Final Scoping Report 14/12/16/3/3/2/419

PROPOSED ESTABLISHMENT OF A RENEWABLE ENERGY GENERATION FACILITY ON PORTION 1 (REMAINING EXTENT) OF THE FARM KLEIN KAREELAAGTE 168, SIYANCUMA LOCAL MUNICIPALITY, PIXLEY KA SEME DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

Short name: Carodex Solar Park

January 2013

Commissioned by: Carodex (Pty) Ltd
Document version 2.0 – Final

AGES
Purpose with Passion

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Final Scoping Report: **14/12/16/3/3/2/419**

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AGES

Purpose with Passion

Proposed establishment of a renewable energy facility on Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Siyancuma Local Municipality, Pixley ka Seme District Municipality, Northern Cape Province

January 2013

PROJECT APPLICANT

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DOCUMENT HISTORY

Report no	Date	Version	Status
14/12/16/3/3/2/419	January 2013	2.0	Final
14/12/16/3/3/2/419	November 2012	1.0	Draft

PROJECT MAIN FEATURES

Project main features - according to the EIA guidelines
Summary of information included in the report

General site information

Site location	
Farm	**Klein Kareelaagte 168 (Herbert R.D.)**
Portion	**Portion 1 (Remaining Extent)**
Surveyor-general 21 digit site	C03200000000016800001
Local Municipality	Siyancuma
District Municipality	Pixley ka Seme
Province	Northern Cape

Property details	
Extent	1028.1286 ha
Land Owner	NEL WYNAND LODEWIKUS
Diagram deed number	T13561/1915
Title deed number	T1208/2004
Registration date	20040326
Current land use	farming

Site data	
Latitude	29° 19' 50" S
Longitude	24° 29' 30" E
Altitude	1215 m a.m.s.l.
Ground slope	flat

PV power plant design specifications and connection to the Eskom grid

Project data	
Project name	**CARODEX SOLAR PARK**
Technology	**Photovoltaic power plant**
Number of Phases	**1**
Maximum generating capacity at the delivery point	**75 MW**
Type of PV modules	Thin-film or Mono/Polycrystalline
Type of mounting system	fixed or horizontal single-axis trackers (SAT)
Average annual energy production (up to)(*)	160.2 GWh/year with thin film modules mounted on fixed mounting system 190.1 GWh/year with mono/polycrystalline modules mounted trackers
Load factor (*)	0.223 with thin film modules mounted on fixed mounting system 0.251 with mono/polycrystalline modules mounted trackers
Full net equivalent hours (EOH) (*)	1950 h/year (Wh/Wp/y) with thin film modules mounted on fixed mounting systems 2200 h/year (Wh/Wp/y) with mono/polycrystalline modules mounted trackers
(*) calculated by PVSYST, simulation professional tool	

Technical specifications	
Installed power capacity - AC side	**75 MW**
Installed power capacity - DC side	**82,134,000 Wp with thin film modules** **86,400,000 Wp with mono/polycrystalline modules**
Number of PV modules	608,400 thin film modules of 135 Wp each 288,000 mono/polycrystalline modules of 300 Wp each
Number of structures (PV arrays)	15,600 fixed mounting systems 7,200 trackers (SAT)
Minimum structure height above ground level	1.0 m
Maximum structure height above ground level	3.1 m

Other information	
Footprint, including internal roads (fenced area)	approximately 200 ha
PV power plant lifetime	25 - 30 years
Construction camp (temporary)	10 ha
Construction timeframe	15 months

Connection to the Eskom grid (**)	
Connection solution: description	The connection to the Eskom grid will be done according to the Eskom connection solution which may require: (i) one small on-site high-voltage loop-in loop-out substation with one or more high-voltage power transformers and a 132 kV bus bar (switching station) to be connected to the Eskom's 132 kV power line called "Klokfontein-Graspan", which crosses the project site; (ii) two new small sections of 132 kV power line allowing the Eskom's "Klokfontein-Graspan" 132 kV power line to loop in and out of the 132 kV busbar of the new on-site substation. The connection solution may also entail intervention on the Eskom's grid and/or on Eskom's "Klokfontein-Graspan" 132 kV power line.
Point of connection	"Klokfontein-Graspan" 132 kV power line
Point of connection (farm, portion)	Portions 7 or 11 of the Farm ROODE LAAGTE 131, within the existing Eskom servitude
Delivery point: voltage level	132 kV
New sections of power line - overall length	2x100 m
New HV substation inside the property - footprint	approximately 4,000 m^2
Servitudes for new power lines	not required
(**) already included in the current EIA application	

Water requirements	
Water consumption	See on paragraph 4.2.5 - water requirements

Site maps and GIS information

Status quo information - site	***ESRI shape files***
Site	To be provided during the EIA phase
Building and other structures	To be provided during the EIA phase
Agricultural field	Not applicable
Natural and endangered vegetation areas	To be provided during the EIA phase
Cultural historical sites and elements	To be provided during the EIA phase
Contours with height references	To be provided during the EIA phase
Slope analysis	To be provided during the EIA phase
High potential agricultural areas	Not applicable
Eskom's substation(s) / power line(s)	To be provided during the EIA phase

Development proposal maps	***ESRI shape files***
Project site	To be provided during the EIA phase
Access road and internal roads	To be provided during the EIA phase
Position of solar facilities	To be provided during the EIA phase
Permanent laydown area footprint	To be provided during the EIA phase
Construction period laydown footprint	To be provided during the EIA phase
River, stream, water crossing	Not applicable
Substation and transformers	To be provided during the EIA phase
Connection routes	To be provided during the EIA phase
Buildings	To be provided during the EIA phase
Tree buffer zone	To be provided during the EIA phase

Other information

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- CDSP_04_DE_Rev.00/SR Mounting System – Alternative option 2: horizontal single-axis trackers with polycrystalline modules
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- CDSP_06_DE_Rev.00/SR Control building and medium-voltage receiving station
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ABBREVIATIONS AND ACRONYMS

AGES	Africa Geo-Environmental and Engineering Consultants (Pty) Ltd
BID	Background Information Document
Carodex	Carodex (Pty) Ltd (applicant)
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSP	Concentrating Solar Power
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DoE	Department of Energy
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIR	Environment Impact Assessment Report
EMP	Environmental Management Plan
ESS	Environmental Scoping Study
FIT	Feed in Tariffs
GHG	Green House Gases
GIS	Geographic Information Systems
GN	Government Notice
GWh	Giga Watt hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IPP	Independent Power Producer
kV	kilovolt
MW	Mega Watt
MWp	Mega Watt peak
NEMA	National Environmental Management Act - Act no. 107 of 1998
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act - Act no. 25 of 1999
NWA	National Water Act - Act no. 36 of 1998
PoS	Plan of Study
Property	Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168
Project company	Carodex (Pty) Ltd (applicant)
Project site	Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168
PV	Photovoltaic
REFIT	Renewable Energy Feed-in Tariffs
RFP	Request For Qualification and Proposals For New Generation Capacity under the IPP Procurement Programme
SAHRA	South African Heritage Resources Agency
SANRAL	South African National Roads Agency Limited
SANS	South African National Standard
UPS	Uninterruptible Power Supply

1. INTRODUCTION

CARODEX (Pty) Ltd (Reg. n. 2012/001634/07) is proposing the development of a renewable solar energy facility in a key strategic location in terms of the connection to the Eskom grid and in terms of the favourable solar irradiation.

The proposed site is located on **the northern side of Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, (Siyancuma Local Municipality, Pixley ka Seme District Municipality, Northern Cape Province),** for the establishment of a solar energy facility with associated infrastructure and structures.

Site location: Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168
Surveyor-general 21 digit site codes:

C	0	3	2	0	0	0	0	0	0	0	0	0	1	6	8	0	0	0	0	1

The name of the project is **CARODEX SOLAR PARK** and it envisages a **photovoltaic (PV) power plant having a maximum generating capacity of 75 MW**.

The **footprint** (fenced area) of the proposed development is approximately **200 ha** on an overall area measuring 210 ha (lease portion), within Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168 (1028.1296 ha in extent).

The Carodex Solar Park is participating to the IPP Procurement Programme issued on 3 August 2011 by the DoE (Department of Energy).

The Carodex Solar Park will be connected to the **Eskom "Klokfontein-Graspan" 132 kV power line**, which runs parallel to the northern boundary of the project site, through two new small sections of 132 kV power line, approximately 100 m long.

In order to develop the facility, Carodex (Pty) Ltd must undertake an Environmental Impact Assessment (EIA) process and acquire environmental authorization from the National Department of Environmental Affairs (DEA), in consultation with the *Northern Cape Department of Tourism, Environmental Affairs & Conservation*, in terms of the EIA Regulations (2010) published in terms of Section 24(2) and 24D of the National Environmental Management Act (NEMA, Act No. 107 of 1998).

This project has been registered with the **DEA application reference number 14/12/16/3/3/2/419** and with the **NEAS reference number DEA/EIA/0001459/2012**.

The EIA procedure of the Carodex Solar Park **includes the connection to the Eskom grid.** Eskom is the entity which assessed the connection solution included and described in this Scoping Report. Eskom also coordinated the necessary liaising between the developer, Eskom Transmission, Eskom Distribution and Eskom Land & Rights Department.

It is important to highlight that all or part of the infrastructure required for the connection (all located inside the site) may be owned and/or operated by Eskom Distribution, this will depend on the Eskom grid code in relation to the IPPs (Independent Power Producers) and on the Connection Agreement to be finalized prior to or simultaneously with the conclusion of the PPA (Power Purchase Agreement) in respect of the options of retaining ownership of the connection works once completed.

The independent Environmental Assessment Practitioners (EAPs) which have been appointed for the undertaking of the detailed environmental studies in compliance with the 2010 EIA Regulations are **AGES (Pty) Ltd.**

With the aim of identifying and assessing all potential environmental impacts related to the development as well as suggesting possible mitigation measures and alternatives, AGES has appointed specialist sub-consultants to compile detailed reports and to study the activities necessary for the assessment of the specific impacts related to their field of expertise.

AGES and the other specialist consultants are in a position of independency from Carodex (Pty) Ltd; therefore they are not subsidiaries or affiliated to the latter. AGES and the specialist consultants have no secondary interest connected with the development of this project or of other projects which may originate from the authorization of the project.

The characteristics, the technology and the extent of the Carodex Solar Park are defined and evaluated in this Final Scoping Report and its annexures.

2. MOTIVATION AND RATIONALE OF THE CARODEX SOLAR PARK IN LIGHT OF THE IPP PROCURMENT PROGRAMME REQUIREMENTS

2.1. THE CHOICE OF THE NORTHERN CAPE PROVINCE AND OF THE SITE LOCATION

The Carodex Solar Park will be located in the Northern Cape Province this province has been identified by Carodex (Pty) Ltd as an ideal macro area for establishing a solar PV plant on the basis of several important considerations:

- solar resource is exceptionally high: the *global horizontal irradiation* of the site is 2,094.1 kWh/m^2/year;
- there are several green projects currently under development in the Northern Cape, because of the high solar resources and the availability of desolate lands with low ecological and agricultural value;
- Northern Cape Province and the local municipalities and communities are eager to start establishing an eco-green image in consideration of the burden of CO_2 emissions they have to bear.

In addition to these very favourable characters in terms of desirability of renewable solar energy projects in the Northern Cape Province, the site of the Carodex Solar Park has been chosen by Carodex (Pty) Ltd on the grounds of several considerations, in particular:

- the availability of an easy connection solution - already confirmed by Eskom - due to the presence of the Eskom 132 kV power line, called "Klokfontein-Graspan", which runs parallel to the northern boundary of the project site;
- the flatness of the proposed project site;
- the low ecological sensitivity and agricultural value of northern side of the proposed project site.

Furthermore, in the light of the IPP procurement Programme requirements, the **Carodex Solar Park** has been developed according to the following main characteristics:

- the installed capacity is within the “eligible capacity” defined by the rules of the RFP (from 1 MW to 75 MW);
- the construction phase will last approximately 15 months and the PV plant will be able of beginning commercial operation before the end of 2016.

With specific reference to the Carodex Solar Park, Eskom has indicated that the project does not interfere with Eskom’s present and future developments and do not affect negatively the voltage in the area. Eskom, as an interested and affected party, recognized the positive outcome of the project in terms of the possibility of meeting the local growth of the energy consumption that is expected.

2.2. NEED AND DESIRABILITY OF THE PROJECT

South Africa currently relies principally on fossil fuels (coal and oil) for the generation of electricity. At the present date, Eskom generates approximately 95% of the electricity used in South Africa. South Africa has a largely unexploited potential in renewable energy resources such as solar, wind, biomass and hydro-electricity to produce electricity as opposed to other energy types (fuel or coal).

South Africa's electricity supply still heavily relies upon coal power plants, whereas the current number of renewable energy power plants is very limited.
In the last few years, the demand for electricity in South Africa has been growing at a rate approximately 3% per annum.
These factors, if coupled with the rapid advancement in community development, have determined the growing consciousness of the significance of environmental impacts, climate change and the need for sustainable development. The use of renewable energy technologies is a sustainable way in which to meet future energy requirements.

The development of clean, green and renewable energy has been qualified as a priority by the Government of South Africa with a target goal for 2013 of 10,000 GWh, as planned in the Integrated Resource Plan 1 (IRP1) and with the Kyoto Protocol.
Subsequently the Department of Energy of South Africa (DoE) decided to undertake a detailed process to determine South Africa's 20-year electricity plan, called Integrated Resources Plan 2010-2030 (**IRP 2010**).

The IRP1 (2009) and the IRP 2010 (2011) outline the Government's vision, policy and strategy in matter of the use of energy resources and the current status of energy policies in South Africa.
In particular, the IRP 2010 highlights the necessity of commissioning 1200 MW with solar PV technology by the end of 2015.

In order to achieve this goal, the DoE recently announced a renewable energy IPP (Independent Power Producers) Procurement Programme.
The IPP Procurement Programme, issued on 3rd August 2011, envisages the commissioning of 3725 MW of renewable projects (1450 MW with solar photovoltaic technology) capable of beginning commercial operation before the end of 2016.

The development of photovoltaic power plants will represent a key feature in the fulfilment of the proposed target goal and the reduction of CO_2 emissions.

