REPORT

On contract research for
Nsovo Environmental Consulting (Pty) Ltd

SOIL INFORMATION FOR PROPOSED 400 kV MAPHUTHA-WITKOP TRANSMISSION LINE, LIMPOPO PROVINCE

By

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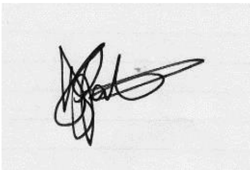
Declaration:

I declare that the author of this study is a qualified, registered natural scientist (soil science), is independent of any of the parties involved and has no other conflicting interests.



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1 INTRODUCTION

The ARC-Institute for Soil, Climate and Water was requested by Nsovo Environmental Consulting to carry out an investigation of the soils and agricultural potential for a proposed 400 kV transmission line in Limpopo Province.

2 STUDY AREA

The proposed route runs from the existing Witkop substation, near Polokwane, south-eastward to the Maphatha substation, near Tubatse on the Steelpoort River. Three alternative routes are under consideration, as shown in Figure 1. Alternative 1, shown in blue, largely follows the main Burgersfort-Polokwane road, while Alternative 2, shown in red, takes a shorter, more direct route. Alternative 3, shown in purple, covers two shorter deviations at the northern and southern ends of the route.

One deviation from the original Alternative 1 route has been adde, to avoid the Potlake Nature Reserve.

Each route has a 1.5 km buffer on each side.

