MAREETSANE BATHO-BATHO SOILS AND AGRICULTURAL POTENTIAL ASSESSMENT

SEF Project Code: 504744

Prepared for:

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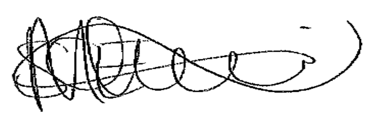
Declaration of Independence

I, **Sinethemba Mchunu,** in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent 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 No. 107 of 1998) (NEMA);
- 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 NEMA;
- 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;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- 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 judgement; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Compiled by: **Sinethemba Mchunu**
Soil Scientist for SEF
(*MSc. Soil Science*)



07/06/2013
Date

Peer reviewed by: John Phipson
Agribusiness Consultant

MZANSI Agriculture

EXECUTIVE SUMMARY

Strategic Environmental Focus (Pty) Ltd, an independent environmental consultant was appointed by Kgatelopele Private Equity and Venture Capital (Pty) Ltd., to conduct a soil assessment study to determine the agricultural potential, as part of the Scoping and Environmental Impact Reporting (S&EIR) process for the proposed 30MW Solar PV facility in Mareetsane Batho-Batho, located in the North West Province, South Africa.

The proposed power line routes for connection of the solar facility to a local substation will inevitably involve crossing a stream, which could potentially affect water flow. Both the solar facility and associated power line route(s) comprise a substantial portion of moderate potential soils, which would limit agricultural production in the area. Negative impacts pertaining to the power line establishment on the agricultural potential will be temporal and mostly restricted to the installation phase. Whereas, the solar facility will impair agricultural potential for a long term, according to the duration of the operation as it is a permanent feature. Installation of the power lines will also disturb sensitive erosive soils. Taking both soil erosion and agricultural potential according to soil types into consideration, power line route alternative A would be the preferred power line alternative, as the stream crossing along this route is relatively narrow in its extent (width) and the route can be altered to a certain degree.

Proposed mitigation measures include conducting all construction activities during the dry season June - August, where the lowest possible flow rate occurs, as well as establishing and maintaining vegetation soil cover for erosion control. All potentially hazardous substances should be contained and drip trays used where leaks occur. Low vehicle speed *ca*. 40 km/h should be maintained during the construction/installation phase.

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1. INTRODUCTION

High agricultural potential land is a scarce non-renewable resource, which thus necessitates assessment of potential impacts prior to land development for any purposes other than agricultural land use. Strategic Environmental Focus (Pty) Ltd (SEF) was appointed by Kgatelopele Private Equity and Venture Capital (Pty) Ltd to undertake a soil and agricultural potential assessment on the area to be affected by the proposed 30MW Solar PV Facility and associated power line infrastructure near Batho-Batho village in the North West Province.

1.1 TERMS OF REFERENCE

The soil assessment entailed the following aspects:

- Demarcating areas with uniform terrain into zones of terrain morphological units;
- Description of individual soil profiles on a series of catenae within the proposed infrastructure footprint, which entailed the following:
  - Identifying master and diagnostic horizons to a depth of restricting layer;
  - Determining soil depth of diagnostic horizons;
  - Estimate soil texture as percentage (%) clay content;
  - Soil structure (uniformity/firmness/workability);
  - Describing potential limitations/restrictions to land use;
- Soil classification into soil form according to the Taxonomic Soil Classification System for South Africa (1991);
- Assessing soil erodibility according to the Soil Loss Estimation Model for Southern Africa (SLEMSA) criteria (NDA, 2002);
- Grouping uniform soil patterns within uniform terrain into map units, with respect to observed limitations; and
- Evaluating agricultural potential and land capability of demarcated map units.

1.2 ASSUMPTIONS AND LIMITATIONS

For purposes of this study, the following assumptions are applicable:

- Some contents of this report (e.g. the veld carrying capacity, evaporation potential etc.) were determined on the basis of a desk-top study, utilizing source materials listed in the Bibliography. This has been supplemented by material from own resources and experience of work in other areas with similar climatic and physical characteristics.
- Soils, erosion, and agricultural potential were classified according to current restrictions on site;
- Agricultural potential was classified on the basis of rain-fed (dryland) agriculture;
- Soil fertility status was not considered a limitation, seeing as inherent nutrient deficiencies and/or toxicities would be rectified by appropriate liming and/or fertilization prior to cultivation for arable agriculture. Thus, availability of capital to provide required inputs (e.g. fertilizer) is assumed; and

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

2. PROJECT BACKGROUND

2.1 SITE LOCATION

The proposed solar site is situated approximately 10km south west of the Batho-Batho Village in the Ngaka Modiri Molema District Municipality in the North-West Province and falls within the Quarter Degree Grid Cell 2625AB (Figure 1).

2.2 CLIMATIC CONDITIONS

Annual precipitation in the region amounts to approximately 520 mm, with rainfall mainly during summer season. The highest rainfall occurs in January and the least in July, with average maximum temperatures ranging from 20℃ in w inter to 35℃ during summer. June and July are coldest months, where temperature typically drops to approximately 2℃ on average during the night, with frequent fros t occurrence (Mucina & Rutherford, 2006).

2.3 PHYSICAL FEATURES

The landscape comprises of plains of overgrazed grasslands with woody vegetation, mostly *Acacia* species, forming a dense thicket towards the west and southern portions of the solar facility site. Several non-perennial drainage lines occur within the greater study area, with Mareetsane and Morokwa Rivers intersecting the proposed power line route alternatives C and B in a North-Easterly direction, and routes C and A towards west of the solar PV facility site, respectively. A railway line traverses through the centre of the study area, along the south-eastern boundary of the proposed development site. Two high voltage Eskom substations and associated high and medium voltage power lines are located in the northern half of the study area.

2.4 LAND USE CAPABILITY

Current land use within the study area is predominantly vacant/unspecified, comprising thicket and bushland vegetation, constituting approximately 60% of the area. Agricultural land uses include maize cultivation and cattle grazing, with small scale subsistence farming. Cultivated land comprises approximately 30% of the study area, with the remainder 10% under subsistence farming. The site falls within the Bd5 Land Type (Land Type Survey Staff, 1972 – 2006), with moderate limitations that restrict agricultural potential to Arable Land Classes III and IV (National Department of Agriculture, 2002).

