Soil, Land Use, Land Capability and Agricultural Potential Assessment for the Proposed Moeding PV Solar Facility and Associated Infrastructure

Submitted by TerraAfrica Consult cc
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Executive Summary

Baseline description

The proposed affected area of the Moeding Solar PV Facility (Moeding Solar) lies within a larger area where cattle farming is the dominant land use. Other land uses in the area include residential areas (the town of Vryburg and the settlement of Huhudi in close proximity) and a school across the road from the affected area. Up to twenty-three other solar projects (in different stages of development) are also being envisaged within a 30km radius around the affected area associated with the Moeding Solar project.

In order to determine the baseline pre-project land capabilities and current land uses, a soil site investigation was conducted using the newly released Soil Classification: A Natural and Anthropogenic System for South Africa (2018). The affected area that was assessed is 642 ha and of this area, 632 ha consists of very shallow, rocky soil underlain by either solid rock, hardpan carbonate or soft carbonate horizons. The remaining 10 ha consists of a combination of hydromorphic soil forms that is the base of the endorheic pans in the area and a small area of deeper red Hutton soil that is the base of higher quality grazing land.

The soil of the affected area is not suitable for irrigated or dryland crop production. It is only suitable for grazing of livestock, although at a density of 10 – 12 hectares per large stock unit (one head of cattle) which is considered of intermediate value. The areas where the endorheic pans are present has wetland land capability and even though it is only saturated with water on a seasonal base (permitting that there was sufficient rainfall), it supports important ecosystem services within the landscape.

Impact Assessment and Management Measures

Three main potential impacts resulting from the proposed project's construction and operation phases are considered to alter the baseline properties described above. These impacts are:

1. Soil erosion caused by construction and operations
2. Soil chemical pollution caused by construction and operations
3. Loss of current land capability as a result of construction activities

Erosion should be mitigated by limiting unnecessary land clearance, doing dust suppression on soil stockpiles and the use of erosion control mats. Revegetation of cleared areas and stormwater management are important erosion control measures during the operational phases.

Soil chemical pollution can be prevented by regular checks on vehicles and construction machinery and the use of impermeable surfaces for storage tanks and vehicle parking. Should a spill occur or any waste be detected during monitoring procedures, immediate clean-up is required.

The loss of the current land capability happens once construction starts and this impact should be limited to the project site boundaries as there are no other mitigation measures.

DEFINITIONS AND ACRONYMS

Base status: A qualitative expression of base saturation. See base saturation percentage. Base saturation refers to the proportion of the cation exchange sites in the soil that are occupied by the various cations (hydrogen, calcium, magnesium, potassium). The surfaces of soil minerals and organic matter have negative charges that attract and hold the positively charged cations. Cations with one positive charge (hydrogen, potassium, sodium) will occupy one negatively charged site. Cations with two positive charges (calcium, magnesium) will occupy two sites.

Calcareous: Containing calcium carbonate or magnesium carbonate.

Cutan: Cutans occur on the surfaces of peds or individual particles (sand grains, stones). They consist of material which is usually finer than, and that has an organisation different to the material that makes up the surface on which they occur. They originate through deposition, diffusion or stress. Synonymous with clayskin, clay film, argillan.

Erosion: The group of processes whereby soil or rock material is loosened or dissolved and removed from any part of the earth's surface.

Fertilizer: An organic or inorganic material, natural or synthetic, which can supply one or more of the nutrient elements essential for the growth and reproduction of plants.

Fine sand: (1) A soil separate consisting of particles 0,25-0,1mm in diameter. (2) A soil texture class (see texture) with fine sand plus very fine sand (i.e. 0,25-0,05mm in diameter) more than 60% of the sand fraction.

Gleying: The process whereby the iron in soils and sediments is bacterially reduced under anaerobic conditions and concentrated in a restricted horizon within the soil profile. Gleying usually occurs where there is a high water table or where an iron pan forms low down in the soil profile and prevents run-off, with the result that the upper horizons remain wet. Gleyed soils are typically green, blue, or grey in colour.

Land capability: The ability of land to meet the needs of one or more uses under defined conditions of management.

Land type: (1) A class of land with specified characteristics. (2) In South Africa it has been used as a map unit denoting land, map able at 1:250000 scale, over which there is a marked uniformity of climate, terrain form and soil pattern.

Land use: The use to which land is put.

Orthic A horizon: A surface horizon that does not qualify as organic, humic, vertic or melanic topsoil although it may have been darkened by organic matter.

Ped: Individual natural soil aggregate (e.g. block, prism) as contrasted with a clod produced by artificial disturbance.

Pedology: The branch of soil science that treats soils as natural phenomena, including their morphological, physical, chemical, mineralogical and biological properties, their genesis, their classification and their geographical distribution.

Saline, soil: Soils that have an electrical conductivity of the saturation soil extract of more than 400 mS/m at 25°C.

Slickensides: In soils, these are polished or grooved surfaces within the soil resulting from part of the soil mass sliding against adjacent material along a plane which defines the extent of the slickensides. They occur in clayey materials with a high smectite content.

Swelling clay: Clay minerals such as the smectites that exhibit interlayer swelling when wetted, or clayey soils which, on account of the presence of swelling clay minerals, swell when wetted and shrink with cracking when dried. The latter are also known as heaving soils.

Texture, soil: The relative proportions of the various size separates in the soil as described by the classes of soil texture shown in the soil texture chart (see diagram on next page). The pure sand, sand, loamy sand, sandy loam and sandy clay loam classes are further subdivided (see diagram) according to the relative percentages of the coarse, medium and fine sand sub-separates.

Vertic, diagnostic A-horizon: A-horizons that have both, high clay content and a predominance of smectitic clay minerals possess the capacity to shrink and swell markedly in response to moisture changes. Such expansive materials have a characteristic appearance: structure is strongly developed, ped faces are shiny, and consistence is highly plastic when moist and sticky when wet.

Declaration of EAP

Details of practitioner

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Declaration of Independence

I, Mariné Pienaar, hereby declare that TerraAfrica Consult, an independent consulting firm, has no interest or personal gains in this project whatsoever, except receiving fair payment for rendering an independent professional service.

I further declare that I was responsible for collecting data and compiling this report. All assumptions, assessments and recommendations are made in good faith and are considered to be correct to the best of my knowledge and the information available at this stage.

TerraAfrica Consult cc represented by M Pienaar
December 2018

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1. Introduction

Savannah Environmental (Pty) Ltd appointed Terra Africa Consult to conduct the soil, land use and land capability study as part of the Basic Assessment process for a proposed Moeding Solar PV Facility (Moeding Solar). The proposed project site is located approximately 8km south of Vryburg in North West Province (Figure 1). The affected properties include the following properties:

- Portion 1 of the farm Champions Kloof 731
- Portion 4 of the farm Waterloo 730
- Remaining Extent of Portion 3 of the farm Waterloo 730
- Remaining Extent of the farm Rosendal 673

The purpose of the study is to determine and describe the baseline soil properties and the land capabilities and land uses associated with it within the proposed project's direct and indirect areas of influence from on-site investigations and data currently available. It also assists with the identification of gaps in information. This report complies with the requirements of the NEMA and environmental impact assessment (EIA) regulations (GNR 326 of 2014 as amended). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014 as amended)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 (as amended) must contain:	Relevant section in report
Details of the specialist who prepared the report	Page vi
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix 2
A declaration that the person is independent in a form as may be specified by the competent authority	Page vi
An indication of the scope of, and the purpose for which, the report was prepared	Pages 14
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 8.2
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 8
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Sections 9 & 10
An identification of any areas to be avoided, including buffers	Not identified
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;	Figure 2, page 21
A description of any assumptions made and any uncertainties or gaps in knowledge;	Sections 5 & 6

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	Relevant section in report
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 10
Any mitigation measures for inclusion in the EMPr	Section 10
Any conditions for inclusion in the environmental authorisation	Sections 10 and 11
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	Section 12
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	Section 13
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable
A summary and copies if any comments that were received during any consultation process	Not applicable

2. Objective of the study

The objective of the Soil, Land Use and Land Capability study is to fulfill the requirements of the most recent South African Environmental Legislation with reference to the assessment and management of these natural resource aspects (stipulated in Section 3 below). The key components of assessment are to determine and describe the baseline soil properties and the land capabilities and land uses associated with it within the proposed project's direct and indirect areas of influence from on-site investigations and data currently available. It also assists with the identification of gaps in information. Once these conditions have been established, the anticipated impacts of the project on these properties can be determined. Mitigation and management measures can be recommended to minimise negative impacts and maximise land rehabilitation success towards successful closure at the end of the project life.

3. Environmental legislation applicable to study

The following South African Environmental Legislation needs to be considered for any new or expanding developments with reference to the management of soil and land use:

- The Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal. This act requires the protection of land against soil erosion and the prevention of water logging and salinisation of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.

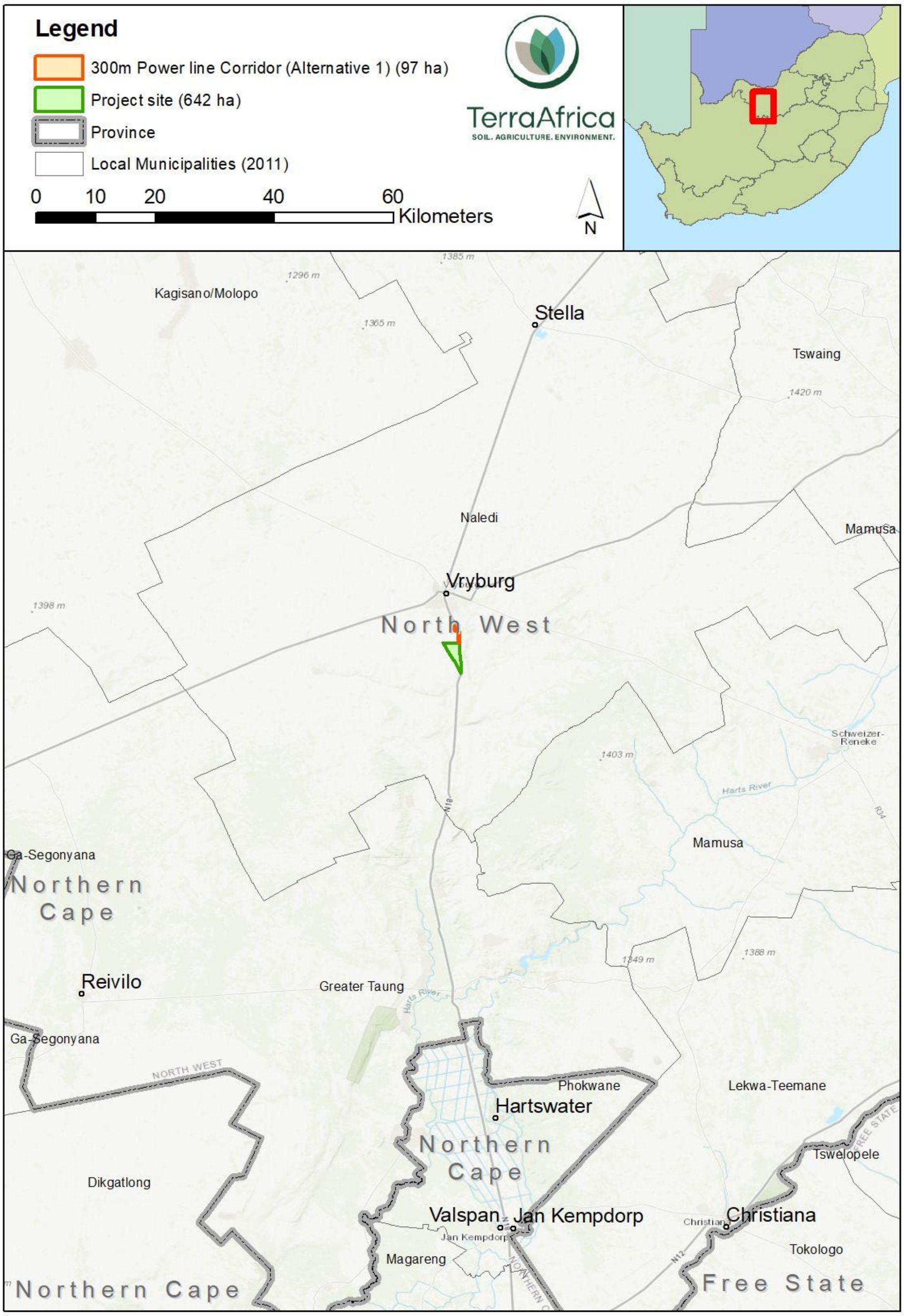

Figure 1: Locality map of the proposed project site and powerline corridor of the Moeding Solar PV Facility

- In addition to this, the National Water Act (Act 36 of 1998) deals with the protection of wetlands. This Act defines wetlands as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." This Act therefore makes it necessary to also assess soil for its hydropedological properties.