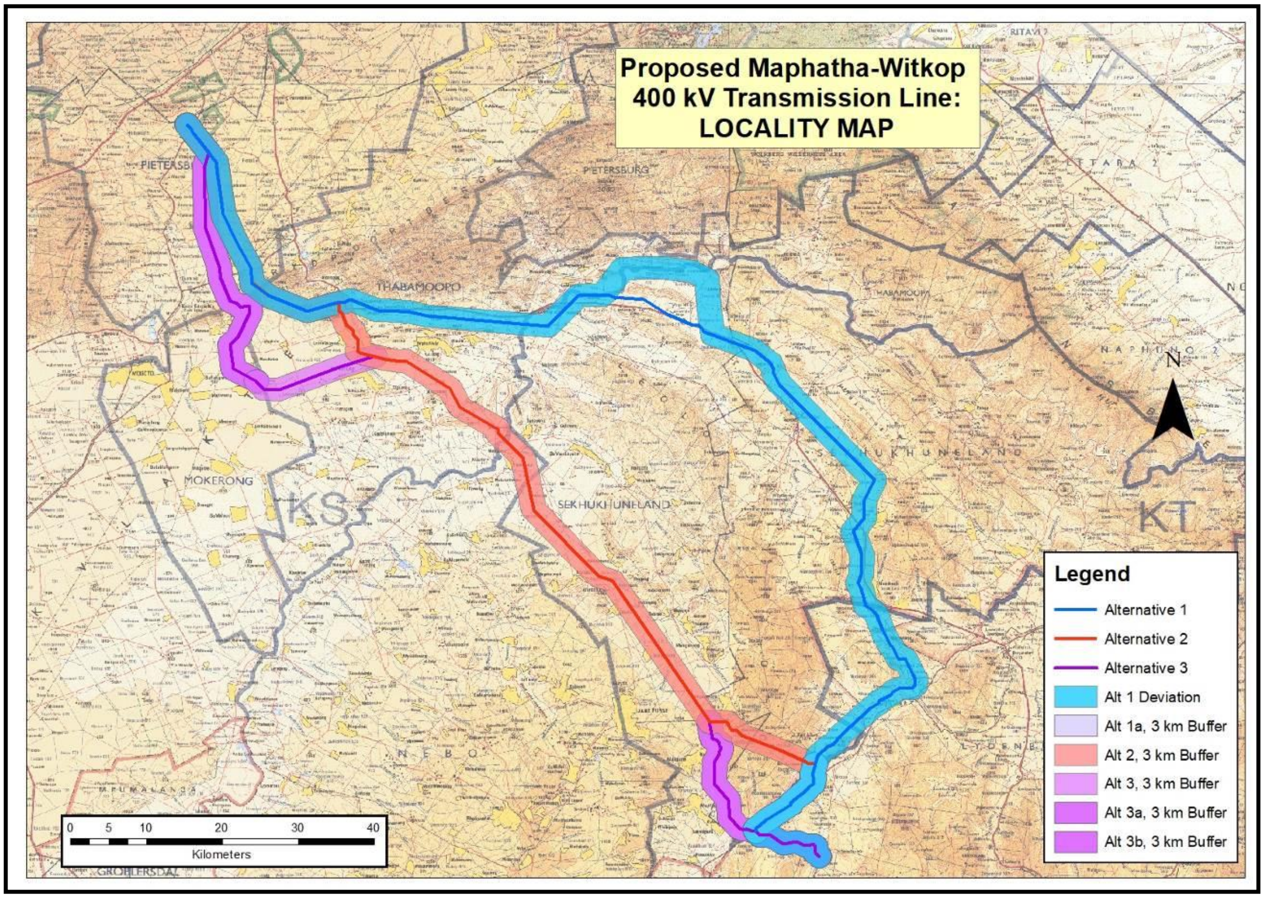

Figure 1 Locality map of the approved route

2.1 Terrain

The terrain within the study area varies greatly. Parts of the area in the south-east and north consists of steep ridges, with slopes exceeding 100% (45^o) in many places. However, most of the middle part of the route follows drainage valleys, which are relatively flat (Alternative 1), or the broad Sekhukhune plain (Alternatives 2 and 3), generally with slopes around 2-10%. Altitude above sea level is around 1 000-1 200 m for most of the route, rising to around 1 400 m on the top of the ridges and falling to around 850 m in the lowest parts.

The major river is the Olifants River, flowing north-eastward through the middle of the route. The Chuene River in the north, Magobwane River in the east (Alternative 1) and Steelpoort River in the south are the other rivers that occur.

2.2 Climate

Climate data was obtained from the national Land Type Survey (Paterson, Koch & Barrow, 1989).

As with the terrain, the climate of the area varies significantly. Rainfall in the area of the Steelpoort valleys is low, around 500 mm per year or less, with Sekhuhune being slightly higher, around 550 mm. Only on the higher mountains to the east will it rise to around can rise to around 1 000 mm per year. Figure 2 shows the rainfall distribution.

Frost will occur in places, although it will be occasional.

