BASIC ASSESSMENT REPORT

Draft – 6 January 2022

THE PROPOSED THAKADU SOLAR POWER PLANT NEAR VILJOENSKROON, FREE STATE PROVINCE

ENVIRONAMICS

PROJECT DETAIL

DFFE Reference No.	**:**	To be confirmed
Project Title	**:**	The proposed Thakadu Solar Power Plant near Viljoenskroon, Free State Province.
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Reviewer	:	Mrs. Carli van Niekerk
Client	**:**	Thakadu Solar Power Plant (RF) (Pty) Ltd
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PLATES

APPENDICES

GLOSSARY OF TERMS AND ACRONYMS

BA	Basic Assessment
BAR	Basic Assessment Report
CEA	Cumulative Effects Assessment
DFFE	Department of Forestry, Fisheries and the Environment
DM	District Municipality
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EP	Equator Principles
EPFI	Equator Principles Financial Institutions
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects.
GNR	Government Notice Regulation
I&AP	Interested and affected party
IDP	Integrated Development Plan
IFC	International Finance Corporation
IPP	Independent Power Producer
kV	Kilo Volt
Mitigate	Activities designed to compensate for unavoidable environmental damage.
MW	Megawatt
NEMA	National Environmental Management Act No. 107 of 1998
NERSA	National Energy Regulator of South Africa
NWA	National Water Act No. 36 of 1998
PPP	Public Participation Process
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
REIPPP	Renewable Energy IPP Procurement Process
SAHRA	South African Heritage Resources Agency
SDF	Spatial Development Framework
SPP	Solar Power Plant
VU	Vegetation Unit

CONTEXT FOR THE DEVELOPMENT

According to Eskom, the demand for electricity in South Africa has been growing at approximately 3% per annum. This growing demand, fuelled by increasing economic growth and social development, is placing increasing pressure on South Africa's existing power generation capacity. Coupled with this, is the growing awareness of environmentally responsible development, the impacts of climate change and the need for sustainable development. The use of renewable energy technologies, as one of a mix of technologies needed to meet future energy consumption requirements is being investigated as part of the national Department of Mineral Resources and Energy's (DMRE) (previously referred to as the Department of Energy) long-term strategic planning and research process.

The primary rationale for the proposed solar photovoltaic (PV) facility is to add new generation capacity from renewable energy to the national electricity mix and to aid in achieving the goal of 42% share of all new installed generating capacity being derived from renewable energy forms, as targeted by DMRE (2019 Integrated Resource Plan Update 2010-2030). The IRP also identifies the preferred generation technologies required to meet the expected demand growth up to 2030 and incorporates government objectives including affordable electricity, reduced greenhouse gas (GHG) emissions, reduced water consumption, diversified electricity generation sources and localisation and regional development. In terms of the Integrated Resource Plan Update (2019 IRP Update, 2010-2030), over the short term (of the next two or three years), clear guidelines arose; namely to continue with the current renewable bid programme with additional annual rounds of 1000MW PV, with approximately 8.4GW of the renewable energy capacity planned to be installed from PV technologies over the next twenty years.

The proposed project is intended to form part of the DMREs Renewable Energy Independent Power Producer Procurement (REIPPP) Programme or any other programs/opportunities to generate power in South Africa. The REIPPP Programme aims to secure 14 725 Megawatts (MW) of new generation capacity from renewable energy sources, while simultaneously diversifying South Africa's electricity mix. According to the 2021 State of the Nation Address, Government will soon be initiating the procurement of an additional 11 800 MW of power from renewable energy, natural gas, battery storage and coal in line with the Integrated Resource Plan 2019 and fulfilling their commitments under the United Nations Framework Convention on Climate Change and its Paris Agreement which include the reduction of greenhouse gas emissions. Eskom, the largest greenhouse gas emitter of South Africa, has committed in principle to net zero emissions by 2050 and to increase its renewable capacity.

In response to the above, Thakadu Solar Power Plant (RF) (Pty) Ltd is proposing the development of a photovoltaic solar facility and associated infrastructure for the purpose of commercial electricity generation on an identified site located on the farm Grootvaders Bosch No. 592 and Anglo No. 593, Registration Division Viljoenskroon, Free State Province (refer to Figure A for the locality map). The project entails the generation of up to 150MW electrical power through photovoltaic (PV) technology. The total development footprint of the project will approximately be 308 hectares (including supporting infrastructure on site) within the 360 hectares assessed as part of the Basic Assessment process. From a regional site selection perspective, this region is preferred for solar energy development due to its global horizontal irradiation value of around 2068 kwh/m^2. The region is also preferred for its inclusion within the Klerksdorp Renewable Energy Development Zone (REDZ) 10.

EXECUTIVE SUMMARY

Like many other small and developing municipalities in the country, the Moqhaka Local Municipality, within which the Thakadu Solar Power Plant is proposed, faces a number of challenges in addressing the needs and improving the lives of the community. The Integrated Development Plan (2020-2021) of the Fezile Dabi District Municipality[1] states that it is the vision of the municipality to improve the lives of their citizens and to meet their economic, basic and social needs through sustainable development. The municipality aims to achieve their key strategic goals, such as delivering quality basic services (i.e. electricity, water and sanitation) to their communities, stimulating local economic growth and to ensure sound financial management and viability within the municipality. The Moqhaka Local Municipality's Integrated Development Plan (2020-2021) vision is to create an environment for sustainable development and socio-economic growth. Providing quality, affordable, efficient and effective services to enhance the quality of life for the people of the community, is the mission of the Moqhaka Local Municipality. The development of the Thakadu Solar Power Plant will contribute to the realisation of the vision and mission of the respective local and district municipalities that will be affected by the proposed development.

Thakadu Solar Power Plant (RF) (Pty) Ltd intends to develop a photovoltaic solar facility and associated infrastructure on the farm Groot Vaders Bosch No. 592 and Anglo No. 593, Registration Division Viljoenskroon, Free State Province situated within the Moqhaka Local Municipality and the greater Feliz Dabi District Municipality. The solar facility will have a generating capacity of up to 150MW. The town of Viljoenskroon is located approximately 32km southeast and the town of Orkney is located approximately 6.5km northwest of the proposed development (refer to Figure A and Figure B for the respective locality and regional maps). The total footprint of the project will be approximately 308 hectares (including supporting infrastructure on site) within the 360 hectares as assessed as part of the Basic Assessment process. The site[2] was identified as being highly desirable due to its suitable climatic conditions, topography (i.e. in terms of slope), environmental conditions (i.e. agricultural potential, ecological sensitivity and archaeology), proximity to a grid connection point (i.e. for the purpose of electricity evacuation into the national grid), as well as site access via a main road (i.e. to facilitate the movement of machinery, equipment, infrastructure and people during the construction phase). Grid connection infrastructure is also being proposed and assessed within this report. The grid connection infrastructure includes a 132kV power line to connect the facility from a 130 MVA (High Voltage - 132kV and Medium Voltage – 33kV) substation to the national grid at the existing Vaal Reefs Eleven Substation 132/6.6kV or by connecting either into either the existing Mercury-South Vaal 2 132kV or the South Vaal-Carrdell 132kV. Two grid connection corridors, each with a width of between 100-150m and up to 250m, have been identified for the assessment and placement of the power line (i.e., the power line will be developed within one of the two proposed corridors)

In terms of the National Environmental Management Act (Act 107 of 1998), with specific reference to Sections 24 and 24D, as read with GNR 324-327, as amended (2017), Environmental Authorisation is

[1] The Moqhaka Local Municipality falls within the Fezile Dabi District Municipality.

[2] The site is defined as the farm Grootvaders Bosch No. 5 92. The full extent of the site has been assessed as part of this BA process for the development by the EAP and the independent specialists.

required for the Thakadu Solar Power Plant. The following listed activities have been identified with special reference to the proposed development and is listed in the EIA Regulations (as amended):

- Activity 11(i) (GNR 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."*
- Activity 12(ii)(a)(b) (GNR 327): *"The development of (ii) infrastructure or structures with a physical footprint of 100 square meters or more (a) within a watercourse or (b) within 32 meters of a watercourse, measured from the edge of a watercourse.*
- Activity 14 (GNR 327): *"The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres."*
- Activity 19 (GNR 327): *"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil sand, shells, shell grit, pebbles or rock of more than 10 cubic meters from a watercourse."*
- Activity 24 (ii) (GN.R 327): *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters"*
- Activity 28 (ii) (GN.R 327): *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare."*
- Activity 56 (ii) (GN.R 327): *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"*
- Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."*
- Activity 15 (GN.R 325): *"The clearance of an area of 20 hectares or more of indigenous vegetation."*
- Activity 4 (b)(i)(ee)(gg) (GN.R 324): *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee) critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."*
- Activity 10 (b)(i)(ee)(gg) (GN.R 324): *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional*

plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."

- Activity 12 (b)(i)(ii)(iv) (GN.R 324): *"The clearance of an area of 300 square metres or more of indigenous vegetation…(b) in the Free State (i) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans and (iv) areas within a watercourse or wetland; or within 100 metres from the edge of watercourse or wetland."*

- Activity 14(xii)(a)(b)(i) (GN.R 324): *"The development of (xii) infrastructure or structures with a physical footprint of 10 square metres or more where such development occurs (a) within a watercourse; in the (b) Free State Province, (i) outside urban areas, within (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve."*

- Activity 18 (b)(i)(ee)(gg)(hh) (GN.R 324): *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas, within (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans, (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas and (hh) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland."*

Activities required for the development of the solar facility which are listed under Listing Notice 1, 2 and 3 (GNR 327, 325 & 324) implies that the development could potentially have an impact on the environment that will require mitigation. The proposed Thakadu Solar Power Plant (SPP) is located within a Renewable Energy Development Zone (REDZ) and subsequently a Basic Assessment process is required to be followed as described in Regulations 19 and 20 of the EIA Regulations (as amended). Environamics has been appointed as the independent Environmental Assessment Practitioner to undertake the Basic Assessment (BA) on behalf of Thakadu Solar Power Plant (RF) (Pty) Ltd.

Regulation 19 of the EIA Regulations (2017) requires that a Basic Assessment Report (BAR) must contain the information set out in Appendix 1 of the Regulations or comply with a protocol or minimum information requirements relevant to the application as identified and gazetted by the Minister in a government notice. Appendix 1 of GNR326 requires that the environmental outcomes, impacts and residual risks of the proposed activity be set out in the BAR. It has been determined through the BA process that the proposed development will have a net positive impact for the area and will subsequently ensure the optimal utilisation of resources and land. All negative environmental impacts can be effectively mitigated through the recommended mitigation measures and no residual negative impacts are foreseen. The potentially most significant environmental impacts associated with the development are briefly summarized below.

Impacts during the construction phase:

Construction of the solar power plant will potentially result in the following impacts: habitat destruction and fragmentation, soil, air and water pollution, increased soil erosion and sedimentation, spread and establishment of alien invasive species, impact on priority and resident avifauna, loss of avian habitats, impact on heritage objects, impact on fossil heritage, potential loss of productive farmland, visual impact on observers in-migration or influx of job seekers, presence of construction workers on the local communities, increased risk of veld fires, impacts on daily living and movement patterns and generation of waste. Socio-economic impacts such as the creation of local employment and business opportunities, skills development and training and technical support to local farmers and municipalities will be positive impacts emanating from the construction.

Impacts during the operational phase:

During the operational phase, the site will serve as a solar PV energy facility and the potential impacts will take place over a period of 20 – 25 years. The negative impacts are generally associated with impacts on the fauna and flora, soils and water pollution, spread and establishment of alien invasive species, displacement of priority and resident avifauna, collisions of avifauna with PV array and power lines, avifauna electrocution when perched on power line infrastructure visual impacts and dangerous goods hazards as part of battery storage facility (catching fire, exploding or leaking dangerous pollutants). The provision of sustainable service delivery from the local municipality also needs to be confirmed. The operational phase will have a direct positive impact through the provision of employment opportunities for its duration, and the generation of income to the local community. Additional electricity will also be generated from a clean renewable resource.

Impacts during the decommissioning phase:

The physical environment will benefit from the closure of the solar facility since the site will be rehabilitated to an acceptable state. The decommissioning phase will however potentially result in impact on the fauna and flora, pressure on existing service infrastructure, fossil and heritage objects and the loss of permanent employment. Skilled staff will be eminently employable, and a number of temporary jobs will also be created in the process.

Cumulative impacts:

According to the DFFE database approximately twelve (12) applications have been submitted for renewable energy projects within the geographical area of investigation, with six (6) of these being considered valid in terms of an Environmental authorisation, two (2) applications have lapsed or was withdrawn, one (1) application is only for transmission infrastructure and one (1) is incorrectly listed on the DFFE database. Two projects are not yet listed on the DFFE database which are the Paleso and Siyanda SPP's that have recently been authorised (Environamics was the EAP responsible for these applications). The majority of these projects are located in close proximity to Orkney, and to the north of the site considered for the Thakadu Solar Power Plant.

The potentially most significant cumulative impacts during the construction phase relate to the displacement of priority avifauna, loss of important avian habitats and the impact with large scale in-migration of people. The potential cumulative effects during the operational phase relate to collision of avifauna with power line infrastructure, electrocution of avifauna when perched on power line infrastructure and visual impacts. During the decommissioning phase, the generation of waste may result in cumulative impacts.

In accordance with the EIA Regulations, this draft BAR evaluates and rates each identified potential impact and identifies and recommends mitigation measures which will be required in order to ensure the reduction of the impact significance of negative impacts to acceptable levels and the avoidance of negative residual risks. This draft BAR also contains information that is required by the competent authority (Department of Forestry, Fisheries and the Environment (DFFE)) to consider the Application for Environmental Authorisation and to reach a decision contemplated in Regulation 20 of GNR 326. No fatal flaws or impacts with unacceptable levels of significance were identified and the impacts from the proposed development are expected to be at an acceptable level with the implementation of mitigation measures and therefore the project can be authorised subject to the implementation of the recommended mitigation measures.

1 INTRODUCTION

This section aims to introduce the final Basic Assessment Report (BAR) and specifically to address the following requirements of the regulations:

Appendix 1. (3) A basic assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include-
(a) details of:

(i) the EAP who prepared the report; and

(ii) the expertise of the EAP, including a curriculum vitae.

1.1 LEGAL MANDATE AND PURPOSE OF THE REPORT

The National Environmental Management Act identifies listed activities (in terms of Section 24) which are likely to have an impact on the environment. These activities cannot commence without obtaining an EA from the relevant competent authority. Sufficient information is required by the competent authority to make an informed decision and the project is therefore subject to an environmental assessment process which can be either a Basic Assessment Process or a full Scoping and Environmental Impact Assessment process.

The EIA Regulations No. 324, 325, and 327 outline the activities that may be triggered and therefore require EA. The following listed activities with special reference to the proposed development is triggered:

Table 1.1: Listed activities

Relevant notice:	**Activity No (s)**	**Description of each listed activity as per project description**:
GNR. 327 (as amended in 2017)	Activity 11(i)	• *"The development of facilities or infrastructure for the transmission and distribution of electricity (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* • Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area. The infrastructure for the distribution of electricity will include a power line (132 kV), an on-site HV/MV substation (130 MVA, High Voltage:88/132kV, Medium Voltage: 33kV) and switching station. It is expected that generation from the facility will tie in with Vaal Reefs Eleven 132/6.6 kV Substation or either the Mercury-South Vaal 2 132kV Power Line or the South Vaal-Carrdell 132kV Power Line.

GNR. 327 (as amended in 2017)	Activity 12(ii)(a)(b)	• *"The development of (ii) infrastructure or structures with a physical footprint of 100 square meters or more (a) within a watercourse or (b) within 32 meters of a watercourse, measured from the edge of a watercourse."* • *The power line requires the development of a service road and pylon infrastructure which will exceed 100 square meters in extent. Surface water features, including a drainage channel, are present within the option 2 grid connection corridor that will need to be crossed by the service road.*
GNR. 327 (as amended in 2017)	Activity 14	• *"The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres."* • The facility will require the infrastructure for the storage and handling of dangerous goods such as diesel, with a combined capacity of 80 cubic metres, but not exceeding 500 cubic metres.
GNR. 327 (as amended in 2017)	Activity 19	• *"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil sand, shells, shell grit, pebbles or rock of more than 10 cubic meters from a watercourse"* • The power line requires the development of a service road. Surface water features, including drainage channels, are present within the option 1 grid connection corridor that will need to be crossed by the service road. This will require the removal and moving of soils of more than 10 cubic meters.
GNR. 327 (as amended in 2017)	Activity 24(ii)	• *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters;* • Activity 24(ii) is triggered as the internal roads will vary between 6 and 12 meters in width.
GNR. 327 (as amended in 2017)	Activity 28(ii)	• *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area,*

		where the total land to be developed is bigger than 1 hectare." • Activity 28(ii) is triggered as portions of the affected farm has been previously used for grazing and the property will be re-zoned to "special" use. The development footprint of the solar power plant will be 308 hectares.
GNR. 327 (as amended in 2017)	Activity 56 (ii):	• *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"* • Activity 56 (ii) is triggered as the existing access to the affected property does not have a reserve and will need to be widened by more than 6 metres.
GNR. 325 (as amended in 2017)	Activity 1	• *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* • Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 150 megawatts electricity through the use of a renewable resource.
GNR. 325 (as amended in 2017)	Activity 15	• *"The clearance of an area of 20 hectares or more of indigenous vegetation."* • In terms of vegetation type the preferred site falls within the Dry Highveld Grassland Bioregion, more precisely the Vaal Reefs Dolomite sinkhole (Gh12) and the Vaal-Vet Sandy Grassland (Gh10) which is described by Mucina and Rutherford (2006) respectively as 'vulnerable' and 'endangered'. Activity 15 is triggered since portions of the site has not been lawfully disturbed during the preceding ten years; therefore, more than 20 hectares of indigenous vegetation will be removed. The development footprint of the solar power plant will be 308 hectares.
GNR. 324 (as amended in 2017)	Activity 4 (b)(i)(ee)(gg)	• *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee) critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or*

		from the core areas of a biosphere reserve, excluding disturbed areas." • Activity 4(b)(i)(ee)(gg) is triggered since the internal roads will not have a reserve and will vary between 6 and 12 meters in width. The project is located within the Free State Province and falls outside of an urban area but a portion of the option 2 connection corridor falls within CBA 1 and CBA 2 areas as identified in the Free State 2015 Biodiversity Plan. The project is located within 5km of a protected area in terms of NEMPAA. The Mispha Game farm is located approximately 1km south of the proposed development as per the South Africa Protected Area Database of the Department of Forestry, Fisheries and the Environment.
GNR. 324 (as amended in 2017)	Activity 10 (b)(i)(ee)(gg)	• *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."* • Activity 10(b)(i)(ee)(gg) is triggered since the proposed development will need to develop infrastructure for the storage and handling of dangerous goods (diesel) in containers with a capacity exceeding 30 but not exceeding 80 cubic metres. The project is located within the Free State Province and falls outside of an urban area but a portion of the option 1 connection corridor falls within CBA 1 and CBA 2 areas as identified in the Free State 2015 Biodiversity Plan. The project is located within 5km of a protected area in terms of NEMPAA. The Mispha Game farm is located approximately 1km south of the proposed development as per the South Africa Protected Area Database of the Department of Forestry, Fisheries and the Environment.

GNR. 324 (as amended in 2017)	Activity 12 (b)(i)(ii)(iv)	• *"The clearance of an area of 300 square metres or more of indigenous vegetation…(b) in the Free State (i) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans."* • Activity 12(b)(i)(ii)(iv) is triggered since the proposed development is located in the Free State province and the vegetation on site is classified as being 'endangered' or 'vulnerable'. Portions of the site has not been lawfully disturbed during the preceding ten years, a portion of the site is located within CBA 1 and CBA 2. The development footprint of the project will be 308 hectares and therefore, more than 300 square meters of indigenous vegetation will be removed.
GNR. 324 (as amended in 2017)	Activity 14(xii)(a)(b)(i)	• *"The development of (xii) infrastructure or structures with a physical footprint of 10 square metres or more where such development occurs (a) within a watercourse; in the (b) Free State Province, (i) outside urban areas, within (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve."* • The power line requires the development of a service road and pylon infrastructure which will exceed 100 square meters in extent. Surface water features, including drainage channel, are present within the option 2 grid connection corridor that will need to be crossed by the service road. The project is located in the Free State province and outside urban areas. A portion of the connection corridor is located within a CBA 1 and CBA 2. The power line and the three collector substations are located within 5km of a protected area as identified in terms of NEMPAA. The Mispha Game farm is located approximately 1 km north east of the proposed development as per the South Africa Protected Area

		Database (SAPAD) of the Department of Forestry, Fisheries and the Environment.
GNR. 324 (as amended in 2017)	Activity 18 (b)(i)(ee)(gg)(hh)	• *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas, within (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans, (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas and (hh) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland."* • Activity 18 (b)(i)(ee)(gg)(hh) is triggered since the existing access road to the site will need to be widened by more than 4 metres. The project is located within the Free State Province and falls outside of an urban area, but a portion of the option 2 grid connection falls within CBA 1 and CBA 2 areas as identified in the Free State 2015 Biodiversity Plan. The project is located within 5km of a protected area in terms of NEMPAA. The Mispha Game farm is located approximately 1km south of the proposed development as per the South Africa Protected Area Database of the Department of Forestry, Fisheries and the Environment. A drainage channel is located within the power line corridor option 2..

The activities triggered under Listing Notice 1, 2 and 3 (Regulation 327, 325 & 324) for the project implies that the development is considered as potentially having an impact on the environment and therefore require the implementation of appropriate mitigation measures. Based on the location of the entire extent of the project within the Klerksdorp REDZ (see Figure D), the process to be followed will be as per GNR 114, as gazetted on 16 February 2018. Therefore, the Thakadu Solar Power Plant is subject to a Basic Assessment process and not a full EIA process, as well as a shortened timeframe for the processing of the Application for Environmental Authorisation by the Department of Forestry, Fisheries and the Environment (DFFE). The Basic Assessment must be undertaken in line with the requirements stipulated under Regulations 19 – 20 of the EIA Regulations. According to Appendix 1 of Regulation 326, the objective of the basic assessment process is to, through a consultative process:

- Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
- Identify the alternatives considered, including the activity, location, and technology alternatives;

- Describe the need and desirability of the proposed alternatives;
- Through the undertaking of an impact and risk assessment process, inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine —
    - The nature, significance, consequence, extent, duration and probability of the impacts occurring; and
    - degree to which these impacts-
        - can be reversed;
        - may cause irreplaceable loss of resources, and
        - can be avoided, managed or mitigated; and
- Through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to –
    - Identify and motivate a preferred site, activity and technology alternative;
    - Identify suitable measures to avoid, manage or mitigate identified impacts; and
    - Identify residual risks that need to be managed and monitored.

This report is the draft Basic Assessment Report (BAR) that has been submitted to the Department of Forestry, Fisheries and the Environment (DFFE) for review and comment. According to GNR 326 all registered interested and affected parties (I&APs) and relevant State Departments (including Organs of State) must be allowed the opportunity to review and provide comment on the report. The draft BAR has been made available to registered I&APs and all relevant State Departments for a 30-day review and comment period from 06 January 2022 to 04 February 2022.They will be requested to provide written comments on the BAR within 30 days of receiving it. All issues identified during the review period will been documented and compiled into a Comments and Response Report (Appendix C6) submitted as part of the Final BAR to DFFE for decision-making.

1.2 DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP)

Environamics was appointed by the applicant as the independent EAP to conduct the BA and prepare all required reports. All correspondence to the EAP can be directed to:

Contact person:	Christia van Dyk
Postal Address:	14 Kingfisher Street, Tuscany Ridge Estate, Potchefstroom, 2531
Telephone:	078 470 5252 (Cell)
Electronic Mail:	christia@environamics.co.za

And/or

Contact person:	Lisa Opperman
Postal Address:	14 Kingfisher Street, Tuscany Ridge Estate, Potchefstroom, 2531

Telephone: 084 920 3111 (Cell)

Electronic Mail: lisa@environamics.co.za

Regulation 13(1)(a) and (b) determines that an independent and suitably qualified and experienced EAP should conduct the BA. In terms of the independent status of the EAP, a declaration is attached as Appendix A to this report. The expertise of the EAP responsible for conducting the BA is also summarized in the curriculum vitae included as part of Appendix A.

1.3 DETAILS OF SPECIALISTS

Table 1.2 provides information of the independent specialists that have been appointed as part of the Basic Assessment process. Regulation 13(1)(a) and (b) determines that an independent and suitably qualified and experienced specialist should conduct the specialist study. In the event where the specialist is not independent, a specialist should be appointed to externally review the work of the specialist as contemplated in sub regulation (2), which must comply with sub regulation 1. In terms of the independent status of the specialists, their declarations are attached as Appendix D to this report. The expertise of the specialists is also summarized in their respective curriculum vitae's.

Table 1.2: Details of specialists

Study	Prepared by	Contact Person	Postal Address	Tel	e-mail
Geotechnical Study	SMEC South Africa	Richard Roberts	267 Kent Avenue, Ferndale, Randburg, 2194	Tel: 011 369 0600	johannesburg@smec.com
Avifaunal Assessment	Agreenco	ASH Haagner	PO Box 19896 Noordbrug, Potchefstroom 2522	Cell: 082 214 3738	adrian.haagner@agreencogroup.com
Ecological and Wetland Assessment	Enviroguard Ecological Services CC	Prof. L.R. Brown	PO Box 703 Heidelberg 1438,	Cell:082 464 1021	envguard@telkomsa.net
Heritage Impact Assessment	J van Schalkwyk Heritage Consultant	J van Schalkwyk	62 Coetzer Avenue Monument Park 0181	Cell: 076 790 6777	jvschalkwyk@mweb.co.za
Paleontological Study	Banzai Environmental (Pty) Ltd	Elize Butler	-	Cell: 084 447 8759	elizebutler002@gmail.com
Agriculture Agro-ecosystem Specialist Assessment	Johann Lanz Soil Scientist	Johann Lanz	P. O. Box 6209 Uniedal ,Stellenbosch 7612	Tel: 021 866 1518 Cell: 082 927 9018	johann@johannlanz.co.za
Visual Impact Assessment	Phala Environmental Consultants	Johan Botha	30 Fouche Street Steynsrus, 9515	Tel: 082 316 7749	phala.env@gmail.com
Social Impact Assessment	Phala Environmental Consultants	Marelie Botha	30 Fouche Street Steynsrus, 9515	Cell: 082 493 5166	phala.env@gmail.com
Traffic Assessment Study	JG AFRIKA (PTY) LTD	Adrian Johnson	Cape Town PO Box 38561 , 7430	Cell: 021 530 1800	Wink@jgafrika.com

1.4 STATUS OF THE BA PROCESS

The BA process is conducted strictly in accordance with the stipulations set out in Regulations 19 – 20 and Annexure 1 of Regulation No. 326. Table 1.3 provides a summary of the BA process and future steps to be taken. It can be confirmed that to date:

- A pre-application meeting request and public participation plan was submitted on 20 October 2021.
- A site visit was conducted on 27 October 2021.
- The DFFE accepted the public participation plan in an email dated 21 October 2021.
- Site notices were erected on site on 27 October 2021 and a newspaper advertisement was placed in the Klerksdorp Record on 29 October 2021 for the initial public participation.
- An application for a Basic Assessment Process and the draft BAR was submitted on 6 January 2022.
- The Basic Assessment report has been made available for a 30-day review and comment period from 06 January 2022 to 04 February 2022.

It is envisaged that the BA process should be completed within approximately five months of submitting the Application for EA and the BAR, i.e. by April 2022 – see Table 1.3.

Table 1.3: Project schedule

Activity	Prescribed timeframe	Timeframe
Submit public participation plan	-	18 Oct. 2021
Public Participation Plan Approval	-	21 Oct. 2021
Site visits (Initial PP – Press Advertisement & Site Notices).	-	27 October 2021
Appointment of specialists	-	18 Oct. 2021
Receive specialist studies	-	15 Nov. 2021 (4 weeks)
Submit application form and DBAR	-	6 Jan. 2022
Public participation (DBAR) (No PP between 15 Dec. 2021 & 5 Jan. 2022)	30 Days	6 Jan. 2022 – 4 Feb. 2022
Submit FBAR	44 Days	Feb. 2022
Department acknowledges receipt	10 Days	Feb. 2022
Decision	57 Days	By April 2022

Department notifies of decision	5 Days	By April 2022
Registered I&APs notified of decision	14 Days	April 2022
Appeal	20 Days	By May 2022

1.5 STRUCTURE OF THE REPORT

This report is structured in accordance with the prescribed contents stipulated in Appendix 1 of Regulation No.326. It consists of seven sections demonstrating compliance to the specifications of the regulations as illustrated in Table 1.4.

Table 1.4: Structure of the report

Requirements for the contents of a BAR as specified in the Regulations		Section in report
Appendix 1. (3) - A basic assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include-		
(a)	details of -	1
	(i) the EAP who prepared the report; and	
	ii) the expertise of the EAP, including a curriculum vitae.	
(b)	the location of the activity, including-	2
	(i) the 21-digit Surveyor General code of each cadastral land parcel;	
	(ii) where available, the physical address and farm name;	
	(iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	
(c)	a plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is-	
	(i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or	
	(ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;	
(d)	a description of the scope of the proposed activity, including-	
	(i) all listed and specified activities triggered and being applied for; and	

	(ii) a description of the activities to be undertaken including associated structures and infrastructure.	
(e)	a description of the policy and legislative context within which the development is proposed including:	3
	(i) An identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and	
	(ii) How the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks and instruments;	
(f)	a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	4
(g)	A motivation for the preferred site, activity and technology alternative.	5
(h)	a full description of the process followed to reach the preferred alternative within the site including –	
	(i) details of all the alternatives considered;	
	(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	
	(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them.	
	(iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	
	(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated;	6 & 7
	(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives;	

	(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	
	(viii) the possible mitigation measures that could be applied and level of residual risk;	
	(ix) the outcomes of the site selection matrix;	
	(x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and	
	(xi) a concluding statement indicating the preferred alternatives, including preferred location of the activity;	
(i)	a full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including -	
	(i) a description of all environmental issues and risks that were identified during the EIA process; and	
	(ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	
(j)	an assessment of each identified potentially significant impact and risk, including-	
	(i) cumulative impacts;	
	(ii) the nature, significance and consequences of the impact and risk;	
	(iii) the extent and duration of the impact and risk;	
	(iv) the probability of the impact and risk occurring;	
	(v) the degree to which the impact and risk can be reversed;	
	(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and	
	(vii) the degree to which the impact and risk can be mitigated;	
(k)	where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	6

(l)	an environmental impact statement which contains-	8
	(i) a summary of the key findings of the environmental impact assessment:	
	(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	
	(iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	
(m)	based on the assessment, and where applicable, impact management measures from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr;	
(n)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Not applicable
(o)	a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	8
(p)	a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	
(q)	where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded, and the post construction monitoring requirements finalised;	Not applicable
(r)	an undertaking under oath or affirmation by the EAP in relation to-	Appendix A to the report
	(i) the correctness of the information provided in the report;	
	(ii) the inclusion of comments and inputs from stakeholders and interested and affected parties (I&APs);	
	(iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and	
	(iv) any information provided by the EAP to I&APs and any responses by the EAP to comments or inputs made by I&APs; and	

(s)	where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	Not applicable
(t)	any specific information that may be required by the CA; and	Not applicable
(u)	any other matters required in terms of section 24(4)(a) and (b) of the Act.	Not applicable

2 ACTIVITY DESCRIPTION

This section aims to address the following requirements of the regulations:

Appendix 1. (3) An BAR (...) must include-

(b) the location of the activity, including-

(i) the 21-digit Surveyor General code of each cadastral land parcel;

(ii) where available, the physical address and farm name;

(iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;

(c) a plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is-

(i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or

(ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;

(d) a description of the scope of the proposed activity, including-

(i) all listed and specified activities triggered and being applied for;

(ii) a description of the associated structures and infrastructure related to the development.

2.1 THE LOCATION OF THE ACTIVITY AND PROPERTY DESCRIPTION

The activity entails the development of a photovoltaic solar facility and associated infrastructure on the Farm Groot Vaders Bosch No. 592 and Anglo No. 593, Registration Division Viljoenskroon, Free State Province situated within the Moqhaka Local Municipality. The proposed development is located in the Free State Province in the central interior of South-Africa (refer to Figure B for the regional map). The town of Viljoenskroon is located approximately 32km southeast and Orkney is located approximately 6.5km northwest of the proposed development (refer to Figure A for the locality map).

The project entails the generation of up to 150MW electrical power through the operation of photovoltaic (PV) panels. The total development footprint of the project will approximately be 308 hectares (including supporting infrastructure on site) within the 360 hectares assessed as part of the Basic Assessment process – refer to Table 2.1 for general site information. The property on which the facility is to be constructed will be leased by Thakadu Solar Power Plant (RF) (Pty) Ltd from the property owner, Die Leeu Trust, for the lifespan of the project (minimum of 20 years).

Table 2.1: General site information

Description of affected farm portion	<u>Solar Power Plant</u> Farm Groot Vaders Bosch No. 592 Farm Anglo No. 593 <u>Power Line: Option 1</u> Portion 2 of the Farm Zuiping No. 394 Farm Anglo No. 593 Remaining Extent of the Farm Zuiping No. 394 <u>Power Line: Option 2</u> Farm Anglo No. 593 Remaining Extent of Portion 1 of the Farm Die Hoek No. 114 Farm Hoekplaats No. 598
Province	Free State
District Municipality	Fezile Dabi District Municipality
Local Municipality	Moqhaka Local Municipality
Ward numbers	22
Closest towns	Viljoenskroon located ~32km south-east and Orkney ~6.5km north-west
21 Digit Surveyor General codes	<u>Solar Power Plant</u> Farm Groot Vaders Bosch No. 592 - F03600000000059200000 Farm Anglo No. 593 - F03600000000059300000 <u>Power Line: Option 1</u> Farm Anglo No. 593 - F03600000000059300000 Portion 2 of the Farm Zuiping No. 394 - F03600000000039400002

	Remaining Extent of the Farm Zuiping No. 394 - F03600000000039400000 <u>Power Line: Option 2</u> Farm Anglo No. 593 - F03600000000059300000 Portion 1 of the Farm Die Hoek No. 114 - F03600000000011400001 Farm Hoekplaats No. 598 – F03600000000059800000
Type of technology	Photovoltaic solar facility
Structure Height	Panels ~6m, buildings ~ 6m, power line ~32m and battery storage facility ~8m height
Battery storage	Within a 4-hectare area
Surface area to be covered (Development footprint)	Approximately 308 hectares
Laydown area dimensions (EIA footprint)	Assessed 360 hectares
Structure orientation	The panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is located in order to capture the most sun.
Generation capacity	Up to 150MW
Expected production	320-360 GWh per annum (Expected production by 150MWdc modules Considering Bifacial and one-axis tracker)

The site is located in a rural area and is bordered by farms where mainly agricultural activities are undertaken and mines. The site survey revealed that the affected property currently consists of grazing cattle – refer to plates 1-13 for photographs of the development area.

2.2 ACTIVITY DESCRIPTION

The proposed development will trigger the following activity:

Table 2.2: Listed activities

Relevant notice:	**Activity No (s)**	**Description of each listed activity as per project description:**
GNR. 327 (as amended in 2017)	Activity 11(i)	• *"The development of facilities or infrastructure for the transmission and distribution of electricity (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* • Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area. The infrastructure for the distribution of electricity will include a power line (132 kV), an on-site HV/MV substation (130 MVA, High Voltage:88/132kV, Medium Voltage: 33kV) and switching station. It is expected that generation from the facility will tie in with Vaal Reefs Eleven 132/6.6 kV Substation or either the Mercury-South Vaal 2 132kV Power Line or the South Vaal-Carrdell 132kV Power Line.
GNR. 327 (as amended in 2017)	Activity 12(ii)(a)(b)	• *"The development of (ii) infrastructure or structures with a physical footprint of 100 square meters or more (a) within a watercourse or (b) within 32 meters of a watercourse, measured from the edge of a watercourse."* • *The power line requires the development of a service road and pylon infrastructure which will exceed 100 square meters in extent. Surface water features, including a drainage channel, are present within the option 2 grid connection corridor that will need to be crossed by the service road.*
GNR. 327 (as amended in 2017)	Activity 14	• *"The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres."*

		• The facility will require the infrastructure for the storage and handling of dangerous goods such as diesel, with a combined capacity of 80 cubic metres, but not exceeding 500 cubic metres.
GNR. 327 (as amended in 2017)	Activity 19	• *"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil sand, shells, shell grit, pebbles or rock of more than 10 cubic meters from a watercourse"* • The power line requires the development of a service road. Surface water features, including drainage channels, are present within the option 1 grid connection corridor that will need to be crossed by the service road. This will require the removal and moving of soils of more than 10 cubic meters.
GNR. 327 (as amended in 2017)	Activity 24(ii)	• *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters;* • Activity 24(ii) is triggered as the internal roads will vary between 6 and 12 meters in width.
GNR. 327 (as amended in 2017)	Activity 28(ii)	• *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare."* • Activity 28(ii) is triggered as portions of the affected farm has been previously used for grazing and the property will be re-zoned to "special" use. The development footprint of the solar power plant will be 308 hectares.
GNR. 327 (as amended in 2017)	Activity 56 (ii):	• *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"*

		• Activity 56 (ii) is triggered as the existing access to the affected property does not have a reserve and will need to be widened by more than 6 metres.
GNR. 325 (as amended in 2017)	Activity 1	• *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* • Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 150 megawatts electricity through the use of a renewable resource.
GNR. 325 (as amended in 2017)	Activity 15	• *"The clearance of an area of 20 hectares or more of indigenous vegetation."* • In terms of vegetation type the preferred site falls within the Dry Highveld Grassland Bioregion, more precisely the Vaal Reefs Dolomite sinkhole (Gh12) and the Vaal-Vet Sandy Grassland (Gh10) which is described by Mucina and Rutherford (2006) respectively as 'vulnerable' and 'endangered'. Activity 15 is triggered since portions of the site has not been lawfully disturbed during the preceding ten years; therefore, more than 20 hectares of indigenous vegetation will be removed. The development footprint of the solar power plant will be 308 hectares.
GNR. 324 (as amended in 2017)	Activity 4 (b)(i)(ee)(gg)	• *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee) critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."* • Activity 4(b)(i)(ee)(gg) is triggered since the internal roads will not have a reserve and will vary between 6 and 12 meters in width. The project is located within the Free State Province and falls outside of an urban area but a portion of the option 2 connection corridor

		falls within CBA 1 and CBA 2 areas as identified in the Free State 2015 Biodiversity Plan. The project is located within 5km of a protected area in terms of NEMPAA. The Mispha Game farm is located approximately 1km south of the proposed development as per the South Africa Protected Area Database of the Department of Forestry, Fisheries and the Environment.
GNR. 324 (as amended in 2017)	Activity 10 (b)(i)(ee)(gg)	• *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."* • Activity 10(b)(i)(ee)(gg) is triggered since the proposed development will need to develop infrastructure for the storage and handling of dangerous goods (diesel) in containers with a capacity exceeding 30 but not exceeding 80 cubic metres. The project is located within the Free State Province and falls outside of an urban area but a portion of the option 1 connection corridor falls within CBA 1 and CBA 2 areas as identified in the Free State 2015 Biodiversity Plan. The project is located within 5km of a protected area in terms of NEMPAA. The Mispha Game farm is located approximately 1km south of the proposed development as per the South Africa Protected Area Database of the Department of Forestry, Fisheries and the Environment.
GNR. 324 (as	Activity 12 (b)(i)(ii)(iv)	• *"The clearance of an area of 300 square metres or more of indigenous vegetation…(b) in the Free State (i) within any critically endangered or endangered*

amended in 2017)		*ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans."* • Activity 12(b)(i)(ii)(iv) is triggered since the proposed development is located in the Free State province and the vegetation on site is classified as being 'endangered' or 'vulnerable'. Portions of the site has not been lawfully disturbed during the preceding ten years, a portion of the site is located within CBA 1 and CBA 2. The development footprint of the project will be 308 hectares and therefore, more than 300 square meters of indigenous vegetation will be removed.
GNR. 324 (as amended in 2017)	Activity 14(xii)(a)(b)(i)	• *"The development of (xii) infrastructure or structures with a physical footprint of 10 square metres or more where such development occurs (a) within a watercourse; in the (b) Free State Province, (i) outside urban areas, within (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve."* • The power line requires the development of a service road and pylon infrastructure which will exceed 100 square meters in extent. Surface water features, including drainage channel, are present within the option 2 grid connection corridor that will need to be crossed by the service road. The project is located in the Free State province and outside urban areas. A portion of the connection corridor is located within a CBA 1 and CBA 2. The power line and the three collector substations are located within 5km of a protected area as identified in terms of NEMPAA. The Mispha Game farm is located approximately 1 km

		north east of the proposed development as per the South Africa Protected Area Database (SAPAD) of the Department of Forestry, Fisheries and the Environment.
GNR. 324 (as amended in 2017)	Activity 18 (b)(i)(ee)(gg)(hh)	• *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas, within (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans, (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas and (hh) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland."* • Activity 18 (b)(i)(ee)(gg)(hh) is triggered since the existing access road to the site will need to be widened by more than 4 metres. The project is located within the Free State Province and falls outside of an urban area, but a portion of the option 2 grid connection falls within CBA 1 and CBA 2 areas as identified in the Free State 2015 Biodiversity Plan. The project is located within 5km of a protected area in terms of NEMPAA. The Mispha Game farm is located approximately 1km south of the proposed development as per the South Africa Protected Area Database of the Department of Forestry, Fisheries and the Environment. A drainage channel is located within the power line corridor option 2..

The potentially most significant impacts will occur during the construction phase of the development, which will include the following activities:

- Site clearing and preparation: Certain areas of the site will need to be cleared of vegetation and access to the site will need to be confirmed.
- Civil works to be conducted:

- Terrain levelling if necessary– Levelling will be minimal as the potential site chosen is relatively flat.
- Laying foundation- The structures will be connected to the ground through cement pillars, cement slabs or metal screws. The exact method will depend on the detailed geotechnical analysis.
- Construction of access roads/paths – existing paths will be used were reasonably possible. A short access road Tertiary road T3767 will be used to link the site with the Stokkiesdraai road which connects to the R30 Provincial Road. Additionally, the turning circle for trucks will also be taken into consideration.
- Trenching – all Direct Current (DC) and Alternating Current (AC) wiring within the PV plant will be buried underground. Trenches will have a river sand base, space for pipes, backfill of sifted soil and soft sand and concrete layering where vehicles will pass.

