Final EIA Report 14/12/16/3/3/2/748

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

Short name: Carodex Solar Park

June 2015

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

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Purpose with Passion

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Purpose with Passion

Proposed Renewable Energy Generation Project on Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD, Siyancuma Local Municipality, Pixley ka Seme District Municipality, Northern Cape Province

Short name: Carodex Solar Park

June 2015

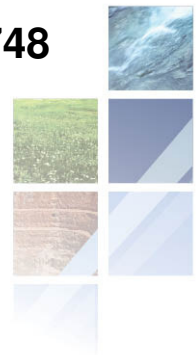
PROJECT APPLICANT

Company name:	**Carodex (Proprietary) Limited (Reg. No. 2012/001634/07)**
Contact Person:	Ms Izel van Rooy (PlanWize)
Physical Address:	5th Floor, Block B, 102 Rivonia Road, Sandton 2196, South Africa
Postal Address:	P.O. Box 651286, Benmore 2010, South Africa
Telephone Number:	+27 (0) 86 599 3858
Fax Number:	+27 (0) 86 599 3858
S.A. Mobile Number	+27 (0) 82 449 7626
E-mail:	planwize@telkomsa.net

ENVIRONMENTAL ASSESSMENT PRACTITIONER

Company Name:	AGES Limpopo (Pty) Ltd (Reg: 2006/020831/07)
Contact Persons:	Mr. Johan Botha / Ms. Engela Grobler
Physical Address:	120 Marshall Street, Polokwane, 0699, South Africa
Postal Address:	P.O. Box 2526, Polokwane, 0700, South Africa
Telephone Number:	+27 (83) 557 6494 / +27 0(15) 291 1577
Fax Number:	+27 (15) 291 1577
E-mail:	**jbotha@ages-group.com/egrobler@ages-group.com**

AGES (Pty) Ltd
J.H. Botha (Senior Environmental Scientist – M.Sc. Environmental Management (*Pri Sci Nat)*
E Grobler (Environmental Scientist – M.Sc. Environmental Management (Univ of Stellenbosch)



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PROJECT MAIN FEATURES IN COMPLIANCE WITH EIA GUIDELINES SUMMARY OF INFORMATION INCLUDED IN THE REPORT

GENERAL SITE INFORMATION

Site location	
Farm	**Klein Kareelaagte 168 (Herbert RD)**
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 LODEWIKUS WYNAND
Diagram deed number	T13561/1915
Title deed number	T1208/2004
Registration date	20040326

Site data	
Latitude	29° 19' 50" S
Longitude	24° 29' 35" E
Altitude	1215 m a.m.s.l.
Ground slope	flat

Adjacent farm portions	
Farm	**Roode Laagte 131 (Herbert R.D.)**
Portion	**7 (Remaining Extent)**
Surveyor-general 21 digit site	C03200000000013100007
Land Owner	HECKROODT TRUST
Diagram deed number	T19510/1928
Title deed number	T968/1997
Registration date	19970325
Extent	1012.4722 ha
Farm	**Roode Laagte 131 (Herbert R.D.)**
Portion	**11**
Surveyor-general 21 digit site	C03200000000013100011
Land Owner	NELL WIID FAMILIE TRUST
Diagram deed number	T403/1937
Title deed number	T1282/2012
Registration date	20120420
Extent	856.5320 ha
Farm	**Karreelaagte 169 (Herbert R.D.)**
Portion	**2**
Surveyor-general 21 digit site	C03200000000016900002
Land Owner	VILJOEN JAN ABRAHAM JACOBUS
Diagram deed number	T2592/1886
Title deed number	
Registration date	19890713
Extent	511.8921 ha

Farm	**Klein Kareelaagte 168 (Herbert R.D.)**
Portion	**2**
Surveyor-general 21 digit site	C03200000000016800002
Land Owner	HECKROODT TRUST
Diagram deed number	T18958/1927
Title deed number	T1260/2011
Registration date	20110721
Extent	441.9705 ha

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 (if necessary)	1
Maximum generating capacity at the delivery point	up to 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)(*)	up to 160 GWh/year with fixed mounting system up to 190 GWh/year with trackers
Load factor	0.223 with fixed mounting system 0.251 with trackers
Full net equivalent hours (EOH)	1950 h/year (Wh/Wp/y) with fixed mounting systems 2200 h/year (Wh/Wp/y) with trackers

Technical specifications (*)	
Installed power capacity - AC side	**up to 77 MW**
Installed power capacity - DC side	**up to 86 MWp**
Number of PV modules (*)	up to 608,400 thin film modules of 135 Wp each up to 288,000 mono/polycrystalline modules of 300 Wp
Number of structures (PV arrays) (*)	up to 15,600 fixed mounting systems up to 7,200 trackers (SAT)
Minimum structure height above ground level	1.0 m
Maximum structure height above ground level	3.1 m
(*) *these numbers are indicative and are subject to changes, depending on the peak power (W) of the PV modules which will be selected at the commissioning date.*	

Other technical information	
Footprint, including internal roads	Up to 215 hectares
PV power plant lifetime	25 - 30 years
Construction site (temporary)	10 hectares
Construction timeframe	Approximately 15 months

Connection to the Eskom grid
The connection to the Eskom grid will be done according to the Eskom connection solution which may require: • 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 "Klokfontein - Graspan" 132 kV power line which runs parallel and adjacent to the northern boundary of the project site;

- two new small sections of 132 kV power line allowing the Eskom **"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.

Point of connection	Eskom "Klokfontein-Graspan" 132 kV power line
Point of connection (farm, portion)	Portions 7 of the Farm Roode Laagte 131, Herbert RD, 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

Water requirements	
Water consumption	See paragraph 4.2.5 - water requirements

Site maps and GIS information

Status quo information - site	***ESRI shapefiles***
Site	Portion 1 of Klein Kareelaagte 168
Building and other structures	Farmstead (KKL 001)
Agricultural field	Not applicable
Natural and endangered vegetation areas	Vegetation and Sensitivity
Cultural historical sites and elements	Farmstead (KKL 001)
Contours with height references	1m contours
Slope analysis	1m contours
Boreholes	Boreholes
High potential agricultural areas	Not applicable
Eskom's substation(s) / power line(s)	Eskom's "Klokfontein-Graspan" 132 kV line
Cadastrals	Cadastrals
Existing roads	existing roads
Railway lines and stations	Railway
Industrial areas	Not applicable
Harbours and airports	Not applicable
Critical Biodiversity Areas and Ecological Support Areas	Not applicable

Development proposal maps	***ESRI shapefiles***
Project site	Portion 1 of Klein Kareelaagte 168
Development Area	Fenced area (footprint)
Access road and internal roads	Access road, Internal roads
Position of solar facilities	PV arrays
Permanent laydown area footprint	Fenced area (footprint)
Construction period laydown footprint	Temporary construction camp
River, stream, water crossing	Not applicable
Substation and transformers	On-site HV substation
Connection routes	Loop-in Loop-out 132kV lines
Buildings	MV stations, On-site HV substation, Control building, Warehouses
Buffers	Vegetation buffer zone

Annexures

Layout and technical drawings of the PV Power Plant and of the connection infrastructure	Annexure A
Photos of the project site	Annexure B
Public Participation Process	Annexure C
Ecological Impact Assessment	Annexure D
Avifauna Impact Assessment	Annexure E
Agricultural Potential Assessment	Annexure F
Wetland Delineation Study	Annexure G
Heritage Impact Assessment	Annexure H1
Paleontological Desktop Study	Annexure H2
Geo-technical and Geo-hydrological Report	Annexure I
Visual Impact Assessment	Annexure J
Socio-economic Impact Assessment	Annexure K
Services Report	Annexure L
Draft Environmental Management Programme	Annexure M
Rehabilitation and Revegetation Plan (Annexure 1 of Draft EMPr)	Annexure M
Alien Invasive Management Plan (Annexure 2 of Draft EMPr)	Annexure M
Rescue and Protection Plan (Annexure 3 of Draft EMPr)	Annexure M
Consents received	Annexure N

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

LIST OF ANNEXURES

Annexure A Layout and technical drawings of the PV Power Plant and of the connection infrastructure:

- Vegetation Map
- Sensitivity Map
- CDSP_00.1_r0 Locality Map and new footprint
- CDSP_00.2_r0 Locality Map with indication of the access road and 2m contours
- CDSP_01_r1 Layout plan - PV power plant up to 75 MW
- CDSP_03_r0 Mounting System – Alternative option 1: fixed mounting systems
- CDSP_04_r0 Mounting System – Alternative option 2: horizontal single-axis trackers
- CDSP_05_r0 Medium-voltage stations
- CDSP_06_r0 Control building and medium-voltage receiving station
- CDSP_07_r0 On-site high-voltage loop-in loop-out substation
- CDSP_08_r0 Warehouse

Annexure B Photos of the project site

Annexure C Public Participation Process

Annexure D Ecological Impact Assessment

Annexure E Avifauna Impact Assessment

Annexure F Agricultural Potential Assessment

Annexure G Wetland Delineation Study

Annexure H1 Heritage Impact Assessment

Annexure H2 Paleontological Desktop Study

Annexure I Geo-technical and geo-hydrological Report

Annexure J Visual Impact Assessment

Annexure K Socio-economic Impact Assessment

Annexure L Services Report

Annexure M Draft Environmental Management Programme

Annexure M Rehabilitation and Revegetation Plan (Annexure 1 of the Draft EMPr)

Annexure M Alien Invasive Management Plan (Annexure 2 of the Draft EMPr)

Annexure M Rescue and Protection Plan (Annexure 3 of the Draft EMPr)

Annexure N Consents received

ABBREVIATIONS AND ACRONYMS

AGES	Africa Geo-Environmental and Engineering Services (Pty) Ltd
BID	Background Information Document
Carodex	Carodex (Pty) Ltd (applicant)
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSP	Concentrating Solar Power
DAFF	Department of Agriculture, Fisheries and Forestry
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DENC	Northern Cape Department of Environment and Nature Conservation
DoE	Department of Energy
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIAR	Environment Impact Assessment Report
EMPr	Environmental Management Programme
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
NCNCA	Northern Cape Nature Conservation Act - Act No. 9 of 2009
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 site	Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168
PV	Photovoltaic
RD	Registration Division
REFIT	Renewable Energy Feed-in Tariffs
RFP	Request for Qualification and Proposals for New Generation Capacity under the IPP Procurement Programme
RFP	Request for Qualification and Proposals for New Generation Capacity under the REIPPPP
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. No. 2012/001615/07) 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 at the site.

The project site is **Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD** (1028.1296 ha in extent), located within the Siyancuma Local Municipality, Pixley ka Seme District Municipality, Northern Cape Province.

Project site: Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD
Surveyor-general 21 digit site code:

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

The name of the project is **CARODEX SOLAR PARK** and it envisages a **photovoltaic (PV) power plant having a maximum generation capacity of 75 MW**. The **footprint** (fenced area) of the proposed development is **up to 215 ha** to be located on the northern side of the property.

Access to the Carodex Solar Park will be from a secondary road starting from the **N12**, 4 km West from the project site. This secondary road run over/along the boundaries of: Portions 2 and 0 (Remainder) of the Farm Roode Laagte 131 and Portions 2, 4 and 7 of the Farm Klein Karreelaagte 168.

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

Carodex Solar Park previously received Environmental Authorisation, issued by the DEA on 26 November 2013 with **Reference No. 14/12/16/3/3/2/419.** The EA authorised the construction and operation of a **75 MW** Photovoltaic (PV) Power Plant within a **155 ha footprint**.

In order to increase the footprint from 155 ha to **up to 215 ha** with the same generating capacity of 75 MW, Carodex (Pty) Ltd has to conduct a new environmental process. Due to the increased footprint, which will allow a wider pitch among adjacent PV arrays, the project will be more competitive in terms of amount of electricity generated by the PV modules.

In order to develop the facility, Carodex (Pty) Ltd must conduct an Environmental Impact Assessment (EIA) and acquire environmental authorization from the Department of Environmental Affairs (DEA), in consultation with the *Northern Cape Department of Environment and Nature Conservation (DENC)*, 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 14/12/16/3/3/2/748.**

The Carodex Solar Park will be connected to the **Eskom "Klokfontein - Graspan" 132 kV power line**, which runs parallel and adjacent to the northern boundary of the project site, through two new small sections of 132 kV power line, approximately 100 m long. The point of the connection will be on Portion 7 of the Farm Roode Laagte 131, within the registered Eskom servitude, which is adjacent to the northern boundary of the project site.

This connection solution has been confirmed by Eskom in the Cost Estimate Letter issued on 9 June 2014 (Eskom Ref. IPP 116982403).

Eskom is the entity which should assess the connection solutions described in this EIA Report. Eskom also coordinates the necessary liaising between Carodex (Pty) Ltd, Eskom Transmission, Eskom Distribution and Eskom Land & Rights.

It is important to highlight that all or part of the infrastructure required for the connection may be owned and/or operated by Eskom Distribution and 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 (EAP's) which have been appointed for the undertaking of the detailed environmental studies in compliance with the 2010 EIA Regulations are **AGES Limpopo.**

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 independent from Carodex; 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 is defined and evaluated in this EIA Report and its annexures.

2. MOTIVATION AND RATIONALE OF THE CARODEX SOLAR PARK IN LIGHT OF THE REIPP 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. The Northern Cape 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 2,128 kWh/m^2/year;
- there are several green projects being developed in the Northern Cape, because of the high solar resources and 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 greenhouse gases emissions they have to bear.

The proposed Carodex Solar Park is situated within the **Siyancuma Local Municipality**. The Siyancuma Local Municipality does not have a formal Spatial Development Framework. However in the Local Economic Development Objectives, the Vision Statement of the Siyancuma Local Municipality is drafted as "*a sustainable and growing local economy that aims to create employment opportunities for local communities, while working towards providing a high quality of life for all*." This can be achieved through education and skills development and diversification of the local economy. The Integrated Development Plan of the Municipality also emphasises the increase of employment opportunities. Employment creation is considered to be the most important criterion for development project prioritisation. There is no specific reference to renewable energy or to solar electricity generation in the LED strategy, despite the clear expression of this priority in the Provincial Growth and Development Strategy. The introduction of a renewable energy project will directly contribute towards these goals: it will be a new industry to the area and will require special skills during the construction and operation phases. The facility will create a multiplier effect as far as job creation, skills upgrading and local empowerment and upliftment is concerned. The Solar Park will therefore stimulate the local (and regional) economy. Various other secondary trades will benefit from the proposed facility. These will include security service providers, local suppliers of building material, steel, cement, etc.

The addition of the Carodex Solar Park to this area will thus contribute towards the provision of employment opportunities to the area and thus boost the local economic growth of the wider area, thereby meeting the LED Vision Statement of the Siyancuma Municipality. In view of the above, it is clear that the proposed Carodex Solar Park will comply with the general spatial development and local economic development goals of the Siyancuma Local Municipality.

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 the northern side of the proposed project site.

In the light of the REIPP 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 starting commercial operation before the end of 2017.

With specific reference to Carodex Solar Park, Eskom has indicated that the projects 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. On the other hand, 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 REIPP 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 2017. The Department of Energy has already announced the intention to procure an additional **3,600 MW** of renewable energy projects by **2020** (DOE Media Statement of 12 December 2014).

Therefore, the development of photovoltaic power plants will represent a key feature in the fulfilment of the proposed target goal and the reduction of greenhouse gases emissions.

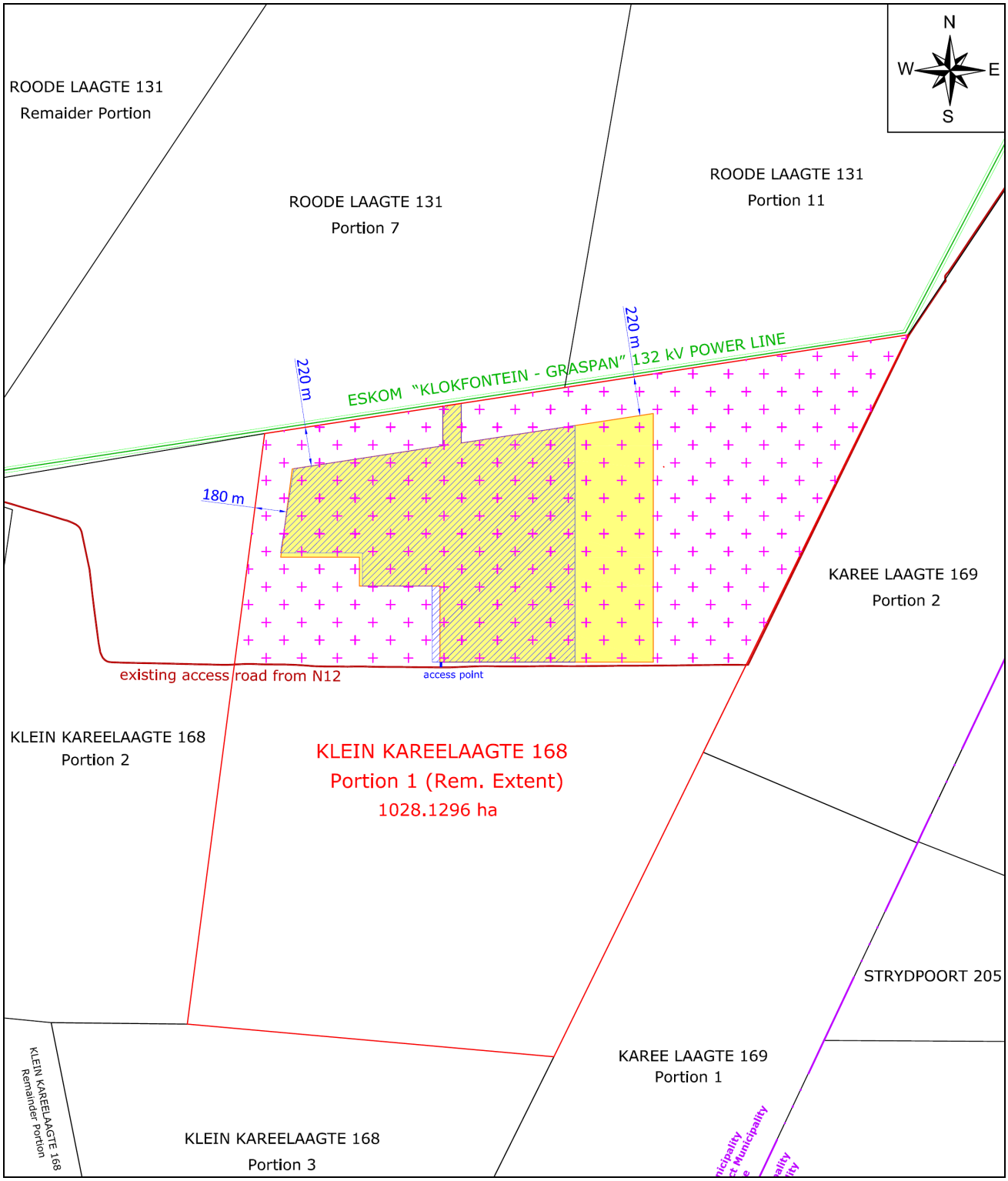
The purpose of the Carodex Solar Park is to add new capacity for the generation of renewable electric energy to the national electricity supply in compliance with the REIPP Procurement Programme and in order to meet the “sustainable growth” of the Northern Cape Province.