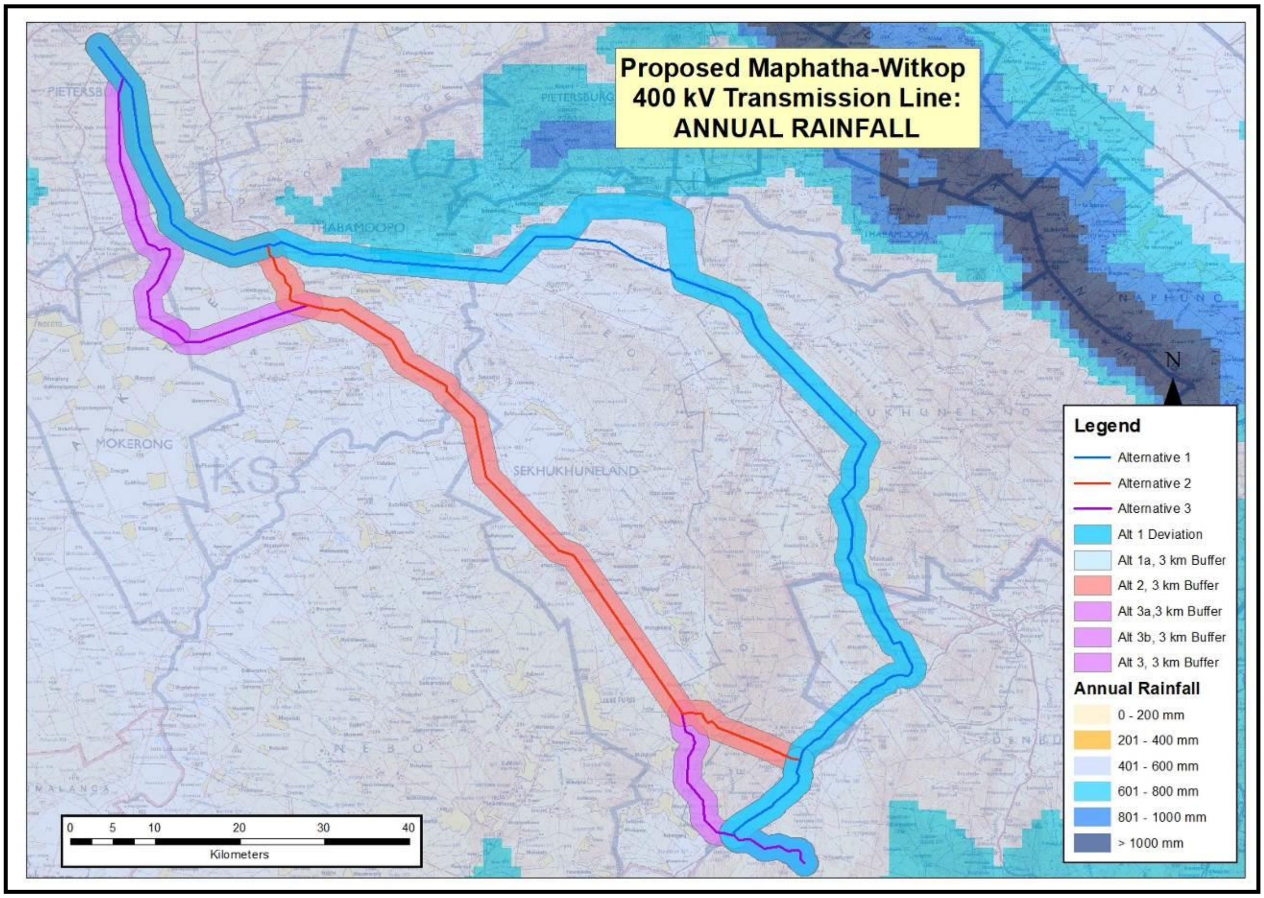

Figure 2. Annual rainfall

2.3 Geology

The area is underlain by varying parent materials, from shale, norite and pyroxenite of the Bushveld Complex in some of the lower areas, as well as shale and quartzite of the Transvaal Sequence in the steeper mountain ridges (Geological Survey, 1984).

3 METHODOLOGY

As far as existing soil information is concerned, the area is covered by two land type maps at a scale of 1:250 000, which have been digitized using ArcGIS. The study area falls within the map sheets 2428 Nylstroom and 2430 Pilgrim's Rest.

Each specific land type is a unique combination of broad soil pattern, terrain type and macroclimate. Where any of these changes, a new land type occurs.

Within any specific land type, the soil forms occurring (MacVicar *et al*, 1977) have been summarized according to their dominance, but the locality or distribution of the various soils within a land type cannot be further determined.

4. SOILS AND AGRICULTURAL POTENTIAL

As indicated on the land type map (Figure 2), there are a number of separate land types occurring within the study area. These are summarized as follows:

- **Ae27, Ae115, Ae117, Ae118, Ae122, Ae123, Ae131, Ae225, Ae233, Ae339, Ae342, Ae343, Ae346, Ae347, Ae348, Ae352, Ae354, Ae355, Ae386** (Red, lightly weathered, structureless soils)
- **Bd39** (Non-red, lightly weathered, structureless soils, often with plinthic subsoils)
- **Db244** (Non-red duplex soils, sandy topsoil over structured clay subsoil)
- **Dc31** (Duplex soils with some black and red clay soils)
- **Ea88** (Black, swelling clay soils)

- **Fa279** (Shallow soils, sometimes rocky, little lime)
- **Fb171, Fb172, Fb534, Fb535** (Shallow soils, sometimes rocky, occasionally some lime)
- **Fc733** (Shallow soils, sometimes rocky, much lime)
- **Ia175, Ia176, Ia177** (Alluvial soils, usually deep)
- **Ib30, Ib31, Ib155, Ib190, Ib191, Ib192, Ib197, Ib239, Ib293, Ib454, Ib456, Ib457** (Rocky areas [>60% rock], often steep with shallow soils)
- **Ic154** (Very rocky areas [>80% rock], usually steep with shallow soils)

The main characteristics of each of the land types are given in Table 1 below (the colours correspond to the map). The soils were classified according to MacVicar *et al*, 1977).

