    - Transformer / Inverter stands throughout the park;
    - A battery energy storage area; and
    - A new sub-station.
- **Transmission Line**
    - 132kV powerline from the existing Jersey Distribution Substation to the site;
    - Servitude width of 30m, 15m on either side of the transmission line; and

- Servitude located alongside existing transmission lines.

The transmission line runs from the park to the Jersey Distribution Sub-station substation. The route of this transmission line is captured in Figure 3 below.

Figure 3: Transmission Line Location

The transmission line is approximately 650m long.

3.3 Social Stimulus

It is estimated that the peak number of workers during the construction phase would be 700 for a period of about 6 months. The construction duration is likely to be 18 months. The total value of the project is estimated at R1 100 million.

Solar PV creates a number of social impacts which are created at different stage of the value chain. The value chain can be conceptualised as being during the following events (IRENA and CEM, 2014):

- Project planning – consulting work conducted by specialists;
- Manufacturing – raw material sourcing and component manufacture and assembly. Component manufacturing covers the solar modules, transformers, inverters, electrical cabling, combiner boxes and module support structures;
- Installation – a labour intensive process involving civil engineering contractors, module installation and electrical engineering contractors;

- Grid Connection – carried out by specialised electrical engineering contractors. This work allows the solar park to contribute to the national grid, thereby contributing to stabilising supply of electricity;
- Operations and Maintenance – a long-term activity requiring regular plant monitoring, equipment inspections and repair services; and
- De-commissioning – plant at the ned of their lifespan require activities such as recycling the modules and disposal or reselling of components.

The potential for creating value within the regional study area and into the broader Free State economy is depends on the level of development of the renewable energy sector. The major cost items for a solar park are the modules, the transformers and the inverters – these will be imported items. The cabling and electrical systems can be manufactured in South Africa. The economic value created through installation and grid connection can be created within South Africa, with much of the labour and semi-skilled workers being available within the regional study area.

As South Africa's level of development in the renewable energy field increases, so the value captured within the country will increase all along the value chain.

3.3.1 Job Creation

The number of jobs created for the construction phase was estimated in 2007 as being 69.1 per MW installed, and 0.73 / MW installed during the operations and maintenance phase (IRENA and CEM, 2014). For the proposed project, this yields total values of 8 292 during construction, and 88 during operations and maintenance. These jobs are not all created on the construction site, they are distributed throughout the value chains of these two phases, at different parts of the country where the value is being created. This estimate did not include the jobs created by the BESS segment of the project.

The Independent Power Producers programme, managed by the Department of Energy has local content requirements and targets for the bid windows. Some of these targets are:

- Job creation for SA citizens – a minimum of 50% and a target of 80%; and
- Local content for SA manufactures – a minimum of 45% and a target of 65%, the minimum has been increased by 10% from bid window 2.

The proportion of employment from local communities for all renewable energy projects have been reported (Department of Energy, 2019). The Department of Energy reports that of the 33 019 job years created for the entire renewable energy procurement programme, 18 253 job years were attributable to people from the local community – this is a proportion of 55%. This proportion can be attributed to the proposed project. The Department of Energy also cites figures that 8% of employment was female and 41% was from the youth category (Department of Energy, 2019). These proportions can also be attributable to the project.

An estimate of the number of jobs to be created by the proposed project can be derived from the Department of Energy Report using the figures to date for the Limpopo Province. A provincial breakdown is provided for 3 projects (all completed) which all use Solar PV technology. It was reported that 118MW of energy was generated, creating 1 240 job years to date (which have included all of the construction jobs) and estimated at 2 917 job years over the 20-year life of the projects (Department of Energy, 2019). Applying these proportions to the proposed project yields the total job years of 2 966 job years and a construction job phase year estimate of 1 261. These figures do not include the contribution from the BESS segment of the project, which has not been studied in the literature.

The table below summarises the job creation estimates for the proposed project. Readers should bear in mind the various sources for this information, the assumptions made and the dates of the data – together these factors combine to set the degree of accuracy for these estimates at 20%.

Table 2: Job Creation Estimate Summary

Description	No. Off
Total Job Years Created (Direct)	2 966
Planning and Construction Phase	1 261
Operation and Maintenance Phase, 20 years	1 705

3.3.2 Economic Value Creation

The contribution of the project to South Africa's Gross Domestic Product (GDP) can be estimated from published literature. A Department of Energy report using the figures for renewable project delivery to date for the Limpopo Province provides an indication. A provincial breakdown is provided for 3 projects (all completed) which all use Solar PV technology. It was reported that 118MW of energy was generated, creating R3.6 billion in GDP contribution (Department of Energy, 2019). Applying this proportion to the proposed project yields a total GDP contribution of R3.7 billion. This captured the total impact of the project on the nation's economy, both through direct and indirect spending.

The local content for Solar PV projects has varied over the four bid windows. Bid window 1 achieved 50% local content, bid window 2 achieved 52%, bid window 3 achieved 55% and bid window 4 achieved 75% (Department of Energy, 2019). This increasing trend demonstrates the possible impact that the proposed project could have on the South African value chain. To date, the average local content spend for PV projects in South Africa has been R46.5 billion versus a comparable total project value of R90.3 billion – a percentage of 51%.

If this value is applied to the proposed project value of R1.1 billion, a local value chain addition of R561 million can be estimated. The proportion of value attributable to the regional study is unknown at this stage and figures from the literature are not available.

3.4 Description of Project Alternatives

The project has been located on land identified by the proponent as being a tract of unused and fallow agricultural land within its boundaries suitable for renewable energy projects. The project proponent has secured suitable rights to the land in the event that the project is selected for implementation.

Hence there are no alternatives considered for the location of the project.

There are two technical alternatives for the project relating to the location of the solar modules within the site. The first layout utilised most of the developable site, includes areas across the stream to the south west of the site. This layout is shown in the figure below.

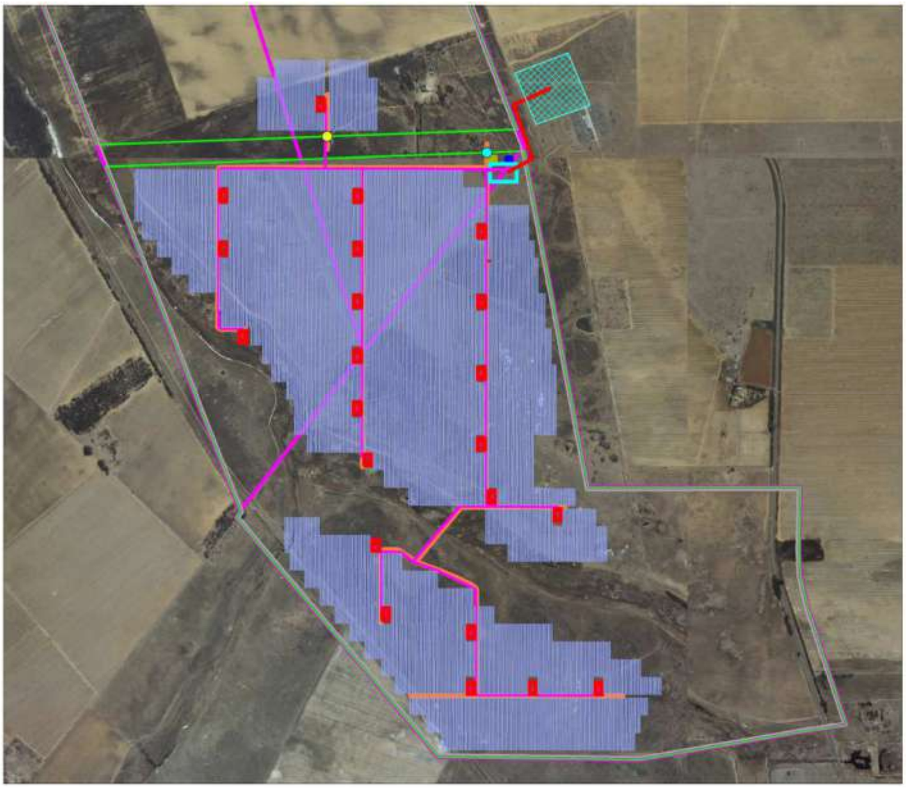


Figure 4: Alternative Layout 1 – Panels Across the River

The second layout avoided the most ecologically sensitive areas of the site, the land across the river. This layout restricts the erection of panels to the areas to the east of the river. Utilised most of the developable site, includes areas across the stream to the south west of the site. This layout is shown in the figure below.

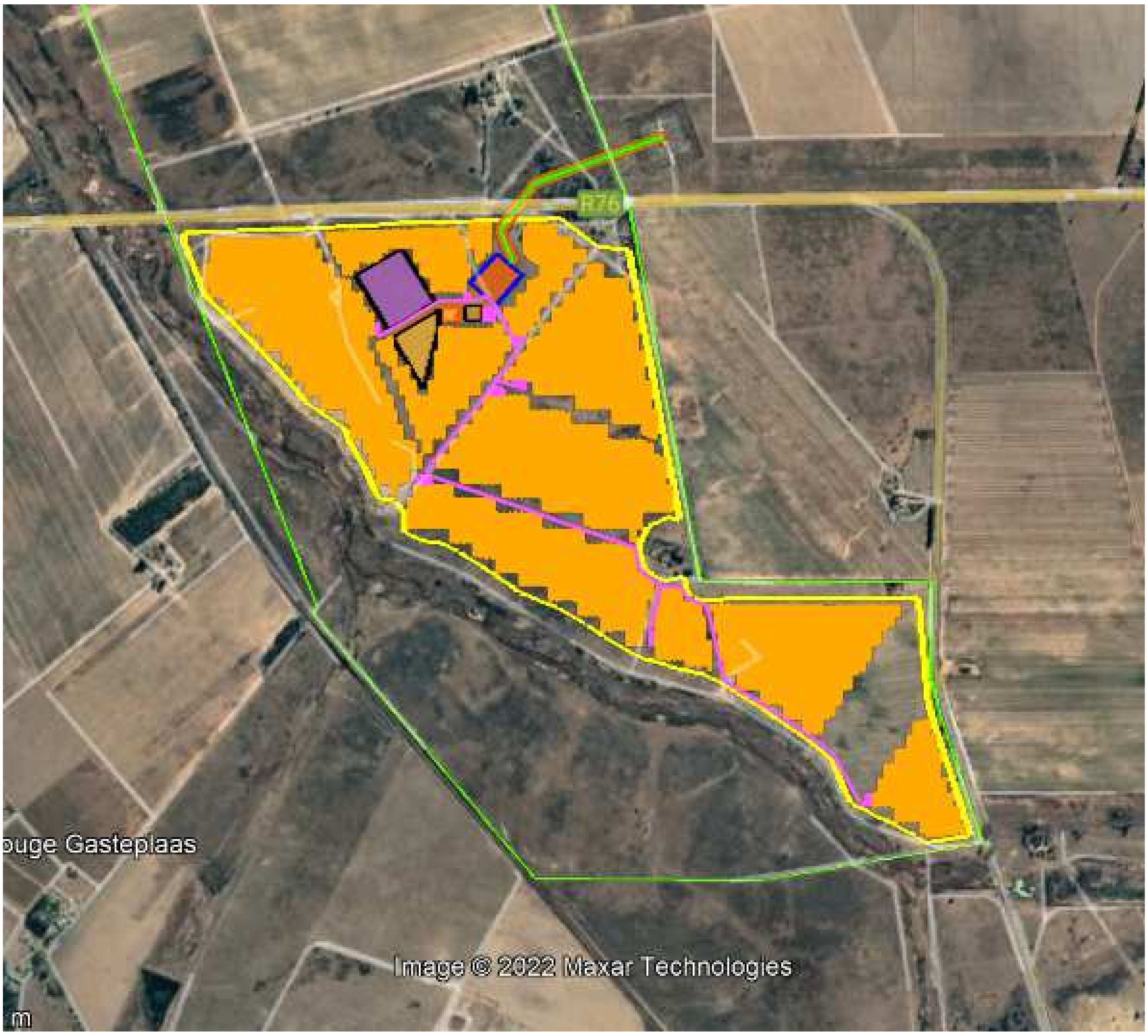


Figure 5: Alternative Layout 2 – Panels Avoiding Sensitive Areas

Alternative layout 2 was provided after the draft report was published and is very similar, but more detailed in is provision of infrastructure, than the version provided in the draft report. For the purposes of the Social Impact Assessment, the layout does not change the study outcomes, given that social impacts are generated by a project size and nature, rather than its precise layout. Neither the project size, nor its nature have changed in any way from that assessed in the draft report.

Both of these layouts will be analysed from a social perspective in later section of this report.

3.5 Definition of the Study Area

Two study areas have been defined for the purposes of analysing the project and its social impacts: a regional study area which comprises the affected local municipality; and a local study area which is the site and its close neighbours upon which the project will be located. For the purposes pf the study a distance of five kilometres from the site has been selected, using the centre of the solar park as the centre of the five-kilometre circle.

This division allows, at once, a broader scale social and economic analysis to gain understanding of the social context of the project, whilst also allowing detailed analysis of the project local area which is will receive the project components and receive most of the impacts.

3.5.1 Regional Study Area

The regional study area is the directly affected local municipality: the Moqhaka Local Municipality (FS201). The municipality is situated in the Fezile Dabi District Municipality in the Free State Province.

The project falls within ward 22 of the municipality, and this municipality is shown in the Google Earth Image below:

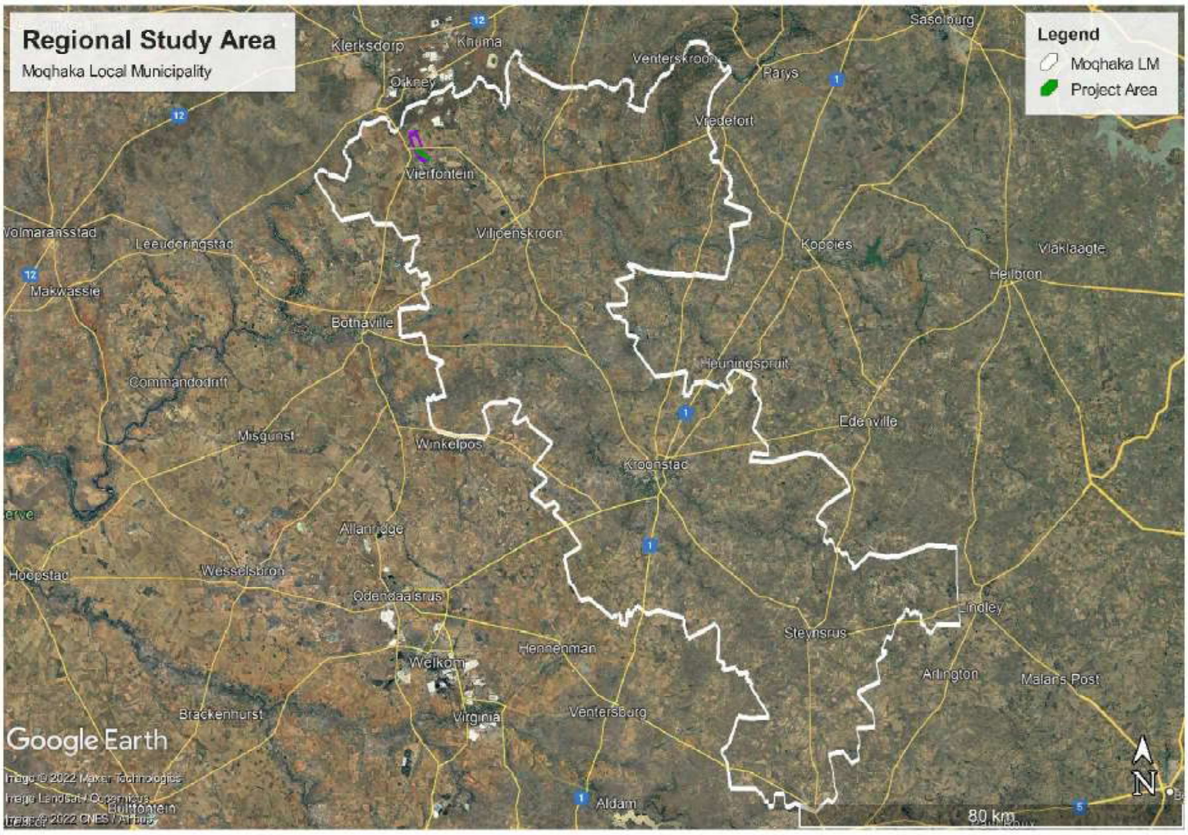


Figure 6: Regional Study Area

The local municipality has a rural character with a strong agricultural character.

The structure of the municipality is such that there are twenty-two wards and eight main places used by Statistics South Africa in their Census 2011. The project is located in a Census 2011 main place named Moqhaka NU. The main places are listed in the table below.

Table 3: Moqhaka LM Main Places – Census 2011

Main Place Name	Area [km^2]	Population [No.]	Population Density [pop/km^2]
Kroonstad	24 723	74.81	330

Main Place Name	Area [km²]	Population [No.]	Population Density [pop/km²]
Maokeng	73 057	14.3	5 109
Matlwangtlwang	7 794	1.92	4 059
Moqhaka NU	21 354	7801.34	3
Rammulotsi	29 377	5.21	5 639
Steynsrus	1 312	6.11	215
Vierfontein	825	8.21	100
Viljoenskroon	2 091	12.67	165
Grand Total	**160 533**	**7 925**	**20**

The area of Moqhaka NU is 98.4% of the total area of the local municipality, and holds 13.3% of the population.

3.5.2 Local Study Area

The local study area is the area on which the project will take place and its close neighbours. This study area is captured in the Google Earth image, Figure 7 , below.

