REPORT

On contract research for

Mokgope Consulting

ESKOM 765 KV
NORTHERN ALIGNMENT PROJECT:

SOILS AND AGRICULTURAL POTENTIAL
FOR HELIOS-ARIES SECTION,
NORTHERN CAPE PROVINCE

By

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1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by Mokgope Consulting to undertake an investigation of the soils and associated agricultural potential for a proposed transmission line ("Northern Alignment") between the Juno substation, near Vredendal (Western Cape), across the Northern Cape to the Perseus substation, near Dealesville (Free State Province).

The objectives of the study are;

- To classify the soils and to produce a soil map of the specified area
- To assess the broad agricultural potential
- Site-specific surveys and analysis (classification and ranking of impacts per alternative).

The route is divided into four sections. This report deals with the section between the **Helios substation** (north of Loeriesfontein) and the **Aries substation**, south of Kenhardt (Northern Cape Province), shown in Figure 1.

There are three different alternatives within this Section, namely the ***northernmost Alternative 1*** (shown in blue), the ***central Alternative 2*** (shown in pink) and the ***southernmost Alternative 3*** (shown in green). The relative positions of the three Alternatives are shown below in Figure 1.

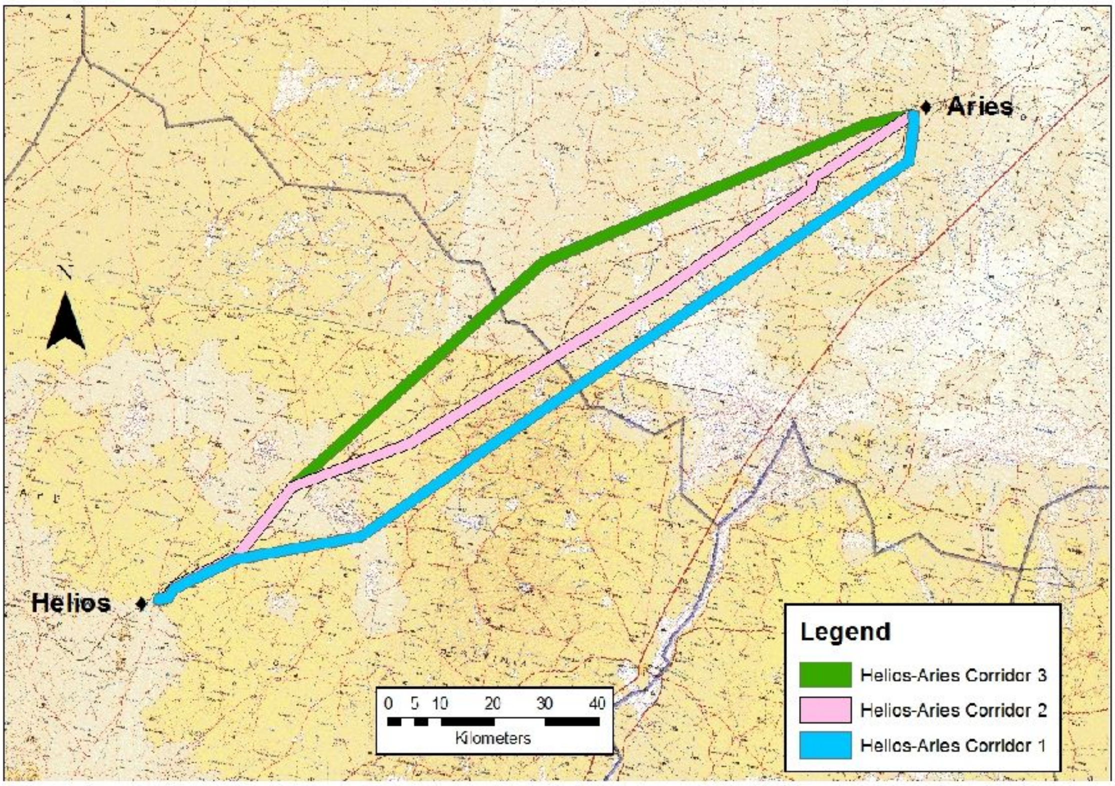

Figure 1 Juno-Helios Section: Alternatives

2. STUDY AREA CHARACTERISTICS

2.1 Terrain

The corridor crosses generally flat to slightly undulating terrain, with virtually no areas of steeper topography. The altitude varies between 850 and 950 metres above sea level. There are no large rivers or perennial streams along the route, but several broad pans, or "vloere", occur.