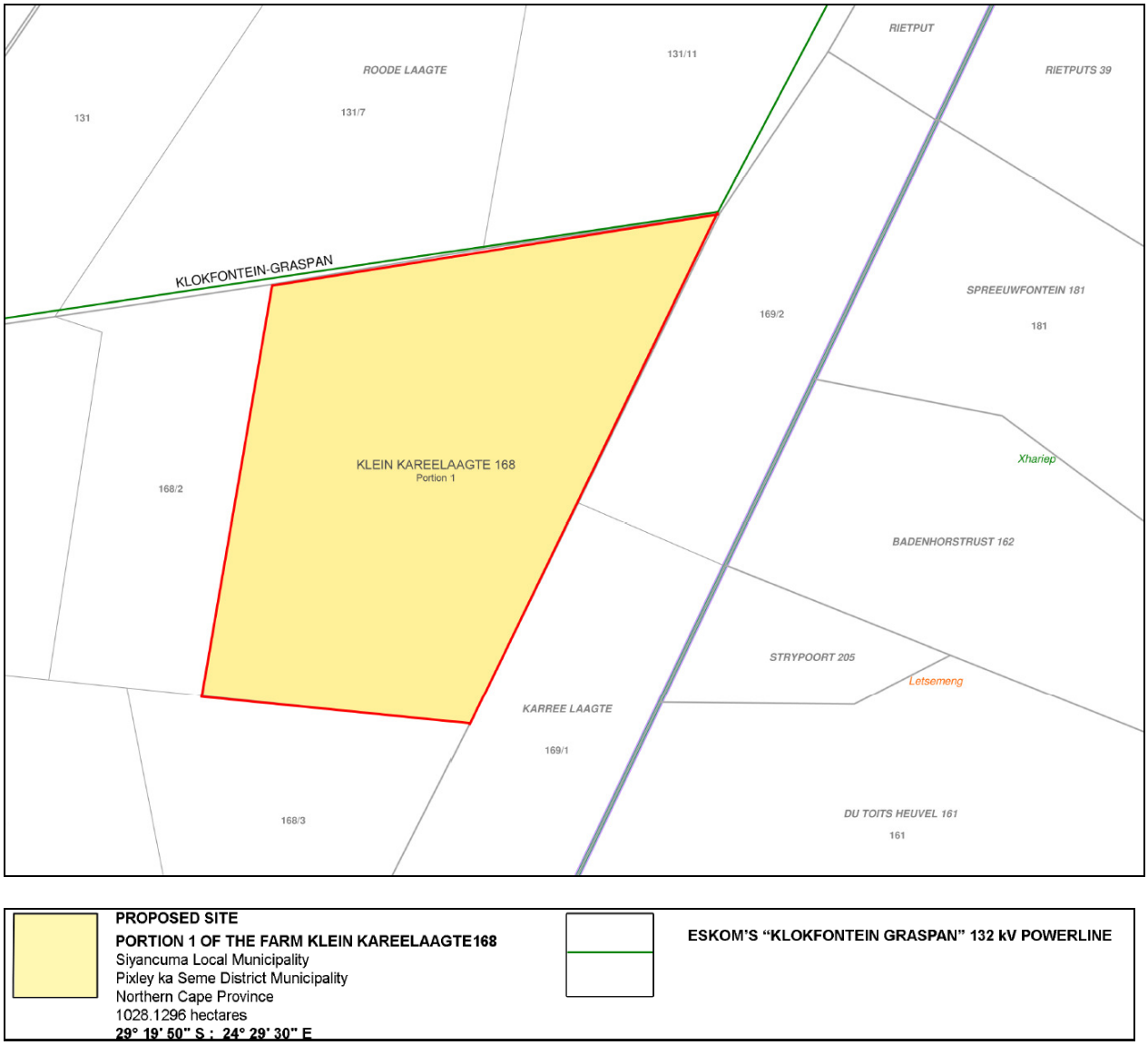
The purpose of the Carodex Solar Park is to add new capacity for the generation of renewable electric energy to the national electricity supply in compliance with the IPP Procurement Programme and in order to meet the "sustainable growth" of the Northern Cape Province.

The use of solar radiation for power generation is considered as a non-consumptive use and a renewable natural resource which does not produce greenhouse gas emissions. The generation of renewable energy will contribute to the growth of South Africa's electricity market, which has been primarily dominated up to this date by coal-based power generation. With specific reference to photovoltaic energy, and the proposed project, it is important to consider that South Africa has one of the highest levels of solar radiation in the world.

The reasons for the location of the project in the selected area can be synthesized as follows:
- low requirement for municipal services;
- compliance with national and provincial energy policies and strategies;
- no impact on people health and wellbeing;
- no waste and noise;
- no impact on air quality;

- compatibility with the ecosystem and the surrounding landscape;
- likelihood of social and economic development of marginalized, rural communities; and
- attraction of environmentally aware (green) tourists to the area.

Figure 1 Locality map of the project site



3. AUTHORITIES, LEGAL CONTEXT AND ADMINISTRATIVE REQUIREMENTS

The legislative and regulatory framework of reference for the solar power plant project includes statutory and non-statutory instruments by which National, Provincial and Local authorities exercise control throughout the development of the same project.

The development and the environmental assessment process of a solar power plant project involve various authorities dealing with the different issues related to the project (economic, social, cultural, biophysical etc.).

3.1. REGULATORY AUTHORITIES

3.1.1. National Authorities

At national level, the main regulatory authorities and agencies are:

- *Department of Energy (DoE):* the Department is competent and responsible for all policies related to energy, including renewable energy. Solar energy is contemplated and disciplined under the White Paper for Renewable Energy and the Department constantly conducts research activities in this respect;
- *Department of Environmental Affairs (DEA):* the Department is competent and responsible for all environmental policies and is the controlling authority under the terms of NEMA and EIA Regulations. The DEA is also the competent authority for the proposed project, and is entrusted with granting the relevant environmental authorisation;
- *National Energy Regulator of South Africa (NERSA):* the Regulator is competent and responsible for regulating all aspects dealing with the electricity sector and, in particular, issues the licence for independent power producers;
- *South African Heritage Resources Agency (SAHRA):* the Agency is responsible for the protection and the survey, in association with provincial authorities of listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes under the terms of the National Heritages Resources Act (Act no. 25 of 1999);
- *South African National Roads Agency Limited (SANRAL):* the Agency is responsible for all National road routes.

3.1.2. Provincial Authorities

At provincial level, the main regulatory authority is the *Northern Cape Department of Tourism, Environmental Affairs & Conservation* and this Department is responsible for environmental policies and is the Provincial authority in terms of NEMA and the EIA Regulations. The Department is also the commenting authority for the proposed project.

3.1.3. Local Authorities

At a local level, the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. In the Northern Cape province, Municipalities and District Municipalities are involved in various aspects of planning and the environment related to solar energy facilities development. The Local Municipality is the *Siyancuma Local Municipality,* which is part of the *Pixley ka Seme District Municipality*.

Under the terms of the Municipal System Act (Act no. 32 of 2000), all municipalities are deemed to go through an Integrated Development Planning (IDP) process in order to devise a five-year strategic development plan for the area of reference.

The identification of priority areas for conservation and their positioning within a planning framework of core, buffer, and transition areas is the subject of bioregional planning. Priority areas are individuated and defined with reference to visual and scenic resources and their identification and protection is granted through visual guidelines drafted for the area included in bioregional plans.

Local authorities also provide specific by-laws and policies in order to protect visual and aesthetic resources with reference to urban edge lines, scenic drives, special areas, signage, communication masts etc.

Finally, there are also various non-statutory bodies and environmental groups, who are involved in the definition of various aspects of planning and the protection of the environment, which may influence in the development of the proposed project.

3.2. LEGISLATION, REGULATIONS AND GUIDELINES

A review of the relevant legislation involved in the proposed development is detailed in table 1 below.

Table 1 Review of relevant legislation

National Legislation	Sections applicable to the proposed project
Constitution of the Republic of South Africa (Act no. 108 of 1996)	• Bill of Rights (S2) • Rights to freedom of movement and residence (S22) • Environmental Rights (S24) • Property Rights (S25) • Access to information (S32) • Right to just administrative action (S33)
Fencing Act (Act no. 31 of 1963)	• Notice in respect of erection of a boundary fence (S7) • Clearing bush for boundary fencing (S17) • Access to land for purpose of boundary fencing (S18)
Conservation of Agricultural Resources Act (Act no. 43 of 1983)	• Prohibition of the spreading of weeds (S5) • Classification of categories of weeds & invader plants and restrictions in terms of where these species may occur (Regulation 15 of GN R0148) • Requirement and methods to implement control measures for alien and invasive plant species (Regulation 15E of GN R0148)
Environment Conservation Act (Act no. 73 of 1989)	• National Noise Control Regulations (GN R154 dated 10 January 1992)
National Water Act (Act no. 36 of 1998)	• Entrustment of the National Government to the protection of water resources (S3) • Entitlement to use water (S4) - Schedule 1 provides the purposes which entitle a person to use water (reasonable domestic use, domestic gardening, animal watering, fire fighting and recreational use) • Duty of Care to prevent and remedy the effects of water pollution (S19) • Procedures to be followed in the event of an emergency incident which may impact on water resources (S20) • Definition of water use (S21) • Requirements for registration of water use (S26 and S34) • Definition of offences in terms of the Act (S151)
National Forests Act (Act no. 84 of 1998)	• Protected trees
National Environmental Management Act (Act no. 107 of 1998)	• Definition of National environmental principles (S2): strategic environmental management goals and objectives of the government applicable within the

	entire Republic of South Africa to the actions of all organs of state, which may significantly affect the environment • NEMA EIA Regulations (GN R543, 544, 545, 546, & 547 of 18 June 2010) • Requirement for potential impact on the environment of listed activities to be considered, investigated, assessed and reported on to the competent authority (S24 - Environmental Authorisations) • Duty of Care (S28): requirement that all reasonable measures are taken in order to prevent pollution or degradation from occurring, continuing and recurring, or, where this is not possible, to minimise and rectify pollution or degradation of the environment • Procedures to be followed in the event of an emergency incident which may impact on the environment (S30)
National Heritage Resources Act (Act no. 25 of 1999)	• SAHRA, in consultation with the Minister and the Member of the Executive Council of every province must establish a system of grading places and objects which form part of the national estate (S7) • Provision for the protection of all archaeological objects, paleontological sites and material and meteorites entrusted to the provincial heritage resources authority (S35) • Provision for the conservation and care of cemeteries and graves by SAHRA, where this is not responsibility of any other authority (S36) • List of activities which require notification from the developer to the responsible heritage resources authority, with details regarding location, nature, extent of the proposed development (S38) • Requirement for the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites for promotion of tourism (S44)
National Environmental Management: Biodiversity Act (Act no. 10 of 2004)	• Provision for the Member of the Executive Council for Environmental Affairs/Minister to publish a list of threatened ecosystems and in need of protection (S52) • Provision for the Member of the Executive Council for Environmental Affairs/Minister to identify any process or activity which may threaten a listed ecosystem (S53) Provision for the Member of the Executive Council for Environmental Affairs/Minister to publish a list of: critical endangered species, endangered species, vulnerable species and protected species (S56(1) - see Government Gazette 29657 • Three government notices have been published up to the present date: GN R150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R151 (Lists of critically endangered, vulnerable and protected species) and GN R152 (Threatened Protected Species Regulations)
National Environmental Management: Air	• Provision for measures in respect of dust control

Quality Act (Act no. 39 of 2004)	(S32) • Provision for measures to control noise (S34)
National Environmental Management: Waste Management Act (Act no. 59 of 2008)	• Waste management measures • Regulations and schedules • Listed activities which require a waste licence

Guideline Documents	**Sections applicable to the proposed project**
South African National Standard (SANS) 10328, Methods for environmental noise impact assessments in terms of NEMA no. 107 of 1998	• Impact of noise emanating from a proposed development may have on occupants of surrounding land by determining the rating level • Noise limits are based on the acceptable rating levels of ambient noise contained in SANS 10103
Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads	• The Guidelines outline rules and conditions related to transport of abnormal loads and vehicles on public roads and detailed procedures to be followed for the grant of exemption permits

Policies and White Papers	**Sections applicable to the proposed project**
The White Paper on the Energy Policy of the Republic of South Africa (December 1998)	• The White Paper supports investment in renewable energy initiatives, such as the proposed solar power plant project
The White Paper on Renewable Energy (November 2003)	• The White Paper outlines the Government's vision, policy, principles, strategic goals and objectives for the promotion and the implementation of renewable energy in South Africa
Integrated Resource Plan (IRP1) Integrated Resources Plan 2010-2030 (IRP 2010).	• The first Integrated Resource Plan (IRP1) was released in late 2009. Subsequently the DoE decided to undertake a detailed process to determine South Africa's 20-year electricity plan, called Integrated Resources Plan 2010-2030 (IRP 2010). • The IRP1 and the IRP 2010 outline the Government's vision, policy and strategy in matter of the use of energy resources and the current status of energy policies in South Africa. • **In particular, the IRP 2010 highlights the necessity of commissioning 1200 MW with solar PV technology by the end of 2015.**
Request For Qualification and Proposals For New Generation Capacity under the IPP Procurement Programme (3 August 2011)	• The IPP Procurement Progamme, issued on 3rd August 2011 by the DoE, envisages the commissioning of **3725 MW** of renewable projects (**1450 MW with Solar photovoltaic technology**) **capable of beginning commercial operation before the end of 2016**.
Equator Principles (July 2006)	• The Equator Principles provide that future developments with total project capital costs of US$10 million or more shall be financed only if socially and environmentally sustainable

3.3. LISTED ACTIVITIES IN TERMS OF NEMA

The "listed activities" in terms of sections 24 and 24D of NEMA involved (or *potentially* involved) in the proposed development are detailed in table 2 below.