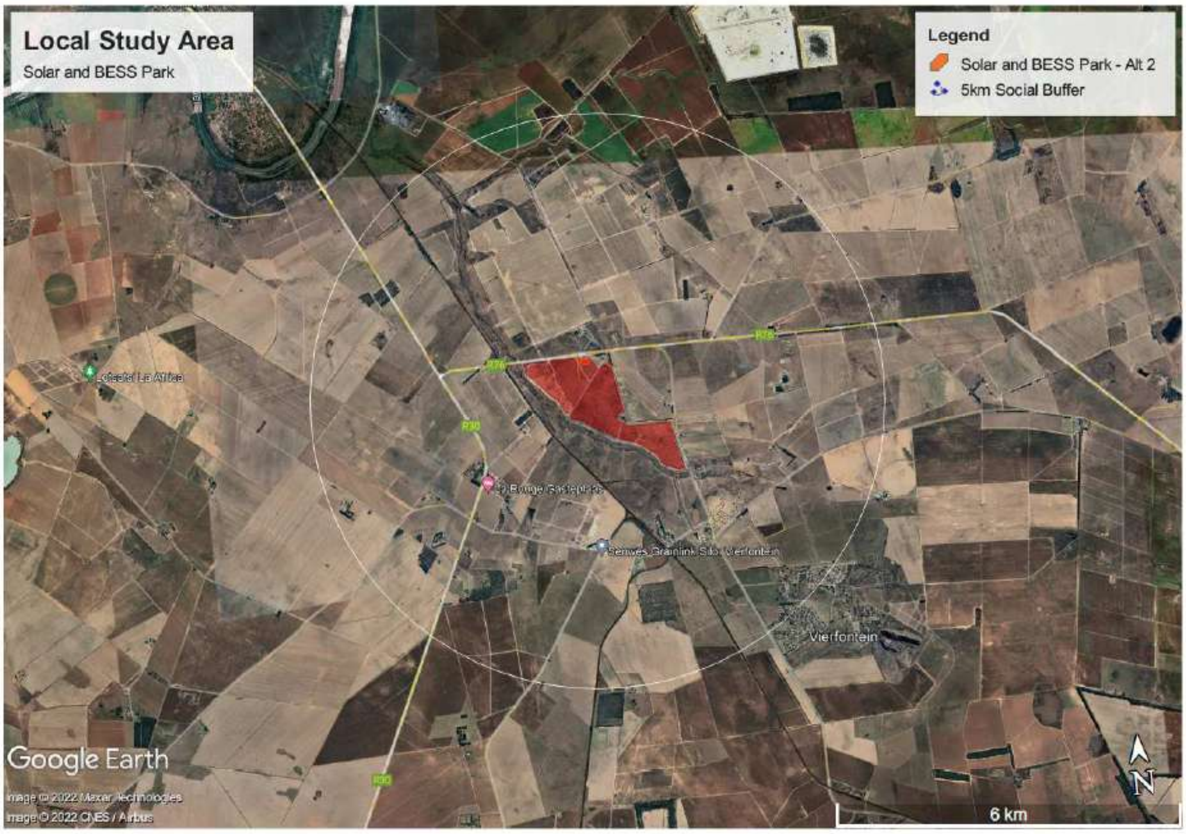


Figure 7: Local Study Area – Solar Park and Transmission Line

These two areas, will be discussed in detail in later sections of the report.

4 METHODOLOGY

The approach to the study was based on The Western Cape Department of Environmental Affairs and Development (DEA&DP) Planning Guidelines for Social Impact Assessment (Barbour, 2007). These guidelines are based on accepted international best practice guidelines and principles which include the Guidelines and Principles for Social Impact Assessment (Inter-organizational Committee on Guidelines and Principles for Social Impact Assessment, May 1994). Accordingly, the study includes a review of:

- Relevant Social data;
- Relevant planning and policy frameworks for the area;
- Information gathered while undertaking similar studies; and
- Social issues associated with similar projects.

4.1 Sourcing of Information and Data Analysis

The SIA sets out the social baseline of the study area, predicts social and economic impacts and makes recommendations for mitigation of negative social and economic impacts and measures which can be taken to enhance the positive social and economic impacts.

The baseline study is based on both primary and secondary data. Primary data was collected directly from engagements with community members, landowners and business owners. Secondary data was accessed through South African economic and social databases. Reports, articles and internet searches were also used and are referenced in the text and in the reference section of this report.

At this draft stage of the report, information continues to flow in from primary data sources, and the report will be updated accordingly.

The profile of the baseline conditions includes describing the current status quo of the community, including information on a number of social and economic issues such as:

- Demographic factors;
- Social factors such as income and population data;
- Access to services;
- Institutional environment;
- Social Organisation (Institutional Context); and
- Statutory and Regulatory Environment.

4.1.1 Primary Data

4.1.1.1 Public Participation

Affected landowners and members of the public were given an opportunity to comment on the project during the public participation process carried out during the public participation phase of a previous the Scoping Phase of an EIA for the project. Comments and responses used during this process have been included into this report and have formed one of the bases the analysis of the social impacts considered in this report.

Further primary data was collected for the purposes of the study, these were collected using the following approaches:

- ***Rapid Rural Assessment***: A survey was conducted to capture visual observations on the social dynamics, community proceedings, community resources and infrastructure;
- ***Stakeholder Consultations***: Consultations with the affected communities carried out by members of the project team along each project component to discuss the proposed project and to gather their concerns and feedback on the project; and
- ***Key Informant Interviews***: Informal discussions with the IAP's to help inform the baseline were conducted during site visits and as well as during the scoping phase. These included community members and authority members.

4.1.2 Secondary Data

An assessment of the scoping phase was conducted to provide an understanding of the project details, location and possible impacts.

The required information was collected using different sources, these included Statistics South Africa Census data, economic data supplied by Quantec Enterprises (Pty) Ltd as well as a review of relevant municipal, district and other literature.

The discussion of the demographics and the development profile of the study area is carried out using Census 2011 data produced by Statistics South Africa.

The Census 2011 data is the most comprehensive dataset available for the subject areas, and it is currently the best data at hand. The ward and municipal data have been extracted using the project Geographic Information System, and the data for the affected areas will be presented in tables and figures throughout the report.

4.1.3 Geographic Information System

A Geographic Information System (GIS) was used to conduct an analysis of the area. The use of GIS brings together the demographic and social data to enable a thorough analysis of the project area.

4.2 Impact Assessment

Barrow (1977) advise that an impact assessment should be designed as a bridge that integrates the science of environmental analysis with the policies of resource management. Furthermore, an impact assessment allows for an estimate of the significance of the identified social impacts to those who will be affected. In addition, the response of the affected parties to such impacts also needs to be clarified (Centre for Good Governance, 2006). All impacts will be analysed with regard to their nature, extent, magnitude, duration, probability and significance (Barbour, 2007). Section 7 of this report lists the definitions that apply to the impact assessment.

The determined impacts are clustered around a common-issue and are assessed before and after mitigation. The identification of the social impacts associated with the project is issues-based, with the main headings referring to a common theme addressing several related impacts. Under each of these issues, the specific impacts and potential mitigation strategies are discussed for pre-construction, construction, operation and decommissioning phases.

4.3 Assumptions and Limitations

The following assumptions and limitations underlie this social impact assessment:

- It was assumed that information obtained during the public participation phase provide a comprehensive account of the community structure and community concerns for the project;
- The study was done with the information and time frames available to the specialist at the time of executing the study. The specialist took an evidence-based approach in the compilation of this report and did not intentionally exclude information relevant to the assessment; and
- It is assumed that no relocation of families or people will take place for this project.

5 STATUS QUO ANALYSIS

The social status quo within the project study area is an important input to the impact study of the proposed project. Here the status quo is described using data obtained from Statistics South Africa's Census 2011 as well as by observations made during site visits to the project area.

5.1 Regional Study Area Overview

The regional study area is the Fezile Dabi District Municipality, formerly known as the Northern Free State District Municipality, situated in the north of the Free State. It is surrounded by the Northwest, Gauteng and Mpumalanga Provinces to the north, Thabo Mofutsanyana District Municipality to the south, and Lejweleputswa District Municipality to the west. The municipality is the smallest district in the province, making up 16% of its geographical area. It consists of four local municipalities: Moqhaka, Metsimaholo, Ngwathe and Mafube.

5.1.1 Basic Data

The Fezile Dabi District Municipality covers a geographical area of 20 829.9 square kilometres (km²) and has a population of 527 788 people living within 166 000 households. This gives the municipality a population density of 23.8 people per square kilometre people and a household density of 3.4/km.

A summary of the key measures for the municipality: the population, household, gender, population group and home language spoken across the area is provided in Table 4 below (COGTA, 2020).

Table 4: Geographical area, Gender Population Grouping and Home Language

		DC20: Fezile Dabi District Municipality
Geographical Area		20 829.9 km
Population		527 788
Households		166 000
Population Density		23.9 people / km²
Household Density		3.4/km²
Gender* Fezile Dabi District Municipality	Female	48.96%
	Male	50.02%
Population Group	Black African	85.21%
	Coloured	2.06%
	White	12.17%
	Indian/Asian	0,49%

5.1.2 Population

The age distribution of the population of the Fezile Dabi District Municipality is provided in Table 5 below (COGTA, 2020).

Table 5: Regional Study Area Age Distribution

Age	Population	Percent of Total
0-14	139 863	26.5%
15-24	77 125	14.61%
25-44	163 000	31.0%
45-64	103 000	19.2%
65+	44 800	8.49%
Grand Total	**527 788**	**100%**

The largest share of population is within the age range of 25 to 44 years old, the young and middle working age category, with a total number of 163 000 (31.0%) of the total population. The age category with the second largest number of people is the young children (0-14 years) age category with a total share of 26.5%, followed by the older working group between 45 and 64 years of age comprising 103 000 people. The age category with the least number of people is the retired / old age (65 years and older) age category which contains 44 800 people.

Analysing the totals, shows that 343 125 people in the population of the regional study area fall within the economically active range of between 15 and 64 years of age, and 184 663 people are either younger than 15 or older than 65. This gives a dependency ratio of 0.54 for the Fezile Dabi District Municipality. The equivalent dependency ratio for the Free State province as whole, using the Community Survey 2016 population data is 1.00. This differences in the dependency ratio indicate that the population in the Fezile Dabi District Municipality has a much larger worked age population than the rest of the province. The equivalent dependency ratio for the Moqhaka Local Municipality, using the Community Survey 2016 population data, is 0.50, again indicating a high proportion at working age population.

In 2019, the Fezile Dabi District Municipality's population consisted of 85.28% African (450 000), 12.17% White (64 200), 2.06% Coloured (10 900) and 0.49% Asian (2 580) people.

Fezile Dabi District Municipality has an annual population growth of 0.3% between 2011 and 2016. The district has a median age of 28 years. In comparison to the Free State Province, with its population growth rate of 0.64 over the same period, the district has more push factors causing people to migrate outwards. The population growth rates for the remaining local municipalities in the district, those of the Mqohaka, Mafube, Metsimaholo and Ngwathe Local Municipalities, are -0.73%, -0.10%; 1.87%; and -0.27% respectively. This indicates that that the Metsimaholo Local Municipality is the most attractive municipality in the district. The varying population growth points to push and pull factors within the regional study area being dominant when people make economic and social decisions about where to live.

Table 6: Population, age structure, dependency and gender ratios

Category	**Detail**	**DC20: Fezile Dabi District Municipality**	**FS201: Moqhaka Local Municipality**
Population	2011	488 036	160 538
	2016	494 777	154 732
Age Structure [2016]	<15	25.5%	27.0%
	15-64	67.5%	66.4%
	65+	7.0%	6.5%
Dependency Ratio [2016]	Per 100 (15-64)	48.1	50.5
Gender Ratio [2016]	Males per 100 females	98.9	-
Population Growth	(% p.a.)	0.31%	-0.73%

* (Free State Government, 2020)

The statistical data described in the last three paragraphs above is presented in Table 6 above.

5.1.3 Employment

Metsimaholo Local Municipality is the only local municipality in which the private sector dominates the economy. The main economic contribution is from the manufacturing sector, dominated by Sasol. Moqhaka has the second highest GDP contribution in the district; the community service sector is the main contributor, as is the case in the Ngwathe and Mafube Local Municipalities.

In 2019 the Fezile Dabi District Municipality working age cohort was recorded at 343 000 and increased annually by an average of 0.69%. The table below shows the employment by sector, with private households, followed by community and social sector and the agricultural sector being the largest employers. Electricity, gas and water sectors are providing the least employment in the district, at below 1%, which is in line with the SA District average.

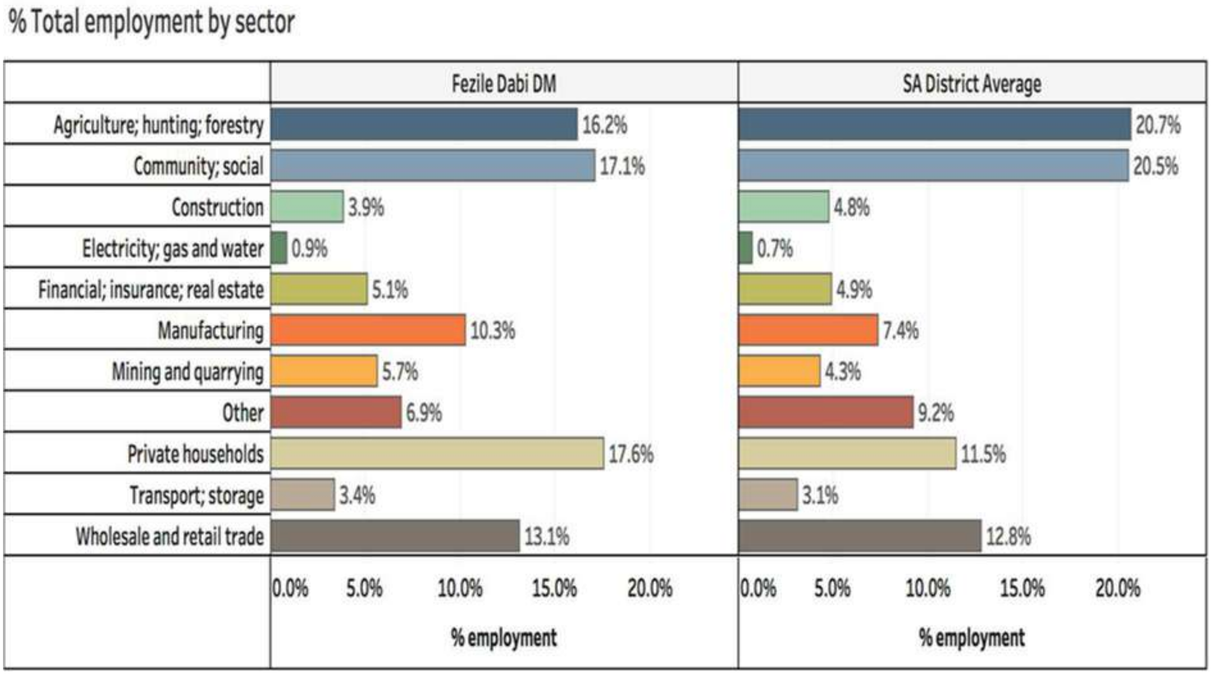


Figure 8:Key employment sectors in Fezile Dabi District

(Source: Municipal Demarcation Board: Municipal Capacity Assessment Report, 2018)

Data pertaining to the labour market across the study area are illustrated in Table 7 below.

Table 7: Regional Labour Market

Municipality	Labour Market	
	Unemployment Rate (official)	
	2001	2011
DC20: Fezile Dabi District Municipality	41.2%	33.9%
FS201: Moqhaka Local Municipality*	39.9%	35.2%
FS: Free State Province	43.0%	32.6%

Unemployment rates have reduced substantially since 2001 in all of the three areas under consideration. Of the three areas, unemployment rates in the local study area are the highest.

These figures can be compared to the most up to date estimate of the official unemployment rate for the regional study area is that for the Free State Non-Metro Areas, in March 2020. The unemployment rate cited in that publication is 22.5% (Statistics South Africa, 2020).

This unemployment rate is the official definition, which does not count discouraged work seekers are being part of the labour force. If discouraged work seekers where to be included, the unemployment rates would increase in all areas.

5.1.4 Education

Sustainable Development Goal 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. At a national level the education system is governed by different laws and regulations such as the South African Schools Act of 1996, which promotes access to education, promotes quality and democratic governance in the schooling system, and makes schooling compulsory for children aged seven to 15 to ensure that all learners have access to quality education without discrimination.

In 2019, the regional area of study had a highest school pass rate of 90.3%, in the Free State province. Educational attendance and levels in the district are profiled using community Survey 2016 data, with comparison to Census 2011 and the data is depicted below.

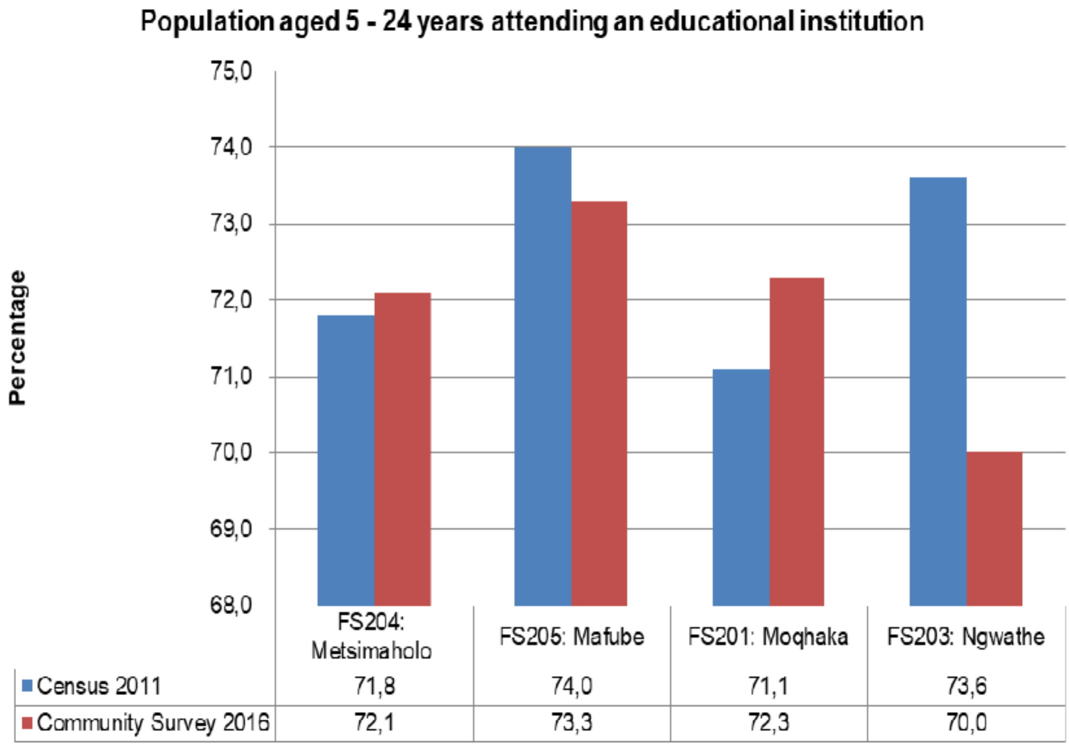


Figure 9: Population aged 5 – 24 years attending an educational institution Stats SA: CS 2016

Attendance at educational institutions is relatively stable over the period of the Census 2011 and Community Survey 2016 at about 71%. Decreases in attendance were experienced in the Ngwathe Local Municipality between 2011 and 2016, and this may be due to the population outflow in this period.

