SOILS, LAND CAPABILITY AND AGRICULTURAL POTENTIAL ASSESSMENT

FOR A BASIC ASSESSMENT APPLICATION FOR THE ERGO MINING SOLAR PV FACILITY (PHASE 1), INCLUDING A PLANT CAPACITY UP TO 19.9MW AND 11KM OF 22KV OVERHEAD POWER LINE, LOCATED WITHIN THE EKURHULENI LOCAL MUNICIPALITY, GAUTENG

Prepared for:

Environmental Management Assistance (Pty) Ltd
c/o Alicia Govender
Tel: 083 784 0460
Email: alicia@hunadigroup.co.za

Prepared by:

MALACHITE ECOLOGICAL SERVICES

Tel: 078 0230532
Email: rowena@malachitesa.co.za

Draft Version 2

May 2021

Declaration of Independence by Specialists

I, Rowena Harrison, hereby declare that I -

- Act as an independent soil consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability.

____

Rowena Harrison

SACNASP Reg. No. 400715/15

Date: May 2021

EXECUTIVE SUMMARY

Malachite Ecological Services was appointed by Environmental Management Assistance (Pty) Ltd to undertake a Soils, Land Capability and Agricultural Potential Assessment for the proposed construction of a Solar Photovoltaic (PV) plant, with a capacity of up to 19.9MW to supply power (embedded generation) to the existing Ergo Mining (Pty) Ltd Brakpan Plant as well as the construction of 11km of an 22KV Overhead Power Line (OHL) to link the PV facility to substations.

The terms of reference for the study were as follows:

- Conduct a soil survey and mapping exercise of the study site to soil form and family level.
- Describe the physical properties of the soils sampled at each sampling location.
- Describe the slope and climate of the site.
- Describe the agricultural potential of the site based on the information attained from the soils identified within the site; slope; climatic data, rockiness, surface crusting and wetness.
- Identify current and possible negative impacts of the proposed project on the agricultural potential of the site.
- Recommend mitigation measures to lessen these impacts within the study site and the implementation of suitable rehabilitation measures.

Augur sample points were taken throughout the proposed PV facility site (taking into consideration both layout alternatives) as well as within a 100m assessment area along the 11km 22KV OHL route during a field assessment conducted between the 5th and 7th of February 2021. Soils were assessed in terms of their texture, soil depth, subsoil permeability, slope, rockiness, surface crusting and wetness.

The study site can be classified into two separate soil types, the Natural Soils and the Anthrosols and Technosols, with the latter dominating the area. The entire area proposed for the PV facility (both layout alternatives) was classified as the Technosol soil form, Stilfontein. This soil is a Hydric Technosol and has undergone saturation for an extended period of time. The classification was applied to this area as hydric properties were identified both at the surface of the soil as well as within the lower reaches of all soil profiles examined within this area. Hydric properties included a gleying of the soil matrix as well as distinct and a high concentration of mottles and concretions. The presence of the Stilfontein soils in this area are a result the transformation of this area to a tailings dam which was remined and then rehabilitated, leaving behind saturated soils as well as an alteration to the natural drainage of the area, causing current ponding of stormwater. Further areas along the OHL route were classified as Stilfontein soils and are associated with mining related dams and stormwater control.

Along the 100m assessment buffer around the 22KV OHL the following further Anthrosols and Technosols were identified, Johannesburg, Grabouw and Witbank. The Johannesburg soil is an Urban Technosol and has been classified where current infrastructure is situated. The Grabouw soil is categorised as Physically Disturbed Anthrosol. This includes areas where the soils have been mixed, compacted, or excavated by human activity. These were often identified adjacent to the Urban Technosol but have not been disturbed to the same degree. The Witbank soil, which is categorised as a Transported Technosol was identified in the southern region of the study area and includes the Brakpan/Withok Tailings Dam facility.

Scattered throughout the study area, between the Anthrosols and Technosols, natural soil profiles were identified, and these were classified as either Mispah/Glenrosa soils, the Nkonkoni soils, or the Bloemdal and Bainsvlei soils.

The Mispah and Glenrosa soil forms are categorised as belonging to the Lithic class. The Nkonkoni and Bloemdal soils belong to the Oxidic class, the Bainsvlei soil to the Plinthic class and the Katspruit soil to the Gley class.

The project area was assessed in terms of the Agricultural and Land Capability Potential. Taking into account the soil forming factors as well as the anthropogenic disturbances to the area, the study site has been categorised into the Class IV, Class V, Class VI, and Class VIII categories. The Class IV category is for the shallower but natural Mispah/Glenrosa and Nkonkoni soils. These soils occupy 10.6% of the site. The Class V category is reserved for saturated soils and was thus mapped where the Stilfontein, Bloemdal, Bainsvlei and Katspruit soils were identified. Class V soils occupy 11.8% of the site. The Grabouw soils have been classified as Class VI soils. Class VI soils have severe restrictions to cropping and are therefore excluded from production under perennial vegetation. Class VI soils occupy 23.1% of the study site. The remaining Johannesburg and Witbank soils are categorised as Class VIII soils. These soils of the proposed site have been completely modified and are not productive for any agricultural activities. These soils occupy 45.5% of the study site.

The project will involve the clearing of portions of the site for the establishment of the 19.9MW power PV facility, within the two zones, as well as the construction of the 11km 22KV Overhead Power Line for the preferred layout. The alternative layout is similar to the preferred layout however the PV facility will have a smaller capacity at 10MW. Impacts to the agricultural potential of the study site are the same for both layouts (preferred and alternative) and are associated with (i) the loss of agricultural land; (ii) soil compaction and exposure of topsoil leading to erosion and (iii) pollution of the soils as a result of construction related activities. Several general and specific measures are proposed to mitigate these impacts.

In conclusion, the site (including both layout alternatives) can be considered to have a negligible to low agricultural production with regards to cultivation of crops as a result of the following findings:

- The majority of the site (including both layout alternatives) has been anthropogenically disturbed to such a level that the natural soil profile is not generally apparent. Cultivation of crops cannot take place in these areas, both within the PV facility and along the Overhead Power Line route.
- The remaining natural soils have serious limitations to the cultivation of crops due to shallow soil profiles and the saturation of the lower solum of the soil profile.

Mitigation measures to lessen the impact of the development on the receiving environment must be implemented as part of the construction and operational phases of the Environmental Management Programme.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION AND BACKGROUND

1.1. Project Background and Locality

Malachite Ecological Services was appointed by Environmental Management Assistance (Pty) Ltd to undertake a Soils, Land Capability and Agricultural Potential Assessment for the proposed construction of a Solar Photovoltaic (PV) plant, with a capacity of up to 19.9MW to supply power (embedded generation) to the existing Ergo Mining (Pty) Ltd Brakpan Plant as well as the construction of 11km of an 22kV Overhead Power Line (OHL) to link the PV facility to two existing substations.

The proposed project is situated on off the R23 (Heidelberg Road) on various portions of the Farm Withok 131IR, various Holdings of the Withok Estates Agricultural Holdings, various portions of the Farm Witpoortje 117IR, as well as various holdings of the Witpoort Estates Agricultural Holdings, within the Ekurhuleni Local Municipality, Gauteng. The project site is furthermore situated within the quarter degree square 2628AD (Figure 1).

Two alternative layouts are presented, with the preferred layout consisting of two zones for the location of the PV Facility, with the substation and Batter Energy Storage System (BESS) located within Zone 2. Zone 1 will have enough solar panels to generate a capacity of 7965.7kW of power while Zone 2 will have enough solar panels to create a capacity of 11602kW of power (Figure 2). The proposed 22kV OHL will follow the same route in both layout alternatives, with the OHL entering the existing Brakpan plant to the south, crossing the plant, and entering into the Ergo substation in the preferred layout.

The alternative layout proposes a smaller PV array facility for the generation of 10MW power capacity. This layout consists of two blocks in which the solar panels will be situated. This alternative layout is located in the same area as the preferred layout. The overhead powerline will enter into an Eskom substation located adjacent to the western boundary of the Brakpan plant (Figure 3).

The primary aim of the assessment is to determine the agricultural capability and potential of the proposed study site (preferred layout for the PV facility as well as a 100m buffer around the 11km OHL) according to the Natural Resources Survey Specifications document (2012). This is achieved through a survey of the soils within the site's footprint; the slope, the climate, the geology, the erosion hazard, and the water resources to ensure the soil resources are utilised in a sustainable manner.

Soil forms are the primary components creating the pedosphere and are integral in the sustainability of life on earth. They are formed through the integration of five key components: namely, parent material (geology); time; climate; microorganisms; and water. The primary attributes of soil forms include:

- Soils are the primary mediums on earth for biological processes and activity;
- They provide and sustain integral ecological processes including water retention, nutrient cycling and the organic carbon cycle; and
- The soil characteristics of a particular area determine the botanical and faunal composition. Therefore, soils provide an important system in which the ecology of the area is founded upon.

South African soils can be classified into approximately 73 forms and further categorised into 14 groups (Fey, 2010). These number have been recently updated to 135 forms in 2018 (Soil Working Group, 2018). The classification and identification of these soil forms are based on the presence of defined diagnostic horizons or materials. Ineffective conservation efforts coupled with increased development within South Africa has exerted pressure on these vital soil resources. It is imperative that all developments employ techniques to ensure the conservation of soils forms.

