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# BRIEF GEOTECHNICAL STUDY FOR PROPOSED TSHEPO SOLAR POWER PLANT NEAR HOTAZEL NORTHERN CAPE PROVINCE

**Report by**
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# 1 INTRODUCTION

Development of Tshepo Solar Power Plant is proposed on the Remaining Extent of the Farm London No. 275, approximately 9 kilometres south east of the town of Hotazel (see Figure 1). The facility will deliver a total capacity of 100MW, with maximum 115MW installed. It will consist of arrays of photovoltaic panels supported by mounting structures, inverter stations, internal access roads, cabling, fencing, an on-site substation with a 132kv connection to the Eskom grid, and a building for a workshop, storage, and offices. The footprint of the energy facility will utilise up to 290 hectares, of the total farm portion of 2,270 hectares.

The objectives of the study are to briefly describe geotechnical site conditions.

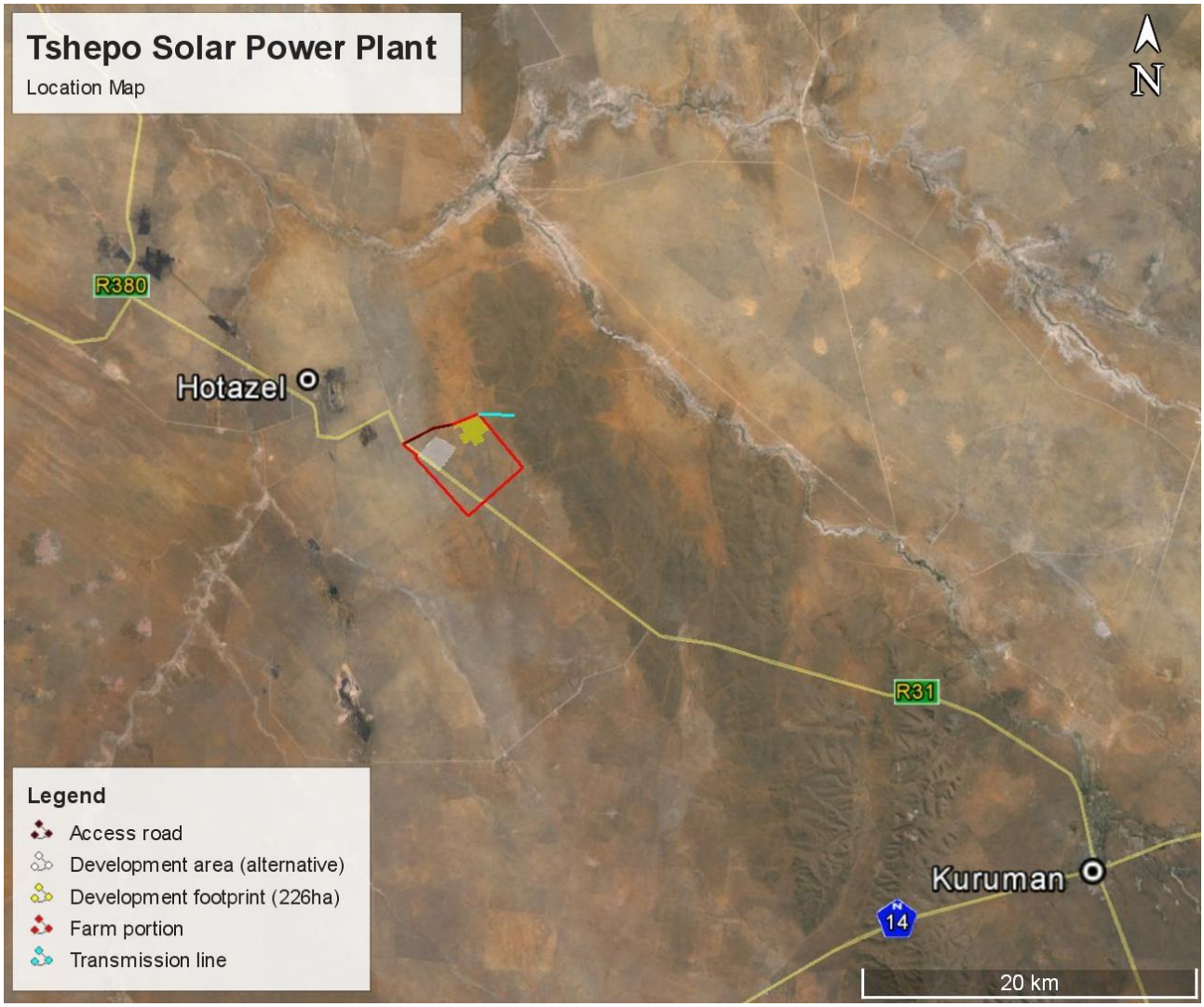


***Figure 1.*** *Location map of the proposed site, south east of the town of Hotazel.*

## 2 TERMS OF REFERENCE

The geotechnical assessment is based on geological maps and the walk-over inspection of the site. The following terms of reference apply to the geotechnical assessment:

- Verify the underlying geology and soil cover by means of limited surface mapping.
- Assessing the suitability of the area with regard to the proposed development, based on the available geological- and geotechnical information.
- Identify the general constraints and required precautionary measures that may be required for the proposed development from a planning perspective.
- Make recommendations on the most- , intermediately- and least suitable portions of the project area with regard to the proposed development.

## 3 METHODOLOGY OF STUDY

### 3.1 Methodology for assessing soils and agricultural potential

The assessment was based largely on existing soil and agricultural potential data for the site. The source of this data was the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, undated). Satellite imagery of the site available on Google Earth was also used for evaluation.