4. Terms of reference

The following Terms of Reference as stipulated by Savannah Environmental (Pty) Ltd applies to the soil, land use and land capability study:

- Undertake a desktop study and site investigation to establish broad baseline soil conditions, land capability and areas of environmental sensitivity at all the proposed alternative sites in order to rate their sensitivity to the proposed development;
- Undertake a soil survey of the proposed subject property area focusing on all landscape features including areas with potentially wetland land capability;
- Describe soils in terms of soil texture, depth, structure, moisture content, organic matter content, slope and land capability of the area;
- Classify and describe soils using the South African Soil Classification: A Natural and Anthropogenic System for South Africa;
- Identify and assess potential soil, land use and land capability impacts resulting from the proposed Moeding Solar Project;
- Identify and describe potential cumulative soil, land use and land capability impacts resulting from the proposed development in relation to proposed and existing developments in the surrounding area;
- Recommend mitigation, management and monitoring measures to minimise impacts and/or optimise benefits associated with the proposed project.

5. Assumptions

No assumptions were made in the assessment and report.

6. Uncertainties, limitations and gaps

The following uncertainties, limitations and gaps exists with regards to the study methodology followed and conclusions derived from it:

- The location of the powerline corridor was not available yet during the site visit on 18 and 19 June. Two soil reports of nearby projects were evaluated as well as land type data (as described in Section 8.1) in order to get an idea of the soil forms that are possibly present in the powerline corridor area.

- Soil profiles were observed using a 1.5m hand-held soil auger. A description of the soil characteristics deeper than 1.5m cannot be given.
- The study does not include a land contamination assessment to determine pre-construction soil pollution levels (should there be any present).

7. Response to concerns raised by I&APs

Thus far, no concerns were raised by I & APs during the Public Participation Process pertaining to the continuation of existing land uses in the surrounding area. As soon as comment is received, it will be addressed in this report.

8. Methodology

8.1 Desktop study

The following data was obtained and studied for the desktop study:

- Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 – 2006). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).
- In order to further address the gap in field survey data for the powerline corridor, two soil reports that are part of the Environmental Impact Assessments (EIAs) of neighbouring projects were assessed to gain insight into the soil properties of this area. These reports are:
  - Soil, land capability and agricultural potential assessment for the proposed Tiger Kloof Solar Photovoltaic Energy Facility conducted by Environment Research Consulting, October 2013.
  - Soil information for grid connections for the proposed Sendawo Solar Energy Plant by D.G. Patterson of the Agricultural Research Council, February 2016.

- The newly released National Land Capability Evaluation Raster Data Layer was obtained from the Department of Agriculture, Forestry and Fisheries (DAFF) to determine the land capability classes of the project site according to this system. The new data was developed by DAFF to address the shortcomings of the 2002 national land capability data set. The new data was developed using a spatial evaluation modelling approach (DAFF, 2017).
- The most recent aerial photography of the area available from Google Earth was obtained. The aerial photography analysis was used to determine areas of existing

impact, land uses within the project area as well as the larger landscape, wetland areas and preferential flow paths.

8.2 Study area survey

A systematic soil survey was undertaken during two days from 07:30 to 17:00 on 18 and 19 June 2018. The season in which the site visit took place has no influence on the results of the survey. The soil profiles were examined to a maximum depth of 1.5m using a hand-held auger. Observations were made regarding soil texture, structure, colour and soil depth at each survey point. A cold 10% hydrochloric acid solution was used on site to test for the presence of carbonates in the soil. The soils are described using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991) published as memoirs on the Agricultural Natural Resources of South Africa No.15. For soil mapping, the soils were grouped into classes with relatively similar soil characteristics.

8.3 Analysis of samples at soil laboratory

Three topsoil samples were collected at the project site. While the usual practice is to collect both topsoil and subsoil samples, the site is dominated by such shallow soil profiles that samples collected between 0 and 30 cm from the surface, is most representative of the soil chemical conditions on site. The samples were sealed in soil sampling plastic bags and sent to Eco Analytica Laboratory that is part of North West University for analyses. Samples taken to determine baseline soil fertility were analysed for pH (KCl), plant-available phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, sodium), organic carbon (Walkley-Black) and texture classes (relative fractions of sand, silt and clay).

8.4 Land capability classification

Agricultural potential is described through the term land capability. Land capability means “the most intensive long term use of land for purposes of rainfed farming, determined by the interaction of climate, soil and terrain and makes provision for eight land capability classes”. The newly developed land capability classification system that was released by the Department of Agriculture, Forestry and Fisheries (DAFF) was used to combine different soil forms into land capability units. The new system has a few strong departures from the old system developed by Schoeman et al. (2002). The new system has fifteen land capability classes as opposed to the initial eight classes. In the new system, Classes 1 to 7 are considered to be of very low land capability making it only suitable for wilderness and grazing with a variety of management measures. The remaining classes (Class 8 to 15) is considered to have arable land capability with the potential for high yields increasing with the number of the land capability class. It should be noted that this land capability classification system does not indicate wetland land capability (soils with hydromorphic properties) as a class. However, to accommodate for the hydromorphic soils, the report author has illustrated it separately on the land capability maps.

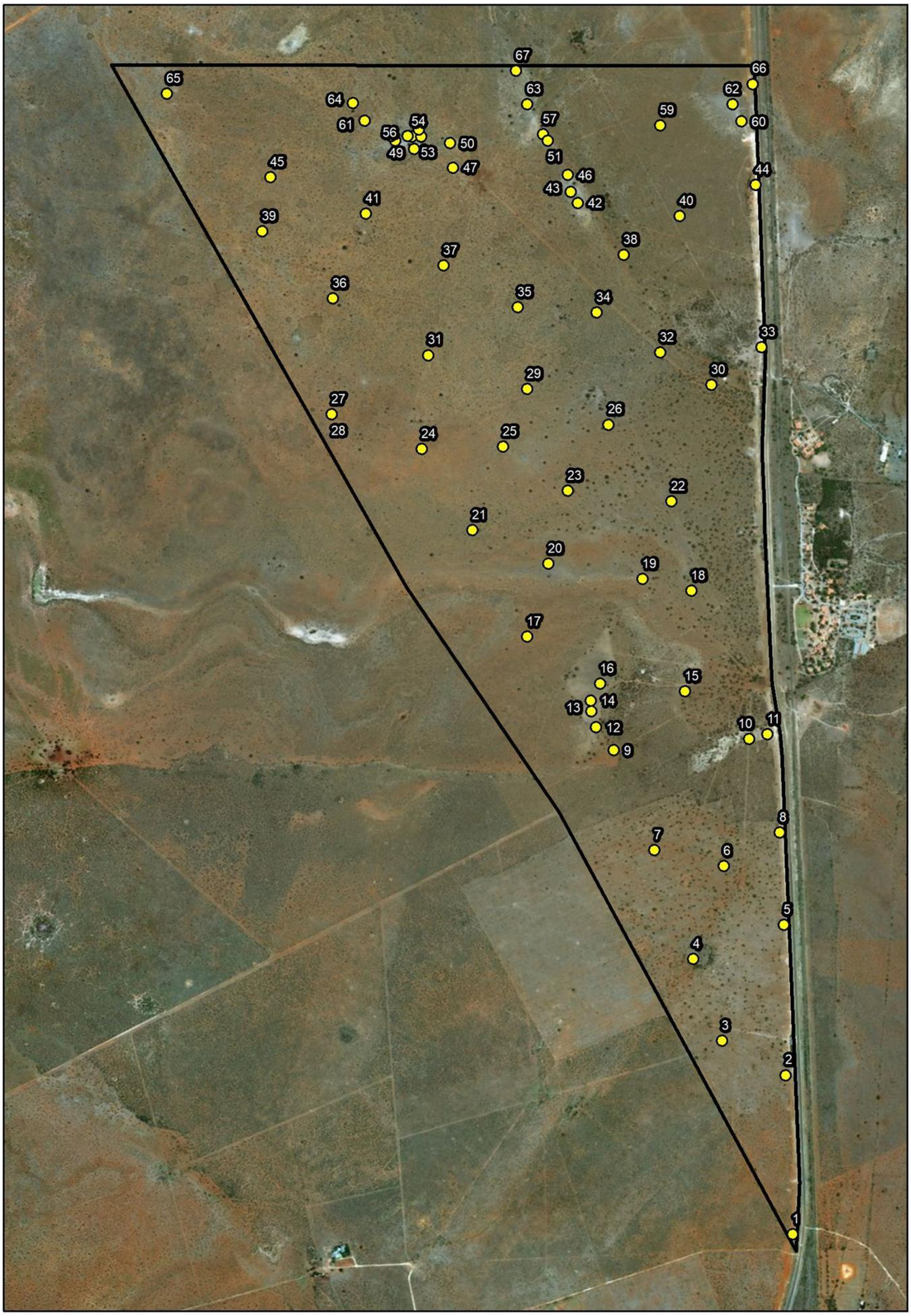

Figure 2 Survey points map of the project site of the Moeding Solar PV Facility.

8.5 Impact assessment methodology

Following the methodology prescribed by Savannah Environmental (Pty) Ltd., the direct, indirect and cumulative impacts associated with the project have been assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
    - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
    - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
    - medium-term (5–15 years) – assigned a score of 3;
    - long term (> 15 years) - assigned a score of 4; or
    - permanent - assigned a score of 5;

- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration

M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

9. Baseline conditions

9.1 Land types of the project site and powerline corridor

The projects site and powerline corridor consist of two different land types. The eastern side of the project site as well as the powerline corridor consists of Land Type Ag10 while the western side of the project site consists of Land Type Ae36. Each of the land types are described below.

Land Type Ag10

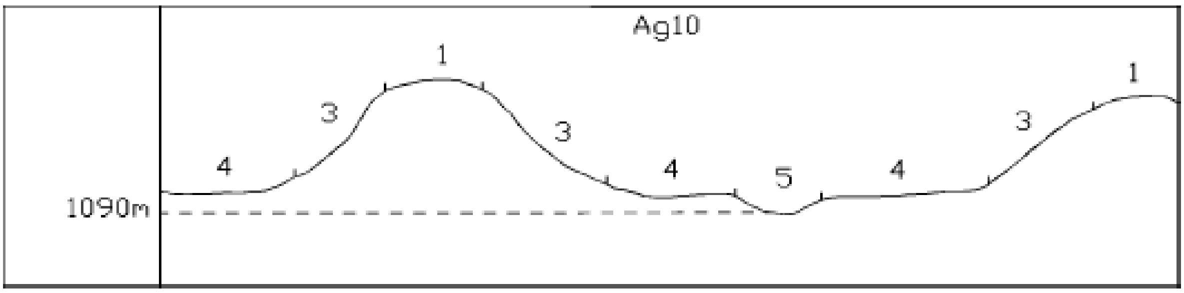

Figure 3: Terrain form sketch of Land Type Ag10

Following Figure 3, Land Type Ag 10 has four different terrain positions where Position 4 consists of flat plains dominated by the shallow rocky Mispah soil form where lithocutanic Glenrosa soils and rock outcrops also occur. Soil depths in this land type range between 100 and 300mm. The underlying geology of Land Type Ag10 is described as andesitic to basaltic lava of the Ventersdorp Supergroup that are, sometimes overlain by calcrete. Quartzite of the Vryburg Formation and Dwyka Tillite may occur in some places. Terrain position 5 indicates that small depressions with hydromorphic soil forms such as Rensburg or Bonheim may be present within this land type.