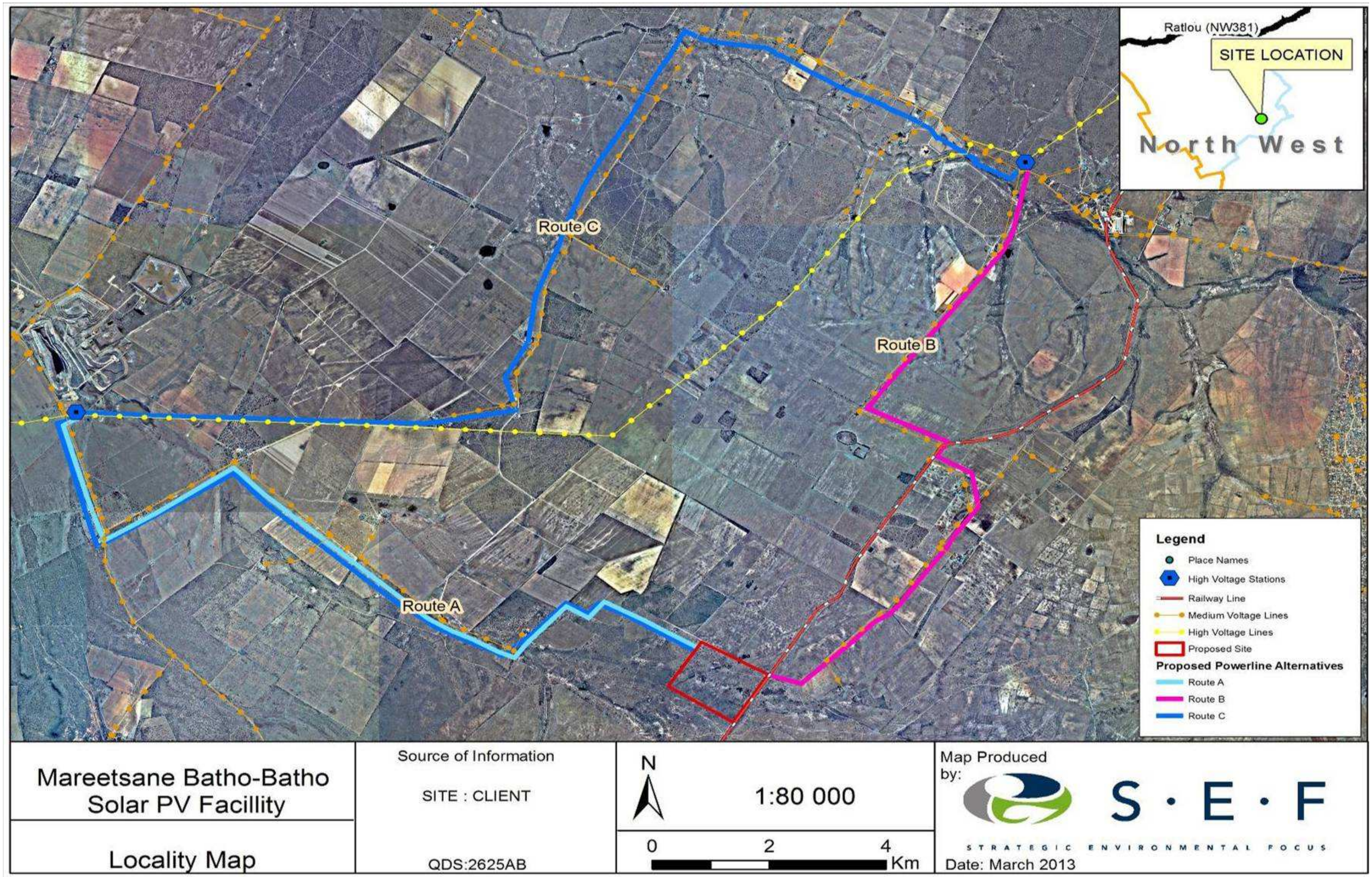

Figure 1: Mareetsane Batho-Batho locality map.

3. OBJECTIVES AND METHODOLOGY

A detailed soil survey was conducted from the 8th to 12th of April 2013 on the solar farm site, and the powerline routes from the 20th to 23rd of May 2013. The survey was carried out in four (4) phases as illustrated below:

- Reconnaissance Survey;
- *In situ* Data Collection;
- Soil Mapping; and
- Report Compilation.

The primary objective of the assessment was to make detailed observations within the identified sensitive areas and identify potential impacts of the proposed activity on environmental resources, particularly soils. Land capability entailed evaluating physical soil restrictions to land use, as well as the susceptibility and risk of erosion damage, including prevalent climatic conditions. Soil observations were made with a hand auger.

3.1 RECONNAISSANCE

The general reconnaissance of the study area revealed the unique characteristic undulating topographic features, including gentle slopes and floodplains/valleys, which indicating spatial soils diversity due to different soil formation processes at play.

3.2 DATA COLLECTION

Soil observations were made by means of a standard hand auger method, and dominant soil types, and soil boundaries classified according to the South African soil classification system (Soil Classification Working Group, 1991). The diagnostic horizon sequence of the soil profiles, texture, colour, and depth were used to classify and allocate soils into soil family level.

At each observation point, the slope gradient and clay content was estimated, and soil colour and depth of horizons determined. The manual hand feel method was used to estimate % clay, and a Munsel colour chart was used for soil colour. Thereafter the soil form was assigned based on the given criteria, and location captured on a GPS. Furthermore, physical limitations that could potentially restrict land use capability were also recorded, where necessary.

The following physical soil properties were assessed in the field:

- Slope gradient;
- Soil form;
- Soil colour;
- Texture - as %clay; and
- Effective depth.

3.3 SOIL MAPPING

Soil map units were determined and mapped from soil types with considerably equivalent potential, and the soil erosion hazard was estimated according to the empirical SLEMSA approach (Department of Agricultural Technical Services, 1976). The SLEMSA approach was used to evaluate soil susceptibility to both water and wind erosion according to soil physical properties and slope gradient.

Agricultural potential was used to infer land use capability of map units according to soil type and physical limitations, which implies the presumption that land suited to agricultural production is concurrently suitable for other less intensive land uses such as pastures, forestry, wildlife, etc.

