Agricultural Agro-Ecosystem Impact Assessment Report

AN AGRICULTURAL AGRO-ECOSYSTEM SPECIALIST REPORT FOR THE PROPOSED DEVELOPMENT OF THE LICHTENBURG SOLAR PARK AND ASSOCIATED INFRASTRUCTUE ON PORTION 25 OF THE FARM HOUTHAALBOOMEN 31 IP AND PORTION 10 OF THE FARM LICHTENBURG TOWN AND TOWNLANDS 27 IP, NORTHWEST PROVINCE

APRIL 202

Prepared for: MATRIGENIX (PTY) LTD

Compiled by Dr BJ Henning

Document version 1.0 – Draft

AGES
Purpose with Passion

Proudly Supporting
TOUCHING AFRICA

Prepared by

AGES

Purpose with Passion

AN AGRICULTURAL AGRO-ECOSYSTEM SPECIALIST REPORT FOR THE PROPOSED DEVELOPMENT OF THE LICHTENBURG SOLAR PARK AND ASSOCIATED INFRASTRUCTUE ON PORTION 25 OF THE FARM HOUTHAALBOOMEN 31 IP AND PORTION 10 OF THE FARM LICHTENBURG TOWN AND TOWNLANDS 27 IP, NORTHWEST PROVINCE

April 2022

Compiled by:

Dr BJ Henning (*Pri Sci Nat – Ecological Science and Soil Science)*
PhD. Plant Ecology
M.Sc. Botany - Soil Science related

Reviewed by :

Ms. E. Grobler (Pr. Sci. Nat.- Ecological Science & Environmental Management)

LIMPOPO PROVINCE: 120 Marshall Street, Polokwane, 0699, PO Box 2526, Polokwane 0700,
Tel: +27 15 291 1577 Fax: +27 15 291 1577 www.ages-group.com

Offices: *Northwest Eastern Cape Western Cape Limpopo Gauteng Kwazulu-Natal*
AGES Limpopo Directors: *J.H. Botha H.P. Jannasch T.H.G. Ngoepe*

REPORT DISTRIBUTION LIST

Name	Institution
Ms. I van Rooy	MATRIGENIX (PTY) LTD
	Limpopo Department of Agriculture
	Registered Interested and Affected Parties

DOCUMENT HISTORY

Report no	Date	Version	Status
	April 2022	1.0	Draft

CURRICULUM VITAE

B J Henning

PhD Plant Ecology

PERSONAL DETAILS

Name:	BAREND JOHANNES HENNING
Date of Birth:	1976-09-06
Profession/Specialization:	Senior Ecologist
Years with Firm:	6 years (previously 2006-2012 & since May 2020)
Nationality:	South African
Years' experience:	15 years

QUALIFICATIONS

University attended:	University of Pretoria, Pretoria (1995- 2002) PhD Plant Ecology, MSc (Botany), BSc (Hons.), BSc

COURSES

Advanced Wetland Course (UP CE, 2010)

Wetland Rehabilitation Course (UFS, 2015)

Course on wetland offsets (SANBI)

KEY QUALIFICATIONS AND EXPERIENCE

- Senior Ecologist / Soil Science Specialist for Ages Limpopo since September 2006 to 2012 and again since May 2020 involved in the following aspects:
  - Agricultural potential and land capability studies of soils on farms. (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)
  - Spatial Development Frameworks.
  - Strategic Development Area Frameworks for local municipalities
  - Vegetation surveys, sensitivity and zoning analysis of development sites, including eco-estates, mines, residential developments, shopping centres, roads, water supply and other related infrastructure etc (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)

  - Faunal analysis and scoping reports (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160)
  - Avifauna studies related to solar plant and power line connection developments.
  - Wetland delineations and functional capacity assessments (completed advanced wetland course of the Continued Education Department, University of Pretoria 2010 as well as Wetland rehabilitation course of the University of the Free State).
  - Wildlife Management Plans and habitat assessment for rare and endangered game species.
  - GIS related functions.
- Senior Ecologist for Exigo (previously AGES Gauteng) November 2012 to April 2020. Involved in all the abovementioned aspects.
- Environmental Consultant for Envirodel Wildlife & Ecological Services cc and Dubel Integrated Environmental Services, Polokwane 2004 - 2006. Involved in the following aspects:
  - Wildlife management plans for game farms /reserves throughout the Limpopo Province
  - Environmental impact assessments (vegetation surveys and faunal scoping reports), habitat suitability analysis and report compilation.
  - Coordinating and performing grass monitoring surveys for the Limpopo Tourism and Parks Board
  - Soil potential studies.
- Environmental Consultant for Ficus – pro Environmental Services cc., Modimolle 2004 / 5. Involved mostly in fieldwork, report compilation or impact studies. Reference: Mr. R. Venter (0147173378)
- Subconsultant for AGES (Africa Geo-Environmental Services 2005-2006. Vegetation surveys and sensitivity zoning and analyses. Mr Johan Botha (0836449957)
- Eco-Agent environmental services cc, Pretoria 2002 - 2004. Involved in environmental impact studies. Prof G. J. Bredenkamp (0825767046), University of Pretoria.
- Enviroguard environmental services cc, Heidelberg 2002 - 2004. Involved in environmental impact studies. Prof L. R Brown (0825767046).
- GIS related aspects for all the above-mentioned aspects on projects

POSITION AND DUTIES

Employed as Senior Ecological Specialist. Main duties and responsibilities include:

- Compilation of project proposals.
- Conducting specialist assessments
    - Ecological assessments
    - Soils and Land use potential studies.
    - Wetland assessments.
    - Wetland rehabilitation plans.
    - Ecological & wetland monitoring.
    - Biodiversity Action & Management Plans.
    - Agricultural assessments.
    - Avifauna assessments.
    - Wildlife Management Plans and assessments.
    - Rehabilitation Strategy & Implementation Programmes (RSIPs)
- Liaison with clients.
- GIS and map compilation.
- Project admin and management.
- Integration and interaction with the environmental consultants.
- Travelling.
- Any ad hoc duties that may be given by immediate manager.

Declaration

I, Dr BJ Henning declare that -

- I act as the independent specialist.
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998; the Act), regulations and any guidelines that have relevance to the activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I will consider, to the extent possible, the matters listed in Regulation 18 of the NEMA EIA Regulations.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the project proponent and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent.
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the Act.

SIGNATURE OF SPECIALIST

Table of contents

List of Figures

List of Tables

List of Photographs

LIST OF ABBREVIATIONS

Abbreviation	Description
ARC	Agricultural Research Council
C-Plan	Limpopo Conservation Plan
CSIR	Council for Scientific and Industrial Research
DEFF	Department of Environment, Forestry and Fisheries
DEA	Department of Environmental Affairs
DMR	Department of Minerals and Energy Resources
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPR	Environmental Management Programme Report
ENPAT	Environmental Potential Atlas
GIS	Geographic Information Systems
GPS	Geographical Positioning System
HGM	Hydro-Geomorphic
HFI	Hydrological Function and Importance
IHI	Index of Habitat Integrity
IUCN	World Conservation Union
MAE	Mean Annual Evaporation
MAMSL	Meter Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NEMA	National Environmental Management Act
PES	Present Ecological State
PESC	Present Ecological Status Class
PQ4	Priority Quaternary Catchment
QDS	Quarter Degree Square
SADC	Southern African Development Community
SANBI	South African National Biodiversity Institute
WMA	Water Management Area
WHO	World Health Organisation

1 ASSIGNMENT

AGES Limpopo (Pty) Ltd was appointed by MATRIGENIX (PTY) LTD to conduct an Agricultural Agro-Ecosystem assessment for the proposed development of the Lichtenburg Solar Park and power line on Portion 25 of the Farm Houthaalboomen 31 IP and Portion 10 of the Farm Lichtenburg Town and Townlands 27 IP, Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, Northwest Province.