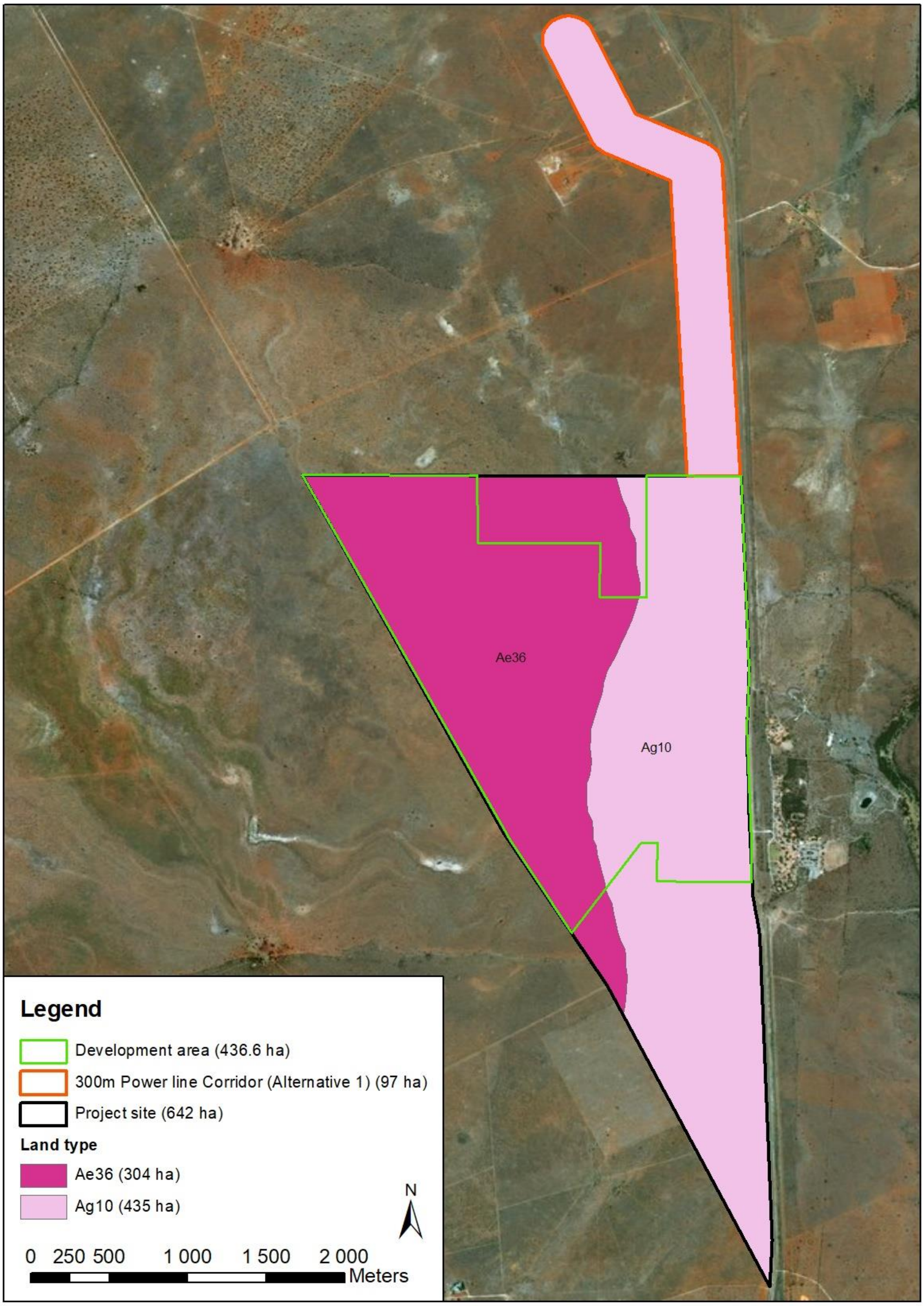

Figure 4: Land type map of the project site and powerline corridor

Land Type Ag10

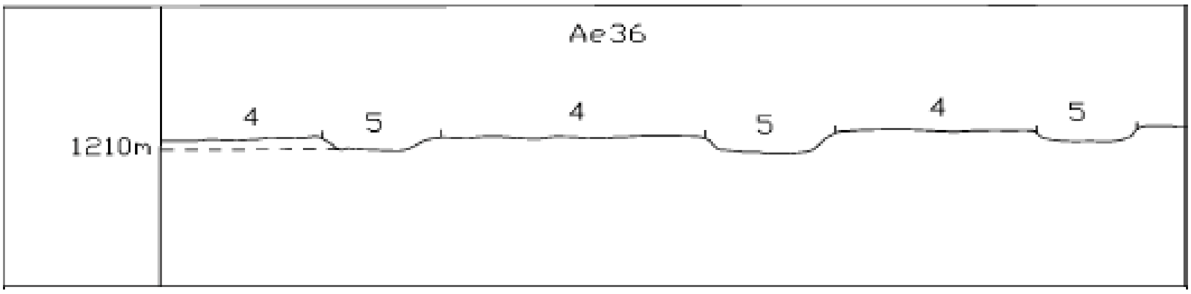

Figure 5: Terrain form sketch of Land Type Ag10

Following Figure 5, Land Type Ae36 only has two different terrain positions with the flat plains of Position 4 dominating the landscape and Position 5 indicating small depressions where water accumulates in the landscape and hydromorphic soil forms can develop. Position 4 consists of a combination shallow, rocky soil of the Mispah and Glenrosa soil forms ranging in depth between 100mm and 300mm interspersed with soil forms such as Hutton, Clovelly, Rensburg and Arcadia. Position 5 is dominated by soil forms with higher clay content such as the two vertic soil forms (Rensburg and Arcadia).

9.2 Soil forms present in the affected area

Eleven different soil forms are present within the project site. These eleven soil forms have been grouped into nine groups (Figure 3). The very shallow to shallow soil of the Mispah, Hutton, Brandvlei and Coega forms have been grouped together since they occur in close proximity to each other over large areas. The vegetation supported by these soil forms are uniform. In addition to this group, very small pockets of other soil forms such as Rensburg, Arcadia, Dresden and Prieska are present in isolated patches.

A large portion of the powerline corridor area overlap with the area that was surveyed by Environment Research Consulting for the purpose of the EIA for the proposed Tiger Kloof Solar Photovoltaic Energy Facility. This report indicates that the powerline corridor area consist of the Mispah soil form. Following this report as well as the land type data assessed, this area was included in the main soil mapping group (Mispah/Glenrosa/Shallow Hutton/Coega/Brandvlei) that is discussed below. In order to verify this inclusion, a walk-through site visit before the construction phase of the project commences, will be recommended.

Below follows a description of each of the soil groups and forms identified:

Mispah/Glenrosa/Shallow Hutton/Coega/Brandvlei

These soil forms have been grouped together for the soil mapping of the affected area of the proposed Moeding Solar PV Project. This group dominates the soil properties of the affected area (642 ha or 98% of the area classified). All the soil profiles observed in these areas have very shallow soil depth (450mm or less) and are underlain by a variety of underlying material ranging from rock (Mispah) and lithic material (Glenrosa) to unspecified material (Hutton), soft carbonate (Brandvlei) and hardpan carbonate (Coega). These soil forms underlie a homogeneous vegetation type with some variation between the carbonate C-horizons and the rock and weathering rock. However, the dominant soil physical property (shallow soil depth) as well as texture (very sandy soil), is homogeneous for the entire area. The different shallow soil forms occur in an interspersed mixture over this area with changes in underlying material ranging from a few meters to more than 500m apart.

This soil group supports indigenous vegetation that is currently used for cattle grazing. The grazing capacity in these areas are low as a result of the combination of shallow soil depth and erratic rainfall patterns. The land capability of this soil group is low to moderate.

Hutton form

Differentiation was made between the very shallow Hutton soil forms that are part of the group discussed above and a small pocket of deeper red Hutton profiles located in the south-western portion of the affected area. This area consists of 1.8 ha (0,3% of the project site) of red apedal profiles ranging in depth between 700mm and 950mm deep. The Hutton soil form consists of an orthic A horizon on a red apedal B horizon overlying unspecified material. The red apedal soils B1-horizon has more or less uniform "red" soil colours in both the moist and dry states and has weak structure or is structureless in the moist state (Soil Classification Working Group, 1991). Hutton soils with no restrictions shallower than 50cm are generally good for crop production, permitting that the rainfall is sufficient (Fey, 2010). This pocket of Hutton soil has moderate land capability and may be suitable for irrigated crop production if there was any irrigation water and infrastructure present.

Rensburg and Arcadia forms

Both the vertic soil forms have been identified on site in the northern part of the project site. While the Arcadia form represents a deep vertic horizon with unspecified underlying material, the Rensburg form consists of a vertic A horizon underlain by a G-horizon. The G-horizon is also referred to as a gleyed horizon and is indicative of wetlands in a landscape. While the Arcadia form is not traditionally a hydromorphic (wetland) soil form, it is often found in lower-lying positions in the landscape where water accumulate. The high clay content of the vertic horizon provides this soil with high water-holding capacity that dries out much slower than the surrounding sandy profiles after a rainfall event. It was also evident during the site visit that the small pocket of Arcadia soils (0.2 ha) forms part of a larger endorheic pan. The land capability of the Arcadia form is therefore assigned as wetland land capability. The Rensburg form occurs in two small areas within the affected area that makes up a total area of 0.9 ha.

Dresden form

The Dresden form was identified in two small different sections in the northern part of the affected area. It forms part of a larger endorheic pan and totals an area of 1.9 ha. The Dresden soil form consists of an orthic A horizon overlying a hard plinthic B horizon. The hard plinthic B horizon has very slow to no permeability for water and therefore allows for water accumulation on top of it. This results in the development of yellow and orange mottles in the topsoil directly above it. These mottles are an indication of water fluctuation and periodic water saturation. The orthic A horizon of these profiles on site were never deeper than 350mm. The Dresden soil has wetland land capability.

Fernwood and Katspruit forms

A large endorheic pan system located just south-west of the middle of the affected property, consists of a combination of the Fernwood (1 ha) and Katspruit (0.4 ha) forms. While the Katspruit form is always considered a wetland soil form, deep Fernwood profiles are considered more typical of crop fields in certain regions than wetlands. However, the Fernwood soil identified on site was between 350 and 450 mm deep and underlain by rock and weathering rock. However, signs of wetness was present in the E-horizon.

The Katspruit form consists of an orthic A horizon overlying a G-horizon. The Katspruit profiles are between 350mm and 550mm deep. Both these soil forms have wetland land capability.

Prieska form

The Prieska soil form (1.8 ha) is present in the north-eastern corner of the project site. The soil profiles here are deeper (500 to 950mm) and consist of an orthic A horizon, overlying a neocarbonate B horizon that again is overlying a soft carbonate horizon. Photographic evidence was collected of the exposed soil profiles where previous pipeline construction has disturbed the in situ soil profiles. However, the vegetation in this area is rather sparse (maybe as a result of the high salt content of the soil) and the area is considered to have low to very low land capability.

Witbank form

The new South African Soil Classification System (released February 2018) has a more elaborate section on different anthropogenic soil forms. The anthropogenic soil form identified within the project site is the Witbank form. This area was originally disturbed by construction activities where blocks of stone have been removed for building purposes. When the pipeline construction took place, the left-over was used to fill the quarry partially. Therefore, the organisation of soil and rocky material now called a transported Technosol (Witbank form). This area has low to very low land capability.

9.2 Soil chemical conditions

The purpose of establishing baseline chemical composition of soil on a site before development commences, is to determine whether there is any deterioration in soil fertility and what the nutrient status of the soil is associated with the natural vegetation. Should the chemical content of the soil be drastically different once rehabilitation commences, the chemical composition might have to be amended by the addition of fertilizers or organic matter. The analyses results obtained from the laboratory is attached as Appendix 1.

