Appendix F.6

SOIL AND AGRICULTURAL POTENTIAL ASSESSMENT

Eskom Holdings (Pty) Ltd

KOMATI POWER STATION SOLAR PHOTOVOLTAIC, BATTERY ENERGY STORAGE SYSTEM FACILITIES AND ASSOCIATED INFRASTRUCTURE

Soil and Agricultural Potential Assessment: EIA Report

JULY 2023

CONFIDENTIAL

Eskom Holdings (Pty) Ltd

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FINAL CONFIDENTIAL

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Soil and Agricultural Potential Assessment: EIA Report

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1

INTRODUCTION

1 INTRODUCTION

WSP in Africa (WSP), a wholly owned affiliate of WSP Global Inc., has been appointed by Eskom Holdings SOC Ltd (Eskom) to undertake a Soil and Agricultural Potential Assessment for the proposed Solar Photovoltaics (PV) Energy and Battery Energy Storage System (BESS) Facilities and associated infrastructure at Komati Power Station in the Mpumalanga Province (herein referred to as the Project).

The aim of this assessment was to provide descriptions of the soils identified and their distribution within the project area, and to establish the site's land capability. An assessment of the potential soil impacts was also carried out and associated mitigation measures recommended.

1.1 PROJECT BACKGROUND

Eskom is a South African utility that generates, transmits and distributes electricity. Eskom supplies about 95% of the country's electricity. Eskom's 2035 strategy encompasses the journey that Eskom intends to take in response to the changing energy environment and the impact this has towards a sustainable power utility. This strategy is necessitated by the challenges that Eskom faces as a business as well as the global and local shifts occurring in the energy sector particularly with respect to environmental and climate change challenges, difficulties in accessing financing and changes to the macro industry environment significantly altering the energy supply industry (ESI).The road to 2035, includes the shutting down of a number of coal-fired power stations, repurposing and repowering, delivering new clean generation projects, expanding the Transmission grid, and rolling out micro grid solutions.

Several power stations are reaching the end of life. These stations will go into extended cold reserve and are most likely to be fully decommissioned in the future. Eskom is considering a shutdown, dismantling and repurposing of some of its power stations as they reach their end of life. Komati Power Station is located close to the intersection of the regional routes R542 and R35, about 14km due east of Vandyksdrift in the Mpumalanga Province (Figure 1-1). The Power Station reached its end-of-life expectancy in September 2022 when Unit 9 reached its dead stop date (DSD). Units 1 to 8 reached their DSDs prior to this. Eskom has developed a Just Energy Transition Plan (JETP) aimed at mitigating the negative social impacts resulting from the shutting down of plant and to implement projects for the repowering and repurposing infrastructure? related to the Komati power station. This is one of several initiatives in which Eskom proposes to establish a solar energy generating facility at the Komati Power Station which will include the installation of a Solar PV energy facility as well as BESS facilities (Figure 1-2).

1.2 LEGISLATIVE CONTEXT

In the context of this study the legislation that is relevant includes:

- Government Gazette 43110 published in Government Notice No. 320 on the 20th of March 2020, which specifies the protocol for the agriculture specialist assessment and minimum report requirements for environmental impacts on agricultural resources.
- The Subdivision of Agricultural Land Act (Act 70 of 1970), which governs the preservation of viable farm portions. Land use changes need to be approved in terms of this act.

- The Department of Agriculture, Forestry and Fisheries (DAFF) guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land (September 2011). These guidelines aim to preserve arable land by prohibiting the development of renewable energy facilities on cultivated and high potential agricultural land.

The legislation that has direct implications for how soils are managed is the Conservation of Agricultural Resources (Act 43 of 1983) (CARA). The purpose of the CARA is to provide for control over the utilization of the natural agricultural resources of the Republic to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants. The Act states that control measures may be applied to (amongst others):

- The utilization and protection of land which is cultivated;
- The prevention or control of waterlogging or salination of land;
- The restoration or reclamation of eroded land or land which is otherwise disturbed or denuded.

The Act further states that different control measures may be prescribed in respect of different classes of land users or different areas or in such other respects as the Minister may determine, stipulating that:

- Any land user who refuses or fails to comply with any control measure which is binding on him, shall be guilty of an offence.

The implication of this for the Project is that control measures will be required to manage and mitigate the impacts of the Project on soil and land capability.

1.3 STUDY LIMITATIONS

The limitations associated with the study are listed below:

- PV Site A has been significantly disturbed by existing agricultural activities.
- The BESS sites have been significantly disturbed owing to the historic construction of the Komati Power Station facilities.
- The site could not be traversed such that an even grid matrix of classification points could be set up. As a result, some augmentation of data and extrapolation of findings was necessary.

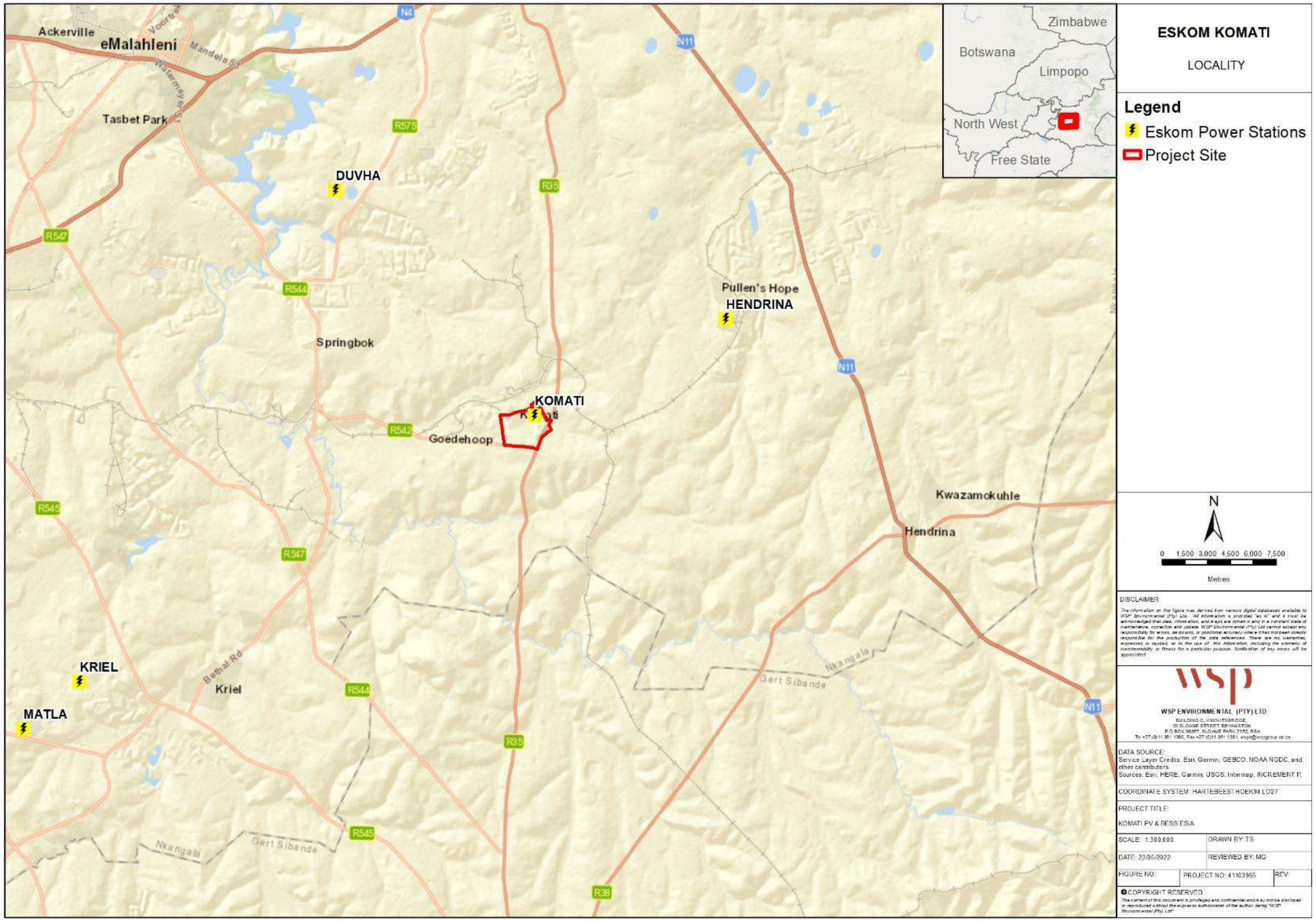


Figure 1-1 - Locality Setting

Figure 1-2 - Site Layout

2 PROJECT DESCRIPTION

2.1 SITE LOCATION

The Komati Power Station is situated about 37km from Middelburg, 43km from Bethal and 40km from Witbank in Ward 4 of the Steve Tshwete Local Municipality located within the Nkangala District Municipality in the Mpumalanga Province. The Solar PV facilities, BESS facilities and associated infrastructure will be located on Eskom-owned land.

2.2 SOLAR PV GENERATION PROCESS

South Africa experiences some of the highest levels of solar radiation in the world (between 4.5 and 6.5kWh/m^2/day) and therefore possesses considerable solar resource potential for solar power generation. In terms of large-scale grid connected applications, the most commonly used technologies include PV and Concentrated Solar Power (CSP); these are described in some detail in the following sections.

It must be noted that this project is specific to solar power generation through the use of solar PV technology only.

2.2.1 PHOTOVOLTAIC (PV) SYSTEMS

Internationally, solar PV is the fastest-growing power generation technology. Approximately 139 GW was added to the installed capacity globally in 2020, increasing the installed capacity by 18% from the previous year. The total capacity from PVs was 760 GW globally, producing approximately 3% of the world's electricity[1]. In South Africa the solar PV installed capacity in 2020 grew by 37% compared to the previous year's value. As much as 3.6 GW of PV is planned to be installed by 2026, with approximately 1.48 GW already installed as recorded in 2019. Utility-scale CSP plants were in operation long before solar PVs became widely commercialized, however PV has taken over the market, attributed to the declining costs of solar PV modules and associated systems. In South Africa, this is also coupled with the supportive government policies. Global CSP capacity grew only 1.6 percent in 2020 to 6.2 GW.