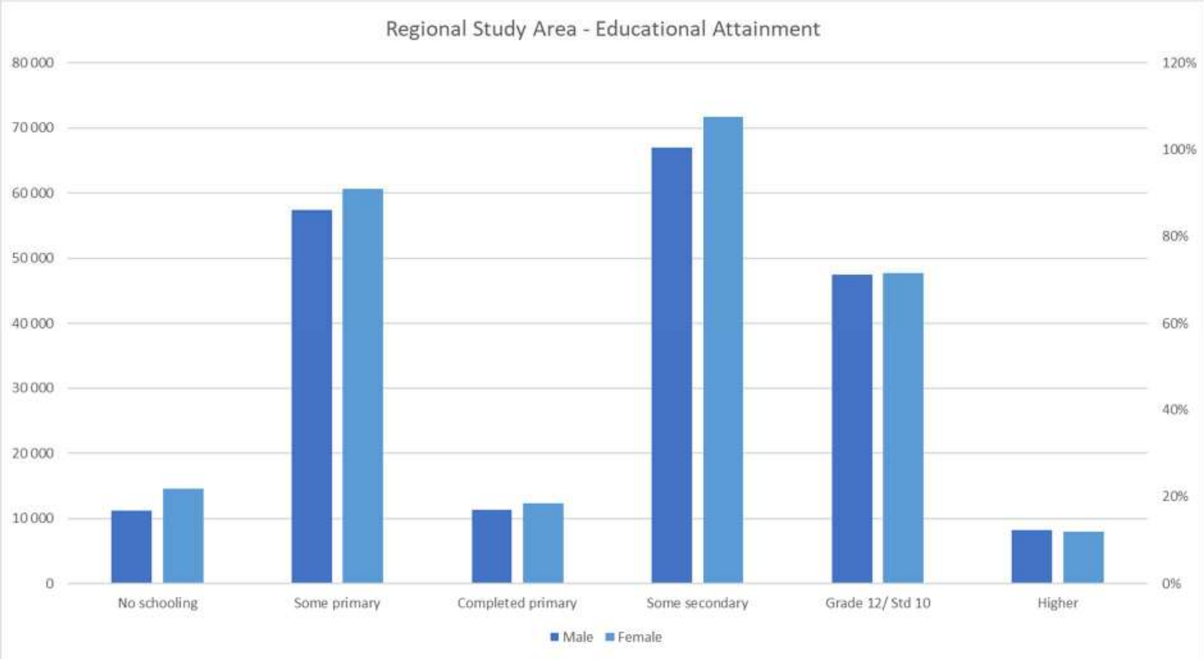


Figure 10: Regional Study Area High Level Educational Attainment for the population aged 20 and older

When assessing educational attainment in the district municipality, it is clear that 35% of the population are functionally illiterate, having either never been to school, or who have partially completed primary school. A further 39% are literate, having completed primary school and some secondary education.

Twenty three percent of the population have completed high school, with a further four percent having obtained some tertiary qualification.

Table 8: Comparison of Educational Attainment

Educational Attainment	Free State [% of Category]	Fezile Dabi DM [% of Category]
Primary School or Less	51.7%	40.1%
Some High School	26.8%	33.2%
Completed High School	17.9%	22.8%
Higher	3.5%	3.9%

The table above demonstrates that the level of educational attainment in the regional study area is noticeably higher than it is for the rest of the Free State province. The regional study area has higher rates of attainment at secondary school level. This implies that the workforce is generally more literate than that found across the broader province.

5.1.5 Economy

The economy of Fezile Dabi District Municipality is made up of several sectors which are summarised in the table below.

Table 8: Fezile Dabi Economic Distribution of Sectors 2018

Economic Sector	% Category
Retail and Wholesale Trade	22%
Community Services	20%
Manufacturing	13%
Private Households	13%
Agriculture	12%
Finance and Business Services	7%
Construction	6%
Transport	5%

(Source: Fezile Dabi District Municipality Final Annual Report 2020-2021)

During the period of 2020 & 2021, the wholesale and retail trade and community services were the largest sectors of the regional economy. Together than accounted for 42% of the economic output.

Manufacturing, private household and agriculture comprise the nest 38% of the economy, with a roughly equal split of 13% of the economy.

The community sector, which includes the government services, is generally a large contributor towards the economic output in smaller and more rural local municipalities. This, combined with the large contributions made by agriculture and from private household economic activity reveal a rural economy with a base found in farming and providing services to its population. Manufacturing does make a significant contribution, and this serves to broaden the base of the economic output of the region.

When looking at the regions within the district municipality, the Metsimaholo Local Municipality made the largest contribution to the community services sector at 40.09% of the district economy. The Metsimaholo Local Municipality contributed R 34.6 billion or 66.47% to the GVA of the Fezile Dabi District Municipality, making it the largest contributor to the overall GVA. This is due to the large petrochemical hub in Sasolburg and the related economic activities (Fezile Dabi District municipality Profile).

5.2 Local Study Area Overview

The local study area comprises the project boundary and its close neighbours. The following discussion captures the areas of potential social impacts.

5.3 Land Use and Infrastructure

The proposed project is located on agricultural land to the south of the town of Orkney in the Free State Province. Orkney and the surrounding region to the south is home to agricultural production and gold mining. Well known mines in the immediate vicinity of the proposed project are the Kopanang Mine / Vaal Reefs Mine and Harmony Moab. Larger towns in the region include Klerksdorp and Potchefstroom.

The dominant land use in the within five kilometres of the proposed project is crop based agriculture and the infrastructure supporting agriculture.

The proposed project has two components:

1. The solar park; and
2. The transmission line.

The land use and infrastructure characteristics of each component is described below. This section of the report relies upon a census of the infrastructure and land-use impacts that has been conducted for this study. The results of the census are contained in **Appendix 1**.

5.3.1 Solar Park

The solar park component of the project is the main segment of the project. A Google Earth image of this component is shown in Figure 11 below.

The image shows the 5 km social buffer that we used to identify social impact elements, as well as the area where the panels will be erected for the project. Superimposed on the images are labels for some of the chief infrastructure and social impact areas that have been noted in the census of the project area.

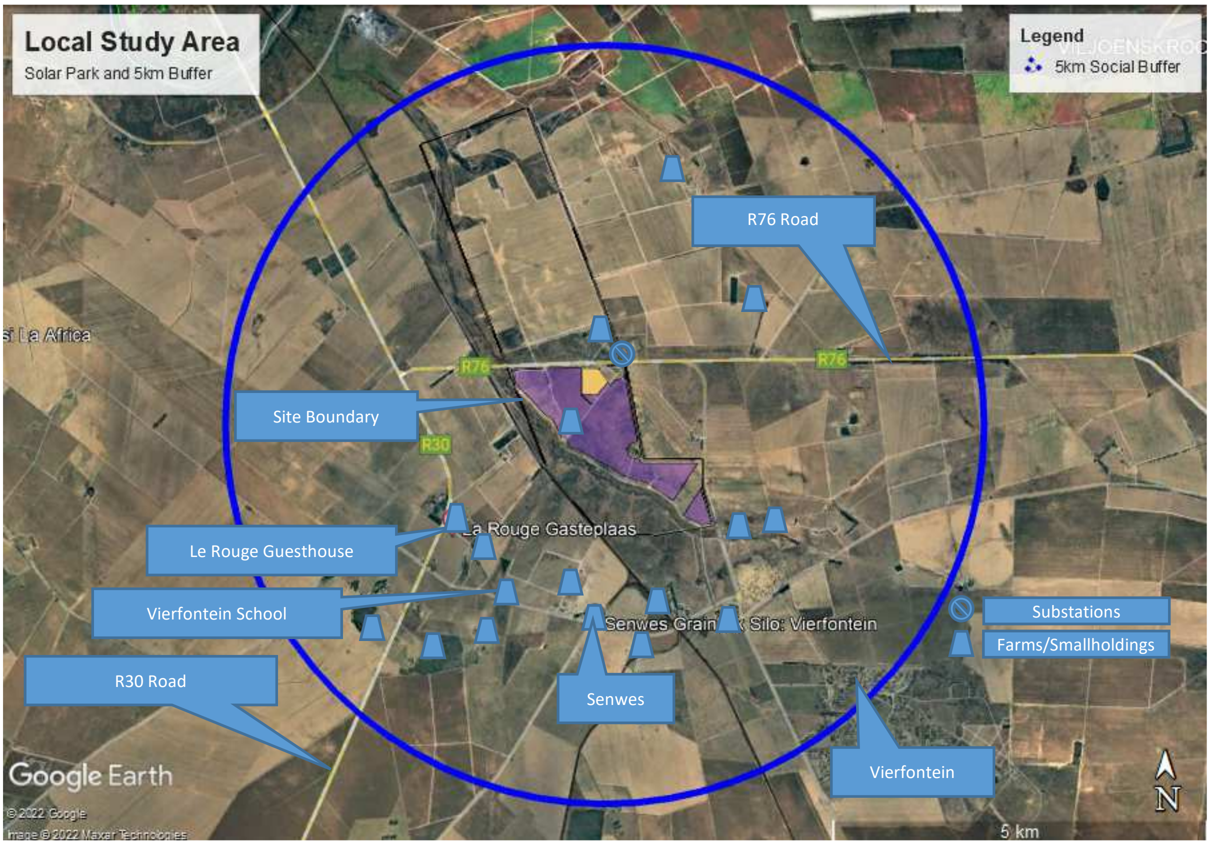


Figure 11: Main Section of the Proposed Project

This impact census noted the presence of the following social infrastructure:

Category / Name	Co-Ordinates
Eskom Powerline	27°01'31.40" S 26°42'57.51" E
Concrete Reservoir	27°01'35.48" S 26°43'17.95" E
Farm Dwellings	27°05'09.88" S 26°44'18.99" E
Farm Dwellings	27°05'04.54" S 26°44'05.41" E
Farm Dwellings/Houses	27°04'15.00" S 26°46'18.49" E
Farm Dwellings/Houses	27°04'12.30" S 26°46'02.55" E
Farm Dwellings/Houses	27°04'24.96" S 26°41'54.68" E
Farm Dwellings/Houses	27°02'45.59" S 26°41'46.50" E
Farm Dwellings/Houses	27°02'50.66" S 26°44'26.85" E
Farm Dwellings/Houses	27°05'09.65" S 26°43'00.69" E
Farm Dwellings/Houses	27°04'42.32" S 26°42'44.57" E
Senwes Grainlink Silo Vierfontein	27°04'42.32" S 26°42'44.57" E
Vierfontein Primary School	27°04'43.68" S 26°43'44.99" E
Natural water Catchment	27°04'45.44" S 26°43'38.34" E

Category / Name	Co-Ordinates
Farm building	27°04'43.09" S 26°43'32.30" E
La Rouge Gasteplaas	27°04'23.74" S 26°43'30.16" E
Boere Boss Restaurant	27°04'12.74" S 26°43'13.30" E
Farm Dwellings/Houses	27°04'24.96" S 26°41'54.68" E
Manmade and Natural Water Structures	27°03'49.53" S 26°44'53.91" E
Manmade Water Structure	27°05'24.00" S 26°43'55.09" E
Manmade Water Structure	27°05'23.31" S 26°43'37.88" E
Manmade Water Structure	27°05'47.32" S 26°43'11.52" E
Community Dwellings	27°05'43.03" S 26°46'15.78" E
Farm Commercial Area	27°01'49.03" S 26°45'15.09" E
Manmade Water Structure	27°01'39.63" S 26°45'17.21" E
Farm Dwellings	27°02'04.09" S 26°45'23.68" E
Farm Dwellings	27°02'31.88" S 26°45'41.97" E
Beefdotcom	27°04'04.59" S 26°43'10.50" E
Suburb in North- West side of Vierfontein Town.	27°05'22.04" S 26°46'40.56" E
Commercial Structure	27°05'14.79" S 26°46'17.67" E
Commercial Structure	27°05'38.50" S 26°46'16.79" E
Project transmission line passing over R76	27°03'02.70" S 26°44'37.97" E

5.3.2 Transmission Line

The transmission line component of the project comprises a power line that runs along a route of 600m to the evacuation Substation. The route is shown in the Google Earth image of this component is shown in Figure 11 below.

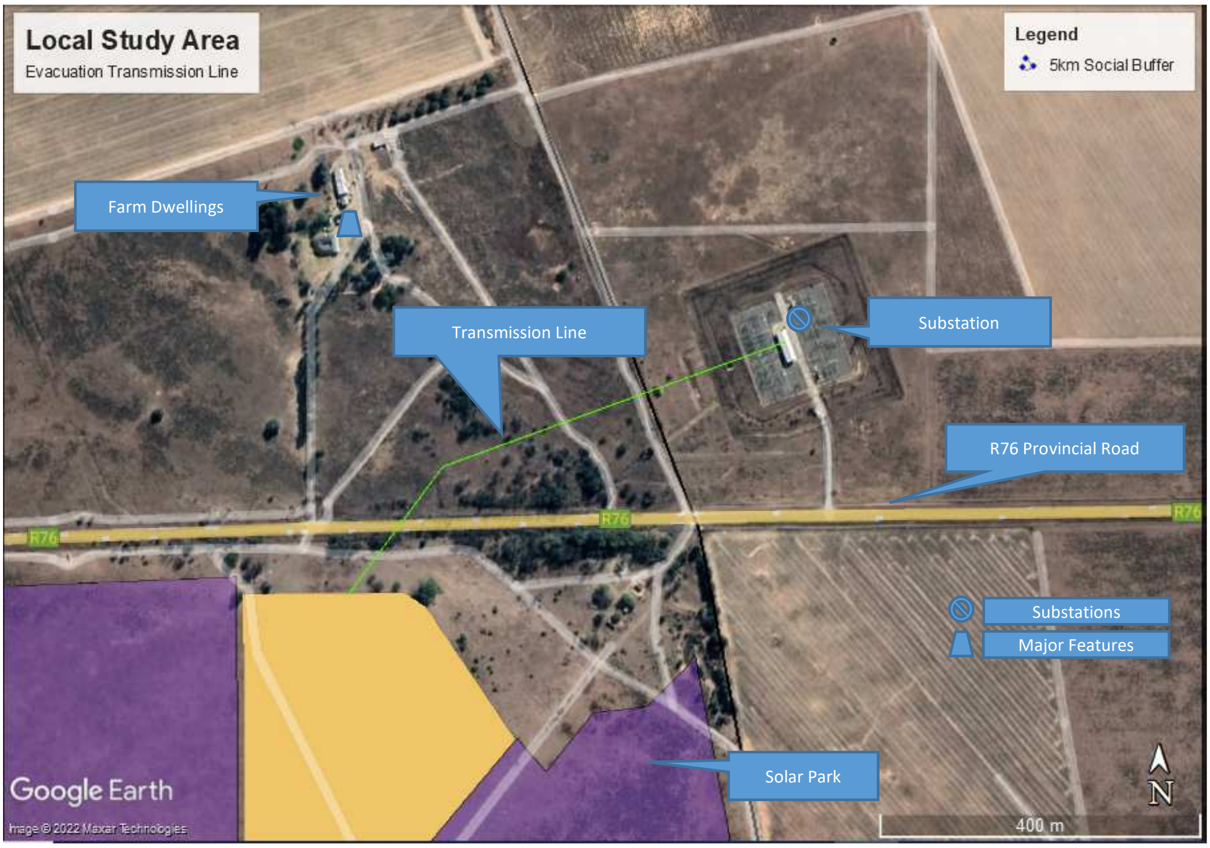


Figure 12: Transmission Line Section of the Proposed Project

This impact census noted the presence of the following social infrastructure:

- R76 road crossing; and
- Farm dwelling to the north of the power line.

5.4 Stakeholder Engagement

The following stakeholder engagement was carried out as part of either the public participation process of the earlier environmental impact assessment process, during the Rapid Rural Assessment and as part of direct contacts with the affected parties.

5.4.1 Site Observations

A further site tour was conducted with the councillor of ward 22, Roderick Jackson and his assistant. The tour included the towns of Viljoeskroon and Vierfontein. The following observations were made:

- The community is located in an agricultural setting;
- The primary languages in the area are Sesotho and Afrikaners;
- Farm dwellings in the area show signs of lack of development, with many being vacant, or having dilapidated buildings.
- The road infrastructure is poorly maintained, the main access road, the R76, is potholed;

- Housing is generally is a better condition in Vierfontein, when compared to the condition in Viljoenskroon;
- A high level of unemployment was inferred from the striking number of youth observed loitering around the central business district of Viljoenskroon.
- Vierfontein is economically more dynamic than surrounding towns, hosting agricultural activities which attract more workers from nearby communities. In this area, agriculture appears to support communities in areas such as Kanana, Viljoenskroon, Orkney and Bothaville;
- There are an observably high proportion of pit latrines in less developed areas of the municipality.

The figure below provides photos of the study area.

	
Agricultural Land	Agricultural Land
	
Agricultural Infrastructure: Grain Silos	Pothole Repairs in Local Roads

	
Local Creche	Subsistence Farming

Figure 13 Photos Taken in the Study Area

5.4.2 Comments Made by the Public

This project was advertised for the environmental impact assessment process in April 2022. The project was advertised in the Parys Gazette, site notices were placed around the project and a database of potentially affected parties was sent notifications via email. These were sent to parties including the elected community representatives.

Comments were received from large institutions and from municipal and government departments. No comments on the project were received from the general public, nor any of the elected representatives. A public meeting was held during the public review of the basic assessment report, and comments with relevance to the social impact assessment included: that water sources in the area were poor and limited, and that a large influx of labour for the project will result in security concerns.

During participatory interviews, which were conducted in the vicinity of the project site, responses were made which include a recognition of the positive economic impact that the agricultural sector has on employment in the study area, lamenting the low level of housing delivery by the local municipality, and the lack of schools.

Interviews were held with stakeholders in the town planning department of the local municipality and the with the ward councillor of the study area. Responses made during these interviews indicated that the lack of economic development was acutely felt and manifested itself in high levels of unemployment, the use of subsistence livestock and vegetable farming to produce a livelihood and the emergence of social ills such as drug and alcohol abuse. A fear within the community as that the proposed project would not yield additional jobs and economic development, and that the project would only impact upon the already economically advantaged residents of the area.

Further responses covered the generally low levels of education in the area, and that outward migration in search of work is a factor that increases the dearth of skills. There was a strong expectation that the project would employ local workers, so as to stimulate the local economy.

Water supply is a stress point in the community, with a major source appearing to be from an Eskom mine. This water was said to be of poor quality, however it would a relatively reliable source which is used by the community. Safety and security is a theme for landowners, with community groups co-operating to ensure low levels of livestock and other theft. The roads are generally in poor state, and in some cases, community members are undertaking road repairs.

6 IDENTIFICATION OF IMPACTS

6.1 Impacts and Mitigation Framework

All impacts are analysed in the section to follow with regard to their nature, extent, magnitude, duration, probability and significance.

ISO 14001-2004 defines impacts as “any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspects”.

When considering an assessment of the impacts and their mitigation, the following definitions as per Table 9 apply.

