BASIC ASSESSMENT REPORT

SOIL, LAND USE AND AGRICULTURAL POTENTIAL SURVEY:

PROPOSED VISSERSPAN SOLAR FACILITY PROJECT NO. 3, ON VISSERSPAN FARM NO. 40, TOKOLOGO LOCAL MUNICIPALITY, FREE STATE PROVINCE

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Compiled by:
J.H. van der Waals
(PhD Soil Science, Pr.Sci.Nat)
Member of:
Soil Science Society of South Africa (SSSSA)

Accredited member of:
South African Soil Surveyors Organisation (SASSO)

Registered with:
The South African Council for Natural Scientific Professions
Registration number: 400106/08

Declaration

I, Johan Hilgard van der Waals, declare that –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

J.H. VAN DER WAALS
TERRA SOIL SCIENCE

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SOIL, LAND USE AND AGRICULTURAL POTENTIAL SURVEY: PROPOSED VISSERSPAN SOLAR FACILITY PROJECT NO. 3, ON VISSERSPAN FARM NO. 40, TOKOLOGO LOCAL MUNICIPALITY, FREE STATE PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by EnviroAfrica cc to conduct a soil and agricultural potential survey/assessment of the proposed Visserspan Solar Facility Project No. 3 on the Farm Visserspan No. 40 in the Tokologo Local Municipality in the Free State Province.

1.2 AGRICULTURAL POTENTIAL BACKGROUND

The assessment of agricultural potential rests primarily on the identification of soils that are suited to crop production. In order to qualify as high potential soils they must have the following properties:

- Deep profile (more than 600 mm) for adequate root development,
- Deep profile and adequate clay content for the storing of sufficient water so that plants can weather short dry spells,
- Adequate structure (loose enough and not dense) that allows for good root development,
- Sufficient clay or organic matter to ensure retention and supply of plant nutrients,
- Limited quantities of rock in the matrix that would otherwise limit tilling options and water holding capacity,
- Adequate distribution of soils and size of high potential soil area to constitute a viable economic management unit, and
- Good enough internal and external (out of profile) drainage if irrigation practices are considered. Drainage is imperative for the removal (leaching) of salts that accumulate in profiles during irrigation and fertilization.

In addition to soil characteristics, climatic characteristics need to be assessed to determine the agricultural potential of a site. The rainfall characteristics are of primary importance and in order to provide an adequate baseline for the viable production of crops rainfall quantities and distribution need to be sufficient and optimal.

In the case where crop production is not possible due to soil or climatic constraints aspects such as grazing potential and carrying capacity is considered. Grazing capacity is mainly determined by vegetation characteristics of a site and would therefore have to be deduced from vegetation reports (that do address carrying capacity) or from dedicated discussions with farmers and land users. The combination of the above-mentioned factors will be used to assess the agricultural potential of the soils on the site.

1.3 LAND CAPABILITY BACKGROUND AND CLASSIFICATION

Land capability refers to the specific land use and agronomic practices that a given piece of land is capable of in the context of the original land capability categories published in the USA in the 1960's. The land capability concept is a bit broader than the "land suitability" approach expounded by the FAO (Food and Agriculture Organisation of the UN) where the latter aims to pronounce on the suitability of a specific area of land for a specific "land utilization type" (LUT). In the more recent South African case for "land capability" the then Department of Agriculture, Forestry and Fisheries (DAFF) established a requirement for the classification of land based on the criteria provided in **Table 1**. These categories are not significantly different from the original concept but have been amended for the South African context.

Table 1 Land capability classes for assessment of land

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

The assessment of land capability rests squarely on the assessment of soil properties for agricultural purposes as discussed in the previous section. These properties will therefore be used to determine the specific land capability class for the survey area.

2. LOCALITY OF THE SURVEY AREA

The 222 ha survey area lies between 28° 34' 50" S and 28° 36' 02" S and 25° 43' 45" E and 25° 45' 21" E approximately 9 kilometres north-north-west of the town of Dealesville in the Free State Province (**Figure 1**).