The main purpose of this study was solely to assess the agricultural potential and value of the soil types on the site. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in compliance with Gazette No. 43310 Government Notice R320.

The assignment is interpreted as follows: Compile an impact study on the Agricultural Agro-Ecosystem of the proposed development site according to guidelines and criteria set by the National Department of Agriculture and the NEMA regulations. The study will include a detailed soil assessment and interpretation. To compile this, the following had to be done:

1.1 Information Sources

The following information sources were obtained:

- All relevant maps through GIS mapping, and information (previous studies and agricultural databases) on land use, soils, agricultural potential and land capability of the area concerned.
- Requirements regarding the agricultural potential survey and prime or unique agricultural land as requested by the NDA.
- Obtain relevant information of land type, geology and soil types of the area. This includes information on the soil potential, clay percentage, soil depth and soil forms, as classified by the Environmental Potential Atlas of South Africa (Institute for Soil, Climate and Water, Agricultural Research Institute).
- Obtain information of the prevailing land use and agricultural activities being practiced in the larger area of the neighbouring properties.
- Obtain an aerial photograph of the area to help in the interpretation and identification of major soil types and land uses in the study area.

1.2 Regulations governing this report

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 43310 Government Notice R. 320. Specialist reports includes a list of requirements to be included in a specialist report for an agricultural agro-ecosystem assessment:

1. A specialist report or a report prepared in terms of these regulations must contain:
    a. Details of
        i. The specialist who prepared the report; and
        ii. The expertise of that specialist to compile a specialist report, including a curriculum vitae.
    b. A declaration that the specialist is independent in a form as may be specified by the competent authority.
    c. An indication of the scope of, and purpose for which, the report was prepared.
    d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment.
    e. A description of the methodology adopted in preparing the report or carrying out the specialized process.
    f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.
    g. An identification of any areas to be avoided, including buffers.
    h. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.
    i. A description of any assumptions made and any uncertainties or gaps in knowledge.
    j. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.
    k. any mitigation measures for inclusion in the EMPr.
    l. any conditions for inclusion in the environmental authorisation.
    m. any monitoring requirements for inclusion in the EMPr or environmental authorisation
    n. a reasoned opinion –
        i. As to whether the proposed activity or portions thereof should be authorised and
        ii. If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr and where applicable, the closure plan.
    o. A description of any consultation process that was undertaken while preparing the specialist report.
    p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and
    q. Any other information requested by the competent authority.

1.2.2 Other related legislation

The natural resources of South Africa constitute a national asset, which is essential for the economic welfare of present and future generations. Economic development and national food security depend on the availability of productive and fertile agricultural land and are threatened by the demand for land for residential and industrial development. Urban and rural planning needs to be integrated rather than sectorial and fragmentary. The use of agricultural land for other purposes should therefore be minimised. Currently the retention of productive agricultural land is administrated through the SUBDIVISION OF AGRICULTURAL LAND ACT, 1970 (ACT NO. 70 OF 1970) which controls the subdivision of agricultural land and its use for purposes other than agriculture. Soon the use of these scarce resources will be regulated through the SUSTAINABLE UTILISATION of AGRICULTURAL RESOURCES BILL. One of the objects of the new Bill is to provide for the use and preservation of agricultural land, especially “prime and unique agricultural land” by means of prescribe criteria in terms of which agricultural land may be used for purposes other than agriculture, in collaboration with principles as laid down in the Development Facilitation Act, 1995 (Act No. 67 of 1995) and in collaboration with the Land Use Bill, 2001. The prescribe criteria shall relate to the importance of the continued use of those agricultural resources for agricultural purposes in general particularly taking into consideration the use of prime and unique agricultural land or its agricultural importance relative to a particular province or area. Different criteria may be prescribed from time to time and such criteria may differ from province and area.

1.3 Terms of reference

1.3.1 Objectives

The objectives of this report are as follows:

- Conduct an agro-ecosystem assessment and soil survey on the proposed development site and identify the different soil types / forms present on the site.
- From the soil survey results link the optimal land use and other potential uses and options to the agricultural potential of the soils by classifying the soils into different Agricultural Potential classes according to the requirements set by the NEMA regulations (GN 320) and the Department of Agriculture, South Africa. From these results soils maps and an agricultural potential map will be compiled.
- Discussion of the agricultural potential and land capability in terms of the soils, water availability, grazing capacity, surrounding developments and status of land.
- Identify potential impacts of the development on the soils and provide mitigation measures to manage these impacts.

1.3.2 Limitations and assumptions

- To obtain a comprehensive understanding of the dynamics of the soils of the study area, surveys should ideally be replicated over several seasons and over a few years. However, due to project time constraints such long-term studies are not feasible.
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative, homogenous sections of soils, as well as general observations, aerial photograph analysis, generic data and a desktop analysis.

2 METHODS

The assessment of agricultural potential and land capability of the study area was based on a combination of desktop studies to amass general information and then through site visit for status quo assessment, soil sampling and characterization, and the validation of generated information from the desktop studies:

- Definition of parameters of land as stipulated by the Subdivision of Agricultural Land Act, 1970 (Act No. 70 of 1970) and the Amended Regulation of Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).
- Classification of high potential agricultural land in South Africa compiled by the Agricultural Research Council (Schoeman, 2004) for the National Department of Agriculture.
- Long-term climatic data record of the study area, obtained from Weather SA.
- Geophysical features of the site using Geographical Information System.
- Moisture availability class, determined through seasonal rainfall and fraction of the potential evapotranspiration (ARC, 2002).
- Field visit to the project site for general observation, survey of the farm in terms of vegetation, soils, water resources, terrain type and infrastructural profile.
- Previous and current land use of the farm and that of the neighbourhood.
- Other agro-ecological factors prevailing in the area.
- Agricultural potential of the property.
- Possible crop productivity or value of the farm for grazing purposes.

2.1 Soil surveys

The site surveys were conducted on 11 April 2022. The relevance of the season had no impact on the outcome of the assessment.

After a thorough investigation of an aerial photograph of the area and visual assessment of the specific sites and areas surrounding the sites, the following was done:

- Field observations were randomly made in the accessible, with specific emphasis on the resource area.
- Since the soils do qualify as high or very high sensitivity soils from an Agricultural Resources point of view according to the Screening Tool, a detailed assessment was conducted on the soil physical characteristics to verify the potential of the soils at small-scale.
- Slopes were analysed to determine the viability to cultivate crops in specific areas.
- The following soil physical and chemical characteristics were analysed through physical investigation:
    - Soil Depth (soil auger used).
    - Soil clay content (land type memoirs).
    - Soil texture and general structure.

2.2 Data recorded of surveys included:

- A description of the soil types and profiles identified on the sites.
- Specific soil characteristics on the proposed development sites and areas surrounding the sites.
- Photographs of the soil profiles and associated vegetation were taken and are included as part of the photographic guide.

2.3 Data processing

A broad classification of the soil types on the farm was done. A soil map indicates the dominant soil types identified by using a Geographic Positioning System (GPS) to locate sampled points on the topographical map of the farm. Soils were classified according to the Taxonomic Soil Classification System for South Africa, 1991. The following attributes were recorded and taken into consideration at each of the sites where samples were collected:

- Soil Type.
- Soil Depth.
- Soil clay content.
- Estimated soil texture class and soil structure.
- Slope.
- Moisture availability.
- Agricultural potential.