3.4 IMPACT ASSESSMENT

The soil and land capability associated impacts of the proposed Solar PV facility and associated power line routes were assessed according to the following listed criteria:

Table 1: Impact assessment criteria and description

Extent	Local/Site:-	The whole or a portion of the site.
	Regional:-	The area including the infrastructure footprint, the surrounding neighbours and/or towns.
Intensity	Low:-	Natural processes or functions are not affected.
	Medium:-	Affected environment is altered but function and process continue in a modified manner.
	High:-	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Duration	Temporal (short term):-	Dissipation of impact through active or natural mitigation in a time span shorter than 5 years or life of the operation.
	Medium term:-	Will most likely last for 5–10 years, and can be entirely negated thereafter.
	Long term:-	The impact will last for the entire operational life of the operation, but will be mitigated thereafter
	Permanent:-	Non-transitory.
Significance	Low:-	Site specific, low intensity
	Medium:-	Site specific, high intensity
	High:-	Regional, high intensity

4. RESULTS

4.1 DOMINANT SOIL TYPES

The surveyed area comprised a wide variety of soils including, oxidic, duplex, plinthic, calcic, and hydromorphic soils. Oxidic soils primarily consisted of well drained apedal Clovelly (Cv) soils (Figure 2), occurring on relatively flat and gently sloping land within the solar plant site and along the proposed power line routes. Duplex Valsrivier (Va) and Sepane (Se) soil forms we also identified on site, and constituted approximately half of the solar plant footprint. Plinthic soils including Longlands (Lo), Westleigh (We), and Katspruit (Ka) soil forms were also identified on landscape depressions and along drainage lines, within the solar plant site and also along the proposed power line route alternative C.

Calcic (calcacreous) soils included Addo (Ad), Molopo (MP), and Brandvlei (Br) were identified on pans (Figure 2), with visible lime nodules and effervesces distinctly when treated with cold 10% hydrochloric acid (HCl). Calcareous forms of Ka and Se soils were also identified on site, also with visible streaks of lime nodules in the G horizons and unspecified material with signs of wetness of the Ka and Se soils, respectively. Slight effervescent was observed when these calcareous Ka and Se soils were treated with cold 10% HCl. The other variety of soils identified during the survey comprises hydromorphic soils, including Fernwood (Fw), Longlands (Lo), Kroonstad (Kd), Cactref (Cf), and Katspruit (Ka) soil forms, also associated with landscape depressions and drainage lines. The G horizon of Ka and Kd soils is saturated with water for long periods under natural conditions. Both plinthic and hydromorphic soils are characteristic of wetlands.

4.2 SOIL ERODIBILITY

Soil erosion within the survey area is primarily attributed to poor vegetation management with injudicious grazing; this reduces vegetation cover which increases soil and organic matter removal through water and wind erosion. Soils with an E horizon including Fw, Lo, Cf, and Kd soil forms are highly susceptible to erosion due to the loose leached nature of the E horizon and their topographic position. This is attributable to the intermittent saturation with water and subsequent lateral discharge of water through the A and E horizons during wet conditions.

4.3 LAND USE CAPABILITY AND AGRICULTURAL POTENTIAL

High potential agricultural land is defined as having "*the soil and terrain quality, growing season and adequate available moisture supply to sustain crop production when treated and managed according to best possible farming practices*" (Land Capability report, 2006). Agricultural potential and land capability is inferred from the influence of physical factors, e.g. soil, climate, and terrain.

Table 2: Soil classification of identified soils

Soil Form	Diagnostic horizons	Description
Cv	Orthic A yellow-brown apedal B Unspecified	Deep well drained with apedal loamy sand soil structure, commonly well known good agricultural potential soil. Occurs on relatively flat and gently sloping land within the solar plant site and along the proposed power line routes. These soils play a vital role of feeding wetlands and some constructed water reservoir for livestock drinking purposes.
Pn	Orthic A yellow-brown apedal B Unspecified material with signs of wetness	Relatively shallow imperfectly drained soils and intermittent signs of wetness at depth. Occurs in a matrix of Fw and Lo soil forms along the power line routes, although with a well drained upper solum
Va	Orthic A Pedocutanic B Unspecified material with *no* signs of wetness	Structured soils with stronger than moderate consistency and shallow rooting depth. Root growth and water infiltration are impeded the strong structure of the pedocutanic B horizon. Typically found on lower footslopes and/or river terraces.
Se	Orthic A Pedocutanic B Unspecified material *with* signs of wetness	
Bo	Orthic A Pedocutanic B Unspecified	Similar to Valsrivier, Sepane soils are typically found on lower footslopes, but with a higher water table, hence has the signs of wetness in the unconsolidated material below the pedocutanic B horizon. The signs of wetness have the same criteria but not as strongly expressed as for hydromorphic soils.
Ka	Orthic A Gleyed "G"	The G horizon of these soils is saturated with water throughout most of the year.
Kd	Orthic A E G	Intermittent saturation with water and lateral discharge of water occurs through the A and E horizons during wet conditions. Similar to Ka, The G horizon is saturated with water throughout most of the year.
Fw	Orthic A E Unspecified	Comprises of a thick E horizon, often with no signs of pedogenesis, which implies alluvial and/or colluvial origin from transported material. Occurs on gently sloping hillslopes and drains to feed wetlands and river(s) downstream. These soils are moderate - highly susceptible to erosion due to poor structural development and landscape position.
Cf	Orthic A E Lithocutanic B	Intermittent saturation with water and lateral discharge of water occurs through the A and E horizons during wet conditions. Unconsolidated rock encountered at shallow depth.
Lo	Orthic A E soft plinthic B	Intermittent saturation with water and lateral discharge of water occurs through the A and E horizons during wet conditions.
We	Orthic A Soft plinthic B	Poorly drained soils, where orthic A grades directly into soft plinthic B. these soils are thus generally wetter than Lo soils in which the orthic A grades indirectly an E horizon.

Ad	Orthic A	Calcareous soils typical of arid climates, containing free carbonates, expressed as lime nodules that effervesce visibly when treated with cold 10% HCl.
	Neocarbonate B	
	Soft carbonate B	
Mp	Orthic A	
	yellow-brown apedal B	
	Soft carbonate B	
Br	Orthic A	The soft carbonate horizon dominates the morphology of the profile, with nodular lime concretions throughout the profile. Distinct mottling with green-blue tints.
	Soft carbonate B	

Figure 2: Redoximorphic signs of wetness characteristic of plinthic and hydromorphic soils (top left), yellow-brown apedal oxidic (Cv) soil (bottom left), and calcareous (Br) with free lime nodules (right).