The AGIS data was supplemented by a field investigation. This was aimed at ground-proofing the AGIS data and achieving an understanding of specific soil and agricultural conditions, and the variation of these across the site. The field investigation involved a drive and walk over of the site using assessment of surface conditions and existing cuttings / excavations. The field assessment was done on 2 April 2016.

Soils were classified according to the South African soil classification system (Soil Classification Working Group, 1991).

The field investigation also included a visual assessment of erosion and erosion potential on site, taking into account the proposed development layout.

Consultation was done with the current farmer of the land, Mr Hendrik Venter, to get details of farming activities.

## 4 CONSTRAINTS AND LIMITATIONS OF STUDY

Data on the spatial distribution of soil types is dependent on the resolution of sampling points. Investigations for different purposes will use different resolutions. These will record the degree of soil variation that occurs naturally, at different levels of accuracy. The intensity of sample points used in this assessment suited the investigation of agricultural potential. However it has limitations in terms of characterising the spatial distribution of variation in geotechnical

conditions across the site. In addition, the limited depth of the investigation means that deeper, subsurface layers were not necessarily identified and described in any detail.

With the level of field investigation undertaken, it is only possible to provide a characterisation of the likely geotechnical conditions. These have not been ground proven in any detail.

There are no other specific constraints, uncertainties and gaps in knowledge for this study.

# 5 DESCRIPTION OF THE SOILS AND AGRICULTURAL CAPABILITY OF THE AFFECTED ENVIRONMENT

## 5.1 Climate and water availability

Rainfall for the site is given as 343 mm per annum (The World Bank Climate Change Knowledge Portal, undated). The average monthly distribution of rainfall is shown in Figure 2. One of the most important climate parameter for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. Moisture availability is classified into 6 categories across the country (see Table 2). The site falls into the second driest 5th category, which is labelled as a severe limitation to agriculture.

There are wind pumps across the farm. These are used for stock watering. The farm does not have access to water for irrigation.