2.3 PHOTOVOLTAIC TECHNOLOGY

The term photovoltaic describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun through a process known as the Photovoltaic Effect. This refers to light energy placing electrons into a higher state of energy to create electricity. Each PV cell is made of silicon (i.e. semiconductors), which is positively and negatively charged on either side, with electrical conductors attached to both sides to form a circuit. This circuit captures the released electrons in the form of an electric current (direct current). The key components of the proposed project are described below:

- PV Panel Array - To produce up to 150 MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun.
- Wiring to Central Inverters - Sections of the PV array will be wired to central inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.
- Connection to the grid - - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the proposed power line. Whilst Thakadu Solar Power Plant (RF) (Pty) Ltd has not yet received a cost estimate letter from Eskom, it is expected that generation from the facility will tie in with either the existing Vaal Reefs Eleven Substation or two options within the same assessment corridor, the existing Mercury-South Vaal 2 132kV Power Line or the South Vaal-Carrdell 132kV. The

Project will inject up to 100MW into the National Grid. The installed capacity will be approximately 150MW.

Two grid connection corridors, each with a width of between 100-150m and up to 250m, have been identified for the assessment and placement of the power line (i.e., the power line will be developed within one of the two proposed corridors). The option is located to the south-west of the SPP site and will connect into either the existing Mercury-South Vaal 2 132kV (maximum length 1,22km) or the South Vaal-Carrdell 132kV (maximum length 0,86km).

The other option is located to the south-east of the SPP site and will connect into the existing Vaal Reefs Eleven Substation. The length of this option is ~2.7km. This is the preferred alternative from a development point of view due to the fact that the Vaal Reefs 11 Substation has capacity to accommodate the project (see Figure 2.1 below).

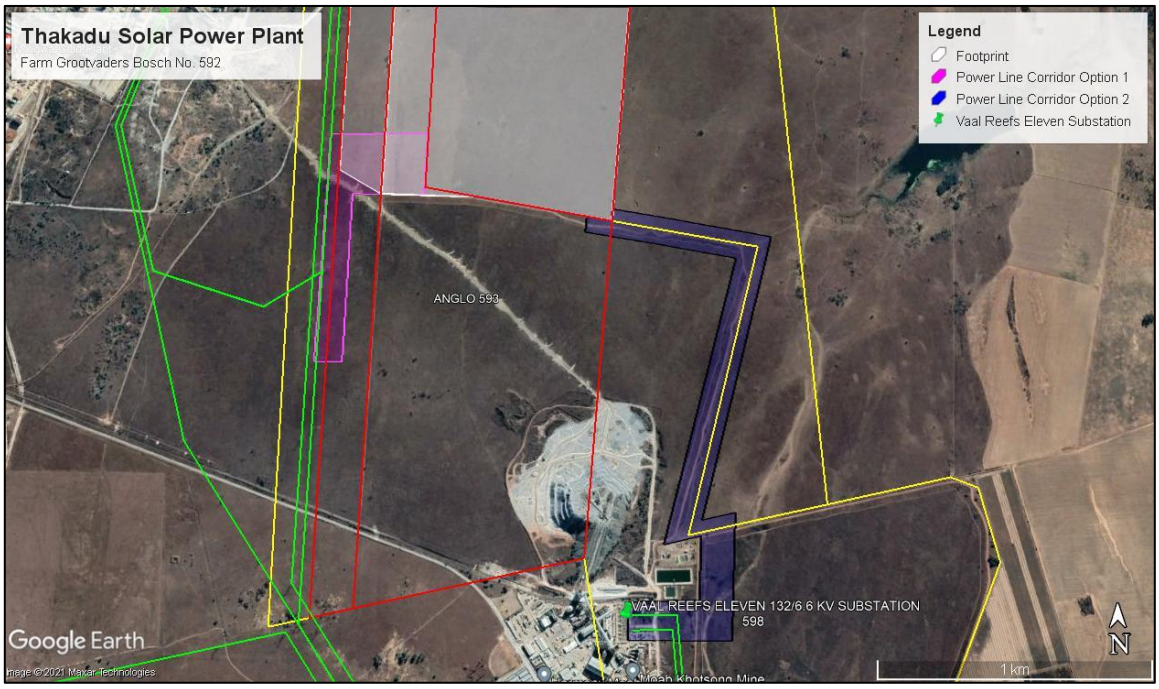


Figure 2.1: Proposed power line corridors for the proposed Thakadu Solar Power Plant

- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain ~2-4 m underground as far as practically possible.

- Supporting Infrastructure – The following auxiliary buildings with basic services including water and electricity will be required on site:

    - - Office (~200 m²);
    - Switch gear and relay room (~400 m²);
    - Staff lockers and changing room (~200 m²); and

- Security control (~60 m²)

- Battery Energy Storage System – Up to 500 MW Battery Storage Facility with a maximum height of 8m and a maximum volume of 1740 m^3 of batteries and associated operational, safety and control infrastructure.
- Roads – Access to the facility will be obtained via Tertiary road T3767 from the Stokkiesdraai road connected to the R30 Provincial Road. An internal site road network will also be required, with a width of between 6 m and 12 m, to provide access to the solar field and associated infrastructure. The access and internal roads will be constructed within a 25-meter corridor.
- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding properties. Fencing with a height of 2.5 meters will be used.

2.4 LAYOUT DESCRIPTION

The layout plan will consider and adhere to the limitations of the site and aspects such as environmentally sensitive areas, roads, fencing and servitudes on site. The total surface area covered by the layout include the PV panel arrays (spaced to avoid shadowing), access and maintenance roads and associated infrastructure (buildings, power inverters, power lines, onsite substation and switching station and perimeter fences). Limited environmental features of significance exist on site. A final layout plan is included in Appendix H under Layout Plans in the report. Table 2.3 below provides detailed information regarding the layout for the proposed facility as per DFFE requirements.

Table 2.3: Technical details for the proposed facility

Component	Description / dimensions
Height of PV panels	6 meters
Area of PV Array	308 Hectares (Development footprint) 360 Hectares (EIA Footprint)
Number of inverters required	Minimum 50
Area occupied by inverter / transformer stations / substations / BESS	Central inverters+ LV/MV trafo: 20 m^2 HV/MV substation with switching station: 15 000 m^2 BESS: 4 000 m^2
Capacity of on-site substation	132kV
Capacity of the power line	132kV

Area occupied by both permanent and construction laydown areas	Permanent Laydown Area: 360 Hectares Construction Laydown Area: ~2000 m^2
Area occupied by buildings	Security Room: ~60 m^2 Office: ~200 m^2 Staff Locker and Changing Room: ~200 m^2
Battery storage facility	Maximum height: 8m Maximum volume: 1740 m^3
Length of internal roads	Approximately 15 km
Width of internal roads	Between 6 & 12 meters
Proximity to grid connection	Approximately 1.6 kilometers
Grid connection corridor width	100 - 150m, and up to 250m
Grid connection corridor length	Approximately 1.6 kilometers
Power servitude width	32m
Height of fencing	Approximately 2.5 meters

Table 2.4 provides the coordinate points for the proposed project site and power line corridor.

Table 2.4: Coordinates

Coordinates			
Project Site	A	26°58'18.48"S	26°48'7.26"E
	B	26°58'14.99"S	26°47'47.42"E
	C	26°58'14.49"S	26°47'33.36"E
	D	26°56'43.93"S	26°47'36.33"E
	E	26°56'40.78"S	26°47'43.17"E
	F	26°56'38.04"S	26°48'4.98"E
	G	26°56'38.09"S	26°48'6.62"E
	H	26°56'41.41"S	26°48'17.56"E
Proposed Access Point		26°56'43.87"S	26°47'36.40"E

Access Point (Alternative)		26°56'41.37"S	26°48'17.44"E
Connection Option 1			
Power Line Corridor – Option 1	A	26°58'6.07"S	26°47'40.06"E
	B	26°58'6.09"S	26°47'25.54"E
	C	26°58'36.89"S	26°47'24.75"E
	D	26°58'37.01"S	26°47'28.81"E
	E	26°58'14.55"S	26°47'29.16"E
	F	26°58'14.68"S	26°47'39.74"E
Substation – Option 1	A	26°58'11.00"S	26°47'35.37"E
	B	26°58'11.00"S	26°47'40.81"E
	C	26°58'14.21"S	26°47'40.83"E
	D	26°58'14.20"S	26°47'35.36"E
Battery Energy Storage System (BESS) – Option 1	A	26°58'4.85"S	26°47'35.25"E
	B	26°58'4.87"S	26°47'43.30"E
	C	26°58'10.64"S	26°47'43.29"E
	D	26°58'10.63"S	26°47'35.13"E
Connection Option 2			
Power Line Corridor – Option 2	A	26°58'16.71"S	26°48'6.83"E
	B	26°58'20.93"S	26°48'30.41"E
	C	26°58'56.98"S	26°48'18.92"E
	D	26°58'56.15"S	26°48'23.52"E
	E	26°59'11.16"S	26°48'22.38"E
	F	26°59'11.01"S	26°48'8.43"E
	G	26°59'6.63"S	26°48'8.45"E
	H	26°59'6.44"S	26°48'18.15"E
	I	26°58'58.87"S	26°48'18.62"E
	J	26°58'59.90"S	26°48'13.52"E

	K	26°58'23.78"S	26°48'25.07"E
	L	26°58'19.96"S	26°48'3.34"E
	M	26°58'17.46"S	26°48'3.68"E
Substation – Option 2	A	26°58'12.56"S	26°48'3.90"E
	B	26°58'13.04"S	26°48'7.45"E
	C	26°58'17.85"S	26°48'6.66"E
	D	26°58'17.34"S	26°48'3.06"E
Battery Energy Storage System (BESS) – Option 2	A	26°58'11.50"S	26°47'51.47"E
	B	26°58'11.56"S	26°48'1.70"E
	C	26°58'17.00"S	26°48'0.53"E
	D	26°58'15.27"S	26°47'50.66"E

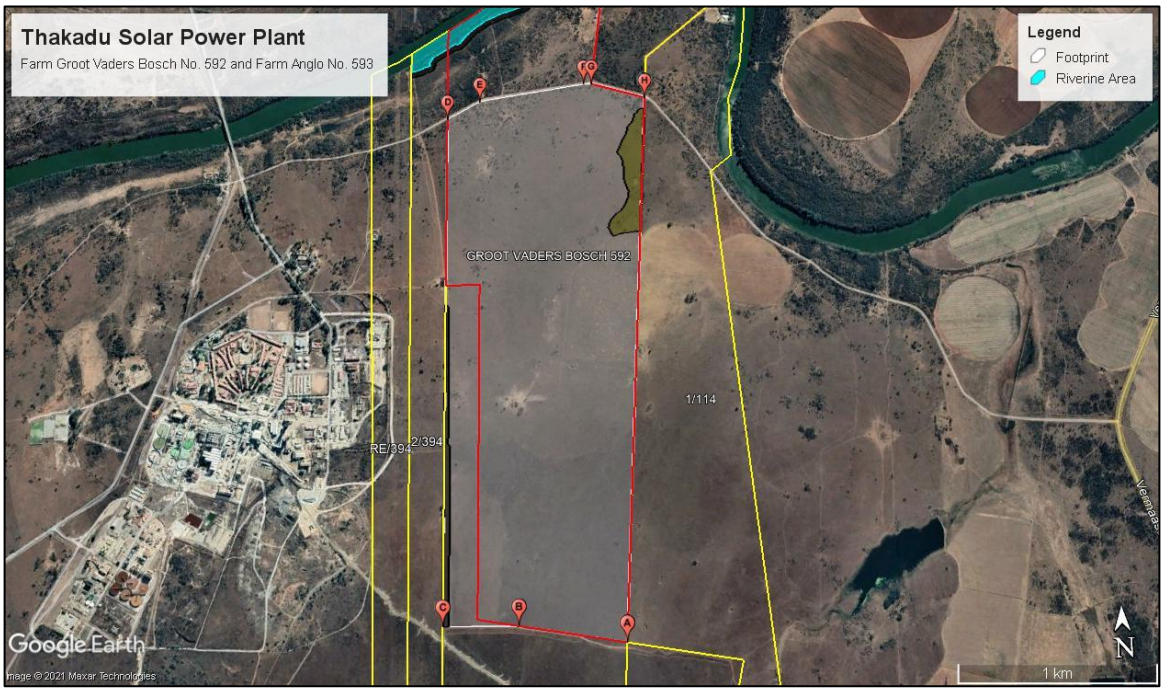


Figure 2.2 : Map indicating coordinate points of the proposed Thakadu Solar Power Plant (including project site)

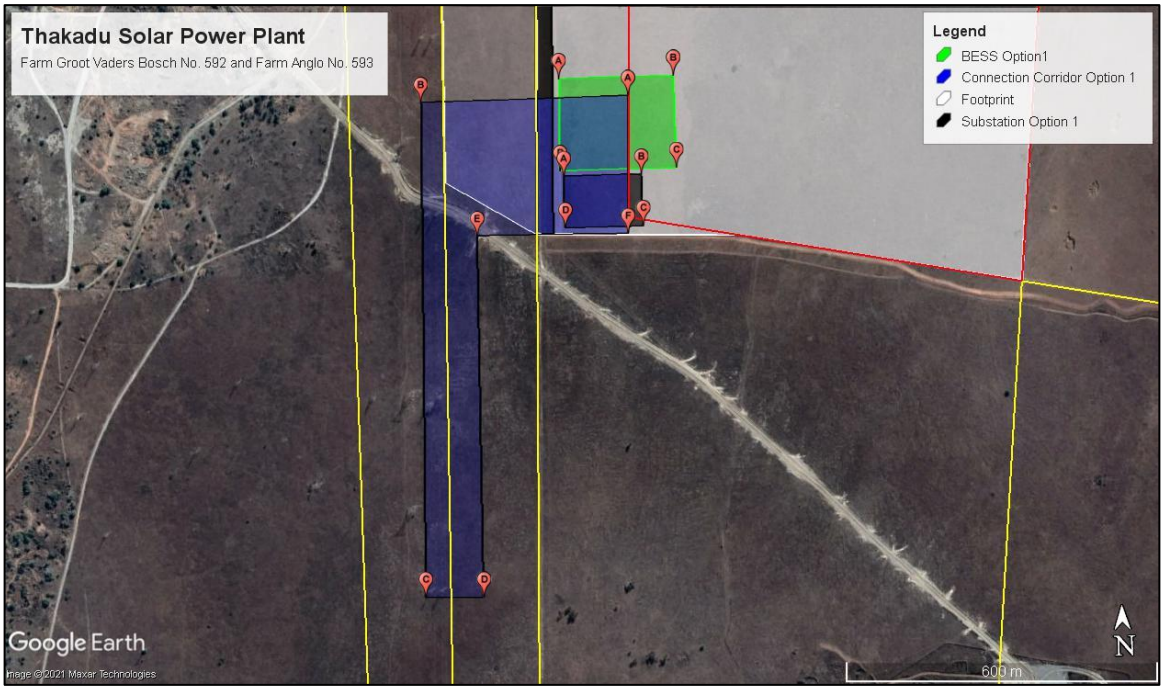


Figure 2.3: Map indicating coordinate points of the proposed Thakadu Solar Power Plant proposed power line corridor, BESS and the substation for connection option 1.

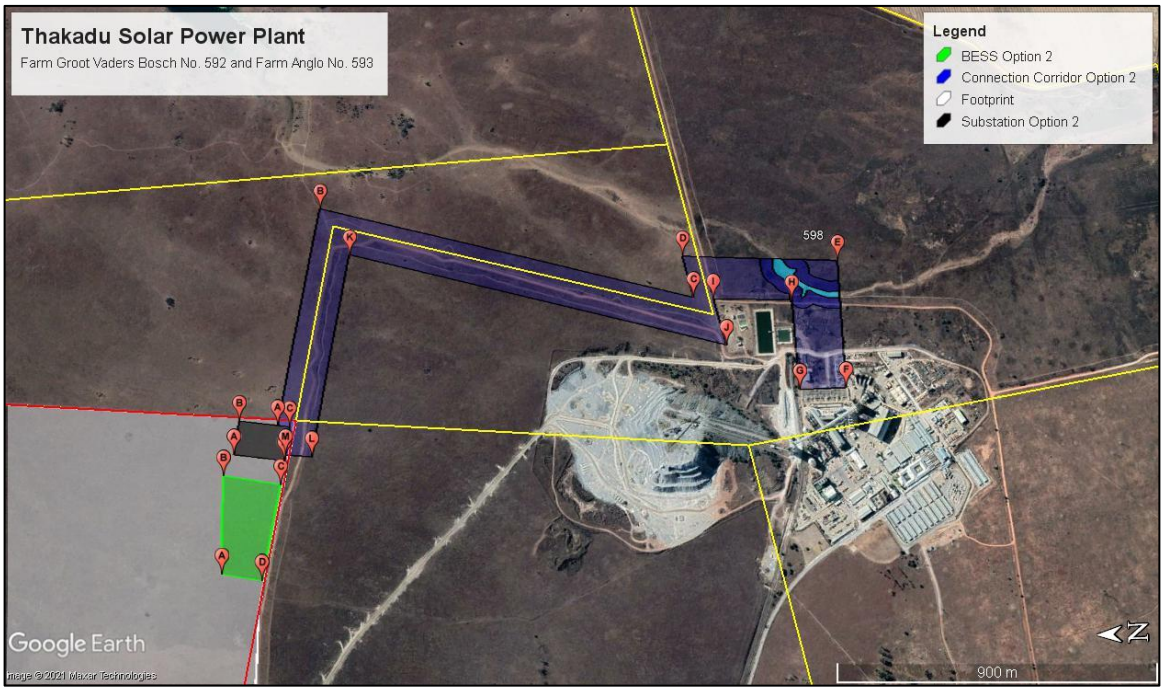


Figure 2.4: Map indicating coordinate points of the proposed Thakadu Solar Power Plant proposed power line corridor, BESS and the substation for connection option 2.

2.5 SERVICES PROVISION

The following sections provides information on services required on the site e.g. water, sewage, refuse removal, and electricity.

2.5.1 Water

Adequate provision of water will be a prerequisite for the development. Water for the proposed development will most likely be obtained from the local municipality, or alternatively from ground water resources. The Department of Water and Sanitation has been asked by the Applicant to confirm the water resource availability in the relevant catchment management area in order to ensure sustainable water supply. A full assessment of the application for water use authorisation will only be undertaken in the event that the project proponent has obtained preferred bidder status by the Department of Mineral Resources and Energy for the development of the project.

The estimated maximum amount of water required during construction is 1200m³ per month during the 12 - 18 months of construction. The estimated maximum amount of water required during the facility's 20 years of production is 4200m³ per annum. The majority of this usage is for the cleaning of the solar panels during the operation phase. Since each panel requires approximately 2 litres of water for cleaning, the total amount of 500000 panels will require 920 000 litres per wash. It is estimated that the panels may only need to be washed twice per annum, but provision is made for quaternary cleaning (March, May, July, and September). This totals approximately 4,200,000 litres per annum for washing and allows 200,000 litres per annum (or 548 litres per day) for toilet use, drinking water, etc as part of operations. This total to approximately 4 200m^3 of water required per annum. Drinking water supplied will comply with the SANS:241 quality requirements and it is noted that the Moqhaka Local Municipality remains the Water Service Authority in the area.

Water saving devices and technologies such as the use of dual flush toilets and low-flow taps, the management of storm water, the capture and use of rainwater from gutters and roofs would be considered by the developer. Furthermore, indigenous vegetation will be used during landscaping and the staff will be trained to implement good housekeeping techniques.

2.5.2 Storm water

To avoid soil erosion, it is recommended that the clearing of vegetation be limited. Storm water management and mitigation measures are included in the Environmental Management Programme (EMPr) – refer to Appendix F.

2.5.3 Sanitation and waste removal

Portable chemical toilets will be utilised, that will be serviced privately or by the local municipality. Waste will be disposed at a licensed landfill site. The construction- and hazardous waste will be removed and disposed of at licensed landfill sites accepting such kinds of wastes. During the

operational phase household waste will be removed to a licensed landfill site by a private contractor or by the local municipality. The relevant Local Municipality(s) will be contacted, to formally confirm that it has the capacity to provide the proposed development with these services for the lifetime of the project (20 years).

2.5.4 Electricity

During the construction phase of the development electricity will either be generated on site through a small solar system or through the use of generators or the existing Eskom supply on the farm will be utilised. This will depend on the Engineering, Procurement, and Construction (EPC) contractor appointed. During operation electricity use will be limited and will primarily be related to the lighting of the facility and domestic use. Design measures such as the use of energy saving light bulbs will be considered by the developer. During the day, electricity will be sourced from the photovoltaic plant, and from the electricity connection at night.

2.6 Decommissioning of the facility

The operating period will be 20 years from the commencement date of the operation phase. Thereafter two rights of renewal periods of 40 years and 20 years will be relevant. It is anticipated that new PV technologies and equipment will be implemented, within the scope of the Environmental Authorisation, when influencing the profitability of the solar facility.

A likely extension of the plant's lifetime would involve putting new, more efficient, solar panels on the existing structures to improve the efficiency of the facility as the technology improves. The specifications of these new panels will be the same as the current panels under consideration, but the conversion efficiency of sunlight to energy will be greater (comparable to new computer chips, that are the same, but faster and more efficient). If, for whatever reason the plant halts operations, the Environmental Authorisation and contract with the landowner will be respected during the decommissioning phase.

<u>The decommissioning process will consist of the following steps:</u>

- The PV facility would be disconnected from the Eskom grid.
- The inverters and PV modules would be disconnected and disassembled.
- Concrete foundations (if used) would be removed and the structures would be dismantled.
- Wastewater storage conservancy tank would be responsibly removed and the area would be rehabilitated.
- The underground cables would be unearthed and removed and buildings would be demolished and removed.
- The fencing would be dismantled and removed.

- The roads can be retained should the landowner choose to retain them, alternatively the roads will be removed and the compaction will be reversed.
- Most of the wires, steel and PV modules are recyclable and would be recycled to a reasonable extent. The Silicon and Aluminium in PV modules can be removed and reused in the production of new modules.
- Any rubble and non-recyclable materials will be disposed of at a registered landfill facility.

The rehabilitation of the site would form part of the decommissioning phase. The aim would be to restore the land to its original form (or as close as possible). The rehabilitation activities would include the following:

- Removal of all structures and rubble;
- Breaking up compaction where required, loosening of the soil and the redistribution of topsoil; and
- Restoration of the surface to the original contours and application of hydro seeding.

3 LEGISLATIVE AND POLICY CONTEXT

This section aims to address the following requirements of the regulations:

Appendix 1. (3) A BAR (...) must include-

(e) a description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context.

3.1 INTRODUCTION

Environmental decision making with regards to solar PV plants and associated infrastructure is based on numerous policy and legislative documents. These documents inform decisions on project level environmental authorisations issued by the National Department of Forestry, Fisheries and the Environment (DFFE) as well as comments from local and district authorities. Moreover, it is significant to note that they also inform strategic decision making reflected in IDPs and SDFs. Therefore, to ensure streamlining of environmental authorisations it is imperative for the proposed activity to align with the principles and objectives of key national, provincial and local development policies and legislation. The following acts and policies and their applicability to the proposed development are briefly summarised:

- The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA]
- The National Energy Act, 2008 (Act 34 of 2008)
- National Water Act, 1998 (Act No. 36 of 1998)
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
- The National Heritage Resources Act, 1999 (Act No. 25 of 1999)
- Conservation of Agricultural Resources Act, 1983 (Act No. 85 of 1983)
- The National Forests Act, 1998 (Act 84 of 1998)
- The White Paper on the Energy Policy of the Republic of South Africa (1998)
- The White Paper on Renewable Energy (2003)
- Integrated Resource Plan (IRP) for South Africa (2010-2030)
- National Development Plan of 2030
- National Infrastructure Plan of South Africa
- New Growth Path Framework

- Free state Provincial Spatial Development Framework (PSDF) (2012)
- Strategic Environmental Assessment (SEA) for wind and solar PV Energy in South Africa (2014)
- Fezile Dabi District Municipality Final Draft Integrated Development Plan (IDP) 2020-2021 (2020)
- Moqhaka Local Municipality Draft Integrated Development Plan 2020/2021 (2020)

The key principles and objectives of each of the legislative and policy documents are briefly summarised in Tables 3.1 and 3.2 to provide a reference framework for the implications for the proposed activity.

3.2 LEGISLATIVE CONTEXT

Table 3.1: Legislative context for the construction of photovoltaic solar plants

LEGISLATION	ADMINISTERING AUTHORITY	DATE	SUMMARY / IMPLICATIONS FOR PROPOSED DEVELOPMENT
The Constitution of South Africa **(Act No. 108 of 1996)**	National Government	1996	The Constitution is the supreme law of the Republic and all law and conduct must be consistent with the Constitution. The Chapter on the Bill of Rights contains a number of provisions, which are relevant to securing the protection of the environment. Section 24 states that "everyone has the right to (a) an environment that is not harmful to their health or well-being and (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that – (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. The Constitution therefore, compels government to give effect to the people's environmental right and places government under a legal duty to act as a responsible custodian of the country's environment. It compels government to pass legislation and use other measures to protect the environment, to prevent pollution and ecological degradation, promote conservation and secure sustainable development. The development of the Thakadu Solar Power Plant and the aspects related thereto considers the creation of an environment which is not harmful or degraded through the implementation of appropriate mitigation measures.
The National Environmental Management Act **(Act No. 107 of 1998)**	National Department of Forestry, Fisheries and the Environment (DFFE) and the Free State Province Department of	1998	NEMA provides for co-operative governance by establishing principles and procedures for decision-makers on matters affecting the environment. An important function of the Act is to serve as an enabling Act for the promulgation of legislation to effectively address integrated environmental management. Some of the principles in the Act are accountability; affordability; cradle to grave management; equity; integration; open information; polluter pays; subsidiary;

	Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA)		waste avoidance and minimisation; co-operative governance; sustainable development; and environmental protection and justice. The mandate for EIA lays with the National Environmental Management Act (107 of 1998) and the EIA Regulations No. 324, 325, 326, and 327 promulgated in terms of Section 24 of NEMA. The EIA Regulations determine that an Environmental Authorisation is required for certain listed activities, which might have a detrimental effect on the environment. The BA process undertaken for the Thakadu Solar Power Plant is in-line with the requirements of NEMA for the Application for Environmental Authorisation.
The National Energy Act (Act No. 34 of 2008)	Department of Mineral Resources and Energy	2008	One of the objectives of the National Energy Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including solar: "To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements (…); to provide for (…) increased generation and consumption of renewable energies…" (Preamble). Considering that the Thakadu Solar Power Plant is proposed to make use of PV technology and the solar resource for the generation of electricity, the proposed project is in-line with the Act.
The National Water Act (Act No. 36 of 1998)	Department of Water and Sanitation (DWS)	1998	Sustainability and equity are identified as central guiding principles in the protection, use, development, conservation, management and control of water resources. The intention of the Act is to promote the equitable access to water and the sustainable use of water, redress past racial and gender discrimination, and facilitate economic and social development. The Act provides the rights of access to basic water supply and sanitation, and environmentally, it provides for the protection of aquatic and associated ecosystems, the reduction and prevention of pollution and degradation of water resources. As this Act is founded on the principle that National Government has overall responsibility for and authority over water resource management, including the equitable allocation and

			beneficial use of water in the public interest, a person can only be entitled to use water if the use is permissible under the Act. Chapter 4 of the Act lays the basis for regulating water use. The site falls within the C24B quaternary drainage region, this drainage region falls under Zone H, which refers to the amount of water that may be taken from the ground water resource, per hectare. Also, should a water use license be required for the project, the National Water Act will be applicable in terms of obtaining the relevant license.
National Environmental Management: Waste Act **(Act No. 59 of 2008)**	National Department of Forestry, Fisheries and the Environment (DFFE)	2008	NEMWA has been developed as part of the law reform process enacted through the White Paper on Integrated Pollution and Waste Management and the National Waste Management Strategy (NWMS). The objectives of the Act relate to the provision of measures to protect health, well-being and the environment, to ensure that people are aware of the impact of waste on their health, well-being and the environment, to provide for compliance with the measures, and to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being. Regulations No. R921 (of 2013) promulgated in terms of Section 19(1) of the National Environmental Management: Waste Act (59 of 2008) determines that no person may commence, undertake or conduct a waste management activity listed in this schedule unless a license is issued in respect of that activity. It is not envisaged that a waste permit will be required for the proposed development as no listed activities in terms of waste management are expected to be triggered. .
National Environment Management: Air Quality Act	National Department of Forestry, Fisheries and the Environment (DFFE)	2004	The object of this Act is to protect the environment by providing reasonable measures for the protection and enhancement of the quality of air in the Republic; the prevention of air pollution and ecological degradation; and securing ecologically sustainable development while promoting justifiable economic and social development. Regulations No. R248 (of 31 March 2010) promulgated in terms of Section 21(1)(a) of the National Environmental Management Act: Air Quality Act (39 of 2004) determine that an

(Act No. 39 of 2004)			Atmospheric Emission License (AEL) is required for certain listed activities, which result in atmospheric emissions which have or may have a detrimental effect on the environment. The Regulation also sets out the minimum emission standards for the listed activities. It is not envisaged that an Atmospheric Emission License will be required for the proposed development.
The National Heritage Resources Act **(Act No. 25 of 1999)**	South African Heritage Resources Agency (SAHRA)	1999	The Act aims to introduce an integrated and interactive system for the management of heritage resources, to promote good governance at all levels, and empower civil society to nurture and conserve heritage resources so that they may be bequeathed to future generations and to lay down principles for governing heritage resources management throughout the Republic. It also aims to establish the South African Heritage Resources Agency together with its Council to co-ordinate and promote the management of heritage resources, to set norms and maintain essential national standards and to protect heritage resources, to provide for the protection and management of conservation-worthy places and areas by local authorities, and to provide for matters connected therewith. The Act protects and manages certain categories of heritage resources in South Africa. For the purposes of the Heritage Resources Act, a "heritage resource" includes any place or object of cultural significance. In this regard the Act makes provision for a person undertaking an activity listed in Section 28 of the Act to notify the resources authority. The resources authority may request that a heritage impact assessment be conducted if there is reason to believe that heritage resources will be affected. A case file has been opened on SAHRIS for the Thakadu Solar Power Plant and all relevant documents were submitted for their comments and approval. The Heritage Impact Assessment undertaken for the solar power plant is included as Appendix D5 and the Paleontological Impact Assessment report is included as Appendix D6 to this final BAR.
Conservation of Agricultural Resources Act	National and Provincial Government	1983	The objective of the Act is to provide control over the utilisation of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

(Act No. 85 of 1983)			Consent will be required from the Department of Rural Development and Land Reform in order to confirm that the proposed development is not located on high potential agricultural land and to approve the long term lease agreement. An Agriculture Agro-Ecosystem Specialist Assessment has been undertaken for the Thakadu Solar Power Plant and is included as Appendix D4 of this final BAR.
The National Forests Act, 1998 (Act 84 of 1998)	Department of Agriculture, Forestry and Fisheries	1998	The purposes of this Act are to: (a) promote the sustainable management and development of forests for the benefit of all; (b) create the conditions necessary to restructure forestry in State forests; (c) provide special measures for the protection of certain forests and trees: (d) promote the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes. (e) promote community forestry; (f) promote greater participation in all aspects of forestry and the forest products industry by persons disadvantaged by unfair discrimination. Section 12(1) read with s15(1) of the NFA stated that the Minister may declare a particular tree, group of trees, woodland; or trees belonging to a particular species, to be a protected tree, group of trees, woodland or species. A list of protected tree species was gazetted in GN 635 of 6 December 2019. The effect of the declaration is that no person may (a) cut, disturb, damage or destroy; or (b) possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, or any forest product derived from a protected tree, except under a license granted by the Minister; or in terms of an exemption published by the Minister in the Gazette.

			A Ecology and Wetland Assessment has been undertaken for the Thakadu Solar Power Plant and is included in Appendix D1 of this final BAR.
Free State Nature Conservation Ordinance, 1969 (Act 8 of 1969)	Free State Province Department of Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA)	1969	The Act provides for the conservation of fauna and flora and the hunting of animals causing damage and for matters incidental thereto. This includes wild animals, fish, indigenous plants, as well as nature reserves. The Act also provides for the permitting of the disturbance of such species. A Terrestrial Biodiversity, Plant and Animal has been undertaken for the Thakadu Solar Power Plant and is included in Appendix D1 of this final BAR.

3.3 POLICY CONTEXT

Table 3.2: Policy context for the construction of solar PV plants

POLICY	ADMINISTERING AUTHORITY	DATE	SUMMARY / IMPLICATIONS FOR PROPOSED DEVELOPMENT
The White Paper on the Energy Policy of the Republic of South Africa	Department of Mineral Resources and Energy	1998	The White Paper on the Energy Policy of the Republic of South Africa establishes the international and national policy context for the energy sector, and identifies the following energy policy objectives: • Increasing access to affordable energy services • Improving energy governance • Stimulating economic development • Managing energy-related environmental and health impacts • Securing supply through diversity

		• Energy policy priorities The White Paper sets out the advantages of renewable energy and states that Government believes that renewables can in many cases provide the least cost energy service, particularly when social and environmental costs are included. The White Paper acknowledges that South Africa has neglected the development and implementation of renewable energy applications, despite the fact that the country's renewable energy resource base is extensive, and many appropriate applications exist. The White Paper notes that renewable energy applications have specific characteristics that need to be considered. Advantages include: • Minimal environmental impacts in operation in comparison with traditional supply technologies; and • Generally lower running costs, and high labour intensities. Disadvantages include: • Higher capital costs in some cases; • Lower energy densities; and • Lower levels of availability, depending on specific conditions, especially with sun and wind based systems. The Thakadu Solar Power Plant is in line with this policy as it proposes the generation of renewable energy from the solar resource.
The White Paper on Renewable Energy	Department of Mineral Resources and Energy 2003	This White Paper on Renewable Energy supplements the *White Paper on Energy Policy*, which recognises that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

			The White Paper notes that while South Africa is well-endowed with renewable energy resources that have the potential to become sustainable alternatives to fossil fuels, these have thus far remained largely untapped. Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels. The medium-term (10-year) target set in the White Paper is: *10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1667 MW) of the projected electricity demand for 2013 (41539 MW)* (Executive Summary, ix). The Thakadu Solar Power Plant is in line with this policy as it proposes the generation of renewable energy from the solar resource.
Integrated Resource Plan (IRP) for South Africa	Department of Mineral Resources and Energy	2010-2030	The Integrated Resource Plan for Electricity for South Africa of 2010–2030 (further referred to as the IRP) is a "living plan" which is expected to be revised and updated continuously as necessary due to changing circumstances. According to the Summary of the plan the current IRP for South Africa, which was originally initiated by the Department of Energy (DoE) in June 2010 (the Department is now known as Department of Mineral Resources and Energy), led to the Revised Balanced Scenarios (RBS) for the period 2010–2030. "*This scenario was derived based on the cost-optimal solution for new build options (considering the direct costs of new build power plants), which was then "balanced" in accordance with qualitative measures such as local job creation". In addition to all existing and committed power plants, the RBS included 11,4 GW of renewables, which relates to the proposed Thakadu SPP. In 2010 several changes were made to the IRP model. The main changes in the IRP were the disaggregation of renewable energy technologies to explicitly display solar photovoltaic (PV), concentrated solar power (CSP), and wind options"* (RSA, 2011a). The summary of the IRP further explains that traditional cost-optimal scenarios were developed based on the previously mentioned changes in the IRP. This resulted in the Policy-Adjusted IRP, which stated that: "*The installation of renewables (solar PV, CSP and wind) have been brought forward in order to accelerate a local industry*;

To account for the uncertainties associated with the costs of renewables and fuels, a nuclear fleet of 9,6 GW is included in the IRP; [SEP]

The emission constraint of the RBS (275 million tons of carbon dioxide per year after 2024) is maintained; and

Energy efficiency demand-side management (EEDSM) measures are maintained at the level of the RBS" (RSA, 2011a:6).

"The Policy-Adjusted IRP includes the same amount of coal and nuclear new builds as the RBS, while reflecting recent developments with respect to prices for renewables. In addition to all existing and committed power plants (including 10 GW committed coal), the plan includes 9,6 GW of nuclear; 6,3 GW of coal; 17,8 GW of renewables; and 8,9 GW of other generation sources" (RSA, 2011a:6).

The IRP highlights the commitments before the next IRP. The commitments pertaining to the purpose of the proposed project in renewable energy is:

"*Solar PV programme 2012-2015: In order to facilitate the connection of the first solar PV units to the grid in 2012 a firm commitment to this capacity is necessary. Furthermore, to provide the security of investment to ramp up a sustainable local industry cluster, the first four years from 2012 to 2015 require firm commitment."*

"*Solar PV 2016 to 2019: As with wind, grid upgrades might become necessary for the second round of solar PV installations from 2016 to 2019, depending on their location. To trigger the associated tasks in a timely manner, a firm commitment to these capacities is necessary in the next round of the IRP at the latest. By then, the assumed cost decreases for solar PV will be confirmed*" (IRP, 2011a:17).

In conclusion the IRP recommends that an accelerated roll-out in renewable energy options should be allowed with regards to the benefits of the localization in renewable energy technologies (RSA, 2011a). It is however important to take note that since the release of the IRP in 2011 there has been a number of developments in the energy sector of South Africa. Therefore, the IRP has been updated and were open for comments until March of 2017. The new IRP of 2019 was formally published in October 2019. The draft

IRP of 2018 was open for comments until the end of October 2018. For the revision scenario analysis were conducted and the results thereof are included in the draft IRP of 2018. The results revealed that for the period ending 2030 that: *"The committed Renewable Energy Independent Power Producers Programme, including the 27 signed projects and Eskom capacity rollout ending with the last unit of Kusile in 2022, will provide more than sufficient capacity to cover the projected demand and decommissioning of plants up to approximately 2025"; "Imposing annual build limits on renewable energy will not affect the total cumulative capacity and the energy mix for the period up to 2030*"; and *"the scenario without renewable energy annual build limits provides the least-cost option by 2030*" (RSA, 2018:34).

Lastly, the draft IRP of 2018 also included the scenario analysis for the period post 2030. Here it was observed that: "*Imposing annual build limits on renewable energy will restrict the cumulative renewable installed capacity and the energy mix for this period; adopting no annual build limits on renewables or imposing a more stringent strategy to reduce greenhouse gas emissions implies that no new coal power plants will be built in the future unless affordable cleaner forms of coal-to-power are available; and the scenario without renewable energy annual build limits provides the least-cost option by 2050*" (RSA, 2018:34–35).

In the final IRP of 2019 key considerations were taken into consideration together with required actions to be taken for the IRP of 2019 to be credible. In terms of renewable energy technologies like solar and wind, the IRP stated that *"The application of renewable build limits 'smoothes out' the capacity allocations for wind and solar PV which provides a constant pipeline of projects to investment; this addresses investor confidence*". The decision stated against this key consideration is to *"retain the current annual build limits on renewables (wind and PV) pending the finalization of a just transition plan"* (RSA, 2019:46). Hereby the IRP also recognises renewable technologies' potential to diversify the electricity mix, create new industries and job opportunities and localize across the value chain (RSA, 2019:13).

The Thakadu Solar Power Plant is in line with this plan as it proposes the generation of renewable energy from the solar resource and will contribute to the energy mix of the country as set out in this plan.

National Development Plan of 2030	The Presidency: National Planning Commission	-	The National Development Plan aims to "eliminate poverty and reduce inequality by 2030" (RSA, undated). In order to eliminate or reduce inequality, the economy of South Africa need to grow faster in order to benefit all South Africans. In May 2010 a draft national development plan was drafted, which highlighted the nine (9) key challenges for South Africa. The highest priority areas according to the plan are considered to be the creation of employment opportunities and to improve the quality of national education. In this regard, the plan sets out three (3) priority areas, namely to raise employment by a faster growing economy, improve the quality of education, and to build the capability of the state in order to play a more developmental and transformative role. One of the key challenges identified was that the economy is unsustainably resource intensive and the acceleration and expansion of renewable energy was identified as a key intervention strategy to address this challenge. The development of the Thakadu Solar Power Plant will contribute to the intervention strategy as identified within the plan.
National Infrastructure Plan of South Africa	Presidential Infrastructure Coordinating Commission	2012	In the year 2012 the South African Government adopted a National Infrastructure Plan (hereafter referred to as the Plan). The aim of this Plan is to transform the economic landscape, while strengthening the delivery of basic services and creating new employment opportunities. This Plan also supports the integration of African communities, and also sets out the challenges and enablers that our country needs in order to respond to the planning and development of infrastructure with regards to fostering economic growth (RSA, 2012). The Plan has developed eighteen (18) strategic integrated projects (further referred to as SIPs). These SIPs stretches over all nine (9) provinces, covering social and economic infrastructure, and projects that enhances development and growth. Of the eighteen (18), five (5) are geographically focused, three (3) spatial, three (3) energy, three (3) social infrastructure, two (2) knowledge, one (1) regional integration, and one (1) water and sanitation focussed. The three (3) SIPs according to the Plan, which are energy focused and correlate to the proposed project are as follow: - SIP 8: Green energy in support of the South African economy; - SIP 9: Electricity generation to support socio-economic development; and

		- SIP 10: Electricity transmission and distribution for all. SIP 8 according to the Plan "*support sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the IRP 2010 and support bio-fuel production facilities*". The purpose of SIP 9 according to the Plan is to "*accelerate the construction of new electricity generation capacity in accordance with the IRP 2010 to meet the needs of the economy and address historical imbalances*". SIP 9 should also monitor the implementation of major projects such as new power stations like Medupi, Kusile and Ingula. Lastly, SIP 10 aims to "*expand the transmission and distribution network to address historical imbalances, provide access to electricity for all and support economic development*" (RSA, 2012:20). The development of the Thakadu Solar Power Plant in line with SIP 8 and SIP 9 as it will provide "Green" energy in support of the South African Economy and will generate electricity which supports socio-economic development. The power line associated with the Thakadu Solar Power Plant is in line with SIP 10 as it will facilitate electricity transmission and distribution for all.
New Growth Path Framework	Department of Economic Development	The New Growth Path was developed after 16 years of South Africa's democracy, to respond to emerging opportunities and risks while building on policies. This framework provides a dynamic vision on how to collectively achieve a more developed, equitable and democratic society and economy. This framework mainly reflects the commitment of the South African Government to create employment opportunities for its people in all economic policies (RSA, 2011b). This framework sets out the markers for job creation and growth and also identify where there are viable changes in the character and structure of production, in order to create a more inclusive, greener economy on the long-term. It is stated in the framework that in order for this framework to reach its objectives, the Government is committed to: - Identify the possible areas of employment creation; and - Develop a policy to facilitate employment creation especially with regards to social equity, sustainable employment and growth in the creation of employment activities (RSA, 2011b).