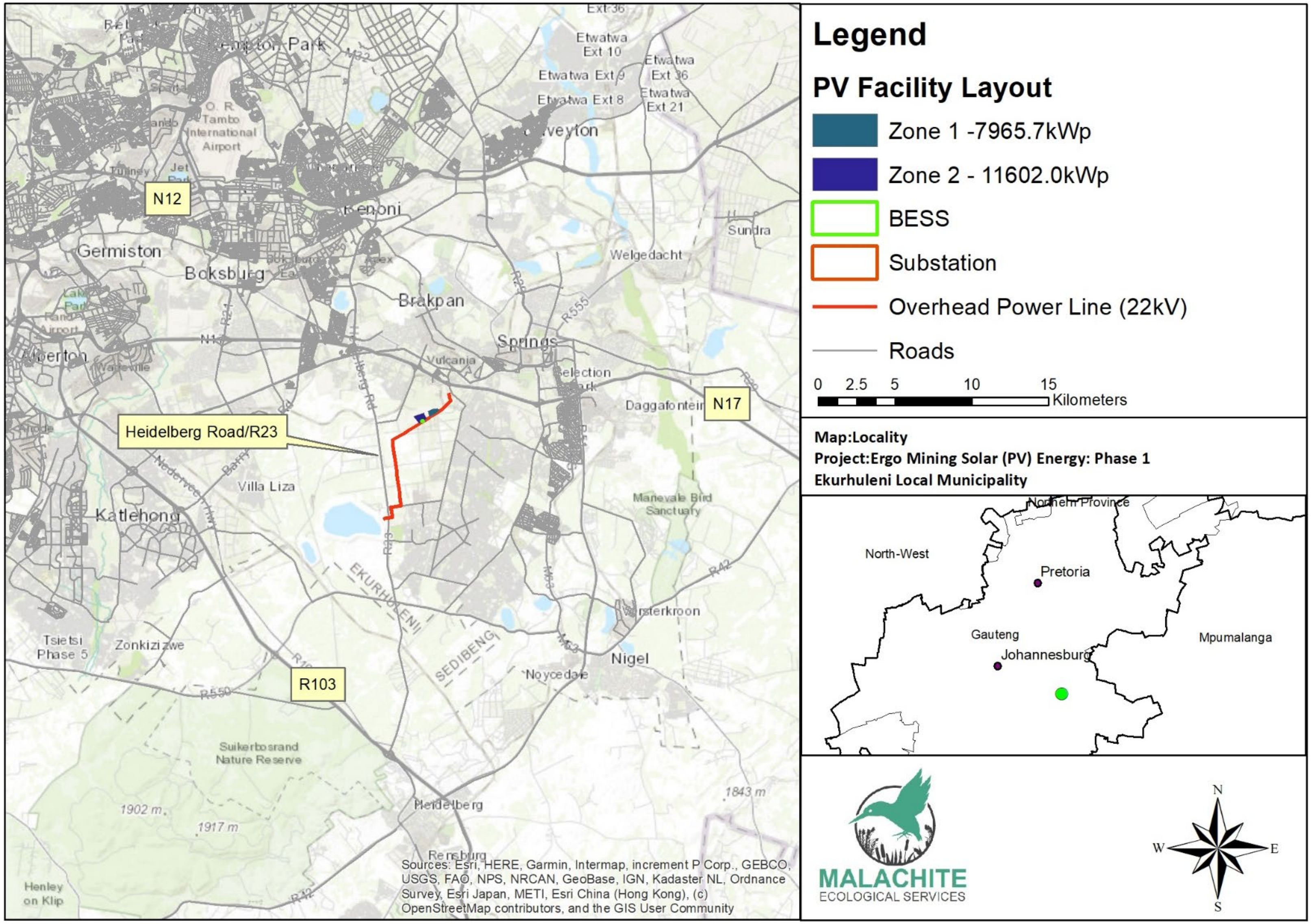


Figure 1: Locality of the study site

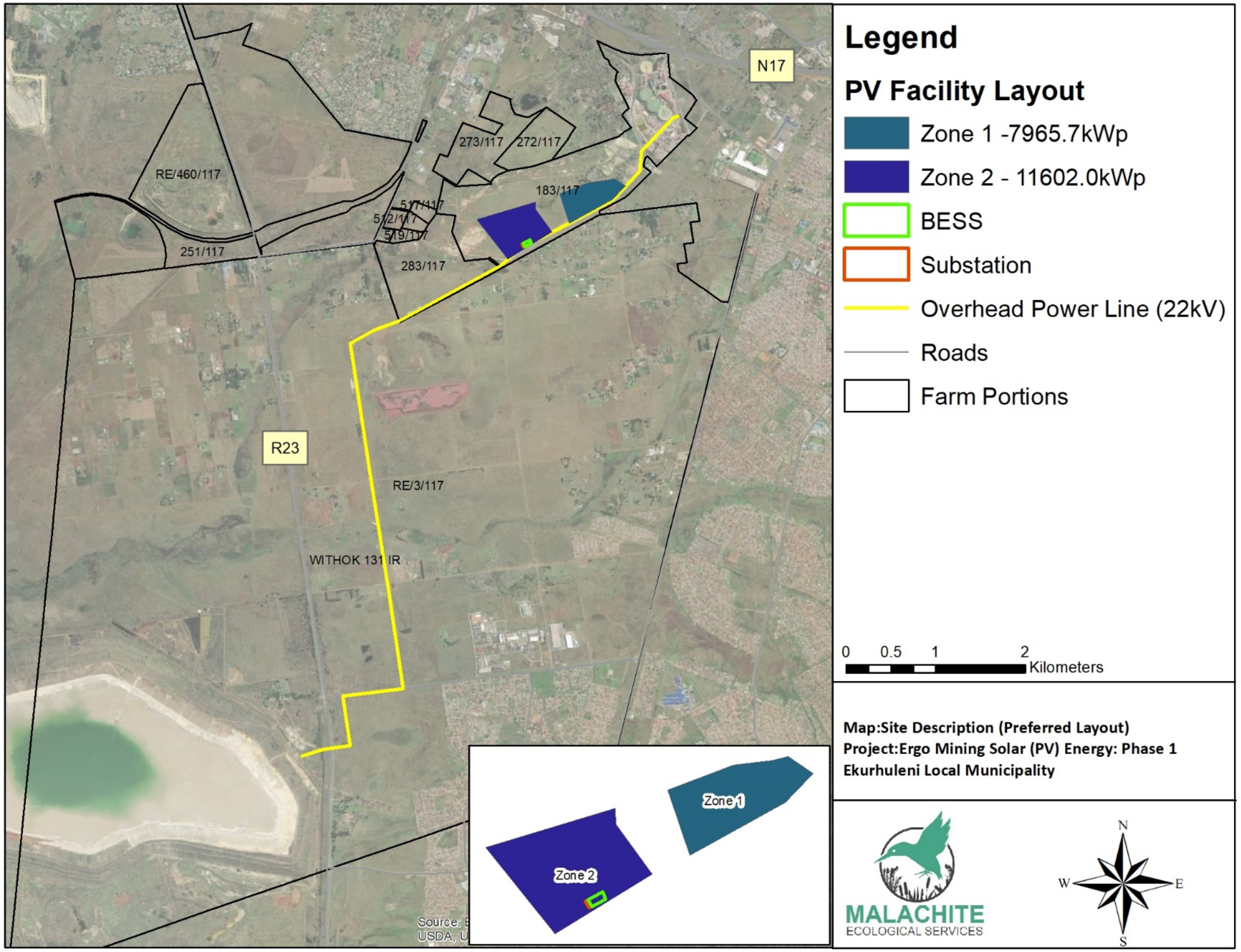


Figure 2: Aerial imagery of the study site showing the preferred layout

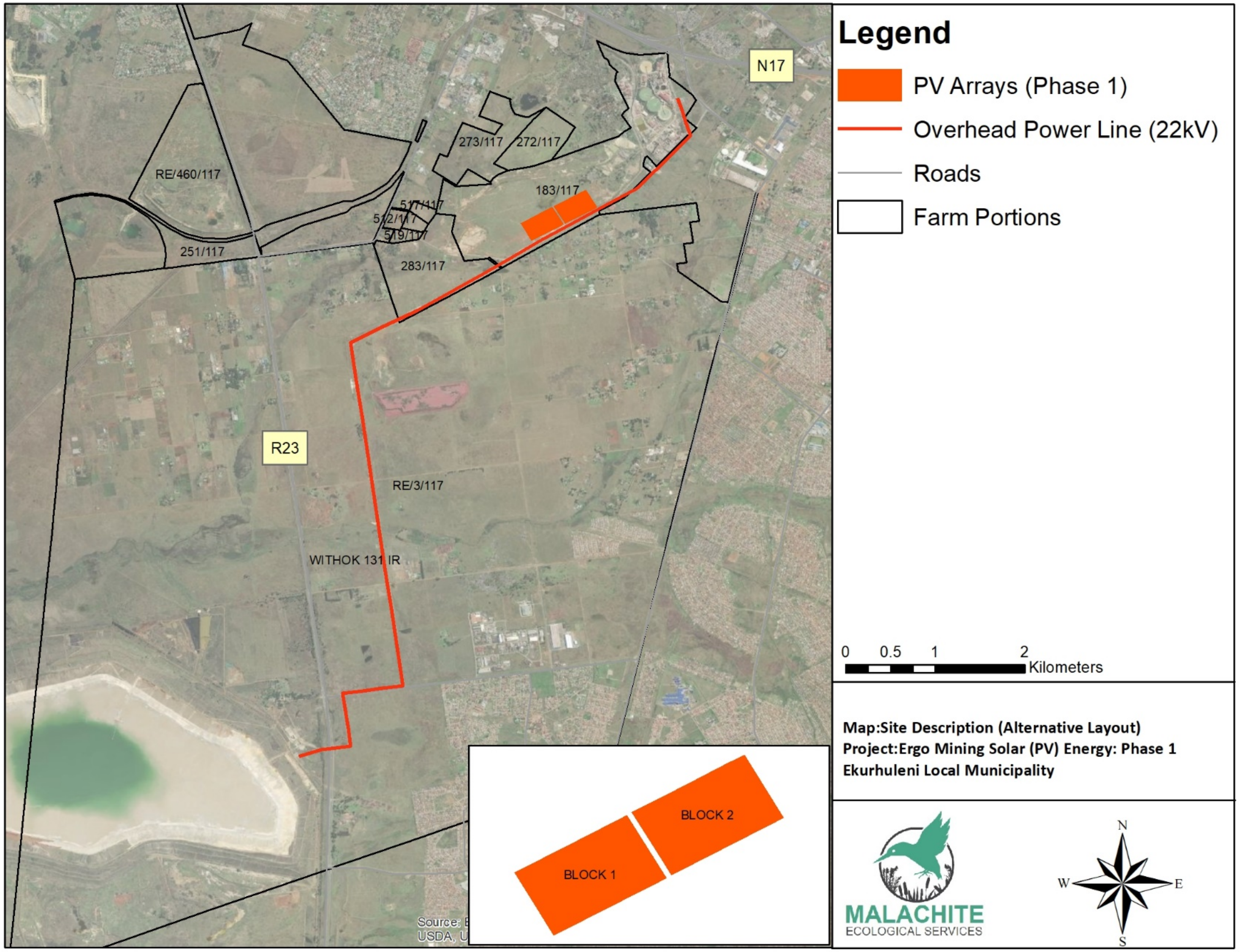


Figure 3: Aerial imagery of the study site showing the alternate layout

1.2. Scope of the assessment

The terms of reference for the study were as follows:

- Conduct a soil survey and mapping exercise of the study site to soil form and family level.
- Describe the physical properties of the soils sampled at each sampling location.
- Describe the slope and climate of the site.
- Describe the agricultural potential of the site based on the information attained from the soils identified within the site; slope; climatic data, rockiness, surface crusting and wetness.
- Identify current and possible negative impacts of the proposed project on the agricultural potential of the site.
- Recommend mitigation measures to lessen these impacts within the study site and the implementation of suitable rehabilitation measures.

1.3. Assumptions and Limitations

It is difficult to apply pure scientific methods within a natural environment without limitations or assumptions. The following apply to this study:

i. Soil mapping was inferred from extrapolations from the auger sampling points, whose locations were recorded on GPS coordinate waypoints with an accuracy of 3 to 6m. The boundaries of the soil forms delineated within the site are based on these waypoint locations. However, it is impossible to achieve 100% purity in soil mapping, the delineated soil map units could include other soil type(s) as the boundaries between the mapped soils are not sharp but rather gradual in reality.

ii. Soils classified as suitable to arable agriculture are also suited to other less intensive agricultural land uses, for instance pasture, natural grazing, and wildlife.

iii. Soil fertility status was not undertaken in this assessment.

1.4. Reporting Conditions

The findings and recommendations provided in this report are based on the author's best scientific and professional knowledge as well as information available at the time of compilation. No form of this report may be amended without the prior written consent of the author.

2. METHODOLOGY

2.1. Assessment techniques and tools

The techniques and tools utilised for this assessment can be divided into baseline data and field investigations. Baseline data was utilised during the desktop component to determine the biophysical context of the site as well as National and Provincial legislation that governs the proposed activity.

2.2. Baseline data

The desktop study involved the examination of aerial photography and Geographical Information System (GIS) databases. The study made use of the following data sources:

- Google Earth™ satellite imagery was used at the desktop level.
- Relief dataset from the Surveyor General was used to calculate slope.
- Climatic data was obtained using a dataset from 1982 to 2012 on the climate-data.org website.
- Historical imagery was obtained from the Department of Rural Development and Land Reform and the National Geospatial Information website (http://cdngiportal.co.za/cdngiportal/)
- Geology dataset was obtained from AGIS[1]
- Vegetation type dataset from Mucina & Rutherford (2006), with amendments by SANBI (NBA, 2018) were used in determining the vegetation type of the study area.
- Background Information was gathered from the Background Information Document (EnvirRoots, 2021).
- Soil and agricultural resources within South Africa are governed by legislation and these legislative requirements were consulted including:
    - Spatial Planning and Land Use Management Act (No. 16 of 2013).
    - Conservation of Agricultural Resources Act No. 43 of 1983.
    - Chapter 11 of the Nature Conservation Ordinance (No. 15 of 1974).

2.3. Site Investigation

In field data collection was taken between the 5th and 7th February 2021. Soil sampling was conducted throughout the proposed PV facility site (both alternative layouts) as well as along the 11km 22kV OHL route using a standard hand-held auger with a depth of 1200mm. At each sampling point the soil was described to form and family level according to “Soil Classification – A Taxonomic System for South Africa” (Soil Classification Working Group, 1991) and Soil Classification: A Natural and Anthropogenic System for South Africa (Soil Classificatoin Working Group, 2018).

The following properties were recorded:

- Soil diagnostic horizons.

[1] Land type information was obtained from the Department of Agriculture’s Global Information Service (AGIS) January 2014 – www.agis.agric.za

- Depth of the profile.
- Soil colour – as per the Munsell System.
- Soil texture including clay percentage.
- Permeability of the B horizon (wetness indicators).
- Effective rooting depth.
- Observations at the sampling point including any surface crusting, vegetation cover and rockiness.

The infield methods of determining soil texture and clay percentage are described in more detail in Appendix A.

Topography must be taken into account during the agricultural assessment, as together with soil form, it plays a large part in determining the land potential of target sites as well as any rehabilitation measures that may need to be taken as a result of the project. Climate is used as an important determinant in the agricultural potential of the site. Climate determines the volume of rainfall precipitation, the type of precipitation, the seasonal occurrence, soil moisture evaporation rate as well as the effect of sunshine hours, heat and chill units on crop yield and ground cover.

Information from the soil samples, the topography and Land type information was utilised to produce the Agricultural Potential and Land Capability map.

3. BASELINE DESCRIPTION

3.1. Local Climatic Conditions

The Ergo Gold Mine is situated within an area characterised by summer rainfall patterns with sporadic rainfall events during the winter months. The mean annual precipitation is 132mm, with the bulk of the rainfall occurring between September and March (summer months). These high intensity rainfall conditions are conducive to high levels of surface runoff and subsequent erosion where soils are shallow, occur on steep slopes or are overgrazed. The wettest time of the year is January with an average of 123mm and the driest is June and July with 7mm (Table 1). The seasonality of precipitation is a driving factor behind the hydrological cycles of water resources within the area. Typically, watercourses have a higher flow rate during the summer months.

Mean temperatures vary between 9.7^{O}C to 19.7^{O}C for the Brakpan region (Table 2). The area is coldest in July with average minimum temperatures of 2.8^{O}C and hottest in November and December with average maximum temperature of 25.2^{O}C on average (Climate-data.org; Mucina & Rutherford, 2006; updated 2018).

Table 1: Mean annual rainfall data for the Brakpan area

	January	February	March	April	May	June	July	August	September	October	November	December
Mean Rainfall (mm)	123	96	86	42	19	7	7	9	24	65	105	109

Table 2: Temperature data for the Brakpan area

	January	February	March	April	May	June	July	August	September	October	November	December
Mean Temperature (^{O}C)	19.7	19.6	18.4	15.7	12.8	10	9.7	13	16.8	18.5	18.9	19.7
Max Temperature (^{O}C)	25	24.9	23.9	21.5	19.6	17.3	17.4	20.9	24.6	25.7	25.2	25.2
Min Temp (^{O}C)	14.8	14.6	13.2	10.2	6.5	3.5	2.8	5.6	9.1	11.6	12.9	14.6

3.2. Geology

South Africa is a semi-arid country with differences in rainfall patterns, topography, and geology. The geological characteristic of an area influences the topography, soil types and textures, vegetation communities and faunal assemblages present.

The study area is underlain predominantly by the Ecca Group of the Madzaringwe Formation of the Karoo Supergroup. The geology of this region is primarily known to be sedimentary strata and is a very thick sequence of carbonaceous siltstone, mudstone, shale, sandstone, and coal.

3.3. Regional Vegetation structure and composition

The project area is located within the Grassland Biome. According to the latest regional vegetation classification for South Africa (Mucina & Rutherford, 2006; updated 2018), the study area falls within the Soweto Highveld Grassland and the Tsakane Clay Grassland vegetation types, with the majority of the site with the latter vegetation type (Figure 4).

The Tsakane Clay Grassland unit is distributed throughout Gauteng and Mpumalanga in areas characterised by flat to slightly undulating plains and low hills. The community structure is comprised of short, dense grassland dominated by a mixture of common highveld grasses such as *Themeda triandra*, *Heteropogon contortus*, *Elionurus muticus* and a number of *Eragrostis* species. The dominant forbs are of the families Asteraceae, Rubiaceae, Malvaceae, Lamiaceae and Fabaceae. Disturbances within these grasslands changes the vegetation dynamics, with an increase in the abundance of *Hyparrhenia hirta* and *Eragrostis chloromelas* noted. Erosion is generally very low.

This vegetation unit is classified as Endangered, with only 1.5% conserved in statutory reserves. The latter was confirmed in the National Biodiversity Assessment (2018) which indicates that the vegetation type is Poorly Protected, with an estimated over 60% transformed for cultivation, urbanisation, mining, dam-building and roads.

A small portion of the northern extent of the OHL is located within the Soweto Highveld Grassland vegetation type (Figure 3). This vegetation type is also present largely in Gauteng and Mpumalanga on gently to moderately undulating landscapes on the Highveld Plateau. It supports short to medium-high dense tufted grassland dominated almost entirely by *Themeda triandra*. Other grasses are also present including *Elionurus muticus, Eragrostis racemose, Heteropogon contortus* and *Tristachya leucothrix*. This vegetation type is classified as Vulnerable within the NBA (2018) database with only a handful of patches statutorily or privately conserved. Over 50% has been transformed by cultivation, urbanisation, mining, dam-building and roads. Erosion is generally very low.

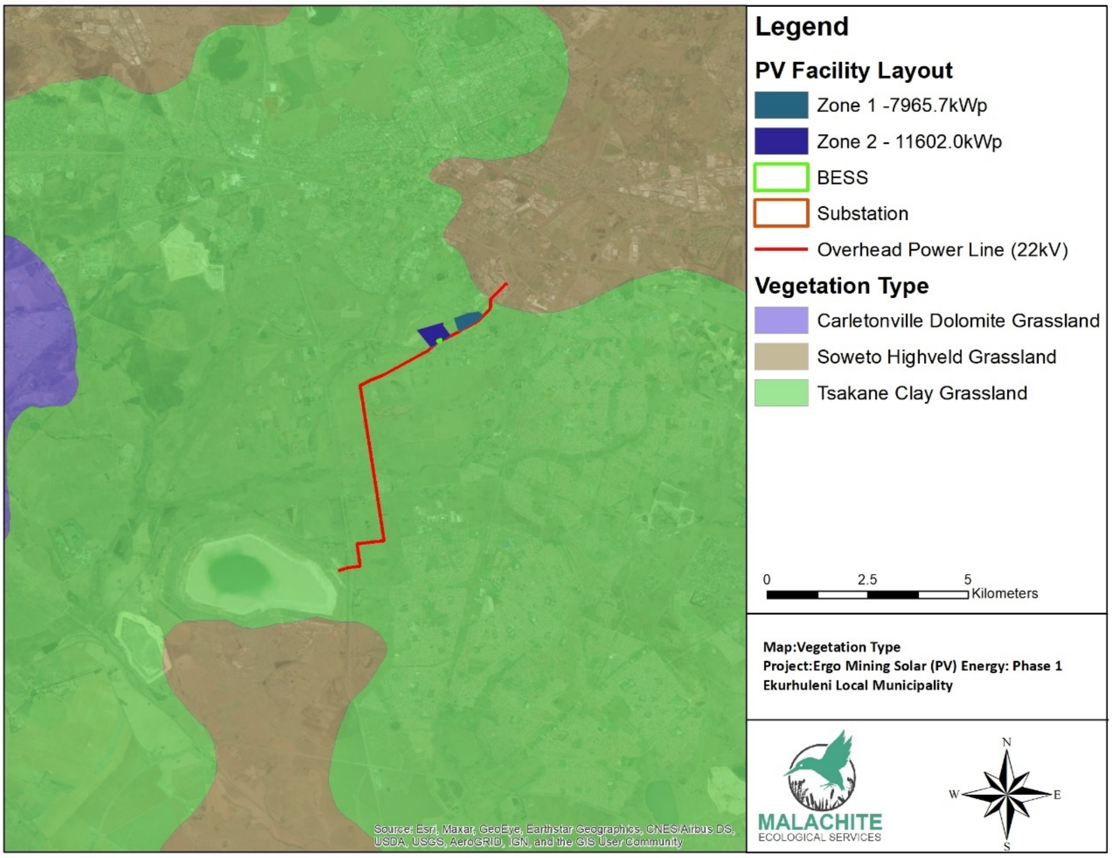


Figure 4: Regional vegetation associated with the study site

3.4. Land Type Data

Land type data for the site was obtained from the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of 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. The soil data was interpreted and re-classified according to the Taxonomic System (Land Type Survey Staff, 1972-2006).

The majority of the study site is situated in the Bb3 land type with small sections of the OHL route in the northern and southern portion situated within the Ba1 land type (Figure 5). The B land types represent a large proportion of the interior of South Africa which occupy the Plinthic Catena. Plinthic soils indicate a fluctuating water table. Hillslope catenas within these land types are represented by the soil forms Hutton, Bainsvlei, Avalon, Longlands, with the valley bottoms consisting of a gley soils such as the Katspruit soil form or Willowbrook, Rensburg or Champagne. In the Ba and Bb land types the plinthic character of soils makes up more than 10% of the area.