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 with indication of the Study Area for EIA and of the old and new footprints



PV plant footprint already approved by the Environmental Authorisation 14/12/16/3/3/2/419
Extent: 155.0 hectares

New PV plant footprint
Extent: 215.0 hectares

Study Area of the EIA process already conducted
Extent: ±500 hectares

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 Environmental Affairs & Nature Conservation (DENC)* 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. The project should comply with the *Northern Cape Nature Conservation Act* (Act No. 9 of 2009).

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.

The Siyancuma Local Municipality does not have a formal Spatial Development Framework. However in the Local Economic Development Objectives, the Vision Statement of the Siyancuma Local Municipality is drafted as "*a sustainable and growing local economy that aims to create employment opportunities for local communities, while working towards providing a high quality of life for all*." This can be achieved through education and skills development and diversification of the local economy. The Integrated Development Plan of the Municipality also emphasises the increase of employment opportunities.

The most significant land use in the municipal area is agriculture. The bulk of the agricultural production value in Siyancuma Local Municipality is derived from irrigation along the Orange and Vaal Rivers. The rest of the area is mostly low to moderate potential grazing land.

Some mining activities in Siyancuma include alluvial diamond mining along the Orange and Vaal Rivers. Various semi-precious stones, such as tiger-eye, are also produced in the region. The four pillars stimulating growth and development within the Siyancuma economy are:

- Agriculture and agro-processing,
- Small, medium and micro enterprise support,
- Tourism development and
- Mineral beneficiation.

Employment creation is considered to be the most important criterion for project development prioritisation. There is no specific reference to renewable energy or to solar electricity generation in the LED strategy, despite the clear expression of this priority in the Provincial Growth and Development Strategy. There are also no specific spatial or land development proposals for this area in the policy documents of the Siyancuma Local Municipality.

It can be accepted that renewable energy as a land use is fairly new to spatial development and land use schemes. Nevertheless with reference to the goals of skills development and diversification of the local economy, the introduction of a renewable energy project will directly contribute towards these goals. It will be a new industry to the area and will require special skills during the construction and operation phases. The facility will create a multiplier effect as far as job creation, skills upgrading and local empowerment and upliftment is concerned. The Solar Park will therefore stimulate the local (and regional) economy. Various other secondary trades will benefit from the proposed facility. These will include security service providers, local suppliers of building material, steel, cement, etc.

The addition of the Carodex Solar Park to this area will thus contribute towards the provision of employment opportunities to the area and thus boost the local economic growth of the wider area, thereby meeting the LED Vision Statement of the Siyancuma Municipality.

In view of the above, it is clear that the proposed Carodex Solar Park will comply with the general spatial development and local economic development goals of the Siyancuma Local Municipality.

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 RSA 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) • **New NEMA EIA Regulations 2014 (GN R. 982, 983, 984, 985 of 4 December 2014)** • 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 MEC 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 MEC for Environmental Affairs/Minister to publish a list of threatened ecosystems and in need of protection (S52) • Provision for the MEC 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 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 Quality Act (Act no. 39 of 2004)	• Provision for measures in respect of dust control (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
Northern Cape Nature Conservation Act (Act No. 9 of 2009)	• Indigenous flora protected under this act • No hunting to take place without a permit
Occupational Health and Safety Act (Act No. 85 of 1993)	• Health and safety of all involved before and after construction must be protected.

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 Programme, 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 2017**. The Department of Energy has already announced the intention to procure an additional **3,600 MW** of renewable energy projects by **2020** (DOE Media Statement of 12 December 2014).
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 potentially triggered by the proposed development (EIA Regulations 2010)

Listed activities	Description of project activity that triggers listed activity
GN R.544, Item 10 ***The construction of facilities or infrastructure for the transmission and distribution of electricity:*** ***(i) Outside urban areas or industrial complexes with a capacity of more than 33 kilovolts but less than 275 kilovolts:***	The project will be established outside urban areas. The connection to the Eskom grid will be done according to the Eskom connection solution, which requires: (i) 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 (132 kV), a 132 kV busbar with protection an metering devices ("switching station") and a control building; (ii) two new small sections of 132 kV power line - approximately 100 m long - allowing the Eskom "Klokfontein-Graspan" 132 kV power line - which runs parallel and adjacent to the northern boundary of the property - to loop in and out of the 132 kV busbar of the new on-site loop-in loop-out substation. The connection solution may also entail intervention on the Eskom's grid and/or on Eskom "Klokfontein-Graspan" 132 kV power line.
GN R.544, Item 22 ***The construction of a road, outside urban areas,*** ***(i) with a reserve wider than 13,5 metres***	Access to the Carodex Solar Park will be from a dirt road starting from the national road N12 and crossing the property. The new section of access road - linking the secondary road to the PV plant - will be 8.0 m wide. During the construction phase, the road reserve may be wider than 13.5 meters in order to allow the transportation of abnormal loads (e.g. the high-voltage step-up transformers of the new on-site high-voltage substation). Internal roads will be maximum 8.0 m wide with a road reserve maximum 12.0 m wide. At the turning points / intersection points, some internal roads may be wider than 8.0 m and the road reserve may be wider than 13.5 m, due to the shape of the intersection / turning points.
GN R.545, Item 1 ***The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more***	**Carodex Solar Park** will be established on **Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD** (1028.13 ha), located in the Siyancuma Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province. The project will consist of construction, operation and maintenance of a Photovoltaic (PV) Power Plant with a generation capacity exceeding 20 MW (up to 75 MW).
GN R.545, Item 15 ***Physical alteration of undeveloped, vacant or derelict land for industrial use where the total area to be transformed is 20 hectares or more***	The Photovoltaic Power Plant with associated infrastructure and structures will be constructed and operated on a footprint **up to 215 ha** within a property measuring 1028 ha. The project will be established on undeveloped land and the proposed activity is regarded as "industrial".

GN R.546, Item 14 ***The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:*** ***a) In Northern Cape,*** ***All areas outside urban areas.***	The Photovoltaic Power Plant with associated infrastructure and structures will be constructed and operated on a footprint **up to 215 ha** within a property measuring 1028 ha. The required footprint should be cleared from the existing indigenous vegetation. The project will be established outside urban areas.

The **footprint** (fenced area) of the proposed development is up to **215 ha,** to be located on the northern side of the property.

The footprint of the proposed development will be located OUTSIDE any watercourse / drainage line / wetland / pan or undevelopable areas indicated in the Ecological Impact Assessment and Geo-technical and Geo-hydrological Study. No infilling or depositing of any material or dredging, excavation, removal or moving of soil will take place in the proximity (<32m) of any watercourse / drainage line / wetland / pan, considering that the construction activities will be restricted to the proposed PV plant fenced area / footprint. Therefore **Activities 11 and 18 of GN R544 are NOT APPLICABLE**.

It should be noted that:

- this authorisation process is conducted **under the old EIA Regulations 2010**, since started in October 2014;
- all the 2010 Listed Activities applied for are still listed in the new EIA Regulations 2014, except for GN R. 546, Item 14;
- the similar Listed Activities under the new EIA Regulations 2014 include the following: GN R. 983, Item 11 and 24; GN R.984, Item 1 and 15.

Please find below the 2010 Listed Activities applied for, and the similar listed activities under the new EIA Regulations 2014.

Table 3: Comparison between Listed Activities in terms of EIA Regulations 2010 and new EIA Regulations 2014 - potentially triggered by the proposed development

Listed activity as described in GN R 544, 545 and 546 of 2010 (old EIA Regulations 2010)	Similar Listed activity as described in GN R 983, 984 and 985 of 2014 (new EIA Regulations 2014)
GN R.544, Item 10 (i) 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	**GN R.983 Item 11 (i)** The development of facilities or infrastructure for the transmission and distribution of electricity - outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts.
GN R.544, Item 22 (i) The construction of a road, outside urban areas - with a reserve wider than 13,5 metres	**GN R.983 Item 24 (ii)** The development of – a road with a reserve wider than 13,5m, or where no reserve exists where the road is wider than 8m.

GN R.545, Item 1 The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more	**GN R.984 Item 1** The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 MW or more
GN R.545, Item 15 Physical alteration of undeveloped, vacant or derelict land for industrial use where the total area to be transformed is 20 ha or more	**GN R.984 Item 15** The clearance of an area of 20 ha or more of indigenous vegetation
GN R.546, Item 14 The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, a) In Northern Cape, All areas outside urban areas.	**N/A**

Final layout and site plans have been drafted by Carodex following the inputs received via public participation. All information acquired was analysed in order to determine the proposed final development layout and site plans. Such approach ensured 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 Local and District Municipal 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 up to 75 MW.**
The construction timeframe is estimated to be approximately 15 months, whereas the commissioning date will depend on the IPP Procurement Programme timeframe.

The preferred technical solutions envisage:

- **thin-film PV modules or mono/polycrystalline PV modules,**
- **fixed mounting systems** or **1-axis horizontal trackers.**

The estimated annual energy production is calculated in approximately:

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

Therefore, the Carodex Solar Park will generate:

- **160.1GWh per year** in the case of PV modules mounted on fixed mounting systems; or
- **190.1GWh per year** in the case of PV modules mounted on trackers.

The calculation is made by the professional tool "PVSYST" and the simulation is done for 1 MW (1 "PV field"). The site data (irradiation, temperature, etc.) charged on the database consists of hourly meteo-data from Meteonorm 7 (years 1991-2010) 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 2,185 kWh/m^2/year (Meteonorm 7, years 1991-2010).

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 160.1 GWh/y or 190.1GWh/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 PV modules mounted on fixed mounting systems, or **192,931 tons of CO_2 per year** in the case of PV modules mounted on trackers.

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 51,373 tons of coal / year** in the case of PV modules mounted on fixed mounting systems, or **43,287 tons of coal / year** in the case of PV modules mounted on trackers.

The detailed description of the characteristic and functioning of the PV 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 easy and quick maintenance and repair for approximately 25-30 years. **The footprint (fenced area) of the Carodex Solar Park will be up to 215 ha.**

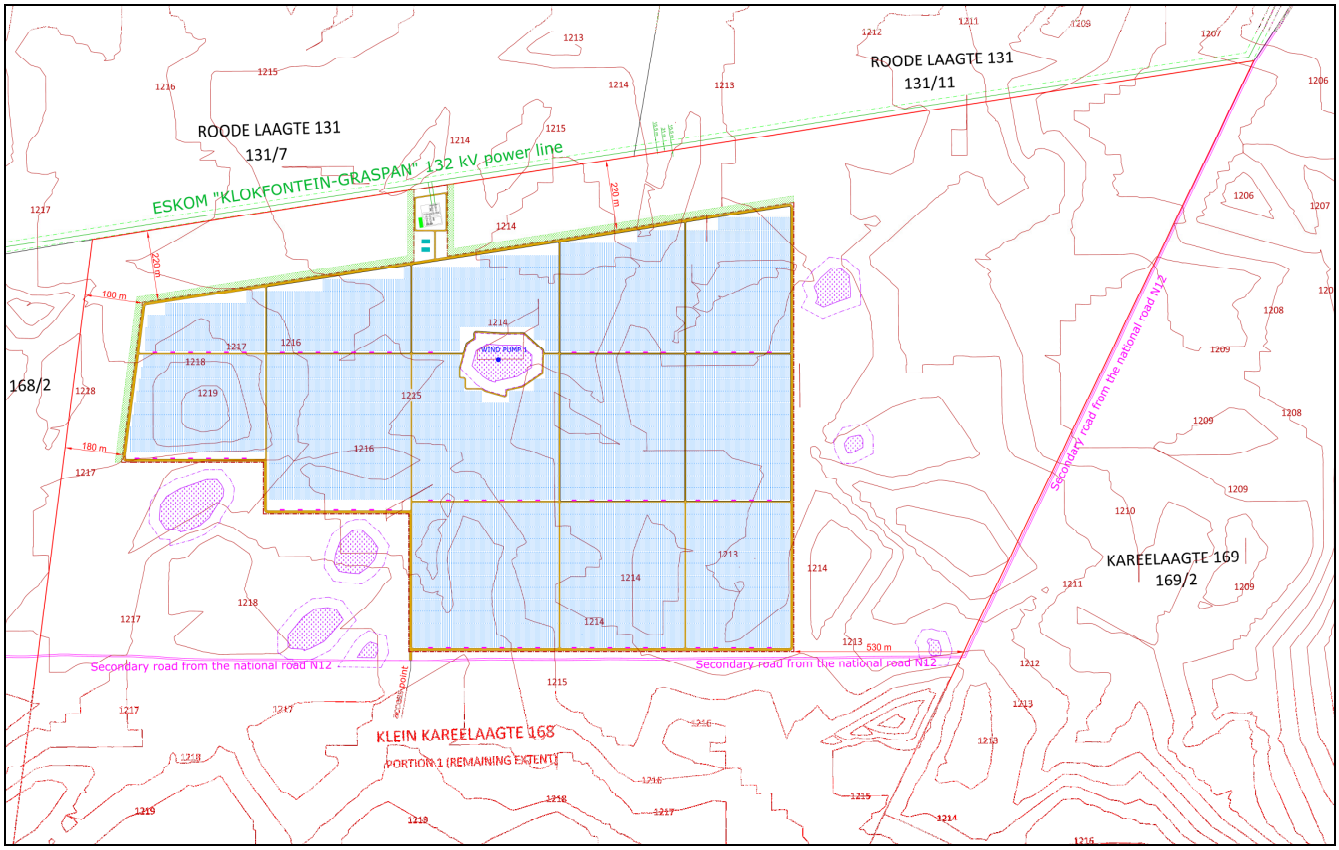
The main drives of the proposed layout are:

- to maximize the energy production and the reliability of the PV plant, by choosing proven solar technologies: thin-film or mono/polycrystalline solar modules mounted on single-axis horizontal trackers (SAT) or 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*) sparsely located on the project site, by providing a buffer 32 m wide;
- to keep a minimum distance of 220 m from the northern boundary of the proposed footprint and the northern boundary of the property, and of 180 m from the western boundary of the proposed footprint and the western boundary of the property, so that the existing vegetation can screen the solar park from the adjacent farm portions (vegetation buffer).
- to foresee an additional vegetation buffer zone - 20 m wide and consisting of planted vegetation - along the western and northern boundary of PV plant footprint, in order to reduce the visual impact from the adjacent properties.

The footprint (fenced area) of the solar park is up to 215 ha. The land use of the farm will be changed only in respect of the planned footprint (fenced area): an application for the Change of the Land Use - from “Agricultural” to “Special Zone” to permit a “Renewable Energy Generation Project” - will be submitted to the Siyancuma Local Municipality for the planned 215 ha footprint (fenced area), while the remainder of the farm will still be agricultural. The Municipality already granted the Special Consent for the land use on 29 July 2014 in respect of the old footprint (155 ha). A new application will be submitted in respect of the increased footprint (215 ha). The proposed layout plan (attached as Annexure A and also shown in Figure 2 below) was drawn using PV modules mounted on trackers; in the case of PV modules mounted on fixed mounting systems, the layout plans do not change, except for the orientation of the PV arrays: East-West instead of North-South. The required **footprint** - corresponding on the fenced area - will be the same: **up to 215 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 area and the other plant components are detailed in the following drawings:

- CDSP_00.1_r0 Locality Map with indication of the new footprint
- CDSP_00.2_r0 Locality Map with indication of the access road and 2m contours
- CDSP_01_r1 Layout plan - PV power plant up to 75 MW
- CDSP_03_r0 Mounting System – Alternative option 1: fixed mounting systems
- CDSP_04_r0 Mounting System – Alternative option 2: single-axis horizontal trackers
- CDSP_05_r0 Medium-voltage stations
- CDSP_06_r0 Control building and medium-voltage receiving station
- CDSP_07_r0 On-site high-voltage loop-in loop-out substation
- CDSP_08_r0 Warehouse

Figure 2: Proposed Layout Plan of the Carodex Solar Park



PV arrays

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

Fenced area (footprint): up to 215 hectares

Medium voltage receiving station
and control building

Medium voltage stations

Warehouses

Internal roads

Vegetation buffer zone, 20 m wide

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

Salt pan and 32 m buffer

Boreholes

4.2. PRIMARY COMPONENTS

The proposed development (the Photovoltaic (PV) Power Plant and its connection infrastructure) consists of the installation of the following equipment:

- Photovoltaic modules (mono-crystalline, polycrystalline or thin-film solar modules)
- Mounting systems (fixed or single-axis horizontal trackers) for the PV arrays and related foundations
- Internal cabling and string boxes
- Medium voltage stations, hosting DC/AC inverters and LV/MV power transformers
- Medium voltage receiving station(s)
- Workshop & warehouses
- 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 132 kV line allowing the **Eskom** "**Klokfontein - Graspan" 132 kV power line** - which runs parallel and adjacent to the northern boundary of the project site - to loop in and out of the 132 kV busbar of the new on-site switching station
- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
- Access road from N12
- 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
- sewage system (*Ballam Waterslot* or *Lilliput* system).

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:

- water access point and water extraction on-site borehole(s) point, water supply pipelines, water treatment facilities;
- pre-fabricated buildings;

to be removed at the end of construction.