Table 2 Listed Activities in terms of sections 24 and 24D of NEMA involved in the proposed development

Relevant notice:	Activity No :	Description of each listed activity:
R.545, 18 June 2010	**1**	*The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more:* The Carodex Solar Park will consist of construction, operation and maintenance of a Photovoltaic (PV) Power Plant with a generating capacity up to 75 MW with associated infrastructure and structures. The proposed solar park will be developed on Portion 1 (Remaining Extent) of the farm Klein Kareelaagte 168, measuring approximately 1028 ha in size. The project will participate in the IPP Procurement Programme, issued by the Department of Energy on 3 August 2011. The facility will comprise several arrays (strings) of PV modules mounted on frames; the associated infrastructure and structures will consist of: (i) internal and external access roads and a small parking area; (ii) fencing of the plant and video security control systems; (iii) foundations / minipiles for the mounted Photovoltaic arrays; (iv) electricity access point for the construction phase, operation phase (if necessary) and UPS (Uninterruptible Power Supply) devices; (v) water access point and/or water extraction on-site from borehole(s), water supply pipelines, water treatment system; (vi) sewage system and stormwater collection system; (vii) workshop & warehouse; (viii) cabling linking Photovoltaic strings and other internal cabling; (ix) medium voltage stations designed to host DC/AC inverters and medium voltage power transformers; (x) one or more medium voltage receiving stations; (xi) a control building with offices; (xii) one small on-site high-voltage loop-in loop-out substation with one or more high-voltage power transformer(s) - stepping up the voltage to the voltage of the Eskom grid - and a high-voltage bus bar with protection an metering devices ("switching station"); (xiii) two new small sections of high-voltage power line allowing the Eskom's "Klokfontein-Graspan" 132 kV power line to loop in and out of the 132 kV busbar of the new on-site substation. The connection may also entail interventions on the Eskom grid, according to Eskom's connection requirements/solution. During the construction phase, the site may be provided with additional: (i) water access point and water extraction on-site borehole(s) point, water supply pipelines, water treatment facilities; (ii) pre-fabricated buildings; to be removed at the end of construction
R.545, 18 June 2010	**15**	*Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 ha or more except where such physical*

		alteration takes place for: *(i) linear development activities; or* *(ii) agriculture or afforestation where activity 16 in this Schedule will apply.* The Photovoltaic Power Plant with associated infrastructure and structures will be constructed and operated on a footprint bigger than 20 ha on an overall available area measuring approximately 1028 ha in size.
R.544, 18 June 2010	**10**	*The construction of facilities or infrastructure for the transmission and distribution of electricity:* *Outside urban areas or industrial complexes with a capacity of more than 33 kilovolts but less than 275 kilovolts: or* The connection to the Eskom grid will be done according to the Eskom connection solution which may require: (i) one small on-site 22kV/132kV loop-in loop-out substation with one or more 22kV/132kV power transformers and a 132kV busbar (switching station) to be connected to the Eskom's 132 kV power line called "Klokfontein-Graspan", which runs along the northern boundary of the project site; (ii) two new small sections of 132kV power line allowing the Eskom's "Klokfontein-Graspan" 132 kV power line to loop in and out of the 132 kV busbar of the new on-site substation. The connection solution may also entail intervention on the Eskom's grid and/or on Eskom's "Klokfontein-Graspan" 132 kV power line.
R.544, 18 June 2010	**22**	*The construction of a road, outside urban areas,* *(i) with a reserve wider than 13,5 metres or,* *(ii) where no reserve exists where the road is wider than 8 metres, or* (iii) *for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010* An access road wider than 8 meters or with a reserve wider than 13.5 meters may be constructed. Some internal roads may be wider than 8 meters.
R.546, 18 June 2010	**14**	*The clearance of an area of 5 ha or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:* *(i) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes;* *(ii) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list;* *(iii) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010.* *a) In Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga, Northern Cape, Northwest and Western Cape: All areas outside urban areas.* The Photovoltaic Power Plant with associated infrastructure and structures will be constructed and operated on a footprint bigger than 20 ha on an overall available area measuring approximately 1028 ha in size. The required footprint should be cleared from the existing trees.

The current EIA procedure of the Carodex Solar Park **includes the connection to the Eskom grid.** Furthermore, a part of the connection infrastructure (the 132 kV busbar of the on-site substation and the two new sections of 132 kV power line) may be executed, owned and operated by Eskom.

Final layout and site plans already drafted by Carodex (Pty) Ltd will be completed once inputs, via public participation have been received, analysed and reviewed. All information acquired will be analysed in order to determine the proposed final development layout and site plans.

Such approach will ensure a holistic view of future requirements of the site and that resources are utilised to their full availability in terms of social and environmental sustainability. It must also be pointed out that this application and all other development applications, in the area, are considered together in order to ensure general sustainability in the Siyancuma Local Municipality and in the Pixley ka Seme District Municipality areas.

4. PROJECT DESCRIPTION AND FUNCTIONING

The project envisages the establishment of a solar power plant with a **maximum generation capacity at the delivery point of 75 MW.**
The construction timeframe is estimated in approximately 15 months, whereas the commissioning date will depend on the IPP Procurement Programme timeframe.

The preferred technical solutions envisage:

- **thin-film modules mounted on fixed mounting systems**
- **polycrystalline modules mounted on horizontal 1-axis trackers.**

A combination of the abovementioned two solutions is also possible.

The estimated annual energy production is calculated in approximately:

- **1950 kWh/kWp/year** (load factor = 0.223), in the case of thin film modules mounted on fixed mounting systems; or
- **2,200 kWh/kWp/year** (load factor = 0.251) in the case of polycrystalline modules mounted on trackers.

Therefore, the Carodex Solar Park will generate:

- **160.2 GWh per year** in the case of thin film modules mounted on fixed mounting systems; or
- **190.1 GWh per year** in the case of polycrystalline modules mounted on trackers

The calculation is made by the professional tool "PVSYST" and the simulation is done for 1 MWp (1 "PV field").
The site data (irradiation, temperature, etc.) charged on the database consists of hourly meteo-data registered by NASA satellites (NASA-SSE satellite data 1983-1993, release 6) and the simulation is made for the timeframe of 1 year.
The output (1,950 kWh/kWp/year and 2,200 kWh/kWp/year) is also called “full net equivalent hours”, which represent the average energy injected into the grid per 1 kWp of installed capacity.
The *Global Horizontal Irradiation* of the site is 2,094.1 kWh/m^2/year (NASA-SSE satellite data, 1983-1993, release 6).

The energy generated by the Carodex Solar Park will reduce the quantity of pollutants and greenhouse gases emitted into the atmosphere. The reduced amount of CO_2 will be the emissions that would have been generated by a thermal power plant using fossil fuels for producing the same quantity of energy that it is produced by the Carodex Solar Park.
The quantity of the avoided CO_2 is calculated as follows: the energy produced by the Carodex Solar Park (up to 160.2 GWh/y) or 190.1 GWh/y) is multiplied by the Eskom’s average emission factor which is 1.015 t CO_2/MWh (*source*: Energy Research Centre, University of Cape Town. (2009 *Carbon accounting for South Africa*).
This means that, in the case of the Carodex Solar Park, the **avoided CO_2 emissions** are approximately **162,564 tons of CO_2 per year** in the case of thin film modules mounted on fixed mounting systems, or **192,931 tons of CO_2 per year** in the case of polycrystalline modules mounted on trackers.

Furthermore, considering that 1 kg of coal generates approximately 3.7 kWh (supposing a caloric value of 8000 kcal/kg and a coal plant efficiency of 40%), **the coal saved by the Carodex Solar Park will be approximately 43,287 tons of coal / year** in the case of thin film modules mounted on fixed mounting systems, or **51,373 tons of coal / year** in the case of polycrystalline modules mounted on trackers.
The detailed description of the characteristic and functioning of the plant and its connection is given in the following paragraphs.

4.1. PROJECT LAYOUT

The layout of the proposed development is the result of a comparative study of various layout alternatives and had been defined in consideration of the results of some specialists studies conducted during this scoping phase.

The PV plant is designed and conceived in order to minimize visual and noise impacts, as well as to operate safely and assuring a high level of reliability, with low water consumption and the need only for easy and quick maintenance and repair for approximately 25-30 years.

The main drives of the proposed layouts were:

- to maximize the energy production and the reliability of the PV plant, by choosing proven solar technologies: horizontal 1-axis trackers with polycrystalline solar modules, or thin-film solar modules mounted on fixed mounting systems;
- to develop the PV power plant on the northern side of the Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168 (1028 ha), which is flat and has a *moderate* ecological sensitivity;
- to avoid the high sensitivity areas (*salt pans / wetlands*) sparsely located on the project site, by providing a buffer 30 m wide;
- furthermore, a tree buffer zone around the footprint, in order to minimise the visual impact of the proposed development.

Two possible suitable areas have been identified for the proposed development, both on the northern side of the project site:

- **Alternative Location 1**: on the north-eastern corner of the farm.
- **Alternative Location 2**: on the north-western corner of the farm.

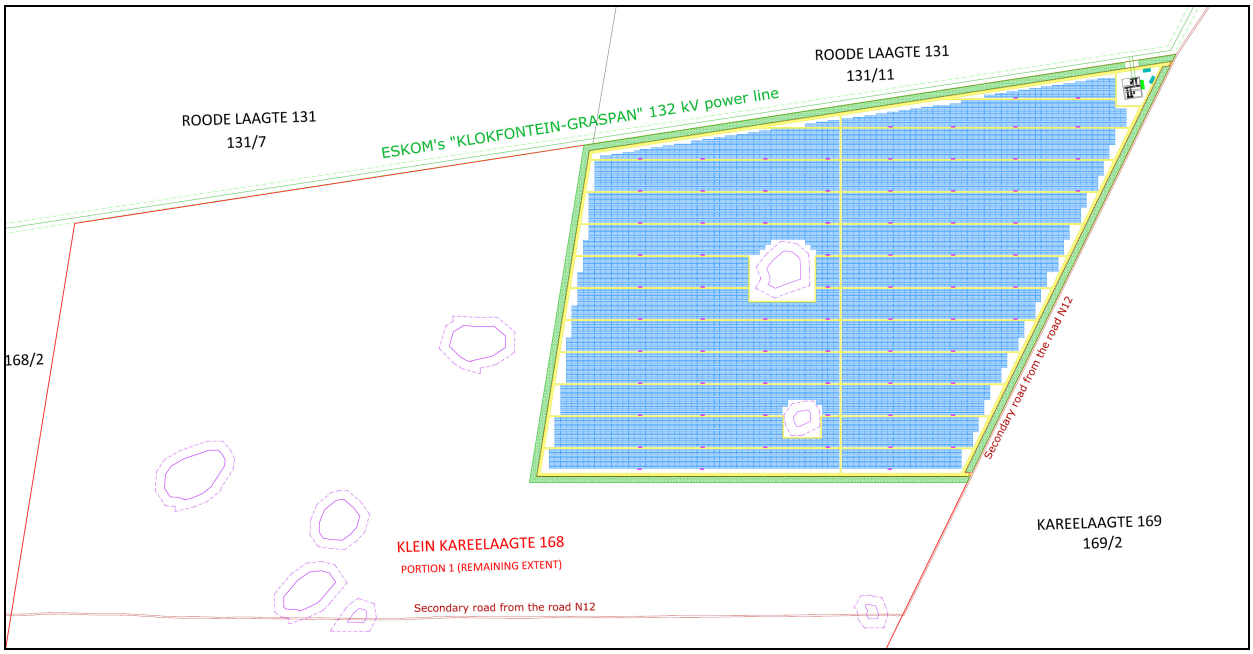
In both cases, the lease portion will be approximately 210 ha, while the footprint (fenced area) of the solar park will be approximately 200 ha.

The two proposed layout plans (attached as Annexure A and also shown in Figures 2 and 3 below) were drawn using thin-film modules mounted on fixed mounting systems; in the case of polycrystalline modules mounted on trackers, the layout plans do not change, except for the orientation of the PV arrays: north-south instead of east-west.
The required **footprint** - corresponding on the fenced area - will be the same: **approximately 200 ha**, and the maximum height of the structures (PV modules and support frames) will be approximately 3.1 m above the ground level. Therefore the impacts and mitigation measures will remain exactly the same.

The project layouts and the other plant components are detailed in the following drawings:

- CDSP_01_DE_Rev.00/SR Layout of the PV power plant - Alternative location 1
- CDSP_02_DE_Rev.00/SR Layout of the PV power plant - Alternative location 2
- DCSP_03_DE_Rev.00/SR Mounting System – Alternative option 1: fixed mounting systems with thin film modules
- CDSP_04_DE_Rev.00/SR Mounting System – Alternative option 2: horizontal single-axis trackers with polycrystalline modules
- CDSP_05_DE_Rev.00/SR Medium-voltage stations
- CDSP_06_DE_Rev.00/SR Control building and medium-voltage receiving station
- CDSP_07_DE_Rev.00/SR High-voltage loop-in loop-out substation
- CDSP_08_DE_Rev.00/SR Warehouse

Figure 2 Layout of the Carodex Solar Park - Alternative location 1



PROJECT SITE
Portion 1 (Remaining Extent) of the Farm KLEIN KAREELAAGTE 168, Herbert RD
Siyancuma Local Municipality
Pixley ka Seme District Municipality
Northern Cape Province
Surveyor-general 21 digit site: C03200000000016800001
Extent: 1028.1296 hectares

PV arrays

High-voltage loop-in loop-out substation
2 X 22 kV /132 kV 40 MVA power transformers