The agricultural potential was inferred in consideration of the susceptibility of soils to damage from erosion and other causes, as well as various limitations to land use due to physical factors, such as climate. Common limiting factors for agricultural production in the area were identified as follows:

- Shallow effective rooting depth due to shallow bedrock and strongly developed structure, impermeable to plant roots;
- Overgrazing by livestock; and
- Low rainfall and limited water availability for dryland agriculture.

Agricultural potential is directly related to Land Capability Class (LCC),.measured on a scale of I to VIII. Majority of the soils within the investigated site and associated power line routes were classified as belonging to class IV and V land capability classes. Class IV soils may be used for arable agriculture under certain circumstances and management practices, whereas land classes V to VIII are not suitable for cultivation. On the contrary classes I to III are well suitable for annual cultivated crops. A flow-sheet depicting how Land Capability Class is deduced is attached as Appendix 2 hereto.

Another major consideration is Climate Capability Class, measured on a scale of 1 to 8. On the basis of available information this area falls into Climate Capability Class 7 or 8, suitable for livestock or game only. The fundamental fact is that the alternate land use proposed by the developer is far more valuable than the current land use could ever be, considering the soil forms and prevailing climate (J. Phipson 2013, pers. comm., 20 June). The key indicators of agricultural potential at the site are as follows:

Table 3: Agricultural Potential Indicators (*source*: AGIS data)

Mean annual rainfall	400 – 600 mm.
Annual evaporation	2000 - 2200 mm
Mean summer temperature	31-32 °C
Mean winter temperature	5.6 – 7.4 °C
Frost severity	Nil
Veld carrying capacity	1 AU* per 18 -21 ha

*AU = Large animal unit – 450 kg ox

Rainfall requirement for most crops is in the 800 -1200mm range, which qualifies the prevailing rainfall on site as below optimum for arable agriculture. Although the actual yields from agricultural production are currently unknown, the fact that livestock is often a more important component of both the local and district agrarian economies than are arable crops is often overlooked in studies of this nature. Nonetheless, the current agricultural potential of the land can be potentially recovered with appropriate management practices after the operation has ceased.

It is common cause that RSA is in dire need of energy sources other than fossil fuel, in particular, coal. The enormous escalation in the cost of coal generated power, currently the least expensive, indicates that by 2015 the cost of power from wind generation will be less costly than that from fossil fuel, followed by Photo Voltaic (PV) generation, both of which are pegged at a Consumer Price Index escalation for the contract period of 20 to 25 years. It is also common cause that the establishment of PV enterprises is a new phenomenon, therefore there is little empirical evidence of the impact of PV enterprises on either arable or grazing land (J. Phipson 2013, pers. comm., 20 June). However, remarks can be extracted from other agricultural impact studies conducted at two different sites, each 200 ha in extent, one in the Cradock area, Eastern Cape, and the other in the Victoria West area, Northern Cape. Remarks from these studies identified the impact of partial shade and soil disturbance on veld type and quality. In the first instance the impact of increased shade was found to have a long term beneficial effect. In the second instance the impact of soil disturbance created a short term to medium term beneficial effect. It was too recent for long term benefits to be determined, but it is unlikely that the prevailing soils and climate would have sustained any long term benefits in the form of improved veld quality (J. Phipson 2013, pers. comm., 20 June).

Climatic constraints due to low seasonal water availability and high evaporation demand were regarded as the most limiting factors to arable agriculture for the investigated site, although the terrain and soil conditions are favourable in some instances, e.g. Cv soils in this case. Although some Fw and/or Lo soils are sufficiently deep to permit root penetration to a water table to compensate for low water holding capacity in the upper solum, erosion susceptibility would be exacerbated by cultivation practices. Thus, caution is highly recommended when these soils are cultivated. Wetness in hydromorphic and plinthic soils is also considered a limitation for crop production, as plant roots struggle to colonise wet soils due to poor respiration (anoxic) conditions. Wetness in these soils is due to lower topographic position and/ or the characteristic nature of the soils being slowly permeable to water. Intensive management would be required for sustainable crop production, including installation of subsurface drainage systems where possible. However, some cases have been documented where maize performed poorly on Kd soils under normal rainfall conditions but spectacularly out-yielding maize on adjacent better drained soils in drought years.

Despite the discussed limitations and capabilities, agricultural potential of the various identified soils is largely restricted by climate, soil water availability in particular. Annual rainfall below 500mm is generally considered as restrictive to crop production unless irrigation provision is accessible. However, some of the Clovelly soils are currently under maize and peanut cultivation along the proposed power line routes. Clovelly soils within the proposed solar facility site have an equivalent agricultural potential, the reason for not cultivating these soils is probably attributed to landowner plans and/or preference. Although constituting a substantial portion of the site and with fairly good potential, these soils play an important role as recharge soils, feeding wetlands and constructed water reservoirs for livestock drinking. No perennial rivers were identified near the study area, which emphasises the essential value of natural and artificial wetlands for livestock survival, particularly during the dry season. Furthermore, this stresses the issue of a shortage of water availability required for sustainable crop yields