Table 4: Project components

Component	Description/ Dimensions
Property / 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 LPI code: C03200000000016800001 Extent: 1028.1296 ha Latitude: 29° 19' 50" S Longitude: 24° 29' 35" E

PV plant footprint	**PV plant footprint (fenced area): up to 215 ha on the northern side of the property** Geo-graphical coordinates of the footprint / security fence: P01: 29° 19' 34.3" S ; 24° 28' 51.0" E P02: 29° 19' 50.4" S ; 24° 28' 48.5" E P03: 29° 19' 50.4" S ; 24° 29' 04.9" E P04: 29° 19' 55.8" S ; 24° 29' 04.9" E P05: 29° 19' 55.8" S ; 24° 29' 21.7" E P06: 29° 20' 09.8" S ; 24° 29' 21.7" E P07: 29° 20' 09.8" S ; 24° 30' 06.2" E P08: 29° 19' 24.4" S ; 24° 30' 06.2" E P09: 29° 19' 29.7" S ; 24° 29' 26.3" E P10: 29° 19' 22.4" S ; 24° 29' 26.3" E P11: 29° 19' 22.9" S ; 24° 29' 22.4" E P12: 29° 19' 30.2" S ; 24° 29' 22.4" E P01: 29° 19' 34.3" S ; 24° 28' 51.0" E
Site access	The access to the Carodex Solar Park will be from a secondary road starting from the **national road N12**, 4 km west from the project site. This secondary road run over/along the boundaries of: Portions 2 and 0 (Remainder) of the Farm Roode Laagte 131 and Portions 2, 4 and 7 of the Farm Klein Karreelaagte 168. Access point from secondary road: 29° 20' 10.6" S ; 24° 29' 21.8" E Gate at the PV plant security fence: 29° 20' 09.8" S ; 24° 29' 21.8" E Length: 100 m
Generation capacity	up to 75 MW
Proposed technology	The preferred technical solutions are: **PV solar modules**: thin-film modules or monocrystalline or polycrystalline modules **Mounting systems:** fixed mounting systems or single-axis horizontal trackers (SAT)
Panel Dimensions	It depends on the technical solutions and electrical configuration. In any case the minimum and maximum height above the ground level will not exceed the values indicated at the item below.
Height of PV module supporting structures from ground level	Maximum height (highest point of the PV arrays): 3.1 m above the ground level Minimum height (lowest point of the PV arrays): 0.7 m above the ground level
Width and length of internal roads	The main internal road around the security fence is max. 8.0 m wide and approximately 7.2 km long. Internal roads are 4.0 m wide.
Height of Fencing	security fence around the footprint: maximum height: 3.0 meters above the ground level
New on-site high-voltage substation	**<u>On-site high-voltage substation - within the fenced area</u>** Substation Fence: 70 m x 70 m Substation Footprint: 0.4 ha Latitude 29° 19' 25.6" S Longitude 24° 29' 24.5" E
Loop-in loop-out lines (Alternative Connection 1)	**<u>Two new sections of 132 kV power line</u> for the connection to the Eskom "Klokfontein - Graspan" 132 kV power line** Length: max. 100 m each Loop-in Line starting point: 29° 19' 24.5" S ; 24° 29' 24.5" E Loop-in Line ending point: 29° 19' 22.2" S ; 24° 29' 24.1" E Loop-out Line starting point: 29° 19' 24.5" S ; 24° 29' 24.9" E Loop-out Line ending point: 29° 19' 22.1" S ; 24° 29' 24.5" E

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 or mono / polycrystalline modules, mounted on:
- fixed mounting systems or 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, mono-crystalline 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.

The required footprint - corresponding on the fenced area - will not exceed 215 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 the examples of “thin-film PV modules on fixed mounting systems” and of “polycrystalline modules on trackers”, but the combination of “thin-film PV modules on trackers” and “polycrystalline PV modules on fixed mounting systems” is also possible and feasible.

The required **footprint** (including internal roads) will not exceed **215 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 PV modules mounted on fixed mounting systems:

Each mounting frame will host several PV modules along two or more parallel rows consisting of PV modules placed side by side, with the position of the PV arrays northwards and at an optimized tilt. The rows are mounted one on top of the other, with an overall mounting structure height **up to 3.1 meters above ground level**.

Figure 3: Lateral views of PV arrays mounted on fixed mounting systems

Figure 4: Frontal view of PV arrays mounted on fixed mounting systems

For further details, Please refer to the Figures 3 and 4 above and to the drawing of the Annexure A:

- CDSP_03_r0 *Mounting System – Alternative option 1: fixed mounting systems*

B) In the case of PV modules mounted on trackers:

Each PV array is composed of several PV modules disposed along one or more parallel rows consisting of PV modules placed side by side.
Each tracker is composed by several PV arrays North-South oriented and linked by a 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.
The maximum mounting structure height will be **up to 3.1 meters above ground level**.

Figure 5: Simulation views of the PV arrays mounted on horizontal 1-axis tracker

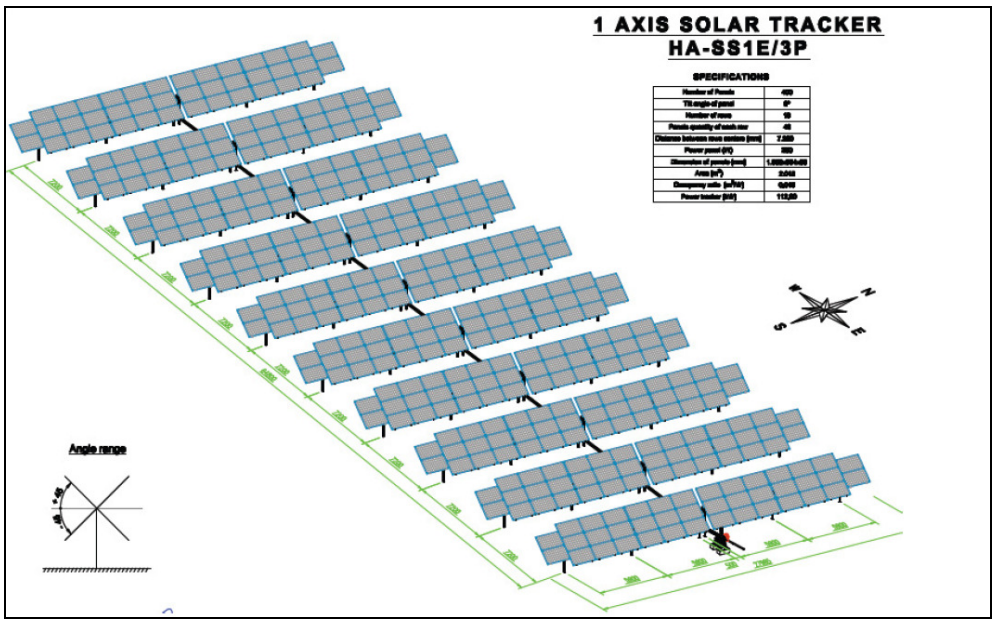


Figure 6: Frontal views of the PV arrays mounted on horizontal 1-axis tracker

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

- CDSP_04_r0 *Mounting System – Alternative option 2: single-axis horizontal trackers*

C) In both cases:

PV modules are series-connected outlining PV strings made of several modules, so that the PV string voltage fits into the voltage range of the inverters. PV strings are set up in order to be connected to DC-connection boxes. Each String Box allows the parallel connection of several PV strings (also called “PV sub-field”).

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 a **medium voltage power transformer** of 1000 kVA. 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_r0 *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 Eskom requirements.

The **Eskom** "**Klokfontein - Graspan" 132 kV power line** - which runs parallel and adjacent to the northern boundary of the project site - will loop in and out the 132 kV busbar of the on-site substation through two new sections of 132 kV line, 100 m long. The new on-site HV 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**.** Two **metering devices and related kiosks** are included in the layout: one for Eskom, close to the 132 kV busbar, and one for Carodex, 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 sub-station, composed of the power transformers, the control building, the 132 kV busbar with protection and metering devices and the kiosks, will have a **footprint covering approximately 4,000 m^2**. The new power line and the busbar (*switching station*) of the on-site HV 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_r0 *Control building and medium-voltage receiving station*
- CDSP_07_r0 *On-site high-voltage loop-in loop-out substation*

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

4.2.2. Access road and internal roads

The access to the Carodex Solar Park will be from a secondary road starting from the **national road N12**, 4 km west from the project site. This secondary road run over/along the boundaries of: Portions 2 and 0 (Remainder) of the Farm Roode Laagte 131 and Portions 2, 4 and 7 of the Farm Klein Karreelaagte 168.

Please refer to the drawing of the Annexure A:

- CDSP_00.2_r0 *Locality Map with indication of the access road and 2m contours*

The Developer will be responsible of the good condition of such road during the construction and operational phase and should repair at its costs any damage which may occur.

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).

4.2.4. Stormwater collection system

Given the low rainfall, flat topography and low flow speed of run-off, **no formal storm water structures are required** as the proposed gravel roads will be developed at ground level so as not to disturb the natural flow of storm water. This means that run-off will not be concentrated 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 approximately **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 100,000 m^2.
- 50 liters of water / m^2 of internal of roads will be required.
    - 100,000 m^2 x 50 l/m^2 = 5,000 m^3 over 15 months

B) Workers

- Approximately 100 people are expected to be employed during the construction period, although this number can increase to 200 for short spaces of time during peak periods. 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

C) Concrete production

- Concrete is necessary for the basements of the medium-voltage stations, the high-voltage 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 10,000 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 not during working days, also in order to not increase the water requirement during the construction activities. In order not to waste a large amount of water, high pressure cleaners will be used. Overall, the water requirement for cleaning activity is very low. The overall and average water consumption during construction is detailed in the following table.

Table 5: Water consumption during the construction phase of the project

WATER REQUIREMENT DURING THE CONSTRUCTION PHASE OF THE PROJECT		
DESCRIPTION	**UNIT**	**TOTAL**
Timeframe of the construction activities	*months*	15
Timeframe of the construction activities	*days*	450
Timeframe of the construction activities	*working days*	330
Overall water consumption for internal roads	m^3	5,000
Overall water consumption for sanitary use	m^3	1,650
Overall water consumption for concrete production	m^3	2,000
OVERALL WATER CONSUMPTION	***m^3***	**8,650**
OVERALL WATER CONSUMPTION	***m^3/day***	**19.2**
EQUIVALENT WATER FLOW OVER 15 MONTHS (450 DAYS)	***l/s***	**0.22**

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 **60 litres** / **day** / **person** per **20 people** (14 people daytime and 6 people at night), The daily water consumption will be approximately **1,200 litres/day.**

B) Water consumption to clean the PV modules

The cleaning activities of the solar panels will take place **twice per year.**
It is assumed that up to 1.0 liters per m^2 of PV panel surface will be needed. Therefore, the amount of water for cleaning is up to **850 m^3 per cleaning cycle and 1,700 m^3 per year**. PV modules cleaning activity can last less than 1 month. If the cleaning activity lasts approximately 2 weeks (12 working days), the daily water consumption will be approximately **71,000 liters/day**, **over 12 days**.

Conclusion

The daily water requirement will be approximately **1,200 liters/day** over 12 months for sanitary use (i.e. **36,000 l/month** and **438 m^3/year**). The water consumption will increase to **72,200 liters/day** during the cleaning of the solar modules (71,000 liters/day for cleaning activity and 1,200 for sanitary use), which will last less than a month and will occur twice a year during the dry period. PV modules are conceived as self-cleaning when it rains.

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 6: Water consumption during the operational phase of the project

WATER REQUIREMENT DURING THE OPERATIONAL PHASE OF THE PROJECT		
DESCRIPTION	**UNIT**	**TOTAL**
Average daily water consumption for sanitary use	*l/day*	1,200
Average daily water consumption during cleaning activity (*)	*l/day*	72,200
Average monthly water consumption for sanitary use (over 30 days)	*l/month*	36,000
Annual water consumption for sanitary use	***m^3/year***	**438**
Annual water consumption for PV modules cleaning activities (twice/year)	***m^3/year***	**1,700**
ANNUAL WATER CONSUMPTION DURING OPERATION	***m^3/year***	**2,138**
DAILY WATER CONSUMPTION DURING OPERATION (average over 365 day)	***m^3/day***	**5.86**
EQUIVALENT WATER FLOW OVER 365 DAYS	***l/s***	**0.067**

(*) over 12 working days, twice per year

4.2.5.3. Water provision during construction and operation

The site is located within the **C51K Quaternary catchment**, and is situated in the **Lower Vaal Water Management Area.** No abstraction under General Authorization is allowed for in this quaternary.

The estimated annual groundwater recharge (9.4 mm/m2 per annum) from an average annual precipitation of 350 mm falling on the project site (1028 ha in extent) will result in 96,632 m^3 of water available. The maximum annual water requirement for the project is 2,138 m^3 and for livestock is 1,800 m^3 per year (100 head of Cattle consumes 50 l of water per day). **The scale of abstraction relative to recharge is 4.1% (Category A)**.

As indicated in the Geo-technical and Geo-hydrological Report, there are two boreholes on the project site:

One borehole equipped with a wind pump (**Wind pump 1**) is located within the proposed development area. This wind pump is not in a working condition. The borehole is shallow and the yield is only 100-200 l/h.

The borehole equipped with a wind pump at the homestead (**Wind pump 2**) is in working condition. This borehole has a sustainable yield of more than 20,000 l/hour; therefore it can be also used for the water needs of the proposed development. Currently the borehole is equipped with a wind pump capable of pumping no more than a 1000 l/h when the wind blows.
With the information available, a sustainable abstraction of 50,000 l/day is assumed for the aquifer. Before construction of the solar park commences, pump testing should be conducted to verify the aquifer and borehole yields.

The water quality analysis of the samples collected at the property conforms to the SANS 241 drinking water standards. Only the turbidity is outside the specification. No health effects are expected. It is recommended that the drinking water supply for the staff on site be treated through an osmotic water filtration system.

A Water Use Licence application has been submitted to the Department of Water Affairs by Carodex on 24 July 2014 (please refer to the Annexure N).

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 *Ballam Waterslot* (or similar) sewer treatment system.

The sewer system will 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 *Ballam Waterslot* (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.

A Water Use Licence application has been submitted to the Department of Water Affairs by Carodex on 24 July 2014 (please refer to the Annexure N).

4.2.7. Refuse removal

During the construction phase, solid waste will mainly consist of vegetation material as a result of the clearing activity. Other type of solid waste will be: wood from packaging, boxboards, expanded polystyrene and household waste. Vegetation material from clearing activity can be recycled to be re-used as organic fertilizer. Where possible, solid waste must be sorted and recycled. Non-recyclable waste will be delivered to the closest landfill of the Municipality.

During the operational phase (25 - 30 years), solid waste will mainly consist of household waste from the operational team. Other type of solid waste will come from the maintenance activity in case of failure of some components.

At the end of the project lifetime, the PV plant will be decommissioned. Silicon of the PV modules and cables (copper and/or aluminium conductor). will be recycled, as well as the aluminium (or zinced steel) frames and piles of the mounting systems.

Carodex 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. Measures to manage waste have been included in the Draft EMPr, submitted this Final EIA Report.

4.3. TEMPORARY CONSTRUCTION CAMP

The construction camp (approximately 10ha) will be located on the south-western side of the planned development area. Consequently, the construction site area will be gradually reduced at the completion of the last four PV fields (4 MW), 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 phases. Steps included here do not follow a time sequence, but considered overlapping and simultaneous events.

4.3.1. 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.

4.3.2. 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 distributed to local communities as the opportunity arises.

4.3.3. 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.

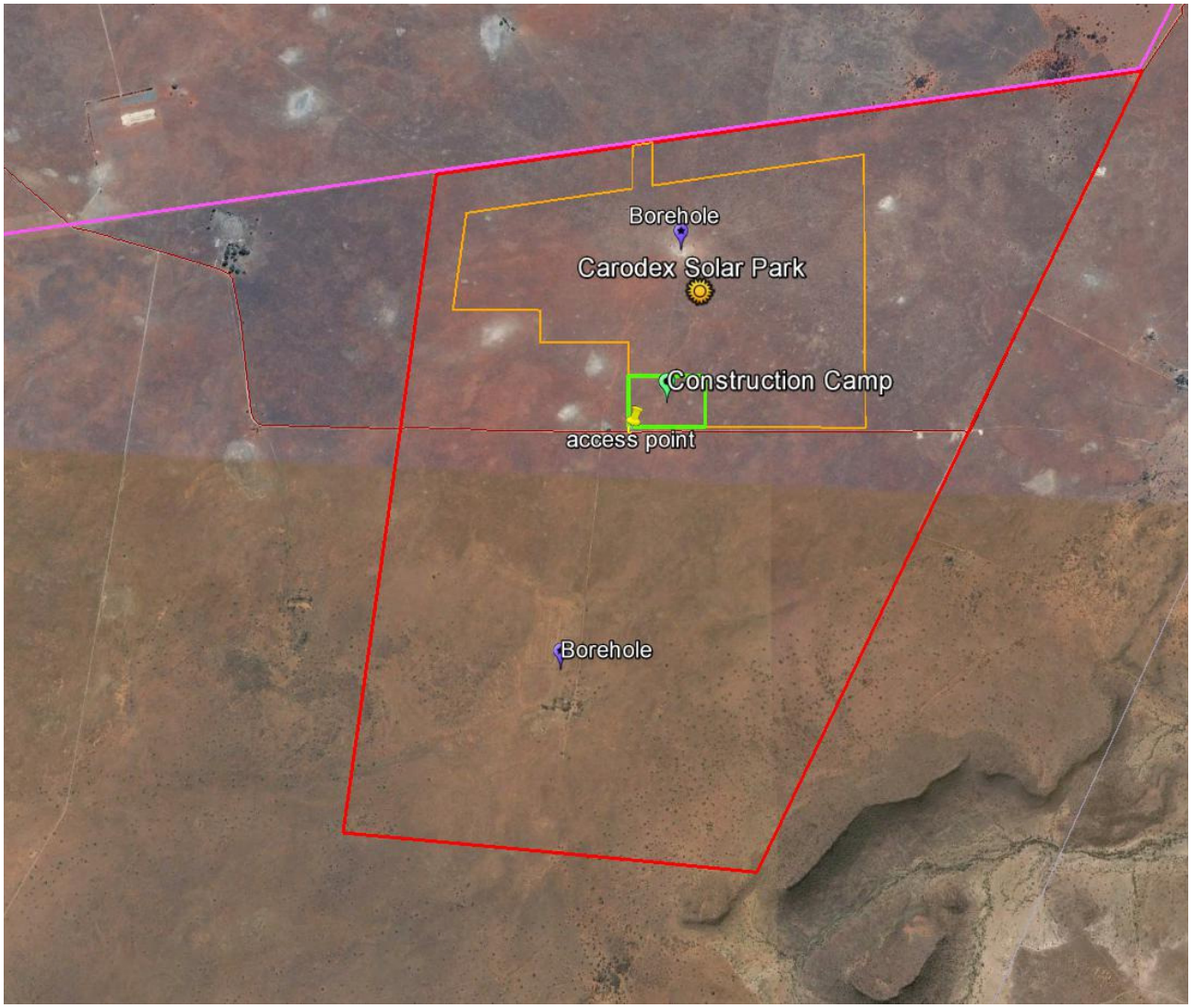
4.3.4. Phase IV

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;
- *Ballam Waterslot* or similar sewer treatment system. The treated water will be used to moisten dusty areas and reduce dust gathering due to windy actions;
- temporary chemical toilets, and
- solid waste collection point.