The soil chemical properties of the affected area can be divided into two main groups. The soil forms underlain by rock, weathering rock, lithic material, hard plinthite and unspecified material are represented by Sample No. 2. The pH(KCl) measured is slightly acidic at pH 5,98 and the major cation levels are within a range considered optimal for plant nutrition. The plant available phosphorus level is considered normal for South African veld conditions. The texture is dominated by the sand fraction (94,7%) and the organic carbon level is very low (0,54%).

The soil forms underlain by soft or hardpan carbonate horizons (represented by Samples 01 and 03) have much higher cation or salt content. Especially the calcium levels are exceptionally high, indicating that the carbonate layers are dominated by calcium carbonate. The pH(KCl) levels of these soil forms are slightly alkaline (7,98 and 7,63 respectively). The texture of these soils contain higher silt and clay fractions that will improve the water-holding capacity of these soils. The organic carbon content of Samples 1 and 3 are 2,63% and 1,17% respectively. The plant-available phosphorus levels for these samples are also low but normal for natural, unfertilized veld conditions in South Africa (1 to 2 mg/kg).

9.3 Land capability

Land capability can be defined as “the extent to which land can meet the needs of one or more uses under defined conditions of management” (Schoeman, 2002). The land capability of an area is the combination of the inherent soil properties and the climatic conditions as well as other landscape properties such as slope and drainage patterns that may inhibit agricultural land use or result in the development of specific land functionality such as wetlands. Land capability affects the socio-economic aspects of human settlements and determine the livelihood possibilities of an area. Baseline land capabilities are also used as a benchmark for rehabilitation of land in the case of project decommissioning.

Following the newly launched land capability classification systems as released by DAFF (2017), the affected area can be divided into four different land capability categories. The small pocket of deeper red Hutton soil (1,8 ha) has moderate land capability (Class 8). Even though the soil properties may be suitable for arable agriculture, the drought-prone climate makes this parcel of land more suitable for grazing purposes. The remaining soil forms have a range of very low to moderately-low land capability and is considered suitable for livestock grazing with good management practices in place.

The area of the proposed powerline corridor also falls into the very low to moderately-low land capability classification according to the report by Environment Research Consulting (2013) for the proposed Tiger Kloof Solar Photovoltaic Energy Facility.

The endorheic pans have been classified as “Wetland land capability”. This classification is currently not part of the DAFF system but is used by the Land Capability Classification System of the South African Chamber of Mines (recommended for use when assessing mining projects). However, these endorheic pans are important components of the landscape and therefore the special assignment of the wetland land capability classification to these soil forms.

9.4 Agricultural potential

The only land parcel with arable agricultural potential is the small portion of deeper Hutton soil just south-west of the middle of the affected area. However, in the absence of irrigation boreholes and supporting irrigation infrastructure, this area is not considered suitable for crop production.

The grazing capacity of a specified area for domestic herbivores is given either in large animal unit per hectare or in hectares per large animal unit. One large animal unit is regarded as a steer of 450kg whose weight increases by 500g per day on veld with a mean energy digestibility of 55%. The grazing capacity of the veld in the project site and powerline corridor is 10 to 12 hectares per large animal unit or large stock unit (LSU) (ARC-ISCW). The project site (642 ha) therefore has grazing veld available for 53 to 64 head of cattle and the powerline corridor area (97 ha) for 8 to 10 head of cattle whilst maintaining the quality of the field.

Cattle farming is a viable long-term land use of the site as long as the field quality is maintained by never exceeding the grazing capacity. Post-project land use should aim to re-establish the cattle farming potential of the land. In addition to this, the area is ideal for a wide variety of small and large game that can be managed as a profitable land use.

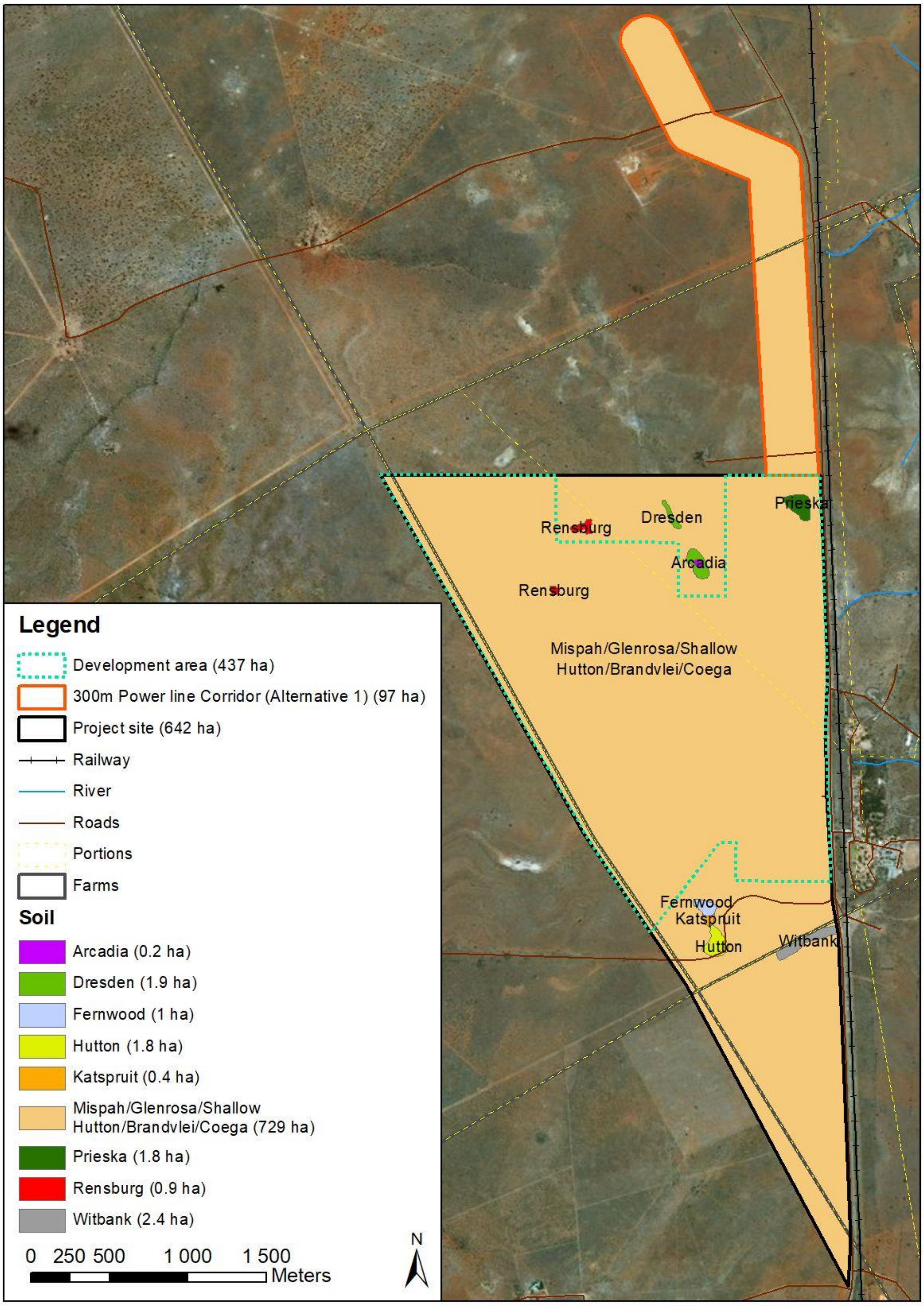

Figure 6: Soil map of the project site and powerline corridor of the proposed Moeding Solar PV Facility

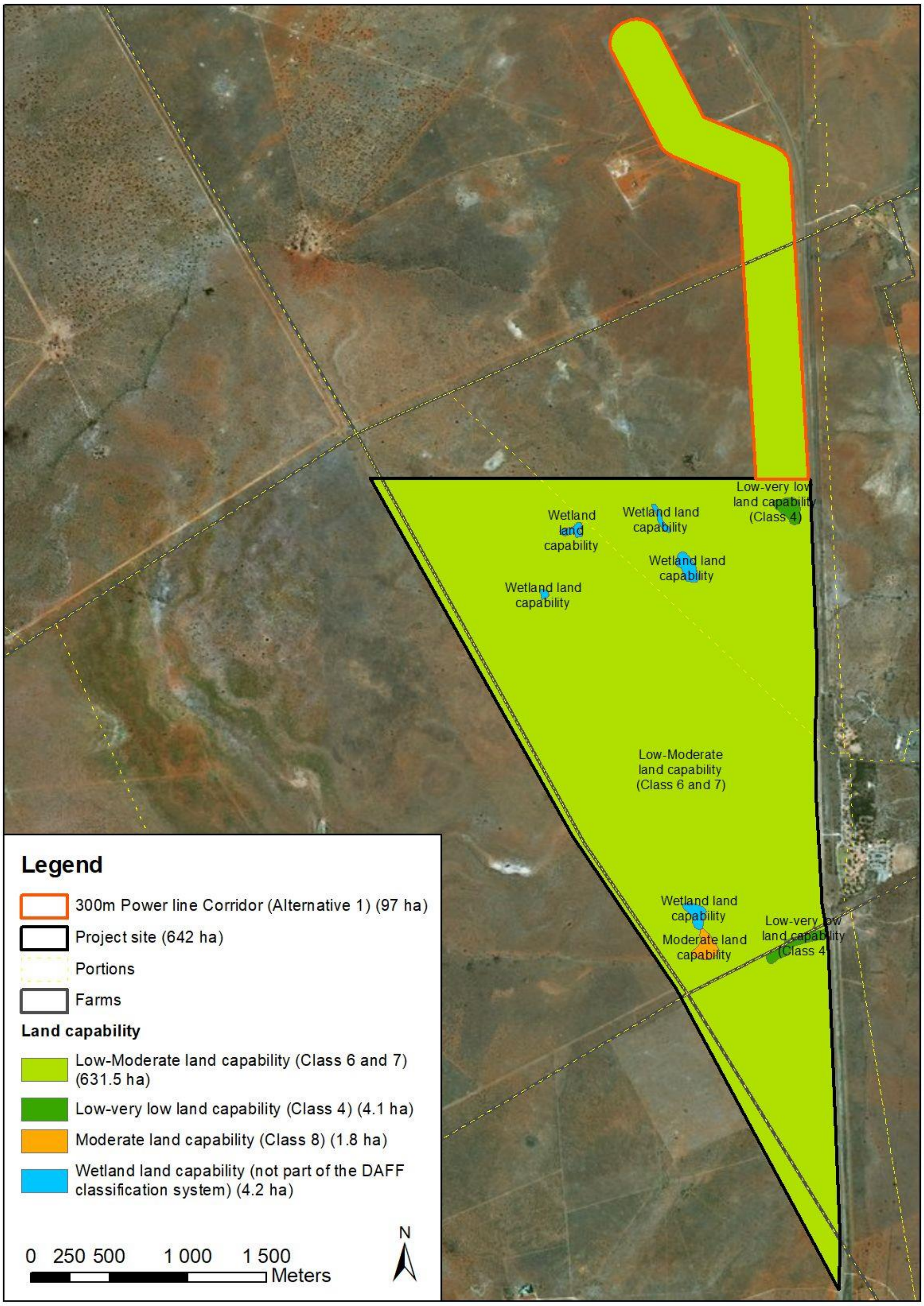

Figure 7: Land capability map of the project site and powerline corridor of the proposed Moeding Solar PV Facility

10. Impact Assessment

10.1 Project description

The development of a commercial photovoltaic (PV) solar energy generation facility, and associated infrastructure on a site situated approximately 8km south of Vryburg.

The facility is proposed to include multiple arrays (static or tracking) of photovoltaic (PV) solar panels with a generating capacity of up to 100MW. The development footprint for the facility is anticipated to be approximately 300ha in extent.