			This framework also identifies investments in five key areas, one of which is energy. This framework also states that the green economy is a priority area, which includes the construction of and investment in renewable energy technologies like solar (RSA, 2011b). In this regard it will also assist creating employment opportunities over the medium- and long-term. Considering that the construction of and investment in renewable energy is a key area identified within the framework, the Thakadu Solar Power Plant is considered to be in-line with the framework.
Strategic Environmental Assessment (SEA) for wind and solar PV Energy in South Africa	National Department of Forestry, Fisheries and the Environment (DFFE)	2014	The then Department of Environmental Affairs (DEA) has committed to contribute to the implementation of the National Development Plan and National Infrastructure Plan by undertaking Strategic Environmental Assessments (SEAs) to identify adaptive processes that integrate the regulatory environmental requirements for Strategic Integrated Projects (SIPs) while safeguarding the environment. The wind and solar photovoltaic (PV) SEA was accordingly commissioned by DEA in support of SIP 8, which aims to facilitate the implementation of sustainable green energy initiatives. This SEA identifies areas where large scale wind and solar PV energy facilities can be developed in terms of SIP 8 and in a manner that limits significant negative impacts on the environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs). The REDZs also provide priority areas for investment into the electricity grid. Currently one of the greatest challenges to renewable energy development in South Africa is the saturation of existing grid infrastructure and the difficulties in expanding the grid. Proactive investment in grid infrastructure is the likely to be the most important factor determining the success of REDZs. Although it is intended for the SEA to facilitate proactive grid investment in REDZs, such investment should not be limited to these areas. Suitable wind and solar PV development should still be promoted across the country and any proposed development must be evaluated on its own merit. The proposed site falls within the Klerksdorp REDZ (refer to Figure 8).

Free State Provincial Spatial Development Framework (PSDF)	Free State Provincial Government	2012	The Free State PSDF is a policy document that promotes a 'developmental state' in accordance with national and provincial legislation and directives. It aligns with the Free State Provincial Growth and Development Strategy which has committed the Free State to 'building a prosperous, sustainable and growing provincial economy which reduces poverty and improves social development'. The PSDF includes comprehensive plans and strategies that collectively indicate which type of land-use should be promoted in the Province, where such land-use should take place, and how it should be implemented and managed. In broad terms, the PSDF: • Indicates the spatial implications of the core development objectives of the Free State Provincial Growth and Development Strategy. • Serves as a spatial plan that facilitates local economic development. • Lays down strategies, proposals and guidelines as it relates to sustainable development. • Facilitates cross-boundary co-operation between municipalities, adjoining provinces, and bordering countries. • Serves as a manual for integration and standardisation of the planning frameworks of all spheres of government in the Province. The Free State Provincial Growth and Development Strategy states that sustainable economic development is the only effective means by which the most significant challenge of the Free State, namely poverty, can be addressed is. The PSDF gives practical effect to sustainable development, which is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. The PSDF is prepared in accordance with bioregional planning principles that were adapted to suit the site-specific requirements of the Free State. It incorporates and complies with the relevant protocols, conventions, agreements, legislation and policy at all applicable levels of planning, ranging from international to the local level.

			The PSDF builds upon achievements and learns from mistakes of the past, reacts to the challenges, incorporates the traditional knowledge of the people of the Free State, and builds upon international best-practice and technology. The development of the Thakadu Solar Power Plant is in-line with the framework based on the contributions and opportunities presented by a development of this nature.
Fezile Dabi District Municipality Final Draft Integrated Development Plan (IDP)	Fezile Dabi District Municipality	2020 - 2021	The long-term vision of the Fezile Dabi DM is: "Improving the lives of citizens and progressively meeting their basic, social and economic needs, thereby restoring community confidence and trust in government". The above stated vision defines what Fezile Dabi District Municipality would like to attain over medium to long-term, and for that achievement to effectively materialise, their mission is that: "Fezile Dabi District Municipality will strive to be a more responsive and accountable municipality towards sustainable development". Of the eighteen (18) SIPs that are contained in the National Infrastructure Plan (NIP), there are eight which impact on the Fezile Dabi District and therefore need to be recognised and where appropriate; the municipality's plans will be aligned with these SIPs in an effort to respond to national government's service delivery initiatives. Furthermore, work is to be done to align key cross-cutting areas, namely human settlement planning and skills development in line with each of the Strategic Infrastructure Projects, especially: • Green Energy in support of the South African economy (SIP 8): Supporting sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP 2010). • Electricity Generation to support socio-economic development (SIP 9): acceleration of the construction of new electricity generation capacity in accordance with the IRP 2010 to meet the needs of the economy; and addressing historical imbalances. Considering the plans for the alignment of the DM's plans with SIP 8 and SIP 9 it is confirmed that the Thakadu Solar Power Plant is in line with the plan.

Moqhaka Local Municipality Draft Integrated Development Plan (IDP)	Moqhaka Local Municipality	2020-2021	The vision of the Moqhaka LM is to "…strive to *be a Municipality that creates an enabling environment for socio-economic growth and sustainable development."* The Mission Statement is *"To maintain and enhance quality of life by providing effective, efficient quality and affordable services equitably and facilitating sustainable socio-economic growth through active community participation."* The vision and mission of the municipality have led to the conceptualisation of the following strategic objectives below: • Broaden access and improve quality of municipal services. • Create an environment that promotes the development of the local economy an facilitates job creation. • Build united, non-racial, integrated and safer communities. • Promote a culture of participatory and good governance. • Improved organisational cohesion and effectiveness. • Improve overall financial management by developing and implementing appropriate financial managements policies, procedures, and systems. The development of the Thakadu Solar Power Plant will contribute to the local economy of the area and therefore assist (albeit to a limited extent) with socio-economic growth and therefore contribute to the strategic objectives of the LM.

3.4 OTHER LEGISLATION

Other legislation mainly refers to the following:

- Planning legislation governing the rezoning process and approval of the layout plan.
- Design standards and legislation for services provision such as water, sewerage, electricity, etc.
- Municipal bylaws related to building plans, building regulations, etc.

3.5 RELEVANT GUIDANCE

The following guidance was considered in conducting the BA:

- The Equator principles III (2013)[3]
- World Bank Group Environmental, Health and Safety General Guidelines (EHS Guidelines) (2007)
- Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution (2007)
- International Finance Corporation's Policy on Environmental and Social Sustainability (2012)
- DEA. (2013). Draft National Renewable Energy Guideline. Department of Environmental Affairs, Pretoria, South Africa
- DEA, (2012), Guideline 5 – Final companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010
- DEA, (2012), Guideline 7 – Public participation in the Environmental Impact Assessment process
- DEA, (2012), Guideline 9 – Need and desirability
- DEAT, (2006), Guideline 3 – General guide to the Environmental Impact Assessment Regulations
- DEAT, (2006), Guideline 4 – Public participation in support of the Environmental Impact Assessment Regulations
- DEAT, (2006), Guideline 5 – Assessment of alternatives and impacts in support of the Environmental Impact Assessment Regulations

[3] Although this report is not written in terms of the Equator Principles (EPs), it fully acknowledges that the EPs will need to be complied with should funding for the project be required.

- BirdLife, (2017). Best Practise Guidelines Birds & Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on bird in southern Africa.

3.6 CONCLUSION

The Basic Assessment was undertaken in accordance with the EIA Regulations (2017) published in GNR 326, in terms of Section 24(5) and 44 of the NEMA as amended as well as all relevant National legislation, policy documents, national guidelines, the World Bank EHS Guidelines, the IFC Performance Standards, and the Equator Principles.

The legislative and policy context plays an important role in identifying and assessing the potential social impacts associated with the proposed development. For this reason, the proposed development project will be assessed and has been considered in terms of its fit with the key legislative, policy and planning documents discussed above.

The main findings of the review of the policy documents on all spheres of Government indicated that strong support was given towards renewable energy, specifically PV solar energy and therefore it is concluded that there is support for the development of the Thakadu Solar Power Plant. The White Paper on the Energy Policy of the Republic of South Africa of 1998 stated that due to the fact that renewable energy resources operate from an unlimited resource base, i.e. the sun, renewable energy can increasingly contribute towards a long-term sustainable energy supply for future generations. This policy further highlights that due to the unlimited resources base of renewable energy in South Africa, renewable energy applications like PV solar energy and associated infrastructure are more sustainable in terms of social and environmental costs. The Integrated Resource Planning for Electricity for South Africa of 2010–2030, the National Infrastructure Plan of South Africa and the New Growth Path Framework all support the development of the renewable energy sector. In particular, the IRP also indicated that 43% of the energy generations in South Africa is allocated to renewable energy applications. On a District and Local level limited attention is given explicitly to renewable sources like PV solar energy, however the documents reviewed do make provision for increase energy supply and efficiency in improving the quality of lives in terms of efficient physical infrastructure as well as socio-economic growth. At Provincial, District and Local level the policy documents indirectly support the applications of renewables as it will contribute to surety of electricity supply and improving the lives of the community.

The review of the relevant policies and documents related to the energy sector therefore indicate that renewables, like solar energy and the establishment of solar energy facilities and associated infrastructure, are supported on all spheres of Government. The proposed Thakadu Solar Power Plant is therefore supported by the related policy and planning documents reviewed in this section of the report.

4 THE NEED AND DESIRABILITY

This section aims to address the following requirements of the regulations:

Appendix 1. (3) An BAR (...) must include-

(f) a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;

4.1 THE NEED FOR THE PROPOSED ACTIVITY

The proposed activity is a direct result of the growing demand for electricity and the need for renewable energy in South Africa. According to Eskom, the demand for electricity in South Africa has been growing at approximately 3% per annum. This growing demand, fuelled by increasing economic growth and social development, is placing increasing pressure on South Africa's existing power generation capacity. Coupled with this, is the growing awareness of environmentally responsible development, the impacts of climate change and the need for sustainable development.

Over 90% of South Africa's electricity generation is coal based, the Word bank estimates that these results in an annual, per capita carbon emission of ~8.9 tons per person. Based on 2008 fossil-fuel CO_2 emissions statistics released by the Carbon Dioxide Information Analysis Centre, South Africa is the 13th largest carbon dioxide emitting country in the world and the largest emitter in Africa (Boden, et al. 2011). In August 2021 article confirmed that South Africa is the 12th highest greenhouse gas emitter in the world (source: https://www.news24.com/fin24/economy/eskom-will-only-able-to-meet-global-air-quality-standards-by-2050-owing-to-financial-woes-20210818).

The proposed project is intended to form part of the Department of Mineral Resources and Energy's (DMREs) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme. The REIPPP Programme aims to secure 14 725 Megawatts (MW) of new generation capacity from renewable energy sources, while simultaneously diversifying South Africa's electricity mix. According to the 2021 State of the Nation Address, Government will soon be initiating the procurement of an additional 11 800 MW of power from renewable energy, natural gas, battery storage and coal in line with the Integrated Resource Plan 2019 and fulfilling their commitments under the United Nations Framework Convention on Climate Change and its Paris Agreement which include the reduction of greenhouse gas emissions. Eskom, the largest greenhouse gas emitter of South Africa, has committed in principle to net zero emission by 2050 and to increase its renewable capacity.

Besides capacity additions, several assumptions have changed since the promulgation of IRP 2010–2030. Key assumptions that changed include the electricity demand projection, Eskom's existing plant performance, as well as new technology costs. These changes necessitated the review and update of the IRP which resulted in the draft IRP 2018 as per table 4.1 below:

Table 4.1: Published Draft IRP 2018 (Approved by Cabinet for Consultation)

	Coal	Nuclear	Hydro	Storage (Pumped Storage)	PV	Wind	CSP	Gas / Diesel	Other (CoGen, Biomass, Landfill)	Embedded Generation
2018	39 126	1 860	2 196	2 912	1 474	1 980	300	3 830	499	Unknown
2019	2 155					244	300			200
2020	1 433				114	300				200
2021	1 433				300	818				200
2022	711				400					200
2023	500									200
2024	500									200
2025					670	200				200
2026					1 000	1 500		2 250		200
2027					1 000	1 600		1 200		200
2028					1 000	1 600		1 800		200
2029					1 000	1 600		2 850		200
2030			2 500		1 000	1 600				200
TOTAL INSTALLED	33 847	1 860	4 696	2 912	7 958	11 442	600	11 930	499	2600
Installed Capacity Mix (%)	44.6	2.5	6.2	3.8	10.5	15.1	0.9	15.7	0.7	

Installed Capacity
Committed / Already Contracted Capacity
New Additional Capacity (IRP Update)

According to the South African Energy Sector Overview (2021), there is currently 1 723MW of installed PV capacity, while an additional 2 600MW from wind and solar has been rewarded as part of Bid Window 5.

4.2 THE DESIRABILITY OF THE PROPOSED ACTIVITY

The facility's contribution towards sustainable development and the associated benefits to society in general is discussed below:

- Lesser dependence on fossil fuel generated power - The deployment of the facility will have a positive macro-economic impact by reducing South Africa's dependence on fossil fuel generated power and assisting the country in meeting its growing electricity demand.
- Increased surety of supply - By diversifying the sources of power in the country, the surety of supply will increase. The power demands of South Africa are ever increasing and by adding solar power this demand can be met, even exceeded without increasing pollution in relation to the use of fossil fuels. The project has the potential of "securing" economic activity by assisting in removing supply constraints if Eskom generation activities result in a supply shortfall. When supply is constrained, it represents a limitation to economic growth. When a supply reserve is available, it represents an opportunity for economic growth.
- Local economic growth - The proposed project will contribute to local economic growth by supporting industry development in line with provincial and regional goals and ensuring advanced skills are drawn to the Free State Province. The project will

likely encounter widespread support from government, civil society and businesses, all of whom see potential opportunities for revenues, employment and business opportunities locally. The development of the photovoltaic solar facility will in turn lead to growth in tax revenues for local municipalities and sales of carbon credits, resulting in increased foreign direct investment.

- Lower costs of alternative energy - An increase in the number of solar facilities commissioned will eventually reduce the cost of the power generated through solar facilities. This will contribute to the country's objective of utilising more renewable energy and less fossil fuel-based power sources. It will assist in achieving the goal to generate 14 725 MW of electricity from renewable energy as per the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme of the Department of Mineral Resources and Energy. The Government will soon be initiating the procurement of an additional 11 800 MW of renewable energy as stated during the 2021 State of the Nation Address.
- Reduction in greenhouse gas emissions - The additional power supplied through solar energy will reduce the reliance on the combustion of fossil fuels to produce power. The South African electricity grid is predominantly coal-fired and therefore Greenhouse Gas (GHG) emissions intensive (coal accounts for more than 92% of the fuel used in South Africa's electricity generation). The reduction of GHG emissions as a result of the project implementation will be achieved due to reduction of CO_2 emissions from combustion of fossil fuel at the existing grid-connected power plants and plants which would likely be built in the absence of the project activity.
- CDM Project - A solar energy facility also qualifies as a Clean Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies).
- Climate change mitigation - On a global scale, the project makes a contribution to greenhouse gas emission reduction and therefore contributes toward climate change mitigation.
- Reduced environmental impacts - The reduction in electricity consumed from the grid will not only result in a reduction in greenhouse gas emissions, but also the prevention of negative impacts associated with coal mining. For example, coal power requires high volumes of water, in areas of South Africa where water supply is already over-stretched and water availability is highly variable. Photovoltaic solar energy technology also does not produce the sulphur emissions, ash or coal mining concerns associated with conventional coal fired electricity generation technologies resulting in a relatively low level of environmental impacts. It is a clean technology which contributes toward a better-quality environment for employees and nearby communities.
- Social benefits - The project activity is likely to have significant long-term, indirect positive social impacts that may extend to a regional and even national scale. The larger scale impacts are to be derived in the utilization of solar power and the experience gained through the construction and operation of the power plant. In future, this experience can be employed at other similar solar installations in South Africa.

- Provision of job opportunities - The main benefit of the proposed development operating in the area is that local companies or contractors will be hired for the duration of the construction period. The operational phase will provide permanent job opportunities to the local communities from the surrounding area since security guards and general labourers will be required on a full-time basis. Approximately 885 employment opportunities will be created during the construction and 15 - 70 operational phases.
- Indirect socio-economic benefits - The increase in the demand for services such as accommodation, transportation, security, general maintenance and catering will generate additional indirect socio-economic benefits for the local community members.
- Effective use of resources - Because of predominantly the climate and soil limitations, the site has limited suitability for cultivated crops, and viable agricultural land use is limited to grazing only. The site assessment has found that the soils across most of the site are unsuitable, or at best very marginal, for the production of cultivated crops, and are therefore only suited to grazing. Limitations within the site includes numerous surface rock outcrops and soils that are shallow on underlying rock. The proposed development in this specific area will generate alternative land use income through rental for the energy facility, which will have a positive impact on agriculture. It will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve the financial sustainability of agricultural activities by the landowner.
- Location of the activity within a REDZ - The Renewable Energy Development Zones (REDZ) have a key role to play in the South Africa's just energy transition. The REDZ create priority areas for investment in the electricity grid. Since the site is located within a REDZ it contributes to the desirability of the project.
- Cumulative impacts of low to medium significance – No cumulative impacts with a high residual risk have been identified. In terms of the desirability of the development of sources of renewable energy therefore, it may be preferable to incur a higher cumulative loss in such a region as this one, than to lose land with a higher environmental value elsewhere in the country.

5 DESCRIPTION OF ENVIRONMENTAL ISSUES

This section aims to address the following requirements of the regulations:

Appendix 1. (3) A BAR (...) must include-

(g) A motivation for the preferred site, activity and technology alternative;

(h) a full description of the process followed to reach the proposed preferred alternative, within the site, including –

(i) details of all the alternatives considered;

(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;

(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;

(iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;

(viii) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives;

(x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and

(xi) a concluding statement indicating the preferred alternative development location within the approved site.

5.1 CONSIDERATION OF ALTERNATIVES

The DFFE 2006 guidelines on 'assessment of alternatives and impacts' proposes the consideration of four types of alternatives namely, the no-go, location, activity, and design alternatives. It is, however, important to note that the regulation and guidelines specifically state that only 'feasible' and 'reasonable' alternatives should be explored. It also recognizes that the consideration of alternatives is an iterative process of feedback between the developer and EAP, which in some instances culminates in a single preferred project proposal.

An initial site assessment (refer to Appendix E) was conducted by the developer on the farm Groot Vaders Bosch No. 592 and Anglo No. 593 and the project site was found to be favourable due to its proximity to grid connections, environmental conditions, relatively flat terrain, high solar radiation values and adequate site access. Some areas of the farm have been deemed less suitable for the proposed development such as areas with heritage resources and existing infrastructure such as roads. These factors were taken into consideration and avoided as far as possible. The site selection also took the site geology, land capability, water availability and land use into consideration before deciding the specific site (Subsolar, 2021).

The following sections explore different types of alternatives in relation to the proposed power line in more detail.

5.1.1 No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. The description provided in section 5.3 of this report could be considered the baseline conditions (status quo) to persist should the no-go alternative be preferred. The site is currently zoned for agricultural land uses. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for grazing for cattle (refer to the photographs of the site). However, it should be noted that the area surrounding the proposed project is already impacted by gold and dolomite mining activities, as well as agricultural activities. The site has limited agricultural potential due to soil and geological limitations (see Agriculture Compliance Statement in Appendix D4). The potential opportunity costs in terms of alternative land use income through rental for the energy facility and the supporting social and economic development in the area would be lost if the status quo persist.

5.1.2 Location alternatives

This alternative asks the question, if there is not, from an environmental perspective, a more suitable location for the project. No other properties have at this stage been secured by Thakadu Solar Power Plant (RF) (Pty) Ltd in the Orkney/ Viljoenskroon area to potentially establish the solar energy facility. From a local perspective, the farm Groot Vaders Bosch No. 592 and Anglo No. 593, is preferred due to its suitable climatic conditions, topography (i.e. in terms of gradient), environmental conditions (i.e. agricultural potential, ecological sensitivity), proximity to a feasible grid connection point (i.e. for the purpose of electricity evacuation), as well as site access (i.e. to facilitate the movement of machinery, equipment, infrastructure and people during the construction phase).

The proposed development falls within an area used for grazing and the site is considered to have limited environmental sensitivity as a result. No alternative areas on the Farm Groot Vaders Bosch No. 592 and Anglo No. 593 have been considered. Therefore, there is a single preferred location alternative that will be assessed – refer to Figure 5.1 below.

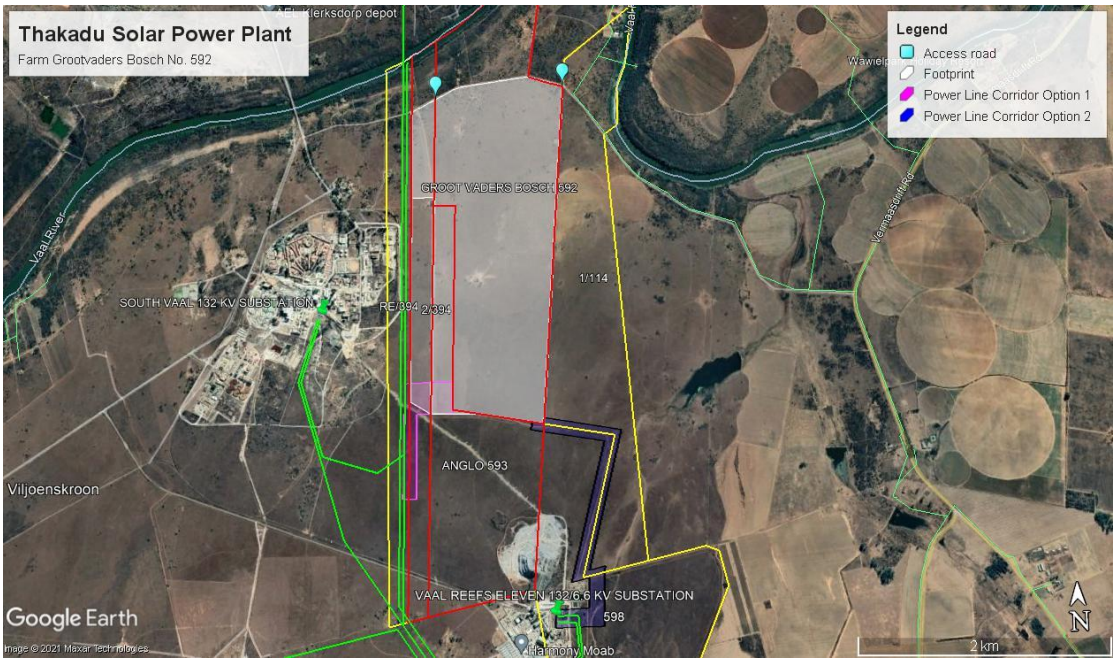


Figure 5.1: Location of the preferred alternative for the Thakadu Solar Power Plant on the farm Groot Vaders Bosch No. 592 and Anglo No. 593.

5.1.3 Activity alternatives

The BA process also needs to consider if the development of a solar PV facility would be the most appropriate land use for the particular site.

- **Photovoltaic (PV) solar facility** – Thakadu Solar Power Plant (RF) (Pty) Ltd is part of a portfolio of solar PV projects throughout South Africa. Thakadu Solar Power Plant (RF) (Pty) Ltd is of the opinion that solar PV technology is perfectly suited to the site, given the high irradiation values for the Orkney / Viljoenskroon area – refer to Figure 5.2. The technology furthermore entails low visual impacts, have relatively low water requirements, is a simple and reliable type of technology and all the components can be recycled.

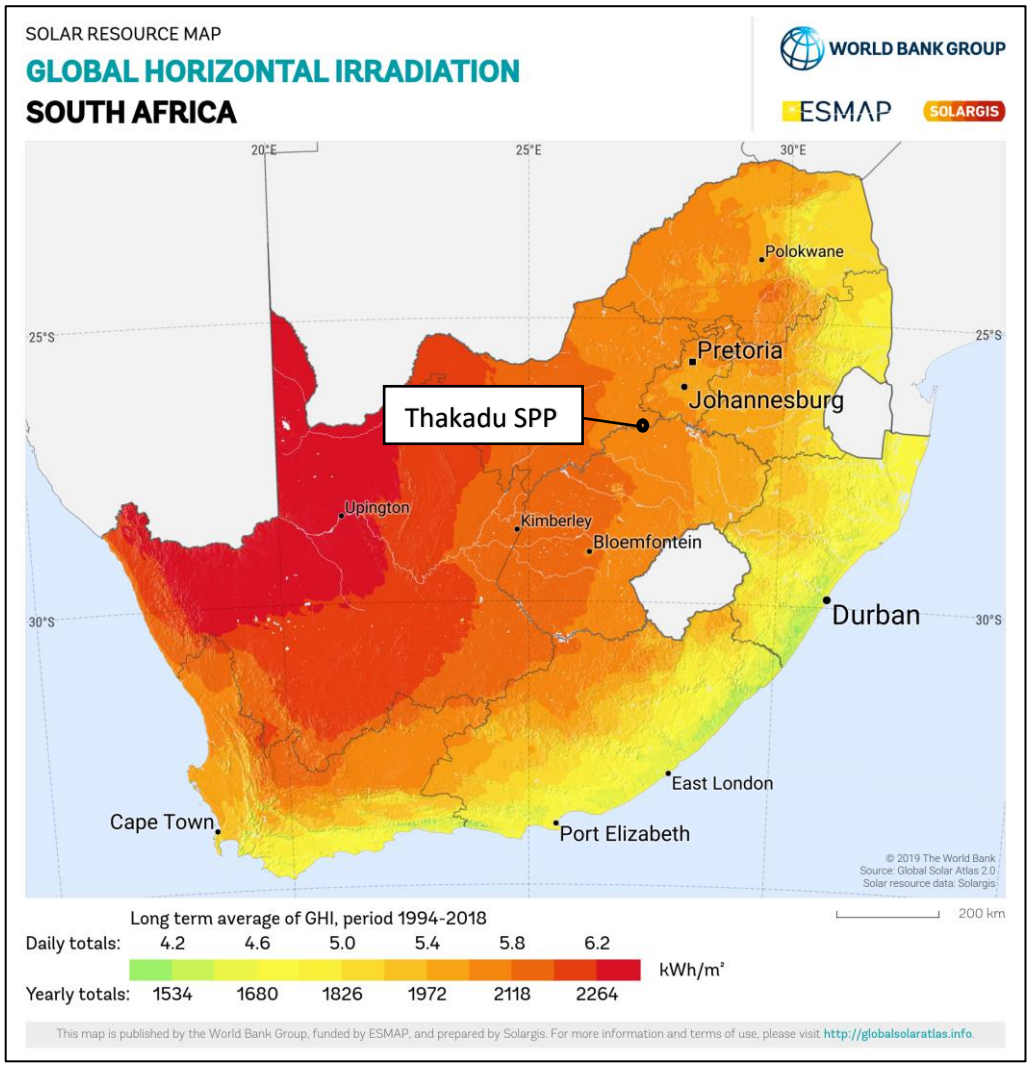


Figure 5.2: Global horizontal irradiation values for South Africa (SolarGIS, 2021) and the location of the Thakadu Solar Power Plant

- **Wind energy facility** - Due to the local climatic conditions a wind energy facility is not considered suitable as the area does not have the required wind resource. Furthermore, the applicant has opted for the generation of electricity via solar power rather than the use of wind turbines. This alternative is therefore regarded as not feasible and will not be evaluated further in this report.

- **Concentrated solar power (CSP) technology** - CSP technology requires large volumes of water and this is a major constraint for this type of technology. While the irradiation values are high enough to generate sufficient solar power, the water constraints render this alternative not feasible. Therefore, this alternative will not be considered further in this report.

5.1.4 Technical alternatives

Possible technical alternatives for the development of a solar PV facility needs to be considered during the BA process.

5.1.4.1 Distribution lines

It is expected that the facility will tie in with the Vaal Reefs Eleven 132/6.6 kV Substation or either the existing Mercury-South Vaal 2 132kV Power Line or the South Vaal-Carrdell 132kV.

Two grid connection corridors, each with a width of between 100-150m and up to 250m, have been identified for the assessment and placement of the power line (i.e., the power line will be developed within one of the two proposed corridors). Option 1 is located to the south-west of the SPP site and will connect into either the existing Mercury-South Vaal 2 132kV (maximum length 1,22km) or the South Vaal-Carrdell 132kV (maximum length 0,86km). The other option (option 2) is located to the south-east of the SPP site and will connect into the existing Vaal Reefs Eleven Substation. The length of this option is ~2.7km. This is the preferred alternative from a development point of view due to the fact that the Vaal Reefs 11 Substation has capacity to accommodate the project. (refer to Figure 5.3).

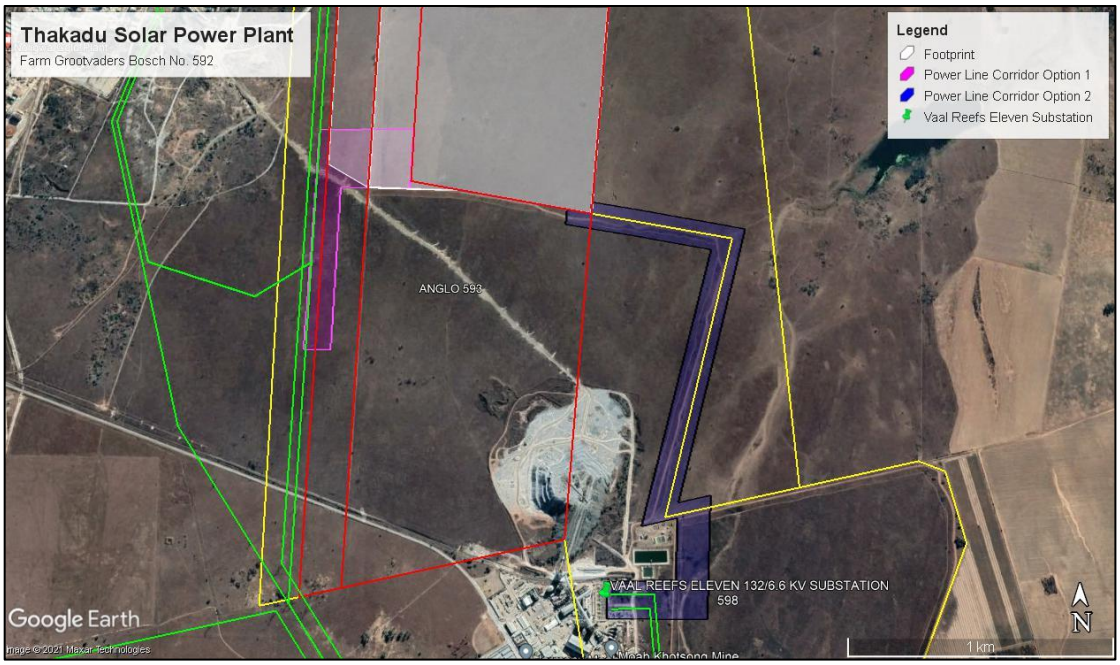


Figure 5.5.3: Proposed 100m to 250m wide power line corridor connecting the Thakadu Solar Power Plant to the grid.

A 132kV overhead distribution line is the only preferred alternative for the applicant due to the following reasons:

- **Overhead Distribution Lines** - Overhead lines are less costly to construct than underground lines. Therefore, the preference for the development of overhead lines is mainly based on the grounds of cost. Overhead lines allow high voltage operations, and the surrounding air provides the necessary electrical insulation to earth. Further, the surrounding air cools the conductors that produce heat due to lost energy (Swingler et al, 2006).

  The overall weather conditions in the Free State Province are unlikely to cause damage and faults on the proposed overhead transmission power line. Nonetheless, if a fault

occurs, it can be found quickly by visual means using a manual line patrol. Repair to overhead lines is relatively simple in most cases the line can usually be put back into service within a few days. In terms of potential impacts caused by overhead transmission lines include visual intrusion and threats to sensitive habitat (where applicable).

Furthermore, overhead power lines also provides an opportunity for the avoidance of sensitive environmental features as the overhead lines can span on-ground environmental features to ensure conservation, therefore providing more flexibility in terms of mitigation of the associated on-ground disturbance.

The choice of structure to be used for the power line will be determined in consultation with Eskom once the Engineers have assessed the geotechnical and topographical conditions and decided on a suitable structure which meets the prescribed technical requirements. The choice of structures to be used will not have any adverse impacts on the environment. The line will be constructed according to the authorised standards for a power line approved by Eskom Holdings SoC Ltd.

The following alternatives may be considered for the overhead power line:

- Single Circuit Overhead Power Line

  The use of single circuit overhead power lines to distribute electricity is considered the most appropriate technology and has been designed over many years for the existing environmental conditions and terrain as specified in the Eskom Specifications and best international practice. Based on all current technologies available, single circuit overhead power lines are considered the most environmentally practicable technology available for the distribution of power. This option is considered appropriate for the following reasons:

  - More cost-effective installation costs;
  - Less environmental damage during installation; and
  - More effective and cheaper maintenance costs over the lifetime of the power line.

- Double Circuit Overhead Power Line

  Where sensitive environmental features are identified, and there is sufficient justification, Eskom will consider the use of double circuit (placing 2 power lines on either side of the same tower structure) to minimise impacts. However, the use of double-circuiting has a number of technical disadvantages:

  - Faults or problems on one power line may mean that the other power line is also disabled during maintenance, and this will affect the quality of supply to an area. Larger and taller towers as well as more towers are required for double-circuit power lines.

The double-circuit overhead power line proves more feasible since the single circuit may not have the capacity to transmit the large amount of electricity generated from the plant and during maintenance the entire plant would not have to be offline as one of the double circuit lines would still be able to supply electricity. However, due to the rapid requirement changes, this will only be determined before construction.

- **Underground Distribution Lines** - Underground cables have generally been used where it is impossible to use overhead lines for example because of space constraints. Underground cables are oil cooled and are also at risk of groundwater contamination. Maintenance is also difficult on underground lines compared to overhead lines. When a fault occurs in an underground cable circuit, it is almost exclusively a permanent fault due to poor visibility. Underground lines are also more expensive to construct than overhead lines.

5.1.4.2 Battery Energy Storage Facility (BESS)

It is proposed that a nominal up to 500 MWh Battery Energy Storage Facility for grid storage would be housed in stacked containers, or multi-storey building, with a maximum height of 8m and a maximum volume of 1,740m^3 of batteries and associated operational, safety and control infrastructure. Three types of battery technologies are being considered for the proposed project: Lithium-ion, Sodium-sulphur or Vanadium Redox flow battery. While there are various battery storage technologies available, the preferred alternative is the utility-scale Lithium-ion (Li-ion) battery energy storage. Li-ion batteries have emerged as the leading technology in utility-scale energy storage applications because it offers the best mix of performance specifications, such as high charge and discharge efficiency, low self-discharge, high energy density, and long cycle life (Divya KC et al., 2009).

Battery storage offers a wide range of advantages to South Africa including renewable energy time shift, renewable capacity firming, electricity supply reliability and quality improvement, voltage regulation, electricity reserve capacity improvement, transmission congestion relief, load following and time of use energy cost management. In essence, this technology allows renewable energy to enter the base load and peak power generation market and therefore can compete directly with fossil fuel sources of power generation and offer a truly sustainable electricity supply option.

5.1.5 Design and layout alternatives

Design alternatives were considered throughout the planning and design phase (i.e. what would be the best design option for the development?). In this regard discussions on the design were held between the EAP and the developer. The layout plan is included in Appendix H.

The layout follows the limitations of the site and aspects such as environmental sensitive areas (supported by specialist input), roads, fencing and servitudes are considered. The total surface area proposed for layout options include the PV panel arrays spaced to avoid shadowing, access and maintenance roads and associated infrastructure (buildings, power inverters, power lines and substations, BESS and perimeter fences). With regards to the structure orientation, the panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is located in order to capture the most sun.

The choice of pylon structure to be used for the power line will be determined in consultation with Eskom. The choice of pylon structure does not significantly affect the environmental impacts of the proposed development as provision has already been made for the visual,

ecological, avifaunal and paleontological impacts of erecting a power line. No defined structure has been confirmed at this stage and will depend on Eskom's technical requirements. The 132kV power line must be constructed according to the authorised standards for a power line approved by Eskom Holdings SoC Ltd. The structure to be utilised for the power line towers will also be informed by the local geotechnical and topographical conditions. The following alternatives are considered with regards to the proposed structures:

Steel lattice towers:

The steel lattice towers provide the following advantages over the other tower types available:

- Enables multipath earthing which enhances the overall electrical performance of the power line.
- Is visually less obtrusive than the mono-pole options.
- Is more practicable that other options i.e. more cost effective and more practical to construct and maintain.
- Is safer to work on than the monopole and wood pole structures.
- Is more durable than the wood pole structures.

Steel monopoles:

The steel monopole is considered less suitable than the steel lattice towers for the following reasons:

- Is visually more intrusive than the lattice towers.
- Is more expensive than the lattice towers.
- Requires more steel than the lattice towers.
- Is more difficult to erect.
- Is not as safe to work on as the lattice towers.

Wood poles:

Wood pole structures are only used in extreme circumstances where a visual impact needs to be avoided. Wood pole structures may be cheaper to produce and to construct, but they have one tenth of the lifespan of the metal counterparts and are far more susceptible to weather conditions which makes them less efficient and practicable. The wood pole structure is also more susceptible to having the cross arms burnt off by electrical faults as well as being susceptible to deformation with height.

5.1.6 Technology alternatives

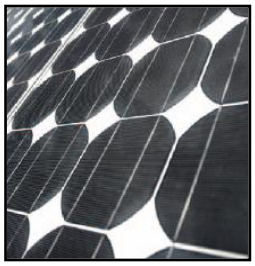
Technology alternatives for the development of a solar PV facility needs to be considered during the BA process.

5.1.6.1 Photovoltaic solar panels

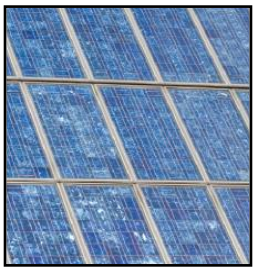
There are several types of semiconductor technologies currently available and in use for PV solar panels. Two, however, have become the most widely adopted, namely crystalline silicon, thin film or bifacial PV panels. These technologies are discussed in more detail below:

- **Crystalline (high efficiency technology at higher cost)**

  Crystalline silicon panels are constructed by first putting a single slice of silicon through a series of processing steps, creating one solar cell. These cells are then assembled together in multiples to make a solar panel. Crystalline silicon, also called wafer silicon, is the oldest and the most widely used material in commercial solar panels. Crystalline silicon modules represent 85-90% of the global annual market today. There are two main types of crystalline silicon panels that can be considered for the solar facility:



- ***Mono-crystalline Silicon*** - mono-crystalline (also called single crystal) panels use solar cells that are cut from a piece of silicon grown from a single, uniform crystal. Mono-crystalline panels are among the most efficient yet most expensive on the market. They require the highest purity silicon and have the most involved manufacturing process.



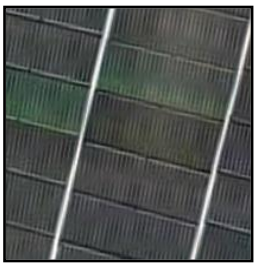
- ***Poly-crystalline Silicon*** – poly-crystalline panels use solar cells that are cut from multifaceted silicon crystals. They are less uniform in appearance than mono-crystalline cells, resembling pieces of shattered glass. These are the most common solar panels on the market, being less expensive than mono-crystalline silicon. They are also less efficient, though the performance gap has begun to close in recent years (First Solar, 2011).

- **Thin film (low-cost technology with lower efficiency)**

  Thin film solar panels are made by placing thin layers of semiconductor material onto various surfaces, usually on glass. The term *thin film* refers to the amount of semiconductor material used. It is applied in a thin film to a surface structure, such as a sheet of glass. Contrary to popular belief, most thin film panels are not flexible. Overall, thin film solar panels offer the lowest manufacturing costs, and are becoming more prevalent in the industry. Thin films currently account for 10-15% of global PV module sales. There are three main types of thin film used:

- ***Cadmium Telluride (CdTe)*** - CdTe is a semiconductor compound formed from cadmium and tellurium. CdTe solar panels are manufactured on glass. They are the most common type of thin film solar panel on the market and the most cost-effective to manufacture. CdTe panels perform significantly better in high temperatures and in low-light conditions.

- ***Amorphous Silicon*** - Amorphous silicon is the non-crystalline form of silicon and was the first thin film material to yield a commercial product, first used in consumer items such as calculators. It can be deposited in thin layers onto a variety of surfaces and offers lower costs than traditional crystalline silicon, though it is less efficient at converting sunlight into electricity.



- Copper, Indium, Gallium, Selenide (CIGS) - CIGS is a compound semiconductor that can be deposited onto many different materials. CIGS has only recently become available for small commercial applications and is considered a developing PV technology (First Solar, 2011).

- **Bifacial panels:**

  As the name suggests, bifacial solar panels have two faces, or rather, they can absorb light from both sides of the panel. A lot of potential energy transfer is lost in traditional solar cells when the light hits the back of a solar panel. Most bifacial solar panels use monocrystalline cells, whereas traditional cells use polycrystalline materials. The monocrystalline materials, alongside the clear light pathway on both sides of the panel, enable the light to be absorbed from either side of the cell, and it is thought that, that the overall efficiency of these cells can be up to 30% greater in commercial applications. Although, the exact amount is variable depending on the surface that they are installed on. The front side of the solar panel still absorbs most of the solar light, but the back side of the solar panel can absorb between 5-90% of the light absorbed by the front of the solar panel.

  Traditional solar panels use an opaque back sheet. By comparison, bifacial solar panels either have a clear/reflective back sheet or have dual panes of glass. Most of these solar panels are frameless so any issues with potential-induced degradation (PID) are reduced. To efficiently convert light into electricity from both sides, bifacial solar cells have selective-area metallization schemes that enable light to pass between the metallized areas, rather than the conventional thick metal collectors as seen with monofacial solar panels.

The technology that (at this stage) proves more feasible and reasonable with respect to the proposed solar facility is crystalline silicon panels, due to it being non-reflective, more efficient, and with a higher durability. However, due to the rapid technological advances being made in the field of solar technology the exact type of technology to be used, such as bifacial panels, will only be confirmed at the onset of the project.

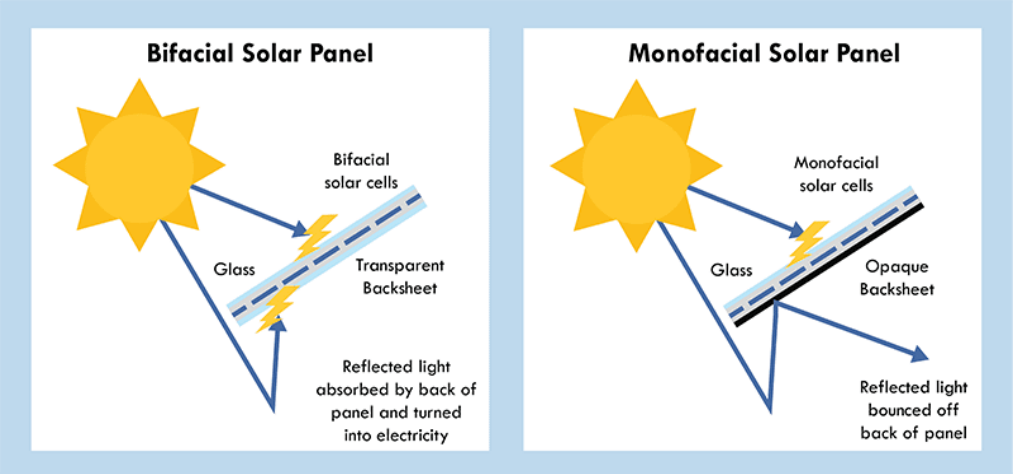


Figure 5.4: Bifacial vs Monofacial Solar Panel absorption

5.2 PUBLIC PARTICIPATION PROCESS

The following sections provide detailed information on the public participation process conducted in terms of Regulations 39 to 44.