**Table 2.** The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

| Climate class | Moisture availability (Rainfall/0.25 PET) | Description of agricultural limitation |
|---|---|---|
| C1 | >34 | None to slight |
| C2 | 27-34 | Slight |
| C3 | 19-26 | Moderate |
| C4 | 12-18 | Moderate to severe |
| C5 | 6-12 | Severe |
| C6 | <6 | Very severe |

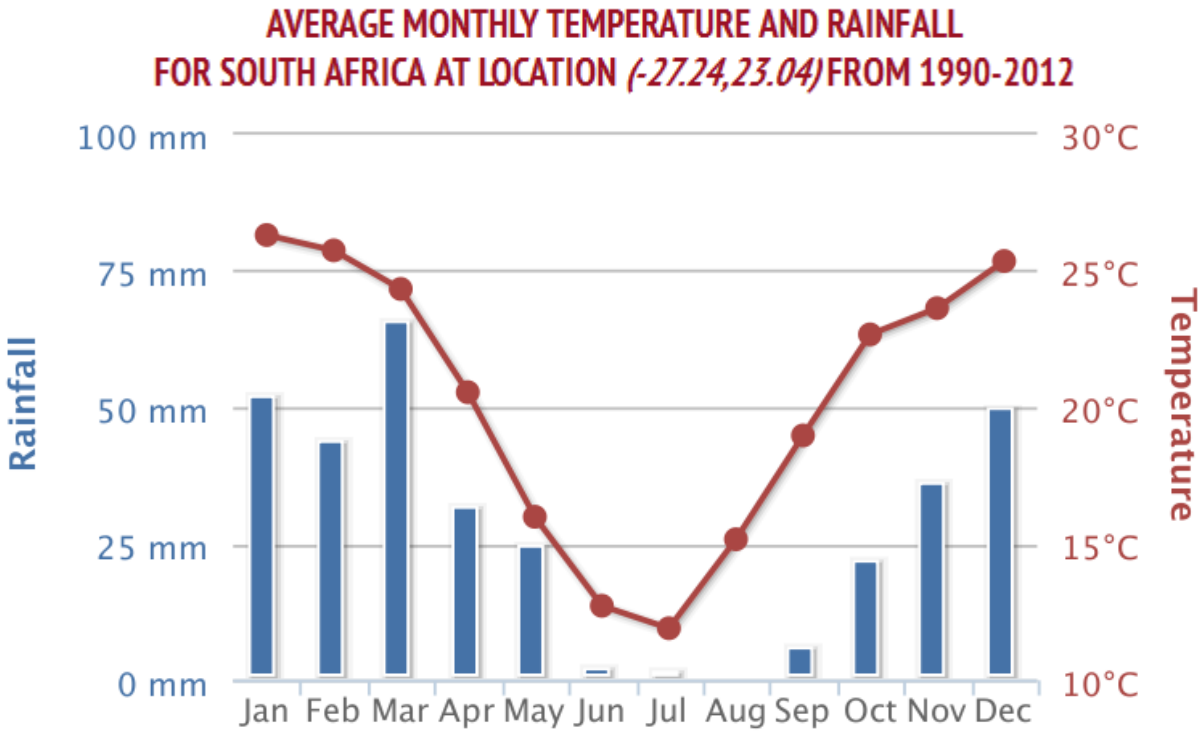


***Figure 2.*** *Average monthly temperature and rainfall for the site (The World Bank Climate Change Knowledge Portal, undated).*

### 5.2 Terrain, topography and drainage

The proposed development is located on a terrain unit of level plains at an altitude of around 1,100 meters. Slope is less than 1% across the site. A satellite image map of the site is shown in Figure 3. Access roads and grid connections are shown in Figure 4. Photographs of site conditions are shown in Figures 5 and 6.

The geology is red wind-blown sand and surface limestone of Tertiary to Recent age. Some outcrops of banded ironstone, jaspillite and crocidolite (Asbestos Hills Formation) and fine and coarse-grained dolomite, chert and dolomitic limestone (Ghaap Plateau Formation) also occurs.

There are no water courses on or near the site. There is a wetland adjacent to the western boundary of the site, but this has been purposefully excluded from the site.