Fenced area (footprint): ±200 hectares

Medium voltage receiving station
and control building

Medium voltage stations

Warehouses

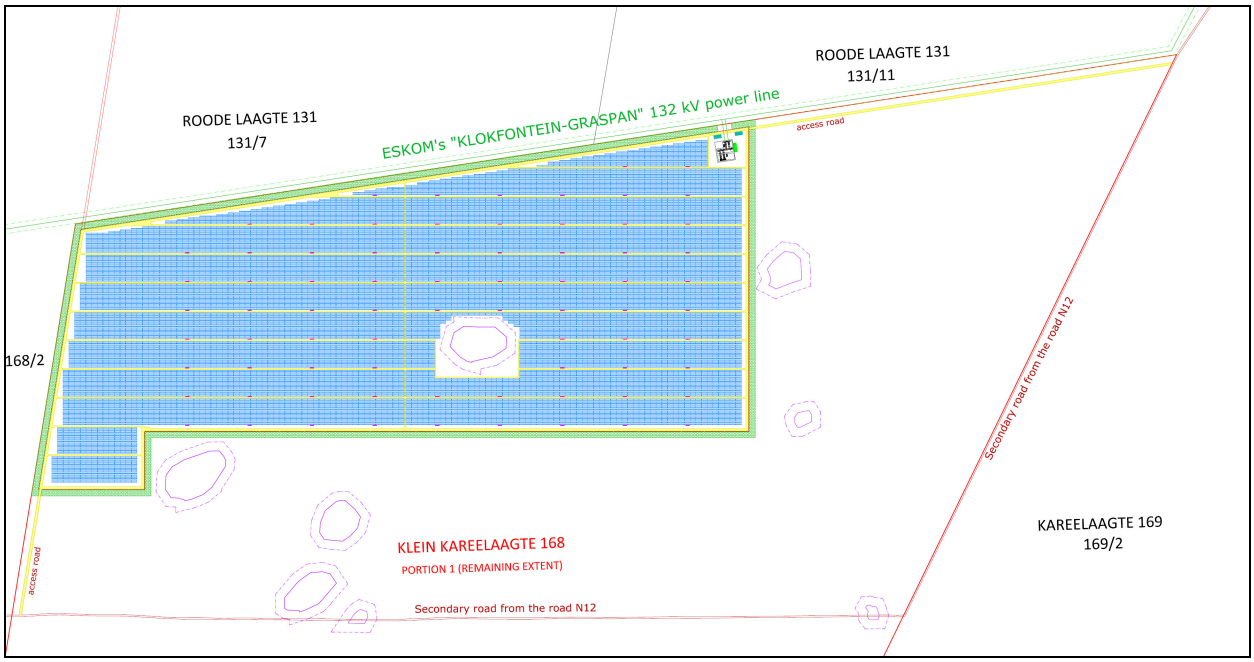
Internal roads

ESKOM's "KLOKFONTEIN-GRASPAN" 132 kV power line
and registered servitude (31.0 m wide)

Tree buffer zone
Width: 20 m

Wetland / pan and 30 m buffer

Figure 3 Layout of the Carodex Solar Park - Alternative location 2



PROJECT SITE
Portion 1 (Remaining Extent) of the Farm KLEIN KAREELAAGTE 168, Herbert RD
Siyancuma Local Municipality
Pixley ka Seme District Municipality
Northern Cape Province
Surveyor-general 21 digit site: C03200000000016800001
Extent: 1028.1296 hectares

PV arrays

High-voltage loop-in loop-out substation
2 X 22 kV /132 kV 40 MVA power transformers

Fenced area (footprint): ±200 hectares

Medium voltage receiving station
and control building

Medium voltage stations

Warehouses

Internal roads

ESKOM's "KLOKFONTEIN-GRASPAN" 132 kV power line
and registered servitude (31.0 m wide)

Tree buffer zone
Width: 20 m

Wetland / pan and 30 m buffer

4.2. PRIMARY COMPONENTS

The Photovoltaic (PV) Power Plant together with its connection infrastructures and structures will require the installation of the following equipment:

- Photovoltaic modules
- Mounting systems (fixed or trackers) for the PV arrays
- Internal cabling and string boxes
- Medium voltage stations hosting DC/AC inverters and LV/MV power transformers
- Medium voltage receiving station & Control building, with offices and a small parking area
- Workshop & warehouse
- One small on-site high-voltage loop-in loop-out substation with high-voltage power transformers, stepping up the voltage to the voltage of the Eskom's grid, and one high-voltage busbar with metering and protection devices (also called "switching station")
- two new small sections of high-voltage power line allowing the **Eskom's "Klokfontein-Graspan" 132 kV power line** to loop in and out of the 132 kV busbar of the new on-site substation
- Electrical system and UPS (Uninterruptible Power Supply) devices
- Storm water collection system
- Lighting system
- Grounding system
- Access road and internal roads
- Fencing of the site and alarm and video-surveillance system
- Water access point and water extraction on-site borehole(s) point, water supply pipelines, water treatment facilities (Lilliput systems).

4.2.1. Project functioning and connection of the solar park to the Eskom grid

Solar energy facilities using PV technology convert sun energy to generate electricity through a process known as the Photovoltaic Effect, which consists of the generation of electrons by photons of sunlight in order to create electrical energy.

The preferred technical solutions are:

- thin-film modules mounted on fixed mounting systems, and,
- mono or polycrystalline modules mounted on horizontal 1-axis trackers,

which at present represent the best performing options in terms of reliability and costs/efficiency.

The PV technology is in constant and rapid evolution, this means that the final choice of the type of solar modules (thin-film, monocrystalline or polycrystalline) and mounting system (fixed or tracker) can be taken at the time of the commission date, on the basis of the availability of PV modules and mounting systems, of the worldwide market and of the cost-efficiency curve.

In any case, the required footprint - corresponding on the fenced area - will be approximately 200 ha, and the maximum height of the structures (PV modules and support frames) will be approximately 3.1 m above the ground level. Therefore the impacts and mitigation measures will not change. For further reference please refer to section 5.2.

The following description is referred to both the preferred technical solutions (mono/polycrystalline modules mounted on horizontal single-axis trackers and thin film modules mounted on fixed mounting system or a combination of them).

The required **footprint** (including internal roads) will be **approximately 200 ha.**

PV modules will be assembled on zinced steel or aluminium frames, to form PV arrays. The metal frames that sustain PV arrays are set to the ground by fixed support poles.

A) In the case of thin-film modules mounted on fixed mounting systems:

The PV generator will contain 608,400 thin-film PV modules of 135 Wp each, with a total peak power of **82,134,000 Wp DC side**, corresponding to **75,000,000 W AC side.**

Each mounting frame will host 39 PV modules along three parallel rows each consisting of 13 modules placed side by side, with the position of the PV arrays northwards and at a 26° tilt. The 3 rows are mounted - with a landscape orientation - one on top of the other, with an overall mounting structure height up to 3.1 meters above ground level.

The 608,400 thin-film PV modules are series-connected outlining strings made of 13 modules each. There will be 46,800 PV strings so that the string voltage fits into the voltage range of the inverters. Branch cables are designed to connect in parallel groups of three strings, to form 15,600 branch strings. Branch strings are set up in order to be connected to DC-connection boxes. Each String Box allows the parallel connection of 13 branch strings (also called "PV sub-field").

Figure 4 Lateral views of PV arrays mounted on fixed mounting systems

Figure 5 Frontal view of PV arrays mounted on fixed mounting systems

For further details, Please refer to the Figures 4 and 5 above and to the drawing of the Annexure A:

- CDSP_03_DE_Rev.00/SR *Mounting System – Alternative option 1: fixed mounting systems with thin-film modules*

B) In the case of mono/polycrystalline modules mounted on trackers:

The PV generator will contain 288,000 PV polycrystalline modules of 300 Wp each, with a total installed peak power of **86,400,000 Wp DC side**, corresponding to **75,000,000 W AC side**.
Each PV array is composed of 40 PV modules disposed along three parallel rows each consisting of 13 PV modules placed horizontally side by side; at the end of the PV array, one further module is placed in the vertical position.
Each tracker is composed by several PV arrays North-South oriented and linked by an horizontal axis, driven by a motor. The horizontal axis allows the rotation of the PV arrays toward the West and East direction, in order to follow the daily sun path.

Figure 6 Simulation views of the PV arrays mounted on horizontal 1-axis tracker

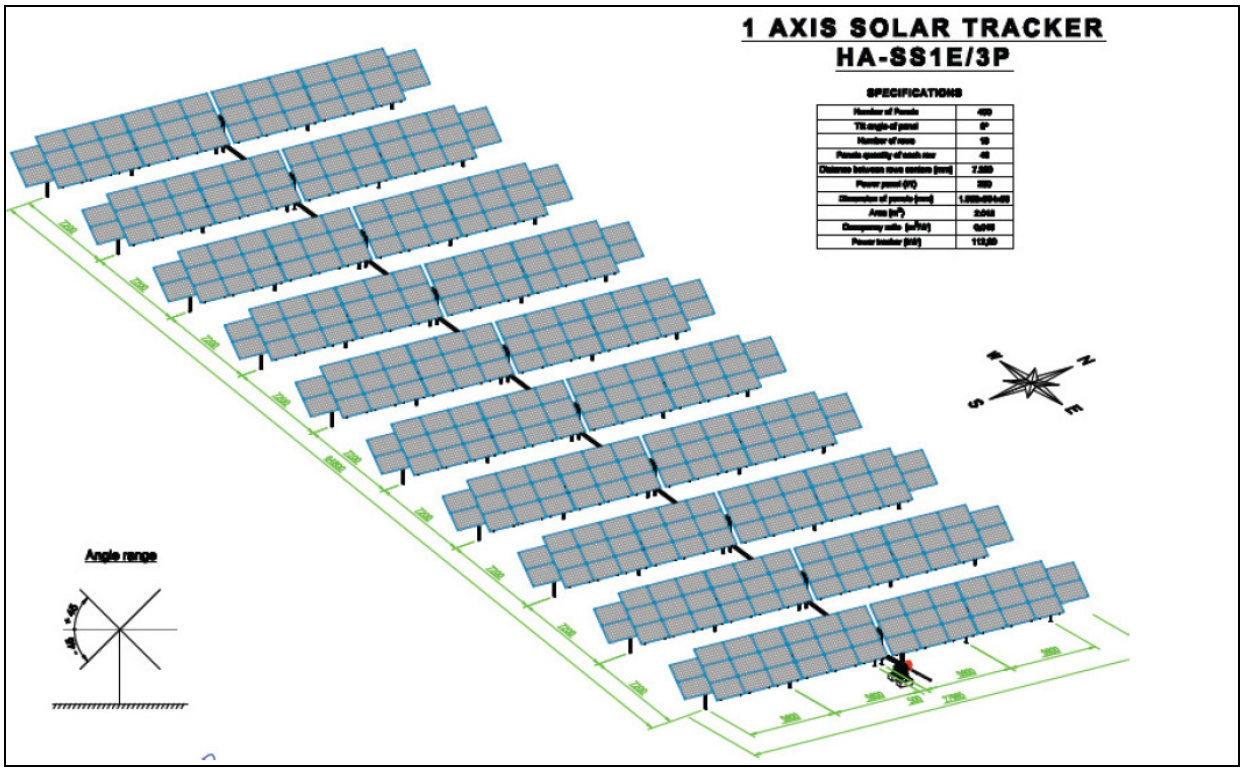


Figure 7 Frontal views of the PV arrays mounted on horizontal 1-axis tracker

For further details, see also the drawing of the Annexure A:

- CDSP_04_DE_Rev.00/SR *Mounting System – Alternative option 2: horizontal single-axis trackers with polycrystalline modules*

The 288,000 polycrystalline PV modules are series-connected, constituting strings made of 20 modules each. There will be 14,400 PV strings in order that the string voltage fits into the voltage range of the inverters. The strings are set up in order to be connected to DC-connection boxes. Each String Box allows the parallel connection of 12 PV strings (also called "PV sub-field").

C) In both cases:

String Boxes monitor the currents in photovoltaic modules and can promptly diagnose faults. String boxes are also designed with a circuit breaker in order to disconnect the photovoltaic sub-fields from the inverters.

The PV sub-fields are thought to be linked to central inverters, located in **75 medium voltage stations**. Each station comprises two adjacent prefabricate buildings designed to host two **DC/AC inverters**, with a total nominal output AC power of 1,000 kW (16 parallel sub-fields), and two **medium voltage power transformers** of 500 kVA each. The DC/AC inverters are deemed to convert direct current (DC) into alternate current (AC) at low voltage (270 V); subsequently the AC will pass through a medium-voltage transformer in order to increase the voltage up to 22 kV (or 11 kV).

The medium-voltage stations are detailed in the drawing of the Annexure A:

- CDSP_05_DE_Rev.00/SR *Medium-voltage stations*

The energy delivered from the 75 medium voltage stations will be collected into one (or more) **medium voltage receiving station**(s), parallel connecting all the 75 PV fields of the PV generator.

From the medium voltage receiving station, the energy will be delivered to two high-voltage power transformers (40 MVA each, plus one as spare), which will step up the electric energy from the medium voltage level (11 kV or 22 kV) to the Eskom required connecting voltage (i.e. 132 kV). The power transformers will be connected to an on-site 132 kV busbar (the so called "***switching station***"), to be equipped with protection and metering devices, according to the Eskom requirements.

The Carodex Solar Park will be connected to the **Eskom's "Klokfontein-Graspan" 132 kV power line**, which crosses the project site,
The Eskom's "Klokfontein-Graspan" 132 kV power line will loop in and out of the 132 kV busbar ("switching station") of a new on-site substation through two new small sections of 132 kV power line, approximately 100 m long.

The new on-site HV loop-in loop-out substation will need to be equipped with circuit breakers upstream and downstream, in order to disconnect the PV power plant and/or the power line in case of failure or grid problems**.**
Furthermore, two **metering devices and related kiosks** are foreseen inside the layout: one for Eskom, close to the busbar, and one for Carodex (Pty) Ltd, close to the power transformers. The kiosks (2.4 x 4.8 x 3.2 m) will contain the peripheral protection and control cabinets and the metering devices.

The on-site HV loop-in loop-out substation, composed of the power transformers, the control building, the 132 kV busbar with protection and metering devices and the kiosks, will have a **footprint approximately 4,000 m^2**.

The new power line and the busbar (*switching station*) of the on-site HV loop-in loop-out substation will be owned and operated by Eskom Distribution.

The layout of the on-site high-voltage substation as well as of the control building and the subdivision between Eskom's side and Carodex's side are detailed in the drawings included in Annexure A:

- CDSP_06_DE_Rev.00/SR *Control building and medium-voltage receiving station*
- CDSP_07_DE_Rev.00/SR *High-voltage loop-in loop-out substation*

The power generation capacity at the delivery point will be 75 MW.

4.2.2. Access road and internal roads

The access to the Carodex Solar Park will be from two secondary roads starting from the **N12**, 4 km west of the project site.

These secondary roads run over/along the boundaries of either:

- Portions 0 (Remainder), 5, 6, 7 and 11 of the Farm Roode Laagte 131 and Portion 2 of the Farm Karreelaagte 169, or
- Portions 2 and 0 (Remainder) of the Farm Roode Laagte 131 and Portions 2 and 4 of the Farm Klein Karreelaagte 168.