The agricultural potential of the soils was determined by using the specified guidelines stated above. The actual soil depth, clay content, slope, moisture potential and soil form were evaluated to determine the agricultural potential status. The soil characteristics and norms used to determine the agricultural potential of the soils were obtained from the National Department of Agriculture, which created criteria for high potential agricultural land in South Africa (Schoeman, 2004) as stated in previous discussion in the report.

3 STUDY AREA

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

Matrigenix (Pty) Ltd is proposing the establishment of a renewable energy generation facility (PV Power Plant) with associated infrastructure and structures, and powerline on Portion 25 of the Farm Houthaalboomen 31 IP and Portion 10 of the Farm Lichtenburg Town and Townlands 27 IP, Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, North West province (Figure 1). The proposed renewable energy generation facility will be Photovoltaic (PV) Power Plant with a maximum generation capacity up to 120 MW, at connection (Export Capacity) with the Eskom connection infrastructure. The name of the facility will be LICHTENBURG SOLAR PARK.

The developed area (footprint) required for the proposed project will be up to 240 hectares. The Lichtenburg Solar Park will deliver the electrical energy to the Eskom's Watershed substation, located on the Remainder Portion of the farm Lichtenburg Town and Townlands 27 IP.

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

- Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
- Mounting systems for the PV arrays (single-axis horizontal trackers or fixed structures) and related foundations
- Internal cabling and string boxes
- DC/AC inverters
- Medium voltage stations, hosting LV/MV power transformers
- Medium voltage receiving station(s)
- Workshops & warehouses
- One on-site high-voltage substation with high-voltage power transformers, stepping up the voltage to 132kV and one high-voltage busbar with metering and protection devices
- One on-site switching station, with one high-voltage busbar with metering and protection devices
- One (1) 132 kV powerline, to the Eskom Watershed substation, located on the Remainder Portion of the farm Lichtenburg Town and Townlands 27 IP.
- Battery Energy Storage Systems (BESS), with a footprint up to 10 ha, next to the on-site high-voltage substation, within the PV plant footprint / fenced areas
- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
- Internal roads
- Fencing of the site and alarm and video-surveillance system
- Water access point, water supply pipelines, water treatment facilities
- Sewage system
- Interventions on the Eskom Watershed Substation.

During the construction phase, the site may be provided with additional activities which will be removed at the end of construction.

- Water access point, water supply pipelines, water treatment facilities
- Prefabricated buildings
- Workshops & warehouses

The connection may also entail interventions on the Eskom grid, according to Eskom's connection requirements/solution. The aerial map of the site is presented in Figure 2.

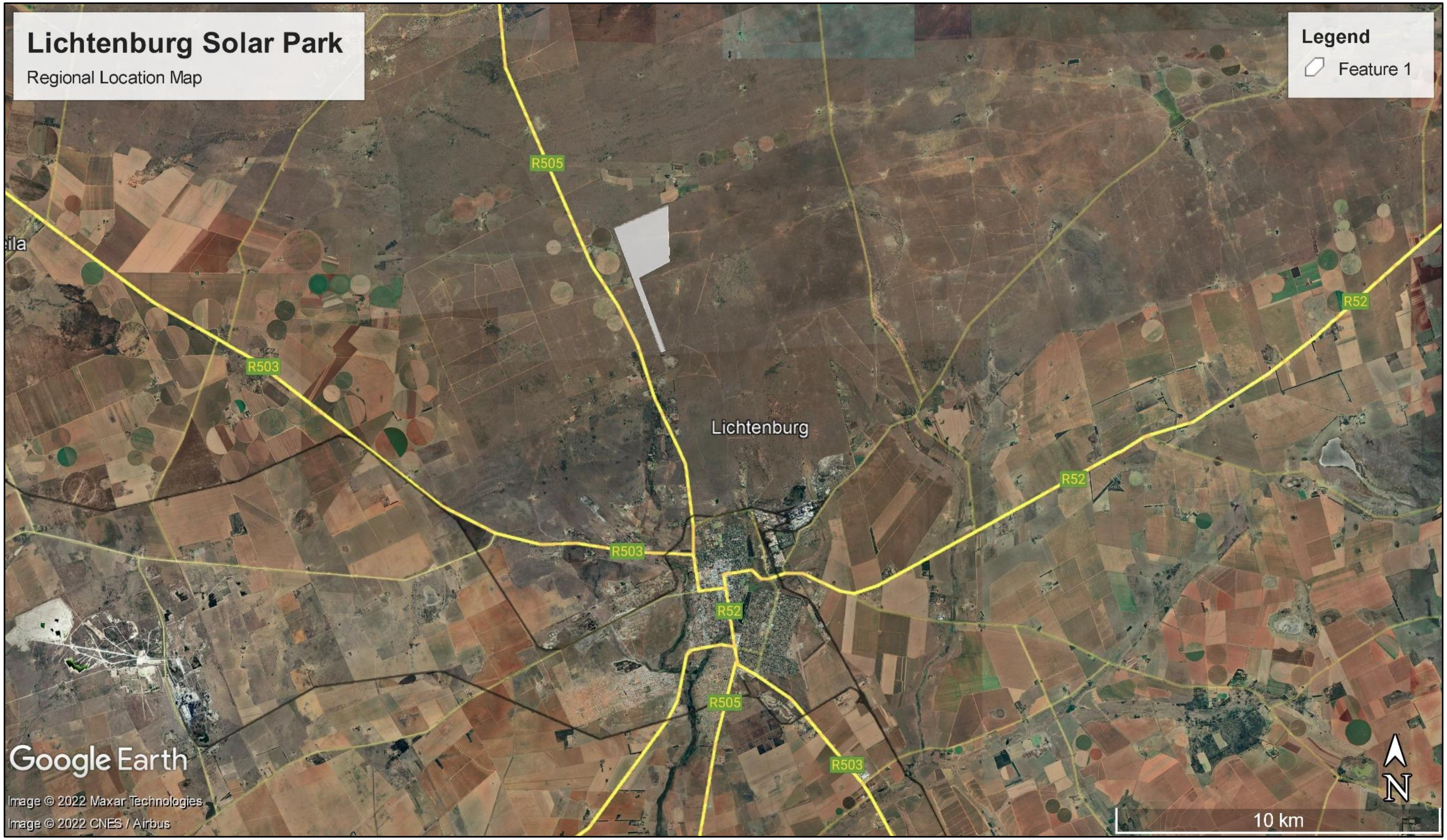

Figure 1. Regional location Map of the project area

Figure 2. Aerial Map of the project area

3.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity, and moisture vary, and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution, and life forms of the major terrestrial biomes (Barbour et al. 1987).

In terrestrial environments, limitations related to water availability are always important to plants and plant communities. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The study area is situated within the summer rainfall region with very dry winters and severe frost that occurs fairly frequently (37 days) during the colder winter months. The mean annual precipitation for the Carletonville Dolomite Grassland vegetation type being the main vegetation type of the area is 593mm, while the mean annual temperature is 16.1˚C. The monthly distribution of average daily maximum temperatures for Lichtenburg ranges from 17.7°C in June to 30°C in January. The region is the coldest during June when the mercury drops to 0°C on average during the night.