Table 9: Impact and Mitigation Quantification Framework

Nature	The project could have a positive, negative or neutral impact on the environment.
Extent	**Local** – extend to the site and its immediate surroundings. **Regional** – impact on the region but within the province. **National** – impact on an interprovincial scale. **International** – impact outside of South Africa.
Magnitude	Degree to which impact may cause irreplaceable loss of resources: **Low** – natural and social functions and processes are not affected or minimally affected. **Medium** – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way. **High** – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
Duration	**Short term** – 0-5 years. **Medium term** – 5-11 years. **Long term** – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention. **Permanent** – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability	**Almost certain** – the event is expected to occur in most circumstances. **Likely** – the event will probably occur in most circumstances. **Moderate** – the event should occur at some time. **Unlikely** – the event could occur at some time. **Rare/Remote** – the event may occur only in exceptional circumstances.
Significance	Provides an overall impression of an impact’s importance, and the degree to which it can be mitigated. The range for significance ratings is as follows- **0** – Impact will not affect the environment. No mitigation necessary. **1** – No impact after mitigation. **2** – Residual impact after mitigation. **3** – Impact cannot be mitigated.

Mitigation	Information on the impacts together with literature from social science journals, case studies and field work will be used to provide mitigation recommendations to ensure that any negative impacts are decreased and positive benefits are enhanced.
Monitoring	Monitoring usually involves developing and implementing a monitoring programme to identify deviations from the proposed action and to manage any negative impacts. The recommended mitigation measures will also include monitoring measures.

A well-designed, well implemented, well managed solar park can bring significant social benefits to the communities that it serves. If configured or operated in a way that ignores significant social needs or potential impacts, the proposed project may have significant social costs or liabilities for the stakeholders and affected communities.

Therefore, assessing social impacts is a complex process due to the multi-dimensional nature of the human interactions. This occurs in situations where a particular impact affects a group of stakeholders differently. An inter-connection of impacts can also be encountered whereby a number of impacts are related and when assessed cumulatively, their impacts may be of significance.

The impact assessment scores both before and after mitigation were arrived at by the specialist team engaging in a modified version of the Delphi technique, where the team discussed the scores, and through a process of iteration arrived at a consensus for each of the values. Where additional information was needed to decide, the technique would be halted, the necessary information would be uncovered and included in the report, and the technique would be recommenced.

6.2 Identification of Activities and Aspects

An "Activity" is defined as a distinct process or risks undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation (International Organization for Standardization, 2011).

An aspect is defined as elements of an organisation's activities or products or services that can interact with the environment.

In order to capture the impacts associated with the proposed infrastructure, an activity – aspect – impact table was created refer to Table 10 below.

Table 10: Activity, Aspects and Impacts of the Project

Activity	Aspect	Potential Impact – Positive	Potential Impact – Negative
Land and Servitude Rights Acquisition	Land Acquisition		Loss of agricultural production
			Loss of land (including structures and cultivated areas) through project infrastructure
	Servitude Rights		Some restrictions on use of productive land

Activity	**Aspect**	**Potential Impact – Positive**	**Potential Impact – Negative**
Scheme Operations	Electricity generation	Economic growth and induced impacts.	Water use, reducing volumes otherwise used by communities
	Presence of operational solar park adjacent to active farming activities	Additive to the local economy	
		Increased economic activity	Increased traffic
			Competition for support resources such as housing by solar park staff
		New skills brought into the area	
	Supply of goods and services to the project	Opportunity for local business	
		Opportunity for local labour force	
	Administration and Technical Input	Employment of staff locally	
		Skills development	
Construction Phase	Access into properties		Security Concerns
	Solar Park Construction – piling, frame erection and solar panel mounting, electrical installation and rehabilitation	Employment of people locally	
		Sourcing of equipment, machinery and services locally	
			Noise
			Dust
		Employment of local people	
			Influx of people seeking employment and associated impacts (e.g. cultural conflicts, squatting, demographic changes, anti-social behaviour, and incidence of HIV/AIDS)
		Sourcing of equipment, machinery and services locally	
	Transport of goods to site and employment of staff		Increased traffic
	Transmission Line – limited in scope owing to its short length		Noise
		Employment of people locally	
			Security concerns when contractor's access private property
		Sourcing of equipment, machinery and services locally	

Activity	Aspect	Potential Impact – Positive	Potential Impact – Negative
	Rehabilitation		Damage or wear to access roads
			Security Concerns
			Damage to property or equipment

6.3 Impact and Mitigation Assessment

Taking these impacts into account and based on the project description as well as the applicable legislation and policy and planning issues, the following social impact variables have been identified as being associated with the project. These impacts are in accordance with Vanclay's list of social impact variables (Vanclay, 2002; Wong, 2013) clustered under the following seven main categories as follows

Health and well-being impacts

- Annoyance, dust and noise;
- Security;
- Increased risk of HIV and AIDS; and
- Personal safety, increased hazard exposure.

Worker Health and Safety

- Construction site risks;
- Exposure to disease; and
- Gender considerations in employment.

Quality of the living environment (Liveability) impacts

- Disruption of daily living activities; and
- Perceived quality of life.

Economic and material well-being impacts (positive)

- Increased economic activity;
- Increase in employment opportunities; and
- Increased opportunities for Small Medium and Micro Enterprises (SMME).

Economic and material well-being impacts (negative)

- Loss of land for productive agriculture.
- Water use, reducing volumes otherwise used by communities.

These categories are not exclusive, nor fully inclusive of the project specific impacts, and at times tend to overlap as certain processes may have an impact within more than one category. For instance, changes to the division of labour, as discussed under the category gender relations, will also have an impact on the family and community. In much the same manner increased demand on existing infrastructure, facilities and social service, addressed under the category institutional, legal, political and equity, will have some bearing on the quality of the living environment.

Cumulative impacts can be both positive and negative. Cumulative impacts refer to the impacts that are incremental on the environment that results from the impacts of the proposed action when added to the existing and foreseeable future actions. These impacts can also be temporary in nature (by being restricted to the construction phase) and permanent (occurring in both the construction and operation phase).

6.4 Impacts During the Planning Phase

During the planning phase, long-term social impacts that should be considered and mitigated where necessary. This pro-active approach ensures that the reduces the scope of the negative impacts. The impacts and mitigations listed below have been sourced from the project team's experience with similar projects.

6.4.1 Family and community impacts

The workforce will be recruited from the regional study area, consequently the influx of construction workers is limited both in terms of numbers and duration, and any disruption to family structures and social networks is most likely to be limited.

The project is located close to existing labour sourcing areas such as Orkney and Vierfontein. The size of these settlements is large enough to be able to supply the labour requirement for the construction of the project.

The import of workers into the area is likely to be limited to a small percentage of skilled and experienced members of the workforce who tend to be skilled in areas such as piling, steelwork erection, electrical installations and the like. Staff in these categories will find accommodation in the nearby towns and commute to work during the construction phase. Their low numbers will allow the existing towns to absorb their activities.

6.4.2 Institutional, legal, political and equity

The institutional, legal political and equity impacts associated with the project include:

- Attitude formation towards the project;
- Decreased level of community participation in decision making, loss of empowerment; and
- Compliance with municipal by-laws.

Decreased level of community participation in decision making, loss of empowerment

Although there does not seem to be any significant attitude formation towards the project it is still important for the project proponent to ensure that a communication channel is created between the project proponent and the general public. Any reasonable public concerns will need to be addressed through a transparent and swift process. The Public Participation Process (PPP) provides a channel through which stakeholder can engage with the project proponents and environmental and social compliance consultants to ensure that they have input in respect of decisions affecting them and needs to be carefully and thoroughly planned.

Compliance with municipal by-laws

It is important that the applicable municipal by-laws are understood and complied with to ensure that the environment and the public remain safe and secure. Noted should be taken of the following by-laws, and action taken if needed:

- Provincial Gazette – Free State Province No: 117 (13 March 2015)
    - Control of Public Nuisances
    - Refuse Removal
    - Dumping and Littering
    - Standard Storm water
- Provincial Gazette – Free State Province No: 124 (27 November 2015)
    - Municipal Land Use Planning By-Law;
- Provincial Gazette – Free State Province No: 134 (11 December 2015)
    - Building Regulations;
    - Fences and Fencing By-Law;

As a result of the analysis above, the following impact/mitigation table (Table 11) has been generated.

Table 11: Institutional, Legal, Political and Equity Impact/Mitigation Table

<table>
<tr><td colspan="2">Environmental Feature</td><td colspan="5">Institutional, Legal, Political and Equity</td></tr>
<tr><td colspan="2">Project life-cycle</td><td colspan="5">All Phases</td></tr>
<tr><td colspan="2">Potential Impact</td><td colspan="5">Proposed Management Objectives / Mitigation Measures</td></tr>
<tr><td colspan="2">Attitude formation towards project</td><td colspan="5">• Promptly deal with any raised expectations amongst communities regarding perceived benefits associated with the project, through a process of communication and consultation.</td></tr>
<tr><td colspan="2"></td><td colspan="5">• Promptly address any concerns raised by the public in a transparent manner.</td></tr>
<tr><td colspan="2"></td><td colspan="5">• Where necessary always provide prompt and clear feedback to communities.</td></tr>
<tr><td colspan="2"></td><td colspan="5">• Include all relevant community members in decisions affecting them.</td></tr>
<tr><td colspan="2">Compliance with municipal by-laws</td><td colspan="5">• Ensure that all municipal by-laws are complied with.</td></tr>
<tr><td></td><td>Nature</td><td>Extent</td><td>Magnitude</td><td>Duration</td><td>Probability</td><td>Significance</td></tr>
<tr><td>Before Mitigation</td><td>Negative</td><td>Site</td><td>Moderate</td><td>Short term</td><td>High</td><td>2</td></tr>
</table>

After Mitigation	Negative	Site	Low	Short term	High	1
Significance of Impact and Preferred Alternatives	The impact on project progress could be significant if grievances are not addressed. This can be effectively mitigated through the establishment of a grievance procedure and adherence to local by-laws The impact has no impact on project alternatives.					

6.4.3 Gender relations

Gender refers to the characteristics attributed to males and females by society and is associated with available power and resources. These characteristics, together with the associated power and resources, vary widely between cultures and tend to change over time. The gender relationships associated with the project may include.

- Cultural resistance towards women; and
- Division of labour.

<u>Cultural resistance towards women</u>

Although equal access to employment across gender lines is a recognised right, the application of this right is often executed without careful consideration of the factors that may frustrate this right amongst women in the workplace. In this regard women are often subjected to cultural factors within the workforce from both peers on the job and from management who may resist both employing and promoting women, often based on cultural prejudices. Consequently, the International Labour Organisation points out that:

"Societies therefore have an obligation to create conducive social environment for all their citizens to be able to exercise their right to work, fully utilizing their human potential. Furthermore, evidence has shown that when women are employed and have their own income in their hands, there exist both direct and indirect social benefits for themselves and their households" (Otobe, 2014, p. 1).

With the employment of women during the construction and operational phases of the project it is important to ensure that cultural factors do not hinder the process of employing women and ensuring that they enjoy equal opportunities to men in the workforce.

<u>Division of labour</u>

Following on from the above, the division of labour is a critical aspect that will also lead to various impacts during both the construction and operational phases of the project. During the construction and operational phases of the project women will be integrated into the workforce, however, this will come with various challenges. Women and men work on different tasks, have different biological, sex, gender and health needs, and have different roles within the family, all of which need to be considered in order to create a workplace, without discrimination, that is accessible to both women and men on an equal basis (World Health Organization, 2006).

In introducing women into the workforce, it must be noted that women are over-represented amongst the poorer sectors of society, particularly within the more rural communities, and under-represented, both vertically in terms of responsibility and seniority as well as horizontally in respect of certain functional areas and job categories (Otobe, 2014, p. 22). This is especially the case in the local project area where the proportion of women to men is higher than the provincial average. Thus, the potential labour force is dominated by women.

As a result of the analysis above, the following impact/mitigation table (Table 12) has been generated.

Table 12: Gender Relations Impact/Mitigation Table

Environmental Feature	Gender Relations
Project life-cycle	Construction Phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Cultural resistance towards women	• Sensitise staff in respect of gender sensitive issues that are pertinent to the workplace.
Division of labour	• Ensure gender inclusivity and equity with respect to all compensation.
	• Prioritise gender inclusivity and equity in access to resources, goods, services and decision making with the aim of empowering women.
	• Promote equal job opportunities for women and men during the construction and operational processes.
	• Prioritise and articulate gender inclusivity and equity in the project documents by including specific strategies and guidelines for implementation.
	• The project documents should also include clear mechanisms through which the actual implementation of the activities and the impact on the ground can be monitored and evaluated.
	• Develop a grievance procedure to specifically address gender matters.
	• Factors such as culture should be considered when planning for gender activities since they play a great role in influencing gender relations.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Site	Moderate	Short term	High	2
After Mitigation	Negative	Site	Low	Short term	High	1
Significance of Impact and Preferred Alternatives	The impact on project equity promotion would be moderate if this impact were not addressed. This can be effectively mitigated through policy and implementation of policy. The impact has no impact on alternative route selection.					

6.5 Impacts during the Construction Phase

The construction activity will impact the social environment both positively and negatively. Given the nature of the project area, construction activity is likely to cause a number of social nuisances as well as possible economic implications on the communities and commercial activities. With a project of this nature, most social impacts are experienced during the construction phase, as this is when construction related activities, relating to the influx of labour and the use of construction machinery occurs.

6.5.1 Economic Opportunity

The project will create meaningful economic stimulus to the local economy during the construction phase.

In addition to the economic value added, the construction phase was estimated to produce some 788 job years of employment in the regional study area. Taking into account past experience with renewable project implementation in South Africa, 63 job years (8%) are likely to accrue to females, and a total of 323 job years (41%) are likely to accrue to youth.

The official youth unemployment rate in the region is likely higher than the general unemployment rate, this being the trend nationwide. This project has the potential to impact positively on this rate should employment practises targeted at workers (male and female) under 35 years old be adopted.

The high number of impoverished households shows that there are vulnerable communities in the study area. It is recommended that the appointed contractor use local SMME's and local unskilled labour as far as possible during the construction phase to enhance any local economic impact. In addition, this would increase the skills in the area after construction is completed.

In this way more project revenue will stay in the area, raising economic activity and increasing welfare, resulting in induced economic opportunity. In South Africa, most employment is generated through small and medium business. Given the size of the proposed project, should contracts between local SMMEs be implemented, it is likely that there will be an increase in employment by SMMEs for the duration of the contracts.

In particular, the project has the potential to create a number of opportunities for existing and new local SMMEs. These opportunities range from site clearing, to fencing, parts of the construction scope and supply of materials. There are also opportunities for community members to provide labour, catering, accommodation and other services to the new workers.

Where possible, the project proponent should support and encourage the development of SMMEs and local or regional suppliers in line with government policy.

Education levels provide an indication of the level of skill in the community and the degree to which skills can be skilled. Rural and less developed areas are mostly defined by poverty, while poverty is associated with poor education outcomes.

Attempts to break the poverty cycle of the project areas will require more than secondary school education. Higher education or further skills training is required. It is therefore important that the community members under-go skills development. It is also recommended that the project proponent institute a skills development program during construction.

The project proponent should monitor the employment process. Employment audits should be conducted. It is important that women are also provided employment opportunities. Audits should pay attention to the employment process of women to ensure that exploitation does not take place.

6.5.2 Noise and Dust

During the construction phase, there is a potential for communities to be exposed to increased dust, noise other nuisance disturbances. The site is located in an isolated area where the number of community receptors is limited to a handful.

The generation of dust stems from activities such as clearing of vegetation, piling and vehicle movement during the construction phase. This situation will be worst during the dry season and during windy seasons. Airborne particulates may pose a hazard to residents downwind of the construction site that suffer from upper respiratory tract problems. Mitigation through dust suppression will allow for this impact to be effectively managed.

During the construction, equipment will be required for the site clearance, and during piling and trench excavation for electrical connections. A degree of noise generation will be unavoidable. The degree of noise, frequency of noise and individual perception are all important considerations when determining the impact on noise. Adequate warning of high noise events such as blasting (if required owing to the nature of the subsoil material) should be communicated to the affected communities prior to carrying out such activities. Construction times should be limited to normal working hours.

6.5.3 Worker Health and Safety

The impacts of construction can affect the health and safety of those working on the construction site and disturbance to the environment and animals. These impacts can be mitigated in the Environmental Management Programme (EMPr) and through adherence to the Occupational Health and Safety Act 85 of 1993.

An influx of workers is often characterised by higher health risks, particularly if the influx is male dominated. These include a higher disease burden and rise in HIV/AIDS rates. There is an increased risk associated with the gathering of construction workers in a concentrated area and the availability of disposable income which may attract prostitution. In this regard the World Bank (Gender in Agriculture Sourcebook, 2009, pp. 367-368) indicates that there is a strong link between infrastructure projects and health as:

"Transport, mobility, and gender inequality increase the spread of HIV and AIDS, which along with other infectious diseases, follow transport and construction workers on transport networks and other infrastructure into rural areas, causing serious economic impacts."

It is expected that this influx will be limited owing to the large pool of potential workers for the project being available in Orkney and Vierfontein. The fact that the towns are close to the construction site will obviate the need for communal living conditions that may increase the chances for the spread of disease.

The risk of COVID-19 rates in Orkney and Vierfontein should be borne in mind – the project should implement mitigation measures to ensure that it does not become a disease vector. Positive cases should be isolated and tracing measures implemented to ensure that an outbreak does not occur at the construction site.

There should also be awareness and education campaigns on health and social risks such as HIV/AIDS, COVID-19 and crime prevention.

Given that the project will employ females are part of the workforce, gender considerations should enjoy priority. The workplace should be free of harassment and employment practises should be transparent and free from any coercion or trading. The workplace should make adequate provision for separate gender changing areas and ablution facilities.

6.5.4 Security

There are safety concerns related to the construction activity. Landowners adjacent to similar projects, generally express security concerns, including an increase in crime rates once an area experiences an increase in population owing to the number of construction workers on site.

Mitigation measures include the project proponent, prior to construction, planning for the management of workers by taking measures such as readily identifiable clothing, having the site fenced and secured and taking measures to ensure workers do not congregate outside the site before or after working hours. A security policy must be drafted and strictly enforced by the contractors.

As a result of the analysis above, the following impact/mitigation table (Table 13) has been generated.