Infrastructure associated with the solar energy facility will include:

- Arrays of PV panels (either a static or tracking PV system) with a capacity of up to 100MW.
- Mounting structures to support the PV panels.
- On-site inverters to convert the power from a direct current to an alternating current.
- An on-site substation to facilitate the connection between the solar energy facility and the Eskom electricity grid.
- A new 132kV power line between the on-site substation and the Eskom grid connection point.
- Battery storage with up to 6hours of storage capacity.
- Cabling between the project components, to be laid underground where practical.
- Offices and workshop areas for maintenance and storage.
- Temporary laydown areas.
- Permanent laydown area.
- Internal access roads and fencing.

Two power line alternatives are being considered:

- Direct connection to the existing Mookodi Substation located approximately 4.5km north of the project site.
- A turn-in turn-out connection into the Mookodi - Magopela 132kV power line (proposed to be constructed along the eastern boundary of the project site).

10.2 Description of the impacts anticipated for the project phases

All infrastructure and activities required for the operational phase will be established during the construction phase. Once construction has ceased, a number of impacts remain during the operational phase (as described below). The main envisaged activities include the following:

- site establishment which will require the limited clearance of vegetation and site levelling;

- construction of permanent access routes which entails the stripping of topsoil, dynamic compaction and the importation of gravel;

- construction of photovoltaic power plant (mounting frame structure installation, installation of modules onto frames, digging of trenches to lay cables between modules);

- construction of campsite and laydown area including:

    - workshops and maintenance area;
    - stores (for handling and storage of fuel, lubricants, solvents, paints and construction material);
    - contractor laydown areas;
    - mobile site offices;
    - temporary waste collection and storage area; and
    - parking area for cars and equipment.

The site preparation activities are disruptive to natural soil horizon distribution and will impact on the current soil hydrological properties and functionality of soil.

The following anticipated impacts have been assessed.

- Soil erosion is anticipated due to slope and vegetation clearance. The impacts of soil erosion are both direct and indirect. The direct impacts are the reduction in soil quality which results from the loss of nutrient-rich upper layers of the soil and the reduced water-holding capacity of severely eroded soils. The off-site indirect impacts of soil erosion include the disruption of riparian ecosystems and sedimentation.

- Soil chemical pollution as a result of storage of hazardous chemicals, concrete mixing, broken PV panels, temporary sanitary facilities and potential oil and fuel spillages from vehicles. This impact will be localised within the site boundary.

- In areas of permanent changes such as roads and the erection of infrastructure, rock spoil material discard site and topsoil stockpiles, the current land capability and land use will be lost permanently. This impact will also be localised within the site boundary.

During the operation phase the impacts related to loss of land use and land capability will stay the same. Areas under temporary buildings, substations, transformers and other covered surfaces are no longer susceptible to erosion, but hard surfaces will increase run-off during rain storms onto bare soil surfaces.

Soil chemical pollution during the operation phase will be minimal. Possible sources are oil that need to be replaced and oil and fuel spillage from maintenance vehicles. This impact will be localised within the site boundary.

Although wind erosion may have an impact before revegetation on adjacent areas, the loss of soil as a resource is restricted to the actual footprint of the solar photovoltaic (PV) power facility.

The only impact that may have effects beyond the footprint area is erosion which may cause the sedimentation of the adjacent wetlands.

10.3 Susceptibility to soil erosion due to construction and operation of solar PV facility

Table 2 Summary of soil erosion impact assessment

Nature: The construction of the PV power facility, access road, camp site and laydown area will require the clearing and levelling of a limited area of land. The following construction activities will result in bare soil surfaces that will be at risk of erosion:

1. vegetation removal during site clearing;
2. creating impenetrable surfaces during the construction phase that will increase run-off onto bare soil surfaces; and
3. leaving soil surfaces uncovered during the rainy season during the construction phase.

During the operation phase the impenetrable surfaces such as paved areas and covered roads stay intact, however, the impact of increased run-off persists on surrounding areas.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- Land clearance must only be undertaken immediately prior to construction activities;
- Unnecessary land clearance must be avoided;
- Soil stockpiles must be dampened with dust suppressant or equivalent;
- Soil stockpiles must be located away from any waterway or preferential water flow path in the landscape, to minimise soil erosion from these;
- Geo-textiles must be used to stabilise soil stockpiles and uncovered soil surfaces during the construction phase and to serve as a sediment trap to contain as much soil as possible that might erode away;
- The Stormwater Management Plan (SWMP) should provide for a drainage system sufficiently designed to prevent water run-off from the solar panels to cause soil erosion;
- Where discharge of rainwater on roads will be channeled directly into the natural environment, the application of diffuse flow measures must be included in the design; and
- Revegetate cleared areas as soon as possible after construction activities.

Residual Impacts:

The residual impact from the construction and operation of the Moeding PV facility, access road, and auxiliary buildings on the susceptibility to erosion will be negligible.

10.4 Chemical pollution due to construction and operation of the Solar PV facility

Table 3 Summary of soil chemical pollution impact assessment

Nature: The following construction activities can result in the chemical pollution of the soil: 1. Hydro-carbon spills by machinery and vehicles during earthworks and the mechanical removal of vegetation during site clearing. 2. Spills from vehicles transporting workers, equipment and construction material to and from the construction site. 3. The accidental spills from temporary chemical toilets used by construction workers. 4. The generation of domestic waste by construction and operational workers. 5. Spills from fuel storage tanks during construction. 6. Polluted water from wash bays and workshops during the construction phase. 7. Accidental spills of other hazardous chemicals used and stored on site. 8. Pollution from concrete mixing. The operation of the PV power facility can result in the chemical pollution of the soil: 1. Spills from vehicles transporting workers and equipment to and from the operation site. 2. The generation of domestic waste by operational workers. 3. Accidental spills of other hazardous chemicals used and stored on site.		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (1)
Duration	Medium-term (3)	Short-term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (14)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: • High level maintenance must be undertaken on all vehicles and construction machinery to prevent hydrocarbon spills; • Impermeable and bunded surfaces must be used for storage tanks and to park vehicles on; • Site surface water and wash water must be contained and treated before reuse or discharge from site; • Spills of fuel and lubricants from vehicles and equipment must be contained using a drip tray with plastic sheeting filled with adsorbent material; • Waste disposal at the construction site must be avoided by separating, trucking out and recycling of waste; • Potentially contaminating fluids and other wastes must be contained in containers stored on hard surface levels in bunded locations; and • Accidental spillage of potentially contaminating liquids and solids must be cleaned up immediately by trained staff with the correct equipment and protocols as outlined in the EMPr.		
Residual Impacts: The residual impact from the construction and operation of the proposed project will be low to negligible		

10.5 Loss of land capability as a result of the project development

Table 4 Summary of land capability impact assessment

Nature: The land capability of the project site where soil layers are changed and construction of infrastructure is done, will be lost. The impact remains present through the operational phase. The following activities can result in the loss of land capability within the project development footprint:

1. The removal of vegetation during site clearing; 2. Earthworks which destroy the natural layers of the soil profiles; and 3. The construction of access roads and photovoltaic power plant (frame structures and installation of modules onto frames) and infrastructure which will cover soil surfaces.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (3)	Permanent (3)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (4)	Probable (4)
Significance	**Medium (40)**	**Medium (32)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: • Keep the project footprint as small as possible; and • Avoid areas with wetland land capability.		
Residual Impacts: The residual impact from the construction and operation of the Moeding PV Facility and supporting infrastructure will be of low significance.		

11. Assessment of cumulative impacts

11.1 Assessment rationale

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[1].

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment or sense of place
- Unacceptable increase in impact

[1] Unless otherwise stated, all definitions are from the 2014 EIA Regulations (GNR 326).

11.2 Other projects in the area

The larger area around the development footprint of the Moeding PV Facility Project have been subject to up to twenty-three of environmental authorisation processes for other renewable energy projects. In addition to the sites where the projects will be constructed, several linear developments for the grid connections will be required to feed the electricity generated into the National grid.

Such a large number of projects will change the dominant current land use of the area from livestock farming to electricity generation. In addition to this, cumulative impacts will be an increased risk for soil erosion when vegetation is removed and possible pollution of soil resources.

Table 5 Assessment of cumulative impact of decrease in areas available for livestock farming

Nature: Decrease in areas with land capability for livestock farming.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Regional (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor to Low (3)
Probability	Probable (4)	Probable (4)
Significance	**Medium (32)**	**Medium (40)**
Status (positive/negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	No
Confidence in findings: High.		
Mitigation: The only mitigation measures for this impact is to keep the footprints of all solar energy facilities as small as possible and to manage the soil quality by avoiding far-reaching soil degradation such as erosion.		

Table 6 Assessment of cumulative impact of areas susceptible to soil erosion

Nature: Increase in areas susceptible to soil erosion		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local to Regional (2)
Duration	Medium-term (3)	Permanent (5)
Magnitude	Moderate (6)	Minor to Low (3)
Probability	Probable (3)	Highly Probable (4)
Significance	**Medium (30)**	**Medium (40)**

Status (positive/negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	No
Confidence in findings: High.		
Mitigation: Each of the projects should adhere to the highest standards for soil erosion prevention and management as defined in Section 10.3 above.		

Table 7 Assessment of cumulative impact of increased risk of soil pollution

Nature: Increase in areas susceptible to soil pollution		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local to Regional (3)	Local to Regional (2)
Duration	Medium-term (3)	Permanent (5)
Magnitude	Moderate (6)	Minor to Low (3)
Probability	Probable (3)	Highly Probable (4)
Significance	**Medium (36)**	**Medium (40)**
Status (positive/negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	No
Confidence in findings: High.		
Mitigation: Each of the projects should adhere to the highest standards for soil pollution prevention and management as defined in Section 10.4 above.		

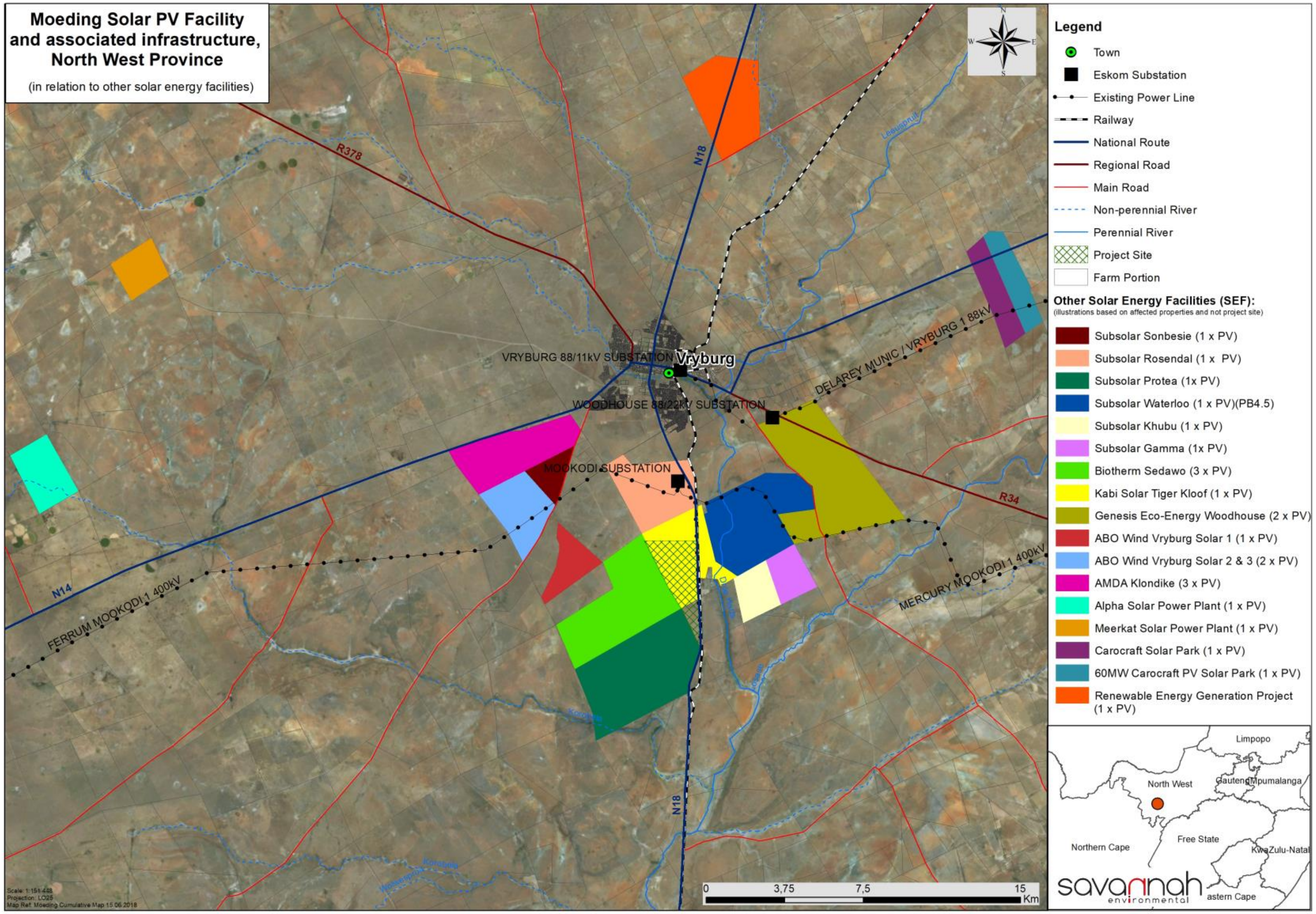

Figure 8: Locality of other renewable energy projects around the proposed Moeding Solar PV Facility and associated infrastructure

12. Soil, land use and land capability management plan

The management plan for the management of the impacts described in Section 10.