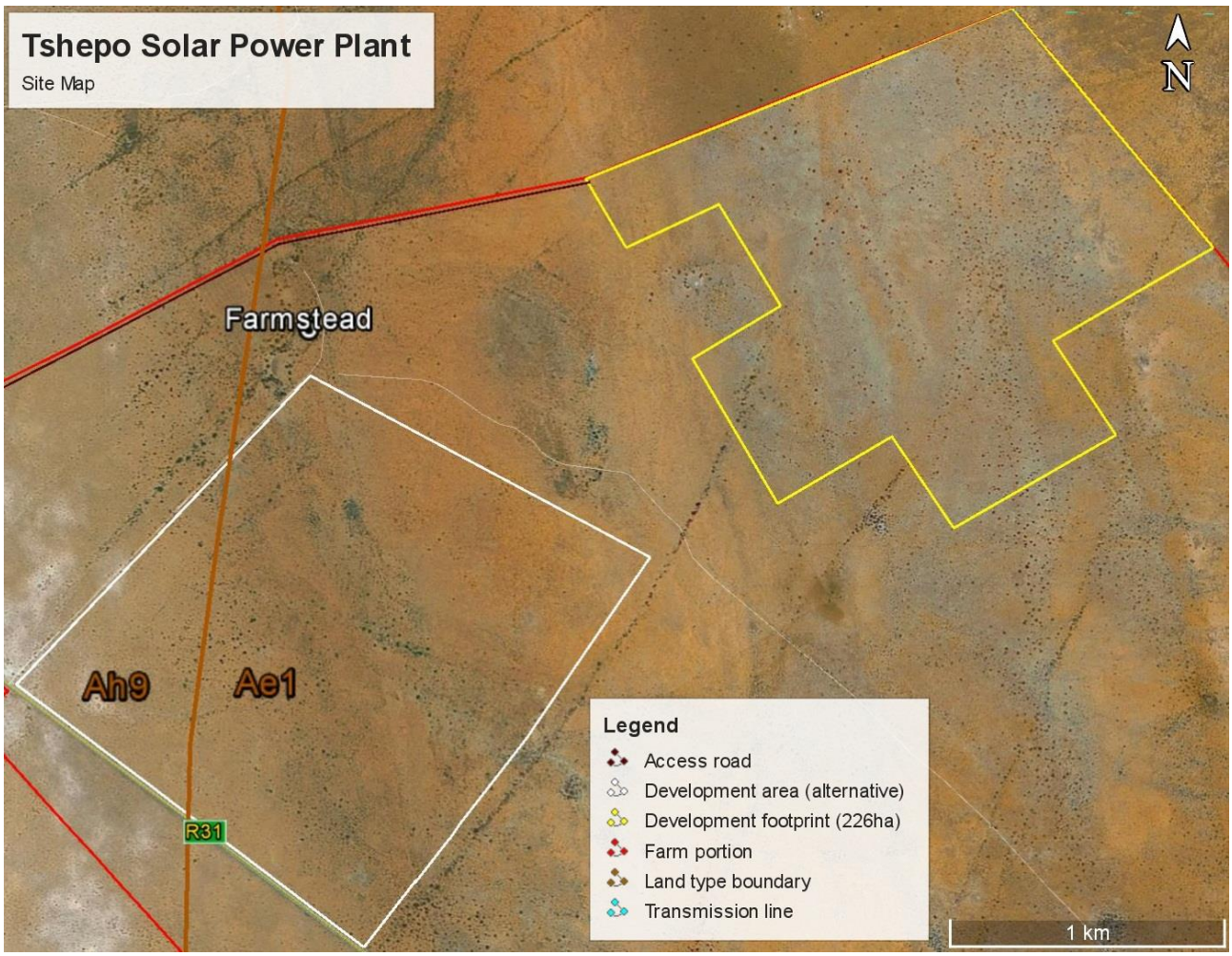


***Figure 3.*** *Satellite image of the proposed site.*

### 5.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climate conditions into different land types. There are two land types across the site, namely Ah9 in the west and Ae1 in the east. Soils of both land types are very similar and are predominantly deep, well-drained, very sandy red and yellow soils of the Hutton and Clovelly soil forms, although some shallower soils on underlying rock and hardpan occur in land type Ae1. The soils fall into the Oxidic soil group according to the classification of Fey (2010). A summary detailing soil data for the land type is provided in Appendix 1, Table A1. The field investigation confirmed that the site comprises predominantly red sands, but there is evidence of shallow underlying rock and outcrops in places (see Figure 5).