Table 13: Construction Phase Impact/Mitigation Table

<table>
<tr><td colspan="2">Environmental Feature</td><td colspan="5">Economic opportunities arising from the construction phase</td></tr>
<tr><td colspan="2">Project life-cycle</td><td colspan="5">Construction phase</td></tr>
<tr><td colspan="2">Potential Impact</td><td colspan="5">Proposed Management Objectives / Mitigation Measures</td></tr>
<tr><td colspan="2">SMME Participation</td><td colspan="5">• Local SMMEs should be given an opportunity to participate in the construction of the project through the supply of services, material or equipment.</td></tr>
<tr><td colspan="2">Job Creation and Skills Development</td><td colspan="5">• The main contractor should employ non-core labour from the regional study area as far as possible during the construction phase.</td></tr>
<tr><td colspan="2">Indirect Employment Impacts</td><td colspan="5">• Spaza/informal trader shops may open next to the site as a consequence of construction. These should be controlled by the contractor to limit their footprint and to ensure that the Moqhaka Local Municipality’s –By-law Relating to Streets are complied with.</td></tr>
<tr><td></td><td>Nature</td><td>Extent</td><td>Magnitude</td><td>Duration</td><td>Probability</td><td>Significance</td></tr>
<tr><td>Before Mitigation</td><td>Positive</td><td>Regional</td><td>Medium</td><td>Short Term</td><td>Likely</td><td>1</td></tr>
<tr><td>After Mitigation</td><td>Positive</td><td>Regional</td><td>Large</td><td>Short Term</td><td>Likely</td><td>3</td></tr>
</table>

Environmental Feature	Economic opportunities arising from the construction phase
Project life-cycle	Construction phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Significance of Impact and Preferred Alternatives	Individuals who will benefit during the construction are limited to those who actively participate in the construction activity through employment, sub-contracting or other economic opportunities. Active participation should be encouraged. The benefits on such a construction will take place irrespective of which routing alternative is preferred.

Environmental Feature	Disturbance arising from the construction phase
Project life-cycle	Construction phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Increase in Dust	• Dust and disturbance can be mitigated through the use of appropriate dust suppression mechanisms; • Adherence to road signage can be added as an advantage and a measure to manage the increase in dust levels; • Mitigation measures management should be adhered to according to the relevant specialist studies.
Influx of workers	• All employment of locally sourced labour should be controlled on a contractual basis. If possible, and if the relevant Ward Councillors deem it necessary, the employment process should include the affected Ward Councillors. • People in search of work may move into the area, however, the project will create a limited number of job opportunities. Locally based people should be given opportunities and preferences over others; • No staff accommodation should be allowed on site; • Influx of workers could may lead to increased diseases and HIV/AIDSs & STI as well as STD infections, therefore awareness programmes should be implemented through the local educational institutions and for the workers as well.
Worker Health and Safety	• The provisions of the OHS Act 85 of 1993 and the Construction Regulations of 2014 should be implemented on all sites; • Account should be taken of the safety impacts on the local community when carrying out the longitudinal aspects of the project, such as the powerline; • Contractors should establish HIV/AIDS awareness programmes at their site camps. • The site should have a COVID-19 risk assessment, policy and plan. The COVID protocols recommended by this process, and those stipulated as the legal minimum should be enforced on site • Gender sensitive work place practises should be planned for and adopted on site. Employment practises should be demonstrated free of coercion or harassment.
Security	• The camp site for the project and the longitudinal construction sub-site laid down areas should be fenced for the duration of construction; • All contractors' staff should be easily identifiable through their respective uniforms; • A project policy on management of workers should be developed. This would include education and awareness to be conducted with regards

Environmental Feature	Disturbance arising from the construction phase					
Project life-cycle	Construction phase					
Potential Impact	Proposed Management Objectives / Mitigation Measures					
	crime, trespassing and not gathering outside the site could be conducted. • Security staff should only be allowed to reside at contractor camps and no other employees.					
Noise impacts	• Prior notice should be given to surrounding communities of noisy event such as blasting. • Construction work should take place during working hours – defined as 07h00 to 17h00 on weekdays and 07h00 to 14h00 on Saturdays. Should overtime work be required, that will generate noise, consultation with the affected community or landowner should take place.					
Damage to property	• If a risk existing of damage taking place on a property as a result of construction, a condition survey should be undertaken prior to construction; • The contractor is to make good and acknowledge any damage that occurs on any property as a result of construction work; • Where crops and agricultural machinery are damaged, compensation is to be paid to the farmer for the proven loss of these crops; • The farmer should be compensated for any loss of income experienced at the account of the contractor.					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Short Term	Likely	2
After Mitigation	Negative	Local	Low	Short Term	Moderate	1
Significance of Impact and Preferred Alternatives	Disturbances and irritation during construction is to be expected. These can then be successfully mitigated through contractor specifications that are issued at a tender stage and through the continuous monitoring of contractor proceedings and performance during construction phase. Negative impacts owing to the construction will unfortunately be experienced irrespective of the site and routing alternative that is most preferred and chosen.					

6.6 Impacts During the Operational Phase

During the operational phase, a project of this nature will have long-term social impacts that should be considered and mitigated where necessary. The impacts and mitigations listed below have been sourced from input by stakeholders, as well as by using the project team's experience with similar projects.

6.6.1 Economic Impacts

The positive economic and material well-being impacts associated with the project include:

- Support to the national grid through the generation of electricity;
- Stimulus to the national and regional study area in the form of spending associated with the project;
- Increase in employment opportunities; and
- Increased opportunities for SMMEs.

Jobs created during the operational phase of the project will be limited when compared to the construction phase, but 1 066 job years will be created directly by the project over its 20-year operational lifespan. In total it was estimated that 55 jobs in total will be created in this timeframe in the South African economy as a result of the project.

Economic opportunities will range from the supply of labour and skills to the project, supply of materials and equipment and an increase in wholesale and retail trade in the regional economy.

To ensure that economic activity derived from the project is localised as far as possible, measures should be adopted to increase local procurement of the human resources and procurement.

As a result of the analysis above, the following operational phase impact/mitigation table (Table 14) has been generated.

Table 14: Operational Phase Economic Impacts (Positive) Impact/Mitigation Table

Environmental Feature	Economic Impacts (positive)
Project life-cycle	Operational Phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Economic	• The solar park will stimulate the local economy through the provision of jobs and through local procurement • It will contribute to the improvement of the national electricity supply at a price that has been set by a competitive bidding process
Local Procurement	• Local SMMEs should be given an opportunity to participate in the operation of the project through the supply of services, material or equipment.
	• A procurement policy promoting the use of local business where possible, should be put in place and applied throughout the operational phases of the project.
Job Creation and Skills Development	• Women should be given equal employment opportunities and encouraged to apply for positions.

	• A skills transfer plan should be put in place at an early stage and workers should be given the opportunity to develop skills whilst in employment.					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Regional	High	Long Term	Likely	3
After Mitigation	Positive	Regional	High	Long Term	Likely	3
Significance of Impact and Preferred Alternatives	The solar park in the regional study area will provide economic stimulus to the regional study area for the long-term. The solar park should adopt policies that are supportive of local procurement and support for local enterprises.					

6.6.2 Economic and material well-being (negative)

There are indirect impacts from the project that may have economic impact. Impacts in this class for the project are:

- Loss of productive agricultural land; and
- Water use, reducing volumes otherwise used by communities

Loss of productive land

The implementation of the proposed project will have an impact on landowners in that land that would otherwise have been used for agriculture would now be re-purposed for use as a solar farm.

The authors view this as a low impact, given that the agricultural yield from the land in the area is very much power than the yield from a solar park. The economic impact – both in terms of contribution of the Gross Value Added to the regional study area, and in terms of jobs created, of the land being used as a solar park will outweigh any possible agricultural use.

The results of the specialist studies related to agriculture will be relied upon when assessing this impact.

Water Impacts

The solar facility will use water to provide for consumption use for staff at the facility, as well as to clean the solar panels when required.

Both if these uses are able to be fulfilled through the use of water tanks, with supplies drawn from municipal water sources. The volumes would be such that they would be no more, and probably a lot less, than the existing farm's requirements for water. The net impact on water use by the solar facility is likely to be less than the existing land use.

As a result of the analysis above, the following impact/mitigation table (Table 15) has been generated. It applies to the planning phase of the proposed project.

Table 15: Operational Phase Economic Well Being (Negative) Impact/Mitigation Table

Environmental Feature	Economic and material well-being (negative)					
Project life-cycle	Operational Phase					
Potential Impact	Proposed Management Objectives / Mitigation Measures					
Loss of productive land	• A very low impact that does not require mitigation.					
Reducing Potable Water Supplies	• This impact can be removed completely by using water from municipal sources and being tanked into the facility. This water tanker measure should be taken, if it is demonstrated that the water quality or the water quantity for other members of the community will be negatively affected by the facilities water use.					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Low	Short Term	Low	1
After Mitigation	Negative	Local	Low	Short Term	Low	1
Significance of Impact and Preferred Alternatives	This impact is not considered significant. It should be noted that this study defers to the agricultural specialists with regards the impact of the project on regional production.					

7 Analysis of Alternatives

Based on the impact assessment and the suggested mitigation measures, the proposed technical alterative detailed for the proposed solar park and transmission line do not have an impact upon the social impact of the project.

Having taken into consideration the project aims of electricity generation using renewable power sources, and considering the assessment above which does not indicate any fatal social flaws. The "No-go" option is not supported by this study.

The benefits from the project going ahead, from a social perspective, will be larger than the project not proceeding.

8 Site Sensitivity Verification

The site sensitivity was verified by means of the methodology and findings of this report. There is no social theme for this project in the screening tool, hence this report conforms with the Environmental Impact Assessment regulations requirements.

The methodology establishes existing land use and includes motivation and evidence of such land use. The nature of this study and its impacts dictate that a larger study area than the immediate site and its adjoining properties be assessed. In this sense, the precise nature of the land development on the site is not relevant in this case.

9 IMPACT STATEMENT

An impact statement is required as per the NEMA regulations with regards to the proposed development.

The regional study area is a rural economy with a narrow base, population growth is lower than in surrounding areas and the per capita economic performance is lower than in surrounding local jurisdictions. The project site has few social receptors surrounding the site, and the project has a low footprint on the social environment. The social and economic impacts of the project are expected to be mainly positive in the sense that the local economy will be stimulated and broadened. The negative impacts are limited in nature and scope and can be successfully mitigated by management rules and practises. It is therefore found that the project, once the recommended mitigation measures have been implemented, has a nett positive impact on the social environment of the regional study area

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APPENDIX 1: CENSUS OF PROPOSED PROJECT IMPACTS

Table 1: Property Directly Impacted by the Solar PV Area within the 5km radius

Name	Co-Ordinates	Image
Eskom Powerline	27°01'31.40" S 26°42'57.51" E	
Concrete Reservoir	27°01'35.48" S 26°43'17.95" E	
Farm Dwellings	27°05'09.88" S 26°44'18.99" E	

Name	Co-Ordinates	Image
Farm dwellings	27°05'04.54" S 26°44'05.41" E	
Farm Dwellings /Houses	27°04'15.00" S 26°46'18.49" E	
Farm Dwellings /Houses	27°04'12.30" S 26°46'02.55" E	

Name	Co-Ordinates	Image
Farm Dwellings /Houses	27°04'24.96" S 26°41'54.68" E	
Farm Dwellings /Houses	27°02'45.59" S 26°41'46.50" E	
Farm Dwellings /Houses	27°02'50.66" S 26°44'26.85" E	

Name	Co-Ordinates	Image
Farm Dwellings /Houses	27°05'09.65" S 26°43'00.69" E	
Farm Dwellings /Houses	27°04'42.32" S 26°42'44.57" E	
Senwes Grainlink Silo Vierfontein	27°04'42.32" S 26°42'44.57" E	

Name	Co-Ordinates	Image
Vierfontein Primary School	27°04'43.68" S 26°43'44.99" E	
Natural water Catchment	27°04'45.44" S 26°43'38.34" E	
Farm building	27°04'43.09" S 26°43'32.30" E	

Name	Co-Ordinates	Image
La Rouge Gasteplaas, Wedding, bed and breakfast and conference centre	27°04'23.74" S 26°43'30.16" E	
Boere Boss Restaurant	27°04'12.74" S 26°43'13.30" E	
Farm Dwellings /Houses	27°04'24.96" S 26°41'54.68" E	

Name	Co-Ordinates	Image
Manmade and Natural Water Structures	27°03'49.53" S 26°44'53.91" E	
Manmade water Structure area	27°05'24.00" S 26°43'55.09" E	
Manmade water Structure area	27°05'23.31" S 26°43'37.88" E	

Name	Co-Ordinates	Image
Manmade Water structure	27°05'47.32" S 26°43'11.52" E	
Community Dwellings	27°05'43.03" S 26°46'15.78" E	
Farm Commercial Area	27°01'49.03" S 26°45'15.09" E	

Name	Co-Ordinates	Image
Water structures	27°01'39.63" S 26°45'17.21" E	
Farm dwellings	27°02'04.09" S 26°45'23.68" E	
Farm dwellings	27°02'31.88" S 26°45'41.97" E	

Name	Co-Ordinates	Image
Beefdotcom	27°04'04.59" S 26°43'10.50" E	
Suburb in North-West side of Vierfontein Town.	27°05'22.04" S 26°46'40.56" E	
Commercial Structure	27°05'14.79" S 26°46'17.67" E	

Name	Co-Ordinates	Image
Commercial structure	27°05'38.50" S 26°46'16.79" E	
The line of transmission passing through R76	27°03'02.70" S 26°44'37.97" E	

Table 2: Property Directly Impacted by the Power Transmission Line

Name	Co-Ordinates	Image

APPENDIX E9: Specialist Declarations

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Palaeontological Desktop Assessment to assess the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Banzai Environmental Pty Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 4	Percentage Procurement recognition	51 %
Specialist name:	Elize Butler			
Specialist Qualifications:	MSc			
Professional affiliation/registration:	PSSA			
Physical address:	14 Eddie de Beer, Dan Pienaar, Bloemfontein			
Postal address:				
Postal code:	9301	Cell:	084 4478759.	
Telephone:		Fax:		
E-mail:	elizebutler002@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, _____Elize Butler_____________________________, 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Banzai Environmental Pty Ltd

Name of Company:

04-05-2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, __________Elize Butler_________________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Banzai Environmental Pty Ltd

Name of Company

04-05-2022

Date

Signature of the Commissioner of Oaths

2022-05-04

Date

SUID-AFRIKAANSE POLISIEDIENS
HUMAN RESOURCE MANAGEMENT
2022 -05- 04
BAYSWATER
SOUTH AFRICAN POLICE SERVICE

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PHASE 1 CULTURAL HERITAGE IMPACT ASSESSMENT: THE PROPOSED ALTINA 120MW SOLAR PHOTOVOLTAIC PROJECT NEAR THE TOWN OF ORKNEY, FREE STATE PROVINCE

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
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Departmental Details

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Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Heritage Consultant			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	0%
Specialist name:	J A van Schalkwyk			
Specialist Qualifications:	D Litt et Phil			
Professional affiliation/registration:	Association of Southern African Professional Archaeologists, No. 164			
Physical address:	62 Coetzer Avenue, Monument Park, Pretoria			
Postal address:	62 Coetzer Avenue, Monument Park, Pretoria			
Postal code:	0181	Cell:	976 790 6777	
Telephone:	-	Fax:	-	
E-mail:	jvschalkwyk@mweb.co.za			

2. DECLARATION BY THE SPECIALIST

I, J A van Schalkwyk, 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;
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- 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

n/a

Name of Company:

14 September 2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, J A van Schalkwyk, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

n/a

Name of Company

14 September 2022

Date

0545496-1

Signature of the Commissioner of Oaths

SUID-AFRIKAANSE POLISIEDIENS
SAPS LYTTELTON
2022 -09- 14
COMMUNITY SERVICE CENTRE
SOUTH AFRICAN POLICE SERVICE

2022-09-14

Date

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

The Proposed Altina Solar Photovoltaic Development, Orkney, Free State Province

1. SPECIALIST INFORMATION

Specialist Company Name:	The Biodiversity Company			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement recognition	100
Specialist name:	Carami Burger			
Specialist Qualifications:	BSc Honours- Ecological Interactions and Ecosystem Resilience			
Professional affiliation/registration:	Cand Sci Nat (121757)			
Physical address:	777 Peridot Street Jukskei Park, Randburg, 2188			
Postal address:	777 Peridot Street Jukskei Park			
Postal code:	2188	Cell:	083 630 9077	
Telephone:		Fax:	086 527 1965	
E-mail:	carami@thebiodiversitycompany.com			

2. DECLARATION BY THE SPECIALIST

I, Carami Burger, 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;
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- 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 48 and is punishable in terms of section 24F of the Act.

Buger

Signature of the Specialist

The Biodiversity Company

Name of Company:

20/07/2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Carami Buger, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Buger

Signature of the Specialist

The Biodiversity Company

Name of Company

20/07/2022

Date

Signature of the Commissioner of Oaths

20/07/2022

Date

TIRELO YA MAPODISI A AFRIKA BORWA
COMMUNITY SERVICE CENTRE
2022 -07- 20
HARTBEESPOORTDAM
SUID-AFRIKAANSE POLISIEDIENS
SOUTH AFRICAN POLICE SERVICE

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Altina 120MW Solar PV Project near the town of Orkney –

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
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Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Index			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)		Percentage Procurement recognition	
Specialist name:	Andries Gouws			
Specialist Qualifications:	BSc, BSc Hons, PhD			
Professional affiliation/registration:	SACNASP			
Physical address:	277 Eridanus Street			
Postal address:	Box 26275, Monument Park			
Postal code:	0108	Cell:	082 807 6717	
Telephone:		Fax:		
E-mail:	Index@iafrica.com			

2. DECLARATION BY THE SPECIALIST

I, J A Gouws 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;
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- 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

INDEX

Name of Company:

14 September 2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, J A Gouws, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

INDEX

Name of Company

14 September 2022

Date

Signature of the Commissioner of Oaths

14 September 2022

Date

FRANCOIS GOUWS
COMMISSIONER OF OATHS
PRACTISING ATTORNEY (RSA)
414 SUSSEX AVENUE
LYNNWOOD, PRETORIA

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
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NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Avifaunal Baseline and Impact Assessment, Altima Solar PV, Free State.

Kindly note the following:

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Pretoria
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Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Marak Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	0
Specialist name:	Tyron Ken Clark			
Specialist Qualifications:	MSc Zoology (Cum Laude)			
Professional affiliation/registration:	SACNASP Pr Sci Nat 121338			
Physical address:	P4 of Farm Schurweberg 11 JQ			
Postal address:	PO Box 343 Tarlton			
Postal code:	1749	Cell:	0836229224	
Telephone:		Fax:		
E-mail:	tyronclark@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, Tyron Ken Clark, 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;
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- 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Marak Consulting

Name of Company:

12/7/22.