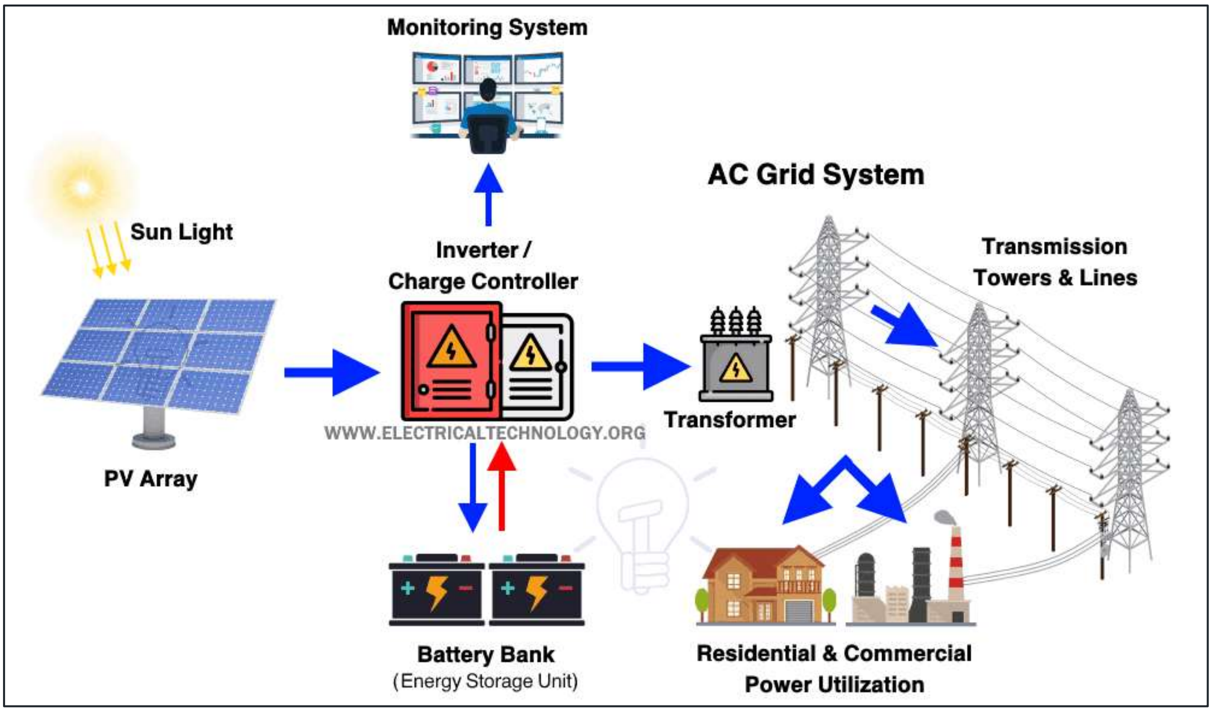
Large-scale or utility-scale PV systems are designed for the supply of commercial power into the electricity grid. Large-scale PV plants differ from the smaller units and other decentralised solar power applications because they supply power at the utility level, rather than to local users.

PV cells are made from semi-conductor materials that are able to release electrons when exposed to solar radiation. This is called the photo-electric effect. Several PV cells are grouped together through conductors to make up one module and modules can be connected together to produce power in large quantities. In PV technology, the power conversion source is via PV modules that convert light directly to electricity. This differs from the other large-scale solar generation technology such as CSP, which uses heat to drive a variety of conventional generator systems.

[1] https://www.c2es.org/content/renewable-energy/

Solar panels produce direct current (DC) electricity; therefore PV systems require conversion equipment to convert this power to alternating current (AC), that can be fed into the electricity grid. This conversion is done by inverters. Figure 2-1 provides an illustration of the main components of a solar PV power plant.

There are two primary alternatives for inverters in large scale systems; being centralised and string inverters.

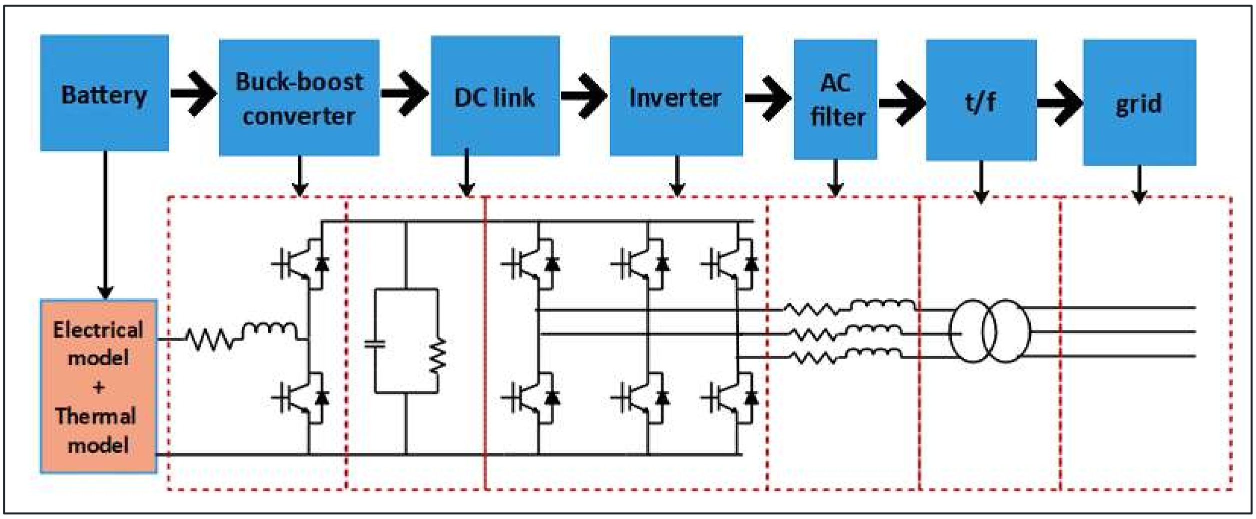


Source: www.electricaltechnology.org/2021/07/solar-power-plant.html

Figure 2-1 - Illustration of the Main Components of a Solar Power Plant

2.3 BESS TECHNOLOGY

BESS consist of two main parts: battery modules and the accompanying Battery Management System (BMS), and a Power Conditioning System (PCS) used to enable the interface of the batteries to the grid. Individual battery cells are connected in a series/parallel arrangement in order to obtain the desired nominal voltage for highest efficiency and required storage capacity. The PCS is a bidirectional power conversion device (inverter), enabling alternating current (AC) power from the grid to be converted to direct current (DC) to charge the batteries in a controlled manner, and discharge DC battery power to feed AC power into the grid (**Figure 2-2**).



Source: www.researchgate.net

Figure 2-2 - BESS Components Schematic

2.4 PROJECT INFRASTRUCTURE

The proposed project will comprise the following key components:

- Solar Energy Facility;
- Grid Connection (i.e. powerlines);
- Site Substation and BESS; and
- Ancillary infrastructure

These items are discussed in more detail below.

2.4.1 SOLAR ENERGY FACILITY

The total site area for PV installation is approximately 200-250 hectares to allow for the construction of a PV facility with capacity up to 100 MW. Solar PV modules, which convert solar radiation directly into electricity, will occupy a total area of approximately 720,000 m^2. The solar PV modules will be elevated above the ground and will be mounted on either fixed tilt systems or tracking systems (comprised of galvanised steel and aluminium). The Solar PV modules will be placed in rows in such a way that there is allowance for a perimeter road and security fencing along the boundaries, and O&M access roads in between the PV module rows. **Table 2-1** provides a high-level project summary of the proposed facilities.

Table 2-1 – High-level Project Summary – Renewable Energy Facilities

	SOLAR PV SITE A	SOLAR PV SITE B
Extent	156 Ha	54 Ha
Buildable Area	127 Ha	50 Ha
Capacity	71.5 MW	28.5 MW

2.4.2 GRID CONNECTION

The transmission line will either be 132kV or 275kV steel single or double structure with a kingbird conductor. The powerline towers will either be steel lattice or monopole structures. The registered servitude will likely between 36m and 40m. The servitude is required to ensure safe construction, maintenance and operation of the powerline.

Figure 2-3 provides an example of a conventional lattice tower compared with a monopole structure. Pole positions will only be available once the powerline design has started. It is anticipated that towers will be located approximately 200m to 250m apart.

Figure 2-3 - Lattice Powerline Tower and Steel Monopile Structure

2.4.3 SUBSTATIONS AND BESS

On-site substations will be established within the extent of the Solar Site A and Solar Site B. The following infrastructure is proposed:

- A high voltage substation yard to allow for multiple 132 kV or 275 kV feeder bays and transformers;
- The control building, telecommunication infrastructure and oil dams, and
- All the access road infrastructure to and within the substation.

Eskom proposes to establish up to four BESS facilities within the existing footprint of the Komati Power Station. The BESS footprints will range from 2ha to 6ha. The BESS storage capacity will be up to 150MW. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The specific technology will only be determined following the appointment of an Engineering Procurement and Construction (EPC) contractor, however. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers. The BESS components will arrive on site pre-assembled.

2.4.4 ANCILLARY INFRASTRUCTURE

Ancillary infrastructure associated with the project will be confirmed once the Conceptual Design is complete, however, it is anticipated that the following will be applicable:

- Access roads;
- Perimeter roads;
- Below-ground electrical cables;
- Above-ground overhead lines;
- Meteorological Station;
- Operations and Maintenance (O&M) Building including control room, server room, security equipment room, offices, boardroom, kitchen, and ablution facilities);
- Spares Warehouse and Workshop;
- Hazardous Chemical Store;
- Security Building;
- Parking areas and roads;
- Temporary laydown areas;
- Temporary concrete batching plant
- Construction camps and temporary laydown areas, and
- Onsite substations.