Internal roads will consist of gravel roads designed in accordance with engineering standards. The roads will have a width of 8.0 meters allowing for the slow moving heavy vehicles.
Once the solar farm is in operation, the internal roads will mainly be used for maintenance and inspections.

The vertical alignment of the roads will not present significant challenges due to the flatness of the terrain. The entire development will be contained inside a fenced area and the roads are not intended for public use.

4.2.3. Lighting system

The lighting system will consist of the following equipment:

- Floodlight-towers: maximum 10 meters high, with 6x400W directional lamps, installed around the HV loop-in loop-out substation. Normal lighting: 15 lux; up to 40 lux in case of emergency.
- Street lighting along internal roads, for the stretch from the access point up to the HV substation inside the property: 1 streetlamp, maximum 5.5 meters high, every 20 meters, having a metal-haloids lamp of 400 W.
- 2x400 W spotlights (SAP type) mounted on the top of medium-voltage stations.

The lighting of the MV stations and of the on-site HV substation will be on only in case of intrusion/emergency or necessity to reach the MV stations / HV substation during the night.

During the night, the video-surveillance system will use infra-red (or micro-wave) video-cameras, which do not need a lighting system (which could reduce the functioning). Only streetlamps along internal roads, for the stretch from the main access up to the HV substation inside the property, may be switched on at night.

4.2.4. Stormwater collection system

The proposed storm water system, where required, will consist of open grass lined channels and possible nominal concrete pipe culverts. The excessive concentration of storm water will be avoided and the existing drainage patterns will be left undisturbed.

4.2.5. Water requirements

4.2.5.1. Water requirements during the construction phase

The construction phase will last maximum **15 months**.

A) Construction of internal gravel roads

- Water is necessary for the construction of internal gravel roads, in order to get the gravel compacted to optimum moisture content (OMC).
- The surface of internal gravel roads will be approximately 137,000 m^2.
- 50 liters of water / m^2 of internal of roads will be required.

B) Workers

- Approximately 100 people are expected to be employed during the construction period, although this number can increase to 150 for short spaces of time during peak periods. This number can be higher in the case Carodex (Pty) Ltd - once being selected as Preferred Bidder by the Department of Energy and having finalized the Connection Agreement with Eskom, where in particular it is agreed the envisaged connection timeline - evaluates to build the Carodex Solar Park in a timeframe shorter than 15 months (i.e. 330 working days). For example, in the case the construction works are planned to last only **6 months** (*i.e* 132 working days), the average number of workers required on site during construction is **250**.
- Each worker needs 50 liters / 8 working hours for sanitary use.
- Water consumption will be:
    - 100 people x 50 l/person x 330 working days = 1650 m^3 over 15 months, or:
    - 250 people x 50 l/person x 132 working days = 1650 m^3 over 6 months.

C) Concrete production

- Concrete is necessary for the basements of the medium-voltage stations, the high-voltage loop-in loop-out substation, the control building and the warehouse and for the foundations of the mounting systems. The overall amount of concrete to be produced will be approximately 15,000 m^3
- 200 litres of water are needed for 1 cubic meter of concrete.

D) Vehicle cleaning

As mitigation measure, the cleaning of vehicles like excavators, mechanical diggers and pile rammers will be done once or twice per month and no during working days, also in order to not increase the water requirement during the construction activities.
Furthermore, in order not to waste a large amount of water, high pressure cleaners will be used. On the whole, the water requirement for cleaning activity is very low.

The overall and average water consumption during construction is detailed in the following table.

Table 3 Water consumption during the construction phase of the project

WATER REQUIREMENT DURING THE CONSTRUCTION PHASE		
DESCRIPTION	**UNIT**	**TOTAL**
Timeframe of the construction activities	*months*	up to 15
Overall water consumption for internal roads	m^3	6,850
Overall water consumption for sanitary use	m^3	1,650
Overall water consumption for concrete production	m^3	3,000
Overall water consumption	***m^3***	**11,500**

Storage tanks will be sized in order to provide a reserve of water approximately 200 cubic meters.

4.2.5.2. Water requirements during the operational phase

During operation, water is only required for the operational team on site (sanitary use), as well as for the cleaning of the solar panels.
Further water consumption may be only for routine washing of vehicles and other similar uses.

A) Water for sanitary use

Approximately 35/40 people will be employed during the operation phase of the PV power plant, which will have a lifetime of 25 - 30 years.
The Carodex Solar Park will be in operation 7 days per week; therefore personnel will operate according to shifts. The surveillance team will be present during day-time, night-time and weekends. The average number of people working at the site on the same time will be of **14 people daytime and 6 people at night**.
The average daily water consumption for sanitary use is estimated to be **150 litres** / **day** / **person** per **20 people** (14 people daytime and 6 people at night), The daily water consumption will be approximately **3,000 litres/day.**

B) Water consumption to clean the PV modules

The cleaning activities of the solar panels will take place **once per year**.
It is assumed that up to 2.0 liters per m^2 of PV panel surface will be needed.
Therefore, the amount of water for cleaning is up to **1,703 m^3 per cleaning cycle**.

PV modules cleaning activity can last less than 1 month. If the cleaning activity lasts approximately 4 weeks (24 working days), the daily water consumption will be approximately **71,000 liters/day**, **over 24 days**.

Conclusion

The daily water requirement will be approximately **3,000 liters/day** over 12 months for sanitary use (i.e. **90,000 l/month** and **1,095 m^3/year**).

The water consumption will increase up to **74,000 liters/day** during the cleaning of the solar modules (71,000 liters/day for cleaning activity and 3,000 for sanitary use), which will last less than a month and will occur once per year during the dry period. Indeed PV modules are conceived as self-cleaning with the rain.

It is further proposed that **90,000 l** of water will be stored in **storage tanks** for fire, emergency and washing of panels twice a year.
The overall and average water consumption during operation is detailed in the table below.

Table 4 Water consumption during the operational phase of the project

WATER REQUIREMENT DURING THE OPERATIONAL PHASE		
DESCRIPTION	**UNIT**	**TOTAL**
Average daily water consumption for sanitary use	*l/day*	3,000
Average daily water consumption during cleaning activity (*)	*l/day*	74,000
Average monthly water consumption for sanitary use (over 30 days)	*l/month*	72,000
Annual water consumption for sanitary use	***m^3/year***	**1,095**
Annual water consumption for PV modules cleaning activities (once/year)	***m^3/year***	**1,703**
ANNUAL WATER CONSUMPTION DURING OPERATION	***m^3/year***	**2,798**
DAILY WATER CONSUMPTION DURING OPERATION (average over 365 day)	***m^3/day***	**7.67**

(*) over 24 working days, once per year

4.2.5.3. Water provision during construction and operation

The water needed for both the construction phase (**11,500 m^3**) and the operational phase (**2,798 m^3/year**) will be provided from new or existing boreholes on the project site.

A Geo-hydrological Study will be conducted in this respect, and a Water Use Licence application will be submitted to the Department of Water Affairs by Carodex (Pty) Ltd.

4.2.6. Sewerage

Considering that the proposed development will not include formal residential properties there is no need to connect the municipal sewer reticulation system. Sewer reticulation will be handled by the patented and commercially available Lilliput (or similar) sewer treatment system.

The sewer system will therefore consist of an installation to serve the offices of the control building. It is foreseen that the system will be installed in line with the requirements of the manufacturer.
Typical systems consist of a conservancy tank (built underground on site), and a patented digester. Most systems require electricity to power the pumps and fans used in aeration process, although some systems use wind power (whirlybird). The system could require chlorine tablets available commercially. The effluent from the Lilliput (or similar) system will be suitable for irrigation of lawns, or re-use in the dwellings as water for the flushing of toilets, or for fire fighting purposes. This could reduce the overall water requirement of the development substantially.

In this respect, a Water Use License application will be submitted to the Department of Water Affairs by Carodex (Pty) Ltd.

4.2.7. Refuse removal

Carodex (Pty) Ltd will enter into an agreement with the Siyancuma Local Municipality for the PV plant's refuse at the nearby municipal refuse site. No refuse will be buried or incinerated on site.

CONSTRUCTION SITE

The construction site (approximately 10 ha) will be located on the north-eastern corner (in the case the Alternative Location 1 is selected) or on the north-western corner (in the case the Alternative Location 2 is selected) of the planned footprint - covering the area where the last 4 MWp are planned. Consequently, the construction site area will be gradually reduced at the completion of the last four PV fields (4 MWp), and at the end of the works all the construction area will be converted into the last PV arrays.

The optimal location of the construction site is an important element of the planning phase also in order to minimize impacts on the surrounding environment.

The site's location has been dictated by the nature of the works to be undertaken, specialist studies, site restrictions, town planning intended uses and access.

The area identified for the construction site had to meet the following requirements:
- sufficient size;
- proximity to existing roads;
- availability of water and energy;
- low environmental and landscape value;
- sufficient distance from residential areas; and
- proximity to the worksite.

In addition, to ensure environmental compatibility, the following factors have been considered:
- restrictions on land use (landscape, archaeological, natural, hydrological, etc.);
- terrain morphology;
- presence of high environmental value areas (e.g. wetlands); and
- sand & stone supply.

The establishment of the construction site will be divided into four distinct phases. The steps individuated hereinafter do not follow a time sequence, but it should be considered as overlapping and simultaneous events.

4.2.8. Phase I

The area will be fenced to prevent intrusion of animals and to protect against materials theft within the site. A video surveillance system will be provided.

4.2.9. Phase II

During the fencing operation as described in Phase I, the most valuable trees, if any, will be removed and placed temporarily in a safe location for future planting at the end of work. This procedure is required for environmental mitigation. The other low value tree species will be cut down and transferred to facilities for wood processing.

4.2.10. Phase III

At completion of the works defined in Phases I and II, the following step will be the site clearing and the construction of internal roads. The internal road network should ensure a two-way traffic of heavy goods vehicles in order to minimize trips. The road system is planned for a width of 8 meters. Roads will be of dry and compacted materials.

The facility will require constant access control, a weigh-house for heavy trucks, removable structures for the storage of yard tools and temporary storage areas.

During Phase III, the installation of MV/LV transformers connected to the Eskom grid is also planned, as well as the laying of underground electrical cables.

4.2.11. Phase IV

Temporary storage areas of materials and workshops will be constructed and used for:

- temporary storage of photovoltaic modules (covered with compacted dry material in order to avoid direct contact with the ground);
- temporary storage for frames and piles of the mounting systems of the PV arrays;
- storage and processing of building material for construction (sand, gravel, concrete batching and mixing plant, steel, etc.);
- drinking water storage for human consumption;

- worker care facilities and site management buildings,
- prefabricated housing modules for workers who may require accommodation inside the site (only key personnel should be allowed to stay overnight);
- technical cabins and management offices;
- medical care unit in a prefabricated module, in order to allow immediate first aid and minor surgical emergency;
- recreation area and canteen (prefabricated modules);
- parking lots for employees (located close to the staff housing), for visiting staff (located close to the offices area), and for trucks and work vehicles during inactivity;
- workshop and storage facilities on the site for contractors;
- electrical network for living units, offices and service structures;
- water supply for living units through polyethylene pipes connected to storage;
- Lilliput or similar sewer treatment system. The treated water will be used to moisten dusty areas and reduce dust gathering due to windy actions; and
- solid waste collection point.

All facilities present in the construction site will be covered with dry material in order to avoid mud formation in case of rain.

4.2.12. Earthworks

Earthworks will be required during the construction of internal roads. The vertical alignment of the roads will not present any significant challenges due to the flatness of the terrain so that no deep cuts or fills will be required.
Considering a road pavement thickness of 300 mm and an overall road surface approximately 137,000 m^2, the amount of cut or fill is estimated to be approximately 41,100 m^3.

Further items of earthworks would be required where temporary storage areas will be prepared for the storage of the photovoltaic modules and other equipment during construction of the solar park.
Small earthworks will be required for the installation of the PV modules and of the medium-voltage stations. None of these activities should require earthworks in excess of 500 mm cut or fill.
Only the foundation plate for the small high-voltage substation may require earthworks in excess of 500 mm cut or fill (the footprint will be up to 4000 m^2).
The topsoil stripping will result in temporary spoil heaps which must be spread over the site upon completion of the project.
Concrete necessary for the basements of the medium-voltage stations, the high-voltage substation, the control building and the warehouse and will be manufactured using aggregate and sand from commercial sources in the vicinity of the development (in Kimberley, Jacobsdal, Douglas or Koffiefontein), or from a borrow pit to be exploited on the site.

Gravel necessary for the construction of internal roads may be provided from a borrow pit on site. The material from this borrow pit will only be utilised for work on this particular site only. The position of this borrow pit is not yet finalized. The required area will be approximately 2 ha. Alternatively, gravel can be provided from the commercial sources in the vicinity of the development (in Kimberley, Jacobsdal, Douglas or Koffiefontein).

4.3. TRAFFIC IMPACT OF THE PROPOSED DEVELOPMENT

4.3.1. Traffic impact – construction phase

Approximately 100 people are expected to be employed during the construction period (15 months), although this number can increase to 150 for short spaces of time during peak periods. This number can be higher in the case Carodex (Pty) Ltd - once being selected as Preferred Bidder by the Department of Energy and having finalized the Connection Agreement

with Eskom, where in particular it is agreed the envisaged connection timeline - evaluates to build the Carodex Solar Park in a timeframe shorter than 15 months (i.e. 330 working days). For example, in the case the construction works are planned to last only 6 months (i.e 132 working days), the average number of workers required on site during construction is 250/300.

An accommodation area with prefabricated buildings inside the work site may be foreseen, if accommodation facilities in Kimberley town are not sufficient to accommodate all workers.

Overall traffic to and from the work site will amount to approximately 1000 heavy vehicle trips over the whole construction period.
The provision of a fuelling area on the work site could reduce the load of heavy vehicles on public roads. The installation of two steel fuel tanks (capacity of 30,000 litres each) is envisaged.

4.3.2. Traffic impact – operation phase

The traffic impact during the operation phase will be insignificant, considering that about 35/40 people will work on the PV facility, in the following manner:

- during the daytime approximately 14 people;
- during the night-time, 6 people.

4.4. MANAGEMENT OF THE SOLAR PARK DURING OPERATION

Approximately 35/40 people will be employed during the operation phase of the PV power plant, which will have a lifetime of 25 - 30 years.
The Carodex Solar Park will be in operation 7 days per week; therefore personnel will operate according to shifts. The surveillance team will be ensured during day-time, night-time and weekends.