The soils are classified as having low to moderate susceptibility to water erosion (class 5), but because of their sandy texture are classified as highly susceptible (class 1a) to wind erosion.

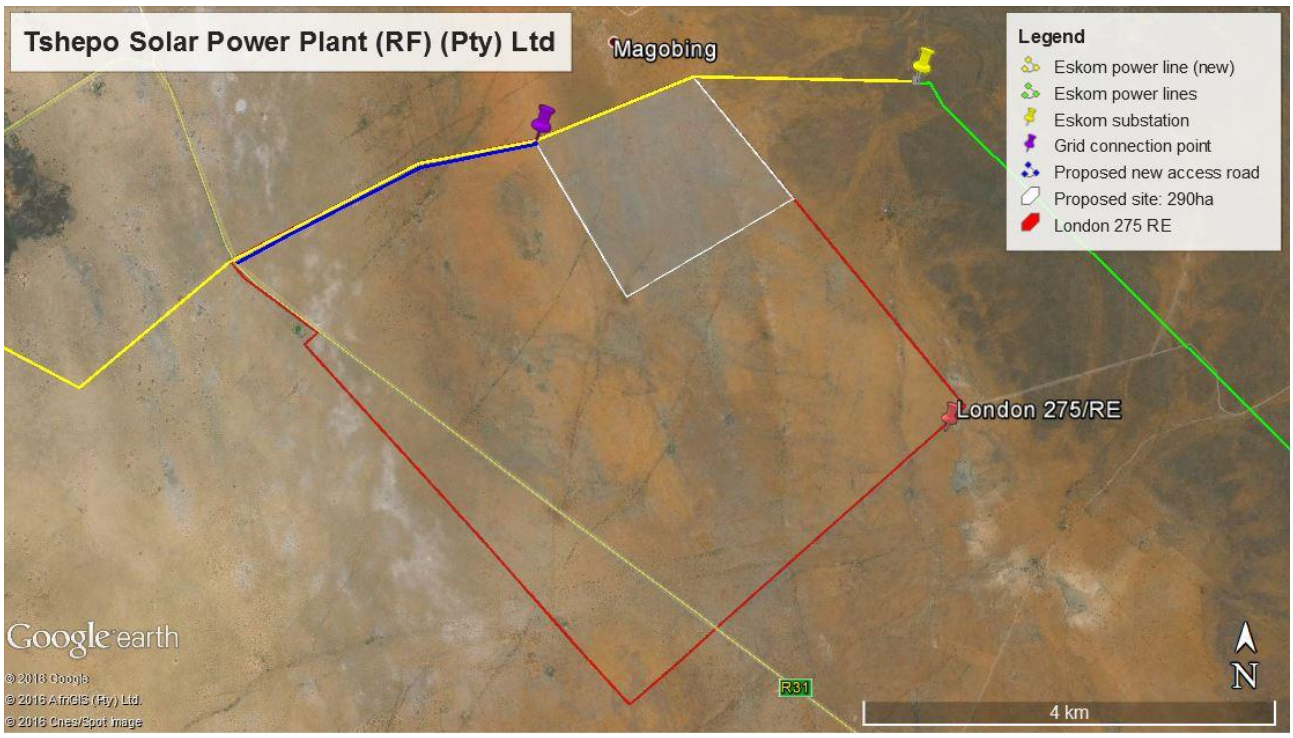


***Figure 4.*** *Access route and preferred power line.*

***Figure 5.*** *View of typical conditions across the site, showing the predominant deep, red sands.*

***Figure 6.*** *View of typical conditions across the site, showing overlying red sands with rock outcrops.*

### 5.4 Agricultural capability

Land capability is the combination of soil suitability and climate factors. The site and surrounds has a land capability classification, on the 8 category scale, of Class 7 – non-arable, low potential grazing land.

The limitations to agriculture are predominantly climate related. The moisture availability class 5 classification, with high variability of rainfall is a very severe limitation to agriculture, which makes any cultivation without irrigation completely non-viable. The very sandy soils, with very limited water holding capacity are a further limitation. The grazing capacity on AGIS is classified as 18-21 hectares per large stock unit.