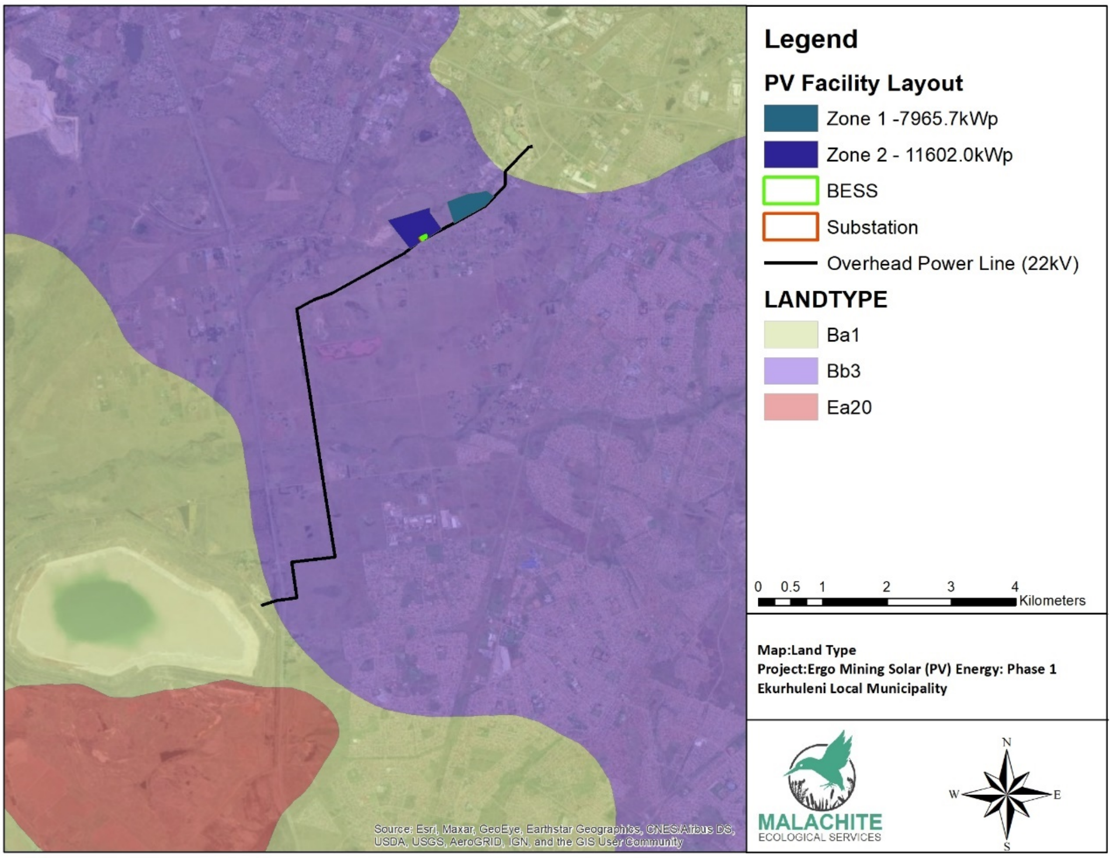


Figure 5: Land Type Data associated with the study site

3.5. Catchment characteristics and watercourses

The project area lies within the Vaal Water Management Area. Major rivers within this WMA include the Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts, Molopo and Vaal. These rivers experience significant levels of high-water demand related stress, particularly during drought seasons. Many of these surrounding communities rely on fresh water from these rivers throughout the year and supply adequate water for domestic, stock and irrigation.

More specifically, the project area is situated within the C22C Quaternary Catchment (Figure 6). The Rietspruit flows approximately 4.5km to the west of the site with a tributary of the Rietspruit crossing the proposed route of the 22kV OHL. Non-perennial drainage channels are also located along the OHL route.

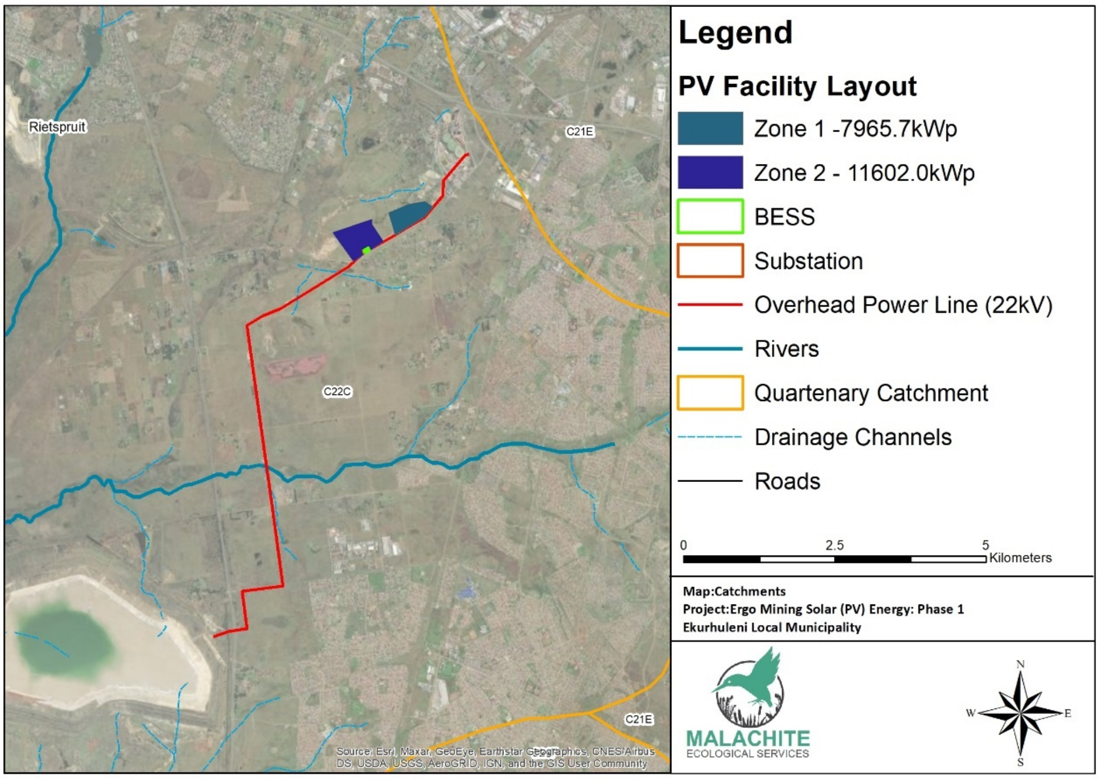


Figure 6: Quaternary catchment location and watercourse systems

3.6. Wetland systems

The recent publication of the National Wetland Map 5 (Van Deventer et al, 2019) (NWM5) database forms part of the National Biodiversity Assessment (2018), within the category of the Inland Aquatic (Freshwater) Realm. This project is a multi-partner project through the CSIR and SANBI. The NWM5 has significantly improved the representation of inland wetland ecosystem types. The representation of the extent of inland wetlands has improved by 123%, whereas the incorrect representation of terrestrial ecosystems as wetlands has been reduced (Van Deventer et al, 2018).

The NWM5 was utilised to assess the project area. As shown in Figure 7, a number of unchannelled valley bottom wetlands, depressions/pans and seep wetlands are located along the proposed 22kV OHL route and within the larger study site.

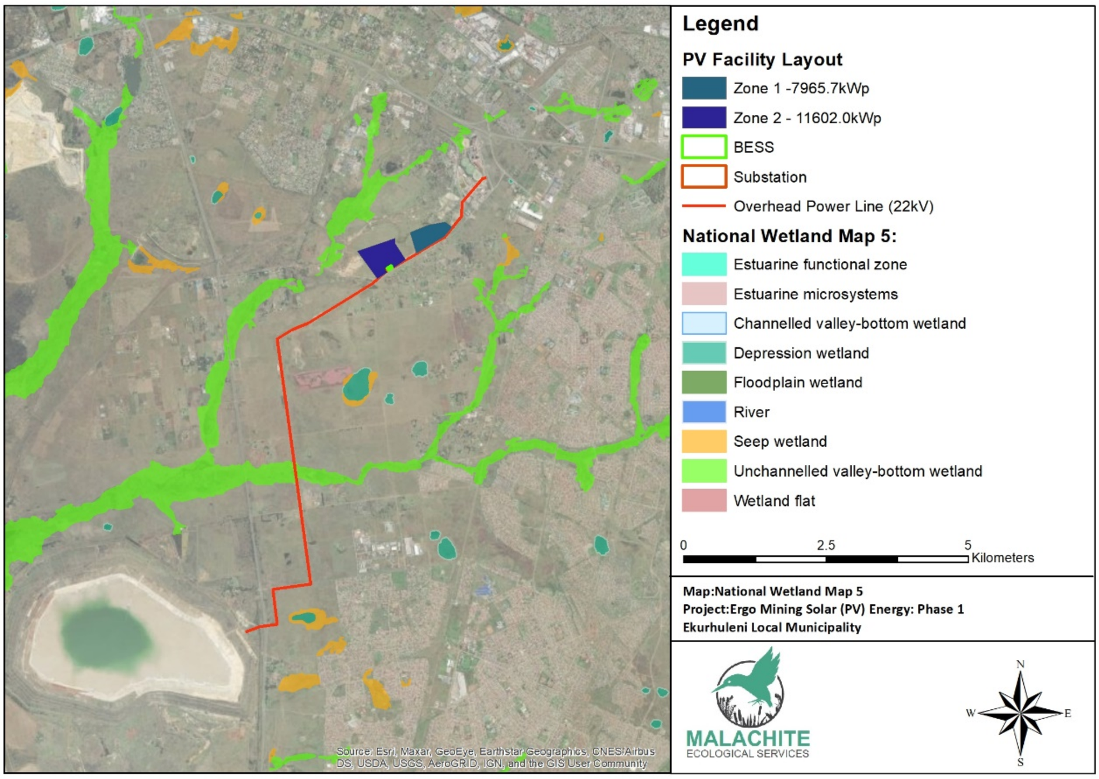


Figure 7: Wetland systems surrounding the site as per the National Wetland Map 5 database

3.7. Topography

The project area is situated on a gently undulating landscape. Average slopes are between 1.5% - 2% with maximum slopes of 6% within the northern section of the OHL route, where the existing Ergo Gold Mine Brakpan Plant is located. The altitude ranges from 1658m above sea level (absl) on the northern extent of the OHL to 1573m absl in the more central region of the OHL and then rises again to 1613m absl in the southern portion adjacent to the existing Brakpan/Withok Tailings Dam facility (Figure 8).

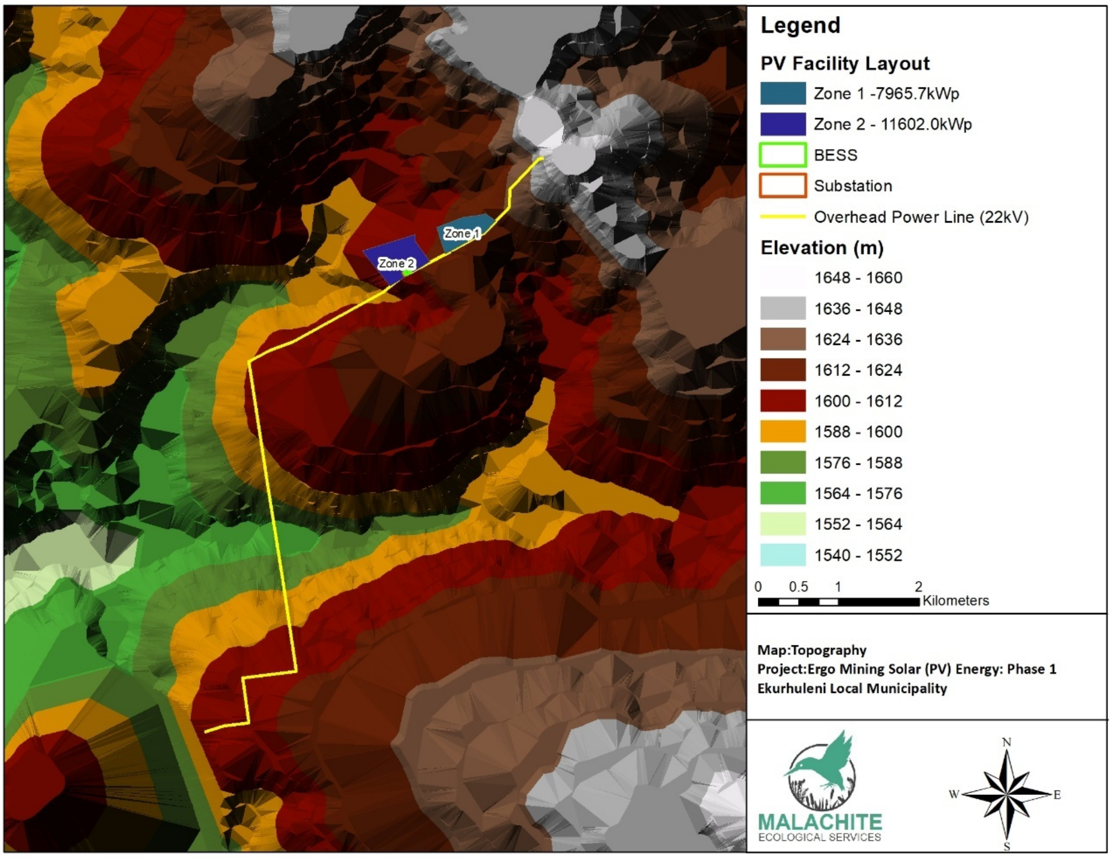


Figure 8: Topography of the site showing the range in altitude

3.8. Historic and Current Land Use

An investigation into historic aerial imagery of the site was undertaken. Aerial imagery from 1938 (Figure 9) shows the proposed position of the PV facility adjacent to and within a wetland system or watercourse. Development is also apparent with mining operations underway within proposed Zone 1. Agricultural activities in the form of cultivation are evident within Zone 2 and to the north and east of the site, with the development of the residential housing evident to the west.

Figure 9: Historic aerial imagery from 1938 showing the proposed PV facility site

In imagery from 1985 the use of the proposed PV facility site as a tailings dam is clearly evident (Figure 10). A second dam is also apparent along the 22kV OHL to the south of the PV facility site. These dams are indications of the disturbed nature of the study site as a result of the use of this area for mining activities.

Figure 10: Historic aerial imagery from 1985

In the 2000's the proposed PV facility site was remined and this is evident in aerial imagery from 2002 (Figure 11). Haul roads, mining operations and the continued transformation of the site is apparent in the aerial imagery.

Figure 11: Aerial imagery from 2002 showing the remining of the area proposed for the PV facility as well as the general area around the 22kV OHL

The rehabilitation of the area was then undertaken, from approximately 2004/2005, with soil deposition and the re-grassing of the area. This is shown in aerial imagery from 2007/2008 (Figure 12).

Figure 12: Aerial imagery from 2007/2008 showing the rehabilitation of the proposed PV facility site as well as the general area along the 22kV OHL

The most current aerial imagery available on Google Earth^{Tm} is from April 2020 (Figure 13). This shows the completed rehabilitation process with the PV facility site now a grassed area. The wetland/watercourse area to the north of the site is apparent as well, having been dammed as part of the mining activities.

Figure 13: Current imagery from April 2020 showing the rehabilitation of the proposed PV facility site as well as the general area along the 22kV OHL

4. ASSESSMENT RESULTS – SOIL SURVEY

4.1. Field Survey – Soil Assessment

Augur sample points were taken throughout the proposed PV facility site as well as within a 100m assessment area along the 11km 22kV OHL route (Figure 17). This was to determine the extent of soil types and this information was then utilised to create a soil map for the study site (Figures 18 to 20).

The study site can be classified into two separate soil types, the Natural Soils and the Anthrosols and Technosols, with the latter dominating the area. Natural soil formation gives rise to soil morphological expression and a sequence of soil horizons without significant human intervention. Anthrosols and Technosols are soils which have been drastically altered by human intervention such that the natural soil properties are no longer identifiable, and an anthropogenic classification is applied. According to the 2018 Soil Classification Working Group, Anthrosols are soils which have been drastically changed by intentional human activity to improve productivity. Within the site the Grabouw Anthrosol was identified. Technosols are soils that comprise material from mining, industry, construction, or urban activities that often supply parent material for new anthropogenic soils. They may also be created from alteration of natural soils by physical, chemical, or hydrological processes resulting from mechanical working, water diversion, pollution, and/or extraneous additions of harmful solids or liquids. Within the site the following Technosols were identified, Stilfontein, Witbank and Johannesburg.