Table 8 Measures to mitigate, manage and monitor soil for susceptibility to erosion

OBJECTIVE: To construct the facility in a manner that ensures the protection of soils against erosion caused by the removal of vegetation cover and compaction of soil, and to maintain and monitor the terrain of the Moeding PV Facility as well as the powerline corridor.		
Project Component/s	Construction and Operation Phases	
Potential Impact	Susceptibility to erosion.	
Activity / Risk source	• Vegetation removal during site clearing; • Creating impenetrable surfaces; • Leaving soil surfaces uncovered by vegetation.	
Mitigation: **Target / Objective**	Revegetate, maintain and monitor Moeding PV Facility site.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Soil stockpiles must be dampened with dust suppressant or equivalent to prevent erosion by wind. • Land clearance must only be undertaken immediately prior to construction activities. • Unnecessary land clearance must be avoided. • All graded or disturbed areas which will not be covered by permanent infrastructure such as paving, buildings or roads must be stabilised with erosion control mats (geo-textiles) and revegetated. • Ensure vegetation is re-established on disturbed surfaces as soon as construction has been completed in an area.	» EPC Contractor » ECO	Ongoing during construction. Revegetate as soon as possible after construction is completed.
Performance indicator	Prevent, minimise and manage any visible erosion on the project site during construction and operation of Solar PV Facility.	
Monitoring	• On-going visual assessment of compliance with erosion prevention by EPC Contractor and ECO. • Monitor visual signs of erosion such as the formation of gullies after rainstorms and the presence of dust emissions during wind storms. • Any signs of soil erosion on site should be documented (including photographic evidence and coordinates of the problem areas) and submitted to the management team of the Moeding PV Facility project.	

	• Monitor compliance of construction workers to restrict construction work to the clearly defined limits of the construction site to keep footprint as small as possible. • Where vegetation is not re-establishing itself in areas where surface disturbance occurred, soil samples must be collected, analysed for pH levels, electrical conductivity (EC) and major plant nutrient levels (calcium, magnesium, potassium) and sodium. • When vegetation re-establishment still remains unsatisfactory, the bulk density of the soil should be measured with a penetrometer to determine whether compaction is an issue. • The results must be submitted to a professional soil or agricultural scientist for recommendations on the amendment of the issue to ensure that the vegetation cover is established and erosion prevented.

Table 9 Measures to mitigate, manage and monitor soil for susceptibility to soil pollution

OBJECTIVE: To construct and operate the Solar PV Facility and powerline corridor in a manner that minimise the pollution of soil by hydrocarbon spills from vehicles and machinery, and resultant waste material and pollution that may result from damaged PV panels and oil during the operation phase. To store and use fuel, lubricants, pesticides, herbicides and other hazardous chemicals safely, and to prevent spills and contamination of the soil resource.		
Project Component/s	Construction and Operation Phases	
Potential Impact	Soil pollution	
Activity / Risk source	• Hydrocarbon spills by vehicles and machinery during leveling, vegetation clearance and transport of workers, materials and equipment and fuel storage tanks; • Accidental spills of hazardous chemicals; • Generation of domestic waste by construction workers; • Polluted water from wash bays and workshops • Pollution from concrete mixing and damaged PV panels.	
Mitigation: **Target / Objective**	Prevent and contain hydrocarbon leaks. Undertake proper waste management. Store hazardous chemicals safely in a bunded area.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment must be contained using a drip tray with plastic sheeting filled with absorbent material when not parked on hard standing. • Waste disposal at the construction site must be avoided by separating and trucking out of waste. • Accidental spillage of potentially contaminating liquids and solids must be cleaned up immediately in line with procedures by trained	» EPC Contractor » ECO	On-going visual assessment during the construction and operation phases to detect polluted areas and the application of clean-up and preventative procedures. .

people with the appropriate equipment.		
Performance indicator	Check vehicles and machinery daily for oil, fuel and hydraulic fluid leaks; Undertake high standard maintenance on vehicles; Proper waste management; Safe storage of hazardous chemicals.	
Monitoring	• On-going visual assessment to detect polluted areas and the application of clean-up and preventative procedures. • Monitor hydrocarbon spills from vehicles and machinery during construction continuously and record volume and nature of spill, location and clean-up actions. • Monitor maintenance of drains and intercept drains weekly. • Analyse soil samples for pollution in areas of known spills or where a breach of containment is evident when it occurs. • Records of accidental spills and clean-up procedures and the results thereof must be audited on an annual basis by the ECO. • Records of all incidents that caused chemical pollution must be kept and a summary of the results must be reported to the Moeding Solar PV Facility Management team annually. • Gaps must be identified and procedures must be amended if necessary by the Moeding PV Facility Project Management Team	

Table 10 Measures to mitigate, manage and monitor loss of land capability

OBJECTIVE: To keep the PV power facility powerline corridor footprint as small as possible and minimise the loss of land capability.		
Project Component/s	Construction and Operation Phases	
Potential Impact	Loss of Land Capability	
Activity / Risk source	• The removal of vegetation during site clearing; • Earthworks which destroy the natural layers of the soil profiles; and • The construction of access roads and photovoltaic power plant (frame structures and installation of modules onto frames) and infrastructure which will cover soil surfaces.	
Mitigation: **Target / Objective**	Keep the project footprint as small as possible	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Keep the project footprint as small as possible; and • Avoid areas with wetland land capability.	» EPC Contractor » ECO	On-going visual assessment of compliance by EPC Contractor to stay within the design footprint. .
Performance indicator	Stay within the boundary of the PV power facility site as designed and agreed upon.	
Monitoring	• Monitor compliance of construction workers to restrict construction work to the clearly defined limits of the construction site by ECO. • Reporting by ECO to the Moeding Solar PV Facility Project Management team if any impacts outside the PV facility fence take place. • If any transgressions occur, corrective actions should be taken.	

13. Consideration of alternatives

Grid connection alternatives were provided by the client for consideration and included:

- Alternative 1 – a direct connection to the existing Mookodi Main Transmission Substation located north of the project site on the Remaining Extent of the Farm Rosendal 673. A new 132kV power line will be constructed over a distance of ~4km. A 300m power line corridor has been assessed for Alternative 1.
- Alternative 2 - a turn-in turn-out connection into the proposed Mookodi - Magopela 132kV power line (to be constructed along the eastern boundary of the project site). A new turn-in and out 132kV power line will be constructed over a distance of ~335m.

These alternatives are illustrated in the figures below (as mapped and provided by Savannah Environmental (Pty) Ltd., 2018).

With regards to impacts on soil, land use, land capability and agricultural potential there are two main considerations:

- The avoidance of areas with high arable agricultural potential as this is a scarce natural resource in South Africa.
- The minimization of the project surface footprint as this is directly proportional to the extent of the impact.

With these two principles in mind, Powerline Alternative 2 is the preferred option in order to minimise the impacts on soil and land capability. The reason for this is that Alternative 2 will only be constructed over a distance of 335m while Alternative 1 will be constructed over a distance of 4000m. Alternative 1 therefore impacts on an additional 3665m of in situ soil profiles that has grazing land capability when compared to Alternative 1. Alternative 1 is still considered an acceptable option as it is located on shallow rocky soil with low to moderate land capability and will therefore not impact on deep, highly-productive agricultural soil.

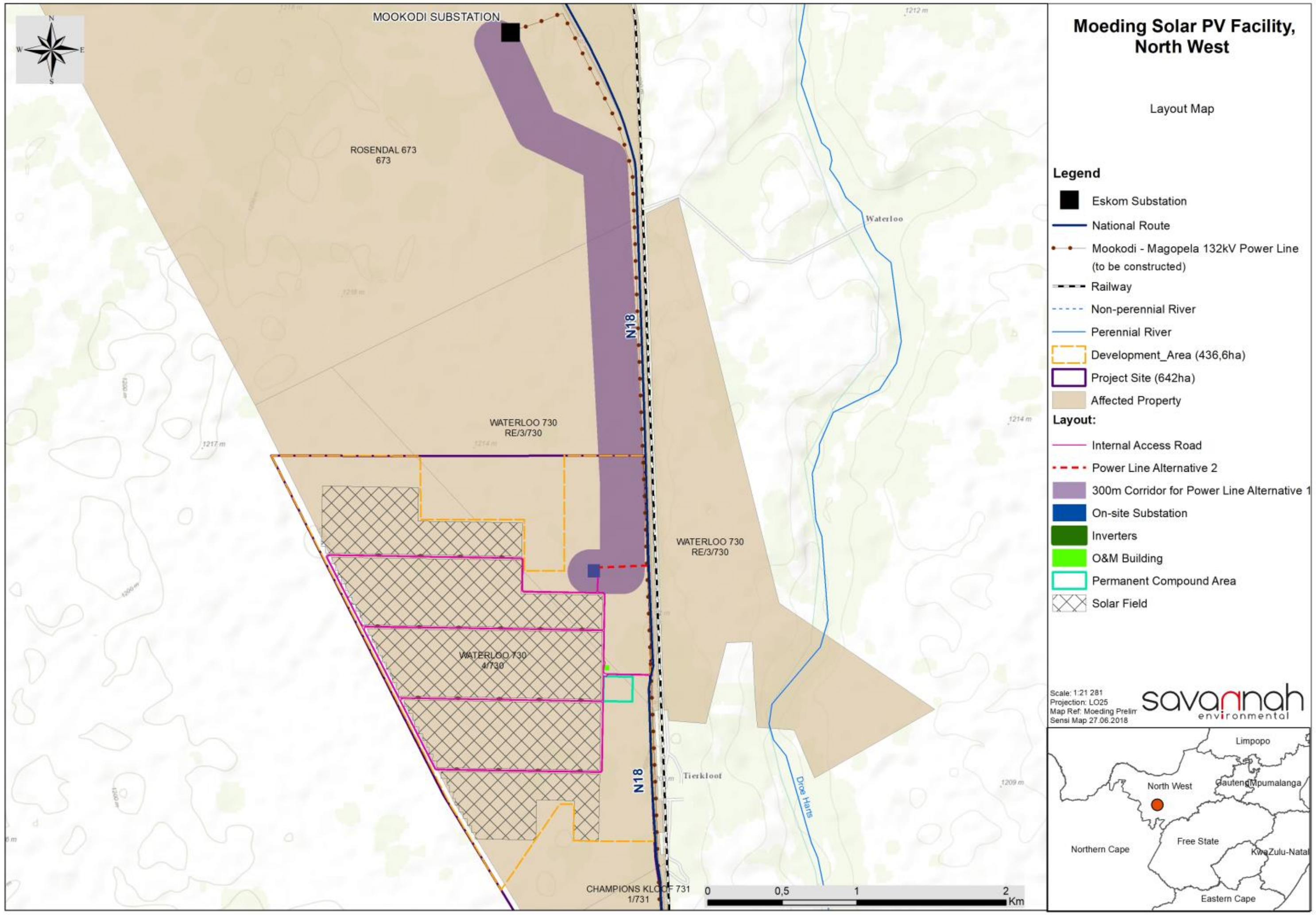

Figure 9 Layout of the Moeding Solar PV Facility Project indicating the location of the powerline alternatives (data source: Savannah Environmental, 2018