5.2.1 General

The public participation process was conducted strictly in accordance with Regulations 39 to 44. The following three categories of variables were taken into account when deciding the required level of public participation:

- The scale of anticipated impacts
- The sensitivity of the affected environment and the degree of controversy of the project
- The characteristics of the potentially affected parties

Since the scale of anticipated impacts is low, the low environmental sensitivity of the site and the fact that no conflict was foreseen between potentially affected parties, no additional public participation mechanisms were considered at this stage of the process. The following actions have already been taken:

- <u>Newspaper advertisement</u>

  Since the proposed development is unlikely to result in any impacts that extend beyond the municipal area where it is located, it was deemed sufficient to advertise in a local newspaper. An advertisement was placed in English in the local newspaper

(Klerksdorp Rekord) on the 29 October 2021 (see Appendix C1) notifying the public of the BA process and requesting Interested and Affected Parties (I&APs) to register with, and submit their comments to Environamics Environmental Consultants. I&APs were given the opportunity to raise comments until 29 November 2021.

- Site notices

  Site notices were placed on site in English and Afrikaans on 27 October 2021 to inform surrounding communities and immediately adjacent landowners of the proposed development. I&APs were given the opportunity to raise comments by 29 November 2021. Photographic evidence of the site notices is included in Appendix C2.

- Direct notification of identified I&APs

  Identified and registered I&APs, including key stakeholders representing various sectors, were directly informed of the Basic Assessment via telephone calls, WhatsApps and emails (as appropriate). For a complete list of I&APs with their contact details see Appendix C3 to this report.

- Direct notification of surrounding landowners and occupiers

  Written notices were provided via WhatsApp or email to all surrounding landowners and occupiers – refer to Figure 5.5. The surrounding landowners were given the opportunity to raise comments within 30 days. For a list of surrounding landowners see Appendix C3.

- Circulation of Draft Basic Assessment Report

  The registered I&APs were notified of the availability of the BAR at the commencement of the 30-day review and comment period. This included the details of where the report can be accessed. They were requested to provide their comments on the report within 30 days (6 January 2022 – 4 February 2022). All issues identified, raised and recorded have been documented and compiled into a Comments and Responses Report (Appendix C6) included as part of this Final Basic Assessment Report.

- Circulation of decision and submission of appeals:

  Notice will be given to all identified and registered I&APs of the decision taken by the DFFE. The attention of all registered I&APs will also be drawn to the fact that an appeal may be lodged against the decision in terms of the National Appeals Regulations. In accordance with the provisions of Regulation 4(1) of Government Notice No. 993, an appellant must submit the appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered I&APs and any organ of state with interest in the matter within 20 days from the date that the notification of the decision was sent to the applicant by the competent authority.

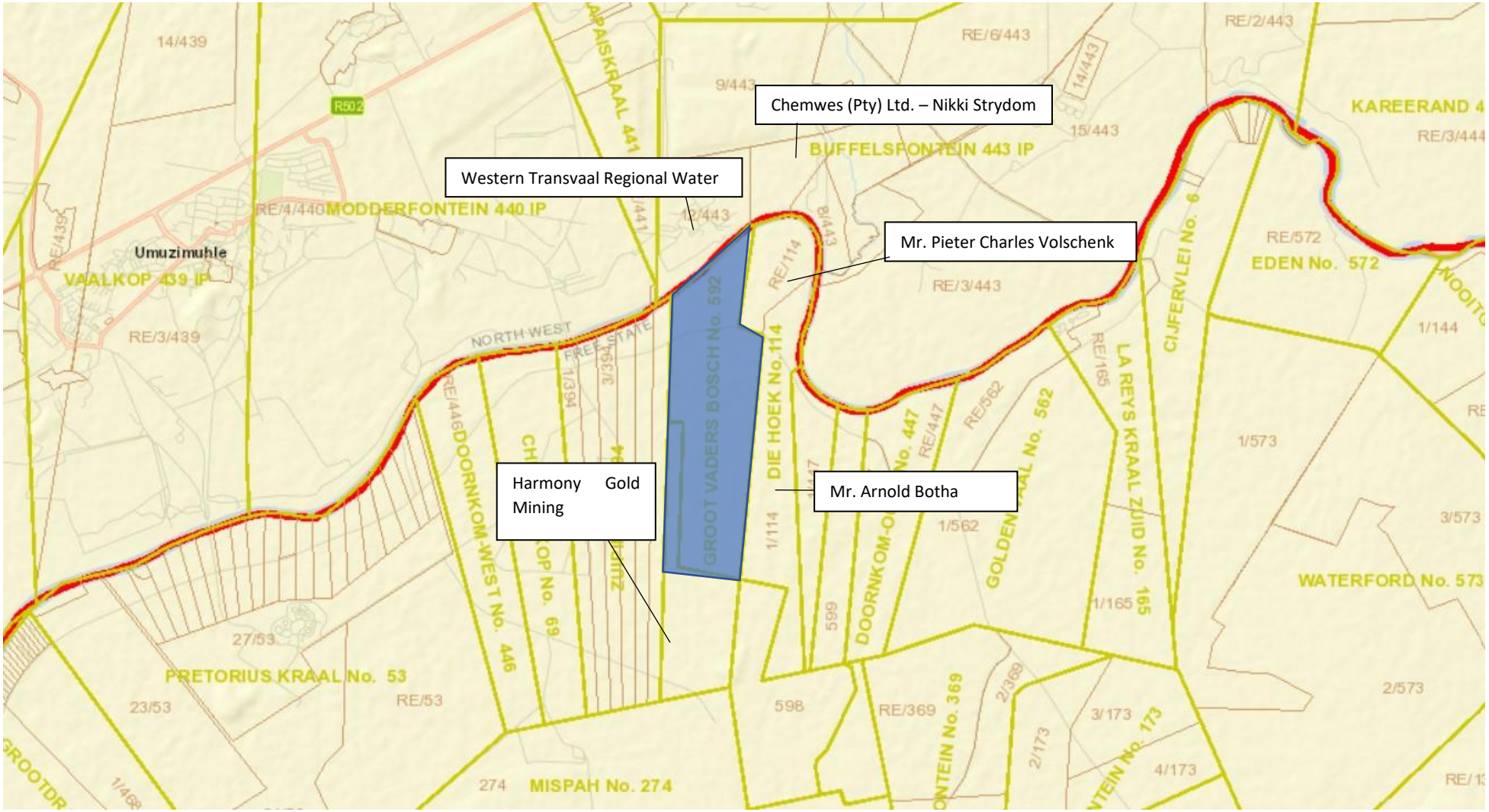


Figure 5.5: Surrounding Landowners

5.2.2 Consultation process

Regulation 41 requires that the landowner, surrounding landowners, municipality, relevant ward councillor, any organ of state having jurisdiction in respect of any aspect of the activity and any other party as required by the competent authority should be given written notice of the activity. A complete list of all the consultees who received written notice as well as proof of correspondence is attached as Appendices C.

5.2.3 Registered I&APs

I&APs include all stakeholders who deem themselves affected by the proposed activity. According to Regulation 43(1) "*A registered interested and affected party is entitled to comment, in writing, on all reports or plans submitted to such party during the public participation process contemplated in these Regulations and to bring to the attention of the proponent or applicant any issues which that party believes may be of significance to the consideration of the application, provided that the interested and affected party discloses any direct business, financial, personal or other interest which that party may have in the approval or refusal of the application*."

This report is the Draft Basic Assessment Report which has been made available to all potential and/or registered I&APs and State Departments. They have been provided with a copy of the Draft BAR and have been requested to provide written comments on the report within 30 days. All issues identified during this review period will be documented and compiled into a Comments and Response Report to be included as part of the Final BAR (Appendix C6).

All comments received prior to the release of the Draft BAR for the 30-day review and comment period have been included in this report as Appendix C6 to provide I&APs an opportunity to confirm that their comments raised during the initial public participation phase have been included and considered.

5.2.4 Issues raised by I&APs and consultation bodies

To date comments have been received from some consultation bodies and is summarised in the Comments and Response Report included in Appendix C6. Any comments received during the circulation of the Draft BAR will be summarised in the Final BAR. The full wording and original correspondence are included in Appendix C5 and Appendix C6.

5.3 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE PREFERRED ALTERNATIVE

The following sections provide general information on the biophysical and socio-economic attributed associated with the preferred alternative.

5.3.1 Biophysical environment

The biophysical environment is described with specific reference to geology, soils, agricultural potential, vegetation and landscape features, climate, biodiversity and the visual landscape. A number of specialists were consulted to assist with the compilation of this chapter of the report – refer to the Table 1.2. However, due to the fact that the area proposed for

development exclusively consists of land used for grazing, nothing of note was identified from an ecological or conservation point of view apart from the close proximity to the Vaal River.

5.3.1.1 Geology, soils and agricultural potential

According to the Agriculture Compliance Statement (attached in Appendix D4) the site is covered by a single land type, namely Fa13. This land type is dominated by shallow soils on underlying rock, mostly of the Glenrosa and Mispah soil forms. Rock outcrops cover 10% of the surface area of the land type. Although deeper soils do also occur in patches, they are interspersed with shallow soils and rock outcrops, with insufficient area between shallow soils to be viable for crop production. That the soils are unsuitable for crop production is evident in the fact that almost no cultivation occurs on the entire land type on which the site is located, but maize production does occur on land types with more suitable soils to the south. The field investigation confirmed the dominance of shallow, rocky soils across the site.

The farm is located in a grain farming agricultural region, but on soils of limited depth that are unsuitable for crop production. There is almost no cultivation on the land type on which the site is located. Maize production occurs on different, suitable soils of a different land type to the south of the site. The development site is used only for grazing of cattle. Mining occurs in the surrounding area.

A map of the proposed development overlaid on the screening tool sensitivity is given in Figure 5.6. The land capability of the site on the screening tool is predominantly 7 but varies from 6 to 9. Values of 6 to 8 translate to a medium agricultural sensitivity and values of 9 translate to a high agricultural sensitivity. There is a limited amount of land across the site that is rated with a value of 9. The small-scale differences in land capability across the project area are not very significant and are more a function of how the land capability data is generated by modelling, than actual meaningful differences in agricultural potential on the ground.

The sensitivity of the site, as identified by the screening tool, is disputed by Agriculture assessment. The motivation for disputing the sensitivity is that, while the climate and terrain is suitable for crop production, the soils are limiting. Much of the site comprises shallow soils on underlying rock and rock outcrops also occur. Although deeper soils do also occur in patches, they are interspersed with shallow soils and rock outcrops, with insufficient area between shallow soils to be viable for crop production. The soils are unsuitable for crop production and is evident in the fact that almost no cultivation occurs on the entire land type on which the site is located, but maize production does occur on land types with more suitable soils to the south. A cultivated field used to exist on the site on deeper soils between rocky areas. These soils are however limited by low clay content and consequent low water holding capacity and so are at best marginal for crop production. A land capability of 9, which should indicate suitability for viable crop production, is therefore not justified for the site, and the land capability is assessed as being a maximum of 7, because of the soil limitations. This translates to medium agricultural sensitivity.

Parts of the site are allocated high sensitivity because they are classified as cultivated land. However, the data on cultivation status on the screening tool is outdated. The lands indicated as cultivated on the screening tool have not been under cultivation for an extended period of at least 14 years, according to historical imagery on Google Earth, and therefore should no longer be classified as cultivated land or allocated high sensitivity because of it. The high

agricultural sensitivity attributed to the site by the screening tool as a result of cultivation status is therefore also disputed by the agriculture assessment.

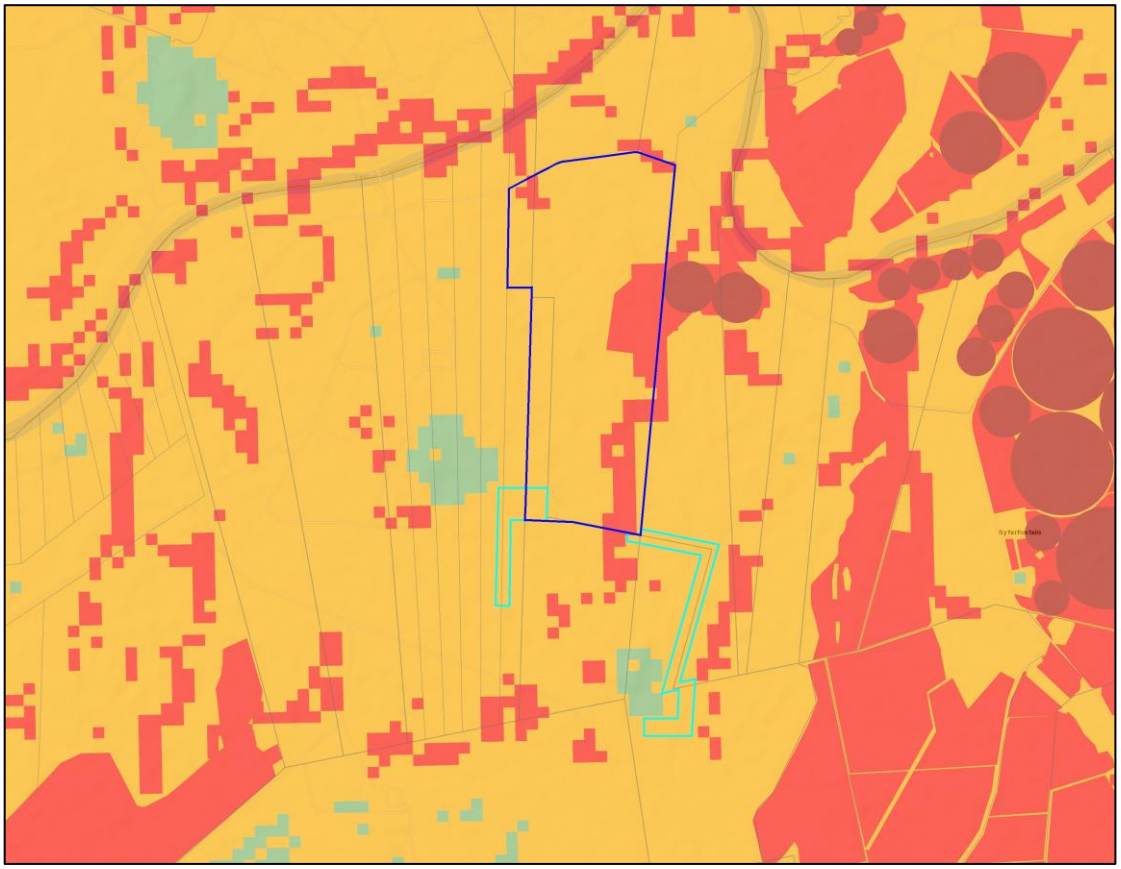


Figure 5.6: The proposed agricultural footprint of the SPP (dark blue outline), with the grid corridor (light blue outline), overlaid on agricultural sensitivity, as given by the screening tool (green = low; yellow = medium; red = high; dark red = very high).

5.3.1.2 Vegetation and landscape features

The largest part of the vegetation of the site is a classified as belonging to the vulnerable Vaal Reefs Dolomite Sinkhole Woodland vegetation type (Gh 12) while a small portion in the south belongs to the endangered Vaal-Vet Sandy Grassland vegetation type (Gh 10) (Mucina & Rutherford 2006) (see Figure F and Figure 5.7 below).

The Vaal Reefs Dolomite Sinkhole Woodland vegetation type occurs at altitudes of 1280-1380m on slightly undulating landscapes that is dissected by chert ridges and dolomite outcrops. The vegetation type occurs on dolomites from the Malmani Subgroup and sinkholes are a prominent feature of the land. The soil is mostly shallow rocky though shallow Hutton soil is also present. The vegetation is characterised by the dominance of the trees *Vachellia erioloba, Celtis africana, Senegalia caffra, Vachellia karroo*, the shrubs *Diospyros lycioides, Grewia flava, Asparagus suaveolens, Gymnosporia buxifolia*, the grasses *Digitaria eriantha, Eragrostis curvula, Anthephora pubescens, Bewsia biflora, Brachiaria nigropedata*, the shrublet *Elephantorrhiza elephantina*, and the forbs *Osteospermum muricatum, Crabbea angustifolia, Hermannia depressa, Commelina africana, Cyanotis speciosa* and *Pollichia campestris*.

Of the target of 24% only a small section is conserved at the Cradle of Humankind World Heritage Site. It is estimated that 25% of this vegetation type is already transformed due to mining, cultivation and urban sprawl.

The Vaal-Vet Sandy Grassland vegetation type occurs at altitudes ranging between 1260-1360m within the Northwest and Free State Provinces. It occurs on plains dominated areas and consist of undulating terrain. The dominance of the vegetation by the climax grass *Themeda triandra* is characteristic. Areas that are heavily overgrazed are characterised by the prominence of the grasses *Elionurus muticus* and *Cymbopogon spp*. The vegetation type is found on aeolian and colluvial sand overlying sand and mudstone. The vegetation is dominated by the grasses *Anthephora pubescens, Aristida congesta, Cymbopogon caesius, Cynodon dactylon, Digitaria argyrograpta, Elionurus muticus, Eragrostis chloromelas, Setaria sphacelata, Themeda triandra, Eragrostis trichophora, Heteropogon contortus*, and the forbs *Stachys spathulata, Barleria Macrostegia, Geigeria aspera, Monsonia burkeana, Hermannia depressa, Hibiscus pusillus Selago densiflora*. The low shrubs *Pentzia globosa* and *Ziziphus mucronata* are also prominent.

This vegetation type is regarded as being endangered with only 0.3% statutorily conserved of the target of 24%. More than 60% is already transformed due to cultivation and overgrazing.

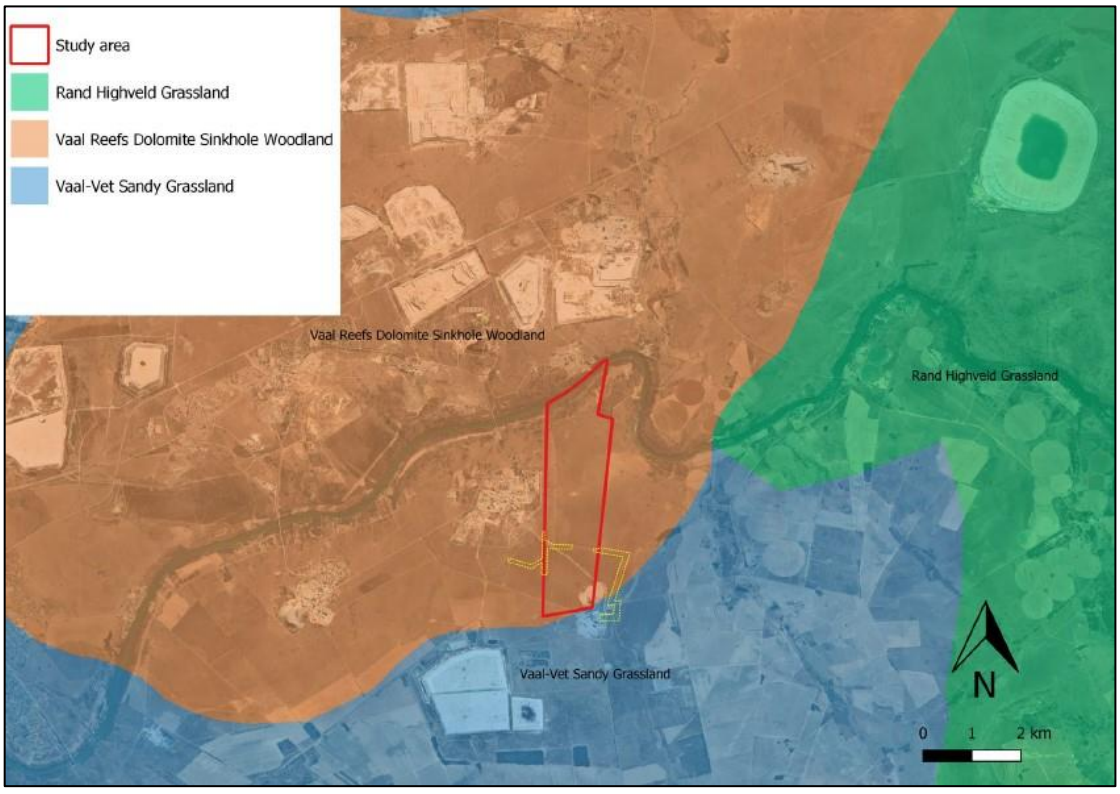


Figure 5.7: Approximate location (red lines) of the study area within the Vaal-Vet Sandy Grassland (Gh10) and the Vaal Reefs Dolomite Sinkhole Woodland (Gh 12) vegetation types (image obtained Mucina & Rutherford, 2006).

The site comprises undulating terrain with the northern section draining towards the Vaal River and the southern section towards the east. The site is surrounded by agricultural areas in the east, mining areas in the south and west and the Vaal River in the north thus little connectivity with natural areas.

Vegetation Units:

A vegetation survey was completed on the site (including the grid connection corridor). According to the Ecology and Wetland Assessment (Appendix D1) nine different vegetation units (VU) were identified (Figure 5.8), namely:

1) *Vachellia karroo* woodland
2) *Vachellia karroo* dolomite woodland
3) *Elephantorrhiza elephantina* shrubland
4) Old cultivated field
5) *Elionurus muticus-Eragrostis curvula* grassland
6) *Hyparrhenia hirta-Elephantorrhiza elephantina* grassland
7) *Tristachya leucothrix-Elephantorrhiza elephantina* grassland
8) Drainage channel
9) Riverine area

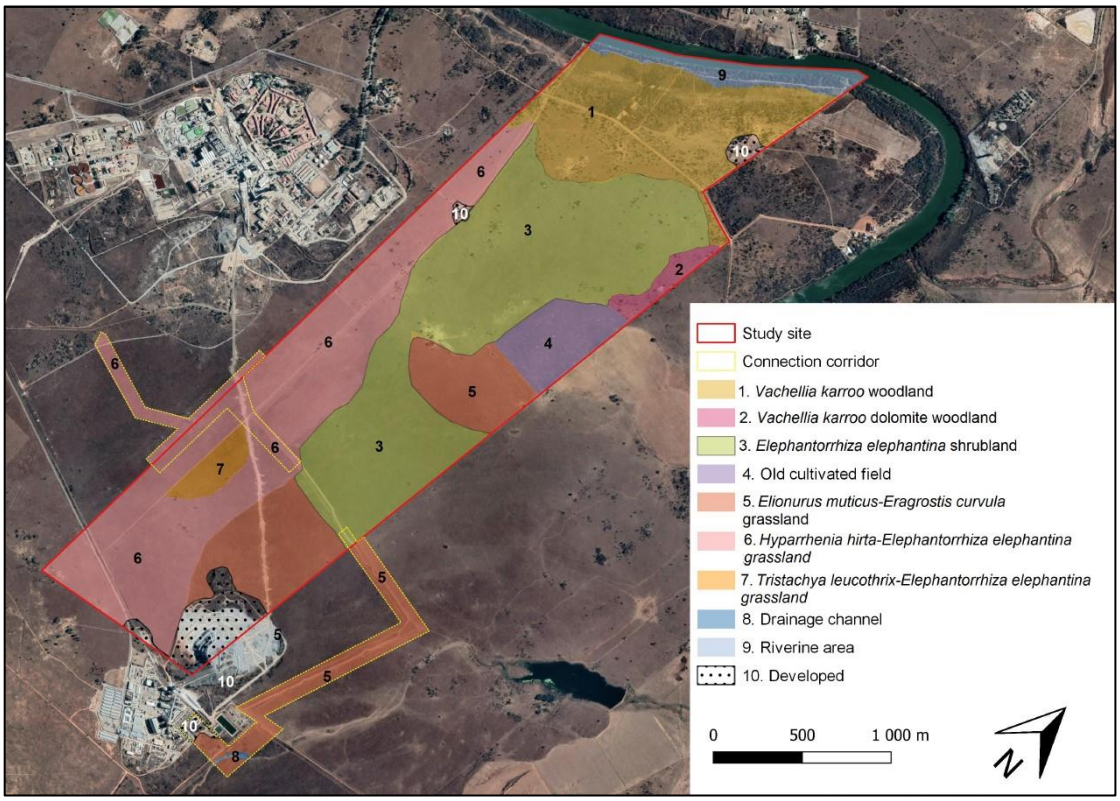


Figure 5.8: Vegetation units of the site for the proposed Thakadu Solar Power Plant

The ***Vachellia karroo* woodland (VU1)** is located in the northern part of the site on deep red loamy clay soil. There are few rocks present covering less than 1% of the area. The soil is deep red loam with rocks covering less than 1% of the area. The woody layer is the most prominent while the grasses have a 70% canopy cover followed by the trees and shrubs (35%).The vegetation is dominated by the tree *Vachellia karroo* while the tree *Ziziphus mucronata*, the

shrublet shrub *Asparagus laricinus* and the pioneer forb *Pseudognaphalium luteo album* are prominent throughout this unit. Other species present include the tree *Searsia pyroides*, the grasses *Hyparrhenia hirta*, *Sporobolus africanus, Cynodon dactylon, Themeda triandra, Eragrostis curvula*, and the forbs *Sansevieria aethiopica, Argemone ochroleuca, Conyza bonariensis, Felicia muricata* and *Sida alba*.

The ***Vachellia karroo* dolomite woodland (VU2)** is located in the north-western corner of the site. The area has large dolomite rock sheets covering up to 65% of the unit with loam to clay soil. The trees cover up to 55% of the area with grasses 65%. The vegetation is dominated by the tree *Vachellia karroo* with various grass and forb species. The shrublet *Elephantorrhiza elephantina* is prominent in sections. Other species present include the grasses *Brachiaria serrata, Heteropogon contortus, Anthephora pubescens, Eragrostis superba, Elionurus muticus*, and the forbs *Kohautia amatymbica, Hypoxis iridifolia, Crinum macowanii, Commelina africana* and *Tephrosia lupinifolia*. Two protected plant species were noted within this unit. The ***Elephantorrhiza elephantina* shrubland (VU3)** comprises the largest section of the site and is located in the northern and central sections of the site on dolomite rock outcrops. The soil is red sandy loam with rocks covering 45% of the area. The vegetation cover is illustrated in the figure right. The vegetation is dominated by the shrublet *Elephantorrhiza elephantina* with few other species present. The dwarf shrub *Ziziphus zeyheriana* is prominent in many sections of this shrubland. Species present include the *grasses Elionurus muticus, Anthephora pubescens*, the forbs *Asclepias aurea* and *Pollichia campestris*.

The **Old cultivated field (VU4)** occurs in the central part of the site and is along the eastern boundary. The soil is red loamy to clay with few rocks present. The grasses have the highest cover followed by the forbs. The vegetation is dominated by the grasses *Eragrostis curvula, Cynodon dactylon* and the forb *Felicia muricata*. Other species present include the grasses *Eragrostis superba, Brachiaria serrata* and the forbs *Vernonia oligocephala, Helichrysum miconiifolium, Rhynchosia minima*, and *Gazania krebsiana*. The ***Elionurus muticus-Eragrostis curvula* grassland (VU5)** comprises a large part of the site and occurs on undulating terrain within the central and southern sections of the site. The soil is red loam with rocks covering 10% of the area. There are no trees present with the grasses having the highest cover. The vegetation is dominated by the grasses *Eragrostis curvula* and *Elionurus muticus* while the dwarf shrub *Seriphium plumosum* is prominent locally. Other species present include the grasses *Eragrostis superba, Themeda triandra* and the forbs *Pseudognaphalium luteo album, Stachys linearis, Gazania krebsiana* and *Senecio coronatus.* One threatened species was found to be present in this unit nl. the *Boophone disticha*.

The ***Hyparrhenia hirta-Elephantorrhiza elephantina* grassland (VU6)** occurs within the proposed power line corridor (Option 1) and is dominated by grasses and dwarf shrubs that has the highest cover. The soil is red loam with few rocks present. The vegetation is dominated by the grasses *Hyparrhenia hirta, Eragrostis curvula* and the shrublet *Elephantorrhiza elephantina*. Other species present include the grasses *Elionurus muticus, Pogonarthria squarrosa* and the forbs *Chamaesyce inaequilatera, Nemesia fruticans* and *Thesium utile*. Small woody pockets occur where the trees *Ziziphus mucronata, Searsia lancea* and the shrublet *Asparagus laricinus* are present. The ***Tristachya leucothrix-Elephantorrhiza elephantina* grassland (VU7)** occurs in the southern section of the site on a small rocky hilltop where dolomitic rocks are present. The grass layer has the highest cover followed by the dwarf shrubs and forbs. The vegetation is characterised by the dominance of the grass *Tristachya*

leucothrix while the shrublet *Elephantorrhiza elephantina* is co-dominant in areas. Other species present include the grasses *Cynodon dactylon, Eragrostis rigidior, Elionurus muticus*, and the forbs *Justicia anagalloides, Crabbea angustifolia, Acalypha angustifolia, Gomphocarpus fruticosus* and *Senecio coronatus*.

The **Drainage channel (VU8)** is located within the proposed power line corridor (option 2) in the south-eastern part of the study area. The grasses and forbs have the highest cover with woody species present. The vegetation is sparse with the medium-tall grass *Eragrostis curvula* prominent while various forbs such as *Argemone ochroleuca, Conyza bonariensis, Datura stramonium* and *Bidens pilosa* are prominent. The **Riverine area (VU9)** is located along the bank of the Vaal River. The area consists of a dense woody layer with tall trees and a floodplain area with dense shrub vegetation. The woody has the highest cover with a degraded herbaceous layer. The riverbank vegetation along the Vaal River is dominated by the tree *Vachellia karroo*, with the trees *Ziziphus mucronata, Searsia pyroides* and the shrublet *Asparagus laricinus* prominent. Within the river and along its edges stands of the reed *Phragmites australis* are present. The herbaceous layer is sparse and include the grasses *Panicum maximum, Cynodon dactylon* and the forbs *Tribulus terrestris, Chenopodium album* and *Rhynchosia totta*. It should be noted that although this area was assessed, no development is planned for the area to the north of the Stokkiesdraai road and along the Vaal River.

Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA)

The largest part of the site is classified as an ESA 1 and the rest ESA 2, while large sections are classified as Degraded. A section of the power line option 2 falls within a CBA 1 and CBA 2. Based on the data of this study, the vegetation of the study area is mostly degraded with little ecological support to other areas since there is little connection with pristine natural areas.

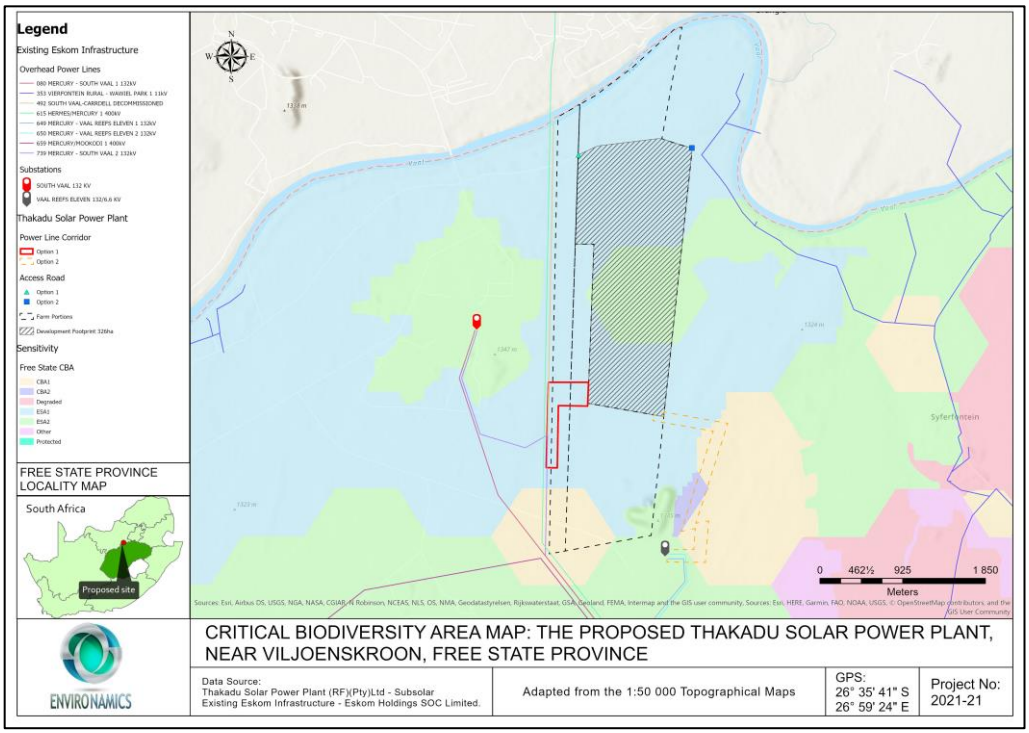


Figure 5.9: Critical Biodiversity Map for the proposed Thakadu Solar Power Plant

Red Data, Protected and Endemic Plant Species

According to the Ecology and Wetland Assessment (Appendix D1) no nationally protected plants (NEMBA listed species, 2005) were recorded on site. Two declining species were recorded on site, the *Boophone disticha* (VU5) and *Crinum bulbispermum* (VU2).

According to the Free State Nature Conservation Ordinance (8 of 1969) various plant species are listed as protected. With reference to the study site all *Aloe* species*, Crinum* species and *Boophone* species are protected. Any removal of these plant species would therefore require permits from the Department. A Crinum and Aloe species were found within vegetation unit 2, however no development is recommended for this unit. A *Boophone* species were noted within vegetation unit 5.

Declared Invaders

The following declared invaders were recorded in the site and should be controlled.

Table 5.1: Declared invader species recorded on the site (NEMBA, 2016)

			Vegetation units								
Species	**CARA**	**NEMBA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Argemone ochroleuca	1	1b	●							●	
Argemone mexicana	1	1b									
Arundo donax L.	1	1b									
Cirsium vulgare (Savi) Ten.	1	1b								●	
Datura stramonium L.	1	1b		●						●	
Eucalyptus camaldulensis Dehnh.	1	2									
Morus alba L.	3	3									●
Opuntia ficus-indica	1b	1	●	●							●
Ricinus communis	2	2									
Solanum sisymbrifolium Lam.	1b	1	●								
Verbena bonariensis L.		1b									●
Verbena brasiliensis Vell.		1b									
Xanthium spinosum L.	1	1b						●			

Category 1 plants are prohibited plants which must be controlled or eradicated. These plants serve no economic purpose and possess characteristics that are harmful to humans, animals or the environment.

- Category 1a: Plants are high-priority emerging species requiring compulsory control. All breeding, growing, moving and selling are banned
- Category 1b: Plants are widespread invasive species controlled by a management program.

Category 2 plants are invaders with certain useful qualities, such as commercial use or for woodlots, animal fodder, soil stabilisation, etc. These plants are allowed in demarcated areas under controlled conditions and in biocontrol reserves.

Category 3 plants are alien plants that are currently growing in, or have escaped from areas such as gardens, but that are proven invaders. No further planting is allowed (except with special permission), nor trade in propagative material. Existing plants may remain but must

be prevented from spreading. Plants within the flood line and watercourses must be removed (Bromilow, 2010).

Medicinal Plants

A total of eleven (11) medicinal plant species were recorded on the study site and are listed in the table below.

Plant name	Plant part used	Medicinal use	Vegetation unit
Aloe davyana	Leaf sap	Treat skin irritations, bruises and burns.	2
Boophone disticha	The bulb scales	Outer scales of the bulb used as dressing after circumcision, also applied to septic wounds. Bulb scales also administered as an enema. Headaches, abdominal pain, weakness and eye condition. Effective sedative.	5
Datura stramonium	Leaves & green fruit	Asthma, rheumatism, abscesses, bronchitis, tonsillitis	2 ; 8
Elephantorrhiza elephantina	Rhizomes	Diarrhoea, dysentery, stomach disorders, haemorrhoids	2; 3; 5; 6; 7
Gnidia capitata	Leaves	snuff, smoked or used a poultice to treat stomach ache, earache or toothache.	6
Gomphocarpus fruticosus	Leaves, sometimes roots	Headache, stomach pain, tuberculosis.	7
Ledebouria ovatifolia	Leaves; bulb	Pregnancy, diarrhoea, influenza, backache, skin irritations, wound treatment	1
Scabiosa columbaria	Leaves & fleshy roots	Heartburn; wound healing	2; 6
Vachellia karroo	Leaves, bark and gum	Diarrhoea & dysentery Gum: colds, oral thrush & haemorrhage.	1; 3; 9
Vernonia oligocephala	Leaves and twigs, rarely roots.	Stomach bitters, rheumatism Treat abdominal pain, colic, dysentery and diabetes. Roots treat ulcerative colitis.	1; 2; 4; 7
Ziziphus mucronata	Roots, bark or leaves	Cough & chest problems; diarrhoea; pain relief	1; 3; 9

Except for the threatened *Boophone disticha,* none of these species are threatened while some are regarded as indicative of disturbed conditions and grow abundantly throughout the province. The forb *Datura stramonium* is a declared alien invasive weed that should be removed.

5.3.1.3 Watercourse Assessment

According to the Ecology and Wetland assessment (Appendix D1) no wetland was found to be present on the site, however the Vaal River (VU 9) and a seasonally moist drainage channel were identified (VU 8).

Riverine Area

The Vaal River (refer to Figure 5.9) achieved a Medium-high Ecological Importance and Sensitivity (EIS) score of 2.33. This is a value between 0 and 4, with 0 being very low and 4 very high. It is regarded as having a medium-high ecological sensitivity with a moderate biodiversity. These areas are important in terms of their water retention and channelling capacity. The Habitat integrity Class for the Vaal River is C. Which indicates that The Vaal River has a moderately modified habitat with some modifications due to anthropogenic influences. Overall, the basic ecosystem functions are still unchanged. The perennial stream in contrast is largely modified due mostly to water pollution and it being artificially fed with sewage water. As a result, some ecosystem functions have been lost. No development within the 32m buffer of the river is recommended. However, it should be noted that no development is planned for the area adjacent to river.

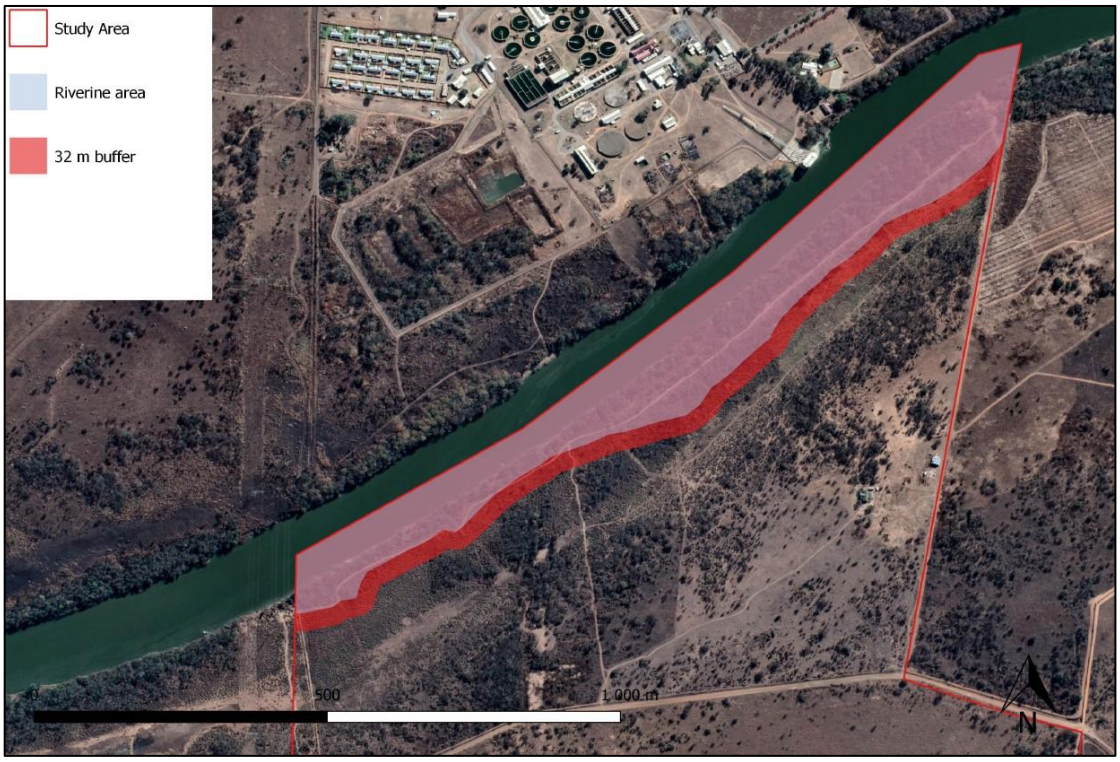


Figure 5.10: Riverine area and its associated 32m buffer

Drainage channel

The Drainage channel (VU8) delineation is indicated in Figure 5.11. The soil is mostly deep sand and was assessed for its Ecological Importance and Sensitivity (EIS), and its Habitat Integrity (HI). The Drainage channel obtained a score of 0.97 indicating the area to have a low ecological sensitivity. This is ascribed to the degraded condition of the vegetation and the polluted water that is released into the system at times. The HI for the drainage channel was

identified as D. This indicates that it is largely modified with a loss in natural habitat and ecosystem functioning. This can be ascribed to the various pioneer and alien invasive weeds and the release of sewage effluent into the channel.

Figure 5.11: Drainage channel delineation and associated 32m buffer.

5.3.1.4 Climate

A summary diagram of the climate encountered within the Vaal Reefs Dolomite Sinkhole Woodland (which dominates the proposed development site) is shown in Figure 5.10 below. The climate is strongly seasonal and semi-arid, with an average rainfall volume of 565 mm/annum, falling between October and May. The summers are hot and wet, with summer temperatures ranging typically between 14-30°C. The winters are cold and dry, with wintertime temperatures ranging typically between -1 to 19°C. An average of 34 frost days occur each winter. The soils are perpetually moisture stressed, with mean annual evaporation of 2,407 mm, resulting in 78% of days where the soils lose more moisture than they receive from precipitation.