The majority of the area proposed for the PV facility was classified as the Technosol soil form, Stilfontein. This soil is a Hydric Technosol and has undergone saturation for an extended period of time. This classification is also applied to former wetland soils that have suffered altered soil properties resulting from direct human intervention. The classification was applied to this area as hydric properties were identified both at the surface of the soil as well as within the lower reaches of all soil profiles examined within this area. Hydric characteristics included a gleying of the soil matrix as well as distinct and a high concentration of mottles and concretions. The presence of the Stilfontein soils in this area are a result the transformation of this area to a tailings dam which was remined and then rehabilitated, leaving behind saturated soils as well as an alteration to the natural drainage of the area, causing current ponding of stormwater. Further areas classified as Stilfontein soils along the OHL route are associated with mining related dams, and stormwater control.

Along the 100m assessment buffer around the OHL the following Anthrosols and Technosols were identified, Johannesburg, Grabouw and Witbank. The Johannesburg soil is an Urban Technosol and has been classified where current infrastructure is situated. Urban Technosols encompass the whole spectrum of urban development and for this area, the classification includes the gravel road, the R23, the slurry pipelines, and buildings. The Grabouw soil is categorised as a Physically Disturbed Anthrosol. This includes areas where the soils have been mixed, compacted, or excavated by human activity. These were often identified adjacent to the Urban Technosol but have not been disturbed to the same degree. The Witbank soil, which is categorised as a Transported Technosol was identified in the southern region of the study area and includes the Brakpan/Withok Tailings Dam facility. Transported Technosols include any relatively fine or crushed material which has been intentionally transported from a separate location and deposited on the land surface.

Scattered throughout the study area, between the Anthrosols and Technosols, natural soil profiles were identified, and these were classified as either Mispah/Glenrosa soils, the Nkonkoni soils, or the Bloemdal and Bainsvlei soils.

The Mispah and Glenrosa soil forms are categorised as belonging to the Lithic class. Lithic soils are characterised by hard rock or saprolite dominating the soil profile. Mispah soils are characterised by an Orthic A horizon overlying hard rock, while Glenrosa soils are characterised by an Orthic A horizon overlying a lithic horizon (weathering rock). These soils were identified on convex and steeper slopes where natural erosion keeps pace with weathering and the result is shallower soil profiles. The Mispah and Glenrosa soil profiles identified within the site ranged in depth from 10cm to approximately 60cm

In the southern portion of the assessment area the Nkonkoni soil form was identified. This soil graded into the Bloemdal soil form as the OHL crosses the channelled valley bottom wetland system. The Nkonkoni and Bloemdal soil forms are categorised as belonging to the Oxidic soil class. Oxidic soils have a B horizon that is uniformly coloured with red and/or yellow oxides of iron. These soils exhibit a broad geographic distribution in South Africa and are considered mature soils, coupled with free drainage in the upper solum of the soil profile. The Nkonkoni soil form consists of an Orthic A horizon overlying a red-apedal horizon which overlies a lithic horizon. The Bloemdal soil form is similar with the exception of a gleyic horizon in the place of the lithic horizon. The gleyic horizon is an indication of a saturated soil and a higher water table.

This is associated with the channelled valley bottom wetland. The gleyic horizon was identified at approximately 60cm.

The Bloemdal soil form is interspersed with the Bainsvlei soil form. This is similar to the Bloemdal soil form with the exception of a soft plinthic horizon in place of the gleyic horizon. Plinthic soils consist of an orthic A horizon which grades into a soft plinthic or hard plinthic horizon either directly or via a red apedal B, a yellow-brown apedal B, or an E horizon. They are easily identified by their iron oxides which are found segregated and concentrated in the soil, forming mottling and cementation. Of importance is that plinthic soils contain distinct mottling and these are indicative of a fluctuating water table and the soils indicate at least seasonal saturation. The soft plinthic horizon identified in the Bainsvlei soil within the assessment area ranged from 30cm to 90cm in depth.

Within the more permanently saturated sections of the channelled valley bottom wetland system, the Katspruit soil form was identified. This soil form belongs to the Gleyic soil class. Gley soils display reduction and are located within saturated environments. They are considered wetland soils and are generally identified in the low-lying parts of the landscape. The Katspruit soil form consists of an Orthic A horizon overlying a gley horizon and this saturated horizon was identified within the first 10cm of the profiles examined.

Figure 14: Examples of the soils classified as (A) Stilfontein and (B) Grabouw. Note the gravelly and hydric appearance of the Stilfontein soils indicating deposition and/or disturbance by human activity as well as seasonal or permanent saturation. Note too, the white substance identified in the Grabouw soils indicating deposition and disturbance through human activity.

Figure 15: Anthropogenic disturbances to the majority of the soils within the assessment area, including dams, stormwater control, gravel road and the slurry pipelines

Figure 16: Examples of the (A) Nkonkoni, (B) Glenrosa, (C) Bainsvlei and (D) Katspruit soils

Table 3 gives information on the different soil characteristics identified at each auger sampling site. Soil sampling points are displayed in Figure 17. These characteristics include:

- Soil form and family;
- Soil colour;
- Soil texture;
- Effective rooting depth;
- Subsoil permeability; and
- Slope at sampling location.

Table 3: Soil Properties identified at each auger sampling point

Number of Sample (as per Fig. 17)	Soil Form	Soil Family Code	Soil Horizons	Soil Colour	Field Texture	Effective Rooting Depth	Permeability	Slope (%)	Observations
1	Stilfontein	St 1200	N/A	10YR 3/4	Silty Clay Loam	40	Severely Restricted	3-5	Saturated soils, gleyic/plinthic horizon at 40cm
2	Stilfontein	St 1200	N/A	5YR ¾	Silty Clay Loam	65	Restricted	0-2	Saturated soils gleyic/plinthic horizon at 65cm
3	Stilfontein	St 1200	N/A	10YR 3/6	Silty Clay Loam	50	Restricted	0-2	Saturated soils gleyic/plinthic horizon at 50cm
4	Stilfontein	St 1200	N/A	10YR 4/1	Silty Clay Loam	60	Restricted	0-2	Saturated soils gleyic/plinthic horizon at 60cm
5	Stilfontein	St 1200	N/A	10YR 5/1	Silty Clay	20	Impermeable	0-2	Saturated soils, depression like feature in landscape
6	Stilfontein	St 1200	N/A	10YR 4/1	Silty Clay Loam	30	Severely Restricted	0-2	Saturated soils depression like feature in landscape
7	Stilfontein	St 1200	N/A	10 YR 4/1	Silty Clay	50	Restricted	0-2	Saturated soils gleyic/plinthic

Number of Sample (as per Fig. 17)	Soil Form	Soil Family Code	Soil Horizons	Soil Colour	Field Texture	Effective Rooting Depth	Permeability	Slope (%)	Observations
									horizon at 50cm
8	Stilfontein	St 1200	N/A	10YR 5/2	Silty Clay	70	Restricted	0-2	Saturated soils gleyic/plinthic horizon at 70cm
9	Stilfontein	St 1200	N/A	10YR 4/1	Silty Clay	40	Severely Restricted	0-2	Saturated soils pan like feature in landscape
10	Stilfontein	St 1200	N/A	10YR 4/1	Silty Clay	30	Severely Restricted	0-2	Saturated soils
11	Stilfontein	St 1200	N/A	10YR 4/1	Silty Clay	35	Severely Restricted	0-2	Saturated soils
12	Stilfontein	St 1200	N/A	10YR 4/4	Silty Clay Loam	50	Restricted	0-2	Saturated soils
13	Stilfontein	St 1200	N/A	10YR 3/3	Silty Clay Loam	60	Restricted	3-5	Saturated soils
14	Stilfontein	St 1200	N/A	5YR 4/4	Silty Clay Loam	40	Severely Restricted	3-5	Saturated soils
15	Stilfontein	St 1200	N/A	10YR 4/1	Silty Clay Loam	50	Restricted	3-5	Saturated soils
16	Nkonkoni	Nk 3222	Orthic A Red Apedal Lithic	5YR 3/4 2.5YR 3/4	Silty Clay Loam	100	Good	0-2	Deeper soils, good drainage, luvic in nature
17	Nkonkoni	Nk 3222	Orthic A Red Apedal Lithic	5YR 3/4 2.5YR 3/4	Silty Clay Loam	110	Good	0-2	Deeper soils, good drainage, luvic in nature
18	Stilfontein	St 1200	N/A	10YR 3/3	Silty Clay	30	Severely Restricted	0-2	Saturated soils

Number of Sample (as per Fig. 17)	Soil Form	Soil Family Code	Soil Horizons	Soil Colour	Field Texture	Effective Rooting Depth	Permeability	Slope (%)	Observations
19	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	20	Severely Restricted	3-5	Adjacent to infrastructure.
20	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	40	Severely Restricted	0-2	Adjacent to infrastructure.
21	Grabouw	Gr 2000	N/A	10YR 3/4	Silty Clay Loam	5	Impermeable	0-2	Adjacent to infrastructure.
22	Johannesburg	Jo 2200	N/A	N/A	N/A	N/A	Impermeable	0-2	Infrastructure
23	Glenrosa	Gs 1120	Orthic A Lithic	10YR 3/6 10YR 4/6	Silty Clay Loam	35	Slightly Restricted	0-2	Shallow topsoil over weathering rock
24	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	30	Slightly Restricted	3-5	Adjacent to infrastructure.
25	Stilfontein	St 1200	N/A	10YR 3/2	Silty Clay	10	Severely Restricted	3-5	Saturated soils
26	Glenrosa	Gs 1120	Orthic A Lithic	10YR 3/4 10YR 3/6	Silty Clay Loam	30	Slightly Restricted	3-5	Shallow topsoil over weathering rock
27	Mispah	Ms 1110	Orthic A Hard Rock	10YR 3/4 10YR 3/6	Silty Clay Loam	10	Severely Restricted	0-2	Shallow topsoil over fractured rock
28	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	30	Slightly Restricted	0-2	Adjacent to infrastructure.
29	Bloemdal	Bd 1220	Orthic A Red Apedal Gleyic	5YR 4/3 2.5YR 3/4 10YR 4/1	Silty Clay Loam	60	Restricted	3-5	Gleyic horizon at 60cm
30	Johannesburg	Jo 2200	N/A	N/A	N/A	N/A	Impermeable	0-2	Infrastructure
31	Johannesburg	Jo 2200	N/A	N/A	N/A	N/A	Impermeable	0-2	Infrastructure

Number of Sample (as per Fig. 17)	Soil Form	Soil Family Code	Soil Horizons	Soil Colour	Field Texture	Effective Rooting Depth	Permeability	Slope (%)	Observations
32	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	40	Severely Restricted	0-2	Adjacent to infrastructure.
33	Nkonkoni	Nk 3222	Orthic A Red Apedal Lithic	5YR 4/3 2.5YR 3/4 10YR 4/4	Silty Clay Loam	65	Good	3-5	Shallower red apedal soil. Luvic in nature
34	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	40	Severely Restricted	3-5	Shallow topsoil over weathering rock
35	Nkonkoni	Nk 3222	Orthic A Red Apedal Lithic	5YR 4/3 2.5YR 3/4 10YR 4/4	Silty Clay Loam	55	Slightly Restricted	0-2	Shallower red apedal soil. Luvic in nature
36	Bainsvlei	Bv 1220	Orthic A Red Apedal Soft Plinthic	5YR 4/4 2.5YR 4/6 10YR 6/1	Silty Clay Loam	60	Good	0-2	Soft Plinthic horizon at 60cm
37	Johannesburg	Jo 2200	N/A	N/A	N/A	N/A	Impermeable	0-2	Infrastructure
38	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	30	Severely Restricted	0-2	Adjacent to infrastructure.
39	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	70	Good	0-2	Deeper topsoil over weathering rock
40	Katspruit	Ka 1210	Orthic A Gley	10YR 4/4 10YR 4/1	Silty Clay	30	Severely Restricted	0-2	Within the wetland system. Permanently saturated
41	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	35	Severely Restricted	0-2	Shallow topsoil over

Number of Sample (as per Fig. 17)	Soil Form	Soil Family Code	Soil Horizons	Soil Colour	Field Texture	Effective Rooting Depth	Permeability	Slope (%)	Observations
									weathering rock
42	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	40	Severely Restricted	0-2	Shallow topsoil over weathering rock
43	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	30	Severely Restricted	0-2	Adjacent to infrastructure.
44	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	30	Severely Restricted	0-2	Adjacent to infrastructure.
45	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	30	Severely Restricted	0-2	Adjacent to infrastructure.
46	Glenrosa	Gs 1120	Orthic A Lithic	10YR 4/4	Silty Clay Loam	50	Restricted	0-2	Adjacent to infrastructure.
47	Witbank	Wb 2300	N/A	N/A	N/A	N/A	Impermeable	0-2	Infrastructure, tailings dam
48	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	40	Severely Restricted	0-2	Adjacent to infrastructure, compacted
49	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	20	Severely Restricted	3-5	Adjacent to infrastructure.
50	Grabouw	Gr 1000	N/A	10YR 3/4	Silty Clay Loam	30	Severely Restricted	3-5	Adjacent to infrastructure.