Due to the number of land types occurring (45 in total), only the specific broad soil pattern distribution is shown in Figure 3.

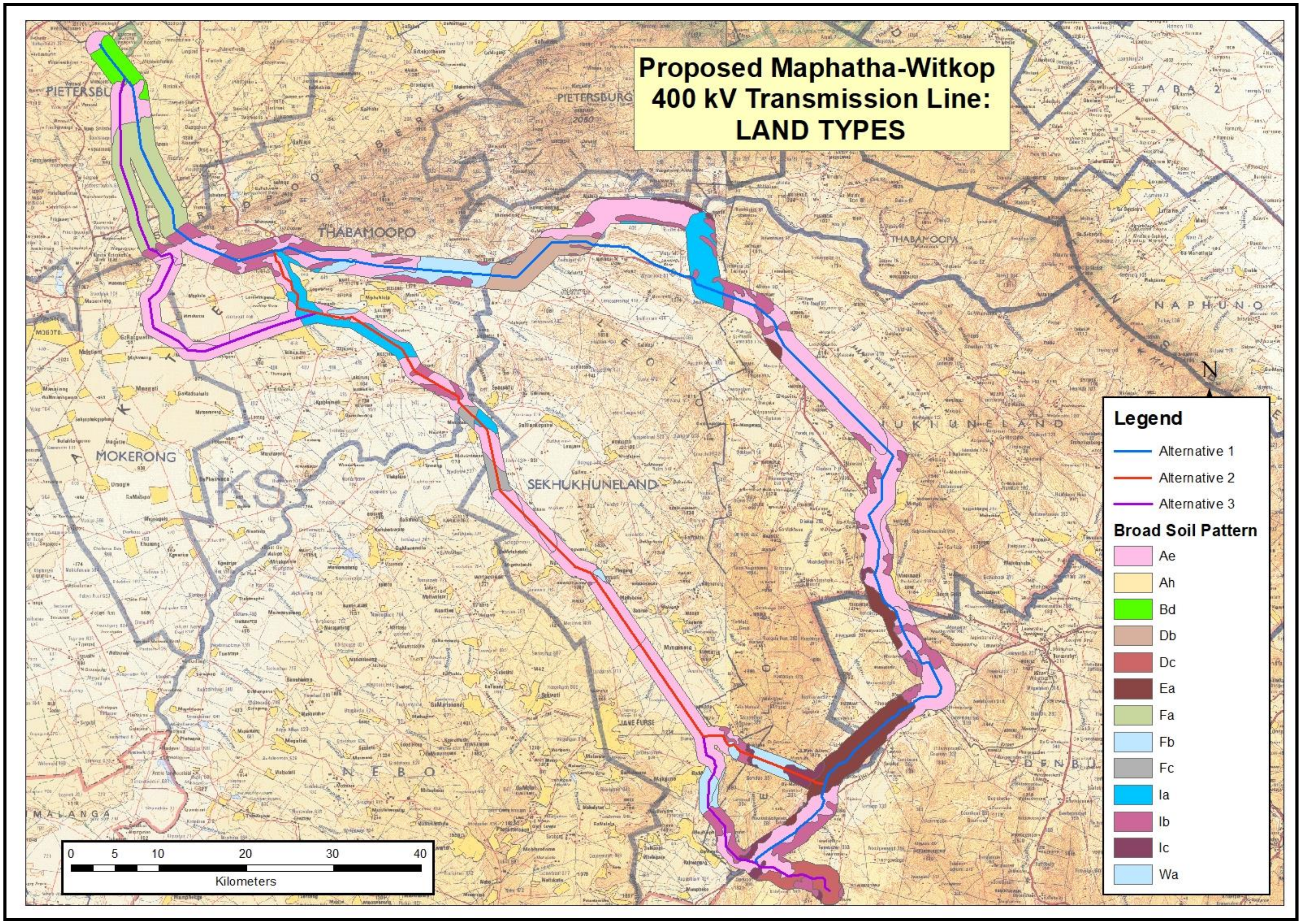

Figure 3. Broad soil patterns of land types occurring

5 AGRICULTURAL POTENTIAL

The relative occurrence of high potential soils in each land type was assessed. High potential soils are those that are relatively deep (generally >750 mm), have a medium texture (neither too sandy or too clayey), without a well-developed structure (which would impede water infiltration and natural drainage) and occur on relatively flat terrain (generally <5% slopes).

<u>NOTE</u>:

"Agricultural potential" refers to the **<u>soil characteristics only</u>** and does not take prevailing local climatic conditions/restrictions into account.

The occurrence of high potential soils within each land type is shown in the map in Figure 4.

From this map, it can be seen that most of the land types with steeper slopes have shallow soils, shown by the red colours, especially in the south and north. Land types with the highest occurrence (>80% such soils) are shown by the dark green colours. However, the climatic conditions are marginal for rain-fed agriculture across much of the area (Section 2.2), with rainfall figures below 600 per annum, along with the variability that characterizes much of the summer rainfall zone of South Africa.