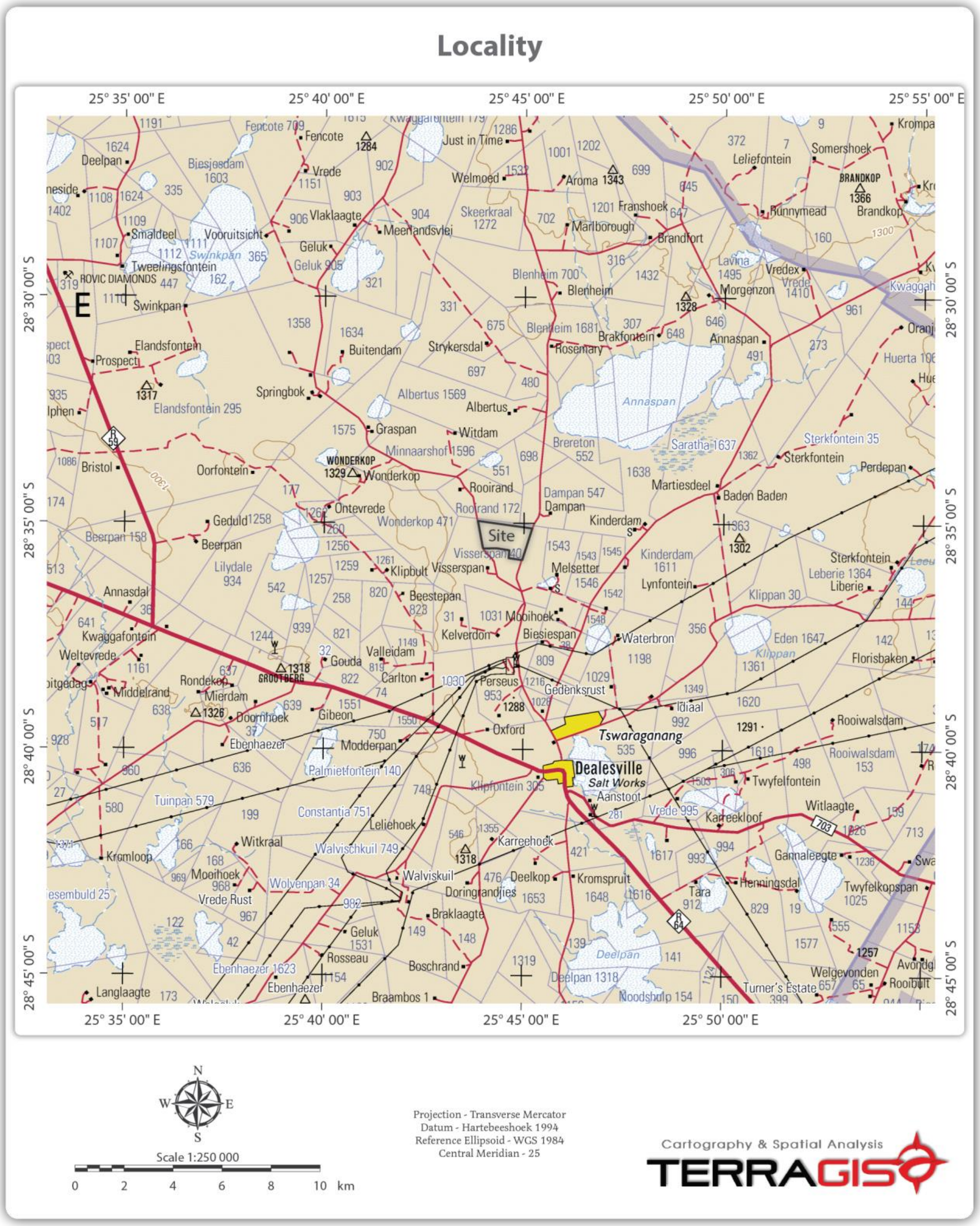

Figure 1 Location of the investigation site

3. METHOD OF SOIL AND AGRICULTURAL SURVEY

The survey was conducted in five phases.

3.1 PHASE 1: BROAD GEOLOGICAL SETTING

The broad geological setting of the investigation area was ascertained from the 1:250 000 Geological Map of South Africa, Council for Geoscience.

3.2 PHASE 2: LAND TYPE DATA

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 – 2006). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (The Soil Classification Working Group, 1991).

The Visserspan site falls into the **Ae46** land type as indicated in **Figure 2** (Land Type Survey Staff, 1972 – 2006). This land type is summarised below with a description of the dominant soils, land capability, land use and agricultural potential.

3.3 PHASE 3: TOPOGRAPHIC AND OTHER BIOPHYSICAL PARAMETERS

The topography of the site was elucidated through the generation of a digital elevation model (DEM) map for the site. From this data a topographic wetness index (TWI) map was generated.

3.4 PHASE 4: SATELLITE IMAGE INTERPRETATION

A dedicated satellite image (Google Earth) interpretation exercise was conducted to determine the current site conditions as well as the historical land uses. This was done through the accessing of Google Earth images from different periods in the past.

3.5 PHASE 5: SITE VISIT AND SOIL SURVEY

A high-level reconnaissance soil survey was conducted to ascertain soil variation across the land types. For the soil survey the area was traversed in a vehicle along public roads and soils were investigated at accessible spots as well as along road cuttings. Photographs were taken of the relevant site and soil characteristics.