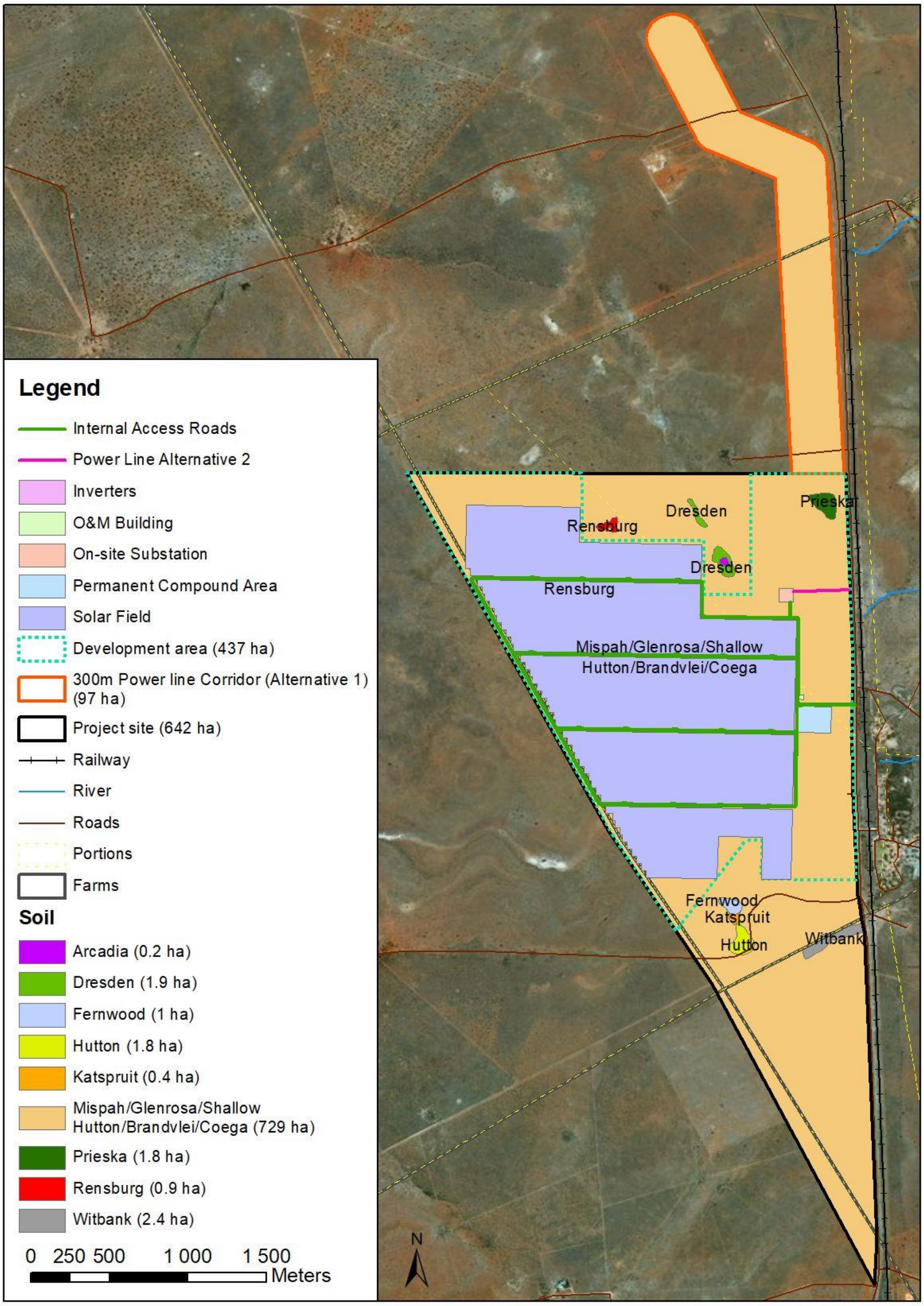

Figure 10 Project layout superimposed on the soil forms of the area

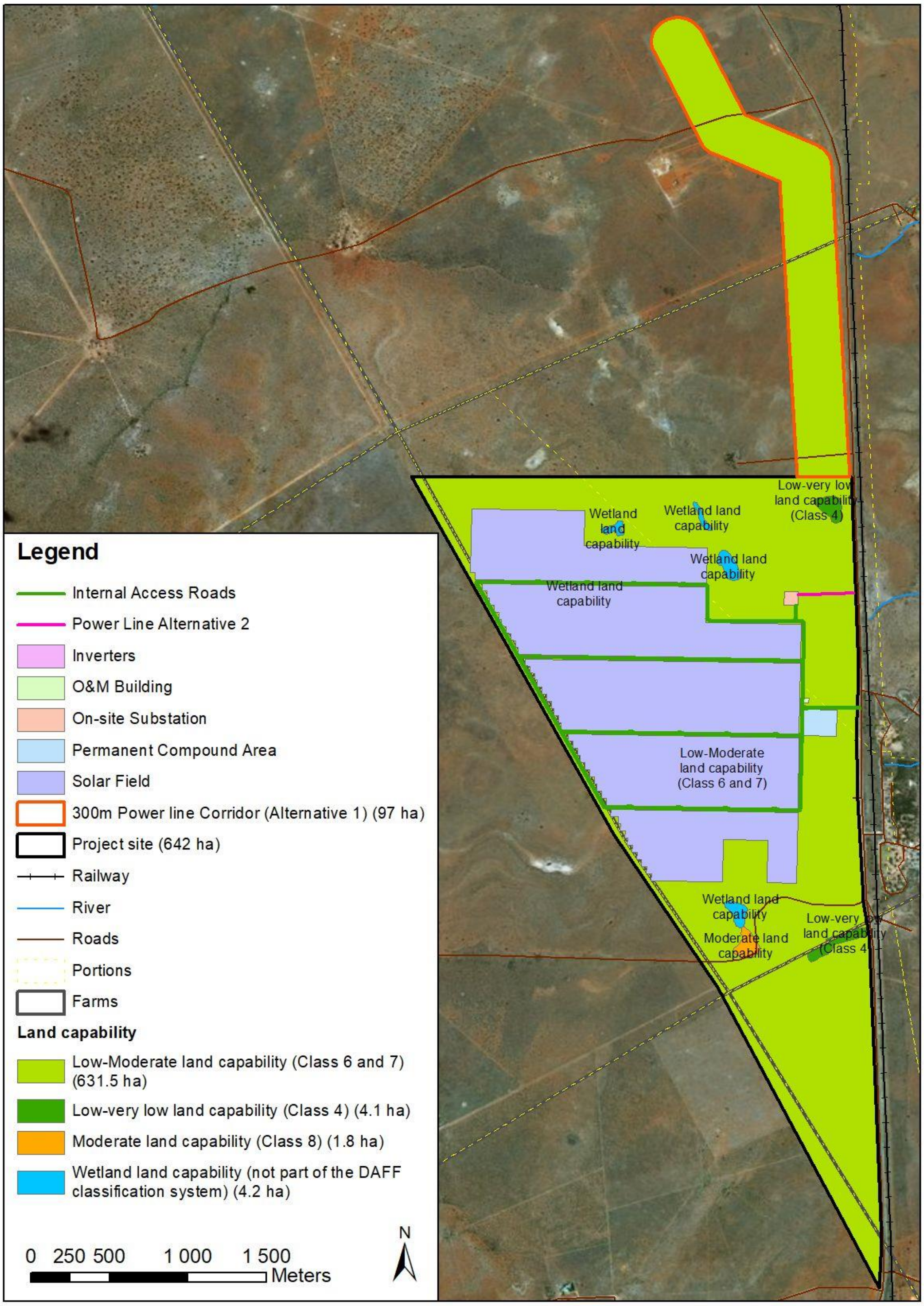

Figure 11 Project layout superimposed on the land capabilities of the area

14. Reasoned opinion

The proposed Moeding Solar PV Facility (Figure 10) project infrastructure are located on shallow, rocky soils with low to moderate-low land capability. While irrigation can increase the yield of marginal land, South Africa is a water-stressed country where a large fraction of the available water has already been allocated to food production. Irrigated crop production also requires significant capital investment and running costs that may not be financially viable for the landowner. It is also possible that the farm portion don't have any viable boreholes that can supply irrigation water.

The land on which the proposed project will be constructed belongs to Tiger Kloof Educational Institute. The construction and operation of a solar plant on the land is considered an acceptable project for it will be an investment for an educational trust to further the educational activities of the school. This will supplement their current income derived from the land in an area where farming is susceptible to periodic droughts.

The proposed Moeding PV Solar Facility with the associated infrastructure will have medium to minor impacts on soil and land capability properties as well as current land uses in the areas where the footprint will result in surface disturbance. Cumulative impacts are related to an increase in the loss of agricultural land used for livestock farming in addition to the other areas where solar PV projects will be constructed. These impacts can be reduced by keeping the footprints minimised where possible and strictly following soil management measures pertaining to erosion control and management and monitoring of any possible soil pollution sources such as vehicles traversing over the sites. From the perspective of soil and land capability conservation, the shortest powerline corridor option (Alternative 2) is considered the alternative that will result in the smallest impacts as a result of the smaller surface footprints than Powerline Alternative 1. Powerline Alternative 1 is still considered acceptable as it will be located on low potential agricultural soil with low to moderately-low land capability.

Moeding Solar falls within a larger area of a number of solar energy projects that are in different stages, intermixed with livestock farming and settlements (both formal and informal). The land capability and soil quality of land affected by the surface footprint of the proposed photovoltaic power plant infrastructure will be slightly compromised. If soil management measures are followed as outlined in this report and the land rehabilitated to the highest standard possible, livestock and game farming will be possible on the rehabilitated land.

It is therefore of my opinion that the activity should be authorised. It follows that the recommendations and monitoring requirements as set out in this report should form part of the conditions of the environmental authorisation for the proposed project.

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Appendix 1 – Laboratory analyses sheet

NOORDWES UNIVERSITEIT
ECO-ANALYTICA

Eco Analytica
Posbus 19140
NOORDBRUG 2522
Tel: 018-285 2732/3/4

TERRA AFRICA (MOEDING)

24/7/2018 **Soil fertility status**

Sample No	Ca	Mg	K	Na	P	pH(KCl)	LOI
no.	(mg/kg)						%C
1	4870,5	1390,0	374,0	11,5	7,0	7,98	2,63
2	648,5	59,0	160,5	1,0	5,4	5,98	0,54
3	4480,0	121,5	195,5	1,0	5,7	7,63	1,17

Uitruilbare katione

Sample No	Ca	Mg	K	Na	S-value
no.	(cmol(+)/kg)				
1	24,30	11,44	0,96	0,05	36,75
2	3,24	0,49	0,41	0,00	4,14
3	22,36	1,00	0,50	0,00	23,86

23/7/2018 **Particle Size Distribution**

Sample no.	**> 2mm (%)**	**Sand**	**Silt**	**Clay**
		(% < 2mm)		
1	0,2	67,5	21,7	10,8
2	5,9	94,7	1,3	4,0
3	9,8	83,4	9,4	7,2

APPENDIX 2 - CURRICULUM VITAE OF SPECIALIST (Mariné Pienaar)

- **Personal Details**

  Last name: **Pienaar**
  First name: **Mariné**
  Nationality: **South African**
  Employment: **Self-employed (Consultant)**

- **Contact Details**

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  Current Job: **Lead Consultant and Owner of Terra Africa Consult**

- **Concise biography**

Mariné Pienaar is a professionally registered soil- and agricultural scientist (SACNASP) who has consulted extensively for the past eleven years in the fields of soil, land use and agriculture in several African countries. These countries include South Africa, Liberia, Ghana, DRC, Mozambique, Botswana, Angola, Swaziland and Malawi. She has worked with mining houses, environmental consulting companies, Eskom, government departments as well as legal and engineering firms. She conducted more than three hundred specialist studies that included baseline soil assessment and rehabilitation planning for new projects or expansion of existing projects, soil quality monitoring, land rehabilitation assessment and monitoring, natural resource assessment as part of agricultural project planning, evaluation and development of sustainable agriculture practices, land use assessment and livelihood restoration planning as part of resettlement projects and land contamination risk assessments. She holds a BSc. Agriculture degree with specialisation in Plant Production and Soil Science from the University of Pretoria and a MSc in Environmental Science from the University of the Witwatersrand. In addition to this, she has attended a number of courses in Europe, the USA and Israel in addition to those attended in South Africa. Mariné is a contributing author of a report on the balance of natural resources between the mining industry and agriculture in South Africa (published by the Bureau for Food and Agricultural Policy, 2015).