All facilities present in the construction site will be covered with dry material available (e.g. crushed stone/gravel) in order to avoid mud formation in case of rain.

Figure 7: Temporary construction camp (10 ha)



4.3.5. Earthworks

Clearing activity is required in order to remove shrubs and trees (if any) from the planned footprint (215 ha).

Due to the flatness of the development area, no earthworks are envisaged for the installation of the PV module mounting systems. The mounting systems will consist of metallic frames to be assembled on-site, supported by the driven piles or pre-bored cast-in-situ concrete piles. Concrete ballasted footing foundations are also possible.

Earthworks will be required during the construction of internal roads and access road. 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 100,000 m^2, the amount of cut or fill is estimated to be approximately 30,000 m^3.
Given the low rainfall, flat topography and low flow speed of run-off - no formal storm water structures are required as the proposed gravel roads will be developed at ground level, so as not to disturb the natural flow of storm water. This means that run-off will not be concentrated and the existing drainage patterns will be left undisturbed.

Small earthworks will be required for the installation 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 spoils heaps which must be spread over the site upon completion of the project.

Underground cables will be laid down along the internal roads.

The concrete necessary for the basements of the medium-voltage stations, the high-voltage substation, the control building and the warehouse will be provided from the commercial sources in the vicinity of the development (in Kimberley, Jacobsdal, Douglas or Koffiefontein).

Gravel necessary for the construction of internal roads may be provided from the commercial sources in the vicinity of the development (in Kimberley, Jacobsdal, Douglas or Koffiefontein).

4.4. TRAFFIC IMPACT OF THE PROPOSED DEVELOPMENT

4.4.1. Traffic impact – construction phase

Approximately 100 people are expected to be employed during the construction period (15 months), although this number can increase to 200 for short spaces of time during peak periods.

A small accommodation area with few prefabricated buildings inside the work site may be needed if accommodation facilities in in Kimberley, Jacobsdal, Douglas or Koffiefontein are not sufficient to accommodate all workers.

Overall traffic to and from the work site will amount to approximately **1000 medium** / **heavy vehicle trips** over the whole construction period. As indicated in the table below, the average number of medium and heavy trucks to and from the site will be of **3 trucks per working day.**

Medium and heavy trucks will access / leave the site only during the working days (Monday to Friday), during daytime. The provision of a fuelling area on the work site could reduce the load of heavy vehicles on public roads. The installation of a steel fuel tank (capacity of 30,000 litres) is recommended.

Table 7: Construction timeframe: average daily trips of medium and heavy vehicles

Transportation of:	months	1	2	3	4	5	6	7	8
fencing and tools	trips/month	8	8	0	0	0	0	0	0
clearance of the site (vegetation transportation)	trips/month	56	32	0	0	0	0	0	0
piles / frames for mounting systems	trips/month	0	0	20	20	20	20	20	0
Sands & gravel for on-site concrete production	trips/month	0	30	48	48	48	52	52	54
PV modules	trips/month	0	0	0	0	0	0	0	0
MV stations	trips/month	0	0	0	0	0	12	12	12
HV substation components	trips/month	0	0	8	8	8	0	0	0
cables	trips/month	0	0	0	0	0	0	0	16
Average trips per month	trips/month	**64**	**70**	**76**	**76**	**76**	**84**	**84**	**82**
Average trips per working day (*)	trips/day	**2.9**	**3.2**	**3.5**	**3.5**	**3.5**	**3.8**	**3.8**	**3.7**

Transportation of:	months	9	10	11	12	13	14	15	TOTAL
fencing and tools	trips/month	0	0	0	0	0	0	0	**16**
clearance of the site (vegetation transportation)	trips/month	0	0	0	0	0	0	0	**88**
piles / frames for mounting systems	trips/month	0	0	0	0	0	0	0	**100**
Sands & gravel for on-site concrete production	trips/month	52	48	32	0	0	0	0	**464**
PV modules	trips/month	0	16	32	68	66	34	0	**216**
MV stations	trips/month	12	12	0	0	0	0	0	**60**
HV substation components	trips/month	0	0	0	0	0	0	0	**24**
cables	trips/month	16	0	0	0	0	0	0	**32**
Average trips per month	trips/month	**80**	**76**	**64**	**68**	**66**	**34**	**0**	**1000**
Average trips per working day (*)	trips/day	**3.6**	**3.5**	**2.9**	**3.1**	**3.0**	**1.5**	**0.0**	**3.03**

(*) assuming 22 working days per month

4.4.2. 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.

4.5. 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. Carodex Solar Park will be in operation 7 days per week; therefore personnel will operate according to shifts. The surveillance team will be on site 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 be composed 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 (±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 "Klokfontein-Graspan" 132 kV power line).

Several sites - along the Eskom "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

1) **Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168** (±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.

2) **Portions 2 and 4 of the Farm Klein Kareelaagte 168** and **Portions 0 and 7 of the Farm Roode Laagte 131** (±420 ha; 570 ha, 980 ha and 1,100 ha in extent) resulted in being <u>not suitable</u> 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.

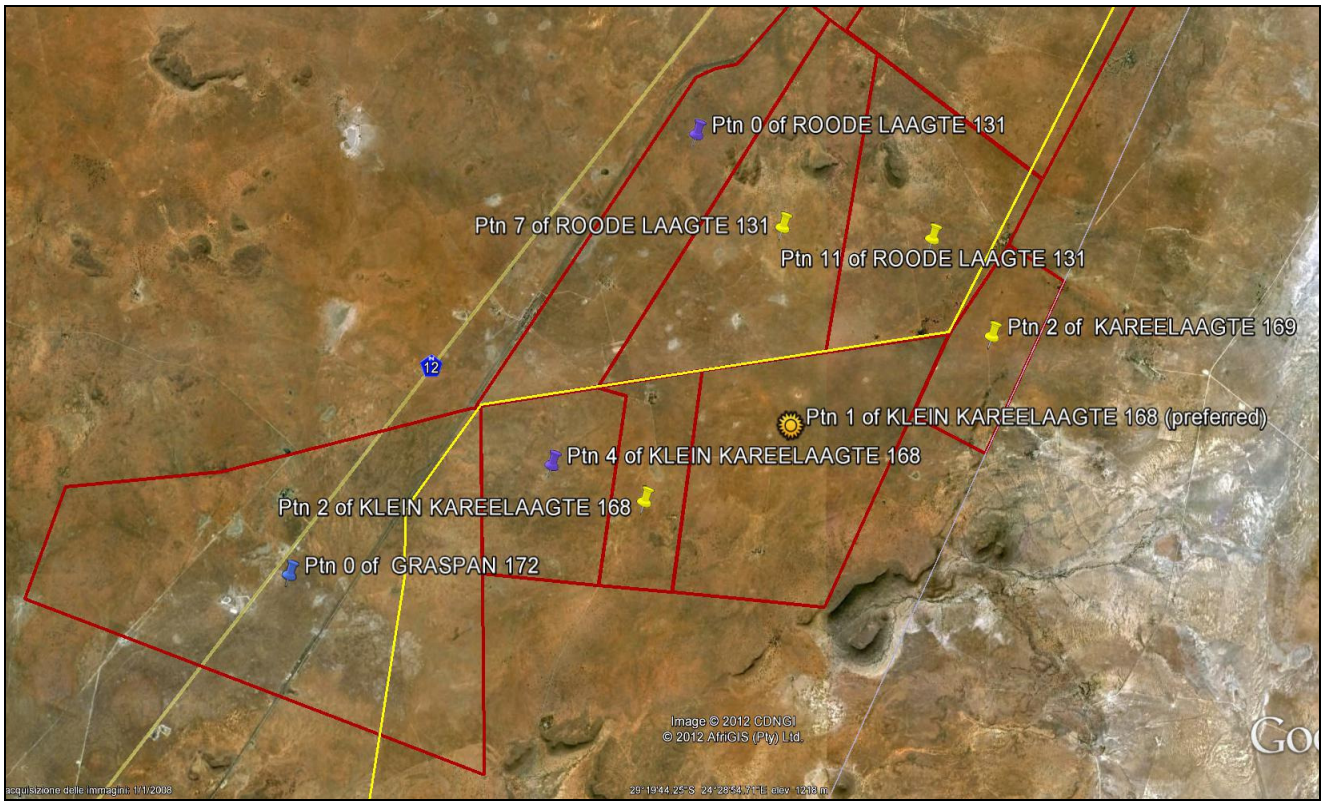
3) **Portions 6 and 11 of the Farm Roode Laagte 131** (approximately 1,800 ha and 860 ha in extent) were found to be almost suitable for a solar park, but <u>not preferred</u> because these farm portions have a higher ecological value than Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168,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

4) **Portion 2 of the Farm Kareelaagte 169** (approximately 500 ha in extent) were found to be almost suitable but <u>not preferred</u>, 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.

5) **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 (PV) Technology

The project envisages photovoltaic power plants with a generating capacity up to 75 MW, on a footprint up to 215 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 higher solar conversion efficiency (14% to 16%), if compared to the thin-film /PV modules (9% to 13%).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 %/℃ instead of 0.45 %/℃ in the case of mono/polycrystalline modules.

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 a higher solar conversion efficiency in a very short time. The high volatility of prices of PV modules 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 (215 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. 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 (230ha) 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, LOCATION AND CONNECTION ALTERNATIVES

The site chosen for the establishing of the proposed Carodex Solar Park is **Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD**. The PV power plant will have a generating capacity of **up to 75 MW**, on a footprint **up to 215 ha**.

5.3.1. Layout design and location

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 the Scoping Phase. The study area was restricted to the northern side of the property, being the southern side hilly and far from the Eskom 132 kV power line where the solar park will be connected to.
The main drives of the proposed layout are:

- to maximize the energy production and the reliability of the PV plant, by choosing proven solar technologies: thin-film or mono/polycrystalline solar modules mounted on single-axis horizontal trackers (SAT) or 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*) sparsely located on the project site, by providing a buffer 32 m wide;
- to keep a minimum distance of 220 m from the northern boundary of the proposed footprint and the northern boundary of the property, and of 180 m from the western boundary of the proposed footprint and the western boundary of the property, so that the existing vegetation can screen the solar park from the adjacent farm portions (vegetation buffer).
- to foresee an additional vegetation buffer zone - 20 m wide consisting of planted vegetation - along the western and northern boundary of PV plant footprint, in order to reduce the visual impact from the adjacent properties.

The footprint (fenced area) of the solar park is up to 215 ha.

The proposed layout plan (attached as Annexure A) was drawn using PV modules mounted on trackers; in the case of PV modules mounted on fixed mounting systems, the layout plans do not change, except for the orientation of the PV arrays: East-West instead of North-South.
The required **footprint** - corresponding on the fenced area - will be the same: **up to 215 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.

5.3.2. Connection alternatives

The Carodex Solar Park is planned to deliver the electrical energy to the Eskom "Klokfontein-Graspan" 132 kV power line, running parallel and adjacent to the northern boundary of the project site. The Eskom 132 kV power line will loop in and out of the 132 kV busbar of the new on-site substation, via two new sections of a 132 kV line (loop in line and loop out line) approximately 100 m long.

The two new section of power line will be overhead, as per the Eskom standards. Underground cables are not considered a viable alternative: considering the short length (maximum 100 m each), the environmental benefits would be negligible.

Alternative connection solutions are not envisaged, being the Eskom "Klokfontein-Graspan" 132 kV power line the only Eskom power line crossing the project site. Other Eskom substations / power lines are too far from the project site or too small to receive the planned export capacity (75 MW) to be taken into account.

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 (215 ha) of the Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD**.**

Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168, Herbert RD

Surveyor-general 21 digit site	C03200000000016800001
Local Municipality	Siyancuma
District Municipality	Pixley ka Seme
Province	Northern Cape
Extent	1028.1286 ha
Land Owner	NEL LODEWIKUS WYNAND
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' 35" E

The site is located 35 km South-West from the town of Jacobsdal, 70 m South of Kimberley and 50 km North-East from Hopetown.

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

6.2. OTHER RENEWABLE ENERGY PROJECTS CLOSE TO THE PROPOSED DEVELOPMENT

The renewable energy projects closest to the proposed Carodex Solar Park and already selected by the DoE under the REIPP Procurement Programme is the **Pulida Solar Park**: a 75 MW Photovoltaic plant located in the Free State Province, 40 km South-East of Kimberley, **48 km** North-East of the proposed Carodex Solar Park. This project has been selected by the DoE under the Window 3 of the REIPP Procurement Programme.

Due to the distance (minimum 48 km) from the proposed Carodex Solar Park of the other renewable energy projects already built or under construction or selected by the DoE, as well as mitigation measures implemented for the proposed Carodex Solar Park, **the cumulative impacts are not applicable.**

6.3. ENVIRONMENTAL FEATURES

6.3.1. 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℃ and -2.3℃, respectively.

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6.3.2. Topography and drainage

The proposed development area is underlain by a valley floor land facet with gentle slope of 0.7% from west to east across the site, the average elevation is 1213 m a.m.s.l with the lowest point 1207 m a.m.s.l and the highest point 1219 m a.m.s.l.
Drainage occurs as sheet-wash towards local drainage east of the site, towards the Riet River, 25 km east of the site. There is no flooding risk from drainage on the site.

6.3.3. Soils, geology and geo-technical features

A Geo-technical and Geo-hydrological site visit was conducted on 9 November 2012, when four trial pits were excavated across the property.

The site is underlain by quaternary calcrete and sand overlying the argillaceous sediments of the Volksrust Formation. Outcrop of dolerite sills and dykes are evident as topographical highs in the area surrounding the areas under investigation.
In invading the Karoo strata, the dolerite sills have almost without exception selected the weaker, predominantly argillaceous horizons along which to intrude and generally represent positive erosion features.
The surface calcrete (Qc) occur as discontinuous layers and concretions and are associated with mudstone, shale tillite, dolerite and dolomite. The calcrete are generally associated with low relief and depressions in the landscape.

Three types of calcrete are represented in the area:

- Hardpan calcrete
- Nodular Calcrete and
- Cliff Calcrete

The higher relief area in the western portion of the site is underlain by Kalahari sand and calcrete.

According to the classification presented by Weinert (1980) where the N value is above 10, disintegration is the major contributor to weathering. Disintegration is the process whereby the rock breaks down to progressively smaller sizes until eventually the individual minerals becomes separated. The end-product is usually a gravely sand composed of the unaltered primary minerals.

The aeolian sand is generally well graded and has a potential to be collapsible. In partially saturated conditions the soil has high relative high shear strength because of the apparent cohesion imparted by pore water suctions. In saturated conditions the reduction in strength is however instantaneous. Therefore for foundation design purposes the effective cohesion is zero and the effective angle of internal friction is between 31° and 36°.

The calcareous pedogenic soil that develop under fluctuating water levels in the soil occur in areas where the host rock is argillaceous is variable and can range from a calcareous soil to hardpan calcrete.

The proposed solar park development areas are underlain by two soil profiles.
The western portion of the site (*profile 1 area*) is underlain by a cover of Kalahari (aeolian) sand with nodular and platy calcrete.
The eastern portion (*profile 2 area*) is underlain by a thin soil cover overlying calcrete and bedrock.

The calcrete soil is suitable for use as road construction material. The soil is also non expansive and settlement potential is low. Calcrete was removed for local road construction from the small borrow pit close to the southern boundary of the development area.

Using the COLTO Standard **excavatability** is classified as hard (boulders larger than 0.1 m^3, blasting or pneumatic and Mechanical rock breaking tools required) or soft (all other conditions).

For the *profile 1 area*, excavatability will be soft up to a depth of 3.0 m.
The excavatability of the *profile 2 area* is variable with the excavatability being harder close to the local depressions or pans.
The potential for collapse of side walls of deep excavations is low. It is however recommended that the sidewalls excavated be battered back to a 1:1.5 grade slope or shored in excavations deeper than 1.5 m to comply with minimum safety regulations.

Profile 1 area, defined as **LAND USE AREA A**, is classified as **developable with precautions**.
The precautions are due to the potential for pockets of aeolian sand occurring within the calcrete. This can result in differential settlement under strip foundations. The recommended foundation solution for the mounting systems will be driven or augered piles. For structures where strip foundations are required, light reinforced strip foundations is recommended.

LAND USE AREA B (*Profile 2 area*) is classified as **developable - low risk** due to variable excavatability. Driven or augered piles, longer than 1.0 m, are not recommended. It is recommended that the holes be drilled with either a top or bottom hammer percussion drill and the H-beams cast in in-situ with concrete. Normal strip foot foundations are acceptable for all other foundations.

The *pan area*s (**LAND USE AREA C**) are **undevelopable**, due to the possibility of water ponding in that area during the rainy season.

No shallow groundwater conditions were encountered in any of the trial pits on site.

No mining activities past or present are present on the property or will impact the property.

The Geo-technical and Geo-hydrological Report (Annexure I) concluded that - from a geotechnical perspective - the proposed location is suitable for the proposed development.

6.3.4. Geo-hydrology

The site is located within the **C51K Quaternary catchment**, and is situated in the **Lower Vaal Water Management Area.** No abstraction under General Authorization is allowed for in this quaternary.

The Recorded Mean annual precipitation is 350 mm per annum, with an annual run-off of 3 mm. The groundwater recharge is 9.4 mm per year and the groundwater level of the area is 30 m below surface. The Eco status is category B. The total groundwater use in the quaternary is 29 Mm3 per year.