### 5.5 Land use and development on and surrounding the site

The farm is located within a cattle farming agricultural region and currently used only for grazing. There has never been any cultivation on the farm.

There are no buildings on the site. The only agricultural infrastructure on the site is fencing into grazing camps. There are wind pumps, stock watering points and a farmstead elsewhere on the farm.

Road access to the site is off the tarred R31 by way of a new access road.

### 5.6 Status of the land

The biome classification for the site is Kathu Bushveld and Kuruman Thornveld. The vegetation is grazed and sparse due to low rainfall, but there is no evidence of significant erosion or other land degradation on the site.

### 5.7 Possible land use options for the site

Because of predominantly the climate limitations, the site is totally unsuitable for cultivated crops, and viable agricultural land use is limited to grazing only.

### 5.8 Agricultural sensitivity

Agricultural conditions and potential are uniform across the site and the choice of placement of infrastructure therefore has no influence on the significance of agricultural impacts. No agriculturally sensitive areas occur within the investigated site and no parts of it therefore need to be avoided by the development. There are no required buffers.

## 6 BRIEF GEOTECHNICAL ASSESSMENT

Factors relevant to a geotechnical description of the site have been discussed in sections 5.1 to 5.6, above. Some aspects are highlighted here for geotechnical purposes.

The site predominantly comprises deep, largely unconsolidated, red sands, but there is evidence of hard, shallow underlying rock and outcrops in places. The depth of the rock below surface across most of the site is unknown, but from the land type data it can be estimated to be between 60 and 150cm across much of the site.

The foundations for mounting structures will need to be erected in sand, but may also need to go into hard underlying rock in places.

None of the following occur on the site:

- Shallow water table (less than 1.5m deep)
- Sinkhole or doline areas.
- Seasonally wet soils (often close to water bodies) Note that there is a wetland adjacent to the western boundary of the site, but this has been purposefully excluded from the site.
- Unstable rocky slopes or steep slopes with loose soil
- Dispersive soils (soils that dissolve in water)
- Soils with high clay content (clay fraction more than 40%)
- Any other unstable soil or geological feature

Soils across the site are susceptible to wind erosion.

The geotechnical conditions are assessed, in terms of this investigation, as suitable for the development of a solar energy facility. Because soil conditions are fairly uniform across the site, there are no more and less suitable parts of the project area for development.

## 7 REFERENCES

Agricultural Research Council. Undated. AGIS Agricultural Geo-Referenced Information System available at http://www.agis.agric.za/.

Fey, M. 2010. Soils of South Africa. Cambridge University Press, Cape Town.

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal available at http://sdwebx.worldbank.org/climateportal/

## APPENDIX 1: SOIL DATA

**Table A1.** Land type soil data for site.

| Land type | Land capability class | Soil series (forms) | Depth (cm) | Clay % A horizon | Clay % B horizon | Depth limiting layer | % of land type |
|---|---|---|---|---|---|---|---|
| Ah9 | 7 | Clovelly | >120 | 2-4 | 3-6 | | 40 |
| | | Hutton | >120 | 3-6 | 6-10 | | 17 |
| | | Clovelly | >120 | 3-6 | 6-10 | | 17 |
| | | Hutton | >120 | 2-4 | 3-6 | | 11 |
| | | Clovelly | >120 | 2-4 | 3-6 | | 8 |
| | | Mispah | 10-25 | 6-10 | | R, ca | 4 |
| | | Fernwood | >120 | 3-6 | 4-8 | | 3 |
| Ae1 | 7 | Hutton | 75->120 | 2-6 | 4-9 | R, ca | 44 |
| | | Hutton | 60-120 | 2-6 | 4-10 | R, ca | 29 |
| | | Hutton | 10-40 | 2-6 | 4-9 | R, ca | 8 |
| | | Mispah | 10-25 | 2-10 | | ca | 6 |
| | | Hutton | 10-35 | 2-6 | 4-10 | R, ca | 4 |
| | | Rock outcrop | 0 | | | R | 4 |

Land capability classes: 7 = non-arable, low potential grazing land.

Depth limiting layers: R = hard rock; ca = hardpan carbonate.