2.2 Climate

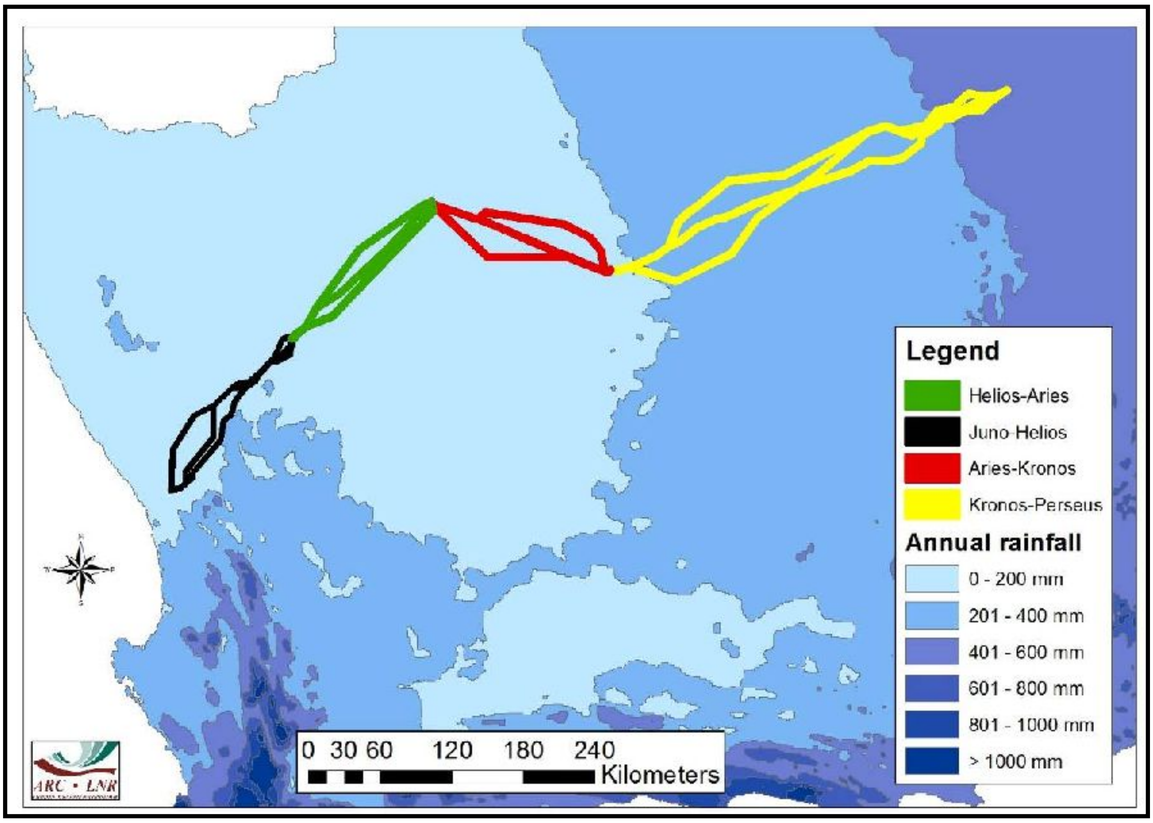

Figure 2 Rainfall map of Northern Alignment route

The climate of the **Helios-Aries section** (shown in **green** in Figure 2), can be classified as dry, with hot summers and cool, occasionally cold winters. On the map it can be seen that the long-term average rainfall is very low, less than 200 mm per annum.

Temperatures show little variation. The figures vary between an average monthly maximum and minimum of 27-31 ºC and 13-15 ºC for January and 5-10 ºC and 20-24 ^{o}C for July respectively, with annual evaporation figures of between 2 000 and 2 400 mm per year (ARC-ISCW, 2012).

Frost will occur in winter throughout the area, especially as the altitude increases.

2.3 Parent Material

The parent material of the Helios-Aries area (Geological Survey, 1984) largely comprises of shale of the Prince Albert and Tierberg Formations, along with dolerite intrusions in places.

3. METHODOLOGY

ArcGIS shape files of the route alternatives were provided, and a buffer zone, 5 km outside all of the routes, was created to represent the study area.