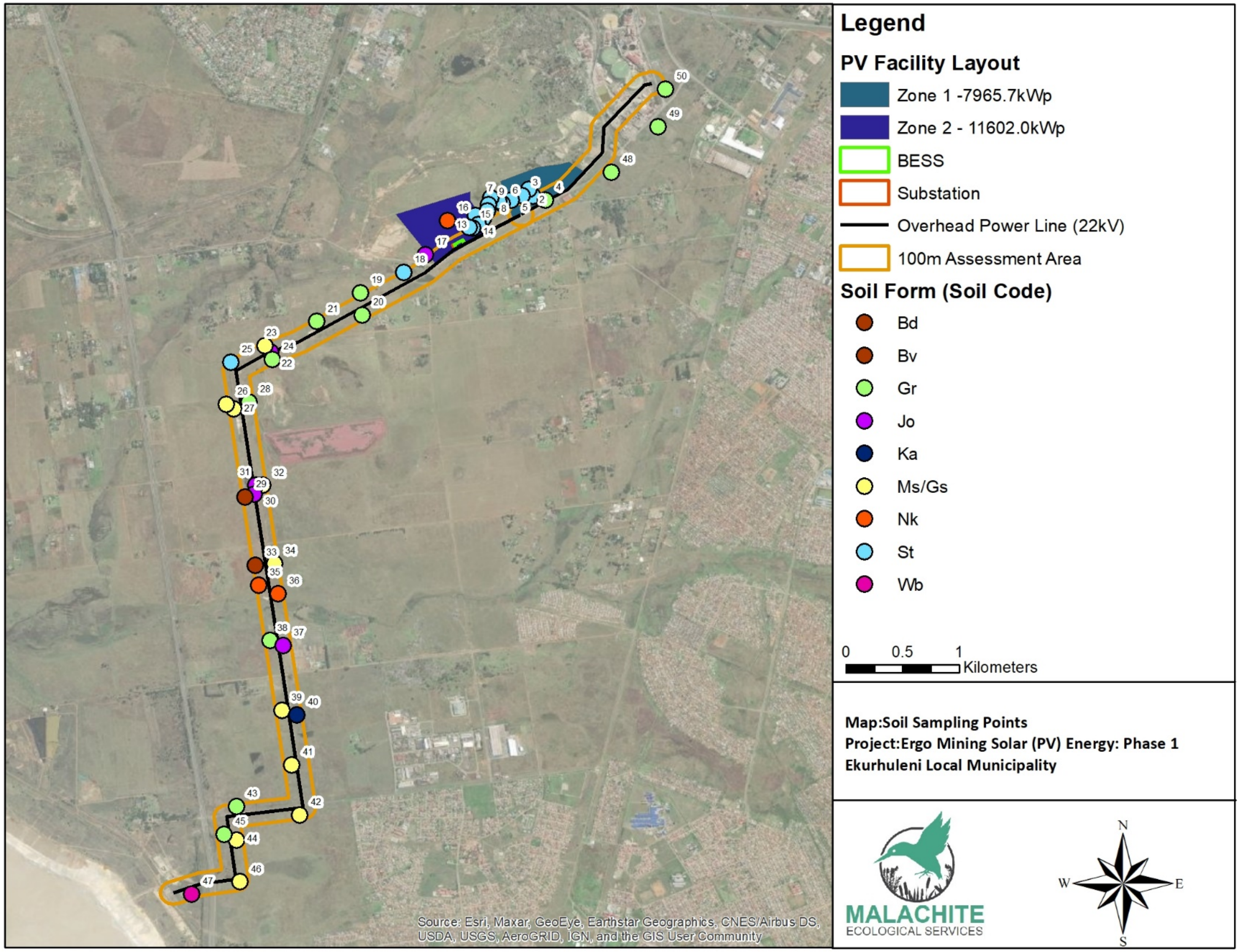


Figure 17: Soil auger points and soil forms identified

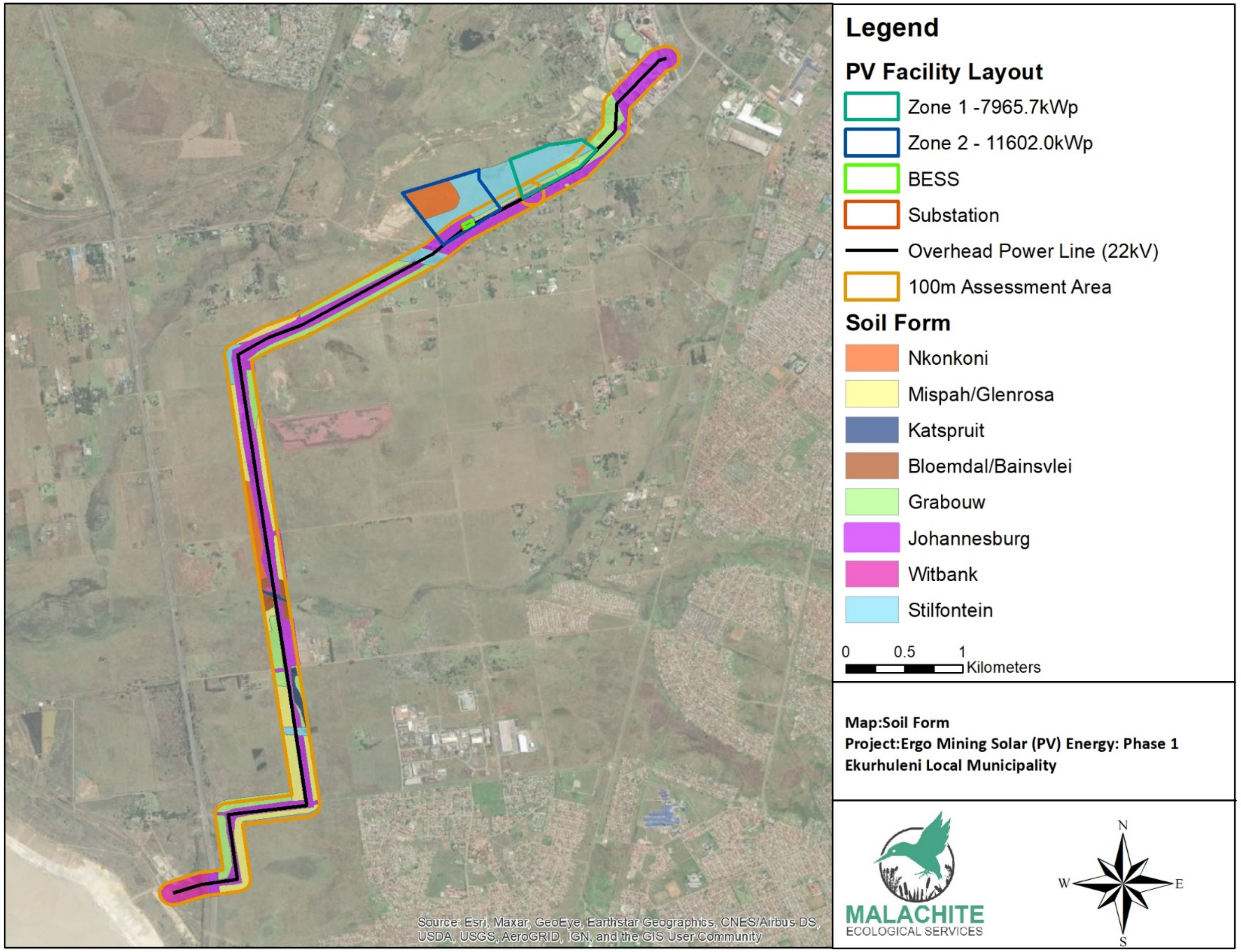


Figure 18: Soil Forms associated with the site

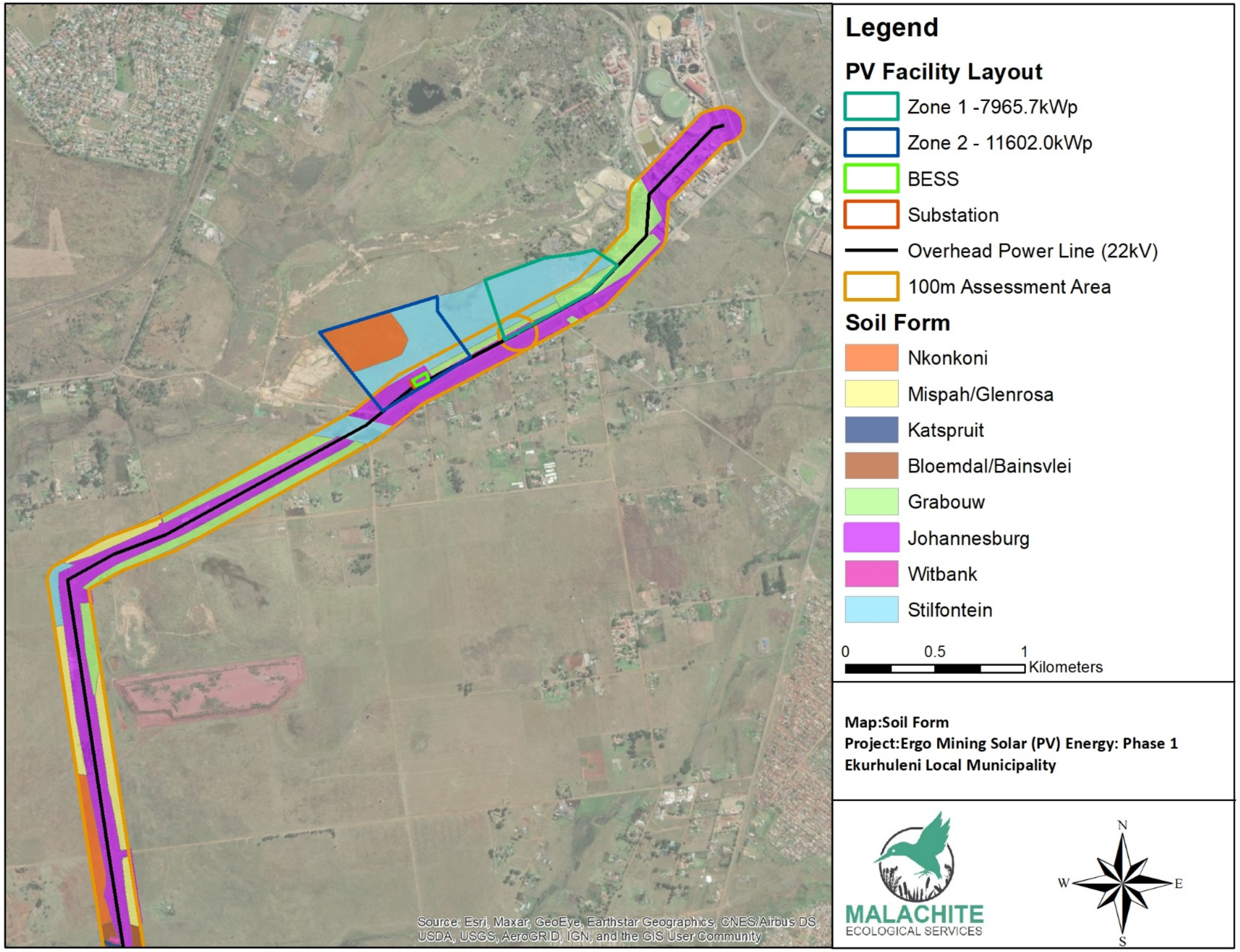


Figure 19: Closer view of the soil forms associated with the study site

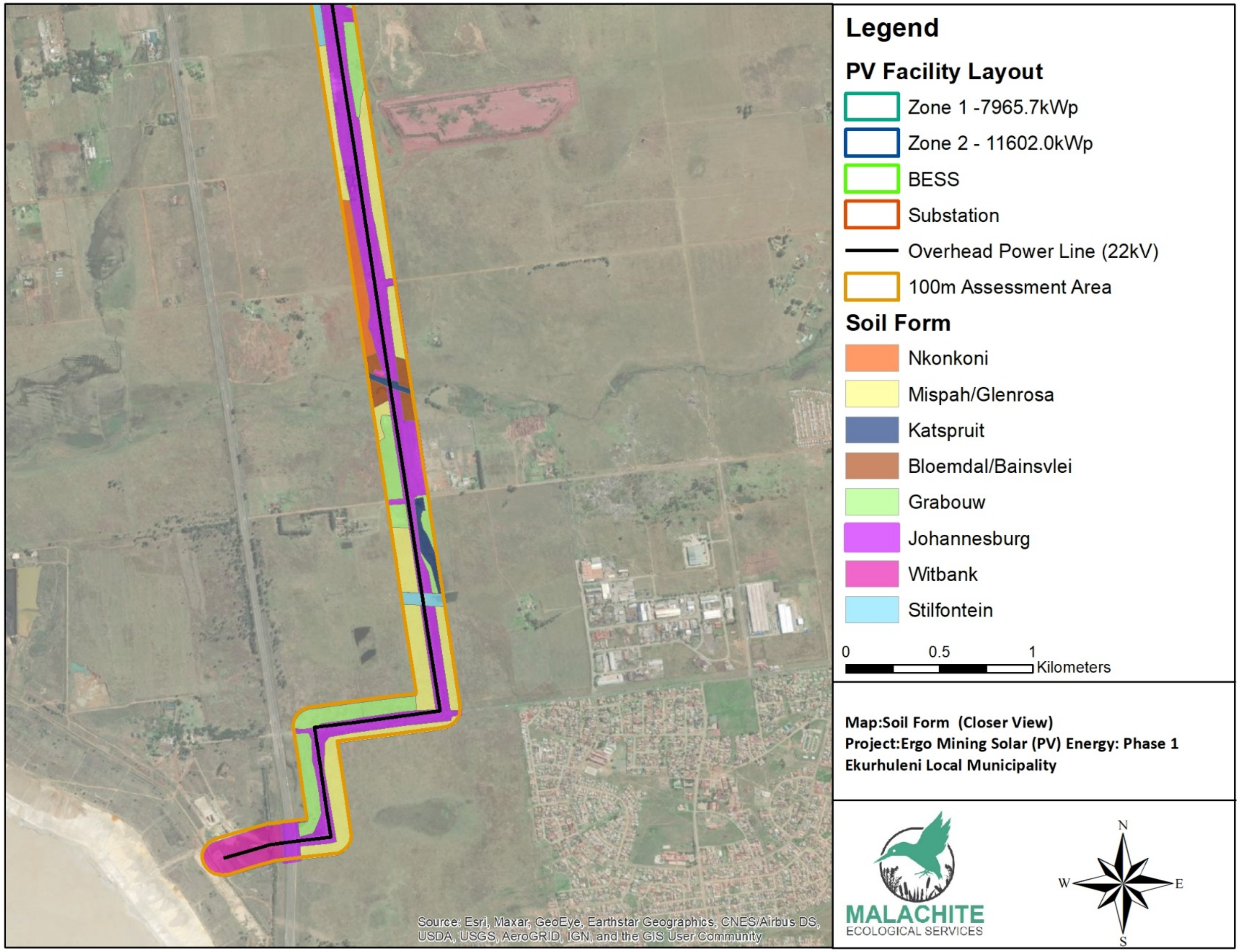


Figure 20: Closer view of the soil forms associated with the study site

5. SOIL AGRICULTURAL POTENTIAL

Land evaluation is the process of estimating the production potential for alternative land uses. The physical data acquired from soil profiles is applied to a flow sheet adapted to South African conditions from the US Department of Agriculture standards and utilised by land usage authorities as the basic template for benchmarking soil quality throughout South Africa.

Land capability evaluation is an attempt to grade the potential of the land in terms of its best and worst uses in an arable situation. The land is classified according to its limitations, either on a permanent or temporary basis. The system is biased towards soil conservation and is based on the negative features of the land. The classification system is categorised on a scale of I to VIII so yield potential matrices can be easily formulated. LCC I to LCC III classes are suitable for arable crops. LCC IV can sometimes be cultivated for annual crops, but under carefully controlled conditions. LCC V are usually wetlands while LCC VI, VII and VIII soils are suited to domestic livestock and wild game only. Table 4 reflects the LCC of each Class. The flowsheets used to determine Land Capability Class are shown in Appendix B.

Table 4: Land capability classification descriptions

Class	Description
I	Little to no limitations, high potential for intensive arable use.
II	Land subject to certain limitations or hazards. It is suitable for cropping with adequate protection measures, which may sometimes include special management practices and regular rotations.
III	Land subject to moderate limitations or risk of damage, which is suitable for cropping only with intensive protection measures and special practices, which may include long ley rotations with short cropping periods
IV	Land subject to severe permanent limitations or hazards. Suitable for occasional row cropping in long ley rotations, or for use under perennial vegetation. Limitations may include steep slopes, shallow soils, soils of very low water-retaining capacity, high erodibility, unfavourable characteristics in the surface soil, and severe, but correctable, wetness.
V	Watercourses and land subject to wetness limitations. These limitations include temporary, periodic and semi-permanent wetness. Cultivation is only permitted with very special practices and measures. Vleis and watercourses subject to severe wetness are best left under permanent vegetation.
VI	Land which has such severe soil and/or slope limitations that cropping must be excluded but which is productive under perennial vegetation but is susceptible to moderate erosion.
VII	Not suited for cultivation, severe limitations for grazing or farming.
VIII	Extremely rough, suited only for wildlife or recreation.

The primary function of land evaluation is to predict the possible effects, both detrimental and beneficial for a change in land use.

The most important soil and landscape characteristics when applying this system are texture (Clay %), soil depth, permeability, slope, rockiness, surface crusting and wetness. At the study site these were found to occur according to the following broad patterns:

- **Soil texture:** Analysis of the texture during the field investigation revealed that the soils within the site have either a silty clay or silty clay loam texture, with the majority of soils falling into the latter classification. Clay percentage in the samples ranges from 25-40% for the silty clay loam soils and 40-60% for the silty clay soils. Clay percentages in the majority of soils examined are not expected to be a limitation to crop production, with a slight restriction in the clayey soils associated with the silty clay texture class.
- **Soil depth:** Soils identified both within the proposed PV facility and along the OHL route were generally shallow, largely as a result of anthropogenic activity within the area causing compaction, soil mixing and saturation. Depths ranged from 50mm to 1000mm, however the majority of soils were identified to be within the 300-700mm depth class. These depths are considered a limitation to crop production, with the study site only really suitable for shallow rooted vegetables or grass pastures.

  Soil permeability: The permeability of the majority of the soils associated with the site was found to be restrictive for crop production. A large proportion of the soils were classified as restricted or severely restricted as a result of anthropogenic modifications, the identification of hydric soils as well as gleyed or plinthic horizons within the soil profiles. This is further exacerbated by the higher clay content of the soils identified. Surface water ponding was noted, particularly where the PV facility is proposed to be located, as well as along parts of the OHL route. Soil permeability is therefore considered a limitation to cultivation in the study site.
- **Slope:** There is a wide range in slopes, which for the land capability classification, have been grouped as follows:
  - 0-8% - land, which depending on soil profile characteristics is potentially in Class II
  - 8-12% - land, which depending on soil profile characteristics is potentially in Class III
  - 12-20% - land, which depending on soil profile characteristics is potentially in Class IV
  - >20% - land, which is in Class VI or even VII, on slopes greater than 40%.

  The site consisted of gentle terrain with all slope percentages recorded in the 0-8% category. Slope is therefore not a limitation to cultivation.
- **Rockiness:** Rockiness was not identified as a limitation to cultivation Surface rocks were encountered on the site, particularly in areas that have been classified as Anthrosols and Technosols as these were deposited in the area. However, these do not pose a major limitation to the site.
- **Crusting:** In the field this was not found to be a major limitation to cultivation. As a result, there is no need to consider this factor further.