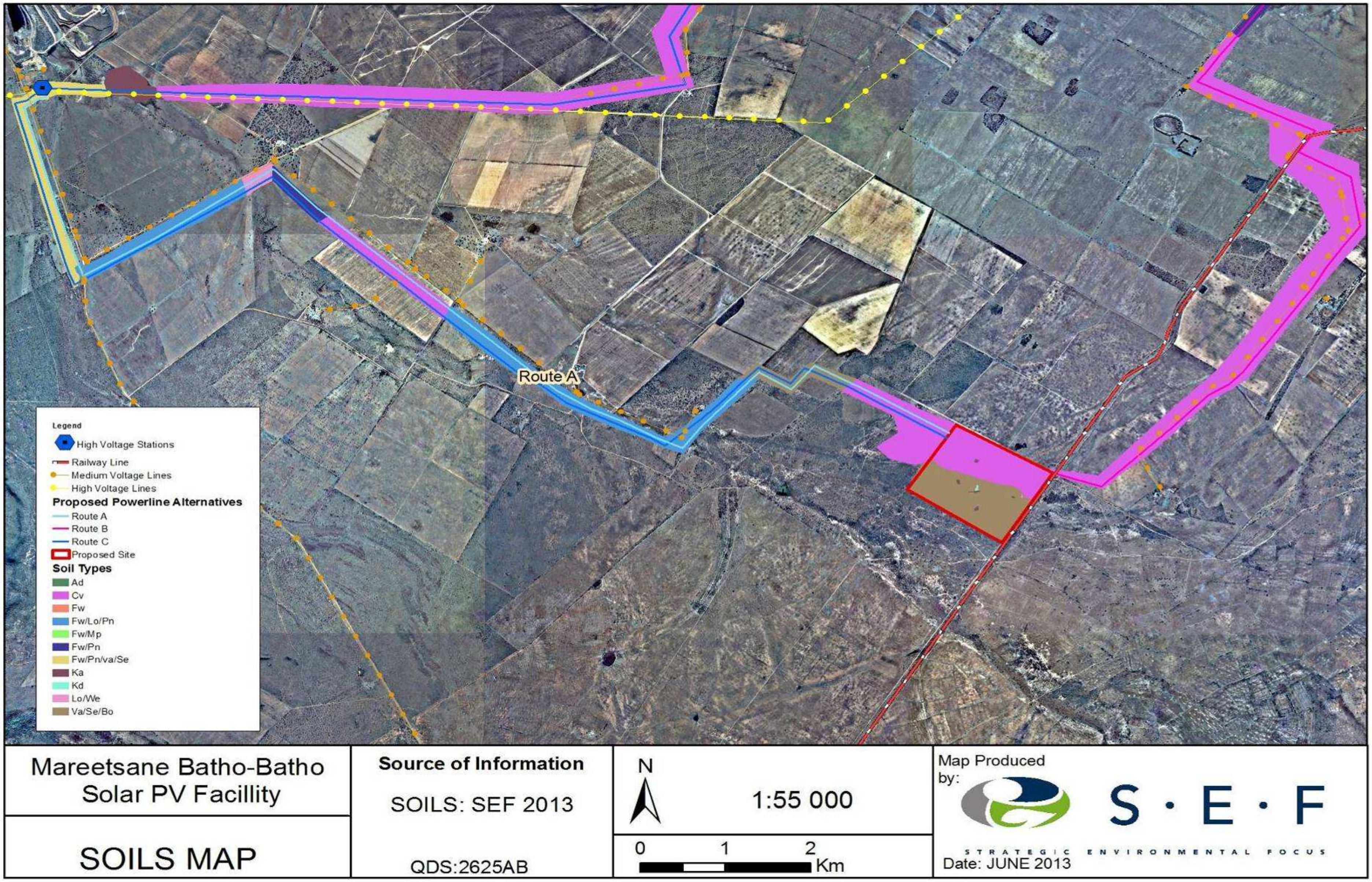

Figure 3: Soil Map illustrating different soils within the solar farm site and along the power line route B towards east, A and C heading west

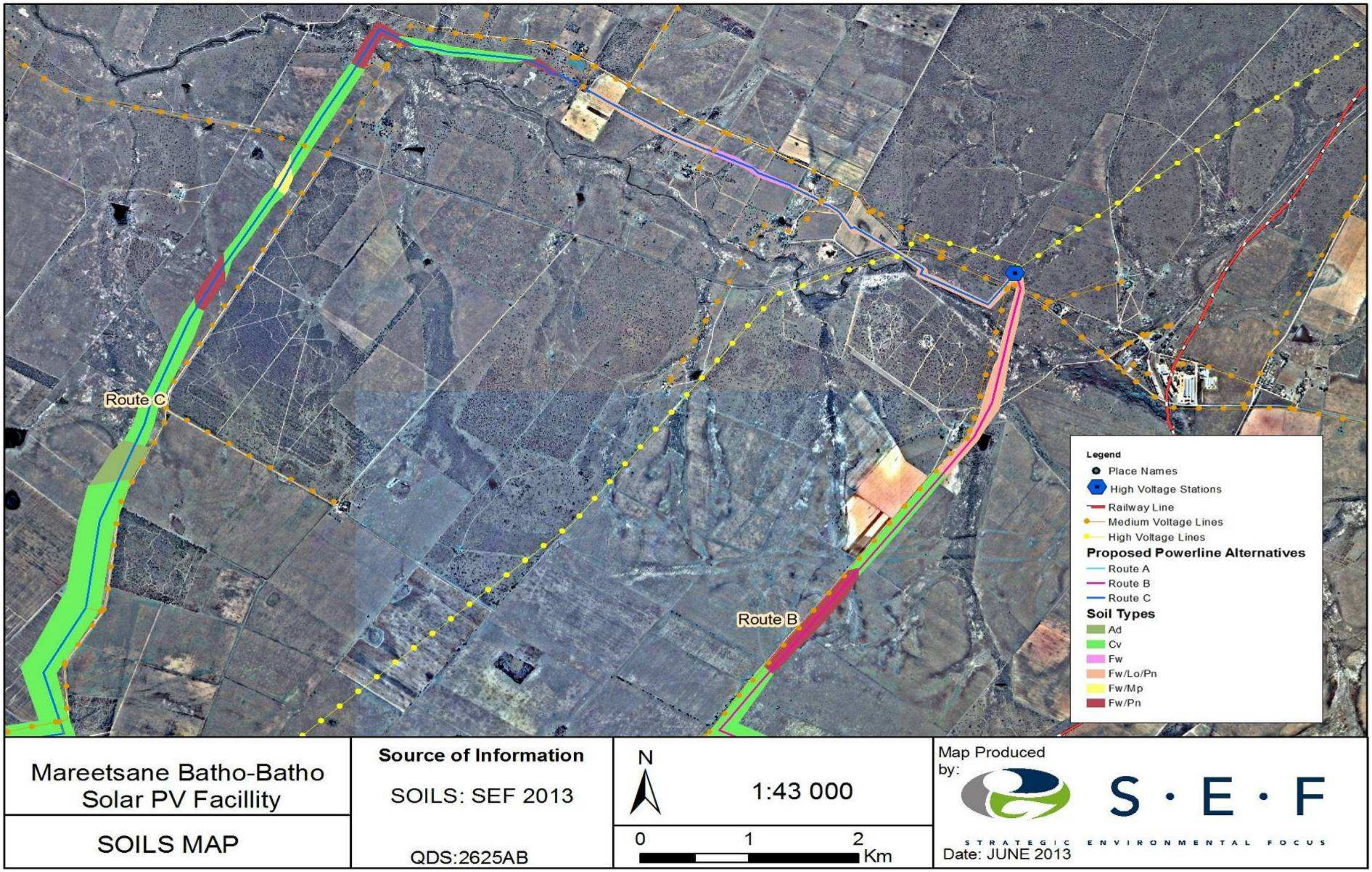

Figure 4: Soil Map illustrating the different soil types of the remainder portion of route B and C connecting to the substation