The area is covered mainly by the national land type survey (Land Type Survey Staff, 1972-2002). The soils were classified (MacVicar *et al*, 1977) and the soils were grouped into map units, called **land types**. Each land type is a unique combination of soil pattern, terrain and macroclimate.

This information was digitised in ArcGIS and the land type boundaries are shown on the map in the Appendix.

4. SOILS

The information contained in the land type survey is of a reconnaissance nature (1:250 000 scale) and as such can only represent the dominant soils within a specific land type. It is to be expected that areas of different soils will occur, but due to the nature and scale of the survey, they can not be delineated in detail.

Due to the prevailing climatic restrictions (Section 2.2), the various land type mapping units occurring within the study area were grouped by their overall broad soil pattern. The general soil characteristics are given in Table 1 below (the colours correspond to the map units on the map in the Appendix).

The soils were classified according to MacVicar *et al.* (1977).

Table 1 Broad soil patterns occurring in the Juno-Helios section of the Northern Alignment route

Broad Soil Pattern	**Description and main soil characteristics**	**Dominant soil forms**	**Dominant soil potential**
Ae	Red, freely-drained, mostly structureless soils, not highly weathered, often calcareous. Depth will vary from shallow (<300 mm) to deep (>1200 mm). Some surface rock/calcreete may occur in places	Hutton, Mispah	Low to high (depth dependent)
Ag	Red, freely-drained, mostly structureless soils, not highly weathered, usually calcareous. Depth is diagnostic dominantly shallow (<300 mm). Some surface rock/calcrete/dorbank may occur in places, occasionally plentiful.	Hutton, Mispah	Low (shallow depth)
Ah	Red and yellow, freely-drained, mostly structureless soils, not highly weathered, often calcareous. Depth is usually at least moderately deep (>800 mm). Soil texture is diagnostic sandy (<15% clay).	Hutton, Clovelly	Moderate (sandy texture, very free drainage)
Ai	Yellow, freely-drained, mostly structureless soils, not highly weathered, often calcareous. Depth is usually at least moderately deep (>800 mm). Soil texture is diagnostic sandy (<15% clay).	Clovelly	Moderate (sandy texture, very free drainage)
Fc	Mixed soil pattern, usually shallow (<450 mm), with regular lime throughout the landscape. Surface stones and rock outcrops may occur extensively in places. Soil texture and colour will vary, usually reddish-brown, sandy/loamy soils.	Mispah, Glenrosa, Hutton	Low (shallow, often stony)
Ia	Deep alluvial deposits, usually in low-lying positions, including river floodplains. Soil textures and colours will vary (dependant on depositional mechanisms), but soils are often saline and/or sodic.	Oakleaf, Valsrivier, Swartland	Low to moderate (often saline)
Ib	Much surface rock outcrops (diagnostic >60% of the landscape). Terrain is often steeper than surrounding areas, with shallow (<300 mm) soils, usually reddish-brown, not highly weathered, sandy/loamy.	Mispah, Glenrosa, Hutton	Very low (rock with shallow soils)

From the table above and the map in Appendix 1, it can be observed that the majority of the routes in this section cross Fc soil patterns, with only small areas of Ae (in the south), Ah and Ai (in the south and north). Therefore, the majority of the soils will be shallow, with areas of rock.

5. AGRICULTURAL POTENTIAL

Most of the soils in the area are shallow, with only limited zones with deeper soils. However, despite potentially favourable soils for cultivation occurring in places, the over-riding restriction is the climatic limitation of the low rainfall and high evaporative loss from the soil surface (Section 2.2). This means that the only potential means of cultivation is by irrigation, and the soils and potential irrigation water are likely to be somewhat saline.

5.1 Alternative 1 (Southern)

This alternative crosses mainly shallow soils. The only soil patterns where deeper soils might be expected would be the **Ae, Ah** and **Ih** zones, which occur as small areas at the southern (**Ae** and **Ai**) and northern (**Ah**) end. No significant areas of cultivation (especially irrigation) occur.

5.2 Alternative 2 (Central)

This alternative also crosses mainly shallow soils. The only soil patterns where deeper soils might be expected would be the **Ae, Ah** and **Ai** zones, which occur as small areas at the southern (**Ae** and **Ai**) and northern (**Ah**) end. No significant areas of cultivation (especially irrigation) occur.