Date

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Tyron van Clark, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Meraki Consulting

Name of Company

12/7/22

Date

Signature of the Commissioner of Oaths

12 July 2022

Date

TIRELO YA MAPODISI A AFRIKA BORWA
COMMUNITY SERVICE CENTRE
2022 -07- 12
HARTBEESPOORTDAM
SUID-AFRIKAANSE POLISIEDIENS
SOUTH AFRICAN POLICE SERVICE

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Wetland Baseline and Impact Assessment, Altina Solar PV, Free State

Kindly note the following:

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Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Merak Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	0
Specialist name:	Tyron Ken Clark			
Specialist Qualifications:	MSc Zoology (Wits)			
Professional affiliation/registration:	SACNASP Pr Sci Nat 121338			
Physical address:	Pt 96 Farm Schurweberg [illegible] 0256			
Postal address:	Po Box 243 [illegible]			
Postal code:	[illegible]	Cell:	0836229226	
Telephone:		Fax:		
E-mail:	tyronk2@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, Tyron Ken Clark, 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;
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- 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Merak Consulting
Name of Company:

12/7/22
Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Turian Ken Clark, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Meraki Consulting

Name of Company

12 July 2022

Date

Signature of the Commissioner of Oaths

12 July 2022

Date

TIRELO YA MAPODISI A AFRIKA BORWA
COMMUNITY SERVICE CENTRE
2022 -07- 12
HARTBEESPOORTDAM
SUID-AFRIKAANSE POLISIEDIENS
SOUTH AFRICAN POLICE SERVICE

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

10741 – Altina Solar PV Project

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Pretoria
0001

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Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Eco Elementum (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)		Percentage Procurement recognition	
Specialist name:	Neel Breitenbach			
Specialist Qualifications:	Bsc Geography			
Professional affiliation/registration:				
Physical address:	361 Oberon Ave, Glenfield Office Park, Nika Building, Faerie Glen, Pretoria			
Postal address:				
Postal code:	0081	Cell:		
Telephone:	012 807 0383	Fax:		
E-mail:	info@eoce.co.za			

2. DECLARATION BY THE SPECIALIST

I, Neel Breitenbach, 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;
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- 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Eco Elementum (Pty) Ltd

Name of Company:

2022-09-14

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Neel Breitenbach, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Eco Elementum (Pty) Ltd

Name of Company

14-09-2022

Date

Signature of the Commissioner of Oaths

2022.09.14

Date

SUID-AFRIKAANSE POLISIEDIENS
STATION COMMANDER
COMMUNITY SERVICE CENTRE
2022 -09- 14
GEORGE
SOUTH AFRICAN POLICE SERVICE

APPENDIX E10: Draft Wetland Rehabilitation Strategy

Wetland Rehabilitation Strategy for the proposed Altina Solar PV Development

Vierfontein, Free State Province

October 2022

Client

NEMAI CONSULTING

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	**Wetland Rehabilitation Strategy for the proposed Altina Solar PV Development, Vierfontein, Free State**
Reference	Wetlands Rehabilitation Strategy (Draft) Altina Solar PV
Submitted to	NEMAI CONSULTING
Report Writer	Andrew Husted (Pr. Sci. Nat. 400213/11)
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 Ecological Assessment Regulations, 2014 (amended 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.

Table of Contents

Tables

Figures

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

Pr. Sci. Nat. 400213/11

October 2022

1 Introduction

1.1 Background

The Biodiversity Company was commissioned to complete a wetland baseline and impact (risk) assessment for the proposed establishment of Altina solar photovoltaic (PV) development. The presence of wetlands within the development area (hereafter referred to as the project area) triggered the need for this wetland delineation and risk assesmment.

Based on the preferred infrastructure layout (Alternative 2) the proposed development will overlap some seepage areas. These seeps were assigned a sensitivity rating of High as they still remain relatively intact and functional (Figure 1-1). The direct loss of seep wetland habitat (under infrastructure Alternative 2) equates to 44.2 ha (9.2% loss of wetland area). It was concluded in the wetland report that the loss of wetland area necessitates a Wetland Offset Strategy. Decisions regarding the development of wetland areas and the required compensation have been considered for this preliminary rehabilitation strategy. impacted systems, but to also provide adequate compensation for the expected loss of wetland areas.

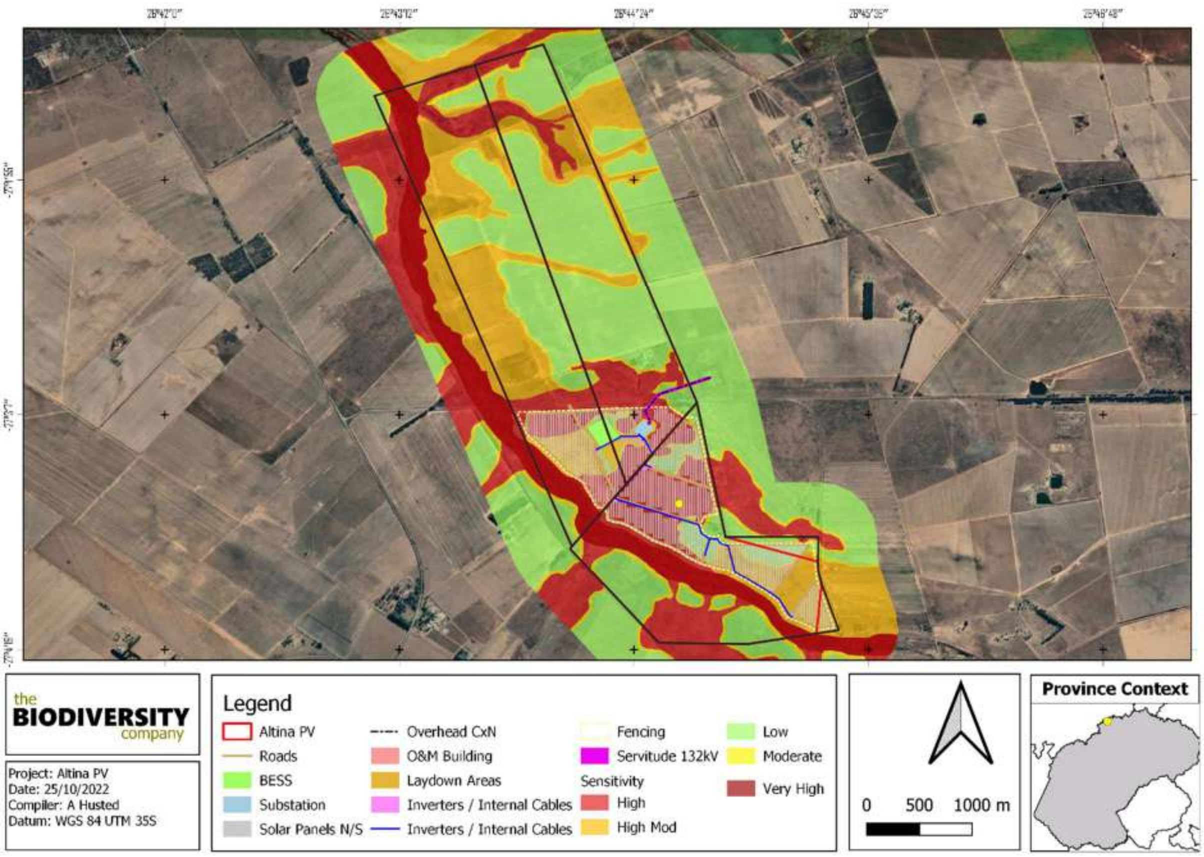

Figure 1-1 The proposed development overlaying the delineated wetlands (sensitivity depicted)

1.2 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- Recommendations relevant to rehabilitation of degraded areas; and
- Report compilation for a draft wetland rehabilitation strategy.

1.3 Limitations

The following has been noted:

- The wetland rehabilitation strategy has been compiled to provide a robust framework and strategy to provide a level of compensation for the expected loss of wetland area. The developer has stated that the total footprint area would equate to 0.35% per hectare. Based on this, the extent of direct impacts to the wetland area would amount to 44.2 ha or 9.2% of the total wetland extent in the project area. This loss has been considered for the rehabilitation strategy; and

- A rehabilitation plan must be compiled to facilitate the successful implementation of the strategy. The pan has not be completed for this phase of the development.

2 Legislative Requirements

Section 24 of the Constitution of South Africa states that, '*everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development'*. The following Acts make provision for wetland rehabilitation:

- The Conservation of Agricultural Resources Act of 1984.
- The National Environmental Management Act 107 of 1998.
- The National Water Act 36 of 1998.

3 Rehabilitation Approach

The approached presented herein provides for a level of compensation for the expected loss of wetland area. Table 3-1 present the mitigation hierarchy process that has informed the rehabilitation strategy being presented. Efforts have been made (as detailed in the wetland report) to avoid direct impacts to wetlands and to further mitigate any unavoidable impacts. This strategy will present rehabilitation measures to facilitate the recovery of impacted systems, but to also provide adequate compensation for the expected loss of wetland areas.

Table 3-1 The mitigation hierarchy requirements and accompanying comments

Category	Requirements	Comment
Avoid or Prevent	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts.	Loss of wetland habitat equates to 126.3 ha or 26.3% of the total wetland extent in the project area. It is possible that Alternative 2 achieves < 10% of wetland area to be lost as a result of the project.
Minimise	Refers to considering alternatives in the project location ,sitting, scale, layout, technology and phasing that would minimise impacts.	The residual risks range from Medium to Low.
Rehabilitation	Refers to rehabilitation of areas where impacts are unavoidable and measures are provided to	Rehabilitation of selected wetland area will be considered for the rehabilitation strategy. This will include wetlands both directly and indirectly affected by the project.

	return impacted areas to near-natural state or an agreed land use after mine closure.	
Offset	Refers to measures over and above rehabilitation to compensate for the residual negative effects.	Onsite rehabilitation will be proposed to provide for suitable compensation. According to Macfarlane et al (2016) a ratio of 1:0 is required for wetlands identified as having high importance and biodiversity value. The extent direct loss of wetland area is expected to be 44.2 ha (9.2% loss of wetland area) but the extent of wetland systems that will be directly affected by the development amounts to 250.6 ha. The selected rehabilitation areas amount to 121.6 ha (or 48%) which effectively achieves a compensation ratio of 1:2. The ratio serves as justification to rehabilitate wetlands on-site, as opposed to seek alternative off-system systems.

3.1 Offset categories

Should a wetland offset be deemed appropriate, various actions may be used to deliver the required outcomes, as provided by Macfarlane D. *et al* (2014) below. For the purposes of this plan, on-site rehabilitation has been proposed to provide for suitable compensation:

- Protection: This refers to the implementation of legal mechanisms (e.g. declaration of a Protected Environment or Nature Reserve under the National Environmental Management: Protected Areas Act, a legally binding conservation servitude, or a long term Biodiversity Agreement under National Environmental Management Act) and putting in place appropriate management structures and actions (this may include setting appropriate water reserve determinations and specifying protection measures within DWA planning instruments, as well as inclusion of offset sites into appropriate land use zones and land use plans including provincial and local conservation plans) to ensure that conservation outcomes are secured and maintained in the long-term.

- Averted loss: This refers to physical activities which prevent the loss or degradation of an existing wetland system, its ecosystem services and its biodiversity, where there is a clearly demonstrated threat of decline in the system's condition, ability to provide ecosystem services or support overall Water Resource Objectives (both quality and quantity).

- Rehabilitation: Rehabilitation results in an improvement in wetland condition, function, and associated biodiversity. Rehabilitation involves the manipulation of the physical, chemical, or biological characteristics of a degraded wetland system in order to repair or improve wetland integrity and associated ecosystem services.

- Establishment: This involves the development (i.e. creation) of a new wetland system where none existed before by manipulating the physical, chemical, or biological characteristics of a specific site.

- Direct compensation: Direct compensation involves directly compensating affected parties for the ecosystem services lost as a result of development activities. This is ideally done by providing an equivalent substitute form of asset or in some cases may take the form of monetary compensation.

3.2 Rehabilitation Targets

Four (4) wetland units have been identified for rehabilitation measures, these include three (3) seepage areas directly associated with the development area, and the adjacent floodplain system (Figure 3-1). The following reasons for these selections are provided:

- The systems are proximal to the development which enables for resource allocation, such as machinery, vehicles and personnel;
- The location of wetland areas allows for (more) easy monitoring of rehabilitation area and any hard interventions; and
- The systems are not currently being cultivated which makes these available for rehabilitation interventions.

The seepage areas have been partially encroached by the development, and the intention of the rehabilitation measures is to secure and enhance the integrity and functioning of the remaining wetland portions. The floodplain is not directly affected by the development, but the system is the beneficiary of water inputs from the adjacent (and upslope) wetland units. A fifth wetland unit has been identified as a potential candidate system for rehabilitation, but this would require agreement from the landowner and no further consideration has been afforded to this option for the strategy at this time. A recommendation has been made to allow for the refinement of this draft strategy on receipt of final designs and project information. This refinement must also make allowances for stakeholder engagement.

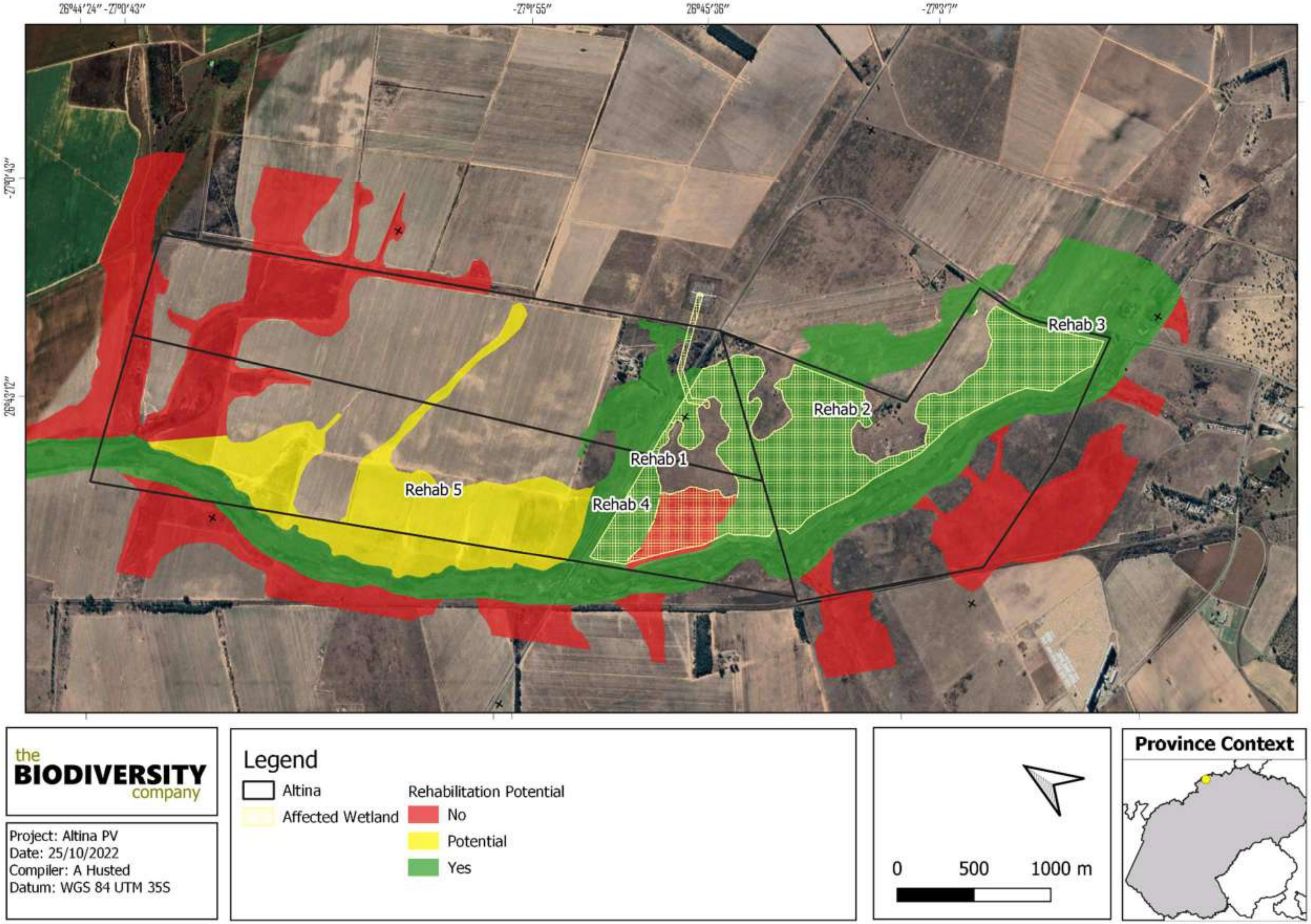

Figure 3-1 Wetland areas that have been considered for rehabilitation intervention

4 Rehabilitation

4.1 Strategy and Planning

The overall aim of this rehabilitation strategy is to remediate the impacts to wetlands associated with the proposed development to the target state (see Section 4.1.5) and prevent further loss of ecological integrity in future through adaptive management and monitoring. It is important to note that rehabilitation is not a static endpoint but rather an ongoing adaptive process that strives to recreate and preferably improve on the former natural state of the wetland. Although each project may have different starting and endpoints the overall result should be a net improvement on the state of the system achieved through a sound understanding of the ecological driving forces and the defined end goal. In South Africa this broad aim can be further subdivided into three themes based on projects specific situations and desired / feasible outcomes namely (1) water resources and indirect services, (2) ecosystem conservation and (3) species of conservation concern. For this project the main focus should be on improving the provision of indirect regulating and supporting services (Theme 1) with a secondary goal of improving and protecting the rehabilitated wetlands (and other wetlands in the regional area) to the point where they contribute meaningfully towards local and provincial targets (Theme 2) and provide suitable habitat to sustain resident populations of conservation important species (Theme 3).

To achieve the aim, three objectives will need to be met, namely to (1) appropriately strategize rehabilitation efforts, (2) effectively implement the rehabilitation measures to restore wetland integrity and (3) maintain that integrity over the long-term. The objectives are listed in Table 4-1 along with their associated activities and the order in which they should take place.

Table 4-1 Activities required to meet the three main objectives for the rehabilitation project and the order in which they should take place

Objective	Activity	Order
Plan	Legal framework	Planning
	Budget	Planning
	Personnel	Planning
	Authorization	Planning
	Targets	Planning
Restore	Landscaping and soil preparation	1
	Erosion control measures	2
	Deactivation of artificial drains	3
	Re-vegetation	4
	Removal and control of alien invasive flora	5
	General environmental considerations	6

4.1.1 Authorisations

It is essential that all necessary permission, authorisations and licenses be applied for before any in-field wetland rehabilitation actions are taken. For a more comprehensive breakdown of applicable authorisations and the consequences associated non-compliance the reader is referred to. However, the following points are considered particularly pertinent and relevant to this project.

- It is important to note that the proposed wetland rehabilitation may require a water use licence. The onus is on the applicant to conduct a risk assessment to inform a decision made by DWS as to whether the final rehabilitation activities to be implemented constitute either a general authorisation in terms of section 39 of NWA or a full Water Use Licence application;
- It would be prudent for the applicant to ensure that none of the proposed rehabilitation activities would require environmental authorisation in terms of NEMA; and
- The applicant will also have to practice the Duty of care, remediation of environmental damage and the polluter pays principle as stipulated in the Constitution, section 28 of NEMA and section 19 of the NWA. Under this principle the applicant is obliged, by law, to act responsibly and prevent and minimise harm to the environment and rectify it if / when it does occur.