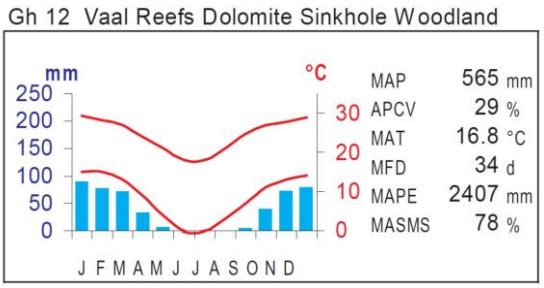


Figure 5.12: Climate diagram representative of the Thakadu SPP (Mucina & Rutherford, 2007)

5.3.1.5 Biodiversity

The primary cause of loss of biological diversity is habitat degradation and loss (IUCN, 2004; Primack, 2006). In the case of this study special attention was given to the identification of sensitive species or animal life and birds on site. The following section will discuss the state of biodiversity on the site in more detail.

Avifaunal

According to the Avifaunal Impact Assessment (Appendix D2) the typical species occurring on the SPP site are common across the western highveld, with good representation from the widespread larks, pipits, cisticolas, finches, widowbirds, bishops, and whydahs in particular. Aerial feeding bee-eaters, swallows and swifts were also well represented. Many palearctic migrants were still present on the site, as were most intra African migrants. Raptors were very poorly represented, as were gamebirds. There are Red Data species that could possibly occur on site, even as vagrants and the likelihood of their occurrence must be assessed. The potential red data species for the Thakadu SPP site, along with probability estimates and notes are presented. No Red Data species were recorded during the surveys, although suitable habitat exist on site for the following species with a reasonable likelihood of occasionally occurring on site:

- *Secretary bird*- Vulnerable. Not recorded in the pentads or during the site visit but has been seen within a 15 km radius of the site and, therefore, has reasonable likelihood of occasionally occurring on site.
- *Lanner Falcon*- Vulnerable. Not recorded in the SABAP2 pentad assessment, nor during the site visit. However suitable habitat exists, and it should be expected to have a reasonable likelihood of occasionally occurring on site.
- *Red-footed Falcon*- Near Threatened. Not recorded in the pentads or during the site visit but has been seen within a 15 km radius of the site and, therefore, has reasonable likelihood of occasionally occurring on site.
- *Martial Eagle*- Endangered. Not recorded during the site visit, but recorded in the wider pentad, thus reasonable likelihood of occasionally occurring on site.
- *African Marsh Harrier*- Endangered. Not recorded in the pentads or during the site visit but has been seen within a 15 km radius (and the DFFE's screening tool indicates that the site is part of the habitat corridor) and, therefore, has reasonable likelihood of occasionally occurring on site.
- Black-winged Pratincole- Near Threatened. Not recorded in the pentads or during the site visit. Habitat suitability is marginal on the SPP site but is expected to occasionally occur in the surrounding croplands.

The following endemic or near-endemic (most of the global range is within South Africa's borders) species were recorded either during prior SABAP2 assessments or during the assessment:

- Cloud Cisticola- recorded on site at numerous transects. Near-endemic.
- Fiscal Flycatcher- recorded on site at numerous transects. Near-endemic.

- Pied Starling- not recorded on site but recorded during SABAP2 assessments for the wider pentad. Endemic to South Africa, Lesotho and Swaziland.
- South African Cliff Swallow- recorded on site at numerous transects.
- Karoo Thrush- not recorded on site but recorded during SABAP2 assessments for the wider pentad(s). Near-endemic.
- Cape White-eye- not recorded on site but recorded during SABAP2 assessments for the wider pentad(s). Near-endemic.

All of the endemic or near-endemic species listed above that have either been confirmed as occurring on site during this assessment or during past SABAP2 assessments have wide distributional ranges and reportedly healthy populations and should not present substantial threats as a result of development of this site.

Fauna

According to the Ecology and Wetland Assessment (Appendix D1) a survey was conducted during October 2021 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the quarter degree grid.

Much of the large and medium-sized mammal fauna that previously occurred on the site is now locally extinct or occurs in small, fragmented populations in reserves. The riparian area is an important habitat and dispersal corridor for moisture-reliant small mammals. The majority of the habitat types are fragmented. Therefore, the expected mammalian richness on these areas is considered low. Breeding habitat of frogs and toads can be found mostly in the permanent wet zone of wetlands. Amphibian species potentially occurring in the larger area include Common River Frog, Gutteral Toad, Raucous Toad and Bubbling Kassina. These species are non-threatened and widespread, and as such the development will not have any impact on amphibian conservation within the region. Several reptile species are likely to be present in the area. They are common and widespread, and as such the development will not have any impact on reptile conservation within the region.

5.3.1.6 Visual landscape

The proposed SPP development is located in close proximity to the Vaal River, approximately 800m north. The area drains to the north towards the Vaal River. Most of the site is located within the Vaal River Mining Area, a degraded grassland transformed by mining. The landscape is dominated by plains with some scattered, slightly irregular undulating plains and hills.

The site is located in an area with relatively low significance in elevation, meaning that the site is not located on a mountain, at the foot of a mountain or in an area with a significant difference in elevation. The preferred site is located at an above mean sea level (amsl) of approximately 1308m at the highest elevation and at an amsl of 1296m at the lowest elevation. The landform and drainage described above is unlikely to limit visibility. Areas within 5km from the proposed development might have a clear view without taking existing screening into account.

The observers in a 5km radius include:

- Eskom power line infrastructure.
- Vaal Reefs Eleven Substation.
- Harmony Moab Mine.
- Tailings dams.
- Water Processing Plant.
- Other mining operations.
- Various homesteads on farms and smallholdings
- R502 road
- S643 road
- Vermaasdrift road
- Stokkiesdraai road
- Vaal River.
- Wawielpark Holiday Resort.

The landscape does not have any specific protection or importance and is characterised by mining activities. Figure 5.13 and 5.14 below indicates the Zone of Theoretical Visibility for the PV facility.

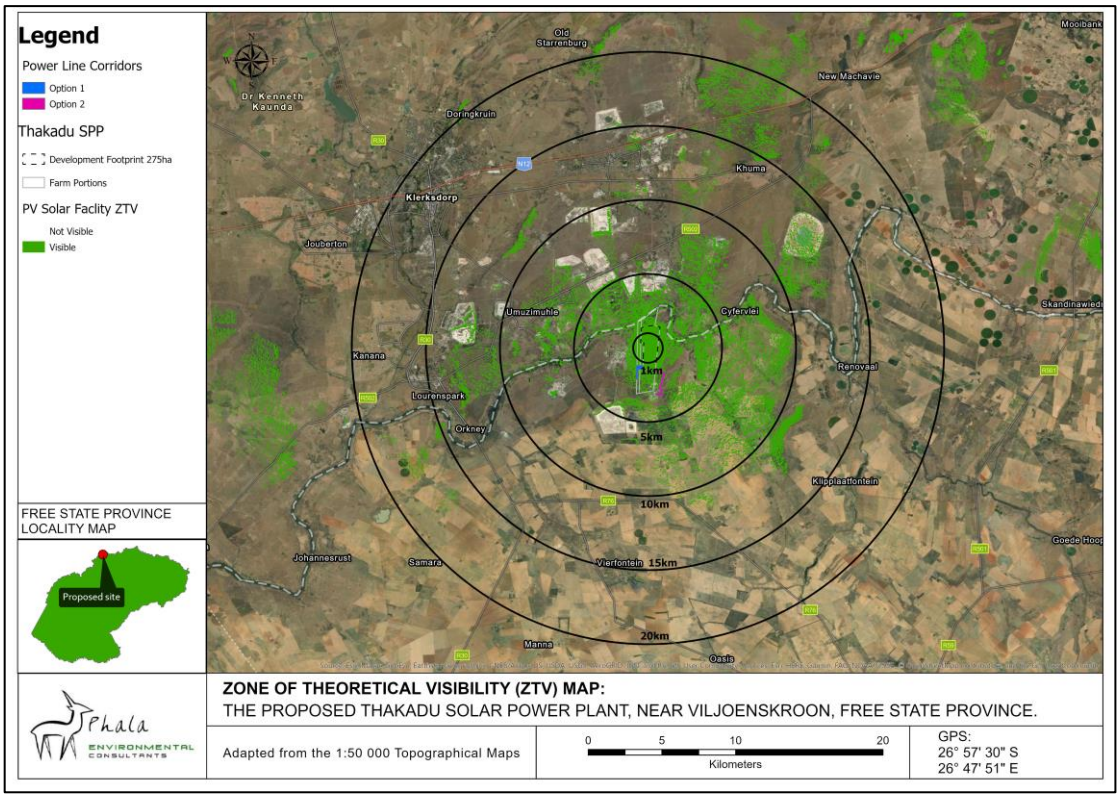


Figure 5.13: Zone of Theoretical Visibility (ZTV) for the Thakadu Solar Power Plant – Satellite.

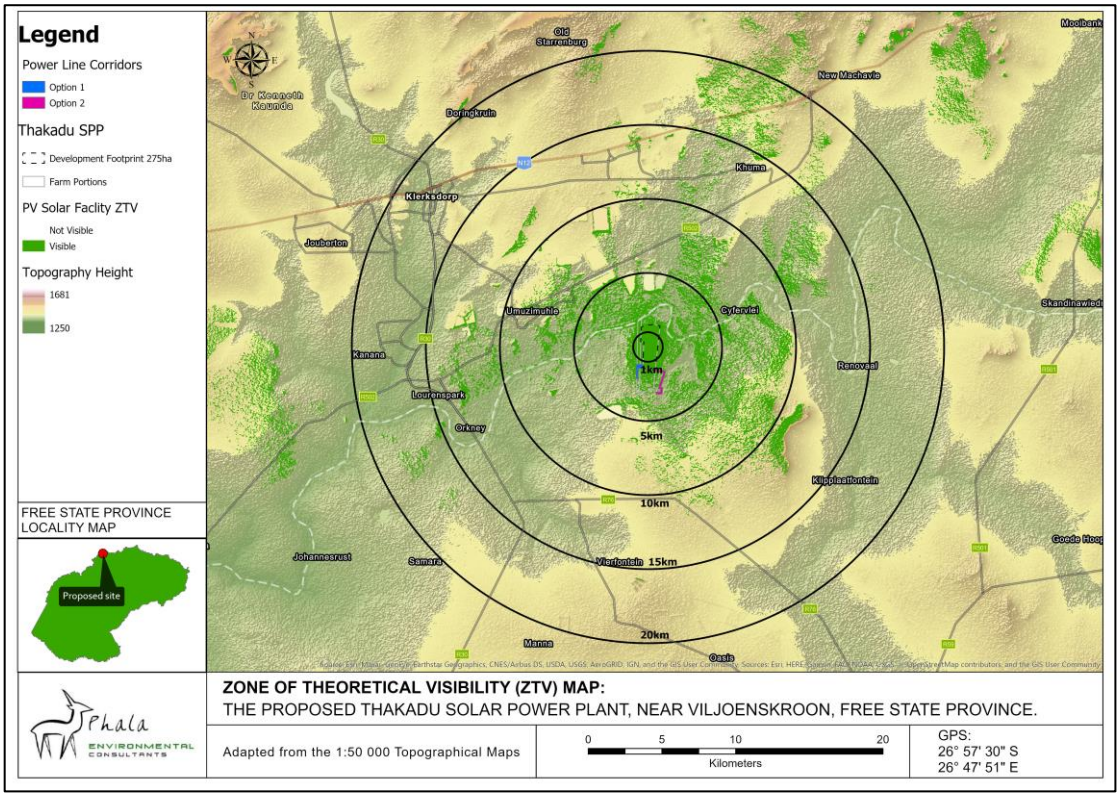


Figure 5.14: Zone of Theoretical Visibility (ZTV) for the Thakadu Solar Power Plant – Topography.

The ZTV assessment did not consider existing screening such as buildings and vegetation cover but rather the terrain's above mean sea level (AMSL) which indicates line of sight. The main visual receptors in the area are industrial developments, the mining sector and to agricultural developments. Option 1 and Option 2 of the proposed power line routes will be visible from approximately the same viewpoints which makes both options suitable (refer to Figure 5.15 and Figure 5.16).

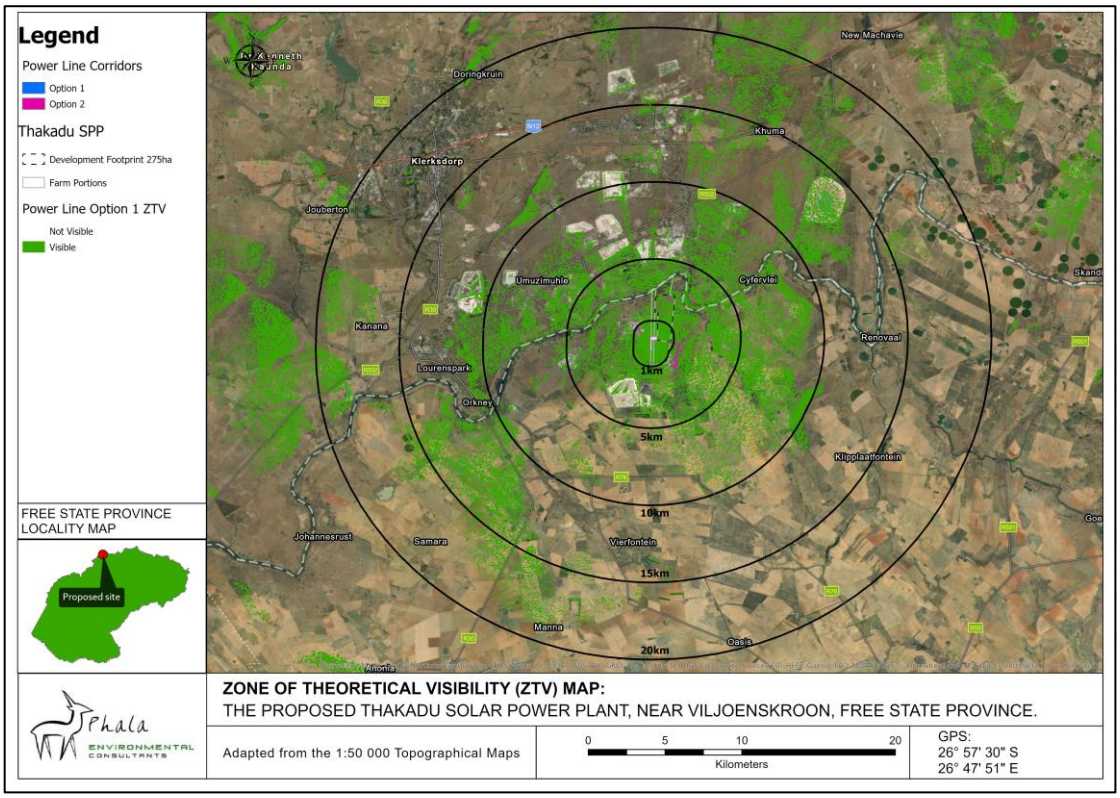


Figure 5.15: Zone of Theoretical Visibility (ZTV) for the proposed power line corridor Option 1.

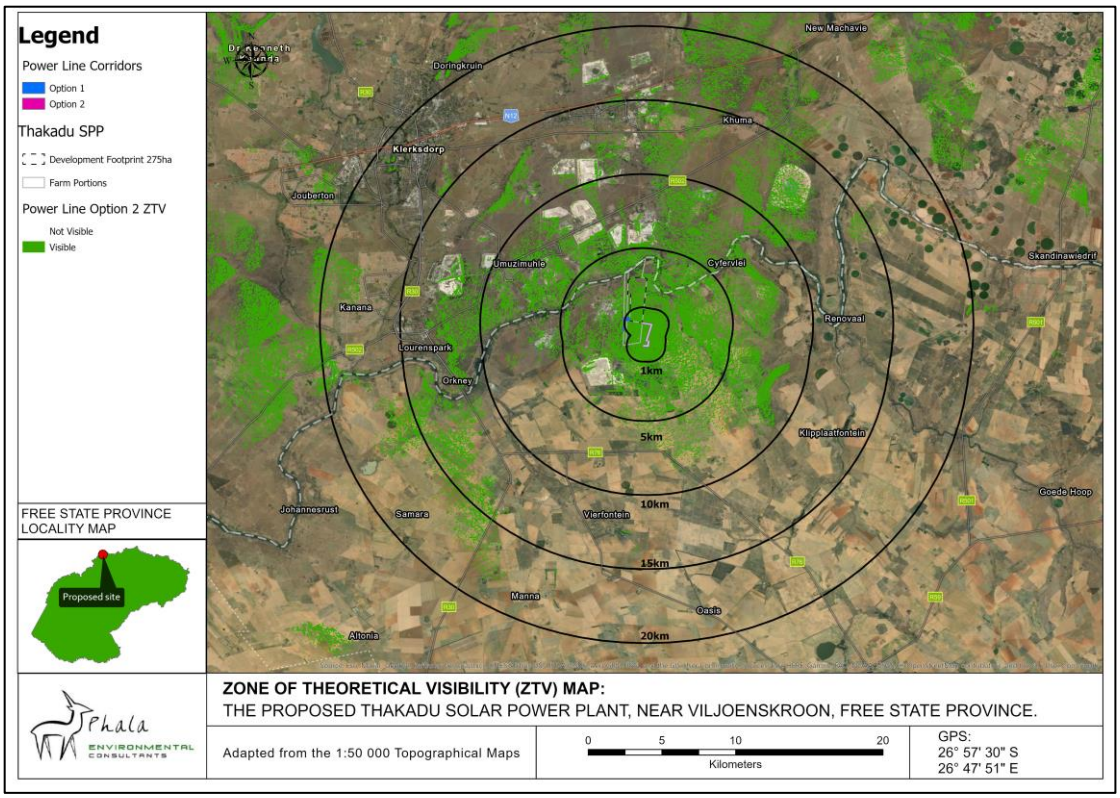


Figure 5.16: Zone of Theoretical Visibility (ZTV) for the proposed power line corridor Option 2.

5.3.1.7 Traffic consideration

According to the Traffic Study (Appendix D8), two access point options were assessed. Access will be obtained via the Tertiary Road T3767 of Stokkiesdraai Road to the north of the site, as shown in Figure 5.17. The gravel portion of Stokkiesdraai Road would need to be upgraded to accommodate the additional traffic loading. Both access point options are deemed feasible from a transport engineering perspective. An internal site road network will also be required to provide access to the solar field and associated infrastructure. The access and internal roads will be constructed within a 25 m corridor.

Figure 5.17: Proposed access point and roads**.**

The proposed access point will need to be upgraded to cater for the construction and abnormal load vehicles. Generally, the road width at the access point needs to be a minimum of 8 m and the access roads on site a minimum of 4.5 m (preferably 5 m). The radius at the access point needs to be large enough to allow for all construction vehicles to turn safely. It is recommended that the access point be surfaced and the internal access roads on site remain gravel.

There are three viable options for the port of entry for imported components – the Port of Richards Bay in KwaZulu Natal (735 km from the site), the Port of Ngqura in the Eastern Cape (905 km from the site) and the Port of Saldanha in the Western Cape (1 330 km from the site). The Port of Richards Bay is the preferred port of entry, however, the Port of Saldanha and the Port of Ngqura can be used as alternatives should the Port of Richards Bay not be available.

The preferred route from the Port of Richards Bay is shown in blue (Figure 5.18), the route from the Port of Saldanha, shown in orange and the alternative route from the Port of Ngqura, shown in green.

Figure 5.18: The preferred and alternative routes for imported components.

It is critical to ensure that the abnormal load vehicle will be able to move safely and without obstruction along the preferred route. The preferred route should be surveyed prior to construction to identify any problem areas.

It is anticipated that elements manufactured within South Africa will be transported to the site from the Cape Town, Johannesburg and Pinetown/Durban areas. It is also assumed that the transformer, which will be transported with an abnormal load vehicle, will be transported from the Johannesburg area and therefore it needs to be verified that the route from the manufacturer to the site does not have any load limitations for abnormal vehicles. At this stage, only a high-level assessment can be undertaken as no information of the exact location of the manufacturer is known and all road structures (such as bridges and culverts) need to be confirmed for their load bearing by the South African National Roads Agency (SANRAL) or the respective Roads Authority.

The nearest towns in relation to the proposed development site are Orkney, Klerksdorp, Stilfontein, Viljoenskroon and Potchefstroom. It is envisaged that most materials, water, plant, services and people will be procured within a 50 km radius of the proposed facility.

5.3.2 Description of the socio-economic environment

The socio-economic environment is described with specific reference to social, economic, heritage and cultural aspects.

5.3.2.1 Socio-economic conditions

According to the Social Impact Assessment (Appendix D7) Free State Province is the landlocked core of the country. It is centrally placed, with good transport corridors to the north and the coast. It is the third biggest of South Africa's nine provinces in terms of size, and primary agriculture is a key economic sector. Mining is also important but has been declining steadily since 2008. Although the Free State is the third-largest province in South Africa, it has the second-smallest population and the second-lowest population density. It covers an area of 129 825km² and has a population of 2 834 714 – 5.1% of the national population. Languages spoken include Sesotho (64.4%), Afrikaans (11.9%) and Zulu (9.1%). The Free State Province contributes 5.4% to South Africa's total gross domestic product (2006).

Agriculture is a key economic sector – 8% of the country's produce comes from Free State. In 2010, agriculture provided 19.2% of all formal employment opportunities in the region. The economy is dominated by agriculture, mining and manufacturing. Known as the 'bread-basket' of South Africa, about 90% of the province is under cultivation for crop production. It produces approximately 34% of the total maize production of South Africa, 37% of wheat, 53% of sorghum, 33% of potatoes, 18% of red meat, 30% of groundnuts and 15% of wool. The province is the world's fifth-largest gold producer, with mining the major employer.

The Fezile Dabi District Municipality is a Category C municipality, formerly known as the Northern Free State District Municipality, situated in the north of the Free State. It is bordered by the North West, Gauteng and Mpumalanga Provinces to the north, Thabo Mofutsanyana District to the south, and Lejweleputswa District to the west. In 2011 the Municipality had a population of 488 036 with an unemployment rate of 33.9% and a youth unemployment rate of 44.4%. By 2016 only 48.3% of dwellings had piped water inside their dwellings and 7.7% of household still did not have electricity in their dwellings.

The Moqhaka Local Municipality is a Category B municipality situated within the southern part of the Fezile Dabi District in the Free State Province. It is the largest of four municipalities in the district, making up over a third of its geographical area and covering an area of 7 925m². The former Kroonstad, Steynsrus and Viljoenskroon Transitional Local Councils and sections of the Riemland, Kroonkop and Koepel Transitional Rural Councils are included in the municipality. The general tendency of migration from rural to urban areas is also occurring in the area, as is the case in the rest of the Free State Province. In comparison to the other municipalities within the Fezile Dabi District, it appears as if Moqhaka is significantly less urbanised. The population dwindled from 2011 at 160 532 to 154 732 in 2016. In 2011 the unemployment rate stood at 35.2% and the youth unemployment rate at 47.2%. In 2016 89.7% of households had flush toilets connected to sewerage and 96.3% of households had electricity for lighting in their dwellings. The main economic sectors in the municipality are agriculture, commercial transport, business services and mining.

In the Moqhaka LM there are 55 594 economically active (employed or unemployed but looking for work) people, and of these 35,2% are unemployed. Of the 27 349 economically active youth (15–34 years) in the area, 47,2% are unemployed. The creation of employment opportunities within the formal sector as a result of the development of Thakadu SPP could therefore contribute towards growing employment within the formal sector in both the LM and DM, which could lead to greater levels of job security than may typically be associated with employment in the informal sector.

5.3.2.2 Cultural and heritage aspects

According to the Heritage Impact Assessment (Appendix D5) special attention was given to the identification of possible cultural or heritage resources on site.

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 site.

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 site and surrounding 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 site, 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.

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).

Site Specific Review:

From a review of the available old maps and aerial photographs it can be seen that the project area has always been open space, with the main activity being grazing or the making of agricultural fields. The built structure development is not visible on the 1961 version of the aerial photograph or on the 1987 and 1996 versions of the 1:50 000 topographic maps. However, on inspection during the site visit, it was determined that these structures are of recent origin, as is confirmed by the type of material used, e.g. face-bricks that were used to construct the buildings

No sites, features or objects of cultural significance from the Stone Age, Iron Age or the historic period were identified on site.

Palaeontology

The geology of the proposed Thakadu Solar Power Plant and grid connection is indicated on the 1: 250 000 2626 Wes-Rand (1986) Geological Map (Council for Geosciences, Pretoria) (Figure 5.19). The proposed development is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani Subgroup (blue-green - Vmd) (Chuniespoort Group) within the Transvaal Supergroup. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Malmani Subgroup is Very High.

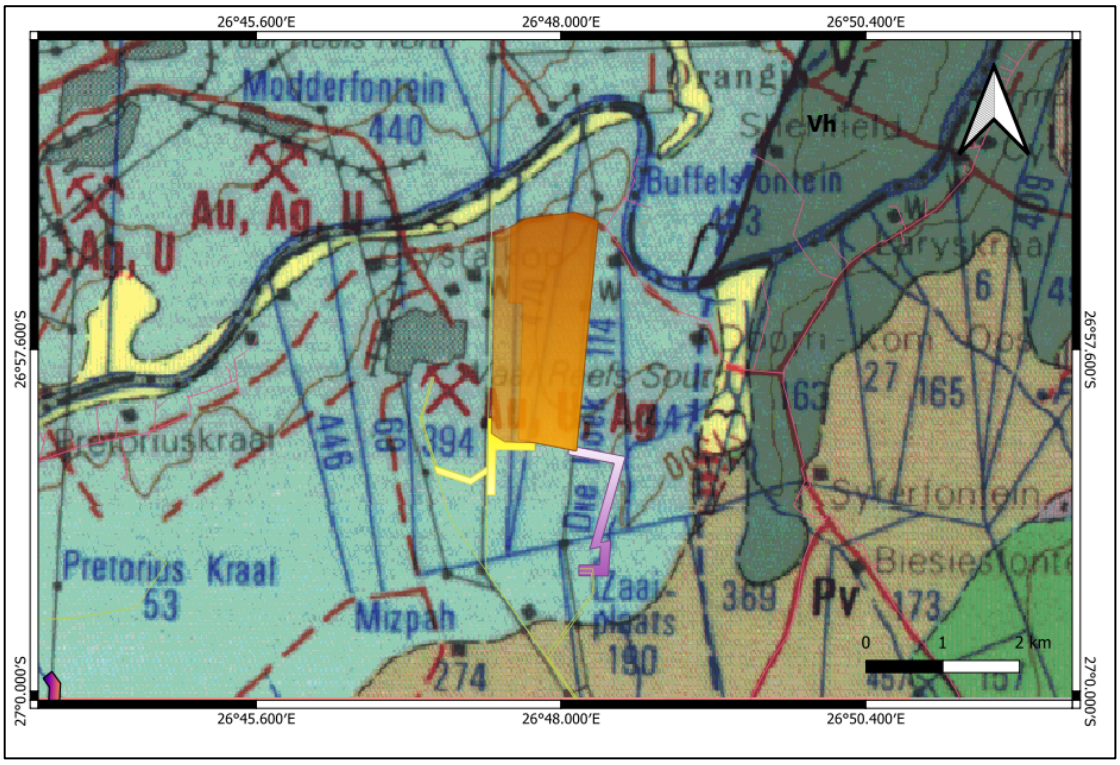


Figure 5.19: Extract of the 1:250 000 2626 Wes-Rand (1986) Geological Map (Council for Geosciences, Pretoria) indicating the proposed Thakadu Solar Power Plant and power line corridors.

The Malmani Subgroup carbonates of the Transvaal Basin comprise of an assortment of stromatolites (microbial laminates), ranging from supratidal mats to intertidal columns and large subtidal domes (Eriksson et al. 2006). Stromatolites are layered mounds, columns and sheet-like sedimentary rocks. These structures were originally formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-bases life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. These algae photosynthesised in the low oxygen atmosphere and deposited layer upon layer of calcium sulphate, magnesium sulphate and calcium carbonate as well as other compounds to form these domes. Researchers have examined and classified the stromatolite structures but seldomly find preserved algal cells. The oxygen atmosphere that we depend on today was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

The Malmani Subgroup succession is about 2 km-thick and consists of a series of formations of oolitic and stromatolitic carbonates (limestones and dolomites), black carbonaceous shales and minor secondary cherts. The Malmani Dolomites also consist of historic lime mines, and palaeocave fossil deposits. Dolomite (limestone rock) forms in warm, shallow seas from slow gathering remainders of marine microorganisms and fine-grained sediment. Dolomites of the Malmani Subgroup has a higher magnesium content than other limestones. These materials contain high levels of calcium carbonate and are often referred to as carbonates.

The Vaal River lies just north of the proposed Thakadu Solar Power Plant. Quaternary alluvium is deposited in this area. The Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million

years ago to present). The rocks and sediments can be found at or near the surface of the Earth. Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt, and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore.

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

The Vryheid Formation (Ecca Group, Karoo Supergroup) is present to the south and east of the proposed Thakadu Solar Power Plant. The Vryheid Formation is characterized by light grey, fine to course sandstone and siltstone sediments. The dark coloured siltstones can be accredited to the existence of carbon enrichment and coal beds. Infrequent coal seams, deltaic mudrocks and sandstones as well as coastal and fluvial deposits are present in this formation. These sediments were probably deposited on a sandy shoreline that stretched out beyond massive swamplands. In these swamps, plants accumulated and formed the coal deposits that are mined today.

The Vryheid Formation is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. Numerous plant fossils have been described from this formation. The Vryheid Formation is also characterised by its trace fossil assemblages of the non-marine Mermia Ichnofacies, insect fossils track ways, fish and small crustaceans. The Mesosaurus reptile may also be present.

The Hekpoort Formation of the Pretoria Group is present to the east of the development. The Hekpoort formation consists of Basaltic andesite and pyroclastic rocks and is volcanic in origin.

Outcrops of weathered to well-preserved stromatolites were discovered on the whole development. A small portion of a stromatolite is usually exposed at the surface while the largest part of the specimen is below surface. Figure 5.20 below indicates the location of the exceptional well preserved oolites and stromatolites preserved in the green area while stromatolites are found throughout the footprint but is more prominent in green areas.

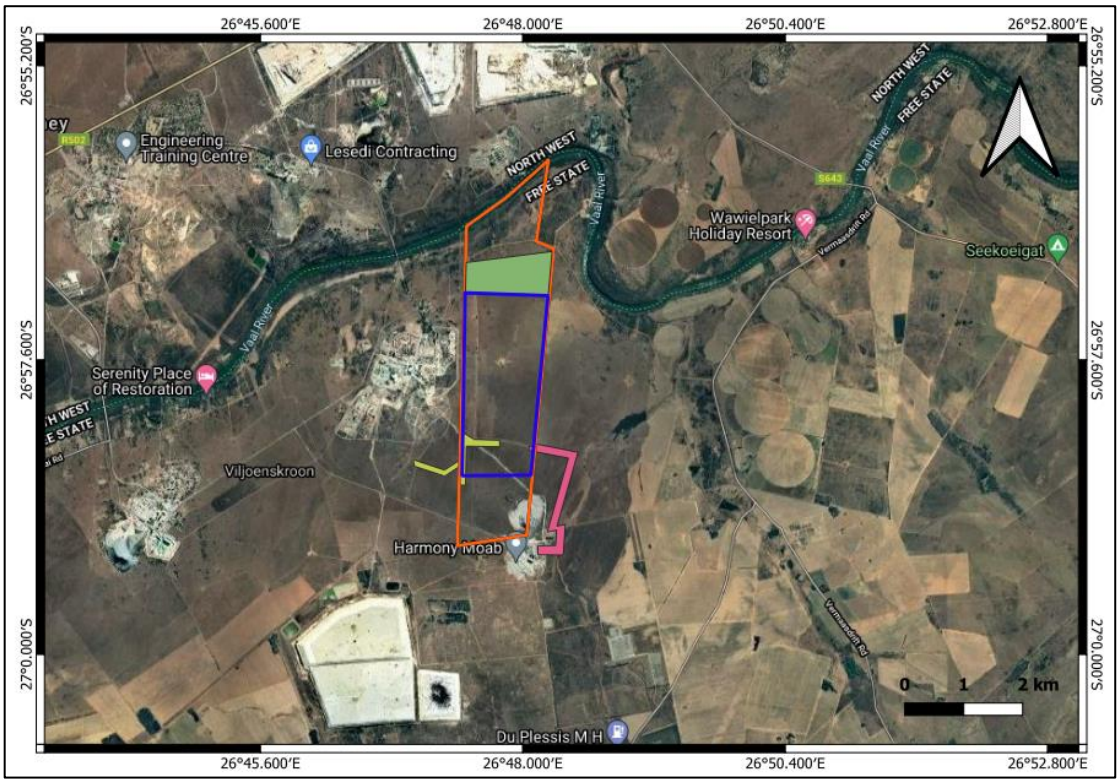


Figure 5.20: Exceptional well preserved oolites and stromatolites are preserved in the green area while stromatolites are found throughout the footprint but is more prominent from the blue and green areas.

5.4 SITE SELECTION MATRIX

Due to the nature of the proposed development, the location of the facility is largely dependent on technical and environmental factors such as solar irradiation, climatic conditions, topography of the site, access to the grid and capacity of the grid. Studies of solar irradiation worldwide indicate that the Free State Province has a huge potential for the generation of power from solar.

The receptiveness of the site to PV development includes the presence of optimal conditions for the sitting of a solar energy facility due to high irradiation values and optimum grid connection opportunities. The farm Groot Vaders Bosch No. 592 and Anglo No. 593, where the project is proposed to be located is considered favourable and suitable from a technical perspective due to the following characteristics:

- **Climatic conditions:** Climatic conditions determine if the project will be viable from an economic perspective as the solar energy facility is directly dependent on the annual direct solar irradiation values of a particular area. The Free State receives a high average of direct normal and global horizontal irradiation daily. This is an indication that the regional location of the project includes a low number of rainy days and a high number of daylight hours experienced in the region. Global Horizontal Radiation of 2118 kwh/m^2 per year is relevant in the area.
- **Renewable Energy Development Zone (REDZ):** The site is also located in the Klerksdorp Renewable Energy Development Zones (REDZ). The solar PV assessment

domain was based on the location of the majority of existing solar PV project applications at the commencement of the Strategic Environmental Assessment (SEA) and includes the five provinces of Northern Cape, Western Cape, Eastern Cape, Free State and North West.

- **Site availability and access:** The land is available for lease by the developer and consent has been provided by the affected landowner for the undertaking of the BA process. Reluctant farm owners or farmers over capitalizing hamper efforts to find suitable farms. Access will be easily obtained via the Stokkiesdraai road.
- **Grid connection**: In order for the PV facility to connect to the national grid a 132kV power line will be constructed within an identified 100m to 250m wide corridor either towards the Vaal Reefs Eleven 132/ 6.6kV Substation or two options within the same assessment corridor, the existing Mercury-South Vaal 2 132kV Power Line or the South Vaal-Carrdell 132kV. Available grid connections are becoming scarce and play a huge role when selecting a viable site.
- **Environmental sensitivities:** From an environmental perspective the proposed site is considered highly desirable due to limited environmental sensitivities in terms of geology, and soils, agricultural potential, vegetation and landscape features, climate, biodiversity and ecological features and the visual landscape – refer to Section 5.3.1 of this report. Nothing of note was identified from an ecological or conservation point of view, except for the riverine area located to the north of the site and the drainage channel located within the Option 2 power line corridor. However, the riverine area is excluded from the development footprint.

It is evident from the discussion above that Farm Groot Vaders Bosch No. 592 and Anglo No. 593 may be considered favourable and suitable in terms of these site characteristics. As mentioned previously, no alternative areas on the Farm Groot Vaders Bosch No. 592 and Anglo No. 593 have been considered. However, provision was made after the initial investigation and specialist studies to exclude the sensitive areas surrounding the riverine area.

5.5 CONCLUDING STATEMENT ON ALTERNATIVES

When considering the information provided by the specialists with regards to the site selection criteria and the comparison, the site is identified as preferred due to the fact that the opportunities presented on the site to develop the project in such a way which avoids the areas and features (including the associated buffers) of environmental sensitivity.

Therefore, development of the 150 MW Thakadu Solar Power Plant on the Farm Groot Vaders Bosch No. 592 and Anglo No. 593, is the preferred option. The preferred layout on Farm Groot Vaders Bosch No. 592 and Anglo No. 593, included in the attached Appendix H. It is therefore concluded that no other alternatives are considered as part of the BA process.

6 DESCRIPTION OF THE IMPACTS AND RISKS

This section aims to address the following requirements of the regulations:

Appendix 1. (3)(i) An BAR (...) must include-

(i) a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including-

(i) a description of all environmental issues and risks that were identified during the EIA process; and

(ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.

(j) an assessment of each identified potentially significant impact and risk, including-

(i) cumulative impacts;

(ii) the nature, significance and consequences of the impact and risk;

(iii) the extent and duration of the impact and risk;

(iv) the probability of the impact and risk occurring;

(v) the degree to which the impact and risk can be reversed;

(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and

(vii) the degree to which the impact and risk can be mitigated;

(k) where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;

6.1 SCOPING METHODOLOGY

The contents and methodology of the basic assessment report aimed to provide, as far as possible, a user-friendly analysis of information to allow for easy interpretation.

- Checklist (see section 6.1.1): The checklist consists of a list of structured questions related to the environmental parameters and specific human actions. They assist in ordering thinking, data collection, presentation and alert against the omission of possible impacts.
- Matrix (see section 6.1.2): The matrix analysis provides a holistic indication of the relationship and interaction between the various activities, development phases and the impact thereof on the environment. The method aims at providing a first order cause and effect relationship between the environment and the proposed activity. The matrix is designed to indicate the relationship between the different stressors and

receptors which leads to specific impacts. The matrix also indicates the specialist studies that have been conducted to address the potentially most significant impacts.

6.1.1 Checklist analysis

The independent consultant conducted a site visit on 05 March 2021. The site visit was conducted to ensure a proper analysis of the site specific characteristics of the site. Table 6.1 provides a checklist, which is designed to stimulate thought regarding possible consequences of specific actions and to assist scoping of key issues. It consists of a list of structured questions related to the environmental parameters and specific human actions. They assist in ordering thinking, data collection, presentation and alert against the omission of possible impacts. The table highlights certain issues, which are further analysed in matrix format in section 6.2.

Table 6.1: Environmental checklist

QUESTION	YES	NO	Un-sure	Description
1. Are any of the following located on the site earmarked for the development?				
I. A river, stream, dam or wetland	×			The Vaal river is located along the northern boundary of the site.
II. A conservation or open space area	×			The majority of the site falls within the Ecological Support Area 1 and 2. A portion of the power line corridor Option 2 falls within a Critical Biodiversity Area 1 and 2.
III. An area that is of cultural importance		×		None.
IV. Site of geological/palaeontological significance	×			Some exceptional well preserved oolites and stromatolites are located on the northern section of the site.
V. Areas of outstanding natural beauty		×		None.
VI. Highly productive agricultural land		×		None.
VII. Floodplain	×			The Vaal River is located along the northern boundary of the site.
VIII. Indigenous Forest		×		None.
IX. Grass land	×			The majority of the site falls within the Vaal Reefs Dolomite Sinkhole Woodland (vulnerable). However, the power line corridor option 2 falls within the Vaal-Vet Sandy Grasslands vegetation unit which is classified by Mucina and Rutherford as Endangered.

X. Bird nesting sites		×		None.
XI. Red data species		×		None.
XII. Tourist resort		×		None.
2. Will the project potentially result in potential?				
I. Removal of people		×		None.
II. Visual Impacts	×			The VIA (refer to Annexure D3) confirmed that the development of the solar power plant and associated power lines will have a visual impact on observers.
III. Noise pollution		×		Construction activities will result in the generation of noise over a period of months. However, there are mines located directly adjacent to the site. The noise impact is therefore insignificant in comparison to the noise generated by the mine and will only be temporary in nature
IV. Construction of an access road	×			Access will be obtained via the Stokkiesdraai Road off of the R30. Internal access roads will be constructed for the facility.
V. Risk to human or valuable ecosystems due to explosion/fire/ discharge of waste into water or air.		×		None.
VI. Accumulation of large workforce (>50 manual workers) into the site.	×			Approximately 885 employment opportunities will be created during the construction and 15 - 70 employment opportunities during the operation phase of the SPP project.
VII. Utilisation of significant volumes of local raw materials such as water, wood etc.	×			The estimated maximum amount of water required during the facility's 20 years of production is approximately 4200 m^3 per annum.
VIII. Job creation	×			Approximately 885 employment opportunities will be created during the construction and 15 - 70 employment opportunities during the operational phases for the SPP.

IX. Traffic generation	×			It is estimated that 72 trips per day will be generated over the 12-18 month construction period for the SPP.
X. Soil erosion	×			The site will need to be cleared or graded, which may potentially result in a degree of dust being created, increased runoff and potentially soil erosion. The time that these areas are left bare will be limited to the construction phase, since vegetation will be allowed to grow back after construction. No existing areas of erosion was identified.
XI. Installation of additional bulk telecommunication transmission lines or facilities	×			There is existing Eskom infrastructure in the area and the Solar Power Plant will require additional power lines to be constructed.
3. Is the proposed project located near the following?				
I. A river, stream, dam or wetland	×			The Vaal River is located along the northern boundary of the site.
II. A conservation or open space area	×			The majority of the site falls within the Ecological Support Area 1 and 2. A portion of the power line corridor Option 2 falls within a Critical Biodiversity Area 1 and 2.
III. An area that is of cultural importance		×		None.
IV. A site of geological/palaeontological resources significance	×			Some exceptional well preserved oolites and stromatolites are located on the northern section of the site.
V. An area of outstanding natural beauty		×		None.
VI. Highly productive agricultural land		×		None.
VII. A tourist resort		×		None.
VIII. A formal or informal settlement	×			The proposed SPP development is located approximately 3km from the town of Orkney

6.1.2 Matrix analysis

The matrix describes the relevant listed activities, the aspects of the development that will apply to the specific listed activity, a description of the environmental issues and potential impacts, the significance and magnitude of the potential impacts and possible mitigation measures. The matrix also highlights areas of particular concern (see Table 6.3) for more in-depth assessment. An indication is provided of the specialist studies which were conducted and that informed the initial assessment. Each cell is evaluated individually in terms of the nature of the impact, duration and its significance – should no mitigation measures be applied. This is important since many impacts would not be considered insignificant if proper mitigation measures were implemented.

In order to conceptualise the different impacts, the matrix specify the following:

- **Stressor**: Indicates the aspect of the proposed activity, which initiates and cause impacts on elements of the environment.
- **Receptor**: Highlights the recipient and most important components of the environment affected by the stressor.
- **Impacts**: Indicates the net result of the cause-effect between the stressor and receptor.
- **Mitigation**: Impacts need to be mitigated to minimise the effect on the environment.

Detailed impact assessments have been undertaken by each of the respective specialists which has informed the matrix analysis as included in Table 6.3, as well as the key issues identified as included in sections 6.2.1-6.2.3. The Table 6.2 includes reference to the sections in the respective specialist studies where the details of the in-depth assessment of potential environmental impacts can be obtained.