- **Wetness:** The entire PV facility site is categorised as a Hydric Technosol as a result of the identification of hydric properties in the soils identified in this area. Sections along the OHL route were furthermore classified as Stilfontein or more natural Bloemdal, Bainsvlei and Katspruit soils. The wetness of the site is due to both natural and anthropogenic disturbances and these areas are not suitable for crop production.

Taking into account the above factors, the study site has been categorised into the Class IV, Class V, Class VI, and Class VIII categories (Figure 21).

The Class IV category is for the shallower but natural Mispah/Glenrosa and Nkonkoni soils. The hard rock or lithic horizon was identified at depths of 300mm to 700mm and this limits the agricultural potential of these soils to shallow rooted crops and grass pastures. These soils occupy 10.6% of the site.

The Class V category is reserved for saturated soils and was thus mapped where the Stilfontein, Bloemdal, Bainsvlei and Katspruit soils were identified. These soils show a high degree of mottling and gleying and indicate a shallow water table for most of the year. The soils were either anthropogenically modified, in the case of the Stilfontein soils or form part of wetland systems. Cropping in these areas would require intensive protection measures and special practices such as the drainage of the soil. Class V soils occupy 11.8% of the site.

The Grabouw soils have been classified as Class VI soils. Class VI soils have severe restrictions to cropping and are therefore excluded from production under perennial vegetation. This is due to the anthropogenic disturbances to these soils and the use of the soils for human activity. Class VI soils occupy 23.1% of the study site.

The remaining Johannesburg and Witbank soils are categorised as Class VIII soils. These soils have been completely modified and are not productive for any agricultural activities. These soils occupy 45.5% of the study site.

Overall, the study site can therefore be considered to have a low to negligible agricultural potential with severe limitations to crop cultivation. This is as a result of a combination of factors including the significant long term anthropogenic modifications to the soils of the site, the presence of saturated horizons, the shallower nature of the remaining natural soils and the use of the surrounding landscape for mining and urban activities.

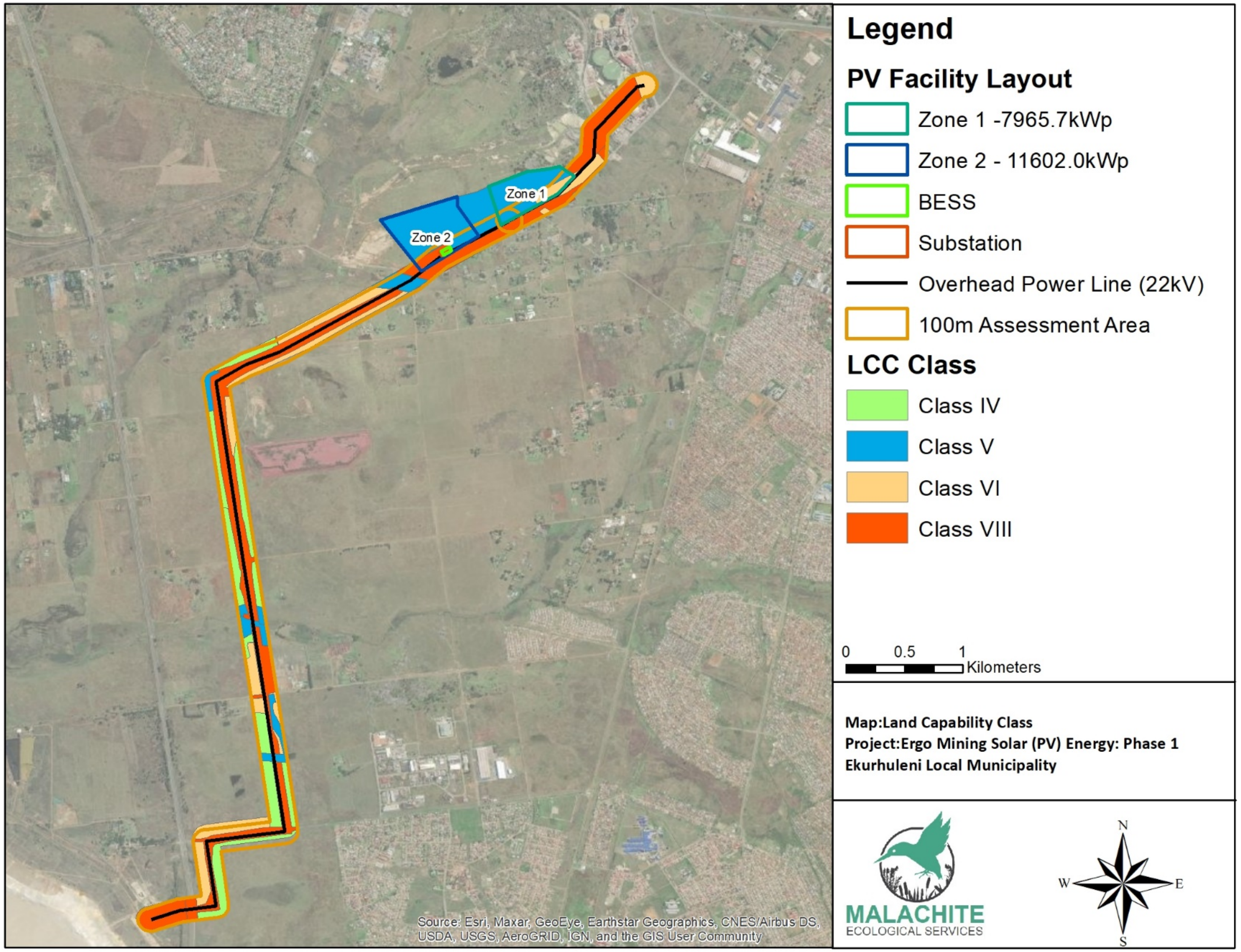


Figure 21: Land Capability Classes which guide the Agricultural Land Potential of the site

6. IMPACT ASSESSMENT

Any development activity in a natural system will have an impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was to identify and assess the significance of the impacts caused by the proposed project on the soils as well as the agricultural potential of the site. Furthermore, mitigation measures are recommended to limit the identified negative impacts on the receiving environment.

The project will involve the clearing of portions of the site for the establishment of the 19.9MW power PV facility, as well as the construction of the 11km 22kV Overhead Power Line for the preferred layout. The alternative layout is similar to the preferred layout however the PV facility will have a smaller capacity at 10MW. Impacts to the agricultural potential of the study site are the same for both layouts (preferred and alternative) and are associated with (i) the loss of agricultural land; (ii) soil compaction and exposure of topsoil leading to erosion and (iii) pollution of the soils as a result of construction related activities. Several general and specific measures are proposed to mitigate these impacts.

6.1. Methodology

Potential impacts of the proposed activity on the agricultural potential of the site were assessed in terms a formalised method, whereby a typical risk assessment process was undertaken in order to determine the significance of the potential impacts without the application of mitigation/management measures (WOMM). Once the significance of the impacts without the application of mitigation/management measures was known, the impacts were then re-evaluated, taking cognisance of proposed mitigation/management measures provided in order to reduce the impact (WMM), thus enabling an understanding of the overall impact after the implementation of mitigation/management measures. The process that was undertaken is described in the section below.

The **EXTENT** refers to the impact footprint. What that means is that if a species were to be lost then the extent would be global because that species would be lost to the world. If human health is threatened, then the impact is likely to be no more than local and possibly regional.

Table 5: Descriptors and scoring for the Extent of an impact

Descriptors	Definitions	Score
Site only	The impact remains within the footprint or cadastral boundary of the site.	1
Local	The impact extends beyond the footprint or cadastral boundary of the site, to include the immediately adjacent and surrounding areas.	2
Regional	The impact includes the greater surrounding area within which the site is located.	3
National	The scale/extent of the impact is applicable to the Republic of South Africa.	4
Global	The scale /extent of the impact is global (i.e. world-wide).	5

The **DURATION** is the period of time for which the impact would be manifest. Importantly, the concept of reversibility is taken into consideration in the scoring. In other words, the longer the impact endures, the less likely is the reversibility of the impact.

Table 6: Descriptors and scoring for the Duration of an impact

Descriptors	Definitions	Score
Temporary	The impact endures for only a short period of time (0-1 years).	1
Short term	The impact continues to manifest for a period of between 1-5 years.	2
Medium term	The impact continues to manifest for a period of 5-15 years.	3
Long term	The impact will cease after the operational life of the activity.	4
Permanent	The impact will continue indefinitely.	5

The **MAGNITUDE** is the measure of the potential severity of the impact on the associated environment. As with duration, the concept of reversibility is taken into account when considering the magnitude of the potential impact.

Table 7: Descriptors and scoring for the Magnitude of an impact

Descriptors	Definitions	Score
Negligible	The ecosystem pattern, process and functioning are not affected, although there is a small negative impact on quality of the ecosystem.	1
Minor	Minor impact - a minor impact on the environment and processes will occur.	2
Low	Low impact - slight impact on ecosystem pattern, process and functioning.	4
Moderate	Valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.	6
High	The environment is affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.	8
Very High	The environment is affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.	10

The **PROBABILITY** is the likelihood of the impact manifesting. Although likelihood and probability may be considered interchangeable, the term likelihood is preferred as probability has a very specific mathematical and/ or statistical connotation. As such the expectation created by the term probability is that there will be an accurate empirically or mathematically defined expression of risk, which is not necessarily required.

Table 8: Descriptors and scoring for the Probability of an impact

Descriptors	Definitions	Score
Very improbable / Rare	Where it is highly unlikely that the impact will occur, either because of design or because of historic experience	1
Unlikely	Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience.	2
Probable	there is a distinct probability that the impact will occur (< 50% chance of occurring)	3
Highly Probable	Most likely that the impact will occur (50 – 90% chance of occurring)	4
Definite	The impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).	5

The **SIGNIFICANCE** of impacts will be derived through a synthesis of ratings of all criteria in the following calculation:

(Magnitude+ Duration + Extent) x Probability = Significance

Table 9: Impact Significance Ratings

Descriptors	Definitions	Score
Low	The perceived impact will not have a noticeable negative influence on the environment and is unlikely to require management intervention that would incur significant cost.	0 – 19
Low to Moderate	The perceived impact is considered acceptable, and application of recommended mitigation measures recommended.	20 – 39
Moderate	The perceived impact is likely to have a negative effect on the receiving ecosystem and is likely to influence the decision to approve the activity. Implementation of mitigation measures is required, as is routine monitoring to ensure effectiveness of recommended mitigation measures.	40 – 59
Moderate to High	The perceived impact will have a significant impact on the receiving ecosystem and will likely to have an influence on the decision-making process. Strict implementation of mitigation measures as provided is required, and strict monitoring and high levels of compliance and enforcement in respect of the impact in question are required.	60 – 79
High	The impact on the receiving ecosystem is considered of high significant and likely to be irreversible, and therefore highly likely to result in a fatal flaw for the project. Alternatives to the proposed activity are to be investigated as impact will have an influence on the decision-making process.	80 - 100

The significance of an impact gives one an indication of the level of mitigation measures required in order to minimise negative impacts and reduce environmental damage during the construction, operational and decommissioning / closure phases. Suitable and appropriate mitigation measures were identified for each of the potential impacts.

6.2. Significance rating tables for the Construction Phase

Activity:	**Loss of agricultural productive land within the study area during construction phases (Both layout alternatives are considered).**				
Impact:	Loss of agricultural land was assessed with regards to the loss of arable land within the site and within adjacent properties. The identified agricultural limitations within the study site as a result of the significant anthropogenic modifications to the soils as well as the saturation of the soil, and the shallow nature of the natural soils reduces the likelihood of the use of this area for the cultivation of crops. The site could however be utilised for grazing; with pasture grasses the current scenario on site. Given that the study site is owned by Ergo Mining and the area utilised for mining operations, both historic and current, the loss of agriculturally productive land is low/not applicable and mitigation measures are aimed at limiting impacts to any adjacent properties.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	1	1	1	**4 (Low)**
Post-Mitigation	1	1	1	1	**4 (Low)**
Is the Impact Reversible?	• There is no loss of agricultural land as a result of this project. The land is owned by Ergo Mining and the area utilised for mining operations. As such the impact is considered not applicable.				
Mitigation Measures:	• During construction, workers must remain within the site and must not affect adjacent properties. • Dust monitoring during construction must form part of the Environmental Management Programme as dust will affect vegetation growth. • Management of waste so that it does not impact adjacent properties must take place as per the Environmental Management Programme (EMPr) particularly during the operational phase. • The implementation of an alien invasive control plan must form part of the EMPr. Alien species will quickly establish on disturbed soils, potentially spread to adjacent properties. Their growth must be monitored, and alien control implemented when necessary.				
Cumulative impacts:	• Portions of the project site are currently used for grazing. Given the low agricultural potential of the site this is the only agricultural activity that will be lost as a result of the area. However, the proposed powerline has a small and linear footprint and thus will not lead to the loss of grazing land along the route. This activity can still occur during both the construction and operational phases of the project. The cumulative impact of the loss of agricultural land is therefore not applicable.				

Residual impacts:	• Not applicable as the only agricultural activity which occurs within the project area, grazing, can still continue during the construction and operational phases of the powerline project. Grazing will only not be allowed to occur in the PV facility site, however surrounding properties will still provide the amenities for this activity as these areas are not developed.
Climate Change:	• Not applicable.

Activity:	**Soil Compaction leading to erosion and sedimentation. (Both layout alternatives are considered)**				
Impact:	The clearing of vegetation for the establishment of the PV facility as well as the construction of the Overhead Power Line will result in the exposure of the topsoil to environmental factors including rainfall and wind. Furthermore, the use of heavy machinery or vehicles during construction, particularly of the PV facility will lead to the compaction of these disturbed soils. This will increase the soil bulk density, reduce the porosity further and the hydraulic conductivity, leading to a greater potential for the formation of erosion gullies. The crossing of the channelled valley bottom by the Overhead Power Line can lead to disturbances to the more natural Bloemdal, Bainsvlei and Katspruit soils. These soils are sensitive to erosion. In the long-term, the existence of the PV facility can lead to the formation of erosion gullies, particularly if there is inadequate stormwater control within this site. Given the disturbed nature of the soils in this area this impact is expected to be low.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	2	2	6	3	**30 (Low to Moderate)**
Post-Mitigation	1	1	4	2	**12 (Low)**
Is the Impact Reversible?	• This is reversible should the mitigation measures recommended below be implemented. Rehabilitation of compacted areas, outside of the footprint of the PV facility as well as the powerline must occur once construction is complete.				
Mitigation Measures:	• Erosion control measures must be implemented in areas sensitive to erosion such as near water supply points, edges of slopes, etc. These measures include but are not limited to - sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes.				

	• Do not allow surface water or stormwater to be concentrated, or to flow down any cut or fill slopes without erosion protection measures being in place. • Vegetation clearing must be undertaken only in the areas to be affected and must not extend outside of the PV facility footprint or Overhead Power Line route. • Demarcate all sensitive ecological areas within the site and ensure that these areas remain off-limits during construction.
Cumulative impacts:	• Cumulative impacts are associated with continued development within the larger landscape. This ever-increasing development of the urban environment leads to a decrease in infiltration rates of stormwater and the increased likelihood of erosion gully formation. Given the limited footprint of the project the cumulative impact is expected to be low.
Residual impacts:	• Residual impacts from the construction phase are associated with the formation of erosion gullies from compacted soils that are not remediated. Over time this will increase in size and will impact areas downstream of the project site
Climate Change:	• Soil erosion leads to the disturbance and loss of predominantly the top soil, this is the most productive horizon of a soil profile and the loss of the ecosystem which forms the topsoil has an impact on nutrient and carbon cycles, leading to an impact on climate change in the long-term.

Activity:	**Soil Pollution (Both layout alternatives are considered)**				
Impact:	Sediment releases (particularly contaminated sediments) from a construction site into the downstream aquatic environment is one of the most common forms of waterborne pollution. Furthermore, mismanagement of waste and pollutants including hydrocarbons, construction waste and other hazardous chemicals will result in these substances entering and polluting the soil profile. These pollutants can quickly be transferred to nearby watercourses situated to the north of the PV facility site as well as along the Overhead Power Line route. During the operational phase, any maintenance of the PV facility can lead to the release of substances into the soil profile, polluting the area.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	2	2	6	3	**30 (Low to Moderate)**
Post-Mitigation	1	1	4	2	**12 (Low)**
Is the Impact Reversible?	• Impacts regarding potential soil pollution as a result of leakage from chemicals can be reversed. Soils that have been contaminated would need to be remediated either on site or removed to a secure location. A spill team would need to be contacted to conduct the remediation exercise.				