The estimated annual groundwater recharge (9.4 mm/m2 per annum) from an average annual precipitation of 350 mm falling on the project site (1028 ha in extent) will result in 96,632 m^3 of water available. The maximum annual water requirement for the project is 2,138 m^3 and for livestock is 1,800 m^3 per year (100 head of Cattle consumes 50 l of water per day). **The scale of abstraction relative to recharge is 4.1% (Category A)**.

6.3.4.1. Boreholes, groundwater availability and quality on the project site

Due to the featureless topography and poor rock exposure it is difficult to identify aquifer boundaries.
The farm is situated on the western flank of the Belmont Basin which historically is regarded as an important aquifer in the area, from which irrigation is done on a number of farms east of the property in question.

There is one borehole equipped with a wind pump (**Windpump 1**), located within the planned footprint. This wind pump however is not in a working condition. The borehole is shallow and the yield is of only 100-200 l/h. The borehole equipped with a windpump at the homestead (**Windpump 2**) is in a working condition. This borehole has a sustainable yield of more than 20,000 l/hour; therefore it can be also used for the water needs of the proposed development. Currently the borehole is equipped with a windpump capable of pumping no more than a 1000 l/h when the wind blows.
With the information available, a sustainable abstraction of 50,000 l/day is assumed for the aquifer. Before construction of the solar park commence, pump testing should be conducted to verify the aquifer and borehole yields.

The water quality analysis of the samples collected at the property conforms to the SANS 241 drinking water standards. Only the turbidity is outside the specification. No health effects are expected. It is recommended that the drinking water supply for the staff on site be treated through an osmotic water filtration system.

6.3.5. Ecology (fauna & flora)

An Ecological Impact Assessment (Annexure D) was conducted by Exigo 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.

6.3.5.1. 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.

After the initial ecological surveys of the study area, the analysis of the data resulted in the identification of three major vegetation units on the proposed development site. The detailed species list for each vegetation unit is included in the Ecological Report. The following vegetation units were identified:

- Mixed Karoo shrubland and grassland
- Salt pans
- Microphyllous woodland

6.3.5.2. Protected flora, plants & trees

No individuals of the endemic or biogeographically important plants were observed during the survey, although it was previously found in the larger area.
No other red data species potentially occur in the QDS of the study area according to the SIBIS database. No other red data species was also found in the area, although the potential habitats were surveyed to the extent representative of the area. The National Forest Act, 1998 (Act No. 84 of 1998) provides a list of tree species that are considered important in a South African perspective as a result of scarcity, high utilization, common value, etc. In terms of the National Forest Act of 1998, these tree species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by DAFF (or a delegated authority). Obtaining relevant permits are therefore required prior to any impact on these individuals. No protected tree species occurs within the study area. Plant species are also protected in the Northern Cape Province according to the **Northern Cape Nature Conservation Act (Act No. 9 of 2009)**. According to this ordinance, no person may pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected or protected plant species. The Appendices to the ordinance provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species, if they are expected to be affected by the proposed project.
After a detailed survey, no protected or specially protected plant was found.

6.3.5.3. 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 should be implemented to ensure the survival of these species other fauna habitats and feeding grounds.

6.3.5.4. 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 32 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.

6.3.6. Avifauna

An Avifauna Impact Assessment (Annexure E) was conducted by Exigo in order to determine whether the proposed development would have negative impact on avifauna.

A number of potential impacts were individuated and assessed:

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

A series of specific mitigation measures were included in the original Avifauna Impact Assessment. The Avifauna Impact Assessment concluded that the proposed development of the Photovoltaic Power Plant would not impact significantly over any avian habitats of high conservation value. Considering the layout and design of the proposed development as well as the impact assessment, the extent of the habitat that will be affected will be minimal.

The Avifauna Report concluded that, provided that the suggested mitigation measures and recommendations are adhered to, it is unlikely that the proposed development will have a long-term, significant negative impact on the local avifauna.

6.3.7. Visual

A Visual Impact Assessment (Annexure J) was conducted to determine the visual impact of the proposed solar park.

The proposed Carodex Solar Park Project would have a *low to moderate significance* on the visual resource.

Significance for the construction phase was rated as *moderate to low*. Due to the duration of the project, the operational phase significance of the impact would be rated as *moderate*.
Identified, potential sensitive viewers included residents of the farmsteads Roodelaagte (approximately 2.2 km north-west of the project) and Spes Bona (approximately 1.4 km to the south) as well as travellers along the N12.

As part of the project, a vegetation buffer screen is proposed. With the effective implementation and proper maintenance of the vegetation buffer screen, the visibility would be reduced significantly and the possible views from the two farmsteads, as well as the N12 road, would be screened.

However, it can be concluded that the introduction of the development, with its final increased footprint layout, will result in a partial alteration, thus *moderate* intensity, to the views from the koppie located on Portion 11 of the farm Roode Laagte 131. This is mainly due to the proposed components being located in the far middle ground, *low* exposure zone, of the viewer.

The anticipated impact of the proposed Carodex Solar Park, with the effective implementation of mitigation measures, would result in a minor impact on the receiving environment.

6.4. SOCIO-ECONOMIC ENVIRONMENT

A report on the socio-economic considerations related to the proposed project was compiled by Glen Steyn & Associates - development economists (Annexure K).

The following issues were highlighted in the report:

- 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 of 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.
- Raising of the capital to finance the installation of solar electricity generation capacity by Carodex (Pty) Ltd represents a significant benefit for the South African economy
- 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 150/200 for short spaces of time during peak periods. During operational phase, the power plant will require a permanent staff of 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.
- The presence of permanent security personnel may be beneficial to the overall safety and security situation in the area.
- Approximately **50% of the operational 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).
- The most important economic benefit is likely to be the experience that will be gained with regard to solar electricity generation in Northern Cape and in South Africa, considering that this forms part of a national strategic plan. This experience will be essential for the roll-out of the strategy, for efficiency improvements and for the establishment of a local manufacturing supply chain for equipment requirements. The project will also make a contribution towards reducing the carbon emissions per unit of electricity generated in South Africa, albeit very small to start with.
- The proposed project is consistent with national, provincial and municipal development. It provides an opportunity to launch the implementation of the national renewable energy generation program, with particular reference to solar energy. The important issue emerging from the local economic development strategy is the imperative of local recruitment.
- Furthermore, the project will comply with the Economic Development Requirements, as requested by the REIPP 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.**

6.5. AGRICULTURAL POTENTIAL

An Agricultural Potential Impact Assessment (Annexure F) on soils potential has been drafted; the site surveys were conducted during November 2012. The current land-use of the proposed development site is grazing by livestock. Neighbouring farms are being used for livestock grazing, with some isolated crop cultivation occurring in the deeper soils. The proposed development site is largely composed of shallow, calcareous and gravelly soils (clay content varies between 5 and 10 % with depth less than 400 mm). The soils are predominantly shallow with the calcrete or tillite bedrock often exposed along the surface. The shallow nature of the soils renders the area investigated unfavourable for effective crop production. The farm is also expected to receive an annual total rainfall of below 400 mm which is low and highly variable. Economically viable crop production is therefore not considered as a viable option on this site.

The current vegetation at the proposed site of development consists mainly of shrubland with a well-developed grass layer. According to databases (ARC) the grazing capacity of the area for livestock is low which indicates the veld to be unsuitable for sustainable grazing over a small area such as the project site. The nature of the vegetation at the farm is therefore marginal for extensive livestock production. Using planted pasture to supplement livestock production is however possible but this could be constrained by high demand for irrigation water due to the shallow and often sandy nature of the soil and relatively higher day temperatures in summer.

The low agricultural potential of the soils is further confirmed by the Agricultural Maps in Figures 11 to 14 below:

- **Agricultural Potential Map** - indicating that the project site (Portion 1 (Remaining Extent) of the Farm Klein Kareelaagte 168) is classified as *Low Agricultural Potential. (Figure 11 below)*
- **Land Capability Map** - indicating that the site is classified as *Non-arable - low potential grazing land. (Figure 12 below)*
- **Potential Grazing Capacity Map** (**1993)** - indicating that the project site has a potential grazing capacity of **9 - 13 ha** / **large stock units**. As indicated in the previous map, this grazing potential is *moderate*, if compared to the maximum value indicated in the legend: less 4 ha / large stock units. *(Figure 13 below)*
- **Potential Grazing Capacity Map (2007)** - indicating that the project site has a potential grazing capacity of **16 - 20 ha** / **large stock units**, which is *low*. This map (2007) is not official yet and should be further confirmed by the Department of Agricultural, therefore in the calculation below we refer to the Map (1993). *(Figure 14 below)*

It can be deduced that the project site, being **1028 hectares in extent**, would allow for **79 to 114 *potential* large stock units (LSU's) on**, while the proposed development (up to 215 ha in extent) would entail a reduction of its grazing potential for only 16 to 23 *potential* large stock units.

Therefore, the property is a viable grazing farm (63 to 91 LSU's > 60 LSU's) both with and without the proposed development in place.

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/)]

6.6. CULTURAL AND HERITAGE RESOURCES

An Archaeological Heritage Assessment (Annexure H1) was conducted to ascertain whether there are any remains of significance in the area that will be affected by the proposed development.

The proposed study area was largely undisturbed except for the fencing of several camps, a farmstead situated on the southern half of the property and several small tracks which crossed the property.

One heritage site was identified on the southern side of the farm, approx. **2.0 km South from the proposed PV plant footprint:**

Site KKL 001
Geo-graphical co-ordinates: 29.34850° S , 24.48606° E

A farmstead with its associated buildings was identified at this location.
The extent of the farmstead and its associated structures measured approximately 100 m x 120 m. The exact age of the farmhouse and its relevant structures could not be determined. The architectural style and the building materials employed could possibly be from before the 1950's and the farmstead should therefore be considered as a site of heritage value and significance and are protected in terms of the National Heritage Act (Act 25 of 1999).

Field Rating:	Generally Protected B (4B)
Heritage Significance:	Medium Significance
Impact:	Moderate
Certainty:	Possible
Duration:	Long Term
Mitigation:	B – Mapping of the site and controlled sampling required

The Heritage Impact Assessment concluded that the proposed development of the Carodex Solar Park in the indicated areas can continue from a heritage point of view if the above mentioned recommendations are adhered to.

A Palaeontological Desktop Study (Annexure H2) was conducted by Prof. Rubidge.
According to the specialist, there is no possibility that the Karoo dolerites will contain any fossils. There is a limited possibility that the Tierberg Formation which was deposited in a marine environment during the Permian Period, and the Quaternary alluvial deposits could contain fossil plants, invertebrates and/or vertebrate bones.
The specialist concluded that the proposed development will not negatively affect palaeontological heritage and suggest that, from a paleontological perspective, this development should proceed.
If, in the unlikely event that fossilized plants or animals are exposed from the Tierberg Formation and the Quaternary alluvial deposits in the process of development activities, it will create a unique opportunity to explore the area for fossils. It is thus recommended that, should fossils be exposed, a qualified palaeontologist be contacted to assess the exposure for fossils so that the necessary rescue operations are implemented.

With a letter dated 19 February 2013, SAHRA granted their consent to the project in respect of the old 155 ha footprint, under the previous environmental authorisation process. The EIA will be submitted to SAHRA for a new consent as a result of the increased footprint (215 ha).