Table 6.2: Reference to the sections in the respective specialist studies where the details of the in-depth assessment of potential environmental impacts can be obtained

Specialist Study	Impact Assessment (pg.)	Cumulative Impacts (pg.)	Mitigation Measures (pg.)
Ecological and Wetland Assessment (Appendix D1)	42-55	Same as Impact Assessment	53 - 55
Avifauna Impact Assessment (Appendix D2)	45 – 47 PV Panels 48 – 49 PL 56 – 58 Description	49 - 50	Same as Impact Assessment
Visual Impact Assessment (Appendix D3)	42 – 58	54 – 57	59 - 61
Agriculture Compliance Statement (Appendix D4)	11 - 12	12 - 14	16 - 22
Heritage Impact Assessment (Appendix D5)	14 – 17	14 - 20	20 - 22
Palaeontological Impact Assessment (Appendix D6)	25 – 30	25 – 30	30
Social Impact Assessment (Appendix D7)	66 – 95	92 - 95	Same as Impact Assessment
Traffic Impact Assessment (Appendix D8)	18 – 25	26 – 29	30 - 32

Table 6.3: Matrix analysis

For ease of reference the significance of the impacts is colour-coded as follow:

Low significance	Medium significance	High significance	Positive impact

LISTED ACTIVITY (The Stressor)	ASPECTS OF THE DEVELOPMENT /ACTIVITY		POTENTIAL IMPACTS		SIGNIFICANCE AND MAGNITUDE OF POTENTIAL IMPACTS							MITIGATION OF POTENTIAL IMPACTS			SPECIALIST STUDIES / INFORMATION
			Receptors	Impact description / consequence	Minor	Major	Extent	Duration	Probability	Reversibility	Irreplaceable loss of resources	Possible Mitigation	Possible mitigation measures	Level of residual risk	
CONSTRUCTION PHASE															
Activity 11(i) (GNR 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* Activity 12(ii)(a)(b) (GNR 327): *"The development of (ii) infrastructure or structures with a physical footprint of 100 square meters or more (a) within a watercourse or (b) within 32 meters of a watercourse, measured from the edge of a watercourse.* Activity 14 (GNR 327): *"The development and related operation of*	Site clearing and preparation Certain areas of the site will need to be cleared of vegetation and some areas may need to be levelled. Civil works The main civil works are: • Terrain levelling if necessary– Levelling will be minimal as the potential site chosen is relatively flat. • Laying foundation- The structures will be connected to the ground through cement pillars, cement slabs or metal screws. The exact method will depend on	BIOPHYSICAL ENVIRONMENT	Fauna & Flora	• Loss of plant species • Loss of rare/medicinal species • Loss of animal species • Loss of biodiversity • Increased soil erosion • Alien plant invasion		-	S	L	D	PR	ML	Yes	- See Table 6.4	L	Ecological and Wetland impact assessment (Appendix D1)
			Wetland/ Riparian areas	• Soil compaction, erosion and sedimentation for the river and riparian area • Soil and water pollution for the river and riparian area • Spread and establishment of alien invasive species for the river and riparian area		-	S	S	U	PR	NL	Yes	- See Table 6.4	L	Ecological and Wetland impact assessment (Appendix D1)
			Avifauna	• Displacement of priority avian species from important habitats. • Displacement of resident avifauna through increased disturbance. • Loss of important avian habitats		-	S	M	Pr	PR	ML	Yes	• Limit construction footprint and retain indigenous vegetation wherever possible.	L	Avifaunal Impact Assessment

facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres." Activity 19 (GNR 327): *"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil sand, shells, shell grit, pebbles or rock of more than 10 cubic meters from a watercourse."* Activity 24 (ii) (GN.R 327): *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters"* Activity 28 (ii) (GN.R 327): *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will*	the detailed geotechnical analysis. • Construction of access and inside roads/paths – existing paths will be used were reasonably possible. Additionally, the turning circle for trucks will also be taken into consideration. Transportation and installation of PV panels into an Array The panels are assembled at the supplier's premises and will be transported from the factory to the site on trucks. The panels will be mounted on metal structures which are fixed into the ground either through a concrete foundation or a deep-seated screw. Wiring to the Central Inverters Sections of the PV array would be wired to central inverters which have a maximum rated power of 2000kW each. The inverter is a pulse width mode inverter that converts DC electricity to alternating electricity (AC) at grid frequency.												• Limit access to remainder of area, avoid breeding season (summer). • Lay-down areas must only be located on disturbed zones. • Construct in shortest timeframe. • Control noise to minimum.		(Appendix D2)
			Air	• Air pollution due to the increase of traffic of construction vehicles and the undertaking of construction activities.	-		S	S	D	CR	NL	Yes	• A speed limit should be enforced on dirt roads (preferably 30-40km/h). • Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.	L	Ecological and Wetland Impact Assessment (Appendix D1)
			Soil	• Loss of agricultural potential by occupation of land • Loss of agricultural potential by soil degradation • Loss of agricultural potential by dust generation	-		S	S	Pr	PR	ML	Yes	- See Table 6.4	L	Agriculture Compliance Statement (Appendix D4)
			Existing services infrastructure	• Generation of waste that needs to be accommodated at a licensed landfill site. • Generation of sewage that need to be accommodated by the local sewage plant. • Increase in construction vehicles on existing roads.		-	L	S	D	PR	ML	Yes	-	L	Confirmation from the Local Municipality to provide services
			Groundwater	• Pollution due to construction vehicles and the storage and handling of dangerous goods.	-		S	S	Pr	CR	ML	Yes	• A groundwater monitoring programme (quality and groundwater levels) should be designed and installed for the site. Monitoring boreholes should be securely capped (where used), and	L	-

occur outside an urban area, where the total land to be developed is bigger than 1 hectare." Activity 56 (ii) (GN.R 327): *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"* Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* Activity 15 (GN.R 325): *"The clearance of an area of 20 hectares or more of indigenous vegetation."* Activity 4 (b)(i)(ee)(gg) (GN.R 324): *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee) critical biodiversity areas as identified in systematic biodiversity plans adopted by the*												must be fitted with a suitable sanitary seal to prevent surface water flowing down the outside of the casing. Full construction details of monitoring boreholes must be recorded when they are drilled (e.g. screen and casing lengths, diameters, total depth, etc). • Sampling of monitoring boreholes should be done according to recognised standards.		
		Surface water / Riparian	• Soil compaction, erosion and sedimentation for the river and riparian area • Soil and water pollution for the river and riparian area • Spread and establishment of alien invasive species for the river and riparian area		-	L	S	U	PR	NL	Yes	• See Table 6.4	L	Ecological and Wetland impact assessment (Appendix D1)
		General Environment (risks associated with BESS)	• Mechanical breakdown / Exposure to high temperatures • Fires, electrocutions and spillage of toxic substances into the surrounding environment. • Spillage of hazardous substances into the surrounding environment. • Soil contamination – leachate from spillages which could lead to an impact of the productivity of soil forms in affected areas. • Water Pollution – spillages into surrounding watercourses as well as groundwater. • Health impacts – on the surrounding communities, particularly those relying on watercourses (i.e. rivers, streams, etc) as a primary source of water.		-	S	M	Pr	PR	ML	Yes	• Operators are trained and competent to operate the BESS. Training should include the discussion of the following: - Potential impact of electrolyte spills on groundwater; - Suitable disposal of waste and effluent; - Key measures in the EMPr relevant to worker's activities; - How incidents and suggestions for improvement can be reported. • Training records should be kept on file and be made available during audits. • Battery supplier user manuals safety specifications and Material Safety Data Sheets (MSDS) are filed on site at all times.	L	-

competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas." <u>Activity 10 (b)(i)(ee)(gg) (GN.R 324):</u> *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified*				• Generation of hazardous waste								• Compile method statements for approval by the Technical/SHEQ Manager for the operation and management and replacement of the battery units / electrolyte for the duration of the project life cycle. Method statements should be kept on site at all times. • Provide signage on site specifying the types of batteries in use and the risk of exposure to harzardous material and electric shock. Signage should also specify how electrical and chemical fires should be dealt with by first responders, and the potential risks to first responders (e.g. the inhalation of toxic fumes, etc.). • Firefighting equipment should readily be available at the BESS area and within the site. • Maintain strict access control to the BESS area. • Ensure all maintenance contractors / staff are familiar with the supplier's specifications. • Undertake daily risk assessment prior to the commencement of daily tasks at the BESS. This should consider any aspects which could result in fire or spillage, and appropriate actions should be taken to prevent these. • Standard Operating Procedures (SOPs) should be made available by the Supplier to ensure that the batteries are handled in accordance with required best practices. • Spill kits must be made available to address any incidents associated with the flow of chemicals from the		

in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas." <u>Activity 12 (b)(i)(ii)(iv) (GN.R 324):</u> *"The clearance of an area of 300 square metres or more of indigenous vegetation…(b) in the Free State (i) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans and (iv) areas within a watercourse or wetland; or within 100 metres from the edge of watercourse or wetland."* <u>Activity 14(xii)(a)(b)(i) (GN.R 324):</u> *"The development of (xii) infrastructure or structures with a physical footprint of 10 square metres or more where such*												batteries into the surrounding environment. • The assembly of the batteries on-site should be avoided as far as possible. Activities on-site for the BESS should only be limited to the placement of the container wherein the batteries are placed. • Undertake periodic inspections on the BESS to ensure issues are identified timeously and addressed with the supplier where relevant. • The applicant in consultation with the supplier must compile and implement a Leak and Detection Monitoring Programme during the project life cycle of the BESS. • Batteries must be strictly maintained by the supplier or suitably qualified persons for the duration of the project life cycle. No unauthorised personnel should be allowed to maintain the BESS. • Damaged and used batteries must be removed from site by the supplier or any other suitably qualified professional for recycling or appropriate disposal. • The applicant should obtain a cradle to grave battery management plan from the supplier during the planning and design phase of the system. The plan must be kept on site and adhered to.		
		SOCIAL/ECONOMIC ENVIRONMENT	Local unemployment rate	• Job creation. • Business opportunities. • Skills development.		+	P	S	D	I	N/A	Yes	• Where reasonable and practical, the SPP service providers should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories	L	Social Impact Assessment (Appendix D7)

development occurs (a) within a watercourse; in the (b) Free State Province, (i) outside urban areas, within (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve." <u>Activity 18 (b)(i)(ee)(gg)(hh) (GN.R 324):</u> *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas, within (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans, (gg) areas within 10 kilometres from national parks or world heritage*			Visual landscape	• Potential visual impact on residents of farmsteads and motorists in close proximity to proposed facility.	-		L	S	D	CR	NL	Yes	• Ensure that vegetation is not unnecessarily removed during the construction phase. • Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e., in already disturbed areas) where possible. • Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads. • Ensure that rubble, litter, etc. are appropriately stored (if it can't be removed daily) and then disposed of regularly at a licenced waste site. • Reduce and control dust during construction by utilising dust suppression measures. • Construction activities should be limited to between the hours of 07:00 and 18:00, where possible, in order to reduce the impacts of construction lighting. • Rehabilitate all disturbed areas immediately after the completion of construction work and maintain good housekeeping.	L	Visual Impact Assessment (Appendix D3)
			Traffic volumes	• Traffic Congestion and the associated dust and noise pollution. • Transport of equipment, material and staff to site will lead to congestion.	-		L	S	D	CR	NL	Yes	• Stagger component delivery to site • Reduce the construction period • Make use of mobile batch plants and quarries in close proximity to the site • Staff and general trips must occur outside of peak traffic periods.	L	Traffic Impact Assessment (Appendix D8)

sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas and (hh) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland."												• Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase		
			Health & Safety	• Air/dust pollution. • Road safety. • Impacts associated with the presence of construction workers on site and in the area. • Influx of job seekers to the area. • Increased safety risk to farmers, risk of stock theft and damage to farm infrastructure associated with presence of construction workers on the site. • Increased risk of veld fires.		-	L	L	Pr	PR	ML	Yes	• See Table 6.4	L	Social Impact Assessment (Appendix D7)
			Noise levels	• The generation of noise as a result of construction vehicles, the use of machinery such as drills and people working on the site.		-	L	S	D	CR	NL	Yes	• During construction care should be taken to ensure that noise from construction vehicles and plant equipment does not intrude on the surrounding residential areas. Plant equipment such as generators, compressors, concrete mixers as well as vehicles should be kept in good operating order and where appropriate have effective exhaust mufflers.	L	Social Impact Assessment (Appendix D7)
			Tourism industry	• Since there are no tourism facilities in close proximity to the site, the proposed activities will not have an impact on tourism in the area.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Heritage resources	• Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries		-	S	S	U	PR	NL	Yes	• No sites or features of cultural and heritage significance were present on site. • Any discovered artifacts shall not be removed under any circumstances. Any destruction of a site can only be allowed once a permit is obtained, and the site has been mapped and noted. Permits shall be obtained from the SAHRA	L	Heritage Impact Assessment (Appendix D5)

													should the proposed site affect any world heritage sites or if any heritage sites are to be destroyed or altered.		
			Paleontological Heritage	• Disturbance, damage or destruction of legally-protected fossil heritage within the development footprint during the construction phase		-	S	P	U	BR	CL	Yes	• The ECO must be made aware that fossils (stromatolites) of the Malmani (Chuniespoort Group, Transvaal Supergroup) has a Very High Palaeontological Significance. • When the Thakadu Power Plant layout has been established a walkdown of the area must be completed by a qualified Palaeontologist to catalogue and photograph well-preserved stromatolites. This action should take place after initial vegetation clearance but *before* the ground is levelled for construction. • If a well-preserved stromatolite outcrop falls in the development footprint the stromatolites ought to be cordoned off and a buffer of 30m should be placed around the outcrop. • A representative example of well-preserved stromatolites should be removed and placed near the offices of the PV as a informative example of fossils in the area.	L	Paleontological Impact Assessment (Appendix D6)
OPERATIONAL PHASE															

Activity 11(i) (GN.R. 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* Activity 10 (b)(i)(ee) (GN.R 324): *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in*	The key components of the proposed project are described below: • PV Panel Array - To produce 150 MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun. • Wiring to Central Inverters - Sections of the PV array will be wired to central inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency. • Connection to the grid Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components	BIOPHYSICAL ENVIRONMENT	Fauna and Flora	• Soil erosion and pollution • Spread and establishment of alien invasive plant species • Negative effect of human activities on fauna and road mortalities • Loss of biodiversity		-	S	M	Po	PR	ML	Yes	• See Table 6.5	L	Ecological and Wetland Impact Assessment (Appendix D1)
			Avifauna	• Displacement of priority avian species from important habitats • Displacement of resident avifauna through increased disturbance • Collisions with PV panels leading to injury or loss of avian life • Collision when flying into power line infrastructure • Electrocution when perched on power line infrastructure		-	S	L	Pr	PR	ML	Yes	• See Table 6.5	M	Avifaunal Impact Assessment (Appendix D2)
			Air quality	• The proposed development will not result in any air pollution during the operational phase.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Soil and Agriculture	• Increased financial security for farming operations • Impacts on agricultural production and employment		-	L	L	D	PR	SL	Yes	• No mitigation required. The development will result in the loss of productivity of 57 head of cattle from the farm. Although there is a one farm worker allocated to the site, he is likely to be utilised for work elsewhere in the farming enterprise, and so the development is likely to have no impact on agricultural employment.	L	Agriculture Compliance Statement (Appendix D4)
			Groundwater	• Leakage of hazardous materials. The development will comprise of a distribution substation and switching station and will include transformer bays which will contain transformer oils. Leakage of these oils can contaminate water supplies.	-		L	L	Po	PR	ML	Yes	• All areas in which substances potentially hazardous to groundwater are stored, loaded, worked with or disposed of should be securely bunded (impermeable floor and sides) to prevent accidental discharge to groundwater.	L	-

systematic biodiversity plans adopted by the competent authority or in bioregional plans."	and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation and switching station will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid. • <u>Supporting Infrastructure</u> – Auxiliary buildings with basic services such as water and electricity will be constructed on the site and will have an approximate footprint 820m². Other supporting infrastructure includes voltage and current regulators, protection circuitry and Battery Energy Storage Systems (BESS). • <u>Roads</u> – Access will be obtained via the Stokkiesdraai road of the R30. An internal site road network will also be required to	SOCIAL/ECONOMIC	Wetland/ riparian areas	• Erosion of riverbank • Soil & water pollution		-	L	L	U	PR	ML	Yes	• No development allowed within the Riverine area associated with the Vaal River. • Drainage must be controlled to ensure that runoff from the site will not culminate in off-site pollution or result in rill and gully erosion.	L	Ecology and Wetland Impact Assessment (Appendix D1)
			Visual landscape	• Visual impact on observers travelling along the roads and residents at homesteads within a 5km radius of the SPP. • Visual impact on observers travelling along the roads and residents at homesteads within a 5-10km radius of the SPP. • Visual impacts of lighting at night on sensitive visual receptors in close proximity to the proposed facility. • Visual impacts of glint and glare on sensitive visual receptors in close proximity to the proposed facility. • Visual impacts on observers travelling along the roads and residents at homesteads in close proximity to the power line structures. • Visual impacts and sense of place impacts associated with the operation phase of Thakadu SPP.		-	L	L	D	PR	ML	Yes	• See Table 6.5	L	Visual Impact Assessment (Appendix D3)
			Traffic volumes	• The proposed development will not result in any traffic impacts during the operational phase.			-	-	-	-	-	-	The traffic generated during this phase will be negligible and will not have any impact on the surrounding road network.	-	Traffic Impact Assessment (Appendix D8)
			Health & Safety	• The proposed development will not result in any health and safety	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A

	provide access to the solar field and associated infrastructure. All site roads will require a width of approximately 6 m – 12 m. • Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm.			impacts during the operational phase.										
			Noise levels	• The proposed development will not result in any noise pollution during the operational phase.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Heritage resources	• Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries.	-		S	S	U	PR	NL	Yes	• No sites or features of cultural and heritage significance were present on site. • Any discovered artifacts shall not be removed under any circumstances. Any destruction of a site can only be allowed once a permit is obtained and the site has been mapped and noted. Permits shall be obtained from the SAHRA should the proposed site affect any world heritage sites or if any heritage sites are to be destroyed or altered.	L	Heritage Impact Assessment (Appendix D5)
			Electricity supply	• Generation of additional electricity. • The power line will transport generated electricity into the grid.	+		I	L	D	I	N/A	Yes	-	N/A	-
			Electrical infrastructure	• Additional electrical infrastructure. The proposed solar facility will add to the existing electrical infrastructure and aid to lessen the reliance of electricity generation from coal-fired power stations.	+		I	L	D	I	N/A	Yes	-	N/A	-
DECOMMISSIONING PHASE															
-	Dismantlement of infrastructure During the decommissioning phase the Solar PV Energy facility and its associated infrastructure will be dismantled. Rehabilitation of biophysical environment	BIOPHYSICAL ENVIRONMENT	Fauna and Flora	• Habitat destruction caused by clearance of vegetation • Soil and water pollution • Spread and establishment of alien invasive species • Negative effect of human activities on fauna and road mortalities		-	S	L	Po	PR	ML	Yes	• All temporary stockpile areas, litter and dumped material and rubble must be removed and discarded with in an environmentally friendly way • Undeveloped areas that were degraded due to human activities must be rehabilitated. • Hazardous chemicals must be stored on an impervious surface and protected from the elements. These chemicals must be strictly	L	Ecology and Wetland Impact Assessment (Appendix D1)

	The biophysical environment will be rehabilitated.												controlled, and records kept of when it was used and by whom. • Any alien plants observed must be reported to the environmental manager and must be removed as soon as possible. • All vehicles should be inspected for oil and fuel leaks on a regular basis. • No activity must be allowed within the Riverine area associated with the Vaal River. • Drainage must be controlled to ensure that runoff from the site will not culminate in off-site pollution or result in rill and gully erosion.		
			Air quality	• Air pollution due to the increase of traffic of construction vehicles	-		S	S	D	CR	NL	Yes	• Regular maintenance of equipment to ensure reduced exhaust emissions.	L	-
			Soil	• Soil degradation, including erosion • Disturbance of soils and existing land use (soil compaction) • Physical and chemical degradation of the soils by construction vehicles (hydrocarbon spills)		-	S	S	Pr	PR	M	Yes	• Implement an effective system of stormwater run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion. • Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion. • If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and	L	Agriculture and Soils Compliance Statement (Appendix D4)

													stockpiled for re-spreading during rehabilitation. • During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.		
			Existing services infrastructure	• Generation of waste that needs to be accommodated at a licensed landfill site • Generation of sewage that needs to be accommodated by the municipal sewerage system and the local sewage plant • Increase in construction vehicles	-		L	S	D	I	NL	Yes	-	L	Confirmation from the Local Municipality to provide services
			Groundwater	• Pollution due to construction vehicles	-		S	S	Pr	CR	ML	Yes	- All vehicles should be inspected for oil and fuel leaks on a regular basis. - Vehicle maintenance yards on site should make provision for drip trays that will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.	L	-
			Surface water / riparian	• Erosion of riverbank • Soil pollution • Increase in stormwater run-off		-	L	S	Po	PR	ML	Yes	• The release of stormwater must be designed such that the force of the water is reduced to prevent unnecessary erosion. • No dumping of waste should take place within the riparian area. If any spills occur, they should be cleaned up immediately. • Remove all substances which can result in groundwater (or surface water) pollution.	L	Ecology and Wetland Impact Assessment (Appendix D1)
			Visual landscape	• Potential visual impact on visual receptors in close proximity to proposed facility. • The decommissioning phase of the project will result in the same visual impacts experienced during the	-		L	S	D	CR	NL	Yes	• Locate laydown and storage areas in zones of low visibility i.e. behind tall trees or in lower lying areas. •	L	Visual Impact Assessment (Appendix D3)

				construction phase of the project. However, in the case of Thakadu SPP it is anticipated that the proposed facility will be refurbished and upgraded to prolong its life.											
			Traffic volumes	- Traffic Congestion and the associated dust and noise pollution. • Transport of equipment, material and staff to site will lead to congestion.	-		L	S	D	CR	NL	Yes	• Stagger component delivery to site. • Reduce the construction period. • Make use of mobile batch plants and quarries in close proximity to the site • Staff and general trips should occur outside of peak traffic periods. • Regular maintenance of gravel roads by the Contractor must be undertaken.	L	Traffic Impact Assessment (Appendix D8)
			Health & Safety	• Air/dust pollution. • Road safety. • Increased crime levels. The presence of construction workers on the site may increase security risks associated with an increase in crime levels as a result of influx of people in the rural area.	-		L	S	Pr	PR	ML	Yes	• Demarcated routes to be established for construction vehicles to ensure the safety of communities, especially in terms of road safety and communities to be informed of these demarcated routes. • Where dust is generated by trucks passing on gravel roads, dust mitigation must be enforced. • Any infrastructure that would not be decommissioned must be appropriately locked and/or fenced off to ensure that it does not pose any danger to the community. • Components that are dismantled must be recycled / reduced as far as possible.	L	Social Impact Assessment (Appendix D7)
			Noise levels	• The generation of noise as a result of construction vehicles, the use of machinery and people working on the site	-		L	S	D	CR	NL	Yes	• The decommissioning phase must aim to adhere to the relevant noise regulations and limit noise within standard working hours in order to	L	Social Impact Assessment

													reduce disturbance of dwellings in close proximity to the development.		(Appendix D7)
			Tourism industry	• Since there are no tourism facilities in close proximity to the site, the decommissioning activities will not have an impact on tourism in the area.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Heritage resources	• It is not foreseen that the decommissioning phase will impact on any heritage resources.	-		S	S	U	PR	ML	Yes	- Any discovered artifacts shall not be removed under any circumstances. Any destruction of a site can only be allowed once a permit is obtained and the site has been mapped and noted. Permits shall be obtained from the SAHRA should the proposed site affect any world heritage sites or if any heritage sites are to be destroyed or altered.	L	Heritage Impact Assessment (Appendix D5)

Nature of the impact:	(N/A) No impact	(+) Positive Impact	(-) Negative Impact	
Geographical extent:	(S) Site;	(L) Local/District;	(P) Province/Region;	(I) International and National
Probability:	(U) Unlikely;	(Po) Possible;	(Pr) Probable;	(D) Definite
Duration:	(S) Short Term;	(M) Medium Term;	(L) Long Term;	(P) Permanent
Intensity / Magnitude:	(L) Low;	(M) Medium;	(H) High;	(VH) Very High
Reversibility:	(CR) Completely Reversible;	(PR) Partly Reversible;	(BR) Barely Reversible;	-
Irreplaceable loss of resources:	(IR) Irreversible	(NL) No Loss;	(ML) Marginal Loss;	(SL) Significant Loss;	(CL) Complete Loss
Level of residual risk:	(L) Low;	(M) Medium;	(H) High;	(VH) Very High	-

The recommended mitigation measures are included in the Environmental Management Programme for the project. The EMPr for the Solar Power Plant is included in Appendix F1. The EMPr for the power line is included in Appendix F2 and the EMPr for the substation is included in Appendix F3.

An Environmental Awareness and Fire Management Plan is included in Appendix I of the EMPr in Appendix F1.

6.2 KEY ISSUES IDENTIFIED

From the above it is evident that mitigation measures should be available for potential impacts associated with the proposed activity and development phases. The scoping methodology identified the following key issues which were addressed in more detail in the BA report.

6.2.1 Impacts during the construction phase

During the construction phase the following activities will have various potential impacts on the biophysical and socio-economic environment:

- Activity 11(i) (GNR 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."*
- Activity 12(ii)(a)(b) (GNR 327): *"The development of (ii) infrastructure or structures with a physical footprint of 100 square meters or more (a) within a watercourse or (b) within 32 meters of a watercourse, measured from the edge of a watercourse.*
- Activity 14 (GNR 327): *"The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres."*
- Activity 19 (GNR 327): *"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil sand, shells, shell grit, pebbles or rock of more than 10 cubic meters from a watercourse."*
- Activity 24 (ii) (GN.R 327): *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters"*
- Activity 28 (ii) (GN.R 327): *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare."*
- Activity 56 (ii) (GN.R 327): *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"*
- Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."*
- Activity 15 (GN.R 325): *"The clearance of an area of 20 hectares or more of indigenous vegetation."*
- Activity 4 (b)(i)(ee)(gg) (GN.R 324): *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee) critical biodiversity areas as identified in systematic biodiversity plans*

adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."

- Activity 10 (b)(i)(ee)(gg) (GN.R 324): *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."*

- Activity 12 (b)(i)(ii)(iv) (GN.R 324): *"The clearance of an area of 300 square metres or more of indigenous vegetation…(b) in the Free State (i) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans and (iv) areas within a watercourse or wetland; or within 100 metres from the edge of watercourse or wetland."*

- Activity 14(xii)(a)(b)(i) (GN.R 324): *"The development of (xii) infrastructure or structures with a physical footprint of 10 square metres or more where such development occurs (a) within a watercourse; in the (b) Free State Province, (i) outside urban areas, within (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve."*

- Activity 18 (b)(i)(ee)(gg)(hh) (GN.R 324): *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas, within (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans, (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas and (hh) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland."*

During the construction phase minor negative impacts are foreseen over the short term. The latter refers to a period of months. Table 6.4 summarises the potentially most significant impacts and the mitigation measures that are proposed during the construction phase.

Table 6.4: Impacts and the mitigation measures during the construction phase

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Ecology and Wetland Assessment (Appendix D1)	Loss of plant species	Negative High	Negative Low	• No development should be allowed in vegetation unit 2 (*Vachellia karroo* dolomite woodland), 8 (Drainage channel) and 9 (Riverine area). • These areas should be fenced off prior to construction and zoned as no-go areas • The entire area to be developed must be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. • To minimise the effect on the vegetation, insects, small mammals, and environment it is recommended that the construction be done within the winter period as far as possible, when most plants are dormant and animals less active • Where vegetation of areas not to be developed needs to be "opened" to gain access it is recommended that the herbaceous species are cut short rather than removing them. • Vegetation clearance should be restricted to the approved development areas allowing remaining animals the opportunity to move away from the disturbance. The Environment Control Officer (ECO) should monitor these areas.

				• Storage of equipment, fuel and other materials should be limited to demarcated areas. • A Re-vegetation and Rehabilitation Manual should be prepared for the use of contractors, landscape architects and groundsmen to rehabilitate areas that became degraded due to construction activities • Monitoring of all these activities must be done on at least a weekly basis by the ECO during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area. Any transgressing of rules must be reported to and by the ECO. • The ECO should keep a daily register of activities and reports.
	Loss of rare/medicinal species	Negative medium	Negative Low	• Where vegetation of areas not to be developed needs to be "opened" to gain access it is recommended that the herbaceous species are cut short rather than removing them. • Vegetation clearance should be restricted to the approved development areas allowing remaining animals the opportunity to move away from the disturbance. The Environment Control Officer (ECO) should control these areas. • The entire area to be developed must be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area.
	Loss of animal species	Negative medium	Negative Low	• To minimise the effect on the vegetation, insects, small mammals, and environment it is recommended that the construction be done within the

				winter period as far as possible, when most plants are dormant and animals less active • No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site • Where equipment or holes pose a risk to animal safety, they must be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. These areas should be monitored on a daily basis to ensure no animal is intentionally injured.
	Loss of biodiversity	Negative Medium	Negative Low	• No development should be allowed in vegetation unit 2 (*Vachellia karroo* dolomite woodland), 8 (Drainage channel) and 9 (Riverine area). • These areas should be fenced off prior to construction and zoned as no-go areas • The entire area to be developed must be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. • To minimise the effect on the vegetation, insects, small mammals, and environment it is recommended that the construction be done within the winter period as far as possible, when most plants are dormant and animals less active • Where vegetation of areas not to be developed needs to be "opened" to gain access it is recommended that the herbaceous species are cut short rather than removing them.

	Increased soil erosion	Negative Low	Negative Low	• All stormwater and runoff generated by the development activities must be appropriately managed (see specialist report for more details) • Clearing activities and earth scraping should preferably be restricted to the dry season to prevent erosion. • A stormwater plan also needs to be developed for the solar panel areas so that erosion over the long-term does not happen. That should include achieving a good vegetation cover and rehabilitation where needed.
	Alien plant invasion	Negative Low	Negative Low	• Alien invasive plants present within vegetation units 1, 2, 8 and 9 must be removed and eradicated
Wetland and Riverine Assessment (Appendix D1)	Soil compaction, erosion and sedimentation for the river and riparian area	Negative High	Negative Low	• No development should be allowed in vegetation unit 2 (*Vachellia karroo* dolomite woodland), 8 (Drainage channel) and 9 (Riverine area). • Area should be fenced off prior to construction and declared as a No-Go area. • Sandbags should be placed along the edge of the 32m buffer zone of vegetation unit 8 (drainage line) if construction is to take place adjacent to this area • Compaction of soils within the drainage line area (vegetation unit 8) should be avoided as far as possible (no development). Compaction will reduce water infiltration and will result in increased runoff and erosion • No construction vehicles must be allowed to drive within the riverine area and associated buffer zone.

	Soil and water pollution for the river and riparian area	Negative High	Negative Low	• No hazardous materials should be stored within 300 m of the river area. • No cleaning of equipment should be done closer than 300m of the edge of the buffer zone
	Spread and establishment of alien invasive species in the river and riparian area	Negative High	Negative Low	• No development should be allowed within the Riverine area or its 32m buffer zone • Area should be fenced off prior to construction and declared as a No-Go area • Any alien plant invasion noted should be reported to the ECO • No dumping of removed plant material must be allowed within 300m of the riverine buffer zone.
Avifaunal Assessment (Appendix D2)	Displacement of priority avian species from important habitats (PV array and associated infrastructure)	Negative Low	Negative Low	• Limit construction footprint and retain indigenous vegetation wherever possible. • Limit access to remainder of area outside of the construction footprint. • Avoid construction during the breeding season (summer). • Laydown areas to be located only in disturbed zones. • Construct in shortest timeframe. • Control noise to minimum.

	Displacement of resident avifauna through increased disturbance (PV array and associated infrastructure)	Negative Medium	Negative Low	• Limit construction footprint and retain indigenous vegetation wherever possible. • Limit access to remainder of area outside of the construction footprint. • Avoid construction during the breeding season (summer). • Laydown areas to be located only in disturbed zones. • Construct in shortest timeframe. • Control noise to minimum.
	Loss of important avian habitats (PV array and associated infrastructure)	Negative Medium	Negative Low	• Limit construction footprint. • Limit access to remainder of area outside of the construction footprint. • Laydown areas to be located only in disturbed zones. • Construct in shortest timeframe. • Use existing roads as far as possible. • Rehabilitate with indigenous vegetation.
	Displacement of priority avian species from important habitats (Power Line)	Negative Medium	Negative Low	• Limit construction footprint and retain indigenous vegetation wherever possible. • Limit access to remainder of area outside of the construction footprint. • Avoid construction during the breeding season (summer). • Laydown areas to be located only in disturbed zones.

				• Construct in shortest timeframe. • Control noise to minimum. • Maintain a single access and maintenance road within power line servitude.
	Displacement of resident avifauna through increased disturbance (Power Line)	Negative Low	Negative Low	• None required due to low significance
	Loss of important avian habitats (Power Line)	Negative Low	Negative Low	• None required due to low significance
Agriculture Compliance Statement (Appendix D4)	Loss of agricultural potential by occupation of land	Negative Low	Negative Low	• No mitigation measures based on the low impact significance. Agricultural land directly occupied by the development infrastructure will become unavailable for agricultural use, with consequent potential loss of agricultural productivity and employment. The site assessment has found that the soils across most of the site are unsuitable, or at best very marginal, for the production of cultivated crops, and are therefore only suited to grazing.
	Loss of agricultural potential by soil degradation	Negative Low	Negative Low	• Implement an effective system of storm water run-off control, where it is required - that is at all points of disturbance where water accumulation might occur. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion. Any occurrences of erosion must be attended to

				immediately and the integrity of the erosion control system at that point must be amended, to prevent further erosion from occurring there. • Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion. • If an activity will mechanically disturb the soil profile below surface, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation, which may be after construction or only at decommissioning. The depth of topsoil stripping is dependent on the specific field conditions. The maximum depth should be 30cm. If additional unconsolidated material exists below 30cm and needs to be removed for construction purposes, it must be stripped and stockpiled separately from the upper 30cm topsoil. Such material should only be used for fill below a topsoil layer, and not used for spreading on the surface. If there is less than 30cm of unconsolidated soil material above a limiting layer of rock or hardpan, then the entire depth must be stripped and stockpiled as topsoil, even if it contains a high proportion of course fragments. • Topsoil should be retained in the area below the panels (or mirrors). It is not desirable to strip and stockpile this topsoil for the whole of the operational phase. It will be much more effective for rehabilitation, to retain the topsoil in place. If levelling requires significant cutting, topsoil should be temporarily stockpiled and then re-spread after cutting, so that there is a covering of topsoil over the entire surface before the panels are mounted. It will be advantageous to have topsoil and vegetation cover

				below the panels during the operational phase for the following reasons: conservation of topsoil, dust suppression and erosion control. • It is only in areas where topsoil cannot be retained on the surface during the operational phase, and where the area will be rehabilitated back to veld after decommissioning, that it should be stripped and stockpiled for the duration of the operational phase for re-spreading during de-commissioning. • Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. • Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land. • During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. • If there is compaction, either in re-spread topsoil or in areas where topsoil was retained during the operational phase, it must be loosened through an appropriate plough action. • If topsoil has been stockpiled for the duration of the operational phase, re-vegetation is likely to require seeding and / or planting. • Erosion must be carefully controlled where necessary on topsoiled areas.
	Loss of agricultural potential by dust generation	Negative Low	Negative Low	• Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil.

Heritage Impact Assessment (Appendix D5)	Direct or physical impacts, implying alteration or destruction of heritage features	Negative Low	Negative Low	• 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).
Palaeontological Impact Assessment (Appendix D6)	Disturbance, damage or destruction of legally protected fossil heritage within the development footprint during the construction phase	Negative Medium	Negative Low	• The ECO must be made aware that fossils (stromatolites) of the Malmani (Chuniespoort Group, Transvaal Supergroup) has a Very High Palaeontological Significance. • When the Thakadu Power Plant layout has been established a walkdown of the area must be completed by a qualified Palaeontologist to catalogue and photograph well-preserved stromatolites. This action should take place

				after initial vegetation clearance but before the ground is levelled for construction. • If a well-preserved stromatolite outcrop falls in the development footprint the stromatolites ought to be cordoned off and a buffer of 30m should be placed around the outcrop. • A representative example of well-preserved stromatolites should be removed and placed near the offices of the PV as a informative example of fossils in the area.
Visual Impact Assessment (Appendix D3)	Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed Thakadu SPP	Negative Medium	Negative Low	Planning • Retain and maintain natural vegetation immediately adjacent to the development footprint. Construction • Ensure that vegetation is not unnecessarily removed during the construction phase. • Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e., in already disturbed areas) where possible. • Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads. • Ensure that rubble, litter, etc. are appropriately stored (if it can't be removed daily) and then disposed of regularly at a licenced waste site.

				• Reduce and control dust during construction by utilising dust suppression measures. • Reduce construction activities between 07:00 and 18:00, where possible, in order to reduce the impacts of construction lighting. • Rehabilitate all disturbed areas immediately after the completion of construction work and maintain good housekeeping.
Social Impact Assessment (Appendix D7)	Direct and indirect employment opportunities and skills development	Positive Low	Positive Medium	Enhancement: • A local employment policy should be adopted to maximise opportunities made available to the local labour force. • Labour should be sourced from the local labour pool, and only if the necessary skills are unavailable should labour be sourced from (in order of preference) the greater Moqhaka LM, Fezile Dabi DM, Free State Province, South Africa, or elsewhere. • Where feasible, training and skills development programmes should be initiated prior to the commencement of the construction phase. • As with the labour force, suppliers should also as far as possible be sourced locally. • As far as possible local contractors that are compliant with Broad-Based Black Economic Empowerment (B-BBEE) criteria should be used. • The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

	Economic Multiplier effect	Positive Low	Positive Medium	Enhancement: • It is recommended that a local procurement policy is adopted to maximise the benefit to the local economy. • A database of local companies, specifically Historically Disadvantaged Individuals (HDIs) which qualify as potential service providers (e.g., construction companies, security companies, catering companies, waste collection companies, transportation companies etc.) should be created and companies listed thereon should be invited to bid for project-related work where applicable. • Local procurement is encouraged along with engagement with local authorities and business organisations to investigate the possibility of procurement of construction materials, goods and products from local suppliers where feasible.
	Potential loss of productive farmland	Negative Medium	Negative Low	• The proposed site for the Thakadu SPP needs to be fenced off prior to the construction phase and all construction related activities should be confined in this fenced off area. • Livestock grazing on the proposed site need to be relocated. • All affected areas, which are disturbed during the construction phase, need to be rehabilitated prior to the operational phase and should be continuously monitored by the Environmental Control Officer (ECO). • Implement, manage and monitor a grievance mechanism for the recording and management of social issues and complaints.

	Influx of jobseekers and change in population	Negative Medium	Negative Low	• Develop and implement a local procurement policy which prioritises "locals first" to prevent the movement of people into the area in search of work. • Engage with local community representatives prior to construction to facilitate the adoption of the locals first procurement policy. • Provide transportation for workers (from Viljoenskroon, Orkney and surrounds) to ensure workers can easily access their place of employment and do not need to move closer to the project site. • Working hours should be kept between daylight hours during the construction phase, and / or as any deviation that is approved by the relevant authorities. • Compile and implement a grievance mechanism. • Appoint a Community Liaison Officer (CLO) to assist with the procurement of local labour. • Prevent the recruitment of workers at the project site. • Implement, manage and monitor a grievance mechanism for the recording and management of social issues and complaints. • Establish clear rules and regulations for access to the proposed site. • Appoint a security company and implement appropriate security procedures to ensure that workers do not remain onsite after working hours.

				• Inform local community organisations and policing forums of construction times and the duration of the construction phase. • Establish procedures for the control and removal of loiterers from the construction site.
	Safety and security impacts	Negative Medium	Negative Low	• Working hours should be kept within daylight hours during the construction phase, and / or as any deviation that is approved by the relevant authorities. • Provide transportation for workers to prevent loitering within or near the project site outside of working hours. • The perimeter of the construction site should be appropriately secured to prevent any unauthorised access to the site. The fencing of the site should be maintained throughout the construction period. • The appointed EPC Contractor must appoint a security company to ensure appropriate security procedures and measures are implemented. • Access in and out of the construction site should be strictly controlled by a security company appointed to the project. • A CLO should be appointed as a grievance mechanism. A method of communication should be implemented whereby procedures to lodge complaints are set out for the local community to express any complaints or grievances with the construction process. • The EPC Contractor should implement a stakeholder management plan to address neighbouring farmer concerns regarding safety and security.

				• The project proposed must prepare and implement a Fire Management Plan; this must be done in conjunction with surrounding landowners. • The EPC Contractor must prepare a Method Statement which deals with fire prevention and management.
	Impacts on daily living and movement patterns	Negative Medium	Negative Medium	• All vehicles must be road worthy, and drivers must be qualified, obey traffic rules, follow speed limits and be made aware of the potential road safety issues. • Heavy vehicles should be inspected regularly to ensure their road worthiness. • Provision of adequate and strategically placed traffic warning signs, that have to be maintained for the duration of the construction phase, and control measures along the R30 and Stokkiesdraai roads to warn road users of the construction activities taking place for the duration of the construction phase. Warning signs must be always visible, especially at night. • Implement penalties for reckless driving to enforce compliance to traffic rules. • Avoid heavy vehicle activity during “peak” hours (when children are taken to school, or people are driving to work). • The developer and EPC Contractor must ensure that all fencing along access roads is maintained in the present condition or repaired if disturbed due to construction activities.

				• The developer and EPC Contractor must ensure that the roads utilised for construction activities are either maintained in the present condition or upgraded if disturbed due to construction activities. • The EPC Contractor must ensure that damage / wear and tear caused by construction related traffic to the access roads is repaired before the completion of the construction phase. • A method of communication must be implemented whereby procedures to lodge complaints are set out for the local community to express any complaints or grievances with the construction process.
	Nuisance impacts (noise and dust)	Negative Medium	Negative Low	• The movement of heavy vehicles associated with the construction phase should be timed to avoid weekends, public holidays, and holiday periods where feasible. • Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. • Ensure all vehicles are road worthy, drivers are qualified and are made aware of the potential noise and dust issues. • A CLO should be appointed, and a grievance mechanism implemented.
	Increased risk of potential veld fires	Negative Medium	Negative Low	• A firebreak should be implemented before the construction phase. The firebreak should be controlled and implemented around the perimeters of the project site.