3 ENVIRONMENTAL SETTING

3.1 CLIMATE

Rainfall in the area is almost exclusively in the form of showers and thunderstorms and falls mainly in the summer months from October to March. The maximum rainfall usually occurs in January. The winter months are usually dry. The mean annual precipitation for Catchment B11B is 687mm and the mean annual evaporation is 1550mm. Mean monthly evaporation exceeds the mean monthly precipitation for every month of the year thus this is a water deficit area.

Average daily maximum temperatures vary from 27°C in January to 17°C in July, but in extreme cases these may rise to 38°C and 26°C, respectively. In comparison, average daily minima of 13°C and 0°C can be expected, with temperatures falling to 1°C and –13°C, respectively, on unusually cold days. Frost conditions are also common over the 120-day period from May to September. These climatic conditions typically give rise to chemically weathered red and yellow soils.

3.2 SURFACE WATER

The Komati Power Station is situated within the upper Olifants Water Management Area (WMA), Highveld Aquatic Ecoregion and B11B quaternary catchment. The Koringspruit River traverses the area and has been classified as a Class D (largely modified) river. Soils with signs of wetness are likely to be found in the vicinity of watercourses.

3.3 GEOLOGY

The site forms part of the Highveld Coalfield and falls within the Carboniferous to early Jurassic aged Karoo Basin, a geological feature that covers much of South Africa. In the Komati area, shales typically define lower and upper levels of the series, with coal measures and associated detrital sediments present between (Truswell, 1977). Two sedimentary units are of interest in this area; the Dwyka Formation, and the Vryheid Formation. The Dwyka Formation is essentially comprised of a succession of glacial deposits characterized by angular to rounded clasts of basement within a silt and clay matrix that were emplaced from the Late Permian, although varved shales, sandstone, and conglomerates typical of a fluvio-glacial environment also occur (Botha *et al*., 1998). The formation unconformably overlies an undulating basement surface defined by lithologies associated with the Bushveld Complex in the area. The soils associated with the study area were thus anticipated to contain kaolinitic clays.

3.4 TOPOGRAPHY

The surface topography of the area is typical of the Mpumalanga Highveld, consisting in the main of a gently undulating plateau. The flood plains of the local streams are at an average elevation of approximately 1595 meters above mean sea level (mamsl). Altitudes vary from ±1650 mamsl to ±1595 mamsl which defines the base of the Koringspruit to the north of the Komati Power Station. The Power Station is situated on a topographic flat ±1605 mamsl with a poor drainage pattern, which has caused signs of wetness within the soils. The southeast-northwest orientated Geluksspruit is another drainage feature of significance and drains the area east and north of the site towards the Koringspruit. This stream was diverted to prevent ingress into power plant areas and remains so due to the location the current Komati Power Station.

4 METHODOLOGY

4.1 DESKTOP ASSESSMENT

The baseline environment was established from reviewed literature of the Komati area, past environmental reports, site characteristics using GIS and aerial imagery and various DFFE databases.

4.2 SITE ASSESSMENT

A site visit was conducted during autumn on the 18 May 2022. The season does not affect the soil classification outcomes. A free format soils classification survey of the study area was undertaken on foot at 21 points, using a hand-held auger to identify soil forms present on site. Current activities at the site and areas of land use were noted and the soil forms encountered were mapped.

4.3 SOIL CLASSIFICATION

The classification of the soil forms identified on site was undertaken using the South African soil taxonomic system (Soil Classification Working Group, 1991). All South African soil forms fall within 12 soil types; Duplex (marked accumulation of clay in the B horizon), Humic (intensely weathered, low base status, exceptional humus accumulation), Vertic (swelling, cracking, high activity clay), Melanic (dark, structured, high base status), Silicic (Silica precipitates as a dorbank horizon), Calcic (accumulation of limestone as a horizon), Organic (peaty soils where water inhibits organic breakdown), Podzolic (humic layer forms beneath an Ae or E), Plinthic (fluctuating water table causes iron re-precipitation as ferricrete), Oxidic (iron oxides weather and colour soils), Hydromorphic (reduced lower horizons) and Inceptic (young soils - accumulation of unconsolidated material, rocky B or disturbed) soils.

4.4 LAND CAPABILITY ASSESSMENT

The South African land capability classification system by Scotney *et al.* (1987) was used to classify and map land capability (see Table 4-1). This system is useful in that it is able to quickly provide an overview of the agricultural capability and limitations of the soils in question and is useful for land capability comparisons. This system is based on a series of groups and classes, as highlighted in Tables 4-1 and 4-2.

Table 4-1 – Land Capability: Class Concepts

Class	Concepts
I	Land in Class I has few limitations that restrict its use; it may be used safely and profitably for cultivated crops; the soils are nearly level and deep; they hold water well and are generally well drained; they are easily worked, and are either fairly well supplied with plant nutrients or are highly responsive to inputs of fertilizer; when used for crops, the soils need ordinary management practices to maintain productivity; the climate is favourable for growing many of the common field crops.
II	Land in Class II has some limitations that reduce the choice of plants or require moderate conservation practices; it may be used for cultivated crops, but with less latitude in the choice of crops or management practices than Class I; the limitations are few and the practices are easy to apply.
III	Land in Class III has severe limitations that reduce the choice of plants or require special conservation practices, or both; it may be used for cultivated crops, but has more restrictions than Class II; when used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain; the number of practical alternatives for average farmers is less than that for soils in Class II.
IV	Land in Class IV has very severe limitations that restrict the choice of plants, require very careful management, or both; it may be used for cultivated crops, but more careful management is required than for Class III and conservation practices are more difficult to apply and maintain; restrictions to land use are greater than those in Class III and the choice of plants is more limited.
V	Land in Class V has little or no erosion hazard but has other limitations which are impractical to remove that limit its use largely to pasture, range, woodland or wildlife food and cover. These limitations restrict the kind of plants that can be grown and prevent normal tillage of cultivated crops; it is nearly level; some occurrences are wet or frequently flooded; others are stony, have climatic limitations, or have some combination of these limitations.
VI	Land in Class VI has severe limitations that make it generally unsuited to cultivation and limit its use largely to pasture and range, woodland or wildlife food and cover; continuing limitations that cannot be corrected include steep slope, severe erosion hazard, effects of past erosion, stoniness, shallow rooting zone, excessive wetness or flooding, low water-holding capacity; salinity or sodicity and severe climate.
VII	Land in Class VII has very severe limitations that make it unsuited to cultivation and that restrict its use largely to grazing, woodland or wildlife; restrictions are more severe than those for Class VI because of one or more continuing limitations that cannot be corrected, such as very steep slopes, erosion, shallow soil, stones, wet soil, salts or sodicity and unfavourable climate.
VIII	Land in Class VIII has limitations that preclude its use for commercial plant production and restrict its use to recreation, wildlife, water supply or aesthetic purposes; limitations that cannot be corrected may result from the effects of one or more of erosion or erosion hazard, severe climate, wet soil, stones, low water-holding capacity, salinity or sodicity.

Table 4-2 – Land Capability: Broad Land Use Options

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

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

4.5 IMPACT ASSESSMENT

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation. The key objectives of the risk assessment methodology adopted within this study were to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects were reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considered direct, indirect and cumulative impacts.

A standard risk assessment methodology was used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects was determined and ranked by considering the criteria presented in Table 4-3.

4.6 CUMULATIVE IMPACT ASSESSMENT

A cumulative impact assessment is the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible (IFC GPH).

Cumulative impacts with existing and planned facilities may occur during construction and operation of the proposed Komati Solar PV Facility. While one project may not have a significant negative impact on sensitive resources or receptors, the collective impact of several projects may increase the severity of the potential impacts.

Several renewable energy developments exist within the surrounding area which have submitted applications for environmental authorisation (some of which have been approved). It is important to note that the existence of an approved EA does not directly equate to actual development of the project.

Table 4-3 - Impact Assessment Criteria and Scoring System

Criteria	Score 1	Score 2	Score 3	Score 4	Score 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probable	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

4.6.1 IMPACT MITIGATION

The impact significance both with and without mitigation measures in place was assessed. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan. The mitigation sequence/hierarchy is shown in Figure 4-1.