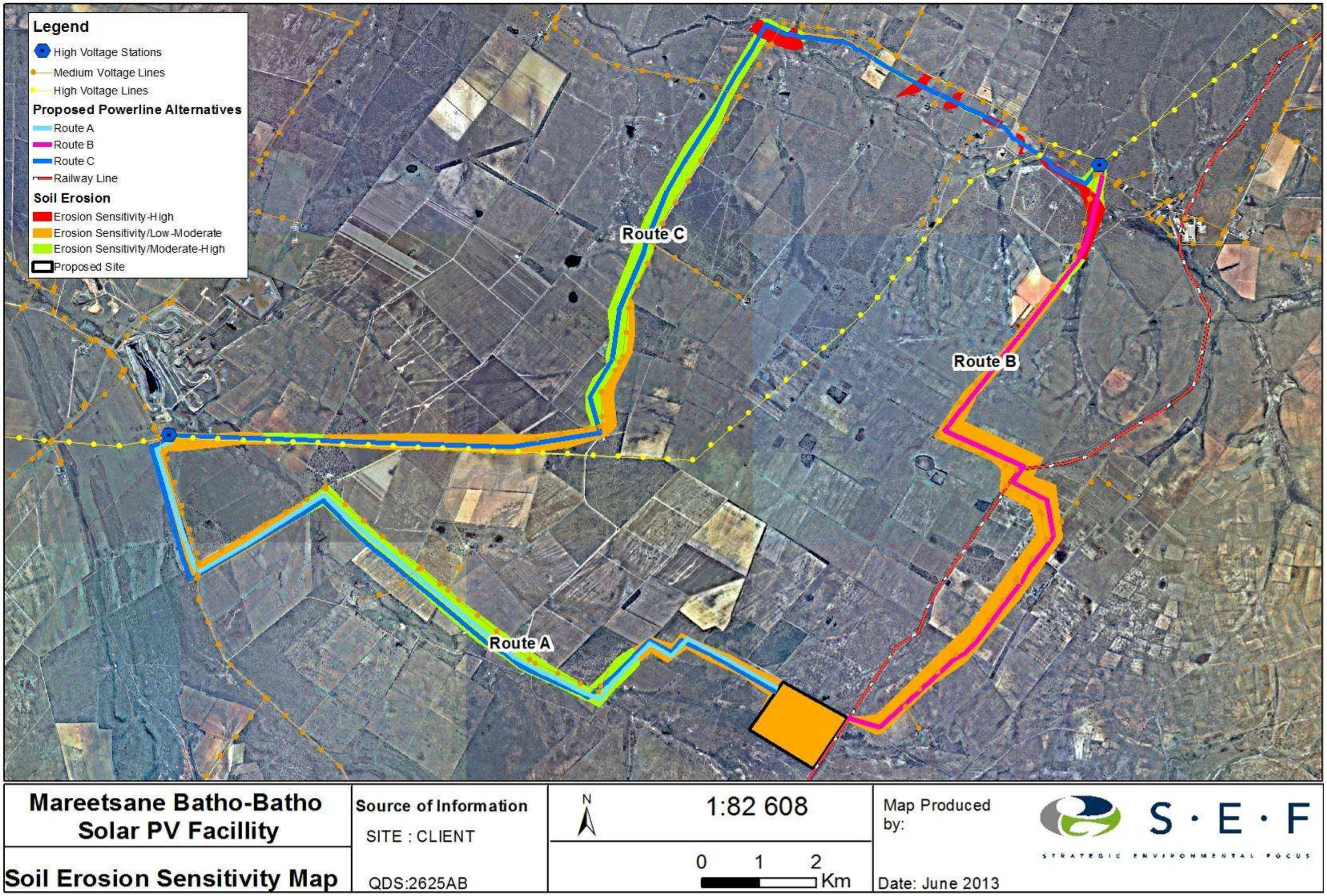

Figure 5: Soil erosion sensitivity map

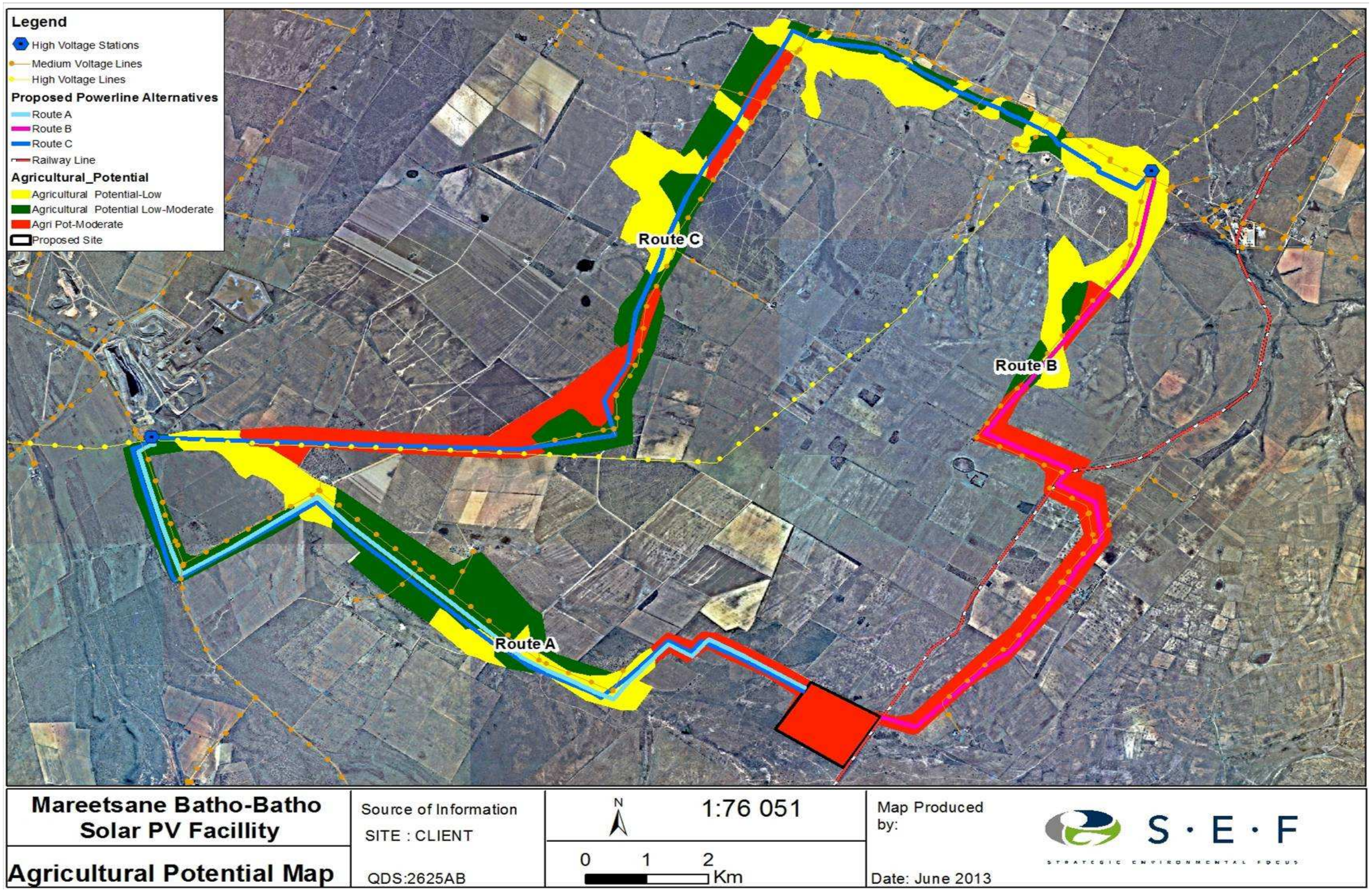

Figure 6: Agricultural potential map

5. IMPACT ASSESSMENT AND MITIGATION

5.1 SOLAR PV FACILITY

The study examined the associated impacts on the soils and agricultural potential where the solar PV facility will be installed. The activities of the proposed development that will potentially affect the agricultural potential are associated with the construction phase of the development during the installation of facility and electrical connectivity through power lines. The proposed solar facility and associated power line route(s) for connection of the solar facility to a local substation comprises a substantial potion of moderate potential soils, as depicted in Figure 6, which would limit agricultural production in the affected areas for the duration of the operation. Majority of the PV facility site is dominated by Se and Va soils, which are both derived from cretaceous sediments, and commonly found in dry bushveld habitats. They are both prone to compaction when the soils are wet and capping when dry, their subsoils are often highly erodible with dispersive clays.

The impact issues at play in the solar panel area are long term and speculative. At this stage there is no empirical evidence of how PV enterprises covering 2 ha to 200 ha will impact on the quality of the veld within the PV panel area. By virtue of the climatic requirements for economically viable power generation the site is located within an arid area, with minimal rainfall and cloud cover, which tends to aggravate climates that are often intrinsically viciously hot in peak summer and bitterly cold during winter. It is a fact of the climatic circumstances at this site that veld quality is poor, which is often further aggravated by shallow and duplex soils (J. Phipson 2013, pers. comm., 20 June).

5.2 POWER LINES

All the proposed power line routes inevitably involve crossing a stream, which could potentially affect water flow, thus mitigation becomes critical in evaluating the impacts of the proposed activity. This will also disturb highly erosive soils as illustrated in Figure 5. The associated impacts of the power lines on both soil erosion and agricultural potential will be minimal and mostly restricted to the installation phase of the development, as the proposed route(s) follow the existing power lines, thus reducing the disturbed surface area. Further anticipated operational phase impacts of the proposed activity on soil and land capability would be relatively low, restricted to maintenance vehicles and dust generation. The power lines are anticipated to require low maintenance once installed. Refer to Table 3 for impact assessment of the entire development during construction and operational phase.

