BIOTHERM ENERGY

Proposed Construction of the Sendawo 1 75MW Solar Photovoltaic (PV) Energy Facility near Vryburg, North West Province

Draft Environmental Impact Assessment Report

DEA Ref No: 14/12/16/3/3/2/891

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Document Title:	Proposed Construction of the Sendawo 1 75MW Solar Photovoltaic (PV) Energy Facility near Vryburg, North West Province: Draft Environmental Impact Assessment Report
Author:	Lynsey Rimbault
Version Number:	1
Checked by:	Andrea Gibb
Approved:	Rebecca Thomas
Signature:	
For:	SiVEST SA Pty (Ltd)

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KEY PROJECT INFORMATION

FARM DESCRIPTION	21 DIGIT SURVEYOR GENERAL CODE
Portion 1 of the Farm Edinburgh No 735	T0HN00000000073500001

SENDAWO PV APPLICATION SITE				
NORTH-WEST CORNER	**NORTH-EAST CORNER**	**CENTRE POINT**	**SOUTH-WEST CORNER**	**SOUTH-EAST CORNER**
S27° 4' 13.872"	S27° 1' 52.680"	S27° 3' 40.690"	S27° 5' 22.740"	S27° 3' 48.672"
E24° 41' 10.716"	E24° 43' 39.900"	E24° 43' 0.553"	E24° 41' 43.116"	E24° 44' 48.228"

DEVELOPMENT AREA			
PHASE	**AREA (HECTARES)**	**CENTRE POINT COORDINATES**	
		SOUTH	**EAST**
SENDAWO SOLAR 1 DEVELOPMENT AREA	367.46	S27° 3' 52.625"	E24° 43' 50.328"

SENDAWO SOLAR 1: DEVELOPMENT AREA		
CORNER POINT COORDINATES (DD MM SS.sss)		
POINT	SOUTH	EAST
S1_01 (NW)	S27° 3' 11.716"	E24° 43' 7.915"
S1_02	S27° 3' 6.917"	E24° 43' 19.999"
S1_03	S27° 3' 32.997"	E24° 43' 31.458"
S1_04	S27° 3' 37.364"	E24° 44' 10.570"
S1_05 (NE)	S27° 3' 32.580"	E24° 44' 36.627"
S1_06 (SE)	S27° 3' 48.539"	E24° 44' 47.636"
S1_07 (SW)	S27° 4' 38.032"	E24° 43' 7.876"

SENDAWO SOLAR 1: COMPONENTS		
CENTRE POINT COORDINATES (DD MM SS.sss)		
COMPONENT	ALTERNATIVE 1	ALTERNATIVE 2
SUBSTATION (132kv)	S27° 4' 17.325"	S27° 3' 32.763"
	E24° 43' 23.472"	E24° 43' 18.037"
O&M BUILDINGS	S27° 4' 17.028"	S27° 3' 34.222"
	E24° 43' 19.665"	E24° 43' 13.589"
LAYDOWN AREA	S27° 3' 53.560" E24° 44' 23.404"	S27° 4' 17.992" E24° 43' 40.594"

SENDAWO SOLAR 1				
PROPOSED 132kV POWER LINE CORRIDOR - CENTRE LINE				
SUMMARY COORDINATES (DD MM SS.sss)				
PROJECT	START POINT	MIDDLE POINT	END POINT	APPROX LENGTH (KM)
SENDAWO SOLAR 1	S27° 2' 9.279"	S27° 3' 1.348"	S27° 2' 0.103"	5.62
	E24° 43' 37.482"	E24° 42' 45.355"	E24° 43' 37.337"	

Refer to Appendix 9 for the full list of coordinates.

TITLE DEEDS: These are included in Appendix 1

PHOTOGRAPHS OF SITE:

General Characteristics of the study area

TYPE OF TECHNOLOGY: Photovoltaic (PV)

STRUCTURE HEIGHT: Estimated to be approximately 4m although the final design details are yet to be confirmed. These details will become available during the detailed design phase of the project.

SURFACE AREA TO BE COVERED: The total area of the application site is approximately 1709 hectares (ha). The Sendawo 1 development area has a total area of 367 hectares. The proposed 132kV onsite substation will require approximately 1 hectare. The footprint of the Operations and Maintenance (O&M) buildings will be approximately 270 m^2. The final design details are yet to be confirmed. These details will become available during the detailed design phase of the project.

PV DESIGN: The plant will comprise of either fixed tilt or single axis tracking mounting structures. Either thin film or crystalline silicon modules will be used. The modules will be mounted in rows on the support structures. An onsite substation will contain transformer (s) for voltage step up from medium voltage to high voltage. DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers. The medium voltage cables will be run underground within the facility, before being fed to the onsite substation

STRUCTURE ORIENTATION: This will be confirmed during the detailed design phase of the project. For single axis tracking the structures will be mounted on a north-south horizontal axis and will track the sun from east to west. For fixed tilt structures the modules will be north facing tilted at an angle of between 15-30 degrees.

FOUNDATIONS: The preferred structure supports will be rammed steel piles, however other foundations will be considered should the ground not be suitable for ramming and these will include but will not be limited to concrete, screws, predrilling and micropiles. The final foundation design will be determined at the detailed design phase of the project.

LAY-DOWN AREA DIMENSIONS: Approximately 5 hectares is required for the temporary laydown area. Permanent laydown for the containers will be required for the storage of spares, which is to be located close to the O&M building. Approximately 6, 3x12m containers will be required

GENERATION CAPACITY: The project will have a total generation capacity of 75MW.

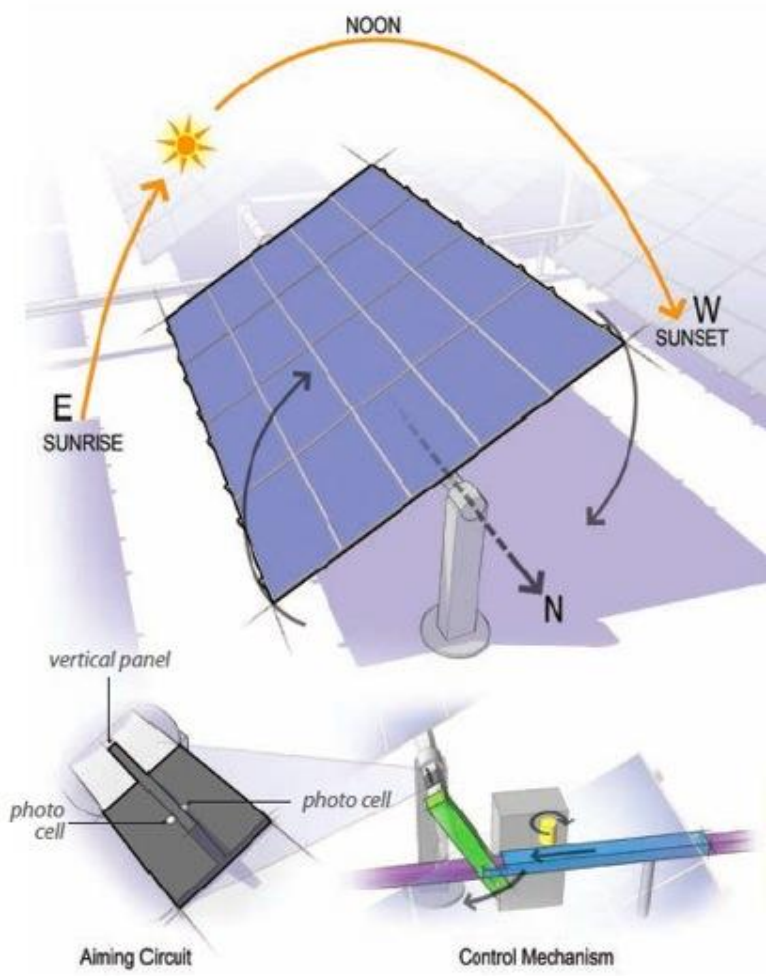

Figure i. Example of a Photovoltaic Panel with tracking capability (Source: http://solartoday.org/2009/07/single-axis-solar-tracking/).

TECHNICAL DETAILS:

Component	Description / Dimensions
Export capacity	Maximum of 75MW
Capacity of the on-site substation	132kV
Number of Panels	Approx. 275 000
Area occupied by each panel	Approx. 2m^2 per panel
Dimensions of panels	Approx. 1956mm x 992mm x 40mm The actual size of the PV modules to be used will be determined in the final design stages of the project.
Max panel height from the ground	Approx. 4m
Area of the application site	1709 hectares
Area of the development	The Sendawo 1 development area has a total area of 367 hectares.
Area of the PV array	Approximately 179 hectares
Footprint of Substation	Substation will occupy a footprint area of approx. 1 hectare
Footprint of O&M building(s)	Approx. 270m^2
Area of construction laydown area	Approx. 5 hectares
Area of permanent laydown area	Permanent laydown for the containers will be required for the storage of spares, which is to be located close to the O&M building.
Width of internal roads	Up to 8m wide.
Length of internal roads	To be confirmed once the EPC contractor has been selected and the design is finalised.
Number of inverters required	To be confirmed once the EPC contractor has been selected and the design is finalised.
Area occupied by inverter / transformer stations / substations	To be confirmed once the EPC contractor has been selected and the design is finalised.
Proximity to grid connection	BioTherm are proposing to develop the Sendawo Common Collector substation and associated power line connecting the solar PV energy facility to the existing Eskom Mookodi Main Transmission Substation (MTS). All three of the Sendawo Solar facilities will be connected to the proposed Sendawo Common Collector Substation. Grid connection of Sendawo 1 will be from the proposed 132kV onsite substation, via a proposed 132kV power line to the proposed Sendawo common collector substation. The proposed Sendawo common collector substation will be connected to the existing Eskom Mookodi 400/132kV Main Transmission Substation (MTS) via a proposed power

	line of up to 400kV. The facility onsite 132kV substation and the proposed 132kV power line are part of this project, however the Sendawo collector substation and its power line to Mookodi MTS are being assessed as part of a separate ongoing Environmental Impact Assessment (EIA) process. The distance from the 132kV onsite substation to the proposed Sendawo collector substation is approximately 5.62km. The final distance from the proposed Sendawo collector substation to the Mookodi MTS will depend on the route corridor selected as preferred and authorised as part of the separate ongoing Environmental Impact Assessment (EIA) process.
Width of the power line servitude	The width of the servitude for the proposed 132kV power line is 31m.
Power line tower types and height	The 132kV power lines are likely to be standard Eskom DT-T 7649 designs.
Diagrams of tower types	DT-T 7649
Approximate distance between towers	200m
Height of fencing	Approx. 2m high.
Type of fencing	Galvanized steel.

A3 Maps of all smaller maps included in the report are included in Appendix 5.

BIOTHERM ENERGY

PROPOSED CONSTRUCTION OF THE SENDAWO 1 75MW SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Executive Summary

BioTherm Energy (Pty) Ltd (hereafter referred to as BioTherm) intends to develop Sendawo 1 solar photovoltaic (PV) energy facility and associated infrastructure near Vryburg in the North West Province of South Africa (hereafter referred to as the "proposed development") (Figure ii). SiVEST SA (Pty) Ltd (hereafter referred to as SiVEST) has been appointed as independent environmental assessment practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed development. The overall objective of the project is to generate electricity to feed into the National Grid. The proposed project will consist of a 75MW export capacity solar PV energy facility.

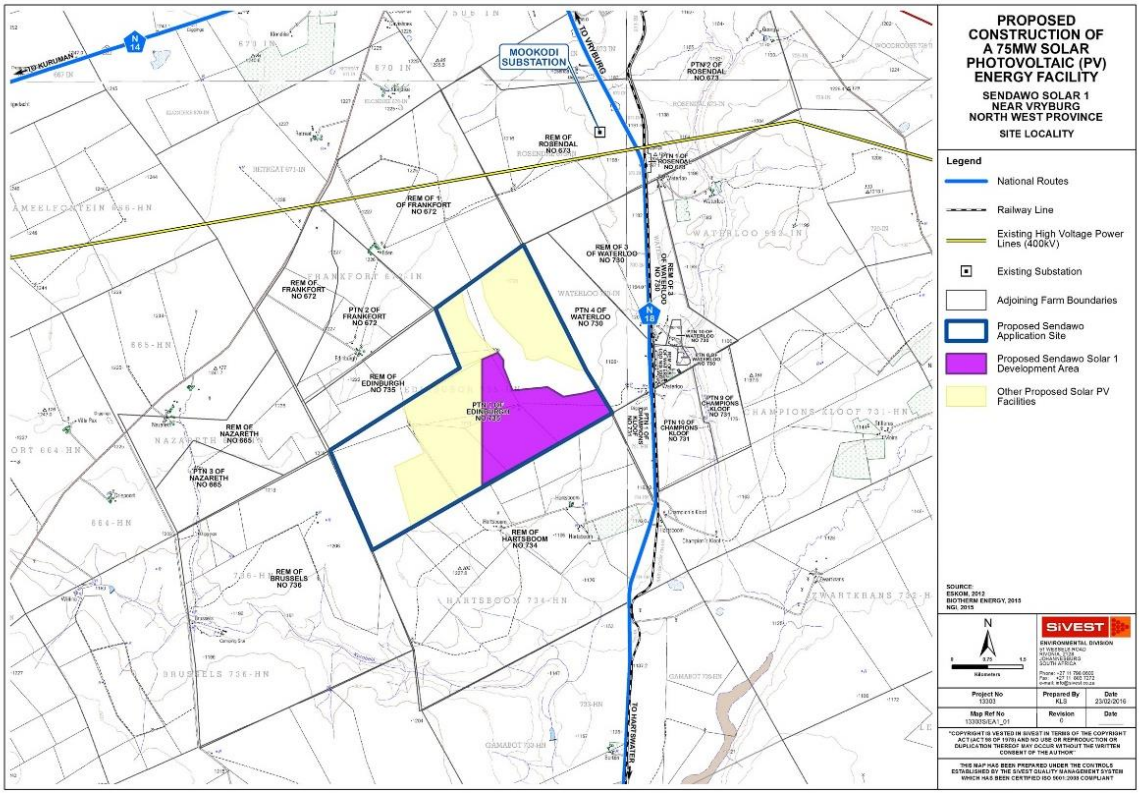

Figure ii: Site Locality

This proposed PV energy facility forms one of three PV energy facilities with a 75MW export capacity that BioTherm are proposing to develop on Portion 1 of the Farm Edinburgh No 735 (Figure iii). Each PV facility will entail the construction of associated infrastructure including a 132kV onsite substation, 132kV power line, operations building and laydown area. In order to accommodate the Department of Energy's (DoE) competitive bidding process for procuring renewable energy from Independent Power Producers in South Africa each PV energy facility will be developed under a separate Special Purpose Vehicle (SPV) and therefore each requires a separate Environmental Authorisation. Additionally, BioTherm are proposing to develop the Sendawo common collector substation and a proposed power line of up to 400kV connecting it to the existing Eskom Mookodi Main Transmission Substation (MTS). This associated electrical infrastructure will also require a separate Environmental Authorisation. All three of the Sendawo Solar facilities will be connected to the proposed Sendawo substation. Although each PV energy facility and the electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider all four proposed developments. The potential environmental impacts associated with all four developments will be assessed as part of the cumulative impact assessment. The DEA reference numbers allocated for the other two proposed PV energy facilities and the substation and power line are provided below:

- Sendawo PV 2: 14/12/16/3/3/2/892
- Sendawo PV 3: 14/12/16/3/3/2/893
- Sendawo Substation and Power Line: 14/12/16/3/3/2/894

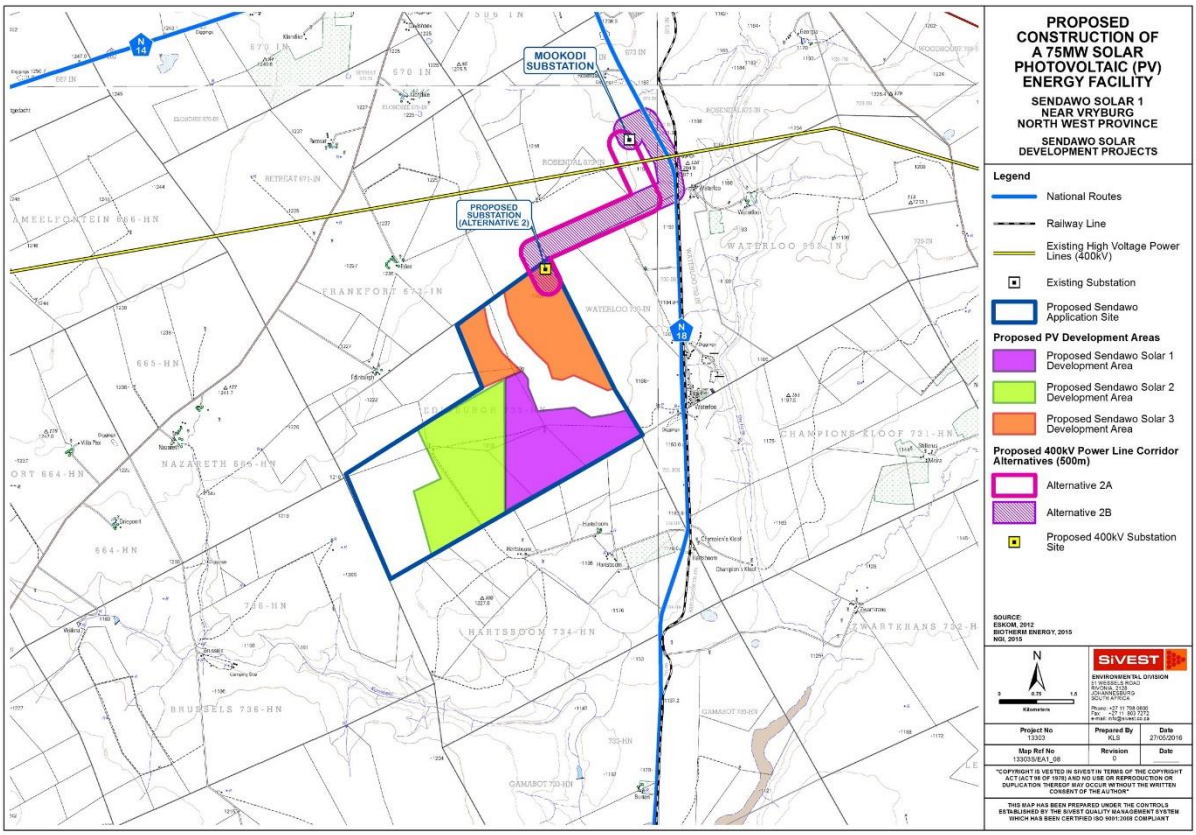

Figure iii: Regional context showing the four proposed projects

DEVELOPMENT AREA			
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Refer to Appendix 9 for the full project coordinates.

The proposed development requires Environmental Authorisation (EA) from the Department of Environmental Affairs (DEA). However, the provincial authority will also be consulted (i.e. the North West Department of Rural, Environment and Agricultural Development (NW READ)). The EIA for the proposed development will be conducted in terms of the EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on the 8th of December 2014. In terms of these regulations, a full EIA is required for the proposed project. All relevant legislation and guidelines (including Equator Principles) will be consulted during the EIA process and will be complied with at all times. The Scoping Phase of the project has been completed and has been accepted by the DEA. The EIA phase is currently in progress.

The proposed project involves the construction of one 75MV solar PV energy facility and associated infrastructure. Layout alternatives have been investigated which relate to the location of the infrastructure on the site. These are illustrated below:

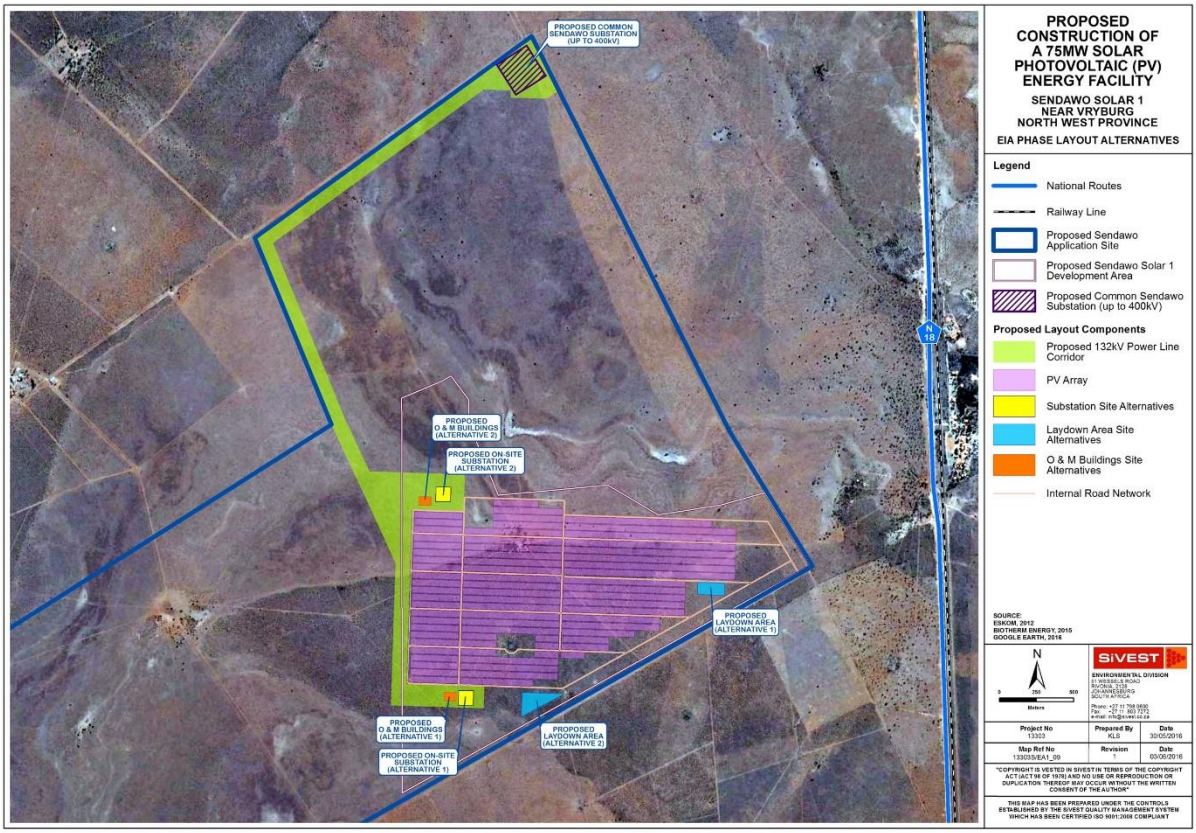

Figure iv: Sendawo 1 solar PV energy facility layout alternatives

The entire study area is covered by the Ghaap Plateau Vaalbosveld vegetation type, which is characterised by a well-developed shrub layer and an open tree layer. In certain areas, man has had an impact on the natural vegetation, especially around farmsteads, where over many years tall exotic trees and other typical garden vegetation have been established. Much of the study area however is still characterised by natural low shrubland with transformation limited to a few isolated areas of cultivation.

Specialist studies were conducted for the following environmental parameters, as part of the EIA phase and as stipulated in the Plan of Study for EIA:

- Biodiversity Assessment
- Avifauna Assessment
- Surface Water Impact Assessment
- Soils and Agricultural Potential Assessment
- Visual Impact Assessment
- Heritage and Palaeontological Assessment
- Socio-economic Impact Assessment
- Traffic Assessment

Table i: Summary of findings

Environmental Parameter	Summary of major findings	Recommendations
Biodiversity	The vegetation type that occurs on site (Ghaap Plateaux Vaalbosveld) is classified as Least Threatened and also has a wide distribution and extent. The natural vegetation on the sites is therefore not considered from this perspective to have high conservation status. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy. However, the site is within areas identified in the Provincial Conservation Assessment to be of importance for various reasons, including as buffer areas for pans, as part of a Provincial corridor network and as part of a dolomite aquifer recharge zone. Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of the following: ▪ Presence of natural vegetation on site, some of which is of elevated conservation priority. ▪ Presence of one protected tree species. ▪ Presence of pan depressions. ▪ Potential presence of several animals of potential conservation concern: ▪ Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.	The report concludes that there are some issues related to the ecology of the site that could result in potentially significant ecological impacts. The seriousness of these impacts is not considered to be high. Some impacts require permits to be issued, either by National or Provincial authorities and additional field data is required for the permit applications.

Avifauna	The proposed PV 1 facility is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective. A potentially high sensitive, no-go area was identified in the core study area, i.e. a small concrete impoundment at a natural spring. A borehole and the Dry Harts River were identified as potential high sensitive areas in the immediate surroundings, as these micro-habitats are potential focal points of bird activity. It is important to note that the sensitivity of the study area could be influenced by the development itself, in that the construction of the solar panels will result in the relocation of the impoundment, currently located at the natural spring, which means that the 250m zone currently classified as high sensitive around the impoundment could fall away. The potential impact of displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure are rated as high, and will remain so after mitigation. The potential impact of displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure, are also rated as high and will remain so after mitigation. The impact of mortality of priority species due to collisions with solar panels is rated as low and could be further reduced through mitigation. The impact of displacement of priority species due to disturbance associated with de-commissioning	In view of the very dry conditions which prevailed at the site during the pre-construction monitoring which was implemented from November 2015 to February 2016, the low number of birds recorded should not necessarily be taken as an absolutely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

	of the PV plant and associated infrastructure is likewise rated as low and could be further reduced through mitigation.	
Surface Water	Ultimately, it was found that there are four pan wetlands (pan wetlands 4, 5, 14, and 15) on the Sendawo PV 1 study site. A 15m construction buffer zone and 18m operation buffer zone is to be applied to the wetlands based on the type and condition of the wetlands as well as the potential impacts expected and mitigations measures to be implemented. In terms of potentially applicable environmental and water related legislature, several listed activities and water uses have been identified that will be applicable to the proposed development based on the current layout. In terms of NEMA (1998) and the EIA Regulations (2014), Activities 12 and 19 of Government Notice 983 have been identified as being applicable as a result of access roads being placed directly within pan wetland 15 and along the boundaries of pan wetland 4. With respect to the NWA (1998), water uses (c) and (i) will also be applicable where the proposed access roads will be directly within pan wetland 15 and along the boundaries of pan wetland 4. The above identified activities and water uses should however be confirmed with the relevant government departments. Foreseen potential negative impacts in terms of the pre-construction, construction, operation and decommissioning phases of the proposed development were identified and assessed. Mitigation measures have been stipulated and must be included and implemented as part of the Environmental	In terms of final specialist recommendations, it is strongly recommended that no access roads are placed within the identified wetlands, as there is sufficient space alongside the proposed PV fields for the roads to be routed outside and away from the wetlands. The implications of access roads in any wetlands mean long term impacts. If these wetlands cannot be avoided, the health of the affected wetlands will need to be assessed to determine if these wetlands are ecologically significant and whether the impacts will be too high, thereby potentially requiring wetland off-setting to compensate for significant degradation as a result of the proposed development. This can be undertaken during the water use license application process, should water use licensing be undertaken for the affected wetlands. However, where access roads can be removed from the wetland areas and should no direct impacts need to take place to the identified wetlands, the need for water use licensing can be avoided where it can be demonstrated to DWS that significant impacts will not take place and/or where other water uses are not required. Where impacts to surface water resources is not avoidable, the relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence

	Management Programme (EMPr) for the proposed development.	
Agricultural Potential and Soils	The shallow soils in the area, coupled with the low rainfall means that the only means of reliable cultivation would be by irrigation and the Google Earth image of the area shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation. The climatic parameters mean that this part of North West is well suited for grazing but here the grazing capacity is relatively low, around 12 ha/large stock unit. The land use in the area is dominantly "shrubland and low fynbos" with some small areas of "bare rock and soil (natural)" as classified by the National Land Cover (Thompson, 1999). As previously mentioned, there are no areas of cultivation that were identified, only a few small, isolated areas of "Improved grassland".	Due to the prevailing low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be kept to a minimum, so that at least the effect on grazing land for livestock is reduced. The main mitigation would be to ensure that physical disturbance caused by soil removal and/or re-distribution is kept to a minimum. In such an area of low rainfall and hot conditions, vegetation is fragile and often difficult to re-establish. The relatively sandy nature of the soils means that if exposed, there is a real hazard of soil removal by wind erosion, especially in the drier winter months. To combat this, any bare soil should be re-vegetated as soon as possible and preventative measures, such as soil covering and windbreaks, may also be required.
Visual	The assessment revealed that overall the proposed Sendawo Solar 1 PV energy facility would have a low visual impact during construction and a medium visual impact during operation, with a number of mitigation measures available. The associated infrastructure would have a low visual impact during construction and operation. The visual impacts are not significant enough to prevent the project from proceeding and that an Environmental Authorisation (EA) should be granted. From a visual impact	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Vegetation clearing should take place in a phased manner. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible.

	perspective only three (3) sensitive visual receptors have been identified within the study area. In addition, the existing electrical infrastructure and other linear elements already present within the study area have already altered the natural character of the surrounding environment to a degree and are expected to lower the visual sensitivity of the area. It must also be noted that the visual impact of the proposed development on these three (3) sensitive visual receptors identified within the study area was rated as being low. SiVEST is therefore of the opinion that the impacts associated with the construction and operation phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented	▪ Limit the number of vehicles and trucks travelling to and from the proposed site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads. ▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles. ▪ Re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid. ▪ Temporarily fence-off the construction site (for the duration of the construction period). Carefully plan to reduce the construction period. ▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ As far as possible, limit the amount of security and operational lighting present on site. ▪ As far as possible, limit the number of maintenance vehicles which are allowed to access the site. ▪ The operations and maintenance (O&M) buildings should not be illuminated at night. ▪ Bury cables under the ground where possible. ▪ The O&M buildings should be natural tones that fit with the surrounding environment. ▪ Select the alternatives that will have the least impact on visual receptors ▪ Limit the number of maintenance vehicles which are allowed to access the site.

		▪ Non-reflective surfaces should be utilised where possible.
Heritage and Palaeontology	The Heritage Impact Assessment has shown that the proposed Sendawo Solar projects have heritage resources present on the property. This has been confirmed through a field survey, archival research and evaluation of aerial photography of the sites. During the fieldwork 2 archaeological resources were identified of which all were archaeological sites representing the Earlier, Middle and Later Stone Age. The sites are all rated as having local heritage significance. No mitigation is required for sites V01 and V06. Local scree material and blocks of dolomite were inspected for fossils and all finds were recorded as photographic records. Outcrop of bedrock with significant stromatolites fossils was recorded and sites with potential cave breccia were recorded in areas where burrows of large vertebrates such as Aardvark were obviously present in the sandy deposits. Based on the fieldwork findings, an extremely high palaeontological sensitivity area has been delineated in the south eastern section of the proposed project area. The palaeontological finds around point 0522 are seen as the most significant of the area and can give a heritage grading of Grade 2 (Provincial Heritage Site) but potentially Grade 1 (National Heritage Site).	The overall impact on heritage resources is seen as acceptable and the proposed mitigation measures to be incorporated in the EMPr will provided the necessary actions to address any impacts on heritage resources.

	Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.	
Socio-economic	The local community of Vryburg, and the Naledi LM at large, is faced with significant levels of illiteracy, high unemployment, and limited economic opportunities. It is estimated that two thirds of the households residing within the LM survive on less than R3 200 per month. Consultation with community leaders revealed that the most significant socio-economic challenge facing the population of the study area is the lack of employment opportunities. This was confirmed during the consultation with the directly impacted land owner, who stated that the farmers are no longer able to employ as many local community members as previously, leaving these individuals with limited other skills and opportunities for re-employment. Portion 1 of Farm Edinburgh 735 is currently being used for predominantly livestock farming and game breeding. The proposed development will not affect these operations, as they are expected to be moved to the adjacent farm. Overall, the impacts discussion and evaluation revealed that no fatal flaws are present from a socio-economic perspective, preventing the proposed development from being approved and implemented. In fact, all of the expected negative socio-economic impacts can be mitigated to low significance. Overall, considering the fact that the significance of the possible positive impacts of the proposed development outweighs the negative impacts, and based on the needs and desirability assessment from a locational perspective, it can be	Considering the possible cumulative impact of the project and the potential effect on food security, care should be taken to not unduly negatively impact on agriculture production in the region. Based on the fact that the land is not considered as high potential agricultural land and the consultation with the impacted land owner, this is not a significant concern for the development of Sendawo 1, assuming mitigation measures are implemented.

	concluded that the project would generate positive socio-economic returns for the local economy and its community and should therefore, be considered for implementation.	
Traffic	The general freight for the solar farms comprise of building materials, solar panels and frames and an 80MVA transformer(s). The imported freight will be transported from South African ports to the site. Building materials will be transported from sources in surrounding towns while certain elements will be transported from various manufacturing centres in South Africa. The preferred import origin of the imported elements to the proposed Sendawo 1 Solar PV Energy Facilities will be from the Durban Port. The distance of 828 km comprises of surfaced roads the full way. However, should the Durban Port not be available for handling the freight, the Port Elizabath/Coega Port could be used as an alternative port. The transport distance in this case is 925 km. Toll fees are required on the route from the preferred port. Abnormal Permits will be required for transport of the transformer in any event. The traffic during construction and during operation will have negligible impact on existing and future traffic. The route is predominantly on National or Provincial Roads with suitable standards for transport of container freight. It is also suitable for abnormal loads with permits. There is a possibility of limited risk of delays for normal routine	It is recommended that the majority of construction personnel is transported to and from site by means of buses and some by private vehicles.

	maintenance works (repairs and reseals) depending of the time of transport and scheduling of roads contracts. The transport of elements from manufacturing centres within South Africa is predominantly on National and Provincial roads, which presents no limitations for normal freight. The proposed preferred access roads from the N18 to the site for is situated in the middle of the proposed site at an existing farm access. The access is at an acceptable safe point with sufficient sight distance which would be acceptable to SANRAL. In general, no obvious problems are expected with freight transport along the proposed routes to the site necessary for the construction and maintenance of the site.	

These specialist studies were conducted to address the potential impacts relating to the proposed development that were identified during the scoping phase. An impact assessment was conducted to ascertain the level of each identified impact, as well as mitigation measures which may be required. The potential positive and negative impacts associated within these studies have been evaluated and rated accordingly. The results of the specialist studies have indicated that no fatal flaws exist as a result of the proposed project. Additionally, the specialists comparatively assessed the alternatives as provided in Figure iv, the results of the comparative assessment are summarised below in Table ii.

Table ii: Summary of comparative assessment

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	FATAL FLAWS
OPERATIONS BUILDING AND SUBSTATION			
Sendawo PV 1 Operations Building and Substation Alternative 1	Biodiversity	NO PREFERENCE	No Fatal Flaws
	Avifauna	NO PREFERENCE	No Fatal Flaws
	Surface Water	FAVOURABLE	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	No Fatal Flaws
	Visual	PREFERRED	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No Fatal Flaws
Sendawo PV 1 Operations Building and Substation Alternative 2	Biodiversity	NO PREFERENCE	No Fatal Flaws
	Avifauna	NO PREFERENCE	No Fatal Flaws
	Surface Water	PREFERRED	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	No Fatal Flaws
	Visual	FAVOURABLE	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No Fatal Flaws
LAYDOWN AREA			
Sendawo PV 1 Laydown Area Alternative 1	Biodiversity	NO PREFERENCE	No Fatal Flaws
	Avifauna	NO PREFERENCE	No Fatal Flaws
	Surface Water	PREFERRED	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	No Fatal Flaws
	Visual	FAVOURABLE	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No Fatal Flaws
Sendawo PV 1 Laydown Area Alternative 2	Biodiversity	NO PREFERENCE	No Fatal Flaws
	Avifauna	NO PREFERENCE	No Fatal Flaws
	Surface Water	FAVOURABLE	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	No Fatal Flaws
	Visual	PREFERRED	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No Fatal Flaws

As depicted in Table ii above, the two substation and operations building alternatives are very similar in terms of which is the environmentally preferred alternative. Almost all of the specialists found there to be no preference between the two alternatives, with the only exceptions being the surface water and visual specialists. Alternative 1 was preferred by the visual specialist because most of the potentially sensitive receptors are more than 2km from the alternative, whereas Alternative 2 was preferred by the surface water specialist because there is a greater distance between this alternative and surface water features. However it was also found that the visual impact of the substation and operations building would be insignificant compared to the PV arrays and for this reason **substation and operations building Alternative 2 has been selected as the preferred alternative**. Additionally, substation Alternative 2 is located further north on the power line corridor and therefore the power line would be shorter than if Alternative 1 had been selected. Selecting the shorter alternative will likely reduce negative impacts which have been identified by the various specialists. Additionally, the shorter alternative is likely to be the technically and economically preferred route.

Similarly, in terms of the laydown area alternatives almost all of the specialists found there to be no preference between the two alternatives, again with the only exceptions being the surface water and visual specialists. Alternative 1 was preferred by the surface water specialist because there are no surface water features within 500m of the proposed alternative, whereas Alternative 2 was preferred by the visual specialist because it is located slightly further from one of the sensitive visual receptors, as well as one of the potentially sensitive visual receptors. However the laydown area would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible and for this reason **laydown area Alternative 1 has been selected as the preferred alternative**.

It is important to note that no fatal flaws were identified and therefore both of the alternatives mentioned above are considered to be acceptable, although not necessarily preferable from an environmental perspective. The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in Figure v.

It should be noted that micrositing may be required within the development area and power line corridor during the detailed design phase to avoid any additional sensitive areas, and any new palaeontological outcrops. In addition, the alignment of the power line within the authorised power line corridor will be determined during the detailed design phase. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

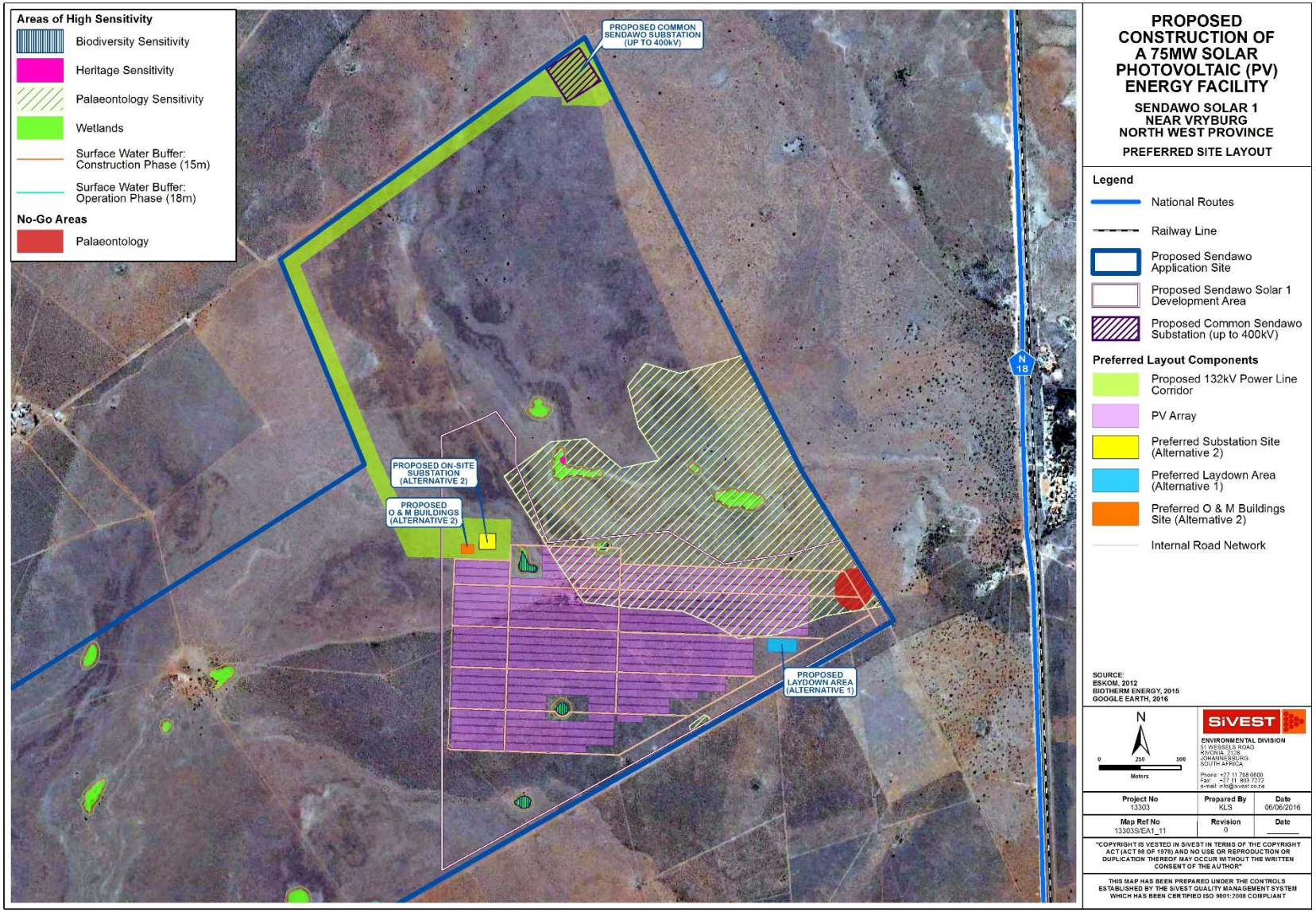

Figure v: Preferred Site Layout in relation to Sensitive Areas

It is the opinion of the EAP that the information and data provided in this DEIAr is sufficient to enable the DEA to consider all identified potentially significant impacts and to make an informed decision on the application. Further, it is the opinion of the EAP that based on the findings of the EIA that the proposed project should be granted an EA and allowed to proceed provided the following conditions are adhered to:

- The preferred substation and operations building is Alternative 2.The preferred laydown area is Alternative 1.
- Final routing of the power line within the corridor should avoid tower placement within 32m of surface water features and any other identified sensitive areas.
- The results of the Geotechnical surveys should be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites within the proposed development area.
- A palaeontologist should be appointed to monitor geotechnical investigations as part of a watching brief to identify and mitigate any newly discovered palaeontological sites. Site visits should include an initial five (5) day visit and then one day every two (2) weeks during construction.
- The palaeontological no-go area around point 0522 should be avoided and no development should take place within this area.
- Micro siting should be undertaken in the delineated high paleontological sensitivity area and palaeontological excavations and collection should be done if the Geotechnical survey indicates necessity for mitigation.
- All feasible and practical mitigation measures recommended by the various specialists must be implemented.
- Final EMPr should be approved by DEA prior to construction.
- The final power line and access road alignment should be submitted to the DEA for approval prior to commencing with the activity.

SiVEST as the EAP is therefore of the view that:

- A preferred substation site, operations building and laydown area has been identified which is less environmentally sensitive compared to the other site considered during the EIA phase.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the proposed project can be mitigated to acceptable levels.

The date on which the activity and post construction monitoring will be concluded cannot be determined at this stage as they are based on the timeframes dictated by the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) bid windows. The date of the next round of bid submissions has not yet been announced. The construction of the Sendawo 1 solar PV energy facility is dependent on being selected as a preferred bidder. The project will therefore require an authorisation of at least 5 years.

It is trusted that the DEIAr provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

BIOTHERM ENERGY

PROPOSED CONSTRUCTION OF THE SENDAWO 1 75MW SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

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Glossary of Terms

Alluvial: Resulting from the action of rivers, whereby sedimentary deposits are laid down in river channels, floodplains, lakes, depressions etc.

Biodiversity: The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

Cumulative Impact: In relation to an activity, cumulative impact means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

"Equator Principles": A financial industry benchmark for determining, assessing and managing social & environmental risk in project financing

Environmental Impact Assessment: In relation to an application, to which Scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of the application.

Environmental Impact Assessment Report: In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

Environmental Management Programme: A legally binding working document, which stipulates environmental and socio-economic mitigation measures which must be implemented by several responsible parties throughout the duration of the proposed project.

Heritage Resources: This means any place or object of cultural significance. See also archaeological resources above

Kilovolt (kV): a unit of electric potential equal to a thousand volts (a volt being the standard unit of electric potential. It is defined as the amount of electrical potential between two points on a conductor carrying a current of one ampere while one watt of power is dissipated between the two points).

Precipitation: Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.

Red Data Species: All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

Riparian: The area of land adjacent to a stream or river that is influenced by stream induced or related processes.

Scoping Report: An “issues-based” report which forms the first phase of an Environmental Impact Assessment process

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.
Early Stone Age 2 000 000 - 150 000 Before Present
Middle Stone Age 150 000 - 30 000 BP
Late Stone Age 30 000 - until c. AD 200

List of Abbreviations

BID	- Background Information Document
BLSA	- Bird Life South Africa
CBA	- Critical Biodiversity
CRM	- Cost Recovery Mechanism
DEA	- Department of Environmental Affairs
DEIAr	- Draft Environmental Impact Assessment Report
DoE	- Department of Energy
DSR	- Draft Scoping Report
DWS	- Department of Water and Sanitation
EAP	- Environmental Assessment Practitioner
EHS	- Environmental, Health, and Safety
EIA	- Environmental Impact Assessment
EMC	- Electromagnetic Compatibility
EMI	- Electromagnetic interference
EMPr	- Environmental Management Programme
ENPAT	- Environmental Potential Atlas
EP	- Equator Principles
EPFI	- Equator Principles Financial Institutions
ESA	- Ecological Support Areas
FD	- Frequency Domain
FEIAr	- Final Environmental Impact Assessment Report
FGM	- Focus Group Meeting
FSR	- Final Scoping Report
GDP	- Gross Domestic Product
GIIP	- Good International Industry Practice
GIS	- Geographic Information System
GPS	- Global Positioning System
GW	- Gigawatts
HIA	- Heritage Impact Assessment
I&AP(s)	- Interested and Affected Parties
IBA(s)	- Important Bird Area(s)
IDP	- Integrated Development Plan
IEP	- Integrated Energy Plan
IFC	- International Finance Corporation
IPP(s)	- Independent Power Producers
IUCN	- International Union for the Conservation of Nature and Natural Resources
KSW	- Key Stakeholder Workshop
kV	- Kilo Volt
MSA	- Middle Stone Age

MW	- Megawatt
NEA	- The National Energy Act No. 34 of 2008
ERA	- The Electricity Regulation Act No. 4 of 2006
IRP	- Integrated Resource Plan
NEMA	- National Environmental Management Act No. 107 of 1998
NEMBA	- National Environmental Management: Biodiversity Act No. 10 of 2004
NFEPA	- National Freshwater Ecological Priority Areas
NHRA	- National Heritage Resources Act No. 25 of 1999
NSBA	- National Spatial Biodiversity Assessment
NWA	- National Water Act No. 36 of 1998
NEMAA	- National Environmental Management: Air Quality Act of 2004
OHL	- Overhead Line
OHSA	- Occupational Health and Safety Act No. 85 of 1993
RE	- Renewable Energy
REIPPP	- Renewable Energy Independent Power Producer Procurement Programme
PoS	- Plan of Study
PM	- Public Meeting
PPA	- Power Purchase Agreement
PPP	- Public Participation Process
PV	- Photovoltaic
REFIT	- Renewable Feed-In Tariff Programme
RFI	- Radio frequency interference
RFP	- Request for Proposals
RFQ	- Request for Qualifications
SA	- South Africa
SABAP 2	- Southern African Bird Atlas Project 2
SAHRA	- South African Heritage Resources Agency
SANBI	- South African National Biodiversity Institute
SDF	- Spatial Development Framework
TD	- Time Domain

BIOTHERM ENERGY

PROPOSED CONSTRUCTION OF THE SENDAWO 1 75MW SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as BioTherm) intends to develop Sendawo solar photovoltaic (PV) energy facility and associated infrastructure near Vryburg in the North West Province of South Africa (hereafter referred to as the "proposed development") (Figure 1). SiVEST SA (Pty) Ltd (hereafter referred to as SiVEST) has been appointed as independent environmental assessment practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed development. The overall objective of the project is to generate electricity to feed into the National Grid. The proposed project will consist of a 75MW export capacity solar PV energy facility.

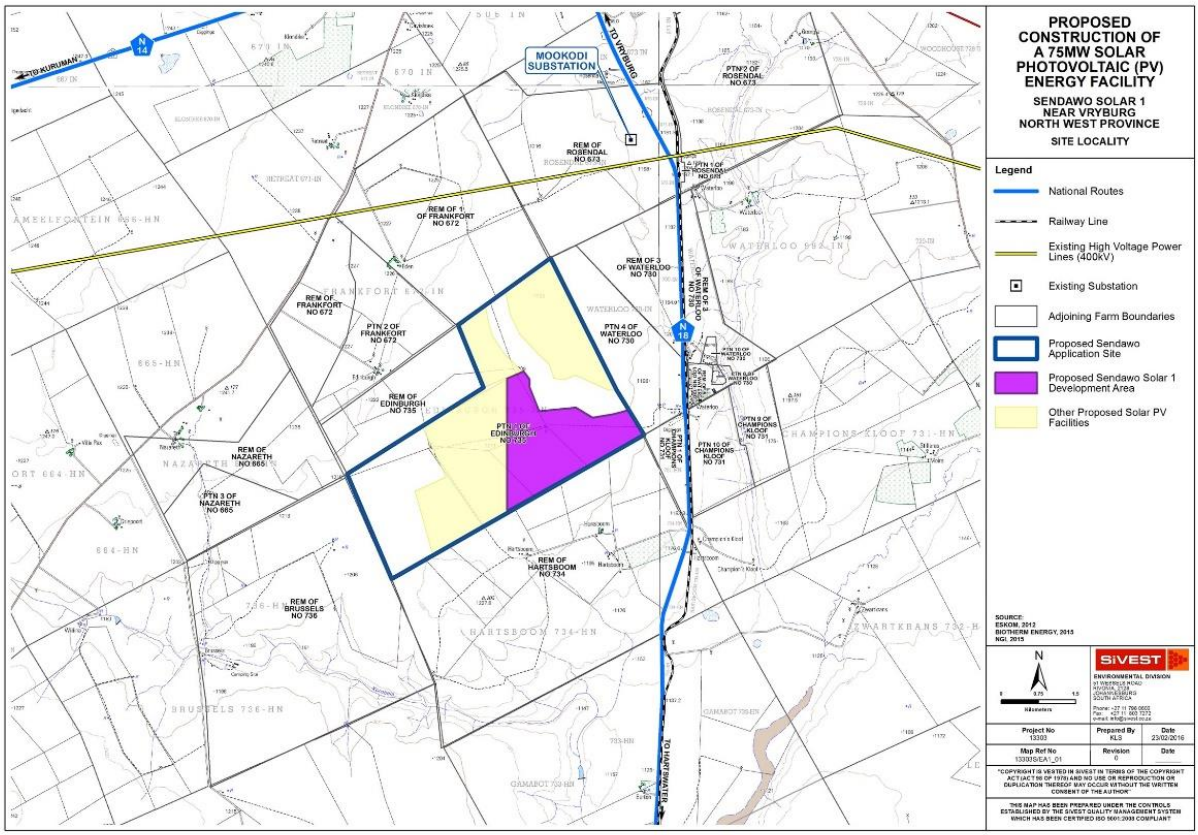

Figure 1: Site Locality

This proposed PV energy facility forms one of three PV energy facilities with a 75MW export capacity that BioTherm are proposing to develop on Portion 1 of the Farm Edinburgh No 735 (Figure 2). Each PV facility will entail the construction of associated infrastructure including a 132kV onsite substation, 132kV power line, operations building and laydown area. In order to accommodate the Department of Energy's (DoE) competitive bidding process for procuring renewable energy from Independent Power Producers in South Africa, each PV energy facility will be developed under a separate Special Purpose Vehicle (SPV) and therefore each requires a separate Environmental Authorisation. Additionally, BioTherm are proposing to develop the Sendawo common collector substation and a proposed power line of up to 400kV connecting it to the existing Eskom Mookodi Main Transmission Substation (MTS). This associated electrical infrastructure will also require a separate Environmental Authorisation. All three of the Sendawo Solar facilities will be connected to the proposed Sendawo substation. Although each PV energy facility and the electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider all four proposed developments. The potential environmental impacts associated with all four developments will be assessed as part of the cumulative impact assessment. The DEA reference numbers allocated for the other two proposed PV energy facilities and the substation and power line are provided below:

- Sendawo PV 2: 14/12/16/3/3/2/892
- Sendawo PV 3: 14/12/16/3/3/2/893
- Sendawo Substation and Power Line: 14/12/16/3/3/2/894

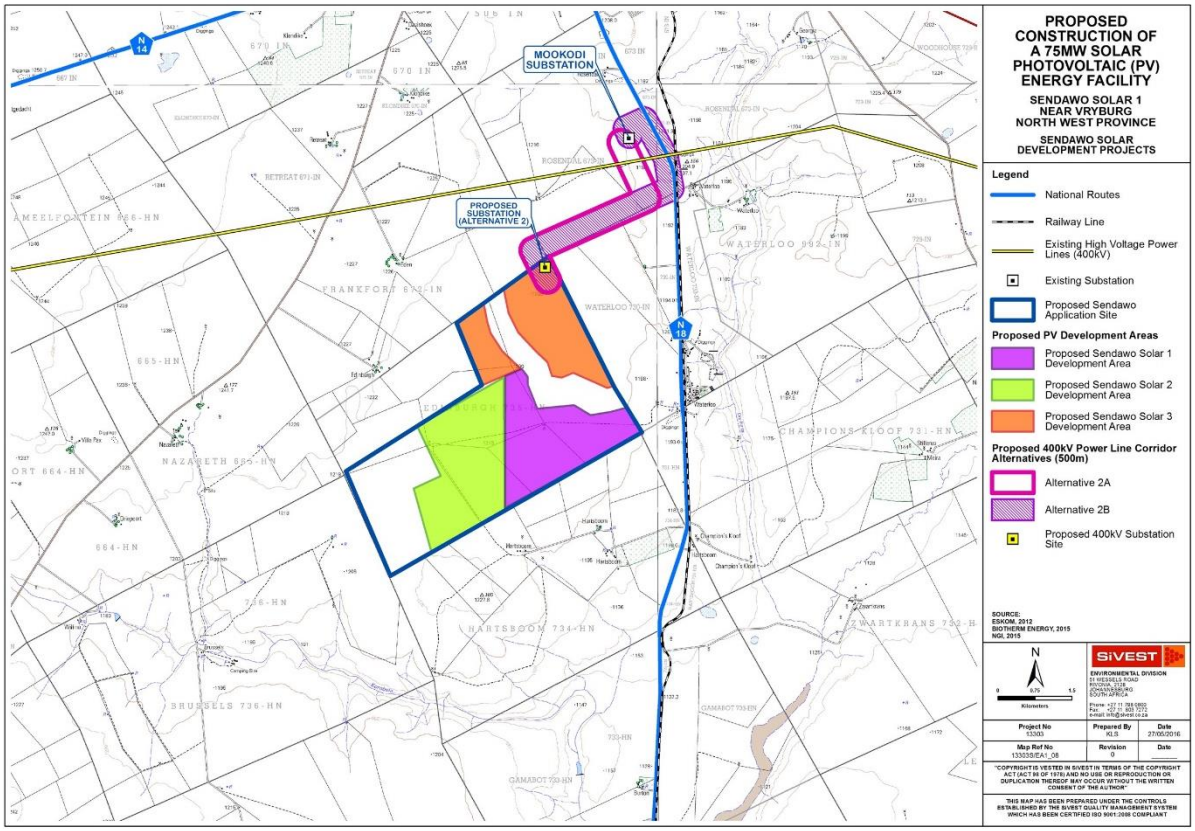

Figure 2: Combined layout map showing the proposed Sendawo 1, 2, and 3 solar PV projects as well as the proposed Sendawo substation and power line

The proposed development requires Environmental Authorisation (EA) from the Department of Environmental Affairs (DEA). However, the provincial authority will also be consulted (i.e. the North West Department of Rural, Environment and Agricultural Development (NW READ)). The EIA for the proposed development will be conducted in terms of the EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on the 8th of December 2014. In terms of these regulations, a full EIA is required for the proposed project. All relevant legislation and guidelines (including Equator Principles) will be consulted during the EIA process and will be complied with at all times. The Scoping Phase of the project has been completed and has been accepted by the DEA. The EIA phase is currently in progress.

This report has been compiled in accordance with World Bank standards and the Equator Principles. The Equator Principles ("EP") is a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing (Equator Principles, 2013). This PV project is considered a Category B project. Category B Projects are those with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures (Equator Principles, 2013). The project will also comply with the International Finance Corporation's (IFC) Social and Environmental Performance Standards (2012) and General Environmental Health and Safety (EHS) Guidelines (2007).

1.1 Structure of this Report

This DEIAr is structured as follows:

- Chapter 1 introduces the project and discusses the experience of the Environmental Assessment Practitioners (EAP), including specialists, who have contributed to the report. It expands on the relevant legal ramifications applicable to the project and describes the Equator Principles, IFC Performance Standards and the relevant development strategies and guidelines.
- Chapter 2 details the approach used to undertake the study i.e. the scoping study, authority consultation and the DEIAr.
- Chapter 3 elaborates on the assumptions and limitations pertaining to the EIA process for the proposed development.
- Chapter 4 provides explanation to the need and desirability of the proposed project by highlighting issues such as security of power supply; local employment as well as regional and local income profile.
- Chapter 5 gives detailed technical descriptions of the solar PV energy facility as well as the alternatives involved.
- Chapter 6 provides a description of the region in which the proposed development is intended to be located. Although the chapter provides a broad overview of the region, it is also specific to the application. It contains descriptions of the site and the specialist studies conducted during scoping phase are also summarised.

- Chapter 7 describes the Public Participation Process (PPP) undertaken during the EIA Phase and tables issues and concerns raised by Interested and Affected Parties (I&APs).
- Chapter 8 documents the findings of the specialist studies and associated potential impacts of the proposed solar PV energy facility.
- Chapter 9 presents a rating of each environmental issue before and after mitigation measures.
- Chapter 10 identifies recommendations from the specialists that have a bearing on the layout alternatives as well as proposed mitigation measures.
- Chapter 11 identifies potential cumulative impacts per environmental issue (specialist study).
- Chapter 12 gives a comparative assessment of all identified alternatives based on the various environmental issues (specialist studies).
- Chapter 13 provides a description of the environmental monitoring and auditing process to be undertaken for the proposed solar PV energy facility.
- Chapter 14 presents a checklist that ensures that the report has been compiled according to the requirements of the World Bank Standards and Equator Principles.
- Chapter 15 summarises the findings and recommendations per specialist study and provides the overall conclusion.
- Chapter 16 lists references indicated in the DEIAr.

1.2 Expertise of Environmental Assessment Practitioner

SiVEST has considerable experience in the undertaking of EIAs. Staff and specialists who have worked on this project and contributed to the compilation of this report are detailed in Table 1 below.

Table 1: Project Team

Name and Organisation	Role
Rebecca Thomas – SiVEST	Environmental Assessment Practitioner (EAP)
Andrea Gibb – SiVEST	EAP and Visual
Lynsey Rimbault – SiVEST	Environmental Consultant / Public Participation Practitioner
Stephan Jacobs - SiVEST	Environmental Consultant / Public Participation Practitioner and Visual
David Hoare – David Hoare Consulting	Biodiversity
Chris van Rooyen – Chris van Rooyen Consulting	Avifauna
Shaun Taylor – SiVEST	Surface Water
D.G. Paterson – ARC Institute for Soil, Climate and Water	Agricultural Potential
Wouter Fourie – PGS	Heritage
Gideon Groenewald – PGS	Palaeontology
Elena Broughton and Mariette Steynberg – Urban-Econ Development Economists	Socio-economic
Hermanus Steyn – Aurecon	Traffic

Name and Organisation	Role
Nicolene Venter – Zitholele Consulting	Senior Public Participation Practitioner
Kerry Schwartz – SiVEST	GIS and Mapping and Visual

As per the requirements of the NEMA (2014), the details and level of expertise of the persons who prepared the DEIAr are provided in Table 2 below.

Table 2: Expertise of the EAP

Environmental Project Manager	SiVEST (Pty) Ltd – Rebecca Thomas
Contact Details	rebeccat@sivest.co.za
Qualifications	B.Sc. Environmental Science, Post Graduate Diploma in Business Management
Expertise to carry out the EMPr	Rebecca is an Environmental Scientist with 10 years' experience across various sectors. She specialises in the overall management and compilation of Environmental Impact Assessments (EIAs) and Environmental Management Programmes (EMPs) primarily related to mining, energy generation and electrical transmission projects. Rebecca has extensive knowledge of the South African Environmental legislation as well as World Bank Guidelines and Equator Principles. She has been involved in several projects to which these skills have been applied. **Environmental Impact Assessments and Environmental Management Programmes:** ▪ EIA for the proposed Eskom 400kV Thyspunt Transmission Lines Integration Project (TTLIP) near Port Elisabeth, Eastern Cape Province (2013 – 2015); ▪ EIA and BA for the proposed Mookodi I and II Integration Projects respectively near Vryburg, North West Province (2013 – 2015); ▪ BA for the Proposed development of the 75MW Droogfontein PV2 and PV3 Photovoltaic Solar Power Plant and associated power lines near Kimberley, Northern Cape Province (2013); ▪ Environmental Advisory Services for the Moloto Development Corridor (MDC) Project which is located between the City of Tshwane Local municipality in Gauteng Province and Groblersdal, Limpopo Province, traversing Mpumalanga Province. Project Leader, SMEC/VelaVKE, 2012 – Current; ▪ Environmental Advisory Services for the Moloto Development Corridor (MDC) Project which is located between the City of Tshwane Local municipality in Gauteng Province and Groblersdal, Limpopo Province, traversing Mpumalanga Province. Project Leader, SMEC/VelaVKE, 2012 – Current; ▪ 3 Year Appointment: Environmental Management Compliance for the Integrated Rapid Transit project for Polokwane Municipality. Project Leader, City of Polokwane, 2013 – Current;

	▪ EIA and EMPr for the proposed 150 MW Renosterberg Wind Energy Company (RWEC) Wind Farm and 75 MW Solar Photovoltaic (PV) Plant, Northern Cape Province. The EIA includes the scoping process and detailed environmental impact assessment. The project includes detailed specialist studies such as social, visual, noise, heritage and biophysical as well as a full public participation process. RWEC, 2012 – Current.
Environmental Practitioner	SiVEST (Pty) Ltd – Andrea Gibb
Contact Details	andreag@sivest.co.za
Qualifications	BSc Landscape Architecture and BSc (Hons) Environmental Management
Expertise to carry out the EMPr	Andrea has 8 years' work experience and specialises in undertaking and managing Environmental Impact Assessments (EIAs) and Basic Assessment (BAs), primarily related to energy generation and electrical distribution projects. She also specialises in undertaking visual impact and landscape assessments, by making use of ArcGIS technology and field surveys. She has extensive experience in overseeing public participation and stakeholder engagement processes and has been involved in environmental baseline assessments, fatal flaw / feasibility assessments and environmental negative mapping / sensitivity analyses. From a business and administrative side, Andrea is actively involved in maintaining good client relationships, mentoring junior staff and maintaining financial performance of the projects she leads. **Environmental Impact Assessments and Basic Assessments:** ▪ EIA for the proposed construction of a 75MW Solar Photovoltaic (PV) Power Plant near Dennilton, Limpopo Province. ▪ EIA for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province. ▪ BA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province. ▪ BA for the proposed construction of two 132kV power lines and associated infrastructure from Silverstreams DS to the Olien MTS near Lime Acres, Northern Cape Province. ▪ BA for the proposed Construction of the SSS1 5MW Solar Photovoltaic (PV) Plant on the Western Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province. ▪ BA for the proposed Construction of the SSS2 5MW Solar Photovoltaic (PV) Plant on the Eastern Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province. ▪ BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the proposed Bophirima Substation to the existing Schweizer-Reneke Substation, North West Province. ▪ BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the Mookodi Substation to the existing

	Magopela Substation, North West Province. ▪ BA for the proposed Mookodi Integration Phase 2: Proposed Construction of the Mookodi - Ganyesa 132kV power line, proposed Ganyesa Substation and Havelock LILO, North West Province. ▪ Amendment of the Final Environmental Impact Report for the Proposed Mookodi 1 Integration Project near Vryburg, North West Province. ▪ BA for the proposed 132kV power line and associated infrastructure for the proposed Redstone Solar Thermal Energy Plant near Lime Acres, Northern Cape Province. ▪ BA for the proposed construction of a 132kV power line and substation associated with the 75MW Photovoltaic (PV) Plant on the Farm Droogfontein (PV 3) in Kimberley, Northern Cape Province. ▪ BA for the proposed establishment of a Learning and Development Retreat and an Executive Staff and Client Lodge at Mogale's Gate, Gauteng Province. ▪ Amendment application in order to increase the output of the proposed 40MW PV Facility on the farm Mierdam to 75MW, Northern Cape Province. ▪ BA for the proposed construction of a power line and substation near Postmasburg, Northern Cape Province. ▪ BA for the proposed West Rand Strengthening Project – 400kV double circuit power line and substation extension in the West Rand, Gauteng. ▪ EIA for the proposed construction of a wind farm and PV plant near Prieska, Northern Cape Province. ▪ Public Participation assistance as part of the EIA for the proposed Thyspunt Transmission Lines Integration Project – EIA for the proposed construction of 5 x 400kV transmission power lines between Thyspunt to Port Elizabeth, Eastern Cape Province. ▪ EIA assistance for the proposed construction of three Solar Power Plants in the Northern Cape Province. ▪ Public Participation as part of the EIA for the proposed Delareyille Kopela Power Line and Substation, North West Province. ▪ Public Participation as part of the EIA for the Middelburg Water Reclamation Project, Mpumalanga Province.
Environmental Consultant	SiVEST (Pty) Ltd – Lynsey Rimbault
Contact Details	lynseyr@sivest.co.za
Qualifications	BA Geography and English, BSc (Hons) Geography, and MSc Biodiversity, Conservation and Management
Expertise to carry out the EMPr	Lynsey has 2.5 years' work experience and holds the position of Environmental Consultant. She is specialising in the management and compilation of Environmental Impact Assessments (EIAs) and Basic Assessment (BAs) primarily related to energy generation and electrical distribution projects. **Environmental Impact Assessments and Basic Assessments:**

	▪ EIA for the Proposed Construction of Two Power Lines, a Linking Station and Two Substations for the Mainstream Renewable Power Wind Farms, Near Beaufort West in the Western Cape Province. ▪ EIAs for the 3 X Helena 75MW Solar Photovoltaic (PV) Energy Facilities near Copperton, Northern Cape Province. ▪ BA for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed development of the Madlanzini Main Transmission Station and Associated 88kV and 400kV turn in power lines, Mpumalanga Province. ▪ EIA for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province. ▪ BA for the proposed Construction of the Mookodi Integration Phase 2 132kV Power Line from the Mookodi MTS to the new proposed Ganyesa Substation, North West Province. ▪ EIA for the proposed construction of the Nokukhanya Solar Photovoltaic Power Plant near Dennilton, Limpopo Province.