5.3 Alternative 3 (Northern)

This alternative also crosses mainly shallow soils. The only soil patterns where deeper soils might be expected would be the **Ae, Ah** and **Ia** zones, which occur as small areas at the southern (**Ae**) and northern (**Ah**) end. No significant areas of cultivation (especially irrigation) occur.

The dryland (rain-fed) agricultural potential of the whole study area is thus very low. The impact of a transmission line (with a comparatively small footprint) will be comparatively small.

6. IMPACTS

There will be two main possible impacts.

Firstly, the loss of agricultural soil due to the construction of the transmission line (mainly the pylon sites), as well as a parallel adjacent access road.

Mitigation: avoid, wherever possible, any areas of cultivation, especially areas under irrigation, such as alongside streams/rivers.

The second potential impact will be the possibility of increased soil erosion due to the loss of surface vegetation and the exposure of bare soil at the surface, again caused by construction activities. This could take the form of removal by <u>*wind erosion*</u> (especially in areas where the topsoil texture is fine and sandy) or by <u>*water erosion*</u> (this will be limited to stream beds and watercourses, but such flash flooding events, though rare, may be severe).

Mitigation: ensure that:-

- the minimum amount of vegetation is removed;
- great care is taken where the transmission line crosses any stream or river course, so that damage to the river banks or adjacent areas is not caused.
- that all possible soil conservation measures (culverts, run-off channels etc) are implemented in the construction of access roads (especially in sloping areas;

- regular monitoring of pylon sites and access roads is done to ensure no worsening of soil erosion.

The impacts can be summarized as follows:

Table 2.1 Helios-Aries Section: Route Alternative 1

Impact		Status	Magnitude	Reversibility	Extent	Duration	Probability	Significance
Loss of agricultural soil	No Mitigation	-1	3	3	1	4	3	**-33**
	With Mitigation	-1	2	3	1	4	2	**-20**
Increased soil erosion	No Mitigation	-1	3	3	1	4	3	**-33**
	With Mitigation	-1	2	2	1	3	2	**-16**

Table 2.2 Helios-Aries Section: Route Alternative 2

Impact		Status	Magnitude	Reversibility	Extent	Duration	Probability	Significance
Loss of agricultural soil	No Mitigation	-1	3	3	1	4	3	**-33**
	With Mitigation	-1	2	3	1	4	2	**-20**
Increased soil erosion	No Mitigation	-1	3	3	1	4	3	**-33**
	With Mitigation	-1	2	2	1	3	2	**-16**

Table 2.3 Helios-Aries Section: Route Alternative 3

Impact		Status	Magnitude	Reversibility	Extent	Duration	Probability	Significance
Loss of agricultural soil	No Mitigation	-1	3	3	1	4	3	**-33**
	With Mitigation	-1	2	3	1	4	2	**-20**
Increased soil erosion	No Mitigation	-1	3	3	1	4	3	**-33**
	With Mitigation	-1	2	2	1	3	2	**-16**

Significance = Status x (Magnitude + Reversibility + Extent + Duration) x Probability

From the information contained in Table 2, as well as the Soil Map (Appendix), it can be seen that for most of the corridor, the three alternative routes cross similar soil patterns. There is therefore little to choose between the three alternatives as far as soils and agricultural potential is concerned.

The conclusion is therefore:

Recommended: Route Alternative 1, 2 or 3 (equally)

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ARC-ISCW, 2012. Agroclimatology database. Agricultural Research Council-Institute for Soil, Climate and Water, Pretoria

Geological Survey, 1984. 1: 1 million scale geological map of South Africa. Department of Mineral and Energy Affairs, Pretoria.