Figure 9: Vegetation Map of the Study Area

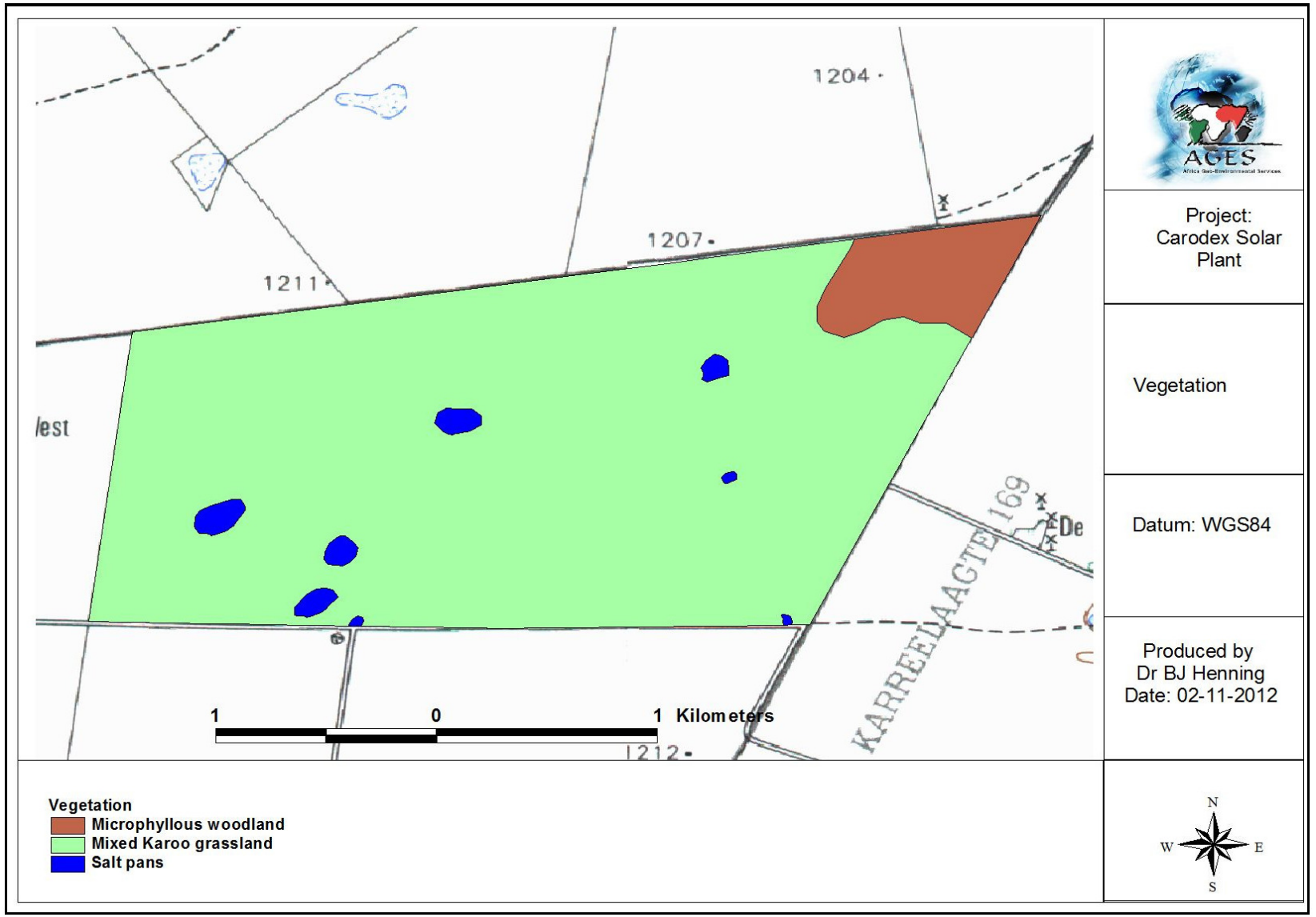


Figure 10: Sensitivity Map of the Study Area

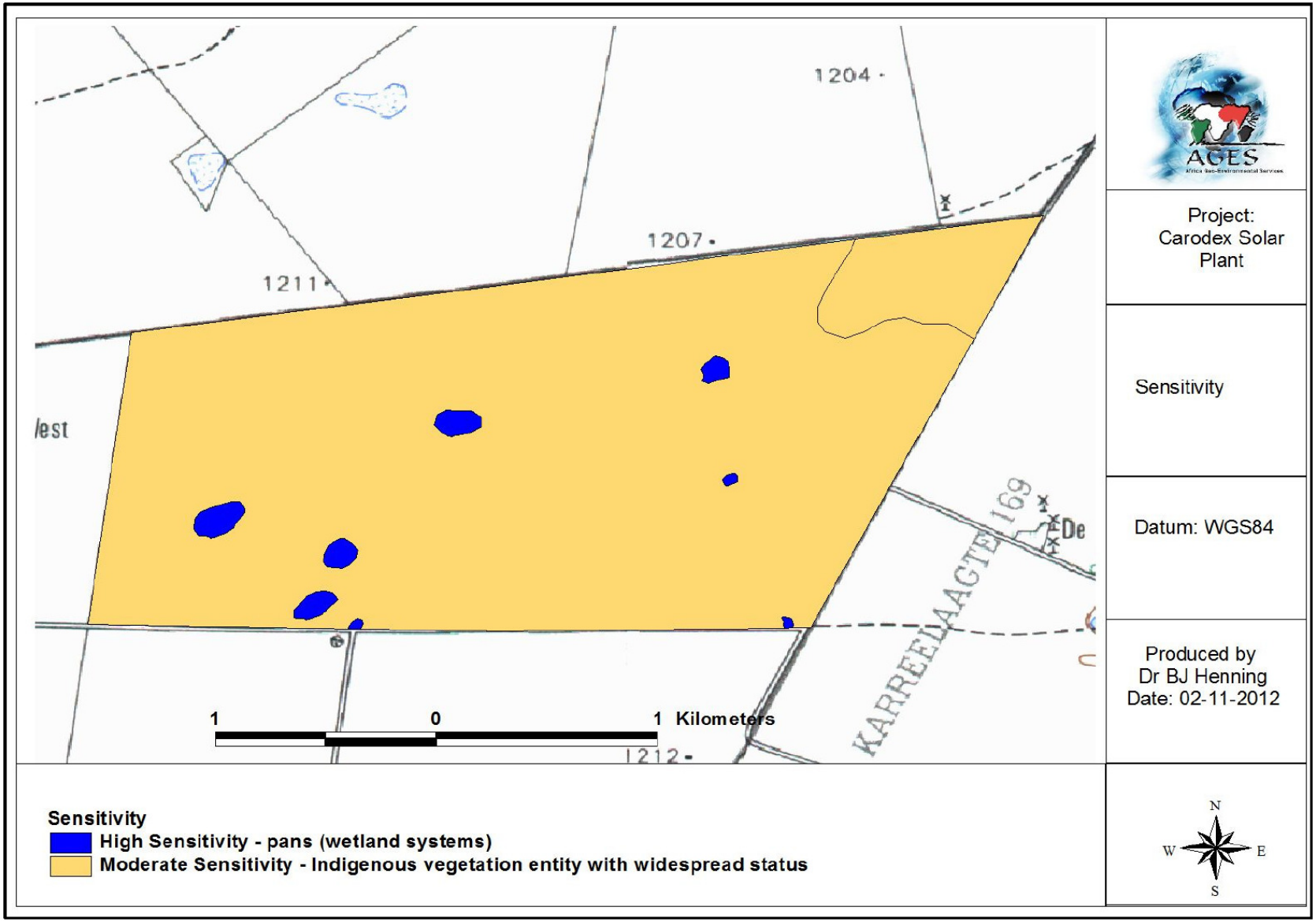


Figure 11: Agricultural Potential Map

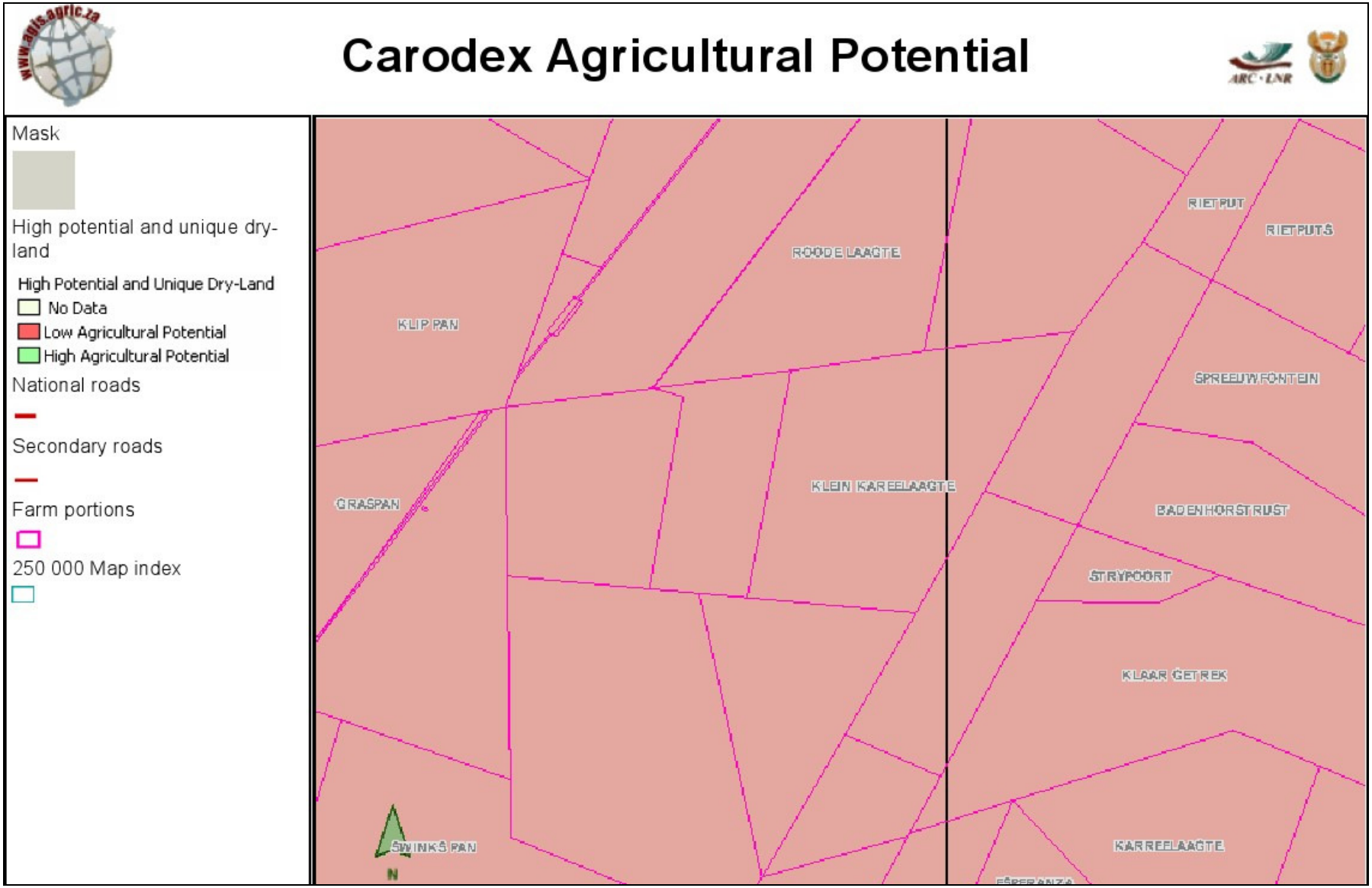


Figure 12: Land Capability Map

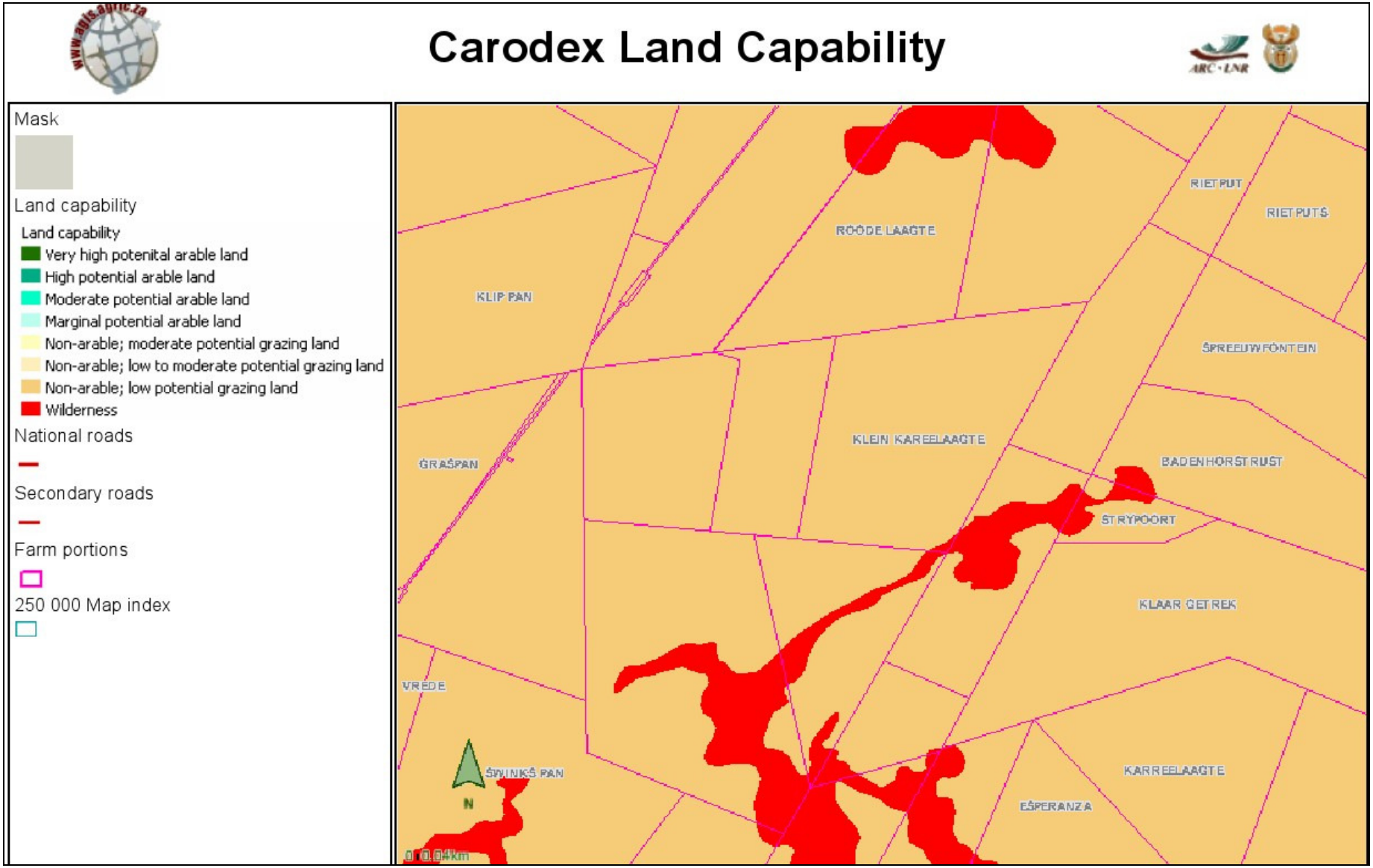


Figure 13: Potential Grazing Capacity Map (1993)

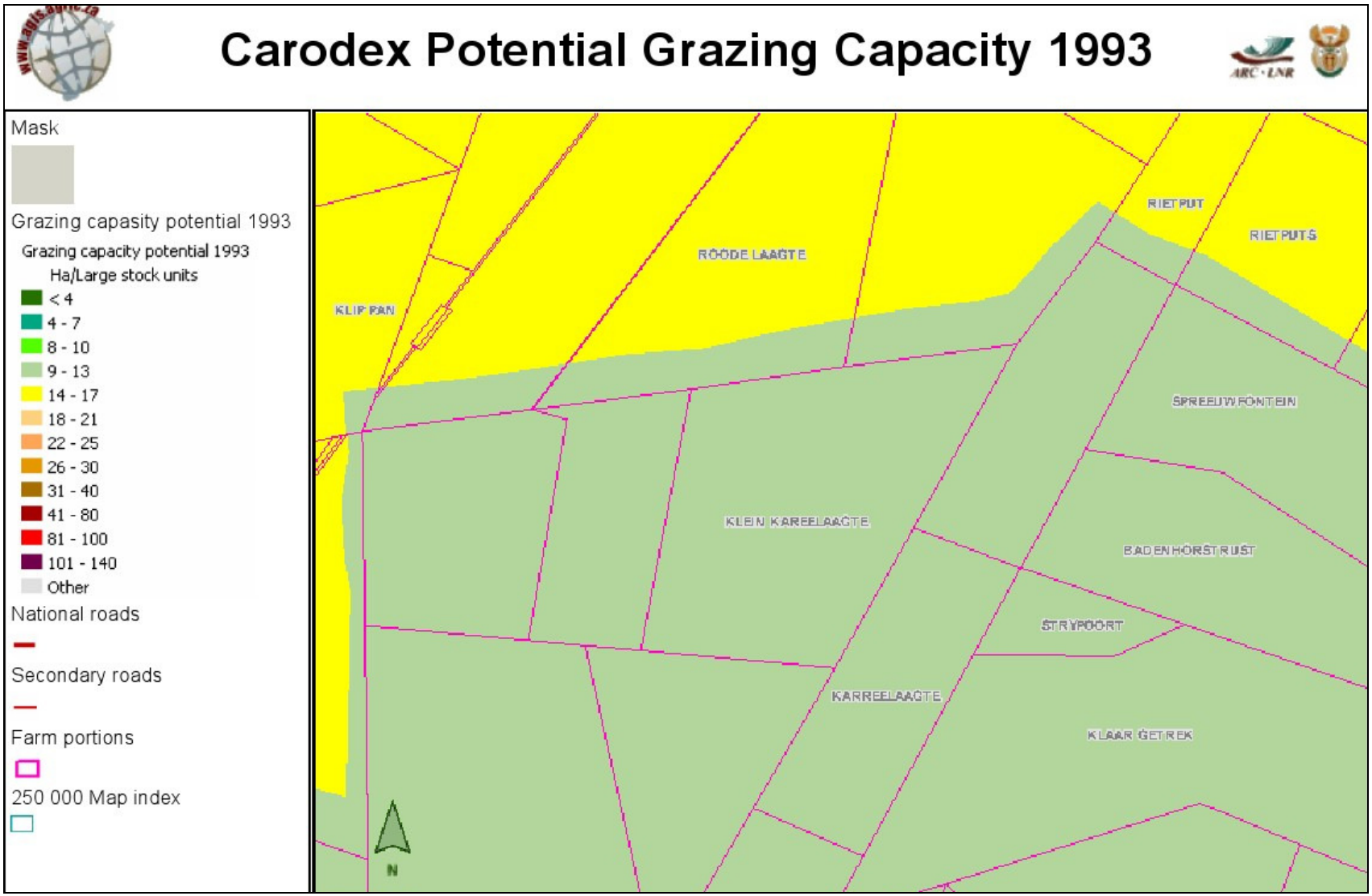
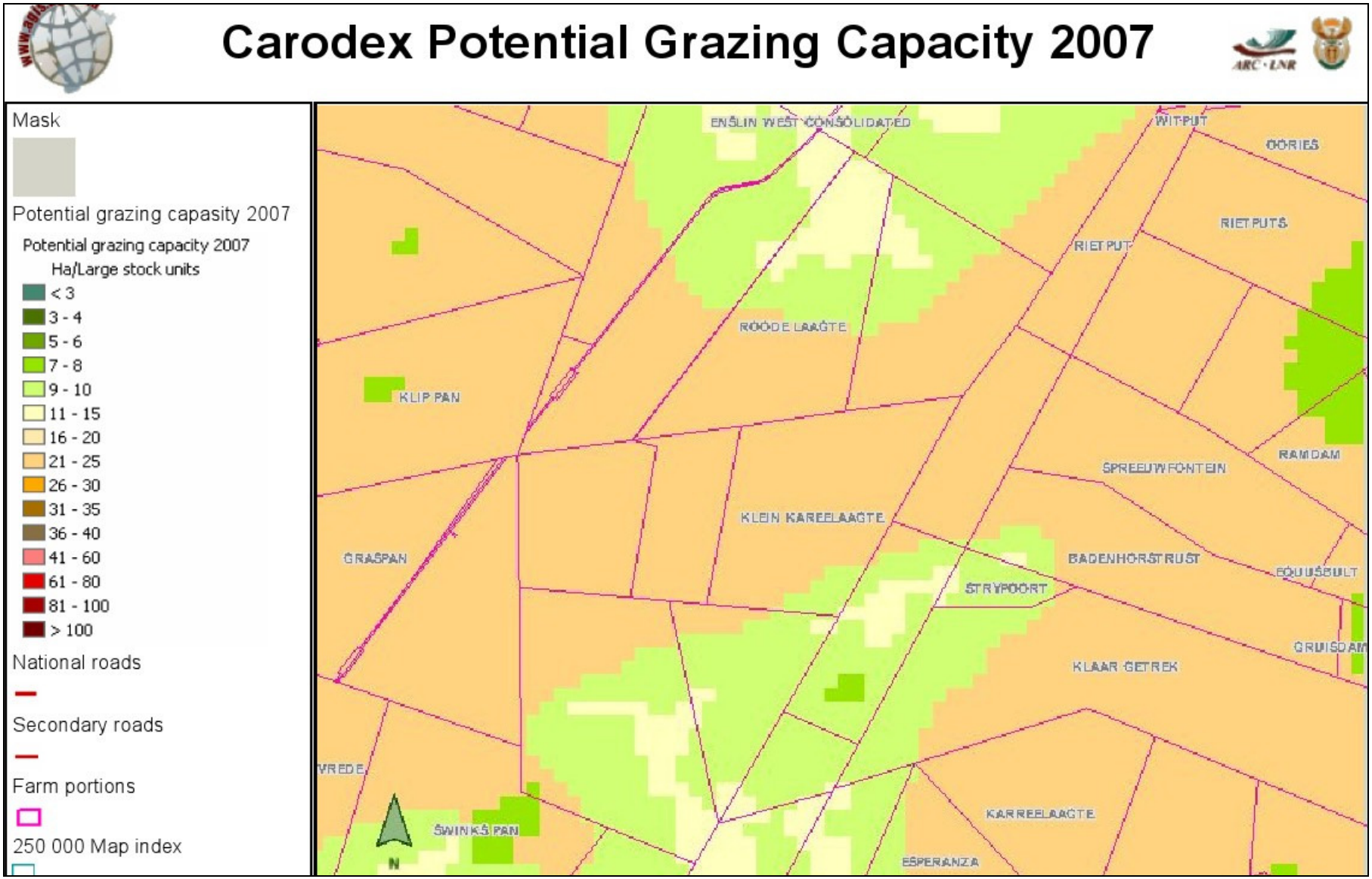


Figure 14: Potential Grazing Capacity Map (2007)



7. 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 Phase
- Phase 2: Environmental Impact Assessment (EIA) and Environmental Management Program (EMPr)

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.

7.1. 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).

In particular, in the case of the proposed development, 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 formed a part of the submitted Final Scoping Report. All issues and concerns identified during the Scoping Phase were documented in the Final Scoping Report which was submitted to the DEA together with a Plan of Study for EIA.

7.2. EIA PHASE

The next (current) 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 is used as a reference to ensure that stakeholders are involved and participate in this second phase of the EIA process.

All relevant issues considered during the Scoping Phase are further investigated and assessed during this EIA Phase of this project. The EIA involves various specialist studies and should provide an overall assessment of the biophysical, social and economic environment affected by the proposed project.

A detailed assessment is carried out in terms of environmental criteria and rating of significant impacts of all options identified in the scoping phase. Appropriate mitigation measures are identified and recommended for all significant impacts. These measures are also included in an

Environmental Management Programme (EMPr), submitted together with the Environmental Impact Assessment Report (EIAR) to the DEA.

During the EIA phase, stakeholders and I&AP's are notified in writing of the continuation of the project to the EIA Phase and are informed as to the way forward and where and when the Draft Environmental Impact Assessment Report is made available for review. Comments from the stakeholders and I&AP's on the Draft EIR and the Draft EMPr have been incorporated into this Final EIA Report.

The stakeholders and I&AP's will furthermore be informed of the final decision regarding the Environmental Authorization and the appeal process.

7.3. 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 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 17 October 2014 until 17 November 2014.

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

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

The public was informed of the project by means of:

- Site notices, which were put up at the proposed development site;
- Background Information Documents (BID) were sent to all adjacent land owners;
- A Notice was published in a local newspaper, which is distributed in the general area;
- Sending of BIDs 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, based on the public participation process followed during the first EIA process.

Site notices were put up on site on the fence surrounding the proposed development area on 17 November 2014. After a Deed Search was done on the surrounding properties a Background Information Document was sent to each of the adjacent landowners. Proof of this is attached in Annexure C. A number of these documents was 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 C.

A newspaper advertisement was published in the 16 October 2014 edition of the Diamond Fields Advertiser which is a local newspaper, which is distributed in the nearby towns and surrounds.