Please refer to Appendix 2 for CV's of each team member. Declarations of Independence and the EAP Affirmation are included in Appendix 4.

1.3 Key Legal and Administrative Requirements Relating to the Proposed Development

1.3.1 National Environmental Management Act No. 107 of 1998 – NEMA EIA Requirements

The National Environmental Management Act (Act No. 107 of 1998) was promulgated in 1998 but has since been amended on several occasions from this date. This Act replaces parts of the Environment Conservation Act (Act No 73 of 1989) with exception to certain parts pertaining to Integrated Environmental Management. The act intends to provide for:

- co-operative environmental governance by establishing principles for decision-making on matters affecting the environment;
- institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state;
- to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment;
- and to provide for matters connected therewith.

NEMA now governs the EIA process with the recent promulgation of the new EIA regulations in December 2014 (Government Gazette No. 38282 of 4th December 2014).

Activities that may significantly affect the environment must be considered, investigated and assessed prior to implementation.

In terms of the newly released EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on 8th December 2014, a full EIA is required for the proposed project.

1.3.2 NEMA EIA Requirements

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an environmental authorisation, the result being that NEMA now governs the EIA process with the said promulgation of EIA Regulations in December 2014 (Government Gazette No. 38282 of 04 December 2014). This EIA has therefore been undertaken in accordance with the NEMA EIA 2014 Regulations which are contained in four Government Notices (GN R 982, 983, 984, and 985) which came into effect on 8th December 2015.

In terms of these Regulations, a full Environmental Impact Assessment is required for the proposed development based on triggered activities. However, several activities which trigger a basic assessment were also identified and need also be specified. Ultimately, these activities will not form a separate assessment, but will fall into the greater EIA.

The following Schedules of the Government Notice No. R. 983 – 985 of the 4th December 2015 are of relevance to the project in question. All of the Listed Activities identified in terms of Sections 24(2) and 24D include:

Table 3: Listed activities in terms of the NEMA Regulations

Activity number of the relevant notice:	**Listed activity as described in GNR 983, 984 and 985**	**Description of Listed Activity**
GN R. 983 Item 11	*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*	**Power lines are proposed to connect the onsite 132kV substation to the proposed Sendawo common collector substation (part of a separate on-going EIA process). The proposed power lines will be located outside an urban area and will have a capacity of 132kV.**
GN R. 983 Item 12	*The development of :* *x) buildings exceeding 100 square metres in size;* *xii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs-* *(a) within a watercourse;*	**The proposed project will entail the development of buildings and other infrastructure exceeding 100 square metres in size. The EIA phase surface water assessment revealed that there are surface water features located on the proposed site. In most cases the layouts have been designed to avoid surface water features, however one road crosses a pan and construction would therefore be required within a watercourse.**
GN R. 983 Item 19	*The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of*	**The EIA phase surface water assessment revealed that there are surface water features located on the proposed site. In**

	soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- *(i) a watercourse;* *But excluding where such infilling, depositing , dredging, excavation, removal or moving-* *(a) will occur behind a development setback;* *(b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or* *(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.*	**most cases the layouts have been designed to avoid surface water features, however one road crosses a pan and during construction soil, sand, pebbles or rock may be removed from this watercourse. The removed material will be stored in stock piles of no more than 3m high to ensure subsoil quality. The stock piles will be located within the development area and thereafter removed to a municipal dump. The infilling material will be sourced from onsite excavations where possible, alternatively similar soil quality will be purchased from regional source.**
GN R. 983 Item 28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development:* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;* *excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.*	**The proposed project site is currently used for cattle and game farming, and the proposed project will result in an area greater than 1 hectare being transformed into an industrial land use.**
GN R. 983 Item 56	*The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre -* *(i) where the existing reserve is wider than 13,5 meters; or* *(ii) where no reserve exists, where the existing road is wider than 8 metres –* *excluding where widening or lengthening occur inside urban areas.*	**Some of the existing access roads may need to upgraded and widened to provide access to the site. The status of the road reserve is unknown at this stage. The existing roads are located outside urban areas and may need to be lengthened by more than 1km to provide access to the site.**
GN R. 984 Item 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, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs* *(a) within an urban area; or* *(b) on rooftops.";*	**It is proposed that a solar PV energy facility with a maximum export capacity of 75MW will be constructed. The proposed project is not in an urban area or on a rooftop.**
GN R. 984 Item 15	*The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-* *(i) the undertaking of a linear activity; or*	**The proposed development will transform more than 20 hectares of undeveloped, vacant or derelict land to industrial use (solar PV energy facility). The vegetation occurring on site is Ghaap Plateau Vaalbosveld. The**

	(ii) maintenance purposes undertaken in accordance with a maintenance management plan.	**development area has a total area of 367 hectares.**
GN R. 985 Item 4	The development of a road wider than 4 metres with a reserve less than 13,5 metres. *(e) In the North West Province* *i Outside urban areas, in:* *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(ee) Critical biodiversity areas (Terrestrial Type 1 and 2) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;*	**Internal roads will be constructed and these are planned to be up to 6m wide. In terms of the North-West Province Biodiversity Conservation Assessment, the project passes through Critical Biodiversity (CBAs) and Ecological Support Areas (ESAs).**
GN R. 985 Item 12	*The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *(a) In the North West Province* *ii. Within critical biodiversity areas identified in bioregional plans;*	**More than 300 square metres of vegetation would need to be cleared. The development area has a total area of 367 hectares. The vegetation on site is Ghaap Plateau Vaalbosveld. In terms of the North-West Province Biodiversity Conservation Assessment, the project passes through CBAs and ESAs.**
GN R. 985 Item 14	*The development of-* *(x) buildings exceeding 10 square metres in size;* *(xii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs-* *(a) within a watercourse;* *(e) In the North West Province* i *Outside urban areas, in:* *(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;*	**The proposed project will entail the development of buildings and other infrastructure exceeding 10 square metres in size. The EIA phase surface water assessment revealed that there are surface water features located on the proposed site. In most cases the layouts have been designed to avoid surface water features, however one road crosses a pan and construction would therefore be required within a watercourse.** **The vegetation on site is Ghaap Plateau Vaalbosveld. In terms of the North-West Province Biodiversity Conservation Assessment, the project passes through CBAs and ESAs.**
GN R. 985 Item 18	*The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.*	**Some existing access roads may need to be upgraded and widened in order to access the site. The vegetation on site is Ghaap Plateau Vaalbosveld. In terms of**

	(e) In the North West Province i *Outside urban areas, in:* *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(ee) Critical biodiversity areas (Terrestrial Type 1 and 2) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;*	**the North-West Province Biodiversity Conservation Assessment, the project passes through CBAs and ESAs.**

1.3.3 Environmental Impact Assessment Guideline for Renewable Energy Projects, DEA Notice 989 of 2015

The purpose of this document is primarily to provide guidance on the environmental management legal framework applicable to renewable energy operations and all the role players in the sector. The guideline is principally intended for use by the following stakeholder groups:

- Public Sector Authorities (as regulator and/or competent authority);
- Joint public sector authorities and project funders, e.g., Eskom, IDC, etc.
- Private Sector Entities (as project funder/developer/consultant);
- Other interested and affected parties (as determined by the project location and/or scope).

This guideline seeks to identify activities requiring authorisation prior to commencement of that activity, and provide an interface between national EIA regulations and other legislative requirements of various authorities.

The guidelines are applicable for the construction, installation and/or development of the following renewable energy projects:

- Concentrating Solar Power Energy facility;
- Wind Farm;
- Hydropower Station; and
- Photovoltaic Power Facility.

As the proposed development is for a photovoltaic energy facility it is subject to the recommendations proposed in the guidelines.

1.3.4 National Energy Act No. 34 of 2008

The National Energy Act (Act no, 34 of 2008), promulgated in 2008, has, as one of its key objectives, the promotion of diversity of supply of energy and its sources. From this standpoint, the Act directly references the importance of the renewable energy (RE) sector, with a mention of the solar energy sector included. The aim is to ensure that the South African economy is able to grow and develop, fast tracking poverty

alleviation, through the availability of a sustainable, diverse energy mix. Moreover, the goal is to provide for the increased generation and consumption of RE (Republic of South Africa, 2008).

1.3.5 National Heritage Resources Act No. 25 of 1999

This Act requires all developers to undertake archaeological impact studies whenever any type of development activity is undertaken. Preliminary archaeological impact studies will consequently become a common procedure for all development activities, even if such development may be exempted in terms of the National Environmental Management Act (Act No 107 of 1998).

The law ensures community participation in the protection of national heritage resources and will involve all three levels of government in the management of the country's national heritage. The South African Heritage Resources Agency (SAHRA) will establish and maintain a national policy, strategy plans and standards for heritage resources management and will monitor the system as a whole.

Heritage authorities will assist and co-operate with individuals and organisations concerned with the study, the conservation, promotion and utilisation of national heritage resources. A newly established National Heritage Resources Fund will provide financial assistance for heritage projects.

A heritage assessment has been conducted to explore how the proposed development may impact on heritage resources as protected by the Act.

1.3.6 National Water Act No. 36 of 1998, as amended

The National Water Act (NWA) No 36 of 1998 was promulgated on the 20th August 1998. This Act is important in that it provides a framework to protect water resources against over exploitation and to ensure that there is water for socio-economic and economic development, human needs and to meet the needs of the aquatic environment. The Act also recognises that water belongs to the whole nation for the benefit of all people.

It is important to note that water resources are protected under the Act. Under the act, water resources as defined include a watercourse, surface water, estuary or aquifer. A watercourse is defined as a river or spring, a natural channel in which water flows regularly or intermittently, or a wetland, lake or dam into which, or from which water flows.

One of the main aims of the Act is the protection of water resources. 'Protection' in relation to a water resource entails:

- Maintenance of the quality of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- The rehabilitation of the water resource.

In the context of the proposed development and any potential impact on water resources, the definition of pollution and pollution prevention contained within the Act is relevant. 'Pollution', as described by the Act is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

This definition of pollution is quite wide ranging, and it applies to all types of water resource. Activities which cause alteration of the biological properties of a watercourse (i.e. the fauna and flora contained within that watercourse are also considered pollution).

In terms of section 19 of the Act owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include (inter alia):

- measures to cease, modify, or control any act or process causing the pollution;
- comply with any prescribed waste standard or management practice;
- contain or prevent the movement of pollutants;
- remedy the effects of the pollution; and
- remedy the effects of any disturbance to the bed and banks of a watercourse.

A surface water assessment has been conducted to explore how the proposed development may impact on water resources as protected by the Act.

1.3.7 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004 as amended)

The overarching aim of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004, within the framework of NEMA, is to provide for:

- The management and conservation of biological diversity within South Africa, and of the components of such biological diversity;
- The use of indigenous biological resources in a sustainable manner; and
- The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources.

The South African National Biodiversity Institute (SANBI) was established by the NEMBA, its purpose being (*inter alia*) to report on the status of the country's biodiversity and the conservation status of all listed threatened or protected species and ecosystems.

NEMBA provides for a range of measures to protect ecosystems and for the protection of species that are threatened or in need of protection to ensure their survival in the wild, including a prohibition on carrying out a “restricted activity” involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. Lists of critically endangered, endangered, vulnerable and protected species have been published and a permit system for listed species has been established.

It is also appropriate to undertake a Faunal and Botanical Impact Assessment where proposed developments, in an area that is considered ecologically sensitive, require an environmental authorisation in terms of NEMA, with such Assessment taking place during the basic assessment or EIA. These two studies will be undertaken during the project.

The NEMBA is relevant to the proposed projects as the construction of the power line and the substation may impact negatively on biodiversity. The project proponent is therefore required to take appropriate reasonable measures to limit the impacts on biodiversity, to obtain permits if required and to also invite SANBI to provide commentary on any documentation resulting from the proposed development.

1.3.8 National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003 as amended)

The overarching aim of the National Environmental Management: Protected Areas Act (NEMPAA) No. 57 of 2003, within the framework of NEMA, is to provide for:

- provide for the declaration and management of protected areas;
- provide for co-operative governance in the declaration and management of protected areas;
- effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity;
- provide for a representative network of protected areas on state land, private land and communal land;
- promote sustainable utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas;
- promote participation of local communities in the management of protected areas, where appropriate; and
- provide for the continued existence of South African National Parks.

1.3.9 National Forests Act, 1998 (Act No. 84 of 1998)

The National Forest Act (NFA) was enacted to:

- Provide for the protection, management and utilisation of forests;
- The protection of certain plant and animal life;
- The regulation of trade in forest produce;
- The control and management of a national hiking way system and National Botanic Gardens.

The NFA enforces the necessity for a license to be obtained prior to destroying any indigenous tree in a natural forest and, subject to certain exemptions, cutting, disturbing, damaging, destroying or removing any

protected tree. The list of protected trees is currently contained in GN 908 of 21 November 2014. Licenses are issued by the Minister and are subject to periods and conditions as may be stipulated.

The NFA is relevant to the proposed project as the removal and/or disturbance and/or clearance of indigenous vegetation may be required and a license in terms of the NFA may be required for this to be done.

1.3.10 Conservation of Agricultural Resources Act No. 43 of 1983

The Conservation of Agricultural Resources Act (CARA) No. 43 of 1983 controls the utilization of natural agricultural resources in South Africa. The Act promotes the conservation of soil, water sources and vegetation as well as the combating weeds and invader plants. The Act has been amended in part by the Abolition of Racially Based Land Measures Act, No. 108 of 1991.

The primary objective of the Act is to conserve natural agricultural resources by:

- maintaining the production potential of land;
- combating and preventing erosion and weakening or destruction of the water resources;
- protecting vegetation; and
- combating weeds and invaders plants.

The CARA is relevant to the proposed projects as the construction of the power line and the substation may impact on agricultural resources and vegetation on the site. The Act prohibits the spreading of weeds and prescribes control measures that need to be complied with in order to achieve this. As such, measures will need to be taken to protect agricultural resources and prevent weeds and exotic plants from invading the site as a result of the proposed development.

An agricultural potential assessment has been conducted to explore how the proposed development may impact on the agricultural production potential of the proposed site.

1.3.11 Subdivision of Agricultural Land Act No. 70 of 1970, as amended

The Subdivision of Agricultural Land Act No. 70 of 1970 controls the subdivision of all agricultural land in South Africa; prohibiting certain actions pertaining to agricultural land. Under the Act the owner of agricultural land is required to obtain consent from the Minister of Agriculture in order to subdivide agricultural land.

The purpose of the Act is to prevent uneconomic farming units from being created and degradation of prime agricultural land. To achieve this purpose the act also regulates leasing and selling of agricultural land as well as registration of servitudes.

The Act is of relevance to the proposed development as any land within the study area that is zoned for agricultural purposes will be regulated by this Act.

Although the whole of this Act has been repealed by section 1 of the Subdivision of Agricultural Land Act Repeal Act 64 of 1998, this Repeal Act has not been implemented and no date of coming into operation has been proclaimed.

It is important to note that the implementation of this act is problematic as the Act defines 'Agricultural Land' as being any land, except land situated in the area of jurisdiction of a municipality or town council, and subsequent to the promulgation of this Act uninterrupted Municipalities have been established throughout South Africa.

1.3.12 National Road Traffic Act No. 93 of 1996, as amended

The National Road Traffic Act (NRTA) No. 93 of 1996 provides for all road traffic matters and is applied uniformly throughout South Africa. The Act enforces the necessity of registering and licensing motor vehicles. It also stipulates requirements regarding fitness of drivers and vehicles as well as making provision for the transportation of dangerous goods.

All the requirements stipulated in the NRTA will need to be complied with during the construction and operational phases of the proposed project.

1.3.13 Civil Aviation Act No. 13 of 2009

The Civil Aviation Act No. 13 of 2009 controls and regulates aviation within South Africa. It provides for the establishment of a South African Civil Aviation Authority and independent Aviation Safety Investigation Board in compliance with Annexure 13 of the Chicago Convention. It gives effect to various conventions related to aircraft offences, civil aviation safety and security, and provides for additional measures directed at more effective control of the safety and security of aircrafts, airports and matters connected thereto.

Although the Act is not directly relevant to the proposed development, it should be considered as the establishment of a substation and power line may impact on aviation and air traffic safety if located directly within aircraft flight paths.

ATNS (Air Traffic and Navigation Services Company Limited) and the Civil Aviation Authority will be consulted and the required approvals will be obtained prior to construction.

1.3.14 Additional Relevant Legislation

- Occupational Health and Safety Act No. 85 of 1993
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008 as amended)
- Development Facilitation (Act No. 67 of 1995)
- The Hazardous Substances Act (Act No. 15 of 1973)
- Water Services Act (Act No. 108 of 1998)

- Electricity Regulation Act (Act No. 4 of 2006 as amended)
- Municipal Systems Act (Act No. 32 of 2000)
- Mineral and Petroleum Resource Development Act (Act No. 28 of 2002 as amended)
- North West Entrepreneurial Development and Sustainable Resources Utilization Act, 2003, as amended
- North West Parks and Tourism Board Act (Act. No. 3 of 1997)

1.4 Key Development Strategies and Guidelines

1.4.1 Integrated Development Plans

An Integrated Development Plan (IDP) is defined in the Local Government: Municipal Systems Act No. 32 of 2000), as an inclusive and strategic plan that:

- Links, integrates and co-ordinates plans and takes into account proposals for the development of the municipality;
- Aligns the resources and capacity of the municipality with the implementation of the plan
- Forms the policy framework on which annual budgets must be based; and
- Is compatible with national and provincial development plans and planning requirements binding on the municipality in terms of legislation.

The main purpose of the IDP is considered the enhancement of service delivery and fighting poverty through an integrated and aligned approach between different role-players and stakeholders.

Each municipality is required to produce an IDP which would address pertinent issues relevant to their municipality. However, common concerns include municipal transformation and development, and service delivery and infrastructural development.

The proposed development falls within the Naledi Local Municipality (LM), which is located within the greater Dr Ruth Segomotsi Mompati District Municipality (DM). The Naledi LM IDP for 2013 – 2014 (2012 – 2017) details the LM's objectives and strategies, among these is the development of an 'Alternative Energy Park'. The IDP states that the electricity system is currently under severe pressure. It is therefore evident that the proposed development is aligned with the goals of the municipal IDP in the study area.

1.4.2 Draft Integrated Energy Plan for the Republic of South Africa, 2013

The Draft Integrated Energy Plan (IEP), developed by the DoE, was undertaken to determine the best way to meet current and future energy service needs in the most efficient and socially beneficial manner, while:

- Maintaining control over economic costs;
- Serving national imperatives such as job creation and poverty alleviation; and
- Minimising the adverse impacts of the energy sector on the environment.

The IEP takes into consideration the crucial role that energy plays in the entire economy and is informed by the output of analyses founded on a solid fact base. It is a multi-faceted, long-term energy framework which has multiple objectives, some of which include:

- To guide the development of energy policies and, where relevant, set the framework for regulations in the energy sector;
- To guide the selection of appropriate technologies to meet energy demand (i.e. the types and sizes of new power facilities and refineries to be built and the prices that should be charged for fuels);
- To guide investment in and the development of energy infrastructure in South Africa; and
- To propose alternative energy strategies which are informed by testing the potential impacts of various factors such as proposed policies, introduction of new technologies, and effects of exogenous macro-economic factors.

1.4.3 Integrated Resource Plan, 2010 and updated 2013

The Integrated Resource Plan (IRP) was created in order to plan for projected national electricity demand. Whilst the medium-term power generation mix will continue to lean heavily on the use of fossil fuels, the Revised Balanced Scenario (RBS) of the 2010 Integrated Resource Plan (IRP) includes for a total additional supply capacity of 17.8GWh from renewable sources by 2030. It recommends continuing with the current renewable bid programme with additional annual rounds (of 1000 MW PV capacity; 1000 MW wind capacity and 200 MW CSP capacity), with the potential for hydro at competitive rates.

1.4.4 Department of Energy White Paper on Renewable Energy, 2003

The Department of Energy (DoE) gazetted its White Paper on Renewable Energy in 2003, and introduced it as a "policy that envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy." At that time the national target was fixed at 10 000GWh (0.8Mtoe) renewable energy contribution to final energy consumption by 2013. The White Paper proposed that this would be produced mainly from biomass, wind, solar and small-scale hydropower. It went on to recommend that this renewable energy should to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. Since the White Paper was gazetted, South Africa's primary and secondary energy requirements have remained heavily fossil-fuel dependant, both in terms of indigenous coal production and use, as well as the use of imported oil resources. Alongside this, the projected electricity demand of the country has led the National utility Eskom, to embark upon an intensive build programme to secure South Africa's longer-term energy needs, together with an adequate reserve margin.

1.4.5 Independent Power Producer Process

(The following information was extracted from the Eskom website: **Guide to Independent Power Producer (IPP) processes in South Africa and Eskom, June 2010**
http://www.eskom.co.za/live/content.php?Item_ID=14324)

The objective of this section is to provide an overview of the processes in the country and within Eskom relating to Independent Power Producers (IPPs). It is important that certain enabling policies, rules and regulations are in place to provide certainty and transparency in the introduction of IPPs.

- **Country Process**

South Africa has two acts that direct the planning and development of the country's electricity sector:

i. The National Energy Act of 2008 (No. 34 of 2008); and
ii. The Electricity Regulation Act (ERA) of 2006 (No. 4 of 2006).

In August 2009, the Department of Energy (DoE) gazetted the Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an IPP Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy.

- Formal Programmes

In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) developed by the DoE sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all IPP procurement programmes will be executed in accordance with the specified capacities and technologies listed in the IRP. The table below highlights the energy plan that has been proposed until 2030.

Table 4: Government Energy Plans up until 2030 in terms of the IRP

New Build Options								
	Coal	**Nuclear**	**Import Hydro**	**Gas - CCGT**	**Peak - OCGT**	**Wind**	**CSP**	**Solar PV**
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	300
2013	0	0	0	0	0	0	0	300
2014	500	0	0	0	0	400	0	300
2015	500	0	0	0	0	400	0	300
2016	0	0	0	0	0	400	100	300
2017	0	0	0	0	0	400	100	300
2018	0	0	0	0	0	400	100	300
2019	250	0	0	237	0	400	100	300
2020	250	0	0	237	0	400	100	300
2021	250	0	0	237	0	400	100	300
2022	250	0	1143	0	805	400	100	300
2023	250	1600	1183	0	805	400	100	300
2024	250	1600	283	0	0	800	100	300
2025	250	1600	0	0	805	1600	100	1000
2026	1000	1600	0	0	0	400	0	500
2027	250	0	0	0	0	1600	0	500

2028	1000	1600	0	474	690	0	0	500
2029	250	1600	0	237	805	0	0	1000
2030	1000	0	0	948	0	0	0	1000
	6250	**9600**	**2609**	**2370**	**3910**	**8400**	**1000**	**8400**

A decision that additional capacity be provided by an IPP must be made with the concurrence of the Minister of Finance. Once such a decision is made, a procurement process needs to be embarked upon to procure that capacity in a fair, equitable and transparent process.

The New Generation Regulations set out the procurement process. The stages within a bid programme are prescribed as follows:

i. Request for Qualifications (RFQ)
ii. Request for Proposals (RFP)
iii. Negotiation with the preferred bidder(s).

A successful bidder will be awarded a Power Purchase Agreement (PPA) subject to approval by the Regulator.

1.4.6 Renewable Energy Strategy for the North West Province

The Renewable Energy Strategy for the North West Province (RES NWP) was released by the Department of Economic Development, Environment, Conservation and Tourism (DEDECT) in December 2012. It was developed in in response to the need of the North West Provinces to participate meaningfully within the renewable energy sector of South Africa. The renewable energy strategy aims to improve the North West Province's environment, reduce the North West Province's contribution to climate change, and alleviate energy poverty, whilst promoting economic development and job creation in the province whilst developing its green economy. This strategy attempts to focus the efforts of all stakeholders and provides a foundation to make the North West Province a primary contributor towards the renewable energy sector within South Africa. The RES NWP states that the North West province has a very good solar potential with an average daily solar radiation greater than 8,000 MJ/m^2.

1.4.7 North West Provincial Growth and Development Strategy, 2004 to 2014

The North West Provincial Growth and Development Strategy provides a framework for integrated and sustainable growth and economic development for the province and its people over the next ten years. It addresses the formulation of a common vision, goals and objectives of what should be achieved and how the provincial government and its social partners should achieve its objectives. The Strategy establishes the foundation blocks from where the Provincial Programme of Action is negotiated in partnership with a variety of stakeholders in the province. It forms the benchmark from which progress and achievements are monitored and evaluated. The strategy identifies several growth and economic development pillars, ones of which is Mining and Energy.

1.4.8 North West Provincial Development Plan, 2013

The North West Provincial Development Plan (PDP) is predominantly based on the National Development Plan (NDP) in an attempt to align with the objectives and priorities it identifies as well as with the vision for 2030 of a united South-Africa. In the North West province eight of the priorities identified in the National Development Plan (NDP) were identified as key focus areas for the North West Provincial Development Plan (PDP). The selected focus areas represent the main challenge areas hampering growth in the province. The chosen development priorities with which the North West intends to align to the National Development Plan (NDP) include the following:

1. Economy and employment
2. Economic infrastructure

The PDP encourages diversification of the economic base, including in industries such as renewable energy. Expanding renewable energy, with special reference to solar power, is one of the stated actions aimed at addressing economic infrastructure. The renewable energy sector is also highlighted as having potential to create jobs in the province. As the proposed project is intrinsically linked to a solar PV energy facility the PDP has relevance.

1.4.9 The Dr Ruth Segomotsi Mompati DM Integrated Development Plan (2015/16)

The Dr Ruth Segomotsi Mompati DM Integrated Development Plan (IDP) (2015/16) states the DM's mission as "To ensure optimal utilisation of available resources through effective, efficient, sustainable, integrated planning and corporate governance". The DM's development plan is aimed at reducing poverty and inequality. The DM's IDP furthermore, states that government should shift investment towards projects and programmes that will assist individuals in improving their lives as well as the lives of their children and the communities they live in. The IDP identifies education and public transport as examples of opportunities that should be explored. Some of the key factors identified inter alia as drivers of the creation of equality and prosperity is job creation, bulk infrastructure expansion, and making the transition to a low carbon economy (Dr Ruth Segomotsi Mompati DM, 2015/16).

To achieve the recognition of Vryburg as a primary regional node, as a part of the DM's spatial vision, the following IDP projects are proposed:

- Infrastructure provision and upgrades,
- By-pass road,
- CBD upgrades,
- Township regeneration projects in previously disadvantaged areas,
- Local economic development strategies.

1.4.10 The Naledi LM Integrated Development Plan (2012 – 2017)

In the Naledi LM Integrated Development Plan (2012 – 2017) it is reiterated that the LM, and Vryburg in particular, has been identified as a priority two investment area due to the LM's regional growth needs, being the main trading centre in the DM, and the district's administrative centre. Some of the opportunities identified with the LM, with reference to the primary study area, include capitalisation on Vryburg's status

as secondary regional centre, and a beef beneficiation programme, with Vryburg envisioned as the institutional headquarters of the beneficiation programme (Naledi Local Municipality, 2013).

Threats or weaknesses applicable to the Vryburg region are also identified in the IDP and relevant problems include, the overcrowding and degradation of agricultural land in settlement areas, and a lack of development capital to provide and maintain bulk infrastructure in the LM. Moreover, the plan states that the LM is characterised by old and dilapidated electricity infrastructure, and that additional provision and strengthening of the network is required to meet the rising demand for electricity (Naledi Local Municipality, 2013).

The municipality is in need of additional generation capacity, and a solar development has previously been approved for the LM (Broedersput area). From a national and provincial policy perspective, the proposed project is supported. Although no clear contravention of local policy was identified, it may even be argued that the project will advance the position of Vryburg as secondary regional centre and primary regional node, it should not interfere with other key development strategies, such as the beef beneficiation strategy planned for Vryburg.

2 APPROACH TO UNDERTAKING THE STUDY

The Environmental Impact Assessment was undertaken in accordance with the EIA 2014 Regulations listed in Government Gazette No. 10328 of 4 December 2014 (GN 982, 983, 984 and 985 of 4 December 2014, as amended), in terms of Section 24 and 44 of the National Environmental Management Act, (No 107 of 1998) (NEMA) as amended; the World Bank Standards (IFC Guidelines) and the Equator Principles, as well as with the relevant legislation and guidelines mentioned above.

2.1 Environmental Scoping Study

The Scoping Study identified the potential positive and negative impacts associated with the proposed development as well as the studies which were required to be undertaken as part of the EIA-phase of the project. The Draft Scoping Report (DSR) was made available for public review from Monday 11 January 2016 to Tuesday 9 February 2016. Comments received on the Draft Scoping Report were included in the Final Scoping Report (FSR) which was submitted to the DEA on Friday 19 February 2016. The DEA accepted the FSR and EIA Plan of study on Friday 1 April 2016.

The following studies were taken through into the EIA Phase:

- Biodiversity (flora and fauna)
- Avifauna
- Surface Water
- Soils and Agricultural Potential
- Visual Impact
- Heritage and Palaeontology
- Socio-economic Impact
- Traffic

2.2 Authority Consultation

The National Department of Environmental Affairs (DEA) are the determining authority on this application. The following consultation took place with DEA:

- An Application and the DSR were submitted to the DEA on the 13th of January 2016.
- The Department confirmed receipt of the Application and DSR on the 18th of January 2016 and the following reference number was allocated to the project: 14/12/16/3/3/2/891
- Comments on the DSR were received on the 8th of February 2016
- The Final Scoping Report (FSR) was submitted to the DEA on the 19th February 2016 and the Department confirmed receipt of the FSR on the 26th of February 2016.

- Acceptance of the FSR and the Plan of Study (PoS) for the EIA was received on the 1st of April 2016.

As part of the letter from the DEA accepting the FSR, it was requested that additional information be included in the DEIAr. The table below provides details as to how this DEIAr fulfils the main information requested by the DEA in the FSR acceptance letter. For a further details, refer to Appendix 3 for the FSR Acceptance Letter.

Table 5: Compliance with the DEA requirements detailed in the FSR acceptance letter

Additional Information Required by the DEA	Notes / Comments
Comments and recommendations made by all stakeholders and I&APs in the draft scoping report and submitted as part of the final scoping report must be taken into consideration when preparing an EIAr in respect of the proposed development.	The Comments and Response Report details how I&APs comments and recommendations have been taken into consideration, it is included in Appendix 5E. All correspondence between authorities and I&APs is included in Appendix 5D.
All mitigation measures and recommendations in the specialist studies must be addressed in the Final Impact Assessment Report (FEIAr) and EMPr.	Specialist recommendations and mitigation measures are included in Chapters 9 and 10, as well as in Chapter 15.1, the summary of findings. All mitigation measures are detailed in the EMPr, included as Appendix 8.
Comments from all relevant stakeholders, including additional stakeholders identified by the DEA in the FSR acceptance letter, must be submitted to the DEA with the FEIAr.	All comments from stakeholders are included in the comments and response report and appended to this report. See Appendix 5D and 5E. A record of distribution to Organs of States, including attempts made to obtain comments, is included in Appendix 5I.
The DEIAr and EMPr must comply with Appendix 3 and Appendix 4 of the EIA Regulations of 2014, before submission to the department. The EAP is required to address all issues raised by Organs of State and I&APs prior to the submission of the FEIAr to the DEA.	The DEIAr complies with the requirements listed in Appendix 3 of the EIA Regulations of 2014, as detailed in the table in Section 2.3 of this report. The EMPr complies with the requirements listed in Appendix 4 of the EIA Regulations of 2014. All issues raised by stakeholders are addressed in the comments and response report. See Appendix 5E.
Proof of correspondence with the various stakeholders must be included in the FEIAr. If the EAP is not able to obtain comments, proof should be submitted to the DEA of the attempts that were made to obtain comments.	Proof of correspondence with stakeholders is included in Appendix 5B and 5D. Proof of attempts made to obtain comments in included will be included in the Chapter 7 of the FEIAr and in Appendix 5B of the FEIAr.
The EAP must, in order to give effect to Regulation 8, give registered I&APs access to, and an opportunity to comment on the report in writing within 30 days before submitting the FEIAr to the DEA.	The EAP will give I&APs an opportunity to comment on this DEIAr within 30 days before submitting the FEIAr. See Chapter 7 for a description of the PPP followed.

The applied listed activities and their relevant issues must be addressed and assessed in the EIAr, including: <u>*GNR 983: Activity 19*</u> *The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from* *(i) a watercourse* With regards to infilling and excavation of watercourses for the construction of the solar facility, the DEA requires the applicant to provide an indication of the preferred and alternative locations from which the material used for infilling will be sourced and where excavated material will be stored and/or disposed of. In addition, the impacts associated with this activity must be adequately assessed in the EIAr. <u>*GNR 983: Activity 12*</u> *The development of:* *x) buildings exceeding 100 square metres in size;* *where such development occurs-* *xii) infrastructure or structures with a physical footprint of 100 square metres or more;* *(a) Within a watercourse* *(b) In front of a development setback; or* *(c) If no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse* The EAP must apply for the specific aspect of the activity, i.e. part (a), part (b) or part (c) as all of these parts of the activity cannot be authorised. <u>*GNR 983: Activity 56*</u> *The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre* *(i) Where the existing reserve is wider than 13,5 metres; or* *(ii) Where no reserve exists, where the existing road is wider than 8 metres.*	Regarding GNR 983 Activity 19 this report and the application has been amended to provide an indication of the location from where the material used for infilling will be sourced and where excavated material will be stored and/or disposed of. All surface water impacts have been assessed in the surface water impact assessment attached as Appendix 6C and summarised in Section 8.3 The application for GNR 983 Activity 12 has been amended to only apply for: *(a) within a watercourse;* Regarding GNR 983 Activity 56the status of the road reserve is unknown at this stage and therefore neither part (i) or part (ii) could be excluded. GNR 985 Activity 14 has been amended to only apply for: *(a) within a watercourse;*

The EAP must apply for the specific aspect of the activity, i.e. either part (i) or part (ii) as both of these parts of the activity cannot be authorised. *<u>GNR 985: Activity 14 (x) and (xii):</u>* *The development of-* *(x) buildings exceeding 10 square metres in size;* *(xii) infrastructure or structures with a physical footprint of 10 square metres or more;* *Where such a development occurs-* *(a) Within a watercourse;* *(b) In front of the development setback; or* *(c) If no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse.* The EAP must apply for the specific aspect of the activity, i.e. part (a), part (b) or part (c) as all of these parts of the activity cannot be authorised.	
Since there is a need to amend the application form, please note that the Department's application form template has been amended and can be downloaded from the following link https://www.environment.gov.za/documents/forms	The comment is noted, the amended application form to be submitted with utilise the updated application form template.
All relevant listed activities should be applied for, these should be specific and should be able to be linked to the development activity or infrastructure in the project description.	A description of listed activities applied for is included in Chapter 1.3.
The DEIAr must provide an assessment of the impacts and mitigation measures for each of the listed activities applied for.	The listed activities that are being applied for as part of this project are detailed in Chapter 1. Impacts and mitigation measures identified by the specialists are included in Chapter 9, and mitigation measures are also detailed in Chapter 10.
The EAP is reminded to provide a description of any identified alternatives for the proposed activity that are feasible and reasonable, including advantages and disadvantages that the proposed activity or alternatives will have on the environment and on the community that may be affected by the activity. Alternatively, written proof should be submitted of an investigation and motivation if no reasonable or feasible alternatives exist.	The project handling of alternatives as per the 2014 Regulations is included in Chapter 5.2. The description and comparative assessment of alternatives is included in Chapter 12.

The FEIAr must provide the technical details for the proposed facility in a table format as well as their description and/or dimensions. A sample of the minimum information required is listed under point 2 of the EIA information required for solar energy facilities included in the FSR acceptance letter.	The required technical details are tabulated in the key technical details included at the beginning of the report.
The FEIAr must provide the four corner's coordinates for the proposed development site (note that if the site has numerous bend points, each bend point's coordinates must be provided) as well as the start middle and end point of all linear activities.	All project co-ordinates have been included. The co-ordinates are included in the executive summary, section 6 and in Appendix 9.
The FEIAr must provide the following: ▪ Clear indication of envisioned area for the proposed solar facility; i.e. placing of PV arrays and all associated infrastructure should be mapped at an appropriate scale. ▪ Clear description of all associated infrastructure. This description must include, but is not limited to: ▪ Power lines; ▪ Internal roads infrastructure; and ▪ All supporting onsite infrastructure such as laydown area, guard house and control room etc.	The layout map included in section 5 and in A3 in Appendix 7. All associated infrastructure is shown on the map. The description of the associated infrastructure is included in section 5.
The FEIAr must provide an indication of the location of the solar facility in respect to the location of other energy facilities and its associated infrastructure.	The map showing the proposed project in relation to the other Sendawo projects is included in the executive summary and the introduction. A map showing all known renewable energy projects in the region of the proposed project is included in section 11. All maps are included in A3 in Appendix 7.
The EIAr must provide detailed need and desirability as to why there is a need for the development and why the specific location is desirable.	Project need and desirability is provided in Chapter 4, and in the discussion of alternatives in Chapter 5.2.
The EIAr must provide an indication of the internal access roads and the impacts associated with them must be adequately assessed in the EIAr and EMPr.	The specialist studies have assessed the impact of the internal access roads and the EMPr includes mitigation measures to reduce the impact of these roads. Roads associated with the PV array are shown on the final preferred layout map in section 12 and section 15, as well as in Appendix 7. The alignment of these roads associated with the power line is subject to the alignment of the power line and the power line alignment has not been determined as it will be routed within the

	authorised corridor. It has been recommended by the EAP that the final power line and access road alignment should be submitted to the DEA for approval prior to commencing with the activity.
All received comments and response thereto must be included in the comments and response report.	The comments and response report is included in Appendix 5E and contains all comments received and the relevant responses.
Information on services required on the site should be included, including: who will supply the services, and an agreement and confirmation of capacity if obtained. Proof of agreements should be included if applicable.	Information on services provision and availability is included in Appendix 10.
The EIAr must provide a layout which depicts the entire facility, i.e. the solar and grid connection infrastructure	A combined layout map showing the proposed Sendawo substation and power line as well as the Sendawo 1, 2, and 3 solar PV projects has been included in Chapter 1 and Chapter 11. The map is included in A3 in Appendix 7.
The assessment of impacts and the EIA process; and, the requirements of the PPP must be in accordance with Regulation 39 to 44 of the GNR 982 of the EIA Regulations 2014.	The assessment of impacts and the EIA and public participation processes will be done in accordance with the EIA Regulations 2014, including regulations 29 to 44.
A copy of the final site layout map must be included in the final report. All available biodiversity information must be used in the finalisation of the layout map. Existing infrastructure must be used as far as possible. The layout map requirements are included in the FSR acceptance letter. (See Appendix 3 for the FSR acceptance letter).	The project description (Chapter 5) details all of the project components shown on various maps throughout the report. Specific technical details may not be available at this stage as they will be determined by the EPC during the detailed design phase. All applicable A3 maps are included in Appendix 7.
An environmental sensitivity map, indicating environmental sensitive areas and features identified during the EIA process, must be included in the DEIAr.	The environmental sensitivity map is included in Chapter 12 and in A3 in Appendix 7.
A map should be provided that combines the final layout map superimposed on the environmental sensitivity map.	The environmental sensitivity map including layouts is included in Chapter 12 and in A3 in Appendix 7.
A shapefile of the preferred development layout/footprint must be submitted to the DEA. The shapefile should be created according to the specifications detailed in the FSR acceptance letter.	The shapefiles will be provided according the specifications in the FSR acceptance letter.
An EMPr must be submitted to the DEA that includes the requirements specified in the FSR acceptance letter.	An EMPr is included in Appendix 8 and included the requirements specified in the FSR acceptance letter.

The EAP must provide a detailed motivation if any of the EMPr requirements, as specified in the FSR acceptance letter, is not required by the proposed development and not included in the EMPr.	The comment is noted. The EMPr has been written in terms of the requirements specified in the FSR acceptance letter.
The EAP must provide the final detailed Site Layout Plan as well as the final EMPr for approval with the FEIAr as the DEA needs to make a decision on the FEIAr, EMPr and Layout Plan.	The EMPr and detailed layout plan will be submitted with the FEIAr in Appendices 8 and 7 respectively.
The DEIAr must include a cumulative impact assessment of the facility since there are other similar facilities in and around the proposed site as well as in the region. The specialist studies as outlined in the PoSEIA which is incorporated as part of the FSR must also assess the facility in terms of potential cumulative impacts.	Chapter 11 provides a detailed summary of all of the cumulative impacts potentially associated with the proposed project.
The EAP must ensure that all the relevant Listing Notice activities are applied for, that the Listing Notice activities applied for are specific and that they can be linked to the development activity or infrastructure in the project description.	A description of listed activities applied for is included in Chapter 1.3, the project description is included in Chapter 5.1.
The EAP is reminded that should the EIAr fail to comply with the requirements of the FSR acceptance letter, the project will be refused in accordance with Regulation 24(1)(b) of the EIA Regulations, 2014.	The comment is noted, the EIAr will comply with the requirements of the FSR acceptance letter, as detailed in this table.
The applicant must comply with the requirements of Regulation 45 with regard to the time period allowed for complying with the requirements of the Regulations, and Regulations 43 and 44 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the DEA. The reports referred are listed in Regulation 43(1).	All regulated timeframes will be complied with. A description of the public participation process to be followed is included in Chapter 7.
The DEA may undertake a site inspection prior to or upon receipt of the final EIAr.	The comment is noted.
Should the application for Environmental Authorisation be subject to the provisions of Chapter II, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then the DEA will not be able to make nor issue a decision in terms of the application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter II, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999. Comments from SAHRA and/or the	The relevant officials from the SAHRA have been included on the project database, notified of the project progress and sent copies of the Scoping phase Heritage Report and DSR. Comments from SAHRA on the impact phase Heritage Report and the DEIAr will be included in the FEIAr.

provincial department of heritage must be provided in the DEIAr.	
Two hard copies and 2 electronic copies of the DEIAr and FEIAr must be submitted to the department as per Regulation 23(1) of the EIA Regulations, 2014.	Two hard copies and 2 electronic copies of the report will be submitted to the DEA.
The EIA information required for solar energy facilities, as per the FSR acceptance letter, must be used in preparation of the DEIAr. This will enable the DEA to speedily review the EIAr and make a decision on the application. This information includes: 1. General site information 2. Sample of technical details for the proposed facility 3. Site maps and GIS information 4. Regional map and GIS information 5. Important stakeholders 6. Agriculture study requirements	All information required for solar facilities, as per the FSR acceptance letter, is included in the DEIAr.
The EAP is reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, which stipulates that no activity may commence prior to an Environmental Authorisation being granted by the DEA.	The comment is noted, and no activity will commence prior to the Environmental Authorisation being granted by the DEA.

A record of all authority consultation is included within Appendix 3.

Consultation with other relevant authorities was and is also being undertaken via meetings and telephonic consultation in order to actively engage them and provide them with information and gain their feedback.

Authorities and key stakeholders consulted include the following:

- National Authorities;
- Provincial Authorities;
- Naledi LM;
- Dr Ruth Segomotsi Mompati DM;
- Government Structures such as SAHRA, SANRAL, Telkom, etc.;
- Agriculture Associations;
- Business and commerce;
- Environmental bodies / NGOs;
- Community representatives, CBOs, development bodies;
- Landowners; and
- Civil Aviation Authority (CAA).

The full list of authorities and key stakeholders that have been consulted is included in Appendix 5I.

2.3 Environmental Impact Assessment Report

The EIA phase of the project has focused on consulting with Interested and / or Affected Parties as well as conducting specialist studies to address the potential impacts identified during the scoping phase.

The NEMA EIA Regulations (GN. R. 982) state that the objective of the environmental impact assessment process is to, through a consultative process:

(a) 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;
(b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
(c) identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
(d) determine the--
    (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
    (ii) degree to which these impacts-
        (aa) can be reversed;
        (bb) may cause irreplaceable loss of resources, and
        (cc) can be avoided, managed or mitigated;
(e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
(f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
(g) identify suitable measures to avoid, manage or mitigate identified impacts; and
(h) identify residual risks that need to be managed and monitored.

The content requirements for an Environmental Impact Assessment Report, as well as details of which section of the report fulfils these requirements, are shown in **Table 6** below.

Table 6: Content requirements for an Environmental Impact Assessment Report

Content Requirements	Applicable Section
(a) details of- (i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae;	Details of the EAP and full project team are included in section 1.2. The expertise (including curriculum vitae) of the EAP and full project team are include in Appendix 2.
(b) the location of the activity, including- (i) the 21 digit Surveyor General code of each cadastral land parcel;	The location of the proposed project is detailed in on page *iii* of the report, as well as in section 6.1.

(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 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;	A map of the regional locality is shown in section 6.1, and the site locality is shown in section 5.1. Additionally, all project maps are included in Appendix 7. Coordinates are shown on page *iii* of the report, as well as in section 6.1.
(d) a description of the scope of the proposed activity, including- (i) all listed and specified activities triggered; (ii) a description of the activities to be undertaken, including associated structures and infrastructure;	The listed and specified activities triggered as per NEMA are detailed in section 1.3.2. The technical project description is included in section 5. This includes a description of activities to be undertaken, including associated structures and infrastructure.
(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;	A description of all key legal and administrative requirements is provided in section 1.3, this includes an explanation of how the proposed development complies with the requirements. Key development strategies and guidelines and their applicability to the proposed project are detailed in section 1.4.
(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;	The need and desirability of the proposed project is discussed in section 4, including the need and desirability of the activity at the location as proposed.
(g) a motivation for the preferred development footprint within the approved site;	The site specific suitability is discussed in section 4.4.
(h) a full description of the process followed to reach the proposed development footprint within the approved site, including: (i) details of the development footprint 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	A description of the alternatives considered in terms of the Regulations is included in section 5.2 and a full description and comparative assessment of the alternatives considered is included in section 12. The public participation process followed is detailed in section 7. Additionally, all

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; (vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks; (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) if no alternative development locations for the activity were investigated, the motivation for not considering such; and (x) a concluding statement indicating the preferred alternative development location within the approved site;	public participation documents are included in Appendix 5. This includes a summary of issues raised by I&APs, and the responses to their comments. A full description of the environmental attributes within the application site is included in section 6 and 8. The impacts and risks associated with each alternative are assessed in section 9.2. The methodology used in identifying the impacts and risks associated with each alternative is included in section 9.1. The positive and negative impacts that the proposed activity will have on the environment are discussed in 9.2. Potential mitigation measures are included in section 10. The inclusion of alternatives is discussed in section 5.2 and in section 12. A concluding statement indicating the preferred alternatives is contained in section 12.
(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 environmental impact assessment 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;	The process undertaken to assess the impacts as well as the assessment of impacts by each specialist are shown in section 9. Each environmental issue and risk is tabulated in section 9.2 and an assessment of the significance of each issue before and after mitigation measures is included.
(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;	The impact rating system contained in section 9.1.2 details the methodology for determining the significance of an impact. This includes the points (j) (i to vii) of Appendix 3.The assessment of each

(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 avoided, managed or mitigated;	risk identified by the specialists is contained in section 9.2.
(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;	All relevant specialist findings are included in section 8, with all recommended mitigation measures detailed in section 10. The mitigation measures have been incorporated into the EMPr which is contained in Appendix 8. The tabulated summary of key specialist findings and recommendations is included in section 15.1 and in the executive summary.
(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;	Section 15 contains a tabulated summary of the key findings in each specialist assessment, it also contains a map showing the final preferred layout superimposed with sensitive areas and buffers where required. The positive and negative impacts associated with the activity, which were identified by each specialist, are also summarised in table form in the section.
(m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	The recommended mitigation measures associated with each impact are included in section 9, and overall specialist recommendations and mitigation measures are included in section 10. These measures are contained in the EMPr which can be found in Appendix 8.
(n) the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	The final proposed alternatives are included in section 12, including a comparative assessment by the specialists.
(o) 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;	Any aspects identified by specialists or the EAP that should be included as conditions of the authorisation are identified in section 15 and in the executive summary.

(p) a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	All assumptions and limitations are highlighted in section 3.
(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;	A reasoned opinion as to whether or not the proposed activity should be authorised, including conditions if required, is included in section 15 and in the executive summary.
(r) 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;	The period required for the environmental authorisation, as well as the date on which the activity and post construction monitoring will be concluded is discussed in section 15 and the executive summary.
(s) an undertaking under oath or affirmation by the EAP in relation to- (i) the correctness of the information provided in the reports; (ii) the inclusion of comments and inputs from stakeholders and I&APs; (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	The EAP affirmation is included in Appendix 4.
(t) where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	If applicable, details of any financial provisions for the management of negative environmental impacts are included in section 10, section 15 and the executive summary.
(u) an indication of any deviation from the approved scoping report, including the plan of study, including- (i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and (ii) a motivation for the deviation;	If required, the details of, and motivation for, any deviation from the FSR plan of study will be detailed in section 2.1. At this stage, no deviation from the approved scoping report and plan of study is anticipated.
(v) any specific information that may be required by the competent authority; and	As part of the letter of acceptance for the FSR the DEA detailed specific information requirements. These requirements are tabulated in section 2.2, along with an explanation of how the requirements are met. All correspondence from the DEA is included in Appendix 3.

(w) any other matter required in terms of section 24(4)(a) and (b) of the Act.	All requirements in terms of section 24(4)(a) and (b) of the Act have been met in this report.

3 ASSUMPTIONS AND LIMITATIONS

- It is assumed that all information provided by the Applicant to the Environmental Team was correct and valid at the time it was provided.
- It is not always possible to involve all Interested and / or Affected Parties (I&APs) individually, however, every effort has / is been made to involve as many interested parties as possible. It is also assumed that individuals representing various associations or parties convey the necessary information to these associations / parties.
- It is assumed that the information provided by the various specialists is unbiased and accurate.
- The following assumptions, uncertainties and gaps in knowledge were encountered by the various specialists:

- Biodiversity:
  - Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.
  - This study excludes invertebrates and avifauna.

- Avifauna:
  - A total of 53 full protocol lists have been completed to date for the 9 pentads where the study area is located (i.e. lists surveys lasting a minimum of two hours each). The SABAP2 data was therefore regarded as a reasonably conclusive snapshot of the avifauna. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring.
  - Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances, especially for a new field such as solar energy.
  - The focus of the study is on waterbirds, raptors, South African Red Data species, and southern African endemics and near-endemics (collectively referred to in the report as priority species).
  - The impact of solar installations on avifauna is a new field of study, with only one scientific study published to date (McCrary et al. 1986). Strong reliance was therefore placed on the opinions of experts and the pre-cautionary principle was applied throughout.
  - The core study area was defined as the area comprising the proposed PV 1 lay-out alternatives.

- Surface Water:

- This study has only focused on the findings of the proposed 75MW Sendawo PV 1 Solar Facility. Associated studies for the remaining components have been compiled in separate reports for each separate impact assessment.
- The identification and in-field delineation of surface water resources were only undertaken within the proposed development area. Delineations of surface water resources in the wider areas were not undertaken.
- Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Nor has a hydrological or groundwater study been included.
- Wetland or river health, ecosystem services and the ecological importance/sensitivity have also not been assessed for identified surface water resources.
- As an avifaunal assessment is being carried out for this project, impacts as related to waterfowl are not included in this report. It is assumed that potential impacts to waterfowl as included in the avi-faunal assessment.

- Agricultural Potential and Soils:
  - No specific assumptions and limitations were identified by the agricultural potential and soils specialist.

- Visual:
  - Given the nature of the receiving environment and the height of the proposed PV panels, the study area or visual assessment zone is assumed to encompass a zone of 5km from the proposed PV energy facility – i.e. all areas within a 5km radius of the application site. The 5km radius was assigned as distance is a critical factor when assessing visual impacts and although the proposed development may still be visible from areas outside the 5km radius, the degree of visual impact would diminish considerably. Thus the need to assess the impact on potential receptors outside the visual assessment zone would not be warranted.
  - Due to the extensive number of farmsteads and residential dwellings located within 5km of the application site, which could potentially be sensitive to the proposed development, the identification and impact assessment rating on potentially sensitive visual receptor locations was based on a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potentially sensitive receptor locations within the study area. Thereafter a site visit was undertaken to assist with rating the impact of the proposed development from each potentially sensitive visual receptor location and to eliminate receptors that are unlikely to be influenced by the proposed development. This involves establishing the visual character and level of transformation within the study area, classifying the study area into zones of visual contrast and identifying screening factors within the study area.
  - It should be noted that the 'experiencing' of visual impacts is subjective and largely based on the perception of the viewer or receptor. A number of broad assumptions were made in terms of the sensitivity of the receptors to the proposed development. This is usually dependent on the use of the facility and the economic dependency on the natural / untransformed quality of views from the facility. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed

development. They include; tourism facilities and residential dwellings within natural / rural settings. Therefore, not all receptor locations would necessarily perceive the proposed development in a negative way.

- No viewsheds were generated during this visual study, as the topography within the study area is relatively flat. Within this context, minor topographical features, vegetative screening, or man-made structures would be important factors which would influence the degree of visibility and which would not be factored in by the viewsheds.
- A matrix has been developed to assist in the assessment of the potential visual impact at each receptor location. The limitations of quantitatively assessing a largely subjective or qualitative type of impact should be noted. The matrix is relatively simplistic in considering three main parameters relating to visual impact, but provides a reasonably accurate indicative assessment of the degree of visual impact likely to be exerted on each receptor location by the proposed solar energy facility. The matrix should therefore be seen as a representation of the likely visual impact at a receptor location.
- The assessment of receptor-based impacts has been based on the solar energy facility layout and alternatives provided by the proponent. It is recognised however that this layout is a preliminary one, and is subject to changes based on a number of potential factors, including the findings of the EIA studies. The PV panel area and associated infrastructure may thus move, which may result in greater or lesser visual impacts on receptor locations.
- A cumulative impact assessment has been undertaken to provide a representation of the number of proposed renewable energy facilities likely to be visible from each potentially sensitive receptor location, if they were all constructed. Factors affecting visibility, such as localised screening from trees or topographical undulations have not been factored into the cumulative impact assessment.
- Visualisation modelling has not been undertaken for the proposed development due to budget limitations. Should the need for visualisation modelling be proven by stakeholder / I&AP feedback, then this will be able to be incorporated into this assessment.
- No feedback regarding the visual environment has been received from the public participation process to date. Any feedback relevant to the visual environment received will be incorporated into further drafts of this report.
- Operational and security lighting will be required for the PV facility and on-site substation proposed within the development footprint. At the time of undertaking the visual study no information was available regarding the type and intensity of lighting required and therefore the potential impact of lighting at night has not been assessed at a detailed level. General measures to mitigate the impact of additional light sources on the ambiance of the nightscape have been provided.
- Most rainfall within the area occurs from November to April during the summer months. Therefore as the fieldwork was undertaken in December during the summer season the surrounding vegetation can be expected to provide the maximum potential screening. During winter months the visual impact of the proposed development may therefore be greater, particularly from farmhouses surrounded by tall deciduous trees.

- Heritage:

- Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage feature or objects not included in the inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well.
- The survey was conducted over 2 days over the extent of the total footprint area. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the heritage character of the area.
- The fieldwork that covered the Sendawo solar PV application site is an area of 17.1 square kilometres.
- A total of 2 sites, which can be considered archaeological were logged within the foot print area of Sendawo 1. All of these sites relate to the Stone Age.

- Palaeontology:
  - Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the palaeontological heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage features or objects not included in the inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to exposing of stromatolite structures as well as cave breccias.
  - The survey was conducted over 1 day and included the extent of the total footprint area by Dr Gideon Groenewald and David Groenewald on 18 February 2016. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the palaeontological heritage character of the area.
  - The fieldwork that covered the Sendawo Solar site as well as the proposed power line corridors covered the whole area by vehicle and on foot, with specific observations recorded as a photographic database. Detailed observation of outcrops were considered as highly important whereas loose gravel and boulders were recorded as representative examples of stromatolites structures which were out of situ observations. Well defined stromatolites and a site with very high potential to be a cave breccia site were observed during the field investigation.

- Socio-Economic:
  - The secondary data sources used to compile the socio-economic baseline (demographics, dynamics of the economy) although not exhaustive, can be viewed as being indicative of broad trends within the study area.
  - The study was done with the information available to the specialist within the time frames and budget specified.

- Possible impacts and stakeholder responses to these impacts cannot be predicted with complete accuracy, even when circumstances are similar and these predictions are based on research and years of experience, taking the specific set of circumstance into account.
- It is assumed that the motivation, and ensuing planning and feasibility studies for the project were done with integrity and that all information provided to the specialist by the project proponent and its consultants to date is accurate.
- It is assumed that the project description and infrastructure components as discussed above are reasonably accurate. These details were used to assess the potential impacts.
- With regard to the in-person interviews undertaken the following assumptions are made:
  - Questions asked during the interviews were answered accurately.
  - The degree of the perceived possible significance of concerns raised by some of the respondents were rated by them truthfully.
  - That the attitudes of the respondents towards the project will remain reasonably stable over the short- to medium- terms.
- The land owner of Portion 2 of Farm Rosendal 673 refused consultation. The assumption is that no significant concern exists or it can be reasonably assumed that consultation would have been sought. Where applicable, Google Earth imagery was used to attempt to determine the current level of economic activity taking place on Portion 2 of Farm Rosendal 673 to aid in the assessment of any potential impact and its extent on the specific land owner.
- At the same time, it is assumed that the general concerns and opinions raised by all other land owners interviewed, such as security concerns, would also apply to the land owners not consulted with for whatever reason.
- Considering the information obtained through primary as well as secondary sources, as well as the fact that the location of Portion 2 of Farm Rosendal 673 is not directly adjacent to the site proposed for Sendawo 1, it can be concluded that the level of risk to the project associated with this knowledge gap is low.

- Traffic
  - Imported elements are shipped to and transported from the nearest and most practical South African Port to the site.
  - Certain elements are transported from manufacturing centres within South Africa.
  - Material for supports and road construction are obtained locally from closest available commercial source.
  - The largest potential load will be single 80MVA transformer, with a payload of approximately 80t.
  - Freight will be transported predominantly on surfaced roads.
  - Foundations will ultimately be dictated by site geotechnical conditions but generally comprise of driven steel piles to reduce risk of failures due to varying conditions for the developer.

4 PROJECT NEED AND DESIRABILITY

4.1 National Renewable Energy Requirement

In 2010 South Africa had 44,157MW of power generation capacity installed. Current forecasts indicate that by 2025, the expected growth in demand will require the current installed power generation capacity to be almost doubled to approximately 74,000MW (SAWEA: 2010).

This growing demand, fuelled by increasing economic growth and social development within Southern Africa, is placing increasing pressure on South Africa's existing power generation capacity. Coupled with this, is the growing awareness of environmental impact, climate change and the need for sustainable development. Despite the worldwide concern regarding GHG emissions and climate change, South Africa continues to rely heavily on coal as its primary source of energy, while most of the countries renewable energy resources remain largely untapped (DME, 2003). There is therefore an increasing need to establish a new source of generating power in SA within the next decade.

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 Eskom's long-term strategic planning and research process. It must be remembered that solar energy is plentiful, renewable, widely distributed, clean and reduces greenhouse gas emissions when it displaces fossil-fuel derived from electricity. In this light, renewable solar energy can be seen as desirable.

4.2 National Renewable Energy Commitment

In support of the need to find solutions for the current electricity shortages, the increasing demand for energy, as well as the need to find more sustainable and environmentally friendly energy resources, South Africa has embarked on an infrastructure growth programme supported by various government initiatives. These include; the National Development Plan (NDP), the Presidential Infrastructure Coordinating Commission (PICC), the Department of Energy's Integrated Resource Plan, the National Strategy for Sustainable Development, the National Climate Change Response White Paper, the Presidency of the Republic of South Africa's Medium-Term Framework, and the National Treasury's Carbon Tax Policy Paper.

The Government's commitment to growing the renewable energy industry in South Africa is also supported by the White Paper on Renewable Energy (2003) which sets out the Government's principals, goals and objectives for promoting and implementing renewable energy in South Africa. In order to achieve the long term goal of achieving a sustainable renewable energy industry, the Department of Energy has set a target of contributing 17,8GW of renewable energy to the final energy consumption by 2030. This target is to be produced mainly through, wind and solar; but also through biomass and small scale hydro (DME, 2003; IRP, 2010).

4.3 Solar PV Power Potential in South Africa and Internationally

Internationally, PV is the fastest-growing power generation technology, South Africa has some of the highest levels of solar radiation in the world and as much as 8GW PV could potentially be installed by 2020 (DEA Guideline for Renewable Energy, 2013). Between 2000 and 2009 the installed capacity globally grew on average by 60% per year. Worldwide more than 35GW of PVs are installed and operating, and in South Africa as much as 8GW PV could potentially be installed by 2020.

4.4 Site Specific Suitability

According to the solar map (Figure 3) the North West Province of South Africa has a solar energy concentration of between 8001 and 9000 MJ/m2. The North West is the province in South Africa with the second highest solar potential. The project site falls within the range of 8501 – 9000 MJ/m2 and is thus suitable for the establishment of solar PV energy facility. Based on an estimation of the solar energy resource as well as weather, dust, dirt, and surface albedo, pre-feasibility studies conducted by BioTherm have identified the site as optimal for the proposed Sendawo solar PV project.

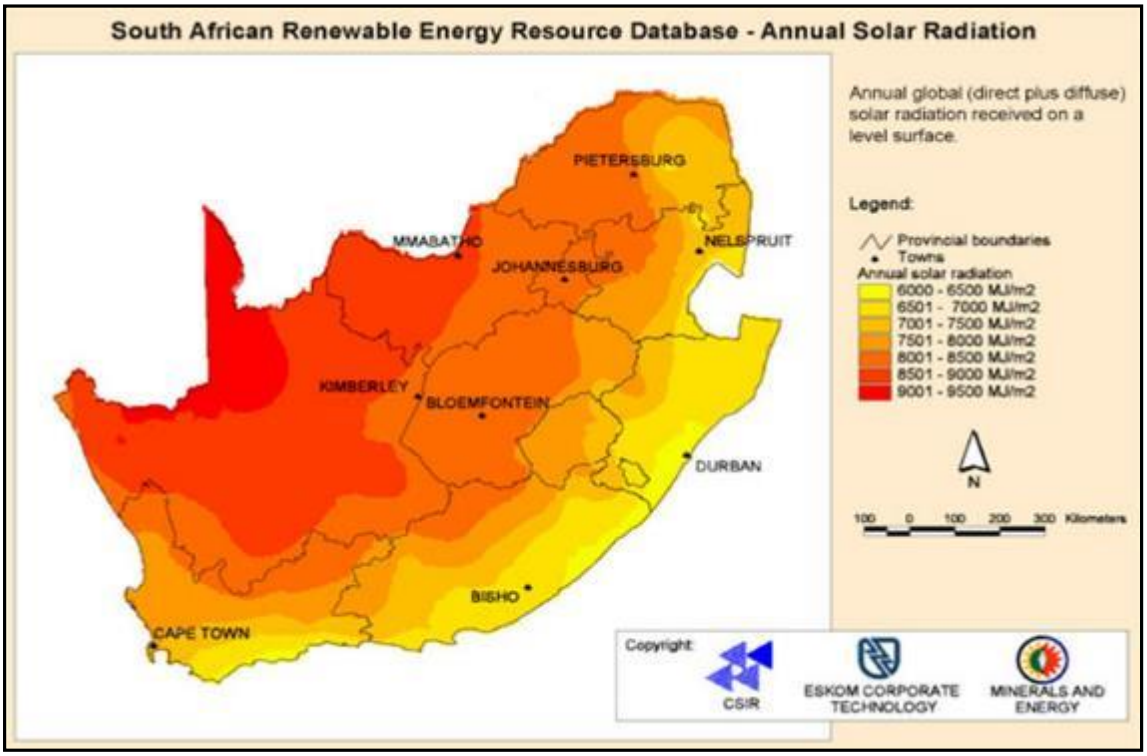

Figure 3: National Solar Resource Map (Source: Solar Vision, 2010)

The proposed solar PV energy facility is situated on the farm Portion 1 of the Farm Edinburgh No 735. Portion 1 of the Farm Edinburgh No 735 is used for cattle and game breeding. There is a homestead on the land, occupation numbers vary, and no relocation is envisaged. The project is not envisioned to impact current economic activities. The land owner is in favour of the project. The proposed development will

therefore have very little impact on current land use on the affected farm. The site is therefore considered to be suitable from a land use perspective.