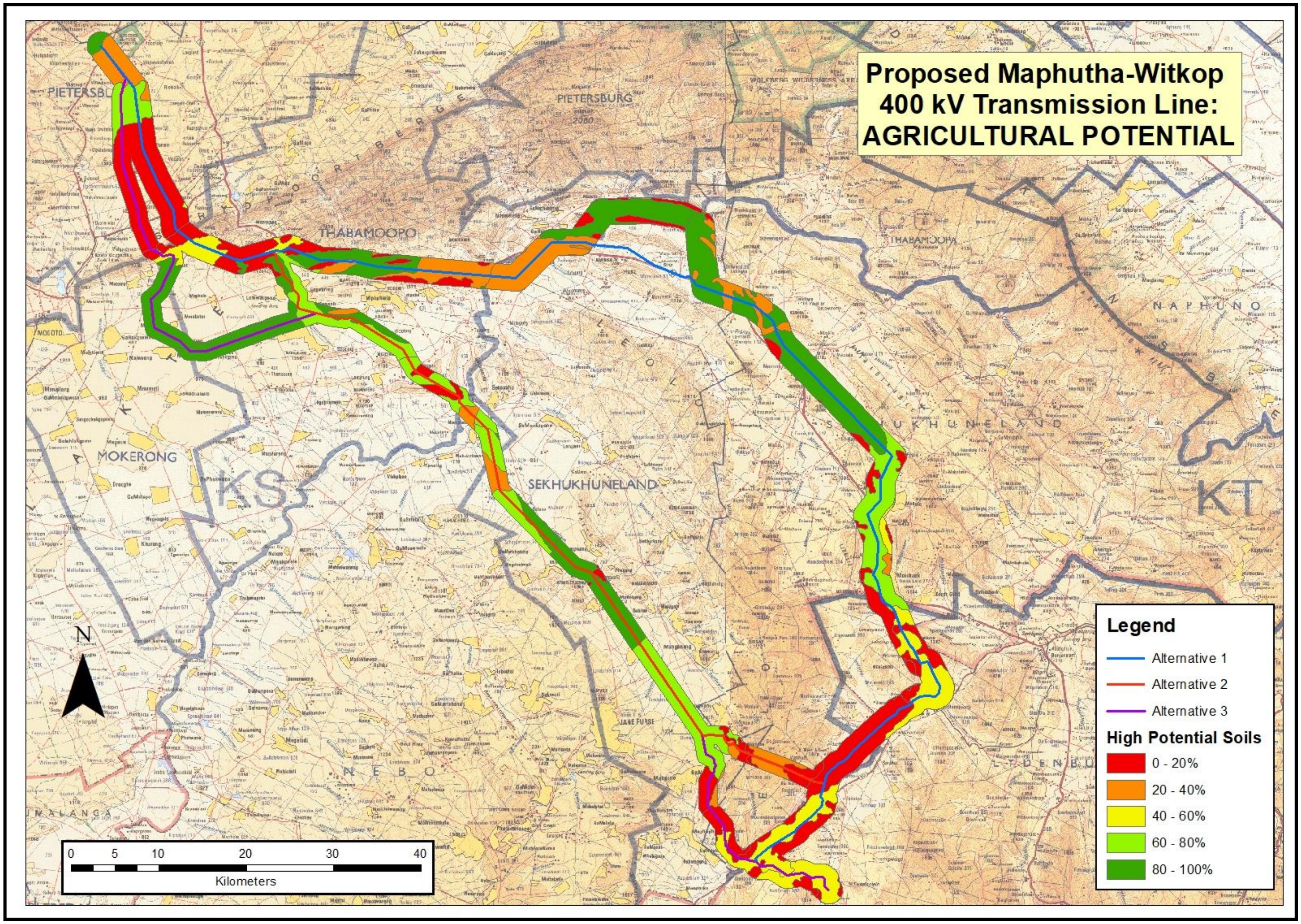

Figure 3. Broad agricultural potential

5.1 Erodibility

Most of the study area is not inherently susceptible to erosion. Most of the high potential soils are on relatively flat topography, and have stable clay mineralogy, while on the steeper slopes, the rock outcrops and continuous vegetation cover mean that these areas are also not highly erodible. However, incorrect management practices in many of the rural areas along the routes (mainly overgrazing or cultivation of unsuitable soils), have led to the development of severe gully erosion. The occurrence can be seen as the black areas on Figure 4.