- **Qualifications**

  Academic Qualifications:

  - **MSc Environmental Science**; University of Witwatersrand, South Africa, 2017
  - **BSc (Agric) Plant Production and Soil Science;** University of Pretoria, South Africa, 2004

- **Senior Certificate / Matric;** Wolmaransstad High School, South Africa, 2000

Courses Completed:

- **World Soils and their Assessment;** ISRIC – World Soil Information, Wageningen, 2015
- **Intensive Agriculture in Arid- and Semi-Arid Environments** – Gilat Research Centre, Israel, 2015
- **Hydrus Modelling of Soil-Water-Leachate Movement;** University of KwaZulu-Natal, South Africa, 2010
- **Global Sustainability Summer School 2012;** Institute for Advanced Sustainability Studies, Potsdam, Germany, 2012
- **Wetland Rehabilitation;** University of Pretoria, South Africa, 2008
- **Enviropreneurship Institute;** Property and Environment Research Centre [PERC], Montana, U.S.A., 2011
- **Youth Encounter on Sustainability;** ACTIS Education [official spin-off of ETH Zürich], Switzerland, 2011
- **Environmental Impact Assessment │Environmental Management Systems – ISO 14001:2004 │Environmental Law;** University of Potchefstroom, South Africa, 2008
- **Carbon Footprint Analyst Level 1;** Global Carbon Exchange Assessed, 2011
- **Negotiation of Financial Transactions;** United Nations Institute for Training and Research, 2011
- **Food Security: Can Trade and Investment Improve it?** United Nations Institute for Training and Research, 2011

- **Language ability**

Perfectly fluent in English and Afrikaans (native speaker of both) and conversant in French.

- **Professional Experience**

Name of firm	Terra Africa Environmental Consultants
Designation	Owner | Principal Consultant
Period of work	December 2008 to Date

- **Prior Tenures**

Integrated Development Expertise (Pty) Ltd; **Junior Land Use Consultant** [July 2006 to October 2008]
Omnia Fertilizer (Pty) Ltd; **Horticulturist and Extension Specialist** [January 2005 to June 2006]

- **Professional Affiliations**

- South African Council for Natural Scientific Professions [SACNASP]
- Soil Science Society of South Africa [SSSA]
- Soil Science Society of America
- South African Soil Surveyors' Organisation [SASSO]
- International Society for Sustainability Professionals [ISSP]

Summary of a selected number of projects completed successfully:

[Comprehensive project dossier available on request]

1. *Sekoko Railway Alignment and Siding Soil, Land Use and Capability Study* in close proximity to the Medupi Power Station in the Lephalale area, Limpopo Province.

2. *Italthai Rail and Port Projects, Mozambique* – The study included a thorough assessment of the current land use practices in the proposed development areas including subsistence crop production and fishing as well as livestock farming and forestry activities. All the land uses were mapped and intrinsically linked to the different soil types and associated land capabilities. This study was used to develop Livelihood Restoration Planning from.

3. *Bomi Hills Railway Alignment Project, Liberia:* soil, land use and agricultural scientist for field survey and reporting of soil potential, current land use activities and existing soil pollution levels, as well as associated infrastructure upgrades of the port, road and railway.

4. *Kingston Vale Waste Facility, Mpumalanga Province, South Africa*: Soil and vegetation monitoring to determine the risk of manganese pollution resulting from activities at the waste facility.

5. *Keaton Mining's Vanggatfontein Colliery, Mpumalanga*: Assessment of soil contamination levels in the mining area, stockpiles as well as surrounding areas as part of a long-term monitoring strategy and rehabilitation plan.

6. *Richards Bay Minerals, KwaZulu-Natal*: Contaminated land assessment of community vegetable gardens outside Richards Bay as a result of spillages from pipelines of Rio Tinto's Richards Bay Minerals Mine.

7. *Buffelsfontein Gold Mine, Northwest Province, South Africa:* Soil and land contamination risk assessment for as part of a mine closure application. Propose soil restoration strategies.

8. Glenover Phosphate Mining Project near Steenbokpan in the Lephalale area – Soil, Land Use and Land Capability Study as part of the environmental authorisation process.

9. *Waterberg Coal 3 and 4 Soil, Land Use and Land Capability Study* on 23 000 ha of land around Steenbokpan in the Lephalale area.

10. *Lesotho Highlands Development Agency, development of Phase II (Polihali Dam and associated infrastructure)*: External review and editing of the initial Soil, Land Use and Land Capability Assessment as requested by ERM Southern Africa.

11. *Tina Falls Hydropower Project, Eastern Cape , South Africa*: Soil, land use and land capability assessment as part of the ESIA for the construction of a hydropower plant at the Tina Falls.
12. *Graveyard relocation as part of Exxaro Coal's Belfast Resettlement Action Plan*: Soil assessment to determine pedohydrological properties of the relocation area in order to minimise soil pollution caused by graveyards.

13. *Rhino Oil Resources: Strategic high-level soil, land use and land capability assessment of five proposed regions to be explored for shale gas resources in the KwaZulu-Natal, Eastern Cape, North-West and Free State provinces of South Africa.*

14. *Eskom Kimberley Strengthening Phase 4 Projec*t, Northern Cape & Free State, South Africa: soil, agricultural potential and land capability assessment.

15. *Mocuba Solar Project, Mozambique* – The study included a land use assessment together with that of the soil and land capabilities of the study area. All current land uses were documented and mapped and the land productivity was determined. This study advocated the resettlement and livelihood restoration planning.

16. *Botswana (Limpopo-Lipadi Game Reserve).* Soil research study on 36 000 ha on the banks of the Limpopo River. This soil study forms part of an environmental management plan for the Limpopo-Lipadi Game Reserve situated here as well as the basis for the Environmental Impact Assessment for the development of lodges and Land Use Management in this area.

17. *TFM Mining Operations [proposed] Integrated Development Zone, Katanga, DRC* [part of mining concession between Tenke and Fungurume]: soil and agricultural impact assessment study.

18. *Closure Strategy Development for Techmina Mining Company – Lucapa, Angola.* Conducted an analysis of the natural resources (soil, water) to determine the existing environmental conditions on an opencast diamond mine in Angola. The mine currently experience severe problems with kimberlite sediment flowing into the river. A plan is currently being developed to change the mining area into a sustainable bamboo farming operation.

19. *Closure of sand mining operations, Zeerust District.* Succesfully conducted the closure application of the Roos Family Sand Mine in the Zeerust District. Land Use Management Plans for rehabilitated soil were developed. The mine has closed now and the financial provision has been paid out to the applicant.

20. *ESIA for [proposed] Musonoi Mine, Kolwezi area, Katanga, DRC:* soil, land use and land capability assessment.

21. *Bauba A Hlabirwa Moeijelik Platinum mine [proposed] project, Mpumalanga, South Africa:* soil, land use and land capability assessment and impact on agricultural potential of soil.

22. *Commissiekraal Coal Mine [proposed] project, KwaZulu*-Natal, South Africa: sustainable soil management plans, assessment of natural resource and agricultural potential and study of the possible impacts of the proposed project on current land use. Soil conservation strategies included in soil management plan.

23. *Cronimet Chrome Mine [proposed] project, Limpopo Province, South Africa:* soil, land use and land capability of project area and assessment of the impacts of the proposed project.
24. *Moonlight Iron Ore Land Use Assessment, South Africa* – Conducted a comprehensive land use assessment that included interviews with land users in the direct and indirect project zones of influence. The study considered all other anticipated social and environmental impacts such as water, air quality and noise and this was incorporated into a sensitivity analysis of all land users to the proposed project.

25. *Project Fairway Land Use Assessment, South Africa* – The study included an analysis of all land users that will directly and indirectly be influenced by the project. It analysed the components of their land uses and how this components will be affected by the proposed project. Part of the study was to develop mitigation measures to reduce the impact on the land users.

26. *Bekkersdal Urban Renewal Project – Farmer Support Programme,* Independent consultation on the farmer support programme that forms part of Bekkersdal Renewal Project. This entailed the production of short and long term business plans based on soil and water research conducted. Part of responsibilities were the evaluation of current irrigation systems and calculation of potential water needs, etc. as well as determining quantities and prices of all project items to facilitate the formalisation of tender documents.

27. *Area-based agricultural business plans for municipalities in Dr. Kenneth Kaunda Municipal District.* Evaluation of the agricultural and environmental status of the total district as well as for each municipality within the district. This included the critical evaluation of current agricultural projects in the area. The writing of sustainable, executable agricultural business plans for different agricultural enterprises to form part of the land reform plans of each Municipality within the district.

28. *Batsamaya Mmogo, Hartswater.* Conducted a soil and water assessment for the farm and compiled management and farming plans for boergoats grazing on *Sericea lespedeza* with pecan nuts and lucerne under irrigation.

29. *Anglo Platinum Twickenham Mine – Irrigated Cotton Project.* Project management of an irrigated cotton production project for Twickenham Platinum Mine. This project will ensure that the community benefit from the excess water that is available from the mine activities.

30. *Grasvally Chrome (Pty) Ltd Sylvania Platinum [proposed] Project, Limpopo Province, South Africa:* Soil, land use and agricultural potential assessment.

31. *Jeanette Gold mine project [reviving of historical mine], Free State, South Africa:* Soil, land use and agricultural potential assessment.

32. *Kangra Coal Project, Mpumalanga, South Africa:* Soil conservation strategies proposed to mitigate the impact of the project on the soil and agricultural potential.

33. *Richards Bay Integrated Development Zone Project, South Africa* [future development includes an additional 1500 ha of land into industrial areas on the fringes of Richards Bay]: natural resource and agricultural potential assessment, including soil, water and vegetation.

34. *Exxaro Belfast Coal Mine [proposed] infrastructure development projects* [linear: road and railway upgrade | site-specific coal loading facilities]: soil, land capability and agricultural potential assessment.

35. *Marikana In-Pit Rehabilitation Project of Aquarius Platinum, South Africa:* soil, land capability and land use assessment.
36. *Eskom Bighorn Substation proposed upgrades, South Africa:* soil, land capability and agricultural potential assessment.

37. *Exxaro Leeuwpan Coal Mining Right Area, South Africa:* consolidation of all existing soil and agricultural potential data. Conducted new surveys and identified and updated gaps in historic data sets.

38. *Banro Namoya Mining Operation, DRC:* soil, land use and agricultural scientist for field survey and reporting of soil potential, current land use activities and existing soil pollution levels, including proposed project extension areas and progressive soil and land use rehabilitation plan.

39. *Kumba Iron Ore's Sishen Mine, Northern Cape, South Africa: soil, land use and agricultural scientist* | *Western Waste Rock Dumps [proposed] Project:* soil, land use and agricultural potential assessment, including recommendations regarding stripping/stockpiling and alternative uses for the large calcrete resources available.

40. *Vetlaagte Solar Development Project, De Aar, South Africa:* soil, land use and agricultural scientist. Soil, land use and agricultural potential assessment for proposed new 1500 ha solar development project, including soil management plan.