The project site near Vryburg has been identified through pre-feasibility studies based on the solar resource. Grid connection and land availability were also important initial considerations. The project site has a relatively flat topography that is suitable for facilities of this kind. The project site also has advantageous grid connection potential, with the existing Mookodi substation via a power line of between between 4.73km and 5.95km in length. The project site is easily accessible as the tarred N18 national road lies adjacent to site that connects to the N14 and leads to Vryburg.

4.5 Local Need

The RE Policy for the North West Province acknowledges that the province is the country's fourth biggest electricity user, with the bulk of this usage taking place in the mining sector. In addition to the job creation opportunities that could ensue from the creation of an RE industry in the province, the RE Policy recognises the impact that this would have on the Province's contribution towards a green South Africa. More specifically, the North West RE Policy mentions the opportunities for the province in the solar energy sphere, making specific reference of the fact that the Dr Ruth S. Mompati DM represents one of the best regions in the province for exploration of the possibility of a solar energy industry (Department of Economic Development, Environment, Conservation, and Tourism, 2012).

Concerning the spatial planning policy, policy makers believe that coordinated government interaction is required to address the challenges facing the country's municipalities. It specifically recommends exploring the possibilities of using natural resources to generate economic growth and address poverty, and seeking out new areas of comparative advantage (The Presidency of the Republic of South Africa, 2006); these are all aligned to the exploration and establishment of a solar energy industry in the North West Province. The North West PSDF – EMP highlights the fact that large parts of the province are still underdeveloped, under-resourced, and under-serviced. It follows the NSDP in stating that the province's natural resources must be effectively used to address this and other developmental challenges, such as high illiteracy levels and rapid urbanisation, for example, in a sustainable manner.

The review of applicable socio-economic development policies state the importance of the RE sector and solar electricity in addressing climate change issues, while achieving job growth and economic development. The NDP identifies the expansion and acceleration of a commercial RE sector as a key intervention strategy to ultimately eliminate poverty and reduce inequality (National Planning Commission, 2011). The North West PDP identifies the RE sector, specifically solar and biomass initiatives as becoming increasingly important in the province, especially since its contribution to the province's consumption will become increasingly important over the next two decades (North West Planning Commission, 2013).

Local socio-economic development is centred on the development of Vryburg as a primary regional node, and directed at taking advantage of the area's status as a priority two investment node. The Dr Ruth S. Mompati DM's IDP states that the investment should shift towards projects that garner equality and job

creation. Key factors identified by the DM as drivers of the growth required to achieve equality and poverty reduction include job creation, bulk infrastructure expansion, and transitioning to a low carbon economy (Dr Ruth Segomotsi Mompati DM, 2015/16).

In the Naledi LM' Integrated Development Plan, it is reiterated that the LM, and Vryburg in particular, has been identified as a priority two investment area due to the LM's regional growth needs, being the main trading centre in the DM, and the district's administrative centre. Some of the opportunities identified within the LM, with reference to the primary study area, include capitalisation on Vryburg's status as a secondary regional centre, and a beef beneficiation programme, with Vryburg envisioned as the institutional headquarters of the beneficiation programme (Naledi Local Municipality, 2013).

5 TECHNICAL PROJECT DESCRIPTION

5.1 Project Description

The proposed project will encompass the installation of a solar PV field and associated components, in order to generate electricity that is to be fed into the Eskom grid. The facility will have a maximum export capacity of 75MW. The total area of the application site is 1709 hectares. The Sendawo 1 development area has a total area of 367 hectares. The footprint of the Operations and Maintenance (O&M) buildings will be approximately 270m² and the onsite substation will occupy a footprint area of 1 ha. The final design details are yet to be confirmed. These details will become available during the detailed design phase of the project.

5.1.1 PV Project Components

BioTherm is proposing the establishment of a solar PV energy facility on the development site near Vryburg (Figure 4). As mentioned, the objective of the solar project is to generate electricity to feed into the national grid. The solar PV energy facility will have a maximum export capacity of 75MW.

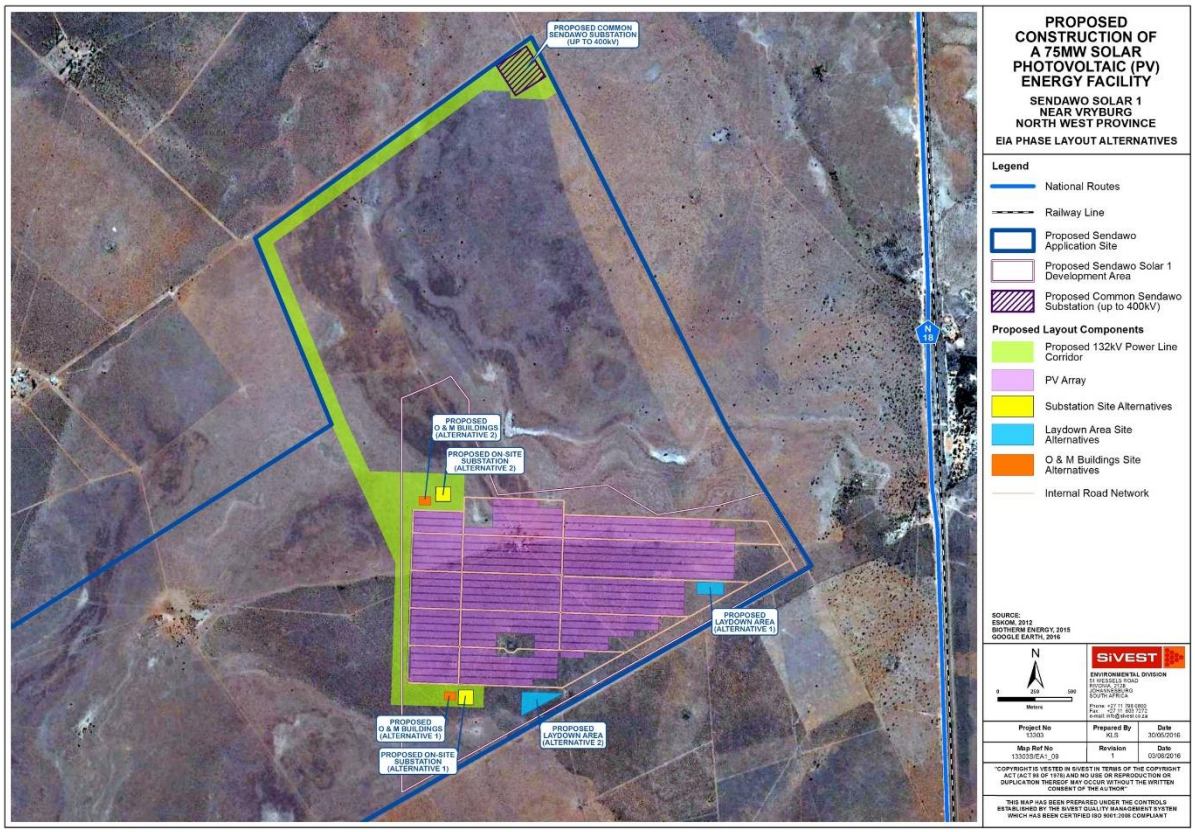

Figure 4: Proposed Sendawo 1 Layout

The key technical details and infrastructure required is presented in the table below (Table 7).

Table 7: Sendawo 1 technical summary

Project Name	Farm name and area	Technical details and infrastructure necessary
Sendawo 1	Portion 1 of the Farm Edinburgh No 735 Sendawo 1 development area: 367 ha	▪ Approximately 275 000 **solar PV panels** with a total export capacity of 75MW; ▪ The technology used will be either **fixed tilt mounting or single axis tracking mounting**, and the modules will be either crystalline silicon or thin film technology; ▪ Onsite **132kV substation**, with the transformers for voltage step up from medium voltage to high voltage; ▪ The onsite **substation** will occupy an area of approximately 1ha. ▪ The panels will be connected in strings to inverters. Inverter stations will typically house several inverters and 1 transformer; ▪ DC power from the modules will be converted into AC power in the inverters and the voltage will be stepped up to 22 or33kV (medium voltage) in the transformers. ▪ The **medium voltage cables** will be run underground in the facility to a common point before being fed to the **onsite substation** where the voltage will typically be stepped up to 132kV.. ▪ Grid connection will be from the proposed facility 132kV onsite substation, via a proposed 132kV power line to the proposed Sendawo collector substation. The proposed Sendawo collector substation will be connected to the existing Eskom Mookodi 4000/132kV Transmission Substation (MTS) via a proposed power line of up to 400kV. The facility onsite 132kV substation and the proposed 132kV power line are part of this project, however the Sendawo collector substation and its power line to Mookodi MTS are being assessed as part of a separate ongoing Environmental Impact Assessment (EIA) process. ▪ The **power line structures** will be a tower (suspension / strain) / Steel monopole structure, which may be self-support or guyed suspension. The height will vary based on the terrain, but will ensure minimum OHL clearances with buildings and surrounding infrastructure. ▪ A **lay-down area** of approximately 10ha for the temporary storage of materials during the construction activities. ▪ **Construction of access roads and internal roads**; ▪ Construction of a **car park and fencing** around the project; and ▪ **Administration, control and warehouse buildings**

As previously mentioned, this proposed PV energy facility forms one of three PV energy facilities with a 75MW export capacity that BioTherm are proposing to develop on Portion 1 of the Farm Edinburgh No 735. In order to accommodate the Department of Energy's (DoE) competitive bidding process for procuring renewable energy from Independent Power Producers in South Africa each PV energy facility will be

developed under a separate Special Purpose Vehicle (SPV) and therefore each requires a separate Environmental Authorisation. Additionally, BioTherm are proposing to develop the Sendawo common collector substation and associated power line connecting it to the existing Eskom Mookodi Main Transmission Substation (MTS). All three of the Sendawo Solar facilities will be connected to the proposed Sendawo common collector Substation.

5.1.2 Solar Array

Solar PV panels are usually arranged in rows consisting of a number of PV modules. The area required for the PV arrays will likely need to be entirely cleared or graded.

Approximately 275 000 solar PV panels will be required for the facility and the facility will have a total export capacity of 75MW. Support structures will either be fixed tilt mounting or single axis tracking solutions, and the modules will be either crystalline silicon or thin film technology. The solar PV modules are variable in size, and are dependent on advances in technology between project inception and project realisation. An example on dimensions of a typical PV module is 1956mm x 992mm x 40mm. The actual size of the PV modules to be used will be determined in the final design stages of the project. The PV modules are mounted on metal frames. Rammed steel piles are commonly used for the support the structures (Figure 5).

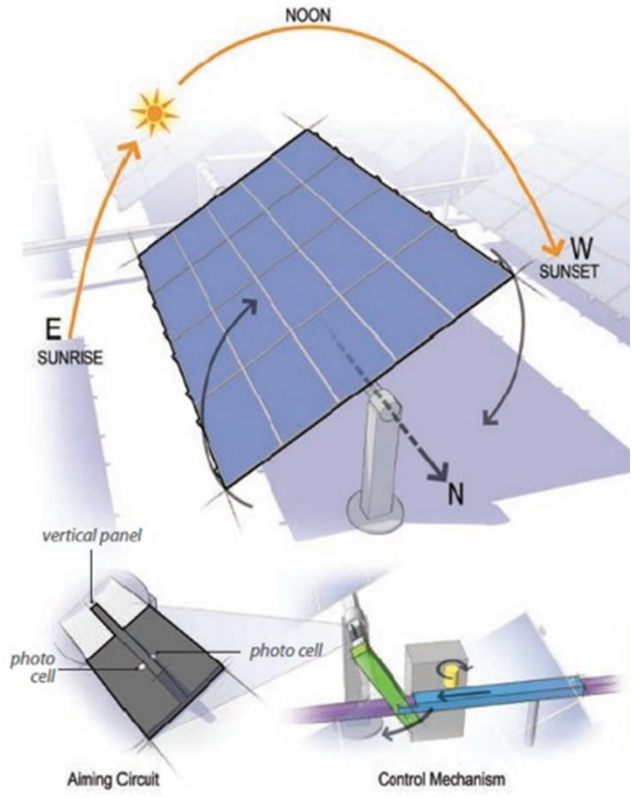

Figure 5: Example of a Photovoltaic Panel with tracking capability.
(Source: http://solartoday.org/2009/07/single-axis-solar-tracking/)

5.1.3 Electrical Infrastructure

The solar arrays are connected in strings, which are in turn connected to inverters. For a 75MW facility, inverter stations which are typically containerised units housing inverters and transformers will be used (Figure 6). DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage (typically 22 or 33 kV in the transformers. The medium voltage cables will be run underground within the facility before being fed to the onsite substation where the voltage will typically be stepped up to 132kV. An onsite power line with a voltage of 132kV will run from the 132kV onsite substation to the proposed Sendawo common substation (part of a separate ongoing EIA process). The 132kV power line will likely be a tower (suspension / strain) / Steel monopole structure, which may be self-support or guyed suspension. Tower types DT-T 7649 are typically used for 132kV power lines, however the final design used will be determined in the final design stages of the proposed project. Diagrams of tower types DT-T 7649 are included in Appendix 11. The height will vary based on the terrain, but will ensure minimum OHL line clearances with buildings and surrounding infrastructure.

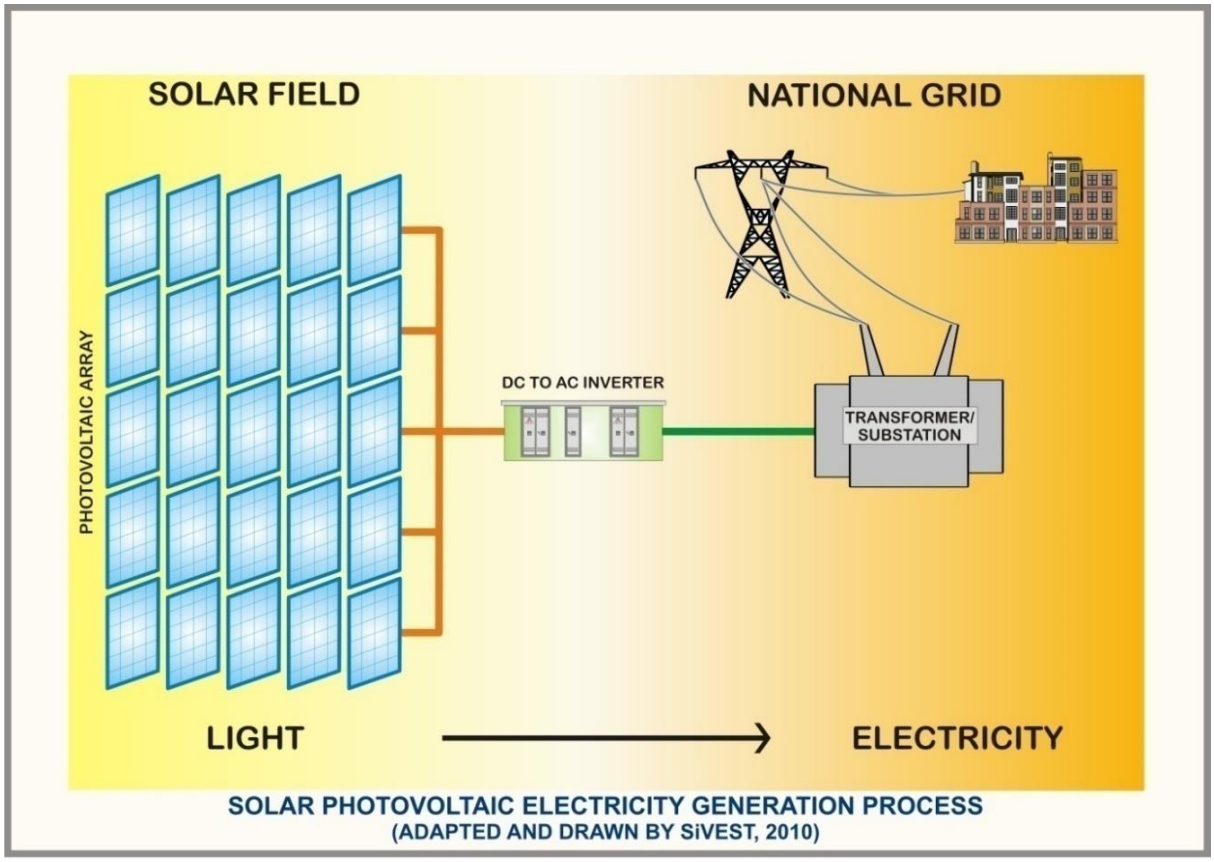

Figure 6: PV process

5.1.4 Other Associated Infrastructure

The solar field will require onsite buildings which will be used in the daily operation of the plant and includes an administration building (office). The buildings will likely be single storey buildings which will be required to accommodate the following:

- Control room
- Workshop
- Kitchen
- Toilets
- Storage
- Car park and fencing around the project

A general construction lay-down area will be required for the construction phase of the proposed solar PV energy facility. The size of this area is yet to be determined, but 10 hectares is likely. A permanent laydown for the containers will be required for the storage of spares, which is to be located close to the O&M building.

Other associated infrastructure includes the following:

- Access roads and internal roads;
- A car park; and
- Fencing around the project.

5.2 Alternatives

As per Chapter 1 of the EIA regulations (2014), feasible and reasonable alternatives are required to be considered during the EIA process. Alternatives are defined at “different means of meeting the general purpose and requirements of the activity” These alternatives may include:

(a) The property on which or location where it is proposed to undertake the activity;
(b) The type of activity to be undertaken;
(c) The design or layout of the activity;
(d) The technology to be used in the activity;
(e) The operational aspects of the activity; and
(f) The option of not implementing the activity.

Each of these alternatives are discussed in relation to the proposed project in the sections below.

5.2.1 The property on which or location where it is proposed to undertake the activity

No site alternatives for this project are being considered because the placement of solar PV installations is dependent on several factors, all of which are favourable at the proposed site location. These include solar resource, climate, topography, grid connections and access to the site. The project site has been identified by BioTherm through a pre-feasibility desktop analysis based on the estimation of the solar energy resource

as well as weather, dust and dirt effects. The North West Province in South Africa has the highest solar irradiation potential after the Northern Cape. The project site receives an annual global horizontal irradiation of approximately 2194 kWh/ m^2/year. The project site has access to the national grid via the existing Mookodi Main Transmission Station located approximately 5 km from the site. There are no operational projects proposed by other developers which surround the site, however, there is one round four additional allocation preferred bidder. The project site has a relatively flat topography which is suitable for the development of a solar PV facility. The project site is easily accessible as the tarred N18 national road lies adjacent to site that connects to the N14 and leads to Vryburg. The site is therefore considered highly suitable for the proposed development and no other locations are being considered.

5.2.2 The type of activity to be undertaken

No other activity alternatives are being considered. Renewable energy development in South Africa is highly desirable from a social, environmental and development point of view. Wind energy installations are not feasible on the site as there is not enough of a wind resource. Concentrated solar power (CSP) installations are also not feasible because they have a high water requirement and the project site is located in an arid area. Therefore solar PV is the only activity being considered for the proposed site.

5.2.3 The design or layout of the activity

Design or layout alternatives are being considered in the EIA process. Various environmental specialists assessed the site during the scoping phase. Two alternative site locations for the 132kV substation, laydown area and O&M building were assessed during the scoping phase. The specialist assessments included the identification of sensitive areas (Figure 7). These sensitive areas were used during the scoping phase to perform a preliminary comparison of layout alternatives.

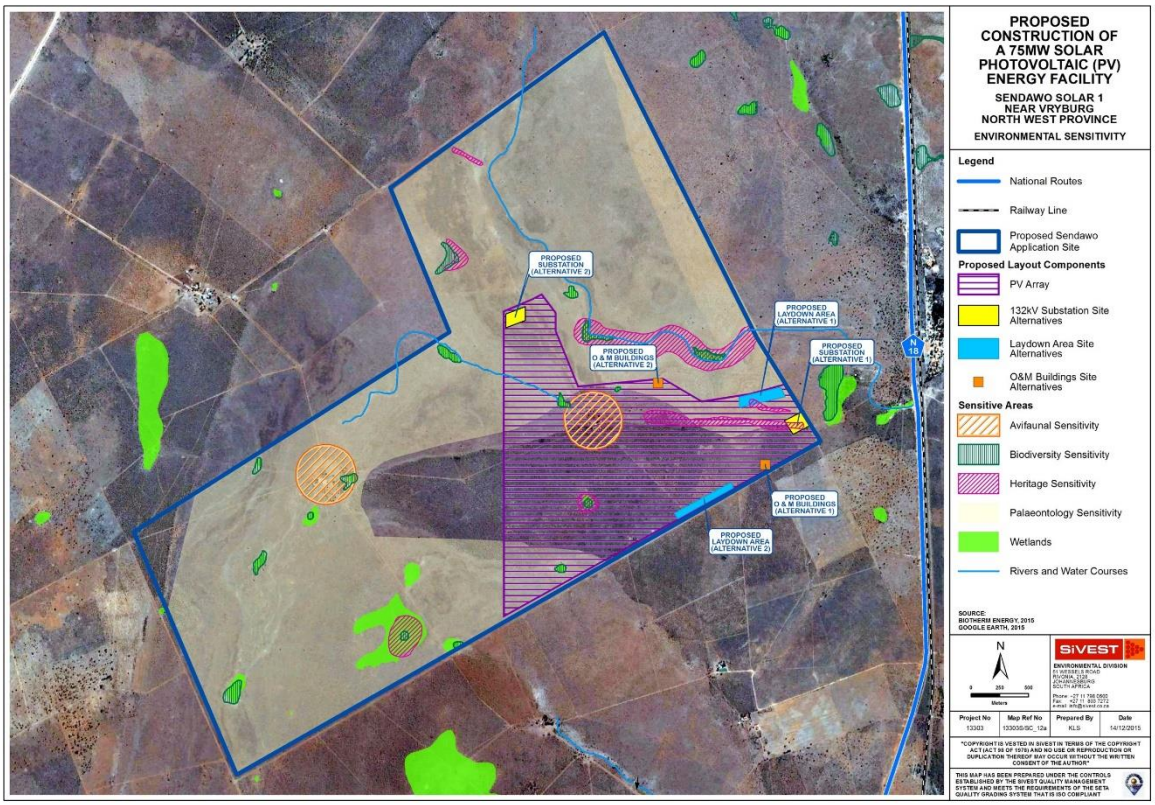

Figure 7: Proposed Scoping Phase Layout Alternatives with Scoping Phase sensitivity

Based on the scoping phase specialist findings, and on discussion with the landowner, the two alternative site locations for the 132kV substation, laydown area and O&M building were amended. Additionally, based on the specialist findings and landowner considerations, the proposed PV array layout and the 132kV power line corridor were designed. These layouts are presented in Figure 8. These EIA phase layout alternatives will be extensively investigated in the EIA phase of the project. The EIA phase layout alternatives, including maps, are presented in Chapter 12. The selected preferred layout alternative will be based on both environmental constraints and design factors.

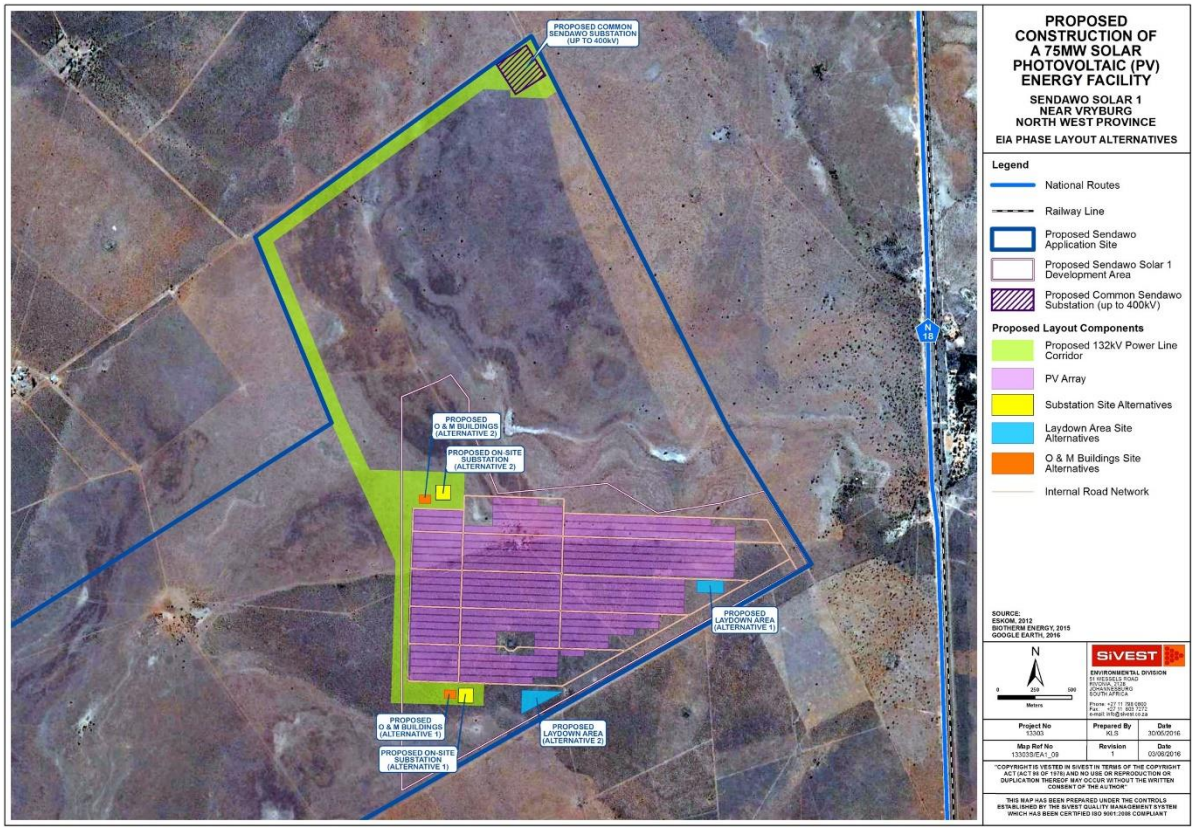

Figure 8: Proposed EIA Phase Layout Alternatives

5.2.4 The technology to be used in the activity

There are very few technological alternatives for PV technology. For the Sendawo 1 solar energy facility the mounting structures will be either fixed axis mounting or single axis tracking solutions, and the modules will be either crystalline silicon or thin film technology. The impacts on the environment of the different types of PV technology are the same during construction, operation and decommissioning. Therefore no technology alternatives will be considered during the EIA. The choice of technology used will ultimately be determined by technological and economic factors at a later stage.

No technology alternatives will be considered for the proposed substation and power line. The type of technology to be used for the substation and power line will largely depend on the terrain and other technological and economic factors. It is proposed that the tower (suspension / strain) / Steel monopole structure type (DT-T 7649) would predominantly be used for the proposed power line in combination with other towers. The impacts on the environment of the different types of substation technology and tower types would be very similar during construction, operation and decommissioning. Therefore no technology alternatives will be considered during the EIA. The choice of technology used will ultimately be determined by Eskom.

5.2.5 The operational aspects of the activity

No operational alternatives were assessed in the EIA as none are available for PV installations.

5.2.6 The option of not implementing the activity

The option of not implementing the activity, or **the 'no-go' alternative, is considered in the EIA**. South Africa is under immense pressure to provide electricity generating capacity in order to reduce the current electricity demand in the country. With the global focus on climate change, the government is under severe pressure to explore alternative energy sources in addition to coal-fired power stations. Although solar power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed solar PV energy facility would be detrimental to the mandate that the government has set to promote the implementation of renewable energy. It is a suitable sustainable solution to the energy crisis and this project could contribute to addressing the problem. This project will aid in achieving South Africa's goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

A general description of the study area is outlined in the section below. The receiving environment in relation to each specialists study is also provided.

The proposed project is located within the North West Province approximately 9km south of Vryburg. It falls within the Naledi Local Municipality that forms part of the Dr Ruth Segomotsi Mompati District Municipality (Figure 9). The proposed development will be accessed by the N18 which lies adjacent to the proposed corridors. The corner point co-ordinates for the development site, centre point co-ordinates for the associated infrastructure and power line corridor are included in Table 8**,** Table 9 and Table 10.

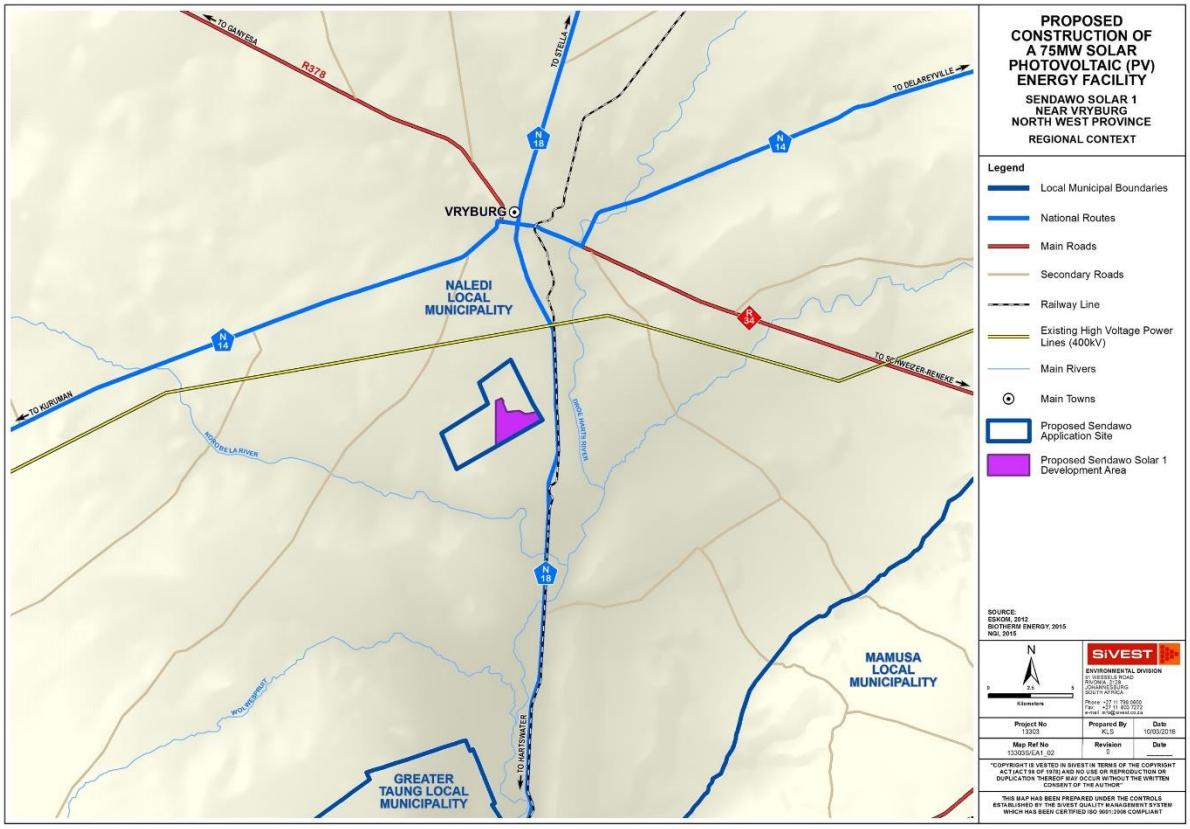

Figure 9: Regional Study Area.

6.1 Study Site Description

The site that is proposed for the Sendawo 1 solar PV energy facility near Vryburg is located on the following farm:

- Portion 1 of the Farm Edinburgh No 735, cadastral number: T0HN00000000073500001.

Table 8: Development Area Corner Points

SENDAWO SOLAR 1: DEVELOPMENT AREA		
CORNER POINT COORDINATES (DD MM SS.sss)		
POINT	SOUTH	EAST
S1_01 (NW)	S27° 3' 11.716"	E24° 43' 7.915"
S1_02	S27° 3' 6.917"	E24° 43' 19.999"
S1_03	S27° 3' 32.997"	E24° 43' 31.458"
S1_04	S27° 3' 37.364"	E24° 44' 10.570"
S1_05 (NE)	S27° 3' 32.580"	E24° 44' 36.627"
S1_06 (SE)	S27° 3' 48.539"	E24° 44' 47.636"
S1_07 (SW)	S27° 4' 38.032"	E24° 43' 7.876"

Table 9: Associated Infrastructure Centre Points

SENDAWO SOLAR 1: COMPONENTS		
CENTRE POINT COORDINATES (DD MM SS.sss)		
COMPONENT	ALTERNATIVE 1	ALTERNATIVE 2
SUBSTATION (132kv)	S27° 4' 17.325"	S27° 3' 32.763"
	E24° 43' 23.472"	E24° 43' 18.037"
O&M BUILDINGS	S27° 4' 17.028"	S27° 3' 34.222"
	E24° 43' 19.665"	E24° 43' 13.589"
LAYDOWN AREA	S27° 3' 53.560" E24° 44' 23.404"	S27° 4' 17.992" E24° 43' 40.594"

Table 10: 132kV Power Line Corridor

SENDAWO SOLAR 1				
PROPOSED 132kV POWER LINE CORRIDOR - CENTRE LINE				
SUMMARY COORDINATES (DD MM SS.sss)				
PROJECT	START POINT	MIDDLE POINT	END POINT	APPROX LENGTH (KM)
SENDAWO SOLAR 1	S27° 2' 9.279"	S27° 3' 1.348"	S27° 2' 0.103"	5.62
	E24° 43' 37.482"	E24° 42' 45.355"	E24° 43' 37.337"	

The application site as shown on the locality map below comprises Portion 1 of the Farm Edinburgh No 735. The total area of the application site is 1709 hectares. The Sendawo 1 development area has a total area of 367 hectares (Figure 10). Portion 1 of the Farm Edinburgh No 735 is used for cattle and game breeding. There is a homestead on the land, occupation numbers vary, and no relocation is envisaged. The land owner is in favour of the project. The proposed development will therefore have very little impact on current land use on the affected farm. The EIA phase layouts will be assessed in detail and refined to avoid sensitive areas as required.

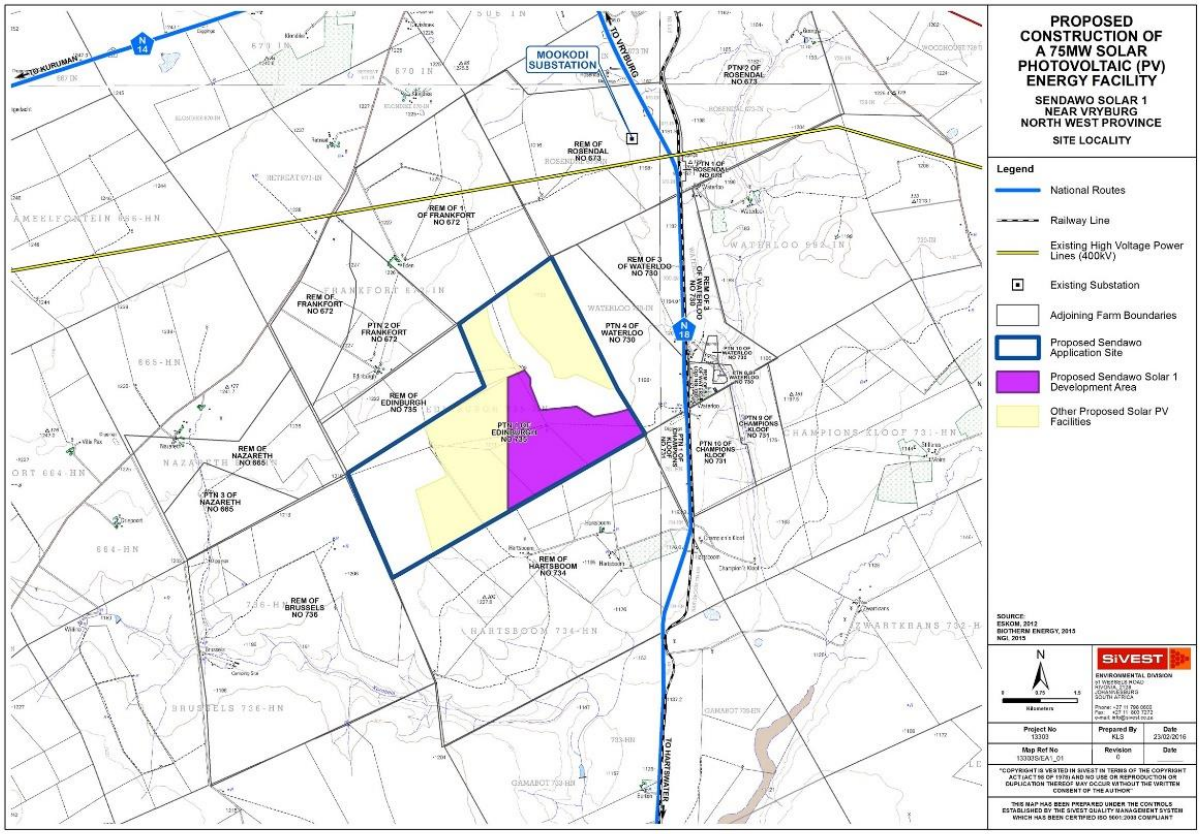

Figure 10: Site Locality

Please note that all maps within the report are included in Appendix 7 and are in A3 format.

6.2 Land Use

Much of the assessment area is characterised by natural unimproved vegetation, which is used as grazing land for game, cattle, sheep and goats (Figure 11). Cultivation is restricted to relatively small areas scattered throughout the surrounding area.

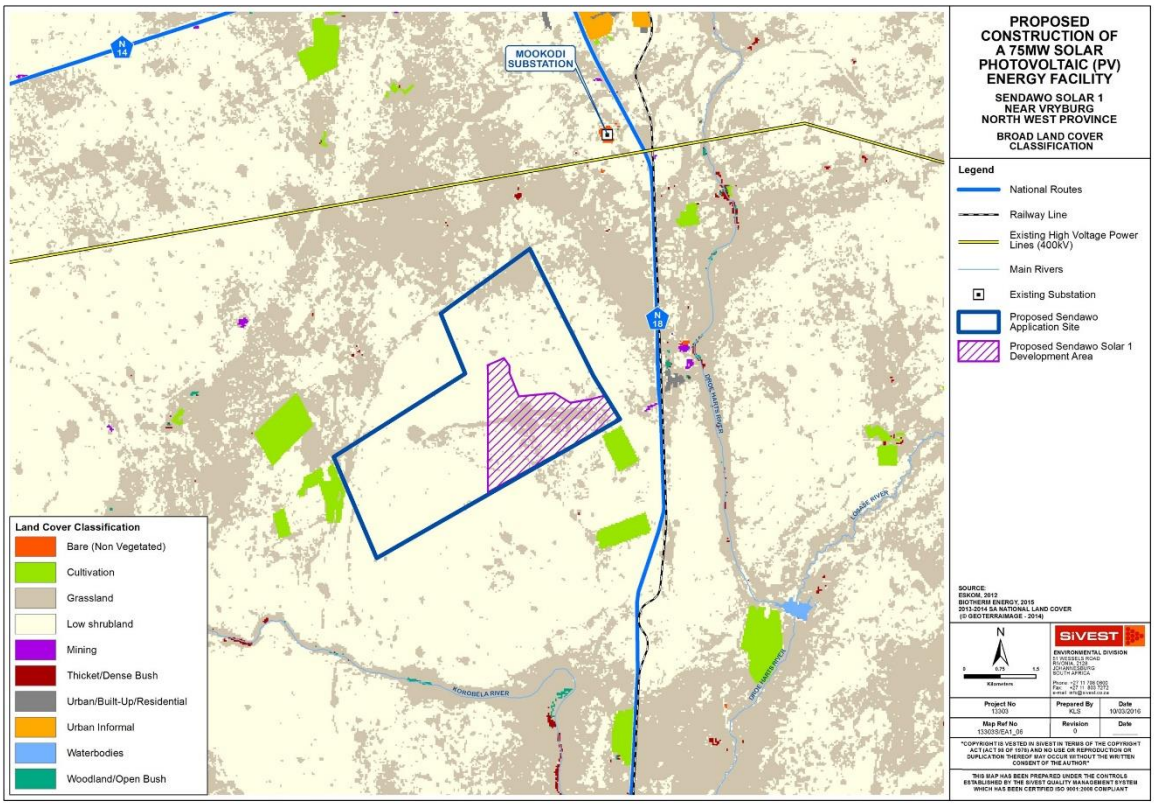

Figure 11: Land Use of the Study Area

Built form, in areas where livestock rearing occurs, is limited to isolated farmsteads, gravel access roads, ancillary farm buildings, telephone lines, windmills, fences and the remnants of old workers' dwellings.

Figure 12: Typical built form present in areas where livestock rearing occurs

It must also be noted that a high voltage 400kV power line bisects the study area to the north of the application site. In addition, the Mookodi Main Transmission Substation (MTS) can be found to the north-east of the application site. However, the tall steel structures that make up the Mookodi MTS are only visible from certain areas of the application site.

Figure 13: View from within the application site showing the Mookodi MTS, which is located to the north-east, as well as the 400kV power line.

The closest built-up areas are the agricultural town of Vryburg and the Huhudi informal/semi-formal settlement which is located in the northern sector of the study area adjacent to the N18. Within this part of the study area, human influence is also visible in the form of the N18 national route and a railway line which both traverse the study area in a north-south direction, as well as electricity transmission infrastructure comprising a 400kV power line and the newly constructed Mookodi MTS (Figure 14). In addition, there are some small quarries in the surrounding area as well as the Arthington Memorial Church and the Tiger Kloof Educational Institution along the N18.

Figure 14: Eskom's newly constructed Mookodi Main Transmission Substation (MTS) which is located to the north-east of the application site

6.3 Topography and Slope

The topography within and in the immediate vicinity of the proposed application site is characterised by a flat to gently undulating landscape sloping down in a south-easterly direction towards the Droe Harts Rivier. The topography in the wider study area is largely characterised by level plains with little noticeable relief and very gradual slopes (Figure 15). The valleys of the Droe Harts and Korobela rivers in the surrounding area tend to comprise of more irregular plains and more pronounced slopes.

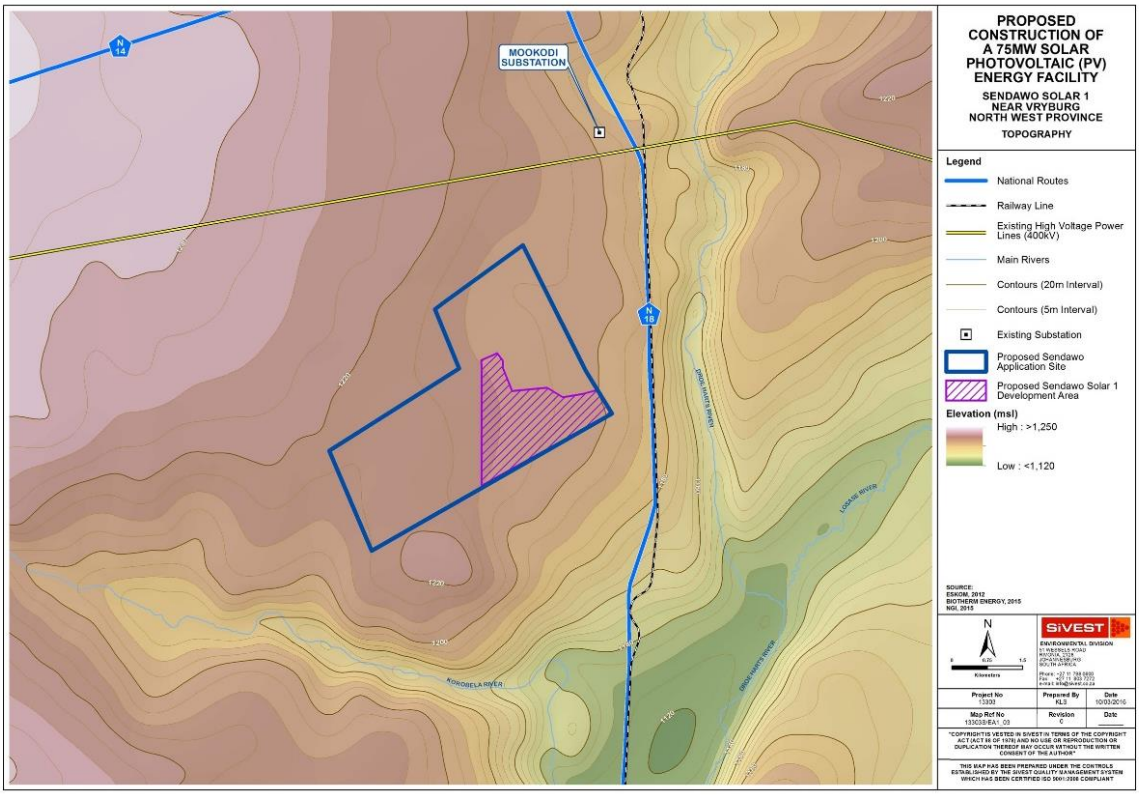

Figure 15: Topography within the study area

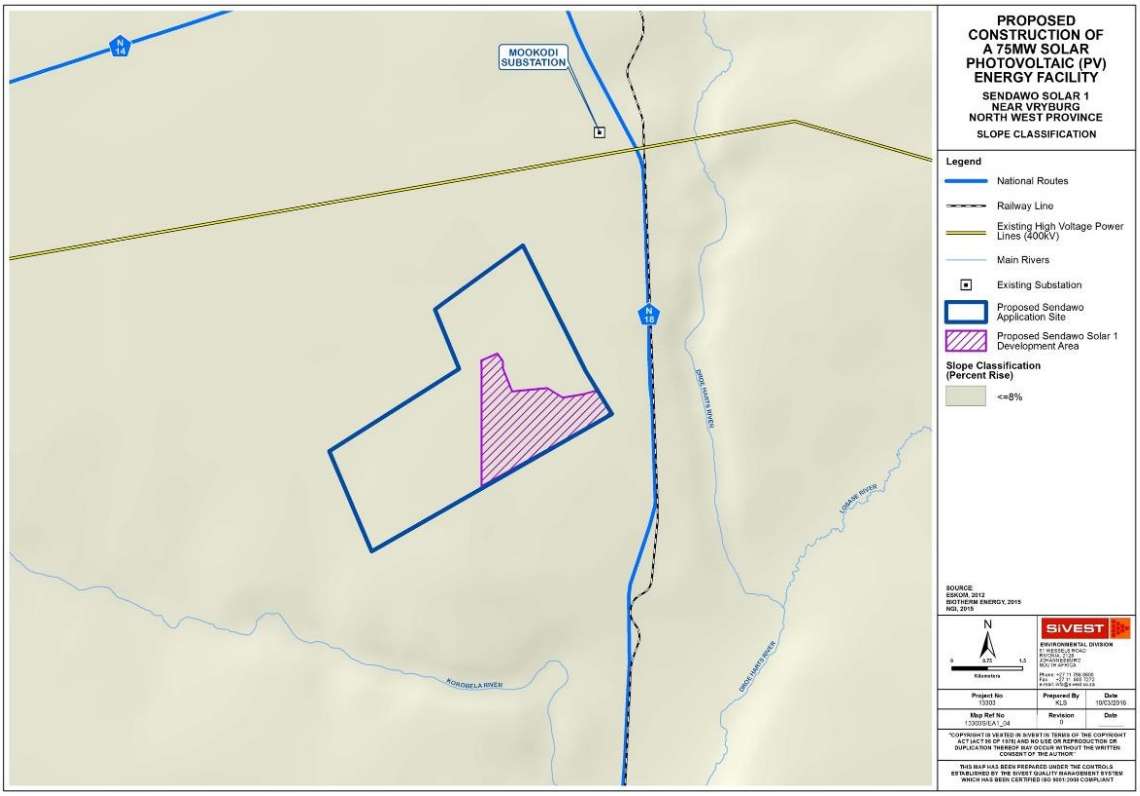

Figure 16: Slope of the study area

6.4 Climate

The climate of the study area (Kotze & Lonergan, 1984) can be regarded as warm to hot with moderate rain in summer and dry winters. The long-term average annual rainfall in this region of North West is only 445 mm, of which 357 mm, or 79.5%, falls from November to April. Rainfall is erratic, both locally and seasonally and therefore cannot be completely relied on for agricultural practices. The average evaporation is over 2 600 mm per year, peaking at over 10.5 mm per day in December.

Temperatures vary from an average monthly maximum and minimum of 32.1ºC and 16.7ºC for January to 19.0ºC and -0.6ºC for July respectively. The extreme high temperature that has been recorded is over 42ºC and the extreme low –10.0ºC. Frost occurs most years on 30-40 days on average between early June and mid-September.

6.5 Geology

The geology of the area comprises Kalahari sand overlying dolomite of the Schmidtsdrift Formation (Geological Survey, 1984).

The distribution of the geological units in the area is shown in Figure 17.

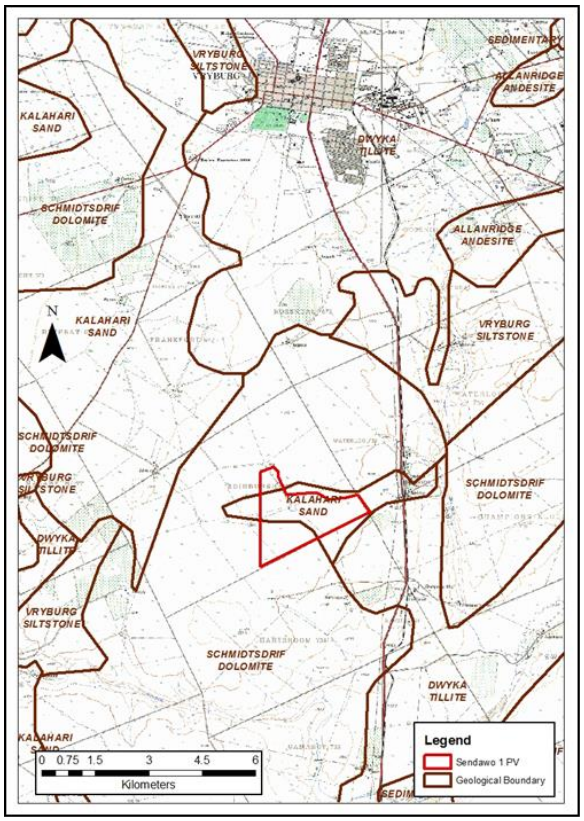

Figure 17: Geology

6.6 Biodiversity (Flora and Fauna)

The Biodiversity Assessment was conducted by David Hoare (Appendix 6A). The environmental baseline from a biodiversity perspective is presented below.

6.6.1 Broad vegetation types of the region

The sites fall within the Savanna Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina et al. 2006). This map shows one vegetation type occurring within the area of interest, Ghaap Plateau Vaalbosveld. This vegetation type is described in more detail below.

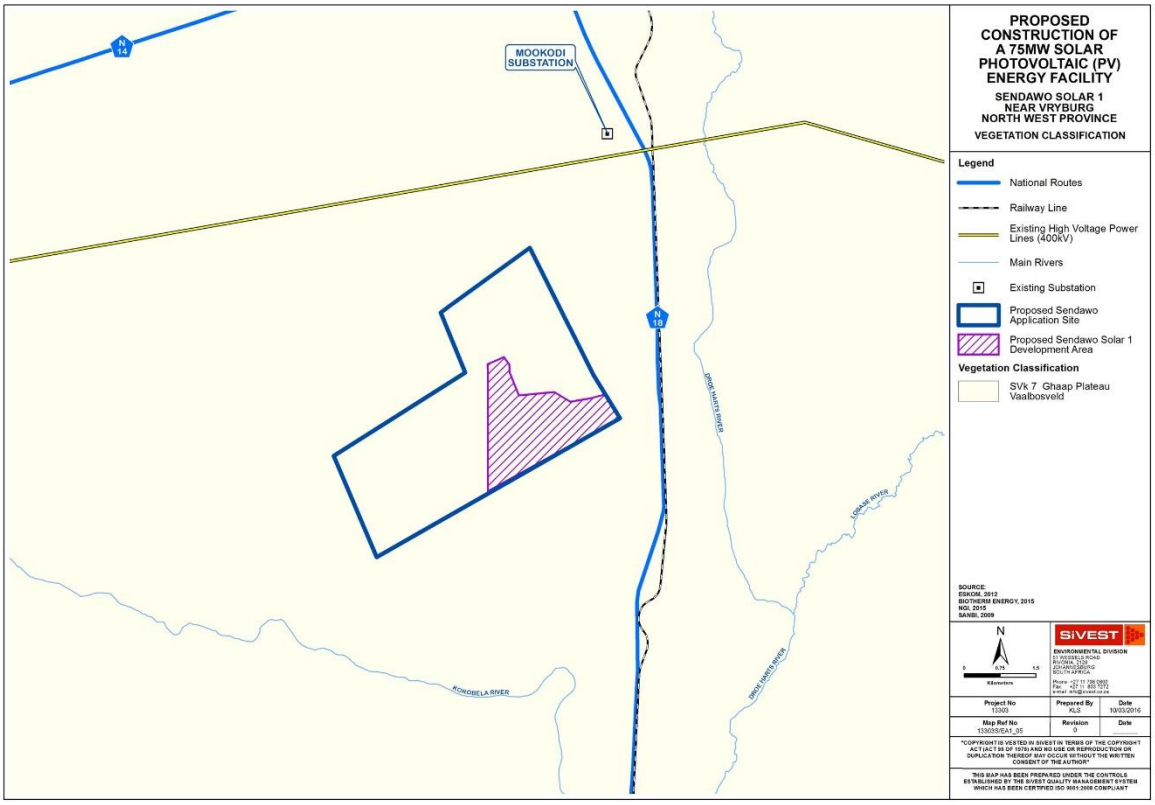

Figure 18: Vegetation of the Study Area.

6.6.2 Ghaap Plateau Vaalbosveld

This vegetation type occurs in the Northern Cape Province and the North West Province on the flat plateau from around Campbell in the south to around Vryburg in the north (Mucina et al. 2006). The vegetation consists of a well-developed shrub layer with *Tarchonanthus camphoratus* and *Acacia karroo* and an open tree layer with *Olea europea* subsp. *africana*, *Acacia tortilis, Ziziphus mucronata* and *Rhus lancea*. The

vegetation has a relatively low cover of Acacia for an arid savannah and is mostly dominated by non-thorny species, such as *Olea europea* subsp. *africana, Rhus lancea* and *Tarchonanthus camphoratus*. The thorny species, *Acacia tortilis*, *Acacia hebeclada* and *Acacia mellifera* are more important in the northern parts of the vegetation type around Vryburg. This vegetation unit contains a high number of Griqualand West and Kalahari endemics.

6.7 Avifauna

The Avifauna Assessment was conducted by Chris van Rooyen (Appendix 6B). The environmental baseline from an avifaunal perspective is presented below.

The habitat in the core study area is highly homogenous and consists of extensive plains with grass and low shrub, with scattered, stunted *Vachellia* trees. The closest Important Bird Areas (IBAs), the Baberspan and Leeupan SA026 and the Sandveld and Bloemhof Dam Nature Reserves SA039 are located approximately 100km away (Barnes 1998, Birdlife 2015). The development is too far away from these IBAs to have any direct impact on them.

6.7.1 Habitat classes and avifauna

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the natural vegetation, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types.

The following bird habitat classes have been recorded at the core study area and immediate surroundings:

- **Savanna**

The dominant natural vegetation type is Ghaap Plateau Vaalbosveld. Ghaap Plateau Vaalbosveld consists of a well-developed shrub layer of *Tarchonanthus camphoratus* with very few trees. Rainfall is in summer and autumn ranging from 300mm – 500mm, with temperatures ranging from -7.5°C to 36°C (Mucina & Rutherford 2006). Ghaap Plateau Vaalbosveld is a form of arid woodland. Arid woodland occurs where there is intermediate, though variable rainfall with hot, wet summers and cool, dry winters.

Priority species that could be found in natural savanna vegetation on the development site are Cape Sparrow, European Roller, Scaly-feathered Finch, Yellow Canary, Kalahari Scrub-robin, Red-headed Finch, Black-chested Prinia, Chestnut-vented Tit-babbler, Crimson-breasted Shrike, Cape Penduline-Tit, Bokmakierie, Eastern Clapper Lark, Pririt Batis, Southern Pale Chanting Goshawk, Chat Flycatcher, Lark-like Bunting, Namaqua Sandgrouse, Fiscal Flycatcher, Karoo Thrush, Northern Black Korhaan, Orange River White-eye, White-backed Mousebird, Cape White-eye and Ant-eating Chat. Occasional visitors to the site could include Martial Eagle, Secretarybird, Kori Bustard, Cape Vulture, White-backed Vulture and Double-banded Courser.

Pre-construction monitoring conducted over six months revealed fewer than expected priority species in the savanna habitat at the application site, which may indicate that the habitat may be under grazing pressure. The very dry and hot conditions which prevailed during the majority of the pre-construction monitoring further contributed to the low bird counts.

- **Surface water**

The ephemeral rivers, particularly the Dry Harts River which is situated east of the core study area, is important for a variety of waterbirds, including Red-listed Black Stork and Maccoa Duck, which were recorded sparsely by SABAP2 and could be attracted to pools in the Dry Harts River. South African Shelduck could also be an occasional visitor. Namaqua Sandgrouse, also sparsely recorded by SABAP 2, could also visit pools in the river to drink and possibly also a few Burchell's Sandgrouse. Abdim's Stork could potentially forage on irrigated fields along the river channel, and in the dry river channel itself (pers. obs). Priority raptors and possibly vultures (rarely) could also use pools in the river bed for bathing and drinking.

Open water troughs are important sources of surface water in arid areas and may be used extensively by various species, including large raptors, e.g. Martial Eagles to drink and bath. Apart from priority raptors such as Southern Pale Chanting Goshawk, smaller priority species such as Sociable Weaver, Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse and Lark-like Bunting congregate in large numbers around water troughs which in turn could attract Lanner Falcon. The presence of trees around surface water often attracts other priority species such as Bokmakierie, Kalahari Scrub-robin, Crimson-breasted Shrike, Chestnut-vented Tit-babbler, Fiscal Flycatcher, Karoo Thrush and White-backed Mousebird.

The core study area contains a natural spring surrounded by shrubs and trees which is used to provide drinking water to cattle via a small, concrete impoundment. This impoundment was monitored as a focal point of bird activity during the pre-construction monitoring. Priority species recorded at the impoundment during focal point surveys included Acacia Pied Barbet, Blacksmith Lapwing, Crimson-breasted Shrike, Fiscal Flycatcher, Marico Flycatcher, Yellow Canary and African Red-eyed Bulbul. Cape Vulture and White-backed Vulture could potentially also descend to the natural spring in the study area to drink and bath. There is also a borehole situated approximately 1.6km to the west of the core study area which is a source of surface water. Similar patterns of avifaunal of occurrence is expected at the water through linked to the borehole.

- **High voltage lines**

High voltage lines are an important potential roosting and breeding substrate for raptors in the study area. Existing high-voltage lines are used extensively by large raptors, especially Martial Eagles, for breeding purposes (Jenkins et al. 2006), but also smaller species such as Lanner Falcon and Greater Kestrel which often breeds in abandoned corvid nests. High voltage lines therefore hold a special importance for large raptors, but also for Sociable Weavers which often construct their giant nests within the lattice work or cross-arms of high voltage structures. One high-voltage line, the Ferrum – Mercury 400kV line, runs in an

east – west direction approximately 3.8km north of the core study area. The section of the line which runs parallel to the core study area was inspected in February 2016 but no nests were recorded on any of the towers.

6.8 Surface Water

The Surface Water Assessment was conducted by Shaun Taylor of SiVEST (Appendix 6C) and the environmental findings from a Surface Water perspective are presented below.

6.8.1 Desktop Findings

In terms of the National and North West ENPAT (2000) databases, the study area is found within the Lower Vaal Water Management Area. The study area was further found to be situated within the Vaal Primary Catchment. More specifically, the study area is found within the C32B quaternary catchment which is considered to have moderate ecological sensitivity.

Of the surface water resources identifiable in the databases (National, North West ENPAT and NFEPA), the study area was not found to contain any surface water resources such as rivers and wetlands.

Within close proximity to the study area, the following surface water resources identifiable in the databases (National & North West ENPAT and NFEPA) were noted:

- Two (2) NFEPA identified rivers, namely the Droe Harts and Korobela, located roughly 1900m east and 2100m south of the study area respectively.
- One (1) WETFEPA identified artificial un-channelled valley bottom wetland located roughly 1700m east of the study area;

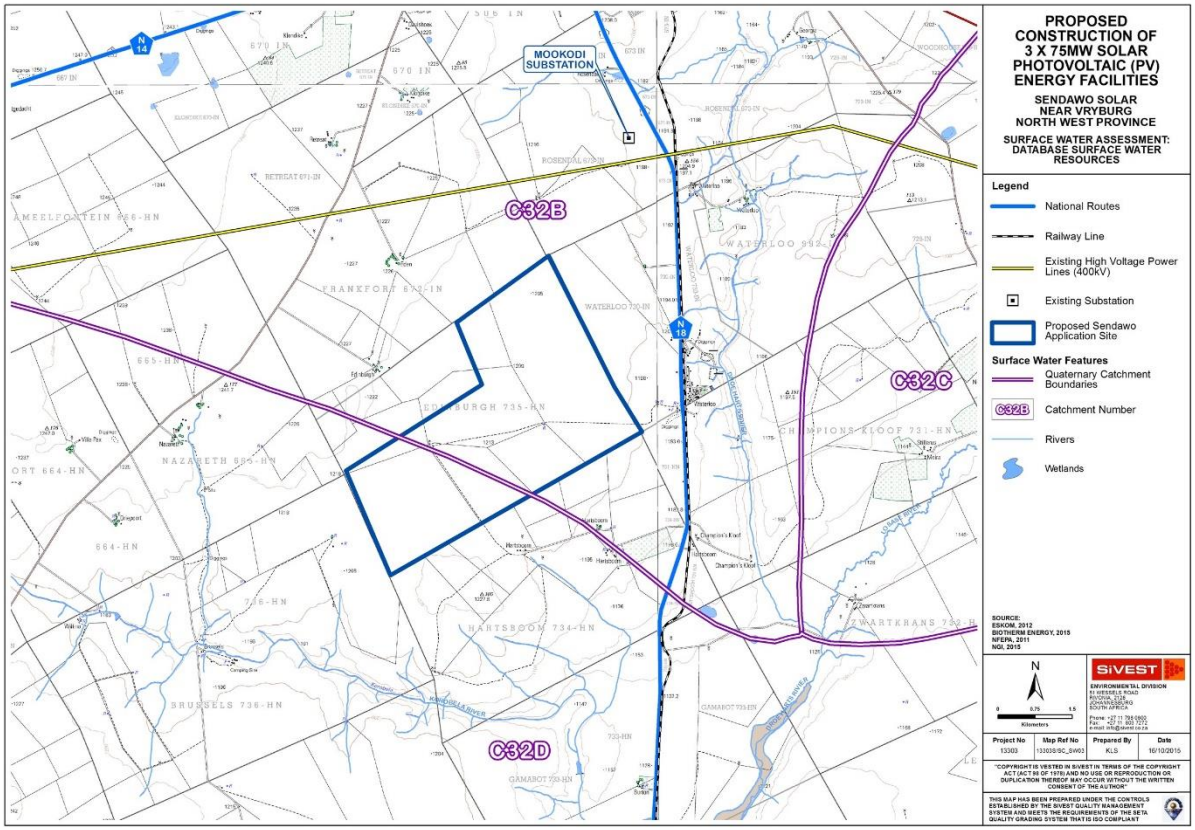

Figure 19. Sendawo Database Surface Water Map

6.9 Agricultural Potential and Soils

The Agricultural Potential Assessment was conducted by Garry Patterson (Appendix 6D) and the environmental findings from an Agricultural Potential perspective are presented below.

Existing soil information was obtained from the map sheet 2624 Vryburg (Eloff et al., 1978) from the national Land Type Survey, published at 1:250 000 scale. A land type is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar et al (1977).

The area under investigation is covered by only one land type, namely:

- **Ae36** (Red, freely-drained soils, high base status)

A summary of the dominant soil characteristics is given in Table 11 below. The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in bold type.

Table 11: Land types occurring

Land Type	Depth (mm)	Dominant soils	Percent of land type	Characteristics	Agric. Potential* (%)
Ae36	300-400	Hutton 36	24%	Red, sandy loam soils on rock or saprolite	High: 2.8
	100-200	Mispah 10/12/22	17%	Brown, sandy loam topsoils, on rock or hardpan calcrete	Mod: 9.1
		Rock	15%		**Low: 88.1**

*Note: Agricultural Potential refers to soil characteristics only, without potentially restricting climatic factors

6.10 Visual

The Visual Assessment was conducted by Andrea Gibb and Stephan Jacobs of SiVEST is included in Appendix 6E. The findings are presented below.