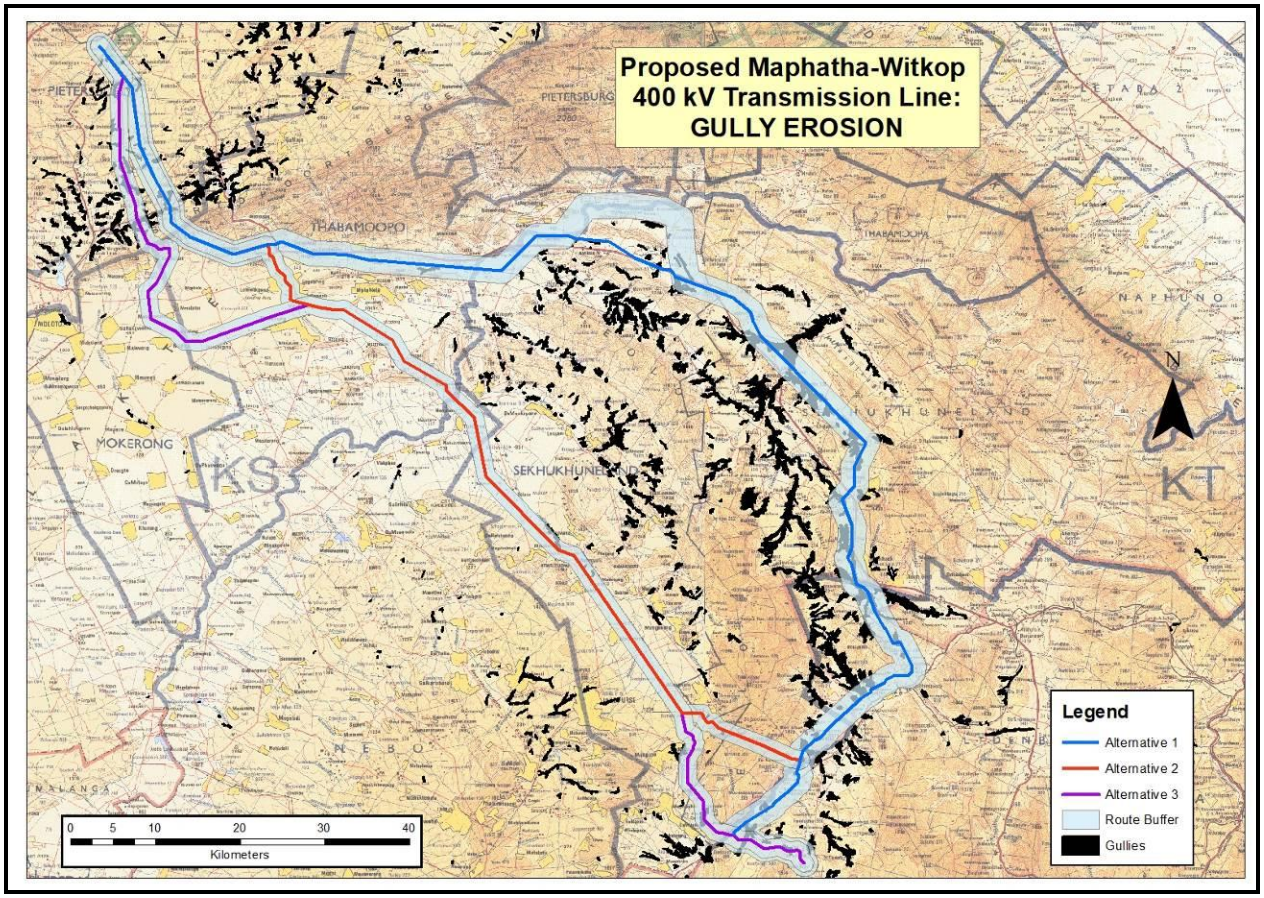

Figure 4. Gully erosion

It is clear that if vegetation cover is disturbed or removed (such as during the construction phase of a transmission line) and especially on steeper slopes, then erosion can occur. Therefore, clear mitigation measures should be implemented, namely:

- Roads should avoid steep slopes wherever possible
- Where steep slopes are used, road stabilization measures (culverts, run-off trenches, banking of bends etc) should be implemented
- Restrict areas cleared of vegetation to road surfaces and infrastructure footprints only

In addition, the possibility of erosion occurring in the future exists, so regular monitoring and inspection should take place, so that if any signs of soil erosion commencing are observed, measures can be put in place as timeously as possible.

6 IMPACTS AND RECOMMENDATIONS

6.1 Impacts

The impacts of constructing a transmission line will be negative, as the natural environment will be disturbed. However, the specific significance on the potential loss of agricultural soil, as well as soil disturbance, needs to be assessed.

This is summarized in Table 1.

Table 1 Impact assessment

Impact: Loss of agricultural soil resource					
Extent (E)	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (E+D+M) x P**	**Significance Class**
Site (1)	Long-term (4)	Low (2)	Medium (3)	21	Low

The isolated nature of the transmission towers means that the impact on the soil resource will be small. Most agricultural activities can still be practiced next to or underneath a transmission line.

The exception is where irrigation, especially by overhead or other spray actions, is practiced. Therefore, as far as possible, the transmission line should avoid such areas.

Mitigation measures will include the rehabilitation of any bare soil areas caused by the construction process (including any access roads or tracks) and wherever possible, the siting of pylons away from any cultivated lands, but rather to use servitudes and boundary lines. Special care should be given to areas with steeper topography and areas adjacent to water courses.

6.2 Fatal Flaws

There are **no fatal flaws** regarding the study area. However, there are a number of sensitive areas that should be avoided, namely wetland soils along the river courses.

6.3 Route Alternatives

Regarding the alternative routes, there is little to choose. It would appear that Alternative 1 (the eastern alternative) crosses more areas with better soils, but there are also high potential soils along Alternative 2. The northern part of Alternative 3 should be avoided if possible, as there are mostly high potential soils along the route.

Taking the above into consideration, the preferred route, from the point of view of soils and agricultural potential is as follows:

From the southernmost point, follow Alternative 1 to the first split. Then follow Alternative 3 to the junction with Alternative 2, which can be followed all the way north to the junction with Alternative 1, and from there follow Alternative 1 to the northern end of the study area. This is shown by the black dashed line in Figure 5.