3.3 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Fa11 land type (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil types is presented in Table 6 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 1. Land types, geology, and dominant soil types of the proposed development site

Landtype	Soils	Geology
Fa11	Glenrosa and/or Mispah forms (other soils may occur), lime rare or absent in the entire landscape	Dolomite and chert belonging to the Chuniespoort Group; chert gravels are abundant on middle and footslopes including valley bottoms.

Soils associated with the site are mostly very shallow Mispah or Glenrosa soils associated with chert bedrock.

3.4 TOPOGRAPHY, LANDUSES AND DRAINAGE

When assessing the ecology of an area, it is important to know in which eco-region it is located.

The study area falls within the Grassland ecoregion. The topography is characterised by slightly undulating plains. The topography of the site can be described as generally favourable, when considering that most of the area consists of slopes of less than 1:5. The site is located at an altitude of 1520 meters above mean sea level (AMSL).

Most properties situated within a 500m radius are being used for livestock and game farming. The proposed development land is used for wildlife grazing at present. The natural vegetation of the site is mostly intact.

The site is located within the C31A quaternary catchment and is situated in the Lower Vaal Water Management Area. Drainage occurs as sheet-wash into the drainage channels to the south of the site, namely the Klein Harts River that eventually drains into the major river namely the Vaal River that occurs to the south of the site.

3.5 BIOME AND VEGETATION TYPE

The development site lies within the Grassland biome. The Grassland Biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu Natal and the Eastern Cape. The topography is flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level. Grasslands (also known locally as Grassveld) are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees. The Grassland Biome is the cornerstone of the maize crop, and many grassland types have been converted to this crop. Sorghum, wheat and sunflowers are also farmed on a smaller scale.

Urbanization is a major additional influence on the loss of natural areas - the Witwatersrand is centred in this biome. The Grassland Biome is considered to have an extremely high biodiversity, second only to the Fynbos Biome. Rare plants are often found in the grasslands, especially in the escarpment area. These rare species are often endangered, comprising endemic geophytes or dicotyledonous herbaceous plants. Very few grasses are rare or endangered. The scenic splendour of the escarpment region attracts many tourists.

Fire and grazing are two of the most important ecological drivers in grassland. Any land-use change that results in reduced ability to manage fire or grazing in the remaining natural areas will have significant implications for grassland biodiversity. Invasive alien species and soil erosion are two of the most pervasive management issues affecting all grassland ecosystems and are key indicators that the limits of acceptable change have been exceeded.

The Highveld also plays an important role in natural water purification, as the peat formed here has been shown to filter out 90 percent of the harmful chemicals in herbicides. Peat is also useful in absorbing various other pollutants, as a source of fuel, in horticulture, and for medicinal purposes. In South Africa, where clean water resources are already particularly valuable, this natural filter is being extracted from the Highveld at an unprecedented rate. Approximately 60 percent of locally extracted peat is used to grow mushrooms, while the remaining 40 percent comprises "environmentally friendly" potting soil and compost. Peat has an extremely slow regeneration rate, increasing between 0.7 mm to 1.2 mm per year depending on environmental conditions (Dada 1999). Given its slow formation process, it is unlikely this resource will recover from the damage caused by its rapid removal. Hence, the Highveld's role as a natural filtration element for scarce water resources could be in danger. Preservation of the resource is imperative and could be fulfilled by moderating or halting the use of peat for gardening purposes.

The most recent classification of the area by Mucina & Rutherford shows that the site is classified as Carletonville Dolomite Grassland. The landscape features of this vegetation type are slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands form a complex mosaic pattern dominated by many species. The conservation status of the Carletonville Dolomite Grassland is Least Concern with small extent conserved in statutory reserves and almost 25% already transformed for cultivation, urban sprawl or mining activities (Sanbi, 2018).

3.6 Moisture Availability

Moisture availability of soils is an aspect which recently has become an important factor to consider when cultivating crops under dry-land conditions. Moisture and water availability is affected by temperature increase, regardless of any change in rainfall. Higher temperatures increase evaporation rates and reducing the level of moisture available for plant growth, although other climatic elements are involved. A warming of 1°C, with no change in precipitation, may decrease yields in core cropping regions such as the US by about 5%. A large decrease in moisture availability in drier regions of the world would be of great concern to the subsistence farmers that farm these lands. Reduced moisture availability would exacerbate the existing problems of infertile soils, soil erosion and poor crop yields. In an extreme case, a reduction in moisture could lead to desertification. Classes as classified for South Africa are shown in Table 2.

Table 2. Moisture availability classes as derived from seasonal rainfall and evaporation

Moisture availability class	Summer rain season (R/0.25PET)	Winter rain season (R/0.4PET)	Agricultural Potential
1	>34	>34	Conducive to rain-fed arable agriculture
2	27-34	25-34	Conducive to rain-fed arable agriculture
3	**19-26**	**15-24**	**Conducive to rain-fed arable agriculture**
4	12-18	10-14	Marginal for rain-fed arable agriculture
5	6-12	6-9	Conditions too dry for rain-fed arable agriculture
6	<6	<6	Conditions too dry for rain-fed arable agriculture

The soils on the proposed development site are classified as class 3, which suggest that climatic conditions are conducive to rain-fed arable agriculture.

3.7 Soil classification of the site from ARC databases

The Agricultural Research Institute uses specific soil characteristics to indicate the suitability of soils for arable agriculture. These characteristics for the site are as follows:

Structurally favourable soils:

- Soils with structure somewhat favourable to arable land use if climate permits.

Soil association:

- Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils (association of Leptosols, Regosols, Calcisols and Durisols.

Soil pH:

- 6.5-7.4.

Prime agricultural activity for the area:

- Grains.

Since the classification of the soil characteristics is based on a broad-scale desktop study of the general area, a thorough investigation of the soil types of the proposed development site is necessary for a more accurate classification of the soils. The main aim of the study is to identify the soil types on site and evaluate their specific characteristics to determine the agricultural potential of the soils. The study will thus reduce the scale at which soils for the area was previously mapped. A detailed discussion of the soil characteristics is included in the following section as part of the results.

4 GUIDELINES FOR AGRICULTURAL POTENTIAL

4.1 National assessment criteria

4.1.1 Agricultural Potential of soils in South Africa

The essence of identifying high potential agricultural land in South Africa is to retain prime area for agricultural development and to retain as much productive areas as possible for the future. South Africa is dominated by shallow soils which are predominantly sandy. This poses a severe inherent limitation to crop production. The poor quality of the soil is due to the influence of the parent material in which they were formed. According to Laker (2005), South Africa has only 13 % (approximately 14 million ha) arable land, of which only 3 % is high potential. Inferring from the international requirement of about 0.4 ha arable land to feed an individual person, South Africa could produce enough food to feed only 35 million people on the available 14 million hectares of arable land. In line with this goal, the Department of Agriculture has developed a set of criteria to define potential and prime areas for agricultural development in South Africa.

Based on Part 1 of the Regulation of Conservation of Agricultural Resources Act 43 of 1983, an agricultural land in the Northwest Province and specifically in the grid square in which the project site falls is considered high potential if the land:

- Is under permanent irrigation; or
- Can be classified into one of the following soil forms:
    - Avalon
    - Bainsvlei
    - Bloemdal
    - Clovelly
    - Glencoe
    - Hutton
    - Oakleaf
    - Pinedene
    - Shortlands
    - Tukulu.
- The effective soil depth is equal to or greater than 900mm; and
- Topsoil clay content between 10 and 35%.