6.10.1 Visual baseline

The very flat nature of the topography is a strong factor influencing the types of vistas typically present in the study area, as there are few areas of rising ground to block views and limit viewsheds. Views are only likely to be partially restricted in the river valleys in the eastern and southern sectors of the study area. As a result, typically wide-ranging vistas are experienced within the study area, especially from locally higher elevations.

The predominant very low shrub layer and open areas of cultivated fields results in wide-open vistas across most of the study area. Only in areas where tall trees (sometimes exotic) have been established around farmhouses, would the vegetation provide visual screening (Figure 20). The relatively low density human habitation and natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting (Figure 21). High levels of human transformation and visual degradation only become evident in the northern sector of the study area where the N18 approaches Huhudi and the outskirts of Vryburg

The influence of the level of human transformation on the visual character of the area is described in more detail below.

Figure 20: Example of tall trees that have been established around a farmhouse

Figure 21: Typical natural rural visual character found within larger portions of the study area

6.10.2 Visual Character

Visual character can be defined based on the level of change or transformation from a completely natural setting, which would represent a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural undisturbed landscape. Visual character is also influenced by the presence of built infrastructure such as buildings, roads and other objects such as electrical infrastructure.

As previously mentioned, much of the study area is characterised by rural areas with low densities of human settlement. Agriculture in the form of livestock grazing is the dominant land use, which has transformed the natural vegetation in some areas. However, a large portion of the study area has retained a natural appearance due to the presence of the low shrubs and taller trees dominated by camel thorn (*Acacia erioloba*). The most prominent anthropogenic elements in these areas include the N18 national route, power lines, a new transmission substation and other linear elements, such as telephone poles, communication poles and farm boundary fences. The presence of this infrastructure is an important factor in this context, as the introduction of the proposed PV energy facility would result in less visual contrast where other anthropogenic elements are already present. Other human infrastructure in this setting occurs at a low density, and includes several gravel access roads and one north-south aligned railway line running parallel to the N18. Overall, the study area has a natural visual character, with certain areas displaying a rural or pastoral component where maize cultivation and farmsteads occur.

The relatively low density of human transformation throughout the surrounding area is an important component contributing to the largely natural visual character of the study area. This is important in the context of potential visual impacts associated with the proposed development of a PV energy facility as introducing this type of development could be considered to be a degrading factor in this context.

It should however be noted that other solar energy facilities are proposed in relatively close proximity to the proposed development. These facilities and their associated infrastructure, typically consist of very large structures which are highly visible. As such, these facilities will significantly alter the visual character and baseline in the study area if constructed and make it appear to have a more industrial-type visual character.

6.10.3 Cultural, historical and Scenic Value

Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world. The concept of ‘cultural landscape’ is a way of looking at a place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). The cultural landscape concept is relatively new in the heritage conservation movement across the world. In 1992 the World Heritage Committee adopted the following definition for cultural landscapes:

Cultural landscapes represent the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

According to the Committee's Operational Guidelines Cultural Landscapes can fall into three (3) categories

i) "a landscape designed and created intentionally by man";
ii) an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
iii) an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The greater area surrounding the proposed development site is an important component when assessing visual character and scenic value. The surrounding area can be considered to be typical of a rural farming landscape that consists of relatively flat areas of natural low savannah shrubland interspersed with farmsteads, windmills, livestock holding pens and agricultural land. It is estimated that approximately 19% of the population of the Naledi Local Municipality (LM) reside on farms. Livestock farming and other forms of agriculture are also evident within the surrounding area. This can be attributed to the fact that the nearby town of Vryburg is considered to be the economic heartbeat of the region due to its agricultural activities. Vryburg is also considered to be South Africa's largest beef producing district, with some of the largest cattle herds in the world found at the town of Stella. Other important agricultural activities in the area include the production of maize and peanuts. The town of Vryburg is therefore considered to be the agricultural and industrial centre of the Dr Ruth Segomotsi Mompati District Municipality (DM) as it is the district's biggest employment generator and GDP contributor. The importance of the agricultural sector in the town is further highlighted by the fact that Vryburg is host to one of the largest cattle sales in the Southern hemisphere as well as South Africa's third largest agricultural show (http://vryburg.com/about-vryburg/).

Vryburg is situated in the Bophirima (Western) region of the North West Province of South Africa and was founded in 1882 when the Republic of Stellaland was also founded (http://www.north-west-info.co.za/provinces/town/690). Today Vryburg is the industrial and agricultural capital of the Bophirima region. In 1904 the London Missionary Society established the Tiger Kloof Native Institute south of Vryburg, which has been classified as a provincial heritage site and is now known as the Tiger Kloof Educational Institution. In addition, the stone church on the premises, namely the Arthington Memorial Church, was built in 1925 by Tiger Kloof's masonry instructor and has subsequently been classified as a national monument. Vryburg is rich in cultural history, with the Theiler Museum located 8km west of the town. The museum houses a collection of the equipment used by Sir Arnold Theiler, the veterinarian who established the Onderstepoort veterinary research institute near Pretoria. Furthermore, the location of Vryburg presents significant income opportunities from tourism. The town is located on the N14, which eventually links Gauteng to Namibia. This in itself represents a possibility for entrepreneurs to earn income from passing tourists. Additionally, the town's rich cultural heritage could be better marketed as a tourism attraction, (as previously mentioned, it houses the Thiel Museum and the Arthington Memorial Church that was declared a national monument). It should also be noted that the western part of Vryburg is utilised as a nature reserve, a factor that could attract additional tourists.

The nearest known heritage site within the surrounding area is the Taung Skull World Heritage Site which is situated approximately 70km south of the application site. This heritage site marks a location of significant scientific importance as it was here, in 1924, where Professor Raymond Dart identified the 2.5 million year old fossilised skull of an infant gracile australopithecine from a limestone quarry near Taung. While numerous fossils have been recovered from the same quarry, the skull of the Taung Child is the only hominin remains recovered from this site. The finding of the Taung skull was thus noted to be one of the most significant archaeological accomplishments of time. The Taung skull discovery site is therefore officially part of the UNESCO Cradle of Humankind World Heritage Site and a monument has been erected to mark the location (http://www.southafrica.net/za/en/articles/entry/article-southafrica.net-taung-skull-heritage-route). Besides for the archaeological significant sites, the Taung Heritage site and the village of Taung present numerous alternative spots that regularly attract tourists.

Based on the above, the study area can be regarded as a type 'ii' organically evolving cultural landscape. It can be considered both a relict landscape, due to rich history dating back to 1882 and a continuing landscape as the typical rural farming landscape represent how the environment has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small towns, such as Vryburg, engulfed by an otherwise rural environment, form an integral part of the wider landscape. In addition, the rich history could attract tourists into the area. This is important in the context of potential visual impacts associated with the proposed development of a PV energy facility as introducing this type of development could be considered to be a degrading factor within this context.

6.11 Heritage and Palaeontology

The Heritage Assessment was conducted by Wouter Fourie from PGS, with Palaeontological input from Gideon Groenewald, and is included in Appendix 6F. The environmental baseline from a heritage perspective is presented below.

The examination of heritage databases, historical data and cartographic resources represents a critical additional tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Therefore, an Internet literature search was conducted and relevant archaeological and historical texts were also consulted. Relevant topographic maps and satellite imagery were studied.

6.11.1 Archival findings

- **Overview of the archaeological fabric of the study area and surroundings**

A small number of archaeological and heritage contract projects have been undertaken in the general surroundings of the study area. Of the three heritage studies located in this area, two were undertaken for proposed photovoltaic solar farms and one for an extension to an existing base metal mine. No purely

academic archaeological research appears to have taken place in the direct vicinity of the study area, with the nearest known research locality the Taung Skull World Heritage Site situated 70km south of the application site. It is important to note that the information listed here does not necessarily represent all the previous archaeological work undertaken in the vicinity of the study area. The second source is information from reports that were accessed from the SAHRA electronic database known as SAHRIS, and which for the most part came about due to the requirement for archaeological and heritage impact assessments to be undertaken for mining (and other development) activities.

- **Archaeological Sites as Revealed Through a Study of Published Literature**

The following sites were identified by studying archaeological journals and books. The sites are grouped according to their respective farm names. At the end of each description the approximate distance between the site and the present study area is provided. No information could however be obtained with regard to any archaeological research that was undertaken in close proximity to the study area. In the surrounding landscape the following archaeological sites are known:

Taung

In 1924 Raymond Dart identified the skull of an infant gracile australopithecine from a limestone quarry near Taung. While numerous fossils have been recovered from the same quarry, the skull of the Taung Child is the only hominin remains recovered from this site. Taung is one of only three localities in South Africa where fossil evidence for early hominins were ever recovered, the other two being the Cradle of Humankind (with sites such as Sterkfontein and Kromdraai) and Makapansgat (Mitchell, 2002). The Taung Skull World Heritage Site is located 70 km south of the present application site.

Harts River Valley Survey Project

In 1989 the University of the Witwatersrand was commissioned to conduct an archaeological survey of a section of the Harts River valley that was scheduled to be flooded by the proposed construction of the Taung Dam. A total of 28 Stone Age and three pastoralist sites were identified during the survey. Of the 38 identified Stone Age sites, a total of 11 could be associated with the Early Stone Age.

The best-preserved sites identified during the survey were excavated in 1992, including two of the Early Stone Age sites namely 2724DB3 and 2724DB4. Incidentally, the research undertaken at these two sites has provided valuable insight into the Acheulean archaeology of South Africa. In the words of Prof. Kathleen Kuman (2001:20), the "...Harts Valley project provides further documentation for the South African part of this picture of technological continuity and the origins of prepared core technology within the Acheulean".

Seven rock art sites were also identified in the footprint area of the proposed Taung Dam. These seven sites comprise finger paintings of geometric patterns as well as one site which contains paintings of "...riders on horseback...riders on horseback chasing an elephant...and two geometric patterns" (Dowson et.al., 1992:28).

If any of these sites identified before the construction of the Taung Dam still exists, they would be located roughly 60 km south east of the present study area.

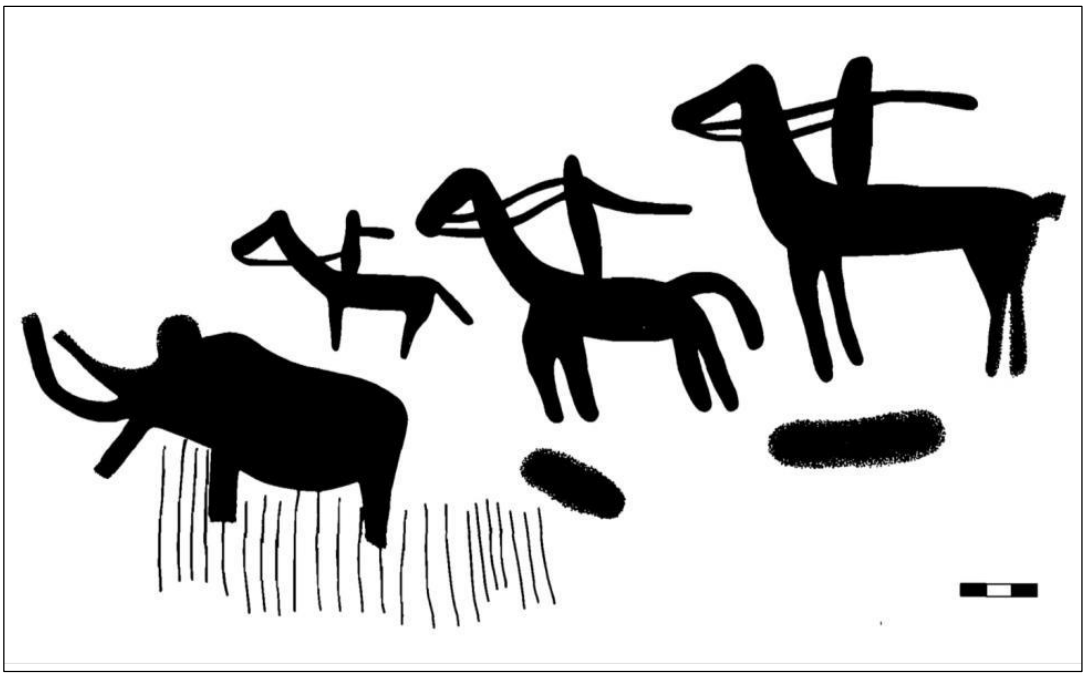

Figure 22: Tracing of one of the rock art panels at a site located roughly 40 km east of the present study area (Dowson, et.al., 1992: 29).

The aim of the archival background research is to identify possible heritage resources that could be encountered during the field work, as summarised in Table 12.

Table 12: Summary of History of Vryburg Town and Surrounding Area

DATE	DESCRIPTION
2.5 million to 250,000 years ago	The Earlier Stone Age (ESA) is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammer stones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age of Southern Africa is known as the Acheulean and comprises more refined and better made stone artefacts such as the cleaver and bifacial handaxe. The Acheulean phase dates back to approximately 1.5 million years ago. A total of 11 Early Stone Age sites with Acheulean lithics have been recorded in the Harts River valley, immediately east of the town of Taung and roughly 60 km east of the present study area (Kuman, 2001).
250,000 to 40,000 years ago	The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. It is associated with flakes, points and blades manufactured by means of the prepared core technique.

40,000 years ago to the historic past	The Later Stone Age is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts (microliths). The Later Stone Age is also associated with rock engravings and rock paintings. Rock engravings are known from the wider vicinity of the study area (Bergh, 1998), with one known site located at Dinkweneng (roughly 43 km east of the study area). Furthermore, a Low Density Surface Scatter of Later Stone Age material was identified at the Pering Mine (approximately 60 km south-west of the study area) (Birkholtz, 2011).
Early 1600s	The Tswana groups known as the Thlaping and Thlaro moved southward into the area presently known as the Northern Cape. A century later they were settled in areas as far south as Majeng (Langeberg), Tsantsabane (Postmasburg) and Tlhaka le Tlou (Daniëlskuil) (Snyman, 1986).
c. 1770	The Kora moved into the area. Due to their superior firearms they applied increasing pressure on the Thlaping and Thlaro groups. In the end the Thlaping moved into a north-eastern direction to settle in the general vicinity of Dithakong, north-east of present-day Kuruman. The Thlaro settled in areas to the west and north-west of the Thlaping (Snyman, 1986).
c. 1795	Legassick (2010) confirms the presence of the Thlaping, Thlaro and Kora in the general vicinity of the study area during this time.
Early 1800s	After the threat of the Kora became less intensive the Thlaping moved to the vicinity of present-day Kuruman. The Thlaro returned to the Langeberg, establishing them on a permanent basis there during the 1820s (Snyman, 1986). During this time German-born deserter Jan Bloem and his followers established themselves at Lekatlong (Legassick, 2010).
1833	Hurutshe refugees established themselves at Taungs (Legassick, 2010). The present-day town of Taung is roughly 40 km due-south of the study area.
1834	Mahura and his Thlaping followers moved from the vicinity of Kuruman to Taungs. Apart from the 1,500 individuals that followed Mahura to Taungs, the settlement of Taungs at the time also included some 2,000 Hurutshe, the Kora leader Mosweu Taaibosch and his followers as well as some 1,500 Maidi (Legassick, 2010).
November 1840	Gasibonwe, the son of Mothibi, attacked Mahura's cattle posts at Taungs and further afield. His aim was to degenerate Mahura's rule and to achieve supremacy over all the Thlaping (Legassick, 2010).
22 April 1842	A treaty was signed between Griqua leader Andries Waterboer and Thlaping leader Mahura at Mahura's settlement near Taungs. The agreement included a definition of the boundary between the two groups. The section of the agreed upon boundary closest to the study area ran from Daniëlskuil to Boetsap, which meant that the study area was defined as part of this treaty as forming part of Thlaping land (Legassick, 2010). This boundary was very similar to an earlier one that was thought to have been agreed to during the 1820s as a boundary between the Griqua and the Thlaping (Legassick, 2010).
1867	Diamonds were discovered for the first time in South Africa near Hopetown. Alluvial diamonds were also discovered along both banks of the Orange River in

	the vicinity of the confluence of the Vaal and Harts Rivers (Van Staden, 1983). This resulted in large numbers of fortune seekers streaming into the area from overseas, which would have had a profound impact on the social-dynamics of the landscape.
27 October 1871	The area located in the triangle formed by the Orange and Vaal Rivers was proclaimed as British Territory and named Griqualand West. This proclamation came as a result of ownership disputes between the Griqua, the Boer Republic of the Orange Free State and the Boer Republic of the Zuid-Afrikaansche Republiek in terms of the newly discovered diamond diggings (www. wikipedia.com).
1879	After Barend Barends was defeated by the Khumalo Ndebele of Mzilikazi, Boetsap was occupied by two shopkeepers, Hunter and Tasker.
1882-1885	The Boer Republic of Stellaland existed during this time in the general area of the Vryburg district. Stellaland had its roots in the conflict between Mankurwane's Tlhaping and Mosweu's Kora over land. Both sides used white mercenaries who as part of their remuneration were to receive farms. Almost 300 Boers joined the side of Mosweu in this war and on 26 July 1882 Mankurwane sued for peace. As a result of the peace agreement a portion of land was set aside for the mercenaries. From September 1882 the capital of Stellaland was being laid out and named Vryburg. On 6 August 1883 the Republic of Stellaland was proclaimed. However, the republic seized to exist when Sir Charles Warren proclaimed the Bechuanaland Protectorate on 30 September 1885 (Bergh, 1999). The Taungs area, including the farm Brakfontein, was located just outside the southern boundary of Stellaland.
30 September 1885	Sir Charles Warren proclaims British Bechuanaland. This proclaimed area included the study area (www.wikipedia.com).
1895	British Bechuanaland was incorporated into the Cape of Good Hope (www.wikipedia.com). The study area now fell within the Cape of Good Hope. In the same year the Kaukwe Native Reserve was established in accordance with British Bechuanaland Proclamation No. 220 (Breutz, 1986). This reserve is located 60km south-west of the present study area
1904	Reverend William Charles Willoughby and his wife Bessie arrives in the vicinity of the current study area with the aim of assisting the Batswana to establish a school in Bechuanaland. After several attempts the Institution was finally established at Tiger Kloof. http://www.tigerkloof.com/index.php/about-us/history

- **Findings of the background research**

The pre-history of the area is evident through the presence of numerous farms with rock engravings, including Verdwaal Vlakte, Bernauw, Schatkist, Wonderfontein and Kinderdam (Van Schalkwyk, 2012; Morris, 1998).

The numerous dry pans in the northern section of the study area also increase the probability of finding Stone Age Sites associated with hunter gatherer subsistence.

Heritage Resources associated with the South African War can be traced through the presence of blockhouse lines between Taung and Vryburg and onwards towards Madibogo, as well as the Vryburg concentration camp situated on the Vryburg Allotment area that is now part of the Leon Taljaard Nature Reserve to the north west of Vryburg.

Other areas of significance identified are the Devondale Mission (*circa* pre-1900), Tiger Kloof Institute (*circa* 1904) as well as the farmstead of the first and only president, Gerrit Jacobus van Niekerk, of the republic of Stellaland on the farm Niekerksrus 36 kilometres northwest of Vryburg.

- **Themes identified during the research were**

- Palaeontology
- Pre-colonial archaeology and early inhabitants – especially associated with inland water in the arid regions of South Africa
- Early Colonial History and settlement
- Routes and transport
- Military history
- Town and village formation

6.11.2 Palaeontology

The palaeontological resources in the Vryburg area have received very little scientific attention. To a great extent they can only be inferred from the rock units represented there on geological maps. Most of the potentially fossiliferous superficial deposits (e.g. Caenozoic alluvium) are not shown on the published geological maps, however.

Stromatolitic carbonate rocks (limestones, dolomites) of Early Precambrian (Archaean) age in outcrops of the Ventersdorp Group (Kameeldorns, Rietgat and Bothaville Formations) as well as the lower part of the Transvaal Supergroup (Ghaap Group, Vryburg Formation & Schmidtsdrift Subgroup, including the Boomplaas Formation). In the Vryburg area and further south towards Taung these include some of the oldest (> 2.5 billion years) and best-preserved stromatolites (fossil microbial mounds) known from this period;

Stromatolites are recorded from the dolomite layers. Highly fossiliferous Caenozoic cave breccias are also known to occur within the dolomite layers, but are not mapped individually. These fossiliferous deposits often contain more recent mammal and hominid fossils, e.g. in the Cradle of Humankind."

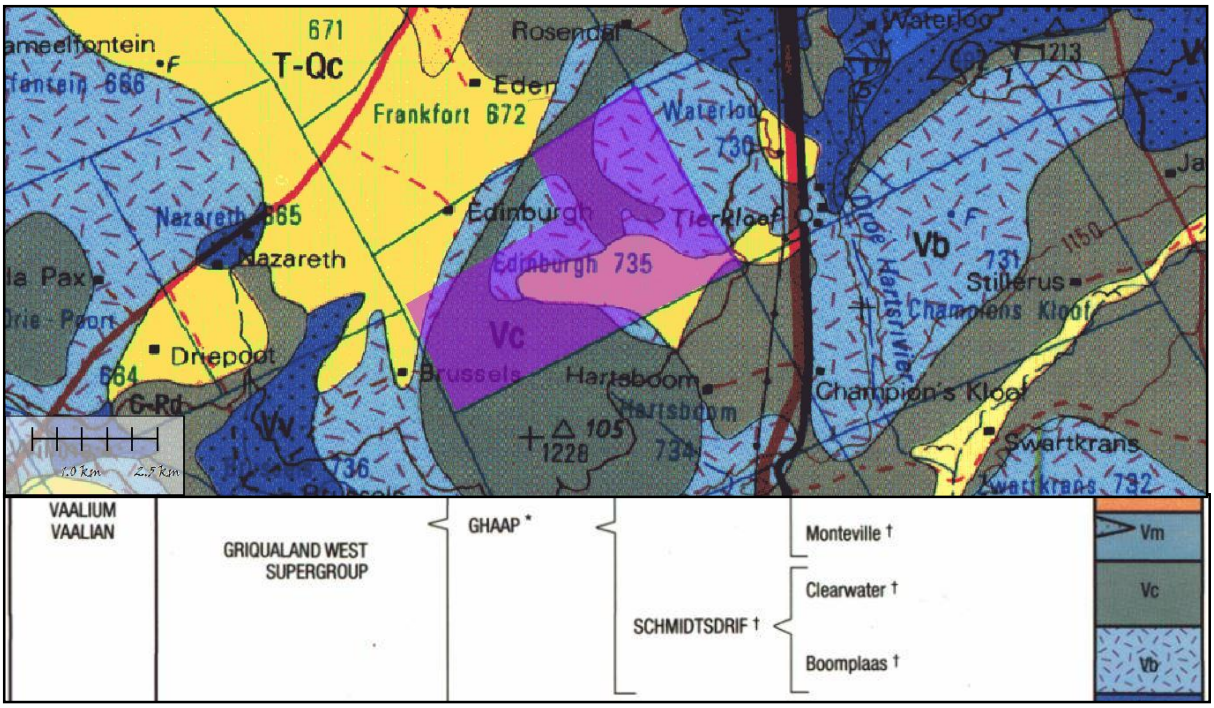

Figure 23: The study area is underlain by rocks of the Boomplaas (Vb) and Clearwater (Vc) Formations of the Ghaap Group, and calcrete (T-Qc)

- **Findings from the studies**

Through the analysis of the aerial photographs and available maps of the study area no obvious heritage sensitive areas were identified inside the study area. Some rocky outcrops that could possibly contain rock engravings and open air stone age sites have been identified as possible heritage sensitive areas.

6.12 Socio-economic Environment

The Social Assessment was conducted by Mariette Steynberg and Elena Broughton from Urban Econ Development Economists and is included in Appendix 6G. The environmental baseline from a socio-economic perspective is presented below.

6.12.1 Study Area Composition

- **Spatial context and regional linkages**

The proposed project is located south of Vryburg in the Naledi LM (see Figure 24). Vryburg hosts Naledi LM's administrative centre, and is considered the agricultural and industrial centre of the Dr Ruth S. Mompati DM. The Naledi LM comprises approximately 15% of the total land area of the DM, and is the

most significant employment creator and GDP contributor in the district. This is chiefly due to the fact that the town hosts the third largest agricultural show in South Africa.

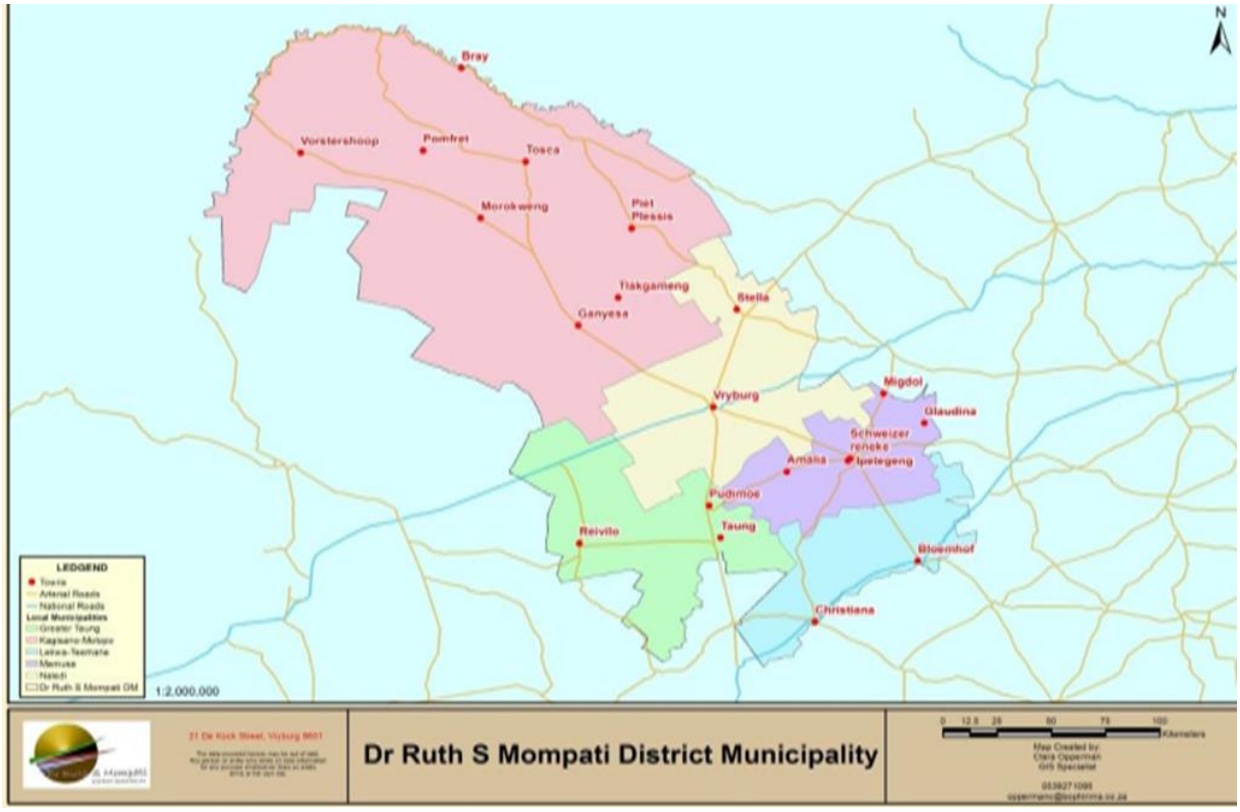

Figure 24: Locality of the Naledi LM (Dr Ruth Segomotsi Mompati DM, 2015/16)

The Naledi LM is one of five local municipalities in the Dr Ruth S, Mompati DM. The DM borders with Botswana to the north, the Ngaka Modiri Molema DM to the north-east, Dr Kenneth Kaunda DM to the south-east, the Free State Province to the south-east, and the Northern Cape Province to the south and west.

The town of Vryburg is situated on the N14 national road, running from the Gauteng Province through Vryburg, Kuruman, and Upington, and connecting Gauteng to the mining town Springbok in the Northern Cape. This regional linkage is further strengthened by the fact that the road also links Gauteng to Namibia. Vryburg is also located on main railway lines connecting Cape Town to Botswana and Zimbabwe.

- **Towns and settlements**

The closest town to the proposed Sendawo project is the town of Vryburg. The town is situated halfway between Kimberley and Mafikeng and is the administrative centre of the DM. It is also considered the economic heartbeat of the region due to its agricultural activities.

Vryburg was founded on September 20th 1882, and by February of 1883 some 400 farms had been established. Stella is located north-east of Vryburg, while the township Huhudi is located just south of the town. In 1904 the London Missionary Society established the Tiger Kloof Native Institute south of Vryburg;

the stone church on the premises is a national monument. The town is rich in cultural history, with the Theiler Museum located 8 km west of Vryburg. The museum houses a collection of the equipment used by Sir Arnold Theiler, the veterinarian who established the Onderstepoort veterinary research institute near Pretoria.

Other settlements in proximity to the proposed project side include:

- Pudimoe
- Huhudi
- Schweizer-Reneke
- Hartswater
- Bloemhof
- Wolmaranstad
- Christiana
- Hoopstad

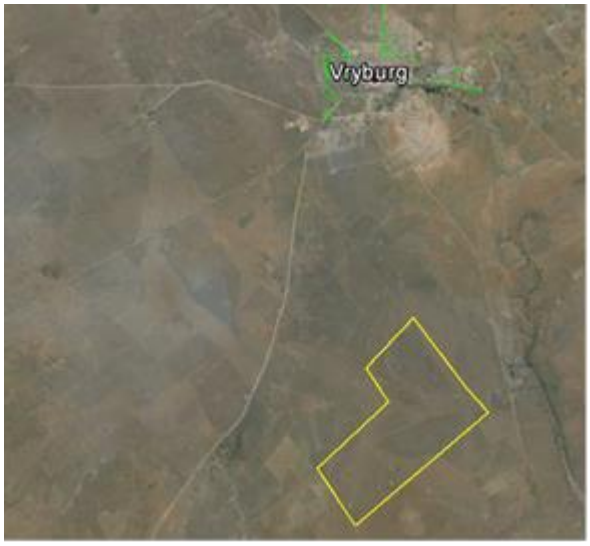

Figure 25: Towns and settlements close to the proposed project site.

- **Resources and land capability**

Vryburg is South Africa's largest beef producing district. Other important agricultural activities include the production of maize and peanuts. The town is considered the agricultural and industrial centre of the Dr Ruth S. Mogomotsi DM, being the districts biggest employment generator and GDP contributor. The importance of the agricultural sector in the town is further highlighted by the fact that the town is host to South Africa's third biggest agricultural show.

The town has been identified as a second priority investment location, and is ideally located on important regional linkage such as the N14 connecting Gauteng to the Northern Cape, as well as key railway lines. Based on its location, policy makers have identified Vryburg as ideal for establishing a primary regional node.

Furthermore, the location of Vryburg also presents significant income opportunities from tourism. The town is located on the N14, which eventually links Gauteng to Namibia. This in itself represents a possibility for entrepreneurs to earn income from passing tourists. Additionally, the town's rich cultural heritage could be better marketed as a tourism attraction, (it houses the Thiel Museum and a stone church that was declared a national monument). According to the Naledi LM IDP, the western part of Vryburg is also utilised as a nature reserve, a factor that could attract additional tourists.

6.12.2 Demographic Profile

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills, and determines the demand for the production output. Examining population dynamics is essential in gaining an accurate perspective of those who are likely to be affected by any prospective development or project.

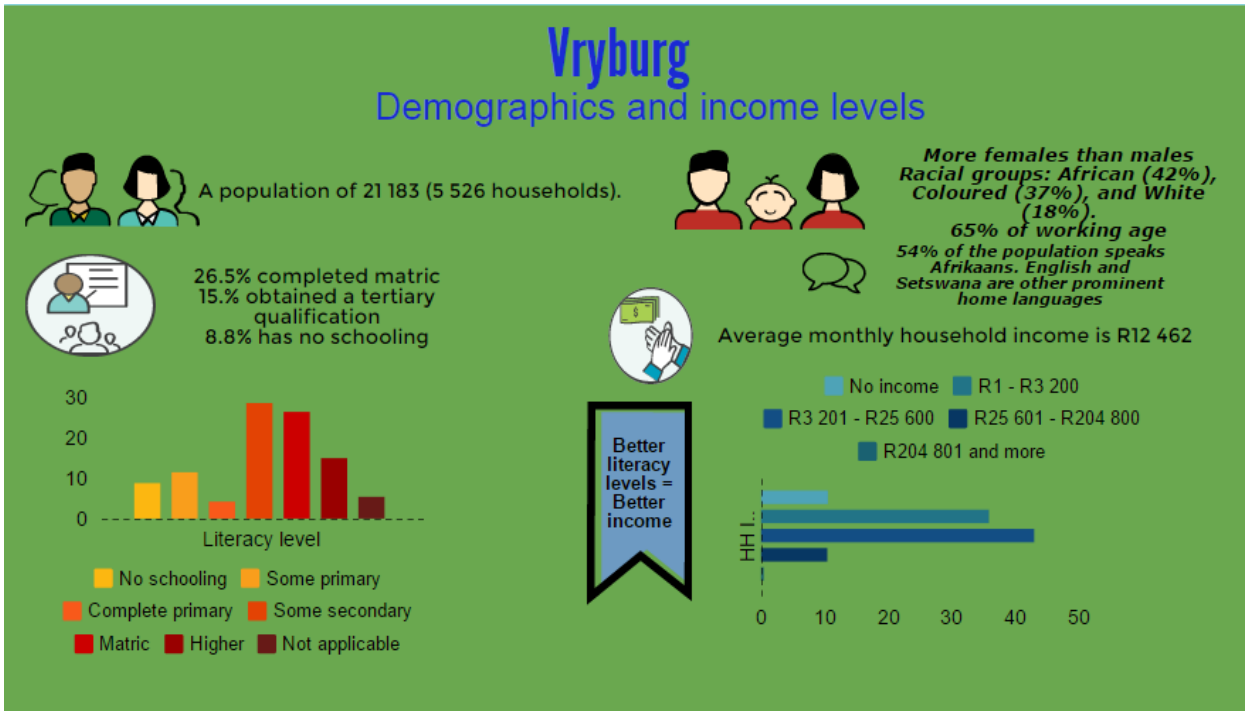

Figure 26: Infographic: Vryburg Demographics in 2011 (Stats SA, 2012)

It is estimated that approximately 19% of the population of the Naledi LM reside on farms. When compared to the 9.45% and 5.3% of the DM, and country's respective populations, the relative importance and size of the agricultural activities taking place in the Naledi LM is again highlighted. As identified in the policy documents reviewed, the Naledi LM and more specifically Vryburg is considered the biggest beef producer in the country. The fact that Vryburg is the administrative centre as well as industry hub of the DM is reflected in the fact that the Naledi LM has only 4.1% of its households living on tribal land or in rural regions, compared to the 55.6% of the households of the Dr Ruth S. Mompati DM living in rural regions.

The racial mix in the DM follows that of the province more closely, while there is more similarities between the Naledi LM and the country. It is estimated that 79% of South Africa's population is African, while in the LM 74.5% of the population is African. In the DM and province, the demographic is distinctly different, with 91.5% and 90% of the respective populations classified as African. The next biggest population group in the municipalities being studied is Coloured, with 14.5% of the LM's population, and 3.9% of those living in the DM from this racial group. 9.4% Of the population of the LM is White while 3.9% of the DM's population is White. The population of Vryburg is slightly more diversified; here 41.7% is African, 37.2% is Coloured, and 17.6% is White. The town also has the biggest Indian/Asian population of all the study communities, and it is estimated that 2.8% of Vryburg's population is of Indian or Asian descent (Stats SA, 2012).

Based on Census 2011 data, more than half (54%) of the population of Vryburg is Afrikaans speaking, a further 31.8% speaks Setswana, and 6.28% speaks of Vryburg's population considers English to be their mother tongue. The dynamic changes slightly in the study municipalities; in the LM 67.7% of the population has Setswana as home language with even more in the DM (82.8%), speaking Setswana. Other prominent home languages in these municipalities are Afrikaans and English, although spoken on a much smaller scale than in Vryburg (Stats SA, 2012).

There are more females (51.9%), than males (48.1%) in the Vryburg population. This follows the pattern of the DM closely; here 48.5% of the population is male and 51.5% is female. In the LM the situation is different, although the ratio between male and female is more equal in the Naledi LM, there are still slightly more males than females (50.3% vs. 49.7%). A study area's dependency ratio can be defined as the proportion of the population who will be dependent on the economically active population, thus individuals aged 0 – 14 years and 65 and older. Based on these qualifications, it can be estimated that roughly 34.5% of South Africa's population can be classified as dependants. In Vryburg this ratio is fairly on par – 34.9% of the population is aged 0 – 14 years or older than 65 years. However, in the LM and DM, the working age population is considerably smaller, leading to a larger proportion of the respective populations who can be considered dependants; 36% in the LM, and 41.6% in the DM (Stats SA, 2012). This could be seen as a development constraint since the social needs would be higher in these communities.

In the Dr Ruth S. Mompati DM literacy levels are worrisome; here 21% of the population aged 20 years and older has had no formal education, with 22.2% achieving only a slightly better level of literacy by completing some primary schooling. Moreover, only 16.8% of the population of the DM, aged 20 and older, has been able to successfully complete matric. The situation in the Naledi LM is less dire but still suggestive of a community with low literacy levels. In the LM, 21.5% of the population has achieved a matric qualification, while 16.5% of the population aged 20 years and older has had no formal education and 16.8% has had some primary schooling. Literacy levels in Vryburg are above the national average, it is estimated that 26.5% of the population aged 20 years and older successfully completed matric with a further 15% obtaining a tertiary education; however, there is still 8.8% of Vryburg's population, aged 20 and older, who has had no education (Stats SA, 2012).

In Vryburg the average monthly household income is R12 462, which is significantly more than the average national household income of R9 235 per month. The broader population of the study area is earning considerably less, with the average monthly income for the DM and LM at R4 320 and R7 168, respectively, per household (Stats SA, 2012). The lower than average national income levels could be indicative of a

limited number of job opportunities available, which in turn is associated with a smaller than average economic base. At the same time, the high earnings in Vryburg are easily explainable when referring to the region's dominance in beef production.

The fact that opportunities in Vryburg are more readily available and of a better quality than the rest of the study areas, is evident when looking in greater detail at the average household income data. Nationally it is estimated that 14.9% of households do not have any regular income. In Vryburg this figure is at 10.5% with 46.4% of the households earning less than R3 200 per month. In the LM 12.9% of households have no access to income, while 66.6% survive on less than R3 200 per month. In the DM the situation is much direr; here 17% of the households do not have an income, with 78.5% of households earning less than R3 200 per month (Stats SA, 2012). The relatively low income levels can be seen as an indication of a small tax base, which presents service delivery challenges for the study municipalities.

6.12.3 Economy

The structure of the economy and the composition of its employment provide valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure, and trends of specific sectors.

The economy of the Naledi LM is valued at R2 857 million in current prices; that is a contribution of 27.3% to the economy of the Dr Ruth S. Mompati DM, (valued at R10 457 million in current prices), or 1.4% contribution to the R199 551 million North West Province's economy (Quantec, 2014). Based on these estimates, it can be stated that the economy of the North West Province contributes approximately 6.5% to the national economy.

Based on constant prices it is estimated that the economy of Naledi LM grew by a Compounded Annual Growth Rate (CAGR), of 2.1% over the ten-year period between 2003 and 2013. This is below the average national CAGR for the same period of 3.3%, but on par with the Province's growth rate (2.2%). At the same time the growth rate in the DM was recorded as 1.5% (Quantec, 2014). In the LM the construction sector showed the most significant growth at 12%, while the transport sector grew at a CAGR of 5.4%. Over the same period the primary sector decreased by 5.2%, driven by a 5.1% decline in the agricultural sector and a 7.2% decline in the mining sector.

The economies of the primary study area's municipalities are predominantly service economies, with 85.6% and 78.2% of the LM and DM's respective economies' GDP in current prices generated by the tertiary sector. This is well above the national average, as 70.5% of South Africa's GDP at current prices is generated by the tertiary sector. As seen in Table 13, the importance of the general government sector in the study area's municipalities is substantially more than in the province and South Africa. In the Naledi LM 29.3% of the current GDP was generated by the government sector, while a quarter of the DM's GDP at current prices was generated by this sector. Vryburg, is the administrative seat of the district, which explains the higher than average contribution by the government sector to the GDP of the LM.

Table 13: Economic structure of the various delineated study areas

Economic Sector	Dr Ruth S. Mompati DM		Naledi LM	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R710	6.8%	R101	3.5%
Mining and quarrying	R543	5.2%	R10	0.4%
Manufacturing	R452	4.3%	R112	3.9%
Electricity, gas and water	R248	2.4%	R85	3.0%
Construction	R330	3.2%	R104	3.6%
Trade	R1 323	12.6%	R365	12.8%
Transport and communication	R896	8.6%	R364	12.7%
Finance and business services	R1 640	15.7%	R551	19.3%
Personal services	R1 688	16.1%	R327	11.5%
General government	R2 628	25.1%	R838	29.3%
TOTAL	**R10 457**	**100%**	**R2 857**	**100%**
Economic Sector	**South Africa**		**North West Province**	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R72 202	2.3%	R4 815	2.4%
Mining and quarrying	R282 366	9.2%	R61 478	30.8%
Manufacturing	R349 066	11.3%	R9 580	4.8%
Electricity, gas and water	R91 201	3.0%	R2 642	1.3%
Construction	R114 754	3.7%	R5 065	2.5%
Trade	R510 666	16.6%	R24 937	12.5%
Transport and communication	R272 303	8.8%	R15 383	7.7%
Finance and business services	R680 443	22.1%	R30 209	15.1%
Personal services	R182 795	5.9%	R16 588	8.3%
General government	R524 716	17.0%	R28 855	14.5%
TOTAL	R3 080 513	100%	R199 551	100%

(Quantec, 2014)

6.12.4 Labour Force and Employment Structure

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being.

Table 14: Labour force of the delineated study areas

Indicator	South Africa	North West Province	Dr Ruth S. Mompati DM	Naledi LM	Vryburg
Working age population	33 928 806	2 273 362	271 161	42 774	13 809
Non-economically active population	13 238 633	907 948	132 786	16 198	4 911
Labour force	18 841 453	1 236 786	112 900	24 749	8 461
Employed	13 254 829	848 107	72 535	18 237	6 952
Unemployed	5 586 624	388 679	40 365	6 512	1 509
Unemployment rate	29.7%	31.4%	35.8%	26.3%	17.8%

Labour force participation rate	55.5%	54.4%	41.6%	57.9%	61.3%
Discouraged work seekers	5.4%	5.7%	9.4%	4.3%	3.2%

(Stats SA, 2012)

As stated previously, the proportion of the working age individuals in the LM and DM's respective total populations is relatively small when compared to the national average. It is estimated that 42 774 individuals in the Naledi LM are of working age (15 – 64 years of age). Proportionally, Vryburg has a bigger working age population, with 13 809 individuals out of 21 183 strong population being of working age.

Based on South Africa's official unemployment rate, only 17.8% of the labour force in Vryburg is unemployed. This is evidence of the comparatively good economic opportunities available in the town. An argument further strengthened by the fact that 64.6% of employment opportunities in the town are formal opportunities, compared to 56.7% and 57.4% in the DM and LM, respectively (Stats SA). In the Naledi LM the unemployment rate is higher (26.3%), but still lower than the national average of 29.7%. Unemployment in the province and DM is; however, much worse. In the province 31.4% of the labour force is unemployed, while more than a third (35.8%), of the labour force in the DM is unemployed. The fact that comparatively better economic opportunities are available in the LM is further reflected in the higher than average labour force participation rate of 61.3%. Furthermore, only 3.2% of the working age population is discouraged work seekers.

In the DM just about three quarters of all employment is created by the tertiary sector, with the community social and personal services sector, and the government sector generating 46% of the total employment creation in this economy. In the Naledi LM the portion of jobs created by the tertiary sector is even greater; here 78.5% of employment opportunities are generated by service industries (23.5% by the personal services sector, 20.4% by the trade sector, and 18.8% by the government sector). Other major employment creators in the LM are the construction industries (8.5%), and agriculture (7%) (Quantec, 2014).

6.12.5 Income

In the Dr Ruth S. Mompati DM literacy levels are worrisome; here 21% of the population aged 20 years and older has had no formal education, with 22.2% achieving only a slightly better level of literacy by completing some primary schooling. Moreover, only 16.8% of the population of the DM, aged 20 and older, has been able to successfully complete matric. The situation in the Naledi LM is less dire but still suggestive of a community with low literacy levels. In the LM, 21.5% of the population has achieved a matric qualification, while 16.5% of the population aged 20 years and older has had no formal education and 16.8% has had some primary schooling. Literacy levels in Vryburg are above the national average, it is estimated that 26.5% of the population aged 20 years and older successfully completed matric with a further 15% obtaining a tertiary education; however, there is still 8.8% of Vryburg's population, aged 20 and older, who has had no education (Stats SA).

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6.12.6 Access to Housing and Basic Services

Access to shelter, water, electricity, sanitation, and other services are indicators that assist to determine the standard of living of the people in the area under investigation. Infrastructure and the state of local infrastructure is another indicator to contemplate when considering living standards. The availability of social and economic infrastructure including roads, educational facilities, and health facilities further indicates the nature of the study area, which is valuable in developing a complete profile of the circumstances in which communities are living. These measurements create a baseline against, which the potential impacts of the proposed project can be assessed.

- **Housing**

According to the 2011 National Census, 81.1% of households in Vryburg were living in formal brick structures. In the LM 82.8% live in formal structures, while proportionally even more households in the DM live in formal structures (85.7%). It follows that Vryburg has the highest number of households living in informal structures – 18.3% of households, compared to the 16.3% in the LM and 10.3% in the DM. In the DM, 3.3% of households reside on tribal land, while 1.3% of households in the LM are living on tribal land. In Vryburg this is considerably less, with 0.1% of households living on informal land.

To address the housing backlog that is evident from the number of informal dwellings in Vryburg, the Naledi LM IDP contains the following housing projects with a total budget of R47.6 million:

- Vryburg – Colride: Renovation of RDP stock.
- Vryburg – Huhudi Southern Buffer: blocked project to be unblocked.
- Vryburg Extension 25: Informal settlement upgrading.
- Vryburg Extension 28: Informal settlement upgrading.
- Rural housing – communal land rights applications across the LM.

- **Access to water**

The provision of piped water to households in the primary study area exceeds the provincial and national statistics significantly. In Vryburg 82% of households have access to piped water in their dwellings or inside their yards. A further 17.4% have to access piped water from a communal stand, while 0.2% of the households in Vryburg have no access to piped water. In the LM, slightly more households have to access piped water via a communal tap (20%), while 78% have access in their own home or yard. Furthermore, in the LM 2% of households have no access to piped water.

The national statistics indicate that 73.4% of households have piped water in their yard or dwelling, while 8.8% have no access to piped water. Service delivery within the DM is below national levels. It is estimated that 47.9% of households have access to piped water inside their home or dwelling, while 47.7% have access from a communal stand. The proportion of the DM's population with no access to piped water is; however, still fewer than that of the country at 4.4%.

According to the Naledi LM's IDP, the municipality is the water services provider and Sedibeng Water was appointed by the district as water services provider for Pudimoe, a settlement south of Vryburg. Huhudi (a settlement located between Pudimoe and Vryburg) needs approximately 2.5 mega litres (ml), per day and is dependent on Pudimoe for water. Currently Huhudi is receiving between .75 and 1.2 ml of water, the town's water need is therefore not met. The plant at Pudimoe is refurbished and operational but the bulk water pipeline is still under construction.

The IDP acknowledges that more water points need to be made available in informal areas to improve access, and that the water meters at existing pumps require replacement. The municipality receives water from the Pudimoe purification plant and 18 boreholes. It is estimated that, depending on the hours pumping, the Pudimoe plant provides between 1 ml and 3 ml per day, with no bulk metering available to measure the yield of boreholes. As mentioned, the challenge is that the water supply is inadequate from the purification plant and boreholes. The LM hopes that refurbishment of the second Pudimoe purification plant and sinking of three additional boreholes will address this.

- **Access to sanitation**

If not managed and provided adequately, the basic need of sewerage and sanitation can pose serious health and safety risks to the communities not receiving these basic services. In Vryburg 82.7% of households had access to a flushing toilet, while 3.1% of the households had no access to toilet facilities. At the same time, 4.1% of the town's households were using pit latrines, while 9.4% were still reliant on the bucket system.

The situation is markedly worse in the municipalities being studied. In the DM only 35% of households had access to a flushing toilet, while 11.2% of the households had no access. The bulk of the households (49.9%) in the DM was using pit latrine systems, with 0.9% of households using the bucket system. More households had access to a flushing toilet in the LM (69.2%); however, 4.5% of the Naledi LM's households were still using the bucket system. A situation that is in stark contrast to the government's determination to eradicate all bucket toilet systems by 2007. 11.8% Of households in the LM were using pit latrines, while 12.6% had no access to toilet facilities.

As discussed, the Naledi LM IDP reveals that the municipality has been awarded as the water services provider. The following sanitation service provision challenges and backlogs are identified in the IDP:

- A new waste water treatment plant is needed at Stella.
- VIP toilets must be chemically treated to clean pits.
- Additional Honey Sucker is needed to improve efficiency at Stella, Dithakwaneng, and Devondale.
- Increased support from the DM is needed.
- Stella requires a new oxidation pond, with the current oxidation pond not up to standard.
- The bulk waste water treatment plant is under capacity, and the bulk sewer network has reached maximum capacity.
- The town of Stella is not connected to the sewer network.

- **Access to electricity**

The indicator “electricity for lighting”, was used as a proxy for measuring households’ access to electricity. Nationally it is estimated that 84.8% of households have access to the grid for lighting. In the primary study area the percentage of households with access is less – 81.1% in Vryburg, 76.8% in the Naledi LM, and 82.3% in the Dr Ruth S. Mompati DM.

The main alternative source for lighting in the study areas was candles; 17.7% of households in Vryburg used candles for lighting, while in the LM 21.3% relied on candles and 16% of households in the DM uses candles for lighting. In Vryburg 0.3% of households had no means of power to generate lighting, while 0.2% of households were using solar power for this purpose.

The Naledi LM IDP states that the electrical infrastructure in the LM is old and dilapidated. It goes on to state that the need exists for strengthening of the network and the creation of additional supply as the need for electricity increases in the LM. The in-migration in to LM further increases this need. Eskom is increasing supply to the LM as the system is already under pressure and a solar farm has been approved for Broedersput. The strategies identified by the LM in its IDP document to improve electricity supply include:

Supply electricity from the southern side of Vryburg in order to reduce the pressure on the main substation at the industrial area.

- Develop the second feeder line to assist the Delarey feeder line of Eskom.
- Strengthening the feeder line feeding Stella substation.
- Upgrade the internal bulk network and distribution lines.
- The introduction of energy saving appliances.
- The introduction of rebates on all housing plans with “more natural” lighting options.

- **Refuse removal service**

It is estimated that 62% of households nationally have their refuse removed by a local authority on a weekly basis. In Vryburg the number of households with access to this service is substantially more (89.6%), while

in the Naledi LM 66.4% of households have access to weekly refuse removal by a local authority. In the DM the main method of garbage disposal is an own refuse dump; 60.7% of households rely on this method, while only 27% has access to weekly garbage collection by a local authority.

The Naledi LM's IDP highlights the following service delivery constraints/problems related to adequate refuse disposal in the LM:

- No access to waste and refuse disposal at Dithakwaneng and Devondale.
- No licensed landfill site at Stella.
- Illegal dumping.
- Insufficient number of refuse bins in Naledi.
- Insufficient number of transfer stations.
- Unreliable transport for refuse removal.
- Mass containers are not being maintained.

- **Internet access**

Internet access has become increasingly important in accessing economic opportunities. Although not a definitive measure, it could be argued that a lack of access to the knowledge readily available on the internet could negatively affect an individual's ability to access quality educational and economic opportunities. It is estimated that 64.5% of all South African households have no access to internet services. In Vryburg just more than half (55%), of households have no access. This effectively excludes 55% of households from the economic and social opportunities that could be accessed via the internet. In the LM and DM the rate of exclusion is even higher, with 67.1% and 79.4% of the respective populations not having access. For those with access, a cell phone is the most common method of access, followed by home internet access or access at work.

6.12.7 Social and Recreational Infrastructure

The Naledi LM's IDP (2012 – 2017) contains information on the social and recreation infrastructure available in the LM. The IDP furthermore, provides a brief description of the general state of the infrastructure available. This section will summarise these findings.

According to the IDP, health facilities in the LM are situated in close proximity to the communities they are intended for and are easily accessible. The communities are using private vehicles and taxis to access these facilities and no need for government transport exists. Table 15 provides information on the health facilities available in the Naledi LM. The only hospital in the LM is located in Vryburg. The town's population also has access to a mobile clinic and a community health centre. The IDP furthermore, suggests that there is a lack of HIV counselling facilities in the LM.

Table 15: Health facilities in the Naledi LM

Town	Hospital	Clinic	Mobile Clinic	Community health centre
Vryburg	1	-	1	1
Colridge	-	1	-	-
Huhudi	-	1	-	-
Stella	-	-	-	1

The sport facilities available in the LM are depicted in Table 16. The municipalities realise the importance of the availability of these facilities in youth development, stating that measures should be implemented to increase the use of these facilities by the youth of the LM. It is evident from the data presented here that the LM is in need of rugby fields to ensure that grassroots development of the sport can take place here if the potential exists.

Table 16: Sport and recreational facilities in the Naledi LM

Town	Public swimming pool	Netball court	Soccer field	Tennis court	Rugby field	Gym
Vryburg	1	3	2	1	-	1
Huhudi	1	-	1	-	-	-
Colridge	1	-	1	1	-	-
Kismet	-	-	1	1	-	-

Also identified within the IDP are five cemeteries, four formal and one informal burial yard exists within the Naledi LM. Cemeteries play a vital cultural role in any community, and it is therefore, important to ensure that adequate provision is made for the communities' needs in this regard.

7 PUBLIC PARTICIPATION PROCESS

Public participation is the cornerstone of any EIA. The principles of NEMA as well as the EIA Regulations govern the EIA process, including public participation. The Public Participation Process (PPP) for the proposed development has been conducted according to regulation 41 of the 2014 EIA Regulations These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment, and ensuring the participation of previously disadvantaged people, women and the youth.

The public participation process is primarily based on two factors; firstly, ongoing interaction with the environmental specialists and the technical teams in order to achieve integration of technical assessment and public participation throughout. Secondly, to obtain the bulk of the issues to be addressed early on in the process, with the latter half of the process designed to provide environmental and technical evaluation of these issues. These findings are presented to stakeholders for verification that their issues have been captured and for further comment.

Input into the public participation process by members of the public and stakeholders can be given at various stages of the EIA process. Registration on the project can take place at any time during the EIA process up until the final EIA report is submitted to DEA. There are however set periods in which comments are required from Interested and / or Affected Parties (I&APs) in order to ensure that these are captured in time for the submission of the various reports. The comment periods during the EIA phase will be implemented according to regulation 43 of the 2014 EIA Regulations

The EIA regulations emphasise the importance of public participation. In terms of the EIA regulations, registered interested and/or affected parties –

- may participate in the application process;
- may comment on any written communication submitted to the competent authority by the applicant or environmental consultant;
- must comment within the timeframes as stipulated by the EIA Regulations;
- must send a copy of any comments to the applicant or Environmental Assessment Practitioner (EAP) if the comments were submitted directly to the competent authority; and
- Must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused.

The following actions were taken upon receiving comments/queries/issues:

- The contact details provided were entered into the project database for use in future notifications.
- Confirmation receipts were sent to those submitting comments.
- Comments were addressed in the Comments & Response Report.

7.1 Overview of the Public Participation Process to date

The public participation process was initiated in early December 2015 with the issuing of the BID and initial landowner consultation. Many site notices (as per regulations) were placed near the study area during a site visit on Thursday and Friday the 3rd and 4th of December 2015. The DSR was released for review on the 11th of January 2016 and the EIA process advert was publicised on the 13th of January 2016 in the Stellalander newspaper. The DSR comment period ran from the 11th of January 2016 to the 9th of February 2016. I&APs were notified at the start of the comment period. The Final Scoping Report (FSR) was submitted to the DEA on the 19th of February 2016, and I&APs were notified on the same day. Prior to the release of the DEIAr, public and focus group meetings were held on the 15th of March. Following the acceptance of the FSR and Plan of Study for EIA, the public was notified of the DEA's decision through the EIA Newsletter which was sent out on 23 May 2016, prior to the DEIAr comment period.

On-going consultation with key stakeholders (e.g. provincial, district and local authorities, relevant government departments, local business, affected and adjacent landowners etc.) and identified I&APs will ensure that I&APs are kept informed regarding the EIA phase (the full stakeholder database list is included in Appendix 5F).

7.2 Consultation and Public Involvement

As in the scoping phase, consultation will continue to be held with key stakeholders and other relevant I&APs in order to identify key issues, needs and priorities for input into the proposed project. Special attention will be paid to the consultation with possibly affected landowners and communities within the study area to try address their main concerns.

Notifications will be sent via email, sms, fax and post to inform I&APs of the availability of the Draft Environmental Impact Assessment Report.

7.3 Comments Received during the Scoping Phase

All comments and recommendations made by stakeholders and I&APs during the scoping phase and submitted as part of the FSR have been taken into consideration when preparing the DEIAr.

All comments received during the scoping phase, including at public and focus group meetings, are addressed and included in Appendix 5E.

7.4 Proof of Notification

Appendix 5 includes all proof of notification to Interested and Affected Parties which includes;

- Proof of process advertisements in the newspapers (Appendix 5C)
- EIA Newsletter (Appendix 5A)
- Correspondence to registered I&APs and key stakeholders (Appendix 5B)

7.5 Focus Group Meetings

Focus Group Meetings (FGMs) are smaller meetings with specific groups or organisations who have similar interests in or concerns about the project.

Two FGMs took place prior to the release of the DEIAr. The meetings were held early in the EIA phase in order to give I&APs greater influence in the project process, and if necessary to allow changes to be make without affecting the legislated time frames. The meetings took place on the 15th of March 2016 and affected landowners and authorities were invited to the respective FGMs.

Table 17: Focus Group meeting

Venue	Interested Parties	Date	Time
Lavender Lodge Guesthouse, 2 Molopo St, Vryburg	Landowners	Tuesday, 15 March 2016	11h00
Lavender Lodge Guesthouse, 2 Molopo St, Vryburg	Councillors and Officials	Tuesday, 15 March 2016	14h00

Minutes of the FGMs were compiled and forwarded to all attendees for their review and comment. The primary aim of the meetings was to:

- Disseminate information regarding the proposed development to I&APs.
- Provide I&APs with an opportunity to interact with the EIA team and the BioTherm representatives present.
- Supply more information regarding the EIA process.
- Answer questions regarding the project and the EIA process.
- Receive input regarding the public participation process and the proposed development.
- Present I&APs with an overview of EIA phase specialist findings.

Minutes of the meetings are included in Appendix 5G.

7.6 Public Meeting

A Public Meeting was held prior to the review of the DEIAr. The meeting was held early in the EIA phase in order to give I&APs greater influence in the project process, and if necessary to allow changes to be make without affecting the legislated time frames.

Invitation letters were sent out via post and e-mail to all registered I&APs on the project's database.

Table 18: Focus Group meeting

Venue	Interested Parties	Date	Time
Huhudi Community Hall, at Mosiapoa St and Voortrekker St, Vryburg	I&APs	Tuesday, 15 March 2016	18h00

The Public Meeting was held in order to provide I&APs with information regarding the proposed development, present the EIA phase environmental findings and invite I&APs to raise any further comments and/or concerns that they may have.

Minutes of the PM were compiled and forwarded to all attendees for their review and comment. Minutes of the meetings are included in Appendix 5G.

7.7 Public review of Environmental Impact Assessment Report

The DEIAr will be made available for review at the following venue for a period of 30 calendar days, excluding public holidays and the December closure period:

Table 19: Venues where the DEIAr will be publically available

Venue	Street Address	Hours	Contact No.
Huhudi Public Library	Cnr Mosiapoa and Nelson Mandela Drive, Huhudi	Mondays- Fridays 09h30 – 17h30	053 9282251

All comments received on this report will be incorporated into the Comments and Response Report, which will be attached to the FEIAr as Appendix 5E.

7.8 Comments and response report

Issues, comments and concerns raised during the public participation process to date are captured in the Comments and Response Report (C&RR) – Appendix 5E. This C&RR provides a summary of the issues raised, as well as responses which were provided to I&APs. This information will be used to feed into the evaluation of social impacts.

8 SPECIALIST STUDIES

The following specialist studies were undertaken as per the Plan of Study for EIA:

- Biodiversity (flora and fauna)
- Avifauna
- Surface Water
- Soils and Agricultural Potential
- Visual Impact
- Heritage and Palaeontology
- Socio-economic Impact
- Traffic

Each specialist assessed the impact of the Sendawo 1 solar PV energy facility and associated infrastructure that BioTherm are proposing to develop near Vryburg and the results are presented below.

8.1 Biodiversity

The full Biodiversity Assessment was conducted by David Hoare and is included in Appendix 6A.

8.1.1 Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver et al. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 20, as determined by best available scientific approaches (Driver *et al*. 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

The vegetation type occurring in the study area (Table 21) is classified as Least Threatened (Driver et al. 2005; Mucina et al., 2006). None of the vegetation is therefore flagged as being of conservation concern.

Table 20: Determining ecosystem status (from Driver et al. 2005)

*BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN

0–*BT	critically endangered	CR

Table 21: Conservation status of different vegetation types occurring in the study area, according to Driver et al. 2005 and Mucina et al. 2005.

Vegetation Type	**Target (%)**	**Conserved (%)**	**Transformed (%)**	**Conservation status**	
				Driver *et al*. 2005; Mucina *et al*., 2006	**Draft Ecosystem List (NEMBA)**
Ghaap Plateau Vaalbosveld	16	0	1	Least Threatened	Not listed

8.1.2 Biodiversity Conservation Plans

The North-West Province Biodiversity Conservation Assessment (obtained from bgis.sanbi.org) provides maps that show CBAs, ESAs, corridors and hills (see Figure 27). This shows a variety of features within the study area, including the following:

1. Wetland CBAs: a number of small pans in the vicinity considered to be irreplaceable wetlands.
2. Wetland ESAs: buffer areas of terrestrial habitat adjacent to wetlands that are important ecological support areas for the aquatic systems (500 m wide).
3. CBA corridors: Provincial-level biodiversity corridor network aimed at retaining connectivity between geographical areas. A small sliver of the eastern corner of the site falls within this category.
4. ESA dolomites: Areas of dolomite and their associated aquifers, important as groundwater recharge areas. Most of the site falls within this category.

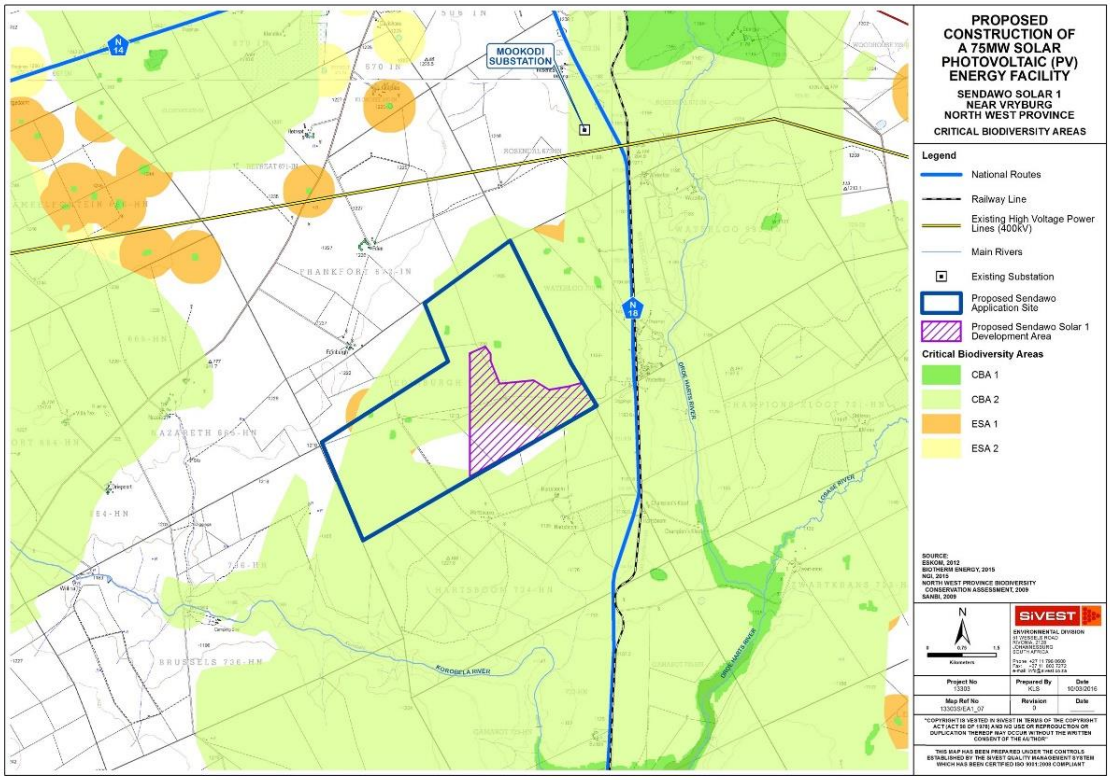

Figure 27: Critical Biodiversity Areas

8.1.3 Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), there is an area 20 km to the north-west of the project study area that has been identified as priority areas for inclusion in future protected areas. This particular component of the landscape is considered to be of high biodiversity value by National Parks, but the proposed project does not affect this area at all.