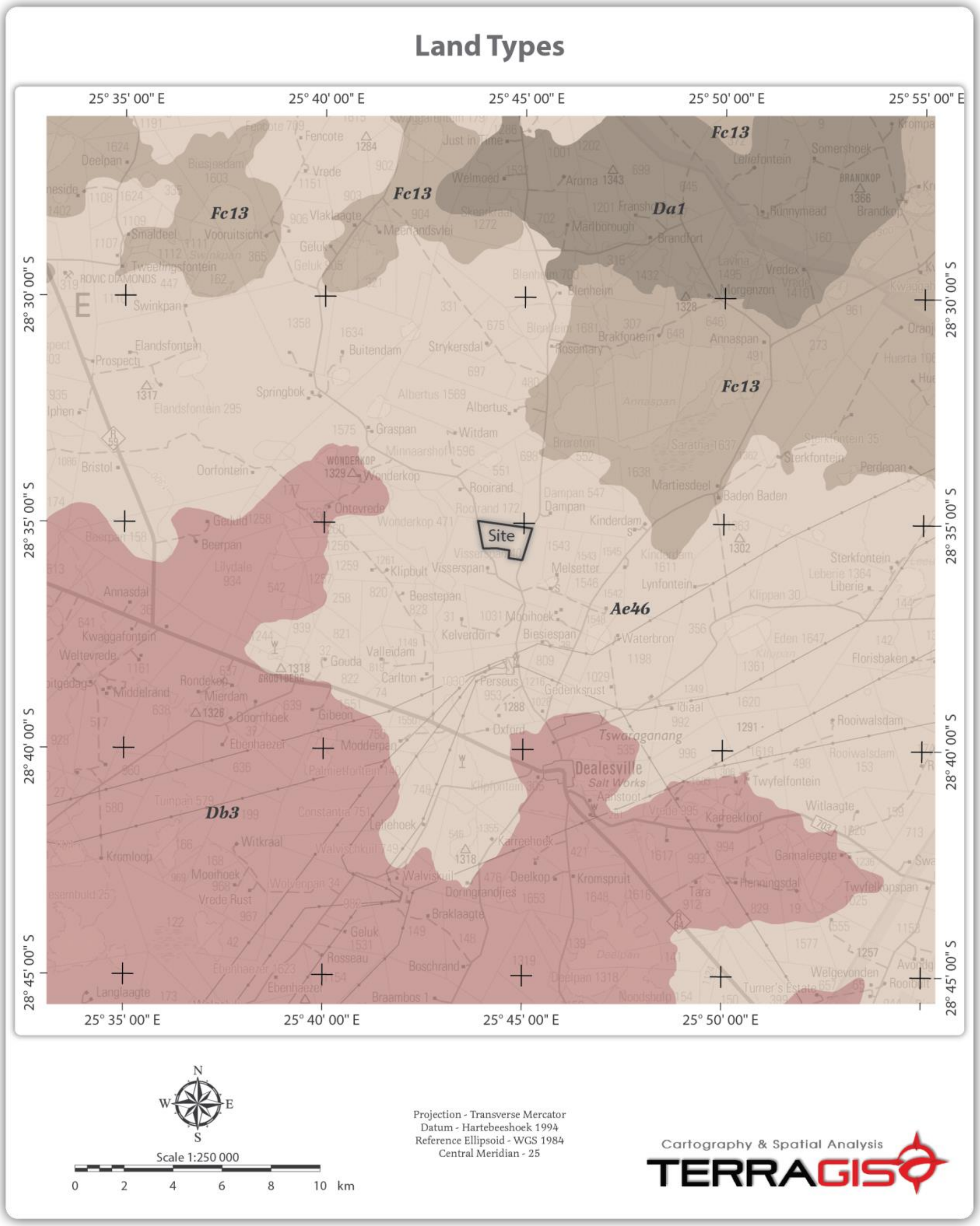

Figure 2 Land type map for the investigation area

4. SURVEY RESULTS

4.1 PHASE 1: BROAD GEOLOGICAL SETTING

The broad geology patterns (1:250 000 Geological Map of South Africa, Council for Geoscience) of the survey area indicates the site to consist of dominantly aeolian sands with dolerite, calcrete and grey shales with interbedded siltstone

4.2 PHASE 2: LAND TYPE DATA

Land Type Ae46

Land Type – General: Ae land types denote landscapes where the dominant soils are red high base status (eutrophic and lime containing) in excess of 300 mm depth..

Soils: Soils are dominantly red coloured, eutrophic and lime containing, well-drained and of sandy to sandy loam texture. Light coloured sandy soils occur in depressions. Some of these soils have lighter colours due to the presence of lime and some are bleached due to occasional ponding of water.

Land capability and land use: The land use in this land type is extensive grazing due to climatic constraints. The land capability mimics the land use.

Agricultural potential: The agricultural potential in terms of dryland cropping is low due to lower than 500 mm pa rainfall (**Figure 3**) with grazing potential being dependent on rainfall and management.