4.1.2 Budget

It is the responsibility of the applicant to ensure that an annual budget is compiled for the implementation of rehabilitation project and that these costs are adequately captured into the mine’s annual financial budget. Costs should be allocated across three main phases namely planning, rehabilitation and monitoring and maintenance (ongoing). It is important that provision is made for, but not limited to, the for the following:

- Relevant authorizations;
- Project planning and administrative costs;
- Equipment and materials;
- Appointment of contractors, personnel and specialists;
- Plans for engineered intervention structures;
- Geotechnical investigations if required;
- Ecotoxicology / contamination assessments (to identify sources of contamination and assess significance); and
- Implementation of wetland monitoring.

4.1.3 Personnel, Roles and Responsibilities

The main responsibility for ensuring that the wetland rehabilitation is effectively managed and implemented lies with applicant and the appointed environmental practitioner but also the contractors responsible for any direct or indirect disturbance of wetlands. The applicant should advise on the responsible contractor for the overseeing the management of the rehabilitation of the relevant areas within the wetland to be conducted by the responsible contractor The Ecological Control Officer (ECO), will be responsible for the wetland monitoring and to identify aspects that may require further attention. This can be done in conjunction with a wetland specialist (overseeing and advisory role).

4.1.4 Recommended Ecological Class

The Recommended Ecological Category (REC) is determined by the Present Ecological State (PES) of the water resource and the importance and/or sensitivity of the water resource. The REC has been determined based on ecological information provided by the delineated wetlands. The following is summarised:

- PES is in an E or F category:
  - The REC should be set at least a D, since E and F ecological categories are considered unsustainable.
- The PES category is in A, B, C or D category, AND the IS criteria are Low or Moderate OR the IS criteria are high or even very high, but it is not feasible or practicable for the PES to be improved:
  - The REC is set at the current PES.
- The PES category is in a B, C or D category, AND the IS criteria are High AND it is feasible or practicable for the PES to be improved:
  - The REC is set at least half an Ecological Category higher than the current PES.
- The PES category is in a B, C or D category, AND the IS criteria are Very High AND it is feasible or practicable for the PES to be improved:
  - The REC is set at least one Ecological Category higher than the current PES.
- The PES category is in an A category, AND the IS criteria are High or Very High:
  - The REC is set at the current PES.

Table 4-2 The ecological categories for the target rehabilitation wetlands

Rehab Wetland	PES	EIS	REC
Rehab 1 (Seep)	Class C (Moderately Modified)	Class B (High)	Class C (Moderately Modified)
Rehab 2 (Seep)	Class C (Moderately Modified)	Class B (High)	Class C (Moderately Modified)
Rehab 3 (Seep)	Class E (Seriously Modified)	Class D (Low)	Class D (Largely Modified)
Rehab 4 (Floodplain)	Class C (Moderately Modified)	Class A (Very High)	Class B (Largely Natural)

Based on this, the REC for the seep systems ranges from class C to class D, with the REC for the floodplain expected to improve to a class B. These classes must be considered for future monitoring programmes.

4.2 Restoration

4.2.1 Erosion and Sedimentation Measures

Based on the ecosystem services assessment the site has a Moderately High erosive potential due to the high runoff intensity from the wetland's catchment and high erodibility of its soils. Consequently, it is important that appropriate erosion control measures are incorporated into the design of the rehabilitation project that cater for periodic bouts of high flow volumes and velocities following significant rainfall events. Erosion control should address both catchment and within system impacts. The following rehabilitation measures are prescribed for erosion and sedimentation:

- Prevention of erosion within the rehabilitated wetland will centre on appropriately address all artificial inputs (stormflows and seepage). Attempts should be made to contain dirty water within the developed area through the re-diversion of any trenches that are currently delivering runoff flows from the area into the dirty water system;

- Reducing and attenuating stormflows entering the wetland by not only effectively designing and maintaining the stormwater infrastructure (e.g. repairing damaged v-drains and regularly clearing them of obstructions to prevent overflows). But by fitting all upstream culverts with flow attenuation structures constructed with rocks and concrete;

- All erosion channels within the catchment are small and can easily be remediated through one of two methods. Shorter channels can be backfilled and compacted while longer channels may be remediated by installing soil plugs at intervals (max spacing of 1 m) along the channel to promote sediment accumulation and re-vegetation. Backfilling is deemed preferable; and

- In the period between site clean-up / landscaping and re-vegetation when a portion of the wetland is denuded of vegetation and bare soils predominate, the wetland will be particularly prone to loss of sediments and erosion. To minimise the loss of sediments and reduce erosion risk during this time it is advised a series of biodegradable fibre logs (hessian tubes filled with locally cut grass and soil) be placed perpendicularly across the wetland at 50-100 m intervals and pegged in place with wooden stakes (do not use wood from *Poplar spp*.) to prevent them being washed away. These logs should span the width of the wetland (±20 m in length) and needn't be tall (<30 cm diameter).

4.2.2 Revegetation

Re-vegetation of areas denuded by disturbances, site clean-up (soil scraping and washing) and landscaping activities should be re-vegetated. Re-vegetation should follow landscaping activities in a phased approach over two consecutive growing seasons (first zone 1 then zone 2). This approach ensures that the entire system is not denuded of vegetation all at once any that any challenges / short comings identified in the first phase to be rectified in the second phase. The three zones for re-vegetation and their priority / schedule for re-vegetation are shown in **Error! Reference source not found.**. These re-vegetation zones essentially represent the flow path (permanent seasonal saturation – zones 1a) and banks (seasonal temporary saturation – zones 1b and 2a).

The floodplain and adjacent seepage wetlands provide a relatively good example of the vegetation structure and species composition that should be aimed for in the rehabilitated wetlands. Rehabilitation should seek to re-establish a wetland vegetation comprised of short, dense hydromorphic grasses in the temporary to seasonal zone with slightly taller sedges becoming more prevalent in the permanent zones along the flow path. Avoid creating a monoculture, species diversity is the key to wetland health and the provision of important ecosystem services such as erosion control and water quality enhancement. To achieve this outcome the following approach is advocated:

- Attempts should be made to maximise the diversity of low hydromorphic grasses and sedges throughout;
- Re-vegetation should involve the use of both re-seeding and mechanical transplanting. Re-seeding should occur in both the flow path and banks to establish a vegetation base while mechanical transplanting of wetland plant sods should take place mainly within the flow path;
- As the saturation, nutrient and oxygen levels will vary markedly depending on the hydrological zonation (permanent, seasonal and temporary) care should be taken to sow or plant the appropriate plant species in each re-vegetation zone (flow path or bank) as indicated in (**Error! Reference source not found.**). The species are generally common and adaptable species that show a tolerance to disturbed soil conditions;
- Only locally indigenous species that are adapted to local climatic conditions should be used. Perennial species should be prioritised for transplanting. Good quality planting material or seed must be readily available;
- Revegetation should commence immediately after landscaping and the preparation of the seedbed, preferably in early spring when conditions for germination and rootstock establishment are optimal. Planting should preferably be timed to take place 1-3 days following a significant rainfall event when soils are within 10% of the field capacity (maximum saturation level);
- Topsoil stripped from the hardstanding area and widening, and construction of on-site roads should be stored for later use and where necessary supplemented with imported topsoil. These soils must be stored in the correct profile and not mixed, separating topsoil and diagnostic sub-horizons. With correct storage and replacement of topsoil species diversity should improve rapidly as species present in the seedbank also germinate;
- Transplanted vegetation can be sourced from nurseries and / or sustainably harvested from local wetlands, with due authorisation. Most of the plants should be harvested from the areas that will be scraped during the site clean-up and landscaped and supplemented with plants from surrounding wetlands. Harvesting should target sedges, rushes and grasses;
- Harvesting would involve carefully digging up parent plants and separating the material into as many individual sods as possible. Parent plants should be large specimens with a high root biomass. These plants should be temporarily stored onsite and transplanted later. Try to minimise the time spent the harvested plants spend in nurseries between harvesting and replanting back in the wetland;
- Try to limit collection and disturbance to wetlands when collecting sods by sticking to the designated collection areas and utilising a single access path. Once complete the soil along the collection paths must be loosened;

- The sods should be planted to an approximate depth. This will vary depending on the size of the plant but will be around 20 cm on average. The recommended planting density depends on plant size (range from 1 plant / m^2 for large plants such as rushes to 8 pants / m^2 for small sedges and grasses) but is generally around 2–3 plants / m^2 for average sized plants. When transplanting sods attempt to retain as much of their roots and soil as possible and maintain saturation levels similar to where they were removed from;

- For larger sedges and rushes trim the foliage (about 10 to 15 cm) to reduce evaporative losses during transplanting. At least some live foliage must remain above ground after planting to drive water uptake and survival;

- Keep plants that are being prepared for later transplanting out of direct sunlight (fodder bags work well) and bag / re-plant as soon as possible. Uprooted plants left in the sun for a several hours will die. Conversely, those left in bags for several days will begin to rot; and

- Avoid the use of fertilizers or any other chemicals or soil enhancers during re-vegetation.

Table 4-3 Recommended species for revegetation

Species	Growth Form	Seeds / sods	Approximate Application rate
	Floodplain and embankments		
Imperata cylindrica	Grass	Sod & seeds	5000 seeds/ 100 m^2
Leersia hexandra	Grass	Sods	-
Typha capensis	Grass (reed)	Sods	-
Phragmites australis	Grass (reed)	Sods	-
Cyperus compresus	Sedge	Sod & seeds	400 seeds/ 100 m^0
Cyperus congestus	Sedge	Sod & seeds	400 seeds/ 100 m^1
Cyperus laevigatus	Sedge	Sod & seeds	400 seeds/ 100 m^2
Kyllinga erecta	Sedge	Sods	-
	Seepages		
Agrostis lachnantha	Grass	Sods / seed	4000 seeds/ 100 m^1
Andropogon eucomus	Grass	Seed	4000 seeds/ 100 m^2
Aristida congesta subsp. Congesta	Grass	Seed	4000 seeds/ 100 m^3
Setaria sphacelata var. sericea,	Grass	Seed	4000 seeds/ 100 m^5
Imperata cylindrica	Grass	Sods & seeds	5000 seeds/ 100 m^2
Sporobolus africanus	Grass	Seed	300 seeds / 100 m^2
Sporobolus fimbriatus	Grass	Seed	300 seeds / 100 m^2
Digitaria eriantha	Grass	Seed	300 seeds / 100 m^3
Eragrostis gummiflua	Grass	Seed	800 seeds / 100 m^2
Scirpoides dioecus	Sedge	Sods	-

4.2.3 Removal and Control of Alien Invasive Flora

Land users are required by law, to remove and / or control Category 1 species alien invasive species (AIS) according to the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). Additionally, unless authorised thereto, in terms of the National Water Act, 1998 (Act No. 36 of 1998), 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.

It is very important to note that no chemical or hormonal control of AIS must be employed within any wetland area or their associated buffers. Although the table below includes chemical and hormonal control options these are intended for terrestrial areas only. In the wetlands themselves only mechanical control (i.e. removal of whole plant by hand) should be permitted. The removal and control of alien vegetation is required for the recommended wetland systems.

Table 4-4 NEMBA listed AIS detected within the project area together with their recommended control method.

ScientificName	Common Name	NEMBA Category	Recommended clearing strategy
Cirsium vulgare	Spear thistle	1b	Control of this plant should be conducted in prior to flowering to optimise results. This plant is easily controlled with regular cultivation and is susceptible to hormone and contact herbicides (Bromilow 2010).
Cortaderia selloana	Pampas grass	1b	The best control for this grass species is repeated applications of systemic herbicide. It is imperative that the herbicide application is repeated to ensure that the roots of this plant are killed. If removed by hand, it is important to wear protective clothing. Fire does not effectively control this grass species (Bromilow 2010). Mechanical control: Dig or grub out seedlings or small plants. Chainsaw small plants and remove sizeable plants by bulldozer. Compost or leave on site to rot down. Burn or bury any flowerheads. Weed wipe (all year round): glyphosate (200ml/L + penetrant). Gallant (150ml/10l + crop oil) for most sites or glyphosate (100ml/10L + penetrant) for very dense sites. Use a marker dye to avoid wastage and a foaming agent to help prevent spray drift. Leave the plants in the ground until the roots have died off (Weedbusters.org.nz).
Arundo donax	Giant Reed	1b	Physical removal must include complete removal of the rhizome. Cut down to ground level, stack & burn. Spray regrowth with a systemic herbicide when new plants reach 1-2m, about 6-8 weeks later. Follow-up is essential for long-term control. Consult herbicide labels for use in wet areas
Crotalaria agatiflora	Canary Bird Bush	1b	Currently there are no herbicides registered for this species in South Africa. It can be physical controlled by uprooting the plant before it can form seeds.
Melia azedarach	Chinaberry	1b	Hand pull seedlings. Adults, cut stump or frill. Several hebicdes can be used including Confront 360 SL (L7314), Plenum 160 ME (L7702), Chopper 100 SL (L3444), Hatchet 100 SL (L7409) Access 240 SL (L4920) and Timbrel 360 SL (L4917). (Methods recommended by the Working for Water Programme).
Eucalyptus grandis	Saligna Gum	1b	Seedlings Hand pull. Mature plants – cut stump and treat with fluroxypyr / picloram 80 / 80 g/L ME Plenum 160 ME (L7702). (Methods recommended by the Working for Water Programme).
Datura ferox/ stramonium	Large thorn apple	1b	Mechanical removal by hand pulling for small infestation or when small. Post emergence herbicides (Bromilow 2010).

Solanum sisymbriifolium	Dense-Thorned Bitter Apple	**1b**	Mechanical removal. Bio-control *Gratiana spadicea* (Chrysomelidae) (Methods recommended by the Working for Water Programme).
Verbena bonariensis	**Wild Verbena**	**1b**	Can easily be controlled by cultivation and with broadleaved herbicides. The mature plant is tough and more tolerant to herbicides and will need to be hand pulled (Bromilow 2010).

4.3 General Rehabilitation Measures

The following measures have been provided to ensure suitable consideration is made for future developments and activities. The following measures can be considered for any interventions not provided in the preceding sections.

4.3.1 Backfill Excavations

During the period in which the excavated material is stockpiled, some of the material may be lost due to wind and water carrying lighter particles away. To compensate for the loss of this material, topsoil must be used to completely fill the excavated areas as well as degraded areas that have experienced a loss of soil reserves. It is worth noting that the topsoil material should not be mixed with the excavated material, but rather introduced to the surface. The surface of this topsoil area outside of the delineated wetland must be slightly compacted to compensate for subsidence of this material.

As part of the rehabilitation measures, the top 30 cm of the excavated soil resources must be stockpiled separately from that below 30 cm. The soil resources must be reintroduced back into the excavated pits/trenches according to the order excavated. In cases where stockpiled material has been lost, topsoil must be reintroduced into areas with insufficient material. It is imperative that weed free topsoil be used.

To summarise;

- Stockpile excavated material according to horizons (the top 30 cm separate from the rest of the material);
- Reintroduce the subsoil into the excavated areas and then gently compact the soil; and
- Reintroduce the topsoil into the excavated area and then compact the soil gently.

4.3.2 Slope Stability

In the event that large portions of wetland and buffer areas are cleared and rehabilitated, the two main concerns that are raised when discussing the stability of slopes (According to Coaltech 2020/Chamber of Mines of South Africa, 2007), is namely “catastrophic failure” and “erosion of slopes”.

The former is associated with the sudden movement of a large volume of soil when the hearing resistance of the soil and the foundation on which the material is backfilled is exceeded. It is recommended by Coaltech 2020/Chamber of Mines of South Africa (2007) that the slope percentage of the backfilled area does not under any circumstances exceed 33%. In addition to this, the following conditions also apply;

- Vertic, gley or any other materials containing high activity, including smectite clays are avoided as foundations;

- Over-steepening by undercutting the toe of the slope is precluded; and
- Wetland or waterlogged areas should be avoided as foundations.

It is however worth noting that a slope percentage of 20% is optimally recommended for logistical and operational reasons. As for erosion of slopes, establishing concave slopes rather than convex slopes post-backfilling is essential. Convex slopes erode most rapidly and produces a larger sediment run-off than concave slopes. As mentioned earlier, it is essential that the established topography includes a slope percentage having a lower value than 2.0 after multiplying the slope percentage with the erodibility factor. It is recommended by Coaltech 2020/Chamber of Mines of South Africa (2007) that a contour survey of the new topography be carried out and be adjusted accordingly after the re-establishment of the topography.

4.3.3 Ripping Compacted Areas

All areas outside of the wetland that will be degraded (by means of vehicles, laydown yards, ablution facilities etc.) must be ripped where compaction has taken place. According to the Department of Primary Industries and Regional Development (Agriculture and Food) (2017), ripping tines must penetrate to just below the compacted horizons (approximately 300 – 400 mm) with soil moisture being imperative to the success of ripping. Ripping must take place within 1-3 days after seeding, and also following a rain event to ensure a higher moisture content.

To summarise;

- Rip all compacted areas outside of the wetland delineations that have been compacted;
- This must be done by means of a commercial ripper that has at least two rows of tines; and
- Ripping must take place between 1 and 3 days after seeding and following a rainfall event (seeding must therefore be carried out directly after a rainfall event).

4.3.4 Revegetate Degraded Terrestrial Areas

According to Russell (2009), areas characterised by a loss of soil resources should be revegetated by means of vegetation with vigorous growth, stolons or rhizomes that more or less resembles the natural vegetation in the area. The following is crucial when revegetating whole plants;

- The planting of whole plants must take place just before or at the beginning of the wet season;
- Whole plants must be dug up with as much of the root intact as possible;
- Roots must be dug up with the soil around it still intact and undisturbed;
- After the plants have been dug up/harvested, all plants must be stockpiled in damp or wet bags and be kept in the shade;
- The soil around the revegetated plants must be manually compacted after planting;

- Holes excavated for revegetation must be approximately 50 cm deep;
- Soil must be stockpiled according to relevant horizons and backfilled in the same order prior to revegetation (the first 30 cm must be stockpiled separately from the rest of the soil reserves).

Degradation will also take place outside the delineated wetland and within temporary saturated wetland areas, which could prove detrimental to the wetland. It therefore is recommended that all areas surrounding the wetland that have been degraded by traffic, laydown yards etc. must be ripped and revegetated by means of indigenous grass species. Mixed stands or monocultures will work sufficiently for revegetation purposes. Mixed stands tend to blend in with indigenous vegetation species and are more natural. Monocultures however could achieve high productivity. In general, indigenous vegetation should always be preferred due to various reasons including the aesthetical presence thereof as well as the ability of the species to adapt to its surroundings.