8.1.4 Red List plant species of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in the Biodiversity Specialist Report. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids, are also listed.

There are two species that may occur in the study area, the succulent, *Lithops lesliei* subsp. *lesliei*, listed as Near Threatened, and the herb, *Rennera stellata*, listed as Vulnerable (see Table 22 for explanation of categories). *Rennera stellata* is found in seasonally waterlogged pans and on unweathered calcrete rocks, in full sun. The species has been recorded in two neighbouring grids in the type of habitat that is found on site and the possibility of it occurring in the study area is therefore considered to be high. *Lithops lesliei* subsp. *lesliei* is found in arid grasslands, usually in rocky places, growing under the protection of forbs and

grasses. It is possible that it could also occur on site. Neither species was seen on site, but there is a possibility of *Rennera stellata* being found in pan depression areas.

Table 22: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	**Definition**	**Class**
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

8.1.5 Red List animal species of the study area

All Red List vertebrates (mammals, birds, reptiles, amphibians) that could occur in the study area are listed in the Biodiversity Specialist Report.

There are 77 mammal species that have a geographical distribution that includes the study area, of which nine are listed in a conservation category of some level (see Biodiversity Specialist Report). Of the listed species, there are three of low conservation concern that could occur in available habitats in the study area (see Biodiversity Specialist Report for habitat requirements of listed species). These are the Brown Hyaena, the Honey Badger and Southern African Hedgehog. All of these species are classified nationally as near threatened (NT), but globally as Least Concern. They are, therefore, of relatively low conservation concern in comparison to more threatened species found in other parts of the country. The Honey Badger and the Hedgehog are protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit.

There are a total of 12 frog species with a geographical distribution that includes the study area (see Biodiversity Specialist Report). The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is listed as Least Concern globally and Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit.

There are a total of 48 reptile species with a geographical distribution that includes the study area. There is one reptile species of conservation concern that has a distribution that includes the study area, the Southern African Python. This species is not listed in a threat category, but is protected under the National Environmental Management: Biodiversity Act.

8.1.6 Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in the Biodiversity Specialist Report. One plant species that appears on this list that could potentially occur in the general region, although they have not previously been recorded in the grids of the study area, is *Harpagophytum procumbens.*

Harpagophytum procumbens occurs in Angola, Botswana, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. Within South Africa this species occurs in the Northern Cape, North West, Free State, and Limpopo Provinces and the largest populations are found in the communally owned areas of the North West Province and the north eastern parts of the Northern Cape. The species is found in well drained sandy habitats in open savanna and woodlands. It has not been previously recorded in this grid, but has been recorded in the grids to the south and north. It is considered possible, but unlikely that this species could occur on site due to habitat conditions found there relative to the species requirements. No individuals of this species were seen on site during the field survey of the site.

8.1.7 Protected trees

Tree species protected under the National Forest Act are listed in the Biodiversity Specialist Report. The only two that have a geographical distribution that includes the study sites are *Acacia erioloba* and *Boscia albitrunca* (Shepherd's Tree / Witgatboom / !Xhi).

Acacia erioloba (Camelthorn / Kameeldoring) is found in savanna, semi-desert and desert areas with deep, sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops. Three individuals of this species were found on site, but there is a possibility that additional individuals could potentially occur on site in areas affected by the proposed project.

Boscia albitrunca (Shepherd's Tree / Witgatboom / !Xhi) occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species could potentially occur on site in areas affected by the proposed project, although none were found during the field survey.

8.1.8 Protected animals

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). According to this Act, "*a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7*". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed*

threatened or protected species". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Those species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) that have a geographical distribution that includes the site are listed in the Biodiversity Specialist Report, marked with the letter "N". This includes the following species: Roan Antelope, Cape Clawless Otter, Brown Hyaena, Spotted-necked Otter, Honey Badger, Leopard, Cape Fox, Southern African Hedgehog, Southern African Python, Giant Bullfrog, Kori Bustard, Blue Crane, Martial Eagle, Lesser Kestrel, Black Stork, Cape Vulture, Lappet-faced Vulture and White-backed Vulture.

Due to habitat and forage requirements and the fact that some species are restricted to game farms and/or conservation areas, only the Brown Hyaena, Black-footed Cat, Honey Badger, Leopard, Cape Fox and Giant Bullfrog have a likelihood of occurring on site. All of these species are mobile animals that are likely to move away in the event of any activities on site disturbing them. They are therefore unlikely to be affected by the proposed development of the solar power facility and associated infrastructure.

8.1.9 Habitats on site

Aerial imagery indicates that most of the site consists of natural vegetation (shrubland called Ghaap Plateaux Vaalbosveld). There are various pan depressions on site. There is also an area in the central part of the site at a kraal where the natural vegetation has become degraded due to overgrazing and trampling. The distribution of main habitats on site, as identifiable from aerial imagery and confirmed during the field survey, is shown in Figure 28.

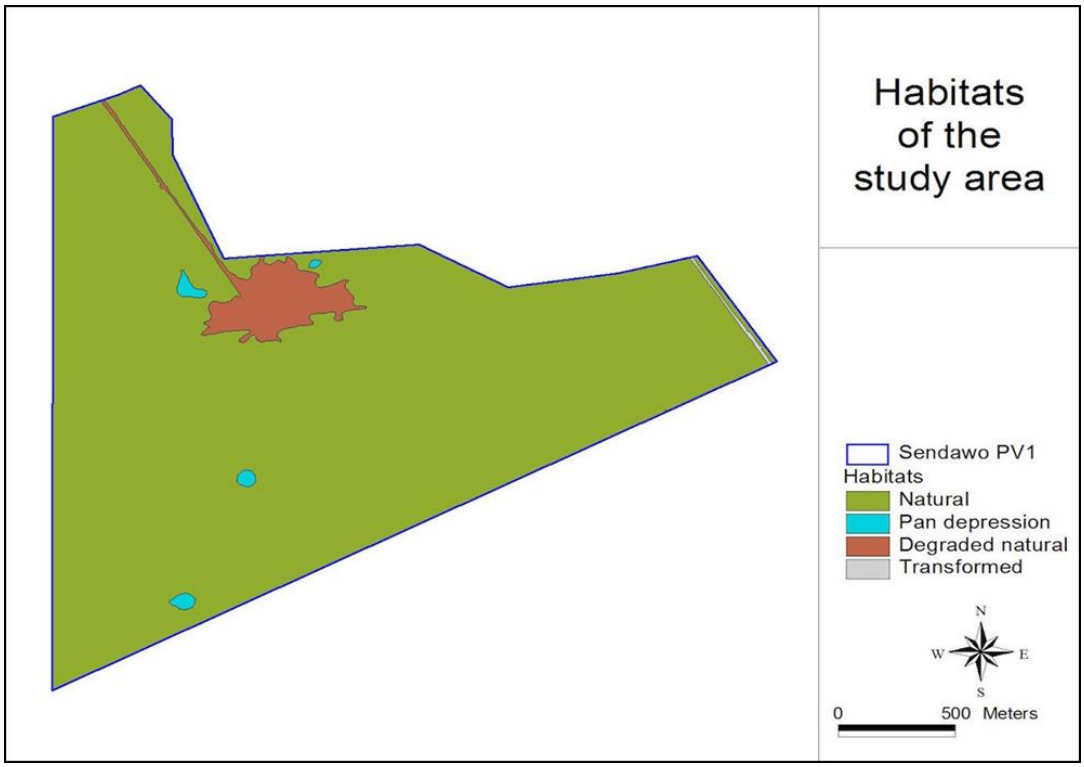

Figure 28: Main habitats of the study area

8.1.10 Watercourses

The study area contains no watercourses / drainage lines that are visible from aerial imagery or that could be seen during the field survey.

8.1.11 Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 29. The information provided in the preceding sections was used to compile a map of remaining natural habitats and areas important for maintaining ecological processes in the study area. The only feature of potential concern that needs to be taken into account in order to evaluate sensitivity in the study area is the presence of pan depressions. These represent ecological processes, including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal. They also have a species composition that differs from other parts of the landscape and therefore act as unique habitats and also refugia for species that are restricted to these areas.

These factors have been taken into account in evaluating sensitivity within the study area. Watercourses are considered to be the most sensitive features on site. The sensitivity classification is as follows:

1. HIGH: All of the watercourses, pans and drainage areas on site are classified as having high sensitivity (see Figure 29). They are protected according to the National Water Act (Act 36 of 1998). Ecologically, they are areas that provide moderate value ecosystem goods and services.
2. MEDIUM-HIGH: The majority of the study area is classified as having medium sensitivity (see Figure 29). These are areas of natural vegetation which harbour no particular features of conservation concern, except for habitat that is potentially suitable for five near threatened animal species and one near threatened plant species (none confirmed to occur on site).
3. MEDIUM: Degraded natural habitat is classified as having medium sensitivity (see Figure 29). These are areas of natural habitat that have been degraded due to over-use and have undergone a shift in species composition, change in vegetation structure and loss of vegetation cover.
4. LOW: Transformed areas are classified as having low sensitivity (see Figure 29). These are areas in which no intact natural habitat still remains.

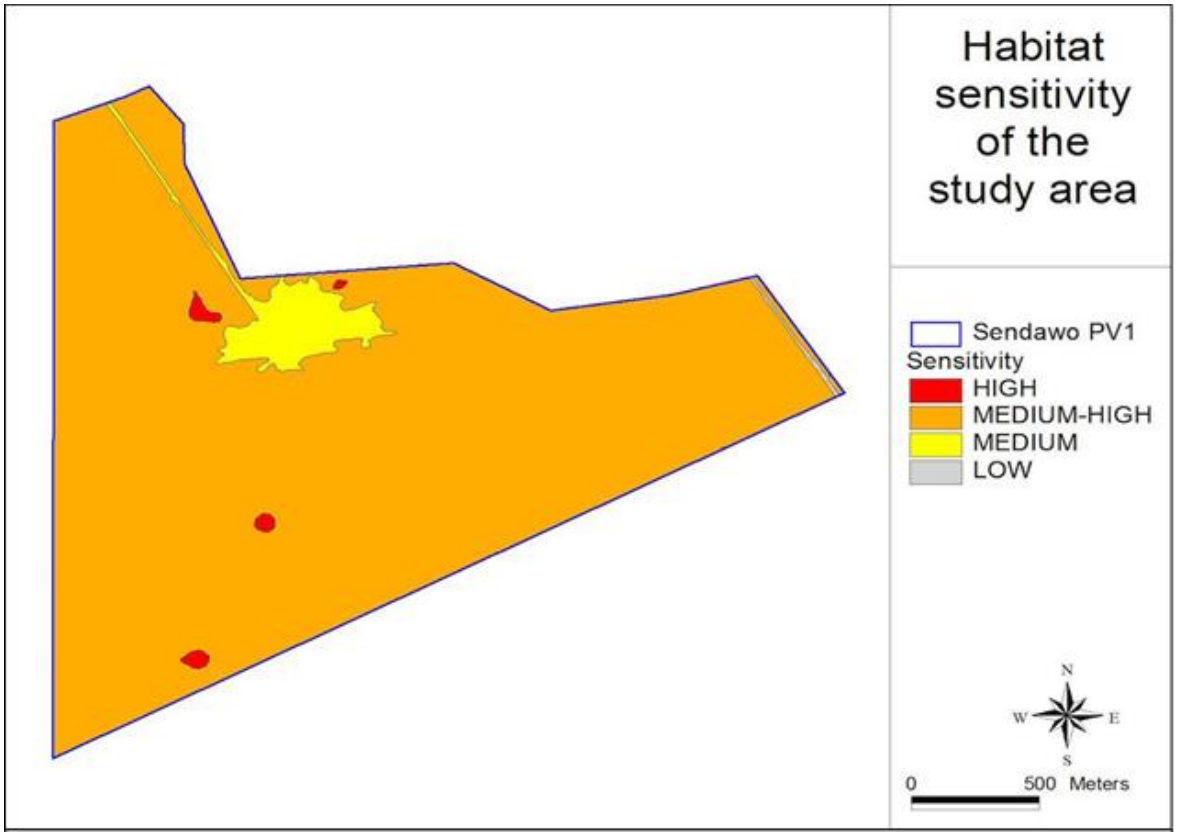

Figure 29: Potentially sensitive areas of the study area

8.1.12 Description of potential impacts

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest and/or woodland and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators;
    - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems that would result from construction of the proposed facility are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of power lines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with operation of the proposed facility, as follows:

- Maintenance of surrounding vegetation as part of management of the power line.
- Animal collisions with infrastructure, especially flying animals.
- Invasion of habitats by alien plants as a consequence of disturbance.

Potential issues for the general study area

A summary of the potential ecological issues for the study area is as follows:

- Presence of natural vegetation on site, some of which is included in Provincial CBA areas and is therefore of potentially high conservation priority.
- Potential presence of two plant species of concern, the succulent, *Lithops lesliei* subsp. *lesliei,* listed as Near Threatened, and the herb, *Rennera stellata,* listed as Vulnerable. Neither was seen on site and it is assumed that they do not occur there.
- Potential presence of one protected plant species, *Harpagophytum procumbens*. The species was not seen on site and it is assumed that it does not occur there.
- Presence of one protected tree species, *Acacia erioloba*, and potential presence of another protected tree species, *Boscia albitrunca*.
- Presence of pan depression areas.
- Potential presence of some animals of potential conservation concern:
    - Brown Hyaena (NT)

    - Honey badger (NT)
    - Southern African Hedgehog (NT)
    - Giant Bullfrog (NT/LC)
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Potential risks to the ecological receiving environment are therefore the following:

1. Loss of indigenous natural vegetation during construction;
2. Impacts on one protected tree species;
3. Impacts on pan depression areas;
4. Mortality of populations of sedentary species during construction (terrestrial and aquatic);
5. Displacement of populations of mobile species (terrestrial);
6. Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats.

8.2 Avifauna

The full Avifauna Assessment was conducted by Chris van Rooyen and is included in Appendix 6B.

An estimated 221 species could potentially occur at the core study area and immediate surroundings (including the Dry Harts River). Of these, 11 are South African Red Data species, 12 are southern African endemics and 22 are near-endemics. This means that 5% of the species that could potentially occur at the core study area and immediate surroundings are Red Data species, and 15% are southern African endemics of near-endemics. Southern Africa contains 13 avifaunal endemic regions, namely Western Arid, Woodland, Evergreen Forest, Grassland, Montane, Rocky slopes and cliffs, Fynbos, Marine and Inland Waters (MacLean 1999). Of these regions, Grassland, where the study area is located, contains the fourth highest number of endemics. Overall, the core study area and immediate surroundings potentially contains a total of 33 endemics and near-endemics, which is 20% of the 167 southern African endemics and near-endemics (Hockey et al. 2005).

See the Avifaunal Specialist Report for a list of all species potentially occurring in the core study area and immediate surroundings. Potential impacts on priority species are listed in Table 23 below.

Table 23: Priority species potentially occurring at the core study area and immediate surroundings. Red Data species are indicated in red.

CR = Critically endangered
EN = Endangered
VU = Vulnerable
NT = Near-threatened
LC = Least concern
End = Southern African Endemic
N-End = Southern African near endemic

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Ant-eating Chat	*Myrmecocichla formicivora*	End	LC	x	x	x	High
Ashy Tit	*Parus cinerascens*	N-end	LC	x	x	x	Low
Black-chested Prinia	*Prinia flavicans*	N-end	LC	x	x	x	High
Bokmakierie	*Telophorus zeylonus*	N-end	LC	x	x	x	High
Cape Penduline – Tit	*Anthoscopus minutus*	N-end	LC	x	x	x	Medium
Cape Sparrow	*Passer melanurus*	N-end	LC	x	x	x	High
Chat Flycatcher	*Bradornis infuscatus*	N-end	LC	x	x	x	Low
Chestnut-vented Tit-babbler	*Parisoma subcaeruleum*	N-end	LC	x	x	x	High
Double-banded Courser	*Rhinoptilus africanus*	NT	LC	x	x	x	Low
Eastern Clapper-Lark	*Mirafra fasciolata*	N-end	LC	x	x	x	High
European Roller	*Coracias garrulus*	NT	NT	x	x	x	Low
Fairy Flycatcher	*Stenostira scita*	End	LC	x	x	x	Low
Grey-backed Sparrowlark	*Eremopterix verticalis*	N-end	LC	x	x	x	Low
Kalahari-Scrub-Robin	*Cercotrichas paena*	N-end	LC	x	x	x	High
Kori Bustard	*Ardeotis kori*	NT	NT	-	x	x	High

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Lark-like Bunting	*Emberiza impetuani*	N-end	LC	x	x	x	Low
Martial Eagle	*Polemaetus bellicosus*	EN	VU	-	x	x	High
Namaqua Sandgrouse	*Pterocles namaqua*	N-end	LC	x	x	x	Low
Northern Black Korhaan	*Afrotis afraoides*	End	LC	x	x	x	High
Orange River White-eye	*Zosterops pallidus*	End	LC	x	x	x	High
Pririt Batis	*Batis pririt*	N-end	LC	x	x	x	Low
Red-headed Finch	*Amadina erythrocephala*	N-end	LC	x	x	x	High
Sabota Lark	*Calendulauda sabota*	N-end	LC	x	x	x	High
Scaly-feathered Finch	*Sporopipes squamifrons*	N-end	LC	x	x	x	High
Secretarybird	*Sagittarius serpentarius*	VU	VU	-	x	x	Medium
Sociable Weaver	*Philetairus socius*	End	LC	x	x	x	Low
South African Shelduck	*Tadorna cana*	End	LC	x	x	x	Low, but could be attracted by the lake effect after construction
Southern Pale Chanting Goshawk	*Melierax canorus*	N-end	LC	x	x	x	Medium
Spike-heeled Lark	*Chersomanes albofasciata*	N-end	LC	x	x	x	High
Yellow Canary	*Crithagra flaviventris*	N-end	LC	x	x	x	High
Black Stork	*Ciconia nigra*	VU	LC	x	-	-	Low, but could be attracted by the lake effect after construction
Burchell's Sandgrouse	*Pterocles burchelli*	N-end	LC	x	-	-	Low
Barred Wren-Warbler	*Calamonastes fasciolatus*	N-end	LC	x	x	x	Low
Burchell's Courser	*Cursorius rufus*	VU, N-end	LC	x	x	x	Low

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Maccoa Duck	*Oxyura maccoa*	NT	NT	x	-	-	Low, but could be attracted by the lake effect after construction
Abdim's Stork	*Ciconia abdimii*	NT	LC	x	-	-	Low
Crimson-breasted Shrike	*Laniarius atrococcineus*	N-end	LC	x	x	x	High
Spike-heeled Lark	*Chersomanes albofasciata*	N-end	LC	x	x	x	High
Southern Pied Babbler	*Turdoides bicolor*	End	LC	x	x	x	Low
Fiscal Flycatcher	*Sigelus silens*	End	LC	x	x	x	High
White-backed Mousebird	*Colius colius*	End	LC	x	x	x	High
Karoo Thrush	*Turdus smithi*	End	LC	x	x	x	High
Cape White-eye	*Zosterops virens*	End	LC	x	x	x	Low
African Fish-Eagle	*Haliaeetus vocifer*	-	-	x	-	-	Medium
African Harrier-Hawk	*Polyboroides typus*	-	-	-	x	x	Medium
Amur Falcon	*Falco amurensis*	-	-	x	x	x	Medium
Black Crake	*Amaurornis flavirostris*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Black-headed Heron	*Ardea melanocephala*	-	-	x	x	x	Medium
Black-shouldered Kite	*Elanus caeruleus*	-	-	x	x	x	High
Blacksmith Lapwing	*Vanellus armatus*	-	-	x	x	x	High
Cattle Egret	*Bubulcus ibis*	-	-	x	x	x	High
Common Sandpiper	*Actitis hypoleucos*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Egyptian Goose	*Alopochen aegyptiacus*	-	-	x	-	-	Medium - could also be attracted by the lake effect after construction
Gabar Goshawk	*Melierax gabar*	-	-	x	x	x	Low
Greater Kestrel	*Falco rupicoloides*	-	-	x	x	x	Medium
Green-backed Heron	*Butorides striata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Grey Heron	*Ardea cinerea*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Lesser Kestrel	*Falco naumanni*	-	-	x	x	x	High
Little Egret	*Egretta garzetta*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Little Grebe	*Tachybaptus ruficollis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Marsh Sandpiper	*Tringa stagnatilis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Pied Kingfisher	*Ceryle rudis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Red-billed Teal	*Anas erythrorhyncha*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Red-knobbed Coot	*Fulica cristata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Reed Cormorant	*Phalacrocorax africanus*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Spotted Eagle-Owl	*Bubo africanus*	-	-	x	x	x	High
Spur-winged Goose	*Plectropterus gambensis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Steppe Buzzard	*Buteo vulpinus*	-	-	x	x	x	High
White-faced Duck	*Dendrocygna viduata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Yellow-billed Duck	*Anas undulata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
White-backed Vultures	*Gyps africanus*	CR	CR	-	-	x	Low
Cape Vulture	*Gyps coprotheres*	EN	EN	-	-	x	Low

*With smaller species this impact might result in partial but not total exclusion from the site, depending on the level of vegetation transformation.

Pre-construction monitoring conducted over six months at the core study area revealed fewer than expected priority species. Two walk transects of 1km each were identified at the site and each surveyed 24 times through the course of the monitoring, to record the diversity and abundance of avifauna. Table 24 below lists the densities and variety of priority species actually recorded at the site in this manner. The densities of priority species are indicated as mean individuals per survey, and individuals per kilometre (index of kilometric abundance - IKA). In addition to the walk transects, one vantage point was selected from which a representative sample of the proposed PV areas could be observed, to record the flight altitude and patterns of priority species. However, no priority species flight activity was recorded in 36 hours of vantage point watches.

Table 24: Priority species recorded during pre-construction monitoring at the core study area.

Species	**Taxonomic name**	**Regional Status**	**Mean number of individuals per survey recorded during transect counts**	**Number of individuals per kilometre**
Black-chested Prinia	*Petrochelidon spilodera*	Endemic	0.13	0.06
Ant-eating Chat	*Myrmecocichla formicivora*	Endemic	0.04	0.02
Bokmakierie	*Afrotis afraoides*	Endemic	0.04	0.02
Cape Sparrow	*Colius colius*	Endemic	0.13	0.06
Crimson-breasted Shrike	*Prinia flavicans*	Near-endemic	0.04	0.02
Eastern Clapper Lark	*Telophorus zeylonus*	Near-endemic	0.21	0.10
Kalahari Scrub-Robin	*Passer melanurus*	Near-endemic	0.21	0.10
Lanner Falcon	*Laniarius atrococcineus*	Near-endemic	0.25	0.13
Marico Flycatcher	*Mirafra fasciolata*	Near-endemic	0.13	0.06
Northern Black Korhaan	*Erythropygia paena*	Near-endemic	1.04	0.52
Sabota Lark	*Bradornis mariquensis*	Near-endemic	0.08	0.04
Scaly-feathered Finch	*Calendulauda sabota*	Near-endemic	0.63	0.31
Shaft-tailed Whydah	*Sporopipes squamifrons*	Near-endemic	0.08	0.04
South African Cliff-Swallow	*Vidua regia*	Breeding endemic	0.08	0.04
Spike-heeled Lark	*Chersomanes albofasciata*	Near-endemic	0.21	0.10

White-backed Mousebird	*Falco biarmicus*	VU	0.13	0.06
Martial Eagle	*Polemaetus bellicosus*	EN	Incidental	Incidental
Kori Bustard	*Ardeotis kori*	NT	Incidental	Incidental
Steppe Buzzard	*Buteo vulpinus*	-	Incidental	Incidental

As can be seen in Table 24 above, the variety and density of priority species at the core study area was low during the survey period which lasted from November 2015 to February 2016. Normally this should be the period of most bird activity at the core study area, as it is in the middle of the rainy season. However, the area was experiencing a severe drought with high temperatures at the time, which is the most logical explanation for the low counts. The effect of the drought on the vegetation is further exacerbated by grazing pressure, which further depletes the grass layer, creating unfavourable conditions for grassland avifauna. The lack of flight activity at the core study area could be linked to the general unfavourable conditions for avifauna at the site at the time, but it could also be partially due to the characteristics of the site itself.

Given the atypical conditions which prevailed at the site during the pre-construction monitoring, the results of the monitoring should not necessarily be taken as a completely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

8.2.1 Impacts of solar facilities and associated infrastructure on avifauna

A literature review reveals a scarcity of published, scientifically vetted information regarding large-scale solar plants and birds. To date, only one published scientific study has been conducted on the direct impacts of solar facilities on avifauna, namely "Avian mortality at a solar energy power plant" by McCrary, McKernan, Schreiber, Wagner & Sciarrotta 1986. This describes the results of monitoring at the experimental Solar One solar power plant in southern California (now de-commissioned), which was a 10 megawatt, central receiver solar power plant consisting of a 32-ha field of 1 818, 6.9 x 6.9m mirrors (heliostats) which concentrates sunlight on a centrally located, tower-mounted boiler, 86m in height. Since then, several much larger plants have been constructed in the Desert Southwest of the USA namely the 250MW, 1 300ha California Valley Solar Ranch PV plant (completed in 2013), the 377 MW, 1 600ha Ivanpah central receiver CSP plant (completed in 2014), the 550MW, 1 600ha Desert Sunlight PV plant (completed in 2015) and the 250MW, 1 880ha Genesis Solar Energy parabolic trough Concentrated Solar Power plant (completed in 2014). The full spectrum of impacts of solar facilities on birds is only now starting to emerge from compliance reports at these solar facilities.

These can be summarised as follows:

- Temporary displacement due to disturbance associated with the construction of the solar plant and associated infrastructure;
- Collisions with the heliostats or solar panels;
- Burning due to solar flux (only relevant to CSP plants, not relevant for PV plants);

- Permanent displacement due to habitat transformation; and
- Collisions with the associated power lines resulting in mortality (not assessed in this report).

8.2.1.1 Collisions with solar infrastructure

There are currently two known types of direct solar-related bird fatalities (McCrary *et al*. 1986; Hernandez *et al.* 2014; Kagan *et al*. 2014):

- Collision-related fatality—fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been documented at solar projects of all technology types.
- Solar-flux-related fatality—fatality resulting from the burning/singeing effects of exposure to concentrated sunlight. Passing through the area of solar flux may result in: (a) direct fatality; (b) singeing of flight feathers that cause loss of flight ability, leading to impact with other objects; or (c) impairment of flight capability to reduce the ability to forage or avoid predators, resulting in starvation or predation of the individual (Kagan *et al.* 2014). Solar-flux-related fatality has been observed only at facilities employing power tower technologies.

McCrary *et al.* (1986) searched for dead birds amongst the heliostat mirrors and around the central receiver tower, and they estimated a bird fatality rate caused by bird collisions with heliostat mirrors and the tower, and by heat encountered when birds flew through the concentrated sunlight reflected toward the tower. Their forty visits (one week apart) to the facility over a two-year period revealed 70 bird carcasses involving 26 species. It was estimated that between 10% and 30% of carcasses were removed by scavengers in between visits, so the actual mortality figure may have been slightly higher. They estimated that 57 (81%) of these birds died through collision with infrastructure, mostly the heliostats. Species killed in this manner included waterbirds, small raptors, gulls, doves, sparrows and warblers. Thirteen (19%) of the birds died through burning in the standby points. Species killed in this manner were mostly swallows and swifts. However, they appeared to have under-appreciated the magnitude of the impacts caused by Solar One, likely because they did not know as much as scientists know today about scavenger removal rates and searcher detection error (Smallwood 2014). Their search pattern was not fixed, so it was not as rigorous as modern searches at wind energy projects and other energy generation and transmission facilities. They placed 19 bird carcasses to estimate the proportion remaining over the average time span between their visits to the project site, though they provided few details about their scavenger removal trial. It is known today that the results of removal trials can vary substantially for many reasons, including the species used, time since death, and the number of carcasses placed in one place at one time, etc. (Smallwood 2007). They also performed no searcher detection trials, because they concluded that the ground was sufficiently exposed that all available bird carcasses would have been found. This conclusion would not be accepted today, based on modern fatality search protocols. Smallwood (2014) recalculated the estimated fatality rate at Solar One, but this time using US national averages to represent scavenger removal rates and searcher detection rates (see Smallwood 2007, 2013). He re-calculated it as 87.4 mortalities per year with an 80% confidence interval (CI) of 69.6 to 105.5.

Although Solar One is a central receiver plant and therefore not directly comparable to the proposed PV 1 facility, the results of the Solar One study indicates that collisions with reflective surfaces are a significant impact at solar facilities in general.

Avian monitoring surveys were conducted at the 1 600ha Ivanpah Solar Electric Generating System CSP (Ivanpah) facility in accordance with the Project's Avian & Bat Monitoring and Management Plan over four seasons from 29 October 2013 to 20 October 2014 (Harvey & Associates 2015). These surveys included avian point counts, raptor/large bird surveys and facility monitoring for avian fatalities. Overall, approximately 29.2% of the facility was searched (not including offsite transects, which are outside the facility). A total of 695 avian mortalities (including 25 injured birds that died), and eight injured birds were found over the first four seasons. These avian fatality search results, along with searcher efficiency carcass removal rates from trials conducted onsite, were input into a fatality estimator model (Huso 2010) to provide an estimate of the fatalities for the facility. Overall, the estimated avian mortality was 1492 or 42.6% of birds (90% confidence interval 1,046-2,371) from known causes and 2012 or 57.4% of birds (90% confidence interval 1,450-3,334) from unknown causes. The sources of mortality for known causes were 47.4% singed, 51.9% with evidence of collision effects, and 0.7% from other Project causes. For the fatalities from unknown causes, the estimate was driven by a high number of feather spots (47.2% of all detections) which may have led to over-estimation of the number of unknowns.

The estimate of 3 504 mortalities at Ivanpah contrasts markedly with an earlier estimate by Smallwood (2014). Smallwood calculated the estimated annual mortality at Ivanpah to be potentially as high as 28 380 birds per year. In his testimony to the California Energy Commission he explains as follows: "The April searches turned up 101 fatalities and the May searches discovered another 82 fatalities. If the searches were performed according to document TB201315, which summarised a monitoring plan for Ivanpah, then weekly searches were performed at 20% of the heliostat mirrors at Ivanpah during April and May 2014. Given the size range of the birds found, including many hummingbirds, swallows and warblers, I would predict that the overall adjustment rate for searcher detection and carcass persistence would be no greater than 20%. That means the number of fatalities found would be divided by 0.2 to arrive at an adjusted estimate of 473 fatalities per month within the search areas. This number then would be divided by 0.2 (corresponding with 20% of the project being searched) to extrapolate the fatality estimate to the rest of Ivanpah, yielding 2,365 birds per month during April and May 2014. If this rate persisted yearlong, then Ivanpah might be killing 28,380 birds, which would be 3.6 times greater than the fatality rate I predicted." With such widely differing estimates, it is clear that systematic study and efforts to standardize data through the development of systematic monitoring protocols are needed to make any conclusions about the avian risks of utility-scale solar development.

Although Ivanpah is also a CSP plant and therefore not directly comparable to the proposed PV 1 facility, it again points to collisions with reflective surfaces as a potentially significant cause of mortality at solar plants.

Weekly mortality searches at 20% coverage are also being conducted at the 1 300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feathers spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

Although the quarterly reports compiled for the California Valley Solar Ranch PV site do not attempt to identify the cause of death, the fact that collisions with reflective surfaces are a proven cause of mortality at solar plants makes this the most likely cause of death for the majority of recorded mortalities.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at the 1 600ha Ivanpah CSP, 1 600ha Desert Sunlight PV and 1 880ha Genesis Parabolic Trough solar plants. The results of the investigation are tabled below in Table 25.

Table 25: Comparison of avian mortality causes at three solar plants in California, USA (Kagan et al. 2014).

Cause of death	**Ivanpah CSP**	**Genesis Parabolic trough CSP**	**Desert Sunlight PV**	**Total**
Solar flux	47	0	0	47
Impact trauma	24	6	19	49
Predation trauma	5	2	15	22
Trauma of undetermined causes	14	0	0	14
Electrocution	1	0	0	1
Emaciation	1	0	0	1
Undetermined (remains in poor condition)	46	17	22	85
No evident cause of death	3	6	5	14
Total	141	31	61	233

When the results of the three solar plants are pooled, collisions with reflective surfaces (impact trauma) emerge as the highest single identifiable cause of avian mortality. In the case of Desert Sunlight PV, impact trauma and predation trauma together are the biggest identifiable causes of avian mortality.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. A recent comprehensive review estimated between 365 – 988 million birds are killed annually in the USA due to collisions with glass panels (Loss *et al*. 2014). It is therefore to be expected that the reflective surfaces of solar panels will constitute a similar risk to avifauna. A related problem is the so-called “lake

effect" i.e. it seems very likely that reflections from solar facilities' infrastructure, particularly large sheets of dark blue photovoltaic panels, may well be attracting birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014). This could either result in birds colliding directly with the solar panels, or getting stranded and unable to take off again because many aquatic bird species find it very difficult and sometimes impossible to take off from dry land e.g. grebes and cormorants. This exposes them to predation, even if they do not get injured through direct collisions with the panels. The unusually high number of waterbird mortalities at the Desert Sunlight PV facility (44%) seems to support this hypothesis. In the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water.

Variables that may affect the illusory characteristics of solar panels are structural elements or markings that may break up the reflection. Visual markers spaced at distances of 28cm apart or less have been shown to reduce the number of window strike events on large commercial buildings (Kagan *et al.* 2014). A paper by Horvath *et al*. (2010) provides experimental evidence that placing a white outline and/or white grid lines on solar panels significantly reduce the attractiveness of those panels to aquatic insects, with a loss of only 1.8% in energy producing surface area. While similar detailed studies have yet to be carried out with birds, this work, combined with the window strike results, suggest that significant reductions in avian mortality at solar facilities could be achieved by relatively minor modifications of panel and mirror design (Kagan *et al.* 2014). This could be an experimental mitigation measure should results of the operational phase monitoring indicate significant mortality of priority avifauna due to collisions with the solar arrays at the proposed facility.

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The priority species that could potentially occur in the core study area and immediate surroundings and which could potentially be exposed to collision risk at the PV site is tabled in Table 23. The so-called "lake effect" could act as an attraction to some species and it is expected that flocking species such as Namaqua Sandgrouse, mixed flocks of seed-eaters consisting of Sociable Weaver, Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse and Lark-like Bunting, and several species of doves would be most susceptible to this impact as they habitually arrive in flocks at water holes to drink. Multiple mortalities could potentially result from this, which in turn could attract raptors e.g. Southern Pale Chanting Goshawk Lanner Falcon and Gabar Goshawk which will feed on dead and injured birds which could in turn expose them to collision risk, especially when pursuing injured birds. In addition, the "lake effect" produced by the solar panels may draw various water birds to the area (see Table 23), including endemics e.g. the South African Shelduck and possibly even the Red Data Black Stork. The proximity of the Dry Harts River to the site may act as an additional aggravating factor as it already holds an attraction for waterbirds.

8.2.1.2 Displacement due to habitat transformation and disturbance associated with the construction and operation of the plant

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. All of these processes have the ability—individually and together—to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

The activities listed below are typically associated with the construction and operation of solar facilities and could have direct impacts on avifauna (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;
- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Soil compaction, dust, and water runoff from construction sites;
- Increased vehicle traffic;
- Short-term construction-related noise (from equipment) and visual disturbance;
- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and
- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity through disturbance and transformation of habitat, which could result in temporary or permanent displacement.

At the 1 600ha Ivanpah Solar Electric Generating System CSP (Ivanpah) facility, seventeen avian use surveys were conducted at each of 80 survey points (40 in desert bajada habitat and 40 in heliostat arrays),

representing more than 350 hours of survey effort. Species composition was compared between these avian use survey results and detections during standardized monitoring surveys. A total of 54 bird species were recorded on avian use surveys during the first four seasons. Total species richness was highest in the desert (47 species), and much lower in the heliostat grids (24 species).

Evidently, the same is true for PV plants. In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault *et al.* (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale. It is highly likely that the same pattern of reduced avifaunal densities will manifest itself at the proposed facility.

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See Table 23 for a list of the priority species that could potentially be affected by this impact. Small birds are often capable of surviving in small pockets of suitable habitat, and are therefore generally less affected by habitat fragmentation than larger species. It is therefore likely that many of the smaller species will continue to use the habitat available within the solar facility albeit at lower densities. This will however differ from species to species and it may not be true for all of the smaller species. Larger species which require contiguous, un-fragmented tracts of suitable habitat (e.g. large raptors, korhaans and bustards) are more likely to be displaced entirely from the area of the proposed plant although in the case of some raptors (e.g. Southern Pale Chanting Goshawk, Lanner Falcon and Gabar Goshawk) the potential availability of carcasses or injured birds due to collisions with the PV panels may actually attract them to the area. The overall significance of the potential displacement impact is difficult to assess at this stage and will have to be determined through post-construction surveys.

8.3 Surface Water

The full Surface Water Assessment was conducted by Shaun Taylor of SiVEST and is included in Appendix 6C.

The in-field wetland delineation assessment took place from the 3rd to 4th December 2016. The fieldwork verification, ground-truthing and delineation assessment was undertaken to scrutinise the results of the desktop identified features as well as to identify any potentially overlooked wetlands or other surface water resources in the field for the greater application site. The results are displayed in Figure 30.

Ultimately, it was found that there are fifteen (15) pan wetlands, one (1) natural spring and one (1) drainage line on the greater application site. The field identified pan wetlands correlated with the wetlands identified at a desktop level for the application site, with the exception of three wetlands which were not verified based on lack of any physical evidence of wetland indicators in the field. Additionally, however, a number of the wetlands were also incorrectly classified as valley bottom wetlands. These were re-classified as pan

wetlands and the one wetland re-classified as a natural spring based on the characteristics identified in the field. The boundaries were refined based on in-field delineations.

Aside from these surface water features, as per the desktop assessment, no rivers were identified on site. Although, a drainage line was identified in-field. This drainage line is substantially shorter than that delineated at the desktop level however, which was also refined based on findings in the field.

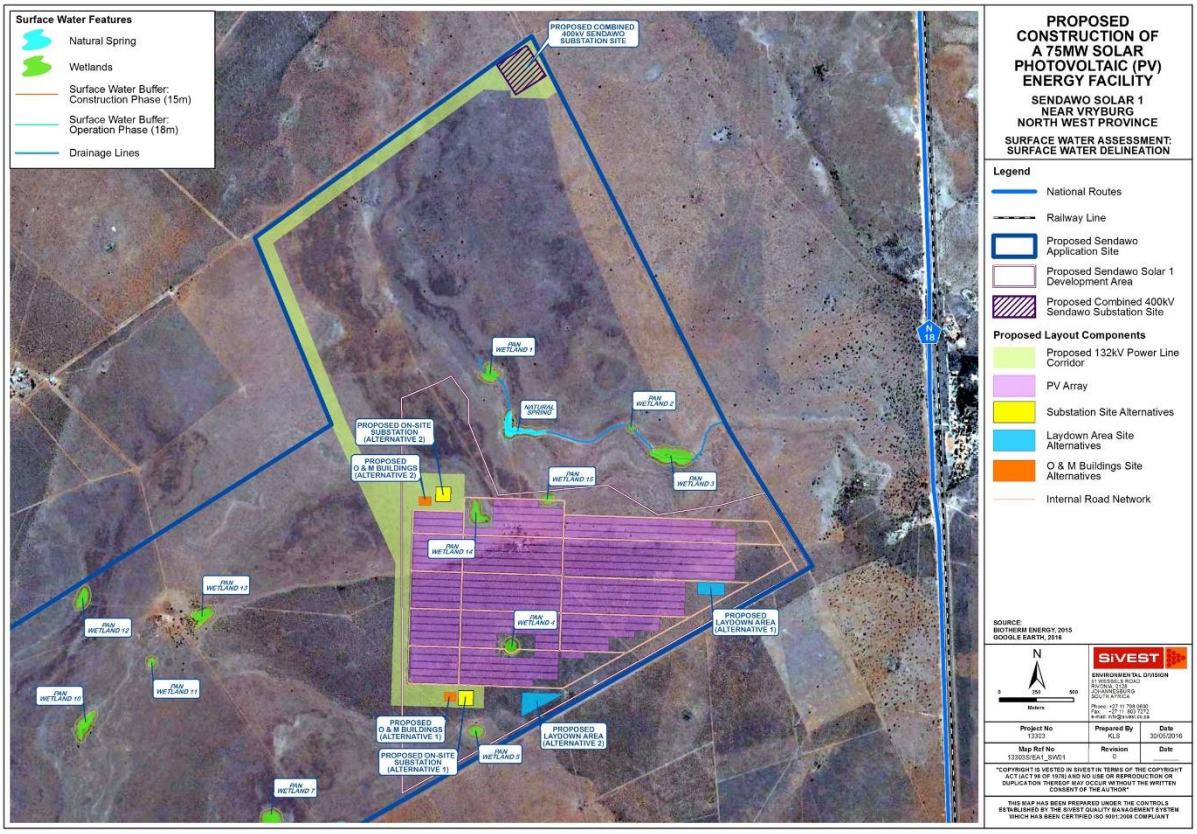


Figure 30: Sendawo 1 Surface Water Delineation Map

8.3.1 Pan Wetlands

- **Terrain and Wetland Soil Characteristics**

The general terrain is mostly flat. There is a very low central ridge line however which runs diagonally from the north west to the south east, bisecting the greater application site. Shallowed out basins within the flatter landscape areas form a suitable physical template for endorheic (closed systems that are in-ward draining) pan/depression wetlands.

The word ‘pan’, in ecological wetland studies, is a generic term used in South Africa to describe a wetland type that has a shallow depression or basin and that is usually a closed-system. Overall, pans are principally

viewed as ephemeral and sporadic (Meintjies et al., 1994). Pans are also regularly restricted to lowlands or plains and can become very turbid after rainfall events, and saline throughout time (Masing et al. 1990). In terms of pan wetland formation in South Africa, several conditions contribute to pan formation. Allan et al. (1995) stresses the role of wind action whereas Goudie and Wells (1995) state the following predisposing conditions:

- Areas must be arid;
- An area should not be one where fluvial processes are fully integrated; and lastly,
- An area should not be one where aeolian accumulation does not result in the infill of any irregularities in the land surface.

The pan wetlands within the power line corridor are good examples of typical pan wetlands in arid areas.

Figure 31: Pan wetland identified near the western boundary of the greater application site

In terms of pan wetland geomorphology, the influx of silt and clay due to inward depositional processes results in the accumulation of sediment. This sediment forms a layer that is relatively impermeable and is found near the surface in the subsoil of a pan basin. However, soil composition (for example, degree of sand, silt and clay) varies between pans. In general however, three types of soil forms were identified within the pan wetlands. The first type of soils within the wetlands were predominantly found to contain clays up to the point that the soils were almost vertic in characteristics. Soils were dark in colour with a vertic structure deeper beneath the Orthic A horizon. Soil depth was however limited (up to 60cm) due to the presence of calcrete or bedrock. Small calcretions were evident in the soil samples drawn, before reaching calcrete (Figure 32). These types of soils were mainly found in the proposed Sendawo 1 and 2 PV plant sites located near the southern and western boundaries of the greater application site. The soil form that could be

attributed to these wetlands include that of the Arcadia Soil Form. This soil form is not typically associated with wetlands. However, mottling at the surface revealed hydric soils thereby indicating wetland conditions.

Figure 32: Dark Clay Soils with Calcretions (left) with Mottling at the Surface (right)

Further north, soils within the pan wetlands were found to be more plinthic (loose, friable or slightly firm consistence, (MacVicar et al., 1991)) in character. Soil particles were a yellow / brown colour. Typical mottling in the form of iron sesquioxide concentrations were observed. Additionally, Iron redox depletions were also noticed (Figure 33). The Soft Plinthic B horizon could be attributed to the sub-soils within these wetlands. A shallow Orthic A horizon was found to overlie the Soft Plinthic sub-soils. Overall, where an Orthic A horizon overlay a Soft Plinthic B horizon, the Westleigh Soil Form could be attributed to the pan wetlands.

Figure 33: Iron Concentrations and Depleted Soils within the Pan Wetlands with the Soft Plinthic Soil Horizon

The third soil form identified could be attributed to the Mispah Soil Form. The soil profile over some of the pans were relatively thin before being interrupted by bedrock (Figure 34). The soils were of an Orthic character and some red iron oxide mottling was observed at the surface in the sandier soils whereas other pans expressed higher clay content with small lime nodules.

Figure 34: Thin Soil Profile of a Pan Wetland with Bedrock Extrusions

Given the characteristics of the soils and the attributed soil forms, the pan wetlands can be considered to be temporary in nature.

- **Wetland Vegetation**

The pan wetlands were somewhat sparsely vegetated to almost completely devoid of vegetation towards the core of the wetlands. Many of the wetlands associated with the vertic soils were however found to contain mainly higher order tree (*Acacia* sp.) species. The pan wetlands associated with the Soft Plinthic soils were more inclined to be vegetated with graminoid species (*Aristida junciformus, Cymbopogon caesius, Cynodon dactylon*, and *Sporobolus iocladus* (fw)). For the pan wetlands with both soils types, aquatic species in the form of *Persicaria* sp. (Figure 35) and other herb like vegetation species were noticed.

Figure 35: *Persicaria* sp. observed in one of the Pan Wetlands

8.3.2 Spring

- **Terrain and Soil Characteristics**

A natural spring occurs when the water table intercepts the earth's surface as a natural flow of water (Tarbuck & Lutgens, 1987). A natural spring was identified on the greater application site located centrally on the property. The spring (Figure 36) is located on flat landscape which slopes very slightly to the south east whereby flow from the spring leads in this direction and forms a drainage line up to a pan wetland.

Connectivity between these three features is considered important in terms of ecological connectivity from a hydrological and habitat perspective.

In terms of soil characteristics, beneath the Orthic A horizon, the sub-soils at the source and nearby the seepage point of the spring were highly bleached (Figure 36) representing an E horizon. However, moving gradually away from the source, the presence of bedrock was found to increase from deep closer to the surface until extruding some distance away into the drainage line area. The Wasbank Soil Form could be attributed to the soils at the spring.

Figure 36: Seepage Point of the Natural Spring (left) and Bleached Soils of the Spring (right)

- **Vegetation**

At the source of the spring, little vegetation was present. However, with increasing distance from the seepage point, graminoid and rush species were identified. Graminoid species included mainly *C. dactylon* whilst the rush species noted included *Facinia nodosa* and *Scirpoides* sp.

Figure 37: *Facinia nodosa* and *Scirpoides* sp. within the spring

Given the characteristics of the soils and the attributed soil forms, the spring can be considered to be seasonal to temporary (for drier years) in nature.

8.3.3 Drainage Line

- **Topography associated with a Watercourse**

As explained above, when in flow, the drainage line acts to connect the spring with a pan wetland located to the south west of the spring. The topography is flat but slopes very slightly to the south east in which the direction of the drainage line flows. The soil profile of the drainage line is very shallow with bedrock extruding for stretches where a soil profile is extremely thin (+-5cm) (Figure 38). The soil type varies from the transition zone of the spring where bleached sandy soils change further into the drainage line where the bedrock influence becomes a factor with limited soil profile.

Figure 38: Bedrock Extruding at the Surface within the Drainage Line

- **Vegetation**

Over the areas where the soil profile is deeper closer to the spring, graminoid species and rushes can be found including that described for the spring above such as *C. dactylon*, *F. nodosa* and *Scirpoides* sp. Within the course of the drainage line, over the areas of thin soil profile underlain by shallow bedrock, only graminoid species were observed presumably as a consequence of reduced soil depth and moisture.

Figure 39: Close to the Transition Zone of Soil Types where Vegetation Communities change from Graminoid to Herbaceous cover within the Drainage Line

Given the characteristics of the soils and the vegetation present, the drainage line can be considered to be reliant on flows from the spring to the north west, with this feature being one of the main sources of water input. It is therefore presumed to be temporary in nature flowing only when receiving significant flows from the spring or after heavy rainfall.

- **Alluvial Soils and Deposited Materials**

No deposited material was evidenced. It is presumed that when flows do occur, run-off is limited to surface run-off in which limited materials (in the form of sediment and vegetation deposits) are present. Given the temporal nature of the drainage line, deposits may well be trampled or blown away by wind. Alluvial deposits from flows associated with the spring are anticipated however.

8.3.4 Surface Water Buffer Zones

Construction and operation buffer zones were determined for the identified wetlands since it is only these features that may be potentially directly affected by the proposed development.
For the wetlands, the primary threat related to PV developments during the construction phase, is increased run-off and sediment inputs (USEPA, 2005 & 2006), as well as turbidity. This is presumably during vegetation clearing for the PV arrays and excavation of pits for the foundations of the individual PV panels. These areas are left vulnerable to surface run-off, consequent erosion and sedimentation. Given the

relatively flat terrain, the size and proximity of the proposed PV field, this is a distinct possibility. However, the aridity of the study area will be a factor in whether there is any run-off at all. Timing of construction is therefore important outside of the rainy season as far as practically possible in order to limit impacts arising from run-off. Nonetheless, the potential impacts can be easily mitigated with simple management measures in place. Therefore, the buffer zones can be of limited size in order to address potential impacts.

For the operation phase, run-off from the PV field and adjacent services roads (SANRAL, 2009b; DNREA, 2006; Walker et al., 2000 & Cummings, 1999) can contribute to increased run-off and sediment inputs, as well as turbidity in the wetlands. Again, the terrain and climate factors will have a bearing on potential impacts. However, with the implementation of mitigation measures, potential impacts can be avoided.

Based on the above as well as the suggested mitigation measures stipulated in Section 9, construction and operation buffer zones were determined for the identified wetlands. As such, the wetland buffer zones that were determined and are applicable include the following:

- Construction Phase Buffer: 15m
- Operation Phase Buffer: 18m

8.3.5 Sendawo 1 Solar PV Facility Surface Water Delineation Results

At a site specific level, the surface water resources delineated on the proposed Sendawo 1 PV Plant site includes only four pan wetlands that could potentially be affected. The surrounding pan wetlands, drainage line and spring have a small chance of being affected from an indirect perspective.

8.4 Agricultural Potential and Soils

The full Agricultural Potential Assessment was conducted by Garry Paterson and is included in Appendix 6D.

8.4.1 Soil Pattern

The desk-top study indicated that the soils in the vicinity of the project were all shallow to very shallow (<500 mm), usually sandy and calcareous, overlying either rock or cemented hardpan calcrete. Some rock outcrops occur in places in the landscape.

The soil investigation confirmed this, with virtually all of the soils observed being less than 450 mm onto hard or weathering rock. The soils are reddish-brown to brown, structureless to weakly structured and belong to the Mispah, Glenrosa and Hutton soil forms (Soil Classification Working Group, 1991).

The location of the points that were visited during the field trip is shown in Figure 40.

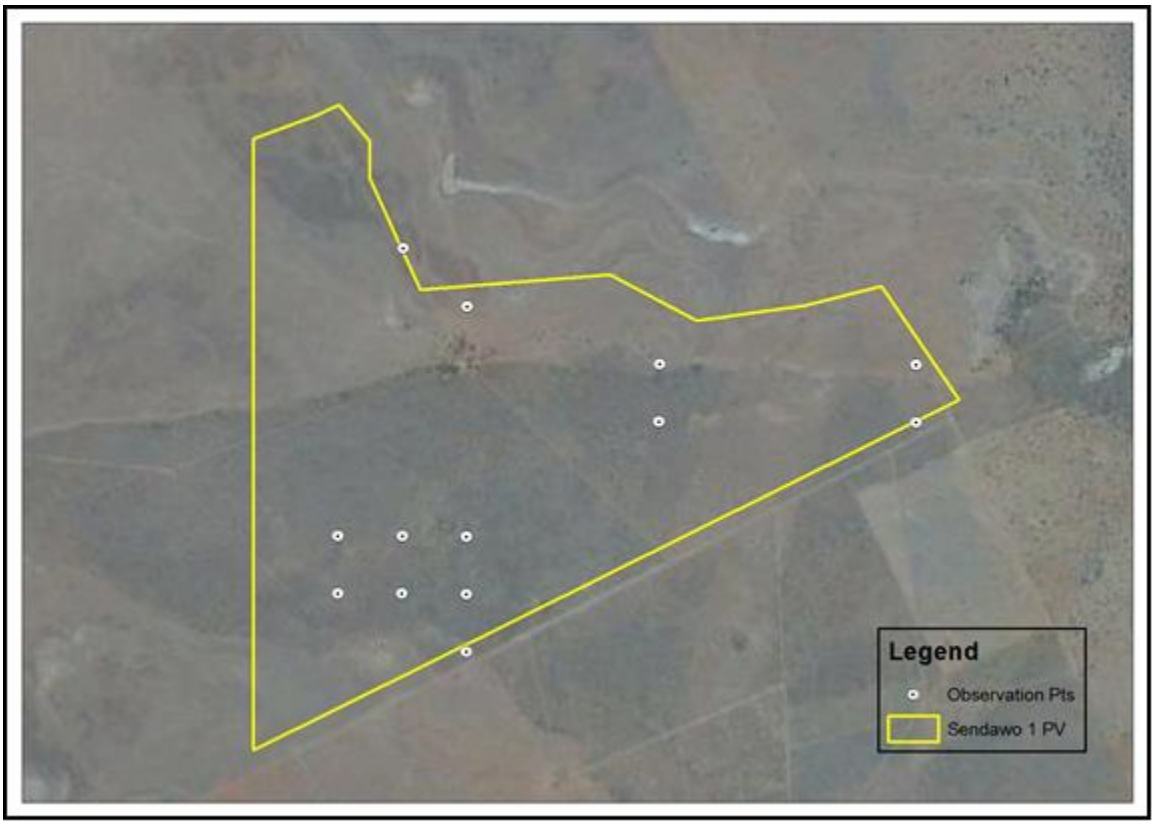


Figure 40: Soil observation points

8.4.1 Agricultural Potential

The shallow soils in the area, coupled with the low rainfall means that the only means of reliable cultivation would be by irrigation and the Google Earth image of the area (Figure 40) shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation.

The climatic parameters mean that this part of North West is well suited for grazing but here the grazing capacity is relatively low, around 12 ha/large stock unit (ARC-ISCW, 2004).

8.4.2 Land Use

The land use in the area is dominantly “shrubland and low fynbos” with some small areas of “bare rock and soil (natural)” as classified by the National Land Cover (Thompson, 1999). As previously mentioned, there are no areas of cultivation that were identified, only a few small, isolated areas of “Improved grassland”.

8.5 Visual

The full The Visual Assessment was conducted by Andrea Gibb and Stephan Jacobs of SiVEST and is included in Appendix 6E.

8.5.1 Visual Sensitivity

Visual Sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (i.e. topography, landform and land cover), spatial distribution of potential receptors, and the likely value judgements of these receptors towards a new development (Oberholzer, 2005). A viewer's perception is usually based on the perceived aesthetic appeal of an area and on the presence of economic activities (such as recreational tourism) which may be based on this aesthetic appeal.

In order to assess the visual sensitivity of the area SiVEST has developed a matrix based on the characteristics of the receiving environment which, according to the Guidelines for Involving Visual and Aesthetic Specialists in the EIA Processes, indicate that visibility and aesthetics are likely to be 'key issues' (Oberholzer, 2005).

Based on the criteria in the matrix (Table 26), the visual sensitivity of the area is broken up into a number of categories, as described below:

i) **High** - The introduction of a new development such as the erection of a PV facility or power line would be likely to be perceived negatively by receptors in this area; it would be considered to be a visual intrusion and may elicit opposition from these receptors

ii) **Moderate** - Presence of receptors, but due to the nature of the existing visual character of the area and likely value judgements of receptors, there would be limited negative perception towards the new development as a source of visual impact.

iii) **Low** - The introduction of a new development would not be perceived to be negative, there would be little opposition or negative perception towards it.

The table below outlines the factors used to rate the visual sensitivity of the study area. The ratings are specific to the visual context of the receiving environment within the study area.

Table 26: Environmental factors used to define visual sensitivity of the study area

FACTORS	RATING									
	1	2	3	4	5	6	7	8	9	10
Pristine / natural character of the environment										
Presence of sensitive visual receptors										
Aesthetic sense of place / scenic visual character										

Value to individuals / society										
Irreplaceability / uniqueness / scarcity value										
Cultural or symbolic meaning										
Scenic resources present in the study area										
Protected / conservation areas in the study area										
Sites of special interest present in the study area										
Economic dependency on scenic quality										
Local jobs created by scenic quality of the area										
International status of the environment										
Provincial / regional status of the environment										
Local status of the environment										
**Scenic quality under threat / at risk of change										

**A rating above '5' for this factor will trigger the need to undertake an assessment of cumulative visual impacts.

Low				Moderate										High
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Based on the above factors, the study area is rated as having a low visual sensitivity. This is mainly owing to the relatively uninhabited character of the area and the presence of road, rail and electricity transmission infrastructure which would likely reduce the scenic quality of the area. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. As described below, a number of potentially sensitive receptors are present in the study area.

Several solar energy facilities are proposed within relatively close proximity to the proposed project. As such, an assessment of the cumulative impact that will be experience from each potentially sensitive receptor is included in Section 11.

8.5.2 Sensitive Visual Receptor Locations

A sensitive receptor location is defined as a location, from where receptors would potentially be adversely impacted by a proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described above, the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of the proposed PV facility into a 'view', which may affect the 'sense of place'. The identification of sensitive receptors is typically undertaken based on a number of factors which include:

- the visual character of the area, especially taking into account visually scenic areas and areas of visual sensitivity;

- the presence of leisure-based (esp. nature-based) tourism or sites with historical and cultural value in an area;
- the presence of sites / routes that are valued for their scenic quality and sense of place;
- the presence of homesteads / farmsteads in a largely natural settings where the development may influence the typical character of their views; and
- feedback from interested and affected parties, as raised during the public participation process conducted as part of the EIA study.

A distinction must be made between a receptor location and a sensitive receptor location. Receptor locations are sites from where the proposed PV energy facility may be visible, but the receptor may not necessarily be adversely affected by any visual intrusion associated with the development. Receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include; tourism facilities, scenic sites and residential dwellings in natural settings.

Generally, the visibility of the development would diminish exponentially over distance. In order to account for this distance bands were used to assign zones of visual impact from the proposed development site. As such, the proposed development would be more visible to receptors located within a short distance and these would experience a higher adverse visual impact than those located at a moderate or long distance from the proposed development. The distance of a sensitive receptor location from the proposed development site was taken into account when rating the visual impact of the proposed development on these potential receptors.

Based on the height and scale of the project, as well as the investigations undertaken during the fieldwork, the radii chosen to assign these zones of visual impact are as follows:

- 0 < 500m (high impact zone);
- 500m < 2km (moderate impact zone); and
- 2km < 5km (low impact zone)

During the EIA phase VIA, a number of potentially sensitive visual receptors were identified. These are indicated in Figure 43 below and each receptor is identified by a specific number (e.g. VR 1 = Visual Receptor 1). Of the potentially sensitive visual receptors identified, two (2) receptor locations were identified as being sensitive within the study area due to their cultural and historical value, namely the Tiger Kloof Educational Institution and Arthington Memorial Church (VR 7 and VR 9 respectively).

The Tiger Kloof Educational Institution was established in 1904 and has subsequently been declared a provincial heritage site. Today Tiger Kloof is regarded as a flourishing educational institute which provides primary as well as secondary school education. Some of the stone buildings and structures which were built as part of the original school can also still be found on the property today (Figure 41). The Arthington

Memorial Church was built in 1925 by Tiger Kloof's masonry instructor and forms part of the facilities within the Tiger Kloof Educational Institution (Figure 42). It must be noted that the Arthington Memorial Church has been proclaimed a national monument and will be regarded as a visually sensitive receptor location for this reason. As previously mentioned, the Tiger Kloof Educational Institution and the Arthington Memorial Church have been declared a provincial heritage site and national monument respectively and are therefore are regarded as visually sensitive due to their historical significance.

Figure 41: One of the original stone structures which can still be found at the Tiger Kloof Educational Institution

Figure 42: The Arthington Memorial Church which was built in 1925 by Tiger Kloof's masonry instructor. Today the church is a national monument.

During the EIA Phase site visit, several scattered farmsteads / homesteads which are used to house the local farmers as well as their farm workers were identified within the study area. These dwellings are located within a mostly rural or pastoral setting and the proposed development will likely alter the natural vistas experienced from these dwellings. It is important to note that these visual receptor locations are regarded as potentially sensitive to the proposed development as the degree of visual impact experienced from these locations will vary from one inhabitant to another, as it is largely based on the viewer's perception and sentiments toward the development. Factors influencing the degree of visual impact experienced by viewers at these locations include the following:

- Value placed by the viewer on the rural characteristics of the area.
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression) or negative (foreign objects degrading the natural landscape).
- Degree to which the viewer will accept a change in the typical pastoral character of the surrounding area.

As mentioned, only two (2) sensitive visual receptor locations were identified within the rural parts of the study area. This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area. In addition, the main concentration of human habitation in the study area is the Huhudi

informal/semi-formal settlement on the northern boundary of the assessment area. Although there is a relatively high concentration of receptors in this area, they are not regarded as sensitive to the visual impact of the proposed development due to the existing visual degradation within these areas.

A list of the visually sensitive and potentially sensitive receptor locations (including coordinates) that were identified during the EIA phase investigation are provided in the visual specialist report.

In many cases, roads, along which people travel, are considered to be sensitive receptor locations. The N18 highway which traverses the study area is considered to be a visually sensitive road as it is the main access road between Vryburg and Kimberley. In addition, this road may be used to access the Taung Skull World Heritage Site, located approximately 15km south-west of Taung. This site forms part of a UNESCO World Heritage Site as a skull of an early hominid child dating back 2.5 million years was unearthed at this site in 1924 (http://www.taungresort.co.za). The site also has extensive tourism potential as other natural wonders are present here, which include limestone cliffs and a collection of rock pools (the Blue Pools). The area is often frequented for a number of recreational activities such as hiking and abseiling and it is a popular picnic site (http://www.tourismnorthwest.co.za).

The relatively high volumes of motorists travelling along this road would be visually exposed to the proposed PV facility which lies just west of the N18.

Figure 43 below provides details of the sensitive visual receptor locations and roads that were identified within the study area.

Table 27**:** Visual receptor locations and roads sensitive to the proposed Sendawo Solar 1 PV energy facility

Name	Distance from the proposed PV development area or associated infrastructure	Visual Impact Zone
VR 7 - Arthington Memorial Church	Approximately 1.6km	Moderate
VR 9 - Tiger Kloof Educational Institution	Approximately 1.3km	Moderate
N18 National Road	Varies (approximately 850m at the closest point)	Moderate and Low

Other thoroughfares in the study area are primarily used by local farmers travelling to and from Vryburg. They are therefore not regarded as visually sensitive as they do not form part of any scenic tourist routes, and are not specifically valued or utilised for their scenic or tourism potential.

The potentially sensitive visual receptor locations in relation to the zones of visual impact are indicted in Figure 43 below.

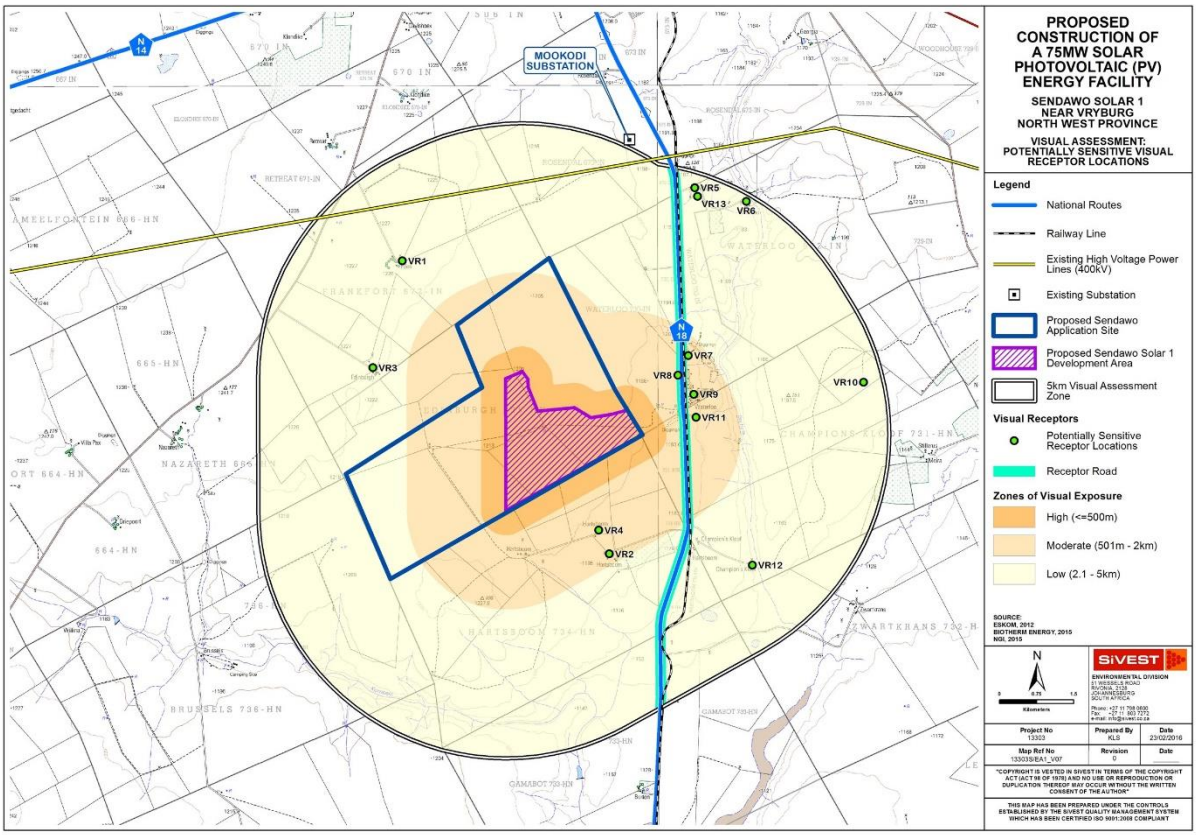


Figure 43: Potentially sensitive visual receptors within the study area

8.5.3 Impact Assessment

- **Visual Compatibility / Contrast**

The visual compatibility of the proposed development refers to the degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would conform with the land use, settlement density, structural scale, form and pattern of elements that define the structure of the surrounding landscape. The visual compatibility is an important factor to be considered when assessing the impact of the development within a specific context. A development that is incongruent with the surrounding area may change the character of the landscape, which could have a significant visual impact from key scenic views within the study area. Where a development corresponds with the surrounding environment the development would be easily absorbed by the surrounding environment and would result in little to no change in the visual character of the area.