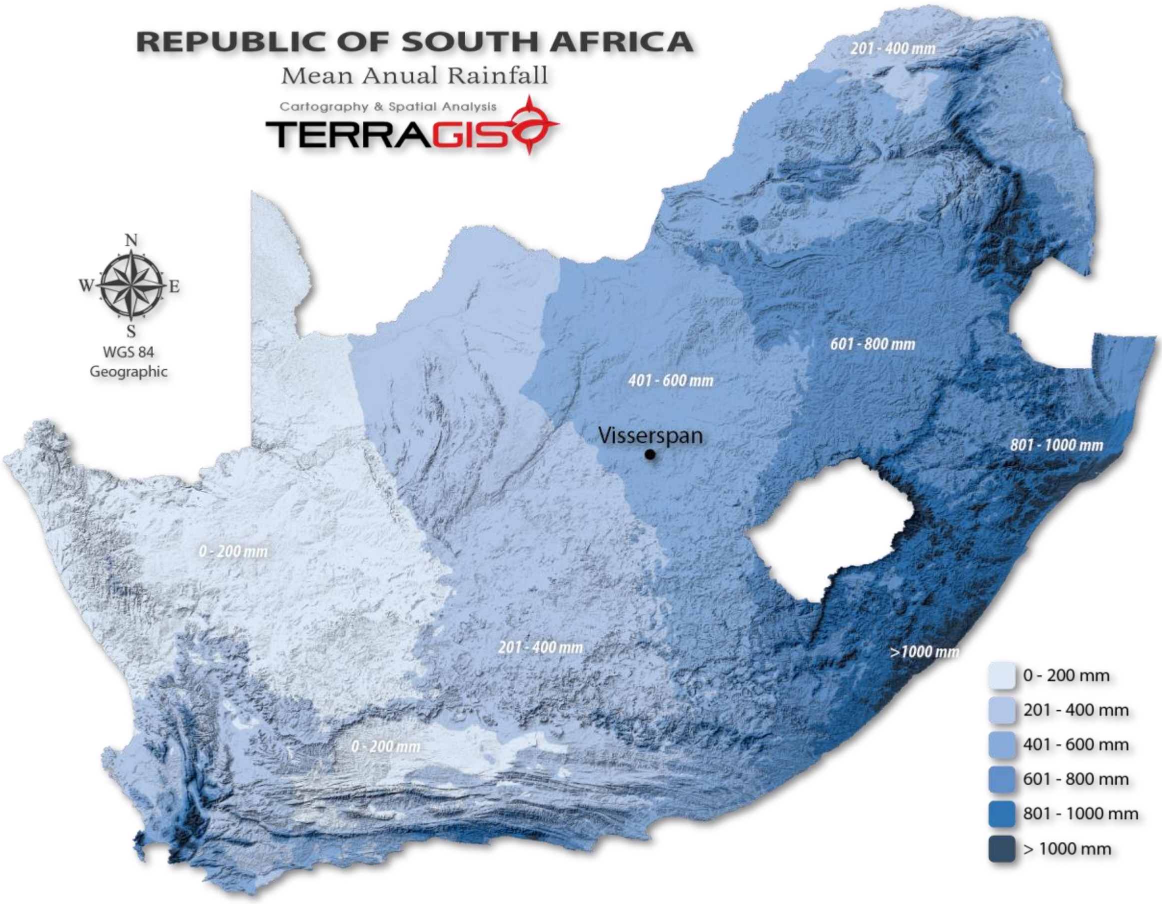

Figure 3 Rainfall map of South Africa indicating the survey site

4.3 PHASE 3: TOPOGRAPHIC AND OTHER BIOPHYSICAL PARAMETERS

Contours of the entire site were used to generate a digital elevation model (DEM –**Figure 4**) and topographic wetness index (TWI – **Figure 5**). The contours indicate a relatively flat landscape with an easterly aspect. No drainage features are evident on the site.