				• Adequate fire-fighting equipment should be provided and readily available on site and all staff should be trained in firefighting and how to use the fire-fighting equipment. • No staff (except security) should be accommodated overnight on site and the contractor should ensure that no open fires are allowed on site. The use of cooking or heating implements should only be used in designated areas. • Contractors need to ensure that any construction related activities that might pose potential fire risks, are done in the designated areas where it is also managed properly. • Precautionary measures need to be taken during high wind conditions or during the winter months when the fields are dry. • The contractor should enter an agreement with the local farmers before the construction phase that any damages or losses during the construction phase related to the risk of fire and that are created by staff during the construction phase, are borne by the contractor.
	Visual and sense of place impacts	Negative Low	Negative Low	• Implement mitigation measures identified in the Visual Impact Assessment (VIA) prepared for the project. • Limit noise generating activities to normal daylight working hours and avoid weekends and public holidays. • The movement of heavy vehicles associated with the construction phase should be timed to avoid weekends, public holidays, and holiday periods where feasible.

				• Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. • All vehicles must be road-worthy, and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits. • Communication, complaints, and grievance channels must be implemented and contact details of the CLO must be provided to the local community in the study area.
Traffic Impact Assessment (Appendix D8)	Traffic Congestion and the associated dust and noise pollution	Negative Medium	Negative Low	• Stagger component delivery to site. • Reduce the construction period. • The use of mobile batch plants and quarries in close proximity to the site. • Staff and general trips should occur outside of peak traffic periods. • Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase.

6.2.2 Impacts during the operational phase

During the operational phase the study area will serve as a solar plant. The potential impacts will take place over a period of 20 – 25 years. During the operational phase the following activities will have various potential impacts on the biophysical and socio-economic environment:

- Activity 11(i) (GN.R. 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."*
- Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."*
- Activity 10 (b)(i)(ee)(gg) (GN.R 324): *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans and (gg) areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas."*

Table 6.5 summarised the negative impacts are generally associated with the Solar Power Plant (including other associated infrastructure) and power line, which include impacts on the fauna and flora, soils, geology, surface water, the pressure on existing services infrastructure, and visual impacts. The provision of sustainable services delivery also needs to be confirmed. The operational phase will have a direct positive impact through the provision of employment opportunities for its duration, and the generation of income to the local community

Table 6.5: Impacts and the mitigation measures during the operational phase

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Ecology and Wetland Assessment (Appendix D1)	Soil erosion and pollution	Negative Medium	Negative Low	• All temporary stockpile areas, litter and dumped material and rubble must be removed and discarded with in an environmentally friendly way • Undeveloped areas that were degraded due to human activities must be rehabilitated. • Hazardous chemicals must be stored on an impervious surface and protected from the elements. These chemicals must be strictly controlled, and records kept of when it was used and by whom • Limit human activity in the no-developed areas as well as the completed areas to the minimum required for ongoing operation • All vehicles should be inspected for oil and fuel leaks on a regular basis.
	Spread and establishment of alien invasive plant species	Negative Medium	Negative Low	• Any alien plant observed should be reported to the environmental manager and should be removed as soon as possible. • Regular monitoring (monthly) for damage to the environment as well as establishment of alien plant species must be conducted.

	Negative effect of human activities on fauna and road mortalities	Negative Medium	Negative Low	• Limit human activity in the no-developed areas as well as the completed areas to the minimum required for ongoing operation • All vehicles should be inspected for oil and fuel leaks on a regular basis
	Loss of biodiversity	Negative Medium	Negative Low	• No dumping or soil stockpiling allowed on No-Go areas (vegetation units 8 & 9) • All temporary stockpile areas, litter and dumped material and rubble must be removed and discarded with in an environmentally friendly way • Undeveloped areas that were degraded due to human activities must be rehabilitated. • No unauthorised removal of plant or animal species allowed.
Wetland / Riverine Assessment (Appendix D1)	Erosion of riverbank	Negative High	Negative Low	No development allowed within the river and drainage line area (Vegetation unit 8 and 9) • Drainage must be controlled to ensure that runoff from the site will not culminate in off-site pollution or result in rill and gully erosion or any erosion of the watercourses
	Soil & water pollution	Negative High	Negative Low	• All vehicles and equipment should be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area at least 300m away from the edge of the river buffer zone to prevent ingress of hydrocarbons into topsoil. • Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent

				leakage. All hazardous chemical must be accompanied by an Safety Data Sheet (SDS). • The release of storm water must be designed such that the force of the water is reduced to prevent unnecessary erosion • No dumping of waste should take place within the riparian area If any spills occur, they should be cleaned up immediately. • Adequate toilet facilities must be provided for all staff to prevent pollution of the environment
Avifaunal Assessment (Appendix D2)	Displacement of priority avian species from important habitats	Negative Medium	Negative Low	• Limit ongoing human activity to the minimum required for ongoing operation. • Control noise to minimum. • Rehabilitate with indigenous vegetation. • Limit roadways and vehicle speeds.
	Displacement of resident avifauna through increased disturbance	Negative Medium	Negative Low	• Limit ongoing human activity to the minimum required for ongoing operation. • Control noise to minimum. • Rehabilitate with indigenous vegetation. • Limit roadways and vehicle speeds.

	Collisions with PV panels leading to injury or loss of avian life	Negative Medium	Negative Low	• Panels to be flat at night. • Preferably low sheen/matt surfaces. • Quarterly fatality monitoring.
	Displacement of priority avian species from important habitats (Power Line)	Negative Low	Negative Low	• None required due to low significance.
	Displacement of resident avifauna through increased disturbance (Power Line)	Negative Low	Negative Low	• None required due to low significance.
	Collision when flying into power line infrastructure	Very High Negative	Medium Negative	• Require walk-through after pole positions are determined to demarcate sections requiring bird deterrents/flappers. • Install flappers on all required sections of power line (as directed by avifaunal specialist) on or directly adjacent to site. • Quarterly fatality monitoring and record-keeping throughout project life
	Electrocution when perched on power line infrastructure	High Negative	Medium Negative	• Pole designs to discourage bird perching and to be signed off by avifaunal specialist. • Quarterly fatality monitoring and record-keeping throughout project life.
	Increased financial security for farming operations	Low Positive	Low Positive	• No mitigation measures required.

Agriculture Compliance Statement (Appendix D4)	Impacts on agricultural production and employment	Negative Low	Negative Low	• No mitigation required.
Heritage Impact Assessment (Appendix D5)	Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries	Negative Low	Negative Low	• 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).

Visual Impact Assessment (Appendix D3)	Potential visual impacts on sensitive visual receptors located within a 5km radius of the SPP	Negative Medium	Negative Low	Planning • Retain/re-establish and maintain natural vegetation immediately adjacent to the development footprint. • Where insufficient natural vegetation exists next to the property, a 'screen' can be planted using endemic, fast growers that are water efficient. Operations • Maintain general appearance of the facility as a whole.
	Visual impact on observers travelling along the roads and residents at homesteads within a 5-10km radius of the SPP.	Negative Low	Negative Low	Planning • Retain/re-establish and maintain natural vegetation immediately adjacent to the development footprint. • Where insufficient natural vegetation exists next to the property, a 'screen' can be planted using endemic, fast growers that are water efficient. Operations • Maintain general appearance of the facility as a whole.
	Visual impacts of lighting at night on sensitive visual receptors in close proximity to the proposed facility.	Negative Medium	Negative Low	Planning & Operation • Shield the source of light by physical barriers (walls, vegetation etc.) • Limit mounting heights of lighting fixtures, or alternatively use footlights or bollard level lights.

				• Make use of minimum lumen or wattage in fixtures. • Make use of down-lighters, or shield fixtures. • Make use of low-pressure sodium lighting or other types of low impact lighting. • Make use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.
	Visual impacts of solar glint and glare as a visual distraction and possible air travel hazard.	Negative Low	Negative Low	• No mitigation measures are required.
	Visual impact on sensitive visual receptors in close proximity to the 132kV overhead power line – Option 1	Negative Medium	Negative Medium	Planning • Retain/re-establish and maintain natural vegetation immediately adjacent to the power line servitude. Operations • Maintain the general appearance of the servitude as a whole.
	Visual impact on sensitive visual receptors in close proximity to the 132kV overhead power line – Option 2	Negative Low	Negative Low	Planning • Retain/re-establish and maintain natural vegetation immediately adjacent to the power line servitude. Operations

				• Maintain the general appearance of the servitude as a whole.
	Visual impact and impacts on sense of place	Negative Low	Negative Low	• The subjectivity towards the project in its entirety can be influenced by creating a "Green Energy" awareness campaign, educating the local community and potentially tourists on the benefits of renewable energy. This can be achieved by also hosting an 'open day' where the local community can have the opportunity to view the completed project which may enlist a sense of pride in the renewable energy project in their area. • Implement good housekeeping measures.
Social Impact Assessment (Appendix D7)	Direct and Indirect employment opportunities and skills development	Positive Low	Positive Medium	Enhancement: • It is recommended that local employment policy is adopted to maximise the opportunities made available to the local community. • The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. • Vocational training programs should be established to promote the development of skills.
	Development of non-polluting, renewable energy infrastructure	Positive Medium	Positive Medium	• No enhancement identified

	Potential loss of agricultural land	Negative Medium		Negative Low		• The proposed mitigation measures for the construction phase should have been implemented at this stage. • Mitigation measures from the Agricultural and Soil Report, should also be implemented.
	Contribution to Local Economic Development (LED) and social upliftment	Positive Medium		Positive High		Enhancement: • A CNA must be conducted to ensure that the LED and social upliftment programmes proposed by the project are meaningful. • Ongoing communication and reporting are required to ensure that maximum benefit is obtained from the programmes identified, and to prevent the possibility for such programmes to be misused. • The programmes should be reviewed on an ongoing basis to ensure that they are best suited to the needs of the community at the time (bearing in mind that these are likely to change over time).
	Impact on tourism	Negative Low	Positive Low	Negative Low	Positive Low	• The impact rating is dependent on how the development is perceived by tourism. In some cases, renewable energy developments can be seen as an addition to the tourist industry in the area (positive low) or it can be viewed as a negative. The rating is subjective. • Due to the extent of the project no viable mitigation measures can be implemented to eliminate the visual impact of the PV panels, but the subjectivity towards the PV panels

				can be influenced by creating a "Green Energy" awareness campaign, educating the local community and tourists on the benefits of renewable energy. Tourists visiting the area should be made aware of South Africa's movement towards renewable energy. This might create a positive feeling of a country moving forward in terms of environmental sustainability. This could be implemented by constructing a visitor's centre on the property allocated to the proposed solar farm which should be open to school fieldtrips, the local community, and tourists
	Visual and sense of place impacts	Negative Low	Negative Low	• To effectively mitigate the visual impact and the impact on sense of place during the operational phase of the proposed Thakadu SPP, it is suggested that the recommendations made in the Visual Impact Assessment (specialist study) should be followed in this regard
Traffic Impact Assessment (Appendix D8)	Increased commuter traffic	Negative Low	Negative Low	• The traffic generated during this phase will be negligible and will not have any impact on the surrounding road network.

6.2.3 Impacts during the decommissioning phase

The physical environment will benefit from the closure of the solar facility since the site will be restored to its natural state. Table 6.6 provides a summary of the impacts during the decommissioning phase. The decommissioning phase will however potentially result in impact on soils, pressure on existing service infrastructure, surface water and the loss of permanent employment. Skilled staff will be eminently employable, and a number of temporary jobs will also be created in the process. Decommissioning of a PV facility will leave a positive impact on the habitat and biodiversity in the area as the area will be rehabilitated to its natural state.

Table 6.6: Impacts and the mitigation measures during the decommissioning phase

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Ecological and Wetland Assessment (Appendix D1)	Habitat destruction caused by clearance of vegetation	Negative Low	Negative Low	- All temporary stockpile areas, litter and dumped material and rubble must be removed and discarded with in an environmentally friendly way - Undeveloped areas that were degraded due to human activities must be rehabilitated. - Hazardous chemicals must be stored on an impervious surface and protected from the elements. These chemicals must be strictly controlled, and records kept of when it was used and by whom - No activity allowed within vegetation units 8 and 9 (drainage line area & Riverine area)
	Soil and water pollution	Negative Medium	Negative Low	- Drainage must be controlled to ensure that runoff from the site will not culminate in off-site pollution or result in rill and gully erosion or any erosion of the watercourses
	Spread and establishment of alien invasive species	Negative Low	Negative Low	- Any alien plant observed should be reported to the environmental manager and should be removed as soon as possible. - All vehicles should be inspected for oil and fuel leaks on a regular basis. - Hazardous chemicals must be stored on an impervious surface and protected from the elements. These chemicals must be strictly controlled, and records kept of when it was used and by whom

	Negative effect of human activities on fauna and road mortalities	Negative Low	Negative Low	• Hazardous chemicals must be stored on an impervious surface and protected from the elements. These chemicals must be strictly controlled, and records kept of when it was used and by whom • No activity allowed within vegetation units 8 and 9 (drainage line area and riverine area)
Wetland/ Riverine Assessment (Appendix D1)	Erosion of riverbank	Negative Low	Negative Low	• No development allowed within riverine ad drainage line area (unit 8 and 9) and associated 32m buffer zone. • The release of storm water must be designed such that the force of the water is reduced to prevent unnecessary erosion • Compaction of soils should be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in increased runoff and erosion • A stormwater plan must be developed with the aid of an engineer to ensure that water runoff does not create soil erosion.
	Soil pollution	Negative Medium	Negative Low	• No dumping of waste should take place within the riparian area If any spills occur, they should be cleaned up immediately. • Remove all substances which can result in groundwater (or surface water) pollution • Vehicle traffic should not be allowed within the drainage line and riverine areas (Vegetation unit 8 and 9) and associated buffer zone. It will have a negative impact due to the dispersive/compaction characteristics of soils and its implications on the long term

	Increase in stormwater run-off	Negative Medium	Negative Low	• A stormwater plan must be developed with the aid of an engineer to ensure that water runoff does not create soil erosion
Avifaunal Assessment (Appendix D2)	Displacement of priority avian species from important habitats	Negative Low	Negative Low	• None required due to low significance
	Displacement of resident avifauna through increased disturbance	Negative Low	Negative Low	• None required due to low significance
Agriculture Compliance Statement (Appendix D4	Loss of agricultural potential by occupation of land	Negative Low	Negative Low	• No mitigation measures.
	Loss of agricultural potential by soil degradation	Negative Low	Negative Low	• Implement an effective system of storm water run-off control, where it is required - that is at all points of disturbance where water accumulation might occur. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion. Any occurrences of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended, to prevent further erosion from occurring there. • Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion. • If an activity will mechanically disturb the soil profile below surface, then any available topsoil should first be stripped from the entire surface to be

				disturbed and stockpiled for re-spreading during rehabilitation, which may be after construction or only at decommissioning. The depth of topsoil stripping is dependent on the specific field conditions. The maximum depth should be 30cm. If additional unconsolidated material exists below 30cm and needs to be removed for construction purposes, it must be stripped and stockpiled separately from the upper 30cm topsoil. Such material should only be used for fill below a topsoil layer, and not used for spreading on the surface. If there is less than 30cm of unconsolidated soil material above a limiting layer of rock or hardpan, then the entire depth must be stripped and stockpiled as topsoil, even if it contains a high proportion of course fragments. • Topsoil should be retained in the area below the panels (or mirrors). It is not desirable to strip and stockpile this topsoil for the whole of the operational phase. It will be much more effective for rehabilitation, to retain the topsoil in place. If levelling requires significant cutting, topsoil should be temporarily stockpiled and then re-spread after cutting, so that there is a covering of topsoil over the entire surface before the panels are mounted. It will be advantageous to have topsoil and vegetation cover below the panels during the operational phase for the following reasons: conservation of topsoil, dust suppression and erosion control. • It is only in areas where topsoil cannot be retained on the surface during the operational phase, and where the area will be rehabilitated back to veld after decommissioning, that it should be stripped and stockpiled for the duration of the operational phase for re-spreading during de-commissioning.

				• Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. • Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land. • During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. • If there is compaction, either in re-spread topsoil or in areas where topsoil was retained during the operational phase, it must be loosened through an appropriate plough action. • If topsoil has been stockpiled for the duration of the operational phase, re-vegetation is likely to require seeding and / or planting. • Erosion must be carefully controlled where necessary on topsoiled areas.
	Loss of agricultural potential by dust generation	Negative Low	Negative Low	• Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil.

6.3 SUMMARY OF RECOMMENDATIONS FROM SPECIALIST STUDIES

To address the key issues highlighted in the previous section the following specialist studies and processes were commissioned:

- Ecological and Wetland Impact assessment – Enviroguard Ecological Services (see Appendix D1)
- Avifaunal Impact Assessment – Agreenco Environmental Projects (see Appendix D2)
- Visual Impact Assessment – Phala Environmental Consultants (see Appendix D3)
- Agriculture Compliance Statement – Johann Lanz (see Appendix D4)
- Heritage Impact Assessment – JA van Schalkwyk (see Appendix D5)
- Palaeontological Impact Assessment – Banzai Environmental (see Appendix D6)
- Social Impact Assessment – Phala Environmental Consultants (see Appendix D7)
- Traffic Impact Assessment – JG Afrika (see Appendix D8)
- Geotechnical Feasibility Assessment – SMEC (see Appendix D9)

The following sections summarise the main findings from the specialist reports in relation to the key issues raised during the scoping phase.

6.3.1 Issue 1: Geotechnical suitability

The geotechnical suitability for the Thakadu SPP site was determined. The main question had to be addressed was:

"Are the geotechnical conditions favourable for the development of a PV solar plant?"

According to the Geotechnical Feasibility Assessment (Appendix D9) the site is underlain by chert and dolomite of the Malmani Subgroup, Chuniespoort Group. The profiles observed within the test pits at the site generally comprised a thin cover of sandy topsoil overlying transported loose to medium dense silty sand, with frequent boulder inclusions. 7no. test pits refused within this layer on boulders at depths of between 0.5 m and 1.7 m. Where deeper excavations were possible, the profile continued into a ferruginised generally sandy gravel/ gravelly sand layer, with an occasional clay constituent. Excavations within this layer were generally unhindered and the soils became progressively more dense with depth. No groundwater was observed within the test pits.

Over some parts of the site (4no. test pits), deep excavation (>1.5 m) was possible. These locations were not clustered together, thus a "deep profile" area cannot readily be delineated. Notwithstanding this, cobbles and boulders were readily observed within the profiles across the site from relatively shallow depth. Therefore, based on this preliminary assessment predrilling should be considered prior to pile installation as a site-wide solution.

Following predrilling the holes may be filled with a suitable compacted media (such as sand) and piles rammed as usual or the piles installed and grouted. Alternatively, concrete bases bearing at nominal depth may also be suitable for this site, however site preparation

may make this solution uneconomical where outcropping or shallow rock mass is not present. Construction of suitable soil rafts should comprise the excavation of the in-situ material to approximately 1 m below foundation underside or to the soft rock strata, whichever is the shallower, and 1 m laterally beyond the foundation base on all sides. The excavated material should then be laid in 200 mm thick compacted layers to 95% Mod. AASHTO and ±2% OMC. It is possible that boulders may be intermittently present within the excavated depth, will have to be removed and the volume made up with imported material or cut from other parts of the site.

No surface deformations/ subsidences associated with dolomitic instability were observed and the sites' greenfield status, i.e. natural surface drainage pathways remain largely intact and very little or no buried wet services are present, would indicate these may be low risk sites. The preliminary dolomitic risk may be further assessed following the topographical surveys of the sites, which should clearly indicate potential linear and circular subsidence features, without interference by surface vegetation. No fatal flaws were identified on site.

6.3.2 Issue 2: Heritage and archaeological impacts

South Africa's heritage resources comprise a wide range of sites, features, objects and beliefs. According to Section 27(18) of the National Heritage Resources Act (NHRA), No. 25 of 1999, 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 therefore appointed to conduct a Heritage Impact Assessment (HIA) to determine if any sites, features or objects of cultural heritage significance occur within the proposed site. The main question which needs to be addressed is:

"Will the proposed development impact on any heritage or archaeological artefacts?"

According to the Heritage Impact Assessment (Appendix D5) 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 and industrial (mining) component.

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.

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

6.3.3 Issue 3: Ecological Impacts

The potential impact of the proposed development on threatened flora and fauna known to occur in the Free State Province had to be determined. The main question which needs to be addressed is:

"How will the proposed development impact on the ecology?"

The site is surrounded by various mining and agricultural activities. Sections of the area are used for cattle grazing (vegetation unit 1) while the other areas are not managed or utilised currently. The areas are fenced off and access can only be freely obtained to the proposed corridor area. The Vaal River forms the northern boundary while a drainage channel is located in the south-eastern section of the proposed powerline corridor.

According to the Ecological and Wetland Assessment (Appendix D1), the site contains areas that are variously categorised in terms of their conservation value and ecosystem functioning. Areas of high, medium and low sensitivity were identified as indicated in Figure 6.1 below.

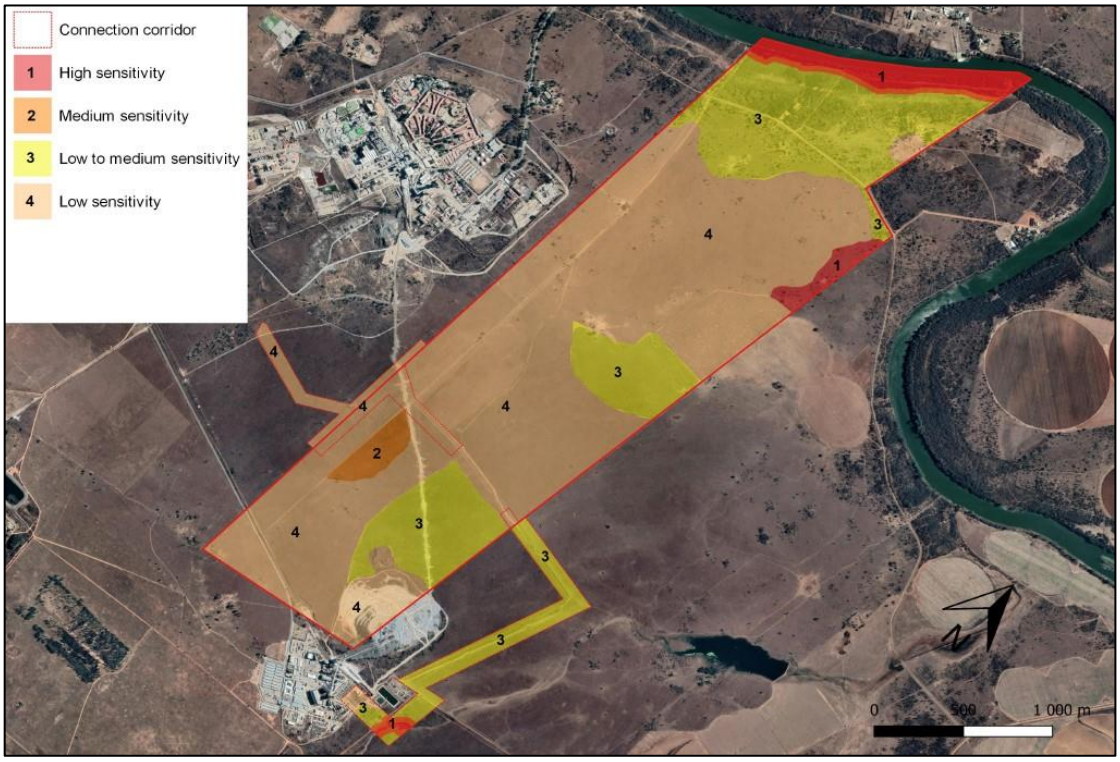


Figure 6.1: Sensitivity map of the various vegetation units of the proposed site.

Any development will have an impact on the natural vegetation. Except for vegetation unit 2, the vegetation of the different vegetation units is degraded although remnants of the original native vegetation are present in vegetation unit 9. Vegetation unit 1 has a high diversity and in a natural condition. Vegetation units 8 & 9 are degraded in terms of their vegetation but are watercourses and as such important. Development in the rest of the vegetation units should therefore not result in a large-scale loss of species and diversity on a regional scale and should have a medium-low impact on the environment. Since these areas are degraded it is thought that the loss of species would not be significant in terms of overall habitat and biodiversity with only few climax species that would be lost. Development within vegetation units 2, 8 & 9 could have a long-term negative impact on the ecosystem. No development should be allowed in vegetation unit 2 (*Vachellia karroo* dolomite woodland), 8 (Drainage channel) and 9 (Riverine area). These areas should be fenced off prior to construction and zoned as no-go areas.

Although relatively few and in low densities on the site, alien species poses a huge threat to the natural environment due to their competitive nature that leads to the displacement of natural indigenous species (plants and animals), and also due to their excessive use of soil water.

Most development activities are characterised by large areas of sealed surfaces such as roads, footpaths, buildings etc. As a result, water infiltration is considerably reduced with an increase in surface run-off. Run-off is generally discharged to surface water systems and often contains pollutants. Pollutants range from organic matter, including sediments, plant materials and sewage, to toxic substances such as heavy metals, oils and hydrocarbons. Although the site is mostly flat, construction activities associated with development can lead to massive short-term erosion unless adequate measures are implemented to control surface run-off. Water runoff from the solar panels will also contribute to surface runoff.

Except for two threatened species (one within vegetation unit 2 and one in vegetation unit 5), no other red data species were found to be present within the different vegetation units although marginal habitat exists in some areas. Both the threatened species and the *Aloe davyana* individuals are regarded as protected species within the Free State Province and a permit will need to be obtained should they have to be removed. The area has relatively few declared alien invasive species with most occurring within vegetation units 1, 8 and 9. Except for the threatened geophyte *Boophone disticha* none of the medicinal plants found to be present are threatened and they occur abundantly in other areas outside the property, while some are pioneer weeds and declared alien invader weeds.

The study area is classified as having a low vegetation sensitivity and the Vaal River as a high aquatic sensitivity according to DFFE, while the area is classified as an ESA 1 & 2 according to SANBIGIS. The results of the Ecology and Wetland Assessment correlate mostly with that of DFFE, and although these areas are open land, they have little ecological support function since they do not surround or protect pristine areas. All areas have moderate to high vegetation cover, but their species composition and the dominant species are indicative of degraded conditions. The site is surrounded by mining and agricultural areas and has no connection to pristine natural vegetation.

The various units with low and low-medium conservation values are not regarded as being ecologically sensitive and any development should not have a high negative impact within a regional context on the natural ecosystems in the area if the recommended mitigation measures as indicated in this report are incorporated into the management plan and adhered to. No development is recommended within the stream and drainage channel areas and their associated 32m buffer zones. The vegetation within the buffer zones should be managed to improve the degraded conditions that exist.

From an Ecological and Wetland perspective the development can be supported.

6.3.4 Issue 4: Wetland Impacts

The potential impact of the proposed development on wetlands known to occur on site, had to be determined. The main question which needs to be addressed is:

"How will the proposed development impact on the wetlands?"

According to the Ecological and Wetland Assessment (Appendix D1) the site borders the Vaal River to the north of the site and a drainage channel is located in the proposed power line corridor option 2. No other rivers or wetlands or sensitive areas was identified on site or in the power line corridor.

The Drainage channel (vegetation unit 8) is degraded from a vegetation ecological point of view and obtained a low EIS score indicating it to be degraded with a loss of plant species and ecosystem functioning. It does however have a water channelling function making it an important ecosystem. The Vaal River (vegetation unit 9) has a stabilised embankment with a well-developed woody layer, although bush densification has occurred in many areas along the river due to anthropogenic influences. This system obtained a Medium-high EIS as well as a medium HI score indicating the ecosystem to be moderately modified, but with the basic functions and diversity still in place. No development is therefore recommended within a 32 m buffer zone around the water courses (vegetation units 8 & 9).

Considering that the river is located on the other side of a tar road from the proposed development, it is not foreseen that the development will have a significant impact on it. It might have some indirect impacts, such as dust pollution and sedimentation, caused by soil erosion. Significance rating of the impacts indicate that the impact on vegetation unit 8 and 9 could possibly be of a high negative s(without mitigation), however the impact can be reduced to a low negative if the proposed mitigation measures are adhered to.

Provided that all the mitigation measures and recommendations surrounding the Vaal River and drainage channel are strictly adhered to, the development of the solar power plant can be supported.

6.3.5 Issue 5: Avifaunal Impacts

The potential impact of the proposed development on birds known to occur in Free State Province had to be determined. The main question which needs to be addressed is:

"How will the proposed development impact on the avifauna?"

According to the Avifaunal Assessment (Appendix D2) The area is not within an IBA; however, it has been identified as 'High Avian Sensitivity' by DFFE's screening tool. No priority species were recorded on the site, but some were for the wider SABAP2 pentad That have at least a reasonable chance of occurring on site (Martial Eagle). However, there are confirmed records (Lanner Falcon) in similar habitat and nearby areas (within 15 km- Secretarybird, Red-Footed Falcon, African Marsh-Harrier) or have a reasonable chance of at least occasional occurrence based on habitat and distribution (Black-winged Pratincole) in previous assessments.

The resident avifaunal community is diverse, with relatively high species richness and abundances. There are numerous endemic or near-endemic species that have been confirmed as present on site (Cloud Cisticola, Fiscal Flycatcher, South African Cliff Swallow) or have been recorded in the wider SABAP2 pentads (Pied Starling, Karoo Thrush, Cape White-eye) in similar habitat. The site contains a threatened habitat type, namely the Vaal Reefs Dolomite Sinkhole Woodland (Gh12) classified as Vulnerable. This is expected to be disturbed during construction.

Some species that are sensitive to powerline collisions occur on site (Black-headed Heron, Black-winged Kite, Egyptian Goose, Goliath Heron, Hadeda Ibis, Helmeted Guineafowl, Spur-

winged Goose, Western Cattle Egret, Blacksmith Lapwing, Northern Black Korhaan, Orange River Francolin, Spotted Thick-knee) or have a reasonable chance of occurring on site (Secretarybird, Lanner Falcon, Red-footed Falcon, African Marsh Harrier, Black-winged Pratincole).

The 132 kV powerlines, if inadequately designed, can electrocute some species that utilise the infrastructure for roosting that occur on site (Black-headed Heron, Black-winged Kite, Egyptian Goose, Goliath Heron, Hadeda Ibis, Helmeted Guineafowl, Spur-winged Goose, Western Cattle Egret) or have a reasonable chance of occurring on site (Secretarybird, Lanner Falcon, Red-footed Falcon, African Marsh Harrier Black-winged Pratincole).

These impacts are expected to start during the construction phase, will last through the operational phase, into and after decommissioning. The habitats have low likelihood to be directly impacted/disturbed but the increased disturbance is likely to deter protected species from accessing the area. The transformation of some of the avian habitats will be permanent. Impacts from the collision with power lines or electrocution when perched on power line infrastructure are expected to start during the construction phase and will persist thereafter, as long as the power line is operational and charged.

The overall impact of the project on avifauna can be effectively mitigated, should the controls prescribed in the Avifaunal Report be adequately followed, with sufficient monitoring of mitigation effectiveness.

Despite some residual impacts, there is no objection, from an avifaunal perspective to the development of the proposed Thakadu SPP development, should the controls prescribed by the independent specialist be adequately followed, with sufficient monitoring of mitigation effectiveness.

6.3.6 Issue 6: Visual Impacts

Due to the extent of the proposed photovoltaic solar plant it is expected that the plant will result in potential visual impacts. The main question which needs to be addressed is:

"To what extent will the proposed development be visible to observers and to what extent will the landscape provides any significant visual absorption capacity"

The construction and operational phase of the proposed Thakadu SPP and its associated infrastructure, may have a visual impact on the study area, especially within (but not restricted to) a 5km radius of the proposed SPP. The visual impact will differ amongst places, depending on the distance of the SPP.

Due to the height of the power line (32m) and extent of the project, no viable mitigation measures can be implemented to eliminate the visual impact of the PV facility and power lines, but the possible visual impacts can be reduced. A number of mitigation measures have however been proposed regardless of whether or not mitigation measures will reduce the significance of the of the anticipated impacts, they are considered good practice and should be implemented and maintained throughout the construction, operational and decommissioning phases of the project.

In terms of possible landscape degradation, the landscape does not appear to have any specific protection or importance and is characterised by mines. No buffer areas or areas to be avoided are applicable for this development.

Aesthetic issues are subjective, and some people find solar farms and their associated infrastructure pleasant and optimistic while others may find it visually invasive; it is mostly perceived as symbols of energy independence; and local prosperity. The visual impact is also dependent on the land use of an area and the sensitivity thereof in terms of visual impact, such as protected areas, parks and other tourism related activities.

Taking into account all positive factors of such a development including economic factors, social factors and sustainability factors, especially in an arid country, the visual impact of this proposed development will be insignificant and is suggested that the development commence, from a visual impact point of view.

The specialist has recommended that the project be approved.

6.3.7 Issue 7: Agricultural / impacts on the soil

In order to determine the potential impacts that the proposed development will have on agricultural production, the soil forms and current land capability of the area where the proposed project will be situated a soil survey has been conducted. The main question which needs to be addressed is:

"To what extent will the proposed development compromise (negative impacts) or enhance (positive impacts) current and/or potential future agricultural production?"

The Agriculture Compliance Statement (Appendix D4) states that the site has low agricultural potential predominantly because of soil constraints. As a result of the constraints, the site is unsuitable for cultivation, and agricultural land use is limited to grazing. The land impacted by the development footprint is confirmed in this assessment as being entirely of medium agricultural sensitivity.

Three potential negative agricultural impacts were identified, loss of agricultural land use, land degradation, and the impact of dust. One positive agricultural impact was identified as enhanced agricultural potential through increased financial security for farming operations. All agricultural impacts are likely to have very low impact on levels of agricultural production and are therefore assessed as having low significance.

The amount of agricultural land loss caused by the project is within the allowable development limits prescribed by the agricultural protocol to ensure appropriate conservation of agricultural production land.

The recommended mitigation measures are implementation of an effective system of stormwater run-off control; maintenance of vegetation cover; and stripping, stockpiling and re-spreading of topsoil.

The conclusion of this assessment is that the proposed development will not have an unacceptable negative impact on the agricultural production capability of the site. The proposed development is therefore acceptable. This is substantiated by the facts that the land

is of limited land capability and is not suitable for the production of cultivated crops, the amount of agricultural land loss is within the allowable development limits prescribed by the agricultural protocol, the proposed development offers some positive impact on agriculture by way of improved financial security for farming operations, as well as wider, societal benefits, and that the proposed development poses a low risk in terms of causing soil degradation.

The conclusion of this assessment on the acceptability of the proposed development and the recommendation for its approval is not subject to any conditions, other than recommended mitigation.

6.3.8 Issue 8: Socio-economic impacts

A Social Impact Assessment has been compiled in order to provide a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed facility; to provide a description and assessment of the potential social issues associated with the proposed facility; and the identification of enhancement and mitigation aimed at maximizing opportunities and avoiding and or reducing negative impacts (refer to Appendix D7). The main question which needs to be addressed is:

"How will the proposed development impact on the socio-economic environment?"

There are some vulnerable communities within the project area that may be affected by the development of Thakadu SPP and its associated infrastructure. Traditionally, the construction phase of a PV solar development is associated with most social impacts. Many of the social impacts are unavoidable and will take place to some extent but can be managed through the careful planning and implementation of appropriate mitigation measures. Several potential positive and negative social impacts have been identified for the project, however an assessment of the potential social impacts indicated that there are no perceived negative impacts that are sufficiently significant to allow them to be classified as "fatal flaws".

Based on the social impact assessment, the following general conclusions and findings can be made:

- The potential negative social impacts associated with the construction phase are typical of construction related projects and not just focussed on the construction of solar PV projects (these relate to an influx of non-local workforce and jobseekers, intrusion and disturbance impacts (i.e., noise and dust, wear and tear on roads) and safety and security risks) and could be reduced with the implementation of the mitigation measures proposed. The significance of such impacts on the local communities can therefore be mitigated.
- The development will introduce employment opportunities during the construction phase (temporary employment) and a limited number of permanent employment opportunities during operation phase.
- The proposed project could assist the local economy in creating entrepreneurial growth and opportunities, especially if local business is involved in the provision of general material, goods and services during the construction and operational phases. This positive impact is likely to be compounded by the cumulative impact associated with the development of several other solar facilities within the surrounding area, and

because of the project's location within an area which is characterised by high levels of solar irradiation, and which is therefore well suited to the development of commercial solar energy facilities.

- The proposed development also represents an investment in infrastructure for the generation of non-polluting, Renewable Energy, which, when compared to energy generated because of burning polluting fossil fuels, represents a positive social benefit for society.
- It should be noted that the perceived benefits associated with the project, which include Renewable Energy generation and local economic and social development, outweigh the perceived impacts associated with the project.

The following recommendations are made based on the SIA. The proposed mitigation measures should be implemented to limit the negative impacts and enhance the positive impacts associated with the project. Based on the social assessment, the following recommendations are made:

- The appointment of a CLO to assist with the management of social impacts and to deal with community issues, if feasible.
- It is imperative that local labour be sourced, wherever possible, to ensure that benefits accrue to the local communities. Efforts should be made to involve local businesses during the construction activities, where possible. Local procurement of labour and services / products would greatly benefit the community during the construction and operational phases of the project.
- Local procurement of services and equipment is required where possible in order to enhance the multiplier effect.
- Involve the community in the process as far as possible (encourage co-operative decision making and partnerships with local entrepreneurs).
- Employ mitigation measures to minimise the dust and noise pollution and damage to existing roads.
- Safety and security risks should be considered during the planning / construction phase of the proposed project. Access control, security and management should be implemented to limit the risk of crime increasing in the area.

The proposed project and associated infrastructure are unlikely to result in permanent damaging social impacts. From a social perspective it is concluded that the project could be developed subject to the implementation of recommended mitigation measures and management actions identified for the project.

6.3.9 Issue 10: Paleontological Impacts

South Africa's heritage resources comprise a wide range of sites, features, objects and beliefs. According to Section 27(18) of the National Heritage Resources Act (NHRA), No. 25 of 1999, 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. The main question which needs to be addressed is:

"How will the proposed development impact on the Palaeontological resources?"

According to the Palaeontological Impact Assessment (Appendix D6) the Thakadu Solar Power Plant site is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani (Chuniespoort Group, Transvaal Supergroup). Two power line options are proposed for the Thakadu Solar Power Plant but as they have the same geology there is no preference between the options from a Palaeontological point of view. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Malmani Subgroup is Very High.

A site-specific field survey of the footprint was conducted on 6-7 November 2021. Outcrops of weathered to well-preserved stromatolites were discovered on the whole development. Examples of exceptionally well preserved oolites were recovered from the northern portion of the development footprint. Mitigation of a sample of well-preserved stromatolites is thus recommended. By implementing mitigation measures the significance of the impact will be reduced to low. Mitigation should take place after initial vegetation is cleared away but before the ground is levelled for construction. These recommendations should be included in the Environmental Management Plan of the Thakadu Solar Power Plant.

Recommendations:

- The ECO must be made aware that fossils (stromatolites) of the Malmani (Chuniespoort Group, Transvaal Supergroup) has a Very High Palaeontological Significance.
- When the Thakadu Power Plant layout has been established a walkdown of the area must be completed by a qualified Palaeontologist to catalogue and photograph well-preserved stromatolites. This action should take place after initial vegetation clearance but before the ground is levelled for construction.
- If a well preserved stromatolite outcrop falls in the development footprint the stromatolites ought to be cordoned off and a buffer of 30m should be placed around the outcrop.
- A representative example of well-preserved stromatolites should be removed and placed near the offices of the PV as an informative example of fossils in the area.

There are no fatal flaws associated with the proposed PV solar project from a palaeontological heritage viewpoint and no objects to authorisation of the development, provided that the recommended mitigation measures are fully implemented.

6.3.10 Issue 10: Traffic Impacts

Large developments are normally associated with an increase in construction vehicle traffic. The main question which needs to be addressed is:

"How will the proposed development impact on the traffic on main delivery routes to the site?"

According to the Traffic Impact Assessment (Appendix D8) the potential transport related impacts for the construction and operation phases for the proposed Thakadu Solar Power Plant were assessed. The construction phase traffic, although significant, will be temporary and impacts are considered to have a low significance after mitigation measures are implemented. During operation, it is expected that staff and security will periodically visit the facility. It is assumed that approximately twenty (20) full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.

The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e. the impact of the traffic on the surrounding road network is temporary and a solar facility, when operational, does not add any significant traffic to the road network.

Both the proposed access point and the access road to the facility are deemed feasible from a traffic engineering perspective. Both access point options are deemed feasible. The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to. The impacts associated with the proposed Thakadu Solar Power Plant are acceptable with the implementation of the recommended mitigation measures and can therefore be authorised.

6.3.11 Risk Assessment for battery storage system

Battery storage facilities are a relatively new technology, particularly in South Africa. Batteries, as with most electrical equipment, can be dangerous and may catch fire, explode or leak dangerous pollutants if damaged, possibly injuring people working at the facility or polluting the environment. Common failure scenarios of Li-ion batteries include: electrical, mechanical, and thermal. The potential hazards associated with them are fire with consequent emission of gas and explosion. The major risks include thermal runaway, difficulty of fighting battery fires, failure of control systems and the sensitivity of Li-ion batteries to mechanical damage and electrical transients.

As with any fire or explosion, a potential consequence of Li-ion battery fires is the endangerment of life and property. These consequences are assessed based on their severity and likelihood. First, the severity of this consequence changes based on the quantity of cells in a system, as well as the system's proximity to people and property. Therefore, the size and location of the installation should be taken into consideration. For the Thakadu SPP the location of the BESS and the fact that the area is sparsely populated will reduce the risk associated with toxic chemicals, flammability and overpressure from explosions. The risk level is seen to be of a low risk that is unlikely to occur with the proper safety measures taken as mitigation. Provided that the facility is designed and managed properly, and the batteries are handled in the manner prescribed by the manufacturer, an incident is unlikely to happen. However, because of the risk special management actions are recommended in the EMPr to reduce the risk of an incident and manage an incident should one ever occur.

6.4 SENSITIVITY ANALYSIS

The sensitivity analysis undertaken as part of the BA Report focusses on providing an understanding of the environmentally sensitive areas and features identified within the SPP site, as well as the grid connection corridor. This section considers the findings of each of the independent specialist studies undertaken for the development and describes the sensitive features and areas identified, including the location, the sensitivity rating of the features or areas as well as the associated buffers recommended by the specialist (where a buffer is considered to be relevant). The sensitive areas and features identified are also displayed on the sensitivity map included as Figure H1-H6 of this BA report.

The following points below provide the sensitivity analysis for the Thakadu SPP:

Ecology and Wetland:

From an Ecological and Wetland perspective (refer to Appendix D1) three vegetation units have been identified as having high conservation values, namely vegetation units (VU) 2, 8 and 9. Vegetation unit 2 has high species richness and is typical of the natural dolomite outcrop grasslands in the region. The drainage channel (VU 8) is degraded from a vegetation ecological point of view and obtained a low EIS score indicating it to be degraded with a loss of plant species and ecosystem functioning. It does however have a water channelling function making it an important ecosystem. The Vaal River (vegetation unit 9) obtained a Medium-high EIS score as well as a medium HI score. No development is therefore recommended within a 32 m buffer zone around the VU 8 and VU 9.