High potential here means prime or unique. Prime refers to the best available land, mainly from the national perspective, suited to and capable of consistently producing acceptable yields of a wide range of crops (food, feed, forage, fibre and oilseeds), with acceptable expenditure of energy and economic resources and minimal damage to the environment. Unique agricultural land means land that is or can be used for producing specific high value crops. Permanent irrigation means the availability for, and regular artificial application of, water to the soil for the benefit of growing crops. The application may be seasonal.

4.1.2 Land capability of soils in South Africa

Scotney et al. (1991) within the concept of land capability defines land capability as —the extent to which land can meet the needs of one or more uses under defined conditions of management, without permanent damage. Land capability is an expression of the effect of physical factors (e.g., terrain form and soil type), including climate, on the total suitability and potential for use for crops that require regular tillage, for grazing, for forestry and for wildlife without damage. Land capability involves the consideration of (i) the risks of damage from erosion and other causes, (ii) the difficulties in land use caused by physical factors, including climate and (iii) the production potential‖ (Scotney et al., 1991).

The current land capability data set that is used as the national norm indicates that there is little or no soils in South Africa that are not subject to limitations. Most of the country's soils have moderate to severe limitations largely due to limited soil depth or moderate erodibility, caused by sandy texture or slopes.

It was determined that nowhere in South Africa do best soil and good climate classes coincide (Schoeman et al, 2002).

The land capability classes used for the South African Agricultural Sector are indicated in Table 3, while Table 4 indicate limitations and land use potential for the Land Capability classes.

Table 3. Land capability classes (Schoeman *et al.* 2002)

Land Capability Class	Increased intensity of use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	Arable land
II	W	F	LG	MG	IG	LC	MC	IC	-	
III	W	F	LG	MG	IG	LC	MC	-	-	
IV	W	F	LG	MG	IG	LC	-	-	-	
V	W	-	LG	MG	-	-	-	-	-	Grazing land
VI	W	F	LG	MG	-	-	-	-	-	
VII	W	F	LG	-	-	-	-	-	-	
VIII	W	-	-	-	-	-	-	-	-	Wildlife

W - Wildlife
F - Forestry
LG - Light grazing
MG - Moderate grazing
IG - Intensive grazing
LC - Light cultivation
MC - Moderate cultivation
IC - Intensive cultivation
VIC - Very intensive cultivation

Table 4. Land capability Classes: Limitations & land use

Land Capability Class	Definition	Conservation Need	Use suitability
I	No or few limitations. Very high arable potential. Very low erosion hazard.	Good agronomic practice.	Annual cropping.
II	Slight limitations. High arable potential. Low erosion hazard.	Adequate run-off control.	Annual cropping with special tillage or ley (25%)
III	Moderate limitations. Some erosion hazards.	Special conservation practice and tillage methods.	Rotation of crops and ley (50 %).
IV	Severe limitations. Low arable potential. High erosion hazard.	Intensive conservation practice.	Long term leys (75 %)
V	Watercourse and land with wetness limitations.	Protection and control of water table.	Improved pastures or Wildlife
VI	Limitations preclude cultivation. Suitable for perennial vegetation.	Protection measures for establishment e.g., Sod-seeding	Veld and/or afforestation
VII	Very severe limitations. Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing and afforestation
VIII	Extremely severe limitations. Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife

From the databases of Department of Agriculture, the site has the following land capability:

- Class VI: Non-Arable: Grazing, Woodland or wildlife.

These aspects still need to be confirmed at ground level though.

Criteria for determining land capability of a piece of land are based on soil and land characteristics. These criteria related back to hazards or limitations to land use and are as follows:

- Slope %.
- Clay %.
- Effective rooting depth.
- Permeability.
- Signs of wetness.
- Rockiness.
- Soil surface crusting.

5 RESULTS

The proposed development site shows some variations in terms of soil characteristics and soil types identified during the survey. The classification of soils on the farm was based on land type description and the Binomial System for South Africa, which classifies soils into forms and families based on the diagnostic horizon of the soil profile. Exposed soil profile characteristics created by road cuttings in the field were also used in describing the local soil form. Soil identification and classification of the dominant soil type were done. The soil type and profile identified on the site will be discussed in detail in the following section.

The soils were classified into broad classes according to the dominant soil form and family as follows:

- Shallow red-yellow apedal soils of the Mispah / Glenrosa soil forms.
- Deep, red apedal soils of the Hutton soil form.

The geological formations and vegetation patterns showed a strong correlation to the major soil units mapped in the study area. The location of the soil forms in the landscape is presented in figure 3, while the land capability map is indicated in Figure 3.

5.1 Shallow red-yellow apedal soils of the Mispah / Glenrosa soil forms

Binominal Classification S.A.: Mispah / Glenrosa soil forms

Description: The shallow Mispah or Glenrosa soil forms occur on the flatter areas and has a shallow depth. The soil in this area has a sandy to sandy-loam structure forms a mosaic of Mispah and Glenrosa soils, although some areas also have exposed bedrock.

Landscape: Undulating plains (Photograph 1).

Depth: 100-250mm.

Texture: Medium coarse sandy to sandyloam soils.

Average Clay Content: 7-15%.

Agricultural Potential: Low potential soils, due to the climatic conditions and shallow gravelly to rocky nature of the soils, making these areas marginally suitable for crop cultivation under arable conditions.

Land capability: The grazing potential of these areas is low. The most suitable and optimal utilization of the area would be grazing by small livestock or game species.

Photograph 1. Shallow Mispah / Glenrosah soils on the flatter plains of the project area.

5.2 Deep red apedal soils of the Hutton soil form

Binominal Classification S.A.: Hutton soil form.

Description: Very deep soils of the Hutton soil form. Hutton soils are identified based on the presence of an apedal (structureless) "red" B-horizon. The Hutton soils found on this section of the site are localised on dyke areas and moderately deep, although it has a Moderate clay content.

Landscape: Slightly undulating plains (Photograph 2).

Depth: 600 - 1200mm.

Texture: Fine sandyloam soils.

Average Clay Content: 8-15%.

Agricultural Potential: Moderate potential soils– soils deep and often sandyloam structure that causes a medium water holding capacity, although the clay content of the soils is sufficient. Under the climatic conditions these soils would not sustain arable crop production. The most viable option for crop production on the soil form is under irrigation considering the variable rainfall and moisture availability due to higher day temperatures. Irrigation is not a common practice in the study area though and for any irrigation to be undertaken in the area, it will require the installation of several surface water impoundments as storage during the dry months. The limited water availability, high evaporation rates and high water demands by crops would therefore render crop cultivation not sustainable in the study area. The many old, cultivated fields in the larger area confirm that crop cultivation over the longer term is not a financially viable option under the prevailing climatic conditions.

Land capability: Livestock and / or game grazing are viable due to the slightly higher nutrient and organic content of the topsoil in woodland areas that support a mixture of palatable and unpalatable species.