Taking both soil erosion and agricultural potential according to soil types into consideration, route A would be the preferred power line route alternative, as the stream crossing along this route is rather narrow in its extent (width), while the route is also flexible. For instance, the power line route can be shifted in a northerly direction to minimize impact on the Morokwa River towards the west of the solar facility site.

5.3 MITIGATION MEASURES

First and foremost, the destructive construction activities should be preferably carried out during the dry season June - August. This timing is ideal as it allows considerable time to mitigate the impacts of erosion and siltation of streams and wetlands before the intense rainfall season. Establishing and maintaining vegetation as a soil cover is the most common practical technique for controlling erosion on disturbed soils, it is very simple and effective when managed properly. Seeding sensitive areas with locally adapted perennial seed mixture of grasses is highly recommended. Grasses are preferred for good contact cover compared to woody vegetation. The erosion control mechanism of vegetation cover entails the following:

- Stabilization of soil structure through formation of aggregates;
- Protects against detachment of soil particles through strong winds and rain-drop impact; and
- Promotes water infiltration for root uptake, and hence reduce surface run-off.

The impact issue at play in the construction, road making and cable laying phase area is the plant and grass succession cycle and the best practice through which this can be achieved. Good topsoil should be stockpiled separately from the remainder subsoils, for purposes of rehabilitation later on. It is highly unlikely that seeded grasses will reach a climax stage under current site conditions. Pioneer grasses should be selected for first seeding, and then disturbed areas left to self rehabilitate in the normal course of natural plant succession.

Immediate excavation and subsequent disposal of contaminated soil where spills have occurred, and direct soil contact with any potentially hazardous substances e.g. leaks from vehicles, should be prevented using drip trays in order to prevent soil contamination. Water should be sprayed on bare soil surfaces where dust fallout occurs, and maintain low vehicle speed ca. 40 km/h during the construction/installation phase. This practice of maintaining 40 km/h speed limit on gravel roads has been proven and widely accepted for combating dust in game reserves and national parks. An additional suggestion would be the use of a TLB with a narrow bucket such as that used by Seacom in their nationwide underground cable network. The effective width of the trench is 250 mm and the depth sufficient to discourage cable theft (J. Phipson 2013, pers. comm., 20 June).