The operational team will consist of the following people:

- 1 person as plant manager
- 1 person for administration
- 4 people as technicians / plant operators
- 9/12 people for electric and generic maintenance
- 20/22 people as guards

The "**fire team**" will comprise of people for generic maintenance, who will attend a comprehensive fire fighting training program. After this training programme, the fire team will be able to drive/use/manage properly the fire extinguishers and the fire fighting vehicle, that will be available on the site.

5. PROJECT ALTERNATIVES

The EIA Regulations, Section 28(1)(c) and NEMA, Section 24(4), require investigation and consideration of feasible and reasonable alternatives for any proposed development as part of the environmental impact assessment process. Therefore, a number of possible alternatives for accomplishing the same objectives must be identified and investigated.

In particular:
- the property on which, or location where, it is proposed to undertake the activity;
- the location within the current identified site;
- the type of activity to be undertaken;
- the design or layout of the activity;
- the technology to be used in the activity;
- the operational aspects of the activity (schedule, process);
- the sustainability of other alternatives, and
- the option of not implementing the activity (No Go Alternative).

5.1. SITE ALTERNATIVES

Several sites have been inspected in order to find out the best solution for the PV power plant. The following selection criteria were applied:
- Connection availability and proximity
- Land availability
- Proper land surface area (at least 200 ha)
- Current land use
- Low environmental impact (low biodiversity)
- Low agricultural potential
- High solar radiance
- Socio-economic issues (land cost and local community unemployment)

The macro area between Jacobsdal and Hopetown towns - along the road N12 - was investigated, due to the high value of solar irradiation and to the presence of an Eskom's HV power line (i.e. the Eskom's "Klokfontein-Graspan" 132 kV power line).

Several sites - along the Eskom's "Klokfontein-Graspan" 132 kV power line - were selected during the feasibility assessment, due to the flatness of the areas, such as:

a) Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168 (*preferred*)
b) Portion 2 of the Farm Klein Kareelaagte 168
c) Portion 4 of the Farm Klein Kareelaagte 168
d) Portion 0 of the Farm Roode Laagte 131
e) Portion 7 of the Farm Roode Laagte 131
f) Portion 6 of the Farm Roode Laagte 131
g) Portion 11 of the Farm Roode Laagte 131
h) Portion 2 of the Farm Kareelaagte 169
i) Portion 0 of the Farm Graspan 172

a) **Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168** (approximately 1028 ha in extent) were found to be available; the northern side of this farm portion is highly suitable for a solar park, being flat and with a low / medium ecological sensitivity and low agricultural potential.

b/c/d/e) **Portions 2 and 4 of the Farm Klein Kareelaagte 168** and **Portions 0 and 7 of the Farm Roode Laagte 131** (approximately 420 ha; 570 ha, 980 ha and 1,100 ha in extent)

resulted in being not suitable for a solar park, due to the presence of several wetlands / salt pans affecting these farm portions, reducing the size of the areas potentially suitable for the development.

f/g) **Portions 6 and 11 of the Farm Roode Laagte 131** (approximately 1,800 ha and 860 ha in extent) were found to be almost suitable for a solar park, but not preferred because these farm portions have a higher ecological value than Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, due to the presence of some big wetlands / salt pans affecting part of these two farm portions.

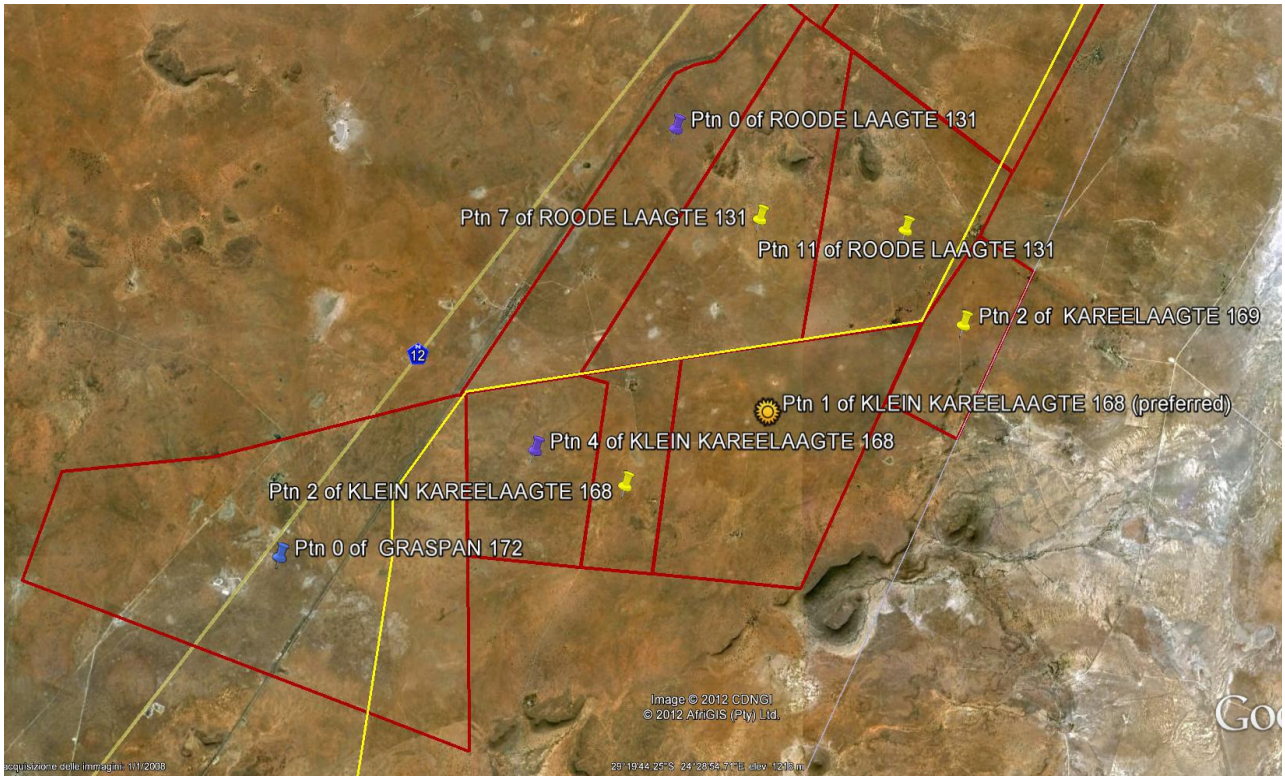
h) **Portion 2 of the Farm Kareelaagte 169** (approximately 500 ha in extent) were found to be almost suitable but not preferred, due to the small size of the farm and because the Eskom 132 kV power line doesn't cross this portion, therefore a servitude would be required for the connection of the solar park to the Eskom network.

i) **Portion 0 of the Farm Graspan 172** (approximately 2,100 ha in extent), it was found that although it might be suitable it's not currently available for this development.

Therefore, **Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168** is the *preferred site*, being the most suitable alternative from an ecological viewpoint.

The location of the alternative sites is indicated in the Figure 8 below.

Figure 8 Location of the alternative sites



5.2. TECHNOLOGY ALTERNATIVES

5.2.1. PV Plant and Solar Thermal Power Plant

The alternative to PV for producing energy from the sun is the thermal solution.
There are different forms of this technology: linear fresnel, parabolic through or tower. These technologies can also be with or without thermal storage and they can use diathermic oils or, the more sophisticated ones can use water and/or molten salts.

The final choice is the PV option because these kinds of project result in:
- lower construction costs;
- lower operating and maintenance costs (O&M);
- it is a simpler, quicker and more experienced technology; and
- lower environmental impact, considering that, among other factors, the PV solution requires a minor quantity of water.

5.2.2. Solar Photovoltaic Technology – PV

The project envisages a photovoltaic power plant with a generating capacity of 75 MW, on a footprint approximately 200 ha.

The preferred types of PV modules are:
- **monocrystalline or polycrystalline PV modules** and,
- **thin-film PV modules**,

which currently represent the best performing options in terms of reliability and costs/efficiency.

At present, mono/polycrystalline modules provide a higher solar conversion efficiency (14%), if compared to the thin-film /PV modules (9%).
On the other hand, thin-film modules (or amorphous silicon / Cd-Te as well) are cheaper and best performing at high temperatures, having an efficiency degradation of only 0.25 %/°C instead of 0.45 %/°C in the case of mono/polycrystalline modules.
However, it is important to consider the fact that the PV technology is in continuous evolution and it may be possible that thin-film (or amorphous silicon / Cd-Te as well) PV modules achieve an higher solar conversion efficiency in a very short time.
Furthermore, it should be kept into account the high volatility of prices of PV modules which depends on the worldwide availability of modules. Therefore the final choice will be taken at the commissioning date, on the basis of the prices and availability of mono/polycrystalline and thin-film / amorphous silicon / Cd-Te PV modules.
The development will not exceed the current planned footprint (approximately 200 ha). Therefore, the final choice of the type of PV modules, whatever it is, will not imply any additional visual or environmental impacts nor the necessity of specific or different mitigation measures.

5.2.3. Alternatives for the Mounting System of the PV Modules

The preferred technical solutions for the proposed solar park entails PV modules mounted on **fixed mounting systems** (*alternative option 1*) or on **horizontal single-axis trackers** (*alternative option 2*).
The tracking solution is the best performing in terms of efficiency, because its energy production is approximately 15% more if compared with fixed systems.
This type of technology is characterized by higher technical complexity and deeper installing and maintenance costs, if compared with the fixed mounting solution.
As previously mentioned, the selected tracking system is the horizontal single-axis tracker (SAT), which doesn't differ from the fixed system, except for the presence of the tracking devices and the orientation of the rows of the PV arrays (north - south instead of west – east direction).

The technology of mounting systems is under continuous evolution. Consequently, the final decision about the mounting system technology will be taken only at the commissioning date: if addressed toward the fixed mounting system or toward horizontal single-axis trackers, the layout of the PV power plant will not imply any additional visual or environmental impacts nor the necessity of specific or different mitigation measures.
The development will not exceed the currently planned footprint (200 ha) and the height of the structures (PV modules and support frames) will be maximum 3.1 m above the ground level.

Both fixed and horizontal single-axis tracking solutions grant the reversibility of the development in respect of the terrain's morphology, geology and hydrogeology. This means that at the end of the PV plant's lifetime, the site can easily be returned to its status prior to the establishment of the PV plant.

5.3. LAYOUT DESIGN AND LOCATION ALTERNATIVES

The site chosen for the establishing of the proposed Carodex Solar Park is the Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168. The PV power plant will have a generating capacity of **75 MW**, on a footprint approximately 200 ha.

The layout of the proposed development is the result of a comparative study of various layout alternatives and had been defined in consideration of the results of some specialists studies conducted during this scoping phase.
Two possible suitable areas have been identified for the proposed development, both on the northern side of the project site:

- **Alternative Location 1**: on the north-eastern corner of the farm.
- **Alternative Location 2**: on the north-western corner of the farm.

The alternative location 1 is the *preferred one*, due to the *moderate* ecological sensitivity of this area, except for the presence of two small pans / wetlands, to be avoided by the proposed development, providing a buffer of 30 m.
The alternative location 2, even if also suitable, is not preferred, because the ecological sensitivity of the western corner of the farm portion - even if also in this case identified as *moderate* in the Ecological Report attached as Annexure E - is slightly higher than the sensitivity of the eastern corner, according to the Ecological Specialist who conducted the Ecological Report. Furthermore, the shape of the required footprint is not "compacted" as in the case of the previous alternative location.

As mentioned in the paragraph 4.1 - *Project layout*, the main drives of the two proposed layouts are:

- to maximize the energy production and the reliability of the PV plant, by choosing proven solar technologies: horizontal 1-axis trackers with polycrystalline solar modules, or thin-film solar modules mounted on fixed mounting systems;
- to develop the PV power plant on the northern side of the Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168 (1028 ha), which is flat and has a *moderate* ecological sensitivity;
- to avoid the high sensitivity areas (*salt pans / wetlands*) sparsely located on the project site, providing a buffer 30 m wide;
- furthermore, a tree buffer zone has been foreseen around the footprint, in order to minimise the visual impact of the proposed development.

The project layouts and the other plant components are detailed in the following drawings:

- CDSP_01_DE_Rev.00/SR Layout of the PV power plant - Alternative location 1
- CDSP_02_DE_Rev.00/SR Layout of the PV power plant - Alternative location 2

The two proposed layout plans (attached as Annexure A and also shown in the Figures 2 and 3) were drawn using thin-film modules mounted on fixed mounting systems; in the case of

polycrystalline modules mounted on trackers, the layout plans do not change, except for the orientation of the PV arrays: north-south instead of east-west.
The required **footprint** - corresponding on the fenced area - will be the same: **approximately 200 ha**, and the maximum height of the structures (PV modules and support frames) will be approximately 3.1 m above the ground level. Therefore the impacts and mitigation measures will remain exactly the same.

5.4. NO-GO ALTERNATIVE

The no-go alternative is the option of not establishing a Photovoltaic Power Plant on the site, or any of its alternatives. The environment will remain in its current state (*status quo*). This will not create any new employment opportunities, and therefore the anticipated economic benefits of the project will accrue to the study area (see the paragraph 6.4 *Socio-Economic Environment*).