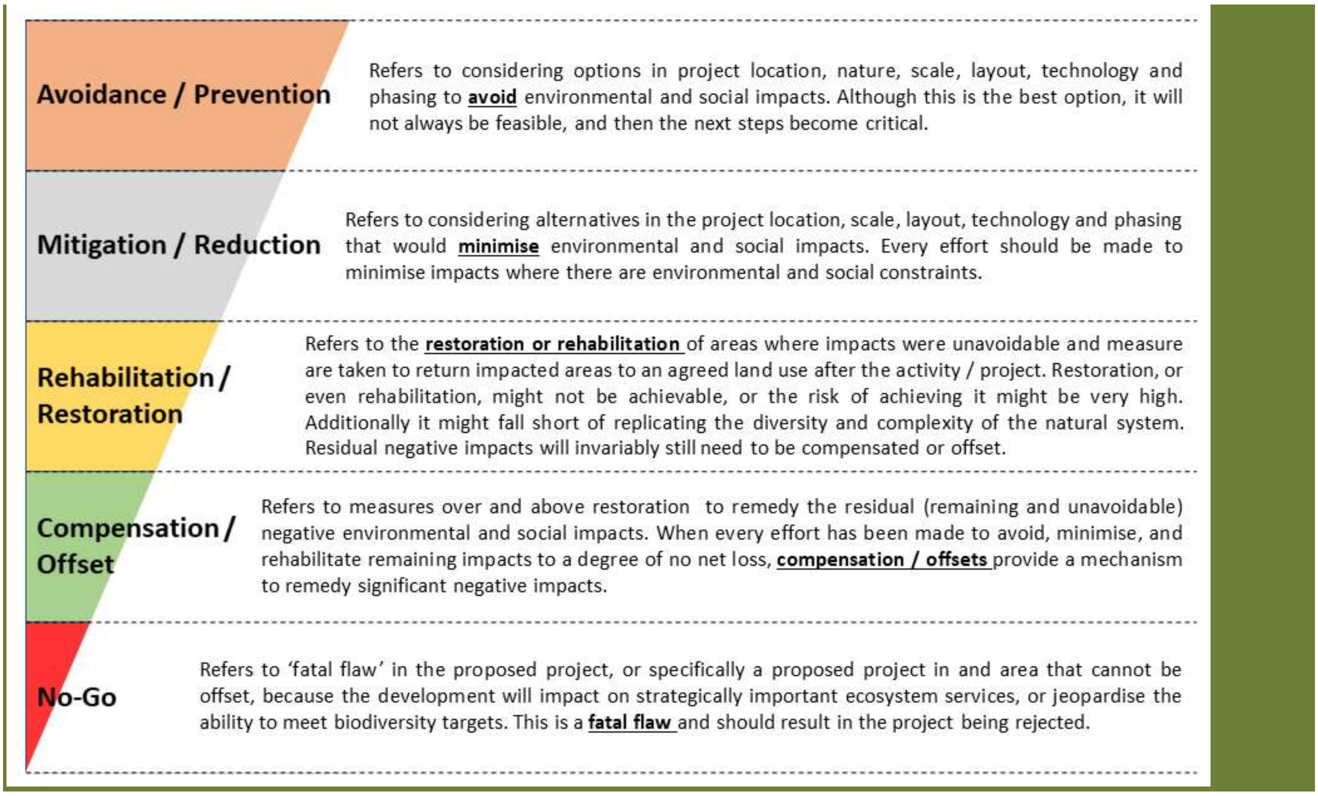


Figure 4-1 - Mitigation Sequence/Hierarchy

5 RESULTS AND DISCUSSION

5.1 SOIL FORM IDENTIFICATION AND CLASSIFICATION

The study area land types (DFFE, 2018) are shown in Figure 5-4. This dataset describes the project site as dominated by a plinthic catena land type, which is characterised by a grading of soils from red through yellow to grey soils down a slope. The colour sequence is ascribed to different iron minerals stable at increasing degrees of wetness. Locations of the soil forms identified on site are shown in Figure 5-6 and are described below. The likely soil form areas are shown in Figure 5-7. These soil forms agree with the DFFE database in that they include red, iron-rich, arable soils and yellow soils – some with signs of wetness. It is likely that grey soils exist in the lower-lying areas to the north-east of the site. The soil forms identified were clay-rich and well structured.

5.1.1 SHORTLANDS

A soil form identified at the site is what is called a Shortlands in the South Africa taxonomic system (see Figure 5-1). These soils comprise an orthic topsoil and a red, structured B horizon with clayskins. The red colour is the result of the accumulation of iron oxides following mineral weathering. The Shortlands soil form is a potentially fertile, manageable soil. It has good moisture intake and moisture holding characteristics.

Figure 5-1 - Shortlands Soil

5.1.2 VALSRIVIER

The Valsrivier soil form dominated the site and is characterised by an orthic A over a pedocutanic B horizon over unconsolidated material without signs of wetness (see Figure 5-2). This is a duplex soil which means that there is a clear transition from the A to the B horizon as a result of clay illuviation. The B horizon is generally an impediment to root growth and water movement.

Figure 5-2 - Valsrivier Soil

5.1.3 SEPANE

The Sepane soil form was found in a limited area on site and is characterised by an orthic A over a pedocutanic B horizon over unconsolidated material with signs of wetness (see Figure 5-3). This is also a duplex soil such that there is again a clear transition from the A to the B horizon as a result of clay illuviation.

Figure 5-3 - Sepane Soil

5.1.4 WITBANK

The final 'soil form' identified at the site was a Witbank. This is commonly found in areas of man-made activities and is a man-made soil deposit.

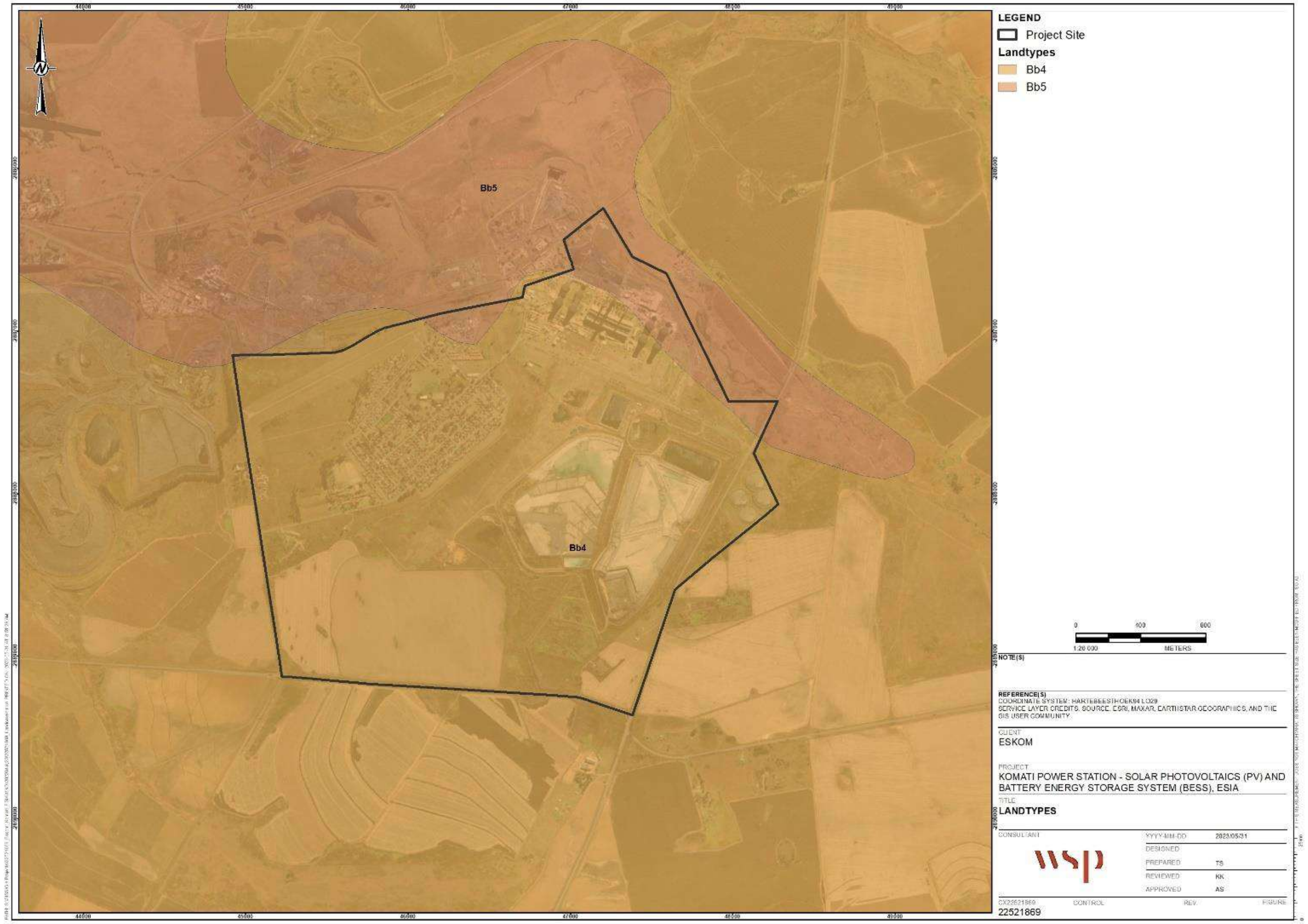


Figure 5-4 - Komati Site Land Types (DFFE, 2018)