Table 4: Possible impacts of the proposed activity

Potential Impact	Development Phase	Extent	Intensity/ Magnitude	Duration	Probability of occurrence	Significance
Soil loss via erosion	Construction Phase	Local/Site	Moderate	Temporal	Moderate	Low

	Operational phase	Local/Site	Low	Temporal	unlikely	Low
Soil Contamination	Construction Phase	Local/Site	Variable	Temporal	Likely	Low
	Operational phase	Local/Site	Variable	Temporal	Unlikely	Low
Dust	Construction Phase	Local/Site	Low-Moderate	Temporal	Most likely	Moderate
	Operational phase	Local/Site	Low-Moderate	Temporal	Unlikely	Low
Agricultural Potential	Construction Phase	Local/Site	Low	Temporal	Unlikely	Low
	Operational phase	Local/Site	Low	Temporal	Unlikely	Low

6. CONCLUSIONS AND RECOMMENDATIONS

The identified soils have varying capabilities for agricultural land use according to their respective properties as mapped in Figure 6, however, their respective agricultural potential is restricted by climate to some extent. Cultivation of soils with an E horizon, e.g. Fw, Lo, and Kd soil types should be preferably avoided due to their characteristic high erosion hazard.

The proposed routes for overhead power lines, required to connect the proposed solar facility to the existing Eskom substations, traverses trough areas of high erosion sensitivity as well as good agricultural potential land. However, the proposed project contributes to the four priority areas in land use sustainability:

- Climate change;
- Nature and biodiversity;
- Environment and health; and
- Natural resources and waste.

The impact on the agricultural potential of the site is regarded to be very low due to the extent of the area to be affected by the proposed Solar PV facility, as well as prevailing soil and climatic conditions. Apart from the rainfall factor, the high summer temperatures would exclude cultivation of most crops due to factors such as flower drop.

It is highly recommended to use drip trays where potentially hazardous leaks from vehicles occur in order to prevent against soil contamination. Excavation and subsequent *ex situ* disposal should be done where spills have occurred to prevent leaching and ingress into rivers downstream. Dust fallout should be combated with water sprays on bare soil surfaces, preferably grey water where possible, and maintain low vehicle speed *ca.* 40 km/h during the construction/installation phase. Construction and infrastructure installation activities should be carried out during the dry season, which coincides with October - March in this reqion in order to minimise soil loss due to erosion. Vegetation should be established as early as possible subsequent to construction and installation of all associated components of the development to further minimise erosion. During this period, grazing should be restricted in order to improve success of re-vegetation.

The final analysis recommends that the income potentially derived from the proposed land use (Solar PV generation) outweighs the benefits that could be derived from crop production or livestock breeding by perhaps as much as a hundredfold, provided that an equitable agreement has been reached with the local community (J. Phipson 2013, pers. comm., 20 June).

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APPENDICES

Appendix 1: Soil Erosion Classification Criteria

Water erodibility criteria for the binomial soil classification system

Basic index	Criterion	Class Limits	Impact Value	Erodibility Index
10	% Clay Content	0-6	4	=10-4
		7-15	3	=10-3
		16-35	2	=10-2
		36-55	1	=10-1
		>5	0	=10
	Leaching Status	Dystrophic	0	=10
		Mesotrophic	1	=10-1
		Eutrophic	2	=10-2
		Calcareous	3	=10-3
	Structure & Transition	Orthic A	1	=10-1
		E	1	=10-1
		Neocutanic B	1	=10-1
		Clear A/B transition	1	=10-1
		Abrupt A/B transition	2	=10-2
	Depth (cm)	>40	0	=10
		<40	1	=10-1

Wind erodibility criteria for the binomial soil classification system

Wind Erodibility Class	% Clay	Sand Grade	Particle Size (mm)	Wind Erosion Hazard
1	15-20	Very fine, fine, medium	0.05-0.5	Low
	7-15	Coarse	>0.5	
2	7-15	Very fine, fine, medium	0.05-0.5	Moderate
	0-6	Coarse	>0.5	
3	0-6	Very fine, fine, medium	0.05-0.5	High

Appendix 2: Land Capability Classification

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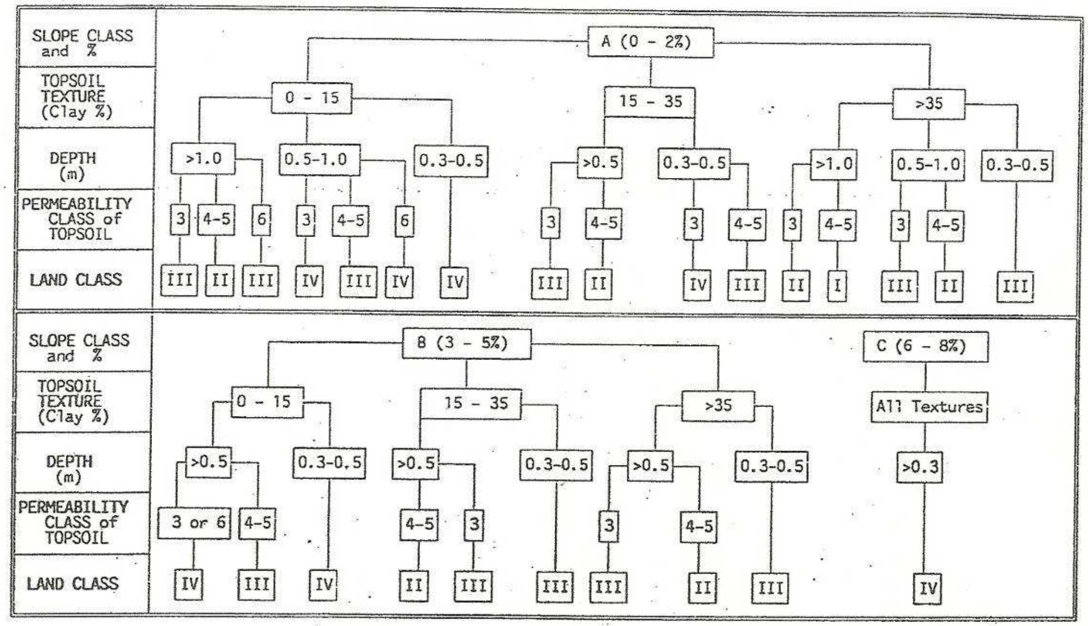
CAPABILITY CLASS DETERMINATION GUIDELINE for BRGs:
Dry Zululand Thornveld (20), Valley Bushveld (21), Lowveld (22), Sandy Bushveld (23) (Average annual rainfall 587-830 mm)

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