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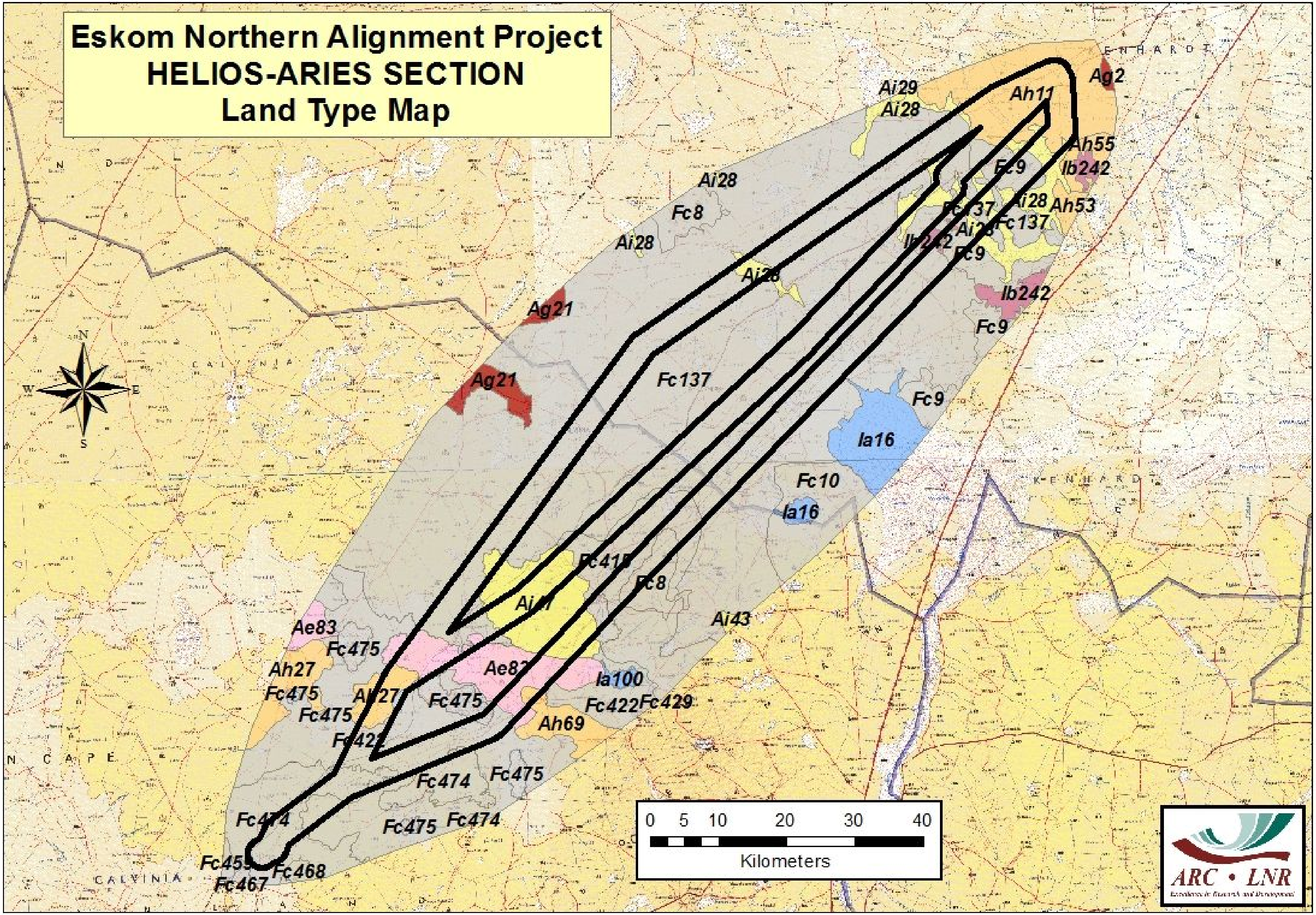
MacVicar, C.N., De Villiers, J.M., Loxton, R.F., Verster, E., Lambrechts, J.J.N., Merryweather, F.R., Le Roux, J., Van Rooyen, T.H. & Harmse, H.J. von M., 1977. Soil classification. A binomial system for South Africa. Dept Agricultural Technical Services, Pretoria.

APPENDIX:

LAND TYPE MAP



Eskom Northern Alignment Project
HELIOS-ARIES SECTION
Land Type Map
Ai29
Ai28
Ah11
Ag2
Ah55
Ib242
Fc9
Ai28
Ah53
Fc137
Ib242
Fc8
Ai28
Ag21
Ib242
Fc9
Ag21
Fc137
Fc9
Ia16
Fc10
Ia16
Fc8
Ai43
Ae83
Fc475
Ah27
Fc475
Fc475
Ae83
Ia100
Fc475
Fc422
Fc429
Ah69
Fc474
Fc475
Fc475
Fc474
Fc468
Fc467
0 5 10 20 30 40
Kilometers
ARC • LNR