The Draft Scoping Report was made available for comments and was provided, on request.

Hard copies of the report were sent to the Local Municipality office as well as all applicable governmental organizations.

The Final Scoping Report was made available for comments and was provided, on request.

The Final Scoping Report and the Plan of Study for EIA were approved by the DEA on 23 March 2015.

The Draft EIA Report was made available for comments and was provided to registered I&AP's and applicable governmental departments from 24 April 2015 until 5 June 2015. The final EIA Report was made available to I&APs on 5 June 2015 but no one requested the report.

7.3.1. Further steps in Public Participation Process

To ensure a transparent and complete public participation process the following steps are still to be taken during the rest of the EIA process:

- Registered I&AP's and governmental organizations will be notified about the final decision of the DEA (Environmental Authorisation granted or not).

7.4. RESULT OF PUBLIC PARTICIPATION PROCESS

No issues were raised during the public participation process and this could be attributed to the fact that a complete process was previously followed and in that process not a lot of I&APs registered. Despite the fact that there wasn't a lot of interest in the application the reports were made available at all stages of the application process.

8. METODOLOGY USED FOR THE IDENTIFICATION AND ASSESSMENT OF THE IMPACTS

The potential environmental impacts identified in the study have been quantified and the significance of the impacts has been assessed according to the criteria set out below. Each impact has been assessed and rated. The assessment of the data, where possible, has been based on broadly accepted scientific principles and techniques. In defect, judgements and assessments are necessarily based on the consultant's professional expertise and experience.

8.1. PROJECT PHASING

For the purpose of assessing these impacts, the project has been divided into phases from which impacting activities can be identified:

- **Planning**
- **Site clearing & construction phase**
- **Operational phase**

The phases have been carefully examined in relation to the PV plant and in relation to the connection infrastructure. Indeed, as already described, in this document all impacts and mitigations are defined also for the connection infrastructure, although this part of the project may be executed, owned and operated by Eskom.

As far as the **decommissioning** phase is concerned, it is important to specify that this phase 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.

This phase is important because it states the **reversibility of the development** and has to be carefully planned and executed, in order to enable the natural re-growth of indigenous vegetation and fauna re-population as well as the reuse of the area for agricultural and grazing purposes. For this reason, in the Draft Environmental Management Plan the decommissioning phase has been included and carefully analyzed, in order to anticipate activities and actions to be taken in order to minimize the relevant impacts.

The decommissioning phase, as described in Chapter 10, is similar to the commissioning phase but all possible care must be considered for the recycling of the materials and for the re-establishment of the site as it was the *status quo – ex ante* the development.

8.2. ASSESSMENT CRITERIA

The terms of reference for the study include criteria for the description and assessment of environmental impacts. These criteria are drawn from the *Integrated Environmental Management Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts*, published by the Department of Environmental Affairs and Tourism in terms of the Environmental Impact Assessment. These criteria include:

Table 8: Impact Assessment Criteria

Nature of impact This is an appraisal of the type of effect the proposed activity would have on the affected environmental component. The description should include what is being affected, and how.		
Extent The physical and spatial size of the impact.	**Site**	The impact could affect the whole, or a measurable portion of the above-mentioned properties.
	Local	The impacted area extends only as far as the activity, e.g. a footprint.
	Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
Duration The lifetime of the impact; this is measured in the context of the lifetime of the proposed base.	**Short term**	The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than any of the phases.
	Medium term	The impact will last up to the end of the phases, where after it will be entirely negated.
	Long term	The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter.
	Permanent	The only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
Intensity	**Low**	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
	Medium	The affected environment is altered, but function and process continue, albeit in a modified way.
	High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Probability This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time.	**Improbable**	The possibility of the impact occurring is very low, due either to the circumstances, design or experience.
	Probable	There is a possibility that the impact will occur to the extent that provisions must be made therefore.
	Highly probable	It is most likely that the impacts will occur at some or other stage of the development. Plans must be drawn up before the undertaking of the activity.

	Definite	The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.
Determination of significance. Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.	**No significance**	The impact is not substantial and does not require any mitigation action.
	Low	The impact is of little importance, but may require limited mitigation.
	Medium	The impact is of importance and therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.
	High	The impact is of great importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

The general approach to this study has been guided by the principles of Integrated Environmental Management (IEM). In accordance with the IEM Guidelines issued by the DEA, an open, approach, which encourages accountable decision-making, has been adopted. The underpinning transparent principles of IEM require:

- informed decision-making;
- accountability for information on which decisions are made;
- a broad interpretation of the term “environment”;
- an open participatory approach in the planning of proposals;
- consultation with I&APs;
- due consideration of alternatives;
- an attempt to mitigate negative impacts and enhance positive impacts of proposals;
- an attempt to ensure that the social costs of development proposals are outweighed by the social benefits;
- democratic regard for individual rights and obligations;
- compliance with these principles during all stages of the planning, implementation and decommissioning of proposals; and
- the opportunity for public and specialist input in the decision-making process.

The study is also guided by the requirements of the EIA Regulations in terms of the NEMA. The NEMA EIA Regulations, which are more specific in their focus than the IEM principles, define the detailed approach to the EIA process.

9. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

9.1. POTENTIAL IMPACTS

Potential impacts associated with the construction and operational phases of the Carodex Solar Park together with its connection infrastructure are outlined and evaluated hereinafter.
Construction activities for the establishment of PV power plants 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, construction of the two new sections of power line - approximately 100 m long - which will deliver the energy to Eskom "Klokfontein - Graspan" 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.

9.2. CUMULATIVE IMPACTS

Cumulative impacts are NOT applicable since there are no renewable energy projects already built / under construction / selected by DoE in the proximity of the proposed project site. Indeed the closest existing project is the 75 MW Pulida Solar Park, located in the Free State Province, 40 km South-East of Kimberley, **48 km** North-East of the proposed Carodex Solar Park. This project has been selected by the DoE under the Window 3 of the REIPP Procurement Programme.

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 have been 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 specialist studies which have been conducted and attached to this EIA Report are the following:

- Ecological Impact Assessment (Annexure D)
- Avifauna Impact Assessment (Annexure E)
- Agricultural Potential Assessment (Annexure F)
- Wetland Delineation Study (Annexure G)
- Heritage Impact Assessment (Annexure H1)
- Palaeontological Desktop Study (Annexure H2)
- Geo-technical and Geo-hydrological Report (Annexure I)
- Visual Impact Assessment (Annexure J)
- Socio-economic Impact Assessment (Annexure K)
- Services Report (Annexure L)

9.4. IMPACTS & MITIGATION MEASURES

9.4.1. Construction & operational phases impacts and mitigation measures

In this section, all the possible impacts that can be predicted in both the construction and operational phases of the PV plant are addressed. Specific mitigation measures are proposed and the significance of these impacts is described with and without the mitigation measures.

Considering that all or part of the construction infrastructure may be owned and/or operated by Eskom, the mitigation measures described in the following paragraphs and in particular in the attached Environmental Management Plan can be, accordingly, of the responsibility of Eskom or of the developer.

9.4.1.1. Atmospheric pollution and noise

Construction Phase

During this phase there will be a concentration of earthmoving equipment and construction vehicles that will level the area, clear vegetation for construction purposes and in the process will create dust and exhaust smoke that will impact on air quality. There will also be more noise created by the vehicles during this phase. Burning of waste and fires at construction sites may also create smoke.

Operational phase

The increased traffic volumes and people will lead to increased levels of air pollution and noise. Smoke from burning of waste can cause air pollution.

Project Phase	Impact :Atmospheric Pollution and noise								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Earthworks and Vegetation clearance	Air pollution : Dust	Low-medium	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Vehicle movement	Air pollution : Smoke	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Vehicle movement	Air pollution : Dust	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Vehicle movement	Noise pollution	Low-medium	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Burning of cleared vegetation, solid waste & veld fires	Air pollution by excessive smoke	Low-medium	Medium-high	Low-medium	Medium	Medium	Low-medium	Medium
	Cooking fires of workers	Air pollution : Smoke	Low	Medium-high	Low-medium	Medium	Medium	Low	Medium

Project Phase	Impact :Atmospheric Pollution and noise								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Operation	Vehicle movement	Noise pollution	Low-medium	Medium-high	Low-medium	High	Medium-high	Low-medium	Medium
	Fireplaces and veldt fires	Air pollution caused by smoke	Low-medium	Medium-high	Low-medium	High	Medium-high	Low-medium	Medium
	Burning of vegetation refuse and solid waste	Air pollution by excessive smoke	Low-medium	Medium-high	Low-medium	High	Medium-high	Low-medium	Medium

Mitigation measures - Construction Phase

- The Developer should be responsible of the good condition of the access road (from the N12) during the construction phase and should repair at its costs any damage which may occur.
- Vehicles must be well serviced so that it does not produce excessive smoke and noise.
- Speed of construction vehicles should be kept as low as possible to reduce the generation of dust and noise.
- Construction areas must be damped to prevent excessive dust formation.
- The clearing of the site should be done in phases as the construction progresses.
- Construction should only take place during the hours between sunrise and sunset on weekdays and Saturdays.
- Contractors must comply with Provincial noise regulations. The construction machinery must be fitted with noise mufflers and be maintained properly.
- Vegetation cleared from the site and solid waste generated by the construction teams may not be burned on site or the surrounding areas, but be regularly removed to the municipal waste disposal site, unless it can be sorted and recycled.
- Fire belts must be made around the development according to the regulations of the Veld and Forest Fire Act.
- The cleared vegetation should stock-piled and removed to a licensed waste disposal site on a regular basis.

Mitigation Measures - Operational Phase

- Speed of vehicles on roads should be controlled e.g. speed bumps and speed restrictions.
- All roads should preferably be sealed to eliminate dust formation caused by strong winds and vehicle movement.
- Solid waste should not be burned on the project area.
- Fire belts around the development must be made according to the regulations of the Veld and Forest Fire Act.
- Vegetation refuse should be composted if possible and re-used.

9.4.1.2. Groundwater and surface water pollution

Planning Phase

- The salt pans sparsely located on the project site should be excluded from the proposed footprint; a 32 m buffer zone should be preserved around the pans boundary, as indicated in the Wetland Delineation Study (Annexure G) and in the Ecological Impact Assessment (Annexure D).

Construction Phase

- Lack of sanitation could result in ground water pollution and associated health risks.
- Construction vehicles will be refuelled at the construction camp.
- Spillage of fuel and lubricants from construction vehicles could occur. Storm water contamination by solid waste could lead to groundwater and surface water pollution.
- In this phase the soil cover as well as the vegetation is removed and storm water over the area could cause erosion as well as siltation of watercourses. Road construction will also increase the possibility of erosion and the siltation/sedimentation of surface water streams, because of increased storm water run-off.

Operational Phase

- Pollution by sanitation leakages, solid waste and erosion may lead to water pollution. Storm water run-off over open areas can cause erosion as well as the washing of soil into the surface water streams.
- Storm water flowing over sealed and/or paved areas could lead to ground and surface water pollution. Chemicals from the vehicle wash area could negatively impact on the quality of surface and groundwater resources.
- Fertilizers, pesticides and herbicides used at the project during operation can create pollution if not handled and applied correctly.

Project Phase	Impact: Groundwater and Surface water Pollution								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Spillage of fuel and lubricants from construction vehicles	Water Pollution	Medium	Medium-high	Low-medium	Medium-high	Medium-high	Low	Medium
	Clearing of vegetation	Erosion & siltation of streams	Low-medium	Medium-high	Low-medium	Medium	Medium-high	Low-medium	Medium
	Solid waste disposal freshwater resources	Pollution of freshwater resources	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Sanitation seepage from chemical toiletsand/or from the temporary sanitation system	Water Pollution	Medium	Medium-high	Low-medium	Medium	Medium	Low	Medium

Project Phase	Impact: Groundwater and Surface water Pollution								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Operation	Spillage of fuel and lubricants from vehicles	Water Pollution	Medium	High	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Solid waste disposal- freshwater resources	Water Pollution	Low	High	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Leakage from the permanent Sanitation system	Water Pollution	Medium-high	High	Medium	Medium	Medium-high	Low-medium	Medium-high
	Use of fertilizers, insecticides and herbicides	Pollution of streams & rivers	Low-Medium	High	Low-medium	Medium	Medium	Low-medium	Medium
	Storm water runoff	Erosion & siltation of streams	Low-medium	Medium-high	Low-medium	Medium	Medium-high	Low	Medium

Mitigation measures - construction phase

The following precautionary measures are recommended to prevent dwater pollution:

- The salt pans sparsely located on the project site should be avoided; a 32 m buffer zone should be preserved around the pans boundary, as indicated in the Wetland Delineation Study (Annexure G) and in the Ecological Impact Assessment (Annexure D).
- Cleared areas should be rehabilitated by reintroducing a grass layer as soon as possible to limit the occurrence of erosion.
- Berms to limit the flow of water over cleared areas will limit erosion and the siltation of surface streams. Preference should be given to plant species indigenous to the area.
- Drip pans should be used during re-fuelling and servicing of construction vehicles. Used parts like filters should be contained and disposed of at a licensed dumping site of these products.
- Oil traps must be installed in the vehicle wash bay to prevent pollution. Oil traps must be serviced on a regular basis by an approved service agent.
- Diesel storage must not exceed 30,000 litres at construction camps. Diesel tanks and other harmful chemicals and oils must be within a bunded area.
- The vehicle maintenance yard and construction storage area should be placed 100 m away from watercourses / wetland areas. This area should have bund walls and lined with impermeable material to prevent ground and surface water pollution.
- The proposed gravel roads should be developed at ground level so as not to disturb the natural flow of storm water.
- Chemical sanitation facilities and the temporary sanitation system in the construction site should be regularly serviced by appropriate companies to ensure that no spills or leaks to surface and groundwater take place. Chemical toilets and the temporary sanitation system should not be placed within 100 m from any watercourse / wetland / pan area.
- Solid waste must be kept in adequate waste bins. Building rubble and waste should be removed on a regular basis to a licensed landfill site, unless it can be sorted and recycled.

Mitigation measures - operational phase

- Solid waste must be kept in adequate waste bins and removed on a weekly basis to a waste disposal site, unless it can be sorted and recycled.
- The use of eco-friendly products e.g. Organic Compost, herbicides and insecticides should be promoted.
- The permanent sanitation system should be regularly inspected to ensure that no spills or leaks from sanitation system to groundwater take place.

9.4.1.3. Water use / water quantity

Construction phase

During this phase, water consumption will be the highest because it will be utilized for gravel roads and building constructions. The water needed for the construction activities will be provided from new on-site boreholes, or from existing boreholes on the adjacent farm portions.

Operational phase

Water use will be limited except for short periods (twice per year) when the panels will be cleaned. The water needed for the operational phase will be provided from new on-site boreholes, or from existing boreholes on the adjacent farm portions.

Project Phase	Impact: Water use								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Construction process	Depletion of water resources: Water consumption	Low-medium	Medium-high	Medium-high	High	High	Medium	Medium-high
Operational	Water use & cleaning of panels	Depletion of water resources: Water consumption	Low	High	Medium	High	High	Low-Medium	Medium

Mitigation measures – Construction Phase

- Water should be used sparingly and it should be ensured that no water is wasted.
- Roads should be treated with chemicals to lower the use of water.
- Washing of construction vehicles should be limited to once or twice a month and must be done with high-pressure sprayers to reduce water consumption.

Mitigation measures - Operational Phase

- Cleaning of panels should be done only when necessary, twice per year.
- Roads should be treated with chemicals to lower the use of water.
- Washing of vehicles should be limited to once a week and must be done with high-pressure sprayers to reduce water consumption.
- Care must be taken not to waste any water. In the offices, half-flush systems in the toilets as well as water aerators in all taps must be installed to reduce water consumption.
- The workers should be educated on the value of water and how to use it sparingly.
- Only indigenous trees and plants should be planted in the vegetation buffer zone.

9.4.1.4. Land and soils

Planning phase

The high sensitivity areas / salt pans (*endorheic depressions*) sparsely located on the project site should remain undeveloped - providing a buffer zone 32 m wide - in compliance with the requirements highlighted in the Geo-technical and Geo-hydrological Report (Annexure I), in the Ecological Impact Assessment (Annexure D) and in the Wetland Delineation Study (Annexure G).

Construction phase

During construction, the vehicles used have the potential to spill diesel and lubricants that can pollute the soil. The storage of solid waste before it can be disposed of has the potential to pollute the soil and becomes a nuisance.

Operational phase

Solid waste can be a nuisance and has the potential to pollute the soil if not managed correctly. The use of conventional fertilizers, herbicides and insecticides should be limited as far as possible. Wastewater from activities can pollute the soil.

Project Phase	Impact: Land and soils								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Spilling of oil/diesel by construction machines	Contamination of soil	Medium	Medium-high	Low-medium	Medium-high	Medium-high	Low	Medium
	Solid waste disposal	Soil pollution + nuisance	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Storm water over roads and cleared areas	Erosion	Low-medium	Medium-high	Low-medium	Medium	Medium-high	Low-medium	Medium
	Trenches for electric cables and water and sewerage pipes	Erosion	Low-Medium	Medium-high	Low	Medium	Medium-High	Low-medium	Medium
Operation	Solid waste	Soil pollution + nuisance	Low	High	Low-Medium	Medium-High	High	Low	Medium
	Storm water from paved areas and roofs	Erosion	Low-medium	High	Low-medium	Medium	Medium-high	Low	Medium
	Use of fertilizers, insecticides and herbicides	Pollution	Low-Medium	High	Low-medium	Medium	Medium	Low-medium	Medium

Mitigation measures - Construction Phase

- Clearance of vegetation should be restricted to the planned 215 ha footprint.
- Construction activities should be restricted to the proposed 215 ha footprint.
- The salt pans sparsely located on the project site should be avoided; a 32 m buffer zone should be preserved around the pans boundary, as indicated in the Wetland Delineation Study (Annexure G) and in the Ecological Impact Assessment (Annexure D).
- Construction vehicles must be well maintained and serviced to minimise leaks and spills.
- Spill trays must be used during refuelling of vehicles on site.
- Diesel storage must not exceed 30,000 litres at construction camp. Diesel tanks and other harmful chemicals and oils must be within a bunded area.
- Solid waste must be kept in containers and disposed of regularly at licensed dumping site, unless it can be sorted and recycled.
- Any building rubble must be removed to a licensed disposal site on a regular basis during construction.
- Trenches that are dug for the supply of services and electrical cables must be filled up and compacted well and slightly higher than the areas around it.
- The clearing of the site should be done in phases as the construction progresses.
- Slopes produced by removing soil must be kept to a minimum to reduce the chances of erosion damage to the area.
- The proposed gravel roads should be developed at ground level so as not to disturb the natural flow of storm water.