Mitigation Measures:	• All waste generated during construction is to be disposed of as per the EMPr. • Management and disposal of construction waste as per the Environmental Management Plan must occur during the construction of the development. • Waste disposal during the construction phase must ensure no litter or other contaminants particularly chemicals stored on site are deposited into the channelled valley bottom system crossed by the Overhead Power Line or any wetland systems to the north of the PV facility site. • Do not locate chemical storage areas associated with the construction camp or construction site on any of the hydric soils (whether natural or artificially saturated), without ensuring that these chemicals cannot leak or spill into these soil profiles. • No release of any substance i.e., cements, oil, or any other substance that could be toxic into the soil profiles. Check vehicles and equipment entering the site for oil and fuel leaks and inspect site for possible spillages. • Spillages of fuels, oils and other potentially harmful chemicals must be contained and cleaned up immediately. Contaminants must be properly drained and disposed of using proper solid/hazardous waste facilities (never to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately.
Cumulative impacts:	• Cumulative impacts relating to soil pollution are associated with the continued development of the larger area. As development occurs soils can and are contaminated with chemicals, hydrocarbons and sediments from a variety of sources such as the existing mine, existing roads and leakage and spillage from construction activities. These soils are not remediated and are therefore changed from their natural state, making it difficult to utilise them in the future. Given the low agricultural potential of the site as well as the limited footprint of the project area, cumulative impacts of this project are low.
Residual impacts:	• Residual impacts occur if leakage or spillage of chemicals occur during the construction phase, and these soils are not remediated. These soils will continue to release these chemicals into the environment after construction has ended. Provided the recommendations of this report are adhered to this impact is expected to be low.
Climate Change:	• Soil pollution leads to a decrease in soil health and changes to the microbial populations of soil ecosystems. This can affect nutrient and carbon cycling leading to an effect on climate change in the long term.

6.3. Significance rating tables for the Operational Phase

Activity:	**Loss of agricultural productive land within the study area during construction and operational phases. (Both layout alternatives are considered).**				
Impact:	• During the operational phase, the impact of the project on agricultural production is expected to be low. Adjacent properties are utilised for mining, housing and other urban activities and grazing to a lesser extent. No commercial crop farms are noted in the area.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	1	1	1	**4 (Low)**
Post-Mitigation	1	1	1	1	**4 (Low)**
Is the Impact Reversible?	• There is no loss of agricultural land as a result of this project. The land is owned by Ergo Mining and the area utilised for mining operations. As such the impact is considered not applicable.				
Mitigation Measures:	• Dust monitoring during the operational phase of the project must continue to form part of the Environmental Management Programme. • Management of waste so that it does not impact adjacent properties must take place as per the Environmental Management Programme (EMPr). • The continuation of the alien invasive control plan which will be established as part of the construction phase EMPr must continue. Their growth must be monitored, and alien control implemented when necessary.				
Cumulative impacts:	• Portions of the project site are currently used for grazing. Given the low agricultural potential of the site this is the only agricultural activity that will be lost as a result of the area. However, the proposed powerline will not lead to the loss of grazing land along the route as this activity can still occur during both the construction and operational phases of the project. The cumulative impact of the loss of agricultural land is therefore not applicable.				
Residual impacts:	• Not applicable as the only agricultural activity which occurs within the project area, grazing, can still continue during the construction and operational phases of the powerline project. Grazing will only not be allowed to occur in the PV facility site, however surrounding properties will still provide the amenities for this activity as these areas are not developed.				
Climate Change:	• Not applicable				

Activity:	**Soil Compaction leading to erosion and sedimentation. (Both layout alternatives are considered)**				
Impact:	In the long-term, the existence of the PV facility can lead to the formation of erosion gullies, particularly if there is inadequate stormwater control within this site. Given the disturbed nature of the soils in this area this impact is expected to be low.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	2	5	6	3	**39 (Low to Moderate)**
Post-Mitigation	1	2	4	2	**14 (Low)**
Is the Impact Reversible?	• This is reversible should the mitigation measures recommended below be implemented. Rehabilitation of compacted areas, outside of the footprint of the PV facility as well as the powerline must occur once construction is complete and the project enters the operational phase. Should compaction of soils occur during the operational phase these must be remediated as soon as possible.				
Mitigation Measures:	• It is recommended that during the operational phase areas that are not in use are planted with a grass cover to limit the exposure time of soils. • Erosion control measures must be implemented in areas sensitive to erosion such as near water supply points, edges of slopes, etc. These measures include but are not limited to - sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes.				
Cumulative impacts:	• Cumulative impacts are associated with continued development within the larger landscape. This ever-increasing development of the urban environment leads to an increase in soil compaction, a decrease in stormwater management, and therefore an increase in the likelihood for erosion gully formation. Mitigation measures recommended in this report will decrease the cumulative impacts of this project on the larger landscape.				
Residual impacts:	• Residual impacts are associated with the formation of erosion gullies from compacted soils that are not remediated. Over time this will increase in size and will impact areas downstream of the project site.				
Climate Change:	• Soil erosion leads to the disturbance and loss of predominantly the top soil, this is the most productive horizon of a soil profile and the loss of the ecosystem which forms the topsoil has an impact on nutrient and carbon cycles, leading to an impact on climate change in the long-term.				

Activity:	Soil Pollution (Both layout alternatives are considered).				
Impact:	During the operational phase, any maintenance of the PV facility can lead to the release of substances into the soil profile, polluting the area.				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	2	5	6	3	39 (Low to Moderate)
Post-Mitigation	1	3	4	2	16 (Low)
Is the Impact Reversible?	• Impacts regarding potential soil pollution as a result of leakage from chemicals can be reversed. Soils that have been contaminated would need to be remediated either on site or removed to a secure location. A spill team would need to be contacted to conduct the remediation exercise.				
Mitigation Measures:	• Waste disposal during the operational phase must ensure no litter or other chemicals used for maintenance activities are spilled or deposited into the soils. • No release of any substance i.e., cements, oil, or any other substance that could be toxic into the soil profiles. Check vehicles and equipment entering the site for oil and fuel leaks and inspect site for possible spillages. • Spillages of fuels, oils and other potentially harmful chemicals must be contained and cleaned up immediately. Contaminants must be properly drained and disposed of using proper solid/hazardous waste facilities (never to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately.				
Cumulative impacts:	• Cumulative impacts relating to soil pollution are associated with the continued development of the larger area. As development occurs soils can and are contaminated with chemicals, hydrocarbons, and sediments from a variety of sources such as the existing mine, existing roads and leakage and spillage from maintenance activities. These soils are not remediated and are therefore changed from their natural state, making it difficult to utilise them in the future. Given the low agricultural potential of the site as well as the limited footprint of the project area, cumulative impacts of this project are low.				
Residual impacts:	• Residual impacts occur if leakage or spillage of chemicals occur during the operational phase, and these soils are not remediated. These soils will continue to release these chemicals into the environment. Provided the recommendations of this report are adhered to this impact is expected to be low.				
Climate Change:	• Soil pollution leads to a decrease in soil health and changes to the microbial populations of soil ecosystems. This can affect nutrient and carbon cycling leading to an effect on climate change in the long term.				

7. CONCLUSION

Augur sample points were taken throughout the proposed PV facility site (taking into account both layout alternatives) as well as within a 100m assessment area along the 11km 22kV OHL route during a field assessment conducted between the 5th and 7th February 2021 Soils were assessed in terms of the texture, soil depth, subsoil permeability, slope, rockiness, surface crusting, and wetness.

The study site can be classified into two separate soil types, the Natural Soils and the Anthrosols and Technosols, with the latter dominating the area.

The project area was assessed in terms of the Agricultural and Land Capability Potential. Taking into account the soil forming factors as well as the anthropogenic disturbances to the area the study site has been categorised into the Class IV, Class V, Class VI, and Class VIII categories. The Class IV category is for the shallower but natural Mispah/Glenrosa and Nkonkoni soils. These soils occupy 10.6% of the site. The Class V category is reserved for saturated soils and was thus mapped where the Stilfontein, Bloemdal, Bainsvlei and Katspruit soils were identified. Class V soils occupy 11.8% of the site. The Grabouw soils have been classified as Class VI soils. Class VI soils have severe restrictions to cropping and are therefore excluded from production under perennial vegetation Class VI soils occupy 23.1% of the study site. The remaining Johannesburg and Witbank soils are categorised as Class VIII soils. These soils have been completely modified and are not productive for any agricultural activities. These soils occupy 45.5% of the study site.

The project will involve the clearing of portions of the site for the establishment of the 19.9MW power PV facility, as well as the construction of the 11km 22KV Overhead Power Line for the preferred layout. The alternative layout is similar to the preferred layout however the PV facility will have a smaller capacity at 10MW. Impacts to the agricultural potential of the study site are the same for both layouts (preferred and alternative) and are associated with (i) the loss of agricultural land; (ii) soil compaction and exposure of topsoil leading to erosion and (iii) pollution of the soils as a result of construction related activities. Several general and specific measures are proposed to mitigate these impacts.

In conclusion, the site (including both layout alternatives) can be considered to have a negligible to low agricultural production with regards to cultivation of crops as a result of the following findings:

- The majority of the site (including both layout alternatives) has been anthropogenically disturbed to such a level that the natural soil profile is not generally apparent. Cultivation of crops cannot take place in these areas, both within the PV facility and along the Overhead Power Line route.
- The remaining natural soils have serious limitations to the cultivation of crops due to shallow soil profiles and the saturation of the lower solum of the soil profile.

Mitigation measures to lessen the impact of the development on the receiving environment must be implemented as part of the construction and operational phases of the Environmental Management Programme.

8. REFERENCES

EnviroRoots (Pty) Ltd. (2021). Background Information Document in relation to the Environmental Authorisation Application by means of a Basic Assessment Report (BAR) Process and the Water Use License Application (WULA) for the Proposed Construction of a Solar Photovoltaic (Pv) Plant to generate 10 Mw of energy including Battery Energy Storage and ~11 Km of 11 KV Overhead Power Line, Brakpan, City Of Ekurhuleni Metropolitan Municipality, Gauteng Province.

Fey, M. (2010). Soils of South Africa. Their distribution, properties, classification, genesis, use and environmental significance. Cambridge University Press. Cape Town

Jennings, K., Le Roux, P.A.L., Van Huyssteen, C.W., Hensley, M., and Zere, T.B. (2008). Redox conditions related to interflow in a soil of the Kroonstad form in the Weatherley catchment, South African Journal of Plant and Soil, 25:4, 204-213, DOI: 10.1080/02571862.2008.10639918

Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds). (2006). Vegetation Map of South Africa, Lesotho and Swaziland, edn 2, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria. ISBN 978-1-919976-42-6

Soil Classification Working Group (1991). Soil Classification: A Taxonomic System for South Africa. Department of Agriculture

Soil Classification Working Group (2018). Soil Classification: A Natural and Anthropogenic System for South Africa. ARC-Institute for Soil, Climate and Water. Pretoria.

van Tol, J. J. Le Roux, P.A.L., Lorentz, S. A. and Hensley, M. (2013). Hydropedological Classification of South African Hillslopes. Journal of Vadose Zone.

Zedler, J.B. & Kercher, S. (2004). Causes and Consequences of Invasive Plants in Wetlands: Opportunities, Opportunists, and Outcomes. Critical Reviews in Plant Sciences, 23(5):431–452

9. APPENDICES

9.1. APPENDIX A – IN FIELD SOIL TESTS

9.2. Soil sampling and mapping

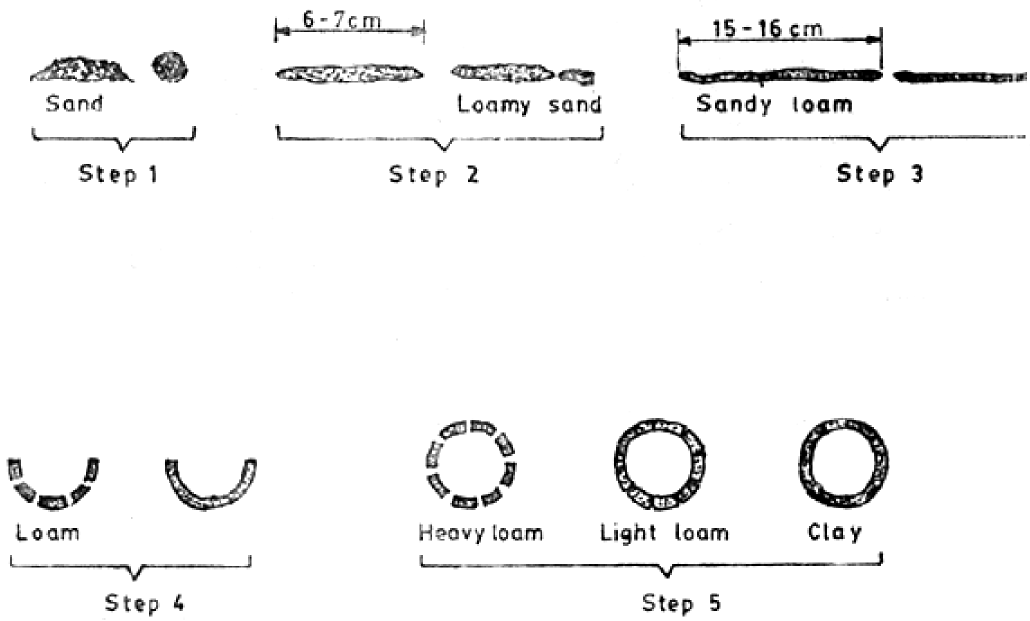
Soil sampling was conducted throughout the site during a field assessment in February 2021 using a standard hand-held auger with a depth of 1200mm. At each sampling point the soil was described to form and family level according to "Soil Classification – A Taxonomic System for South Africa" and the following properties were recorded:

- Soil colour – as per the Munsell System
- Soil texture including clay percentage
- Surface rockiness
- Surface crusting
- Vegetation cover
- Permeability of the B horizon (Wetness)
- Effective rooting depth.

An in-field assessment technique was utilised with the texture triangle to determine soil texture.