Photograph 2. Typical natural landscape associated with the deep Hutton soils

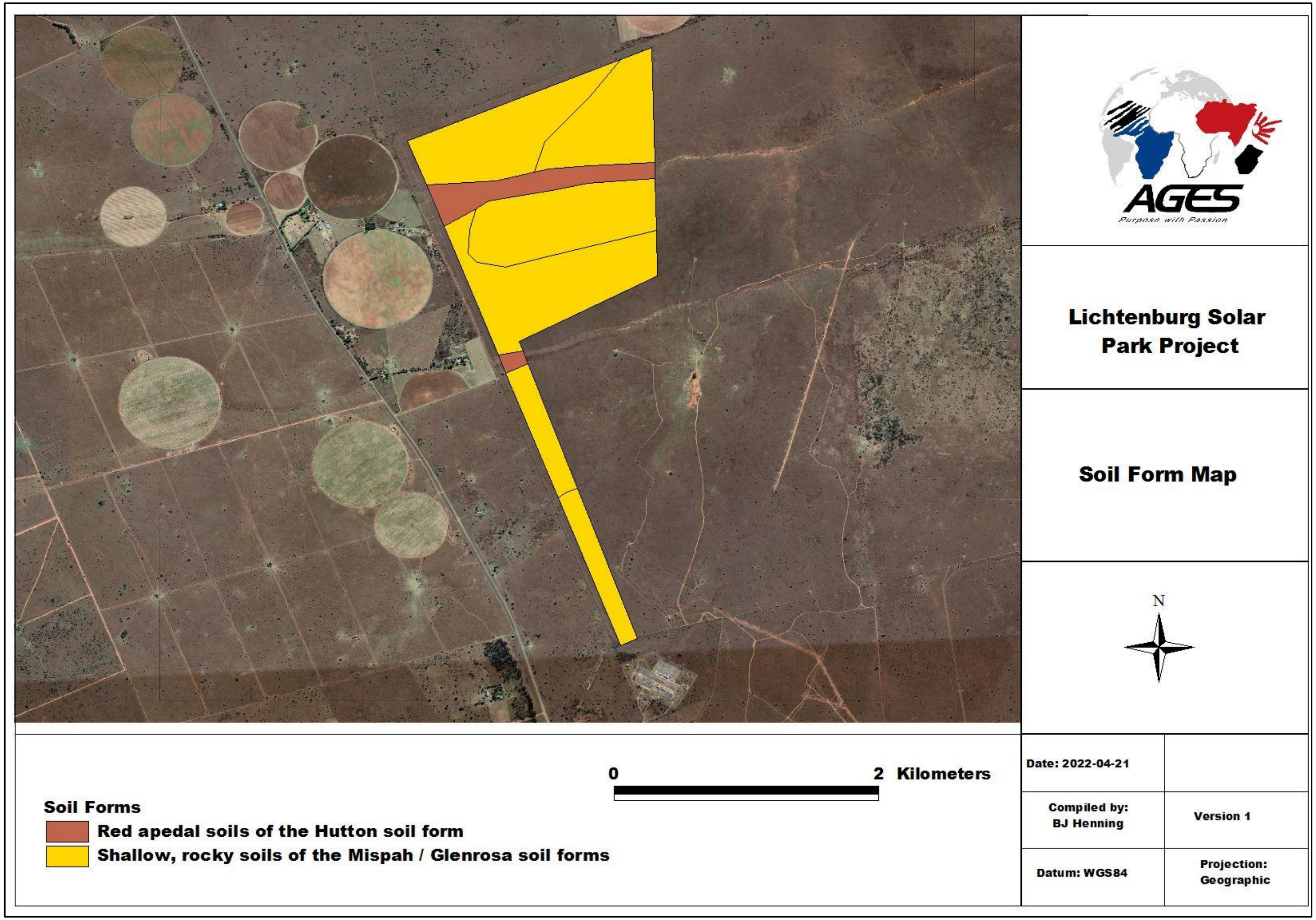

Figure 3. Soil Form Map

6 AGRO-ENTERPRISE AND LAND CAPABILITY

Land capability is a system that was developed by the U.S. Department of Agriculture in the 1950s. It separates soils into classes of increasing land use limitations. Criteria used in the original system related only to soil physical properties and not soil fertility. If land capability is to be utilised in the agricultural sector, soil fertility parameters alongside yield data need to be considered (Bouma, 2000). Increasingly this has been the case with the development of soil potential mapping. The land capability map of the area is indicated in Figure 6.

6.1 Change in land productivity for last 5 years

The site has not been changed in the last 5 years.

6.2 Change in employment figures

In terms of employment from an agricultural point of view no changes occurred recently on the site considering that the site was used for wildlife grazing.

6.3 Alternative development footprint assessment on low or medium sensitivity areas

The areas with a low or medium sensitivity from an agricultural point of view was not considered suitable due to having shallow and rocky soils that is not considered suitable for the construction process of the solar plant. The rocky areas are also ecologically sensitive and therefore not considered as suitable for the development.

6.4 Potential long-term benefits of development in relation to agricultural activities

The long-term benefit of the development would be job creation, compared to the current usage from an agricultural point of view that is restricted to wildlife grazing.

6.5 Agricultural activities on neighbouring land

Most of the surrounding areas is used for livestock and game grazing as well as crop production.

6.6 Arable land (crop production)

The proposed development site is composed of sandy to sandy-loam soils. From the soil textural analysis, it can be concluded that the soil has a clay content varying between 4 and 10%. The soils are further predominantly red-yellow apedal soils with a loamy texture, with some section shallow and gravelly, although most of the site consist of shallow Mispah soils. The areas with shallow soils render these areas unfavourable for effective crop production which could result from high moisture demands by planted crops. The red apedal soils have a marginal potential for arable crop production, although these areas are limited and does not constitute an economically viable farming unit.

The farm is also expected to receive an annual total rainfall of about 600 mm which is relatively low and highly variable. In addition, the farm is in an area which is marginal to dry for rain-fed arable crop production. Economically viable farming is thus, restrictive to irrigated cropping due the high risk that could be associated with dry-land farming. At present no irrigation or centre pivots occur on the property. Furthermore, higher day temperatures and evaporation rates in summer months may hamper soil moisture storage for crop use.

6.7 Grazing land (Livestock production)

The current vegetation at the proposed site of development consists mainly of areas of native woody perennial species and unpalatable grasses (low quality grazing grass species) on the shallow, to gravelly soils. Mixed quality grazing (highly palatable and unpalatable grasses) occurs in the central section of the site and these areas can support limited grazing by livestock and game species. The nature of the vegetation and size of the properties make the area marginal for extensive livestock production. Using planted pasture to supplement livestock production is also not an option considering the limited water availability for extensive irrigation.

Considering that re-growth of grass will take place under the panels as the mounting systems are at least 1m above ground level, the grazing value of the land will still be available to small livestock such as game, goats and sheep. At the end of the lifetime of the solar plant, structures will be removed and natural vegetation will re-establish naturally. The grazing value of the land can therefore be increased by using planted pasture underneath the solar panel mounts.

The nature of the vegetation at the farm is therefore marginal for extensive livestock production. The low agricultural potential of the soils and the low to moderate grazing capacity is further confirmed by the Agricultural Maps below:

- Land Capability Map - site is classified as Non-arable – Moderate to low potential grazing land (Figure 4). Classes VI and VII.