Should this alternative be selected the socio-economic and environmental benefits related to the use of renewable energy resources will not be realised with prejudice to the development of the area. The benefits related to the establishment of a renewable energy power plant are for example analysed in detail in the REFIT Regulatory Guideline published by NERSA (March 2009:

- ***Enhanced and increased energy security***: renewable energy plays an important role in terms of power supply, improving grid strength and supply quality and contemporarily reducing transmission and distribution costs and losses.
- ***Resource economy and saving***: the energy production by coal fired plants consumes a significant amount of water, this amount of water could instead be saved if a renewable energy facility like the proposed one is put in operation.(the Energy White Paper envisages that the implementation of its targets will determine water savings approximately 16.5 million kilolitres). This will be beneficial on the large scale for the water conservation measures that the country is currently undertaking.
- ***Support of new technologies and new industrial sectors***: the development and establishment of renewable energy power plants contribute to the growth of new technologies and new industrial sectors with benefits for its economy.
- ***Exploitation and capitalization of South Africa's renewable resources***: with the aim of increasing energy security.
- ***Employment creation and career opportunities***: the construction and operation of a renewable energy power plant contributes to job creation and new career opportunities.
- ***Pollution reduction***: the use of renewable energy resources decreases the demand and the dependence from coal and oil for electricity generation.
- ***Contrast to Global warming and climate mitigation***: the development of renewable energy contributes to reduce global warming through the reduction of greenhouse gas (GHG) emissions.
- ***Protection of natural foundations of life for future generations***: the development and establishment of renewable energy power plants offers the opportunity of consistently reducing the risks related to climate change caused by CO2 and CO emissions, therefore preserving life for future generations.
- ***Acceptability to society and community***: the use of renewable energy is largely accepted by society and community as a mean to reduce pollution concerns, improve human health and wellness, protect the environment, the ecosystem and climate;
- ***Commitment to and respect of international agreements***: in particular in light of the possible commitment to the Kyoto Protocol.

6. STATUS QUO OF THE RECEIVING ENVIRONMENT

The receiving environment has been described using a combination of specialist inputs, on-site observations, a review of existing literature and utilizing Geographic Information Systems (GIS) planning tools.

6.1. PROPERTY DESCRIPTION AND CURRENT LAND USE

The proposed development will stretch over a part of the Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168.

Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168 (Herbert R.D.)

Surveyor-general 21 digit site	C03200000000016800001
Local Municipality	Siyancuma
District Municipality	Pixley ka Seme
Province	Northern Cape
Extent	1028.1286 ha
Land Owner	NEL WYNAND LODEWIKUS
Diagram deed number	T13561/1915
Title deed number	T1208/2004
Registration date	20040326
Current land use	farming
Geo-graphical Co-ordinates	29° 19' 50" S ; 24° 29' 30" E

The site is located 35 km south-west from the town of Jacobsdal, 70 m south from Kimberley and 50 km north-east from Hopetown.

Farm portions close to the project site are also used for farming purpose.

6.2. ENVIRONMENTAL FEATURES

6.2.1. Climate

Rainfall in the study area peaks during autumn. The study area is situated within the autumn rainfall region with the mean annual precipitation varying between 200 and 400mm. The mean maximum and minimum monthly temperatures for the area are 37.1°C and -2.3°C, respectively.

6.2.2. Soils and geology

A Geo-technical & Geo-hydrological Study is under drafting and will form part of the EIA Report.

The land type unit represented within the proposed footprint area include the Ag146 and Ae279 land types. According to the classification by the Environmental Potential Atlas, South Africa (ENPAT, 2000) the soils on the site comprise of red-yellow apedal, freely drained soils, which is red with a high base status and is usually no deeper than 300 mm. Geology comprise of shale and mudstone of the Ecca Group and Karoo sequence as well as dolerite.
Soils associated with the site are mostly shallow Hutton or Glenrosa soils associated with limestone and shale.

6.2.3. Ecology (fauna and flora)

An Ecological Impact Assessment was conducted by AGES in order to describe the ecology (fauna and flora) present in the site, to assess its ecological sensitivity and to indicate the most suitable areas for the proposed development.

For this purpose, detailed ecological (fauna habitat & flora) surveys were conducted on 8 November 2012 to verify the ecological sensitivity and ecological components of the site at ground level.

6.2.3.1. Vegetation types

The development site lies within the Nama Karoo biome which occurs on the central plateau and western half of South Africa, at altitudes between 500 and 2000 m. The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. The geology underlying the biome is varied, as the distribution of the biome is determined primarily by rainfall. This also determines the predominant soil type with over 80% of the area covered by lime-rich weakly developed soil over rock (Low & Rebelo, 1996). The most recent classification of the area by Mucina & Rutherford (2006) shows that the site is classified as Northern Upper Karoo.

The vegetation features of this vegetation type are shrubland dominated by dwarf karoo shrubs, grasses and Acacia mellifera subsp. detinens and some other low trees. Landscape features include flat to gently sloping, with isolated hills of Vaalbos Rocky Shrubland and many interspersed pans. The conservation status of the Northern Upper Karoo is Least Threatened with none conserved in statutory reserves and 4% transformed for cultivation (Mucina & Rutherford, 2006).

The pans on the proposed development site represent the Highveld Salt Pans vegetation type on site. These pans represent depressions containing temporary water bodies. On the pan edges open to sparse dwarf shrubland may develop, especially when under heavy grazing pressure.

6.2.3.2. Fauna

A survey was conducted during November 2012 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the quarter degree grid.

Some potential rare fauna may also occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low.

A number of ecological potential impacts were identified and assessed. A few of these were assessed as having potentially medium or high significance.

The recommendations and mitigating measures highlighted in the Ecological Impact Assessment (Annexure E) should be implemented to ensure the survival of these species other fauna habitats and feeding grounds.

6.2.3.3. Summary and results of the Ecological Impact Assessment

Detailed ecological (fauna habitat & flora) surveys were conducted during November 2012 to verify the ecological sensitivity and ecological components of the site at ground level.

Considering the results from the field surveys, mitigation needs to be implemented to prevent any negative impacts on the ecosystem, since most of the site is in a natural state. A sensitivity analyses was conducted to identify the most suitable site for the development of the Photovoltaic Power Plant.

From this investigation and ecological surveys the following main observations was made:
The most suitable area for the development of the project would be throughout most parts of the site, even though the most parts of the site represents natural Nama Karoo types. The False

Karoo and woodland variations of the site have a moderate sensitivity. Limited mitigation is needed for the preservation of some sections of this natural vegetation entity, while the eradication of invasive species such as Prosopis should be considered a high priority. The herbaceous layer should preferably be preserved below the solar panels and managed through slashing during the entire lifetime of the project.

The salt pans represent sensitive wetland habitat type that will be seasonally wet and have a high sensitivity. No development can occur in these areas and a buffer zone of 30 meters should be implemented around these areas.

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance. Provided that al mitigation measures and recommendations in the report are strictly adhered to, the proposed development won't significantly influence the potential rare habitats for flora and fauna on the site.

6.2.4. Avifauna

An Avifauna Impact Assessment will be conducted by AGES in order to determine whether the proposed development would have negative impact on avifauna.

A number of potential impacts will be individuated and assessed:

- Direct habitat destruction
- Habitat fragmentation
- Electrocutions
- Collision
- Disturbance of human activities and noise.

A series of specific mitigation measures will be individuated in respect of all the aforementioned potential impacts in the Avifauna Impact Assessment, which will form part of the Draft and Final EIA Reports.

6.2.5. Visual

A Visual Impact Assessment will be conducted to determine the visual impact of the proposed solar park and will form part of the Draft and Final EIA Reports.

Vegetation however plays a major role in screening the proposed intervention from adjacent and nearby sensitive viewers. A tree buffer zone 20 metres wide is foreseen along the perimeter of the area where the solar power plant will be developed, in order to avoid any visual impact also from close observation points.

The effect of the lighting at night will be low, considering that at night only streetlamps from the access point up to the loop-in loop-out substation on the property will be switched on. This is because video-surveillance system will use infra-red (or micro-wave) video-cameras, that do not need a lighting system, which could reduce its functioning.

6.3. SOCIO-ECONOMIC ENVIRONMENT

A report on the socio-economic considerations related to the proposed will be conducted and attached to the Draft and Final EIA Reports.

The following issues can be anticipated:

- The national and local economies will benefit from civil contractor work, labour and building materials that will be required on site. On the whole, a share approximately **40% of total**

CAPEX (investment costs) will be sourced locally. This share is likely to increase once there will be a specific and competitive industry in the Republic of South Africa able to supply PV modules and other technological components.

- After approval, the project will take approximately **15 months** to be built and will have a lifetime of 25-30 years. Approximately **100 people** are expected to be employed during the construction period, although this number can increase to 150 for short spaces of time during peak periods. This number can be higher in the case Carodex (Pty) Ltd - once being selected as Preferred Bidder by the Department of Energy and having finalized the Connection Agreement with Eskom, where in particular it is agreed the envisaged connection timeline - evaluates to build the Carodex Solar Park in a timeframe shorter than 15 months. For example, in the case the construction works are planned to last only **6 months**, the average number of workers required on site during construction is **250**/**300**.
- During operational phase, the power plant will require a permanent staff approximately **35**/**40 people**. That impact will be positive, also in consideration of the slowing down of the recruitment rate due to mining stabilization activities.
- Approximately **50% of the operation costs** will have a local economic return (mostly for maintenance works by local sub-contractors), then the impact will also be positive during the operational phase (25÷30 years).
- Furthermore, the project will comply to the Economic Development Requirements, as requested by the IPP Procurement Programme, issued on 3rd August by the DoE. This economic development programme identifies needs of the surrounding communities in order to have a positive socio-economic impact. In particular, Carodex (Pty) Ltd is required to identify a **Local Community** for the purpose of entering into a partnership for the Project.

6.4. AGRICULTURAL POTENTIAL

An Agricultural Potential Impact Assessment on soils potential will be conducted and it will form part of the Draft and Final EIA Reports.

It can be anticipated that the property has low agricultural potential, as indicated in the Agricultural Maps attached as Annexure B:

- **Agricultural Potential Map** - indicating that the project site (Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168) is classified as *Low Agricultural Potential*
- **Land Capability Map** (further depicted in Figure 9 below) - indicating that the site is classified as *Non-arable - low potential grazing land*
- **Potential Grazing Capacity Map** - indicating that the project site has a potential grazing capacity of 21 - 25 ha / large stock units. As indicated in the previous map, this grazing potential is *low*, if compared to the maximum value indicated in the legend: less 3 ha / large stock units.
- **Grazing Capacity Map** - indicating that the project site has an average actual grazing capacity of 26 - 30 ha / large stock units, therefore it is exploited under its grazing potential.

It can be deduced that the project site would allow for 41 to 49 large stock units on 1028 ha, which is not regarded as an economically viable unit, as 60 LSU cannot be accommodated on the property.

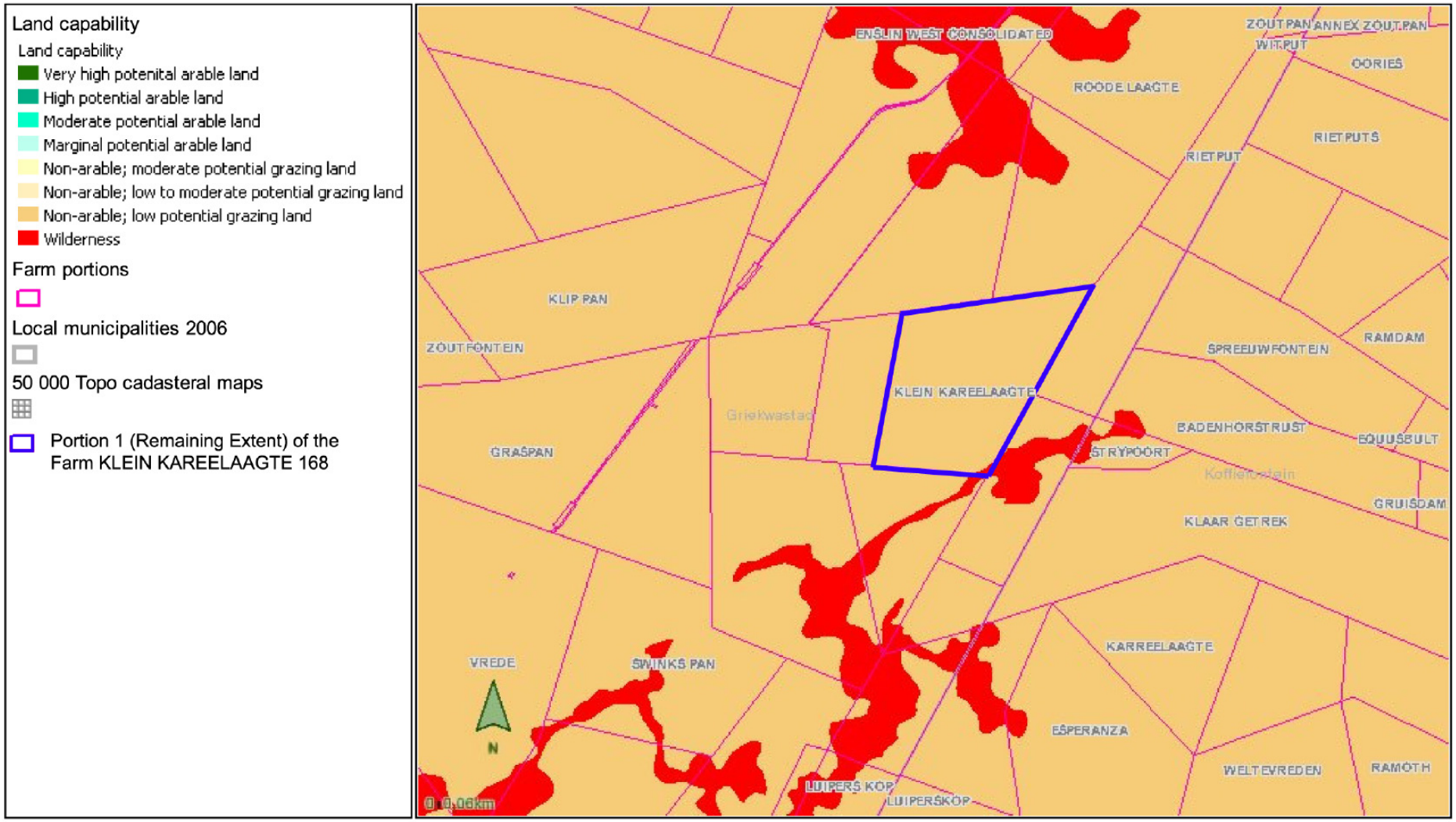
These maps were generated from the Website: **http://www.agis.agric.za/agisweb/agis.html** [***AGIS (Agricultural Geo-Referenced Information System) Comprehensive Atlas***, commissioned by the Department of Agricultural to CETI Development CC (http://www.ceit.cc/)]

Considering the fact that re-growth of grass will take place under the PV arrays as the mounting systems are at least 1 m above ground level, the grazing and agricultural potential of the land will not be lost since smaller livestock such as game, goats and sheep will still be able to utilize the grass layer underneath the PV modules. At the end of the lifetime of the solar plant, structures will be removed and natural vegetation will re-establish naturally.