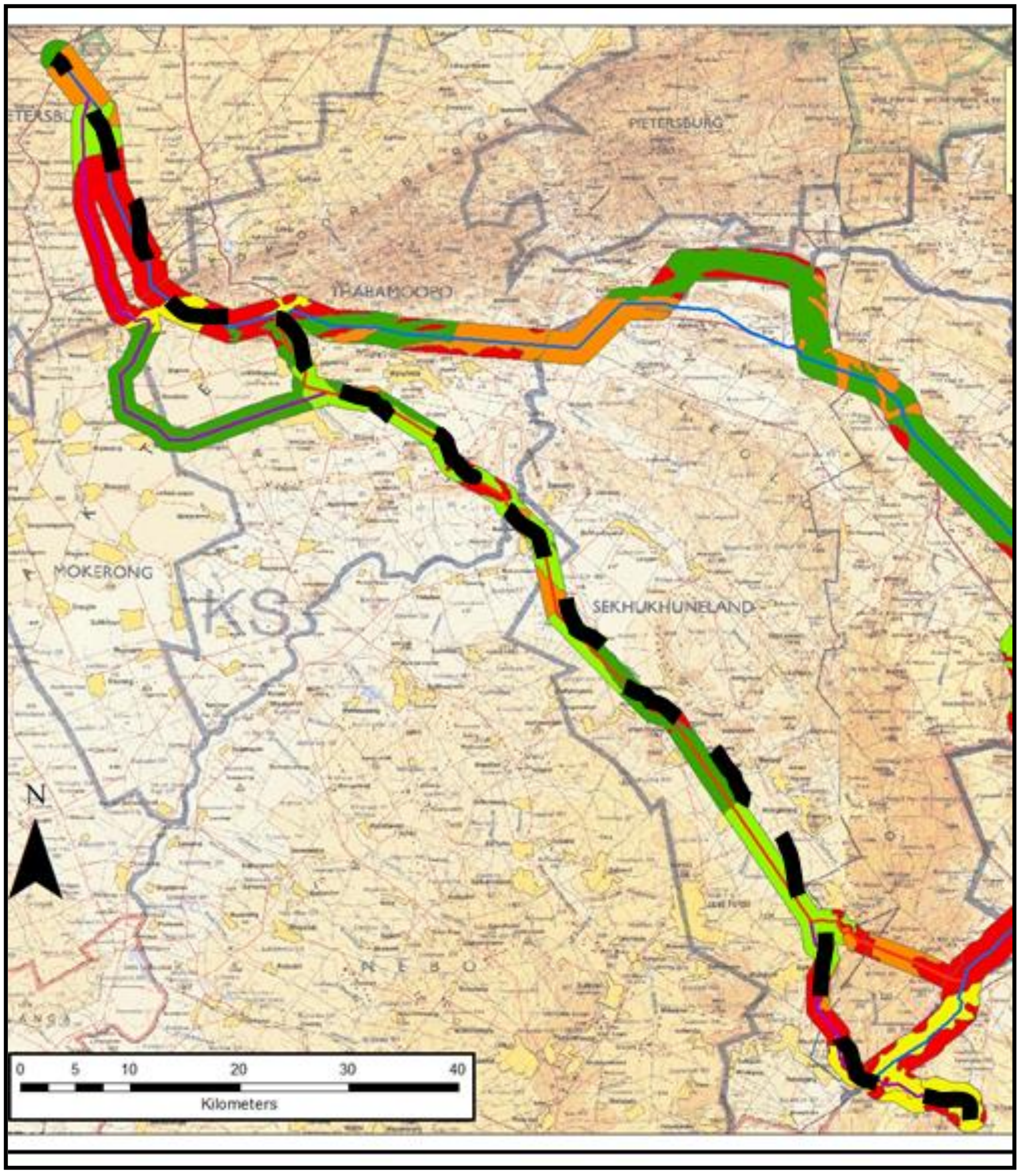

Figure 5. Preferred route

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