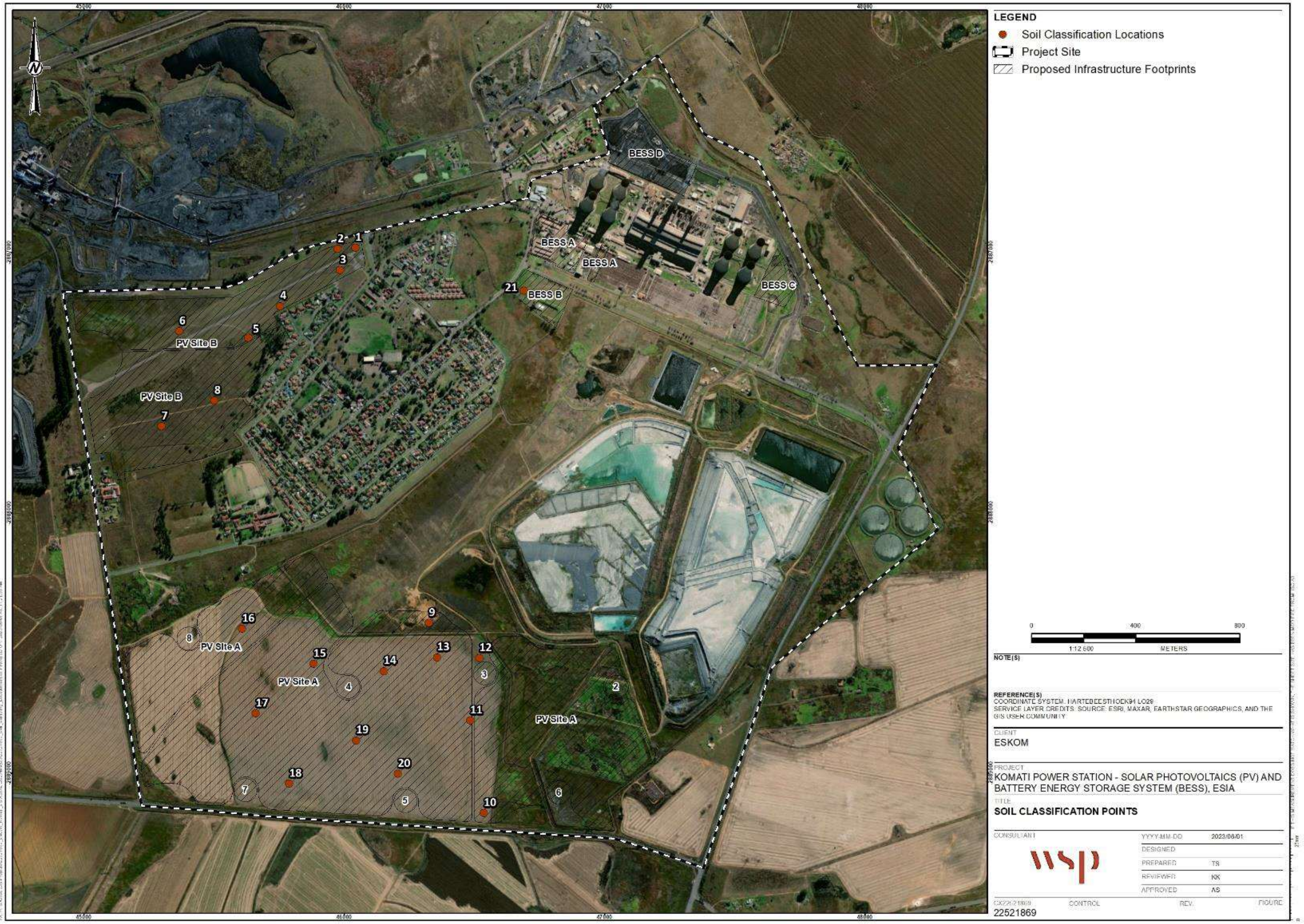


Figure 5-5 – Komati Identified Site Soil Form Points

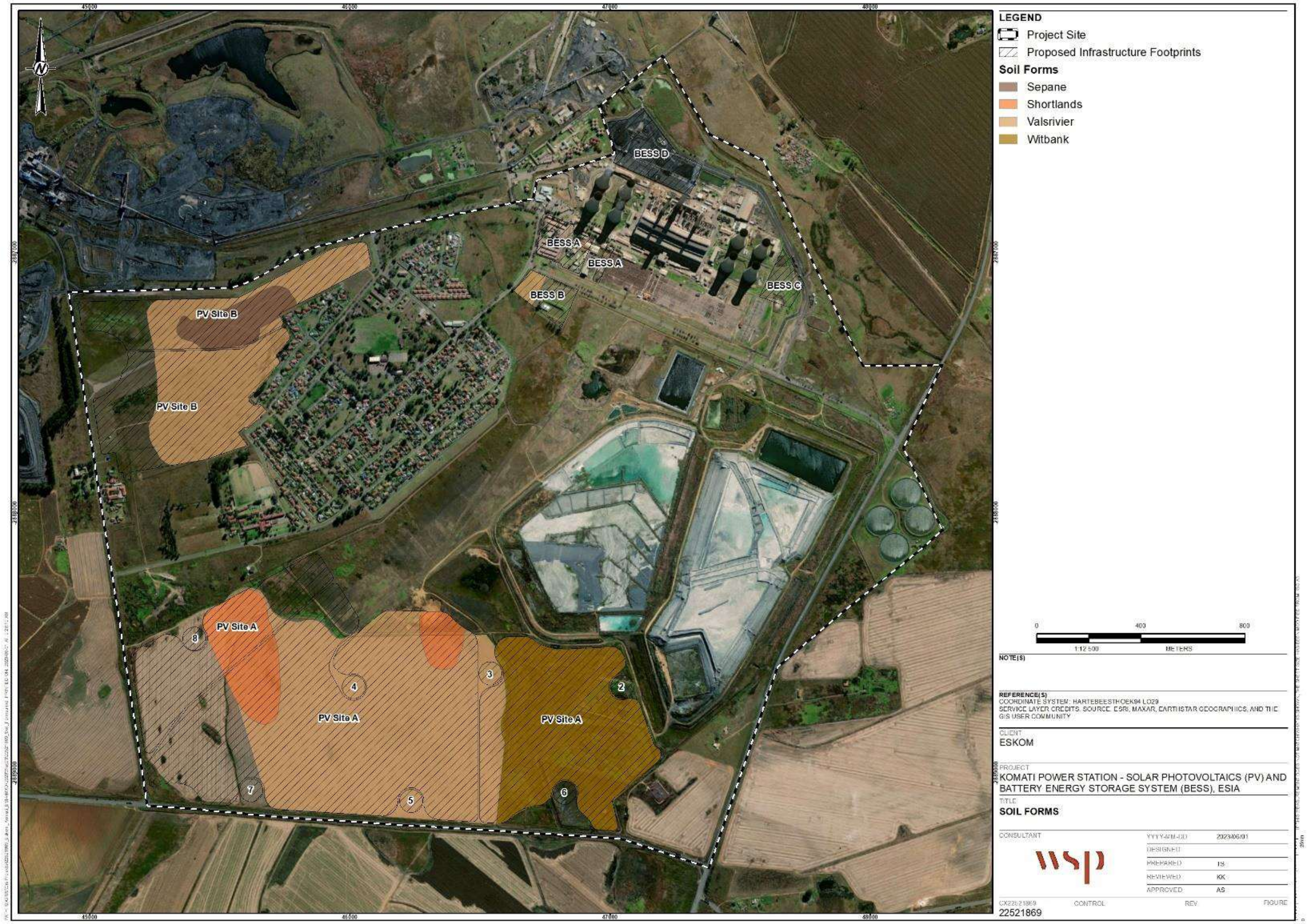


Figure 5-6 - Komati Extrapolated Site Soil Form Areas

5.2 SOIL CAPABILITY ANALYSIS

Land capability is the inherent capacity of land to be productive under sustained use and specific management methods. The land capability of an area is the combination of the inherent soil properties and the climatic conditions as well as other landscape properties, such as slope and drainage patterns that may have resulted in the development of wetlands, as an example.

Using the Scotney *et al.* (1987) system and based on the soils identified on the Project site, a portion of the site's land capability class is Arable III (underlain by Shortlands soils), a portion is Grazing VI (underlain by Valsrivier soils), a portion is Grazing V (underlain by the Sepane soils) and a remaining portion is Wildlife VII (underlain by the Witbank soils). Because the site soil classification was undertaken in a freeform manner and not based on a set grid across the whole site, land use (DFFE, 2021) information has been used to augment the soil forms information in order to better inform the soil capability mapping (see Figure 5-7).

According to the DFFE 2021 database, the current land use of the portions of the site proposed for infrastructure is a combination of cultivated fields and grassland in the main, with small built up and forested sections. Cultivated fields are located along the southern boundary of the site and at the time of the field survey these were planted with maize. Figure 5-8 shows the DFFE land uses of the project area. When combining the soils and land use information, the cultivated fields and areas underlain by Shortlands soils have been ascribed Arable III, the grassland and areas underlain by Valsrivier soils have been ascribed Grazing VI, the area underlain by Sepane soil has been ascribed Grazing V and the area underlain by Witbank soil has been ascribed Wildlife VII (see Figure 5-8).

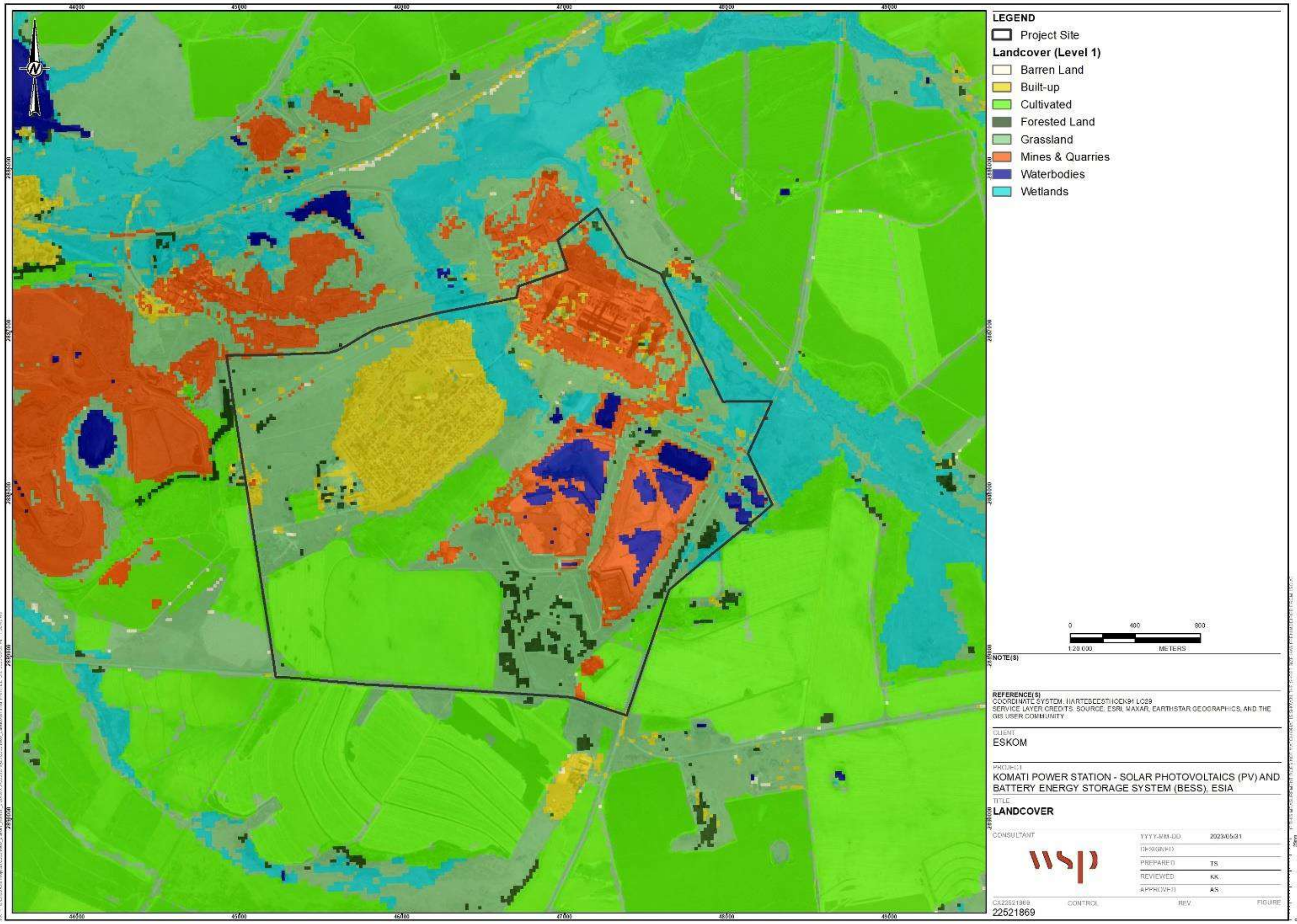


Figure 5-7 – Komati Site Land Cover (DFFE, 2021)