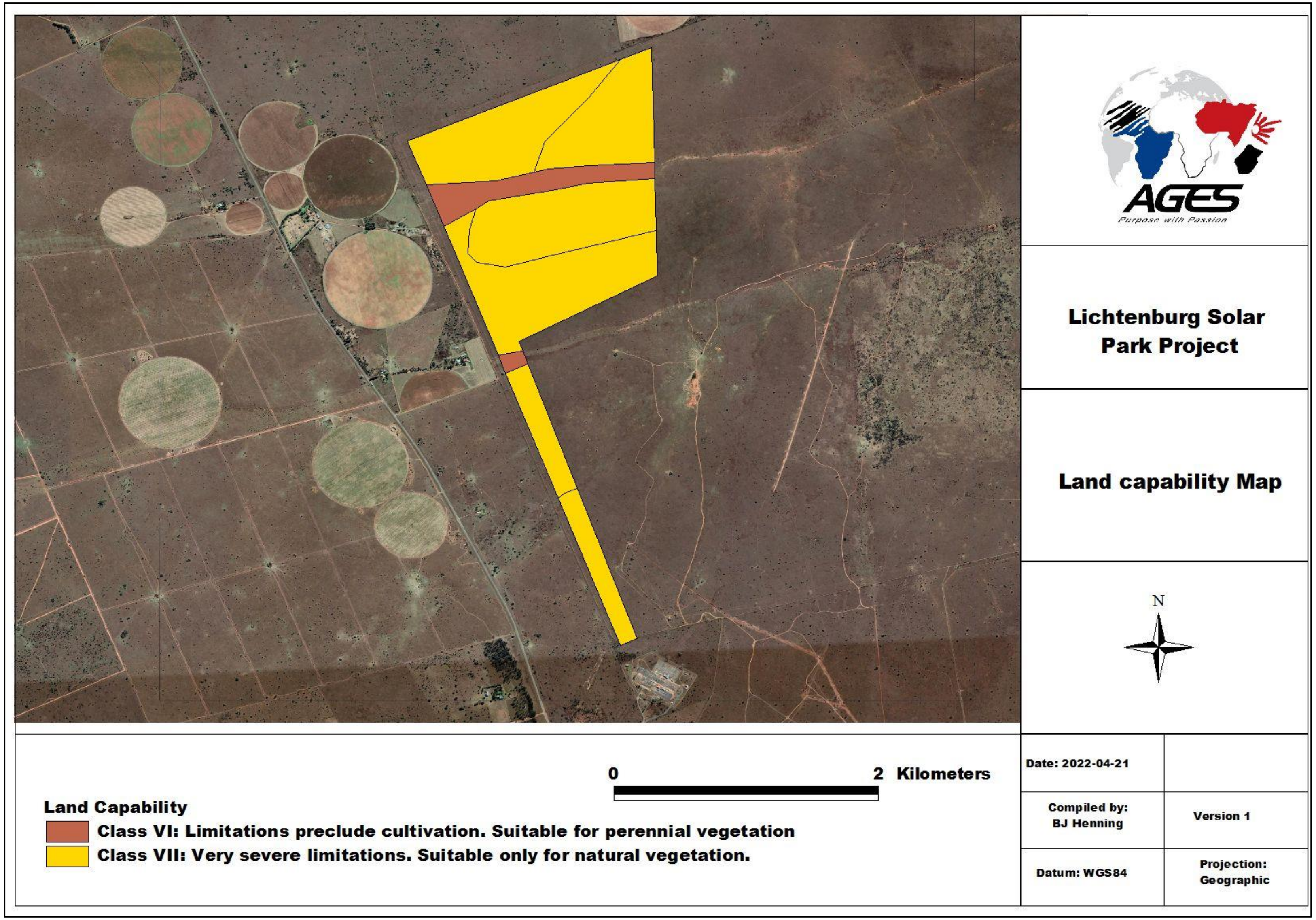

Figure 4. Land Capability Map of the project area

7 ANTICIPATED SOIL IMPACTS ON AGRO-ECOSYSTEM

The impacts associated with the proposed development on the agro-ecosystem capability will depend on the specific area where the development will take place. If the activities take place along the slightly undulating terrain the impacts will be lower with only marginal erosion risks that can be managed though proper mitigation measures. The mitigation of the overall impacts on soils (compaction, erosion) will be easier on these flatter areas.

The following list of impacts is anticipated with the proposed developments on the soils and land capability in the area during the construction phase:

- Disturbance of soils (Soil compaction, erosion and crusting).
- Sterilisation of soil (soil stripping).
- Soil contamination due to leaching of soluble chemical pollutants.
- Loss of current and potential agricultural land.

7.1 PLANNING AND DESIGN PHASE

Planning and design are necessary to ensure that mitigation and impact management can be effectively implemented and minimise impacts in future. The planning and design phase of the solar plant will involve the following actions:

- Layout avoidance of sensitive soil types associated with soils with high erosion / compaction risk.

No specific direct impacts will occur on the soils of the area during this phase.

7.2 Construction Phase

The development and start-up of the solar plant development covers the period when considerable changes take place as the infrastructure and services are constructed. The most immediate impacts are disruptions and disturbances to soil including stripping of topsoil and exposure of soils due to site clearance for construction of the solar plant and associated infrastructure. This is usually a significant change to the visual appeal of the area.

Exposure of rocks, ore and soils to rainfall and wind may lead to atmospheric contamination from fugitive dust and increased erosion of the site and sedimentation of local water courses. An increase in the movement of construction vehicles will result in an increase in the dust levels in the area. The following impacts will occur during the construction phase of the solar plant:

- **Soil compaction** occurs when soil particles are pressed together, reducing pore space between them. Heavily compacted soils contain few large pores and have a reduced rate of both water infiltration and drainage from the compacted layer. In addition, the exchange of gases slows down in compacted soils, causing an increase in the likelihood of aeration-related problems. Finally, while soil compaction increases soil strength (the ability of soil to resist being moved by an applied force), compacted soil also means that roots must exert greater force to penetrate the compacted layer. In the case of the construction activities associated with the proposed solar plant, soil compaction will be caused by regular heavy vehicle movement (wheel impact) and laydown areas of stockpiles on soils during construction. If mitigation measures are not implemented the effect of the compaction will negatively affect the soil structure of soils on the site.
- **Soil erosion and sedimentation**: Development activities may further result in widespread soil disturbance and is usually associated with accelerated soil erosion, particularly in the study area during the summer months that receives high rainfall. Soil is especially prone to erosion once the topsoil has been stripped, leaving the subsoil exposed to wind and water erosion. Any soils left exposed throughout the construction phase could lead to significant erosion of the soils in the vicinity of the development. Soil, sediments and associated contaminants are transported into streams, rivers and other water bodies, resulting in the loss or alteration of habitats for aquatic organisms, as well as changes in water quality. The hardened surfaces and compacted soils of the development area will also lead to an increase in surface run-off during storm events which will likely be discharged via stormwater outlet points, concentrating flows leaving the development area. Soil erosion also promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora.
- **Soil pollution**: Construction work of the magnitude contemplated for the proposed solar plant will always carry a substantial risk of soil pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. Building waste, batching plants, sewage and domestic waste are also potential contributors to this problem. If not promptly dealt with, spillages or accumulation

of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on soil chemical composition.

- **Soil destruction** is a form of soil degradation that involves the destruction of natural soil bodies and all the parameters that led to the formation of the soil. Stripping of the topsoil during construction will remove the fertile layer of the soil. This will result in the loss of the soil carbon content as well as soil micro-organisms that support the soil nutrient cycles. Topsoil stripping will mostly occur during the foundation digging of residences.
- **Loss of land capability**: This impact involves the loss of land available for farming and tourism: The area where the solar plant is proposed is in an area used for game farming, livestock grazing and some crop farming although solar plant development activities also occur in the broader area. The land in general has a low capability for crop cultivation, except under extensive irrigation on large pockets of land and deeper soil forms and can mostly be utilized as grazing for wildlife. The construction of the proposed solar plant will result in a total loss of the land capability as it currently is and will change the current land use from agriculture and grazing to residential land-use.

8 MITIGATION MEASURES / MANAGEMENT OF SOILS

8.1 Soil compaction

- Soil should be handled when dry during removal and placement to reduce the risk of compaction.
- Vegetation (grass and small shrubs) should not be cleared from the site prior to construction except if vegetation requires relocation as determined through an ecology assessment). This material is to be stripped together with topsoil as it will supplement the organic and possibly seed content of the topsoil stockpile depending on the time of soil stripping (whether plants are in seed or not); and
- Soil should be sampled and analysed prior to replacement during rehabilitation. If necessary, and under advisement from a suitably qualified restoration ecologist, supplemental fertilisation may be necessary.
- During construction, sensitive soils with high risk of compaction (e.g., clayey soils) must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.