6.5. CULTURAL AND HERITAGE RESOURCES

An archaeological-cum-heritage assessment will be conducted to ascertain whether there are any remains of significance in the area that will be affected by the proposed development. This specialist study will form part of the Draft and Final EIA Reports.

Figure 9 Land Capability Map of the project site



7. IMPACT IDENTIFICATION AND ASSESSMENT

A clear statement will be made, identifying the environmental impacts of the construction, operation, maintenance and management of the proposed project. As far as possible, the suite of potential environmental impacts identified in the study will be quantified and the significance of the impacts will be assessed.
Each impact will be assessed and rated. The assessment of the data, whereas possible will be based on broadly accepted scientific principles and techniques. In defect, judgements and assessments will be necessarily based on the consultant's professional expertise and experience.

As previously described, **construction activities** for the establishment of the proposed PV power plant include:

- land clearing activities necessary for preparation of the site and access routes;
- excavation and filling activities;
- transportation of various materials;
- construction of the storage structures;
- installation of the PV modules and construction of associated structures and infrastructure;
- construction of the on-site loop-in loop-out substation and of the two new sections of 132 kV power line - 100 m long - , for the connection to the Eskom's "Klokfontein-Graspan" 132 kV power line.

EXTENT:

The extent of most of the construction activities is localized and impacts will only occur at the development site. Some activities will extend to adjacent landowners as access roads will be used which will lead to an increase in the traffic in the area.
These will be further investigated and mitigations measures will be included in EIA report.

DURATION:

The impact of construction activities will only be for the duration of the construction phase, after which it will cease completely. (Construction period envisaged to be minimum 6 months and maximum 15 months).

PROBABILITY:

The probability of impacts occurring during the construction is phase very high as there will be impacts on the vegetation as most will be removed to make way for the proposed development.
Please note that the evaluation of environmental impacts as a result of the proposed development will be discussed in detail in the EIA report.
Environmental impacts associated with the **operational phase** of a solar energy facility may include visual and other impacts.
The **decommissioning activities** of the PV plant mainly include the removal of the project infrastructure and the restoring of the site *status quo ante*.

The identification of impacts will be based on:

- legal and administrative requirements;
- the nature of the proposed activity;
- the nature of the receiving environment;
- specialist studies and
- issues raised during the public participation process.

Potential impacts may include:

- **Impacts on soils & agricultural potential;**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Low

- **Impacts on ground water;**
  Extent: Limpopo Water Catchment
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Low

- **Impacts on the road system and traffic;**
  Extent: Surrounding and adjacent land
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Low

- **Impacts on air quality and potential emissions;**
  Extent: Regional
  Duration: Life of the project (between 25 – 30 years)
  Probability: Very Low
  Significance: Very Low

- **Geological, soil and erosion impacts;**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Low

- **Impacts on avifauna;**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Low

- **Impacts on vegetation;**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: High
  Significance: Medium

- **Impacts on heritage resources;**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Low

- **Noise impacts;**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: Low
  Significance: Very Low

- **Impacts on tourism;**
  Extent: Regional
  Duration: Life of the project (between 25 – 30 years)
  Probability: Unknown
  Significance: Unknown

- **Social impacts;**
  Extent: Regional & Locally
  Duration: Life of the project (between 25 – 30 years)
  Probability: High
  Significance: High - Positive

- **Visual impacts.**
  Extent: Locally at the proposed site
  Duration: Life of the project (between 25 – 30 years)
  Probability: Definite
  Significance: to be determined

Please note that the statements above with regard to potential impacts are preliminary and have not been analysed as all the information to do this accurately has not been obtained yet.

In the following section: the Plan of Study for EIA it is outlined which studies are to be conducted in order to evaluate the identified impacts and to propose mitigation measures.

The significance of the potential impacts can and will then be determined.

8. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS AND PUBLIC PARTICIPATION PROCESS

The environmental impact studies can be summarized in a two-phased approach:

- Phase 1: Environmental Scoping Study (ESS)
- Phase 2: Environmental Impact Assessment (EIA) and Environmental Management Program (EMP)

The scope of the EIA procedure is to provide an assessment of all impacts related to the proposed project in compliance with the EIA Regulations 2010.

8.1. SCOPING PHASE

The Scoping Phase aims to produce the following:
- a description of the proposed activity, the property and the receiving environment;
- the identification of potential significant positive and negative impacts;
- the identification of opportunities and constraints, alternatives and mitigation measures which need to be evaluated and investigated during the successive EIA phase, especially in order to prevent environmental fatal flaws and sensitive or “no-go” areas.

The Scoping Phase includes the Public Participation Process. The PPP has the aim to identify concerns and issues by the interested and affected parties (I&AP’s).
Issues and concerns raised by the I&AP’s and key stakeholders during the Public Participation Process were collected, processed and addressed in the Comments and Response document which forms a part of this Final Scoping Report.

All issues and concerns identified during the Scoping Phase were documented in this Final Scoping Report which is submitted to the DEA together with a Plan of Study for EIA.

8.2. EIA PHASE

The next step of the EIA process is the development of guidelines for execution of the impact assessment and the compilation of an Environmental Impact Assessment Report.

The database of the stakeholders and I&AP’s developed during the scoping process will be used as a reference to ensure that stakeholders are involved and participate in the second phase of the EIA process.
All relevant issues considered during the Scoping Phase will be further investigated and assessed during the EIA Phase of this project. The EIA will involve various specialist studies and should provide an overall assessment of the biophysical, social and economic environment affected by the proposed project.

A detailed assessment will be carried out in terms of environmental criteria and rating of significant impacts of all options identified in the scoping phase. Appropriate mitigation measures will be identified and recommended for all significant impacts. These measures should be included in an Environmental Management Program (EMP) to be submitted together with the Environmental Impact Assessment Report (EIAR) to the DEA.
During the EIA phase stakeholders and I&AP’s will be notified in writing of the continuation of the project to the EIA Phase and will be informed as to the way forward and where and when the Draft Environmental Impact Assessment Report will be made available for review. Comments from the stakeholders and I&AP’s on the Draft EIR and the Draft EMP will be incorporated into the final EIAR.
The stakeholders and I&AP’s will furthermore be informed of the final decision regarding the Environmental Authorization and the appeal process.

8.3. PUBLIC PARTICIPATION PROCESS

All relevant I&AP's have been identified and involved in the public participation process from the beginning of the project as per sections 54, 55, 56 and 57 of the EIA regulations 2010.

The public participation process offers the opportunity to become actively involved through constant sharing of information. The main purposes of the public participation process are to ensure that:

- all relevant information in respect of the application is made available to I&AP's for their evaluation and review;
- reasonable opportunity is given to I&AP's to comment and to submit queries related to the proposed project;
- comments and queries by the I&AP's to the Draft Scoping and to the EIA Reports are submitted and evaluated in a reasonable timeframe and in predetermined terms.

The initial informative stage of the public participation was done from 19 October 2012 until 12 November 2012.

The public was informed of the proposed development and a database of Interested and Affected parties was compiled.

In the enclosed Annexure D there is the list of all components of the public participation process.

The public was informed of the project by means of:
- site notices;
- Background Information Documents (BID) sent to all adjacent land owners;
- notices in a local newspaper; and
- sending of BID to other possible interested and affected parties/stakeholders.

A data base of registered I&AP's has been established to date and will be maintained and added to as required.

Site notices were put up on site on the fence surrounding the proposed development area on 19 October 2012.

After a Deed Search was done on the surrounding properties Background Information Documents were sent to adjacent landowners. Proof of this is attached in Annexure D.
A number of these documents were also distributed to the relevant governmental departments including *inter alia* Department of Water Affairs, Agriculture Land Reform & Rural Development *etc*. Other identified interested and/or affected parties/stakeholders include Eskom, the Local municipality, the District municipality *etc*.
Proof of all correspondence is included in Annexure D.

A newspaper advertisement was published in the 19 October 2012 version of the Diamond Fields Advertiser, which is a local daily newspaper.

Two adjacent landowners registered as I& AP's and includes Mrs. Myburgh from Klein Karreelagte, Portion 3 and Mr. Nel of Klein Karreelaagte, Portion 1. The Draft Scoping Report was sent to these I&APs on CD by Registered mail on 14 November 2012.
No comments were received on the Draft Scoping Report.

Hard copies of the report were sent to the Local Municipality office as well as all applicable governmental organizations there was a commenting period of 40 days. No comments were received from any Governmental Department or the local municipality.

This final scoping report will be submitted to the Department of Environmental Affairs for approval. Registered I&APs and Governmental Departments will be informed that the Final Scoping Report is available for perusal and will be made available, on request.

After approval of Final Scoping Report was received the Draft EIA report will be compiled and will be made available for comments for a 40 day period after which the final EIA report will be submitted to the DEA.

9. PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Hereinafter there is a brief description of the approach that will be used in the EIA study. Assumptions and sources of information will be identified and the knowledge of local people will be incorporated in the final EIA study.

9.1. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A description of the affected environment will be provided. It will also be provided an additional indication of the sensitivity of the affected environment. Sensitivity, in this context, refers to the "ability" of an affected environment to tolerate disturbance, for example, if disturbance of the natural habitat results in the permanent loss of its biodiversity. The affected environment could be categorised as having a "low tolerance" to disturbance and is, therefore, termed a highly sensitive habitat. Instead, if a habitat is able to withstand significant disturbance without a marked impact on its biodiversity, the affected environment could be categorised as having a high tolerance to disturbance (i. e. "low sensitivity" habitat).

9.2. IMPACT IDENTIFICATION AND ASSESSMENT

A clear statement will be made, identifying the environmental impacts of the construction, operation, maintenance and management of the proposed project. As far as possible, the suite of potential environmental impacts identified in the study will be quantified and the significance of the impacts will be assessed. Each impact will be assessed and rated. The assessment of the data, whereas possible will be based on broadly accepted scientific principles and techniques. In defect, judgements and assessments will be necessarily based on the consultant's professional expertise and experience.

As previously described, **construction activities** for the establishment of the Carodex Solar Park include:

- the land clearing activities necessary for preparation of the site and access routes;
- the excavation and filling activities;
- the transportation of various materials;
- the preparation of the temporary worksite;
- the installation of the PV modules and construction of associated structures and infrastructure;
- construction of the on-site loop-in loop-out substation and of the two new sections of 132 kV power line - 100 m long - , for the connection to the Eskom's "Klokfontein-Graspan" 132 kV power line.

Environmental impacts associated with the **operational phase** of a solar energy facility may include visual and other impacts.

The **decommissioning activities** of the PV plant mainly include the removal of the project infrastructure and the restoring of the site *status quo ante*.

The identification of impacts will be based on:

- legal and administrative requirements;
- the nature of the proposed activity;
- the nature of the receiving environment;
- specialist studies;
- issues raised during the public participation process.

Potential impacts may include:

- Impacts on soils & agricultural potential;
- Impacts on ground water;
- Impacts on the road system and traffic;
- Impacts on air quality and potential emissions;
- Geological, soil and erosion impacts;
- Impacts on avifauna;
- Impacts on vegetation;
- Impacts on heritage resources;
- Noise impacts;
- Impacts on tourism;
- Social impacts;
- Visual impacts.

9.3. SPECIALIST STUDIES

Due to the nature of the project, a number of specialist studies are required in the EIA process in order to investigate the potential environmental impacts associated with the proposed development.

Detailed studies on potentially significant impacts will be carried out to address these impacts throughout the EIA process. The public participation process provides valuable information in the identification of issues requiring further and specific investigation throughout the EIA process.

The report takes into consideration that fact that not all the information is available at this stage but will be for the Draft and final Environmental Impact Assessment Report (EIAR).

An **Ecological Impact Assessment** was conducted on November 2012 by AGES and it is attached as Annexure E.

The following specialist studies are under drafting and will be included in the EIAR:

- **Services Report**
- **Geo-technical & Geo-hydrological Report**
- **Wetland Delineation Study**
- **Visual Impact Assessment**
- **Agricultural Potential Soil Assessment**
- **Socio-economic Impact Assessment**
- **Heritage Impact Assessment**
- **Palaeontological Desktop Study**
- **Avifauna Impact Assessment**

10. DECOMMISSIONING PHASE

Decommissioning activities of the PV plant mainly include removal of project infrastructure and restoring of the site's *status quo ante*.

The decommissioning phase will start at the end of the PV power plant lifetime (25 - 30 years) and will last approximately 6 months, involving a team of 50 workers.

Decommission will be subject to a decommissioning plan once the project is nearing its operational life (25-30 years). Decommissioning will also be subject to an environmental authorization (Activity 27 of R544 of 18 June 2010).

10.1. SITE PREPARATION

In order to ensure a correct decommissioning of the site, the first step of the process will include adequate site preparation. Integrity of access points and of laydown areas will be confirmed and eventually re-established in order to accommodate equipment and to load vehicles.

10.2. DISASSEMBLE AND REPLACEMENT OF EXISTING COMPONENTS

All components will be disassembled. Silicon of the PV modules will be recycled, as well as mounting structures (aluminium or zinced steel frames and piles) and cables (copper and/or aluminium conductor).

Non-recyclable components of inverter, transformers and electrical devices will be disposed in appropriate way, in compliance with applicable laws and international standards.

10.3. RESTORATION OF THE SITE

Adequate measures will be undertaken in order to restore the site by re-planting of indigenous plant species.

11. CONCLUSIONS AND RECOMMENDATIONS

This Final Scoping Report and Plan of Study for Environmental Impact Assessment (EIA) describe the activities that will be undertaken for the proposed development of the Carodex Solar Park and give indications to DEA related to the EIA which will be conducted.

A detailed assessment of the status quo of the receiving environment was conducted, in order to ensure that all pertinent environmental aspects were correctly identified and addressed.

A comprehensive public participation process has been conducted during the Scoping Phase (details of the public participation process are enclosed under Annexure D). All issues and questions raised will be noted and addressed during the EIA phase.

On the basis of the results of this Scoping Study it is requested and suggested that this Final Scoping Report be accepted by the competent authority.

It is also requested that the “Authority Review Process” be expedited - any additional information that might be required by DEA for review purposes should be requested from the EAP when the PoS for EIA is approved.