As previously mentioned, the proposed development includes the construction of a 75MW export capacity solar PV facility which is aimed at feeding electricity back into Eskom's national grid. In general, the

development would not be consistent with the prevailing residential and pastoral land use within the surrounding area. However, the anthropogenic elements and built-up areas present within parts of the study area are expected to partially alter the visual character and baseline and make certain areas appear to have a more industrial-type visual character. As such, the proposed development would increase the urban footprint and current level of visual transformation within the study area, but the existing unnatural forms will lessen the degree to which the proposed development would be considered incongruent with the surrounding landscape. As a whole the proposed development would contrast with the natural earthly tones of the prevailing shrubland vegetation and create a dark grey / black mass within the relatively uniform flat landscape. However, if some or all of the other solar energy facilities that are proposed within relatively close proximity to the proposed project are also constructed, the visual contrast would be significantly less as the proposed development would conform with the scale and form of these facilities.

- **Receptor Impact Rating**

In order to assess the potential visual impact of the proposed development on the sensitive / potentially sensitive receptor locations identified during the field investigation, a matrix that takes into account a number of factors has been developed, and is applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the proposed development (distance banding)
- Presence of potential screening factors (topography, vegetation etc.)
- Location of the receptor in terms of zones of visual contrast

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive / potentially sensitive visual receptor within this context. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as a representation of the likely visual impact at a receptor location. This rating matrix is a relatively simplified way to assign a likely representative visual impact, which allows a number of factors to be considered. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact.

Table 28: Visual assessment matrix used to rate the impact of the proposed development on potentially sensitive visual receptors

	VISUAL IMPACT RATING			
VISUAL FACTOR	**HIGH**	**MEDIUM**	**LOW**	**OVERRIDING FACTOR: NIL**
Distance of receptor away from proposed development	0 < 500m **Score: 3**	500m < 2km **Score: 2**	2km < 5km **Score: 1**	5km <
Presence of screening factors	Limited or no screening factors – development highly visible **Score: 3**	Screening factors likely to partially obscure the development **Score: 2**	Screening factors likely to obscure most of the development **Score: 1**	Screening factors completely block any views towards the development, i.e. the development is not within the viewshed
Zone of Visual Contrast	**High:** The development would contrast highly with the typical land use and/or pattern and form of human elements (infrastructural form). Typically a natural / pastoral environment with low-density rural infrastructure present (low voltage power lines and farm boundary fences). **Score: 3**	**Moderate:** The development would contrast moderately with the typical land use and/or pattern and form of human elements (infrastructural form) and existing level of visual transformation. Typically areas within close proximity to other prominent infrastructure (high voltage power lines and railway lines) and within intensive agricultural lands / cultivated fields. **Score: 2**	**Low:** The development would correspond with the typical land use and/or pattern and form of human elements (infrastructural form) and existing level of visual transformation. Presence of urban form and industrial-type infrastructure. The area is not highly valued or sensitive to change (e.g. the outskirts of urban and built-up areas). **Score: 1**	

- Distance

As described above, distance of the viewer / receptor location away from the development is an important factor in the context of experiencing of visual impacts. A high impact rating has thus been assigned to receptor locations that are located within 0<500m of the proposed development. Beyond 5km, the visual impact would be virtually nil, as the development would appear to merge with the elements on the horizon. Any receptor location beyond this distance has therefore been assigned an overriding nil impact rating. As such, despite the impact rating assigned to the other visual factors, the overall impact rating would remain nil, as the proposed development would not visually influence any receptors located more than 5km from the development. Where a receptor is located within more than one distance band, such as a receptor road, it is assigned the score according to the closest distance it will get from the proposed development i.e. the highest visual impact experienced.

- Screening factors

The presence of screening factors is equally important in this context as the distance away from the development. Screening factors can be vegetation, buildings, as well as topography. For example, a grove of trees located between a receptor location and an object could completely shield the object from the receptor location. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is in close proximity, but not in its viewshed. As such, the complete screening of the development has also been assigned an overriding nil impact rating, as the development would not impose any impact on the receptor.

- Zones of visual contrast

The degree to which the proposed development would appear to contrast with the surrounding land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape is also considered in the matrix. The visual contrast is an important factor to be considered when assessing the impact of the proposed development from a specific location, as a development that appears contrasts with the visual backdrop may change the visual character of that landscape. This could have a significant visual impact on potentially sensitive visual receptors within the study area.

Based on the land use and visual character in the surrounding landscape, the area was assessed to determine the level of transformation and degree to which the proposed development would appear to be visually compatible with the surrounding environment when viewed from a particular location. In the context of this proposed development, the presence or absence of existing electrical infrastructure, dense settlement or other urban built-up form is an important factor influencing the level of visual contrast. For example, if the development was located adjacent to an existing substation or power line it would result in significantly less visual contrast. The study area was therefore classified into the following zones of visual contrast:

- **High** – undeveloped / natural / rural areas;
- **Moderate –** Intensive agricultural lands / cultivated fields or areas within 500m of existing power line, road or rail infrastructure in undeveloped / natural / rural area; and
- **Low –** within 1 km from visually transformed urban / built-up areas.

The outcome of the visual contrast classification in relation to the potentially sensitive visual receptor locations is provided in **Figure 44** below.

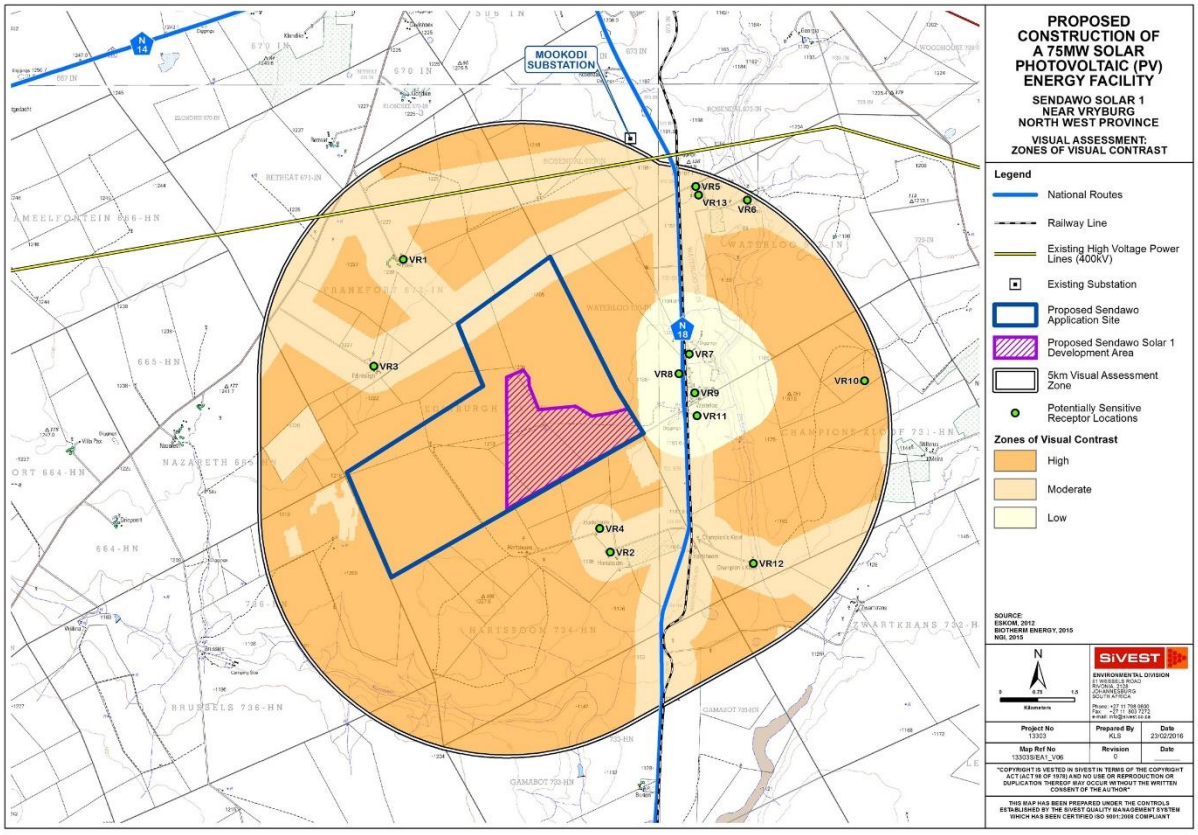


Figure 44: Zones of visual contrast

Table 29 below presents the results of the visual impact matrix

Categories of impact:

Rating	Overall Score
High Visual Impact	8-9
Moderate Visual Impact	5-7
Low Visual Impact	3-4
Negligible Visual Impact	(overriding factor)

Table 29: Visual impact of the proposed development on sensitive / potentially sensitive visual receptors within the study area

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 1	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 2	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 3	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 4	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 5	Low (1)	High (3)	Moderate (2)	**MODERATE**
VR 6	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 7 – Arthington Memorial Church	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 8	Moderate (2)	Moderate (2)	Low (1)	**MODERATE**
VR 9 – Tiger Kloof Educational Institution	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 10	Low (1)	High (3)	High (3)	**MODERATE**
VR 11	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 12	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 13	Low (1)	High (3)	Moderate (2)	**MODERATE**

As indicated above, the proposed development would result in a moderate visual impact on most potentially sensitive visual receptor locations with the study area (10 in total). It is important to note that the proposed development would have a low visual impact on both of the sensitive visual receptor locations, namely VR 7- The Arthington Memorial Church and VR 9 – Tiger Kloof Educational Institution. Although he development would be visible (to a degree) from all of the potentially sensitive visual receptor locations, it would not have a high impact on any and would exert a low impact on three (3) of the potentially sensitive visual receptor locations.

- **Night-time Impacts**

The visual impact of lighting on the nightscape is largely dependent on the existing lighting present in the surrounding area at night. The night scene in areas where there are numerous light sources will be visually degraded by the existing light pollution and therefore additional light sources are unlikely have a significant impact on the nightscape. In contrast, introducing light sources into a relatively dark night sky will impact on the visual quality of the area at night. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed PV energy facility at night.

The area surrounding the proposed development site is mostly uninhabited and as a result, relatively few light sources are present. The town of Vryburg and the informal/semi-formal settlement of Huhudi are the main source of light within the surrounding area, however they are located more than 5km away and are therefore expected to have a limited impact on the night scene. It must however be noted that the Tiger Kloof Educational Institution and the Arthington Memorial Church can be found within very close proximity to the application site and are expected to require a significant amount of lighting for security reasons. In addition, another prominent light source within the study area at night is the security lighting at the Eskom Mookodi MTS which, according to local farmers, can be seen at night from relatively far away. Other sources of light are limited to, isolated lighting from the surrounding farmsteads. In general, the study area is characterised by a picturesque dark starry sky at night and the visual character of the night environment is considered to be generally 'unpolluted' and relatively pristine.

Security lighting at night will be required for the proposed PV energy facility. The type and intensity of lighting required was unknown at the time of writing this report and therefore the potential impact of the development at night has been discussed based on the general effect that additional light sources will have on the ambiance of the nightscape.

Although the area is not generally renowned as a tourist destination, the relatively dark character of the nightscape will be sensitive to the impact of additional lighting at night, particularly from nearby farmhouses. The security lighting required for the proposed project is likely to intrude on the nightscape and create glare, which will contrast with the dark backdrop of the surrounding area. Existing night time views toward the proposed site from potentially sensitive receptors are characteristic of a relatively dark night scene with some light sources visible in the distance as well as those from the nearby Mookodi MTS and Tiger Kloof Educational Institution, as a result lighting impacts from the proposed solar energy facility will increase the existing light pollution in the surrounding area.

8.5.4 Summary of Visual Impacts

- **Access Roads**

A network of gravel access roads will also be constructed to provide access to the PV panels. As mentioned above, roads are typically only associated with significant visual impact if they traverse sloping ground on an aspect that is visible to the surrounding area. Considering the flat nature of the terrain on the site, it is likely that the visual impact associated with these roads would be limited to the impact of clearing the vegetation. However, if these roads are not maintained correctly during the construction phase, construction vehicles travelling along the gravel access roads could expose surrounding farmstead to dust plumes.

- **Underground cabling**

The visual impact of the underground cabling would be very similar to roads in that the 'scar' associated with the cable could create a visual contrast with the largely natural vegetation on the site. However, as the

PV panels are to be placed on flat terrain and there are no high ridges / high points on the proposed site, the visual impact of the cabling would be minimal. In spite of this it is recommended that all reinstated cable trenches should be re-vegetated with indigenous vegetation with shallow root systems, in order to reduce the potential for creating unnatural linear features in the environment.

- **On-site Substation**

A new on-site substation is being proposed as part of the PV energy facility development and will house transformers for voltage step up from medium voltage to high voltage. In isolation, the substations may be considered to be visually intrusive; however, it must be assumed that the on-site substation would be built to serve the needs of the power generated from the PV energy facility. Thus the substation would only be constructed if the PV energy facility was developed as well. The substation would likely form part of the PV complex, as viewed from the surrounding farmsteads. Views of the substation would therefore be dwarfed by the large number of PV panels that would be visible. As such, the substation is not expected to be associated with a significant visual impact, or even a measurable cumulative impact.

8.6 Heritage and Palaeontology

The full Heritage Assessment was conducted by Wouter Fourie and Gideon Groenewald from PGS and is included in Appendix 6F.

Fieldwork was conducted on the application site of the Sendawo Solar PV Project from 3-4 December 2015. The methodology focused of a tracked selective walkthrough of the foot print areas of proposed PV project application area (Figure 45). An accredited professional archaeologist, Miss Jessica Angel, completed the fieldwork. The fieldwork was done on foot and by vehicle.

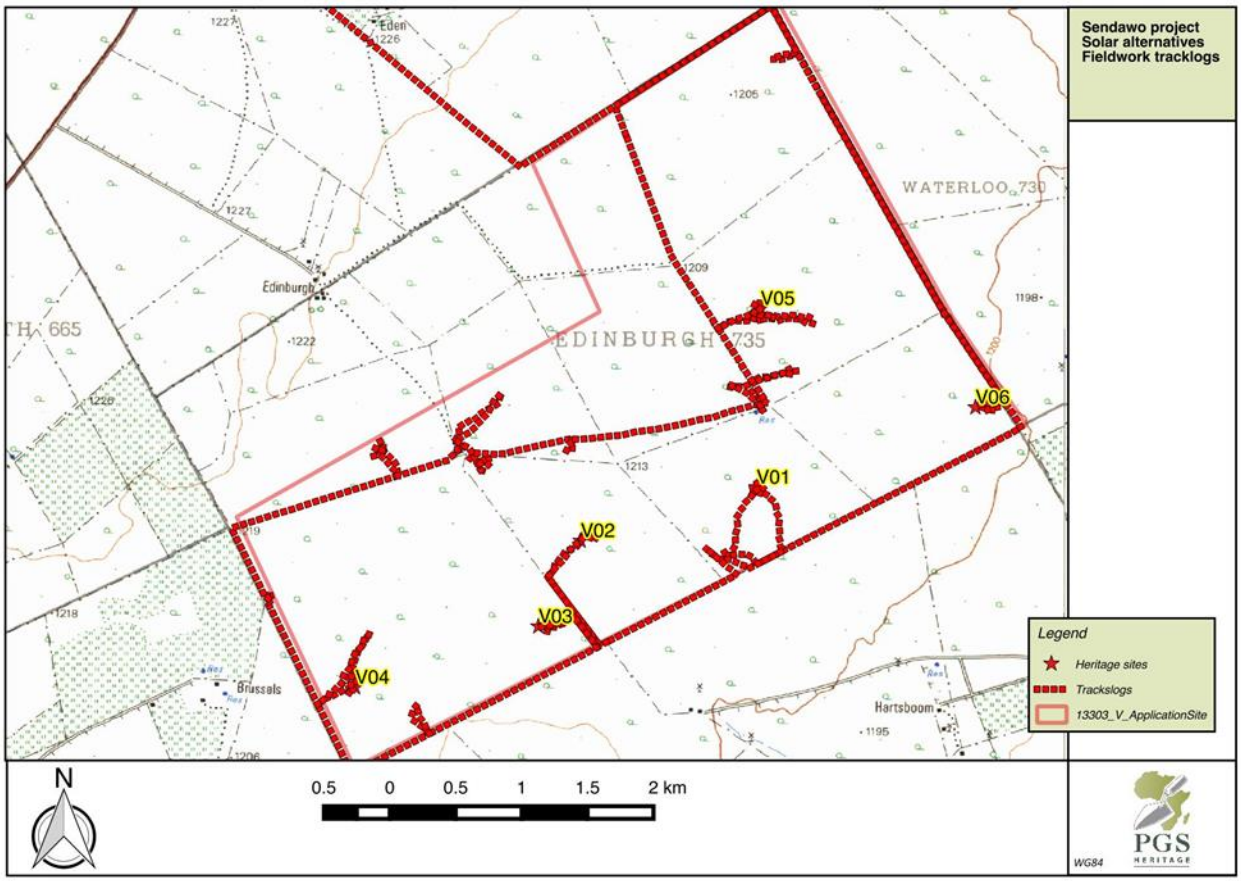


Figure 45: Fieldwork tracklogs

It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the heritage character of the area.

The field work that covered the Sendawo solar PV application site is an area of 17.1 square kilometres.

A total of 2 sites, which can be considered archaeological were logged in the Sendawo 1 footprint. Both of these resources relate to the Stone Age.

A general background scatter of Stone Age artefacts (lithics) occurring over the extent of the area, required a refinement of the methodology and the defining of what constitutes an archaeological site as appose to a findspot.

It was decided to use the density of lithics present on the ground to be the guiding rule towards elaborating on a findspot and defining it as an archaeological site. A find spot was classified as an area containing a density of more than 10 lithics per square meter, while a density of or than 20 lithics per square meter was deemed to be the trigger mechanism for converting a find spot to an archaeological site.

8.6.1 Description of area

The study area and surrounds is characterised by low vegetation growth dispersed over fairly flat terrain. Dominating the surface area are vast exposed pebble layers usually associated with low rises in the landscape. Drainage lines and flat surface are characterised by red sand cover in between the exposed pebble layers.

Figure 46: View of general area. This area is a pan than revealed archaeological materials

Figure 48: General view of the area, dried pan with no archaeological finds

Figure 47: View of general area

Figure 49: Dried riverbed. At this location a substantial amount of LSA artefacts were located (V05)

8.6.2 Finds

The find spots varied from Later Stone Age (LSA) scatters consisting of flakes, chips and some cores manufactured from fine-grained quartzite, chalcedony, and cryptocrystalline (ccs) material; Middle Stones Age (MSA) lithics consisting of cores, chips and flakes with a low occurrence of formal tools. The majority

of the material utilised were either lideanite that occur in the form of medium sized boulders or round washed pebbles in the area or coarse-grained quartzite that occur as sporadic outcrops.

Earlier Stone Age (ESA) lithics found at some of these finds spots consisted of a hand axe, cleavers and large flakes. Most of the lithics were either rolled or heavily weathered with patination evident on many of the lithics.

Find spots, **V01**, and **V06** have a low significance, however the possibility of subsurface deposits cannot be discounted and was kept in mind with the development of the mitigation recommendations.

Table 30: Sites – Application footprint

Site number	Type	Longitude	Latitude	Description	Heritage Significance
V01	MSA site	24.726070°	-27.068260°	Medium density scatter of MSA lithics over an area of approximately 20 $m^{2.}$ The site is characterised by a large pebble concentration within a dry pan. The lithics assemblage is characterised by a large number of flakes and chips, while a small percentage of the material on site can be described as cores. The size of the site is about 60 $m^{2.}$	Grade 4B
V06	MSA site	24.742815°	-27.062160°	Low-density scatter. MSA core. The site is open air and characterised by the typical Savanna Biome and more specifically in the Ghaap Plateau Vaalbosveld Group.	Grade 4B

Figure 50: Site V01, MSA Lithics (silcrete and quartzite)

Figure 52: V06, Weathered quartzite MSA core.

Figure 51: Site V01, MSA quartzite core found at the same location as Figure 50

8.6.3 Palaeontological Fieldwork

During the fieldwork it was observed that most of the areas have little outcrop but an area at GPS stations 0482 to 0562 has significant outcrops of dolomite with both stromatolites and possible cave breccia (Table 31).

Table 31: Photographic observations during fieldwork session

Photo	GPS station no (Figure 53) and coordinates	Description	Picture
1	(0452) -27° 03' 51.8" 24° 43' 46.3"	Calcrete outcrop covered by thin sandy soils, no outcrop, no fossils observed	
2	(0462 -27° 03' 41.2" 24° 43' 35.2"	Typical dolomitic terrain with water point on fault zone associated with calcrete outcrops on dolomite	
3	(0472) -27° 03' 24.5" 24° 43' 34.8"	Calcrete on dolomite, wetland area possibly under water during wet season, close to spring	
4	(0482) -27° 03' 20.2" 24° 43' 32.5"	Shallow soils on stromatolitic dolomites and chert. Wetland area with indication of flooding during wet season, old spring that dried up during 2016. No significant fossils observed, but clear indication of human activity	

5	(0482) -27° 03' 20.2" 24° 43' 32.5"	Chert and stromatolitc dolomite at site of historically known spring that dried up for the first time in human memory during 2016	
6	(0482) -27° 03' 20.2" 24° 43' 32.5"	Deep sandy soils on dolomite. Circular excavations at site of spring ion dolomite.	
7	(0482) -27° 03' 20.2" 24° 43' 32.5"	Ash layers at6 the site of the historic spring, possibly indicating an attempt to drill a borehole with a percussion drill. Ash clearly the remains of coal, with nearest outcrop of coal at Pretoria, several hundred kilometres to the east of the site.	
8	(0492) -27° 03' 48.1" 24° 44' 16.4"	Significant Aardvark or similar animal burrows associated with fault zone in dolomite. Possible site to find cave breccia and fossils. To be confirmed by geotechnical investigation. Any new finds must to be recorded by the ECO.	

9	(0492) -27° 03' 48.1" 24° 44' 16.4"	Relatively large entrances to an underground chamber obviously occupied by large animals.	
10	(0502) -27° 03' 42.6" 24° 44' 09.7"	Dense tree growth at sites of possible cave breccias on dolomite fault zone	
11	(0512) -27° 03' 44.4" 24° 44' 28.2"	Calcrete with river gravel and cobblestone. Indication of old river channel.	
12	(0522) -27° 03' 42.5" 24° 44' 39.2"	Well-defined stromatolites in situ. Area must be excluded from planned development and it is recommended that structures be preserved in situ.	

13	(0522) -27° 03' 42.5" 24° 44' 39.2"	Scale of stromatolites and the configuration of the structures gives a very clear picture of the ancient seabed at the time of formation of these structures millions of years ago. A no-go area of 100 meters must be demarcated around this point.	
14	(0522) -27° 03' 42.5" 24° 44' 39.2"	The relatively small area where the fossils are found warrants the exclusion of this site from the proposed development.	
15	(0592) -27° 02' 02.7" 24° 43' 43.1"	Deeper red sandy soils in possibly Tertiary Aged river bed. outcrops are mostly shale and quartzite outcrops with minor stromatolitic dolomites	
16	(0602) -27° 01' 53.9" 24° 43' 38.0"	Deep red soils on shale and quartzite with minor dolomites, no fossils observed	

17	(0612) -27° 01' 57.5" 24° 43' 31.9"	Shallow sandy soils on shale and quartzites with minor dolomite. No fossils observed.	
18	(0622) -27° 02' 19.2" 24° 42' 57.8"	Deeper sandy soils, windblown sand on shale and quartzites, minor dolomite and no significant fossils observed	
19	(0632) -27° 02' 23.8" 24° 42' 56.0"	Deep soil and Aardvark burrows in sandy zone. Geotechnical investigation might reveal cave breccia site	

During the fieldwork period several well-defined finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded (Table 31). Confirmation of the significance of new sites will only be possible after completion of the geotechnical surveys.

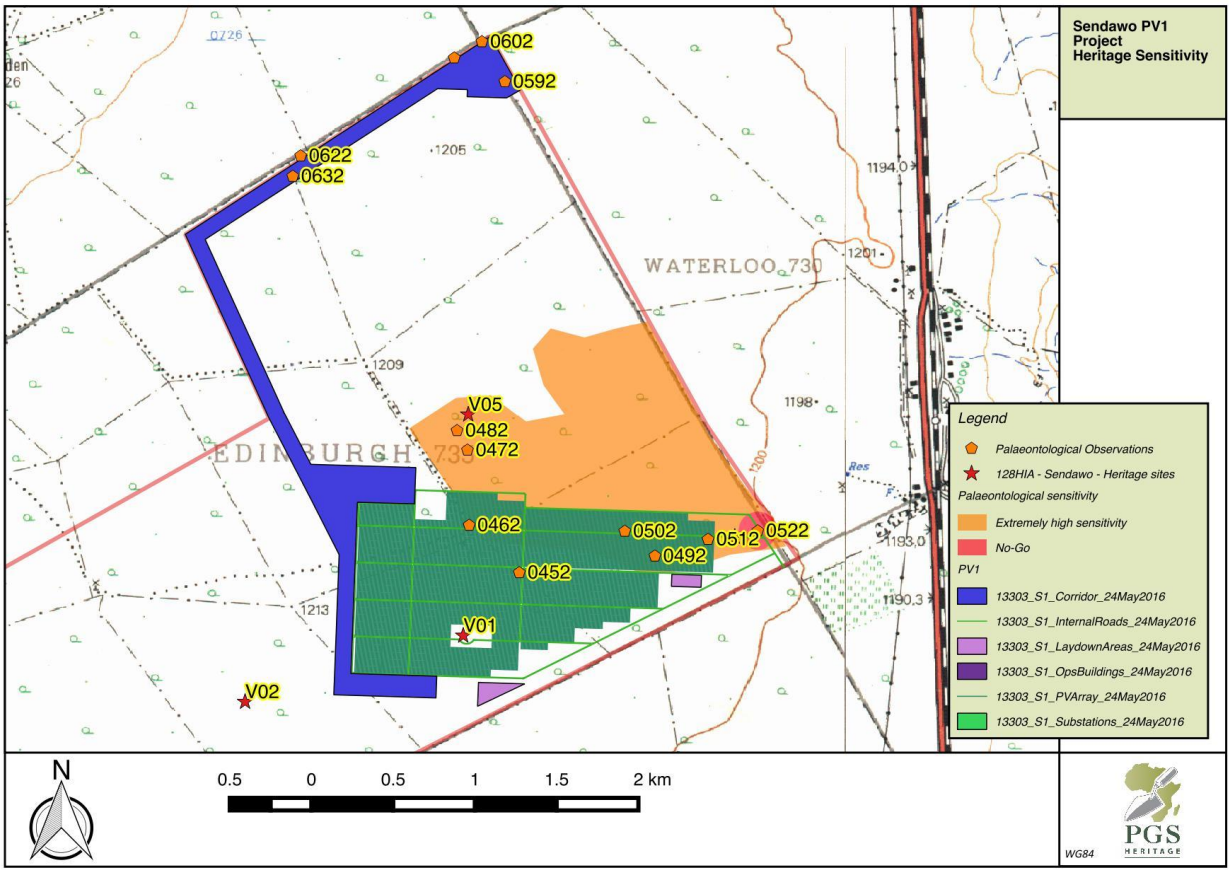


Figure 53: Heritage resource finds and sensitivities

8.6.4 Assessment

The fieldwork findings have shown that the study area is characterised by a background scatter of Stone Age artefacts. The methodology utilised in the identification and classification of finds between find spots and sites enable a clear distinction between groupings.

A small part of the study area is characterised by the presence of significant Stromatolites and that stromatolites are present in almost all the dolomite boulders on site. Some areas have possible remains of cave breccia but no in situ outcrops were recorded. Based on the fieldwork findings, an extremely high palaeontological sensitivity area has been delineated in the south eastern section of the proposed project area. The palaeontological finds around point 0522 are seen as the most significant of the area and can give a heritage grading of Grade 2 (Provincial Heritage Site) but potentially Grade 1 (National Heritage Site).

It must be kept in mind that the fieldwork could in no way identify all heritage resource within the development footprint and as such the fieldwork has shown that the possibility of encountering other Stone Age archaeological and palaeontological resources are extremely high.

8.7 Socio Economic

The full Social Assessment was conducted by Mariette Steynberg and Elena Broughton from Urban Econ Development Economists and is included in Appendix 6G.

The following paragraphs provide the socio-economic profiles of the farm portions where the proposed project is planned to be constructed.

8.7.1 Land-use profile

Figure 54 shows the farm portion earmarked for development of the proposed Sendawo PV facilities, with the Sendawo 1 array highlighted. The primary data were gathered from the site visit that took place between 2 December 2015 and 4 December 2015.

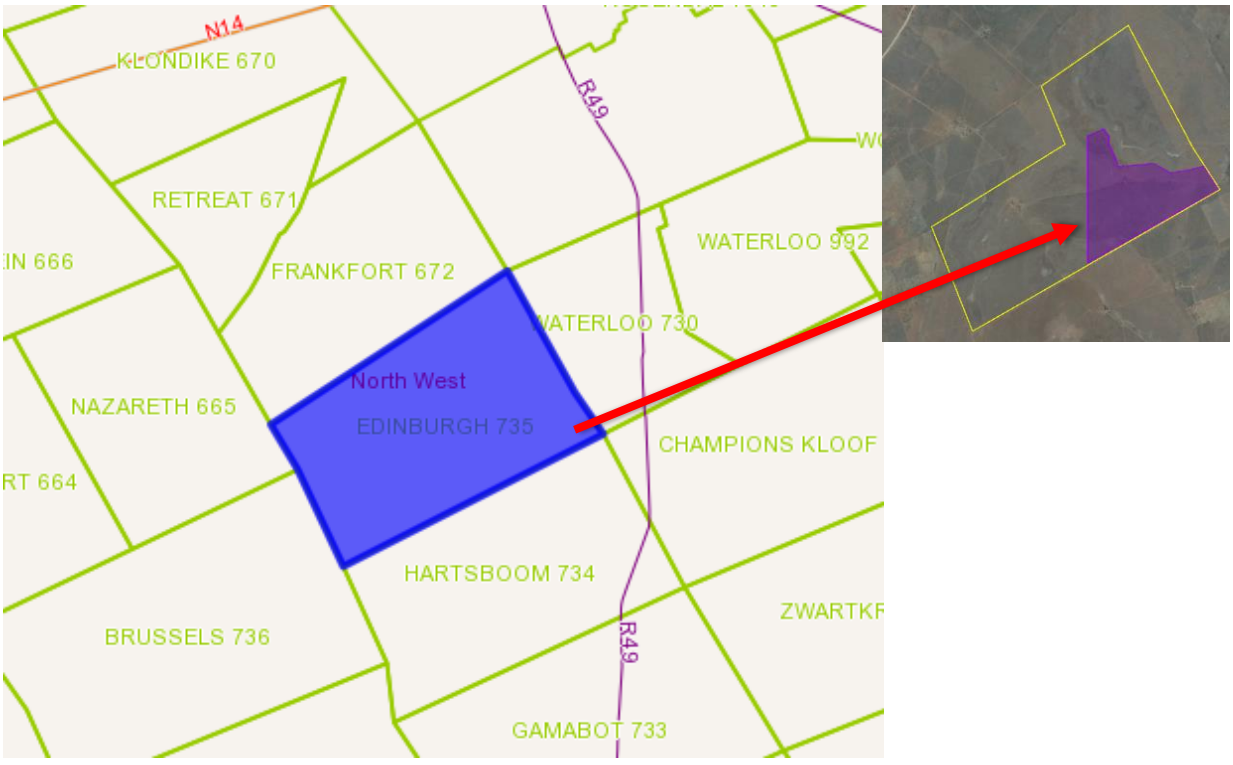


Figure 54: Farms directly and indirectly impacted by the proposed Sendawo 1 PV facility project (Chief Surveyor-General, 2016)

- **Portion 1 and Remainder of Farm Edinburgh 735**

Portion 1 and Remainder of Farm Edinburgh 735 is currently in the Edinburgh Trust together with various other family farms. Mrs Adele Oberholzer is the nominated beneficiary of Portion 1 of Farm Edinburgh 735; she manages and operates the agricultural activities taking place on the farm. The farms in the family trust have been in the family for four generations. The development is proposed to be located on Portion 1 of the Farm Edinburgh; the Remainder of the Farm Edinburgh does, however, belong to the same land owner with the economic activities taking place across the farm portions. No distinction can therefore be made between the two farm portions. The consultation with the land owner revealed the following.

- **Demographics and residence:** There is one residence on the farm, where the land owner's elderly mother stays. No workers reside on the farm.
- **Economic activities:** The land is primarily used for cattle and game breeding. Some hunting takes place during the winter months but this is an insignificant part of the business. The particulars of the commercial farming activity include:
  - Between 15 and 20 buffalos for breeding.
  - A breeding herd of Sable Antelope with 25 bulls.
  - Other game is uncounted, roaming freely.
  - Approximately 150 breeding cows for the weaner market.
  - The total operations employ two individuals from Huhudi on a permanent basis.
  - Casual labour is employed as required and varies; the average is five per day as needed.
  - All labour is paid well above the minimum wage requirement.
- **Services:** The farm uses borehole water; electricity is supplied by Eskom. Solar power is used for electric fences and security.
- **Concerns raised:** The following concerns were raised by the land owner during the consultation process:
  - During construction and operation, all access gates to the farm will have to be kept close to prevent game from escaping. This is a major concern.
  - The proposed PV farm would have to be carefully fenced according to the standard for game fences to ensure that the animals can graze on the rest of the Farm Edinburgh without causing damage to the Sendawo development. The land owner has made it clear that no responsibility will be accepted from her for any damage of this kind.
  - Stock theft and personal security, especially as far as it applies to the elderly female residing on the farm.
  - Water currently extracted from the borehole cannot be used for the proposed project and alternative means to acquire access to water for the operations of the PV facility will need to be sought by the developer.
- **Community observations:** The land owner made the following observations about the broader community:
  - The biggest problem facing the surrounding community is the lack of proper education.

- Initially, agricultural activities in the area attracted hopeful job seekers. Farmers are now employing less individuals or even laying off some. As a result, there are some individuals with no other experience but farming, who cannot find jobs in the agricultural sector and who do not possess any skills to be employed in other industries.

- **Farm Waterloo 730**

Farm Waterloo 730 is a private property, on which a government school (i.e. the Tiger Kloof School) is located. It is an institution with a rich history.

The information gathered from the consultation with the Tiger Kloof School director, Mr Mark Boobbyer can be summarised as follows:

- In total, 800 ha of Farm Waterloo 730 is leased out, 50 ha is used for the school and related buildings, and the remaining 350 ha is used for the school farm and the adventure training and camp that started at the end of 2015.
  - Portion 4 of Farm Waterloo, the area directly adjacent to the proposed Sendawo application site, is leased to the land owner of Remainder of Farm Hartsboom. The analysis of socio-economic activities of this portion is combined with that of Farm Hartsboom.
  - Remainder 3 of Waterloo 730 is leased to a farmer, Mr Seeco. Mr Seeco only farms on this land in the area.
- The current school director's tenure is set to end in June 2016. Although he has done significant work at the school since 2012; it is not foreseen that his departure will negatively impact on the operations at the school.
- **School operations:**
  - The school has 680 learners, of whom 170 are boarders. The school plans to expand in the future.
  - The school employs 100 individuals including educators and auxiliary staff. Of these individuals, 20% are government employees. A significant portion of the educators are Zimbabwean.
  - The school's biggest source of financial support is from a Swiss Trust.
  - A fee is payable at the school, although a significant proportion of the pupils are disadvantaged, coming from Huhudi and surrounds.
- **The school farm operations:**
  - The church attracts a lot of tourists. The church, along with the Tiger Kloof School Hall, is rented out for weddings and other functions. Although this venture only started in 2015, it has proven to be very popular.
  - The adventure camp and training centre is a new venture too but is showing significant potential and attracting big interest. The maximum capacity at the camp is 60 beds.
  - The farming and tourism activities being operated by the school are not yet profitable.
- **Services:** The school uses borehole water and has a grid connection.

- **Concerns and issues raised:**
  - A negative impact on the supply of borehole water.
  - The school will not grant permission for any sort of access road without receiving compensation.
  - Although not raised by the stakeholder, the potential negative impact of the proposed PV facility on the tourism activities operated by the school should be considered.

The following information was gathered from consultation with Mr. Seeco during the site visit in December 2015:

- The total area leased is 500 ha. Only 250 ha is shown on the lease agreement signed with the school; the other 250 ha is being considered for the potential development of another RE project.
- The lessee is not aware of other available land should the current land become unavailable to him.
- **Demographics and residence:** No one resides on this portion of land.
- **Economic activity:**
  - The lessee is using the land for the grazing of cattle. Usually the land is utilised at its full carrying capacity; lower than usual cattle was grazing during December due to the drought.
  - The lessee is employing one full time worker and one-part time worker. These workers receive a minimum wage.
- **Concerns raised:**
  - The possibility of stock theft as the presence and movement of people in the area increases is the biggest concern.
  - Possible negative impact on the water supply since the animals are drinking the borehole water.

- **Portion 1 of Farm Championskloof 731**

The portion 1 of Farm Championskloof 731 that could be impacted indirectly by the proposed Sendawo development is leased to the owner of Farm Hartsboom 731. This landowner therefore operates commercial agricultural activities across the Farms Hartsboom, Portion 1 of Championskloof and Portion 4 of Waterloo. Discussion of these operations is provided under Farm Hartsboom 734.

- **Remainder of Farm Hartsboom 734**

As mentioned, the owner of Remainder of Farm Hartsboom 734, Mr Nico Van Rooyen, is also leasing Portion 4 of Farm Waterloo 730 and Portion 1 of Farm Championskloof 731. The following information was gathered from the consultation with the stakeholder during the site visit in December 2015.

- **Demographics and residence:**
  - The owner and his family reside on the farm.
  - Farm Hartsboom has been in his family for two generations.

- **Economic activity:**
  - The current lease contract is for three years with the option of extension. It has been in place for six years previously.
  - The leased land is used mainly for grazing of game, which mostly comprise of antelope family animals such as Kudus, Rooibokke, etc.
  - Farm Hartsboom is used for cattle breeding (i.e. 200 breeding cows).
  - The leased land hosts an additional 70 breeding cows.
  - The farming operations employ four permanent workers; they receive a minimum wage.
- **Services:** The farm uses borehole water. Eskom supplies electricity, but solar power is used for the electric gates.
- The **concerns** raised are:
  - The most likely and most probable access road to the proposed project is not ideal, it will split the grazing land on Portion 4 of Farm Waterloo 730 and Portion 1 of Farm Championskloof 731 in two.
  - The impact of dust on the residence. This is a concern not only during the construction phase but also once the facility reaches operations, since vegetation will be removed for the solar PV facility to be established. He is concerned about wind blowing sand in the direction of the farm and the residence.
  - Noise disturbances: any possible noises to be kept to office hours.
  - Increased risk of theft and other social ills as the number of construction workers present in the area and on site increases.
  - Concerned about water availability and sand erosion. According to the stakeholder it is especially significant as his farm is at an incline with the other farm.
  - The land owner raised the issue that if vegetation on the proposed site is removed, firebreaks will need to be established. The project proponent must ensure that the correct measures are implemented since it could impact the entire community if not managed.

- **Remainder of Farm Brussels 736**

Remainder of Farm Brussels 736 is a family-owned farm that belongs to the Kromkloof Trust. Ms Jill Blackwood, who is a sister of the nominated beneficiary of the farm where the proposed project is to be located, is a beneficiary of Remainder of Farm Brussels 736 and Farm Frankfort 665. As advised by the beneficiary of the farm, her brother, Mr Malcolm Blackwood and his wife reside illegally on Remainder of Farm Brussels 736, which they also use for farming. Consultation with Ms Blackwood and Mrs Oberholzer revealed that they are in the process of evicting Mr Blackwood off the land.

The consultation with Mr Blackwood, which took place during the site visit in December 2015, revealed the following:

- Mr. Blackwood's daughter, Linda, is a beneficiary of the Edinburgh Trust, with the land portion known as Eden bequeathed to her. Eden is part of Remainder of 1 of Frankfort 672, which is

directly adjacent to the proposed project site on the north-west side. He is thus farming on Eden and Remainder of Farm Brussels 736.

- Remainder of Farm Brussels 736 is approximately 2 000 ha, and Farm Eden 1 000 ha.
- **Demographics and residence:**
  - Mr Blackwood and his wife reside on the farm.
  - Six families of workers employed on the farm reside on the farm.
- **Economic activity**
  - In total, the farming operations include approximately 300 heads of cattle and 50 heads of game from the antelope family.
  - During the site visit, some small-scale farming with sheep, pigs, and chickens close to the residence was also observed. These are believed to be used primarily for subsistence.
  - The aim is eventually to offer hunting activities at the farm.
  - The total operations employ six individuals. They receive above minimum wages.
- **Concerns raised:**
  - Increased risk of livestock theft.
  - Disturbance of peace. Currently their residence is fairly remote; they are concerned what may happen if the movement of people increases as a result of the construction activities.
  - Water supply: the borehole water supply to the farm is already irregular.

The consultation with Ms Blackwood, the beneficiary of the farm, raised the concern over the security risk for both human and stock theft. She does not foresee the proposed project, and the potential need for the relocation of the game belong to Mrs. Oberholzer to the Middelkop Safaris grazing land, impacting negatively on the level of her current economic activities associated with Middelkop Safaris.

- **Remainder of Farm Nazareth 665**

Remainder of Farm Nazareth 665 is not directly adjacent to the Sendawo proposed project site, but it shares boundaries with Remainder of Farm Edinburgh 735, which may host the proposed project on a portion of it. It forms part of the Edinburgh Trust., whose trustees include Mrs Adele Oberholzer, her mother, and their lawyer. A portion of Remainder of Farm Nazareth belongs to the lawyer, with his mother, Mrs Hanna Kruger, residing on Portion 3 of Nazareth 665. The farm is not used for any commercial economic activity.

- **Portion 2, Remainder, and Remainder of 1 of Farm Frankfort 672 (excluding Eden)**

Farm Frankfort 672 is administered by the Kromkloof Trust. Ms Jill Blackwood and Mrs Adele Oberholzer have a joint venture called Middelkop Safaris, which is operated from Portion 2 and Remainder of Farm Frankfort 672. They each also operate their own farming operations as indicated previously. The land owner is not concerned that the proposed project would negatively impact on any of her current economic activities. The biggest concern raised applies to personal security and the risk of stock theft.

- **Summary and the zone of influence**

In general, with respect to the current land use, it can be concluded that the immediate study area is mainly used as grazing land. The proposed development is thus, slightly in conflict with the current land use, as it may result in sterilisation of the agricultural land from its current potential. The concern would be to ensure that the development of the PV facility does not unduly negatively impact on the level of agricultural activity currently taking place in the area.

Some low-intensity tourism activities are in the early stages of operation at the Tiger Kloof School. The installation of the proposed PV facility may negatively impact on the tourism potential at this site. However, it should be noted that the rural natural characteristic of the area is already partially degraded by visible railway lines, a road, and bulk electrical infrastructure.

Although all of the land owners and lessees discussed above are adjacent and potentially indirectly affected properties; the location of the proposed Sendawo 1 PV array means that the impact will most likely be limited to only a few of the farms and farm portions. These include:

- Farm Hartsboom 734, and due to the nature of operations on this farm also Portion 4 of Farm Waterloo 730 and Portion 1 of Farm Championskloof 731
- Portion 3 of Farm Waterloo 730
- The Tiger Kloof School

It should also be highlighted that should the Sendawo 1 development be approved, it will have an impact on the existing land uses taking place on the rest of the Farm Edinburgh 735. For the purpose of the study, it is assumed that only Sendawo 1 is implemented. The discussion on the possibility and level of the impacts that may ensue should all three Sendawo developments be approved will be discussed in length under the section that will deal with cumulative impacts of the development of the solar PV industry in the broader study area.

8.7.2 Access to infrastructure

Consultation with the land owner of the farm where the proposed project is to be developed revealed that Farm Edinburgh 735 is connected to the national electricity grid; however, solar power is used for the electric fences and other security matters. The farm uses borehole water, and it was expressly stated by the land owner that this water will not be made available for use during construction and operation of the proposed Sendawo 1 project. Provision of water to the project would thus be something that must be provided for in the final design of the project's infrastructure requirements.

The only option available for access to Sendawo 1 is currently small farm tracks. Should it be negotiated to use these for access to the proposed site; these roads will need to be upgraded.

8.8 Traffic

The Traffic Assessment was conducted by Hermanus Steyn of Aurecon and is included in Appendix 6I.

8.8.1 General Freight Requirements

- **Legislation**

The general limitations on road freight transport are currently:

- Axle load limitation of 7,7t on front axle, 9,0t on single rear axles.
- Axle unit limitations are 18t for dual axle unit and 24t for 3 axle unit.
- Bridge formula requirements to limit concentration of loads and to regulate load distribution on the vehicle.
- Gross vehicle mass of 56t. This means a typical payload of about 30t.
- Maximum vehicle length of 22m for interlinks, 18,5m for horse and trailer and 13,5m for a single unit.
- Width limit of 2,6m.
- Height limit 4,3m.

Abnormal permits are required for vehicles exceeding these limits.

- **Solar Facility Freight**

Materials and equipment transported to the site comprise of:

- Building materials (concrete aggregates, cement and gravel).
- Construction equipment such as piling rigs and cranes.
- Solar panels (panels and frames).
- Transformers and cables.
- Inverters possibly containerised.

The following is anticipated:

(a) Building materials comprising of concrete materials for strip footings or steel piles will be transported using conventional trucks which should adhere to legal loading limits.
(b) Solar Panels and frames will probably be transported in containers using conventional heavy vehicles within the legal limits from nearest South African port. The number of loads will be a function of the capacity of the solar farm and the extent of the frames.
(c) Transformers will most probably be transported by abnormal vehicles from the nearest South African port.

8.8.2 Traffic Statement

It is estimated from experience on other similar projects that the number of heavy vehicles per 1MW installation would be between 15 and 20 heavy vehicle trips depending on the site condition and foundation requirements. The total trips for the 75 MW plant would be between 1100 and 1500 heavy vehicle trips. These trips would be made over an estimated period of 12 months.

In the worst case the number of heavy vehicle trips per day would be in the order of 5 to 10 trips. The impact of this on the general traffic would therefore be negligible as the additional peak hour traffic would be at most 2 trips.

Personnel during construction is estimate to be 400 and will most likely reside in Vryburg as the closest community or alternatively a compound on site or close by. It is recommended that the majority of construction personnel is transported to and from site by means of buses and some by private vehicles.

Assuming that busses with an average of 20 passengers will be used to transport personnel, the personnel transport will contribute to approximately 15 to 25 daily trips of which 50% is assumed to be within the traffic peak hour.

The additional peak hour trips during construction would therefore be in the order of 10 to 15 vehicles (2 transporting equipment and 12 transporting construction personnel)

After construction, the generated site traffic would be limited to operational and maintenance support, with only a few light vehicles per day.

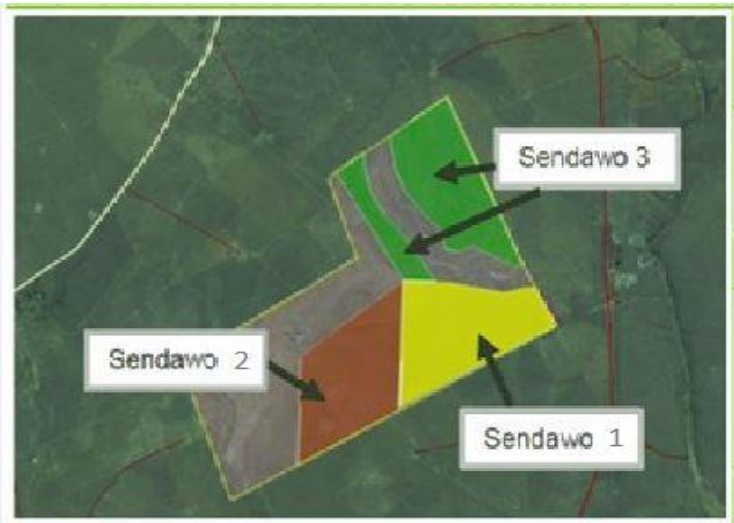
Access to the site will be from the N18. The current available Annual Average Daily Traffic (AADT) traffic volumes on N18 is estimated from the 2013 SANRAL yearbook for the station approximately 30 km North-West from Vryburg. It is estimated to be around 2000 and a maximum hourly flow of about 200 veh/h according to data interpolated from SANRAL traffic counts in the greater Vryburg area.

It can therefore be stated that the construction traffic of less than 20 vehicles during the peak hour (<10% impact) and the post construction traffic of less than 5 vehicles per day (<3% impact) would have almost no noticeable impact on the existing traffic service levels.

8.8.3 Sendawo Solar PV Energy Facilities - Access Route

- **Site Description**

The site description is as follows:



Location	27°03'33.57"S 24°43'27.62"E
Distance from Vryburg Distance from Schweizer-Reneke	7.5 km 65 km
Generation Capacity	3x75MW
Distance from Ports Durban Port Elizabeth/Coega Saldanha	 828 km 925 km 1150 km
Farm	Portion 1 of Farm Edinburgh 735

Figure 55: Site Description for Sendawo Solar PV Energy Facilities

The site is proposed to be developed in three separate phases as seen in Figure 55 above. These will however be assessed separately as they may or may not be implemented at the same time.

- **Preferred Route from Port**

The route for transportation of imported equipment is either from Port Elizabeth/Coega or Durban with the latter having a shorter travelling distance of only 828 km. The preferred route avoids busy towns such as Kroonstad and was therefore chosen as the preferred route.

An alternative route from the port indicated in red in Figure 56 below can also be utilised if the preferred route is unavailable due to maintenance or any other reason. The two routes are similar in length, where the alternative route passes through Kroonstad, Bothaville and Wolmaransstad.

It should be noted that the Ports Authority also has preferences on freight import, which should be considered.

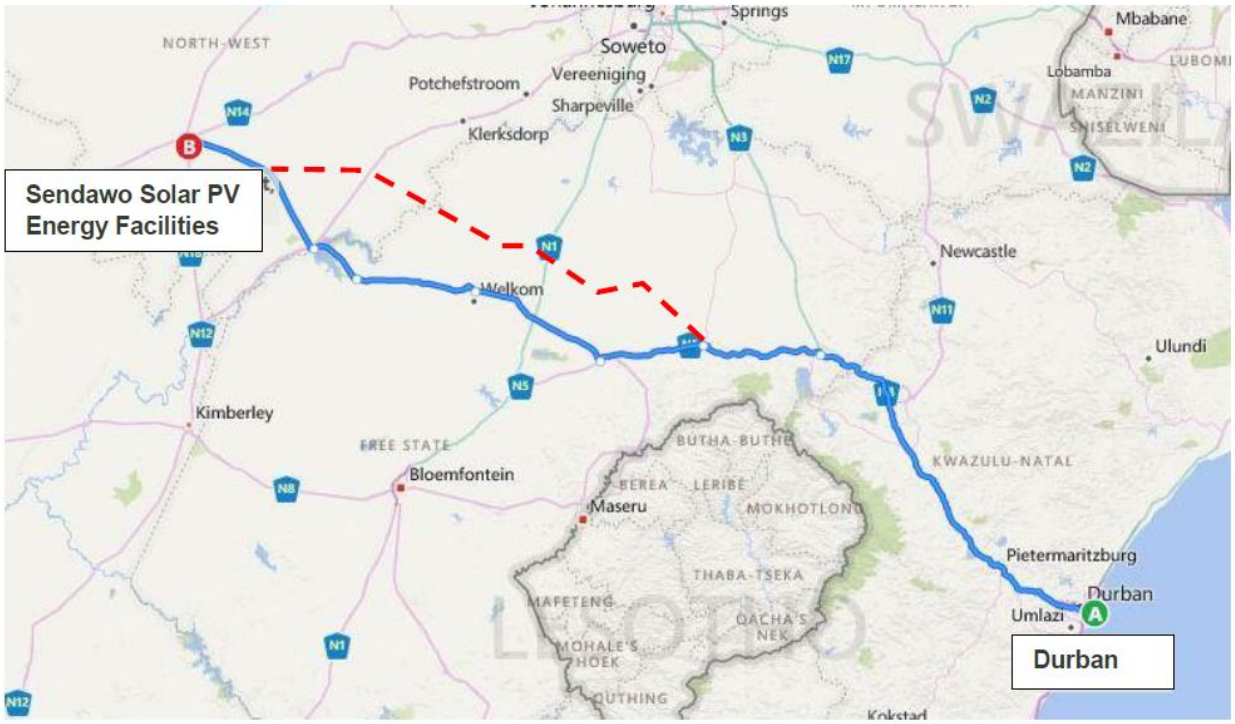


Figure 56: Preferred Route from Port

The Preferred Route's elements are shown in the Traffic Specialist Report.

- **Route from Alternative Port**

Should the preferred port not be available for any reason – especially in view of the large volume of wind turbine equipment currently imported, then the Port Elizabeth/Coega Port could be used as alternative. The route from Port Elizabeth (a distance of 925km) is shown in Figure 57.

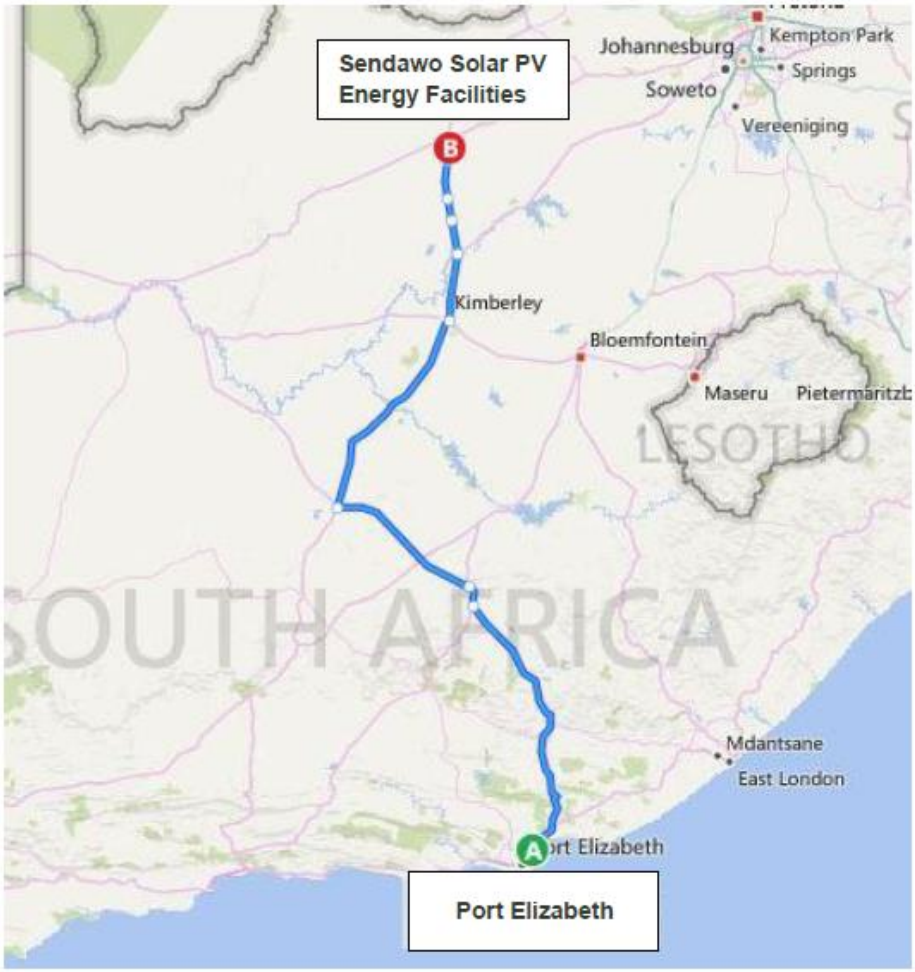


Figure 57: Alternative Port Route

- **Route for Construction Materials**

Material sources for road building and concrete works is available in Vryburg and all material will most likely be transported from these and possibly other surrounding towns on the National and Provincial roads. If not it will have to be transported from larger manufacturing centres discussed below.

- **Routes from other Larger Manufacturing Centres**

The other main manufacturing centres include:

- Greater Johannesburg area (Modderfontein, Edenvale, Nigel, Germiston, Brakpan, Elandsfontein) for inverters and support structures.
- Cape Town – greater metropolitan area for some of the components.

The routes to the site from these centres are predominantly on Provincial and National roads. There are no limitations on normal freight within the legal limits on these routes.

- **Authority and Permit Requirements**

The following is noted:

a. Toll fees are required on the routes from the port. On the routes from the other manufacturing centres certain portions of the national routes are also tolled which will require toll fees. Toll fees are estimated at approximately R550 per heavy vehicle with 5+ axles for a single one-way trip.
b. Abnormal permit(s) will be required for the transport of the transformer by the logistics contractor for each province as these are issued by each Provincial Authority. The estimated total permit value will be a function of the actual vehicle configuration as well as the convoy requirements, but is estimated at R9000 – R15000 per trip. This application process would take approximately a month to complete and should be applied for once the project has reached financial close.

- **Route Limitations of the Preferred Route from the Port**

The identified routes have possible limitations that will require more detailed investigations to determine the level of upgrading that will be required (if any) to accommodate the abnormal loads. All the possible limitations will potentially be encountered on the gravel roads from the N18 intersection to the prospective site, even though the length to be travelled on these roads are minimal. Other possible limitations might include: overhead power and telecommunication lines with an insufficient ground clearance, substandard geometry and drainage issues.

- **Site Access Road**

- Access to Road Network

The access to the site is proposed off the National Road N18. The access position could be at one of three positions, which should be approved by SANRAL as sufficient sight distances (stopping and shoulder) are present, as follows:

- **Access Road Option 1:** Off the N18 in the middle of the Sendawo 1 Solar PV Energy Facility. There is an existing road where minor upgrades will be required along approximately 1km of the road as well as an upgrade of the intersection itself. The location of the access to the newly proposed road is shown in Figure 58 below.

Figure 58: Sendawo 1 Solar PV Energy Facility - Access Option 1

- **Access Road Option 2:** Off the N18 just north of the Sendawo 1 Solar PV Energy Facility. There is an existing road where minor upgrades will be required along approximately 3km of the road. The intersection will also require an upgrade. The location of the access to the newly proposed road is shown in the Figure 59 below.

Figure 59: Sendawo 1 Solar PV Energy Facility- Access Option 2

The different options are indicated in the following figure:

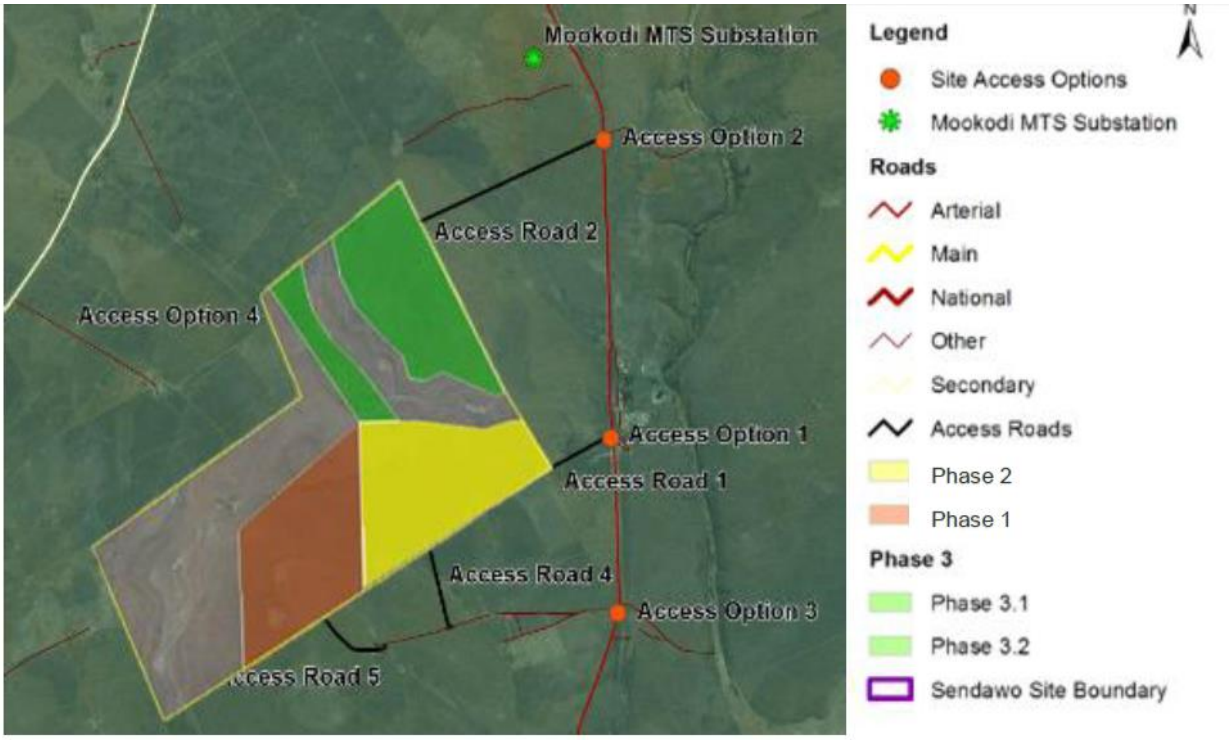


Figure 60: Sendawo Solar PV Energy Facilities - Access Options and Access Roads

- **Preferred Access Route**

All of the access options illustrated above are considered to be viable from environment and technical viewpoints, however access option 1 is preferred because it is situated in the middle of the Sendawo 1 Solar PV Energy Facility and requires the least upgrades. Regardless of the project phase, each site will be reachable from this access. An application for using any of the accesses must be submitted to SANRAL. These alternatives must be investigated in further detail at a later stage.

The access road should be upgraded to at least a 5m width (preferable 6m with sufficient shoulders) finished with a gravel wearing course layer.

- **Structures and Services**

Existing structures and services such as drainage structures and pipelines will be evaluated at crossings and suitably strengthened if required.

The site drains to the west. Suitable drainage elements will be provided on the access road to ensure minimal disturbance of the existing drainage patterns.

- **Accommodation of Traffic during Construction**

During construction of the access, traffic will have to be accommodated as per SADC Road Traffic Signs Manual requirements. The following typical minimum signage requirements will have to be implemented to ensure safety if the road needs closure during construction on the public road.