8.2 Soil erosion

- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads.
- Institute a storm water management plan.
- Have both temporary (during construction) and permanent erosion control plans.
  - Temporary control plans should include:
    - Short-term seeding or mulching of exposed soil areas (particularly on slopes)
    - Limitations on access for heavy machinery and the storage of materials to avoid soil compaction.
  - Permanent erosion control plans should focus on the establishment of stable native vegetation communities.
- Other mitigation measures needed to prevent soil erosion include:
  - Ensure the amount of bare soil exposed is minimized by staging earthworks in phases and leaving as much ground cover intact as possible during construction.
  - Protect all areas susceptible to erosion and ensure there is no undue soil erosion resultant from activities in and adjacent to construction camp and work areas.

8.3 Soil pollution

- Chemicals to be stored on an impervious surface protected from rainfall and storm water run-off.
- Spill kits should be on-hand to deal with spills immediately.
- Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance.
- All construction vehicles should be inspected for oil and fuel leaks regularly and frequently. Vehicle maintenance will not be done on site except in emergency situations in which case mobile drip trays will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

8.4 Soil destruction and sterilisation

- Conservation of topsoil should be prioritized on site and done as follows:
  - Topsoil should be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify.
  - Stockpile topsoil separately from subsoil.
  - Stockpile in an area that is protected from storm water runoff and wind.
  - Topsoil stockpiles should not exceed 2.0 m in height and should be protected by a mulch cover where possible.
  - Maintain topsoil stockpiles in a weed free condition.
  - Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it.
  - Stockpile topsoil for the minimum time possible i.e., strip just before the relevant activity commences and replace as soon as it is completed.

8.5 Loss of land capability

No specific mitigation can be applied during the construction phase itself to prevent loss of land capability considering that the land use will change to industrial. This, however, does not prevent the development from ensuring that disturbance and clearing should be confined to the footprint areas of the solar plant and not over the larger area. This can be done in the following ways:

- Corridors should be secured around the development footprint areas to ensure the current land use (grazing and agriculture) surrounding the site can continue in a functional way after construction.

- Clearly demarcate the entire development footprint prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This could be done through the fencing of the entire development footprint and institute strict access control to the portions of the owner-controlled property that are to remain undisturbed as soon as possible after initial site clearance. The fence should preferably be impermeable (for example a solid wall) to discourage invertebrates and small animals from entering the site. [Normally solid perimeter walls are not recommended to facilitate the movement of invertebrates, but in this case restriction of their movement into the area will be advantageous.]
- All development activities should be restricted to specific recommended areas and strict buffer zones should be applied around the sensitive areas. The Environment Control Officer (ECO) should demarcate and control these areas. Unnecessary bulldozing through the veld should be avoided.

9 DISCUSSION & CONCLUSION

Based on Part 1 of the Regulation of Conservation of Agricultural Resources Act 43 of 1983, the proposed area, earmarked for the for the proposed development of the Photovoltaic Stellar Solar Park on Portion 17 of the Farm Turffontein 14 Ks Polokwane Local Municipality, Capricorn District, Limpopo Province. can be classified as having Moderate to Low potential soils because of the following:

It is low potential on the shallow soils because:

- The shallow and often sandy nature of the soil makes the potential to cultivate crops under arable conditions basically impossible, especially considering that the shallow soils would not allow ploughing of the topsoils. Therefore, the site should be classified as not suitable for arable agriculture due to its physical characteristics.

It is of Moderate to marginal arable potential on the reddish apedal soils because:

- Although the soil texture and depth are suitable for arable agriculture, the climatic conditions render the soils unsuitable for arable agriculture.

The results indicate that the agricultural potential of soils on the proposed development area varies from low (shallow, soils or very sandy to sandyloam soils with limited suitability for grazing) to moderate (deeper, red apedal soils with moderate potential for grazing). The results obtained from the study were done after field observations were done to verify the soil potential classified by the Department of Agriculture on a small scale. The site should subsequently be considered as moderate potential grazing land with Moderate to low potential for arable agriculture considering the climatic conditions, soil physical characteristics and size of land potentially available.

The impacts associated with the proposed development on the agro-ecosystem capability will depend on the specific area where the development will take place. The following list of impacts is anticipated with the proposed developments on the soils and land capability in the area during the construction phase:

- Disturbance of soils (Soil compaction, erosion and crusting).
- Sterilisation of soil (soil stripping).
- Soil contamination due to leaching of soluble chemical pollutants.
- Loss of current and potential agricultural land.

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance. Furthermore, the proposed layout plan of the solar plant should be consistent with the agro-ecosystem maps and recommendations stipulated in this report, and the impact on the sensitive soil forms on site should be kept to a minimum.

Statement: Provided that the proposed development and layout plans is consistent with the agro-ecosystem sensitivity map and take all the mitigation measures into consideration stipulated in this report, the planned development can be supported.

10 REFERENCES

Acocks, J.P.H. Veld Types of South Africa, Botanical Research Institute, Pretoria.

ARC. Areas in which high potential agricultural land may occur, superimposed on moisture availability zones. 2002. Map Scale: 2 500 000. Project No. 041_2000/bw/Mois.gra.

ENPAT, 2000. Environmental Potential Atlas. Department of Environmental Affairs and Tourism, Pretoria.

Franzmeir, D.P., E.J. Pedersen, T.J. Longwell, J.G. Byrne, and C. Losche. 1969. Properties of some soils in the cuberland plateau as related to slope aspect and position. Soil Sci. Soc. Am. Proc. 33:755-761.

Jiang, P., and K.D. Thelen. 2004. Effect of soil topographic properties on crop yield in north-central corn-soybean cropping system. Agron. J. 96:252-258.

Laker, M.C. 2005. South Africa's soil resources and sustainable development. http://www.environment.gov.za/nssd_2005/Web/NSSD%20Process%20Documents%20and%20Reports/REVIEW_Soil_and_Sustainability_Oct 05.pdf.

Low, A.B. &Rebelo, A.G. (eds). 2006. Vegetation of South Africa, Lesotho and Swaziland, Dept Environmental Affairs & Tourism, Pretoria.

Macvicar, C. N. 1991. Soil Classification: A Taxonomic system for South Africa. Department of Agriculture, Pretoria.

Mucina L., Rutherford M.C. &Powrie L.W. (eds) (2005). Vegetation Map of South Africa, Lesotho and Swaziland, 1:1000000 scale sheet maps.

Peverill, K.I., L.A. Sparrow, and D.J. Reutter. 1999. Soil Analysis, an Interpretation Manual. CSIRO Publication. Collingwood, Victoria. Australia

Schoeman, J.L. National Department of Agriculture. 2004. Criteria for prime or unique agricultural land in South Africa. Report Number GW/A/2002/21.

Soil classification working group. 1991. Soil classification, A Taxonomic System for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development. Pretoria.

Stone, J.R., J.W. Gilliam, D.K. Cassel, R.B. Daniels, L.A. Nelson, and H.J. Kleiss. 1985. Effect of erosion and landscape position on the productivity of piedmont soils. Soil Sci. Am. J. 49:987-991.

Van Der Merwe, C. R. 1952. Soil Groups and subgroups of South Africa. Science Bulletin 356.