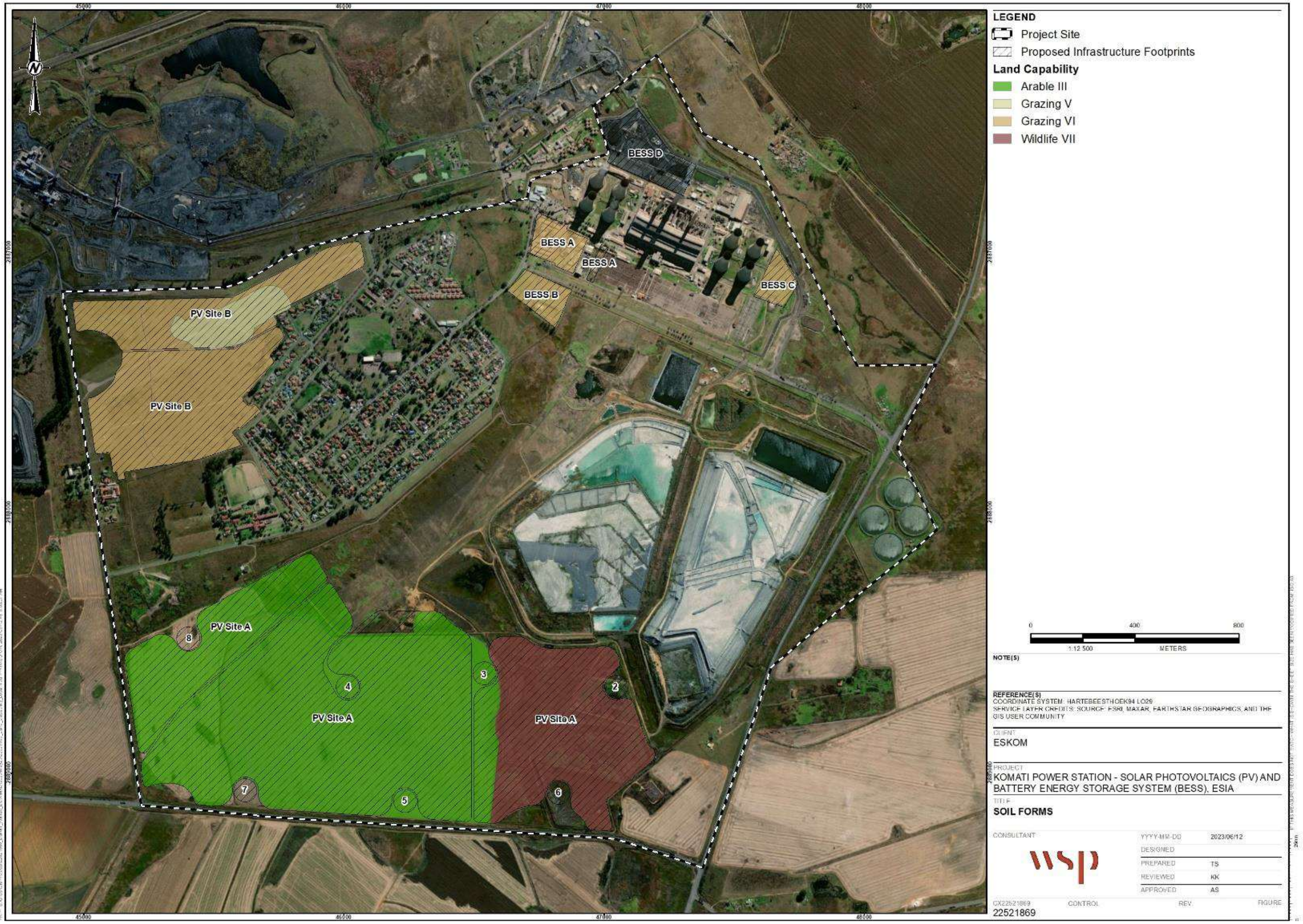


Figure 5-8 – Komati Site Soil Capability (Scotney *et al.* 1987)

6 SOIL SENSITIVITY ANALYSIS

The Project site areas were allocated agricultural sensitivities in accordance with Table 6-1.

The DFFE 2021 land sensitivity database shows that the Project site comprises a combination of high and medium agricultural sensitivity areas, with a very small area of low sensitivity (see Figure 6-1). The soils survey undertaken for this study showed that the site is less agriculturally sensitive than the DFFE database indicates. For the purposes of this study, the areas of the site underlain by arable soils (Shortlands) and those that have been cultivated have been considered moderate sensitivity areas (see Figure 6-2) because some of the Shortlands identified were relatively shallow and much of the cultivated land was underlain by Valsrivier soils. Limited development is typically allowed on agricultural land as the major agricultural concern for any development is the loss of high potential agricultural land and there is already a shortage of arable land available in South Africa. What is available is under threat from competing land uses, leading to a cumulative loss of arable land across the country. Further to this, subdivision of land may create portions that are too small to be agriculturally economically viable. The Department of Agriculture, Forestry and Fisheries (DAFF) thus limits the portion of agricultural land that can be utilised for renewable energy development to 10% (CSIR, 2015). The areas of the site underlain by the uncultivated Valsrivier soils, the Sepane soils and the grassland areas were considered low sensitivity areas and the areas underlain by Witbank soils were considered very low sensitivity areas.

Table 6-1 – Sensitivity Classes

SENSITIVITY	AREAS	PERMITTED
MODERATE	Cultivated areas	Linear infrastructure such as cabling and powerlines are allowed. Solar PV and associated infrastructure and roads should be avoided, if possible.
LOW	Grassland	Solar PV and associated infrastructure and roads are allowed.
VERY LOW	Developed areas	Solar PV and associated infrastructure and roads are allowed.

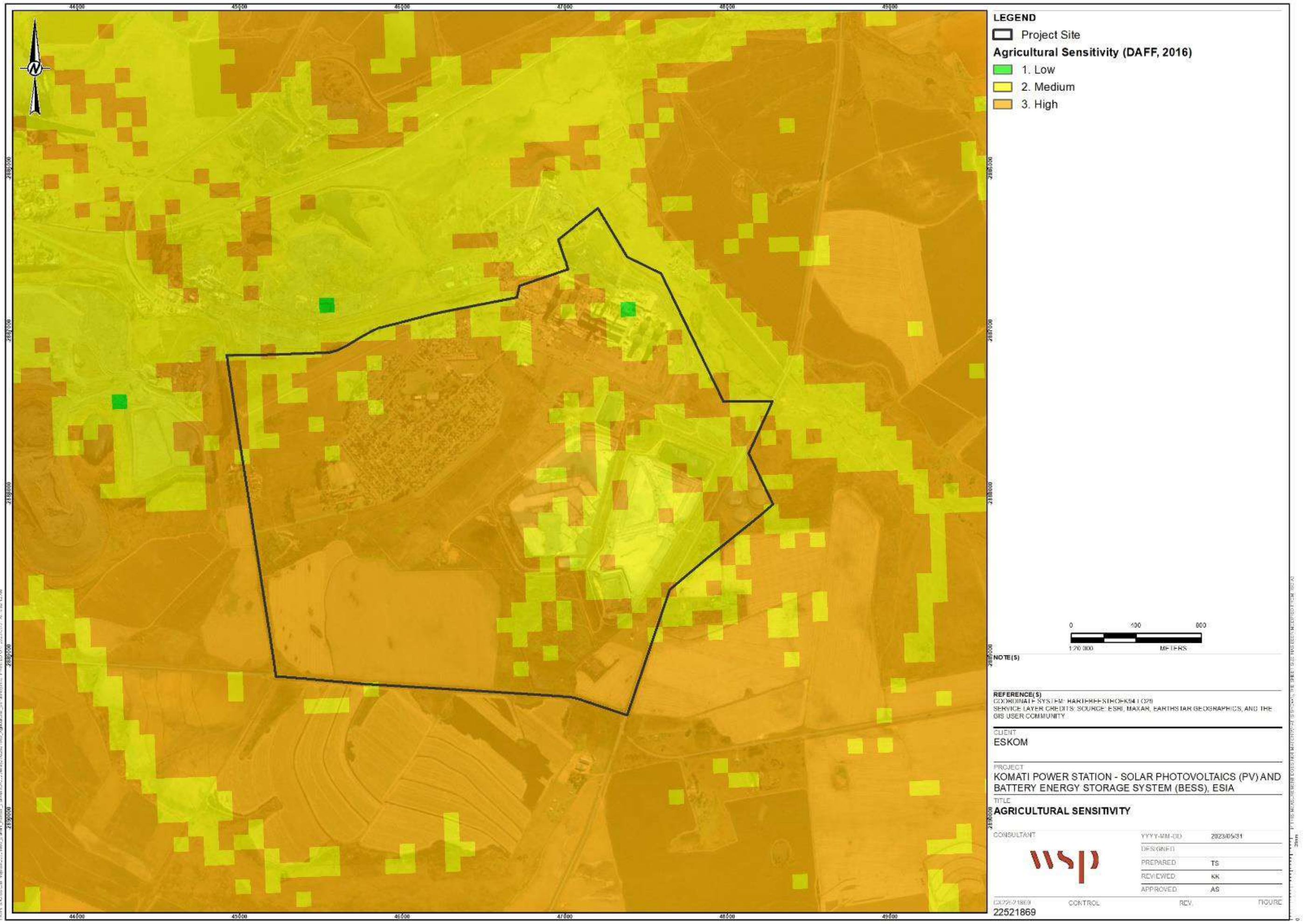


Figure 6-1 – Komati Site Agricultural Sensitivity (DFFE, 2021)