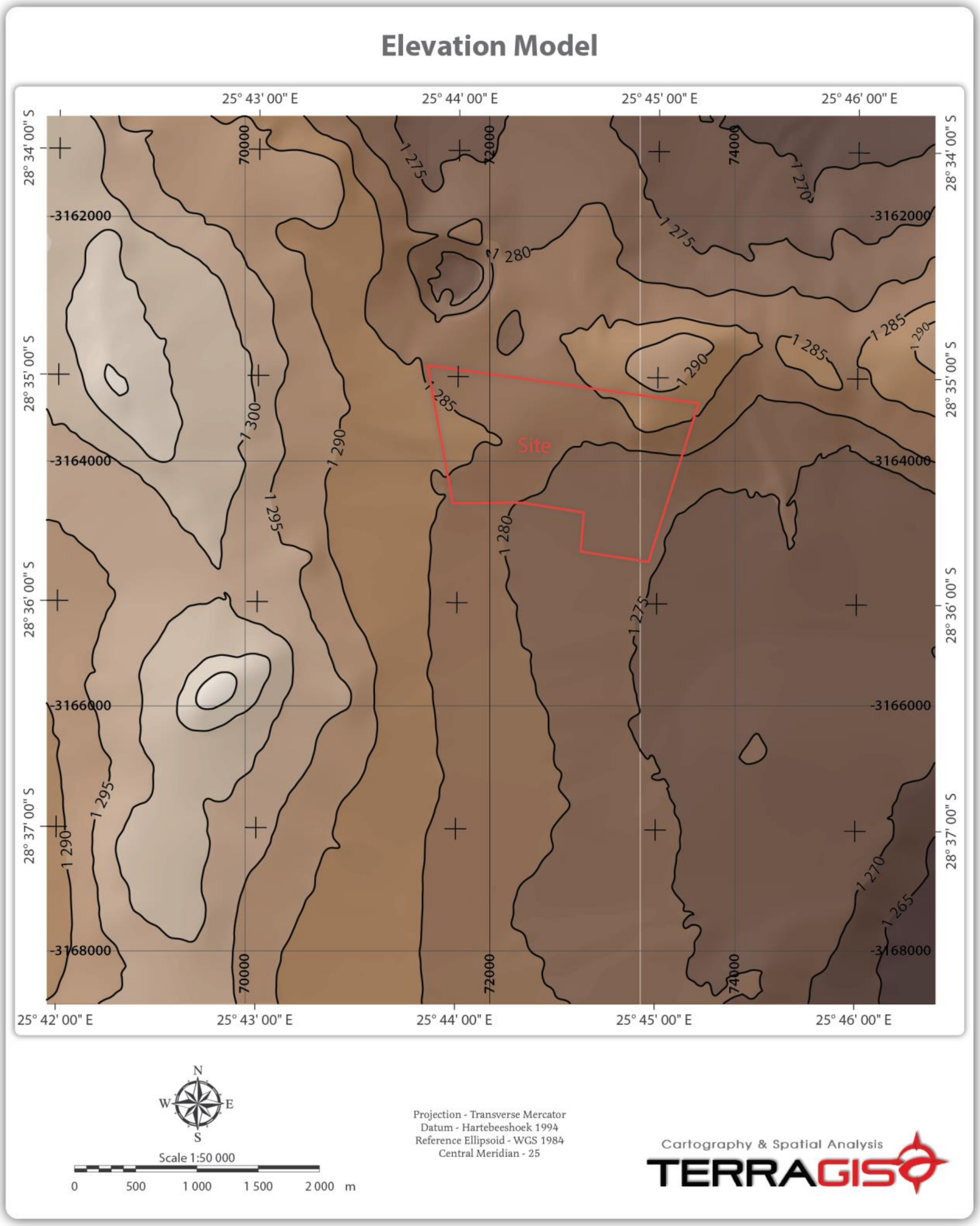

Figure 4 Digital elevation model for the entire survey area

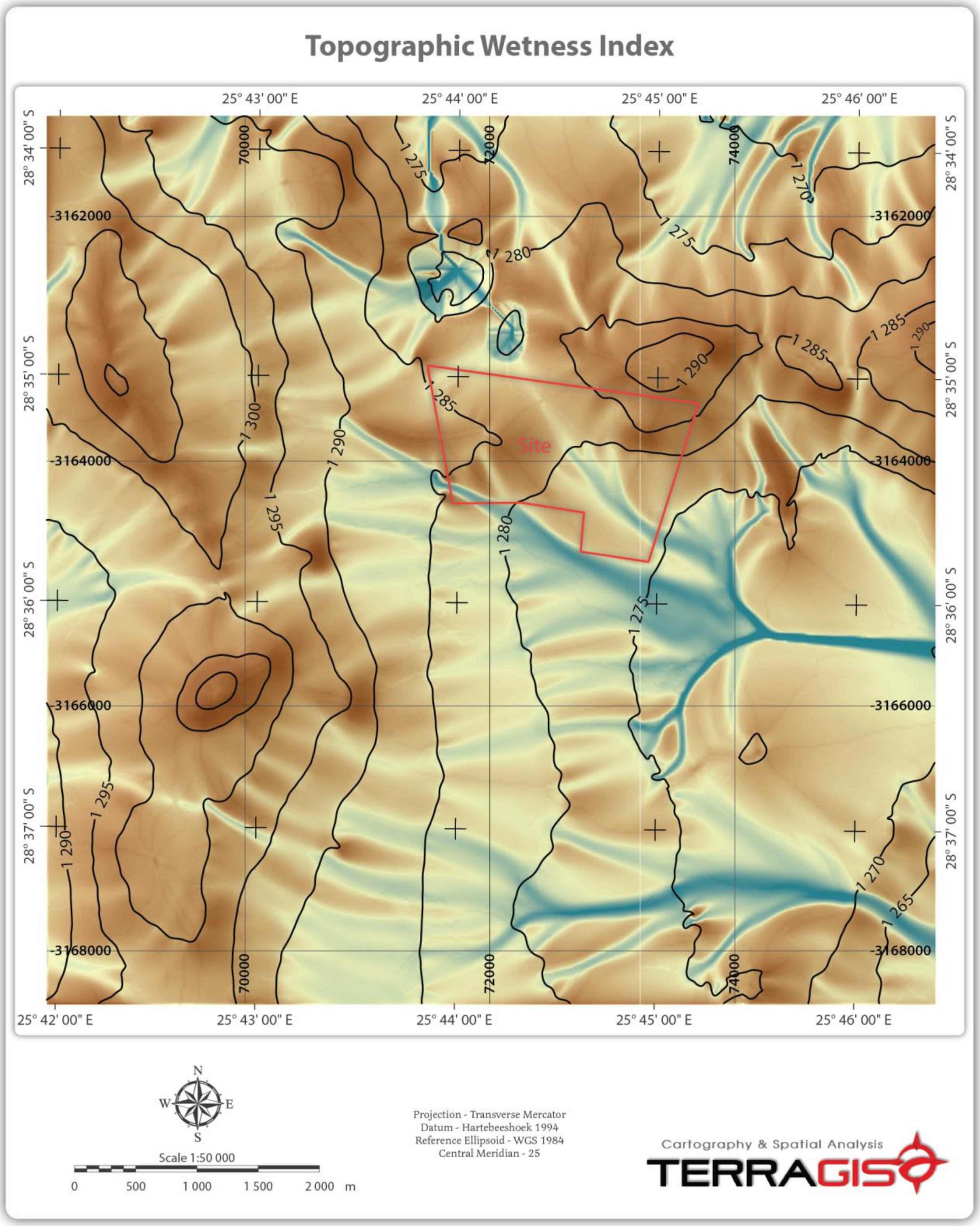

Figure 5 Topographic wetness index (TWI) for the entire survey area

4.4 PHASE 4: SATELLITE IMAGE INTERPRETATION

The satellite image of the Visserspan No. 3 site and surrounding area (with 5 m contours) is provided in **Figure 6**.