Mitigation measures - Operational Phase

- Solid waste must be kept in adequate waste bins and removed on a weekly basis to the waste disposal site, unless it can be sorted and recycled.
- The maintenance of the roads must be kept up to standard to prevent and reduce the incident of erosion next to the roads.
- The use of eco-friendly products e.g. organic compost, herbicides and insecticides should be promoted.

9.4.1.5. Archaeological, Cultural and Social Features

Construction phase

The clearing of the site may have a negative impact on the archaeological features of the site. Care must be taken in the excavations and moving of soil to observe any archaeological feature of importance, which must be left and reported to the archaeological consultant for comments and actions.

Operational phase

The operational phase will not have any negative impact on the archaeological features of the site, if the recommendations of the Heritage Impact Assessment (Annexure H1) and of the Palaeontological Desktop Study (Annexure H2) to be undertaken will be adhered to.

Project Phase	Impact: Loss of Archaeological, Cultural and social features								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Earth moving and soil clearance	Destroy archaeological evidence and heritage and graves	Low-medium	Medium-high	Low	Low	Low-medium	Low	Low-medium
Operation	Operational activities of development	Destroy archaeological evidence and heritage and graves	Low-medium	High	Low	Low	Low-medium	Low	Low-medium

Mitigation measures – Construction and operational phases

- Care must be taken during the construction process that anything of archaeological value that is unearthed must be recorded. See Phase 1 - Heritage Impact Assessment, Annexure H1. The archaeologist or SAHRA must be notified whenever anything of importance is discovered.
- The heritage site KKL 001 (farmstead with its associated buildings) found on the property should be excluded from the planned footprint.
- As indicated in the Palaeontological Desktop Study (Annexure H2): if, in the unlikely event that fossilized plants or animals are exposed from the Tierberg Formation and the Quaternary alluvial deposits in the process of development activities, it will create a unique opportunity to explore the area for fossils. Should fossils be exposed, a qualified palaeontologist be contacted to assess the exposure for fossils so that the necessary rescue operations are implemented.

9.4.1.6. Impact of the development on the ecology (fauna & flora) of the area

Planning and construction phase

The removal of natural vegetation and destruction of habitat will have a negative effect on the biodiversity. The specific mitigation measures included in the Ecological and Avifauna Impact Assessment (Annexures D & E) should be adhered to.

The high sensitivity areas / salt pans (*endorheic depressions*) sparsely located on the project site should remain undeveloped - providing a buffer zone 32 m wide - in compliance with the requirements highlighted in the Ecological Impact Assessment (Annexure D) and in the Wetland Delineation Study (Annexure G).

Operational phase

The operation of the development can have a negative impact on the bio-diversity if it is not managed correctly. Exotic invasive plant species can have a negative impact on the indigenous vegetation.

Project Phase	Environmental Aspect: Ecology (Fauna and Flora)								
	Activity that causes impact	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Earthworks and vegetation clearance at construction site	Loss of indigenous plant species & disturbance to sensitive habitat	Medium	Medium	Low-Medium	Medium	Medium-High	Low-medium	Medium
	Vegetation clearance and the use of herbicides to control re-growth at the different development areas	The eradication and control of exotic invasive plant species Loss of indigenous plant species	Medium	Medium	Medium	Low-Medium	Medium-High	Low-Medium	Medium
	The occurrence of veldt fires on site	Destruction of flora/habitats Loss of indigenous fauna	Medium-High	Medium	Medium	Medium-High	High	Medium	Medium-high
	Littering (e.g. cans and plastics) along access road and at construction site	Public nuisance and loss/death of indigenous fauna	Low-Medium	Medium	Medium	Medium-High	Medium	Low	Medium
	The control of animals on site Killing, poisoning or hunting of animals	Loss of indigenous fauna to the area	Medium-High	Medium	Medium	Medium	Low-Medium	Low-Medium	Medium
Operation	Rehabilitation of cleared areas	The spreading of exotic invasive plant species Loss of habitat and indigenous flora	Medium	High	Medium	Low-Medium	Medium	Low-Medium	Medium
	The occurrence of veldt fires	The loss of indigenous fauna and flora	Medium-High	Medium	Medium	Low-Medium	High	Medium	Medium-high
	The functioning of the permanent sewage treatment systems – treated sewage outflow	Deterioration in the habitat for avifauna and aquatic life	Medium-High	High	Medium	Medium-High	Medium	Low-Medium	Medium-High
	Disposal and storage of solid waste and littering	The death/loss of indigenous fauna e.g. raptors, mammals and reptiles	Medium-High	High	Medium-High	Medium-High	Medium	Low-Medium	Medium
	The control of pests and vermin	Killing and poisoning of fauna feeding on the poisoned vermin or pest	Low-Medium	High	Low-Medium	Medium-High	Medium	Low	Medium

Project Phase	Environmental Aspect: Ecology (Fauna and Flora)								
	Activity that causes impact	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
	The feeding of fauna e.g. birds &small mammals	Disturbance to bio-diversity and the natural movement of the animals through the site The death/loss of indigenous fauna	Low-Medium	High	Low-Medium	Medium-High	Low-Medium	Low	Medium
	Catching of wild animals e.g. reptiles, bids and small mammals as pets	Disturbance to bio-diversity and decline in indigenous faunal numbers	Medium-High	High	Low-Medium	Low-Medium	Low	Low	Medium
	Birds colliding with power line and panels	Electrocution of birds	Medium-High	High	Low-Medium	Low-Medium	Low	Low	Medium
	The erection of fences and the construction of roads with a kerb	The fragmentation of available habitat and the restriction of movement of small mammals, reptiles and amphibians	Low-Medium	High	Low-Medium	High	Medium	Low	Medium

Mitigation measures – Construction phase

- Care must be taken that unnecessary clearance of vegetation does not take place. Where possible, natural vegetation must be retained.
- Clearance of vegetation should be restricted to 215 ha footprint.
- Construction activities should be restricted to the proposed 215 ha footprint.
- The salt pans sparsely located on the project site should be avoided; a 32 m buffer zone should be preserved around the pans boundary, as indicated in the Wetland Delineation Study (Annexure G) and in the Ecological Impact Assessment (Annexure D).
- Protected trees (if any) and protected plant species (if any) can only be removed once the necessary permits have been obtained (DAFF and DENC).
- The project should comply with the Northern Cape Nature Conservation Act (Act No. 9 of 2009).
- The herbicides used to control the invasive plant species should be chosen in consultation with an ecologist, as some of the agents might be detrimental to the surrounding indigenous fauna and flora e.g. Roundup is for example extremely toxic to frogs.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Fires should only be allowed in designated places within the construction camp and extra care should be taken to prevent veldt fires of occurring.

- Firebreaks should comply with the National Veldt and Forest Fire Act, 1998 (Chapter 4: Duty to Prepare and maintain firebreaks).
- Cleared areas should be rehabilitated by reintroducing a grass layer as soon as possible to limit the occurrence of erosion.
- The cleared vegetation should not be burned on site. The cleared vegetation should be stockpiled and taken to the closest available landfill site.
- Solid waste must be kept in adequate animal proof waste bins at the construction camp and construction sites. Building rubble and various wastes should be removed on a regular basis to the closest available landfill site, unless it can be stored and recycled.
- Regular clean-up programs should be put into effect along the access road and throughout the premises to limit the impact of littering caused by construction activities.
- The stockpiled topsoil and construction material should be managed in such a way that the material is not transported by wind or rain. This can be done by restricting the height of the stockpiles, sandbagging and avoiding steep slopes.
- No animals may be killed, captured or hunted on site by construction workers. Do not feed any wild animals on site.
- Where trenches pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and being trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during construction process.
- Existing game on the developed area will be relocated when the proposed solar park is developed. The relocation of the game will be executed according to the relevant legislation.

Mitigation measures – Operational phase

- An ecologist should be consulted on the use of herbicides/eco-friendly products to control exotic tree and shrub species.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- The high-risk sections of the power line should be marked with a suitable anti-collision marking device on the earth wire as per the Eskom guidelines.
- Solid waste must be kept in animal proof waste bins.
- A monitoring program should be compiled and implemented to ensure that the sewage treatment system is functioning properly and that the treated wastewater conforms to the standards set by the Department of Water Affairs.
- Staff members should be discouraged from attempting to catch or kill any wildlife for use as food, pets or to feed any wild animals.
- Firebreaks should comply with the National Veldt and Forest Fire Act, 1998 (Chapter 4: Duty to Prepare and maintain firebreaks).
- The impact on the flying invertebrates will be minimized through the use of sodium vapour (yellow) lights as outside lighting.
- The use of eco-friendly products e.g. Organic Compost and/or Effective Microorganisms (EM), which reduces the frequency of application of conventional fertilizers, herbicides and insecticides, should be promoted.

9.4.1.7. Visual impacts

Construction phase

The natural aesthetic character of the site will be changed. The Eskom "Klokfontein - Graspan" 132 kV power line crossing the developed area has already changed the visual characteristics of the site.

Operational phase

Buildings and the solar modules have a *visual impact* and lights at night can be a *nuisance.*

Project Phase	Impact: Visual disturbance								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Buildings & panels	Visual	Low	High	Low-Medium	High	High	Low-Medium	Medium
	Lights	Visual	Low	Medium	Low-medium	Medium-high	High	Low-Medium	Medium
Operation	Buildings and panels	Visual	Low	High	Low-Medium	High	High	Low-Medium	Medium
	Lights	Nuisance	Low	High	Low-medium	Medium-High	High	Low-Medium	Medium
	Electrical lines	Visual	Low	High	Low	High	High	Low-Medium	Low-Medium

Mitigation measures

- Earth works should be executed in such a way that only the footprint and a small 'construction buffer zone' around the proposed components are exposed. In all other areas, the natural occurring vegetation, more importantly the indigenous vegetation should be retained.
- Retain a visual screen of existing vegetation around the proposed project components to reduce the negative visual impact.
- Provide a vegetation buffer zone, 20 m wide, consisting of planted bushes and trees, along the western and northern boundary of the planned footprint.
- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the project site.
- Minimise the amount of light fixtures to the bare minimum and connecting these lights to motion sensors can also considered in reducing light pollution.
- A video-surveillance system using infrared or microwave video cameras, which do not need a switched on lighting system, is recommended.

9.4.1.8. Safety, security and fire hazards

Construction phase

Construction activities such as excavating of foundations and trenches, movement of construction vehicles, the use of equipment and the congregation of workers and staff on site further increases the risk of injury. The activities of construction personnel on site may contribute to an increase in the level of crime in the area and may also contribute to an increase in the risk for fires.

Operational phase

Fires and criminal activities pose a significant risk during the operation of the development.

Project phase	Impact: Safety, security and fire hazards								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Construction activities – excavation of foundations, trenches etc.	Loss or injury to human life	Low-medium	Medium-high	Low	High	Medium	Low	Medium
	Security	Crime	Medium	Medium-high	Low-medium	Medium	Medium-high	Low - medium	Medium
	Fire hazards	Loss of human life and construction equipment etc.	High	Medium-high	Medium	Low	Low-Medium	Low-Medium	Medium
Operation	Security	Crime	Medium	High	Medium	Medium	Medium-high	Medium	Medium-high
	Fire hazards	Loss of human life, bio-diversity, buildings, infrastructure etc.	High	Medium	Medium -High	Low	Low	Low	Medium

Mitigation measures

- The Contractor shall conform to the stipulations of the Occupational Health and Safety act (Act 85 of 1993) and regulations applicable. The Act requires the designation of a Health and Safety representative when more than 20 employees are employed.
- Open trenches or excavations must be marked with danger tape.
- The number of construction workers to stay on site should be limited to the minimum.
- Proper access control (I.D. cards) should be enforced to ensure that no authorised persons enter the site.
- No solid waste or vegetation may be burnt on the premises or surrounding areas.
- Firebreaks should comply with the National Veldt and Forest Fire Act, 1998 (Chapter 4: Duty to prepare and maintain firebreaks).
- Fire extinguishers and fire fighting equipment must be available.
- A fence should be constructed along the boundary of the development.

9.4.1.9. Socio-economic impact

Construction phase

The construction and operation phases of the development will have a positive impact on the socio-economic environment of beneficiary communities through employment opportunities and training and skills development.

Operational phase

A number of permanent jobs will be created for local people during this phase.
Carodex (Pty) Ltd should identify a local Community for the purpose of entering into a partnership for the Project, as required by the rules of the REIPP Procurement programme.

Project phase	Impact: Job creation								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Operation	Job creation	Job Creation	High +	High +	Medium-high +	High +	High +	N/A	High +
Operation	Local Community development	Local Community development	High +	High +	high +	High +	High +	N/A	High +

Mitigation measures

- During the construction and operational phases, jobs must be created for unemployed local people and skills must be transferred to them.
- Where viable, the work must be executed in a labour intensive manner to create as many jobs possible.

9.5. POTENTIALLY SIGNIFICANT IMPACTS

Impacts with a rating of Medium-high or High are impacts which are regarded as potentially significant, rated without any mitigation measures. In this impact assessment, the following impacts were regarded as potentially significant impacts:

i. Water pollution by the inadequate functioning of the sanitation system.
ii. Water consumption and depletion during construction phase.
iii. The occurrence of veldt fires.

These impacts (i-iii) will now briefly be discussed.

9.5.1. Cumulative impacts

i. The effect of water pollution (surface and groundwater) by a malfunctioning of the sanitation system will have a cumulative effect only if it is not detected by a regular monitoring and if it takes place on a regular basis.
i. This effect is cumulative only if care is not taken to conserve water and if water usage and the water levels of boreholes are not monitored regularly.
ii. This can have a cumulative effect if preventative measures are not followed.

9.5.2. Nature of impact

i. This is pollution of a renewable resource.
ii. This is a negative impact that affects water quantity available for use in the area.
iii. Damage to property, ecology and safety of people.

9.5.3. Extent and duration of impact

i. The extent could potentially be within the farm of the proposed development and the surrounding farms.
ii. The extent could potentially be within the area of the proposed development and the surrounding farms. The duration is only during construction.
iii. The extent is potentially on the development area as well as surrounding properties and even regional. The duration is for the life of the development.

9.5.4. Probability of occurrence

i. The probability is unlikely.
ii. The probability is possible.
iii. The probability is infrequent or seldom.

9.5.5. Degree to which impact can be reversed

i. Impact is reversible if mitigated in time.
ii. This impact is reversible because the higher abstraction will only be during the construction period.
iii. If the development is not continuing there will be no guarantee that veldt fires will not occur on the property. This impact must therefore be managed accordingly.

9.5.6. Degree to which impact can cause irreplaceable loss of resource

i. If this impact takes place over a very long time and there is gross negligence, the water resource can be damaged to a point where it will take very long to recover and where it could almost be seen as being irreplaceable.
ii. The recovery of the water resource is linked to rainfall and will recover accordingly. The negative impact is during the construction period.
iii. Veldt fires can create such damage that it will take a long time for the veldt to recover but the fact is that the vegetation has been subjected to veldt fires ever since. Loss of property (buildings) can be replaced.

9.5.7. Degree to which impact can be mitigated

i. Successful mitigation is possible
ii. Successful mitigation is possible
iii. Successful mitigation is possible

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.

10.4. ALTERNATIVE OPTION: UPGRADING THE SOLAR PARK

At the end of the PV power plant lifetime (25 ÷ 30 years), as alternative option to the decommissioning, it will be evaluated the feasibility of upgrading the solar park with the most appropriate technology/infrastructure available at that time.

11. CONCLUSIONS AND RECOMMENDATIONS

The EIA Report describes the activities undertaken for the development of the Carodex Solar Park.

The purpose of this report is to provide the relevant authorities and interested and affected parties with sufficient information regarding the potential impacts of the development to render meaningful comments. Potential impacts were identified in consultation with I&AP's and technical specialists (where applicable) and were assessed using a matrix and by applying professional knowledge.

The potentially significant negative impacts that have been identified should be mitigated through the implementation of the mitigation measures highlighted in this report. It is submitted that the proposed mitigation measures, will effectively diminish the impacts to acceptable levels. Given the socio-economic imperatives of the development, the residual impacts are not of sufficient importance to thwart the development.

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 "Klokfontein - Graspan"**, **132 kV power line**, which runs parallel and adjacent 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.

The development of clean, green and renewable energy has been qualified as a priority by the Government of South Africa. The **Renewable Energy IPP Procurement Programme (REIPPPP)**, issued on 3rd August 2011 by the Department of Energy, envisages the commissioning of 3725 MW of renewable projects (1450 MW with solar photovoltaic technology) capable of beginning commercial operation before the end of 2017. The Department of Energy has already announced the intention to procure an additional **3,600 MW** of renewable energy projects by **2020** (DOE Media Statement of 12 December 2014). The development of photovoltaic power plants will represent a key feature in the fulfilment of the proposed goals 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 REIPP Procurement Programme and in order to meet the "sustainable growth" of the Northern Cape Province.

Thanks to the Carodex Solar Park:

- the **avoided CO_2 emissions** will be from approximately **162,000 to 193,000 tons of CO_2 per year**;
- the **coal saved** is estimated from approximately **43,000 to 51,000 tons of coal** / **year**.

The following socio-economic benefits were found in the Socio-economic Impact Assessment:

- 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, each project will take approximately **15 months** to be built and will have a lifetime of 25-30 years. For each project, 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.
- During operational phase, each 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).
- The project will comply with the Economic Development Requirements, as requested by the REIPP 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.

It is the professional opinion of AGES that the proposed development is **highly desirable** and **does not present any fatal flaws in terms of negative impacts to the environment** and therefore will not have any significant detrimental impacts to render the project unfeasible.

It is proposed that the following conditions must be included in the Record of Decision if the project is authorised:

- The mitigation measures contained in this report must be implemented.
- The management and or mitigation measures contained in the Environmental Management Plan must be implemented.
- The responsibilities to obtain any further authorisations and/or licenses will rest on the proponent of the project, PRIOR to any activities on site.