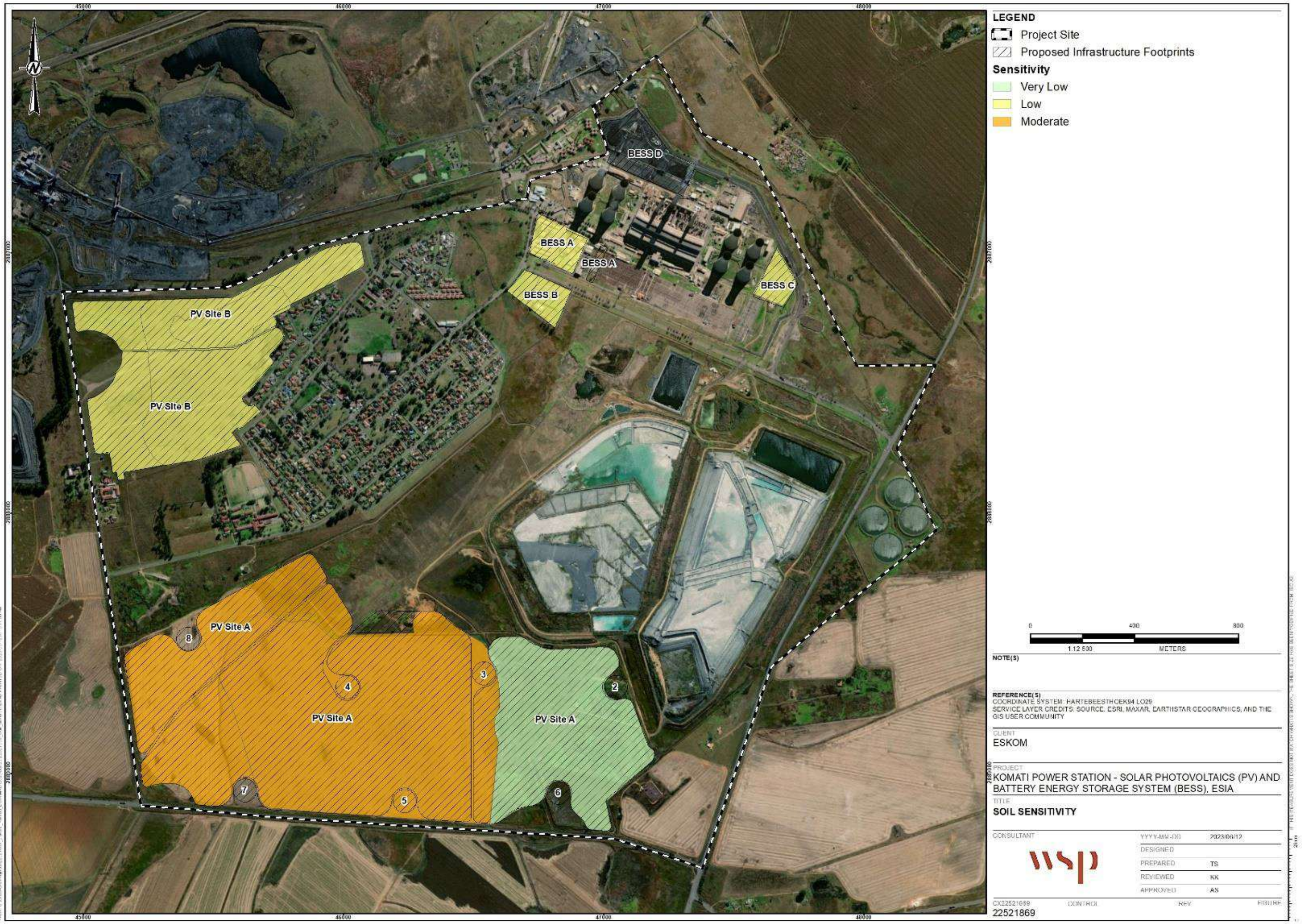


Figure 6-2 – Komati Site Soil Sensitivity Areas

7 IMPACT ASSESSMENT

7.1 POTENTIAL IMPACTS

The greatest impacts to soil are typically felt during the site preparation and construction phase of development as a result of vehicular movement, the removal of vegetation within the development footprint and associated disturbances to soil, and access to the site. Site preparation is followed by earthworks required for establishment of structures, leading to stockpiling and exposure of loose soils, as well as movement of construction equipment and personnel within the project area. Based on the information available, the following potential negative impacts of the proposed development were considered and evaluated for the construction, operational and decommissioning phases and the cumulative impacts were assessed (see Tables 6-1 to 6-4). It is understood that all infrastructure will be placed outside of the onsite wetland areas and that no cultivation is being undertaken at the site currently.

CUMULATIVE IMPACTS:

As mentioned, other renewable energy developments exist within the surrounding area. The projects within 30km of the proposed Komati Solar Facility are shown in Table 7-1 and Figure 7-1.

Table 7-1 - Renewable Energy Projects within 30km of the Project site

PROJECT TITLE	DFFE REFERENCE	STATUS
Proposed installation of a Solar photovoltaic power plant at ESKOM Duvha power station	14/12/16/3/3/2/759	Approved
Proposed Forzando North Coal Mine photovoltaic solar facility in Emalahleni Local Municipality, Mpumalanga Province	14/12/16/3/3/1/452	In process

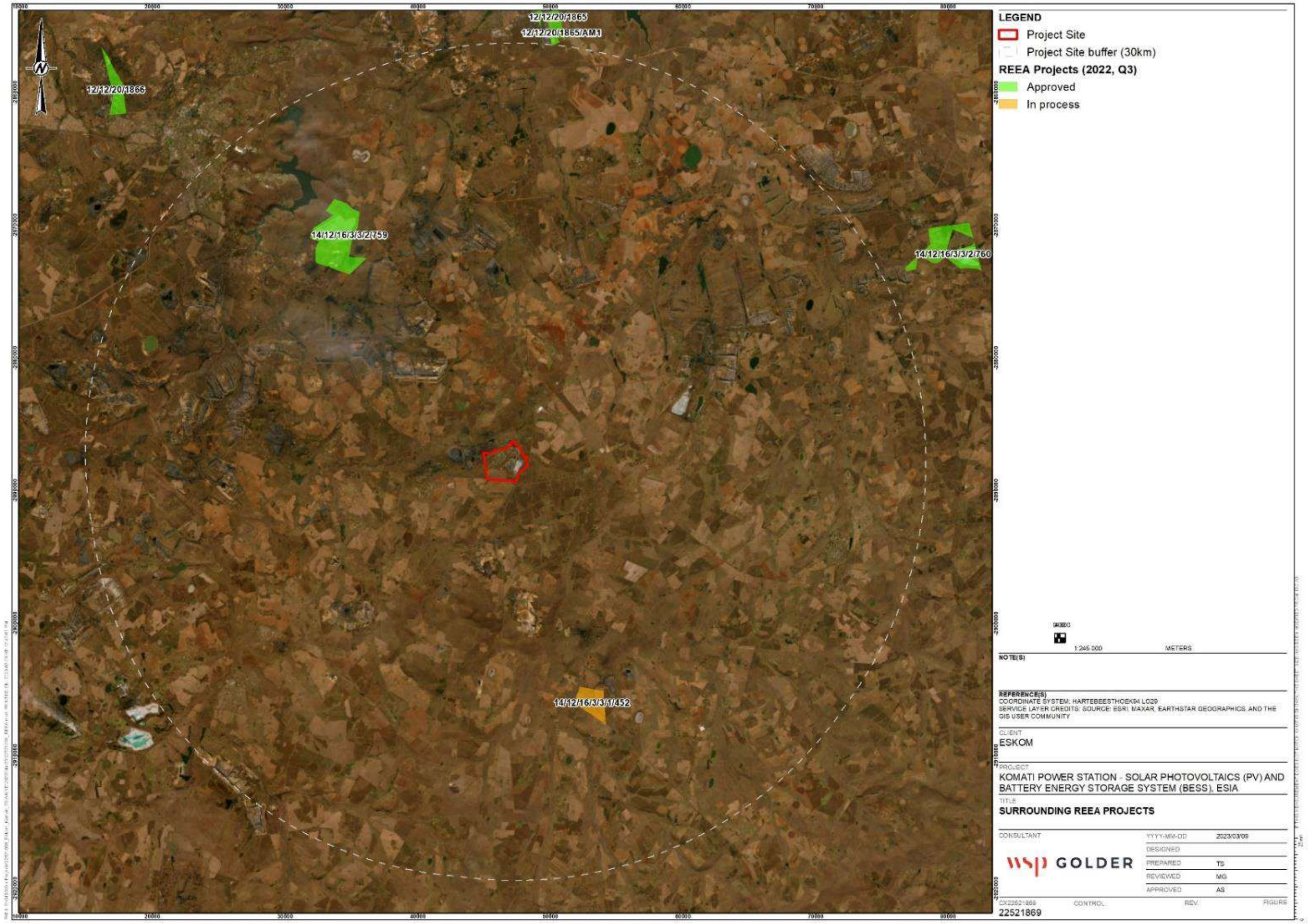


Figure 7-1 – Renewables Projects within 30km of the Project Site

The proposed Project infrastructure will be placed within the existing footprint of the Komati Power Station, within which there are already built-up areas and mining areas. While the renewables projects shown in Figure 7-1 are more than 10km from the Project site and tend to have a limited footprint, the Goedehoop Colliery is directly next door to Komati and is an extensive coal mining operation. Although the proposed solar project is unlikely to contribute significantly to the impacts listed below when compared to its surroundings, there will be a cumulative impact of the proposed development.