Plant phase plants which are characterised by fast growing and rapid spreading conditions. Seed germination, seed density and seed size are key aspects to consider before implementing revegetation activities. The amount of seed should be limited to ensure that competition between plants are kept to a minimum. During the establishment of seed density, the percentage of seed germination should be taken into consideration. *E curvula* is one of the species recommended due to the ease of which it germinates. This species is also easily sown by means of hand propagation and hydro seeding. The following species are recommended for rehabilitation purposes;

- *Cynodon species (Indigenous and altered types);*
- *Chloris gayana;*
- *Panicum maximum;*
- *Digitaria eriantha;*
- *Anthephora pubescens; and*
- *Cenchrus ciliaris.*

4.4 Landscape Management Plan

The following landscaping measures are derived from the DWS document titled "Specifications DWS 2410 Landscaping". Only pertinent items have been considered and concise descriptions provided. These items include aspects for ecological functions and purposes.

4.4.1 Contractor

A reputable Contractor must be appointed to undertake the specified work. This contractor must have a proven track record that displays gross competence.

4.4.2 Environmental Management

The Contractor shall make every effort to preserve the area, to minimise environmental disturbance and to inform employees as to the ecological sensitivity and importance of the area. The Contractor shall be responsible for any avoidable damages to the environment resulting from the actions of any employees. In order to minimize disturbances, the following must be considered:

4.4.3 Rehabilitation Workers

The Contractor shall be responsible for workers insofar as they shall be made aware of the seriousness of disregarding orders which relate to:

- Hunting, poisoning, trapping or disturbing fauna;
- Damaging of natural flora;
- Littering on the area;
- The use of supplied toilet facilities; and
- The use of the areas provided for eating.

Furthermore, no exotic plant material or domestic animal of any kind will be allowed to be brought onto the project area.

The Contractor shall also be responsible for ensuring the area worked on is free of erosion, pollution and/or any other unwanted materials. Nontoxic materials may not be dumped and buried in the spoil dumps. All other unwanted materials shall be collected and disposed of in a satisfactory manner.

All imported construction material shall also be checked for the importation of exotic seeds and/or any other foreign matter through these materials.

4.4.4 Marker Fences

All activities by the Contractor shall be contained within the fenced areas. The Contractor shall be liable for any damages which may result from trespassing outside these areas.

4.4.5 Surface Water

The Environmental Compliance Officer (ECO) should report on Surface Water Management, and ensure Contractor complies with necessary findings regarding any surface water, be it from rain, excavations or any other source.

4.4.6 Time of Planting

All planting shall be carried out as far as is practicable during the period most likely to produce beneficial results but as soon as possible after the soil properties are estimated to be adequate. The seasonal period is from the beginning of October to March.

4.4.7 Erosion

During rehabilitation, the Contractor shall protect all areas susceptible to erosion by installing all necessary temporary and permanent drainage works and by taking such other measures as may be necessary to prevent the concentration of surface water and scouring of slopes, banks and other areas. All erosion, such as runnels, channels or sheet erosion, that develops during the project phase shall be backfilled and consolidated and the areas restored to their proper condition at the Contractor's expense. The Contractor shall not allow erosion to develop on a large scale before effecting repairs and all erosion damage shall be repaired as soon as possible and, in any case, not later than two months before the termination of the Period of Maintaining. All topsoil or other material accumulated inside drains shall be removed at the same time. Topsoil washed away shall be replaced.

4.4.8 Establishing Cover

The Contractor shall be solely responsible for establishing an acceptable grass cover and for the cost of replanting or re-hydroseeding when an acceptable cover is not obtained. However, where in the opinion of the Contractor, it is doubtful from the outset that it will be possible to establish an acceptable cover this must be communicated to the authorities.

4.4.9 Fire

The Contractor shall take adequate precautions to prevent and control veld fires of the area. The Contractor shall take all steps to ensure that the fire hazard on and near the project area is reduced to a minimum. The Contractor shall be held responsible for any damage to property adjoining the project area as a result of any fire caused by one of his employees.

The Contractor shall take immediate steps to extinguish any fire which breaks out, and shall comply with all statutory provisions which may be in force from time to time in relation to fire danger or to restrictions on the lighting of fires in the open. The Contractor shall have a supply of beaters to use in the extinguishing of bush fires to which this area is susceptible.

4.4.10 Shaping

Areas requiring shaping involving bulk earthworks shall be excavated, filled, compacted when required, and shaped to the correct contours to within a tolerance of plus or minus 150 mm. Shaping will be to roughly round off cuts and fills and any other earthworks to stable forms, sympathetic to the natural surrounding landscape. Such work shall be considered as earthworks and measurement.

The natural slope or topography of the area that has been affected by the clearing (as a result of the large earth moving machinery) needs to be restored in order to ensure that the flow of water and the growth of vegetation occurs naturally. The re-adjustment of the topography will also improve the general aesthetics of the area. The removal of all the piles within the project area such as vegetation, soil and old rubble is compulsory. The building rubble and general litter must be removed entirely from the area and disposed of at licensed facilities.

The following are methods that can be used to reshape the slope of the area

- Sand Bags
    - Only biodegradable bags are to be used, this includes Geojute sacks or similar. No plastic bags may be utilised. The bags must be filled with a sand or rock mixture under no circumstances may any contaminants be put into the bags (i.e., cementitious material, soil with chemical spill or fuel etc.). This must be checked by the ECO.
- Terracing and Soil Stabilisation
    - For this process rows of straw, hay or bundles of cut vegetation may be used. The hay, straw or vegetation is dug into the soil in contours, in order to help

slow surface wash and capture eroded soil. The spacing between rows would be dependent on slope and the specific area.

- Geojute Netting
    - Netting or matting (biodegradable) can also be utilised on slopes to protect the soil from wind and water erosion. This assists with soil retention, weed control and vegetation establishment. Plants can be installed by making small incisions for planting. This would be an effective method in this area due to the high level of wind present. It is however important that this cannot be placed over existing vegetation growth and can only be used right after sloping have been performed.
- Geojute Rolls
    - Cylindrical rolls of Geojute fabric filled with sand (as described in the sandbag section) are effective on slopes and large cleared areas. This method is very effective in assisting with erosion control. Geojute rolls are kept in place with the use of pegs (alien invasive plant material can be utilised for this).
- Gabion Baskets and Reno Mattresses
    - These represent engineered solutions to steep slopes and banks; in this instance it would be relevant to the edges of the cliffs or the river (This would be in extreme cases as this is an area that should be seen as a no-go area). These methods are to be utilised in areas where drainage and flooding is a concern. Gabion baskets are 1m x 1m x 1m wire baskets that are filled with uniform sizes rocks. Reno mattresses are generally used to cover a larger area and is made of flat baskets. These two features are often used to enhance one another.

In most cases, no existing or emerging vegetation should be destroyed or damaged during this process, however in this case no natural vegetation exists except for the fringes of the project area.

4.4.11 Trimming

Trimming shall consist of bringing the existing or previously shaped ground to an even surface with the final levels generally following the original surface. Where machine operations are not practicable trimming shall be done using hand tools.

Trimmed surfaces shall be left slightly rough to facilitate binding with topsoil or the natural establishment of vegetation. During trimming all stones with any dimension in excess of 30 mm in areas to be mowed by machine, all stones with dimensions in excess of 150 mm in other areas and all other excess material shall be removed to selected dumping sites.

4.4.12 Soiling and Seeding

The Contractor shall undertake all soiling, seeding and grass establishment, with particular emphasis in the rehab toe, taking into account the climatic conditions prevalent in order to maximise growth of vegetation and therefore reduce erosion.

4.4.13 Watering, Weeding, Cutting and Replanting

All grassed areas shall be maintained during the rehabilitation of the area by adequate watering at frequent and regular intervals in order to ensure proper germination of seeds and growth of grass until an acceptable cover has been established and thereafter until the end of the rehabilitation phase. The amount and frequency of watering shall be at the discretion of the Contractor.

Weeds shall be controlled by means of extraction, cutting or other approved means.

The Contractor shall mow or cut all grassed areas to promote adequate coverage, until the end of the rehabilitation phase. All grass cuttings shall be collected and disposed of.

Any plants not immediately replanted are the responsibility of the Contractor and shall be kept under approved nursery conditions. All plants shall be maintained by regular watering and fertilizer applications, as well as by providing protection against wind, frost and direct sunlight until such time as they are to be replanted.

4.4.14 Preparation for Grassing

The areas to be grassed consists of suitable material and the areas should be scarified to a minimum depth of 75 mm with furrows spaced at 250-300 mm centres. Scarifying along slopes shall run parallel to the contours, forming horizontal terraces. All loose stones and other excess material shall be removed during trimming. Where topsoil is required the surface should be left slightly rough during trimming to ensure a proper bond between the topsoil and the subsoil. The topsoil should be placed on the prepared surfaces and trimmed to the uniform thickness and unless otherwise specified, a 75 mm layer of topsoil should be placed. The top 150 mm of the prepared surfaces should have the adequate amount and type of chemical soil properties required for establishing proper growth conditions for grass. The choice of the fertilizer to be used and the application thereof shall be the responsibility of the Contractor but shall be approved by the Engineer before application. Hydroseeding is the process of combining seed, mulch, fertilizer, and healthy soil amendments with water to mix in a tank to form a thick slurry, the slurry is applied with pressure to the surface for seed germination and vegetation development.

To this end, the following notes should be considered:

- Avoid creating a monoculture, species diversity is the key to the provision of important ecosystem services such as erosion control and water quality enhancement;
- Only locally indigenous species that are adapted to local climatic conditions should be used. Perennial species should be prioritised for transplanting. Good quality planting material or seed must be readily available;
- Revegetation should commence immediately after landscaping and the preparation of the seedbed meets the adequate amount of chemical properties, preferably in the wet season when conditions for germination and rootstock establishment are optimal. Planting should preferably be timed to take place 1-3 days following a significant rainfall event when soils are within 10% of the field capacity (maximum saturation level);

- Ripping must take place between 1 and 3 days after seeding and following a rainfall event (seeding must therefore be carried out directly after a rainfall event).
- The planting of whole plants must take place just before or at the beginning of the wet season.
- Whole plants must be dug up with as much of the root intact as possible.
- Roots must be dug up with the soil around it still intact and undisturbed.
- The soil around the revegetated plants must be manually compacted after planting.
- Keep plants that are being prepared for later transplanting out of direct sunlight (fodder bags work well) and bag / re-plant as soon as possible. Uprooted plants left in the sun for a several hours will die. Conversely, those left in bags for several days will begin to rot; and
- Avoid the use of fertilizers or any other chemicals or soil enhancers during re-vegetation.

5 Monitoring Plan

The monitoring plan (Table 5-1) has been designed to be achievable and realistic for the nature of the project. The plan will provide details as to the frequency of the monitoring efforts, the location of these efforts and what should be monitored. The primary focus for the monitoring plan is to evaluate the success of the rehabilitation efforts. Numerous monitoring frequencies have been proposed for this aspect of the project, the details of which are presented in Table 5-1. Further descriptions (clarity) of the referred to frequencies is discussed below.

Rehabilitation: Monitoring will be required for the wetlands during the rehabilitation period to determine if the measures are being applied correctly, and if any unforeseen issues need to be addressed. This monitoring can be undertaken by the Environmental Control Officer (ECO) appointed to oversee compliance with the Environmental Management Plan (EMP). A wetland specialist be appointed to monitor the PES and ecosystem services provided by the system on an annual basis.

Post-rehabilitation: After completion of the rehabilitation phase wetland areas should be monitored to evaluate the success of the rehabilitation efforts. In the unlikely event of potential "risks" to the systems being identified, this inspection may allow for corrective measures to be applied. This monitoring can be undertaken by the ECO appointed to oversee compliance with the EMP.

Seasonal monitoring: The applicant must appoint an independent contractor to conduct seasonal (wet season) monitoring for a period of two years after the completion of the rehabilitation measures. The monitoring should be conducted during October or shortly after the first summer rains, and then towards the end of the growing season. The monitoring should inspect the following:

- Extent of erosion gullies;
- Recovery of the vegetation layer;

- Extent of alien vegetation establishment;
- Hydrology and inundation of the systems;
- The stability of the embankments;
- The attenuation of the wetland systems (including settling ponds); and
- Extent of sedimentation of the wetlands.

Annual monitoring: After completion of the season monitoring, it is recommended that the areas be monitored on an annual basis, preferably in the middle of the rainy season (January). This inspection must include aspects from all the above-mentioned monitoring efforts but should also include a general inspection of the wetland systems.

Some best practice recommendations that must be incorporated into all monitoring efforts include the following:

- In the event of issues being noted, these may include leaks, erosion gullies, poor vegetation recovery, sedimentation etc., these should be reported, and corrective measures applied immediately;
- Corrective measures may include the full suite of rehabilitation efforts or part thereof, this will be dependent on the issues being recorded. It is recommended to consult the relevant specialist (wetland / engineer) for the best possible solution;
- In the event that issues not pre-empted in this report are identified, similarly, it is recommended to consult the relevant specialist (wetland / engineer) for the best possible solution; and
- The discretion of deciding when to consult a specialist should lie with the ECO during the construction phase and the appointed independent environmental auditor during the operational phase.

Table 5-1 The proposed monitoring plan for the project

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Wetland health and ecosystem services	• Conduct PES and ecosystem services assessments on rehabilitated wetland to gauge success of rehabilitation efforts. • Monitor against the REC.	• Annual (peak of growing season e.g. January) • Commence at the onset of rehabilitation and continue for at least three years, following successful completion of intervention measures.	• Hydrology, geomorphology and vegetation • Ecosystem services assessment criteria	• Adapt rehabilitation approach accordingly.
Integrity of rehabilitation structures (stormwater infrastructure / gabions)	• On-site inspection • Fixed point photography	• After rehabilitation • Seasonal for the first two years and rapidly after heavy rainfall • Thereafter annually	• Extent and duration of attenuation. • Establishment vegetation	• Structures should be fixed where possible or new structures should be implemented or constructed where required
Water quality (for floodplain)	• Sample collection and analysis at a certified laboratory	• Bi-annually for the life of the project	• Parameters must be within Target Water Quality Range for drinking water standards (DWS, 1996)	• Regular inspections and monitoring of the wetlands. • Replacement of faulty or failing equipment and / or infrastructure
Vegetation cover	• Monitor species and cover abundance • Monitor indigenous vs alien plant encroachment • Fixed point photography	• After rehabilitation • Seasonal for the first two years • Thereafter annually	• Establishment of primarily indigenous plants • Ground cover abundance is approximately 60% after the first year, and 80% after year two and 100% thereafter.	• Replanting of indigenous plants should be done at sites of concern
Erosion	• On-site inspection • Fixed point photography • Compare to adjacent areas	• After rehabilitation • Seasonal for the first two years and soon after heavy rainfall events	• Areas with no cover • Erosion gullies and head-cuts • Storm water discharge area	• Short term: Rocks / boulders, and on-site debris • Medium term: Replanting of indigenous vegetation • Long term: Rehab methods that may include gabion baskets, mattresses and should be discussed with specialists.

Sedimentation	• On-site inspection • Fixed point photography	• During & after rehabilitation • Seasonal for the first two years and soon after heavy rainfall events • Thereafter annually	• Excess sediment in wetlands	• Sources of sedimentation should be noted and addressed • If possible, excess sediment can be removed manually.
Exotic Invasive Plant Species	• Monitor exotic invasive plant encroachment • On-site inspection • Fixed point photography	• After rehabilitation and follow- up clearing • Seasonal for the first two years • Thereafter annually	• Establishment of exotic invasive plant species	• Regularly survey the property to detect any new or emerging listed invasive plant species. • Continue to apply suggested control measures as required tackling areas of dense infestation first. Do not use chemicals for the removal process within wetlands or their associated buffers. • All mechanically removed plants must be collected, piled and burnt. • Do not allow emerging or new species to produce seeds, or start growing vegetative, act immediately by removing them. • No listed invasive and alien plant species must be planted • Areas bordering onto neighbouring land must be prioritized for control to prevent existing invasive plants from spreading beyond the boundaries of the property. • No listed invader animal species must be introduced on the property. • Update the species list by including these species and indicate where on the property they were located.
Solid waste	• On-site inspection • Fixed point photography	• After rehabilitation and follow-up clearing • Monthly (by residents / representatives)	• The presence of: • Litter; • Dumping material; and/or • Building rubble.	• Removal of solid waste and disposal at a licensed facility.

5.1 Recommendations

The following recommendations are provided:

- A wetland rehabilitation plan must be implemented for the development, to be informed by this strategy. The plan must be implemented from the onset of the construction phase of the project. The plan must include monitoring as presented in this report. Prior to the layout being finalised the rehabilitation strategy must be refined to determine the suitable ‘amount’ (or ratio) for compensation, and to confirm suitable wetland target areas.

5.2 Design Considerations

A strategic framework for improved wetland management was consulted for the provision for infrastructure requirements. The framework recognises that some infrastructure development may be required in areas and with the need for supporting service infrastructure, further impacts can be expected. It is however important that infrastructure development (including roads and service infrastructure) minimises impacts to wetland management zones and seek to avoid disruption of natural corridors as far as practicable. The following design principles are applicable to roads and pipelines/cables:

- **Road** crossings (traversing a watercourse) should be aligned perpendicular to flow (not near-parallel), located in areas of least sensitivity (along existing corridors of disturbance), placed at a narrow section of the wetland system and designed in a manner that causes least disturbance to natural habitat through the incorporation and implementation of the following objectives and best practice design measures:

  i) Avoid and/or minimize the constriction of wetland flows. This should be achieved through the establishment of an adequate number and adequately sized culverts across the wetland systems, taking into account the full extent / width of these systems.

  ii) Avoid and/or minimize the deactivation of valley bottom and floodplain areas. This should be achieved through ensuring impedance of flow and sediment distribution is limited through appropriate crossing design and by minimizing encroachment of road fill embankments. In this regard, crossings should be widened and/or culverts should be installed within fill embankments to maintain the natural distribution of flows and sediment across the relevant fluvial surfaces.

  iii) Maintenance and/or establishment of faunal movement and habitat connectivity. Wetland, aquatic and terrestrial faunal movement and habitat connectivity must be maintained (or improved) as far as practicable through the establishment of adequately sized culverts and bridges.

  iv) Reduce visual impact. Infrastructure features should be designed to be aesthetically pleasing and not detract from the open space.

- **Pipeline/cables** should be aligned in areas of least sensitivity as far as possible (along existing corridors of disturbance), placed at a narrow section of the wetland system and designed in a manner that causes least disturbance to natural habitat through the incorporation and implementation of the following objectives and best practice design measures:

i) Avoid and/or minimize the extent of direct physical disturbance. Pipe bridges are preferred over underground trenched crossings. In this regard, the number of piers/plinths established within the wetland habitat must be minimized and where possible the wetland habitat must be spanned. Where possible, such infrastructure should be accommodated alongside existing road networks.

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