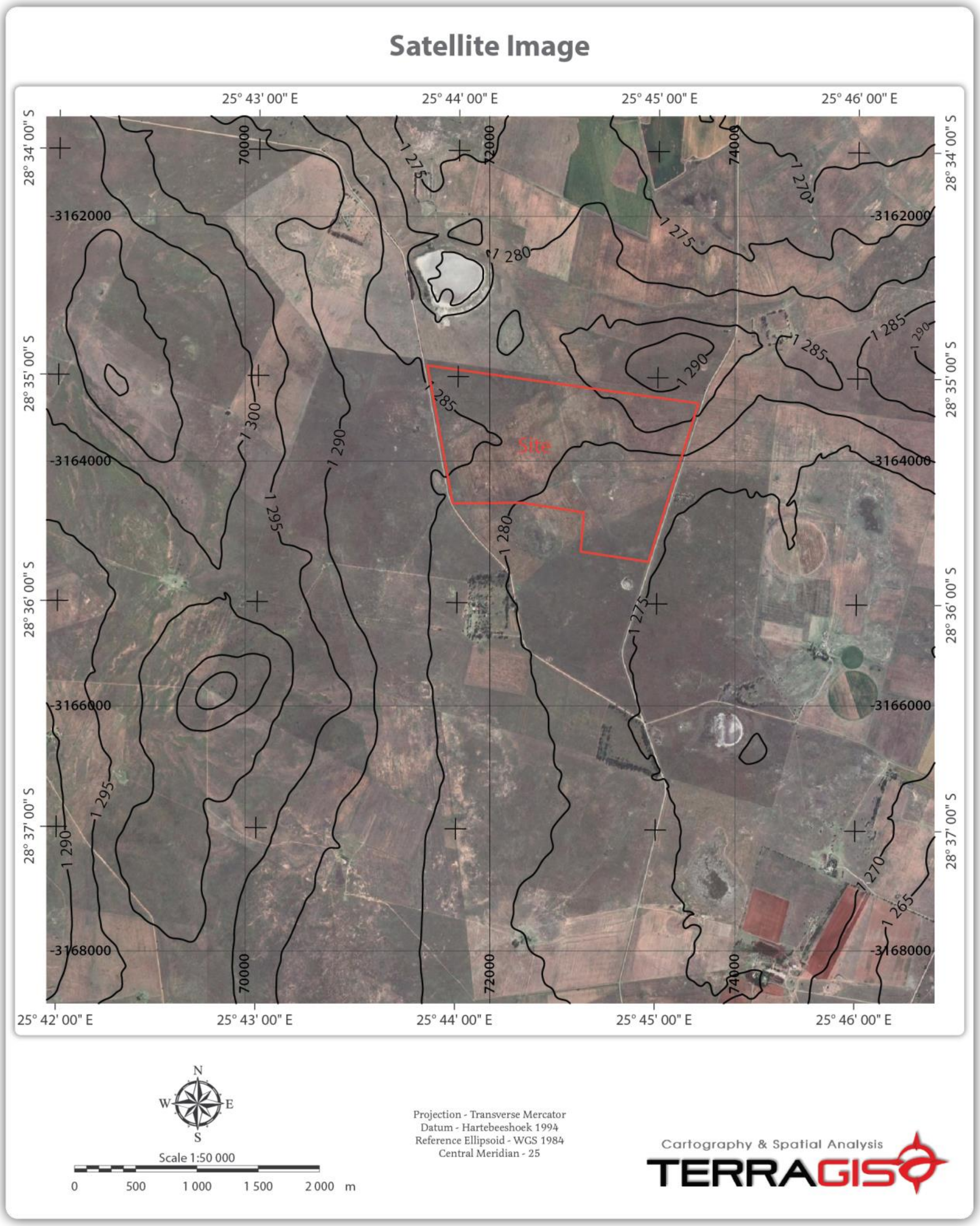

Figure 6 Satellite image of the Visserspan No. 3 site and surrounding area

An additional Google Earth image with a different surface colour is provided in **Figure 7**. This image is provided with an indication of the interpreted geological features. These features are discussed in more detail in section 4.5.

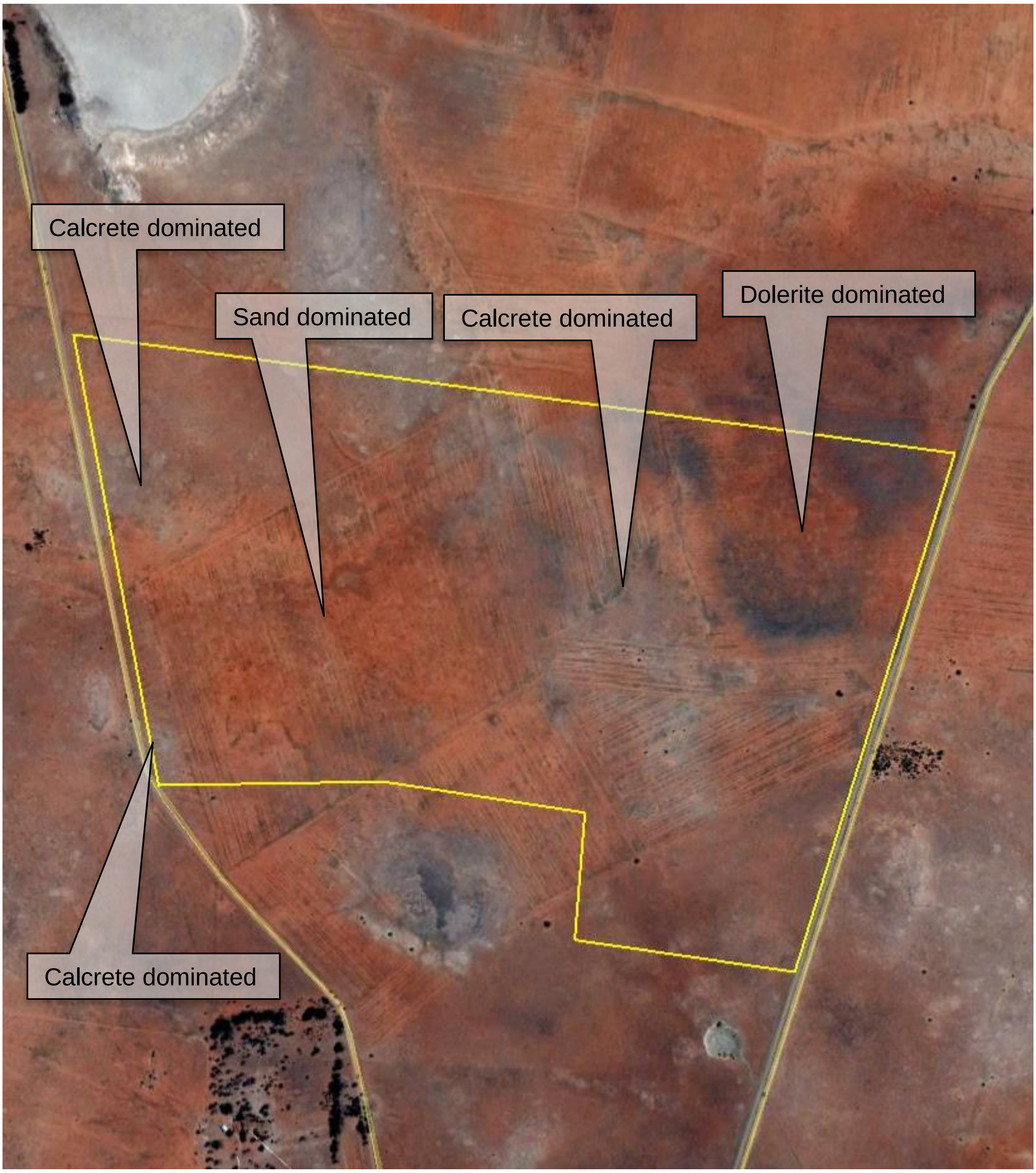

Figure 7 Google Earth image (2016/10/07) of the investigation site with geological features