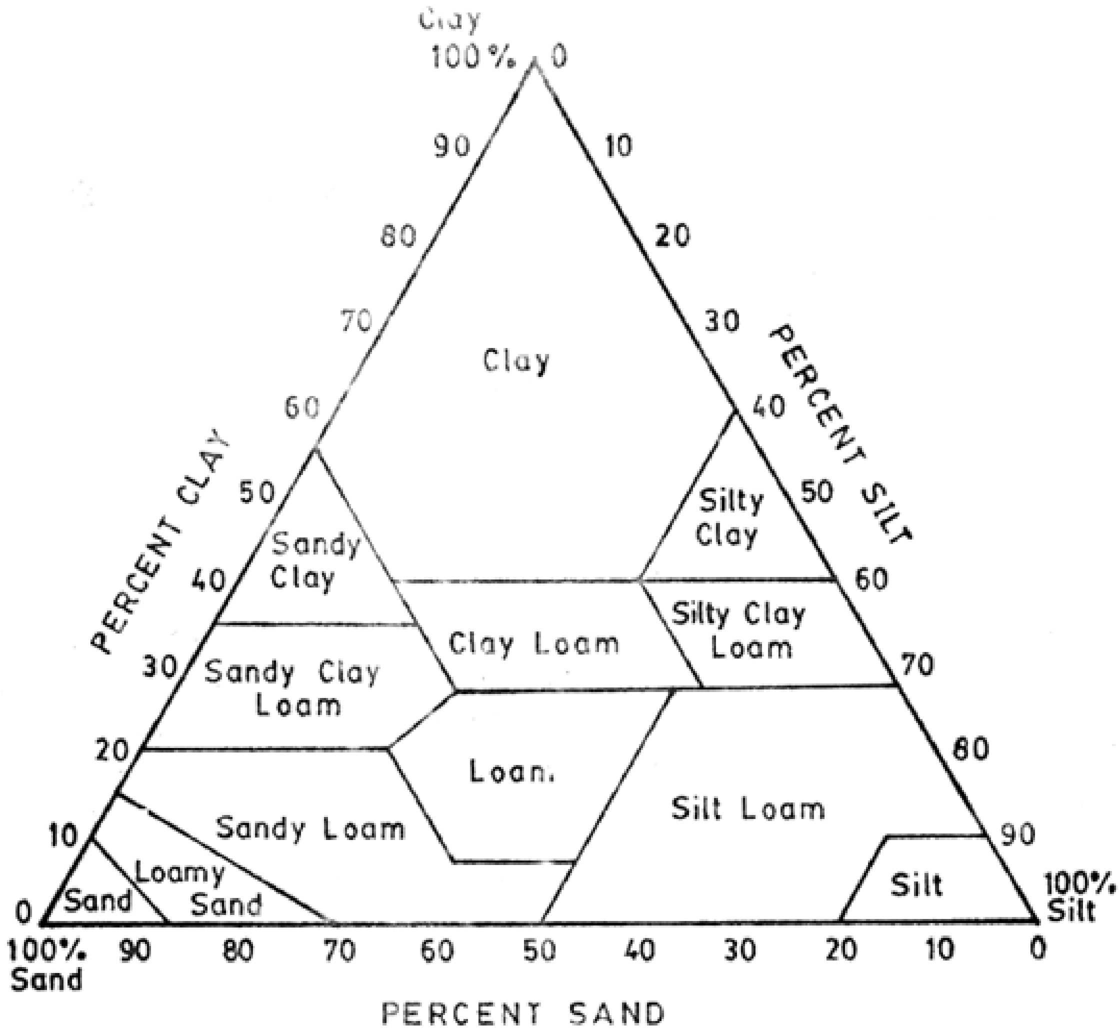
9.3. In Field Determination of soil texture

FEEL METHOD



BALL AND RIBBON METHOD

9.4. Soil texture triangle use to calculate clay percentage



9.5. APPENDIX B – Agricultural Potential and Land Capability Classes

All factors regarding the assessment of the agricultural potential and land capability of the site were undertaken including an assessment of the:

- Topography
- Climate
- Soil texture
- Soil depth
- Subsoil permeability
- Rockiness and Surface Crusting

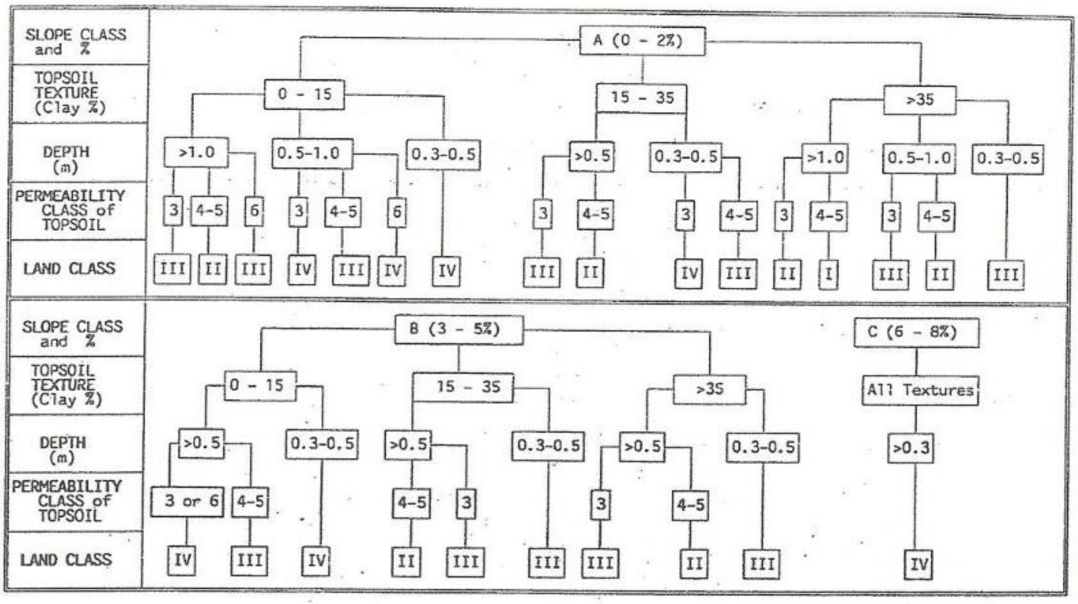
Using the information gathered at the site as well as during the literature review, a soil form map was produced. Information was also gathered from the Land type information. This information was utilised in conjunction with the soil data recorded on site (i.e. soil form, depth, permeability, wetness) to produce the Land Capability Map.

9.6. Land Capability Classes – Flow Sheet

33

CAPABILITY CLASS DETERMINATION GUIDELINE for BRGs:
Dry Zululand Thornveld (20), Valley Bushveld (21), Lowveld (22), Sandy Bushveld (23) (Average annual rainfall 587-830 mm)

Use the following flow chart to determine the land capability classes for land to be cropped in the above Bioresource Groups.



PERMEABILITY CLASS DESCRIPTION*			
Class	Rate (seconds)	Description	Texture
7	<1	Extremely rapid	Gravel and Coarse Sand. 0 to 10 % clay.
6	1-3	Rapid	5% to 10% clay.
5	4-8	Good	> 10% clay.
4	9-20	Slightly restricted	
3	21-40	Restricted	Strong structure, grey colours, mottles. > 35% clay.
2	41-60	Severely restricted	Strong structure, weathered rock. > 35% clay.
1	>60	Impermeable	Rock and very strong structure. > 35% clay.

* If roots can penetrate the subsoil, test permeability of upper subsoil.
If roots cannot penetrate the subsoil, test the permeability of the mid-topsoil.
Dark structured clay topsoil (vertic & melanic) with a Class 2 permeability should be assessed in the chart as if it has a Class 3 permeability. If permeability is Class 7, downgrade to Land Class IV.

Now refer to the opposite page to make adjustments for wetness, rockiness, crusting or permeability.

USE THE FOLLOWING LAND CHARACTERISTICS TO MODIFY THE LAND CLASS OBTAINED OPPOSITE, IF NECESSARY: The land capability class determined using the "flowchart" cannot be upgraded through consideration of wetness, rockiness, surface crusting or permeability classes given below, but it may be downgraded as indicated.

WETNESS		
Class	Definition	Land Class
W0	Well drained - no grey colour with mottling within 1.5 m of the surface. Grey colour without mottling is acceptable.	No change
W1	There is no evidence of wetness within the top 0.5 m. Occasionally wet - grey colours and mottling begin between 0.5 m and 1.5 m from the surface.	Downgrade Class I to Class II, otherwise no change
W2	Temporarily wet during the wet season. No mottling in the top 0.2 m but grey colours and mottling occur between 0.2 m and 0.5 m from the surface. Included are: soils with G horizons (highly gleyed and often clayey) at depths deeper than 0.5 m; soils with an E horizon overlying a B horizon with a strong structure; soils with an E horizon over G horizons where the depth to the G horizon is more than 0.5 m.	Downgrade to Class IV
W3	Periodically wet. Mottling occurs in the top 0.2 m, and includes soils with a heavily gleyed or G horizon at a depth of less than 0.5 m. Found in bottomlands.	Downgrade to Class Va
W4	Semi-permanently / permanently wet at or above soil surface throughout the wet season. Usually an organic topsoil or an undrained vlei. Found in bottomlands.	Downgrade to Class Vb

PERMEABILITY	
Permeability Class	Adjustment to be made
1 - 2	If in sub-soil, rooting is likely to be limited: Use the permeability of the topsoil in the flow chart. If this is the permeability of the topsoil, then the topsoil is probably a dark structured clay, in which case a permeability Class 3 can be used in the flow chart.
3 - 5	Classify as indicated in the flow chart.
6	Topsoil should have <15% clay - use the flow chart.
7	Downgrade Land Classes I to III to Land Class IV.

ROCKINESS		
Class	Definition	Land Class
R0	No rockiness	No change
R1	2 - 10% rockiness	Downgrade Classes I to II, otherwise no change
R2	10 - 20% rockiness	Downgrade Classes I to II, otherwise no change
R3	20 - 30% rockiness	Downgrade to Class IV
R4	>30% rockiness	Downgrade Classes I, II, III & IV to Class VI

SOIL SURFACE CRUSTING		
Class	Definition	Land Class
t0	No surface crusting when dry	No change
t1	Slight surface crusting when dry	Downgrade Class I to Class II, otherwise no change
t2	Unfavourable surface crusting when dry	Downgrade Classes I & II to Class III, otherwise no change

NB **Any land not meeting the minimum requirements shown is considered non-arable (Class V, VI, VII or VIII).**
Non-arable land in BRGs 2, 4, 6, 9, 12, 14, 15, 16, 17, 18 & 19 includes:
* all land with W3, W4 or R4,
* all land with slope exceeding 20%,
* land with slope 13-20%, if clay <15% or depth <0.4m,
* land with slope 8-12% and clay >15%, if depth <0.25m,
* land with slope 8-12% and clay <15%, if depth <0.5m, and
* land with slope 0-7%, if depth <0.25m.

20 March 1996

9.7. APPENDIX C – CV of Author

PERSONAL DETAILS

Name	Rowena Harrison
Date of Birth	21 April 1982
Identity Number	8204210320081
Nationality	South African
Current Position	Director (Wetland Specialist and Soil Scientist)
Office Location	Durban, KwaZulu-Natal
Website	www.malachitesa.co.za
Tel	+27 (0)78 023 0532
Email	rowena@malachitesa.co.za

ACADEMIC QUALIFICATIONS

2019 – present	PhD Soil Science (University of Free State and the University of Burgundy, France)
2015	Certificate in Wetland Rehabilitation – University of the Free State
2009	MSc (Soil Science) – University of KwaZulu-Natal
2008	Certificate course in Wetland Delineation, Legislation and Rehabilitation, University of Pretoria
2006	BSc (Environmental Science) – University of KwaZulu-Natal
2005	BSc (Applied Environmental Science) – University of KwaZulu-Natal

PROFESSIONAL AFFILIATIONS

- South African Council for Natural Scientific Professions – SACNASP (Pr. Sci.Nat 400715/15: Soil Science)
- International Association for Impact Assessments – IAIAsa
- South African Wetland Society

CONFERENCES ATTENDED AND PRESENTED

NAME	DATE
Biodiversity Symposium – Presenter on Hydropedology and Carbon Dynamics	November 2019
IAIAsa – KZN Branch – Presenter on wetland offsets from a soil's perspective	October 2019
Zoological Society of Southern Africa Conference	July 2019
Grass Identification Course hosted by African Land-Use Training	March 2019
Groundwater Modelling Course hosted by the Nelson Mandela Metropolitan University	February 2019
Hydropedology Course hosted by TerraSoil Science and the Water Business Academy	November 2018
Wetland National Indaba	October 2018
Wetland National Indaba	October 2017
Wetland Vegetation training course	February 2017
National Biodiversity and Business Network (NBBN). Biodiversity Indaba	March 2017
Certificate course in Wetland Rehabilitation and Management, University of the Free State	March 2015
Gauteng Wetland Forum: Basic Wetland Delineation course	February 2013
EIA Training Course: Real World EIA, Metamorphosis Environmental Consultants	November 2008
Certificate course in Wetland Delineation, Legislation and Rehabilitation, University of Pretoria	May 2008

EMPLOYEMENT RECORD

• April 2016 – Present	Malachite Ecological Services – Director (Soil Scientist)
• March 2014 - March 2016	Afzelia Environmental Consultants (Pty) Ltd (Soil Scientist and Wetland Specialist)
• September 2012 - February 2014	Strategic Environmental Focus (Pty) Ltd (Junior Wetland Specialist)
• February 2008 - December 2009	Afzelia Environmental Consultants cc (Soil Scientist/Junior Wetlands Specialist and Environmental Assessment Practitioner)

PROJECT EXPERIENCE

Rowena has obtained a MSc. In Soil Science from the University of KwaZulu Natal, Pietermaritzburg. She is professionally affiliated to the South African Council for Natural Scientific Professions (Pr. Sci. Nat) and has 12 years consulting experience in the wetland and soil science field. She has conducted numerous wetland and soil assessments for a variety of development types across South Africa, Swaziland and into West Africa, and has recently added hydropedology assessments to her list of services offered.

She is a member of the International Association for Impact Assessment (IAIA) as well as a founding member of the South African Wetland Society. She is currently a joint PhD candidate at the University of the Free State and the University of Burgundy in France. Her research is focused on the interactions of dissolved organic carbon and hydropedology at a catchment scale.

Below is an abridged list of projects completed:

Soil and Agricultural Assessments

- Mutanda Mine, Kolwezi Province, Democratic Republic of Congo
- Soil and Agricultural Assessment for the cultivation of soil within pivot irrigation systems, Kokstad, KwaZulu-Natal.
- Pedological rehabilitation report for the implementation plan for the restoration of the conservation area within the Dube Tradeport Precint, Ethekwini Metropolitan Municipality.
- Macadamia Orchards, Paddock, KwaZulu-Natal
- Geluk Mine, Limpopo Province
- Madundube Housing Development, KwaZulu-Natal
- Vryheid Substations, Swellendam Local Municipality; Western Cape Province

- Gunther Muhl Agricultural Project; Vryheid; KwaZulu Natal Province
- Sokhulu Agricultural Development Project; KwaZulu Natal Province
- Portion 22 of the Farm Vaalkop Camperdown; KwaZulu-Natal Province
- Vlakfontein Mine, Ogies, Mpumalanga Province
- Silverhill Retreat; Kamberg KwaZulu Natal; KwaZulu Natal Province
- Cleopatra Extension Development; Kamberg; KwaZulu Natal Province
- Bartlett Estate, Hammarsdale KwaZulu Natal Province
- Valley View Estate Residential Development; Camperdown; KwaZulu Natal

Rehabilitation Plans

- De JagersKraal Compensation, wetland rehabilitation plan, KwaZulu-Natal
- Intaba Ridge Housing Estate, Pietermaritzburg, KwaZulu-Natal
- Greytown Bulk Water Supply, Greytown, KwaZulu-Natal
- Hluhluwe iMfolozi Park Bitumen Spill Rehabilitation Plan
- Hollingwood Housing Development, Pietermaritzburg, KwaZulu-Natal
- Samrand Estate; Centurion, Gauteng Province
- Paulpietersburg Shopping Centre; KwaZulu- Natal Province
- L1524 Road Upgrade; KwaZulu- Natal Province
- P187/1 Road Upgrade; KwaZulu- Natal Province
- P254/1 Road Upgrade; KwaZulu- Natal Province
- P483 Road Upgrade; KwaZulu- Natal Province
- N2/R56 Interchange
- Hluhluwe iMfolozi Park Bitumen Spill Rehabilitation Plan

Hydropedology Assessments

- Packo Industrial Site, KwaZulu- Natal Province
- St Joseph's Housing Development. KwaZulu- Natal Province
- Lions River Housing Development, KwaZulu- Natal Province
- Cato Scrap Industrial Site, KwaZulu- Natal Province
- Somkhele Anthracite Mine, Hydropedological Buffers, KwaZulu- Natal Province

Wetland Impact Assessments

- Wetland and ecological sensitivity of Farm 1287, Mbabane Swaziland
- Ulundi Crossings Shopping Centre, KwaZulu-Natal
- Somkhele Mine, Mtubatuba, KwaZulu-Natal
- Lynton Hall housing development, Pennington KwaZulu-Natal
- Pennington PumpStation – Wetland Monitoring
- Enyathi Water Supply project, Vryheid, KwaZulu-Natal
- Agulhus Vryheid Eskom powerline and Substation, Swellendam, Western Cape
- D1095 road upgrade, KwaZulu-Natal
- Juno-Gromis 230km power line corridor, Northern and Western Cape Provinces

- Mt Albert Mixed Use Development, KwaZulu Natal
- Saldanha Strengthening Project, Saldanha, Western Cape Province
- Intaba Ridge Housing Development, Pietermaritzburg, KwaZulu-Natal
- Yoyo Mixed Use Development, Republic of Cameroon
- Elandspruit Colliery, Middleburg, Mpumalanga
- Bokoko Infrastructure Development, Douala, Republic of Cameroon
- P483 Road Upgrade; KwaZulu- Natal Province
- Paulpietersburg Shopping Centre; KwaZulu- Natal Province
- Tshipi e Borwa Strengthening Projects, Postmasburg, Northern Cape
- Portion 68 Hammarsdale, Wetland Assessment for a Section 24G application
- Esikhumbeni Stand Alone Water Supply System; KwaZulu- Natal Province
- AMI Colliery; Vryheid; KwaZulu- Natal Province
- Ephateni Bulk Water Supply System; KwaZulu- Natal Province
- Samrand Estate; Centurion, Gauteng Province