7.1.1 IMPACT 1: LOSS OF SOIL

The stripping of soil, especially topsoil, ahead of the development of roads and infrastructure will lead to a loss of usable soil if not undertaken correctly. The soil horizons need to be separately stripped, stockpiled and reused to rehabilitate the disturbed footprint. The disturbed footprint is likely to be relatively small and will not result in a significant loss of soil and agricultural potential. Post construction rehabilitation in the form of shaping and grassing of disturbed areas should be undertaken in order to stabilise loose soil and reduce erosion losses.

Usable soil is also likely to be lost to compaction. The clay-rich soils identified on site (Shortlands, Valsrivier, Sepane) will be vulnerable to compaction and wet soils (Sepane) will be more vulnerable to compaction than the dry soils (Valsrivier, Shortlands). Soil compaction reduces the pore space available for air and water within soil, reducing soil arability and increasing the risk of soil erosion. Soil compaction cannot be fully mitigated against as compacted soil cannot regain its original structure.

Using the impact assessment methodology described in Section 4, the impact significance is as follows:

- Construction Phase: Moderate without mitigation and Low with mitigation.
- Operational Phase: Low without mitigation and Very Low with mitigation,
- Decommissioning Phase: Low without mitigation and Very Low with mitigation, and
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

Recommended mitigation measures are as follows:

- Strip and stockpile all useable soil material.
- Soil stockpiles should be kept low (below 3m tall).
- Irrespective of where soil is stockpiled, it should be vegetated as soon as possible to protect against erosion, discourage weeds and maintain active soil microbes.
- Soils can be ripped to make them more suitable for cultivation post-decommissioning.
- Onsite vehicle routes must be limited on site by demarcating traffic areas and limiting vehicle access.
- Soils must only be stripped when they are dry.
- All stripping and stockpiling should be undertaken according to the guidelines below:
  - Demarcate the area to be stripped clearly, so that the contractor does not strip beyond the demarcated boundary.
  - The stripped soil should be relocated by truck along set removal paths.
  - The area to be stripped requires storm water management and the in-flow of water should be prevented with suitable structures.

- Prepare the haul routes prior to stripping.
- Stripping should not be undertaken in wet conditions.

7.1.2 IMPACT 2: EROSION AND SEDIMENTATION

Soil stripping, clearing of vegetation, movement of vehicles and earthworks are very likely to result in increased loose material being exposed and consequent erosion. Some erosion will occur wherever soils are disturbed, especially if mitigation measures are not correctly put in place. The site soils are clay-rich (Valsrivier, Shortlands, Sepane) so are not very vulnerable to erosion. Soil erosion could lead to sedimentation of the nearby wetlands, and to the loss of valuable topsoil that is essential for rehabilitation purposes.

Although the magnitude and extent of erosion and sedimentation are likely to be limited if the recommended mitigation measures are properly implemented, some erosion is inevitable when clearing an area, and erosion and sedimentation are not easily reversible.

Using the impact assessment methodology described in Section 4, the impact significance is as follows:

- Construction Phase: Moderate without mitigation and Low with mitigation.
- Operational Phase: Moderate without mitigation and Low with mitigation.
- Decommissioning Phase: Moderate without mitigation and Low with mitigation, and
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

Recommended mitigation measures are as follows:

- Limit earthworks and vehicle movement to demarcated paths and areas.
- Limit the duration of construction activities, especially those involving earthworks / excavations.
- Access roads associated with the development should have gradients or surface treatment to limit erosion, and road drainage systems should be accounted for.
- Existing roads should be used and regraded instead of creating new roads wherever possible.
- Removal of vegetation must be avoided until such time as soil stripping is required and similarly exposed surfaces and soil stockpiles should be re-vegetated or stabilised as soon as is practically possible.
- Phase-specific storm water management plans should be designed for the site and adhered to.
- During periods of strong winds, stockpiles that have not yet been vegetated should be covered with appropriate material.

7.1.3 IMPACT 3: LOSS OF AGRICULTURAL LAND

There exists the potential for loss of agricultural land owing to direct occupation of the footprint of the energy facility infrastructure. The movement of vehicles and equipment is likely to result in compaction, disturbance and possible sterilization of soils and associated change in land capability. As mentioned, the site's clay-rich soils will be vulnerable to compaction which cannot be fully mitigated against as compacted soil cannot regain its original structure. Having said this, the post-mitigation impacts are low as the surrounding areas appear to comprise far better quality agricultural land.

In the case of this proposed project, the impact significance is as follows:

- Construction phase: Moderate without mitigation and Low with mitigation,
- Operational phase: Moderate without mitigation and Low with mitigation,
- Decommissioning: Very Low with and without mitigation, and
- Cumulative impact: High without and Moderate with mitigation.

Soil compaction mitigation measures that should be considered include:

- Limiting vehicle routes on site by demarcating traffic areas.
- Limiting site vehicle access.
- Reuse of existing roads will prevent additional areas from becoming compacted.
- Stripping soils when they are dry.
- Compacted soils can be ripped to make them more suitable for cultivation.

7.1.4 IMPACT 4: SOIL CONTAMINATION

Movement of vehicles and plant / equipment on site could result in leaks and spills of hazardous materials including hydrocarbons. Contaminated soil is expensive to rehabilitate and contamination entering the soils of the project area will infiltrate into the ground as well as migrate from site during rainfall events. The clay-rich soils identified on site will be vulnerable to contamination as they are chemically active so will interact with the contaminants. All soils will be at risk of contamination especially during the construction phase.

Using the impact assessment methodology described in Section 4, the impact significance is as follows:

- Construction Phase: High without mitigation and Low with mitigation.
- Operational Phase: Moderate without mitigation and Low with mitigation.
- Decommissioning Phase: Low with and without mitigation.
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

The following mitigation measures are recommended:

- On-site vehicles should be well-maintained,
- Drip trays should be placed under parked vehicles;
- On-site pollutants/hazardous materials should be contained in a bunded area and on an impermeable surface;
- Ensure proper control of dangerous substances entering the site, and
- Adequate disposal facilities must be provided.

Table 7-2 - Impact Assessment – Construction Phase

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	4	1	3	4	5	60	Moderate
		With	N	3	1	3	4	2	22	Low
2	Erosion and Sedimentation	Without	N	4	1	3	4	5	60	Moderate
		With	N	2	1	3	4	3	30	Low
3	Loss of Arable Land	Without	N	4	1	3	4	5	60	Moderate
		With	N	2	1	3	4	5	30	Low
4	Contamination	Without	N	4	2	3	5	5	70	High
		With	N	3	1	3	4	2	22	Low

Table 7-3 - Impact Assessment – Operational Phase

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	1	1	3	4	5	45	Moderate
		With	N	1	1	3	4	1	9	Very Low
2	Erosion and Sedimentation	Without	N	2	1	3	4	5	50	Moderate
		With	N	1	1	3	4	2	18	Low
3	Loss of Arable Land	Without	N	2	1	3	4	5	50	Moderate
		With	N	2	1	3	4	3	30	Low
4	Contamination	Without	N	2	2	3	5	5	60	Moderate
		With	N	2	1	3	4	3	30	Low

Table 7-4 - Impact Assessment – Decommissioning Phase

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	1	1	3	4	3	27	Low
		With	N	1	1	3	4	1	9	Very Low
2	Erosion and Sedimentation	Without	N	3	1	3	4	5	55	Moderate
		With	N	2	1	3	4	2	20	Low
3	Loss of Agricultural Land	Without	N	1	1	3	4	1	9	Very Low
		With	N	1	1	3	4	1	9	Very Low
4	Contamination	Without	N	2	1	3	5	2	22	Low
		With	N	1	1	3	4	2	18	Low

Table 7-5 - Impact Assessment – Cumulative Impacts

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	5	3	3	5	5	80	High
		With	N	3	3	3	4	4	52	Moderate
2	Erosion and Sedimentation	Without	N	4	3	3	5	5	75	High
		With	N	2	3	3	4	5	60	Moderate
3	Loss of Agricultural Land	Without	N	2	3	3	4	5	60	Moderate
		With	N	1	1	3	4	3	27	Low
4	Contamination	Without	N	4	3	3	5	5	75	High
		With	N	2	3	3	4	5	60	Moderate

7.2 MONITORING REQUIREMENTS

Should the project go ahead, the following aspects should be monitored visually by the ECO during the construction phase:

- Ensure that all operations are restricted to the areas demarcated as construction areas and not move outside of those areas.
- Ensure that the topsoil is stripped ahead of excavations.
- Monitor the vegetative cover of the soil stockpiles.
- Monitor signs of erosion and consequent sedimentation.
- Monitor signs of contamination of soils, especially where vehicles and equipment are present.
- Monitor rehabilitation progress at the locations where the infrastructure is situated.

8 IMPACT STATEMENT

Potential Project impacts in all phases include a loss of soil through stripping and compaction, erosion and consequent sedimentation, a loss of agricultural land and soil contamination. If the recommended mitigation measures are correctly implemented and appropriate monitoring is undertaken, all the potential impacts can be reduced to Low aside from some of the cumulative impacts. The overall impact of a loss of agricultural land will be Low as there are large areas of better quality agricultural land surrounding the Project site.

It is recommended that infrastructure be sited away from the arable areas wherever possible and well away from the wetlands within the larger site.

9 REFERENCES

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