The *Tristachya leucothrix-Elephantorrhiza elephantina* grassland (VU 7) is a small area on an undulating rocky hill. This area has a moderate species richness with some climax species present and therefore has a medium conservation value and has connectivity with other open areas, though they are degraded making this grassland a small, isolated section. If needed limited development could be approved in this unit.

Vegetation units 1 (*Vachellia karroo* woodland) and 5 (*Elionurus muticus-Eragrostis curvula* grassland) have a common vegetation type with a moderate to low species and habitat diversity but are degraded due to anthropogenic influences and are in a secondary successional phase with a large number of pioneer plant species present.

Vegetation units 3, 4, and 6 (*Elephantorrhiza elephantina* shrubland; Old cultivated field; *Hyparrhenia hirta-Elephantorrhiza elephantina* grassland) are all low in species richness and characterised by the dominance of pioneer or encroacher species. The natural vegetation of these areas has mostly been destroyed/displaced and the areas have a low ecosystem functioning.

Except for two threatened species (one within vegetation unit 2 and one in vegetation unit 5), no other red data species were found to be present within the different vegetation units although marginal habitat exists in some areas.

No wetlands were identified on site.

Overall, from an ecological and wetland perspective no other areas have been identified as no-go for the development of the SPP and the associated infrastructure, except for the area surrounding the Vaal River, the drainage channel and Vegetation Unit 2.

Avifauna:

No specific areas of sensitivity have been identified from an avifauna perspective (Avifauna Impact Assessment, Appendix D2). Therefore, from an avifauna perspective, no areas have been identified as no-go for the development of the SPP and associated infrastructure.

Visual:

No specific areas of sensitivity have been identified from a visual perspective (Visual Impact Assessment, Appendix D3). Therefore, from a visual perspective, no areas have been identified as no-go for the development of the SPP and associated infrastructure.

Heritage:

No sites, features or objects of cultural significance were identified from a heritage perspective (Heritage Impact Assessment, Appendix D5). Therefore, from a heritage perspective, no areas have been identified as no-go for the development of the SPP and associated infrastructure.

Palaeontology:

The palaeontological sensitivity of the SPP, and the grid connection corridor options have been confirmed as being of a **medium** sensitivity (Palaeontological Impact Assessment, Appendix D6). No palaeontological no-go areas have been identified for the project. However, outcrops of weathered to fairly well-preserved stromatolites were discovered and requires mitigation. Therefore, from a palaeontological perspective, no areas have been identified as no-go for the development of the SPP and associated infrastructure.

Social:

No specific areas of sensitivity have been identified from a social perspective (Social Impact Assessment, Appendix D7). Therefore, from a social perspective, no areas have been identified as no-go for the development of the SPP and associated infrastructure.

Traffic:

No specific areas of sensitivity have been identified from a traffic perspective (Traffic Impact Assessment, Appendix D8). Therefore, from a traffic perspective, no areas/road aspects have been identified as no-go for the development of the SPP and associated infrastructure.

Agriculture:

The agricultural sensitivity of the SPP, and the two grid connection corridor options have been confirmed as being of a **low and medium** sensitivity (Agricultural Compliance Statement, Appendix D9). The site has low agricultural potential due to soil constraints, including shallow soils on underlying bedrock, which makes the site unsuitable for cultivation. Therefore, the agricultural land use is limited to grazing. No specific areas of sensitivity have been identified by the specialist that needs to be considered for the placement of infrastructure. Therefore, from an agricultural perspective, no areas have been identified as no-go for the development of the SPP and associated infrastructure.

6.5 METHOD OF ENVIRONMENTAL ASSESSMENT

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 6.7.

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 total number of points scored for each impact indicates the level of significance of the impact.

6.5.1 Impact Rating System

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 project phases:

- planning
- construction
- operation
- 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 6.7: The rating system

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
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. 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 effects.

7 CUMULATIVE EFFECTS ASSESSMENT

This section aims to address the following requirements of the regulations:

Appendix 1. (3)(i) An BAR (...) must include-
(j) an assessment of each identified potentially significant impact and risk, including- (i) cumulative impacts.

7.1 INTRODUCTION

The EIA Regulations (as amended in 2017) determine that 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 the existing and reasonably foreseeable impacts eventuating from similar or diverse activities*." Cumulative impacts can be incremental, interactive, sequential or synergistic. EIAs have traditionally failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires coordinated institutional arrangements;
- Complexity - dependent on numerous fluctuating influencing factors which may be completely independent of the controllable actions of the proponent or communities; and
- Project level investigations are ill-equipped to deal with broader biophysical, social and economic considerations.

Despite these challenges, cumulative impacts have been afforded increased attention in this Basic Assessment Report and for each impact a separate section has been added which discusses any cumulative issues, and where applicable, draws attention to other issues that may contextualise or add value to the interpretation of the impact – refer to Appendix E. This chapter analyses the proposed project's potential cumulative impacts in more detail by: (1) defining the geographic area considered for the cumulative effects analysis; (2) providing an overview of relevant past and present actions in the project vicinity that may affect cumulative impacts; (3) presenting the reasonably foreseeable actions in the geographic area of consideration; and (4) determining whether there are adverse cumulative effects associated with the resource areas analysed.

The term "Cumulative Effect" has for the purpose of this report been defined as: the summation of effects over time which can be attributed to the operation of the project itself, and the overall effects on the ecosystem of the site that can be attributed to the project and other existing and planned future projects.

7.2 GEOGRAPHIC AREA OF EVALUATION

The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in this cumulative effects analysis

generally includes an area of a 30km radius surrounding the proposed development – refer to Figure 7.1 below.

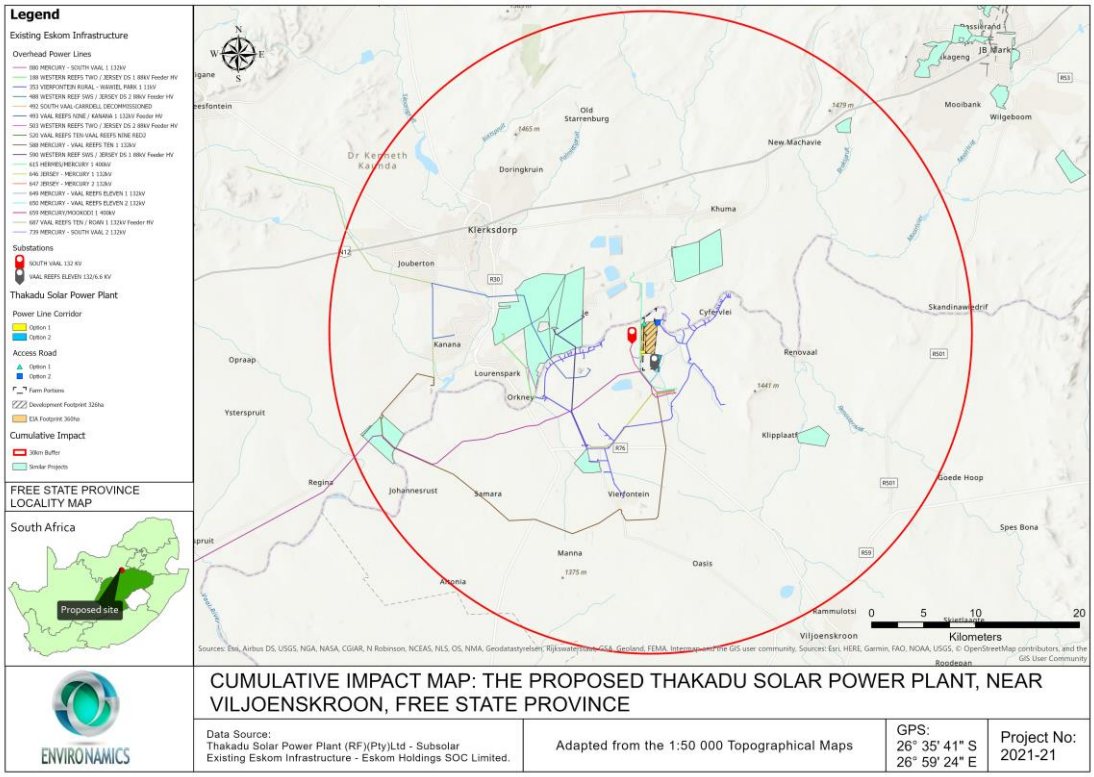


Figure 7.1: Geographic area of evaluation with utility-scale renewable energy generation sites and power lines

The geographic spread of PV solar projects, administrative boundaries and any environmental features (the nature of the landscape) were considered when determining the geographic area of investigation. It was argued that a radius of 30km would generally confine the potential for cumulative effects within this particular environmental landscape. The geographic area includes projects located within the Free State Province. A larger geographic area may be used to analyse cumulative impacts based on the specific temporal or spatial impacts of a resource. For example, the socioeconomic cumulative analysis may include a larger area, as the construction workforce may draw from a much wider area. The geographic area of analysis is specified in the discussion of the cumulative impacts for that resource where it differs from the general area of evaluation described above.

7.3 TEMPORAL BOUNDARY OF EVALUATION

A temporal boundary is the timeframe during which the cumulative effects are reasonably expected to occur. The temporal parameters for this cumulative effects analysis are the anticipated lifespan of the Proposed Project, beginning in 2023 and extending out at least 20 years, which is the minimum expected project life of the proposed project. Where appropriate, particular focus is on near-term cumulative impacts of overlapping construction schedules for proposed projects in the area of evaluation.

7.4 OTHER PROJECTS IN THE AREA

The following section provides details on existing, and project being proposed in the geographical area of evaluation.

7.4.1 Existing projects in the area

According to the DFFE's database twelve (12) PV solar plant applications (of which two applications have lapsed) have been submitted to the Department within the geographic area of investigation, – refer to table 7.1. It should be noted that there is uncertainty with regards to the accuracy and validity of the information obtained from the Departments database.

Table 7.1: A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the study area

Site name	Distance from study area	Proposed generating capacity	DEFF reference	EIA process	Project status
Paleso SPP[4]	0.8km	150MW	14/12/16/3/3/1/2365	Basic Assessment	Approved
Siyanda SPP	0km	150MW	14/12/16/3/3/1/2369	Basic Assessment	Approved
Kabi Vaalkop PV 3	1.4km	75 MW	12/12/20/2513/3	Scoping and EIA	Approved
Kabi Vaalkop PV 2	5.4 km	75 MW	12/12/20/2513/2	Scoping and EIA	Approved
Kabi Vaalkop PV[5]	1.4 km	75 MW	12/12/20/2513/4	Scoping and EIA	Approved
Kabi Vaalkop PV 1	1.4 km	75 MW	12/12/20/2513/1	Scoping and EIA	Approved
Buffels Solar PV 1	15.3 km	100MW	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

[4] Environamics was the EAP responsible for the Basic Assessments for the Paleso and Siyanda Solar Power Plants.

[5] The application was only for transmission infrastructure (i.e. substation and power lines) and not a PV solar power plant.

Witkop Solar[6]	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
Genesis 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

It is unclear whether other projects not related to renewable energy is or has been constructed in this area, and whether other projects are proposed. In general, development activity in the area is focused on agriculture and mining. It is quite possible that future solar farm development may take place within the general area.

The next section of this report will aim to evaluate the potential for solar projects for this area in the foreseeable future.

7.4.2 Projects in the foreseeable future

As part of the SEA for Wind and Solar Energy in South Africa, the CSIR and the DFFE mapped the location of all EIA applications submitted within South Africa. According to this database approximately ten (10) applications have been submitted for renewable energy projects within the geographical area of investigation, with six (6) of these being considered valid in terms of an Environmental Authorisation as two (2) applications have lapsed or was withdrawn, one (1) application is only for transmission infrastructure and there is uncertainty regarding the completion of the EIA process for one (1) project which seems to be incorrectly listed on the DFFE database based on the lack of information available for the project. Environamics was the appointed EAP for two (2) other projects in close proximity to the development, which is not yet included in the DFFE database, but is considered in the cumulative impact assessment. The majority of these projects are located in close proximity to Orkney, and to the north of the site considered for the Thakdau Solar Power Plant.

7.5 SPECIALIST INFORMATION ON CUMULATIVE EFFECTS

In line with the Terms of Reference (ToR) provided, specialists were asked to, where possible, take into consideration the cumulative effects associated with the proposed development and other projects which are either developed or in the process of being developed in the local area – refer to Figure 24 for a process flow. The following sections present their findings.

[6] There is uncertainty regarding the project and whether the EIA process was completed. This is based on the lack of information available for the project.

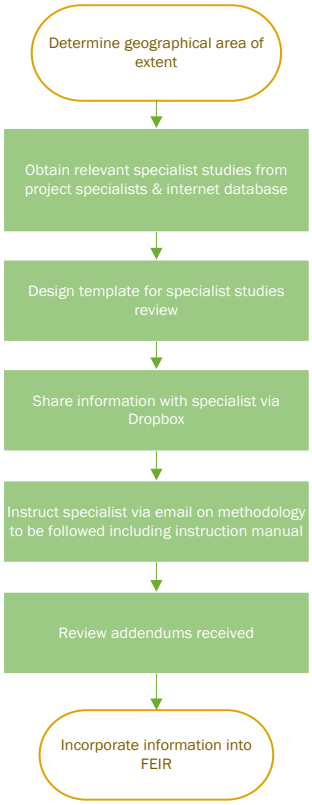


Figure 7.2: Process flow diagram for determining cumulative effects

7.5.1 Soil, Land Capability and Agricultural Potential

According to the Agriculture Compliance Statement (Appendix D4) the most important concept related to cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss (including by degradation) of agricultural land, with a consequent decrease in agricultural production.

In quantifying the cumulative impact, the area of land taken out of agricultural use (grazing) as a result of these eight projects plus this one (total generation capacity of 786 MW) will amount to a total of approximately 1,965 hectares. This is calculated using the industry standards of 2.5 and 0.3 hectares per megawatt for solar and wind energy generation respectively, as per the Department of Environmental Affairs (DEA) Phase 1 Wind and Solar Strategic Environmental Assessment (SEA) (2015). As a proportion of the total area within a 30km radius (approximately 282,700 ha), this amounts to only 0.70% of the surface area. That

is considered to be well within an acceptable limit in terms of loss of agricultural land that is only suitable for grazing, of which there is no scarcity in the country. This is particularly so when considered within the context of the following point:

In order for South Africa to achieve its renewable energy generation goals, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land in a region such as the one being assessed, which has no cultivation potential, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country. The limits of acceptable agricultural land loss are far higher in this region than in regions with higher agricultural potential.

As discussed above, the risk of a loss of agricultural potential by soil degradation is low and can effectively be mitigated for renewable energy developments. If the risk for each individual development is low, then the cumulative risk is also low.

Due to all of the considerations discussed above, the cumulative impact of loss of agricultural land use will not have an unacceptable negative impact on the agricultural production capability of the area. The proposed development is therefore acceptable in terms of cumulative impact, and it is therefore recommended that it be approved.

Because of the negligible agricultural impact of grid connection infrastructure, its cumulative impact is also assessed as negligible

7.5.2 Ecology and Wetland Assessment

The development will result in loss of and damage to natural habitats if the vegetation is cleared for the development of the solar plant. Rehabilitation of some areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction phase. Vegetation communities are likely to be impacted on a small spatial scale in comparison to the extent of the vegetation communities' total area in the region. Natural movement patterns will be disrupted for a limited period and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations, although the impact will be minimal and restricted to the construction phase.

Construction work for the proposed development will always carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or groundwater, leading to potential medium/long-term impacts on fauna and flora.

An increase in human activity on the site and surrounding areas is anticipated. The risk of snaring, killing, and hunting of certain faunal species is increased. If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased. The presence of many construction workers or regular workers during the construction and decommissioning phases on site and within the surrounding areas associated with other projects over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc. Large numbers of fauna are also killed daily

on roads. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles.

The river and riparian area are located on a part of the farm that will not be developed and is separated from the rest of the farm with a tar road. Therefore, the cumulative impact on the river and riparian area are considered to be negligible.

Overall, the cumulative impact of the proposed development is rated as being negative low, but with proper mitigation for the proposed site and the other proposed projects the cumulative impact can be reduced to negative low.

7.5.3 Avifaunal Assessment

Cumulative impacts associated with displacement of priority avian species from important habitats scored high-negative, as did the cumulative loss of important avian habitats whilst the cumulative displacement of resident avifauna scored medium-negative. Cumulative impacts associated with displacement of priority avian species from important habitats scored high-negative, whilst the cumulative displacement of resident avifauna scored medium-negative. Cumulative impacts associated with powerline collisions and electrocutions scored very high-negative.

It is the cumulative impacts, when considering the existing transformation of the threatened habitats to croplands and mining, in addition to the prevalence of planned solar developments, that increase the cumulative risks and, therefore, warrant mitigations.

Mitigating the cumulative impacts would require limiting the impact of the Thakadu Solar Power Plant to an absolute minimum, which is not necessarily feasible but should be pursued. The mitigations to reduce cumulative impacts involve limiting the disturbance footprint (overall size), focussing the development on already disturbed zones, limiting human activity and noise throughout the project life, disturbing as little natural vegetation as possible, retaining the natural vegetation beneath the panels and around infrastructure, limiting the extent and width of roadways, reducing the speeds that vehicles travel, and then thoroughly rehabilitating the entire footprint back to natural grassland representing the Vaal-Vet Sandy Grassland after decommissioning. An alternative would be to create a buffer of acceptable size (proposed 25%), where no development takes place and where intact habitats are present but this is not possible for the Thakadu Solar Power Plant as it is surrounded by transformed habitats or proposed development. Buffers are not necessarily feasible due to their small size and large ‘edge effect’.

Implementing successful mitigations would reduce the cumulative impacts of displacement of priority species by 32% to medium-negative, would reduce the cumulative impacts of displacement of resident avifauna by 29% to an acceptable low-negative score, and would reduce the cumulative impacts of loss of important avian habitats by 33% to medium-negative.

Implementing successful mitigations along the power line should reduce the impact rating for cumulative displacement of resident avifauna by 19% down to an acceptable low-negative score, however cumulative displacement of priority avian species would reduce by 28% but would still be in the medium-negative category.

7.5.4 Social Impact Assessment

The potential for cumulative impacts to occur as a result of the surrounding projects, agricultural and mining activities are likely. Potential cumulative impacts identified for the project include positive impacts on the economy, business development, and employment, as well as negative impacts such as an influx of jobseekers and change in the area's sense of place.

Thakadu SPP and the establishment of other solar power projects within the area has the potential to result in significant positive cumulative impacts, specifically with regards to the creation of a number of socio-economic opportunities for the region, which in turn, can result in positive social benefits. The positive cumulative impacts include creation of employment, skills development and training opportunities, and downstream business opportunities. The cumulative benefits to the local, regional, and national economy through employment and procurement of services are more considerable than that of Thakadu SPP alone.

While the development of a single solar power project may not result in a major influx of people into an area, the development of several projects may have a cumulative impact on the in-migration and movement of people. In addition, the fact that the project is proposed within an area characterised by good levels of solar irradiation suitable for the development of commercial solar energy facilities implies that the surrounding area is likely to be subject to considerable future applications for PV energy facilities. Levels of unemployment, and the low level of earning potential may attract individuals to the area in search of better employment opportunities and higher standards of living. It is exceedingly difficult to control an influx of people into an area, especially in a country where unemployment rates are high. It is therefore important that the project proponent implement and maintain strict adherence with a local employment policy in order to reduce the potential of such an impact occurring.

7.5.5 Visual Impact Assessment

The potential for cumulative impacts to occur as a result of the project is likely. On the other hand, the location of the solar power plants within the Klerksdorp REDZ will contribute to the consolidation of SPP structures to this locality and avoid a potentially scattered proliferation of solar energy infrastructure throughout the region. The anticipated cumulative visual impact of the proposed SPP is expected to include the change in sense of place, as well as the precedent being set for SPP development in the area where currently there is only a precedent for agricultural and mining related activities. Due to the number of mines in the area, the scenic quality of the region is low, further construction and operation of the SPP in the area is likely to have a negative impact.

7.5.6 Heritage Impact Assessment

The cumulative impact of the proposed Thakadu Solar Power Plant 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 12 other plants. However, meaningful assessment of cumulative impacts require a comprehensive review of all developments in the larger region of the site and not only those involving renewable energy.

From a review of available databases, publications, as well as available heritage impact assessments done for the purpose of developments in the region it was determined that the Thakadu Solar Power 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. 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 site, the impacts to heritage sites are expected to be of medium significance. However, this 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 site. The chances of further material being found, however, are considered to be negligible. After mitigation, the overall impact significance would therefore be low.

7.5.7 Paleontological Impact Assessment

The following is considered from a palaeontological perspective:

- Palaeontological impact significances inferred for renewable energy projects, where these are assessed at all, may well reflect different assessment approaches rather than contrasting palaeontological sensitivities and impact levels;
- Meaningful cumulative impact assessments require comprehensive data on all major developments within a region, not just those involving renewable energy, as well as an understanding of the extent to which recommended mitigation measures are followed through;
- Trying to assess cumulative impacts on different fossil assemblages from different stratigraphic units (for example, Precambrian stromatolites from 2.6 billion years ago versus Pleistocene alluvial deposits less than 2.5 million years old) has limited value.

Given the comparatively small combined footprint of the renewable energy projects under consideration compared with the very extensive outcrop areas of Malmani Group stromatolitic carbonate bedrocks as well as the probable (albeit unconfirmed) rarity of scientifically valuable occurrences of well-preserved stromatolites within flat-lying terrain preferred for solar energy projects, the cumulative impact of the proposed or authorised solar

power plant developments in the Viljoenskroon/ Orkney region- including the proposed Thakadu Solar Power Plant is assessed as medium (without mitigation), potentially falling to low (with full mitigation). There are therefore no objections on palaeontological grounds to authorisation of this project, considering potential cumulative impacts

7.5.8 Traffic Impact Assessment

The construction and decommissioning phases are the only significant traffic generators for renewable energy projects. The duration of these phases is short term (i.e. the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

7.6 IMPACT ASSESSMENT

Following the definitions of the term, the "residual effects on the environment", i.e. effects after mitigation measures have been put in place, combined with the environmental effects of past, present and future projects and activities will be considered in this assessment. Also, a "combination of different individual environmental effects of the project acting on the same environmental component" can result in cumulative effects.

7.6.1 Potential Cumulative Effects

The receptors (hereafter referred to as Valued Ecosystem Components (VECs) presented in Section 6 (refer to the matrix analysis) have been examined alongside other past, present and future projects for potential adverse cumulative effects. A summary of the cumulative effects discussed are summarized in Table 7.2. There have been 22 specific VECs identified with reference to the Solar Project (Table 6.2), which relates to the biophysical and socio-economic environments. Table 7.2 indicates the potential cumulative effects VECs and the rationale for inclusion/exclusion.

Table 7.2: Potential Cumulative Effects for the proposed project

	Valued Ecosystem Components (VECs)	Rationale for Inclusion / Exclusion	Level of Cumulative Effect
Construction Phase			
Ecological and Wetland Impact Assessment	Loss of plant species	The construction phase of the development and associated infrastructure will result in loss of and damage to natural habitats if the vegetation is cleared for the development of the solar plant. Rehabilitation of some areas would be possible but there is likely to be long-term damage in large areas.	- Medium

		Most habitat destruction will be caused during the construction phase.	
	Loss of rare/medicinal species	Vegetation communities are likely to be impacted on a small spatial scale in comparison to the extent of the vegetation communities' total area in the region. The impact is considered as cumulative as it will influence the vegetation communities in the area.	- Low
	Loss of animal species	The construction of the solar development and associated infrastructure will result in natural movement patterns being disrupted for a limited period and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations, although the impact will be minimal and restricted to the construction phase. The grassland in the site is however already partly fragmented, by mines, roads and crop fields around it and therefore considered to have a cumulative impact.	- Low
	Loss of biodiversity	Construction work for the proposed development will pose a risk to biodiversity of the area. As the construction activities will lead to the clearance of vegetation and destruction of habitats. Through the successful implementation of mitigation measures the cumulative impact of the proposed development can be kept at a minimum.	- Low
	Increased soil erosion	The construction activities associated with the solar power plant will result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora. The wider area is already impacted by soil erosion and sedimentation due to agricultural and mining activities. Therefore, the development will contribute towards the cumulative impact of erosion and sedimentation.	- Low
	Alien plant invasion	Continued movement of vehicles on and off the site during the construction phase will result in a risk of importation of alien species. Vehicles often transport many seeds, and some may be of invader species, which may become established along the access road, especially where the area is disturbed. The construction carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the	- Low

		greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites. The wider area is already impacted by the spread of alien invasive species due to agricultural and mining activities. Therefore, the development will contribute towards the cumulative impact of spread of alien invasive species. The impact will be low as the mitigation measures proposed will reduce the overall impact of the development.	
Wetland Assessment	Soil compaction, erosion and sedimentation for the river and riparian area	The use of heavy machinery during the construction and decommissioning phases of the development will result in the compaction of soil, resulting in decreased infiltration of rainwater and increased surface run-off volumes and velocities leading to a greater erosion risk. The hardened surfaces of the road and compacted soils of the proposed development area will also lead to an increase in surface run-off during storm events which will likely be discharged via stormwater outlet points, concentrating flows leaving the exposed areas. This can lead to erosion in the cleared areas and channel forming where culverts concentrate water on the side of the road where the river and riverine area are located. It can lead to sedimentation, in the river. The impact is considered to be cumulative due to proposed development contributing to the risk of sediment transport and erosion in the area.	- Low
	Soil and water pollution for the river and riparian area	Construction work will also carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface- or groundwater, leading to potential medium/long-term impacts on fauna and flora. The impact is considered to be cumulative due to proposed development contributing to the risk of soil and water pollution in the area.	- Low

	Spread and establishment of alien invasive species	The construction almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites. Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. Furthermore, the spread of the alien invasive species through the area will be accelerated when seeds are carried by stormwater into the drainage features on the site that will cause environmental degradation and indigenous species to be displaced. The wider area is already impacted by the spread of alien invasive species due to agricultural and mining activities. Therefore, the development will contribute towards the cumulative impact of spread of alien invasive species. The impact will be low as the mitigation measures proposed will reduce the overall impact of the development.	- Low
Avifaunal Impact Assessment	Displacement of priority avian species from important habitats	The displacement of resident avifauna through increased disturbance and possible collisions with PV panels leading to injury or loss of avian life are considered as a cumulative impact due to the large number of planned solar development in a 30 km radius.	- Medium
	Displacement of resident avifauna	The displacement of resident avifauna through increased disturbance and possible collisions with PV panels leading to injury or loss of avian life are considered as a cumulative impact due to the large number of planned solar development in a 30 km radius.	- Low
	Loss of important avian habitats	The loss of important avian habitats through increased disturbance are considered as a cumulative impact due to the large number of planned solar development in a 30 km radius.	- Medium

Agricultural Agro-Ecosystem Specialist Assessment	Loss of agricultural land	The cumulative impact of loss of agricultural land use will not have an unacceptable negative impact on the agricultural production capability of the area. The proposed development is therefore acceptable in terms of cumulative impact, and it is therefore recommended that it is approved. Because of the negligible agricultural impact of grid connection infrastructure, its cumulative impact is also assessed as negligible.	- Low
Heritage Impact Assessment	Loss or damage to sites, features or objects of cultural heritage significance	The cultural heritage profile of the larger region is very limited. 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. 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. Because of the low likelihood of finding further significant heritage resources in the relevant area proposed for development and the generally low density of sites in the wider landscape the cumulative impacts to the heritage are expected to be of low significance.	- Low
Palaeontological Impact Assessment	Disturbance, damage or destruction of legally-protected fossil heritage within the development footprints during the construction phase (impacts on well-preserved and / or rare fossils of scientific and conservation value)	Given the comparatively small combined footprint of the renewable energy projects under consideration compared with the very extensive outcrop areas of Malmani Group stromatolitic carbonate bedrocks as well as (2) the probable (albeit unconfirmed) rarity of scientifically valuable occurrences of well-preserved stromatolites within flat-lying terrain preferred for solar energy projects, the cumulative impact of the proposed or authorised solar power plant developments in the Viljoenskroon/Orkney region is assessed as medium (without mitigation), potentially falling to low (with full mitigation).	- Low
Social Impact Assessment	Impacts of employment opportunities, business opportunities and skills development	Thakadu SPP and the establishment of other solar power projects within the area has the potential to result in significant positive cumulative impacts, specifically with regards to the creation of a number of socio-economic opportunities for the region, which in turn, can result in positive social benefits. The positive cumulative impacts include creation of employment, skills development and training	+ Medium

		opportunities, and downstream business opportunities. The cumulative benefits to the local, regional, and national economy through employment and procurement of services are more considerable than that of Thakadu SPP alone.	
	Impact with large-scale in-migration of people	While the development of a single solar power project may not result in a major influx of people into an area, the development of several projects may have a cumulative impact on the in-migration and movement of people. In addition, the fact that the project is proposed within an area characterised by good levels of solar irradiation suitable for the development of commercial solar energy facilities implies that the surrounding area is likely to be subject to considerable future applications for PV energy facilities. Levels of unemployment, and the low level of earning potential may attract individuals to the area in search of better employment opportunities and higher standards of living. It is exceedingly difficult to control an influx of people into an area, especially in a country where unemployment rates are high. It is therefore important that the project proponent implement and maintain strict adherence with a local employment policy in order to reduce the potential of such an impact occurring.	- Medium
Traffic Impact Study	Increase in construction vehicles	The construction and decommissioning phases are the only significant traffic generators for renewable energy projects. The duration of these phases is short term (i.e. the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.	- Low

Operational Phase			
Wetland Assessment	Spread and establishment of alien invasive species	Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. Furthermore, the spread of the alien invasive species through the area will be accelerated when seeds are carried by stormwater into the drainage features on the site that will cause environmental degradation and indigenous species to be displaced. The wider area is already impacted by the spread of alien invasive species due to agricultural and mining activities. Therefore, the development will contribute towards the cumulative impact of spread of alien invasive species. The impact will be low as the mitigation measures proposed will reduce the overall impact of the development.	- Low
Avifaunal Impact Assessment	Collisions when flying into power line infrastructure	Collisions with power line infrastructure leading to injury or loss of avian life are cumulative impacts due to the large number of planned solar developments and power lines in a 30 km radius.	- Medium
	Electrocutions when perched on power line infrastructure	Electrocutions when perched on power line infrastructure are cumulative impacts due to the large number of planned solar developments and power lines in a 30 km radius.	- Medium
Visual Impact Assessment	Visual impacts related to the SPP and power line	The anticipated cumulative visual impact of the proposed SPP is expected to include the change in sense of place, as well as the precedent being set for SPP in the area where currently there is only a precedent for agricultural and mining related activities. Due to the number of mines in the area, the scenic quality of the region is low, further construction and operation of the SPP in the area is likely to have a negative impact, however the level of significance of the impact is considered to be acceptable.	- Medium
Heritage Impact Assessment	Loss or damage to sites, features or objects of cultural heritage significance	The cultural heritage profile of the larger region is very limited. 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. 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	- Low

		purpose of this review, heritage sites located in urban areas have been excluded. Because of the low likelihood of finding further significant heritage resources in the relevant area proposed for development and the generally low density of sites in the wider landscape the cumulative impacts to the heritage are expected to be of low significance.	
Decommissioning Phase			
Ecological and Wetland Impact Assessment	Increased soil erosion and sedimentation	The decommissioning activities associated with the solar power plant will result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora. The wider area is already impacted by soil erosion and sedimentation due to agricultural and mining activities. Therefore, the development will contribute towards the cumulative impact of erosion and sedimentation.	- Low
	Soil and water pollution	Photovoltaic panels may contain hazardous materials, and although they are sealed under normal operating conditions, there is the potential for environmental contamination if they were damaged or improperly disposed upon decommissioning. The impact is considered to be cumulative due to proposed development contributing to the risk of soil and water pollution in the area.	- Low
Visual Impact Assessment	Visual Intrusion	The decommissioning of the PV plant and 132kV power line may increase the cumulative visual impact together with farming activities and people using the existing gravel roads adjacent to site increasing the amount of dust generated. Dust control and housekeeping will be the main factors to consider.	- Low
Other	Generation of waste	An additional demand on municipal services could result in significant cumulative impacts with regards to the availability of landfill space.	- Medium

7.7 CONCLUSION

This chapter of the final Basic Assessment Report (BAR) addressed the cumulative environmental effects of the construction, operation and decommissioning project phases. The information to date has shown that no significant adverse residual impacts are likely. However, cumulative impacts could arise as other similar projects are constructed in the area.

The potential most significant cumulative impacts relate to:

- Cumulative effects during construction phase:
  - Loss of plant species (- Medium)
  - Displacement of priority avian species from important habitats (- Medium)
  - Loss of important avian habitats (- Medium)
  - Impacts of employment opportunities, business opportunities and skills development (+ Medium)
  - Impact with large-scale in-migration of people (- Medium)
- Cumulative effects during the operational phase:
  - Avifauna collisions when flying into power line infrastructure (- Medium)
  - Electrocutions when perched on power line infrastructure (- Medium)
  - Visual intrusion (- Medium)
- Cumulative effects during the decommissioning phase:
  - Generation of waste (- Medium)

The cumulative impact for the proposed development is medium to low and no high, unacceptable impacts related to the project is expected. Considering the extent of the project and information presented in section 7 of this report, it can be concluded that the cumulative impacts will not result in large scale changes and impacts on the environment. Photovoltaic solar energy technology is a clean technology which contributes toward a better-quality environment. The proposed project will contribute to local economic growth by supporting industry development in line with provincial and regional goals and ensuring advanced skills are drawn to the Free State Province. No cumulative impacts with a high residual risk have been identified. In terms of the desirability of the development of renewable energy, it may be preferable to incur a higher cumulative loss in such a region as this one (which has already been degraded by mining and agricultural activities), than to lose land with a higher environmental value elsewhere in the country. Also, the acceptable cumulative impacts expected will not result in a whole-scale change of the environment and therefore are considered to be acceptable, and considering the associated positive impacts associated with the development of solar energy facilities the proposed facility is considered desirable.

8 ENVIRONMENTAL IMPACT STATEMENT

This section aims to address the following requirements of the regulations:

Appendix 3. (3) An BAR (...) must include-

(l) an environmental impact statement which contains-

(i) a summary of the key findings of the environmental impact assessment:

(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and

(iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;

(m) based on the assessment, and where applicable, impact management measures from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr;

(n) any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;

(o) a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;

(q) a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;

8.1 SUMMARY OF KEY FINDINGS AND ASSESSMENT RESULTS

Based on the contents of the report the following key environmental issues were identified, which were addressed in this final BA report. The ratings provided gives an indication of the impact significance with the implementation of the recommended mitigation measures.

- Impacts during construction phase:
  - Loss of plant species (- Low)
  - Soil compaction, erosion and sedimentation for the river and riparian area (- Low)
  - Soil and water pollution of the river and riparian area (- Low)
  - Spread and establishment of alien invasive species in the river and riparian area (- Low)
  - Displacement of resident and priority avifauna (- Low)
  - Loss of important avian habitats (- Low)

- Loss of productive agricultural land (- Low)
- Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries – Grave/ Burial sites and Farmstead (- Low)
- Disturbance, damage or destruction of legally protected fossil heritage within the development footprint during the construction phase (- Low)
- Visual impact (- Low)
- Direct and indirect employment opportunities and skills development (+ Medium)
- Economic multiplier effect (+ Medium)
- Influx of jobseekers and change in population (- Low)
- Impacts on daily living and movement patterns (- Medium)
- Increased risk of potential veld fires (- Low)

➢ Impacts during the operational phase:

- Soil erosion and pollution (- Low)
- Spread and establishment of alien invasive plant species (- Low)
- Negative effect of human activities on fauna and road mortalities (- Low)
- Erosion of riverbank (- Low)
- Soil & water pollution (- Low)
- Displacement of priority avifauna (- Medium)
- Collision when flying into power line infrastructure (- Medium)
- Electrocution when perched on power line infrastructure (- Medium)
- Increased financial security for farming operations (+ Low)
- Visual impact on sensitive visual receptors in close proximity to the Solar Power Plant (- Low)
- Visual impact on sensitive visual receptors in close proximity to the 132kV overhead power line (- Medium)
- Direct and Indirect employment opportunities and skills development (+ Medium)
- Development of non-polluting, renewable energy infrastructure (+ Medium)
- Contribution to Local Economic Development (LED) and social upliftment (+ High)

➢ Impacts during the decommissioning phase:

- Habitat destruction and fragmentation (- Low)
- Soil and water pollution (- Low)
- Spread and establishment of alien invasive species (- Low)
- Negative effect of human activities on fauna and road mortalities (- Low)
- Erosion of riverbank (- Low)
- Soil pollution (- Low)
- Increase in stormwater run-off (- Low)

➢ Cumulative biophysical impacts resulting from similar development in close proximity to the proposed activity (Negative Medium to Negative Low).

8.2 SENSITIVITY ANALYSIS SUMMARY AND SITE-SPECIFIC CONDITIONS

The sensitivity analysis has guided the developer in optimising the final layout of the Thakadu Solar Power Plant through identifying specific environmental areas and features present within the site which needs to be avoided through the careful placement of infrastructure as part of the development footprint. Refer to Section 6.4 for the complete sensitivity analysis and Appendix H for the final layout map which avoids the areas required to be conserved.

The main features to be avoided are related to ecology and wetlands. The Vaal River (VU9) to the north of the site, the drainage channel (VU8) in the proposed power line corridor option 2 and vegetation unit 2 were identified as areas with high sensitivity. The specialist has recommended a 32m buffer area around VU9 and VU8. Development should be avoided in vegetation unit 2. These areas have been avoided by the proposed final layout as per Appendix H.

Further mitigation measures for the development, as recommended by the independent specialists, have been included in the EMPr(s) for the project as per Appendix I1-I4.

8.3 TECHNICAL DETAILS OF THE PROPOSED INFRASTRUCTURE TO BE AUTHORISED

- PV Panel Array - To produce up to 150MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun.

- Wiring to Central Inverters - Sections of the PV array will be wired to central inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.

- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required on the site to step the voltage up to 132kV, after

which the power will be evacuated into the national grid via the proposed power line. Whilst Thakadu Solar Power Plant (RF) (Pty) Ltd. has not yet received a cost estimate letter from Eskom, it is expected that generation from the facility will tie in with either the existing Vaal Reefs Eleven Substation (option 2) or two options within the same assessment corridor, the existing Mercury-South Vaal 2 132kV Power Line or the South Vaal-Carrdell 132kV (option 1). The Project will inject up to 100MW into the National Grid. The installed capacity will be approximately 150MW.

Two grid connection corridors, each with a width of between 100-150m and up to 250m, have been identified for the assessment and placement of the power line (i.e., the power line will be developed within one of the two proposed corridors). Option 1 is located to the south-west of the SPP site and will connect into either the existing Mercury-South Vaal 2 132kV (maximum length 1,22km) or the South Vaal-Carrdell 132kV (maximum length 0,86km).

The other option (option 2) is located to the south-east of the SPP site and will connect into the existing Vaal Reefs Eleven Substation. The length of this option is ~2.7km. This is the preferred alternative from a development point of view due to the fact that the Vaal Reefs 11 Substation has capacity to accommodate the project.

- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible.

- Supporting Infrastructure – The following auxiliary buildings with basic services including water and electricity will be required on site:

  - Office (~200 m²);
  - Switch gear and relay room (~400 m²);
  - Staff lockers and changing room (~200 m²); and
  - Security control (~60 m²)

- Battery Energy Storage System – Up to 500 MW Battery Storage Facility with a maximum height of 8m and a maximum volume of 1740 m^3 of batteries and associated operational, safety and control infrastructure.

- Roads – Access will be obtained from the Stokkiesdraai road off of the R30 Regional Road onto the tertiary road T3767 access road situated adjacent the development footprint where direct access will be obtained to the facility. An internal site road network will also be required to provide access to the solar field and associated infrastructure. The access and internal roads will be constructed within a 25-meter corridor and will be between 6 and 12 metres wide.

- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding properties. Fencing with a height of 2.5 meters will be used.

8.4 RECOMMENDATION OF EAP

The final recommendation by the EAP considered firstly if the legal requirements for the EIA process had been met and secondly the validity and reliability of the substance of the information contained in the BA report. In terms of the legal requirements it is concluded that:

- All key consultees have been consulted as required by Chapter 6 of the EIA Regulations (as amended in 2017)
- The Basic Assessment process has been conducted as required by the EIA Regulations (as amended in 2017), Regulations 19 and Appendix 1.
- The EMPr was compiled in conjunction with the Generic EMPr for overhead electricity transmission and distribution infrastructure as per Government Notice 435, which was published in Government Gazette 42323 on 22 March 2019.
- The EMPr was compiled in conjunction with the Generic EMPr for the development of the associated substation infrastructure for transmission and distribution of electricity as per Government Notice 435, which was published in Government Gazette 42323 on 22 March 2019.
- The EMPr was compiled for the Thakadu Solar Power Plant as per Appendix 4 of the EIA Regulations (GN.R. 326), published in Government Gazette 40772 on 07 April 2017.
- The proposed mitigation measures will be sufficient to mitigate the identified impacts to an acceptable level.
- No additional specialist studies are proposed on any environmental issue raised and therefore, no terms of reference are provided for such studies.
- Option 2 (connecting to the Vaal Reefs Eleven Substation)of the power line route alternatives (assessed within the 100m wide grid connection corridor) is preferred from an environmental perspective and is therefore recommended for approval as part of the EA.

In terms of the contents and substance of the BA report the EAP is confident that:

- All key environmental issues were identified. These key issues were adequately assessed during the BA process to provide the competent authority with sufficient information to allow them to make an informed decision.

The final recommendation of the EAP is that:

It is the opinion of the independent EAP that the proposed development will have a net positive impact for the area and will subsequently ensure the optimal utilisation of resources. All negative environmental impacts can further be effectively mitigated through the proposed mitigation measures. Based on the contents of the report it is proposed that an environmental authorisation be issued, which states (amongst other general conditions) that the Thakadu Solar Power Plant and associated infrastructure on the Farm

Groot Vaders Bosch No. 592 and Anglo No. 593, Registration Division Viljoenskroon, Free State Province be approved subject to the following conditions:

- Implementation of the proposed mitigation measures set out in the EMPr(s).
- Implementation of the proposed mitigation measures set out in the specialist studies.
- The proposed solar facility must comply with all relevant national environmental laws and regulations.
- All actions and tasks allocated in the EMPr(s) should not be neglected and a copy of the EMPr(s) should be made available onsite at all times.
- Should archaeological/ heritage 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.
- When the Thakadu Power Plant layout has been established a walkdown of the area must be completed by a qualified Palaeontologist to catalogue and photograph well-preserved stromatolites. This action should take place after initial vegetation clearance but before the ground is levelled for construction.

We trust that the department find the report in order and eagerly await your final decision in this regard.

Christia van Dyk

Environamics - Environmental Consultants

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