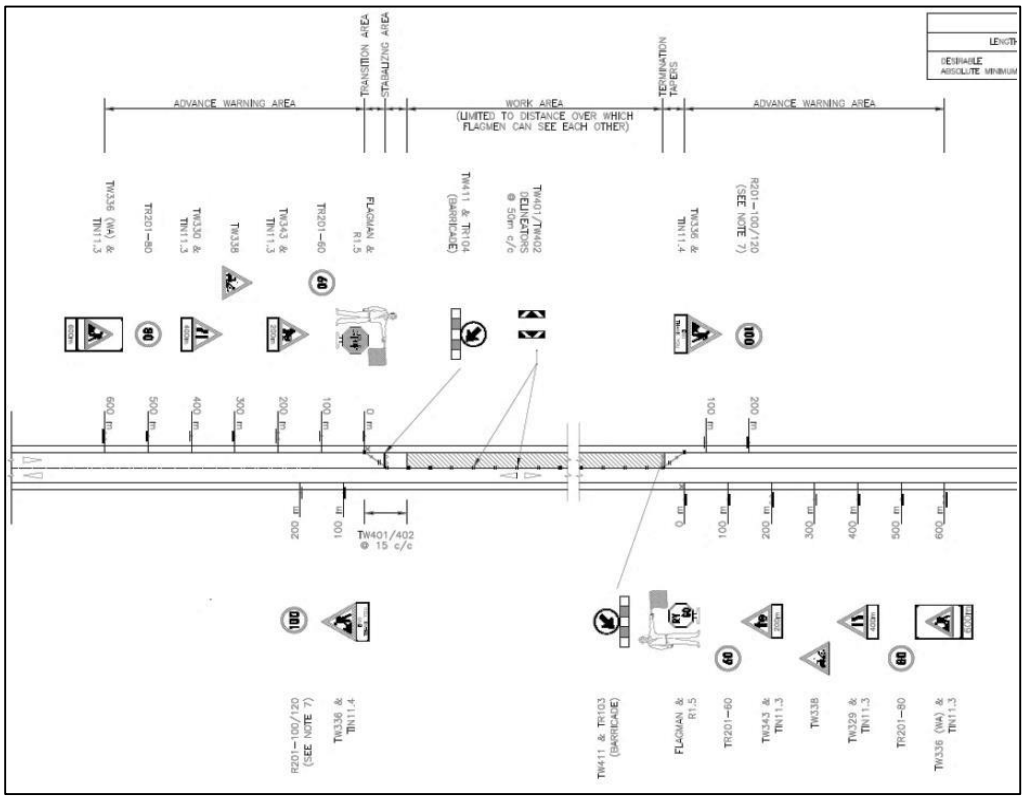


Figure 61: Accommodation of Traffic - Typical Layout

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 Methodology for Impact Assessment

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

9.1.1 Determination of Significance of Impacts

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 33.

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.

9.1.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- 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 has also been included.

- Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 32: Description

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 expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
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).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter 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.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects 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 and its effects 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 – 50 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 transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/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

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 (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

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. This describes the significance of the impact on the environmental parameter. 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.

Table 33: Rating of impacts

IMPACT TABLE FORMAT	
Environmental Parameter	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water
Issue/Impact/Environmental Effect/Nature	A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as A result of the proposed activity e.g. oil spill in surface water
Extent	A brief description indicating the chances of the impact occurring
Probability	A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity
Reversibility	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water
Irreplaceable loss of resources	A brief description of the degree in which irreplaceable resources are likely to be lost
Duration	A brief description of the amount of time the proposed activity is likely to take to its completion

IMPACT TABLE FORMAT		
Cumulative effect	A brief description of whether the impact will be exacerbated as a result of the proposed activity	
Intensity/magnitude	A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily	
Significance Rating	A brief description of the importance of an impact which in turn dictates the level of mitigation required	
	Pre-mitigation impact rating	**Post mitigation impact rating**
	Pre-mitigation impact rating	
Extent	1	4
Probability	1	4
Reversibility	1	4
Irreplaceable loss	1	4
Duration	1	4
Cumulative effect	1	4
Intensity/magnitude	2	2
Significance rating	-12 (low negative)	-48 (medium negative)
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analysing the significance. These measures will be detailed in the EMPr.*	

The 2014 regulations also specify that alternatives must be compared in terms of impact assessment.

9.2 Environmental Impact Assessment

9.2.1 Biodiversity

- Planning

No impacts are expected during planning.

- Construction

Table 34: Rating of impacts on indigenous natural vegetation for solar array and associated infrastructure

IMPACT TABLE

Environmental parameter	Indigenous natural vegetation	
Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of vegetation.	
Extent	The impact will affect natural vegetation on site and possibly in immediately surrounding areas.	
Probability	The impact will definitely happen.	
Reversibility	Irreversible in human timeframes, since natural successional processes cannot compensate for complete local loss of habitat and diversity. Secondary vegetation will probably never resemble the original vegetation found on site.	
Irreplaceable loss of resources	Significant loss of resources will occur.	
Duration	The impact will be permanent (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 transient.)	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.	
Intensity/magnitude	Medium. Regional vegetation will continue to function.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-38 (medium negative)	-38 (medium negative)
Mitigation measures	The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity: ▪ Compile a rehabilitation programme. ▪ Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.	

Table 35: Rating of impacts of loss of individuals of protected plants for all infrastructure components

IMPACT TABLE

Environmental parameter	Protected plants, as per NEM:BA and provincial legislation.	
Issue/Impact/Environmental Effect/Nature	Loss of individuals.	
Extent	The impact will affect local populations or individuals of the affected species.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible. Individuals can be rescued or else cultivated to replace lost specimens.	
Irreplaceable loss of resources	Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.	
Duration	The impact will be medium-term.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-9 (low negative)
Mitigation measures	The following mitigation measures would help to limit impacts: ▪ It is a legal requirement to obtain permits for specimens that will be lost. ▪ A pre-construction walk-through survey will be required to locate any protected plants. ▪ Plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the irreplaceable loss of resources as well as the cumulative effect. ▪ If any protected plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals.	

Table 36: Rating of impacts of loss of individuals of protected trees for all infrastructure components

IMPACT TABLE		
Environmental parameter	Protected trees, as per National Forests Act.	
Issue/Impact/Environmental Effect/Nature	Loss of individuals.	
Extent	The impact will affect local populations or individuals of the affected species.	
Probability	The impact may definitely happen.	
Reversibility	Irreversible. Individuals are not possible to be rescued.	
Irreplaceable loss of resources	Marginal loss of resources could occur. The species that occurs on site is relatively common throughout its range and only a small number of individuals were seen to occur on site.	
Duration	The impact will be permanent.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	5
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-9 (low negative)
Mitigation measures	The following mitigation measures would help to limit impacts: ▪ It is a legal requirement to obtain permits for specimens that will be lost. ▪ A pre-construction walk-through survey will be required to locate any protected trees and record information about each specimen.	

Table 37: Rating of impacts of damage to pans and drainage areas for all infrastructure components

IMPACT TABLE	
Environmental parameter	Pan
Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of vegetation.

Extent	The impact will affect pan depressions on site.	
Probability	Assuming total coverage of the target area, the impact will definitely happen.	
Reversibility	Irreversible in human timeframes, since natural successional processes cannot compensate for complete local loss of habitat and diversity. Secondary vegetation will probably never resemble the original vegetation found on site.	
Irreplaceable loss of resources	Marginal loss of resources will occur.	
Duration	The impact will be permanent (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 transient.)	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of habitat.	
Intensity/magnitude	Medium. Wetland systems will probably continue to function, but in a modified way.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	4	2
Irreplaceable loss	2	2
Duration	4	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-34 (medium negative)	-10 (low negative)
Mitigation measures	The following mitigation measures would help to limit impacts: ▪ Avoid depression areas by siting the infrastructure to avoid these areas. ▪ Prevent erosion impacts on wetland systems. ▪ Rehabilitate disturbance as quickly as possible. ▪ Prevent invasion by alien plants. ▪ As part of the environmental auditing undertaken during the construction phase, the ECO should monitor to evaluate whether further measures would be required to manage the impacts on the onsite pans.	

- Operation

Table 38: Rating of impacts of the establishment and spread of declared weeds

IMPACT TABLE		
Environmental parameter	Vegetation and habitat	
Issue/Impact/Environmental Effect/Nature	Loss of habitat due to invasion by alien plants	
Extent	The impact will affect habitat on site and possibly in immediately surrounding areas.	
Probability	The impact will probably happen in the absence of control measures.	
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.	
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.	
Duration	The impact will be long-term.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Medium. Severe invasion can alter the functioning of natural ecosystems.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-11 (low negative)
Mitigation measures	▪ Compile and implement an alien management plan. ▪ Undertake regular monitoring to detect alien invasions early so that they can be controlled. Implement control measures.	

- Decommissioning

It is expected that the project will operate for a minimum of twenty years or more (a typical planned life-span for a project of this nature). Decommissioning will probably require a series of steps resulting in the removal of equipment from the site and rehabilitation of footprint areas. It is possible that the site could be returned to a rural nature, but it is unlikely that natural vegetation would become established on site for a very long time. The reality is that it is not possible to determine at this stage whether rehabilitation measures

will be implemented or not or what the future plans for the site would be nor is it possible at this stage to determine what surrounding land pressures would be. These uncertainties make it impossible to undertake any assessment to determine possible impacts of decommissioning.

9.2.2 Avifauna

- Planning

No impacts are expected during planning.

- Construction

Table 39: Rating of impacts of displacement of priority species due to disturbance and habitat transformation

IMPACT TABLE	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.
Extent	Site = 1 The displacement impact will be restricted to the site.
Probability	Definite = 4 The impact will definitely occur.
Reversibility	Barely reversible = 3 The impact is unlikely to be reversed as the habitat transformation after the construction phase will be significant. Many species will not be able to re-colonise the area.
Irreplaceable loss of resources	Significant loss of resources = 3 The impact on priority species will result in a significant loss of resources at a site level (see also discussion on cumulative impacts below).
Duration	Long term = 3 The impact is likely to continue for the duration of the operational phase.
Cumulative effect	High cumulative impact = 4 The cumulative impact will be high at a site level (see also discussion on cumulative impacts below)
Intensity/magnitude	High = 3 At a site level the functioning of the bird population will be severely impacted and for many species it will cease completely.
Significance Rating	18 x 3 = 54

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	-54 (High negative)	-51 (High negative)
Mitigation measures	▪ Construction activity should be restricted to the immediate footprint of the infrastructure. ▪ Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. ▪ Measures to control noise and dust should be applied according to current best practice in the industry. ▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.	

Table 40: Rating of impacts of displacement of priority species due to disturbance and habitat transformation.

IMPACT TABLE	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.
Extent	Site = 1 The displacement impact will be restricted to the site.
Probability	Definite = 4 The impact will definitely occur.
Reversibility	Barely reversible = 3 The impact is unlikely to be reversed as the habitat transformation after the construction phase will be significant. Many species will not be able to re-colonise the area.
Irreplaceable loss of resources	Significant loss of resources = 3The impact on priority species will result in a significant loss of resources at a site level (see also discussion on cumulative impacts below).

Duration	Long term = 3 The impact is likely to continue right through the operational life-time of the facility.	
Cumulative effect	High cumulative impact = 4The cumulative impact will be high at a site level (see also discussion on cumulative impacts below)	
Intensity/magnitude	High = 3 At a site level the functioning of the bird population will be severely impacted and for many species it will cease completely.	
Significance Rating	17 x 3 = 51	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	-54 (high negative)	-51 (medium negative)
Mitigation measures	▪ Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. ▪ The recommendations for the vegetation management as detailed in the botanical specialist report must be strictly implemented.	

- Operation

Table 41: Rating of impacts of collisions of priority species

IMPACT TABLE	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Mortality of priority species due to collisions with solar panels
Extent	Site = 1 The impact should only affect the site
Probability	Probable = 3 The impact will likely occur.
Reversibility	Partly reversible = 2 The impact is partly reversible but more intense mitigation measures are required.

Irreplaceable loss of resources	Marginal loss of resources = 2 The impact on priority species is likely to be moderate.	
Duration	Long term = 3 The impact is likely to continue right through the operational life-time of the facility.	
Cumulative effect	Medium cumulative impact = 3 The cumulative impact on priority species is likely to be moderate.	
Intensity/magnitude	Medium = 2 At a local level the functioning of the bird population will be moderately affected.	
Significance Rating	14 x 2 = 28 Negative low impact	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-22 (low negative)
Mitigation measures	▪ Monitoring should be implemented to search the ground between arrays of solar panels on a two-weekly basis for at least one year to determine the magnitude of collision fatalities. Searches should be done on foot. Searches should be conducted randomly or at systematically selected arrays of solar panels to the extent that equals 33% or more of the project area. Detection trials should be integrated into the searches. ▪ The exact protocol to be followed for the operational phase monitoring should be compiled by the avifaunal specialist in consultation with the plant operator and Environmental Control Officer before the commencement of operations. The exact scope and nature of the operational phase monitoring will be informed on an ongoing basis by the result of the monitoring and the EMPr will be updated accordingly. ▪ Depending on the results of the carcass searches, a range of mitigation measures will have to be	

	considered if mortality levels turn out to be significant, including minor modifications of panel and mirror design to reduce the illusory characteristics of solar panels. What is considered to be significant will have to be established on a species specific basis by the avifaunal specialist.

- Decommissioning

Table 42: Rating of impacts of priority species due to disturbance and habitat transformation associated with de-commissioning.

IMPACT TABLE		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.	
Extent	Site = 1 The displacement impact will be restricted to the site.	
Probability	Definite = 4 The impact will definitely occur.	
Reversibility	Completely reversible = 1 The impact will be completely reversible on de-commissioning of the plant provided the solar panels are all removed and the habitat allowed to recover over time.	
Irreplaceable loss of resources	Marginal loss of resources = 2 The impact on priority species will result in a minor loss of resources at a site level.	
Duration	Short term = 1 The impact is likely to last for a short time (0-2 years).	
Cumulative effect	Low cumulative impact = 2 The cumulative impact will be high at a site level (see also discussion on cumulative impacts below)	
Intensity/magnitude	Low = 1 At a site level the functioning of the bird population will be slightly impacted.	
Significance Rating	11 x 1 = 11	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1

Probability	4	3
Reversibility	1	1
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-10 (low negative)
Mitigation measures	• De-commissioning activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.	

9.2.3 Surface Water

- Planning

No impacts are expected during planning.

- Construction

Table 43: Impact rating for impacts related to the construction lay-down area and the wetland

IMPACT TABLE	
Environmental Parameter	Wetlands
Issue/Impact/Environmental Effect/Nature	Impacts associated with the construction lay-down area near to the wetland
Extent	Site
Probability	Possible
Reversibility	Partly reversible
Irreplaceable loss of resources	Marginal loss of resources
Duration	Medium term
Cumulative effect	Low cumulative impact

Intensity/magnitude	Medium	
Significance Rating	Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be further reduced.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	- 22 (low negative)	- 7 (low negative)
Mitigation measures	**Preventing Indirect Erosion, Sedimentation and Run-off Impacts** – In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used around the lay-down area to prevent run-off from the cleared proposed construction lay-down area flowing into the surrounding area and possibly, any nearby wetlands. This will additionally assist with preventing consequent erosion and sedimentation in susceptible surrounding areas.	

Table 44: Impact rating for construction vehicle and machinery degradation impacts to surface water resources

IMPACT TABLE	
Environmental Parameter	Wetlands
Issue/Impact/Environmental Effect/Nature	Vehicle and machinery degradation to wetlands
Extent	Site
Probability	Definite
Reversibility	Partly reversible
Irreplaceable loss of resources	Marginal loss of resources
Duration	Medium term
Cumulative effect	Medium cumulative Impact

Intensity/magnitude	Medium	
Significance Rating	Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced somewhat.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	- 30 (medium negative)	- 14 (low negative)
Mitigation measures	**Preventing Physical Degradation of the Wetland** – A water use license will be required before construction takes place and all stipulated mitigation measures and conditions of the WUL are to be implemented accordingly. Where a WUL permit has been issued as well as environmental authorization for construction of the access roads in and around the aforementioned wetlands, construction workers will only be allowed in the designated roads within and around the wetlands. Outside of the established roads within the wetlands, these areas are to be clearly demarcated as highly sensitive and no access into these areas is to be allowed. All wetlands in the proposed development site are to be designated as highly sensitive and will need to be clearly demarcated at all times. Access into the remaining wetlands not affected by the roads are also not to be accessed at all. **Preventing Soil Contamination** – No vehicles are to be allowed in the highly sensitive areas unless authorised. Should vehicles be authorised in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in	

	the highly sensitive areas. The study site is to contain sufficient spill contingency measures throughout the construction process. These include, but are not limited to, oil spill kits to be available, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby wetland or the associated buffer zone.

Table 45: Impact rating for construction phase human degradation of flora and fauna associated with surface water resources

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Human degradation to fauna and flora associated with the wetlands	
Extent	Site	
Probability	Probable	
Reversibility	Completely reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Medium term	
Cumulative effect	Low cumulative impact	
Intensity/magnitude	Low	
Significance Rating	Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be further reduced.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	- 11 (low negative)	- 6 (low negative)
Mitigation measures	**Minimising Human Physical Degradation of Sensitive Areas** – Construction workers are only allowed in designated construction areas and not into the wetlands designated as highly sensitive, unless the environmental	

	authorisation and respective water use license authorize them to do so. No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed, eaten or kept as pets. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed environmental control officer (ECO) is to be contacted should removal of any fauna be required during the construction phase. No "long drop" toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the wetland where these are required. Temporary chemical sanitation facilities must be placed over a bunded or a sealed surface area and adequately maintained to prevent pollution impacts. No water is to be extracted unless a water use license is granted for specific quantities for a specific water resource. No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive area. Appropriate safety measures as stipulated above must be implemented. No cement mixing is to take place in the wetland. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive area.

Table 46: Impact rating for construction phase degradation and removal of vegetation and soils associated with wetlands and the associated buffer zone

IMPACT TABLE	
Environmental Parameter	Wetlands

Issue/Impact/Environmental Effect/Nature	Degradation and removal of soils and vegetation associated with wetlands	
Extent	Site	
Probability	Definite	
Reversibility	Barely reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Long term	
Cumulative effect	Medium cumulative Impact	
Intensity/magnitude	Medium	
Significance Rating	Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced slightly.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	- 32 (medium negative)	- 30 (medium negative)
Mitigation measures	**Avoiding Direct Impacts to the Wetland** – The access roads should be amended if possible prior to finalization of the layout to avoid the wetland areas as well as the associated buffer zones, since it is apparent that sufficient space exists for roads to be re-aligned alongside the PV panels around pan wetlands 4 and 15. Should this not be able to be undertaken, roads established on the boundary and within the respective wetlands mentioned above will need to have specific erosion and sedimentation mitigation measures to prevent unnecessary potential impacts affecting the wetlands. Adequate structures must therefore be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used along the boundaries of the access roads to prevent sediment flowing into wetlands.	

	This will additionally assist with preventing consequent erosion.

Table 47: Impact rating for construction phase increased storm water run-off, erosion and sedimentation impacts

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Increased storm water run-off, erosion and increased sedimentation impacting on wetlands	
Extent	Site	
Probability	Definite	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Significant loss of resources	
Duration	Short term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low negative impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	1	1
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	- 39 (medium negative)	- 8 (low negative)
Mitigation measures	**Preventing Increased Run-off and Sedimentation Impacts** – Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future. An appropriate storm water management plan formulated by a suitably qualified professional must accompany the	

	proposed development to deal with increased run-off in the designated construction areas. In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used to prevent erosion in susceptible construction areas. All impacted areas are to be adequately sloped to prevent the onset of erosion. Importantly, special attention must be given and implemented at the recommendation of the ECO for site specific erosion, sedimentation and run-off mitigation measures at the edge of the buffer zones of the wetlands.

- Operation

Table 48: Impact rating for operation phase vehicle damage

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Vehicle damage to surface water resources	
Extent	Site	
Probability	Probable	
Reversibility	Barely reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Long term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	High	
Significance Rating	Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be further reduced slightly.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2

Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	3
Significance rating	- 48 (medium negative)	- 39 (medium negative)
Mitigation measures	**Minimising Vehicle Damage to the Wetland** – Potential impacts can be completely avoided by the routing of access roads outside of and away from the wetland and the associated buffer zone along the boundary of the proposed PV fields where sufficient space exists for this to be established. Where access through the wetland is unavoidable and is absolutely required, it is recommended that any road plan and associated structures be submitted to the relevant environmental and water departments for approval prior to implementation. The access roads that are environmentally authorised and have been permitted in terms of water use licensing in the highly sensitive area will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month in the rainy season (October to March). Additionally, after short or long periods of heavy rainfall or after long periods of sustained rainfall, the roads will need to be checked on an ad hoc basis for erosion. Rehabilitation measures will need to be employed should erosion be identified. Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the wetland. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland/surface water specialist must be obtained in this respect.	

- Decommissioning

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar potential impacts are therefore

expected to occur and the stipulated mitigation measures (where relevant) must be employed as appropriate to minimise impacts.

9.2.4 Agricultural Potential and Soils

- Planning

No impacts are expected during planning.

- Construction and Operation

Table 49: Rating of impacts (loss of potential)

IMPACT TABLE		
Environmental Parameter	Soil resources and associated agricultural potential	
Issue/Impact/Environmental Effect/Nature	The loss of agriculturally productive soil due to the establishment of the infrastructure of the PV project	
Extent	Confined to the site only	
Probability	It is probable that impacts will occur	
Reversibility	The impact will in all probability be partly to completely reversible if the infrastructure is removed.	
Irreplaceable loss of resources	No loss of irreplaceable resources.	
Duration	Long term, for the operational life of the project	
Cumulative effect	Negligible to no cumulative effects	
Intensity/magnitude	Low to medium – not to any significant degree.	
Significance Rating	A brief description of the importance of an impact which in turn dictates the level of mitigation required	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1

IMPACT TABLE		
Intensity/magnitude	2	1
Significance rating	-22 (negative low)	-10 (negative low)
Mitigation measures	Due to the prevailing low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be kept to a minimum, so that at least the effect on grazing land for livestock is reduced.	

Table 50: Rating of impacts (erosion hazard)

IMPACT TABLE		
Environmental Parameter	Increased hazard of soil erosion	
Issue/Impact/Environmental Effect/Nature	The loss of topsoil by being exposed to wind action due to construction processes	
Extent	Confined to the site only, but possibly in the broader vicinity, if not mitigated	
Probability	It is probable that impacts will occur	
Reversibility	The impact will in all probability be partly to completely reversible if the infrastructure is removed.	
Irreplaceable loss of resources	No loss of irreplaceable resources.	
Duration	Long term, for the operational life of the project	
Cumulative effect	Possible medium cumulative effects	
Intensity/magnitude	Medium – not to any significant degree, though some modification is possible	
Significance Rating	A brief description of the importance of an impact which in turn dictates the level of mitigation required	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	-42 (negative medium)	-9 (negative low)

IMPACT TABLE	
Mitigation measures	The main mitigation would be to ensure that physical disturbance caused by soil removal and/or re-distribution is kept to a minimum. In such an area of low rainfall and hot conditions, vegetation is fragile and often difficult to re-establish. The relatively sandy nature of the soils means that if exposed, there is a real hazard of soil removal by wind erosion, especially in the drier winter months. To combat this, any bare soil should be re-vegetated as soon as possible and preventative measures, such as soil covering and windbreaks, may also be required.

- Decommissioning

Agricultural impacts during the decommissioning phase are potentially similar to those during the construction phase.

9.2.5 Visual

- Planning

No impacts are expected during planning.

- Construction

Table 51: Rating of visual impacts of the proposed Sendawo Solar 1 PV energy facility (including associated infrastructure) during construction

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose visual receptors to visual impacts associated with the construction phase. The construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. In addition, vehicles and trucks travelling to and from the proposed site on gravel access roads would increase dust emissions. The increased traffic on

	the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. The visual intrusion of the construction activities could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N18 and visitors at the Arthington Memorial Church or Tiger Kloof Educational Institution. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the generally flat landscape. Wind blowing over these disturbed areas could therefore result in dust which would have a visual impact. The clearing of vegetation will be required for the installation of the PV panels. This is also expected to result in the generation of dust, alter the natural character of the surrounding area and therefore create a visual impact.	
Extent	Local / District (2)	
Probability	Probable (3)	
Reversibility	Completely reversible (1)	
Irreplaceable loss of resources	Marginal loss (2)	
Duration	Short term (1)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Low negative impact **After mitigation measures:** Low negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-24 (negative low)	-20 (negative low)

Mitigation measures	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Vegetation clearing should take place in a phased manner. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible. ▪ Limit the number of vehicles and trucks travelling to and from the proposed site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads. ▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles. ▪ Re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid. ▪ Temporarily fence-off the construction site (for the duration of the construction period).

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

- Operation

Table 52: Rating of visual impacts of the proposed Sendawo Solar 1 PV energy facility during operation

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	The proposed Sendawo Solar 1 PV energy facility could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations to visual impacts. The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the PV energy facility via gravel access roads and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from

	surrounding viewers. Security and operational lighting at the proposed PV energy facility could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the proposed PV energy facility could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N18 and visitors at the Arthington Memorial Church or Tiger Kloof Educational Institution.	
Extent	Local/district (2)	
Probability	Definite (4)	
Reversibility	Irreversible (4)	
Irreplaceable loss of resources	Marginal (2)	
Duration	Long term (3)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Medium negative impact **After mitigation measures:** Medium negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-36 (medium negative)	-36 (medium negative)
Mitigation measures	▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ As far as possible, limit the amount of security and operational lighting present on site. ▪ As far as possible, limit the number of maintenance vehicles which are allowed to access the site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads.	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

Table 53: Rating of visual impacts of the infrastructure associated with the Sendawo Solar 1 PV energy facility during operation

IMPACT TABLE		
Environmental Parameter	Visual Impact	
Issue/Impact/Environmental Effect/Nature	The infrastructure associated with the proposed Sendawo Solar 1 PV energy facility could exert a visual impact by further altering the visual character of the surrounding area and exposing sensitive visual receptors to visual impacts. The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the application site via gravel access roads in order to perform maintenance activities on the associated infrastructure and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting at the infrastructure associated with the proposed PV energy facility could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the associated infrastructure could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N18 and visitors at the Arthington Memorial Church or Tiger Kloof Educational Institution.	
Extent	Local / District (2)	
Probability	Probable (3)	
Reversibility	Irreversible (4)	
Irreplaceable loss of resources	Marginal loss of resources (2)	
Duration	Long term (3)	
Cumulative effect	Medium cumulative impact (3)	
Intensity/magnitude	Low (1)	
Significance Rating	**Prior to mitigation measures:** Low negative impact **After mitigation measures:** Low negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	2	2
Probability	3	2
Reversibility	4	4
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-15 (low negative)
Mitigation measures	▪ Light fittings for security at the proposed substation at night should reflect the light toward the ground and prevent light spill. ▪ The operations and maintenance (O&M) buildings should not be illuminated at night. ▪ Bury cables under the ground where possible. ▪ The O&M buildings should be painted with natural tones that fit with the surrounding environment. ▪ Select the alternatives that will have the least impact on visual receptors ▪ Limit the number of maintenance vehicles which are allowed to access the site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads. ▪ Non-reflective surfaces should be utilised where possible.	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

- Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

9.2.6 Heritage

- Planning

No impacts are expected during planning.

- Construction

Table 54 Rating of impacts – chance finds

IMPACT TABLE		
Environmental Parameter	Heritage Resources	
Issue/Impact/Environmental Effect/Nature	The possibility of encountering previously unidentified heritage resources and specifically Stone Age archaeological sites. As well as the impact on the identified archaeological sites	
Extent	Will impact on the footprint area of the development	
Probability	The fieldwork has shown that such a predicted impact will definitely occur	
Reversibility	Due to the nature of archaeological sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site	
Irreplaceable loss of resources	The development could lead to significant losses in unidentified and unmitigated site	
Duration	The impact on heritage resources such as archaeological sites will be permanent	
Cumulative effect	As the type of development impact on a large area, and other similar development in the area will also impact on archaeological sites the cumulative impact is seen as having a medium negative impact.	
Intensity/magnitude	The large scale impact on archaeological sites and will require mitigation work.	
Significance Rating	The overall significance rating for the impact on heritage resources is seen as significant pre-mitigation. This can be attributed to the very definite possibility of encountering more archaeological sites as shown through fieldwork. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a lower impact rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-28 (Low Negative Impact)	10 (Low positive Impact)

Mitigation measures	▪ Monitoring during construction by an archaeologist. Site visits should include an initial five (5) day visit and then one day every two (2) weeks during construction. ▪ Mitigation through archaeological excavations and collection

Table 55: Rating of Impacts on palaeontological resources

IMPACT TABLE	
Environmental Parameter	Palaeontological Resources
Issue/Impact/Environmental Effect/Nature	The presence of previously unidentified Palaeontological heritage resources and specifically Palaeontological sites as well as the impact on the identified palaeontological sites. A small section of extremely high sensitivity as well as a delineated no-go area occurs in the south eastern section of the project layout.
Extent	Will impact on the footprint area of the development but will have a significant impact on the National Heritage database
Probability	The fieldwork has shown that such a predicted impact will definitely occur
Reversibility	Due to the nature of palaeontological sites the impact is seen as irreversible, however mitigation could enable the exclusion of a small area to preserve the highly sensitive sites and collection of enough information to preserve the data from such a site
Irreplaceable loss of resources	The development could lead to significant losses in unidentified and unmitigated sites. Fossils can never be replaced
Duration	The impact on heritage resources such as palaeontological sites will be permanent unless mitigated by exclusion from this development
Cumulative effect	As the type of development impact on a large area, and other similar development in the area will also impact on palaeontological sites the cumulative impact is seen as having a major negative impact.
Intensity/magnitude	The large scale impact on palaeontological sites will require mitigation by exclusion of a small area from the proposed development
Significance Rating	The overall significance rating for the impact on heritage resources is seen as very high negative pre-mitigation. This can be attributed to the confirmed presence of significant

	stromatolites (around point 0522) and the very high possibility of encountering more palaeontological sites (in the delineated palaeontological zone) during geotechnical investigations. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating or even significant positive rating in the case where the no-go zone at 0522 is implemented.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	3
Probability	4	4
Reversibility	4	2
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	4	2
Intensity/magnitude	4	3
Significance rating	-96 (high negative)	+57 (high positive)
Mitigation measures	▪ Mitigation through exclusion of the no-go area around point 0522 as indicated. ▪ Micro siting in the delineated extremely high paleontological sensitivity area and palaeontological excavations and collection if Geotechnical Survey indicates necessity for mitigation. ▪ Monitoring during construction by palaeontologist if fossils are exposed during excavation of more than 1.5m of soil cover. Site visits should include an initial five (5) day visit and then one day every two (2) weeks during construction.	

- Operation

No impacts are expected during operation.

- Decommissioning

Heritage impacts during the decommissioning phase are potentially similar to those during the construction phase.

9.2.7 Socio-economic

- Planning

No impacts are expected during planning.

- Construction

Table 56: Rating of impacts of loss of productive agriculture land

IMPACT TABLE		
Environmental Parameter	The current economic activity on the directly impacted farm portion is game and cattle farming. Similar commercial agriculture activities are taking place on the farms directly adjacent to the Sendawo 1 array.	
Issue/Impact/Environmental Effect/Nature	Loss of productive agriculture land.	
Extent	The impact is only expected to affect the site.	
Probability	The impact will occur (greater than 75% chance).	
Reversibility	The impact is partly reversible but more intense mitigation is required.	
Irreplaceable loss of resources	The impact will result in significant loss of resources.	
Duration	The impact and its effects will continue and last for the entire operational life of the development, but will be mitigated by direct human action or natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact could contribute towards a significant cumulative effect as the food security is threatened due to lower beef production in the province as more PV facilities are developed.	
Intensity/magnitude	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).	
Significance rating	**Prior to mitigation measures:** Negative medium: The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** The proposed mitigation measures should achieve the desired low negative rating due to decreased intensity of the impact as the productive land negatively impacted is successfully managed.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4

Reversibility	2	2
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-34 (medium negative)	-17 (low negative)
Mitigation measures	• Consultation with the directly affected and adjacent land owners must be on-going to limit the effect on productive agriculture land. • The recommendations made by the other relevant specialists must be implemented where possible to ensure that the effects of the impact are minimised. • Areas of high agriculture potential should be avoided to curb the cumulative effect on food security.	

Table 57: Rating of impacts of temporary employment creation

IMPACT TABLE	
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment. The result is that although the area has sufficient labourers it is most likely limited to unskilled opportunities. The local community is not likely to have the skills required for the skilled and highly skilled job opportunities.
Issue/Impact/Environmental Effect/Nature	The impact will create at least 62 temporary job opportunities for the local community members and up to 130 employment opportunities in total.
Extent	The impact will affect the local community.
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).
Reversibility	The impact is completely reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Short-term – the impact and its effects will disappear once the construction period is over.
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time.
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the high levels of unemployment prevalent in the study area.
Significance rating	**Prior to mitigation measures:**

	Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** Promoting and ensuring local procurement of labour, goods, and services by the project proponent will increase the significance of the impact but it will remain Positive Low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	12 (low positive)	26 (low positive)
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • Public consultation and information sharing will ensure that the proposed development is understood, enabling those individuals with fitting skills, if any, to make their services and/or knowledge available to the project proponent. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.	

Table 58: Rating of impacts of skills development

IMPACT TABLE	
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment.
Issue/Impact/Environmental Effect/Nature	Employed individuals will benefit from on-the-job training and experience.
Extent	The impact will affect the local community
Probability	The impact will may occur (between 25% and 50% chance of occurrence)
Reversibility	The effect of the impact (increased experience and knowledge) is unlikely to be reversed.
Irreplaceable loss of resources	The impact will not result in any loss of resources

Duration	Permanent – knowledge and experience cannot be considered to stop over a certain period, the effect of the impact will continue indefinitely.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Individuals will work and gain experience for longer periods, or more local community members will gain employment.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the current low levels of skills and literacy in the study area.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The proposed mitigation measures should increase the significance of the impact to medium positive impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	4
Reversibility	3	3
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	16 (low positive)	36 (medium positive)
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation. • Knowledge sharing and on-the-job training should be viewed as a prerequisite, where feasible, for all contractors/service providers working on the project and employing local labour.	

Table 59: Rating of impact on living standard (due to temporary increase in income)

IMPACT TABLE

Environmental Parameter	Living standard, and a community's ability to afford health care and quality nutrition is greatly influenced by the income earned by that community. It is estimated that 12.9% of the households living in the Naledi LM is not receiving any income while two thirds are living on an income of less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	About 130 in total and 62 employment opportunities for the local community members will be created. The individuals hired for these positions, and their family members, will experience a temporary increase in living standards due to an increase in disposable income, albeit temporarily and short term.	
Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The positive effects of the impact are completely reversible, will cease to exist once the construction phase is completed	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Short term, the higher standard of living resulting from the increased disposable income is temporary, as the employment generating the income is temporary.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Employed individuals and their families will benefit from higher income for longer.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the employment creation in relation to the high levels of joblessness.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The mitigation, although positive measures to increase local benefit, does not change the significance of the impact's effect.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4

Intensity/magnitude	1	1
Significance rating	12 (low positive)	12 (low positive)
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.	

Table 60: Rating of impact of temporary increase in social pathologies

IMPACT TABLE	
Environmental Parameter	Large construction activities associated with projects such as these often attract large numbers of hopeful job seekers, which result in a change in demographics of the area, which is often associated with an increase in social pathologies or ills.
Issue/Impact/Environmental Effect/Nature	Although temporary in nature, the construction activities may attract migrant workers and job seekers if expectations are not managed.
Extent	The impact will affect the local community
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)
Reversibility	The impact is reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in significant loss of resources.
Duration	Medium term – the impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter.
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Migrant job seekers may therefore decide to stay in the area for longer with the activities attracting even more work seekers, making the changes of not finding employment even greater.
Intensity/magnitude	Impact alters the quality, use, and integrity of the system but the system still continues to function in a moderately modified way and maintains general integrity.
Significance rating	**Prior to mitigation measures:** Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:**

	Implementation of the mitigation measures decreases the significance rating resulting in an impact rating of negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	3
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-32 (medium negative)	-16 (low negative)
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.	

Table 61: Rating of impact on safety and security

IMPACT TABLE	
Environmental Parameter	The study area is characterised by rural nature. All of the land owners expressed concern about the increase of human movement and the impact this may have on their personal and business security.
Issue/Impact/Environmental Effect/Nature	Although temporary in nature, the construction activities may attract migrant workers and job seekers if expectations are not managed. All of these individuals will nor find employment with some of them deciding to stay in the area the risk of crime increases.
Extent	The impact will affect the local area or district.
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)
Reversibility	The impact is reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in marginal loss of resources.
Duration	Medium term – the impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter.
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Migrant job seekers may therefore decide to stay in the area for longer with the

	activities attracting even more work seekers, making the changes of not finding employment even greater.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system but the system still continues to function in a moderately modified way and maintains general integrity.	
Significance rating	**Prior to mitigation measures:** Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating resulting in an impact rating of negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-14 (low negative)
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. • During construction the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided. • Manage workers to ensure that they are only on site during the reasonable working hours.	

Table 62: Rating of impact of change in the sense of place

IMPACT TABLE	
Environmental Parameter	"Sense of place" consists of three elements: identity, attachment and dependence, with these aspects together impacting on an individual's cultural capital.
Issue/Impact/Environmental Effect/Nature	The directly and indirectly affected land owners will experience a negative change in sense of place, albeit small. This is not a concern raised at all during consultation with the land owners.
Extent	The impact will affect the local area or district.
Probability	The impact will certainly occur (greater 75% chance of occurrence).

Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources.	
Duration	Permanent – The impact can be considered indefinite.	
Cumulative effect	The cumulative impact on the sense of place could be a significant positive impact since the broader community's perception on the land use of the proposed site will be changed to a land use that create opportunities for all.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system/component in a way that is barely perceptible.	
Significance rating	**Prior to mitigation measures:** Negative low impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating, however, the impact remains to be rated as negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	4	4
Cumulative effect	4 (positive)	4 (positive)
Intensity/magnitude	1	1
Significance rating	-18 (low negative)	-15 (low negative)
Mitigation measures	• Adhere to the mitigation measures recommended by the visual, noise, and air quality specialists, this will limit the negative impact on sense of place of the directly and indirectly affected community members. • Ensure that expectations are carefully managed so that the perception of the proposed land use is not negatively affected by community members who feel that promises made have not been kept.	

Table 63: Rating of impact of temporary increase in production

IMPACT TABLE	
Environmental Parameter	The project requires capital investment during the construction phase, this CAPEX investment will stimulate the South African economy and create various other multiplier effects for production.

	The benefit to the local community will, however, be limited due to the specialised nature of the bulk of the inputs required.	
Issue/Impact/Environmental Effect/Nature	It is expected that a percentage of the total CAPEX requirement will be spent in South Africa, the local spent is not known at this stage of the project.	
Extent	The impact will affect the entire country.	
Probability	The impact will certainly occur (greater 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Short term: the impact will continue for the duration of the construction period.	
Cumulative effect	The impact could result in a significant cumulative impact. The national economy will be stimulated by the various investments. At the same time, the local economy may be able to achieve the economies of scale required for the development of a local support industry, increasing the benefit to the local economy.	
Intensity/magnitude	High, the investment value is considerate.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** No mitigation exists that will increase the significance rating of the impact. However, certain measures may be implemented that will increase the benefit to the local economy.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	45 (medium positive)	45 (medium positive)
Mitigation measures	• Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.	

Table 64: Rating of impact of upgrading of existing local road infrastructure

IMPACT TABLE

Environmental Parameter	The existing tarred roads are of a fair quality, however, some gravel roads exist which may be upgraded due to the project's associated infrastructure requirements.	
Issue/Impact/Environmental Effect/Nature	At this stage the detailed layout and design of the infrastructure associated with Sendawo 1 is not known, however, it can be expected that some of the gravel roads in the area will be upgraded to accommodate the proposed development.	
Extent	The impact will only affect the site.	
Probability	The impact may occur (between 25% and 50% chance of occurrence).	
Reversibility	The impact is partly reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Medium term: the upgrading of some roads may coincide with the construction of the proposed Sendawo 1 development. However, maintenance of the road networks cannot reasonably be expected to be the responsibility of the project proponent.	
Cumulative effect	The impact will result in insignificant cumulative effects.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive low impact. The anticipated impact will have minor positive effects. **After mitigation measures:** No mitigation exists for this impact, the rating remains at low positive.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	20 (low positive)	20 (low positive)
Mitigation measures	• No mitigation measures exist.	

Table 65: Rating of impact of temporarily increased traffic and the impact on road infrastructure

IMPACT TABLE	
Environmental Parameter	The traffic observed during the site visit is that what would be perceived to be common for a relatively quiet farming area. Big trucks were observed on a regular basis though, on the national routes closest to the proposed study area.

Issue/Impact/Environmental Effect/Nature	The construction of the proposed Sendawo 1 facility can be expected to impact on the amount of traffic on the local road network and could contribute toward sits deterioration.	
Extent	The impact will affect the local area/district	
Probability	The impact may occur (between 25% and 50% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact may result in marginal loss of resources.	
Duration	Short term: the impact and its effects will cease to exist once the construction period is completed.	
Cumulative effect	The impact could result in a significant cumulative impact. The development and construction of numerous PV facilities in the area would impact on the traffic numbers in the area and thus also the increased need for maintenance of the local road infrastructure	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative low impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure would retain the rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-13 (low negative)
Mitigation measures	• Where feasible, implement the mitigation measures recommended by the various other specialists to minimise the negative impacts of increased traffic during the construction period. • Limit construction activity to normal working hours and avoid activity over weekends as far as practically possible	

Table 66: Rating of impact of increased demand for social facilities

IMPACT TABLE

Environmental Parameter	The status quo in the area with regards to the provision of social infrastructure is that the study area does not have sufficient health infrastructure.	
Issue/Impact/Environmental Effect/Nature	If unmanaged, expectations about job opportunities during the construction of the proposed project may attract numerous migrant workers. The result will be increased pressure on the local social facilities.	
Extent	The impact will affect the local area.	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Medium term, the effect may last slightly longer than the construction phase since some migrant job seekers could linger in the area.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase. At the same time, the construction is not likely to all take place at the same time, increasing the length of the impact by acting as motivation for migrants to remain in the area longer in hopes of finding employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative low impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures**.** **After mitigation measures:** Implementation of the proposed mitigation measure would retain the rating at negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-13 (low negative)
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations.	

	• Ongoing consultation with the local municipality to prepare local authorities for the activity and the increase demands that may result from this.

Table 67: Rating of impact on service delivery

IMPACT TABLE		
Environmental Parameter	The Naledi LM has a housing backlog of 18%. Furthermore, there is also problems with the provision of adequate water, electricity, and sewerage provision.	
Issue/Impact/Environmental Effect/Nature	If unmanaged, expectations about job opportunities during the construction of the proposed project may attract numerous migrant workers. The result will be increased pressure on the local authorities to adequately provide basic services.	
Extent	The impact will affect the local area.	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Medium term, the effect may last slightly longer than the construction phase since some migrant job seekers could linger in the area.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase. At the same time, the construction is not likely to all take place at the same time, increasing the length of the impact by acting as motivation for migrants to remain in the area longer in hopes of finding employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative low impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure would retain the rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2

Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-13 (low negative)
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations. • Ongoing consultation with the local municipality to prepare local authorities for the activity and the increase demands that may result from this.	

Table 68: Rating of temporary increase in household disposable income

IMPACT TABLE	
Environmental Parameter	It is estimated that two thirds of the households in the Naledi LM earn less than R3 200 per month.
Issue/Impact/Environmental Effect/Nature	An estimated minimum of 62 households in the Naledi LM may temporarily benefit from an increase in disposable income directly as a result of the proposed development. Since skilled labour will most likely come from outside the local area, and even the province it can be stated that the rest of the impact's effects will be felt in the rest of South Africa.
Extent	The impact will affect the country
Probability	The impact will certainly occur (greater than 75% chance of occurrence).
Reversibility	The impact is completely reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Short term, the increased disposable income will disappear once the construction is completed.
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase. At the same time, the construction is not likely to all take place at the same time, increasing the length of the impact. The benefitting households will benefit for longer or more households will benefit.
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** The proposed mitigation measures will increase the benefit to the local community but will not change the significance rating of the impact.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	30 (positive medium)	30 (positive medium)
Mitigation measures	• Where possible, local labour should be used during the construction activities. • When feasible local procurement of goods and services should be implemented to further increase the benefit to the local community.	

Table 69: Rating of temporary increase in tax revenue for government

IMPACT TABLE	
Environmental Parameter	The government will benefit from an increased local tax base in the Naledi LM due to the proposed investment. This will increase the ability of the government to deliver on basic services.
Issue/Impact/Environmental Effect/Nature	The project proponent will have to pay taxes such as income taxes and payroll taxes. It cannot be said with certainty how this income will be applied, however, the government will no doubt utilise it to better service provision somewhere in South Africa.
Extent	The impact will affect the entire country
Probability	The impact will certainly occur (greater than a 75% chance of occurrence).
Reversibility	The impact is completely reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Short term, the increase in government revenue linked to the construction of the development will cease once construction is completed.
Cumulative effect	The impact could result in a significant cumulative impact.
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** No mitigation measures exist the impact rating will thus remain positive medium.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	30 (positive medium)	30 (positive medium)
Mitigation measures	• No mitigation measures exist.	

- Operation

Table 70: Rating of impact of employment creation

IMPACT TABLE	
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment. The result is that although the area has sufficient labourers it is most likely limited to unskilled opportunities. The local community is not likely to have the skills required for the skilled and highly skilled job opportunities.
Issue/Impact/Environmental Effect/Nature	It is most likely that the project will create at least 29 permanent employment opportunities for local community members. An additional 14 jobs will be created for skilled positions, which may need to be filled by workers from outside the local community.
Extent	The impact will affect the local community
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)
Reversibility	The impact is completely reversible
Irreplaceable loss of resources	The impact will not result in any loss of resources
Duration	Long term: the impact and its effects will continue and last for the entire operational life of the development.
Cumulative effect	The impact could contribute towards a significant cumulative effect since the region may develop a PV industry which would improve the local skills base, in addition the supporting businesses would then create additional job opportunities.
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the high levels of unemployment prevalent in the study area.
Significance rating	**Prior to mitigation measures:**

	Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The impact rating will stay the same.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	12 (low positive)	28 (medium positive)
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • Public consultation and information sharing will ensure that the proposed development is understood, enabling those individuals with fitting skills, if any, to make their services and/or knowledge available to the project proponent. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.	

Table 71: Rating of impact of skills development

IMPACT TABLE	
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment.
Issue/Impact/Environmental Effect/Nature	Permanently employed individuals (43) will benefit from on-the-job training and experience. No certainty exists at this stage, but the project proponent could initiate skills development as a part of the Enterprise Development and Social Development requirement during operations
Extent	The impact will affect the local community
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)
Reversibility	The effect of the impact (increased experience and knowledge) is unlikely to be reversed.
Irreplaceable loss of resources	The impact will not result in any loss of resources

Duration	Permanent – knowledge and experience cannot be considered to stop over a certain period, the effect of the impact will continue indefinitely.	
Cumulative effect	The impact could contribute towards a significant cumulative effect as a PV facility develops in the area due to economies of scale being achieved.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the current low levels of skills and literacy in the study area.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The proposed mitigation measures should increase the significance of the impact to medium positive impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	4
Reversibility	3	3
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	17 (low positive)	34 (medium positive)
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation. • Knowledge sharing and on-the-job training should be viewed as a prerequisite, where feasible, for all contractors/service providers working on the project and employing local labour. • Research should be undertaken to determine the viability of a skills development programme as a part of the Enterprise Development and Social Development initiatives that will have to be implemented by the project proponent during operations.	

Table 72: Rating of impact on living standard

IMPACT TABLE		
Environmental Parameter	Living standard, and a community's ability to afford health care and quality nutrition is greatly influenced by the income earned by that community. It is estimated that 12.9% of the households living in the Naledi LM is not receiving any income while two thirds are living on an income of less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	A total of 43 households will benefit from the project, of which 29 will most definitely come from the local community. These individuals, and their family members, will experience an increase in living standards due to an increase in disposable income, in a sustained long term manner.	
Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The positive effects of the impact are completely reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Long term: the impact and its affects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could contribute towards a significant cumulative effect as a local PV facility develops over time.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the employment creation in relation to the high levels of joblessness.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The mitigation, although positive measures to increase local benefit, does not change the significance of the impact's effect.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	14 (low positive)	14 (low positive)

Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.

Table 73: Rating of impact of increased social pathologies

IMPACT TABLE		
Environmental Parameter	Migrant job seekers attracted to the area during the construction of the proposed project may stay in the area into the operational phase of the project, which result in a more permanent change in demographics of the area, which is often associated with an increase in social pathologies or ills.	
Issue/Impact/Environmental Effect/Nature	Migrant job seekers attracted to the construction of the proposed project, and even some of those temporarily employed during construction may decide to stay in the area longer in hopes of finding permanent employment.	
Extent	The impact will affect local area	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The impact is reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in significant loss of resources.	
Duration	Long term – The impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could contribute towards a significant cumulative effect. Migrant job seekers may therefore decide to stay in the area for longer with the activities attracting even more work seekers, making the changes of not finding employment even greater.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system but the system still continues to function in a moderately modified way and maintains general integrity.	
Significance rating	**Prior to mitigation measures:** Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating resulting in an impact rating of negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	34 (medium negative)	16 (low negative)
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.	

Table 74: Rating of impact of increase in production

IMPACT TABLE	
Environmental Parameter	Once operational the project will incur operation expenditure which will benefit the South African economy and create various other multiplier effects for production. The benefit to the local community will, however, be limited due to the specialised nature of the bulk of the inputs required.
Issue/Impact/Environmental Effect/Nature	The OPEX associated with the proposed Sendawo 1 development is expected to be roughly R1.75 billion in 2015 prices over the 20-year lifespan of the project. South African local procurement is unsure but estimated to be limited due to the specialised nature of the inputs required.
Extent	The impact will affect the entire country.
Probability	The impact will certainly occur (greater 75% chance of occurrence).
Reversibility	The impact is completely reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources
Duration	Long term – the impact and its effects will continue and last for the entire operational life of the development.
Cumulative effect	The impact could result in a significant cumulative impact. The national economy will be stimulated by the various investments. At the same time, the local economy may be able to achieve the economies of scale required for the development of a local support industry, increasing the benefit to the local economy.
Intensity/magnitude	Medium considering the investment value is for the entire 20-year lifespan of the project.
Significance rating	**Prior to mitigation measures:** Positive low impact. The anticipated impact will have minor positive effects.

	After mitigation measures: No mitigation exists that will increase the significance rating of the impact. However, certain measures may be implemented that will increase the benefit to the local economy.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	26 (low positive)	26 (low positive)
Mitigation measures	• Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.	

Table 75: Rating of impact of increased demand for social facilities

IMPACT TABLE	
Environmental Parameter	The status quo in the area with regards to the provision of social infrastructure is that the study area does not have sufficient health infrastructure.
Issue/Impact/Environmental Effect/Nature	Some migrant workers may stay in on in the area with the hopes of finding permanent employment, increasing pressure on local authorities.
Extent	The impact will affect the local area.
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Long term, the impact and its effects will continue and last for the entire operational life of the development.
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase which would attract more individuals hopeful of finding permanent employment.
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.
Significance rating	**Prior to mitigation measures:**

	Negative medium impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure could decrease the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-15 (low negative)
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations. • Ongoing consultation with the local municipality to prepare local authorities for the activity and the increase demands that may result from this. .	

Table 76: Rating of impact on service delivery

IMPACT TABLE	
Environmental Parameter	The Naledi LM has a housing backlog of 18%. Furthermore, there is also problems with the provision of adequate water, electricity, and sewerage provision.
Issue/Impact/Environmental Effect/Nature	If unmanaged, migrant workers will stay in the area post the construction phase and even more workers may be attracted to the area in the hopes of finding permanent employment. The result will be increased pressure on the local authorities to adequately provide basic services.
Extent	The impact will affect the local area.
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Long term, the impact and its effects will continue and last for the entire operational life of the development.

Cumulative effect	The impact could result in a significant cumulative impact. As an industry is developed in the area more migrant workers will settle there, hoping to find permanent employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative medium impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure could decrease the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-14 (low negative)
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations. • Ongoing consultation with the local municipality to prepare local authorities for the activity and the increase demands that may result from this.	

Table 77: Rating of impact of increased household disposable income

IMPACT TABLE	
Environmental Parameter	It is estimated that two thirds of the households in the Naledi LM earn less than R3 200 per month.
Issue/Impact/Environmental Effect/Nature	At least 29 households from the local community may benefit from a sustained increase in disposable income directly as a result of the proposed development. Since skilled labour will most likely come from outside the local area, and even the province it can be stated that the rest of the impact's effects will be felt in the rest of South Africa.
Extent	The impact will affect the local area
Probability	The impact will certainly occur (greater than 75% chance of occurrence).
Reversibility	The impact is completely reversible
Irreplaceable loss of resources	The impact will not result in any loss of resources.

Duration	Long term – the impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the local area will be able to develop a supporting industry due to economies of scale. Increasing the number of local community members who can benefit.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** The proposed mitigation measures will increase the benefit to the local community but will not change the significance rating of the impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	30 (medium positive)	30 (medium positive)
Mitigation measures	• Where possible, local labour should be used. • When feasible, local procurement of goods and services should be implemented to further increase the benefit to the local community.	

Table 78: Rating of impact on property values

IMPACT TABLE	
Environmental Parameter	Any development with the potential for negative environmental impacts will have an impact on property values in the area.
Issue/Impact/Environmental Effect/Nature	It is expected that the demand for residential and commercial property will increase in line with the economic stimulation and development that the project will result in, increasing property value in the region.
Extent	The impact will affect the local area.
Probability	The impact may occur (between a 25% and 50% chance of occurrence).
Reversibility	The impact is partly reversible

Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Long term – the impact and its effects will continue and last for the entire operational life of the development	
Cumulative effect	The impact could result in a significant cumulative impact.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive low impact. The anticipated impact will have marginal positive effects. **After mitigation measures:** No mitigation measures exist the impact rating will thus remain positive low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	28 (low positive)	28 (low positive)
Mitigation measures	• No mitigation measures can be applied.	

Table 79: Rating of impact of increased government tax revenue

IMPACT TABLE	
Environmental Parameter	The government will benefit from an increased local tax base in the Naledi LM due to the proposed investment. This will increase the ability of the government to deliver on basic services.
Issue/Impact/Environmental Effect/Nature	The project proponent will have to pay taxes such as income taxes and payroll taxes. It cannot be said with certainty how this income will be applied, however, the government will no doubt utilise it to better service provision somewhere in South Africa.
Extent	The impact will affect the entire country
Probability	The impact will certainly occur (greater than a 75% chance of occurrence).
Reversibility	The impact is completely reversible.
Irreplaceable loss of resources	The impact will not result in any loss of resources.
Duration	Long term, the impact and its effects will last and continue for the operational span of the project
Cumulative effect	The impact could result in a significant cumulative impact.

Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** No mitigation measures exist the impact rating will thus remain positive medium.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	34 (medium positive)	34 (medium positive)
Mitigation measures	• No mitigation measures exist.	

- Decommissioning

Socio-economic impacts stimulated during the decommissioning phase are expected to be similar to those that take place during the construction phase

10 SPECIALIST RECOMMENDATIONS AND MITIGATION MEASURES

10.1 Mitigation Measures

10.1.1 Biodiversity

The mitigation hierarchy approach

The mitigation hierarchy consists of a number of sequential steps (avoid, mitigate, restore or rehabilitate and offset). This approach enables an infrastructure development project to work towards "no net loss" of biodiversity, and ideally, a net gain. The mitigation hierarchy is defined as:

- **Avoidance:** measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.
- **Minimisation:** measures taken to reduce the duration, intensity and / or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.
- **Rehabilitation/restoration:** measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.
- **Offset:** measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.

Mitigation measures

Re-site components of the infrastructure

Components of the infrastructure can be re-sited to avoid sensitive habitats, either partially or completely. This is especially important for avoiding CBA habitats, protected areas and buffer areas. The re-siting can also be used to create buffer areas around sensitive sites in order to protect their ecological integrity. In the case of the current project, there are various pan depressions where it has been recommended that these are not developed and that an appropriate buffer zone is maintained around them.

Avoid impacts on pan depressions

The pan depressions, as well as an appropriate buffer zone, should be excluded from development, if possible. This should apply especially to larger pan depressions and those that are in an unaltered state.

For any pan depressions that will be affected, the appropriate permits will be required, as per the National Water Act.

Surface Runoff and Stormwater Management Plan

The purpose of a Surface Runoff and Stormwater Management Plan is to prevent damage to areas downslope / downstream of the project area. This is an impact avoidance measure. This plan must indicate how all surface runoff generated as a result of the project and associated activities (during both the construction and operational phases) will be managed (e.g. artificial wetlands/stormwater and flood retention ponds) prior to entering any natural drainage system or wetland and how surface water runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions.

Rehabilitation Programme

The purpose of a Rehabilitation Plan is to provide a framework for rehabilitating areas outside of the infrastructure footprint that will be disturbed during the construction of the proposed project. Rehabilitation Programme should be established before operation. The programme must address the rehabilitation of the existing habitats as well as rehabilitation after closure. This Rehabilitation Programme must be approved by the relevant government departments. Should it be deemed necessary, rehabilitation can also be undertaken in habitats adjacent to sensitive areas that will not be developed, but that are currently disturbed by existing impacts on site. Rehabilitation must include aspects such as undertaking rehabilitation as quickly as possible after disturbance, soil management measures and using native plants during rehabilitation.

Botanical walk-through survey

A preconstruction walk-through survey should be undertaken to list the identity and location of all listed and protected species. The results of the walk-through survey should provide an indication of the number of individuals of each listed species that are likely to be impacted by the proposed development. The botanical walk-through survey is a requirement for various permit applications.

Search and rescue

Search and rescue operation of all listed species within the activity footprint. For each individual plant that is rescued, the plant must be photographed before removal, tagged with a unique number or code and a latitude longitude position recorded using a hand-held GPS device. The plants must be planted into a container to be housed within a temporary nursery on site or immediately planted into the target habitat. If planted into natural habitat, the position must be marked to aid in future monitoring of that plant. Rescued plants housed in temporary nursery may be used in one of two ways: (1) transplanted into suitable natural habitats near to where they were rescued, or (2) used for replanting in rehabilitation areas. Receiver sites must be matched as closely as possible with the origin of the plants and, where possible, be placed as near as possible to where they originated.

Obtain permits for protected plants

It is a legal requirement that permits will be required for any species protected according to National or Provincial legislation. The identity of species affected by such permit requirements can only be identified during the walk-through survey (previous mitigation measure). It is common practice for the authorities that issue the permits to require search and rescue of affected plants. There are a number of individuals of the protected tree, Acacia erioloba, that occur on site. The location and condition of each individual tree must be recorded and a permit obtained for the removal of each of these.

Alien plant management plan

It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species, especially within the riparian habitat. An Alien Invasive Programme is an essential component to the successful conservation of habitats and species. Alien species, especially invasive species are a major threat to the ecological functioning of natural systems and to the productive use of land. In terms of the amendments of the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of alien species on their properties. The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). This programme should include monitoring procedures.

Undertake regular monitoring

Monitoring should be undertaken to evaluate the success of mitigation measures. Monitoring methods must be in accordance with features that need to be monitored and can form part of a monitoring programme to be compiled.

Worker education

Educate workers (permanent staff and contractors) regarding the occurrence of important ecological features and resources in the area and the importance of their protection.

Dust control

Use abatement measures to minimise fugitive dust that could have a negative effect on vegetation and habitats, especially adjacent to sensitive areas and in areas adjacent to the project site.

10.1.2 Avifauna

- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.

- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- The recommendations for the vegetation management as detailed in the botanical specialist report must be strictly implemented.
- Monitoring should be implemented to search the ground between arrays of solar panels on a two-weekly basis for at least one year to determine the magnitude of collision fatalities. Searches should be done on foot. Searches should be conducted randomly or at systematically selected arrays of solar panels to the extent that equals 33% or more of the project area. Detection trials should be integrated into the searches.
- The exact protocol to be followed for the operational phase monitoring should be compiled by the avifaunal specialist in consultation with the plant operator and Environmental Control Officer before the commencement of operations. The exact scope and nature of the operational phase monitoring will be informed on an ongoing basis by the result of the monitoring and the EMPr will be updated accordingly.
- Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including minor modifications of panel and mirror design to reduce the illusory characteristics of solar panels. What is considered to be significant will have to be established on a species specific basis by the avifaunal specialist.
- De-commissioning activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.

10.1.3 Surface Water

Preventing Indirect Erosion, Sedimentation and Run-off Impacts – In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used around the lay-down area to prevent run-off from the cleared proposed construction lay-down area flowing into the surrounding area and possibly, any nearby wetlands. This will additionally assist with preventing consequent erosion and sedimentation in susceptible surrounding areas.

Preventing Physical Degradation of the Wetland – A water use license will be required before construction takes place and all stipulated mitigation measures and conditions of the WUL are to be implemented accordingly.

Where a WUL permit has been issued as well as environmental authorization for construction of the access roads in and around the aforementioned wetlands, construction workers will only be allowed in the

designated roads within and around the wetlands. Outside of the established roads within the wetlands, these areas are to be clearly demarcated as highly sensitive no access into these areas is to be allowed. All wetlands in the proposed development site are to be designated as highly sensitive and will need to be clearly demarcated at all times. Access into the remaining wetlands not affected by the roads are also not to be accessed at all.

Preventing Soil Contamination – No vehicles are to be allowed in the highly sensitive areas unless authorised. Should vehicles be authorised in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive areas. The study site is to contain sufficient spill contingency measures throughout the construction process. These include, but are not limited to, oil spill kits to be available, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby wetland or the associated buffer zone.

Minimising Human Physical Degradation of Sensitive Areas – Construction workers are only allowed in designated construction areas and not into the wetlands designated as highly sensitive, unless the environmental authorisation and respective water use license authorize them to do so.

No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed, kept as pets or eaten. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed environmental control officer (ECO) is to be contacted should removal of any fauna be required during the construction phase.

No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the wetland where these are required. Temporary chemical sanitation facilities must be placed over a bunded or a sealed surface area and adequately maintained to prevent pollution impacts.

No water is to be extracted unless a water use license is granted for specific quantities for a specific water resource.

No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive area. Appropriate safety measures as stipulated above must be implemented.

No cement mixing is to take place in the wetland. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive area.

Avoiding Direct Impacts to the Wetland – The access roads should be amended if possible prior to finalization of the layout to avoid the wetland areas as well as the associated buffer zones, since it is apparent that sufficient space exists for roads to be re-aligned alongside the PV panels around pan wetlands 4 and 15.

Should this not be able to be undertaken, roads established on the boundary and within the respective wetlands mentioned above will need to have specific erosion and sedimentation mitigation measures to prevent unnecessary potential impacts affecting the wetlands. Adequate structures must therefore be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used along the boundaries of the access roads to prevent sediment flowing into wetlands. This will additionally assist with preventing consequent erosion.

Preventing Increased Run-off and Sedimentation Impacts – Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future.

An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas.

In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used to prevent erosion in susceptible construction areas. All impacted areas are to be adequately sloped to prevent the onset of erosion.

Importantly, special attention must be given and implemented at the recommendation of the ECO for site specific erosion, sedimentation and run-off mitigation measures at the edge of the buffer zones of the wetlands.

Minimising Vehicle Damage to the Wetland – Potential impacts can be completely avoided by the routing of access roads outside of and away from the wetland and the associated buffer zone along the boundary of the proposed PV fields where sufficient space exists for this to be established.

Where access through the wetland is unavoidable and is absolutely required, it is recommended that any road plan and associated structures be submitted to the relevant environmental and water departments for approval prior to implementation.

The access roads that are environmentally authorised and have been permitted in terms of water use licensing in the highly sensitive area will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month in the rainy season (October to March). Additionally, after short or

long periods of heavy rainfall or after long periods of sustained rainfall, the roads will need to be checked on an ad hoc basis for erosion. Rehabilitation measures will need to be employed should erosion be identified.

Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the wetland. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland/surface water specialist must be obtained in this respect.

10.1.4 Agricultural Potential and Soils

- Due to the prevailing low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be kept to a minimum, so that at least the effect on grazing land for livestock is reduced.
- The main mitigation would be to ensure that physical disturbance caused by soil removal and/or re-distribution is kept to a minimum. In such an area of low rainfall and hot conditions, vegetation is fragile and often difficult to re-establish.
- The relatively sandy nature of the soils means that if exposed, there is a real hazard of soil removal by wind erosion, especially in the drier winter months. To combat this, any bare soil should be re-vegetated as soon as possible and preventative measures, such as soil covering and windbreaks, may also be required.

10.1.5 Visual

- Carefully plan to reduce the construction period.
- Minimise vegetation clearing and rehabilitate cleared areas as soon as possible.
- Vegetation clearing should take place in a phased manner.
- Maintain a neat construction site by removing rubble and waste materials regularly.
- Make use of existing gravel access roads where possible.
- Limit the number of vehicles and trucks travelling to and from the proposed site.
- Ensure that dust suppression techniques are implemented on all gravel access roads.
- Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place.
- Ensure that dust suppression techniques are implemented on all soil stockpiles.
- Re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid.
- Temporarily fence-off the construction site (for the duration of the construction period). Carefully plan to reduce the construction period.
- Light fittings for security at night should reflect the light toward the ground and prevent light spill.
- As far as possible, limit the amount of security and operational lighting present on site.

- As far as possible, limit the number of maintenance vehicles which are allowed to access the site.
- The operations and maintenance (O&M) buildings should not be illuminated at night.
- Bury cables under the ground where possible.
- The O&M buildings should be painted with natural tones that fit with the surrounding environment.
- Select the alternatives that will have the least impact on visual receptors
- Limit the number of maintenance vehicles which are allowed to access the site.
- Non-reflective surfaces should be utilised where possible.