4.5 PHASE 5: SITE VISIT AND SOIL SURVEY

The soils on the site are predominantly sandy surface horizons overlying calcrete and weathered dolerite. As such the soils vary from moderately deep sandy Hutton (orthic A / red apedal B / unspecified material – usually hard or weathering rock) forms to Glenrosa (orthic A / lithocutanic B) or Mispah (orthic A / hard rock) forms. The patterns are relatively easy to identify on satellite images with bleached and lime containing topsoils indicating shallower soils overlying calcrete.

There is a large section that shows evidence of historical tillage and crop production but that has now been abandoned. This aspect is considered to indicate a general low agricultural potential. The grazing potential can only be assessed based upon more detailed vegetation surveys (not part of this investigation).

5. AGRICULTURAL POTENTIAL

5.1 AGRICULTURAL POTENTIAL OF THE SITE

The agricultural potential of the site is considered to be low due to variable and shallow depth soils as well as the average rainfall that is below 500 mm pa.

5.2 LAND CAPABILITY CLASSIFICATION

The land capability of the landscape is very much determined through the current land use (**Figure 7**). The entire site is classified as VII land capability (as discussed in section 1.3 and **Table 1**).

6. ASSESSMENT OF IMPACT

6.1 ASSESSMENT CRITERIA

The following assessment criteria (**Table 2**) will be used for the impact assessment.

Table 2 Impact Assessment Criteria

CATEGORY	DESCRIPTION OF DEFINITION
Direct, indirect and cumulative impacts	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Nature	A description of the cause of the effect, what will be affected and how it will be affected.
Extent (Scale) • 1 / 2 / 3 / 4 / 5	The area over which the impact will be expressed – ranging from local (1) to regional (5).
Duration • 1 • 2 • 3 • 4 • 5	Indicates what the lifetime of the impact will be. • Very short term: 0 – 1 years • Short-term: 2 – 5 years • Medium-term: 5 – 15 years • Long-term: > 15 years • Permanent

CATEGORY	DESCRIPTION OF DEFINITION
Magnitude • 2 • 4 • 6 • 8 • 10	This is quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
Probability • 1 • 2 • 3 • 4 • 5	Describes the likelihood of an impact actually occurring. • Very Improbable • Improbable • Probable • Highly probable • Definite
Significance	The significance of an impact is determined through a synthesis of all of the above aspects. S = (E + D + M)*P S = Significance weighting E = Extent D = Duration M = Magnitude
Status • Positive • Negative • Neutral	Described as either positive, negative or neutral
Other	• Degree to which the impact can be reversed • Degree to which the impact may cause irreplaceable loss of resources • Degree to which the impact can be mitigated

6.2 List of Activities for the Site

Table 3 lists the anticipated activities for the site. The last two columns in the table list the anticipated forms of soil degradation and geographical distribution of the impacts.

6.3 Assessment of the Impacts of Activities

Many of the impacts are generic and their impacts will remain similar for most areas on the site. The generic activity will therefore be assessed. The impacts associated with the different activities have been assessed below for each activity. These impacts have been summarized in **Table 9**. **Note:** The impacts listed below indicate that no mitigation is possible. It is important to note that any soil impact in the form of drastic physical disturbance (as with construction activities) is a permanent one and no mitigation is possible. The mitigation that can be applied is the restriction of off-site effects due to developments through adequate implementation of environmental management measures (discussed later in the report).

Table 3 List of activities and their associated forms of soil degradation

Activity	Form of Degradation	Geographical Extent	Comment (Section described)
Construction Phase			
Construction of solar panels and stands	Physical degradation (surface)	Two dimensional	Impact small due to localised nature (Section 6.3.1)
Construction of buildings and other infrastructure	Physical degradation (compound)	Two dimensional	(Section 6.3.2)
Construction of roads	Physical degradation (compound)	Two dimensional	(Section 6.3.3)
Construction and Operational Phase Related Effects			
Vehicle operation on site	Physical and chemical degradation (hydrocarbon spills)	Mainly point and one dimensional	(Section 6.3.4)
Dust generation	Physical degradation	Two dimensional	(Section 6.3.5)

6.3.1 Construction of Solar Panels and Stands

Table 4 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Table 4 Construction of solar panels and stands

Criteria	**Description**	
Cumulative Impact	The cumulative impact of this activity will be small as it is constructed on land with low agricultural potential.	
Nature	This activity entails the construction of solar panels and stands with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area	None possible. Limit footprint to the immediate development area

5.3.2 Construction of Buildings and Other Infrastructure

Table 5 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Table 5 Construction of buildings and other infrastructure

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small as it is constructed on land with low agricultural potential.	
Nature	This activity entails the construction of buildings and other infrastructure with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area	None possible. Limit footprint to the immediate development area

6.3.3 Construction of Roads

Table 6 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of roads.

Table 6 Construction of roads

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small as it is linear and limited in geographical extent.	
Nature	This activity entails the construction of roads with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible

6.3.4 Vehicle Operation on Site

It is assumed that vehicle movement will be restricted to the construction site and established roads. Vehicle impacts in this sense are restricted to spillages of lubricants and petroleum products. **Table 7** presents the impact criteria and a description with respect to soils, land capability and land use for the operation of vehicles on the site.