10.1.6 Heritage and Palaeontology

- Mitigation through exclusion of the no-go area around point 0522 as indicated.
- Micro siting in the delineated extremely high paleontological sensitivity area and palaeontological excavations and collection if Geotechnical Survey indicates necessity for mitigation.
- It is recommended that a palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. Site visits should include an initial five (5) day visit and then one day every two (2) weeks during construction.
- It is essential that the results of the Geotechnical Surveys be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites on all the proposed development areas.
- If excavation of deeper than 1.5m is planned, the palaeontologist must assess the results of the geotechnical information and given the opportunity to comment on the likelihood of significant finds of fossils in all the planned development areas.
- If any excavation or collection of fossils is recommended, such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.
- Due to the presence of significant stromatolites in a small area and the large number of boulders with stromatolites present on site it is recommended that a palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. The aim being the identification and mitigation of any newly discovered palaeontological sites, if recorded. The significant finds recorded must lead to exclusion of the specific sites from this development.

- **Archaeology**

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also

possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the Environmental Management Programme (EMPr) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological monitoring programme.

In the case where archaeological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological material, a buffer of at least 20 meters should be implemented.
- If archaeological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the material permit must be applied for from SAHRA under Section 35 of the NHRA.

- **Graves**

In the case where a grave is identified during construction the following measures must be taken:

- Upon the accidental discovery of graves, a buffer of at least 50 meters should be implemented.
- If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a permit must be applied for from SAHRA (Section 36 of the NHRA) and other relevant authorities (National Health Act and its regulations). The local South African Police Services must immediately be notified of the find.
- Where it is recommended that the graves be relocated, a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

i. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
ii. Site notices indicating the intent of the relocation;
iii. Newspaper notices indicating the intent of the relocation;
iv. A permit from the local authority;
v. A permit from the Provincial Department of Health;
vi. A permit from the South African Heritage Resources Agency, if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
vii. An exhumation process that keeps the dignity of the remains intact;
viii. The whole process must be done by a reputable company that is well versed in relocations;
ix. The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the developing company.

10.1.7 Socio-economic

- Consultation with the directly affected and adjacent land owners must be on-going to limit the effect on productive agriculture land.
- The recommendations made by the other relevant specialists must be implemented where possible to ensure that the effects of the impact are minimised.
- Areas of high agriculture potential should be avoided to curb the cumulative effect on food security.
- Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community.
- Public consultation and information sharing will ensure that the proposed development is understood, enabling those individuals with fitting skills, if any, to make their services and/or knowledge available to the project proponent.
- If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.
- Knowledge sharing and on-the-job training should be viewed as a prerequisite, where feasible, for all contractors/service providers working on the project and employing local labour.
- Research should be undertaken to determine the viability of a skills development programme as a part of the Enterprise Development and Social Development initiatives that will have to be implemented by the project proponent, during operation.
- Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.
- During construction the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided.
- Manage workers to ensure that they are only on site during the reasonable working hours.

- Ensure that expectations are carefully managed so that the perception of the proposed land use is not negatively affected by community members who feel that promises made have not been kept.
- Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.
- Where feasible implement the mitigation measures recommended by the various other specialists to minimise the negative impacts of increased traffic during the construction period.
- Limit construction activity to normal working hours and avoid activity over weekends as far as practically possible.
- Ensure effective communication of the project information throughout all stages to effectively manage expectations.
- Ongoing consultation with the local municipality to prepare local authorities for the activity and the increase demands that may result from this.
- Public consultation and information sharing will ensure that the proposed development is understood, enabling those individuals with fitting skills, if any, to make their services and/or knowledge available to the project proponent.

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11 CUMULATIVE IMPACTS

The area has seen a notable interest from developers of various renewable energy projects, which could be associated with the solar energy resource potential found in the region, proximity to the existing sub-station and its evacuation capacity, as well as other factors. Such developments, whether already approved or only proposed, need to be considered as they have the potential to create numerous cumulative impacts, whether positive or negative, if implemented. Table 80 lists the projects that will need to be considered when examining the cumulative impacts; their location relative to the project under review is illustrated in Figure 62. The specialists have identified specific cumulative impacts and these are outlined below.

Table 80: Proposed renewable energy projects in the area

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Sendawo 2	14/12/16/3/3/2/892	EIA ongoing	BioTherm Energy	75MW	Portion 1 of the Farm Edinburgh No 735
Sendawo 3	14/12/16/3/3/2/893	EIA ongoing	BioTherm Energy	75MW	Portion 1 of the Farm Edinburgh No 735
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 1 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729

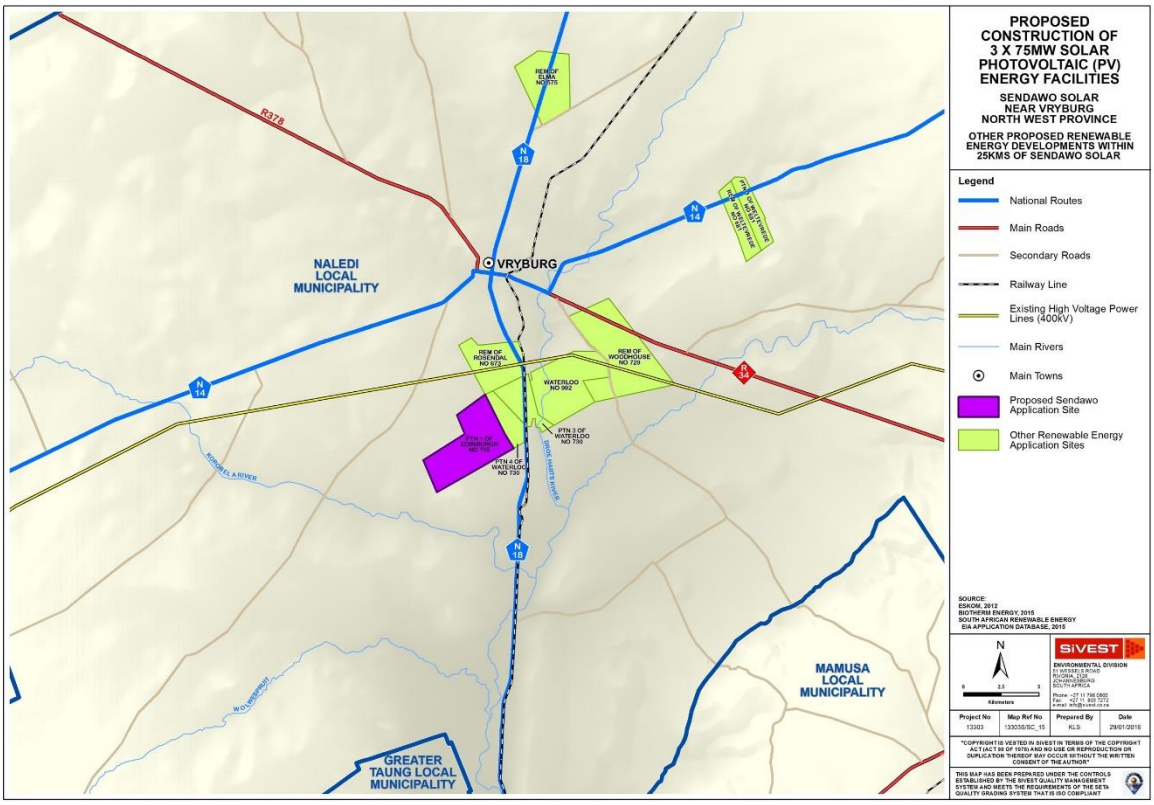

Figure 62: Location of other renewable energy projects (proposed and approved) in the area

11.1 Biodiversity Impacts

Cumulative impacts on indigenous natural vegetation

The regional terrestrial vegetation type in the broad study area is Ghaap Plateaux Vaalbosveld, listed as Least Threatened. This is the same vegetation type that will be affected by many of the other proposed projects. Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned. The vegetation type occupies an area in excess of 25 000 km2, of which less than 2% has been altered. The total loss of habitat due to all the projects together will be greater than for any single project, so a cumulative effect will occur. However, the area lost in total will be small compared to the total area of the vegetation type and will not result in a change in the conservation status of the vegetation type. The cumulative effect will therefore be low.

Cumulative impacts on listed plant species

There are two listed plant species that may occur in the study area, the succulent, *Lithops lesliei* subsp. *lesliei*, listed as Near Threatened, and the herb, *Rennera stellata*, listed as Vulnerable. The first species is relatively widespread, whereas the latter is only known from three populations. An increased number of projects increases the likelihood of one of the populations being affected, but unless a population is directly affected, there is no cumulative effect.

Cumulative impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens,* which may potentially occur on site. There are also a number of plant species protected according to Provincial legislation. An increased number of projects will increase the likelihood of protected species being affected as well as the number of individuals likely to be affected. There is therefore a cumulative effect, but this is considered to be low.

Cumulative impacts on protected trees

There is one protected tree species that occurs on site, *Acacia erioloba*. With each additional project that is constructed there will be an increasing likelihood of individuals being affected and the number of individuals affected will increase. There is therefore a cumulative effect. The significance of this effect is, however, likely to be low due to the high number of individuals of this species that occurs over its entire geographical range.

Cumulative impacts on pan depressions

There are a number of small pan depressions occurring on site and probably at the sites of the other proposed projects. With each project that is constructed, the number of pan depressions affected will increase. There is therefore a cumulative effect. Due to the fact that many of these depressions have already been affected by existing land-uses, there is a possibility that the significance of the cumulative effect could potentially be of moderate significance.

Cumulative impacts on populations of sedentary fauna

There are two species of sedentary fauna likely to be impacted by the current project, the Southern African Hedgehog and the Giant Bullfrog. Both have a relatively wide geographical distribution and loss of some habitat in part of their range will have a minimal effect on the species. The combination of a number of projects will have a cumulative effect, but this is likely to be of low significance.

Cumulative impacts on mobile fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. This effect will be increased if there are a number of projects being constructed at the same time or in quick succession, so the effect is likely to be cumulative. However, the geographical ranges of the species of concern is wide and it is considered that the significance of the effect will be low.

Cumulative impacts due to spread of declared weeds and alien invader plants

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The greater the number of projects, the more likely this effect will happen, therefore the effect is cumulative. For the current site, the impact is predicted to be low due to existing impacts on site and the high ability to control any additional impact. The significance will therefore be low, especially if control measures are implemented.

11.2 Avifauna Impacts

The total surface area in a 25km radius around the proposed development amounts to approximately 194 874ha. The combined area taken up by the proposed renewable energy developments, including the Sendawo PV 1, 2 and 3 projects, amounts to approximately 9 797ha. This is approximately 5% of the total amount of habitat available within the 25km radius. The potential cumulative impact of the Sendawo PV 1, 2 and 3 projects on priority species is therefore rated as low.

11.3 Surface Water Impacts

The key factor to consider when evaluating surface water impacts from a cumulative perspective is downstream impacts. Where a development takes place upstream, should impacts occur these are likely to have an effect downstream to some extent.

In the context of the proposed development, similar developments (solar facilities) are located directly to the north and north east. Several more are located much further (over 10kms away) to the north and north east which will not have any effect on the proposed development, nor will the proposed development have an effect on these developments.

Importantly, there is a drainage system that stems from the Sediba Power Plant 75MW PV Solar Facility on the Remainder of the Farm Rosendal 673 that is located to the north of the proposed development site. The drainage systems flows in a southerly direction and hence any upstream increase in storm water flows or sedimentation volumes can have an adverse impact on the greater proposed PV application sites (Sendawo PV 1, 2 and 3). Consequent erosion can also ensue as a result of increased surface run-off. Conversely, the same downstream impacts can be associated with the construction of Sendawo 1, 2 and 3 on the adjacent property to the east (Tiger Kloof Solar PV Facility on Portion 4 & 3 of the Farm Waterloo 730).

However, should the mitigation measures stipulated in this report be strictly adhered to, downstream impacts can be limited. Overall, cumulative impacts are not expected to be significant several kilometres downstream of any linear hydrological system and will be fairly localized within the particular catchment. With the implementation of mitigation measures (generic and specific), downstream impacts can be significantly reduced.

11.4 Soils and Agricultural Potential Impacts

The main cumulative impact would be as a result of the fact that several solar power generation projects are planned in the vicinity of Vryburg (eight projects within an approximate 20 km radius). The soils on each site would not have an impact on any other site, but there would be a potential of increased dust production as a result of construction activities, especially in the drier months, when wind can cause soil particles to become detached from the bare soil surface. The main mitigation measures would include ensuring that the topsoil remains moist if possible, and that the construction footprint is as small as possible, with minimum soil surface disturbance due to construction activities.

11.5 Visual Impacts

A 5km radius was used when determining the cumulative visual impact experienced by each sensitive receptor location. The cumulative impact assessment therefore investigated the number of proposed developments within a 5km radius from each respective sensitive receptor location. The number of proposed developments that each visually sensitive receptor would be visually exposed to (i.e. the cumulative impact experienced at each location) is discussed below. It should be noted that the impact on each receptor location is indicative of the ‘worst case’ scenario which assumes that all of the proposed facilities would be developed.

The cumulative impact on the N18, the Tiger Kloof Educational Institution and the Arthington Memorial Church was assessed as these were identified as sensitive visual receptor locations. These sensitive receptors could therefore be visually exposed to seven (7) additional proposed PV energy facilities should

they all be constructed. It is also important to note that the Tiger Kloof Educational Institution and Arthington Memorial Church have been declared a provincial heritage site and national monument respectively. In addition, the N18 highway is considered to be a visually sensitive road as it is the main access road between Vryburg and Kimberley and may also be used to access tourism venues such as the Taung Skull World Heritage Site. The relatively high volumes of motorists travelling along this road could therefore be visually exposed to the seven (7) additional proposed PV energy facilities should they all be constructed.

Several scattered farmsteads / homesteads, which are used to house the local farmers as well as their farm workers, were identified within the study area and are regarded as potentially sensitive visual receptor locations. It was noted that a number of these dwellings are also located within a 5km radius from some of the additional renewable energy developments and are therefore expected to experience some visual impacts if some or all of the additional proposed PV energy facilities are constructed. These farmsteads / homesteads have however not been included as part of the cumulative assessment as the sensitivity of these visual receptors is largely subjective.

11.6 Heritage Impacts

An evaluation of the possible cumulative impacts from the combined solar projects in the area on heritage resources has shown that the biggest envisaged impact could be on the palaeontological heritage of the area with the Rosendal and Waterloo solar facilities just east and north east of the of this proposed development increasing the possibility of impacts on the breccias that could occur in the area.

Though with the implementation of mitigation measures these impacts could be transformed into a positive impact through the discovery of previously unknown fossils and the subsequent study of such fossil finds adding to the academic knowledge of the palaeontological resources of the study area.

11.7 Socio-Economic Impacts

Cumulative impacts can be defined as changes to the environment, which are caused by an action in combination with other past, present, and future human actions; however, in practice the assessment of cumulative impacts as on a single-project basis relates to one concept: the specific consideration of effects due to other projects. It follows that in general, the expected impacts that may ensue from the project being evaluated is similar to the cumulative impacts that may be observed (The Cumulative Effects Assessment Working Group, 1999).

Various reasons exist for the projects listed above not all becoming operational:

- Limitations to the capacity of the existing Eskom grid.
- Not all environmental authorisation applications will be successful.

- Appeals and objections to the process by various stakeholders could potentially delay implementation and operation of the various projects.
- Project not approved under the existing Renewable Energy Independent Power Producer Procurement Programme and not developed due to challenge in securing alternative off-taker (i.e. municipality or private company).

If the assumption is applied that these projects will receive environmental authorisation and become operational, the possibility of a more significant cumulative impact becomes more likely. Especially when considering the fact that developments are planned for farms directly adjacent to the application site (Waterloo and Rosendal). Moreover, the fact that there are numerous developments planned for the rest of the North West Province (the project proponent is proposing two more in Lichtenburg in addition to the three in Vryburg) by the project proponent and other developers, the case can be made that any cumulative impact will spread further than the Sendawo zone of influence, into the Province. Some of the more prominent effects may be:

- The development of solar energy projects in the area will considerably increase the demand for goods and services required for the construction of these facilities. Depending on the timing of these listed solar PV facilities, it could extend the demand for these goods and services for a longer period than the construction phase of one project, which would be more beneficial than if all projects were to be built over the same timeframe. Since the development of the majority of solar PV projects at the moment follows a bid process, it is likely that some developments will also follow one after another. Coupled with projects developed in other parts of the Province, this could provide sufficient economies of scale and thus open opportunities for the establishment of supporting industries, leading to a growth of the economy and sustainable job creation.
- Aside from positive cumulative impacts, the development of solar energy projects in the area at the same time or one after another, will also increase the negative cumulative impacts during construction periods of these projects. The magnitude of these impacts will be dependent on whether the construction of solar PV projects in the area is done within the same period of time or whether they are distributed over a longer period. The more projects are built during the same period, the greater the cumulative impact will be as the local economy and communities in and around Vryburg have a small economic base and are not capable to absorb the demand for additional services and goods, while their social and economic infrastructure (i.e. affordable housing, water, sanitation, roads, etc.) might not be able to deal with the sharp increase in demand for these amenities that would be stimulated from an increase in construction workers and job seekers in the area. The increase in the number of construction workers and generally job seekers in the area could have a detrimental impact on the ability of the local authorities to service their residents, which could further translate into growing un-satisfaction with performance of local government and create unrest in the areas. A significant change in demographics, i.e. sharp increase in male population as observed in mining areas, growth of informal settlements, and increase in social pathologies (health issues, crime, prostitution, xenophobia, etc.) could also become bigger problems in the local community.

- The land uses in the local municipality and areas surrounding Vryburg are largely dominated by agricultural activities. Solar energy facilities tend to sterilise the land from agricultural uses. The bigger the number of projects developed in the region, the greater the losses of the agricultural sector will be. While one project might not impact on food security and the performance of the sector in general, a sterilisation of productive agricultural land on multiple sites could potentially create concerns over supply of meat and other produce in the area and the growth potential of the local agricultural sector.
- Last but not least is the assessment of the cumulative impact if all three solar PV projects are to be built on Farm Edinburgh 735. If these activities are approved, the commercial cattle and game farming operations undertaken by the owner will be significantly scaled down. This may also impact on Middelkop Safaris, which is run in a joint venture between the owner of Farm Edinburgh 735 and adjacent Farm Frankfurt 672 focusing on game breeding for commercial purposes. Commercial production of cattle may also be downscaled due to the loss of grazing land.

12 DESCRIPTION AND COMPARATIVE ASSESSMENT OF ALTERNATIVES

As described above, layout alternatives have been considered during the EIA phase. Various environmental specialists assessed the site during the scoping phase. Two alternative site locations for the 132kV substation, laydown area and O&M building were assessed during the scoping phase. The specialist assessments included the identification of sensitive areas. These sensitive areas were used during the scoping phase to perform a preliminary comparison of layout alternatives.

Based on the scoping phase specialist findings, and on discussion with the landowner, the two alternative site locations for the 132kV substation, laydown area and O&M building were amended. Additionally, based on the specialist findings and landowner considerations, the proposed PV array layout and the 132kV power line corridor were designed. These layouts are presented in Figure 63.

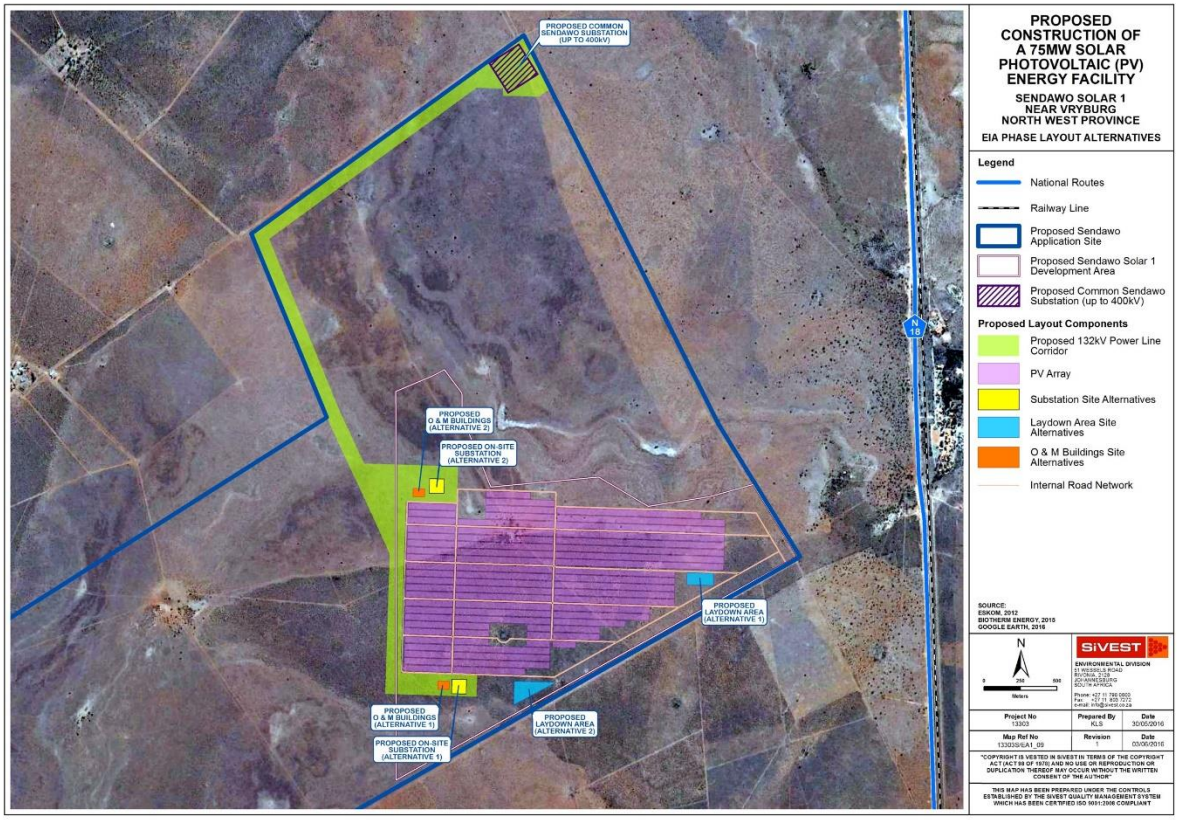

Figure 63: EIA phase layout alternatives

The sensitive areas used to determine the alternatives in the scoping phase were based on desktop studies. The specialist studies in the EIA phase have provided a more detailed assessment of sensitive areas. The highly sensitive areas identified by each specialist study in relation to the EIA phase layout alternatives are

presented in Figure 64 below. Each of these alternatives are comparatively assessed below in terms of the findings from the specialist studies conducted during the EIA.

Table 81 below highlights the issues and preferences associated with each alternative thereby identifying the preferred alternative.

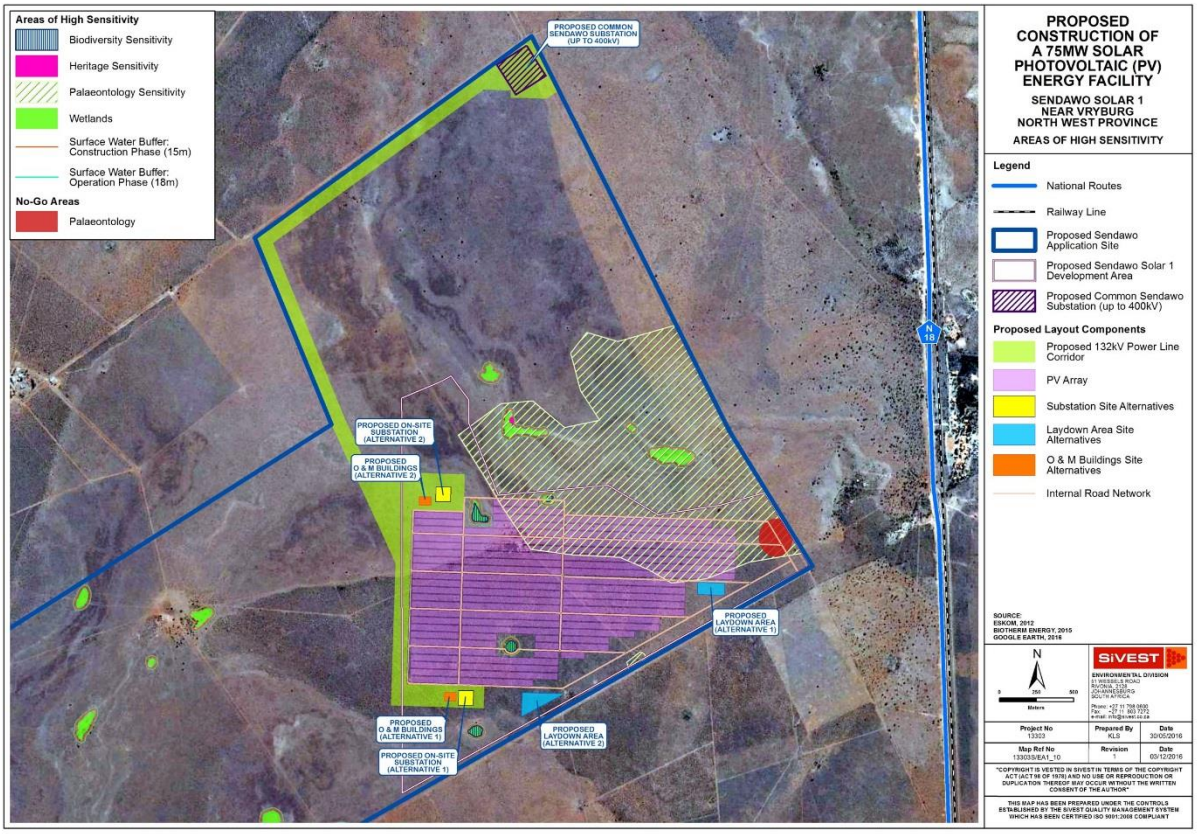

Figure 64: EIA phase layout alternatives in relation to sensitive areas

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 81: Alternatives Assessment summarising the impacts, highlighting issues/concerns and indicating the preference associated with each alternative

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
OPERATIONS BUILDING AND SUBSTATION				
Sendawo PV 1 Operations Building and Substation Alternative 1	Biodiversity	NO PREFERENCE	Affect similar areas of similar habitat.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.	No Fatal Flaws
	Surface Water	FAVOURABLE	The proposed location for the Sendawo PV 1 Operations Building and Substation Alternative 1 is located approximately 150m north west of a pan wetland. The next nearest surface water resource is a pan wetland located north east approximately 350m away. This proposed alternative is viewed as favourable given the closer proximity to surface to the second pan wetland which may result on slightly higher potential run-off and sedimentation impacts.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Agricultural Potential and Soils	NO PREFERENCE	Relatively uniform shallow soils, low rainfall, limited impacts	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	The position of the foot print area impacts on no new heritage resources and no preference above the other alternatives have been identified	No Fatal Flaws
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of the O&M Building and Substation Alternatives, within the high impact zone. Only one (1) potentially sensitive visual receptor, namely VR 4, can be found within 2km, within the moderate impact zone. It must be noted that four (4) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible with based on distance. The rest of the potentially sensitive visual receptors are located further than 2km, within the low impact zone. In addition, both of the sensitive visual receptors identified within the study area, namely VR 9 – Tiger Kloof Educational Institution and VR 7 – Arthington Memorial Church, can be found further than 2km from these proposed alternatives, within the low impact zone. As such, O&M Building and Substation Alternative 1 is preferred as most of the potentially sensitive receptor locations are located further than 2km, within the low impact zone. In addition, the O&M Building and Substation would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
Sendawo PV 1 Operations Building and Substation Alternative 2	Biodiversity	NO PREFERENCE	Affect similar areas of similar habitat.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.	No Fatal Flaws
	Surface Water	PREFERRED	The proposed location for the Sendawo PV 1 Operations Building and Substation Alternative 2 is located approximately 150m north west of a pan wetland. The next nearest surface water resource is a pan wetland located directly east approximately 650m away. This proposed alternative is slightly more preferred given the further proximity to surface to the second pan wetland which may result in a lower potential impact as a result of increased run-off and sedimentation impacts. Otherwise, there is not much difference between the two options.	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	Relatively uniform shallow soils, low rainfall, limited impacts	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	The position of the foot print area impacts on no new heritage resources and no preference above the other alternatives have been identified	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of the O&M Building and Substation Alternatives, within the high impact zone. Six (6) potentially sensitive visual receptors can however be found within 2km	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			of the proposed alternatives, within the moderate impact zone. In addition, both of the sensitive visual receptors identified within the study area, namely VR 9 – Tiger Kloof Educational Institution and VR 7 – Arthington Memorial Church, can also be found further than 2km from these proposed alternatives, within the low impact zone. It must be noted that five (5) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. Although these alternatives are mostly located within 2km of the proposed alternatives, within the moderate impact zone, it is still a favourable alternative as the O&M Building and Substation would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
LAYDOWN AREA				
Sendawo PV 1 Laydown Area Alternative 1	Biodiversity	NO PREFERENCE	Affect similar areas of similar habitat.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Surface Water	PREFERRED	There are no wetlands within a 500m radius of Sendawo PV 1 Laydown Area Alternative 1. This option is viewed as preferred.	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	Relatively uniform shallow soils, low rainfall, limited impacts	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	The position of the foot print area impacts on no new heritage resources and no preference above the other alternatives have been identified	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of the Laydown Area Alternative, within the high impact zone. One (1) sensitive visual receptor, namely VR 9 – Tiger Kloof Educational Institution, can be found within 2km of the proposed laydown area alternative, within the moderate impact zone. The other sensitive visual receptor identified within the study area, namely VR 7 – Arthington Memorial Church, can however be found further than 2km, within the low impact zone. In addition, three (3) potentially sensitive visual receptors can also be found within 2km of the proposed alternative, within the moderate impact zone, while three (3) of the other potentially sensitive visual receptors can be found further than 2km, within the low impact zone. It must also be noted that five (5) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. Although this alternative is located slightly closer to one (1) of the sensitive visual receptors, as well as one (1) of the potentially sensitive visual receptors, it is still favourable as	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			the laydown area would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
Sendawo PV 1 Laydown Area Alternative 2	Biodiversity	NO PREFERENCE	Affect similar areas of similar habitat.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.	No Fatal Flaws
	Surface Water	FAVOURABLE	Sendawo PV 1 Laydown Area Alternative 2 is located approximately 280m from two pan wetlands located to the north west and west. There is a potential that indirect potential impacts including increased run-off and sedimentation impacts may occur if this area is utilized during the construction phase. However, the distance is relatively far and with minor mitigation measures, these impacts can be easily mitigated. This option is viewed as favourable.	No Fatal Flaws
	Agricultural Potential and Soils	NO PREFERENCE	Relatively uniform shallow soils, low rainfall, limited impacts	No Fatal Flaws
	Heritage and Palaeontology	NO PREFERENCE	The position of the foot print area impacts on no new heritage resources and no preference above the other alternatives have been identified	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of the Laydown Area Alternative, within the high impact zone. Both of the sensitive visual receptors identified within the study area, namely VR 7 – Arthington Memorial Church and VR 9 – Tiger Kloof Educational Institution, can be found further than 2km from the proposed alternatives, within the low impact zone. Two (2) potentially sensitive visual receptors can also be found within the low impact zone. In addition, only two (2) potentially sensitive visual receptors can be found within 2km of the proposed Laydown Area Alternative, within the moderate impact zone. It must also be noted that five (5) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. As such, Laydown Area Alternative 2 is preferred as it is located slightly further from one (1) of the sensitive visual receptors, as well as one (1) of the potentially sensitive visual receptors. In addition, the laydown area would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws

As depicted in Table 81 above, the two substation and operations building alternatives are very similar in terms of which is the environmentally preferred alternative. Almost all of the specialists found there to be no preference between the two alternatives, with the only exceptions being the surface water and visual specialists. Alternative 1 was preferred by the visual specialist because most of the potentially sensitive receptors are more than 2km from the alternative, whereas Alternative 2 was preferred by the surface water specialist because there is a greater distance between this alternative and surface water features. However it was also found that the visual impact of the substation and operations building would be insignificant compared to the PV arrays and for this reason **substation and operations building Alternative 2 has been selected as the preferred alternative**. Additionally, substation Alternative 2 is located further north on the power line corridor and therefore the power line would be shorter than if Alternative 1 had been selected. Selecting the shorter alternative will likely reduce negative impacts which have been identified by the various specialists. Additionally, the shorter alternative is likely to be the technically and economically preferred route.

Similarly, in terms of the laydown area alternatives almost all of the specialists found there to be no preference between the two alternatives, again with the only exceptions being the surface water and visual specialists. Alternative 1 was preferred by the surface water specialist because there are no surface water features within 500m of the proposed alternative, whereas Alternative 2 was preferred by the visual specialist because it is located slightly further from one of the sensitive visual receptors, as well as one of the potentially sensitive visual receptors. However the laydown area would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible and for this reason **laydown area Alternative 1 has been selected as the preferred alternative**.

It is important to note that no fatal flaws were identified and therefore both of the alternatives mentioned above are considered to be acceptable, although not necessarily preferable from an environmental perspective. The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in Figure 65.

Refer to Appendix 9 for the coordinates of the preferred site layout.

It should be noted that micro-siting may be required within the development area and power line corridor during the detailed design phase to avoid any additional sensitive areas, and any new palaeontological outcrops. In addition, the alignment of the power line within the authorised power line corridor will be determined during the detailed design phase. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

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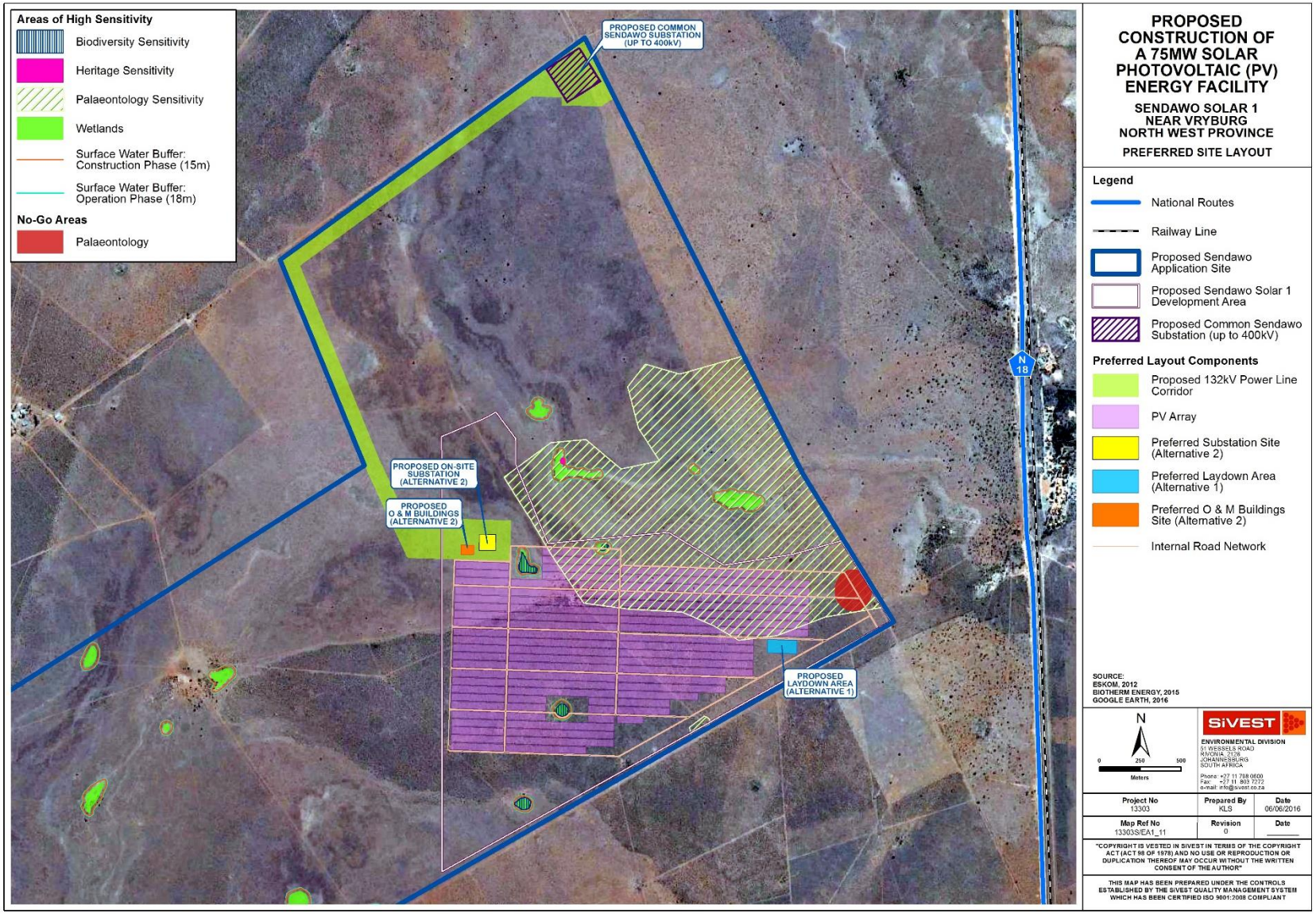

Figure 65: Preferred Site Layout in relation to Sensitive Areas

12.1 No Go Alternative

The option of not implementing the activity, or **the 'no-go' alternative, is considered in the EIA**. South Africa is under immense pressure to provide electricity generating capacity in order to reduce the current electricity demand in the country. With the global focus on climate change, the government is under severe pressure to explore alternative energy sources in addition to coal-fired power stations. Although solar power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed solar PV energy facility would be detrimental to the mandate that the government has set to promote the implementation of renewable energy. It is a suitable sustainable solution to the energy crisis and this project could contribute to addressing the problem. This project will aid in achieving South Africa's goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

Although the negative impacts identified would not occur if the project did not go ahead, the socio economic benefits of the proposed project should not be overlooked. The No-Go alternative has thus been eliminated due to the fact that the identified environmental impacts can be suitably mitigated and that by not building the project, the socio-economic benefits would be lost.

13 ENVIRONMENTAL MONITORING AND AUDITING

The Environmental Management Programme (EMPr) becomes a tool by which compliance on the proposed site can be measured against. In order to utilise this tool, environmental monitoring needs to take place with regular audits against the EMPr to ensure that all aspects are attended to.

Environmental monitoring establishes benchmarks to judge the nature and magnitude of potential environmental and social impacts.

Some of the key parameters for monitoring and auditing of the proposed project include the following inter alia:

- Soil erosion and siltation.
- Oil spillages
- Dust and gaseous emissions.
- Water quality
- Noise and vibration
- Change in biodiversity
- Socio-economic change
- Land use changes.

The overall objective of environmental and social monitoring is to ensure that mitigation measures are implemented and that they are effective. Environmental and social monitoring will also enable responses to new and developing issues of concern. The activities and indicators that have been recommended for monitoring are presented in the EMPr.

Environmental monitoring will be carried out to ensure that all construction activities comply and adhere to environmental provisions and standard specifications, so that all mitigation measures are implemented. The contractor shall employ an officer responsible for implementation of social/environmental requirements. This person will maintain regular contact with the local / district Environmental Officers. The contractor and proponent will have a responsibility to ensure that the proposed mitigation measures are properly implemented during the construction phase.

The environmental monitoring program will operate through the preconstruction, construction, and operation phases. It will consist of a number of activities, each with a specific purpose with key indicators and criteria for significance assessment. The following aspects will be subject to monitoring:

- Encroachment into sensitive areas
- Maintenance of project footprint
- Vegetation maintenance around project work sites, workshops and camps
- Health & Safety

Monitoring should be undertaken at a number of levels. Firstly, it should be undertaken by the Contractor at work sites during construction, under the direction and guidance of the Supervision Consultant who is responsible for reporting the monitoring to the implementing agencies. It is not the Contractor's responsibility to monitor land acquisition and compensation issues. It is recommended that the Contractor employ local full time qualified environmental inspectors for the duration of the Contract. The Supervision Consultant should include the services of an independent environmental and monitoring specialist on a part time basis as part of their team.

Environmental monitoring is also an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measure, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time.

Periodic ongoing monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

The EMPr is included in Appendix 8.

14 COMPLIANCE WITH WORLD BANK STANDARDS AND EQUATOR PRINCIPLES

This report has been prepared to comply with various environmental legislation as well as World Bank Standards (IFC Guidelines) and the Equator Principles. Thus in order to ensure compliance with these, a checklist has been compiled to ensure that all aspects of these guidelines have been taken into account when compiling this document. Table 82 below indicates that all applicable performance standards have been complied with.

The performance standards which have not been addressed at this stage as indicated in Table 82 below will be addressed at a later stage when the proponent has reached financial closure. Therefore, the compliance level is partially compliant at this stage. It is important to note that the project proponent is committed to achieving compliance with the EPs.

The coding key is as follows:

Compliance level			
Clear			
Not assessed/determined	Not compliant	Partially compliant	Compliant

Appendix 10 includes the IFC Performance Standards on Environmental and Social Sustainability.

Table 82: Compliance with Equator Principles

PRINCIPLES	**COMPLIANCE LEVEL**	**REFERENCE**
Performance Standard 1 Environmental & Social Reporting		
1. Baseline Information		Refer to Chapter 6
2. Impacts and Risks		Refer to Chapter 9
3. Global impacts		N/A
4. Transboundary		N/A
5. Disadvantaged / vulnerable groups		Refer to Chapter 8.7
6. Third party		Refer to Chapter 8.7
7. Mitigation measures		Refer to Chapter 10.1 and the EMPr - Appendix 8
8. Documentation of Assessment process		Refer to Chapter 9
9. Action Plans		No major Action Plans required as mostly generic mitigation

		measures have been required.
10 Organizational capacity		Refer to Appendix 10
11. Training		Refer to Appendix 10
12. Grievance mechanism	The proponent will commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
Performance Standard 2, Labour & Working Conditions		
1. Human Resource Policy	The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
2. Working relationship		Refer to Appendix 10
3. Working conditions with and terms of employment		Refer to Appendix 10
4. Workers organization		Refer to Appendix 10
5. Non-discrimination and equal opportunities		Refer to Appendix 10
7. Occupational Health and Safety		Refer to Appendix 10
8. Non-employee workers		Refer to Appendix 10
9. Supply Chain		Refer to Appendix 10
10. Labour Assessment Component of a Social and Environmental Assessment		Refer to Appendix 10
Performance Standard 3, Pollution		
1. Pollution Prevention, Resource Conservation & Energy Efficiency		Refer the EMPr - Appendix 8

2. Wastes		Refer the EMPr - Appendix 8
3. Hazardous material		Refer the EMPr - Appendix 8
4. Emergency preparedness & response	The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
5. Technical guidance – ambient considerations		Refer to Appendix 10
6. Greenhouse gas emissions		No greenhouse gas emissions will result from the proposed development.
Performance Standard 4, Health & Safety		
1. Hazardous materials safety		Refer the EMPr - Appendix 8
2. Environmental and natural resource issues		Refer to chapters 6 and 8
Performance Standard 5, Land Acquisition		**Refer to chapter 5**
Performance Standard 6, Biodiversity		**Refer to Chapter 6.6 and 8.1**
Performance Standard 7, Indigenous People		**Refer to Chapter 8.7**
Performance Standard 8, Cultural Heritage		**Refer to Chapter 8.7**

15 EVALUATION AND RECOMMENDATIONS

Table 83 summarises the key recommendations for the environmental issues identified in the DEIAr. In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this EIA (where practical and possible) have been included within an Environmental Management Programme (EMPr). This EMPr should form part of the contract with the contractors appointed to construct and maintain the proposed project. The EMPr would be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases (i.e. construction, operation and de-commissioning) of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.

An Environmental Management Programme is included with this Environmental Impact Assessment Report as Appendix 8.

It is also recommended that the process of communication and consultation with the community representatives is maintained after the closure of this EIA process, and, in particular, during the construction phase associated with the proposed project.

The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in Figure 66.

15.1 Summary of Findings

Table 83: Summary of findings and Recommendations

Environmental Parameter	Summary of major findings	Recommendations
Biodiversity	The vegetation type that occurs on site (Ghaap Plateaux Vaalbosveld) is classified as Least Threatened and also has a wide distribution and extent. The natural vegetation on the sites is therefore not considered from this perspective to have high conservation status. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy. However, the site is within areas identified in the Provincial Conservation Assessment to be of importance for various reasons, including as buffer areas for pans, as part of a Provincial corridor network and as part of a dolomite aquifer recharge zone. Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of the following: ▪ Presence of natural vegetation on site, some of which is of elevated conservation priority. ▪ Presence of one protected tree species. ▪ Presence of pan depressions. ▪ Potential presence of several animals of potential conservation concern: ▪ Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.	The report concludes that there are some issues related to the ecology of the site that could result in potentially significant ecological impacts. The seriousness of these impacts is not considered to be high. Some impacts require permits to be issued, either by National or Provincial authorities and additional field data is required for the permit applications.

Avifauna	The proposed PV 1 facility is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective. A potentially high sensitive, no-go area was identified in the core study area, i.e. a small concrete impoundment at a natural spring. A borehole and the Dry Harts River were identified as potential high sensitive areas in the immediate surroundings, as these micro-habitats are potential focal points of bird activity. It is important to note that the sensitivity of the study area could be influenced by the development itself, in that the construction of the solar panels will result in the relocation of the impoundment, currently located at the natural spring, which means that the 250m zone currently classified as high sensitive around the impoundment could fall away. The potential impact of displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure are rated as high, and will remain so after mitigation. The potential impact of displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure, are also rated as high and will remain so after mitigation. The impact of mortality of priority species due to collisions with solar panels is rated as low and could be further reduced through mitigation. The impact of displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure is likewise rated as low and could be further reduced through mitigation.	In view of the very dry conditions which prevailed at the site during the pre-construction monitoring which was implemented from November 2015 to February 2016, the low number of birds recorded should not necessarily be taken as an absolutely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

Surface Water	Ultimately, it was found that there are four pan wetlands (pan wetlands 4, 5, 14, and 15) on the Sendawo PV 1 study site. A 15m construction buffer zone and 18m operation buffer zone is to be applied to the wetlands based on the type and condition of the wetlands as well as the potential impacts expected and mitigations measures to be implemented. In terms of potentially applicable environmental and water related legislature, several listed activities and water uses have been identified that will be applicable to the proposed development based on the current layout. In terms of NEMA (1998) and the EIA Regulations (2014), Activities 12 and 19 of Government Notice 983 have been identified as being applicable as a result of access roads being placed directly within pan wetland 15 and along the boundaries of pan wetland 4. With respect to the NWA (1998), water uses (c) and (i) will also be applicable where the proposed access roads will be directly within pan wetland 15 and along the boundaries of pan wetland 4. The above identified activities and water uses should however be confirmed with the relevant government departments. Foreseen potential negative impacts in terms of the pre-construction, construction, operation and decommissioning phases of the proposed development were identified and assessed. Mitigation measures have been stipulated and must be included and implemented as part of the Environmental Management Programme (EMPr) for the proposed development.	In terms of final specialist recommendations, it is strongly recommended that no access roads are placed within the identified wetlands, as there is sufficient space alongside the proposed PV fields for the roads to be routed outside and away from the wetlands. The implications of access roads in any wetlands mean long term impacts. If these wetlands cannot be avoided, the health of the affected wetlands will need to be assessed to determine if these wetlands are ecologically significant and whether the impacts will be too high, thereby potentially requiring wetland off-setting to compensate for significant degradation as a result of the proposed development. This can be undertaken during the water use license application process, should water use licensing be undertaken for the affected wetlands. However, where access roads can be removed from the wetland areas and should no direct impacts need to take place to the identified wetlands, the need for water use licensing can be avoided where it can be demonstrated to DWS that significant impacts will not take place and/or where other water uses are not required. Where impacts to surface water resources is not avoidable, the relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence

Agricultural Potential and Soils	The shallow soils in the area, coupled with the low rainfall means that the only means of reliable cultivation would be by irrigation and the Google Earth image of the area shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation. The climatic parameters mean that this part of North West is well suited for grazing but here the grazing capacity is relatively low, around 12 ha/large stock unit. The land use in the area is dominantly "shrubland and low fynbos" with some small areas of "bare rock and soil (natural)" as classified by the National Land Cover (Thompson, 1999). As previously mentioned, there are no areas of cultivation that were identified, only a few small, isolated areas of "Improved grassland".	Due to the prevailing low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be kept to a minimum, so that at least the effect on grazing land for livestock is reduced. The main mitigation would be to ensure that physical disturbance caused by soil removal and/or re-distribution is kept to a minimum. In such an area of low rainfall and hot conditions, vegetation is fragile and often difficult to re-establish. The relatively sandy nature of the soils means that if exposed, there is a real hazard of soil removal by wind erosion, especially in the drier winter months. To combat this, any bare soil should be re-vegetated as soon as possible and preventative measures, such as soil covering and windbreaks, may also be required.
Visual	The assessment revealed that overall the proposed Sendawo Solar 1 PV energy facility would have a low visual impact during construction and a medium visual impact during operation, with a number of mitigation measures available. The associated infrastructure would have a low visual impact during construction and operation. The visual impacts are not significant enough to prevent the project from proceeding and that an Environmental Authorisation (EA) should be granted. From a visual impact perspective only three (3) sensitive visual receptors have been identified within the study area. In addition, the existing electrical infrastructure and	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Vegetation clearing should take place in a phased manner. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible. ▪ Limit the number of vehicles and trucks travelling to and from the proposed site.

	other linear elements already present within the study area have already altered the natural character of the surrounding environment to a degree and are expected to lower the visual sensitivity of the area. It must also be noted that the visual impact of the proposed development on these three (3) sensitive visual receptors identified within the study area was rated as being low. SiVEST is therefore of the opinion that the impacts associated with the construction and operation phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented	▪ Ensure that dust suppression techniques are implemented on all gravel access roads. ▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles. ▪ Re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid. ▪ Temporarily fence-off the construction site (for the duration of the construction period). Carefully plan to reduce the construction period. ▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ As far as possible, limit the amount of security and operational lighting present on site. ▪ As far as possible, limit the number of maintenance vehicles which are allowed to access the site. ▪ The operations and maintenance (O&M) buildings should not be illuminated at night. ▪ Bury cables under the ground where possible. ▪ The O&M buildings should be painted with natural tones that fit with the surrounding environment. ▪ Select the alternatives that will have the least impact on visual receptors ▪ Limit the number of maintenance vehicles which are allowed to access the site. ▪ Non-reflective surfaces should be utilised where possible.

Heritage and Palaeontology	The Heritage Impact Assessment has shown that the proposed Sendawo Solar projects have heritage resources present on the property. This has been confirmed through a field survey, archival research and evaluation of aerial photography of the sites. During the fieldwork 2 archaeological resources were identified of which all were archaeological sites representing the Earlier, Middle and Later Stone Age. The sites are all rated as having local heritage significance. No mitigation is required for sites V01 and V06. Based on the fieldwork findings, an extremely high palaeontological sensitivity area has been delineated in the south eastern section of the proposed project area. The palaeontological finds around point 0522 are seen as the most significant of the area and can give a heritage grading of Grade 2 (Provincial Heritage Site) but potentially Grade 1 (National Heritage Site). Local scree material and blocks of dolomite were inspected for fossils and all finds were recorded as photographic records. Outcrop of bedrock with significant stromatolites fossils was recorded and sites with potential cave breccia were recorded in areas where burrows of large vertebrates such as Aardvark were obviously present in the sandy deposits. Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.	The overall impact on heritage resources is seen as acceptable and the proposed mitigation measures to be incorporated in the EMPr will provided the necessary actions to address any impacts on heritage resources.
Socio-economic	The local community of Vryburg, and the Naledi LM at large, is faced with significant levels of illiteracy, high unemployment, and limited economic opportunities. It is estimated that two thirds of	Considering the possible cumulative impact of the project and the potential effect on food security, care should be taken to not unduly negatively impact on

	the households residing within the LM survive on less than R3 200 per month. Consultation with community leaders revealed that the most significant socio-economic challenge facing the population of the study area is the lack of employment opportunities. This was confirmed during the consultation with the directly impacted land owner, who stated that the farmers are no longer able to employ as many local community members as previously, leaving these individuals with limited other skills and opportunities for re-employment. Portion 1 of Farm Edinburgh 735 is currently being used for predominantly livestock farming and game breeding. The proposed development will not affect these operations, as they are expected to be moved to the adjacent farm. Overall, the impacts discussion and evaluation revealed that no fatal flaws are present from a socio-economic perspective, preventing the proposed development from being approved and implemented. In fact, all of the expected negative socio-economic impacts can be mitigated to low significance. Overall, considering the fact that the significance of the possible positive impacts of the proposed development outweighs the negative impacts, and based on the needs and desirability assessment from a locational perspective, it can be concluded that the project would generate positive socio-economic returns for the local economy and its community and should therefore, be considered for implementation.	agriculture production in the region. Based on the fact that the land is not considered as high potential agricultural land and the consultation with the impacted land owner, this is not a significant concern for the development of Sendawo 1, assuming mitigation measures are implemented.
Traffic	The general freight for the solar farms comprise of building materials, solar panels and frames and an 80MVA transformer(s). The imported freight will be transported from South African ports	It is recommended that the majority of construction personnel is transported to and from site by means of buses and some by private vehicles.

	to the site. Building materials will be transported from sources in surrounding towns while certain elements will be transported from various manufacturing centres in South Africa. The preferred import origin of the imported elements to the proposed Sendawo 1 Solar PV Energy Facilities will be from the Durban Port. The distance of 828 km comprises of surfaced roads the full way. However, should the Durban Port not be available for handling the freight, the Port Elizabeth/Coega Port could be used as an alternative port. The transport distance in this case is 925 km. Toll fees are required on the route from the preferred port. Abnormal Permits will be required for transport of the transformer in any event. The traffic during construction and during operation will have negligible impact on existing and future traffic. The route is predominantly on National or Provincial Roads with suitable standards for transport of container freight. It is also suitable for abnormal loads with permits. There is a possibility of limited risk of delays for normal routine maintenance works (repairs and reseals) depending of the time of transport and scheduling of roads contracts. The transport of elements from manufacturing centres within South Africa is predominantly on National and Provincial roads, which presents no limitations for normal freight. The proposed preferred access roads from the N18 to the site for is situated in the middle of the proposed site at an existing farm	

	access. The access is at an acceptable safe point with sufficient sight distance which would be acceptable to SANRAL. In general, no obvious problems are expected with freight transport along the proposed routes to the site necessary for the construction and maintenance of the site.	

A summary of the impact rating of the proposed development according to each environmental aspect are provided in Table 84 below.

Key

LOW NEGATIVE	**LOW POSITIVE**
MEDIUM NEGATIVE	**MEDIUM POSITIVE**
HIGH NEGATIVE	**HIGH POSITIVE**

Table 84: Impact rating summary for the proposed Sendawo 1 solar PV energy facility during the construction phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Loss of indigenous natural vegetation	-38 (medium negative)	-38 (medium negative)
	Loss of individuals of protected plant species	-11 (low negative)	-9 (low negative)
	Loss of individuals of protected trees	-17 (low negative)	-9 (low negative)
	Damage to pans and drainage areas	-34 (medium negative)	-10 (low negative)
Avifauna	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	- 54 (high negative)	-51 (high negative)

	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure	- 54 (high negative)	-51 (high negative)
Surface Water	Construction Lay-down Area	- 22 (low negative)	- 7 (low negative)
	Vehicle and Machinery Degradation	- 30 (medium negative)	- 14 (low negative)
	Human Degradation of Flora and Fauna associated with the Wetland	- 11 (low negative)	- 6 (low negative)
	Degradation and Removal of Soils and Vegetation associated with the Wetland	- 32 (medium negative)	- 30 (medium negative)
	Increased Run-off and Sedimentation	- 39 (medium negative)	- 8 (low negative)
Agricultural Potential and Soils	The loss of agriculturally productive soil due to the establishment of the infrastructure	-22 (low negative)	-10 (low negative)
	The loss of topsoil by being exposed to wind action due to construction processes	-42 (medium negative)	-9 (low negative)
Visual	Rating of visual impacts of the proposed Sendawo Solar 1 PV energy facility (including associated infrastructure) during construction	-24 (low negative)	-20 (low negative)
Heritage	Impact on heritage resources during construction	-28 (low negative)	10 (low positive)
	Impact on palaeontological resources during construction	-96 (high negative)	+57 (high positive)
Socio-economic	Loss of productive agriculture land	-34 (medium negative)	-17 (low negative)
	Temporary employment creation	+12 (low positive)	+26 (low positive)
	Skills development	+16 (low positive)	+36 (medium positive)
	Temporary increase in living standard	+12 (low positive)	+12 (low positive)
	Temporary increase in social pathologies	-32 (medium negative)	-16 (low negative)
	Impact on business and personal security	-30 (medium negative)	-14 (low negative)
	Change in sense of place	-18 (low negative)	-15 (low negative)
	Temporary increase in production	+45 (medium positive)	+45 (medium positive)
	Upgrading of existing local road infrastructure	+20 (low positive)	+20 (low positive)
	Temporary increase in traffic	-26 (low negative)	-13 (low negative)

	Increased demand for social facilities	-28 (low negative)	-13 (low negative)
	Impact on basic service delivery	-28 (low negative)	-13 (low negative)
	Temporary increase in household disposable income	+30 (medium positive)	+30 (medium positive)
	Temporary increase in tax revenue for government	+30 (medium positive)	+30 (medium positive)

Table 85: Impact rating summary for the proposed Sendawo 1 solar PV energy facility during the operational phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Establishment and spread of declared weeds	-28 (low negative)	-11 (low negative)
Avifauna	Mortality of priority species due to collisions with solar panels	-28 (low negative)	-22 (low negative)
Surface Water	Vehicle Damage to the Wetland	- 48 (medium negative)	- 39 (medium negative)
Visual	Rating of visual impacts of the proposed Sendawo Solar 1 energy facility during operation	-36 (medium negative)	-36 (medium negative)
	Rating of visual impacts of the infrastructure associated with the Sendawo Solar 1 PV energy facility during operation	-17 (low negative)	-15 (low negative)
Socio-Economic	Employment creation	+12 (low positive)	+28 (low positive)
	Skills development	+17 (low positive)	+34 (medium positive)
	Increase in living standard	+14 (low positive)	+14 (low positive)
	Increased social pathologies	-34 (medium negative)	-16 (low negative)
	Increase in production	+26 (low positive)	+26 (low positive)
	Increased demand for social facilities	-30 (medium negative)	-15 (low negative)
	Impact on service delivery	-30 (medium negative)	-14 (low negative)
	Increase in household disposable income	+30 (medium positive)	+30 (medium positive)
	Increased property values	+28 (medium positive)	+28 (low positive)
	Increase in government revenue	+34 (medium positive)	+34 (medium positive)

Table 86: Impact rating summary for the proposed Sendawo 1 solar PV energy facility during the decommissioning phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Avifauna	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.	-11 (low negative)	-10 (low negative)

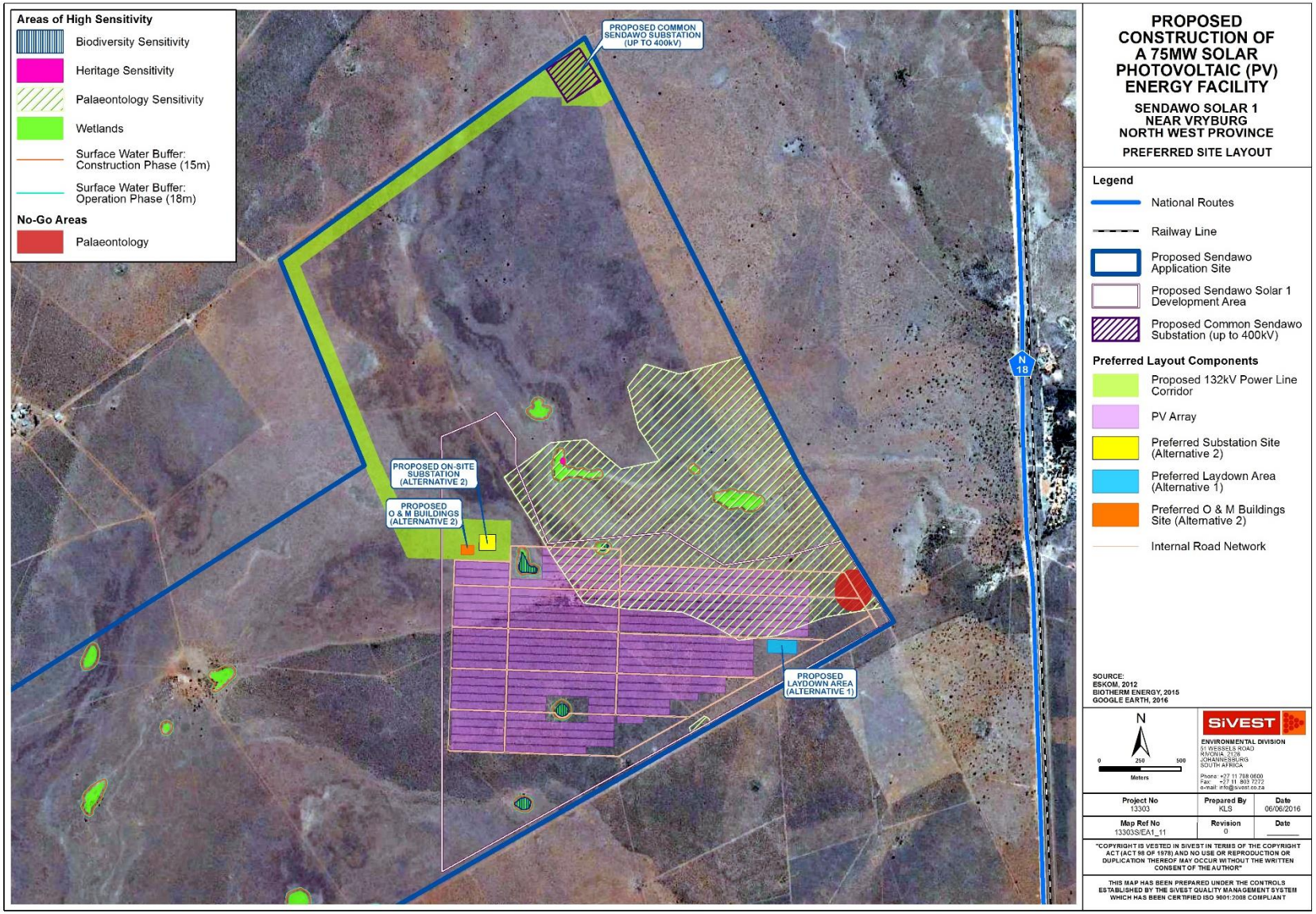

Figure 66: Preferred Site Layout in relation to Sensitive Areas

15.2 Conclusion and Environmental Impact Statement

The findings of the specialist studies undertaken within this EIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed Sendawo 1 Solar PV energy facility. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding. Areas of special concern have however been identified which will require site specific mitigation measures to reduce impacts. These are included within the EMPr to ensure that these areas receive special attention.

It was determined during the EIA that the proposed project will result in limited potential negative impacts and certain positive impacts. A preferred layout has been identified which is less environmentally sensitive and will result in the least environmental impact.

A detailed public participation process was followed during the EIA process which conforms to the public consultation requirements as stipulated in the EIA Regulations, 2014. In addition, all issues raised by I&APs will be captured in the FEIAr and where possible, mitigation measures provided in the EMPr to address these concerns.

As sustainable development requires all relevant factors to be considered, including the principles contained in section 2 of NEMA, the DEIAr has strived to demonstrate that where impacts were identified, these have been considered in the determination of the preferred layout.

It should be noted that micro-siting may be required within the development area and power line corridor during the detailed design phase to avoid any additional sensitive areas, and any new palaeontological outcrops. In addition, the alignment of the power line within the authorised power line corridor will be determined during the detailed design phase. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

It is the opinion of the EAP that the information and data provided in this DEIAr is sufficient to enable the DEA to consider all identified potentially significant impacts and to make an informed decision on the application. Further, it is the opinion of the EAP that based on the findings of the EIA that the proposed project should be granted an EA and allowed to proceed provided the following conditions are adhered to:

- The preferred substation and operations building is Alternative 2
- The preferred laydown area is Alternative 1
- Final routing of the power line within the corridor should avoid tower placement within 32m of surface water features and any other identified sensitive areas.
- The results of the Geotechnical surveys should be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites within the proposed development area.

- A palaeontologist should be appointed to monitor geotechnical investigations as part of a watching brief to identify and mitigate any newly discovered palaeontological sites. Site visits should include an initial five (5) day visit and then one day every two (2) weeks during construction.
- The palaeontological no-go area around point 0522 should be avoided and no development should take place within this area.
- Micro siting should be undertaken in the delineated high paleontological sensitivity area and palaeontological excavations and collection should be done if the Geotechnical survey indicates necessity for mitigation.
- All feasible and practical mitigation measures recommended by the various specialists must be implemented.
- Final EMPr should be approved by DEA prior to construction.
- The final power line and access road alignment should be submitted to the DEA for approval prior to commencing with the activity.

SiVEST as the EAP is therefore of the view that:

- A preferred substation site, operations building and laydown area has been identified which is less environmentally sensitive compared to the other site considered during the EIA phase.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the proposed project can be mitigated to acceptable levels.

The date on which the activity and post construction monitoring will be concluded cannot be determined at this stage as they are based on the timeframes dictated by the REIPPP bid windows. The date of the next round of bid submissions has not yet been announced. The construction of the Sendawo 1 solar PV energy facility line is dependent on being selected as a preferred bidder. The project will therefore require an authorisation of at least 5 years.

It is trusted that the DEIAr provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

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SiVEST Environmental Division
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Andrea Gibb
Cell No.: +27 72 587 6525
Email: andreag@sivest.co.za