Table 7 Assessment of impact of vehicle operation on site

Criteria	**Description**	
Cumulative Impact	The cumulative impact of this activity will be small if managed.	
Nature	This activity entails the operation of vehicles on site and their associated impacts in terms of spillages of lubricants and petroleum products	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	2 – Short-term	2 – Short-term
Magnitude	2	2
Probability	4	2 (with prevention and mitigation)
Significance of impact	S = (1 + 2 + 2)*4 = 20	S = (1 + 2 + 2)*2 = 10 (with prevention and mitigation)
Status	Negative	Negative
Mitigation	Maintain vehicles, prevent and address spillages	Maintain vehicles, prevent and address spillages

6.3.5 Dust Generation

Generated dust can impact large areas depending on environmental and climatic conditions. **Table 8** presents the impact criteria and a description with respect to soils, land capability and land use for dust generation on the site. For the sake of this assessment contributions of dust generation other than the activities on the site have been ignored.

Table 8 Assessment of impact of dust generation on site

Criteria	**Description**	
Cumulative Impact	The cumulative impact of this activity will be small if managed but can have widespread impacts if ignored.	
Nature	This activity entails the operation of vehicles on site and their associated dust generation	
	Without Mitigation	With Mitigation
Extent	2 - Local: The impact is diffuse (depending on environmental and climatic conditions) and will probably be limited to within 3 – 5 km of the site	2 - Local: The impact is diffuse (depending on environmental and climatic conditions) and will probably be limited to within 3 – 5 km of the site
Duration	2 – Short-term	2 – Short-term
Magnitude	2	2
Probability	4	2 (with mitigation and adequate management)
Significance of impact	S = (2 + 2 + 2)*4 = 24	S = (2 + 2 + 2)*2 = 12 (with mitigation and adequate management)
Status	Negative	Negative
Mitigation	Limit vehicle movement to absolute minimum, implement dust suppression strategies	Limit vehicle movement to absolute minimum, implement dust suppression strategies

Table 9 Summary of the impact of the development on agricultural potential and land capability

Nature of Impact	*Loss of agricultural potential and land capability owing to the development*	
	Without mitigation	With mitigation
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (2)	Low (2)
Probability	Highly probable (4)	Highly probable (4)
Significance*	32 (Low)	32 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	No
Mitigation: The loss of agricultural land is a long-term loss and there are no mitigation measures that can be put in place to combat this loss.		
Cumulative impacts: Soil erosion may arise owing to increased surface water runoff. Adequate management and erosion control measures should be implemented.		
Residual Impacts: The loss of agricultural land is a long-term loss. This loss extends to the post-construction phase. The agricultural potential is very low though.		

6.4 ENVIRONMENTAL MANAGEMENT PLAN

Tables 10 to **12** provide the critical aspects for inclusion in the EMP.

Table 10 Measures for erosion mitigation and control

Objective: Erosion control and mitigation		
Project components	Soil stabilisation, construction of impoundments and erosion mitigation structures	
Potential Impact	Large scale erosion and sediment generation	
Activity / risk source	Poor planning of rainfall surface runoff and storm water management	
Mitigation: Target / Objective	Prevention of eroded materials and silt rich water running off the site	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Plan and implement adequate erosion control measures	Construction team and engineer	Throughout project
Performance indicator	Assessment of storm water structures and erosion mitigation measures. Measurement of actual erosion and sediment generation.	
Monitoring	Monitor and measure sediment generation and erosion damage	

Table 11 Measures for limiting vehicle operation impacts on site (spillages)

Objective: Erosion control and mitigation		
Project components	Maintenance of vehicles and planning of vehicle service areas	
Potential Impact	Oil, fuel and other hydrocarbon pollution	
Activity / risk source	Poor maintenance of vehicles and poor control over service areas	
Mitigation: Target / Objective	Adequate maintenance and control over service areas	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Service vehicles adequately	Construction team and engineer	Throughout project
Maintenance of service areas, regular cleanup	Construction team and engineer	Throughout project
Performance indicator	Assessment number and extent of spillages on a regular basis.	
Monitoring	Monitor construction and service sites	

Table 12 Measures for limiting dust generation on site

Objective: Dust generation suppression		
Project components	Limit and address dust generation on site linked to construction activities	
Potential Impact	Large scale dust generation on site	
Activity / risk source	Inadequate dust control measures, excessive vehicle movement on unpaved roads	
Mitigation: Target / Objective	Minimise generation of dust	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Implement dust control strategies suitable for the site conditions	Construction team and engineer	Throughout project
Limit vehicle movement on unpaved areas to the absolute minimum	Construction team and engineer	Throughout project
Performance indicator	Assessment of dust generated on site	
Monitoring	Monitor construction site and surrounds	

7. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development of a photovoltaic facility on the site will not have large impacts due to the low agricultural potential of the site as well as the rainfall that is below 500 mm pa.

Even though the soils on the site are not considered to be highly sensitive to erosion such prevention measures should be put in place due to the general slope of the site. The main impacts that have to be managed on the site during the construction activities are:

1. Erosion must be controlled through adequate mitigation and control structures.
2. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated.
3. Dust generation on site should be mitigated and minimised as the dust can negatively affect the quality of grazing as well as livestock production.

The impacts on the site need to be viewed in relation to the opencast mining of coal in areas of high potential soils – such as the Eastern Highveld. With this comparison in mind the impact of a solar energy facility is negligible compared to the damaging impacts of coal mining – for a similar energy output. Therefore, in perspective, the impacts of the proposed facility can be motivated as necessary in decreasing the impacts in areas where agriculture potential plays a more significant role.

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